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DOCKET
08-AFC-11
DATE
RECD. APR 06 2009

April 6, 2009

Mr. Rod Jones
Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: CPV Vaca Station (08-AFC-11)
Response to CEC Staff Data Requests 1 through 53

Dear Mr. Jones:

Attached please find one original and 12 copies of CPV Vaca Station, LLC's responses to California Energy Commission Staff Data Requests 1 through 53 for the Application for Certification for the CPV Vaca Station Project (08-AFC-11).

If you have any questions about this matter, please contact me at (916) 286-0278 or Sarah Madams at (916) 286-0249.

Sincerely,

CH2M HILL

Douglas M. Davy, Ph.D.
AFC Project Manager

Attachment

cc: A. Welch (CPV)
S. Madams

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S. Madams

Application for Certification

Response to CEC Staff Data Requests 1 through 53

CPV
Vaca Station

Submitted by CPV Vacaville, LLC

Submitted to
California Energy Commission

With Technical Assistance by
CH2MHILL

April 2009

ES122007003SAC

Supplemental Filing

Response to CEC Staff Data Requests
1 through 53

In support of the

Application for Certification

for

CPV Vaca Station

Vacaville, California
(08-AFC-11)

Submitted to the:

California Energy Commission

Submitted by:

CPV Vacaville, LLC

CPV Vacaville, LLC

With Technical Assistance by:

CH2MHILL
Sacramento, California

April 2009

Contents

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Introduction

Attached are CPV Vacaville, LLC's (CPVV's) responses to California Energy Commission (CEC) Staff data requests numbers 1 through 53 for the CPV Vaca Station (CPVVS) project (08-AFC-11). The CEC Staff served the data requests on March 5, 2009, as part of the discovery process for the CPVV project.

The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as CEC Staff presented them and are keyed to the Data Request numbers (1 through 53). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table DR15-1. The first figure used in response to Data Request 28 would be Figure DR28-1, and so on.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of a discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

Air Quality (1–29)

Combustion Turbine Supplier Schedule

1. *Please describe the anticipated schedule for selecting the supplier of the combustion turbine generators.*

Response: We expect to select the supplier of the combustion turbine generators once the project has been certified. This should not, however, affect the review of the project, because the differences between the two candidate generators are small, and everywhere there is a difference between the two, compliance has been demonstrated for both.

Particulate Emissions During Duct Firing

2. *Please provide vendor specifications confirming the combined-cycle system emission rates and confirming the maximum particulate matter emission rate of 7.5 pounds per hour for the Siemens turbines, compared to 9.0 pounds per hour for the General Electric turbines (as in AFC Tables 5.1A-2A and 5.1A-2B).*

Response: The proposed particulate matter emission rates are not based on vendor specifications. They are based on the Applicant's experience with similar installations in California. The Applicant is willing to accept permit conditions limiting PM_{10} emissions to 7.5 pounds per hour (lb/hr) without duct firing and 9.0 lb/hour with duct firing, for both Siemens and GE turbines.

The emission rate specified in the AFC of 7.5 lb/hr during duct burning for the Siemens turbine is an error; the corrected AFC Tables 5.1A-2A and 5.1A-2B are attached (Attachment DR2-1). The higher PM_{10} emissions for the Siemens duct firing case do not affect the air quality analysis previously provided, because the higher emission rate is identical to the duct firing emissions for the GE turbines, and all analyses were based on worst-case conditions.

Total and Annual GHG Emissions

3. *Please show the total and annual GHG emissions for the construction phase of the proposed project including all activities at the construction site and any construction activities for linear facilities (gas pipeline and transmission lines), worker travel, and trucked material deliveries.*

Response: Greenhouse gas emission estimates are presented in Table DR3-1.

TABLE DR3-1
Construction GHG Emissions

(Metric Tonnes CO_2eq)							
	Fuel	**Fuel Use (Gallons)**	**GHG**	**Emission Factor (kg/gallon)**	**Emissions (MT)**	**Global Warming Potential**	**Emissions ($MTCO_2$eq)**
Off-road Engines	Diesel	8,056	CO_2	9.96	80	1	80
			CH_4	0.000405	0	21	0
			N_2O	0.000081	0	310	0
Worker Travel	Gasoline	85,120	CO_2	8.55	728	1	728
			CH_4	0.000375	0	21	1
			N_2O	0.000201	0	310	5
Truck Deliveries	Diesel	70,099	CO_2	9.96	698	1	698
			CH_4	0.000281	0	21	0
			N_2O	0.0000257	0	310	1
Total							1,513

Notes: GHG emission factors from CARB Mandatory Reporting Rule, Appendix A, Tables 4-8
Global Warming Potentials form CARB Mandatory Reporting Rule, Appendix A, Table 2
Automobile mileage = 25.5 mpg
Delivery truck mileage = 5.35 mpg

Criteria Pollutants and GHG from Commute and Material Delivery

4. *Please quantify emissions of criteria pollutants and GHG from worker commutes and material deliveries during operation of the proposed project.*

Response: During operation, the project is expected to employ 31 workers. The Applicant estimates an average of one delivery to the site per week. Greenhouse gas emission estimates for these vehicle trips are shown in Table DR4-1.

TABLE DR4-1
Operating GHG Emissions from Vehicles

(Metric Tonnes CO2eq/year)							
	Fuel	**VMT**	**GHG**	**Emission Factor (kg/mile)**	**Emissions (MT)**	**Global Warming Potential**	**Emissions (MTCO2eq)**
Worker Travel	Gasoline	77,500	CO_2	0.3352941	26	1	26
			CH_4	0.0000147	0	21	0
			N_2O	0.0000079	0	310	0
Truck Deliveries	Diesel	520	CO_2	1.8616822	1	1	1
			CH_4	0.0000051	0	21	0
			N_2O	0.0000048	0	310	0
Total							27

Notes: GHG emission factors from CARB Mandatory Reporting Rule, Appendix A, Tables 7 and 8
Global Warming Potentials form CARB Mandatory Reporting Rule, Appendix A, Table 2
Automobile mileage = 25.5 mpg
Delivery truck mileage = 5.35 mpg

Proposed ERCs

5. *Please identify whether the confidential filing dated December 5, 2008 represents the proposed ERCs that would be used for offsets and mitigation.*

Response: The confidential filing described the pool of potential sources of mitigation that had been developed at that time. As described in the filing, the list did not represent the proposed ERCs that would be used for offsets and mitigation but instead represented the pool of ERCs from which mitigation was expected to be drawn.

Since that time, the Applicant has identified additional potential sources of offsets. The Applicant is still identifying and negotiating with potential suppliers of offsets. Once the mitigation package has been finalized, it will be submitted to the Yolo-Solano Air Quality Management District (YSAQMD and the CEC, along with the requested demonstrations of compliance with applicable requirements.

Distance Ratios, Interpollutant Trade Ratios and Transfers of Credits

6. *Please specifically state the proposed distance ratios, interpollutant trade ratios, and transfers of credits from other air districts.*

Response: Please see response to Data Request #5. The requested data will be part of the final ERC submittal.

Sources of PM_{10} Offsets

7. *Please provide a brief description of the PM_{10} sources that were shut down in order to create the ERCs.*

Response: Please see response to Data Request #5.

Demonstration of Compliance: PM_{10} and $PM_{2.5}$ Mitigation

8. *Please provide an analysis of the ERCs that are proposed to be surrendered that demonstrates the expected level of PM_{10} and PM2.5 mitigation provided by the ERCs.*

Response: Please see response to Data Request #5.

Interpollutant Offsets: SOx for PM

9. *Please provide an explanation of whether any SOx ERCs would be used to offset PM_{10} and PM2.5 emissions and, if so, an analysis of the appropriate interpollutant trading ratio.*

Response: Please see response to Data Request #5. The Applicant has not yet ruled out possibility that SOx ERCs might be used to offset PM emissions. The analysis supporting the proposed SO_2 for PM_{10} and $PM_{2.5}$ interpollutant offset ratio will be provided as part of the offset package if interpollutant offsets are proposed.

Demonstration of Compliance: SOx Mitigation

10. *Please provide information showing how the ERCs that are proposed to be surrendered would be of a sufficient quantity to achieve a one-to-one offset of project SOx emissions.*

Response: Please see response to Data Request #5.

Interpollutant Offsets: VOC for NOx Ratio, Justification

11. *Please identify the source of the proposed 1.4-to-1 ratio for VOC to NOx and any technical studies or regional air quality management plans that support use of this ratio.*

Response: The proposed 1.4-to-1 ratio was an estimate based on similar inter-precursor trades approved in the Sacramento Valley Air Basin. Because the offset package has not yet been finalized, it is not certain that inter-precursor offsets will be utilized.

The analysis supporting the proposed VOC for NOx inter-precursor offset ratio will be provided as part of the offset package if inter-precursor offsets are proposed.

Interpollutant Offsets: VOC for NOx Ratio, Prior Approvals

12. *Please identify the circumstances and provide citations to where the YSAQMD or another air quality management agency with jurisdiction in the Sacramento Valley air basin, including the U.S. EPA, approved the proposed VOC to NOx interpollutant offset ratio.*

Response: Colusa County and the CEC approved an inter-precursor offset ratio of 1.4:1 for the Colusa Generating Station (06-AFC-9), located in Colusa County, adjacent to the YSAQMD and within the Sacramento Valley Air Basin. The Colusa County AQMD staff assessment of this approach states (Preliminary Determination of Compliance, April 3, 2007, p. 16.):

> The Applicant has proposed a 1.4:1 ratio as a VOC for NOx interpollutant offset ratio based upon the two nearest relevant studies: the Sacramento Area Ozone Study (CARB, 1995) and the San Francisco Bay Area Ozone Attainment Plan (OAP) (ABAG, BAAQMD, and MTC, 2001). The rate of ozone formation is heavily dependent on initial NOX and VOC concentrations, as well as local meteorological conditions. The relationship between ozone formation and the initial concentrations of NOX and VOC has been the subject of many studies and is often depicted graphically through ozone isopleth diagrams. Ozone isopleth diagrams illustrate the dependence of ozone production on the initial amounts of VOC and NOX. The total 2005 VOC and NOX emissions for Colusa County were 6.81 tons per day VOC and 10.12 tons per day NOX. The peak 1-hour ozone level, used as the background in the AFC was 89 ppb. There is consistency between the peak ozone reading predicted by the Colusa isopleth and the actual peak ozone concentration measured in Colusa. Although theoretically the ratio predicted is 1.4:1 NOx to VOC the Applicant is proposing to reverse the ratio and provide 1.4 tons of VOC emission reductions to offset a 1.0 ton increase in NOx emissions.

Additionally, the CEC and the applicable Districts have approved VOC for NOx offsets for the following projects:

- Blythe Energy Project (Mojave Desert)(99-AFC-8); VOC for NOx ratio of 1.6:1
- Cosumnes (Sacramento); VOC for NOx ratio of 2.6:1
- High Desert (Mojave Desert); VOC for NOx ratio of 1.6:1
- Palomar (San Diego); VOC for NOx ratio of 2.0:1
- Sutter Energy Center (Feather River); VOC for NOx ratio of 2.0:1

Water Droplet Evaporation

13. *Please provide substantiating evidence or copies of technical reports supporting the assumption that "when a water droplet evaporates, the dissolved solids form a single particle" (AFC Appendix 5.1A, p. A-6). This information should address the likelihood of every water droplet remaining coherent through evaporation, rather than breaking up into smaller droplets, as well as the likelihood of different dissolved salts adhering to each other to form the single particle.*

Response: As discussed in the AFC, the exhaust from the cooling tower contains entrained water droplets, called "drift." Drift is minimized through the use of drift eliminators, which rely on inertial separation caused by providing multiple directional changes of airflow to remove water droplets from the air.[1]

Suspended droplets shrink by evaporation.[2] They can also collide with each other with various results. Smaller droplets (200-micron diameter and smaller) can collide, but the mutual collisional kinetic energy of these droplets, or their collisional kinetic energy with respect to anything else, is so low they can't overcome surface tension and shatter into smaller droplets should they chance to collide. More likely, they will deflect off each other, or coalesce.

Much larger colliding drops can create small droplets, however. Studies of the behavior of raindrops indicate that a 4,600-micron drop colliding with a 1,800-micron drop will produce many droplets, some of which may be as small as 20 microns in diameter. Droplets this size, however, are very sparse, so these collisions are exceedingly rare.

When droplets between 200 and 1,000 microns collide, they can bounce off each other, coalesce, or break up into a small number of smaller droplets. If any of the droplets created in this manner are smaller than 60 microns, they may evaporate completely to form PM_{10}. However, the number of large droplets is very small. There are a thousand times more droplets smaller than 60 microns than greater than 60 microns. There are more than 30,000 times more droplets smaller than 200 microns than there are droplets bigger than 200 microns. It is overwhelmingly more likely that two droplets will collide and coalesce (resulting in a larger particle) than it is for two droplets to collide and shatter. Furthermore, as the plume ages, the droplets will continue to shrink by evaporation, further reducing the likelihood that two droplets large enough to shatter will collide.

PM forms from cooling tower drift when a cooling tower droplet evaporates to a salt crystal. As the droplet evaporates, the concentration of dissolved solids increases until the droplet is saturated; further evaporation results in precipitation of dissolved solids as a salt crystal. This process continues until all of the water has evaporated, and all of the solids have crystallized around the initial nucleus. Thus one droplet forms one particle.

AP-42 characterizes the assumption that all solid particles from cooling tower drift are in the PM_{10} range as "conservatively high."[3] An assumption that is conservatively high is appropriate for screening purposes (that is, an analysis that demonstrates compliance using

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[1] AP-42 Section 13.4, p. 13.4-3.

[2] AP-42 Section 13.4, p. 13.4-2.

[3] AP-42 Section 13.4 p. 13.4-3.

conservatively high assumptions means that a more detailed analysis, using more realistic assumptions, will also demonstrate compliance), which greatly simplifies the analysis. In this case, however, a more realistic analysis is required to demonstrate compliance.

The analysis in the AFC is based on a droplet size distribution provided by the vendor (see Attachment DR13-1). This distribution is applicable to the cooling tower exhaust far enough after the drift eliminator for turbulence to be damped out. As a result, significant changes to the droplet size distribution (coalescence or shattering) is not expected. Droplets will, of course shrink as the water evaporates.

Diameter of Cooling Tower Droplet

14. *Please provide substantiating evidence or copies of technical reports supporting the equation used for predicting the diameter of a solid particle formed from a cooling tower droplet (AFC Appendix 5.1A, p. A-6).*

Response: See the following article: Reisman, J. and Frisbie, G.; "Calculating Realistic PM_{10} Emissions from Cooling Towers," *Environmental Progress* Vol. 21, Issue 2, pages 127-130 (20 Apr 2004). An earlier version of this paper was prepared in support of the Blythe Energy Project, and presented at the 94th Annual Air & Waste Management Association's Annual Meeting (June 2001). The methodology presented in these papers is identical with the one used in the CPV Vaca Station AFC.

Mathematical Steps Confirmation

15. *Please review the mathematical steps described and confirm that there are no errors or correct the apparent errors.*

Response: There are no mathematical errors. Staff's calculation correctly calculates the ***physical*** diameter of the particle remaining behind when the droplet evaporates. However, as discussed in the AFC, the PM ambient air quality standards utilize ***aerodynamic*** particle diameter, not physical diameter, to classify particle size. The droplet size distribution, and the physical and aerodynamic diameter of the resulting particles, are shown in Table DR15-1.

The equation for deriving aerodynamic diameter from a particle's physical diameter and density is provided in the AFC; the citation for the methodology (EPA) is also provided in the AFC. These are presented here for convenience.

TABLE DR15-1
Droplet and Particle Size Distribution

Percent mass less than droplet size	Droplet diameter, micron	Physical particle diameter, micron	Particle aerodynamic diameter, micron
12	10	1.6	2.4
20	15	2.4	3.6
40	35	5.6	8.3
60	65	10.4	15.4
80	115	18.4	27.3
90	170	27.2	40.3
95	230	36.8	54.6

TABLE DR15-1
Droplet and Particle Size Distribution

Percent mass less than droplet size	Droplet diameter, micron	Physical particle diameter, micron	Particle aerodynamic diameter, micron
99	375	60.0	89.0
99.8	525	84.0	124.5
Interpolated percent			
12.9	10.5	1.7	2.5
44.8	42.2	6.7	10

Water density = 1.0
Particle density = 2.2
Droplet size distribution from cooling tower vendor

The size of the final aerosol particle depends on the volume fraction of solid material and the droplet diameter as follows:

$$D_s = D_d \text{ x } (F_v)^{1/3}$$

Where:

D_s = diameter of solid particle
D_d = diameter of liquid droplet
F_v = volume fraction of solid material

This equation can be converted to calculate the resulting particle diameter for a cooling tower by accounting for the density of the particle:

$$D_s = D_d \text{ x } (\rho_d/\rho_s \text{ x } TDS/1{,}000{,}000)^{1/3}$$

Where:

D_s = diameter of solid particle
D_d = diameter of liquid droplet
ρ_d = density of droplet = 1 g/cm^3
ρ_s = density of solid particle = 2.2 g/cm^3 for sodium chloride
TDS = total dissolved solids, ppmw

The above equation predicts the physical diameter of a particle formed from a cooling tower droplet. This equation assumes that a single particle will be formed when a droplet evaporates, because there is no evidence that multiple particles will be formed.

The term “aerodynamic diameter” has been developed by aerosol physicists in order to provide a simple means of categorizing the sizes of particles having different shapes and densities with a single dimension. The aerodynamic diameter is the diameter of a spherical particle having a density of 1 gm/cm^3 that has the same inertial properties (terminal settling velocity in the gas as the particle of interest). The PM_{10} and $PM_{2.5}$ standards refer to aerodynamic diameter.

Therefore, in order to calculate PM_{10} and $PM_{2.5}$ emissions, the aerodynamic diameter of the cooling tower particles must be calculated as follows:[4]

$$D_a = D_s \times (\rho_s)^{0.5}$$

Airborne Particles Matching Sodium Chloride

16. *Please provide substantiating evidence or laboratory analysis of the proposed cooling water supporting the assumption that the density of the airborne particles would best match that of sodium chloride (AFC Appendix 5.1A, p. A-6).*

Response: It is important to note that the assumed particle density does not have a strong effect on the percent of total PM that is PM_{10} (Table DR16-1). Because the calculation is not sensitive to the density of the particle, any reasonable assumption regarding particle density will serve.

It is unlikely that the particle left behind by evaporation of water from a drift droplet will actually be sodium chloride.[5] The particle should consist primarily of calcium carbonate ($CaCO_3$). This is the principle component of the scale that is deposited when the solids content of boiler water is too high.

Solid calcium carbonate has a density of 2.7.

Because it predicts that more of the PM will have an aerodynamic diameter smaller than PM10, the assumed particle density of 2.2 is a slightly conservative assumption, and tends to overpredict the PM10 emissions from the cooling tower.

TABLE DR16-1
Percent of PM that is Smaller than PM_{10}, by Particle Density

Particle density (water =1)	percent of drift < PM_{10}
1.8	45.7
2	45.2
2.2	44.8
2.4	44.4
2.6	44.0
2.7	43.8

Cooling Tower Drift Droplet Size Assumptions

17. *Please provide substantiating evidence or copies of technical reports supporting the assumptions of mass distribution and various cooling tower drift droplet sizes (AFC Appendix 5.1A, p. A-7).*

Response: The size distribution data provided by the cooling tower vendor is provided as Attachment DR13-1.

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[4] http://www.epa.gov/air/oaqps/eog/bces/module3/diameter/diameter.htm accessed August 8, 2008

[5] The density of sodium chloride was used in the AFC for two reasons. First, it was the density assumed by Reisman and Frisbie; second, it is a mildly conservative assumption.

Cooling Tower Assumptions Approval

18. *Please identify whether the assumptions used in the emission calculations for the cooling tower have been reviewed and approved by air management agencies, including U.S. EPA or the California Air Resources Board, and provide the approving documentation or a guidance document supporting use of the assumptions.*

Response: A number of projects have been permitted with PM_{10} to TDS ratios of 50 percent and lower. The CEC is among those agencies approving such calculations. Approved projects include the High Desert Power Project (permit revision) at 50 percent, Mesquite Generating Station (in Arizona) at 31.5 percent, and the Blythe Energy Project at 15 percent. In a November 1, 2001, email sent to the Maricopa County Environmental Services Department related to the permitting of the Arlington Valley Energy Facility (AVEF), the EPA (Scott Bohning) stated that “I am comfortable with the 50 percent figure, ” but he wanted to obtain further feedback before accepting the lower levels proposed by the AVEF project.

In support of the Blythe Energy Project, a technical paper was written and presented at the 94th Annual Air & Waste Management Association’s Annual Meeting (June 2001). The methodology presented in that paper is identical with the one used in the CPV Vaca Station AFC. Additionally, please see the YSAQMD’s Preliminary Determination of Compliance (PDOC).

Reduction of Dissolved Solids

19. *Please describe what steps could be taken to reduce the maximum total dissolved solids from 9,000 parts per million to a lower number.*

Response: The CPV Vaca Station project will use a zero liquid discharge system. These systems, by nature, require a minimization of blowdown flow from cooling system in order to function effectively. The 9,000 parts per million TDS is a result of this minimization of blowdown flow.

BACT for CO

20. *Please explain why a limit of 2.0 ppmvd on an l-hour averaging basis is not being proposed for the CPV Vaca Station project.*

Response: The permit for the Magnolia Power Project was issued at a time when the South Coast Air Quality Management District was not in attainment with federal ambient CO standards, and represented an extraordinary effort to minimize CO emissions due to the extraordinary conditions. Because of the unique situation, most agencies have considered the project to be in a class by itself, and not a precedent for other projects.

In most jurisdictions and situations, including YSAQMD, CO is a pollutant with very low impacts and priority, especially relative to NOx. Because the combustion conditions that minimize CO emissions tend to encourage NOx formation and vice versa, tight NOx limits make it more difficult to comply with tight CO limits. YSAQMD regulations allow the Air

Pollution Control Officer (APCO) to consider that BACT requirements for one pollutant may preclude achieving the lowest possible emissions for another pollutant.[6]

This consideration is relevant to application of the Magnolia permit limits to the current project. Air districts have recognized that NOx and CO BACT levels must be considered together. Specifically, districts have determined that compliance with a CO permit limit that is coupled with a specific NOx limit does not "demonstrate in practice" that CO limit for another more stringent NOx limit.[7]

The NOx limit in the Magnolia permit is 2.0 ppm (3 hour average). The proposed BACT NOx limit for CPV Vaca Station is 2.0 ppm (1 hour average). The difference in averaging time is viewed by the regulatory agencies as a significant tightening of the NOx requirement. Compliance with a CO limit set in conjunction with a NOx limit of 2 ppm (3 hour average) does not establish that the CO limit has been "achieved in practice" for a turbine subject to a more stringent NOx limit.

Review of the other projects listed in AFC Table 5.1E-2 with CO BACT levels of 2.0 ppm (Vernon City Power & Light, Wanapa Energy Center, Berrien Energy) results in the same conclusion: no project subject to a 2 ppm NOx limit (1 hour average) has been subject to, much less demonstrated ongoing compliance with, a 2 ppm CO limit. The level proposed in the AFC is the same as the most stringent level approved to date by the CEC (for the Colusa project, which is currently under construction).

Because a CO limit of 2 ppm has not been achieved in practice on a turbine subject to a 2 ppm (1 hour average) NOx limit, it cannot be deemed BACT on that basis. In fact, Table DR20-1 shows that the "achieved in practice" BACT level for CO is 4.0 ppm. However, a lower value may still be BACT if it is both technically feasible and cost effective.

The reduction in emissions that would be achieved by reducing the CO emission rate from 3 ppm to 2 ppm would be 67.8 TPY. The cost of achieving that reduction would be $32,000 per year[8]. The cost effectiveness of controlling CO is therefore $532/ton, which exceeds the District's $300/ton threshold for cost-effective CO controls. Therefore 2 ppm CO is not BACT for this application, because it is technologically feasible but not cost effective.

TABLE DR20-1
CEC Limits on NOx and CO Since Magnolia

Project	NOx limit	Averaging Time	CO Limit
Magnolia	2.0	3 hours	2.0
Russell City	2.0	1 hour	4.0
Blythe	2.0	3 hour	4.0
Walnut	2.0	1 hour	4.0
Colusa	2.0	1 hour	3.0

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[6] YSAQMD Rule 3-4 Sec. 208.2.

[7] See, for example, Bay Area Air Quality Management District. Revised Preliminary Determination of Compliance for Los Esteros. March 14, 2005, p. 18.

[8] YSAQMD guidelines for calculating the annualized cost of capital equipment for BACT determinations use equipment life of 10 years and an interest rate of 10%. The increased capital cost of going from 3 ppm CO to 2 ppm CO is $100,000 per turbine, or $200,000 for the project.

Background Response to Data Requests 21–25

Response: Startup and shutdown periods are a normal part of the operation of combined-cycle natural gas-fired power plants. BACT applies during all modes of operation, including startup and shutdown periods. The BACT limits established for steady-state operation are not technically feasible during startup and shutdown of the CTGs/HRSGs. Therefore, alternate BACT limits must be specified for these modes of operation.

Startup and shutdown periods, when compared to emissions generated at steady-state operation, generate elevated emissions for various reasons. For instance, startups require extended periods of operation at low turbine loads (less than 50 percent), where turbine operation must be tuned for operational stability rather than emissions compliance. Furthermore, during startup and shutdown, exhaust temperatures that fall outside of the optimal temperature range for the control equipment (SCR and oxidation catalyst) may lead to non-operation of the control equipment for all or part of the duration of startup and shutdown periods.

Various approaches to reducing emissions during startups and shutdowns are currently being tested by turbine manufacturers. However, these configurations are not yet reliable enough to be considered BACT—this is clearly demonstrated by the fact that the manufacturer is not willing to guarantee the emission reductions. The emission reductions are promising, not promised.

Proposed Emissions During Startups and Low Loads

21. *Please provide technical information, including vendor specifications that support the proposed emissions during startups and low loads (AFC Tables 5.1A-9A and 5.1A-9B), preferably on vendor letterhead. This information should include enough detail to determine emissions as a function of time in a hot startup and a cold startup and at certain increasing loads. If necessary, proprietary or confidential information may be submitted pursuant to the Energy Commissions siting regulations for the designation of confidential records.*

Response: Proposed maximum hourly emission rates for NOx and CO during startups are based on the Applicant's experience at similar facilities, not vendor guarantees. Startup emissions are not guaranteed by turbine vendors because emissions during startups are a function of integrated plant performance, and not the performance of any individual plant component (such as the gas turbine). Continuous emissions monitoring systems (CEMs) for NOx and CO will ensure compliance with the proposed limits.

Also note that, except for the emission rate (in lb/hour), the emission estimates are **not** predictions of actual emissions per startup or shutdown. They are estimates prepared for the purpose of budgeting annual emission offset requirements. The estimates are not predictions because the duration, and resulting emissions, of any given startup (defined as the length of time between the initiation of fuel flow and reaching compliance with NOx limits) are functions of the conditions (primarily equipment temperatures) at fuel flow initiation, and the firing rate during startup.

Thus, the excess emissions during any single startup event are going to lie anywhere between zero (restart of an already-hot system after a momentary break in power production) and the emissions associated with a completely cold start. For annual emission/offset budgeting purposes, this spectrum of possible conditions is simplified to two or three representative cases (hot, warm, cold start-ups). The dividing lines between these cases are somewhat arbitrary. In this application, warm starts were assumed to average one hour each. This represents the average time it will take to bring the system up to temperature after being shut down overnight.

From an operating standpoint, however, the only case that is distinctly definable is the cold start; and even that is subject to the seasonal variation of ambient temperature. All other startups are "warm" or "hot" startups of a duration that varies with the amount of residual heat in the combined-cycle system.

For all of the above reasons, the requested information concerning startup emissions is not available.

NOx Emission Limit Specifications

22. *Please provide vendor specifications demonstrating compliance with the 140 lb/hr NOx emission limit in YSAQMD Rule 2.16.*

Response: Proposed maximum hourly emission rates during startups are based on the Applicant's experience at similar facilities, not vendor guarantees. CEMs for NOx and CO will ensure compliance with the proposed limits.

The AFC proposes limiting startup NOx emissions to 140 lb/hr (max) for a 190-MW turbine. The CEC has approved the following projects utilizing similar startup emission rates for similar turbines:

- Delta Energy Center (98-AFC-3); NOx emissions = 80 lb/hot start; 240 lb/cold start (max duration 3 hours)
- Elk Hills (99-AFC-1) NOx emissions = 76 lb/hr
- Metcalf (99-AFC-3) NOx emissions = 80 lb/hr
- Moss Landing (99-AFC-4) NOx emissions = 320 lb/startup; max duration 4 hours
- El Segundo (00-AFC-14) NOx emissions = 80 lb/hr
- East Altamont Energy Center (01-AFC-4) NOx emissions = 240 lb/startup; max duration 3 hours

We understand that the data request has its origins in the CEC's experience with overly optimistic characterizations of startup emissions contained in previous applications. In some cases, applicants needed to have permit conditions adjusted after construction because the emission limits during startup were impossible to meet consistently.

The cost of offsets is a strong incentive for the applicant to minimize its estimate of startup emissions. On the other hand, overly optimistic characterization of startup emissions can result in compliance problems, and insufficient offsets can restrict project operation. The characterization of startup emissions in the AFC represents the applicant's balance of the cost of offsets and minimizing the risk of non-compliance. Experience with similar facilities provides confidence that the 140 lb/hour not-to-be-exceeded level can be met; and that, on average, warm starts will be at or below 100 lb/startup. Furthermore, the project includes design features that are expected to minimize the duration of (and therefore emissions from) each startup. However, each individual startup's emissions is a strong function of the conditions at the time. All of this means that any emission limit that can be consistently complied with will be meaningless as a tool for ensuring that startup emissions are minimized.

Turbine Load Data

23. *Please provide turbine load data (electrical and percent) for AFC Tables 5.1A-2A and 5.1A-2B, in order to confirm the part-load scenarios analyzed in the dispersion modeling and to evaluate the low-load performance of the proposed power plant.*

Response: The requested information has been added to the revised AFC Tables 5.1A-2A and 5.1A-2B (see Attachment DR2-1).

"Rapid Response" Technologies

24. *Please describe why the proposed project is not incorporating "Rapid Response" technologies (including the GE OpFlex enhancements or the Siemens Flex Plant technology) for controlling and reducing low-load emissions to the extent feasible. Staff is required to ensure that the applicant incorporates into the project all measures that can be shown to be feasible, reasonably necessary, and available to substantially lessen or avoid significant adverse environmental effects (Title 20, California Code of Regulations, section 1741(b)).*

Response: Only significant environmental impacts are required to be mitigated; the Applicant does not believe there are any such impacts related to the proposed project design.

Furthermore, the benefits that these systems might offer in reducing startup emissions are still speculative. The vendors will not guarantee emissions performance for these systems at this time.[9] Startup emissions associated with operation of the Palomar facility are matched by other facilities without enhanced control systems. To our knowledge, no facility that has installed (or proposed to install) these technologies has claimed an enforceable emission reduction as a result.

The CPV Vaca Station project does plan to incorporate plant features that enhance startup flexibility, but even if these systems perform as advertised, the reduction in NOx and CO emissions will be modest.

The duration of and emission rates associated with startups and shutdowns of combined cycle power plants are a function of each plant's unique design, including factors such as the gas turbine model, the heat recovery steam generator manufacturer, the steam turbine manufacturer and model, the plant distributed control system, as well as other balance of plant features. Furthermore, as discussed above, every single startup is a unique event with different initial conditions that affect the time it takes to reach operating conditions. These unique factors make it impossible to establish a single set of emission rates as BACT for these transient conditions. However, there are basic principles of operation, or Best

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[9] General Electric guarantees that "base load" emission rates can be achieved at lower loads with some of their OpFlex options, but does not guarantee lower startup emission rates associated with this technology.

Management Practices, that minimize emissions during startups and shutdowns,. These Best Management Practices are as follows:

- During a startup, bring the gas turbine to the minimum load necessary to achieve compliance with the applicable NOx and CO emission limits as quickly as possible, consistent with the equipment manufacturers' recommendations and safe operating practices
- During a startup, initiate ammonia injection to the SCR system as soon as the SCR catalyst temperature and ammonia vaporization system have reached their minimum operating temperatures
- During a shutdown, once the turbine reaches a load that is below the minimum load necessary to maintain compliance with the applicable NOx and CO emission limits, reduce the gas turbine load to zero as quickly as possible, consistent with the equipment manufacturers' recommendations and safe operating practices
- During a shutdown, maintain ammonia injection to the SCR system as long as the SCR catalyst temperature and ammonia vaporization system remain above their minimum operating temperatures

A key underlying consideration of these Best Management Practices is the overall safety of the plant staff by promoting operation within the limitations of the equipment and systems and allowing for operator judgment and response times to respond to alarms and trips during the startup sequence.

Finally, the OpFlex and Flex Plant systems are proprietary process control systems. In order to use one of these control systems, the project must purchase all of the combustion train (gas turbine, steam turbine, HRSG, and controls) from a single vendor, potentially increasing the cost of the project. A more important commercial consideration is the potential risk should a single component of the package be unavailable at the time of purchase (such as the steam turbine)

OpFlex System Feasibility

25. *Please investigate and describe the feasibility of implementing the OpFlex system low load emission reduction controls which have been in use since 2007 at Palomar Energy Center, or similar competing technologies.*

Response: The OpFlex low load emission reduction controls in use at the Palomar energy center are not expected to achieve any operating emission reductions at CPV Vaca Station, because CPV Vaca Station is not expected to operate at the low loads where an emissions benefit might be achieved.

In the background discussion for this data request, staff specifically referred to the use of OpFlex at Palomar to avoid startup events entirely. OpFlex's potential contribution to emission reductions in this mode is to allow more turndown during low load operation, reducing the mass emissions that result from running the turbines during periods of no demand.

The version of OpFlex technology in use at the Palomar Energy Center is the OpFlex – Turndown configuration. According to GE's marketing information, the OpFlex Turndown allows the turbine to meet NOx limits at 40 percent of full load (instead of 50 percent of full load). Palomar was able to operate at 45 percent of full load.[10] NOx emissions associated with operating the unit for 8-16 hours at 40 percent load are 56 to 112 pounds (7 lb/hr NOx emission rate at 40 percent load). This is to be compared to nominal emissions of 100 lb per shutdown/startup cycle assumed in the AFC. Use of OpFlex technology will, at best, reduce project emissions somewhere between 0 and 44 pounds of NOx per hot start if the plant remained in operation throughout the night. The OpFlex technology in use at the Palomar Energy Center will have no material effect on cold-start emissions.

Operating the turbines at night when there is no demand for them, even at low load, will seriously affect the overall efficiency of the operation, wasting fuel and resulting in increased emissions of SO_2, particulate, and GHGs, as well as the nightly emissions of NOx and CO that must be balanced against the reduced emissions from avoiding startups. It is also possible that a day or more may pass when this facility would not be dispatched at all. In that case, the use of OpFlex would require operation at 40 to 45 percent load for 32 hours instead of 8; the resulting NOx emissions would substantially exceed the emissions associated with a single startup.

As discussed previously, use of the OpFlex system requires that all components of the facility (turbines, HRSGs, and controls) be purchased from the only supplier who sells the system. Because of the vendor's monopoly, the system's price is much higher and the potential unavailability of this equipment poses a significant cost and schedule risk.

Because the suggested mode of operation results in increased emissions of PM, SO_2, and GHGs (and, under some circumstance, NOx); because the existing amount of experience with the technology is too small for the manufacturer to be able to guarantee emission reductions; because the burning of fuel to operate the turbines at a time when there is no demand for the power generated is wasteful; and because of the potentially significant cost increase that use of this system would require, the OpFlex system should not be required for this project, and should not be deemed a "feasible alternative" as defined under CEQA.

Automatic Generation Control

26. *Please provide a thorough description of "automatic generation control" and what role the California Independent System Operator (CAISO) has in implementing the automatic generation control.*

Response: Automatic Generation Control (AGC)/Regulation is the online, synchronized, generation capacity that is available to respond to the CAISO's AGC control signals on a second-by-second basis. This capacity enables a continuous balancing of resources and load within the CAISO-controlled grid, as well as maintaining frequency during normal operating conditions.

CAISO AGC is a standard mode of operation that is an ongoing condition for power plants that provide the CAISO with this ancillary service. The proposed project will be providing this service to the CAISO. As such, the CAISO (along with the service utility) will effectively

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[10] SDGE letter to SDAPCD Hearing Board (April 11, 2007).

be controlling the routine operation of the proposed project. The onsite operators will mainly be responsibility for monitoring equipment operation and will take over equipment operation if necessary to respond to system alarms and/or during gas turbine startups/shutdowns.

It is the Applicant's understanding that nearly every combined cycle and boiler power plant in California with a rating greater than 50 MW is currently operating under CAISO AGC.

Effect of Automatic Generation Control on Emissions

27. Please describe what effect, if any, the automatic generation control will have on any aspect of the criteria pollutant emission levels for the project.

Response: The use of AGC is not expected to have any impacts on the project's ability to comply with all proposed emissions limits. Any AGC control agreement with the CAISO would include a "not-to-exceed" ramp rate that would prevent the CAISO from forcing turbine load changes that would exceed the control system's ability to keep the turbines within their permitted emissions limits. However, it is possible that, under certain conditions, the CAISO may require the plant to change load at the maximum allowable rate which, in combination with other conditions (such as ambient temperature), could result in short-term excursions in excess of the NOx emission limit. This is one of the reasons why the Applicant will be seeking approval for a limited number of NOx excursions similar to conditions approved by the CEC and air regulatory agencies for a number of projects in California over the last 10 years.

Periodic Combustor Tuning

28. Please describe whether the chosen model combustion turbine would require periodic combustor tuning. If so, then please provide the following information:

a. The proposed frequency of combustor tuning.

Response: Combustor tuning would be conducted as needed to ensure compliance with operating requirements. Based on the experiences at other plants, the Applicant expects that combustor tuning activities could occur as often as once or twice every calendar year.

b. When tuning would take place, for example during the normal annual maintenance inspection, or at some other manufacturer-specified time period.

Response: Following periodic maintenance on the gas turbine combustion system, it will be necessary to re-adjust fuel and combustion air flows to the combustor cans to minimize NOx and CO at the turbine exhaust. These adjustments are standard in the industry for dry low-NOx combustors, and have been recognized in Commission approvals for the following projects:

- Delta Energy Center (98-AFC-3C); order approving amendment, 9/8/2004
- Metcalf Energy Center (99-AFC-3C); order approving amendment, 3/16/2005
- Moss Landing Power Project (99-AFC-4C); order approving amendment, January 2004
- Mountainview Power Project (00-AFC-2C); order approving amendment, 9/16/2004

- Inland Empire Energy Center (01-AFC-17C); order approving amendment, 5/14/2007
- Russell City Energy Center (01-AFC-7C), Condition AQ-19; order approving amendment, 10/3/2007
- Pastoria Energy Facility Expansion (05-AFC-1), Condition AQ-34; Commission Decision (December 2006)

c. A description of what the combustor tuning process entails.

Response: Combustor tuning entails re-adjustment of fuel and combustion air flows to the combustor cans to minimize NOx and CO at the turbine exhaust.

d. The criteria pollutant emission rates that would occur (concentrations and mass emission levels), and the duration in which emission rates over those of normal steady-state operation would occur.

Response: Gas turbine tuning activities are not expected to occur for more than 12 hours per day or more than 40 hours per year. During these tuning activities, maximum hourly emissions are not expected to be higher than during an extended (six hour) gas turbine startup.

Sources Included in Cumulative Impact Analysis

29. Please provide the list of cumulative sources to be considered and the cumulative analysis for ambient air quality impacts.

Response: The Bay Area Air Quality Management District (BAAQMD) and YSAQMD provided lists of all projects under their review for which permits (Authority to Construct or Permit to Operate) have been issued, but whose emissions would not have been part of the measured ambient background. These lists are provided as attachments to this document.

The facilities listed in Table DR29-1 have emission increases in excess of 5 tpy of VOC, NOx, or PM_{10} (CO is not included because the margin of compliance is so great that cumulative impacts are not possible).

TABLE DR29-1
New Emissions Greater Than 5 tpy Within 6 miles of CPVVS

Facility	Source	Distance (miles)	VOC (tpy)	NOx (tpy)	SOx (tpy)	PM_{10} (tpy)
Kaiser Health	Boilers, Engines	4.0	-	13.1	-	-
Jepson Prairie	Composting	3.8	1,562	-	-	-
Ramos Oil Co.	Retail Gasoline	9.6	6.03	-	-	-
Norcal Waste	Landfill	3.8	11.4	-	-	-
State Compensation Insurance	Boilers, Engines	4.4	-	6.4	-	-
Alza Corp	Alcohol cleaning	5.3	7.4	-	-	-
CalPeak Power	Utility Power Generation	4.1	5.1	15	5	11.8

TABLE DR29-1
New Emissions Greater Than 5 tpy Within 6 miles of CPVVS

Facility	Source	Distance (miles)	VOC (tpy)	NOx (tpy)	SOx (tpy)	PM_{10} (tpy)
Costco	Retail Gasoline	4.3	12.56	-	-	-
CEMEX	Cement Batch Plant	5.6	-	-	-	6.15
TOTAL			**1,694**	**34.5**	**5**	**18.0**

Based on the data in Table DR29-1, emissions from the Kaiser Health Facility at 1 Quality Drive, Vacaville; State Compensation Insurance Fund at 4040 Horse Creek Drive, Vacaville; CalPeak Power project at 5157 Quinn Road, Vacaville; and CEMEX, 4964 Peabody Road Fairfield, will be included with CPVVS project emissions and the cumulative impacts for NOx, PM_{10}, and $PM_{2.5}$ will be determined using the AERMOD dispersion model.

ATTACHMENT DR2-1

Corrected AFC Tables 5.1A-2A and 5.1A-2

Table 5.1A-2 A (revised 4/1/09)
GE 7FA with HRSG
Emissions and Operating Parameters for
CTGs /

Case	Cold Base	Cold Low	Avg. Base	Avg. Low	Avg. Peak	Hot Base	Hot Low	Hot Peak
Turbine Load, MW	190.3	95.2	179.4	88.1	179.4	166.7	73.4	166.7
Ambient Temp, F	26.2	26.2	59	59	59	105.6	105.6	105.6
Turbine Load, %	100%	50%	100%	50%	100%	100%	50%	100%
Chiller On/Off	Off	Off	On	On	On	On	On	On
CTG heat input, MMBtu/hr (HHV)	1902.0	1234.0	1815.0	1171.0	1815.0	1719.0	1040.0	1719.0
DB heat input, MMBtu/hr (HHV)	0.0	0.0	0.0	0.0	512.0	0.0	0.0	512.0
Total heat input, MMBtu/hr (HHV)	1902.0	1234.0	1815.0	1171.0	2327.0	1719.0	1040.0	2231.0
Stack flow, lb/hr	3,832,424	2,473,500	3,621,900	2,388,700	3,808,855	3,418,600	2,256,800	3,581,322
Stack flow, acfm	1,076,770	695,018	1,021,418	672,599	1,053,087	976,059	636,146	1,002,679
Stack flow, dscfm	802,061	517,495	752,663	498,162	780,661	694,289	470,685	716,266
Stack temp, F	195	195	195	195	180	195	195	180
Stack exhaust, vol %								
O2 (dry)	13.80%	13.76%	13.67%	13.86%	11.96%	13.48%	14.28%	11.55%
CO2 (dry)	4.11%	4.14%	4.18%	4.08%	5.16%	4.29%	3.84%	5.39%
H2O	7.60%	7.63%	8.59%	8.12%	10.14%	11.76%	8.21%	13.41%
Emissions								
NOx, ppmvd @ 15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NOx, lb/hr	13.81	8.96	13.18	8.50	16.90	12.48	7.55	16.20
NOx, lb/MMBtu	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073
SO2, ppmvd @ 15% O2	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
SO2, lb/hr	5.27	3.42	5.03	3.24	6.44	4.76	2.88	6.18
SO2, lb/MMBtu	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028
CO, ppmvd @ 15% O2	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
CO, lb/hr	12.61	8.18	12.04	7.76	15.43	11.40	6.90	14.79
CO, lb/MMBtu	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
POC, ppmvd @ 15% O2	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
POC, lb/hr	4.82	3.12	4.60	2.96	5.89	4.35	2.63	5.65
POC, lb/MMBtu	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
PM10, lb/hr	7.5	7.5	7.5	7.5	9.0	7.5	7.5	9.0
PM10, lb/MMBtu	0.0039	0.0061	0.0041	0.0064	0.0039	0.0044	0.0072	0.0040
PM10, gr/dscf	0.00109	0.00169	0.00116	0.00176	0.00135	0.00126	0.00186	0.00147
NH3, ppmvd@15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3, lb/hr	12.78	8.29	12.20	7.87	15.64	11.55	6.99	14.99

Table 5.1A-2 B (revised 4/1/09)

Siemens SGT6500F

Emissions and Operating Parameters for CTGs

Case	Cold Base	Cold Low	Avg. Base	Avg. Low	Avg. Peak	Hot Base	Hot Low	Hot Peak
Turbine Load, MW	223	108	206	100	206	193	82	192
Ambient Temp, F	26.2	34.4	59	59	59	105.6	105.6	105.6
Turbine Load, %	100%	50%	100%	50%	100%	100%	50%	100%
Chiller On/Off	Off	Off	On	On	On	On	On	On
CTG heat input, MMBtu/hr (HHV)	2182.6	1289.3	2047.9	1224.4	2078.5	1947.6	1089.1	1961.2
DB heat input, MMBtu/hr (HHV)	0.0	0.0	0.0	0.0	500.0	0.0	0.0	500.0
Total heat input, MMBtu/hr (HHV)	2182.6	1289.3	2047.9	1224.4	2578.5	1947.6	1089.1	2461.2
Stack flow, lb/hr	4,236,856	2,854,325	4,006,679	2,665,485	4,210,055	4,023,569	2,441,375	4,171,263
Stack flow, acfm	1,170,701	843,783	1,107,845	777,295	1,131,327	1,144,745	697,786	1,132,656
Stack flow, dscfm	885,159	600,496	831,584	558,023	862,725	821,306	512,260	839,533
Stack temp, F	184	230	182	219	162	194	206	162
Stack exhaust, vol %								
O2 (dry)	13.51%	14.47%	13.52%	14.33%	11.93%	13.80%	14.54%	12.11%
CO2 (dry)	4.28%	3.73%	4.27%	3.81%	5.18%	4.11%	3.69%	5.08%
H2O	7.78%	7.00%	8.73%	7.68%	10.17%	11.13%	7.40%	12.68%
Emissions								
NOx, ppmvd @ 15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NOx, lb/hr	15.85	9.36	14.87	8.89	18.72	14.14	7.91	17.87
NOx, lb/MMBtu	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073
SO2, ppmvd @ 15% O2	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
SO2, lb/hr	6.04	3.57	5.67	3.39	7.14	5.39	3.02	6.81
SO2, lb/MMBtu	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028
CO, ppmvd @ 15% O2	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
CO, lb/hr	14.47	8.55	13.58	8.12	17.10	12.91	7.22	16.32
CO, lb/MMBtu	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
POC, ppmvd @ 15% O2	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
POC, lb/hr	5.53	3.26	5.19	3.10	6.53	4.93	2.76	6.23
POC, lb/MMBtu	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
PM10, lb/hr	7.5	7.5	7.5	7.5	9.0	7.5	7.5	9.0
PM10, lb/MMBtu	0.0034	0.0058	0.0037	0.0061	0.0035	0.0039	0.0069	0.0037
PM10, gr/dscf	0.00099	0.00146	0.00105	0.00157	0.00122	0.00107	0.00171	0.00125
NH3, ppmvd@15% O2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
NH3, lb/hr	14.67	8.66	13.76	8.23	17.33	13.09	7.32	16.54

ATTACHMENT DR13-1

Cooling Tower Droplet Size Distribution

SPX Cooling Technologies
Balcke | Hamon Dry Cooling | Marley

COOLING TOWER DRIFT MASS DISTRIBUTION
TU12 Excel Drift Eliminators

The following table represents the predicted mass distribution of drift particle size for cooling tower drift dispersed from Marley TU12 Excel Drift Eliminators.

Mass in Particles (%)		Droplet Size (Microns)
0.2	Larger Than	525
1.0	Larger Than	375
5.0	Larger Than	230
10.0	Larger Than	170
20.0	Larger Than	115
40.0	Larger Than	65
60.0	Larger Than	35
80.0	Larger Than	15
88.0	Larger Than	10

How to read table: Example – 0.2% of the drift will have particle sizes larger than 525 microns.

Biological Resources (30–35)

Burrowing Owl Surveys

30. *Please conduct additional surveys of western burrowing owl according to the California Burrowing Owl Consortium survey protocol (CBOC 1993) within the CPVVS 1-mile survey area (including project linears, temporary laydown area, and substation) and provide survey results. If owls are found, also report results to the California Department of Fish and Game (CDFG).*

Response: The western burrowing owl survey report is included as Attachment DR30-1.

Swainson's Hawk Survey

31. *Please provide a detailed report of the Swainson's hawk protocol survey, including methodology and results.*

Response: The Swainson's hawk protocol survey report is included as Attachment DR31-1

Project Permits

32. *Please coordinate with USACE, RWQCB, and CDFG (as applicable) to determine the need for project permits. Provide any supporting documents (letter or record of conversation) that result from communication with these agencies.*

Response: The Applicant has been unsuccessful in scheduling discussions with USACE, RWQCB, and CDFG regarding the need for project permits, despite attempts to do so. The Applicant will continue to work with CEC Staff and these agencies to identify and resolve any regulatory or permitting issues for the project and file records of conversation with these agencies as soon as it is possible to do so.

Jurisdictional Delineation of Waters

33. *Please conduct a preliminary jurisdictional delineation of waters of the United States, including wetlands, and waters of the State. The jurisdictional delineation should be conducted within the CPV Vaca Station 1-mile survey area (including project linears, temporary laydown area, and substation). Please provide the survey results and related map delineation.*

Response: The preliminary jurisdictional delineation of waters is included as Attachment DR33-1.

Identified Jurisdictional Wetlands/Waters

34. *If potentially jurisdictional wetlands and/or waters are identified, please coordinate with USACE, RWQCB, and CDFG (as applicable) regarding project permitting requirements. Provide any supporting documents (letter or record of conversation) that result from communication with these agencies, including the permits required for the project, the steps the applicant has taken or plans to take, and the schedule for obtaining the permits.*

Response*:* Project construction that requires dredging or filling any of the jurisdictional waters or contributes to the loss or degradation of wetlands may require a permit under Section 404 of the Clean Water Act from USACE and water quality certification from the RWQCB under Section 401 of the Clean Water Act, and possibly a Streambed Alteration Agreement from CDFG. The Applicant has contacted these agencies to initiate discussions regarding permitting and expects to meet with these agencies in the near term to identify and resolve any permitting issues.

Temporary disturbance of some of the agricultural ditches will be required to construct the CPVVS natural gas pipeline. However, the ditches will be restored to their original condition after construction. It is therefore possible that a preconstruction notification to USACE will suffice for permitting, if the total disturbance of the agricultural ditches is less than 0.10 acre. If the total disturbance is more than 0.10 acre and less than 0.5 acre, then the project might qualify for coverage under a general, or Nationwide permit held by the USACE Sacramento District. An applicable Nationwide permit would be the Nationwide Permit No. 12 for Utility Line Discharges, which was designed to provide streamlined permitting for projects that would have minor effects to waters of the United States during temporary construction of utility lines such as natural gas pipelines.

Construction of the electrical transmission line would be unlikely to cause any disturbance of jurisdictional waters because agricultural jurisdictional drainages could be avoided by transmission tower placement and conductor stringing, pulling, and tensioning activities.

Supporting Documents

35. *Please provide any supporting documents (letter or record of conversation) that result from communication with U.S. Fish and Wildlife Service (USFWS) and CDFG regarding potential impacts to state and/or federally protected species. Communication should be focused on:*

    a. Potential impacts and agency approval of applicant-proposed mitigation measures (AFC Sec. 5.2.4, pgs. 5.2-68 through 5.2-73).

Response: If it is determined that the project will cause impacts to state or federally protected species, the Applicant will work with the applicable agencies to develop appropriate mitigation measures. See also the response to Data Request #32.

b. Permits required for the project (e.g., Incidental Take Permits), the steps the applicant has taken or plans to take, and the schedule for obtaining the permits.

Response: Permits required for the project may include the Incidental Take Permit for federally-protected species or the Individual Take Permit for state-protected species. The Applicant will work with the applicable agencies to develop appropriate mitigation measures. See also the response to Data Request #32.

ATTACHMENT DR30-1

Burrowing Owl Survey Report

CPV Vaca Station Burrowing Owl Surveys

PREPARED FOR:	CPV Vaca Station, LLC
PREPARED BY:	Michael Clary
COPIES:	Debra Crowe, Douglas Davy
DATE:	March 19, 2009
PROJECT NUMBER:	370668

Introduction and Background

This technical memo supplements information previously presented in Chapter 5.2 of the CPV Vaca Station (CPVVS) Application for Certification (08-AFC-11). In response to California Energy Commission Staff Data Request #30, this memo presents the methods and results of additional surveys for western burrowing owl (*Athene cunicularia*) within the proposed CPVVS site. The site was initially surveyed for western burrowing owls on June 13, 2008 and was determined at that time to be too heavily vegetated to provide suitable nesting or forage habitat for western burrowing owl. Subsequent to those surveys the CPVVS site was disked, an event that could have altered habitat suitability for western burrowing owl. Based on clarification from the data request author (Blair, 2008), this memo discusses updated surveys conducted within the disked portion of the CPVVS site only. No additional project areas were observed to provide habitat for western burrowing owl during the updated surveys.

At the time of the initial surveys no western burrowing owls were reported in the CNDDB from within the 1-mile survey area. The CPVVS was determined to be within an area that provides potential western burrowing owl foraging habitat as identified in the Draft Solano MHCP. Western burrowing owl is a California state species of special concern, and it is protected under the Migratory Bird Treaty Act (MBTA) and several of California's Fish and Game codes including 3503, 3503.5, and 3513.

Methods

Prior to the updated site surveys for western burrowing owl, the California Natural Diversity Database (CNDDB, 2009) was queried to identify any new western burrowing owl occurrences, and the western burrowing owl survey recommendations published in *Burrowing Owl Survey Protocol and Mitigation Guidelines* (California Burrowing Owl Consortium [CBOC], 1993) were reviewed for appropriate survey protocols.

The CBOC guidelines advise an initial habitat assessment (Phase I) of all areas of project related activities. If suitable habitat is determined to be present, a burrow survey (Phase II) is necessary. If burrows or burrowing owls are observed on site, then burrowing owl surveys, census and mapping (Phase III) is required. This technical memo serves as the resource summary written report (Phase IV).

The Phase I habitat assessment evaluated the presence of burrowing owl habitat on the project site including a 150-meter (492 foot) buffer zone around the site boundary. For the purposes of the Phase I assessment, burrowing owl habitat was determined to include annual and perennial grasslands characterized by low-growing vegetation, as well as trees and shrubs if the canopy covers less than 30 percent of the ground surface (CBOC 1993).

Phase II burrow surveys were conducted by walking through suitable habitat over the entire CPVVS site and in areas within 150 meters of the area of project-related disturbance. Surveys were conducted for burrows made by fossorial mammals such as ground squirrels, as well as man-made structures such as culverts, debris piles, or openings beneath pavement. Because no burrowing owls or burrows were observed at the site, Phase III surveys were not required.

A western burrowing owl Phase I habitat assessment and Phase II burrow survey were conducted by Mr. Michael Clary on March 17, 2009 within the proposed CPVVS site following the methodology provided in the CBOC guidance. Weather during the surveys was clear and cool, with light winds from the south and 5 to 10 percent cloud cover.

Results

The CNDDB denotes no western burrowing owl occurrences within the proposed CPVVS site. The nearest reported western burrowing owl (CNDDB occurrence #962) is located 1.5 miles north of the CPVVS site at the top of a drainage ditch near the intersection of Lewis and Holdener Roads. No western burrowing owls were observed at the proposed CPVVS site during any of the site surveys.

The Phase I habitat assessment identified marginal nesting and foraging habitat for BUOW. Although the site had been disked subsequent to the June 13, 2008 survey and is currently dominated by annual vegetation, it possesses few areas with the low growing vegetation required to provide suitable foraging habitat (Photo 1). The site is predominantly flat, with a single densely vegetated 3 to 4-foot-high berm along an access road to the west (Photo 2). The site appears to be reestablishing the density of annual vegetation present prior to disking, and no bare areas, trees or shrubs were observed. A list of observed vegetation is provided in Table 1.

Due to the presence of marginal habitat, Phase II burrow surveys were conducted concurrent with Phase I surveys. Burrow surveys did not reveal any burrows or man-made structures that could provide shelter, protection or nesting habitat for western burrowing owls. Several culverts are located beyond the disked areas that were observed to be actively channeling agricultural drainage. No fossorial mammals were observed within the proposed CPVVS site.

TABLE 1
Observed Plant Species at the CPVVS site

Scientific Name	Common Name
Hirschfeldia incana	shortpod mustard
Avena barbata	slender oat
Medicago polymorpha	burclover
Erodium cicutarium	redstem stork's bill
Lolium perenne ssp. multiflorum	Italian ryegrass
Malva parviflora	cheeseweed mallow

Conclusion

The proposed CPVVS survey site does not currently provide suitable nesting or foraging habitat for western burrowing owl, and no burrowing owl occurrences have been reported within the CPVVS site. Due to the lack of suitable habitat for western burrowing owl, the proposed CPVVS project is unlikely to impact western burrowing owl. Per the discussions in the AFC section 5.2, mitigation is unlikely to be required for this species.

References

Blair, Heather. 2008. Pers. Comm. March 10.

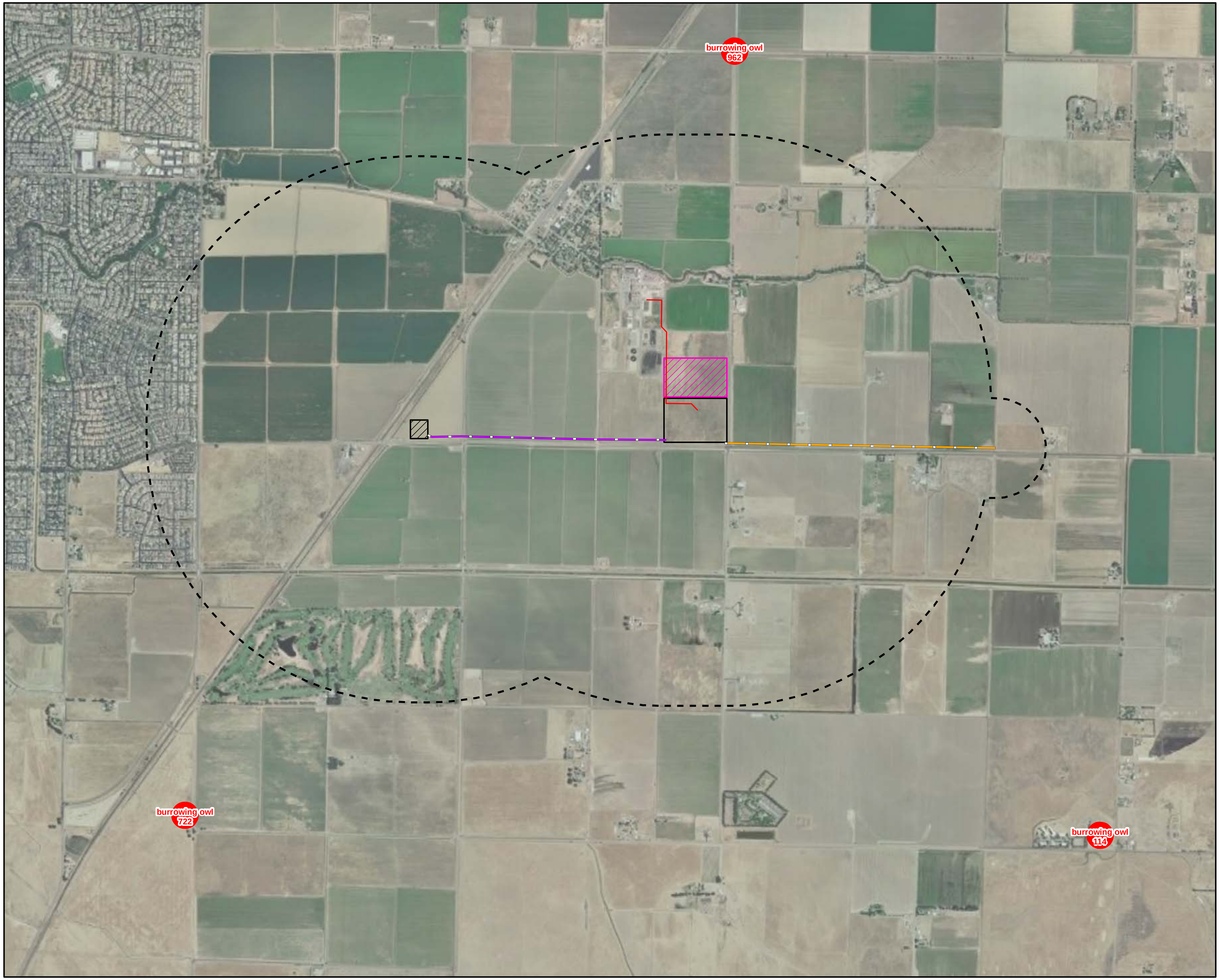
California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. April.

California Department of Fish and Game (CDFG). 2008. California Natural Diversity Data Base. Search of the Mt. Vaca, Fairfield North, Fairfield South, Allendale, Elmira, Denverton, Dixon, Dozier, Birds Landing, Saxon, Liberty Island, and Rio Vista 7.5-minute USGS quadrangles

LSA. 2007. Solano Multispecies Habitat Conservation Plan. Version 2.2 Final Administrative Draft. Available online: http://www.scwa2.com/hcp2.2.html

Photo 1 - Site interior, showing shortpod mustard (Hirschfeldia incana) and red-winged blackbird (Agelaius phoeniceus).

Photo 2 - CPVVS site from the northwest showing roadside berm and annual vegetation



LEGEND

- Utility Corridor to WWTP
- Natural Gas Pipeline Route
- Electrical Transmission Line Route
- Drainage
- ▨ New Substation
- ▨ Laydown Area
- ☐ Project Site
- One Mile Buffer

CNDDB April, 2008

- 🟥 Animal (80m)
- Animal (specific)
- Animal (non-specific)
- ☐ Animal (circular)

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

FIGURE 1
BURROWING OWL OCCURRENCES WITHIN THE ONE MILE STUDY AREA

CPV VACA STATION

VACAVILLE, CALIFORNIA

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ATTACHMENT DR31-1

Swainson's Hawk Survey Report

CPV Vaca Station Swainson's Hawk Surveys

PREPARED FOR:	CPV Vaca Station, LLC
PREPARED BY:	Michael Clary
COPIES:	Debra Crowe, Douglas Davy
DATE:	March 19, 2009
PROJECT NUMBER:	370668

This technical memo supplements information previously presented in Chapter 5.2 of the CPV Vaca Station (CPVVS) Application for Certification (08-AFC-11). In response to California Energy Commission Staff Data Request #31, this memo presents the methods and results of a survey for Swainson's hawk (*Buteo swainsoni*) within the proposed CPVVS site and along the alignments of a proposed electrical transmission line and natural gas pipeline that was conducted in June of 2008. Swainson's hawk is listed by the state of California as a threatened species, and it is protected under the federal Migratory Bird Treaty Act (MBTA).

Methods

Prior to site surveys for Swainson's hawk, the California Natural Diversity Database (CNDDB, 2008) was queried and GIS locations of reported Swainson's hawk occurrences were depicted on a paper map for use in the field. The Solano Multi-species Habitat Conservation Plan (SMHCP) was reviewed to determine whether or not the CPVVS 1-mile survey area is within recognized Swainson's hawk habitat (LSA, 2007), and Swainson's hawk survey recommendations published in *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley* (Swainson's Hawk Technical Advisory Committee [SHTAC], 2000) were reviewed for appropriate survey protocols.

The SHTAC methodology advises that Swainson's hawk nests are often well-hidden during the brood period (Survey Period IV) and that surveys should therefore not be conducted during that period. Surveys were delayed until the beginning the fledgling period (Survey Period V), established in the SHTAC methodology as beginning on June 10, 2008. Swainson's hawk young are typically active and visible during the fledgling period, and parents make numerous trips to the nest and can often be seen soaring above nest sites.

The methodology recommends surveys within 0.5 miles of project-related activities; however, CEC AFC requirements dictate surveys within 1.0 mile of the project site and within 1,000 feet of linear appurtenances. Therefore, in order to satisfy both requirements, the surveys of all suitable nesting habitat were conducted within 1.0 miles of the CPVVS facility and within 0.5 miles of the linear appurtenances.

Swainson's hawk surveys were conducted by Mr. Dan Williams and Mr. Michael Clary on June 13, 2008 within the CPVVS 1-mile survey area following the guidance provided in the SHTAC methodology. Weather during the survey was clear and warm, with light winds from the west and 10-30 percent cloud cover.

Both driving and walking surveys of the CPVVS 1-mile survey area were conducted. Driving surveys are preferred in the SHTAC methodology over walking surveys, and driving surveys of suitable nesting habitat did not exceed 5 miles per hour. Walking surveys of the proposed CPVVS site and linear appurtenances were conducted concurrent with a habitat assessment for western burrowing owl (*Athene cunicularia*) and included the use of high quality binoculars.

Results

The CNDDB reports 10 Swainson's hawk occurrences within the survey area (Figure 1). The nearest occurrence to the CPVVS facility (CNDDB occurrence #1303, last observed August 12, 2005) is located 0.5 miles south of the CPVVS site in a Eucalyptus tree adjacent to an alfalfa field. Five nests have been reported along Alamo Creek: CNDDB occurrence 569 was last observed August 8, 2005, and occurrences 860, 990, 996, and 1304 were last observed July 24, 2005. One Swainson's hawk nest has been reported within 250 feet of the proposed natural gas pipeline (CNDDB occurrence #1305, last observed July 23, 2005). Three additional Swainson's hawk nests have been reported to the northeast (CNDDB occurrences 989 last observed August 12, 2005 and CNDDB occurrence 1486, last observed June 24, 2002) and to the southwest (CNDDB occurrence 316, last observed May 18, 1990) of the proposed CPVVS site.

The CPVVS project is within an area identified in the SMHCP as an Irrigated Agriculture Conservation Area. This area encompasses all irrigated, non-irrigated, and some grassland habitat in the northeastern and eastern portions of the SMHCP Plan Area, and contains the majority of known Swainson's hawk records.

Suitable Swainson's hawk nesting and foraging habitat was observed throughout the survey area. The highest concentration of suitable nesting habitat is in large trees in the Alamo Creek riparian woodland north of the proposed CPVVS site, where the five nest occurrences have been reported in the CNDDB. The majority of the survey area is comprised of agricultural lands that provide suitable Swainson's hawk foraging habitat. Except for locations that would cross existing roads and associated drainage ditches, the proposed project site and linear appurtenances is comprised of active and inactive agriculture areas that provide suitable foraging habitat for Swainson's hawk.

No Swainson's hawk nests were observed during the protocol field surveys in June, 2008; however, several adult Swainson's hawk were observed foraging in the parcels to the north and west of the CPVVS site and in the vicinity of the reported nest locations north of the CPVVS site.

Conclusion and Recommendations

The CPVVS survey area is known to provide suitable nesting and foraging habitat for Swainson's hawk. Ten Swainson's hawk nest occurrences have been reported in the CNDDB within the survey area, the project vicinity recognized by the SMHCP as providing suitable habitat, and positive observations of Swainson's hawk presence were made during field surveys.

Due to the proximity of the proposed project to suitable nesting habitat and the presence of suitable foraging habitat at the project site, the CPVVS project has potential to impact Swainson's hawk.

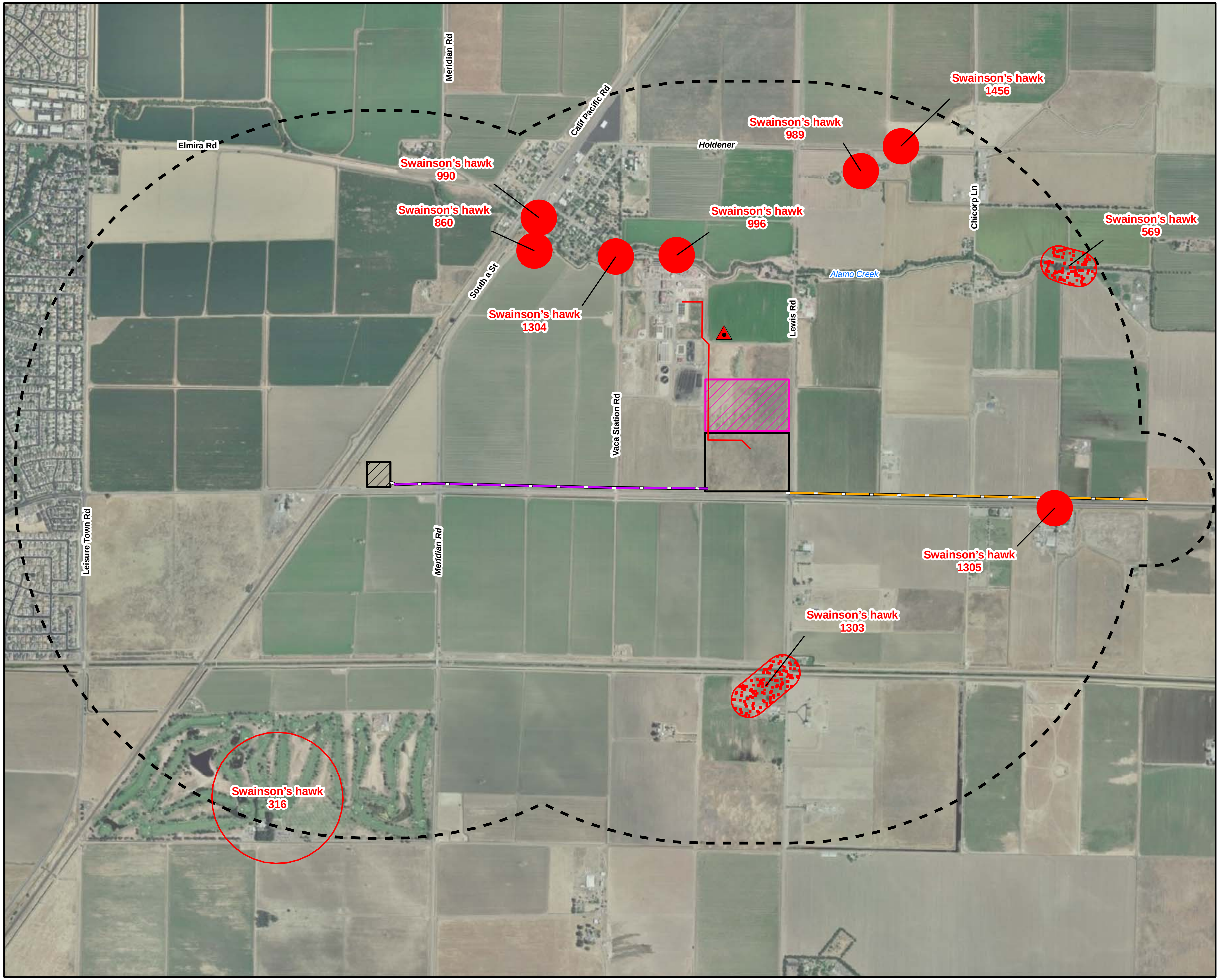
The SHTAC methodology recommends additional surveys at least during the two survey periods immediately prior to a project's initiation. Compensation for the loss of potential forage habitat at the project site will also be required. Mitigation Measure 2 in Section 5.2.4.2.1 of the CPVVS AFC recommends additional preconstruction surveys and compensatory mitigation for Swainson's hawk.

References

California Department of Fish and Game (CDFG). 2008. California Natural Diversity Data Base. Search of the Mt. Vaca, Fairfield North, Fairfield South, Allendale, Elmira, Denverton, Dixon, Dozier, Birds Landing, Saxon, Liberty Island, and Rio Vista 7.5-minute USGS quadrangles

LSA. 2007. Solano Multispecies Habitat Conservation Plan. Version 2.2 Final Administrative Draft. Available online: http://www.scwa2.com/hcp2.2.html

Swainson's Hawk Technical Advisory Committee (SHTAC). 2000. Recommended timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley. May 31.



LEGEND

▲ Observed Special-status Species (Swainson's Hawk)

— Utility Corridor to WWTP

— Natural Gas Pipeline Route

— Electrical Transmission Line Route

▨ New Substation

▨ Laydown Area

☐ Project Site

┅ One Mile Buffer

CNDDB April, 2008

🟥 Animal (80m)

▨ Animal (specific)

▨ Animal (non-specific)

☐ Animal (circular)

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 750 1,500
Feet

FIGURE 1
SWAINSON'S HAWK OCCURRENCES WITHIN THE ONE MILE STUDY AREA

CPV VACA STATION
VACAVILLE, CALIFORNIA

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ATTACHMENT DR33-1

Pre-jurisdictional Waters Delineation Study

CPV Vaca Station Pre-jurisdictional Waters Delineation Study

PREPARED FOR:	CPV Vaca Station, LLC
PREPARED BY:	Michael Clary
COPIES:	Debra Crowe, Douglas Davy
DATE:	March 19, 2009
PROJECT NUMBER:	370668

Introduction and Background

This technical memo supplements information previously presented in Chapter 5.2 of the CPV Vaca Station (CPVVS) Application for Certification (08-AFC-11). In response to California Energy Commission Staff Data Request #33, this memo presents the methods and results of preliminary jurisdictional determination of Waters of the United States, including wetlands and waters of the State, associated with agricultural drainages present within the proposed CPVVS site and linear appurtenances. These drainage locations were depicted in Figure 5.2-2a-o of the AFC and are represented in Figure 1 of this memo. Additional wetlands and Waters within 1-mile of the project are discussed in AFC Section 5.2.2.2., *Wetlands and Waters of the U.S.*

Methods

Prior to site visits, an aerial image of the proposed CPVVS project site, electrical transmission line and natural gas pipeline was examined to identify aerial signatures consistent with potentially jurisdiction waters of the U.S. associated with the agricultural drainages common in the area. Digitized reaches of drainages previously identified in the AFC were also re-evaluated.

In the field, proposed locations of the electrical transmission line and natural gas pipeline alignments and portions of the CPVVS site were examined from the public roadway to identify and correlate agricultural drainages with signatures identified on the aerial imagery. Hydrological connectivity was evaluated by tracing the routes of each observed drainage downstream to its confluence with Alamo Creek. Field notes and photographs were recorded at each location where a potential agricultural drainage was identified within the proposed project area. Where possible, field notes of each drainage included information on the width, typical vegetation (NRCS, 2009), visible inundation, and hydrologic connectivity with other drainages. Photographs of each secondary drainage were taken to show the overall character of each drainage in the project area, as well as secondary drainage outfall connectivity to primary drainages (see Photos 1-28 below).

Results

A field study of potential USACE and/or state jurisdictional agricultural drainages was conducted by Mr. Michael Clary on March 17, 2009 within the proposed CPVVS site, electrical transmission line and natural gas pipeline as described in the AFC.

A total of eleven secondary agricultural drainages were identified during the field study that would intersect either the proposed electrical transmission line or the natural gas pipeline (Figure 1). Each of these drainages conveys agricultural runoff water to the south, perpendicular to Fry Road. Three irrigation canals (I- 4, I-12, I-13) were visible on aerial imagery and were identified in the field. These distribute water to agricultural fields

All of the agricultural drainages identified eventually confluence with Alamo Creek, a Water of the United States (jurisdictional waters), via one of two primary drains that run parallel to and south of Fry Road. The western primary drainage flows to the east from the Union Pacific Railroad to Lewis Road, and then flows south to New Alamo Creek (Photo 1). The eastern primary drainage flows east from Lewis Road to Old Alamo Creek (Photo 2). New Alamo Creek confluences with Old Alamo Creek approximately 1.5 miles southwest of the proposed CPVVS site.

All 14 agricultural drains and irrigation canals are depicted in Figure 1 and are described in detail below. Table 1 at the end of this memo summarizes the width, typical vegetation and facultative status, and photo number for each drainage and canal.

Agricultural Drainage AD-01

AD-01 is the westernmost agricultural drainage within the proposed CPVVS project area (Photo 3). This drainage is approximately 2 feet wide and is sparsely vegetated with shortpod mustard (*Hirschfeldia incana*). AD-01 runs to the south along the western shoulder of Meridian Road and connects with the western primary drainage through a culvert southwest of the Fry Road/Meridian Road intersection (Photo 4). An associated agricultural drainage that will not be impacted by the project runs parallel to and north of the Fry Road shoulder (AD-01P), confluencing with AD-01 at the culvert inlet (Photo 5).

Agricultural Drainage AD-02

AD-02 is located between Meridian and Vaca Station Roads (Photo 6). Vegetation within this drainage is dominated by poison hemlock (*Conium maculatum*, FACW) and rough cocklebur (*Xanthium strumarium*, FAC+). The AD-02 channel is approximately two feet wide and runs between two agricultural fields. This drainage connects with the western primary drain through a culvert that outfalls beneath an unpaved access road south of Fry Road (Photo 7).

Agricultural Drainage AD-03

AD-03 is located west of Vaca Station Road (Photo 8). It is vegetated with shortpod mustard (*Hirschfeldia incana*) and rough cocklebur (FAC+). AD-03 is approximately 2 feet wide and runs between two agricultural fields. This drainage connects to AD-05 via a perpendicular drainage that will not be impacted by the project (AD-03P, Photo 9). Both AD-03 and AD05 connect to the western primary drainage via a culvert beneath Fry Road.

Irrigation Canal I-04

I-04 is an unvegetated irrigation canal located between AD-03 and AD-05 (Photo 10).

Agricultural Drainage AD-05

AD-05 is located adjacent to the west shoulder of Vaca Station Road and confluences with AD-03P (Photo 11) at the culvert inlet north of Fry Road (Photo 12). AD-05 is 3 feet wide and is vegetated with shortpod mustard and curly dock (*Rumex crispus*, FACW-). The culvert to the western primary drainage is located southwest of the intersection of Vaca Station and Fry Roads. (Photo 13).

Agricultural Drainage AD-06

AD-06 is located adjacent to the west shoulder of Lewis Road (Photo 14). The drainage is 3 feet wide and is dominated by shortpod mustard, poison hemlock, and curly dock (FACW-). The culvert to the western primary drainage is located west of the Lewis Road/Fry Road intersection (Photo 15).

Agricultural Drainage AD-07

AD-07 is located adjacent to the east shoulder of Lewis Road (Photo 16). AD-07 is 2 feet wide, and is vegetated with shortpod mustard and ripgut brome (*Bromus diandrus*). No culvert to the eastern primary drainage is visible to the southwest of the Lewis Road/Fry Road intersection; however, a large block of concrete may be obscuring the outfall at this location (Photo 17).

Agricultural Drainage AD-08

AD-08 is located approximately 1200 feet east of Lewis Road (Photo 18). AD-08 is approximately 4 feet wide, and vegetation is dominated by shortpod mustard and cultivated radish (*Raphanus sativus).* The culvert outfall to the eastern primary drainage is opposite Fry Road (Photo 19).

Agricultural Drainage AD-09

AD-09 is adjacent to the west shoulder of Chicorp Lane (Photo 20). AD-09 is approximately 4 feet wide and is vegetated with shortpod mustard, slender oat (*Avena barbata*), and hummingbird trumpet (*Epilobium canum*). The culvert outfall to the eastern primary drainage is opposite Fry Road (Photo 21).

Agricultural Drainage AD-10

AD-10 is adjacent to the east shoulder of Chicorp Lane (Photo 22). AD-10 is approximately 5 feet wide and is sparsely vegetated with hummingbird trumpet. A concrete headwall is located at the culvert inlet. An outfall to the eastern primary drainage was not found; this drainage may confluence with the AD-09 outfall beneath Fry Road.

Agricultural Drainage AD-11

AD-11 is approximately 1100 feet east of Chicorp Lane (Photo 23). The drainage is approximately 4 feet wide and is vegetated with slender oat and ripgut brome. The culvert outfall to the eastern primary drainage is opposite Fry Road (Photo 24).

Irrigation Canal I-12

I-12 is approximately 1125 feet east of Chicorp Lane (Photo 25).

Irrigation Canal I-13

I-13 is approximately 1125 feet east of Chicorp Lane (Photo 26).

Agricultural Drainage AD-14

AD-14 is approximately 2,600 feet east of Chicorp Lane (Photo 27). The drainage is vegetated with hummingbird trumpet, redstem stork's bill (*Erodium cicutarium*), bristly oxtongue (*Picris echioides*, FAC*), willowleaf lettuce (*Lactuca saligna*), and shepard's purse (*Capsella bursa-pastoris*, FAC-). The culvert outfall to the eastern primary drainage is opposite Fry Road (Photo 28).

Conclusion and Recommendations

Federal USACE jurisdictional waters of the U.S include all rivers and creeks that are tributary to navigable waters as well as wetlands, wet meadows, and seeps that are adjacent to such features. The USACE may take jurisdiction over agricultural drainages that have connectivity to navigable waters. State Water Resources Control Board (SWRCB) jurisdictional waters include all surface waters within the State, including agricultural drainages.

The proposed CPVVS project area contains or its features cross 11 secondary agricultural drainage features that are hydrologically connected to Alamo Creek via two primary drainages (Figure 1). Therefore, these features are likely to be determined jurisdictional waters, based on the connectivity to the navigable waters of Alamo Creek and subject to USACE confirmation. These are designated as Agricultural Drainages (AD) in the descriptions, above. Three irrigation canals within the proposed CPVVS site or that cross its linear appurtenances are not hydrologically connected to jurisdictional waters of the U.S., and are therefore unlikely to be considered under the jurisdiction of the USACE. There is no downstream hydrological connectivity from these waters to jurisdictional ones; rather, the water in these canals is distributed to agricultural fields. These are designated as Irrigation Canals (I-04, I-12, and I-13) in the discussions, above.

TABLE 1
Observed Drainage Features at the CPVVS Site

Drainage/ Irrigation	**Width (feet)**	**Dominant Vegetation**	**Notes**	**Photos**
AD-01	2	shortpod mustard (*Hirschfeldia incana*, NOL)	Recently dug, very sparsely vegetated. Connects with drainage AD-01P to the west.	3, 5
AD-02	2	poison hemlock (*Conium maculatum*, FACW), rough cocklebur (*Xanthium strumarium*, FAC+)	No inundation	6, 7
AD-03	2	shortpod mustard (*Hirschfeldia incana*, NOL), rough cocklebur (*Xanthium strumarium*, FAC+)	Parallel drains to the West of Vaca Station Road are connected by a perpendicular drain parallel to Fry Road A common culvert is located near the Vaca Station/Fry intersection.	8, 9

TABLE 1
Observed Drainage Features at the CPVVS Site

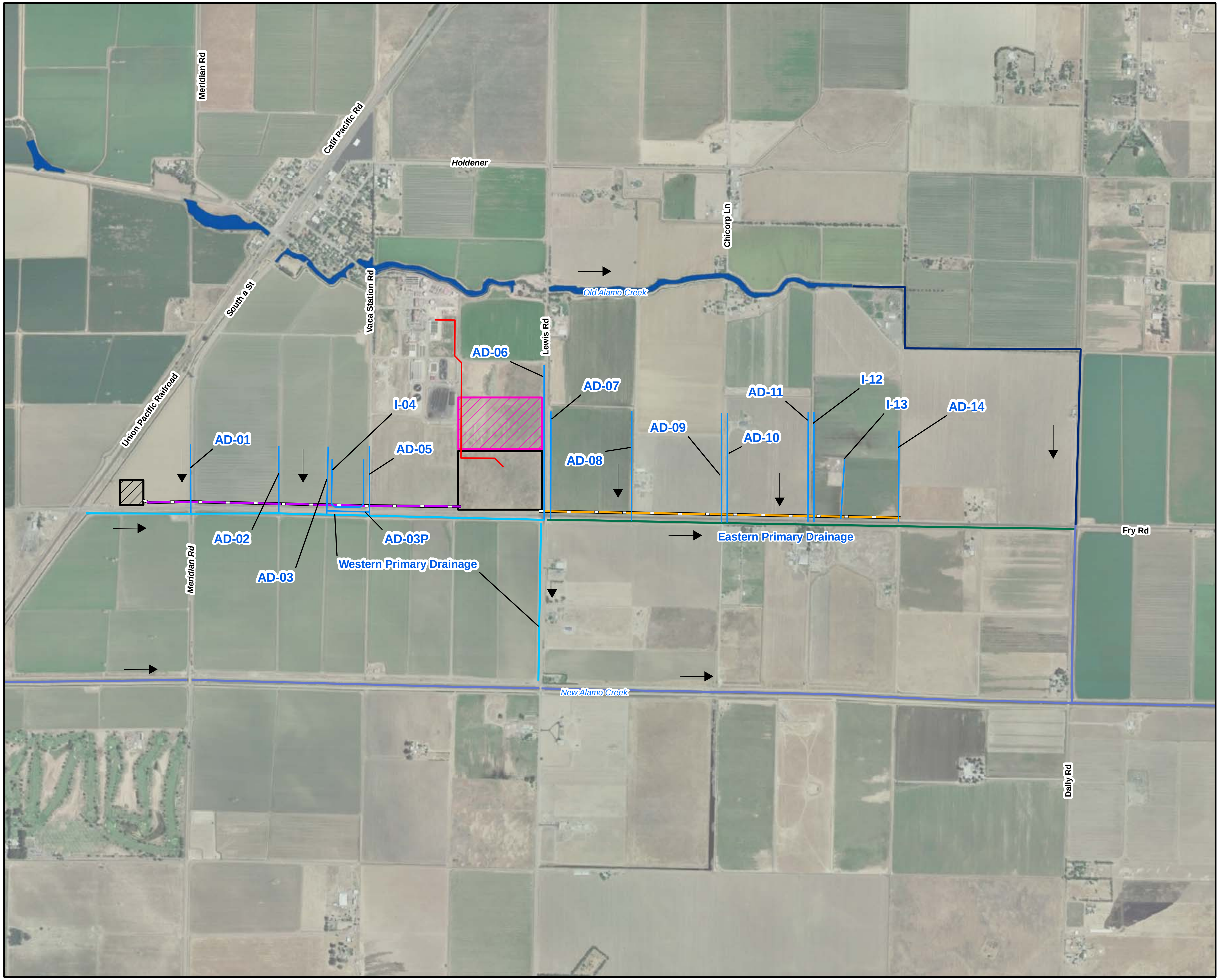
Drainage/ Irrigation	Width (feet)	Dominant Vegetation	Notes	Photos
I-04	2	shortpod mustard (*Hirschfeldia incana*, NOL), rough cocklebur (*Xanthium strumarium*, FAC+)	Irrigation canal	10
AD-05	3	shortpod mustard (*Hirschfeldia incana*, NOL), curly dock (*Rumex crispus*, FACW-)	Not inundated	11, 13
AD-06	3	shortpod mustard (*Hirschfeldia incana*, NOL), poison hemlock (*Conium maculatum*, FACW), curly dock (*Rumex crispus*, FACW-)		14, 15
AD-07	2	shortpod mustard (*Hirschfeldia incana*, NOL), ripgut brome (*Bromus diandrus*)	Not inundated	16, 17
AD-08	4	shortpod mustard (*Hirschfeldia incana*, NOL), cultivated radish (*Raphanus sativus*, NOL)	Inundated	18, 19
AD-09	4	shortpod mustard (*Hirschfeldia incana*, NOL), slender oat (*Avena barbata*, NOL), hummingbird trumpet (*Epilobium canum*, NOL)		20, 21
AD-10	5	hummingbird trumpet (*Epilobium canum*, NOL)	Sparsely vegetated	22
AD-11	4	slender oat (*Avena barbata*, NOL), ripgut brome (*Bromus diandrus*)	Inundated	23, 24
I-12	2	hummingbird trumpet (*Epilobium canum*, NOL)	Irrigation canal	25
I-13	2	hummingbird trumpet (*Epilobium canum*, NOL)	Irrigation canal, sparsely vegetated	26
AD-14	4	hummingbird trumpet (*Epilobium canum*, NOL), redstem stork's bill (*Erodium cicutarium*), bristly oxtongue (*Picris echioides*, FAC*), willowleaf lettuce (*Lactuca saligna*), and shepard's purse (*Capsella bursa-pastoris*, FAC-)	Inundated	27, 28

[a] National List of Plant Species that Occur in Wetlands, Region 0 [California] (Reed, 1988).
FAC = Facultative Status Species; Estimated probability of 33% to 67% chance of occurring in wetlands.
FAC- = Species not considered to be typically adapted for life in anaerobic soil conditions.
FACW = Facultative Wetland Status; Estimated probability of 67% to 99% chance of occurring in wetlands.
NOL = Not on 1988 List.
+, -, * = Modifiers developed by the National Plant List Panel.

References

Reed, Porter B., Jr. 1988. *National List of Plant Species That Occur in Wetlands: California Region (Region 0)*. Biological Report 88 (26.10). Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. In cooperation with: National and Regional Interagency Review Panels. 135 pp.

USDA, NRCS (NRCS). 2009. The PLANTS Database (http://plants.usda.gov, 27 March 2009). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.



LEGEND

— Utility Corridor to WWTP

— Natural Gas Pipeline Route

— Electrical Transmission Line Route

→ Direction of Flow

— Agricultural Drainage Ditch

— Eastern Primary Drainage

— New Alamo Creek

— Old Alamo Creek

— Western Primary Drainage

▨ New Substation

▨ Laydown Area

☐ Project Site

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 750 1,500
Feet

FIGURE 1
POTENTIALLY JURISDICTIONAL AGRICULTURAL DRAINAGES

CPV VACA STATION
VACAVILLE, CALIFORNIA

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CH2MHILL

Photo 1- Confluence of eastern primary drainage with Old Alamo Creek, to the west.

Photo 2 – Confluence of western primary drainage with New Alamo Creek, to the north

Photo 3- AD-01 to the northeast from Fry Road

Photo 4- AD-01 outfall to the western primary drainage, to the northeast

Photo 5- AD-01P, to the west.

Photo 6- AD-02, to the north

Photo 7-AD-02, showing unpaved access road above culvert to western primary drainage, to the north.

Photo 8- AD-03, to the north.

Photo 9- AD-03P, to the east

Photo 10 - I-04, to the north

Photo 11- AD-03P, to the west.

Photo 12 – AD-03P culvert inlet, to the southwest.

Photo 13- AD-05 outfall to the western primary drainage, to the west.

Photo 14- AD-06, to the north.

Photo 15 - AD-06 outfall to the western primary drainage, to the north.

Photo 16 – AD-07, to the north.

Photo 17- AD-07, possible obscured outfall to the eastern primary drainage, to the north.

Photo 18 – AD-08, to the north

Photo 19 – AD-08 outfall to the eastern primary drainage, to the southwest.

Photo 20 – AD-09, to the north

Photo 21 – AD-09 outfall to the eastern primary drainage, to the east.

Photo 22 – AD-10, to the north.

Photo 23 - AD-11, to the north.

Photo 24- AD-11showing outfall to eastern primary drainage, to the east

Photo 25 – I-12, to the north.

Photo 26 – I-13, to the north.

Photo 27- AD-14, to the north.

Photo 28 – AD-14, showing outfall to the eastern primary drainage, to the northwest.

Cultural Resources (36–41)

Depths of Excavations

36. *Please provide the depths of the excavations, in feet and inches from the ground surface, required for the following foundations for proposed CPVVS equipment, systems, and features:*

a. Combustion turbine generator
b. Steam turbine generator
c. Heat recovery system generator
d. Raw/fire water storage tank
e. Control building
f. Water treatment building
g. Demineralized water storage tank
h. Neutralization tank
i. Feedwater pump enclosure
j. Utility bridge
k. Fire/water pump house
l. Ammonia storage tank
m. Switchyard
n. Air cooled condensers
o. Generator step-up
p. Monopoles for the interconnection transmission line

Response: Table DR36-1 and Figure DR36-1 show the depths of excavations for each of these features. Please note that the project design does not include an air cooled condenser (item n). The table includes a cooling tower and cooling tower pump pit in its place.

TABLE DR36-1
Depths of Excavation (feet)

Equipment	Ground Surface Elevation[a]	Top of Foundation	Depth of Foundation	Bottom of Foundation	Depth of Excavation
Combustion turbine generator	63.3	65.5	6	59.5	3.8
Steam turbine generator	63.3	65.5	9	56.5	6.8
Heat recovery steam generator	62.7	65.5	6	59.5	3.2
Raw/fire water tank	62.5	66.4	5	61.4	1.1
Control building	63.5	64.8	3	61.8	1.7
Demineralized water tank	62.7	66.8	5	61.8	0.9
Neutralization tank	62.5	65.3	5	60.3	2.2
Feedwater pump enclosure	62.7	65.5	3.5	62	0.7

TABLE DR36-1
Depths of Excavation (feet)

Equipment	Ground Surface Elevation[a]	Top of Foundation	Depth of Foundation	Bottom of Foundation	Depth of Excavation
Utility bridge	63.0	65.5	4	61.5	1.5
Fire water pumphouse	62.5	66.3	3.5	62.8	-0.3
Ammonia storage tank	62.3	63.4	3	60.4	1.9
Switchyard	64.5	64.5	3	61.5	3
Cooling tower	62.0	63.8	2.5	61.3	0.7
Cooling tower pump pit	62.0	63.8	25	38.8	23.2
Step up transformer	63.7	64.5	6	58.5	5.2
Transmission line monopoles[b]	various	various	25	25	25

[a] Ground surface elevations based on ALTA Survey
[b] The depths of the independent monopole foundations are highly dependant on the soil, loads, etc. Final determination will be made during final design.

Revised Figure – Project Elevations

37. *Please adapt and provide a revised Figure 2.1-3 (the CPVVS project elevations) to show the expected depths of foundations for the illustrated equipment, pipelines, and underground tank installations at the power plant.*

Response: Please see Figure DR36-1.

Widths and Depths of Conveyance Pipelines

38. *Please provide the maximum widths and depths, in feet and inches from the ground surface, of trenches for the conveyance pipelines for recycled water, potable water, and sewage.*

Response: The location of the recycled water line, potable water line, and sewer line are shown on Figure 2.1-1 of the AFC. All three lines will be under pressure, and will be constructed to minimal depths where possible. In certain locations, the depths of these lines may need to be increased to accommodate underground obstructions. These locations represent the location of the maximum width and depth of the excavation. It is estimated that the maximum width and depth of each excavation is as follows:

Recycled Water:	5′-0″ wide x 12′-0″ deep
Potable Water:	4′-0″ wide x 12′-0″ deep
Sewer Lines:	3′-0″ wide x 12′-0″ deep

Historical Geomorphology of Project Site

39. *Please provide a study of the historical geomorphology of the project site by a professional geoarchaeologist, who, at a minimum, meets the U.S. Secretary of the Interior's Professional Qualifications Standards for a professional in archeology and is able to demonstrate the completion of graduate-level coursework in geoarchaeology, physical geography, geomorphology, or quaternary science. The study should evidence consideration of the*

> *potential at the CPVVS for buried archaeological deposits from the surface to the maximum depth of excavation proposed for construction. The discussion should include information on the development of local landforms during and subsequent to the Late Pleistocene era, along with the apparent stability of the course of Alamo Creek during the Holocene. The primary grounds for the discussion should be data on the geomorphology, sedimentology, pedology, and stratigraphy of the project area or near the vicinity the Late Quaternary period. The sources of these data may be a combination, as necessary, of extant literature or primary field research.*

Response: The major physiographic features of this region are the north-south trending Coast Ranges to the west, and the Great Valley paralleling them to the east in which the CPVVS lies. The Sacramento Valley begins north of the confluence of the Sacramento and San Joaquin Rivers, about 10 miles southeast of the project area. The Montezuma Hills approximately 7 miles south of the CPVVS represent an area of active deformation and a recently upwarped crustal segment (Weber, 2005), with Quaternary sediments exposed by erosion of its flanks.

The proposed CPVVS site lies on the gently sloping alluvial plain that extends southeast and east from the Vaca and English Hills, foothills of the Coast Ranges that lie only about 2.6 miles west-northwest of the project area. These north-south trending hills are the easternmost outcrops of the monoclinal ridges that comprise the Great Valley Complex of Cretaceous and Paleogene marine sediments. Physiographically, the ridges mark the western margin of the Sacramento Valley and the beginning of the Coast Ranges (Graymer et al., 2002; Helley and Harwood, 1985). The alluvial plain that extends from these highlands through the project area slopes at less than 15 feet per mile to the east-northeast.

The project site is about 0.3 mile south of the current course of Alamo Creek, a tributary to Ulatis Creek, which in turn drains southeast to Cache Slough on the northwestern margin of the Sacramento–San Joaquin River Delta. The head of Cache Slough is about 13.5 miles southeast of the project site. The project laterals, which extend approximately 1 mile east and west of the CPVVS plant site, do not encounter topography or subsurface geology substantively different from the vicinity of the proposed plant site. Available data consist of surface geological mapping, and borehole logs completed for geotechnical and environmental investigations. Additional information is provided by remote imagery and in-field examination of drainage channels and shallow road cuts. No Quaternary geological or archaeological investigations with information immediately relevant to the topics and project area are available.

The most detailed geological mapping of the project area was completed by Helley and Harwood (1985), who recognized four Neogene and Quaternary sedimentary units in the vicinity (Table DR39-1).

TABLE DR39-1
Sedimentary Units Mapped in the Vicinity of the Project Area

Symbol	Name	Age and Descriptive Notes*
Qa	Alluvium	Holocene silts, sands, and gravels deposited by present-day stream and river systems. This sedimentary unit lies inboard of the low terraces that flank current stream systems.
Qb	Basin Deposits	Undivided Holocene basin deposits. Fine-grained silt and clay with the distal deposits being very dark gray to black. Thickness is limited (1 to 2 m) on the valley margins, to much greater (60 m) in the valley axis.
Qml	Lower member, Modesto Formation	Late(?) Pleistocene (early to middle Wisconsin?) valley fill consisting of unconsolidated, slightly weathered gravel, sand, silt and clay. The lower member forms terraces that are a few meters higher than the younger, upper member. Upstream of major drainages (such as in the study area), the lower member of the Modesto formation is preserved as isolated terraces. The lower member is much more extensive than the upper member, and soils developed in the lower member have a distinct argillic (clay-rich) B horizon.
Tte	Tehama Formation	Pliocene valley fill, in this area resting unconformably on Cretaceous marine strata. Pale green, gray, and tan sandstone and siltstone derived (in this area) from the Coast Ranges. Tephrachronology securely places the age of the base of the Tehama Formation at about 3.4 million years (Sarna-Wojcicki et al., 1991).

*After Helley and Harwood (1985) unless otherwise noted.

Others have mapped the project area (e.g., Graymer et al., 2002; Wagner et al., 1981), but these do not match the detail that Helley and Harwood (1985) provide. All these mapping efforts agree that the Pliocene Tehama Formation is responsible for the most pronounced topographic highs in the project area, but only Helley and Harwood (1985) differentiate the more subdued terraces attributable to the lower member of the Modesto Formation from later, Holocene alluvium. Their mapping shows that the project site is several hundred feet south of the southern limit of a subdued terrace composed of Lower Modesto Formation sediment (Qml), and is within the limit of an expansive area occupied by Holocene alluvium (Qa; Figure DR39-1). A relatively prominent terrace about 2 miles to the east represents the inverted topography of a Tehama Formation outcrop.

Geotechnical investigations in support of the Easterly Wastewater Treatment Plan Expansion (Kleinfelder, 1999) and the Phase II ESA for this project (CH2M HILL, 2008) provided borehole logs that were examined to better understand the subsurface stratigraphy of the site. These data are consistent with the mapping results of Helley and Harwood (1985) to the extent that boreholes to the north and west of the project site, and within the area mapped as the lower member of the Modesto Formation, show a much greater proportion of clay at depth than those within the project site. Boreholes within the project site record a transition from silty-clay and silt to sand at depths from 4 to 8 feet below the surface. Although pedological analysis is lacking, these differences are consistent with the presence of a well-developed, clay-rich horizon on the older Modesto Formation.

The Holocene-age alluvium of the project site would not possess such a well-developed argillic (clay-rich) soil horizon.

There are no immediately available data that speak to past variations in the position of Alamo Creek, which currently lies about 0.3 mile north of the project area. The very low gradient of the terrain in the area naturally results in a highly meandering stream course, which can easily be seen where the creek remains unchannelized. Meandering streams alter their course frequently, and therefore it is possible that Alamo Creek once flowed closer to the project site that it does at present. There is, however, no available evidence for change in the course of Alamo Creek other than the Quaternary alluvium itself that comprises the near-surface sediment at the site. That alluvium is stream-borne sediment, and therefore likely originated from Alamo Creek or a proto Alamo Creek. Because the subdued topographic high immediately north and west of the project site is a bounding terrace for Holocene streams flowing generally from west to east (Helley and Harwood, 1985), it is possible that in the past Alamo Creek could have flowed south of that terrace on a course that was south of but generally parallel to its current course. That would account for the Quaternary basin deposits about 1 mile south-southeast of the project site (Figure DR39-1).

Few data are available to address the subsurface archaeological potential of the project area. Available information suggests a rather homogenous subsurface environment, which is consistent with the current subdued terrain of the surrounding alluvial plain. The edge of a low terrace is mapped several hundred feet to the north and west of the project site (Figure DR39-1), and borehole logs suggest a lateral change in sediment characteristics consistent with the presence of the lower member of the Modesto Formation there. This terrace is the only potential paleotopographic feature in the project vicinity, although its paleoenvironmental and, therefore, archaeological significance is equivocal given the scant information available on subsurface conditions.

References

CH2M HILL. 2008. Draft preliminary Phase II Environmental Site Assessment for the Competitive Power Ventures Vaca Station Project. Sacramento, California.

Graymer, R. W., D. L. Jones, and E. E. Brabb. 2002. Geologic map and map database of northeastern San Francisco Bay region, California – most of Solano County and parts of Napa, Marin, Contra Costa, San Joaquin, Sacramento, Yolo, and Sonoma Counties: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2403, scale 1:100000. Denver, Colorado.

Helley, E. J., and D. S. Harwood. 1985. *Geologic map of the Late Cenozoic deposits of the Sacramento Valley and northern Sierran foothills, California*. Miscellaneous Field Studies Map MF-1790. Denver, Colorado: U.S. Geological Survey.

Kleinfelder, Inc. 1999. Geotechnical Engineering Services Easterly Wastewater Treatment Plan Expansion Vacaville, California. Fairfield, California.

Sarna-Wojcicki, A. M., K. R. Lajoie, C. E. Meyer, D. P. Adam, and H. J. Reick. 1991. Tephrochronologic correlation of upper Neogene sediments along the Pacific margin, conterminous United States. In *The Geology of North America, Volume K-2, Quaternary Non-Glacial Geology: Conterminous U. S.*, edited by R.B. Morrison, pp. 117-140. Boulder, Colorado: Geological Society of America.

Wagner, D. L., C. W. Jennings, T. L. Bedrossian, and E. J. Bortugno. 1981. *Geologic map of the Sacramento quadrangle, California, 1:250,000*. California Division of Mines and Geology, Regional Geologic Map 1A, Sacramento.

Weber, Janine. 2005. "Active tectonic deformation east of the San Andreas Fault system, California Coast Ranges." *Association of Engineering Geologists San Francisco Section Newsletter*. September.

Geoarchaeologist Resume

40. Please provide the resume of the geoarchaeologist demonstrating his/her qualifications.

Response: Dr. W. Geoffrey Spaulding's resume is included as Attachment DR40-1.

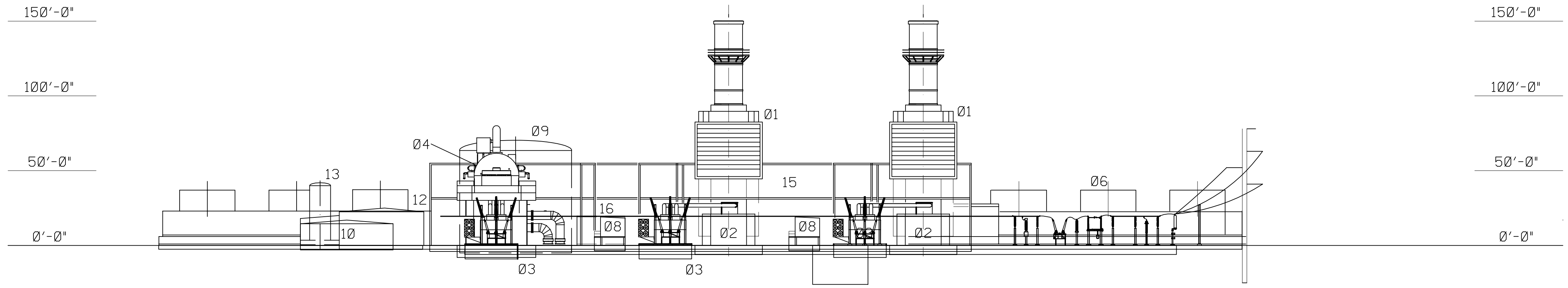
Soil Borrow or Disposal Sites

41. Please indicate whether the proposed project may use any non-licensed, noncommercial soil borrow or disposal sites. If so:

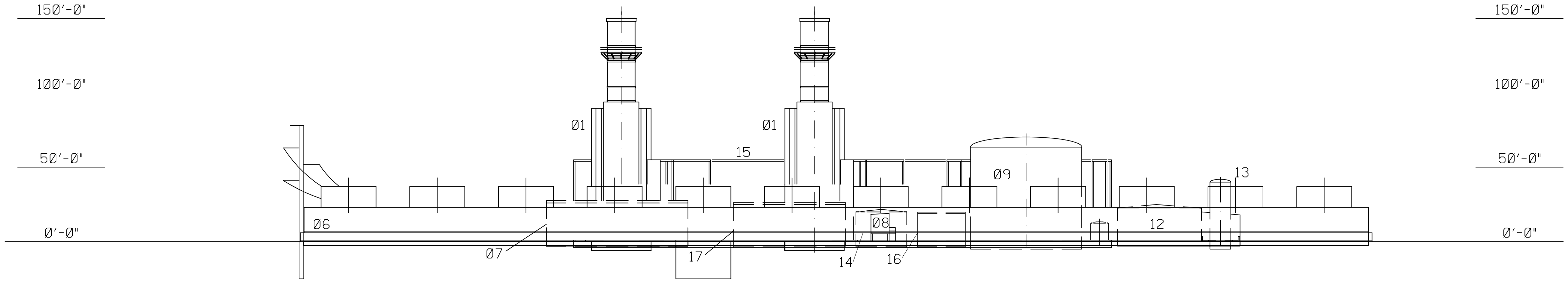
a. Please have a qualified archaeologist survey these sites and record on Department of Parks and Recreation (DPR) 523 forms any cultural resources that are identified; and

b. Please submit to staff a report on the methods and results of these surveys, with recommendations for the treatment of any cultural resources identified in the surveys.

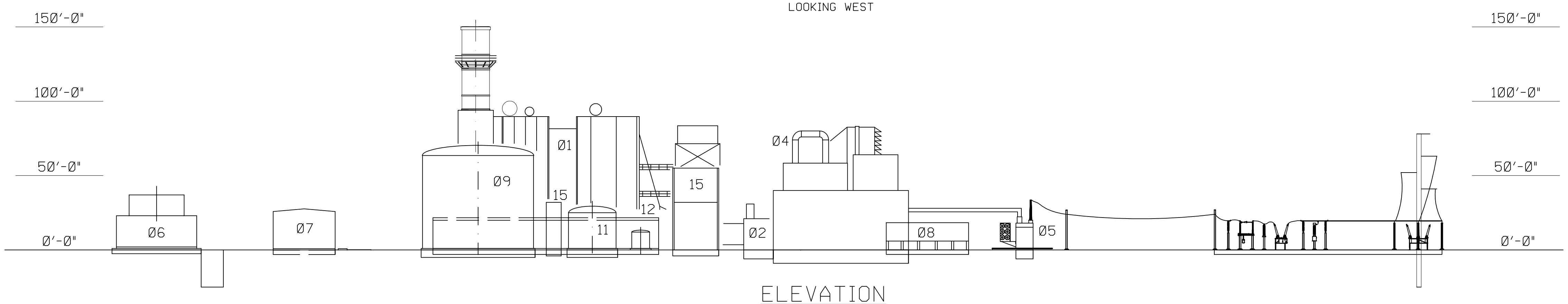
Response: The project does not propose to use any non-licensed, noncommercial soil borrow or disposal sites.



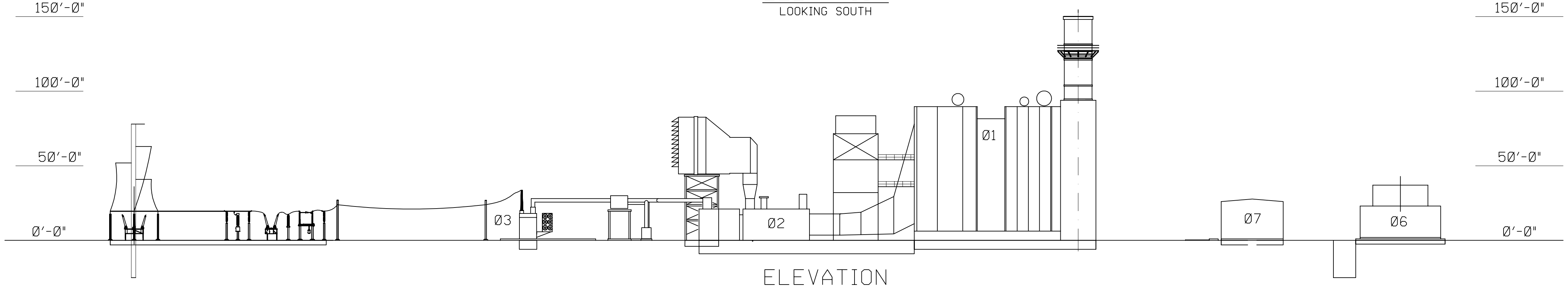
ELEVATION
LOOKING EAST



ELEVATION
LOOKING WEST



ELEVATION
LOOKING SOUTH



ELEVATION
LOOKING NORTH

LEGEND:

01- HRSG
02- COMBUSTION TURBINE GENERATOR
03- CT GENERATOR STEP-UP TRANSFORMER
04- STEAM TURBINE GENERATOR
05- ST GENERATOR STEP-UP TRANSFORMER
06- COOLING TOWER
07- COOLING TOWER CHEMICAL FEED BUILDING
08- PDC
09- RAW/FIRE WATER STORAGE TANK
10- CONTROL BUILDING
11- DEMINERALIZED WATER STORAGE TANK
12- WATER TREATMENT BUILDING
13- NEUTRALIZATION TANK
14- FEEDWATER PUMP ENCLOSURE
15- UTILITY BRIDGE
16- FIRE WATER PUMP HOUSE
17- AMMONIA STORAGE TANK

40 0 40 80 120

SCALE: 1" = 40'

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C	03 17 09	ISSUED FOR REVIEW	KSW	--	--	--	MP	MP	SB
B	05 25 08	ISSUED FOR REVIEW	SAB	--	--	--	MP	MP	SB
A	04 09 08	ISSUED FOR REVIEW	RAK	--	--	--	MP	MP	SB
REV	DATE	DESCRIPTION	DRAWN	CHECKED	LEAD DESIGNER	ENGINEER/ TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER	PROJECT MANAGER

PRELIMINARY STATUS DATE
LDE M. PELLETIER 04/09/08
REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED.

APPROVED STATUS DATE
LDE ------------ --------
REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.

ORIGINATING PERSONNEL

DRAWN BY
RAK

CHECKED BY

LEAD DESIGNER

ENGINEER/TECH SPECIALIST

PROJECT ENGINEERING MANAGER
M. PELLETIER

PROJECT MANAGER
S. BLUE

Zero Harm
Leadership
No Incidents
Safe Behavior

PROFESSIONAL ENGINEER'S SEAL

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION O
PE:___ ____ ____ ___ STATE:_____ _____
LIC. NO.:____ ____ ____ DATE:_____ _____

WorleyParsons
resources & energy

CLIENT/PROJECT TITLE
COMPETITIVE POWER VENTURES
VACAVILLE

GENERAL ARRANGEMENT
ELEVATIONS

SCALE
1"=40'

DRAWING SIZE
ARCH D (36" x 24")

WORLEYPARSONS DWG. NO.
VACA-0-SK-111-002-102

REV
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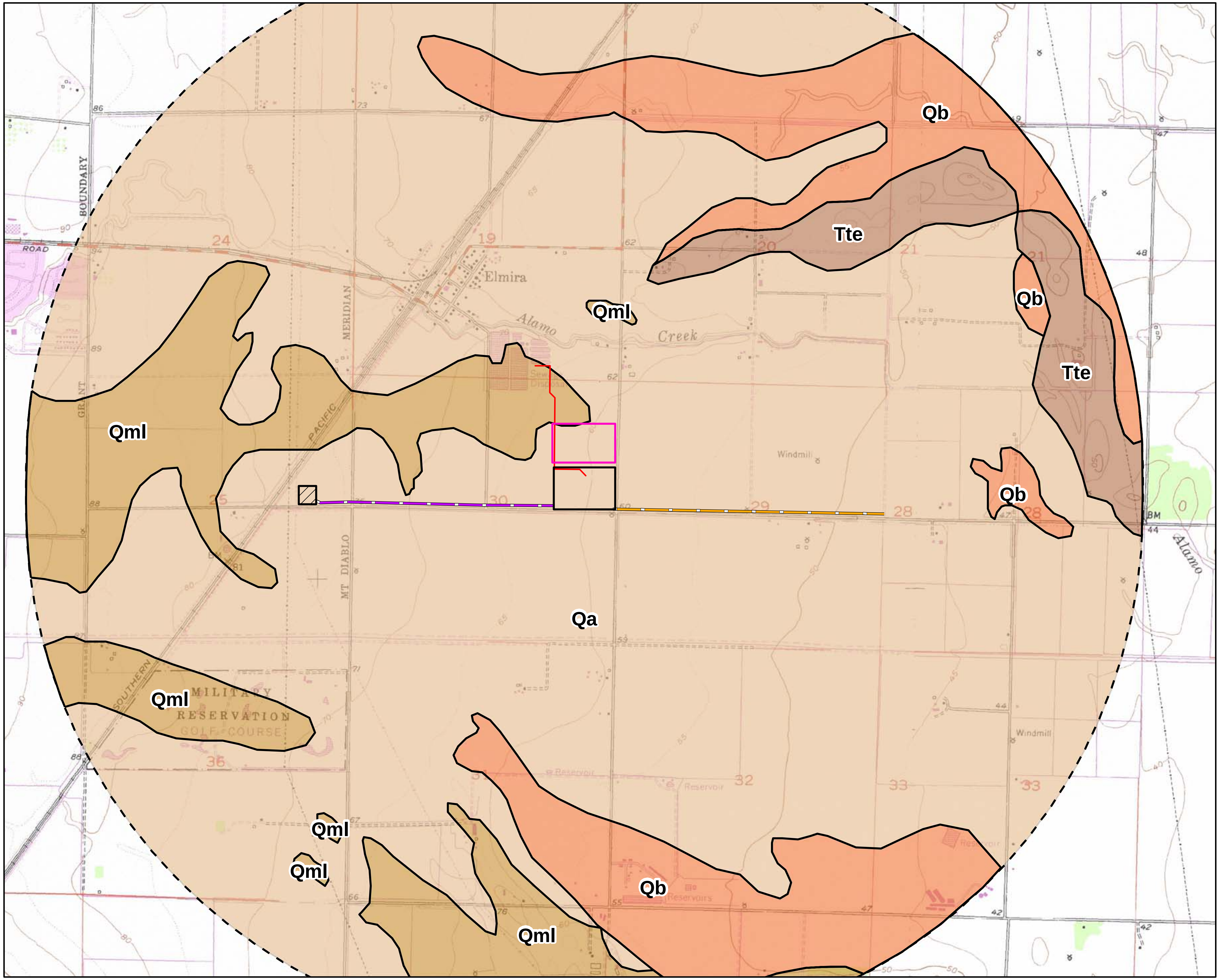
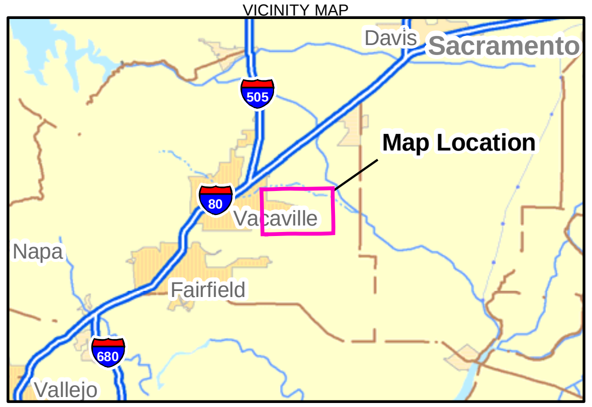


VICINITY MAP



LEGEND

- Utility Corridor to WWTP
- Natural Gas Pipeline Route
- Electrical Transmission Line Route
- ☐ Construction Laydown Area
- ☐ Project Site
- ▨ New Substation
- Two Mile Buffer

Geology Type

- Geologic Contact (approximate)
- Qa - Quaternary Alluvium
- Qb - Quaternary Basin Deposit
- Qml - Quaternary Modesto Formation, Lower Member
- Tte - Tehama Formation

Notes:
1. Area of interest subject to change.
2. Source: Geologic map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, Califorina. by E.J. Helley and D.S. Harwood, 1985. USGS MF-1790
3. No paleontological sites are recorded within one mile of the project site, or within the map coverage shown here

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

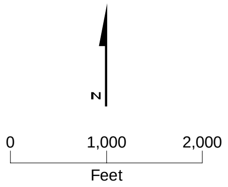


FIGURE DR39-1
GEOLOGY WITHIN TWO MILES OF SITE

CPV VACA STATION
VACAVILLE, CA

SAC\\ZION\SACGIS\PROJ\VACAVILLE_AFC_370668\MAPFILES\GEOLOGYTYPE_PALEO.MXD MHASKELL 4/6/2009 09:22:13

CH2MHILL

ATTACHMENT DR40-1

Resume of W. Geoffrey Spaulding

W. Geoffrey Spaulding
Paleontological Resources Specialist / Geoarchaeologist

Education

Ph.D., Geology (Paleobiology & Quaternary Geology), University of Arizona, 1981
M. S., Geology (Palynology & Vertebrate Paleobiology), University of Arizona, 1974
B. A., Anthropology (Archaeology), University of Arizona, 1972

Certifications

- California State Bureau of Land Management Paleontological Resources Use Permit CA-07-17
- Approved Paleontological Resources Specialist by the California Energy Commission, State of California
- Qualifications as Paleontological Resources Expert Witness accepted by the Attorney General of the State of Washington

Distinguishing Qualifications

- Specialist in Paleontological Resources Management
- Expert in the Quaternary Paleoenvironments of Western North America
- Specialist in Site Formation Processes, Quaternary Geology, Geoarchaeology, Paleohydrology
- Captain, Signal Corps, U. S. Army Reserve (Retired)

Relevant Experience

Dr. Spaulding is a senior scientist and paleontologist with CH2M HILL with extensive experience in geomorphology, geoarchaeology, paleobiology and paleoecology. He also is accomplished in the study of site formation processes, and in age determinations of archaeological and paleontological sites in the western United States. He has more than three decades of technical experience in the Earth and Life sciences focusing on the Quaternary of western North America including California. Representative projects that he has managed in the last 12 years are listed below. Prior to joining private industry, he was a Research Professor at the University of Washington, Seattle, with his office and laboratory housed in the Quaternary Research Center. During this time he worked with the well-known Quaternary geologists Stephen C. Porter, A. Lincoln Washburn, and Brian Atwater. During his preceding graduate student tenure at the University of Arizona, the pre-eminent PaleoIndian geoarchaeologist C. Vance Haynes sat on Dr. Spaulding's Ph.D. committee, and Spaulding took the opportunity to attend all classes and seminars offered by Dr. Haynes. He also took the geomorphology classes offered by the renowned geomorphologist William B. Bull. Finally, while on contract with the

U.S. Geological Survey and the State of Nevada Dr. Spaulding was fortunate enough to work several times with Roger B. Morrison, one of the best known Quaternary geologists of the late 20th century.

Paleontological Resources Management

California Energy Commission Approved Paleontological Resources Specialist, Multiple Power Generation Projects, California. Conduct literature reviews, records searches, and field surveys to develop Paleontological Resources Assessments, prepare paleontological resources impacts assessment and mitigation measures, for the projects' Application for Certification before the California Energy Commission. Determine the relative levels of paleontological sensitivity of Mesozoic through Quaternary rock units in the context of the geological history of the project areas, direct field surveys, and prepare resource specific documentation for more than 16 separate projects from San Diego in the south to Arcata in the north. Prepare Paleontological Resources Monitoring and Mitigation Plans for construction-phase compliance activities.

Paleontological Resources Specialist, Construction-Phase Mitigation Implementation, Multiple Power Generation Projects, California. Develop and manage paleontological resources monitoring and mitigation programs for the construction of power generation projects including the Walnut Energy Center south of Modesto, the Roseville Energy Park east of Sacramento, and the Gateway generation Station near Antioch. Prepare the Paleontological Resources Module of the worker education program and visual aids for worker education. Direct the recovery of discovered paleontological resources (Quaternary vertebrate and paleobotanical remains), and consult with client representatives and the California Energy Commission on the adequacy of mitigation efforts. Develop site-specific stratigraphic framework to identify paleontologically sensitive sediments, and to provide client and the CEC with guidance regarding what construction activities need and need not be monitored.

Ivanpah Valley Bright-Source Energy EIS/AFC. Conduct records review and literature search, field reconnaissance and subsequent field survey of paleontologically sensitive areas, and recordation of Paleozoic and Quaternary paleontological sites in support of a large solar powered electrical generation facility. Include modeling of pluvial lake highstands to determine maximum elevation of paleontologically sensitive sediments. Prepare appropriate paleontological resources sections for BLM EIS and California Energy Commission Application for Certification.

Salton Sea Ecosystem Restoration Project EIR. Geological and paleontological literature review, records search including consultations with California State Paleontologist, to develop large scale paleontological sensitivity assessment of the Salton Trough. Develop impact assessment and mitigation measures for Environmental Impact Report. Develop mitigation measures for eight different action alternatives, and respond to comments on the PEIR.

Paleontological Resources Assessment for Kinder Morgan's EPX Pipeline, Texas, New Mexico, and Arizona. Literature and records review, remote-sensing and map analyses to characterize the affected environment and environmental impacts for a Bureau of Land

Management Environmental Assessment for the installation of an interstate petroleum products pipeline. Prepare appropriate sections of the EA, and assemble technical information from museums in three states.

Transportation-Related Paleontological Resources Management Services, southern California. Perform paleontological resources assessments, develop management and monitoring plans, prepare, review and amend subconsultant scopes of work, and provide audit services to clients for paleontological resources management work. Multiple contracts for the City of San Diego, the Regional Transportation Commission, and the Counties of Riverside, San Diego and Orange. Formations addressed included Quaternary terrestrial and lacustrine units, and Tertiary marine and estuarine sediments.

Client Task Oversight & Expert Witness Testimony On Paleontological Resources Sensitivity. Review and develop discovery and mitigation plans, and provide testimony to the Attorney General of the State of Washington. On the paleontological data potential and impacts to Middle Tertiary age fossil resources in the Columbia Basin, and on potential project-related impacts pursuant to Washington's Energy Facility Siting & Environmental Certification process, on behalf of Olympic Pipeline Corporation.

Paleontological Resources Assessment & Mitigation Plan Development, McKittrick Tar Pits, central California. Review the extensive literature; develop a resources assessment and preliminary management plan for paleontological resources in the vicinity of the renowned McKittrick Tar Pits in the Central Valley for a confidential client interested in the development of the oil-rich diatomites and sands of the area.

Duke Energy of North America, Paleontological Support Services for The Potrero and Contra Costa Applications For Certification. Conduct literature reviews, record searches, and site surveys; and prepare appropriate sections of Applications for Certification according to the format and data requirements of the California Energy Commission. Respond to CEC staff questions and requests for additional data. Provide cost-control strategies to client. In support of the relicensing efforts for two power plants in the Bay Area of California.

Owens Lake Air Quality Mitigation Program, Paleontological Resources Review and Strategy Development. Review resource assessments and draft mitigation plans on the clients behalf to assure that mitigation measures called for are consistent with the resources that may be found in the project area. Audit of consultant work to assure economy of scale in mitigation requirements.

Cultural Resources Management

Nellis Air Force Range Three Lakes Valley Archaeological Survey & Subsistence Modeling. A multi-phase project involving site formation analysis and paleohydrologic modeling and, in cooperation with project archaeologists, the development of an integrated subsistence and settlement model to predict the occurrence and density of prehistoric sites in a large desert valley. Managed the subsequent survey of an approximately 3,000-acre area to test and refine the predictive model, and relate site occurrences to Holocene pluvial climatic events.

Kern River Pipeline Cultural & Paleontological Resources Compliance, California, Nevada, and Utah. Coordination and implementation of cultural resources mitigation and monitoring efforts along a 678-mile pipeline corridor involving up to 160 personnel operating in three states. Consult with state and federal agencies (FERC, Advisory Council on Historic Preservation Bureau of Land Management), and coordinate with client representatives. Direct and participate in state-wide field compliance programs. Participate in and direct technical studies of sites ranging in age from Paleoindian to Formative Periods. Manage the preparation of reports perform the task of senior report editor.

Nellis Air Force Range Complex, General Site & Rock Art Inventories. Manage and participate in the design and execution of a multi-phase archaeological recordation project over an area larger than the state of Vermont. The second phase included the relocation and recording of twelve Archaic to Late Prehistoric rock art sites in remote areas of the U.S. Air Force's Nellis Range. Included in this effort was the contracting and management of specialist subconsultants in rock art, development of illustration techniques, and preparation of draft and final reports in consultation with the Base Archaeologist.

Metropolitan Water District of Southern California, West Valley Lateral and Eastside Reservoir Projects, Cultural and Paleontological Resources Support Services. Design and conduct archaeobotanical, paleoecological, and paleoclimatic studies in support of paleontological and cultural resources testing and mitigation programs for a large reservoir development program. Manage and participate in paleobotanical and archaeobotanical research programs; direct subconsultants in palynological investigations. Develop pioneering reconstructions of inland southern California's climatic and ecological history over the last 40,000 years; consider these in the context of regional environmental changes and the archaeological record.

Nellis Air Force Base Golf Course Expansion, Phase 2 Archaeological Testing. Design, manage and participate in the archaeological and geomorphologic testing of three Archaic sites in the Las Vegas Valley. Develop a site specific formational model to account for the stratigraphic setting of the sites and cultural remains, and to justify the lack of further archaeological potential of the site area.

Los Angeles Department of Water and Power, Mead/McCullough - Victorville/Adelanto Transmission Line. Manage cultural and paleontological resources monitoring and mitigation in conjunction with the construction of a 500 kV power line extending through Nevada and California. Assess levels of significance of paleontological sites discovered during survey and monitoring, implement mitigation measures for affected sites, manage analyses, prepare reports.

City of Mesquite Cultural and Paleontological Resource Compliance. Design and manage resource surveys for linear-facilities rights of way and BLM land exchanges. Bureau of Land Management consultation on mitigation and avoidance measures, coordinate data recovery and analyses, and prepare final reports on discovered Pliocene paleontological sites.

Molycorp, Inc., Ivanpah Valley Geoarchaeological Studies. Plan for and contribute to cultural resources surveys and Phase 2 Testing and Evaluations for a large project involving over

30 Archaic to Late Prehistoric archaeological sites within and on the margins of a presently dry lake bed. Develop and implement special studies in geoarchaeology, paleohydrology, and paleoenvironmental reconstruction. Manage biological resources surveys and monitoring in support of a multiyear remediation effort; consult with land management agencies to assure compliance on behalf of the client.

Pacific Gas & Electric, Pit 3,4,5 Project, Cultural Resources Support Services. Archaeobotanical, paleoecological, and paleohydrologic studies in support of cultural resource mitigation efforts in the vicinity of Lake Britton, California. Develop a 7,000-year paleoecological record directly applicable to the study area. Contract and direct subconsultants in the development of a 1,000-year dendrohydrologic reconstruction of the flow of the Middle Pit River. Compare and contract paleoenvironmental and archaeological records to determine possible environmental drivers of cultural change.

U.S. Geological Survey Yucca Mountain Site Characterization Studies. . Multiple contracts for field and laboratory research, report preparation and review focusing on the timing and magnitude of past hydrologic and climatic changes in the Nevada Test Site, Yucca Mountain, and the Amargosa Desert. Assessment of millennial scale variability of groundwater levels and their potential effect on performance criteria for a high-level nuclear waste repository, as well of geomorphic process affecting paleoenvironmental data.

Yosemite National Park Cultural Resources Management Plan & Research Design. Assist in the preparation of the twenty-year update of the National Park Service's *Archaeological Research Design*. Review, evaluate, and provide a comprehensive summary of research in paleoecology, geoarchaeology, Quaternary geology, and tephrachronology. Prepare chapters on for the *Research Design* for NPS use.

National Academy of Sciences, National Research Council Panel On Coupled Hydrologic, Tectonic, and Hydrothermal Processes. Appointed by the National Academy of Sciences to a three-year tenure as an expert panel member to review research and evaluate evidence for changes in water-table elevation in the vicinity of the proposed Yucca Mountain Nuclear Waste Repository.

Yosemite National Park, Upper Tuolumne Meadows Archaeological Testing and Evaluation Program. Field and laboratory studies, and report preparation, focused on geochronology, tephrachronology, and site formation processes in support of Yosemite National Park's visitor services expansion program. Identification and characterization of accelerated colluvial depositional processes following volcanic ash fall-out in prehistoric times, and possible effects on human occupation of the area.

Other Representative Projects

Southern Nevada Water Authority's Intake No. 3 Clean Water Act Compliance Assistance. Manage and participate in site survey and permit application preparation for a $600 million critical-path water project. The scope of this on-going effort includes the delineation of jurisdictional waters of the U.S., preparation of an Individual Permit application to the U.S.

Army Corps of Engineers including all exhibits and appendices, and preparation of three separate application packages to the Nevada Division of Environmental Protection. Support of the applicant's agency consultations is a continuing component of this work.

Boulder City / U.S. 93 Corridor Study Final Environmental Impact Statement (FEIS). Environmental lead in charge of preparation of an FEIS for a major highway project in southern Nevada. Manage the update of the Draft EIS, provide strategic input to client regarding NEPA, NHPA and ESA compliance strategies. Participate in agency consultations with the Environmental Protection Agency, Nevada Department of Wildlife, U.S. Army Corps of Engineers, and the Nevada Historic Preservation Office on behalf of the FHWA and Nevada DOT. Prepare, update, and gain signatures on a six-agency Programmatic Agreement for project-related cultural resources impacts mitigation.

California Desert District's Imperial Sand Dunes Recreation Area Management Plan NEPA Compliance Program. Manage a complex and fast-track NEPA compliance program, direct and participate in the preparation of a Draft Environmental Impact Statement addressing a highly visible and controversial recreational area management measures proposed by the Bureau of Land Management. Direct the final preparation of a Biological Assessment of the project. Organize and attend public meetings as a client representative, including presenting components of the project to the public on behalf of the BLM.

Reliant Energy Southern Nevada Development Program Environmental Compliance & Permitting Services. Initial services include the performance of fatal flaw analyses for multiple siting options in Clark County, consultations with client representatives and land management agencies; preparation of site-specific cost projections for NEPA, ESA, and NHPA compliance programs, as well as State and local permits and entitlements. Continuing services include coordinating Nevada Power Company/Sierra Pacific Resources and Southwest Gas efforts, scheduling tasks and activities for permitting at different sites, and tracking consultant performance on behalf of the client.

Environmental Compliance Services to Del Webb Corporation. Manage and participate in the preparation of multiple NEPA, NHPA, and ESA compliance documents, consult with agencies, and direct the compliance efforts for a complex land exchange program involving properties throughout the State of Nevada. Provide a wide range of support services including biological and cultural resources assessments, preparation of use plans, and assessments of air quality impacts, municipal budgets, and economic effects.

Apex Heavy Use Industrial Park Environmental Compliance & Permitting Assistance. Consult with agencies and facilitate client interests on critical environmental issues including air quality impacts and water resources. Prepare NEPA compliance documents for a 11,200 acre land sale, and assist subsequent infrastructure development.

Hanford Nuclear Reservation Barrier Development Program Peer Review Panel. Reviewing research strategies, team organization, and prototype designs for protective barriers intended for use on high-level and mixed waste repository sites. Reviewing studies of past and potential future environmental change.

U. S. Nuclear Regulatory Commission, Advisory Committee on Nuclear Waste. Preparation of briefing documents, participation in panel meetings, and presentation of oral evaluations of governmental studies on the characterization, data acquisition, and model evaluation of climatic and hydrologic conditions at the proposed Yucca Mountain Nuclear Waste Repository.

Professional History

Environmental Compliance Manager & Paleontological Resources Specialist, CH2M HILL, Las Vegas, 2001 to present

Manager, Division of Planning & Compliance, URS Corporation, Las Vegas, 2000-2001

Manager, Environmental Services, Dames & Moore, Las Vegas, 1990-2000

Research Professor of Botany, Director of the Laboratory of Arid-lands Paleoecology, Quaternary Research Center, University of Washington, Seattle, 1983-1990

Adjunct Professor, Remote Sensing Laboratory, Department of Geosciences, University of Washington, Seattle, 1985-1990

Post-Doctoral Research Associate, College of Forest Resources, University of Washington, Seattle, 1979-1983

Graduate Research Assistant, Laboratory of Paleoenvironmental Studies, Department of Geosciences, University of Arizona, Tucson, 1974-1978

Countries Worked In

United States, Mexico, Australia

Professional Affiliations

American Association for the Advancement of Science

Selected Publications

2008 - A Late Holocene Record of Vegetation and Climate from a Small Wetland In Shasta County, California. (with R. S. Anderson, S. J. Smith, and R. B. Jass. *Madroño*, Vol. 55, No. 1, pp. 15–25.

2004 - Development of Vegetation in the Central Mojave Desert of California during the Late Quaternary. (with P. A. Koehler and R. S. Anderson). *Palaeogeography, Palaeoclimatology, Palaeoecology* 215:297-311.

2001 – Ploidy Race Distributions since the Last Glacial Maximum in the North American Desert Shrub, *Larrea tridentata* (with K.L. Hunter, J.L. Betancourt, B.R. Riddle, T.R. Van Devender, and K.L. Cole). *Global Ecology & Biogeography* 10: 521-533.

2000 – A Molecular Analysis of Ground Sloth Diet through the Last Glaciation (with M. Hofreiter, H. N. Poinar, K. Bauer, P.S. Martin, G. Possnert, and S. Paabo). *Molecular Ecology* 9: 1975-1984.

1999 - Middle to Late Quaternary Climatic Changes in Death Valley and Vicinity. In *Proceedings of Conference on Status of Geologic Research and Mapping in Death Valley National Park.* U.S. Geological Survey Open-File Report 99-153, pp. 121-124.

1999 - Environmental Imperatives Reconsidered: Demographic Crises in Western North America During The Medieval Climatic Anomaly (with T. L. Jones, G. M. Brown, L. M. Raab, J. L. McVickar, D. J. Kennett, A. L. York, and P. L. Walker). *Current Anthropology* 40(2): 137-170.

1998 - Molecular coproscopy: dung and diet of the extinct Shasta ground sloth *Nothrotheriops shastensis* (with H. Poinar, M. Hoffreiter, P. S. Martin, and S. Paabo). *Science* 281: 402-406.

1996 - Paleobiotic and isotopic analysis of mollusks, fish, and plants from Core OL-92: Indicators for an open or closed lake system (with J. R. Firby, S. E. Sharpe, J. F. Whelan, and G. R. Smith). In *An 800,000-year paleoclimatic record from Owens Lake, California*, edited by G. I. Smith and J. L. Bischoff, pp. 143-160. Geological Society of America Special Paper 317.

1995 - Environmental change, ecosystem responses, and the Late Quaternary development of the Mojave Desert. In *Quaternary Environments and Deep Time: Papers in Honor of Paul S. Martin* (D. S. Steadman and J. I. Mead, eds.), pp 225-256. Fenske Printing, Inc., Rapid City, South Dakota.

1995 - Pika (*Ochotona*) and the Late Quaternary paleoecology of the Great Basin (with J. I. Mead). In *Quaternary Environments and Deep Time: Papers in Honor of Paul S. Martin* (D. S. Steadman and J. I. Mead, eds.), pp 257-283. Fenske Printing, Inc., Rapid City, South Dakota.

1993 - Climatic changes in the western United States since 18,000 yr. B.P. (with R. S. Thompson, C. Whitlock, P. J. Bartlein, and S. P. Harrison) In *Global climates since the last glacial maximum*, edited by H. E. Wright, Jr., J. E. Kutzbach, T. Webb, III, W. F. Ruddiman, F. A. Street-Perott, and P. J. Bartlein, pp. 468-513. University of Minnesota Press, Minneapolis.

1992 - An alternative perspective on Mojave Desert prehistory (with J. H. Cleland). *Society for California Archaeology Newsletter* 26: 1-6.

1992 - *Ground water at Yucca Mountain: How high can it rise?* (with members of the NAS, NRC Panel on Coupled Hydrologic/Tectonic/Hydrothermal Processes at Yucca Mountain). National Academy Press, Washington, D.C.

1992 - Ecological characterization of fossil plants (with S. J. Mazer, T. L. Phillips, R. E. Taggert, and B. H. Tiffney). In *Terrestrial ecosystems through time: Evolutionary paleoecology of terrestrial plants and animals*, edited by A.K. Behrensmeyer *et al.*, pp. 139-180. University of Chicago Press.

1992 - Late Cenozoic terrestrial ecosystems (with R. E. Taggart, J. A. Harris, B. Van Valkenberg, L. D. Martin, J. D. Damuth, and R. Foley). In *Terrestrial ecosystems through time: Evolutionary* *paleoecology of terrestrial plants and animals*, edited by A. K. Behrensmeyer *et al*., pp. 419-541. University of Chicago Press.

1992 - Glacial/Interglacial 13C/12C ratios of atmospheric CO2 inferred from carbon in C4 plant cellulose (with B. D. Marino, M. B. McElroy, and R. J. Salawitch). *Nature* 357: 461-466.

1991 - A middle Holocene vegetation record from the Mojave Desert and its paleoclimatic significance. *Quaternary Research* 35: 427-437.

1991 - Pluvial climatic episodes in North America and North Africa: Types and correlation with global climate. *Palaeogeography, Palaeoclimatology, Palaeoecology* 84: 217-227.

1991 - Comparison of pollen and macrofossil based reconstructions of Late Quaternary vegetation in western North America. In *Proceedings of the 7th International Palynological Congress, Brisbane, Australia*, edited by E. M. Truswell and J. A. K. Owen, pp. 359-366. Elsevier, Amsterdam.

1990 - Packrat middens: Their composition and methods of analysis (with K. L. Cole, J. L. Betancourt and L. K. Croft. In *Packrat middens: The last 40,000 years of biotic change*, edited by J. L. Betancourt, P. S. Martin, and T. R. Van Devender, pp. 59-84. University of Arizona Press, Tucson.

1990 - Environments of the last 50,000 years in the vicinity of Yucca Mountain, central-southern Nevada. *High Level Radioactive Waste Management* 2: 1251-1258.

1990 - Vegetation dynamics during the last deglaciation, southeastern Great Basin, U.S.A. *Quaternary Research* 33: 188-203 (1990).

1990 - Vegetational and climatic development of the Mojave Desert: The last glacial maximum to the present. In *Packrat middens: The last 40,000 years of biotic change*, edited by J. L. Betancourt, P. S. Martin, and T. R. Van Devender, pp. 166-199. University of Arizona Press, Tucson.

1988 - Climatic changes of the last 18,000 years: Observations and model simulations (with COHMAP Project Members). *Science* 241: 1043-1052.

1986 - The last pluvial climatic episodes in the deserts of southwestern North America (with L. J. Graumlich). *Nature* 320:441-444.

1985 - Vegetation and Climates of the last 45,000 years in the vicinity of the Nevada Test Site, south-central Nevada. U. S. Geological Survey Professional Paper No. 1329.

1983 - Late Wisconsin paleoecology of the American southwest (with E. B. Leopold and T. R. Van Devender). In *The late Pleistocene of the United States*, edited by S.C. Porter, pp. 259-293. University of Minnesota Press, Minneapolis.

1983 - Late Wisconsin macrofossil records of desert vegetation in the American southwest. *Quaternary Research* 19: 256-264.

1979 - Development of vegetation and climate in the western United States (with T. R. Van Devender). *Science* 204: 701-710.

Traffic and Transportation (42–46)

Fry Road Mitigation Measures

42. *Please discuss the mitigation measures planned to minimize the impact to drivers on Fry Road during pipeline construction activities.*

Response: A Transportation Management Plan (TMP) will be prepared by the Applicant and submitted to the appropriate agencies (Solano County, City of Vacaville, Caltrans) for their review. The purpose of the TMP is to identify potential hazards associated with project-related traffic. The plan would incorporate measures such as information signs, flagmen when equipment may result in blockages of throughways, and traffic control to implement any necessary temporary changes in lane configuration. Specific provisions will include measures at least as stringent as the following:

- Parking for workers, construction vehicles, and trucks
- Construction along affected roadways at night where permitted
- Traffic diversion plans (in coordination with the City and County) to ensure access during temporary lane/road closures
- Traffic control devices, signing, and lighting to mitigate the impacts associated with street or lane closures during the construction of the transmission line
- Advance notification to residents, emergency providers, and hospitals that would be affected when roads may be partially or completely closed
- Lane closure as needed for transmission line and pipeline construction with optimal timing to prevent having long stretches of roadway closed without any construction in progress

Additional provisions may be identified by the appropriate regulatory agencies.

The TMP will also mitigation potential impacts related to pipeline construction on auto traffic near Fry Road. These TMP measures will be developed further and incorporated into the TMP. Please note, in addition, that the pipeline will be constructed, owned, and operated by Pacific Gas and Electric Company.

Traffic Control Programs

43. *Please indicate the types of traffic control programs that will be used to ensure safe roadway conditions, (such as lane marking, construction notices, roadway signage, detours, flagperson, etc.).*

Response: The TMP will incorporate measures to ensure safe roadway conditions at least as stringent as those listed above in the response to Data Request #42. The TMP measures may include lane marking, construction notices, and roadway signage. Detours may be imposed only when a roadway is blocked for more than a few minutes.

Parking Policies

44. *Please indicate what policies will be in place to ensure pipeline construction workers will park in designated areas.*

Response: The TMP will incorporate parking policies at least as stringent as those listed above in the response to Data Request #42. The contractor will be provided with a map of the designated parking areas. Should the contractor's workforce park in non-designated areas, the linear contractor will be held responsible for any resulting land damage; the penalty could be a risk of being towed at owner's expense, cost to restore any land damage that may have been incurred, etc.

Central Parking Transportation

45. *Please indicate if transportation will be available from a central parking area to and from the work site for the linears.*

Response: Ideally, the immediate workforce would park along the portion of the pipeline or transmission line being constructed. However, should the landowner not authorize this, the workforce will be required to park at the designated power plant parking area and then be bussed all together to the work area. The TMP will include measures to avoid or reduce any potential impacts from parking either near the pipeline construction worksite or at a central location.

Delivery Route of Hazardous Materials

46. *Please review the ease-west bound route for the delivery of hazardous material and provide a modified truck route of roadways that may be used for the delivery of hazardous material.*

Response: Lewis Road is a north-south roadway along most of its length (Lewis Road is about 7 miles long, and 0.3 mile is in the east-west direction near the intersection with Chevron Way). Trucks coming from west of the project site (north-west or south-west) using Interstate 80 (I-80) can exit I-80 at Midway Road, turn onto Lewis Road, and travel south to enter the project site. This solution was offered to avoid the residential areas in Vacaville and minimize the potential safety hazards to the public.

Trucks coming from east of the project site (north-east or south-east) using State Route 113 (SR 113) can exit SR 113 at Fry Road and turn onto Lewis Road to enter the project site.

These proposed routes are subject to Caltrans approval.

46a. *Identify any traffic safety points such as railroad crossings or sharp curves; and any sensitive receptors such as school routes or bus stops along these routes.*

Response: The routes proposed for hazardous material deliveries avoid densely populated areas; no transit route would use the same routes in the project's vicinity. The Vacaville Transportation Department indicated that a school bus stop was located at the corner of Lewis Road and Holdner Road; however, its policy does not allow disclosure of the exact route. The department also indicated that the routes changed often. Although there are schools in Dixon along SR 113, Dixon Unified School District does not offer school bus service. There are no hospitals or schools along this route.

The at-grade railroad crossing on Lewis Road near the intersection of Lewis Road and Hawkins Road is a potential safety hazard. The crossing is protected by two drop guards and flashing cross-buck signs. The transporter will not only be required to obtain a Hazardous Material Transportation License in accordance with California Vehicle Code Section 32105 but will also be required to follow appropriate safety procedures at railroad crossings to ensure safe delivery/removal of hazardous materials.

The only sharp turn that could be identified is located at the north end of Lewis Road. The software Autoturn v5 was used to determine if a turn could be made within the paved area of the road. It was determined that the biggest truck that could achieve the turn within the paved area is a WB-40 truck as defined in AASHTO 2001 (45.5-foot-long semi-trailer) could achieve the turn within the paved area of the road.

Transmission System Engineering (47)

System Impact Study

47. Please provide a supplemental System Impact Study and submittal date, noted in the discussion with staff and Navigant Consulting, Inc. on February 24, 2009.

Response: The Applicant has requested additional time to complete the supplemental System Impact Study (request docketed March 25, 2009, Docket Log # 50668).

Visual Resources (48–50)

Redwood Tree Height

48. *Please provide the assumed height of the redwood tree depicted in the simulation.*

Response: Per AFC section 5.13.2.3.4, the trees in the photographic simulation of Figure 5.13-6 are shown at maturity, at estimated heights of approximately 125 feet.

The trees in the row behind are expected to be coast redwoods (se*quoia sempervirens*) or similar trees, which would be planted as 36-inch box specimens that will be approximately 12 feet tall at planting, 27 feet tall at 5 years, and 125 feet or taller at maturity. Figure 5.13-5 depicts the appearance of this landscaping at 5 years after planting, and Figure 5.13-6 depict its appearance at maturity.

As described in the AFC, this landscape planting will be done by the City of Vacaville as part of a broader program to provide landscape screening for the Easterly Wastewater Treatment Plant. Under current plans, the City will complete the landscaping before CPVVS begins construction.

Interconnection Substation Layout Plan

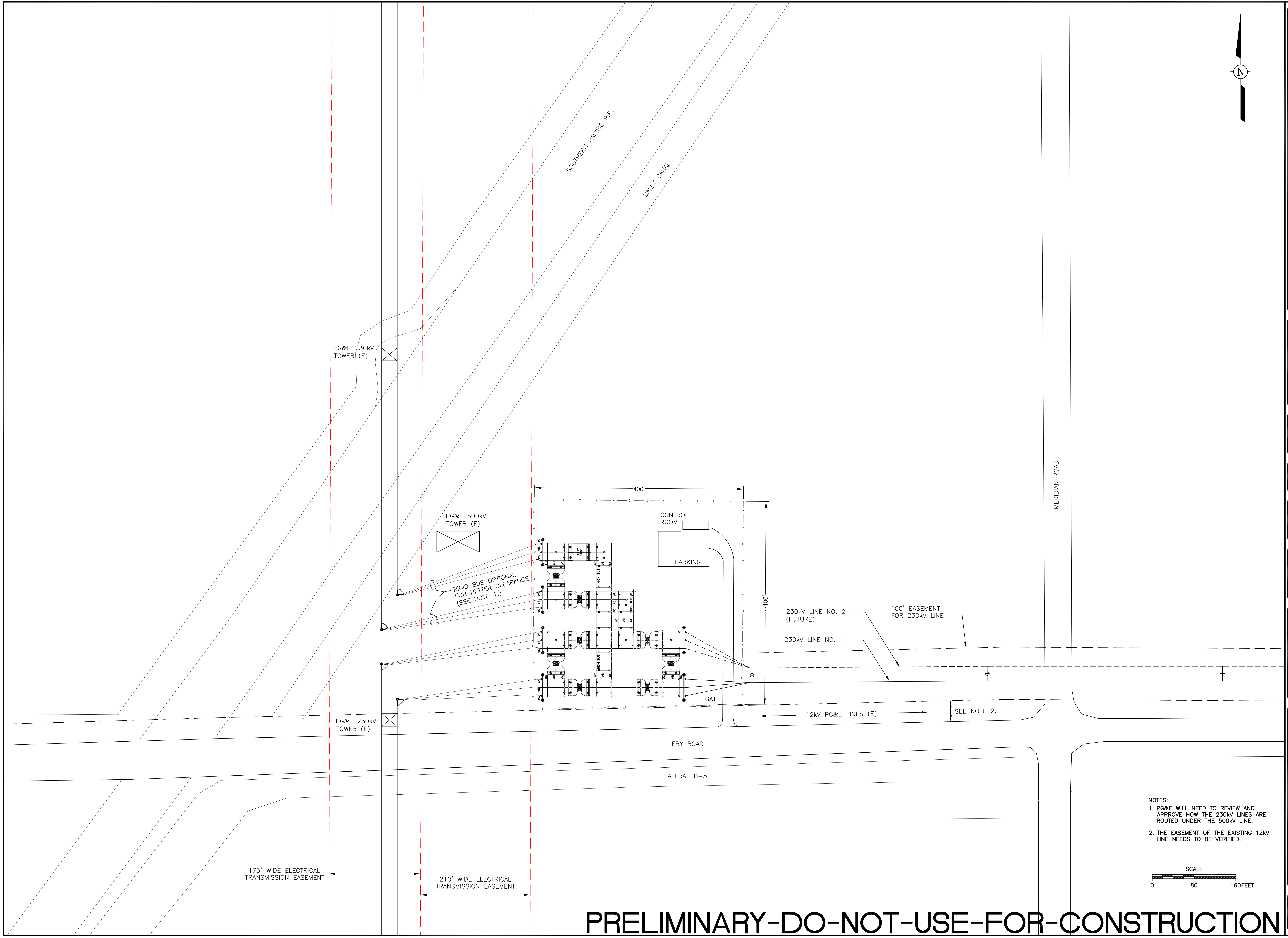
49. *Please provide a scaled layout plan of the interconnection substation showing major components and site boundaries, in relation to Fry Road; and scaled elevation views of the proposed interconnection substation.*

Response: Figure DR49-1 is a scaled layout plan of the substation showing major components and site boundaries in relation to Fry Road. The visual simulation (see response to Data Request #50) provides an elevation view based on typical structure heights for this equipment.

Interconnection Substation Visual Simulation

50. *Please provide an additional visual simulation depicting the proposed interconnection substation and 230-kV transmission line as seen from Fry Road. A suggested viewpoint would be the vicinity of Meridian Road looking west, framed to capture both the transmission towers and substation.*

Response: Figure DR50-1 is a photographic simulation of the proposed interconnection substation and 230 kV transmission line seen from Fry Road immediately west of its intersection with Meridian Road, view west.



NOTES:

1. PG&E WILL NEED TO REVIEW AND APPROVE HOW THE 230kV LINES ARE ROUTED UNDER THE 500kV LINE.
2. THE EASEMENT OF THE EXISTING 12kV LINE NEEDS TO BE VERIFIED.

ISSUED/REVISED FOR:

LEVEL	APPR. BY	DATE	DESCRIPTION

PROJECT MANAGER:	PROJECT-MGR
ENGINEER:	ENGINEER-NAME
DESIGNER:	DESIGNED-BY
DRAFTER:	DRAWN-BY
DATE:	DATE
SCALE:	SCALE
CHECKED BY:	CHECKED-BY
ELEC. APPROVAL:	ELEC-APPROVED
CIVIL APPROVAL:	CIVIL-APPROVED

PROJECT DESIGNED FOR:

PROJECT:

TITLE:

CPV VACAVILLE PROJECT
230kV SWITCHING STATION LAYOUT

Shaw® Shaw Energy Delivery Services, Inc.
4005 Port Chicago Highway
Concord, CA 94520-1120

NOTICE:

THE DATA IN THIS DOCUMENT INCORPORATES PROPRIETARY RIGHTS OF SHAW ENERGY DELIVERY SERVICES. ANY PARTY ACCEPTING THIS DOCUMENT DOES SO IN CONFIDENCE AND AGREES THAT IT SHALL NOT BE DUPLICATED IN WHOLE OR PART, NOR DISCLOSED TO OTHERS WITHOUT THE CONSENT OF SHAW ENERGY DELIVERY SERVICES.

CONTRACTOR SHALL VERIFY ALL CONDITIONS ON JOB SITE & NOTIFY PROJECT MANAGER OF ANY VARIATIONS FROM DIMENSIONS SHOWN ON THESE DRAWINGS BEFORE PROCEEDING WITH ANY CONSTRUCTION.

SEAL

SEAL

PROJECT NUMBER
3301115085

DRAWING No.	SEQ No.	REV.
330115085-D2		

A. Appearance of the substation site before construction. View west along Fry Road from the intersection with Meridian Road.

B. Appearance of site after construction.

FIGURE DR50-1
PHOTOGRAPHIC SIMULATION, INTERCONNECTION SUBSTATION

CPV VACA STATION
VACAVILLE, CA

Waste Management (51–53)

Field Sampling and Analysis

51. a. Please provide results of field sampling and analysis which adequately characterize the presence or absence of harmful chemicals or conditions and whether there will be any risk to construction or plant personnel due to the presence of these chemicals.

b. Please determine if there is any analytical characterization data for the agriculture chemicals and biosolids that were applied to the land.

Response: A Phase II Environmental Site Assessment for the project site is included as Attachment DR51-1. This assessment provides the results of field sampling and analysis, and includes discussions of the potential risks from agricultural chemicals and biosolids.

Construction and Demolition Waste Diversion Program

52. Please identify whether the City of Vacaville or Solano County operates a Construction and Demolition Waste Diversion Program, and cite the jurisdiction to which the CPVVS project would be accountable.

Response: Because the CPVVS is within the Vacaville city limits, the City has jurisdiction. The City of Vacaville has no ordinance requiring a Construction and Demolition Waste Diversion Program.

Project Operations

53. Please describe how project operations will meet each of the requirements of the program cited in the previous data request.

Response: See response to Data Request #52.

ATTACHMENT DR51-1

Phase II Environmental Site Assessment

Final

Preliminary Phase II Environmental Site Assessment for the Competitive Power Ventures Vaca Station

Solano County, California

Prepared for

CPV Vacaville, LLC.

March 26, 2009

CH2MHILL
2485 Natomas Park Drive
Suite 600
Sacramento, California 95833

Final

Preliminary Phase II Environmental Site Assessment for the Competitive Power Ventures Vaca Station

Solano County, California

ANTHONY MICHAEL CHAKURIAN No. 7667

Submitted to

CPV Vacaville, LLC.

March 26, 2009

Steve P. Long

Steve Long
Environmental Scientist

Anthony Chakurian

Anthony Chakurian, CA P.G. No 7667
Professional Geologist

There are no beneficiaries of the work products other than CPV Vacaville, and no other person or entity is entitled to rely upon the work products without the written consent of CH2M HILL.

CH2MHILL

Contents

SECTION 1

Introduction

Competitive Power Ventures (CPV) Vacaville, LLC. is proposing to lease the 25–acre property (north and west of the intersection of Fry and Lewis Roads, as shown in Figure 1) in Vacaville, California. The subject property is being considered for future uses associated with the development of a gas-fired electrical generating station identified as the CPV Vaca Station (CPVVS) project. A Phase I environmental site assessment (ESA) for the proposed CPVVS property was prepared by CH2M HILL (May, 2008).

Based on a review of historic aerial photographs, it was determined that the property has been used historically as an agricultural field from prior to 1937 up to the early 2000s. The property was purchased in 1999 by the City of Vacaville as part of a 143.5-acre parcel. It was used for 4 or 5 years for the application of biosolids; municipal wastewater treatment sludge (CH2M HILL, 2008). Historical groundwater impacts at the site have been attributed to agricultural practices rather than the program of biosolids application (Luhdorff and Scalmanini, 2005, included in Appendix B).

Because of the long-term use of the subject property for agricultural production (row crops), it was recommended in the Phase I report that a limited program of soil sampling and laboratory analysis be completed to determine if metals or organochlorine pesticide residues remained that could pose a potential future health risk to construction workers or other workers on the property. While the proposed CPVVS would not use groundwater or create discharges that would affect groundwater resources, it was also recommended that baseline groundwater conditions be assessed prior to CPVVS construction or operation as a due diligence measure to protect CPVVS against future environmental liability.

The signed proposal with Scope of Work (Appendix A) was received from CPV on June 25, 2008. This report has been prepared for the proposed CPVVS project to satisfy the requirements of that proposal.

It should be noted that this report is intended to provide the basis for an initial screening of environmental site conditions at the proposed CPVVS site, as they pertain to CPV's decision to acquire and operate a facility on the property. This assessment focuses on soils and groundwater and does not address the conditions of other site environmental media (such as surface water or sediment) and does not establish the lateral or vertical limit of detected contamination. For these reasons, this report does not constitute a full-scale Phase II ESA, as described in the *Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process* (Designation E 1903-97) published by the American Society for Testing and Materials (ASTM, February 1998).

SECTION 2
Site Description

The 25-acre subject property is a portion of a 143.5-acre parcel identified as APN 142-200-040. The subject property is located on the northwest corner of the intersection of Fry and Lewis Roads, in Vacaville, Solano County, California. The site topography is relatively flat with a slight gradient toward the east and southeast. Rainfall is expected to infiltrate or flow overland to a roadside ditch located along the east side of the property. The nearest surface water bodies are unlined canals, operated by Solano Irrigation District, located south of Fry Road. The nearest natural water body is Alamo Creek, approximately 0.4 mile north of the subject property (Figure 1). The subject property is located in an area used primarily for agricultural production of corn and other row crops. The site has been fallow for a few years but had been mowed and disked during the September 2008 field investigation. Other property owned by the City of Vacaville to the west and north of the proposed CPVVS site was also fallow during site visits in 2008.

No structures are located on the proposed CPVVS site except for a utility pole with a transformer and a utility box located near the southeast corner. A groundwater monitoring well (MW-5) is also located near the southeast corner of the site (Figure 2). This monitoring well was part of a shallow groundwater study conducted for the City of Vacaville Easterly Wastewater Treatment Plant (WWTP) (Luhdorff and Scalmanini, 2005) that is included in Appendix B. This study showed that the flow direction of the unconfined shallow groundwater is toward the southeast.

The WWTP is located approximately 500 feet northwest of the proposed CPVVS site (Figure 1). A gravel access road for the WWTP (the sludge haul road) is located along the west side of the subject property and was elevated approximately 2 to 4 feet in the northwest corner of the site.

Soils at the subject site are mapped almost entirely as a Capay silty clay loam (**Ca**) map unit, with a very limited portion in the north central margin of the subject site mapped as a San Ysidro sandy loam, 0 to 2 percent slopes (**SeA**). Both of these moderately well-drained, deep soils are formed on basin rims in alluvium derived from sedimentary rocks. The Capay silty clay loam soils are described as nearly level to level with a silty clay loam texture throughout the profile. The San Ysidro sandy loam has a sandy loam surface layer with a clay loam subsurface (NRCS, 1977).

SECTION 3

Methodology

All Phase II ESA site activities were conducted by CH2M HILL staff as follows.
On September 2, 2008, prior to the sample collection, the sample locations were staked in the field by Steve Long and Wilfred Akah. On August 8, 2008, Ed Haas and Wilfred Akah conducted the surface soil sampling effort at the proposed CPVVS site. Sample locations were collected at this time using a hand-held, resource-grade Trimble GeoXT global positioning system (GPS) unit. On September 19 and 20, 2008, Ed Haas and Steve Long, respectively, returned to the site with subcontractor, Gregg Drilling and Testing, Inc. (Gregg) to complete subsurface soil and groundwater sampling.

3.1 Sampling Approach

Guidance on the number of samples required to characterize the property was obtained from the DTSC (2002) *Interim Guidance for Sampling Agricultural Fields for School Sites*. This guidance recommends a minimum of 15 samples for areas that are 21 to 60 acres. Discrete samples are recommended on centers of approximately 1 acre. As shown in Figure 2, the current assessment of the 25-acre parcel used an even distribution of 20 sample locations with five rows (A to E, north to south) and four columns (1 to 4, west to east). A minimum of four offsite background samples are also recommended for assessing ambient levels for heavy metals. As shown in Figure 2, five background sample locations were sampled (two in the northwest portion, one along the south margin, and two along the eastern margin). Background sample locations were chosen in areas that were not likely to have received a biosolids (for example, elevated northwestern portion [BG-1 and BG-2], beneath roadway fill [BG-3], and far side of drainage ditch [BG-4 and BG-5]). No background samples were collected along the northern margin because that area was contiguous with the site, previously farmed, and probably also received biosolids.

Guidance on the sampling depths required to characterize the property was also obtained from the DTSC (2002) document that recommends discrete samples at each location in the 0-to-6-inch-below-ground-surface (bgs) depth interval (surface samples) and in the 2-to-3-foot-bgs interval (subsurface). This was the soil sampling approach adopted for the 20 locations within the parcel and the background sample locations (except for BG-3, which did not get a surface sample because it was adjacent to Fry Road). Based on previous experience with DTSC, some deeper soil data around the 5-foot-bgs depth is generally required, especially when potential onsite excavations during construction could extend to this depth. For this reason (as shown in Figure 2), samples around the 5-foot depth were also collected at select site locations (A1, B3, C4, D2, and E1) and at the five background soil locations.

Groundwater grab samples were collected at three sample locations (A1, B3, and D2) in order to achieve a reasonable spread across the site when supplemented with the groundwater sample from MW-5 in the southeastern corner of the site. The groundwater grab samples were collected from the first encountered shallow groundwater in the boring.

3.2 Sample Collection and Analysis Methodology

Surface soil samples were collected from the 20 site locations using individually wrapped, dedicated plastic scoops and were placed directly in pre-cleaned laboratory sample containers. The containers were immediately labeled with the sample designation, date, time, the name of person collecting the sample, and the requested laboratory analyses. The fully labeled sample containers were placed into bubble wrap and into a sealable plastic bag and then placed immediately onto ice in a cooler where they were kept until received at the analytical laboratory. All samples were shipped via priority overnight delivery in a sealed cooler under normal chain of custody procedures to Applied Sciences Laboratory (ASL) in Corvallis, Oregon.

Deeper soil samples (that is, those beneath fill or in the 3- to 5-foot depth range) were collected using a Geoprobe™ direct push technology (DPT) drill rig under subcontract with Gregg Drilling and Testing, Inc. The samples were collected using dedicated polyethylene sleeves within a 2-inch drive tube. Downhole portions of the drive tube sampler were decontaminated in the field prior to each boring. Standard decontamination procedures (Alconox-water scrub, tap water rinse, and distilled water rinse) were used to prevent cross-contamination of the samples. After retrieval of the sampler from the ground, the polyethylene sleeve was cut open and the desired depth interval was removed and placed into pre-cleaned laboratory sample containers. Samples were chilled and prepared for shipment as previously discussed. Soil samples were described with respect to soil field texture (Unified Soil Classification System) and color (Munsell Soil Color chart).

Field duplicates were collected to provide a way to assess sampling precision. Field duplicate samples were collected from within the same depth interval as the original (native) sample. The field duplicates were sampled and preserved in the same way as the native sample and were labeled in a manner that was "blind" to the laboratory (that is, did not reveal the associated, native sample). Field duplicate soil samples were collected for five of 59 native samples, as follows: A1-05SB, A3-03SB, B3-03SB, C4-05SB, and E1-05SB.

Groundwater grab samples were collected using the Geoprobe™ rig Hydropunch® sampler at three locations (A1, B3, and D2). Another groundwater sample was also collected from monitoring well MW-5 in the southeastern portion of the site. Groundwater samples were collected from MW-5 after purging the well until field monitoring parameters (pH, conductivity, temperature, turbidity, and redox) were stable. The soil boring logs for locations A1, B3, and D2, as well as the groundwater sampling field data sheet for MW-5 are provided in Appendix C. The groundwater samples analyzed for metals were filtered to reflect dissolved metal concentrations. Samples for organochlorine pesticide analyses were not filtered.

All soil and groundwater samples were analyzed for CAM 17 metals and for organochlorine pesticides. Chemical analyses for the CAM 17 metals were performed by Method SW6010B (except mercury was analyzed by Method SW7471A [for soils] or Method SW7470A [for groundwater]). Method SW8081 was used for organochlorine pesticides for both soils and groundwater.

Soil and groundwater sample analytical results (detected chemicals only) were screened against the U.S. Environmental Protection Agency (Region 9) Preliminary Remediation Goals (PRGs) for an industrial scenario. The detected values for soils were also compared to the California Human Health Screening Levels (CHHSLs) for an industrial/commercial, new construction scenario. In addition, results were compared to California hazardous waste total threshold limit concentration (TTLC) criteria (total concentration in milligrams per kilogram [mg/kg] on a wet weight basis for soil) or to the toxicity criteria in micrograms per liter (µg/L) for water.

The soil analytical data were used to develop summary statistics tables for the different inorganic analytes. The Shapiro-Wilk W test was used to test whether or not the distribution of the analytes was normally distributed. If a normal distribution was indicated, then an arithmetic mean is presented in the summary statistics; otherwise, a geometric mean is presented. The soil analytical data for inorganic constituents were also used to compare means of different groups and test the statistical significance for the following questions.

- Are metals concentrations different between surface soils in the in-field (native) samples and the background samples?
- Are metals concentrations different between the surface and subsurface soils in the in-field samples?

A non-paired t-test was used to compare group means. This parametric test provides a robust way to assess whether or not the means values of two groups of different sizes are significantly different from one another for the different inorganic analytes. Because there were a number of non-detect values in the data set, a less robust, non-parametric test was also used to compare the group means, the Mann-Whitney U test.

SECTION 4

Results

As shown in Figure 2, surface (0- to 6-inch-bgs) and near surface (3-foot-bgs) soil samples were collected at 20 locations evenly arranged over the approximately 25-acre proposed CPVVS site. Of these 20 locations, five locations (A1, B3, C4, D2, and E1) received additional samples at the 5-foot-bgs depth). Surface and subsurface soils were also sampled at five locations (BG-1 through BG-5) in areas that did not receive biosolids to provide a way to assess ambient (background) metals concentrations. A total of 59 soil samples were collected, with five additional samples collected as field duplicates.

Groundwater grab samples were collected from three of the 20 locations (A1, B3, and D2) to supplement the groundwater sample from MW-5 in the southeastern corner of the site. The intent of the groundwater sampling program was to document baseline shallow groundwater conditions prior to CPVVS construction or operations. Table 1 provides a summary of the preliminary Phase II ESA sampling at the proposed CPVVS site.

Because the metals were most widely detected in the different samples, summary statistics are provided in Table 2. Table 2 shows that in the surface soils, antimony, cadmium, molybdenum, and thallium were either not detected at all or in relatively few samples. In the subsurface soils, antimony and thallium were again detected in only one or two samples while cadmium and molybdenum were detected in 92 percent and 76 percent of subsurface soils, respectively. Most of the CAM-17 metals sought were detected in nearly all surface and subsurface samples, including arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, silver, vanadium, and zinc.

Among the 13 metals detected in the surface soils, seven were normally distributed (arsenic, beryllium, chromium, lead, nickel, vanadium, and zinc) so their central tendency was estimated by the arithmetic mean. Among the 15 metals detected in the subsurface soils, the same metals were also normally distributed. Additionally, cadmium, copper, mercury, and molybdenum were also normally distributed. The central tendency for metals that did not have a normal distribution was estimated by the geometric mean.

Table 3 provides the mean concentrations of metals for surface and subsurface samples in both the in-field and the background samples. Table 3 shows that mean metals concentrations are higher within the in-field surface soil samples compared to background surface soils for beryllium, chromium, copper, lead, mercury, selenium, silver, vanadium, and zinc. However, only three of these constituents, copper, silver, and zinc, were significant higher at the $p \leq 0.05$ level. It is possible that the metals are found at higher concentrations within the field due to agricultural practices that included the applications of biosolids. However, it was also noted that mean concentrations of certain metals are higher in the background surface samples than in the in-field samples. These metals included arsenic, barium, cobalt, and nickel. Among these metals, the only statistically significant difference was for nickel.

Table 3 also shows that mean metals concentrations are higher within the in-field surface soil samples compared to subsurface soils for chromium, copper, lead, mercury, silver, vanadium, and zinc. All of these findings are statistically significant except those for chromium and vanadium. These elevated metals in the surface soils could be explained by agricultural practices and the application of biosolids. However, it should also be noted that mean concentrations of arsenic, barium, beryllium, cobalt, nickel, and selenium are higher in the subsurface soils than in the surface soils. Of these, all were statistically significant except for selenium.

Certain plants have the ability to accumulate metals, which could account for lower concentrations of certain metals in the surface layer. Brown et al. (1983) noted that the following metals could be accumulated and removed from surface soils in harvested plants: copper and cobalt by plants in the Mint (Lamiaceae), Legume (Fabaceae), and Figwort (Scrophulariaceae) families; nickel by plants in the Mustard (Brassicaceae) family; selenium in plants from the Legume and Aster (Asteraceae) families; and zinc by plants in the Birch (Betulaceae), Aster, Legume, and Violet (Violaceae) families. Accumulation in plants and removal by harvesting is a possible mechanism that could explain how the concentrations of certain metals (that is, copper, cobalt, nickel, selenium, and zinc) could be lower in the in-field surface soils when compared to surface background or in-field subsurface soils.

Table D-1 (Appendix D) provides a summary of all soil analytical results for metals and organochlorine pesticide constituents and compares the detected values to regulatory agency thresholds, including preliminary cleanup thresholds, hazardous waste thresholds, and human health screening levels. Table D-1 also shows that arsenic and chromium values were found in excess of the screening values for all the samples. In the case of arsenic, the health risk-based values are very low (1.6 and 0.24 mg/kg dry weight [dw] basis). In Table 3, it was noted that arsenic in surface soils was higher in the background samples than in the field (8.80 vs. 8.145 mg/kg). It was also noted that arsenic was higher in the subsurface soils than in the surface soils. The calculated 95 percent upper confidence limit (UCL) for the in-field surface and subsurface samples is 8.99 and 11.37 mg/kg dw, respectively. When all of the background surface and subsurface samples are taken together, the mean concentration is 10.1 with a standard deviation of 1.702, which gives a 95 percent UCL of 10.95 mg/kg dw. This indicates that, while arsenic is present at levels in excess of the low risk-based screening values, the arsenic levels detected in the soils at the proposed CPVVS site are not dramatically different than local background levels. Additionally, the concentrations of arsenic observed at the subject site are generally consistent with background levels for arsenic within California (Kearney Foundation, 1996). While this report did not provide total background arsenic values for the two soil series mapped at the CPVVS site (Capay silty clay loam or San Ysidro sandy loam), there were reported values for two fine-textured soil series in Solano county (Hugo clay loam and Yolo clay loam series) at 9.6 and 4.5 mg/kg, respectively. The highest documented total background arsenic value was 11 mg/kg for an Altamont clay loam in San Diego County.

For chromium, the CHSSL criterion based on chromium VI (37 mg/kg dw) was exceeded for all the in-field samples. However, the CHSSL criterion based on chromium III (10,000 mg/kg dw) was not exceeded by any of the samples, which ranged between 25.5 and 48.0 mg/kg dw. While chromium speciation was not done to characterize the percent distribution between chromium VI and III, it is not expected that a significant amount (if any) of the total chromium results are composed of chromium VI. This is because chromium VI is much more likely to be present under reduced or saturated conditions, which were not present in soil samples at the proposed CPVVS site.

The organochlorine pesticide results (Table D-1) indicate that these constituents were detected almost exclusively in the surface soil samples. All subsurface samples were non-detect for organochlorine pesticides except for a single estimated (J-flagged) result for Endosulfan II that was detected in the field duplicate of the 3-foot sample at location B-3. With only two exceptions (alpha-chlordane and 4,4-DDE), organochlorine pesticides in the surface soil samples were estimated at levels that were between the method detection limit and the report limit (that is, J-flagged). Alpha-chlordane was detected above the reporting limit in three surface samples (A4, E3, and BG-2) at concentrations ranging from 0.5 to 0.87 mg/kg dw. 4,4-DDE was detected above the reporting limit in the surface soil samples in all but one of the in-field samples (ranging from 0.5 to 1.6 mg/kg dw) and in three of four of the background samples (ranging from 0.48 to 1.3 mg/kg dw).

Other organochlorine pesticides that were detected at levels below the reporting limit in surface samples include gamma-BHC (Lindane), beta-BHC, delta-BHC, alpha-chlordane, 4-4′-DDE, 4,4′-DDT, dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Heptachlor and Heptachlor epoxide. Summary statistics and statistical comparisons were not prepared, due to the limited occurrence of organochlorine pesticide compounds in the surface soils and the relatively low number of detected results.

Table D-1 also shows the comparison of analytical soil results against the hazardous waste criteria as defined by the California Code of Regulations Title 22, Division 4.5, Chapter 11, Section 66261.24. The blue-shaded values in Table D-1 show that five of the in-field surface samples and one of the background surface soil samples had 4,4′-DDE detections that were above the total threshold limit concentration (TTLC) hazardous waste criterion of 1.0 mg/kg (on a wet weight [ww] basis). The 4,4′-DDE was only detected in the surface soil samples but was found in both the in-field and the background samples. The calculated 95 percent UCL for the in-field surface soil samples is 1.031 mg/kg on a dw basis. Using the average moisture content of the surface samples (3.25 percent), the 95 percent UCL would be 0.997 mg/kg on a ww basis, which is roughly equivalent to (but just below) the TTLC criteria of 1.0 mg/kg (ww basis). The 95 percent UCL for the background surface soils samples was 1.200 mg/kg (dw basis) or roughly 1.161 mg/kg (ww basis).

Table D-2 (Appendix D) summarizes the analytical results for the groundwater samples collected at the proposed CPVVS site on September 19, 2008. The analytical data indicated some relatively minor detections of metals and organochlorine pesticide in the shallow groundwater beneath the proposed CPVVS site. However, the analytical data did not indicate any exceedances of health risk-based criteria (tap water PRGs) for metals, although it should be noted that the method detection limits were too high to assess the relatively low risk criteria for tap water for arsenic (0.045 µg/L) and thallium (2.4 µg/L). There was a single exceedance (in sample A1-12GW) of the health risk-based criteria for the organchlorine pesticide, Heptachlor epoxide. This compound was detected at 0.026 µg/L, which exceeded the tap water PRG (based on Heptachlor) of 0.015 µg/L. Because groundwater will not be used for potable water at the proposed CPVVS project, it is not anticipated that these results pose a significant threat to human health during construction or operation of the CPVVS. These data provide a baseline of shallow groundwater conditions during the late dry season (September) prior to CPVVS construction or operation.

For the proposed CPVVS site, the soil contaminant levels observed in this limited sampling program are such that, without mitigation, construction worker risks would be expected to be higher than an industrial/commercial scenario, given the potential for increased direct exposure via dermal contact, ingestion, and inhalation. This elevated risk to workers is primarily due to exposure to arsenic and, to a lesser degree, organochlorine pesticides (especially 4,4’-DDE) which were detected near the hazardous waste TTLC. Exposure mitigation for construction workers should therefore include soil handling best management practices (BMPs) aimed at minimizing soil contact and fugitive dust generation during construction.

SECTION 5

Conclusions and Recommendations

A preliminary Phase II ESA, composed of soil and groundwater sampling and chemical laboratory analysis, was conducted for the proposed CPVVS site near Vacaville, California. The results of the assessment, as documented in this report, indicate that inorganic and organochlorine constituents exist in surface and subsurface soils at levels that warrant consideration in the plans to develop the proposed CPVVS.

The data collected for this report indicate arsenic concentrations exist at levels above the comparative health risk-based values (PRGs and CHHSLs) in surface and subsurface soils at the site. Chromium was also detected above the risk-based values for chromium VI; however, it is expected that the total chromium levels detected in surface and subsurface soils are associated with the less toxic form (chromium III) due to the unsaturated (oxidizing) conditions in surface soils at the site. Based on these conditions, we conclude that the actual chromium levelsare below the risk-based values (ie., those for chromium III).

In surface soils only, a residual organochlorine pesticides (4,4'-DDE) was noted at levels near the hazardous waste TTLC criterion; however, these were below health risk-based screening levels (PRGs and CHHSLs). With only a few minor exceptions, organochlorine pesticides were not detected in subsurface soils.

Arsenic levels in the field were detected at concentrations that were consistent with the background soils collected from around the site. They were also comparable with arsenic levels documented in a state-wide assessment of background concentrations of metals (Kearney Foundation, 1996). While arsenic is a known carcinogen and represents a potential risk for human health under an industrial/commercial worker exposure scenario to surface soils, it is expected that the implementation of normal dust-control and erosion mitigation measures (as part of the construction BMPs) would go a long way toward avoiding potential health risks for construction workers and offsite receptors during the CPVVS construction activities.

A baseline assessment of dry season groundwater conditions beneath the CPVVS property was also completed. The analytical data indicated some relatively minor detections of metals and organochlorine pesticide in the shallow groundwater beneath the proposed CPVVS site. While the analytical data did not indicate any exceedances of health risk-based criteria (tap water PRGs) for metals, it should be noted that the method detection limits were too high to assess the relatively low risk criteria for tap water for arsenic and thallium. There was a single exceedance (in sample A1-12GW) of the health risk-based criteria for the organchlorine pesticide, Heptachlor epoxide. Because groundwater will not be used for potable water at the proposed CPVVS project, it is not anticipated that these results pose a significant threat to human health during construction or operation of the CPVVS.
CH2M HILL recommends that following.

- CPV should notify the current landowner (City of Vacaville) of these initial results. According to information obtained during the Phase I ESA, the proposed CPVVS property is not currently under regulatory agency mandate to address surface soil contamination. Given the historic nature of activities that resulted in the current site conditions, there is no apparent regulatory requirement for notification other than that required under the California Energy Commission (CEC) review process. Based on the findings in this technical memorandum, it is not expected that the levels of contaminants detected at the site would trigger a regulatory-mandated cleanup action. However, CPV should review the findings of this report with their legal staff to make final decisions on regulatory liability and notification.

- Prior to initiating construction activities, a Construction Health and Safety Plan (and/or Soil Management Plan) should be prepared that addresses the issues of construction worker exposure to soil and the potential off-site impacts by wind and/or water erosion. The Plans should be protective of site workers and potential off-site receptors and prepared in general conformance with regulatory requirements. The Plans can then be used by stakeholders (CPV and construction contractors) for determining any incremental construction costs that could be associated with potentially harmful soil constituents during the bidding process. These Plans should describe specific actions to control construction worker exposures to onsite soil constituents (such as personal protective equipment, safe work practices, and engineered controls) and to limit offsite impacts (such as erosion and sedimentation controls).

The preliminary Phase II ESA activities described in this report were completed in accordance with the Attached Scope of Work (Appendix A), which was signed and received by CH2M HILL from CPV on June 25, 2008. The approaches described in the Scope of Work are consistent with generally accepted standards of practice for environmental investigations. These types of investigations are based on the analytical testing for a limited number of analytes on a limited number of discrete soil samples.

The sample locations were chosen to be representative of site conditions and the analytical testing designed to detect expected contaminants. However, these investigations do not provide a warranty that other contaminants of a similar nature do not exist on other areas of the property that were not sampled. Increased certainty about overall environmental site conditions can be achieved with an increased amount of sampling and analyses, but the need for further site investigations should be based upon CPV’s requirements for risk management relative to their real estate portfolio.

SECTION 6

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Tables

TABLE 1
Sample Summary
Draft Phase II Environmental Site Assessment

Location	Latitude	Longitude	Easting	Northing	Samples[a]
A1	38.339344	-121.901009	6159836.503	2313168.198	Soil: 0-6 in, 3 ft, 5 ft GW: grab at 12 ft
A2	38.339381	-121.899909	6160152.262	2313176.617	Soil: 0–6 in and 3 ft
A3	38.339415	-121.898815	6160466.025	2313184.493	Soil: 0–6 in and 3 ft
A4	38.339432	-121.897711	6160782.760	2313185.938	Soil: 0–6 in and 3 ft
B1	38.338945	-121.901004	6159835.800	2313022.832	Soil: 0–6 in and 3 ft
B2	38.338958	-121.899903	6160151.616	2313022.715	Soil: 0–6 in and 3 ft
B3	38.338988	-121.89881	6160465.337	2313029.030	Soil: 0–6 in, 3 ft, 5 ft GW: grab at 12 ft
B4	38.338996	-121.897713	6160779.991	2313027.064	Soil: 0–6 in and 3 ft
C1	38.338541	-121.901013	6159831.110	2312875.712	Soil: 0–6 in and 3 ft
C2	38.338541	-121.899916	6160145.769	2312870.901	Soil: 0–6 in and 3 ft
C3	38.338541	-121.898824	6160458.820	2312866.416	Soil: 0–6 in and 3 ft
C4	38.338546	-121.897726	6160773.667	2312863.352	Soil: 0–6 in, 3 ft, 5 ft
D1	38.338134	-121.901022	6159826.310	2312727.430	Soil: 0–6 in and 3 ft
D2	38.338128	-121.899917	6160143.083	2312720.587	Soil: 0–6 in, 3 ft, 5 ft GW: grab at 12 ft
D3	38.338121	-121.898824	6160456.610	2312713.152	Soil: 0–6 in and 3 ft
D4	38.338106	-121.897726	6160771.475	2312703.212	Soil: 0–6 in and 3 ft
E1	38.337725	-121.901033	6159820.806	2312578.729	Soil: 0–6 in, 3 ft, 5 ft
E2	38.337701	-121.899935	6160135.672	2312565.091	Soil: 0–6 in and 3 ft
E3	38.337705	-121.898835	6160451.201	2312562.012	Soil: 0–6 in and 3 ft
E4	38.337707	-121.897735	6160766.720	2312557.770	Soil: 0–6 in and 3 ft
BG1	38.339716	-121.901436	6159716.220	2313305.210	Soil: 0–6 in, 3 ft, 5 ft
BG2	38.339132	-121.901441	6159711.472	2313092.604	Soil: 0–6 in, 3 ft, 5 ft
BG3	38.337255	-121.899419	6160281.035	2312400.687	Soil: 3 ft and 5ft
BG4	38.338098	-121.897107	6160948.800	2312697.724	Soil: 0–6 in, 3 ft, 5 ft
BG5	38.339000	-121.897100	6160955.842	2313026.014	Soil: 0–6 in, 3 ft, 5 ft
MW-5	—	—	—	—	GW: est. 30–35 ft screen interval[b]

Note: Sample locations collected on August 8, 2008, using a hand-held Trimble GeoXT GPS device.

[a] Samples are noted in depth below ground surface. For background samples (BG1, BG2, and BG3) the depth below ground surface is interpolated below fill to correspond to ground surface within the site.

[b] A GPS location was not collected for MW-5. The screened interval for this well is estimated from Luhdorff and Scalmanini (2005).

ft = feet
GW = groundwater
in = inches

TABLE 2
Summary Statistics for Metals in Surface and Subsurface Soils Within the Site
Draft Phase II Environmental Site Assessment

Parameter	Number of Detects	Detection Frequency	Normal Distribution?	Mean	Standard Deviation	Minimum	Maximum
Surface Soils (n = 20)							
Antimony	0	0%	—	—	—	—	—
Arsenic	20	100%	Yes	8.14	1.292	6.2	11.1
Barium	20	100%	No	167.6*	36.64	135	307
Beryllium	20	100%	Yes	0.73	0.073	0.57	0.83
Cadmium	0	0%	—	—	—	—	—
Chromium	20	100%	Yes	40.09	4.356	30.8	45.9
Cobalt	20	100%	No	11.63*	6.455	9.1	39.5
Copper	20	100%	No	43.50*	5.072	37	59.8
Lead	20	100%	Yes	12.64	1.194	10.4	15.9
Mercury	20	100%	No	0.09*	0.034	0.58	0.22
Molybdenum	0	0%	—	—	—	—	—
Nickel	20	100%	Yes	28.24	3.155	22.9	33.2
Selenium	3	15%	No	1.61*	0.748	1.35	3.7
Silver	20	100%	No	1.43*	0.221	1.1	2.1
Thallium	0	0%	—	—	—	—	—
Vanadium	20	100%	Yes	72.68	9.707	54.6	85.9
Zinc	20	100%	Yes	78.67	5.658	66.1	89.4
Subsurface Soils (n = 25)							
Antimony	1	4%	—	—	—	—	—
Arsenic	25	100%	Yes	10.72	1.646	6.74	14.1
Barium	25	100%	No	277.9*	244.4	79.8	1360
Beryllium	25	100%	Yes	0.81	0.055	0.70	0.96
Cadmium	23	92%	Yes	0.13	4.668	0.03	0.32
Chromium	25	100%	Yes	37.86	4.855	25.5	48.0
Cobalt	25	100%	No	14.86*	8.839	7.49	50.8
Copper	25	100%	Yes	33.93	4.428	26.8	47.6
Lead	25	100%	Yes	10.83	1.412	8.72	14.0
Mercury	25	100%	Yes	0.046	0.017	0.015	0.088
Molybdenum	19	76%	Yes	0.34	4.175	0.20	0.68
Nickel	25	100%	Yes	33.70	4.652	26.8	42.5
Selenium	18	72%	No	1.81*	1.490	0.58	4.67
Silver	17	68%	No	0.11*	0.212	0.022	0.80
Thallium	2	8%	—	—	—	—	—
Vanadium	25	100%	Yes	69.63	7.123	54.3	86.5
Zinc	25	100%	Yes	66.50	7.160	52.1	83.2

Notes:

Summary statistics are based on native samples only and do not include background or field duplicate values. The reported values are in mg/kg on a dry weight basis.

The test for normal distribution of data was significant at the $\alpha \geq 0.05$ level.

Reported means are arithmetic except where noted by (*) where the geometric mean was reported instead.

For the calculation of means, estimated (J-flagged) values were used while non-detected (U-flagged) values were estimated as one-half of the reported method detection limit.

Summary statistics were not calculated when the number of detected values was below 3.

TABLE 3

Mean Metal Concentrations (mg/kg on dry weight basis) and Comparisons Between Surface and Subsurface Soils

Draft Phase II Environmental Site Assessment

Parameter	Mean Concentrations in Surface Samples		Significant Difference?	
	Native Samples (n = 20)	**Background Samples (n = 4)**	**Unpaired t-test**	**Mann-Whitney U**
Antimony	Not calculated	Not calculated	—	—
Arsenic	8.145	**8.80**	No (p = 0.3517)	No (p = 0.2012)
Barium	170.5	**182.5**	No (p = 0.5485)	No (p = 0.2299)
Beryllium	**0.728**	0.698	No (p = 0.4253)	No (p = 0.2012)
Cadmium	Not calculated	Not calculated	—	—
Chromium	**40.09**	36.98	No (p = 0.1793)	No (p = 0.0958)
Cobalt	12.37	**14.3**	No (p = 0.5907)	No (p = 0.5355)
Copper	**43.76**	33.40	**Yes** (p = 0.0006)	**Yes** (p = 0.0019)
Lead	**12.64**	11.25	No (p = 0.0754)	No (p = 0.1411)
Mercury	**0.094**	0.064	No (p = 0.1151)	No (p = 0.1411)
Molybdenum	Not calculated	Not calculated	—	—
Nickel	28.24	**32.150**	**Yes** (p = 0.0371)	No (p = 0.1038)
Selenium	**1.718**	1.438	No (p = 0.4700)	No (p = 0.9383)
Silver	**1.44**	1.095	**Yes** (p = 0.0067)	**Yes** (p = 0.0067)
Thallium	Not calculated	Not calculated	—	—
Vanadium	**72.68**	66.63	No (p = 0.2385)	No (p = 0.1519)
Zinc	**78.67**	65.95	**Yes** (p = 0.0003)	**Yes** (p = 0.0053)

Parameter	Mean Concentrations in Native Samples		Significant Difference?	
	Surface Samples (n = 20)	**Subsurface Samples (n = 25)**	**Unpaired t-test**	**Mann-Whitney U**
Antimony	Not calculated	Not calculated	—	—
Arsenic	8.145	**10.72**	**Yes** (p < 0.0001)	**Yes** (p < 0.0001)
Barium	170.5	**329.2**	**Yes** (p < 0.0063)	**Yes** (p = 0.0006)
Beryllium	0.728	**0.808**	**Yes** (p = 0.0001)	**Yes** (p = 0.0004)
Cadmium	Not calculated	Not calculated	—	—
Chromium	**40.09**	37.86	No (p = 0.1180)	No (p = 0.0910)
Cobalt	12.37	**16.36**	No (p = 0.0985)	**Yes** (p = 0.0073)
Copper	**43.76**	33.93	**Yes** (p < 0.0001)	**Yes** (p < 0.0001)
Lead	**12.64**	10.38	**Yes** (p < 0.0001)	**Yes** (p = 0.0001)
Mercury	**0.094**	0.046	**Yes** (p < 0.0001)	**Yes** (p < 0.0001)
Molybdenum	Not calculated	Not calculated	—	—
Nickel	28.24	**33.70**	**Yes** (p < 0.0001)	**Yes** (p = 0.0001)
Selenium	1.178	**2.321**	No (p = 0.1062)	No (p = 0.2009)
Silver	**1.44**	0.213	**Yes** (p < 0.0001)	**Yes** (p < 0.0001)
Thallium	Not calculated	Not calculated	—	—
Vanadium	**72.68**	69.63	No (p = 0.2312)	No (p = 0.1534)
Zinc	**78.67**	66.50	**Yes** (p < 0.0001)	**Yes** (p < 0.0001)

Notes:

Summary statistics are based on native samples only and do not include field duplicate values.

For the calculation of means, estimated (J-flagged) values were used while non-detected (U-flagged) values were estimated as one-half of the reported method detection limit.

Means were not calculated when the number of detected values was below 3 and significance testing was only done when adequate number of detections was available in both the surface and subsurface soils.

Boldface means are the higher value in the groups compared and are shaded when the difference was statistically significant at the $p \leq 0.05$ level.

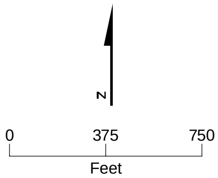
Figures

LEGEND

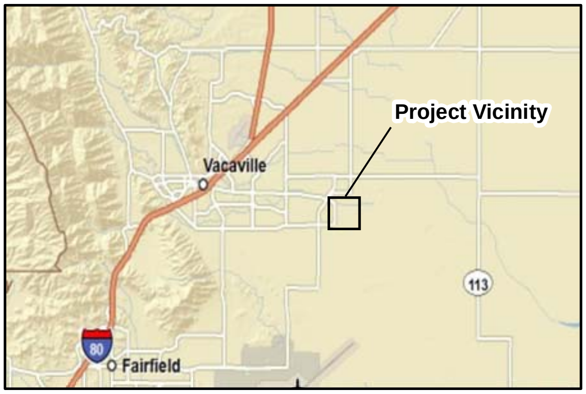
◑ Monitering Well

◪ Transformer and Utility Box

▭ Project Site



VICINITY MAP



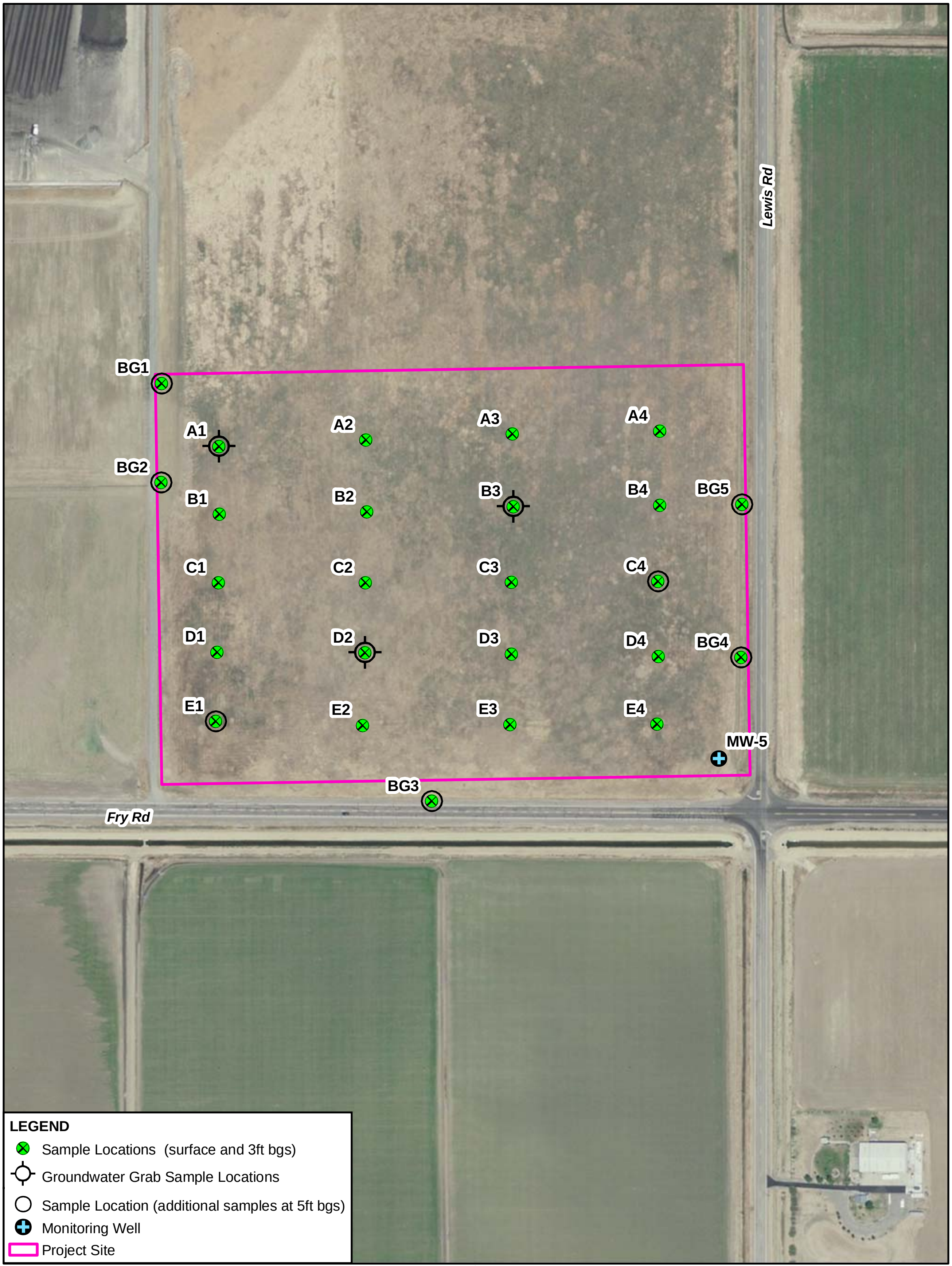
This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

FIGURE 1
SITE MAP

PHASE II ENVIRONMENTAL SITE ASSESSMENT
VACAVILLE ENERGY CENTER, VACAVILLE, CA

SAC\\ZION\SACGIS\PROJ\VACAVILLE_AFC_370668\MAPFILES\PHASEII\PHASEII_LOCATION.MXD MHASKELL 10/30/2008 15:57:29

CH2MHILL



Source: Sample locations collected on
08/05/08 using a Trimble GeoXT GPS unit.

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

FIGURE 2
SAMPLE LOCATIONS MAP

PHASE II ENVIRONMENTAL SITE ASSESSMENT
VACAVILLE ENERGY CENTER, VACAVILLE, CA

Appendix A
Signed Phase II Proposal

CH2MHILL

CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916-920-0300
Fax 916-920-8463

June 5, 2008

Mr. Andrew C. Welch
Vice President
Competive Power Ventures, Inc.
8403 Colesville Road, Suite 915
Silver Spring, MD 20910

Suject: Preliminary Phase II Environmental Site Assessment
Vacaville Energy Center, Vacaville, California

Dear Mr. Welch:

CH2M HILL is pleased to submit this proposal to CPV Vacaville, LLC (CPV Vacaville) to perform soil sampling and analysis activities for CPV Vacaville's new power plant site, located in Vacaville, Solano County, California. The proposed activities are intended to address the recommendations that were included in the *Phase I Environmental Site Assessment* (ESA) by CH2M HILL, dated May 12, 2008. These recommendations were that the soil be analyzed for residues of agricultural chemicals and municipal waste water sludge (i.e., biosolids) and that the baseline groundwater conditions be assessed. This proposed work will support the due diligence for CPV Vacaville in association with the proposed construction and operation of a power plant on the subject property. It is also intended to address potential California Energy Commission (CEC) concerns for future worker health and safety.

The project site is a 25-acre (±) parcel located south of the City of Vacaville's Easterly Wastewater Treatment Plant within the Vacaville City limit. The Phase I ESA noted that subject property was part of a larger 143.5-acre parcel. This agricultural property was acquired by the City of Vacaville in the late 1990's and was held by private individuals prior to that time. The subject property has been used for corn production and, for approximately 4 to 5 years, it had received biosolids (i.e., wastewater treatment facility sludge) under a permit from the Central Valley Regional Water Quality Control Board (CVRWQCB). During that period, the rate of biosolids application was dictated by the crop uptake capacity. Reportedly, the biosolids applications were halted and the field has been fallow for approximately 6 years.

Because the subject property has agricultural site use history and because it was known to receive biosolids from a municipal wastewater treatment facility, there is a potential for the on-site soils to contain residues of persistent agricultural chemicals or biosolid constituents, such as heavy metals, at levels that could be potentially harmful to human health. The proposed soil sampling and analysis activities are intended to characterize the residues of agricultural chemicals and biosolids that could remain on the property.

Scope of Work

The scope of work for this project includes the following tasks:

- Task 1 – Sampling and Analysis
  - Obtain and review copies of the analytical data for the biosolids that have been applied to the field
  - Arrange for laboratory analyses of the soil and groundwater samples
  - Lay out sampling grid and record locations with global positioning system (GPS) unit
  - Complete underground utility locating and obtain Solano County drill permits
  - Conduct field sampling program using direct push technology (DPT) drill rig and collect soil and groundwater samples
  - Ship samples to the analytical laboratory under chain-of-custody
- Task 2 – Reporting
  - Produce soil logs and sample data sheets
  - Summarize and review soil and groundwater sample analytical results
  - Compare soil analytical results to appropriate risk-based and hazardous waste criteria
  - Interpret the implications of the findings for the proposed project.
- Task 3 - Project Management

Task 1 – Sampling and Analysis

CH2M HILL will obtain copies of analytical data reports for the biosolids that were applied to the subject property. It is assumed that these analytical data are readily available from the City of Vacaville under their permit to apply the biosolids from the CVRWQCB. The shallow groundwater study will also be reviewed to determine what parameters have been recently sampled. These data will be used to determine what analyses may be required for the new samples.

All the soil samples will be analyzed for persistent organochlorine pesticides using USEPA Method 8080A. For the purpose of costing, it is assumed that all soil samples will also be analyzed for CAM 17 metals (USEPA Series 6000 and 7000 and 7471 for mercury), although the final suite of analyses will be determined after analytical reports for the biosolids have been reviewed.

Soil sampling for the agricultural field will be done in general accordance with the California EPA Department of Toxic Substances Control (DTSC) *Interim Guidance for Sampling Agricultural Fields for School Sites (Second Revision,* August 26, 2002). While it is recognized that the proposed use of the Vacaville property is not for a school, this document provides conservative guidelines for characterizing soil conditions in agricultural fields.

Based on the DTSC guidance and size of the subject parcel, it is recommended that discrete samples be collected at 20 locations uniformly distributed throughout the property. A resource-grade GPS unit (Trimble GeoXT) will be used to locate samples within the field. At all locations, samples will be collected using a direct push technology (DPT) drill rig at two depths, near surface (0 to 6 inches) and subsurface (2 to 3 feet below ground surface [bgs]). At five of the sample locations, deeper samples will be collected near 5 feet bgs. Five additional soil samples will be collected as field duplicates of existing samples to assess sampling and laboratory quality assurance/quality control (QA/QC). Ten more samples will be collected at five locations in adjacent areas to use as background samples for metals. Based on this approach, the total estimated number of soil samples to be collected is 60.

In addition, groundwater samples will be collected for the subject property. First, the existing groundwater monitoring well in the southeast portion of the field will be sampled. At three additional locations throughout the field, the DPT drill rig will be used to collect a groundwater grab sample. Based on this approach and one additional QAQC sample, the total number of groundwater samples estimated for this effort is 5. All groundwater samples will be field filtered before shipping to the laboratory. As previously explained, the analytical suite will include organochlorine pesticides and metals with the final choice of analytes determined by the review of existing analytical data for the site.

It is expected that surface soil samples will be collected with dedicated, disposable scoops. Subsurface soil and groundwater grab samples will be collected using the DPT drive sampler that has been decontaminated prior to each use to prevent cross-contamination of samples. Soil samples will be collected directly into laboratory-provided sample containers and chilled as soon as practical in an ice chest. The samples will be kept chilled until they are received at the analytical laboratory under chain-of-custody procedures.

Task 2 – Reporting

Descriptive logs for the soil borings will be included in the report as an attachment.

Upon receipt of the analytical data from the laboratory, the results will be tabulated for the memorandum. Comparative screening-level criteria (where available for each analyte) will be taken from sources such as the USEPA Preliminary Remediation Goals (PRGs) and California Human Health Screening Levels (CHHSLs). The applicable Title 22 Hazardous Waste Criteria, where available, will also be determined. These comparative values will be shown along with the analytical results in the summary table in order to document the comparison to the screening criteria.

The findings and conclusions will be included in a technical memorandum entitled Preliminary Phase II Environmental Site Assessment. This report will document the justification for the soil sampling, field activities, and the findings as they pertain to the proposed project. If further activities are warranted, those recommendations and their basis will also be provided in the technical memorandum.

Task 3 – Project Management

Project management for this project will include staff management and scheduling; supervision of the entire work scope, contract management, financial management, and client communication. Douglas M. Davy will serve as the Project Manager for this task. Dr.

Davy has 22 years of experience managing environmental permitting projects for infrastructure development. Mr. Steve Long will serve as Senior Technical Lead and has 19 years of experience conducting Phase I and Phase II Environmental Site Assessments.

The Preliminary Phase II Environmental Site Assessment memorandum will be conveyed electronically to allow review and client input prior to final production of the memorandum. For this reason, it is assumed that no meetings will be required to discuss the findings of this due diligience investigation.

Budget

We propose to conduct this work on a time and materials basis with a budget not to exceed without prior approval by CPV Vacaville. Attachment B is an itemized listing of costs by task.

Schedule

The duration of this scope of work is approximately 10 weeks from receipt of the notice to proceed. This duration includes time to plan for, schedule, and conduct the sampling, to complete the laboratory analyses, and to draft the technical memorandum. It should be noted that it may take as long as 5 weeks to schedule the drilling contractor and obtain the required permits. CH2M HILL will work with CPV Vacaville to adjust the schedule for specific tasks performed under this scope of work. It is anticipated that all work will be completed by December 31, 2008.

Deliverables

The draft Preliminary Phase II ESA will be provided electronically to CPV Vacaville for review and comment. Within 1 week of receipt of comments, 5 copies will be submitted to CPV Vacaville.

Assumptions

It is assumed that the client will arrange for access to the subject property for CH2M HILL and their subcontractors to conduct the field investigations. It is also assumed that the City of Vacaville will provide copies of relevant information concerning the analytical data for the biosolids that were applied to the property. This information will need to be obtained prior to the field sampling event so that it can be reviewed and incorporated into the sample analytical program. For the purpose of this cost estimate for the 65 samples, the individual sample analytical cost is assumed to be $500 per sample. It the actual sample costs determined after the data review will exceed this amount, it will be necessary to increase the budget accordingly.

The technical memorandum will address the data collected under the proposed scope of work. The approach described in this scope of work are consistent with generally accepted standards of practice for environmental investigations. These type of investigations will be based on the analytical testing for a limited number of analytes on a limited number of discrete soil and groundwater samples.

The sample locations will be chosen to provide an adequate coverage of the subject property and are expected to be representative of site conditions. However, these investigations do not provide a warranty that other site contaminants of a similar nature do not exist on other areas of the property that were not samped. Increased certainty about overall environmental site conditions can be achieved with increased amount of sampling and analyses. The need for further site investigations should be based upon CPV Vacaville's requirements for risk management relative to the proposed power plant project.

It has been assumed that this project will be completed in the year 2008.

Contract Terms

This work will be accomplished on a time and materials basis and in accordance with the Terms and Conditions of the February 19, 2008 Agreement for Consulting Services between CPV Vacaville, LLC and CH2M HILL, as amended by CH2M HILL's specific additional provisions (see Attachment A) for conducting a Phase 2 ESA.

If you have any questions or require additional information, please contact Doug Davy, Senior Project Manager in our Sacramento office (916-286-0278).

Sincerely,

CH2M HILL

Karen L. Parker
Operations Leader

Accepted by CPV Vacaville, LLC

Name:
Signature: Peter Podurgiel
Date: June 25, 2008

c: D. Davy
S. Long

ATTACHMENT A - OTHER PROVISIONS

For Phase 2 Site Assessment Services ("Phase 2 Services") under the Agreement for Consulting Services between CH2M HILL and CPV Vacaville, LLC (CPV Vacaville) date February 19, 2008 (AGREEMENT), the following provisions shall apply:

1. Limitation of Liability

To the maximum extent permitted by law, CH2M HILL's liability for CPV Vacaville's damages for any cause or combinations of causes for Phase 2 Services will, in the aggregate, not exceed $100,000. CPV Vacaville agrees to indemnify CH2M HILL for any damages that exceed this liability. CPV Vacaville waives all claims against CH2M HILL, including those of latent defects, that are not brought within two years of completion of the Phase 2 Services or final payment, whichever is later. This provision takes precedence over any conflicting provision of the AGREEMENT or any document incorporated into them or referenced by them.

2. No Third Party Beneficiaries

All work products will be prepared for the exclusive use of CPV Vacaville, for specific application to the property described in the SCOPE OF SERVICES. No warranty, expressed or implied, is made. There are no beneficiaries of the work products other than CPV Vacaville, and no other person or entity is entitled to rely upon the work products without the written consent of CH2M HILL.

Should CPV and CH2M HILL agree that the work product will be released to a financial institution or others for review, CPV Vacaville will obtain an executed reliance letter from the financial institution which states that CH2M HILL's liability for any reliance on the work product will be subject to the same limitations as agreed between CPV Vacaville and CH2M HILL in this AGREEMENT.

3. Additional Terms

a. It is beyond CH2M HILL's scope of work to review or examine: (1) materials containing asbestos; (2) the presence of radon; (3) the presence of lead-based paint; (4) lead in drinking water; (5) identification or delineation of jurisdictional wetlands; (6) issues associated with worker health and safety; (7) issues pertaining to compliance with environmental regulations; (8) issues pertaining to cultural/historic resources, (9) issues pertaining to endangered species and ecological resources, (10) indoor air quality, (11) issues pertaining to biological agents or mold or (12) liabilities associated with the offsite management of solid or hazardous wastes.

b. Unless specifically identified in the Scope of Work, cost estimates for cleanup and identification of parties potentially responsible for the cleanup of hazardous substance releases are not included.

c. At CPV's direction, CH2M HILL has not performed any surface or subsurface sampling and cannot therefore give any assurance as to the absence or presence of surface or subsurface contamination.

d. Any report prepared under the SCOPE OF SERVICES is based, in part, on unverified preliminary information supplied to CH2M HILL from several sources during the project; therefore, CH2M HILL cannot guarantee its completeness or accuracy.

e. CH2M HILL makes no representation regarding whether this investigation constitutes "all appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice" as defined under Section 101(35)(B) of CERCLA.

f. The CH2M HILL's staff who performed the site assessment are not attorneys; therefore any report prepared under the SCOPE OF SERVICES is not a legal representation or interpretation of environmental laws, rules, regulations, or policies of local, state, or federal governmental agencies.

g. Any opinions or recommendations presented apply to site conditions existing when services were performed. CH2M HILL cannot report on, or accurately predict events that may change the site conditions after the described services are performed, whether occurring naturally or caused by external forces.

h. CH2M HILL assumes no responsibility for conditions we are not authorized to investigate, or which are not in our specific SCOPE OF SERVICES.

i. CH2M HILL's services shall not include directly or indirectly storing, arranging for or actually transporting, disposing, treating or monitoring hazardous substances, hazardous materials, hazardous wastes or hazardous oils

j. CH2M HILL's services shall not include an independent verification of the quality of work conducted and information provided by independent laboratories or other independent contractors retained by CH2M HILL in connection with CH2M HILL's services provided to CPV Vacaville.

Vacaville Energy Center Preliminary Phase II ESA

CH2MHILL

Price by Element

Lowest Tasks, All Budgets, without Budget Subtotals, without Period Subtotals, without Estimating Frequency Subtotals

Task	Hours	Labor	Labor Subtotal	Expense	Subs	Travel	Subtotal
Top Task 01							
01.01 - Soil and GW sampling							
01.02 - Sample analyses							
Subtotal for 01							
Top Task 02							
02.01 - Data analyses and reporting							
Subtotal for 02							
Top Task 03							
03.01 - Administrative tasks							
Subtotal for 03							
Grand Total							

Appendix B
Shallow Groundwater Study

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

GROUND-WATER RESOURCES
HYDROLOGY • DEVELOPMENT • MANAGEMENT

August 23, 2005
File No. 05-4-051

Ms. Jacqueline McCall
Water Quality Manager, Department of Public Works
City of Vacaville
6040 Vaca Station Road
Elmira, CA 95625

SUBJECT: SHALLOW GROUNDWATER QUALITY IN THE VICINITY OF THE EASTERLY WASTEWATER TREATMENT PLANT, SOLANO COUNTY, CA

Dear Ms. McCall:

Per your request, Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this letter report investigating shallow groundwater quality in the vicinity of the City of Vacaville's Easterly Wastewater Treatment Plant (EWWTP) located at 6040 Vaca Station Road, Elmira, CA 95625 (**Figure 1**).

This investigation is in response to Order WQO 2002-0015 issued by the California State Water Resources Control Board (State Board) remanding Waste Discharge Requirements (WDRs) Order No. 5-01-044 to the Central Valley Regional Water Quality Control Board (RWQCB) for appropriate modifications.

Specifically, the State Board objects to the RWQCB's lenient language regarding potential impacts to groundwater quality as in *Finding 32* of the RWQCB's Order No. 5-01-044*: "Current monitoring data has not identified significant changes of groundwater quality as a result of the operation of the wastewater treatment facility.*" The State Board contends that based on the historical variability of electrical conductivity (EC) values, total dissolved solids (TDS) and nitrate-N (nitrate as nitrogen) concentrations, and pH in samples retrieved from the five monitoring wells, the water quality record does not appear to support the RWQCB's findings. The State Board also criticizes the lack of information on monitoring well locations. Specifically, the State Board concludes (page 62, State Board Order WQO 2002-0015):

> "Without more information on well location and some explanation of the changes in nitrate-N, TDS and pH concentrations, the Board is unable to draw any meaningful conclusions from the monitoring data. The Board will remand this issue to the Central Valley Regional Board for clarification. If the treatment plant's operation has caused groundwater quality changes, Vacaville should be given the opportunity to submit

> information demonstrating that the changes meet the criteria in Resolution No. 68-16. If increases in nitrate-N concentrations over the MCL in groundwater are, in fact, due to the Easterly treatment plant operation, these changes would not meet the Resolution No. 68-16 criteria."

SCOPE

The purpose of this letter report is to determine whether or not the historical operation of the EWWTP has caused groundwater quality changes in its vicinity and, if applicable, delineate the sources of such changes.

EWWTP OPERATION

The plant was initially constructed in 1959 and has been expanded several times since then. The plant provides secondary treatment, employing activated sludge reactors and secondary clarifiers with nitrification. The treatment plant capacity was designed for 10 million gallons per day (mgd) average dry weather flow (ADWF); it averaged 6.9 mgd ADWF in 1997. Construction work to expand the plant commenced in late 2000 and continues through the present. At the end of the Phase I construction in 2006, the facility will have a design flow capacity of 15 mgd (ADWF). The expanded facility layout is shown on **Figure 2**.

MONITORING NETWORK

The City maintains a network of five shallow monitoring wells, MW #1 through MW #5, in the vicinity of the plant (**Figure 1**). These wells were constructed between 1990 and 1994 to a depth of 30 to 35 feet below ground surface (bgs) (**Table 1**). MW #1 is located in very close proximity to the northwest corner of the decommissioned West Pond and Old Alamo Creek. MW #2 and MW #3 are located about 550 and 850 feet east of the West Pond, respectively. MW #4 and MW #5 are located about 2,500 to 3,000 feet southeast of the southeast corner of the West Pond on historically farmed agricultural land.

POTENTIAL SOURCES FOR GROUNDWATER CONTAMINATION

Old Alamo Creek and SID Canal

Treated effluent wastewater is discharged to Old Alamo Creek and flows eastward along the northern facility boundary. The creek was identified as a major source of groundwater recharge and contributor to near-surface groundwater levels in the area (*Investigation of Shallow Groundwater, Elmira Project Final Report, August 1988* [LSCE, 1988]). The EWWTP's wastewater effluent discharge constitutes the greatest flow component of the creek; other flows include a small amount of natural flow (in the winter months, if any), agricultural tailwater, and urban stormwater runoff from the City of Vacaville (prior to 1988).

Irrigation water infiltration along the unlined portion of the Solano Irrigation District's (SID) canal north of the EWWTP (paralleling the creek) was also found to contribute to groundwater recharge during the irrigation season (LSCE, 1988).

West Pond and East Pond

The unlined West Pond and East Pond were used for temporary storage of effluent prior to its discharge to the creek (**Figure 3**). Thus, losses of effluent from these ponds to deep percolation would affect the quality of underlying groundwater similarly to recharge from the creek. The West Pond typically contained effluent between October and May/June until it was decommissioned in 2003 to allow plant expansion and modernization. The East Pond has not been operated or received effluent since 1990. Also, the East Pond was largely removed when the most recent plant expansion occurred. Its former location is now occupied by new facilities such as paved parking lots, the administrative building, and primary and secondary treatment facilities (**Figure 2**).

Effluent quality data from 1994 and 1995 (as monitored at the outfall to Old Alamo Creek) show an EC ranging from 800 to 1,182 µS/cm with an average of 969 µS/cm (41 samples); a pH (standard pH units) ranging from 6.8 to 7.7 (monthly average of daily measurements) with an average of 7.2 (730 samples); and TDS concentrations ranging from 471 to 670 mg/L with an average of 584 mg/L (44 samples). Nitrate-N concentrations ranged from 8 to 21.3 mg/L (1996-1997) and from 4.8 to 16.4 mg/L (1998-1999; 20 monthly samples) averaging 10.2 mg/L in 1998 and 13.1 mg/L in 1999.

Lagoons

Two sloped tile-lined sludge holding lagoons, located in the eastern portion of the plant, received sludge from a secondary anaerobic digester at about 2% solids through 2004 (**Figure 3**). Drained water was collected and returned to the plant's headworks. During the wet weather months, solids cake (8 – 12% solids) was hauled to the Biosolids Storage Lagoon #3. Each year, starting in late spring, the stored cake was excavated and hauled to the Interim Biosolids drying area and ultimately hauled to B&J Landfill. Biosolids samples retrieved in April and October 2004 contained 40 and <7 mg/kg nitrate-N on a dry weight basis, respectively. The Biosolids Storage Lagoon #3 was not lined, but it was equipped with a French Drain system to remove leachate. The Interim Biosolids drying area had a compacted soil base and a drain system. Drained fluids from the Interim Biosolids drying area and the storage lagoon were returned to the plant's headworks.

The potential for groundwater contamination posed by the lagoons and biosolids drying facilities is considered low as tiled floors and drain systems were installed to prevent deep percolation of leachate. The old lagoons have been decommissioned since 2001 and replaced with new state-of-the-art facilities during the plant expansion. The new facilities eliminate the potential for movement of waste products into the subsurface.

Soil Fields

Soil Fields #1 and #2 located south of the plant (**Figure 1**) received biosolids applications in 1989, 1990, 1992, and 1993. Soil Field #3 received biosolids applications only in 1990, 1992, and 1993. Since then, these fields have not received any biosolids from the plant. In 1995 and 1997, soil samples were retrieved from depths of 7 and 15 inches. Nitrate concentrations in the samples retrieved from the 7-inch depth samples ranged from 10 to 47 mg/kg (dry weight). Nitrate concentrations in the samples retrieved from the 15-inch depth samples ranged from 5.4 to 31 mg/kg (dry weight). Field #4, used as a control field, never received biosolids applications. Nitrate concentrations in the control field ranged from 7.6 to 13 mg/kg (dry weight) at depths of 15 and 7 inches, respectively.

Local Agricultural Land Use

Fields #1 through #4 and north to Holdener Road (**Figure 1**) have been farmed historically as irrigated croplands. Irrigation water is provided via the SID canal, although the land has periodically been dry farmed as well. All fields have received fertilizers in the course of being farmed.

GROUNDWATER LEVELS

Groundwater elevations in the three on-site monitoring wells (MW #1, MW #2, and MW #3) ranged from about 59 to 66 feet, mean sea level (msl) prior to Fall 2000, with the highest and lowest water levels typically observed in MW #1 and MW #3, respectively (**Figure 4**). Seasonal water level fluctuations were on the order of three to five feet, and the gradient beneath the plant was typically between 0.0004 to 0.0015.

Contours of equal groundwater elevation are provided for January 2005 (**Figure 5**), a period of high water levels, and April 2002 (**Figure 6**), a period of low water levels. During both of these periods, groundwater flow was roughly to the southeast, with gradients between MW #1 and MW #5 of 0.0016 and 0.0018, respectively.

In Winter 2000/01, water levels in MW #2 and MW #3 did not recover, but rather levels continued to decline to 56.44 and 54.74 feet (msl), respectively, by mid-2001. Water levels stayed notably depressed until 2004, when sustained recovery was observed. Generally, similar water level trends were also observed in MW #1 during this period.

The lowest water levels during the monitoring period (with the exception of 2001) were consistently observed in MW #4 and MW #5. Water levels in these two off-site wells have been stable and range between 53 and 60 feet (msl).

Groundwater beneath the EWWTP occurs within a few feet of the ground surface. The shallowest depths to groundwater occur at MW #1 (about 4 to 12 feet, below ground surface). The pond floor near MW #1 is at an elevation of about 65 feet (msl), which indicates that groundwater has periodically intersected the pond floor. At MW #2 and MW #3, the depth to groundwater has ranged from about 7 to 18 feet (bgs). The water level records for MW #4 and MW #5 show that groundwater levels southeast of the plant site are commonly even shallower than under the facility. Specifically, groundwater levels are usually less than 4 feet, bgs (MW #4) and less than 6 feet, bgs (MW #5). Occasionally, groundwater is at the land surface at these locations.

The near-surface water table was also reported in *Investigation of Shallow Groundwater, Elmira Project Final Report* (LSCE, 1988). In 1987, 48 temporary monitoring wells were installed at selected sites on 200-foot centers to depths of 4 to 6 feet to investigate shallow groundwater movement in the plant's vicinity (**Figure 7**). Bi-weekly to monthly water level measurements were obtained from October 1987 to July 1988 (**Attachment**). During this time, the direction of flow south of Old Alamo Creek was predominantly to the east and southeast. North of the creek, the direction of flow was predominantly to the east and northeast. The creek acted as a source of recharge to groundwater during much of the monitoring period. The SID canal north of the plant also contributed to high groundwater levels during the irrigation season.

The lowered water levels observed in late 2000 and early 2001 are associated with excavation activities (starting in late 2000) and the associated dewatering of construction pits (starting in early 2001) during the expansion of the EWWTP. Although there are no records of the exact timing and magnitude of the dewatering activities, dewatering is known to have continued through early 2005 (the last pump was removed in January/February 2005). Water extracted from the pits was added to the plant's inflow for treatment and ultimately discharged to the creek.

Wells most affected by the dewatering were MW #2 and MW #3, as most construction related excavation occurred in close proximity to these wells (in the area of the former East Pond and east of it). The upgradient well, MW #1, was less affected by pit dewatering most likely due to its relative remoteness, and its closer proximity to the creek and local recharge from creek bed infiltration.

High summer water levels have been observed in MW #4 and MW #5 (since the monitoring frequency has been increased from a semi-annual to a quarterly schedule) indicating that deep percolation of irrigation water is also a source of groundwater recharge. High summer water levels were also observed in the network of 48 temporary monitoring wells in 1988.

WATER QUALITY

Electrical Conductivity

Samples retrieved from MW #1 had electrical conductivity (EC) values ranging from 760 to 940 μS/cm in 1994; EC increased to about 1,300 μS/cm in 1995, and continued to fluctuate between 1,000 and 1,200 μS/cm through 1999 (**Figure 8**). From mid-1999 to mid-2001, the EC decreased at this location to about 700 μS/cm; it then briefly increased in the latter half of 2001 and has since been stable around 700 μS/cm.

The EC values observed in MW #2 have decreased from the beginning of the water quality record for this well. Particularly, EC values declined from 2,040 µS/cm in January 1994 to less than 1,000 µS/cm since the beginning of 2003. This represents an average decline of 100 µS/cm per year between January 1994 and January 2005. Most notably, the EC dropped by 350 µS/cm in 2001, the year when excavation dewatering commenced.

The EC of samples retrieved from MW #3 increased steadily from about 2,000 µS/cm in 1994 to about 2,500 µS/cm in mid-1999, and then decreased to 1,970 µS/cm by March 2001. A significant decline (350 µS/cm) occurred between November 2000 and March 2001; this decline coincided with the commencement of excavation dewatering. Since 2001, the EC continued to decline another 400 µS/cm to less than 1,600 µS/cm in 2005.

The EC results for samples retrieved from MW #4 show little variability over the historical record; EC values ranged from 840 to 1,050 µS/cm. A slight increase of about 100 µS/cm occurred during 2001. Similar to MW #4, the EC in MW #5 has been stable throughout the monitoring period with values in 2005 similar to those in 1994 (between 1,500 and 1,600 µS/cm). EC values observed in MW #5 have been consistently about 500 µS/cm higher than in MW #4, although it is farther removed from the EWWTP than MW #4.

In April and May 1988, groundwater quality samples were retrieved from ten temporary shallow monitoring wells in the vicinity of the EWWTP (**Figure 9**). At the same time, surface water samples were retrieved from Old Alamo Creek upstream from the plant at CR1, just downstream of the effluent outfall at CR2, and from the SID canal at the sampling location identified as "S/D" on **Figure 9**. The EC values of upstream and downstream creek water samples were 334 and 773 µS/cm, respectively. The SID canal had an EC of 287 µS/cm. Groundwater from wells north of the creek had EC's ranging from 820 µS/cm at C-3 (closest to the creek) to 3,640 µS/cm at B-1 (furthest removed from the EWWTP). Wells located immediately downgradient from the plant had EC values ranging from 993 µS/cm at G-5 to 1,600 µS/cm at H-3, and as high as 5,120 µS/cm at F-4. Further downgradient at I-1, the EC was 1,210 µS/cm, and cross-gradient well H-8 had an EC of 1,150 µS/cm.

pH

The three on-site monitoring wells (MW #1, #2, and #3) have similar pH values. MW #1 exhibits slightly higher concentrations than MW #2, and MW #3 exhibits slightly lower concentrations than MW #2 (**Figure 10**). Minor apparent fluctuations are closely correlated between these wells. The median pH concentrations for samples from these wells during 1994 to 2005 are 7.12, 7.01, and 6.96, respectively. Notably, the pH concentrations decrease with increasing distance from the creek. The data record for MW #1 shows somewhat higher variability than the other on-site wells, particularly in 1995.

The pH values for MW #4 and MW #5 are slightly higher than in the on-site wells, with median values of 7.43 and 7.36, respectively; the variability is also somewhat greater. Over the period of record, the pH has been generally stable.

Nitrate-N

Nitrate-N concentrations in samples from MW #1 spiked from nondetect (<0.1 mg/L) in early 1994 to 30.1 mg/L in early 1995, then subsequently dropped to about 10 mg/L by the end of 1995, and continued to gradually decline to near zero concentrations in 2001 **(Figure 11)**. Since then, nitrate-N concentrations have remained below 0.5 mg/L and have been generally non-detectable at a detection limit of 0.1 mg/L.

In contrast to the wide variability observed at MW #1, nitrate-N concentrations in MW #2 have always been very low and did not exceed 0.7 mg/L until early 2001 when dewatering commenced. In mid-2001, nitrate-N concentrations were up to 2.3 mg/L and then slowly declined to 0.7 mg/L in 2005.

Nitrate-N concentrations in samples retrieved from MW #3 slowly declined from about 5 mg/L in 1994 to 0.2 mg/L in early 1999. Nitrate concentrations increased again in late 1999 and continued this trend at an accelerated rate from early 2001 (shortly after excavation dewatering commenced) until April 2004. A slight decrease in nitrate has been noted since then.

The historical record shows stable nitrate-N concentrations at MW #4, ranging from 1.0 to 5.3 mg/L. MW #5, though, has experienced a steady increase in nitrate-N concentrations from less than 6 mg/L in 1994 to about 12 mg/L in 2005. There are two notable concentration fluctuations that occurred in wells MW #4 and MW #5 (in 1995 and in 2004). In 1995, nitrate-N concentrations spiked to 5.3 mg/L and 15 mg/L in MW #4 and MW #5, respectively. These spikes coincided with the aforementioned nitrate-N spike in MW #1.

The water quality results for the April/May 1988 sampling event showed nitrate-N concentrations for upstream and downstream creek water samples of <1 and 8.1 mg/L, respectively. Similar to the upstream creek location, nitrate-N was not detected in the SID canal. Groundwater from wells north of the creek had nitrate-N concentrations ranging from <1 mg/L (A-4) to 5.6 mg/L (B-1). Wells located immediately downgradient from the plant had concentrations ranging from <1 mg/L (G-4, G-5, and H-3) to 15 mg/L at E-4. Further downgradient at I-1, the concentration was 2.1 mg/L, and cross-gradient well H-8 had a concentration of 1.4 mg/L.

Other Water Quality Data

The proportional abundance of major cation and anion concentrations, as exhibited in the samples from the 1988 sampling event, was plotted on trilinear diagrams (**Figures 12** and **13**). The close clustering of data points on these diagrams reflect the similar water type in most wells, including creek water quality near the effluent outfall (CR2), with sodium (40 to 60%) being the major cation at most locations (**Figure 12**). Creek water from the upstream location CR1 and the irrigation canal were distinctly different with higher proportional representation of magnesium. Downgradient wells H-3 and I-1 had distinctly greater sodium concentrations. The anion clustering was not quite as dense; however, CR1 and the canal exhibit a relatively higher abundance of bicarbonate (**Figure 13**). Well B-1 stands out due to its high sulfate concentration.

The creek water at CR1, the canal water, and groundwater at C-3 were classified as magnesium-bicarbonate type. Groundwater from most of the temporary shallow wells was classified as sodium-bicarbonate type. Exceptions were B-1 and H-3, both of which had proportionately higher sulfate concentrations.

DISCUSSION AND CONCLUSIONS

Ongoing groundwater quality monitoring occurred in the vicinity of the EWWTP for the period from 1994 to the present. Data also exist from an isolated sampling event in Spring 1988. Since the EWWTP has been in operation since its construction in 1959, a comparison of pre-project conditions to project conditions is not possible.

Groundwater level data from MW #1 through MW #5 show that shallow groundwater predominantly flows in easterly to southeasterly directions south of Old Alamo Creek. Groundwater level data from 48 temporary shallow wells (October 1987 to July 1989) identified the creek as a major source of groundwater recharge. This is also supported by the distribution of major cations and anions in both wastewater effluent and groundwater. Creek water just downstream of the effluent outfall was characterized as sodium-bicarbonate type, and groundwater of a similar type was observed in all temporary shallow wells downgradient of the plant. In contrast, SID water, creek water upstream of the plant, and groundwater in C-3 north of the creek were classified as magnesium-bicarbonate type.

There are only small differences in pH concentrations among the three on-site monitoring wells; however, these differences appear significant. The correlation between the subtle fluctuations in pH values observed at wells MW #1, MW #2, and MW #3 indicates a common source.

High summer water levels observed in MW #4 and MW #5, and the Summer 1988 data from the temporary monitoring wells, indicate that deep percolation of irrigation water is also a source of groundwater recharge. This is supported by pH values that are somewhat elevated compared to those observed in on-site wells MW #1 through MW #3. The SID water has a significantly higher pH (8.1 in 1988) than the effluent (averaging 7.2 in 730 daily samples retrieved in 1994 to 1995), and the fields adjacent to the plant are irrigated with SID water.

Deep percolation of irrigation water also appears to have mobilized nitrate residue, however, the historical water quality data record is insufficient to definitively determine to what degree the slightly elevated nitrate-N concentrations observed in MW #5 (about 12 mg/L) is attributable to historical and ongoing agricultural land uses or the limited period of application of biosolids on Fields #1 through #3. However, even though wells MW #4 and MW #5 are located on the eastern boundary of Field #3, MW #5 has exhibited greater increase in nitrate-N concentrations (an increase of about 7 mg/L) over its period of record than exhibited at MW #4 (an increase of about 1.5 to 2 mg/L). As noted above, EC values at MW #5 (which is further downgradient of the EWWTP than MW #4) have been consistently about 500 μS/cm greater than at MW #4. These factors suggest that the contributing source of the nitrate-N increase is more likely due to historical agricultural land use than the limited period of biosolids applications.

Above, a correlation is noted between a spike in nitrate concentrations in 1995 at wells MW #1, MW #4, and MW #5. These spikes are possibly explained by high groundwater levels that occurred in early 1995 causing increased mobilization of nitrate in the soil profile. Groundwater intersected the bottom of the West Pond in early 1995, and a local groundwater mound and reversal of the groundwater gradient toward MW #1 may have occurred.

Infiltration from the West and East Ponds is not directly evident on groundwater contour maps but seems likely based on the shallow depths to groundwater.

Evidence for groundwater recharge via infiltration from the early sludge lagoons is not apparent from groundwater contour maps, and the water quality records from MW #2 and MW #3 suggest that the impacts of the sludge lagoons prior to the recent plant modifications were minimal due to mitigation measures such as the tile liners and the various drain systems. More recently, during expansion construction activities, it appears that excavation work near MW #3 resulted in the mobilization of nitrate, as nitrate concentrations exhibited a notable increase between early 2001 and mid-2004 coincident with construction activities implemented at the plant. The elevated nitrate concentrations observed in well MW #3 are expected to continue to decline since potential sources for nitrate loading have been removed and the newly installed lagoons are fully lined; however, it is recommended that groundwater quality sampling be continued.

The steady decline in EC in the three on-site monitoring wells (MW #1 through MW #3) and essentially stable conditions observed in the downgradient off-site wells MW #4 and MW #5 over the entire monitoring history are indicative of successful operational changes at the EWWTP such as the decommissioning of the East Pond in 1990 and West Pond in 2003; and cessation of biosolids applications in 1993. Also, the excavation of potentially impacted soils during expansion construction activities and the replacement of old sludge lagoons with new facilities have further mitigated potential sources of groundwater contamination. Since 2001, the EC values in all wells but MW #3 have been significantly lower than in MW #5; and, after five years of steady decline, the EC at MW #3 reached a historical low in 2005 (with the exception of an isolated measurement in 1995) and is now similar to the EC observed in MW #5 for more than 11 years.

SUMMARY OF KEY FINDINGS

- ☐ Creek bed infiltration along the effluent-dominated Old Alamo Creek provides a major source for groundwater recharge in the vicinity of the EWWTP. This recharge contributes to shallow groundwater levels and affects the local shallow groundwater quality.

- Irrigation water infiltration along the unlined portion of the SID canal paralleling Old Alamo Creek contributes to groundwater recharge during the irrigation season.
- Deep percolation of irrigation water south of the plant contributes to groundwater recharge during the irrigation season and has the potential to mobilize soil nitrate and other constituents.
- Infiltration from the West and East Ponds is not directly evident on groundwater contour maps but seems likely based on the shallow depths to groundwater. Such infiltration would affect the quality of underlying groundwater similarly to recharge from the creek.
- Evidence for groundwater recharge via infiltration from the early sludge lagoons is not apparent from groundwater contour maps, and the water quality record suggests that the impacts of the sludge lagoons prior to the recent plant modifications were minimal.
- The EC at MW #4 and MW #5 has been generally stable throughout the more than 11-year period of monitoring (1994-2005). Notably, EC values have been about 500 µS/cm greater at MW #5 than at MW #4. Additionally, MW #5 is located further downgradient from the plant site than MW #4. The higher EC values suggest historical agricultural practices are a contributory factor to the water quality observed at MW #5.
- The historical water quality data record is not sufficient to definitively delineate to what degree the slightly elevated nitrate-N concentration observed in MW #5 (about 12 mg/L) is attributable to historical and ongoing agricultural land uses or the application of biosolids. However, the higher EC at this location, and difference in the nitrate-N trend occurring over the historical record, suggest that agricultural land use is the greater contributing factor.
- The EC in the on-site monitoring wells has significantly decreased for the past six or more years, and is presently still declining (MW #2 and #3) or stable (MW #1). Particularly, EC values in MW #1 and MW #2 have declined to concentrations similar to those displayed in off-site well MW #4. Further, the EC values in well MW #3 have recently declined to levels consistent with those observed for more than eleven years in off-site well MW #5. Nitrate concentrations are very low and stable at locations MW #1 and MW #2. These trends are indicative of the operational changes at the EWWTP such as the decommissioning of the East Pond in 1990 and West Pond in 2003; and cessation of biosolids applications in 1993. Also, the excavation of potentially impacted soils during expansion construction activities and the replacement of old sludge lagoons with new facilities have further mitigated potential sources of groundwater contamination.
- It appears that excavation work near MW #3 resulted in the temporary mobilization of soil nitrate, as reflected by increasing nitrate concentrations in MW #3 between 2001 and 2004. During the last three quarters, nitrate concentrations have steadily decreased again, and it is anticipated that this trend will continue in the long-term.

Please call if you have any questions.

Sincerely,

LUHDORFF AND SCALMANINI
CONSULTING ENGINEERS

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8/23/2005
STATE OF CALIFORNIA

TEA/vk

Cc: Mr. Dave Tompkins, City of Vacaville

Enclosures:

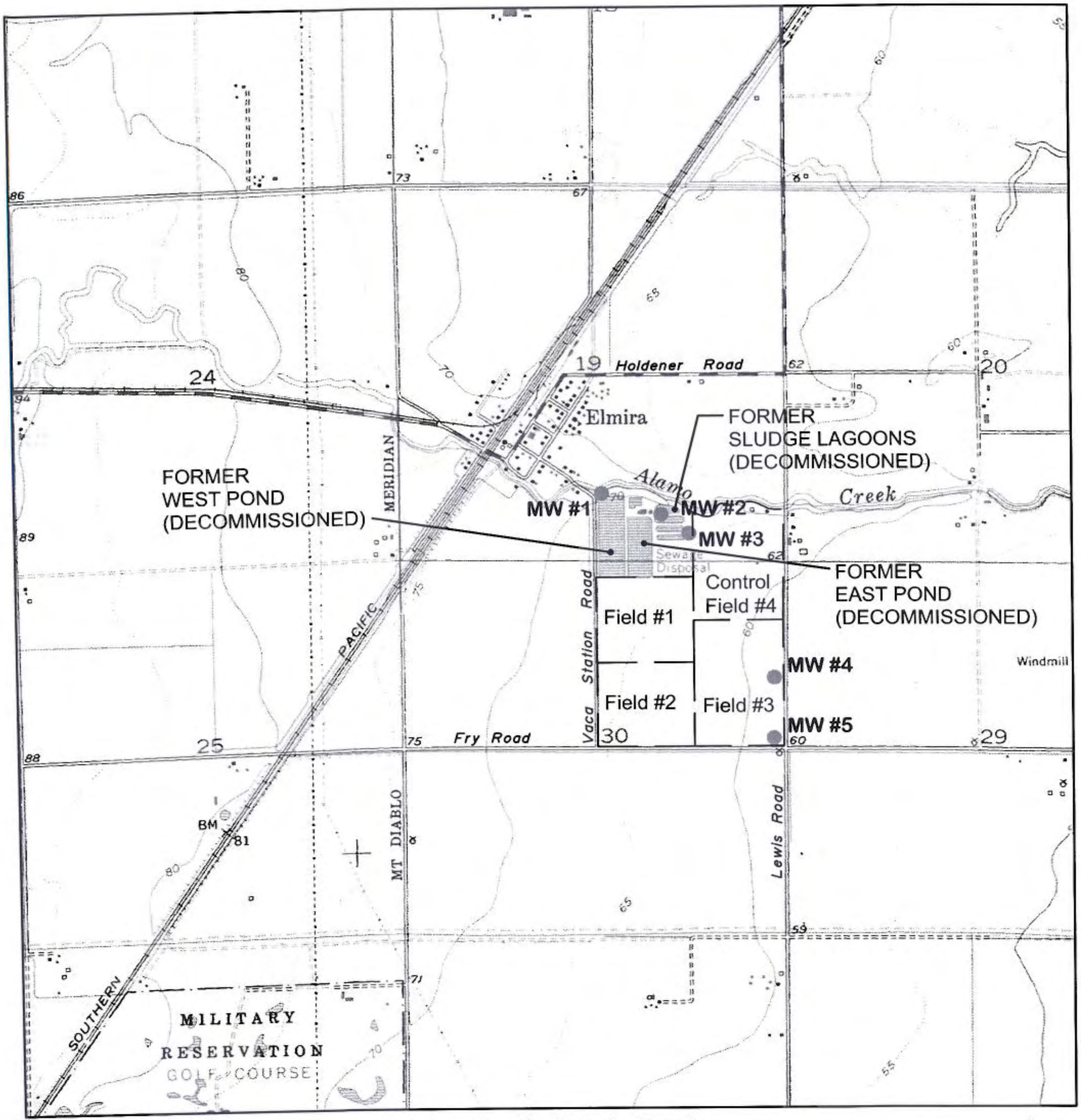
Table 1	Well Construction Details
Figure 1	Site Location Map, Easterly Wastewater Treatment Plant, Vacaville, CA
Figure 2	Site Plan, EWWTP – Vacaville, CA
Figure 3	Interim Biosolids Drying and Storage Facilities, EWWTP – Vacaville, CA
Figure 4	Groundwater Hydrographs for Shallow Monitoring Wells, EWWTP – Vacaville, CA
Figure 5	Contours of Equal Groundwater Elevation, January 19, 2005, EWWTP – Vacaville, CA
Figure 6	Contours of Equal Groundwater Elevation, April 11, 2002, EWWTP – Vacaville, CA
Figure 7	Temporary Monitoring Facilities (1987/88), EWWTP – Vacaville, CA
Figure 8	Electrical Conductivities in Shallow Monitoring Wells, EWWTP – Vacaville, CA
Figure 9	Spring 1988 Monitoring Results, EWWTP – Vacaville, CA
Figure 10	pH in Shallow Monitoring Wells, EWWTP – Vacaville, CA
Figure 11	Nitrate Concentrations in Shallow Monitoring Wells, EWWTP – Vacaville, CA
Figure 12	Trilinear Plot of Relative Cation Concentrations, EWWTP – Vacaville, CA
Figure 13	Trilinear Plot of Relative Anion Concentrations, EWWTP – Vacaville, CA
Attachment	Historical Groundwater Level and Quality Data (1987-1988)

Table 1
Well Construction Details
Easterly Wastewater Treatment Plant, City of Vacaville

Well Name	Date Drilled	Depth of Borehole (feet)	Cement Seal (feet)	Bentonite Seal (feet)	Gravel Pack (feet)	Perforated Interval (feet)	Casing Material	Top of Casing[1] (feet, msl)	Top of Casing[1] (feet, msl)	Top of Housing[1] (feet, msl)	Ground Surface Elevation[1] (feet, msl)
MW1	10/18/1990	35	0 - 17	17 - 22	22 - 33	23 - 33	PVC	72.19	*73.86*	*74.11*	*72.0*
MW2	10/18/1990	35	0 - 20	20 - 25	25 - 35	25 - 35	PVC	74.63	74.63	*75.06*	*73.5*
MW3	10/19/1990	30	0 - 14	14 - 19	19 - 30	20 - 30	PVC	72.98	*73.55*	*73.63*	*72.1*
MW4	1993/94	35[2]					Sch. 40 PVC 2"[3]	61.38	61.38	61.58	59.2
MW5	1993/94	35[2]					Sch. 40 PVC 2"[3]	61.88	61.88	61.95	58.6

Notes:

1. Phillippi Engineering, Inc. (letters dated 11/19/1990 and 7/12/1994); all surveyed elevations are based on NGVD 1929. Using the top of PVC casing of MW #2 as the reference elevation, the relative elevation differences between wells MW #1 , #2 , and #3 were resurveyed August 2, 2005 by Luhdorff and Scalmanini, Consulting Engineers (*italic* font style).
2. Well permit application dated 7/30/1993.
3. Layne-Western bid schedule (letter dated 7/29/1993).



REFERENCE: USGS 7.5 Minute Quadrangle, Elmira, California.

Scale in Feet

0' 1000' 2000'

● **MW #4** SHALLOW MONITORING WELL

CAD FILE: G:/Projects/City of Vacaville/05-4-051/Location Map.dwg CFG FILE: LSCE2500.PCP_MRG DATE: 08-22-05 11:19am

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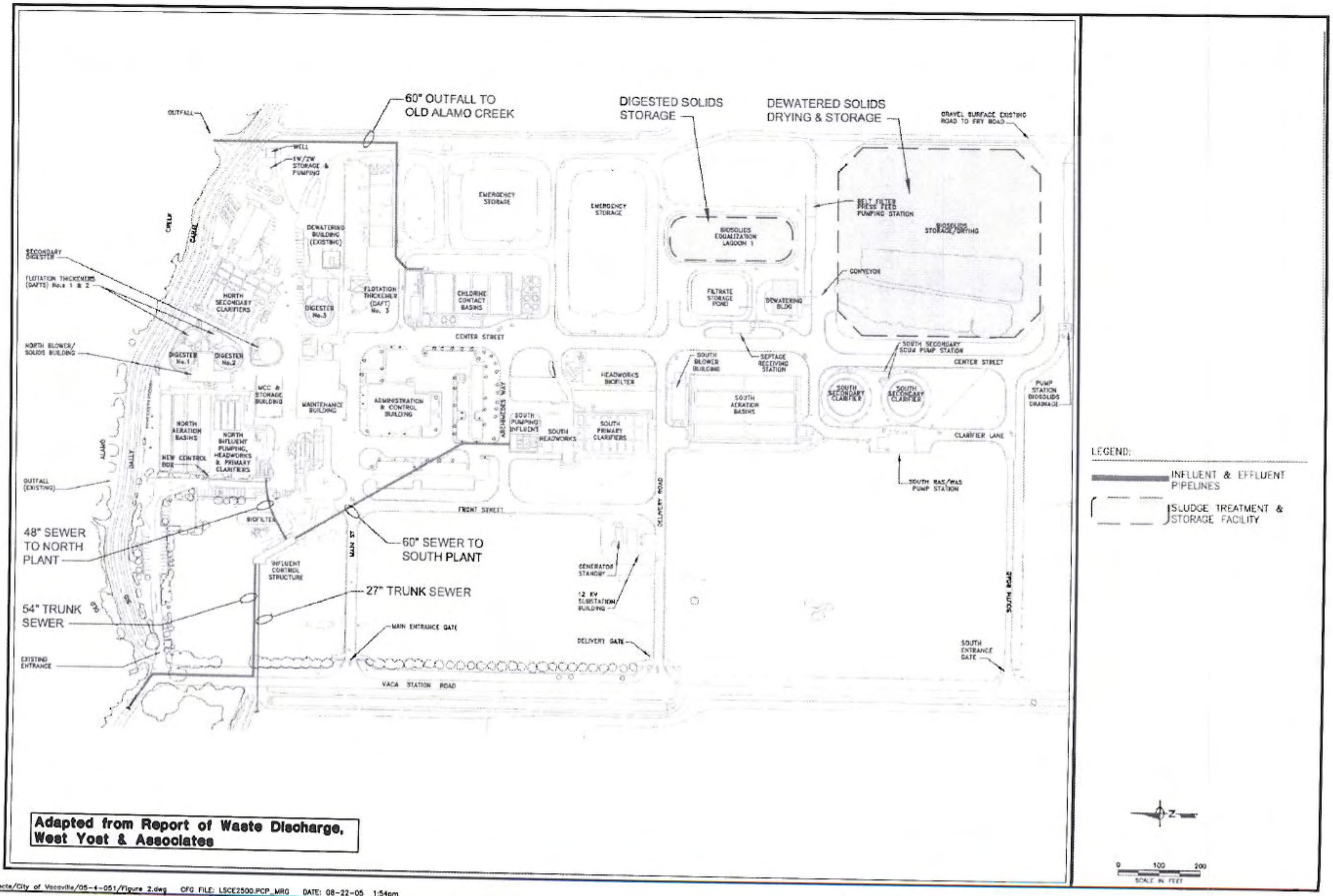
Figure 1
Site Location Map
Easterly Wastewater Treatment Plant
Vacaville, California



Adapted from Report of Waste Discharge, West Yost & Associates

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Figure 2
Site Plan
EWWTP - Vacaville, California

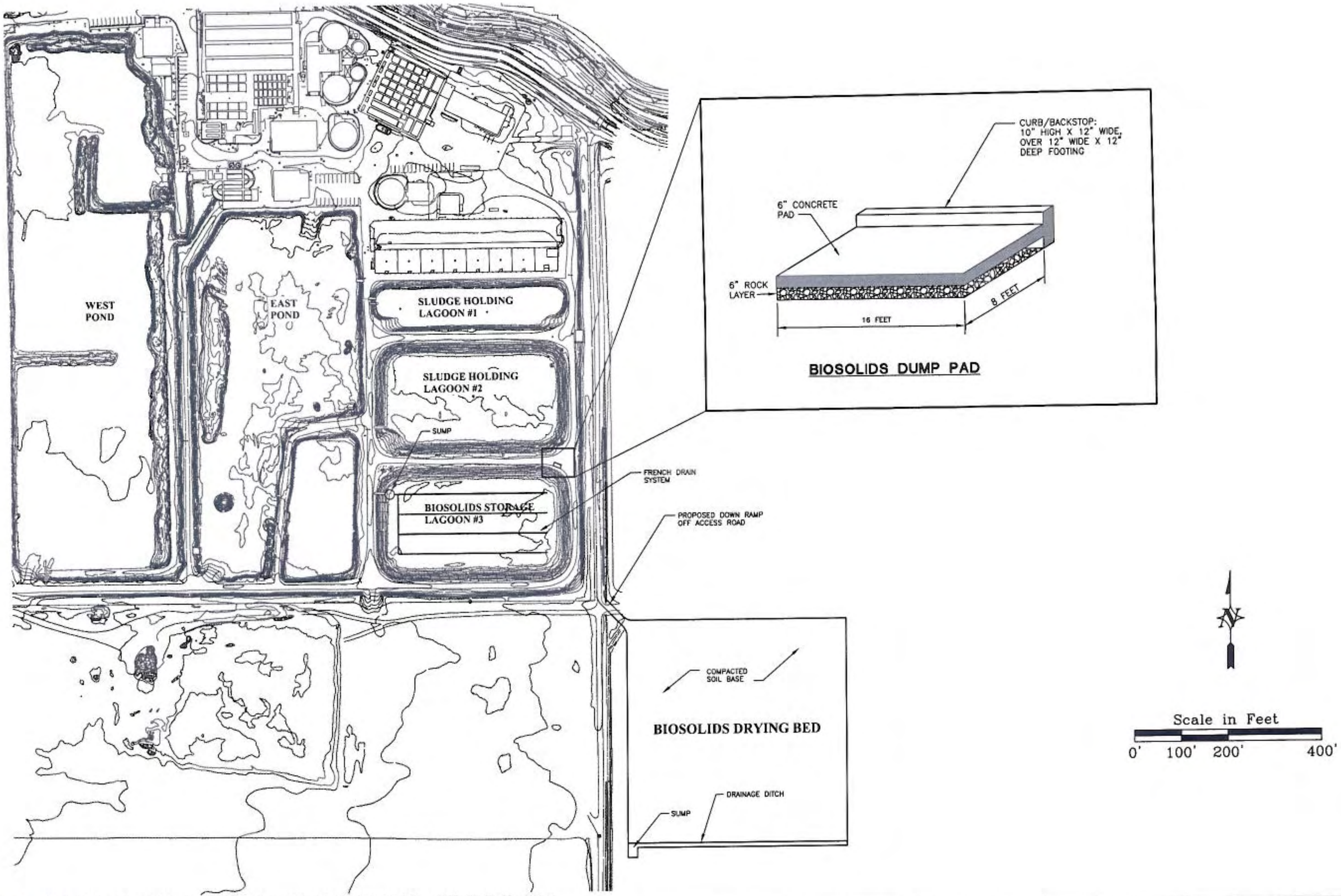

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Figure 3
Interim Biosolids Storage and Drying Facilities
EWWTP - Vacaville, California

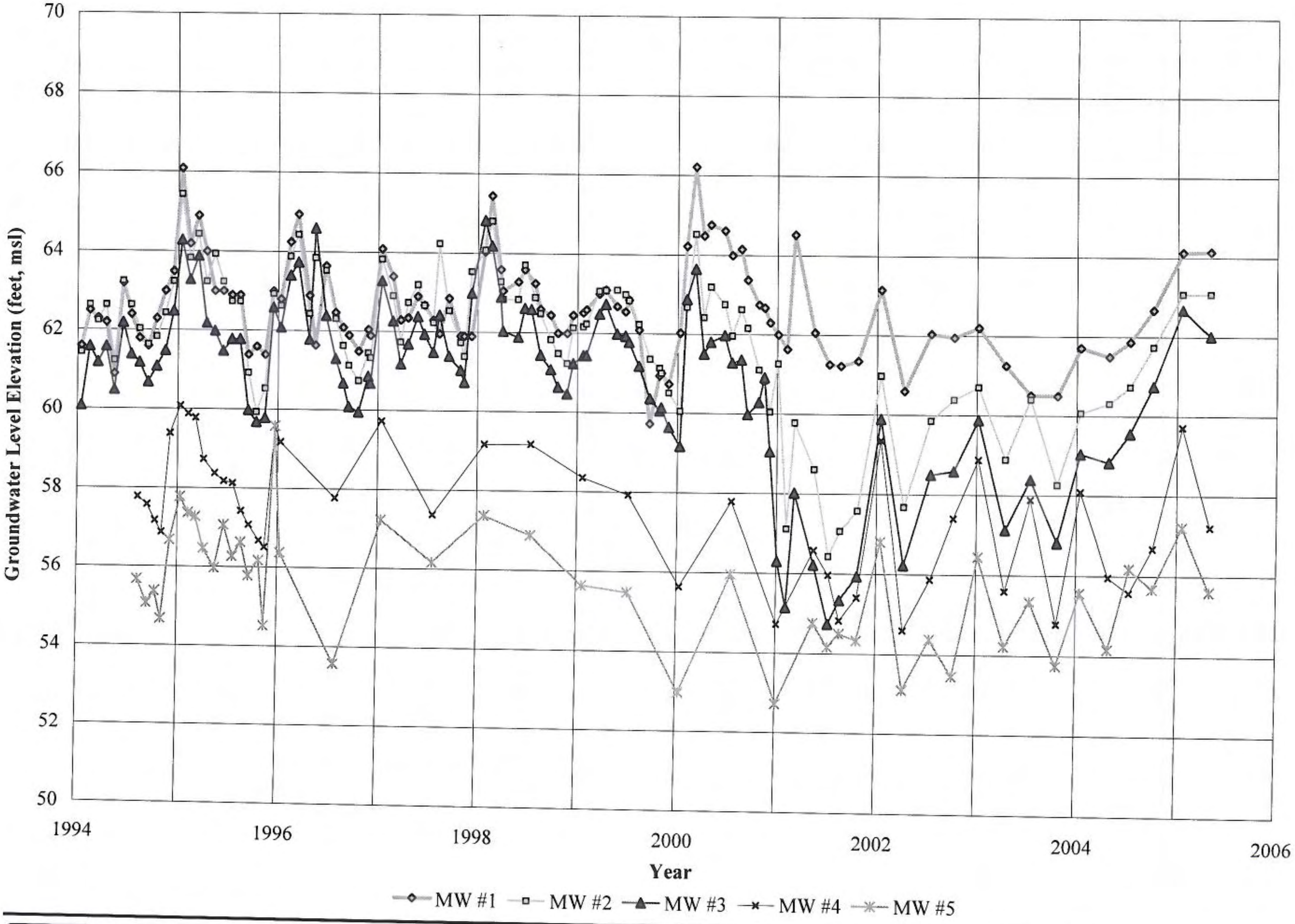

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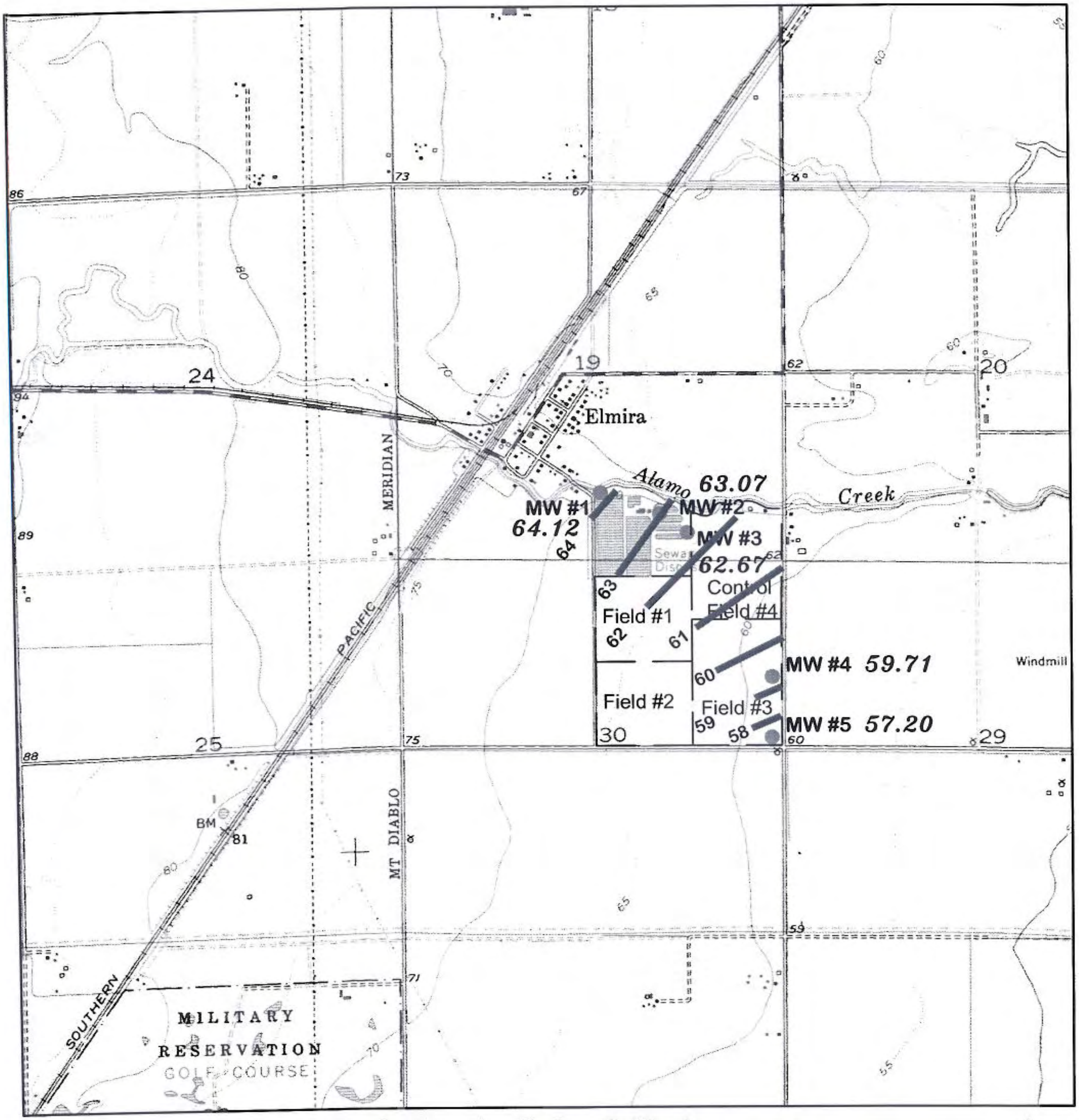
Figure 4
Groundwater Hydrographs for Shallow Monitoring Wells
EWWTP - Vacaville, California



REFERENCE: USGS 7.5 Minute Quadrangle, Elmira, California.

Scale in Feet

0' 1000' 2000'

● **MW #4** SHALLOW MONITORING WELL

59.71 WITH GROUNDWATER ELEVATION (feet, msl)

60 ▬ GROUNDWATER ELEVATION CONTOUR (feet, msl)

N

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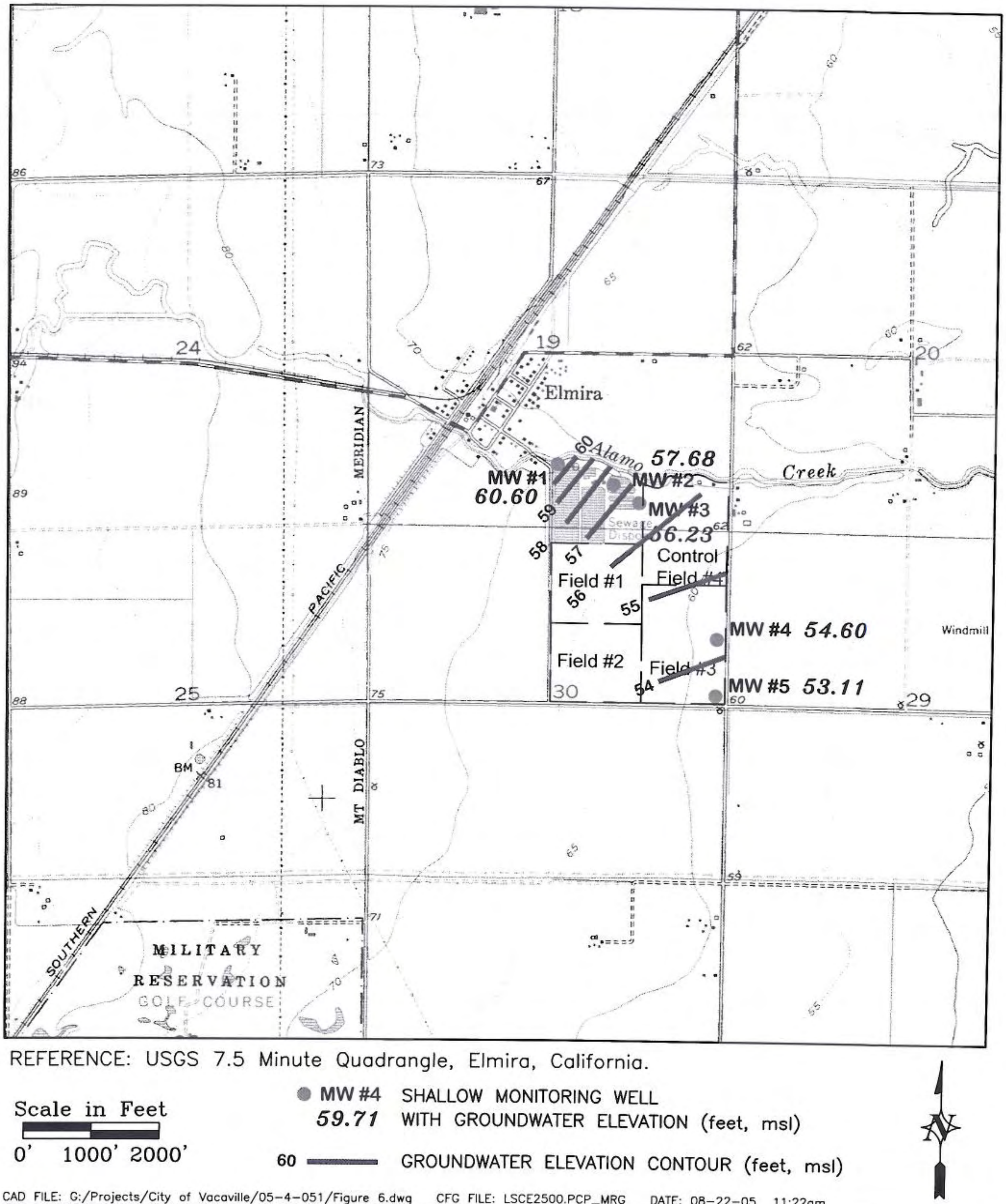
Figure 5
Contours of Equal Groundwater Elevation
January 19, 2005
EWWTP - Vacaville, California



REFERENCE: USGS 7.5 Minute Quadrangle, Elmira, California.

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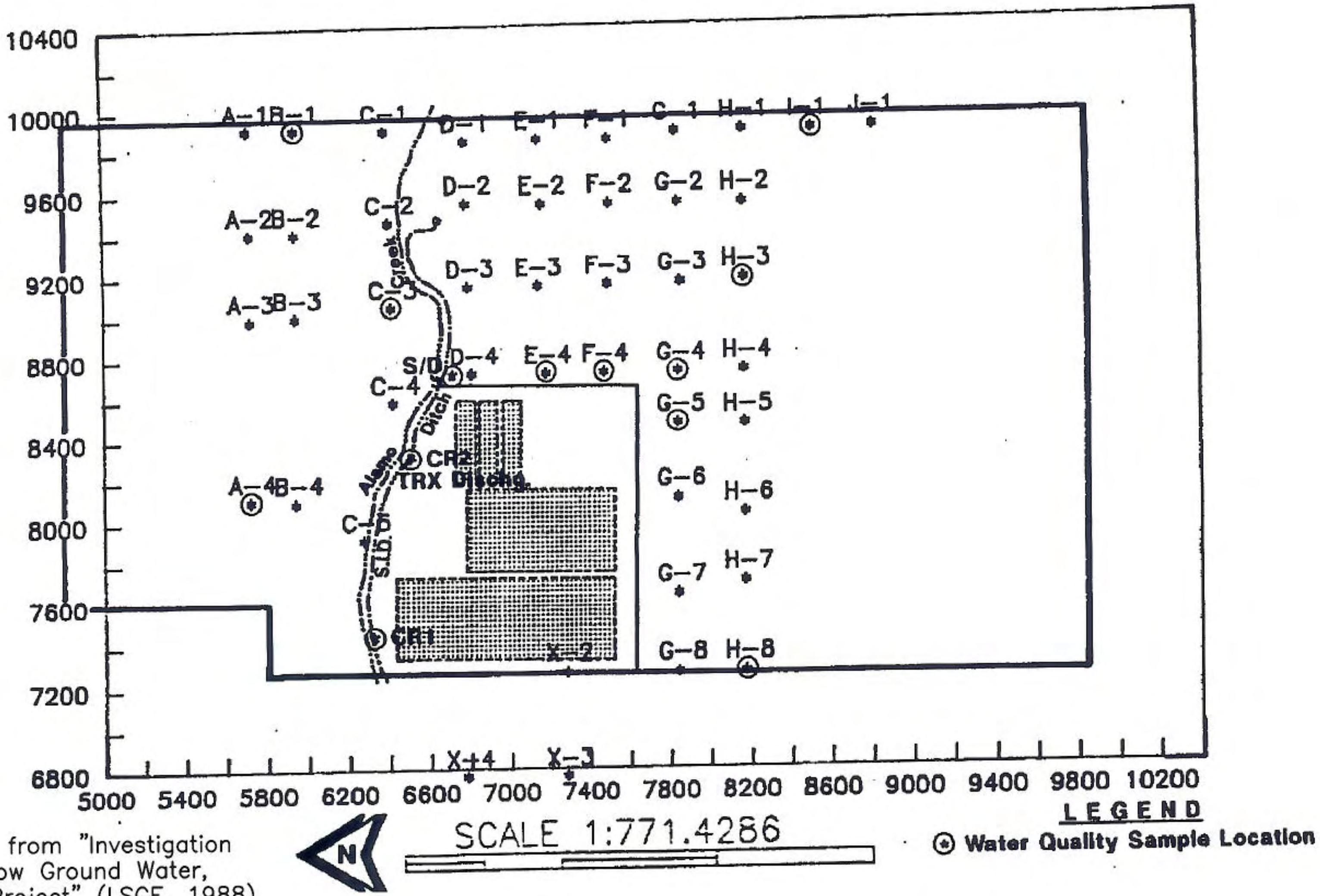
Figure 6
Contours of Equal Groundwater Elevation
April 11, 2002
EWWTP - Vacaville, California

R. LOZANO AND SONS - MONITORING SITES



Adapted from "Investigation of Shallow Ground Water, Elmira Project" (LSCE, 1988)

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Figure 7
Temporary Monitoring Facilities (1987/88)
EWWTP - Vacaville, California

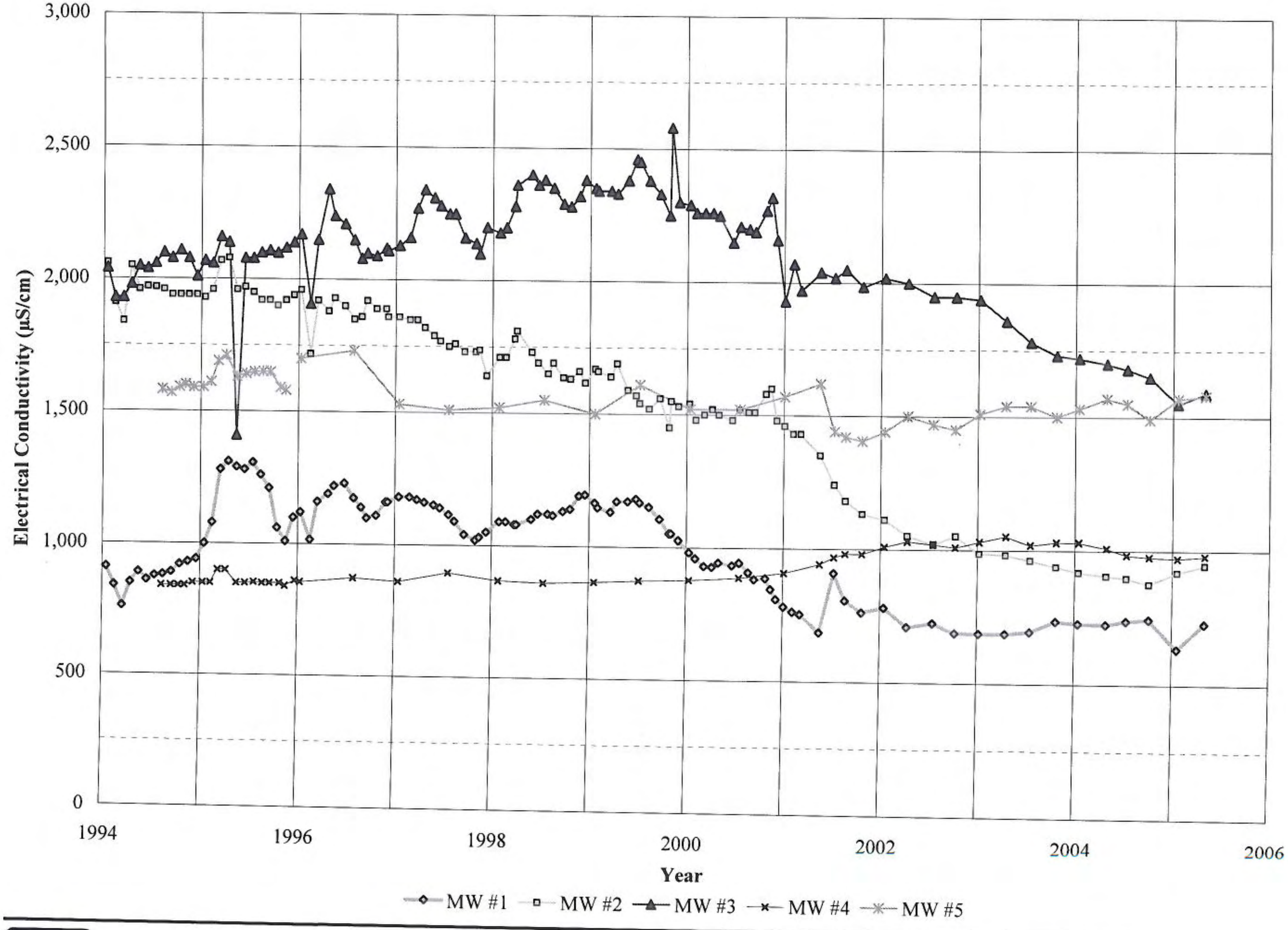

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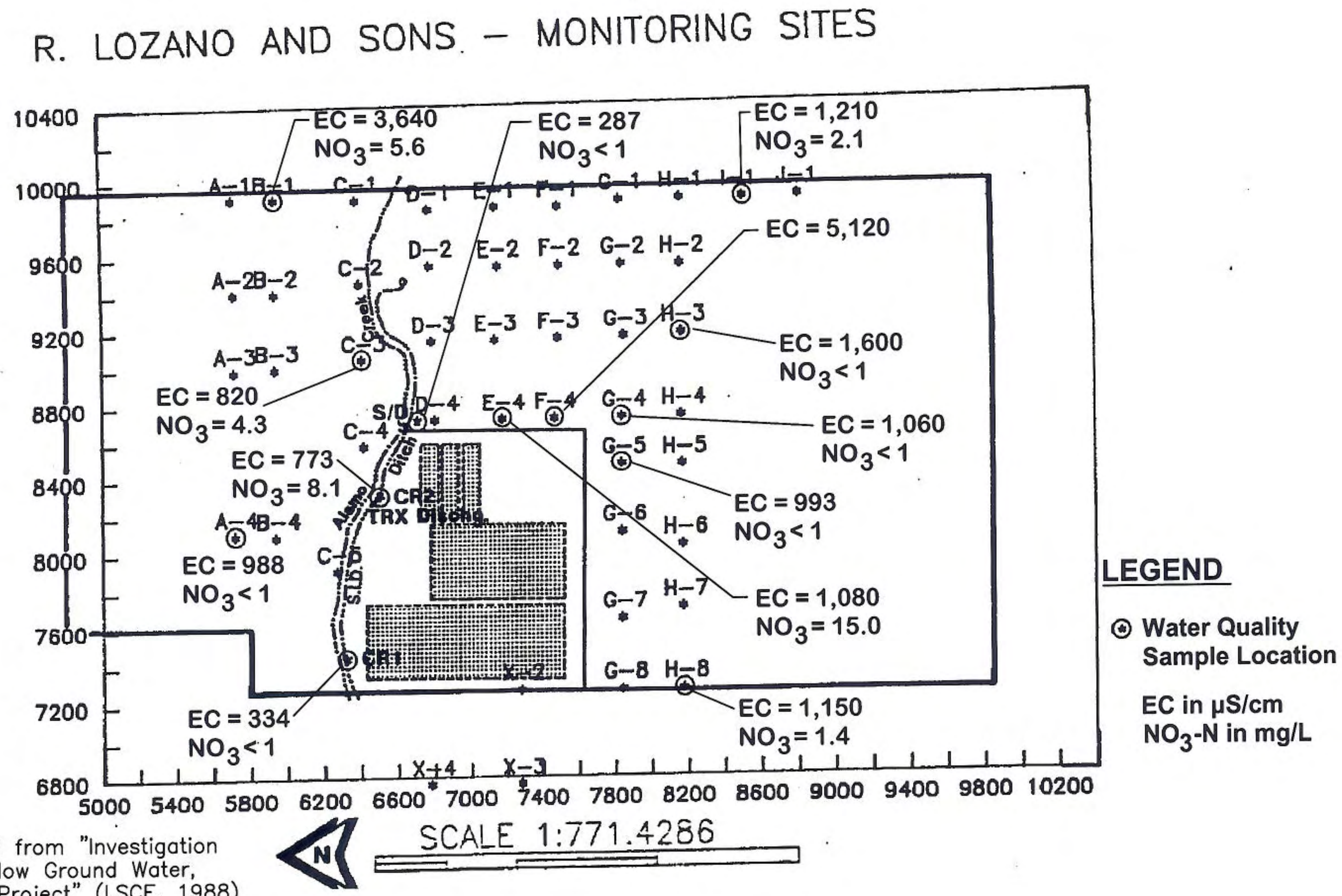
Figure 8
Electrical Conductivities in Shallow Monitoring Wells
EWWTP - Vacaville, California



Adapted from "Investigation of Shallow Ground Water, Elmira Project" (LSCE, 1988)

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Figure 9
Spring 1988 Monitoring Results
EWWTP - Vacaville, California

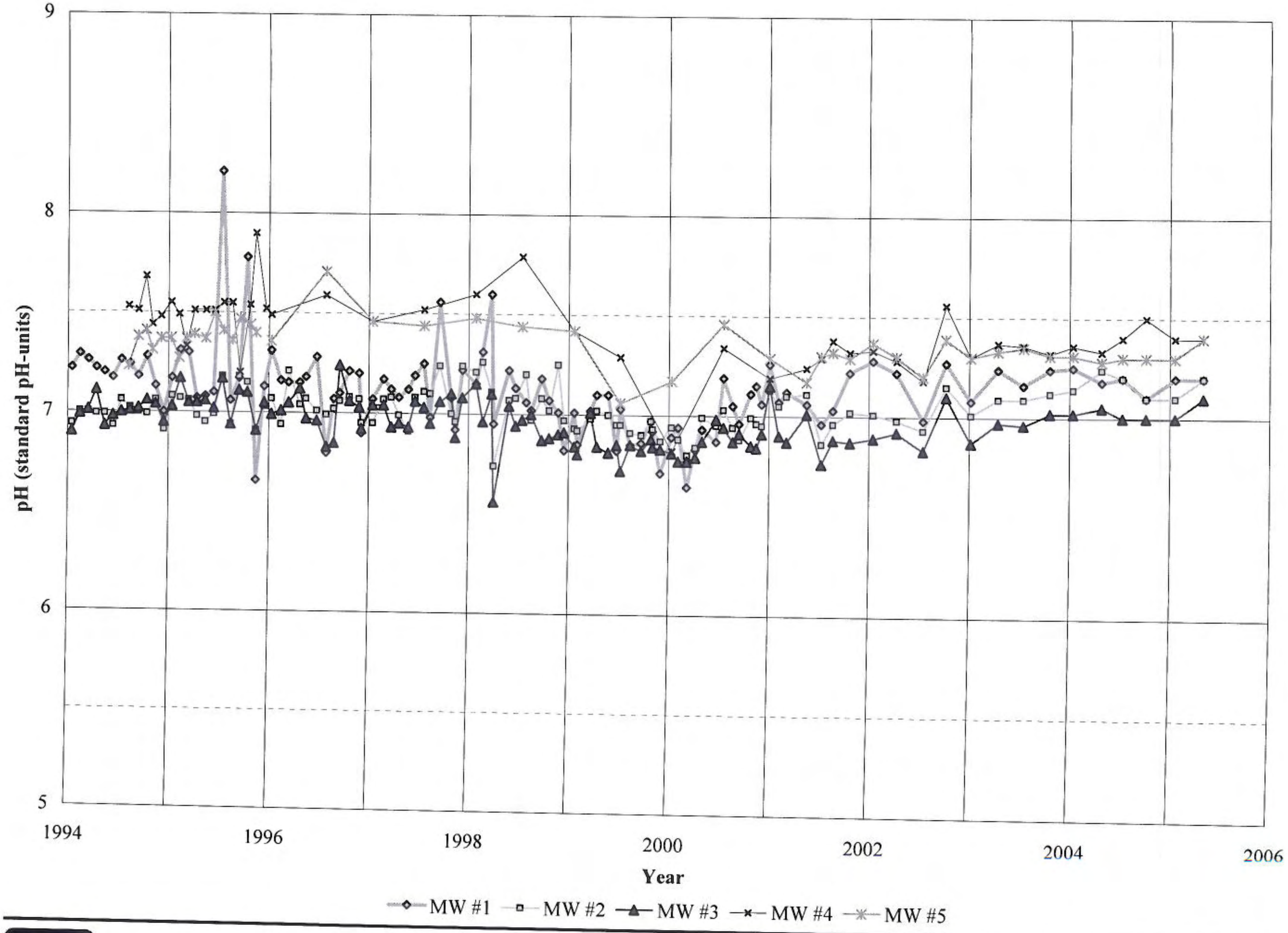

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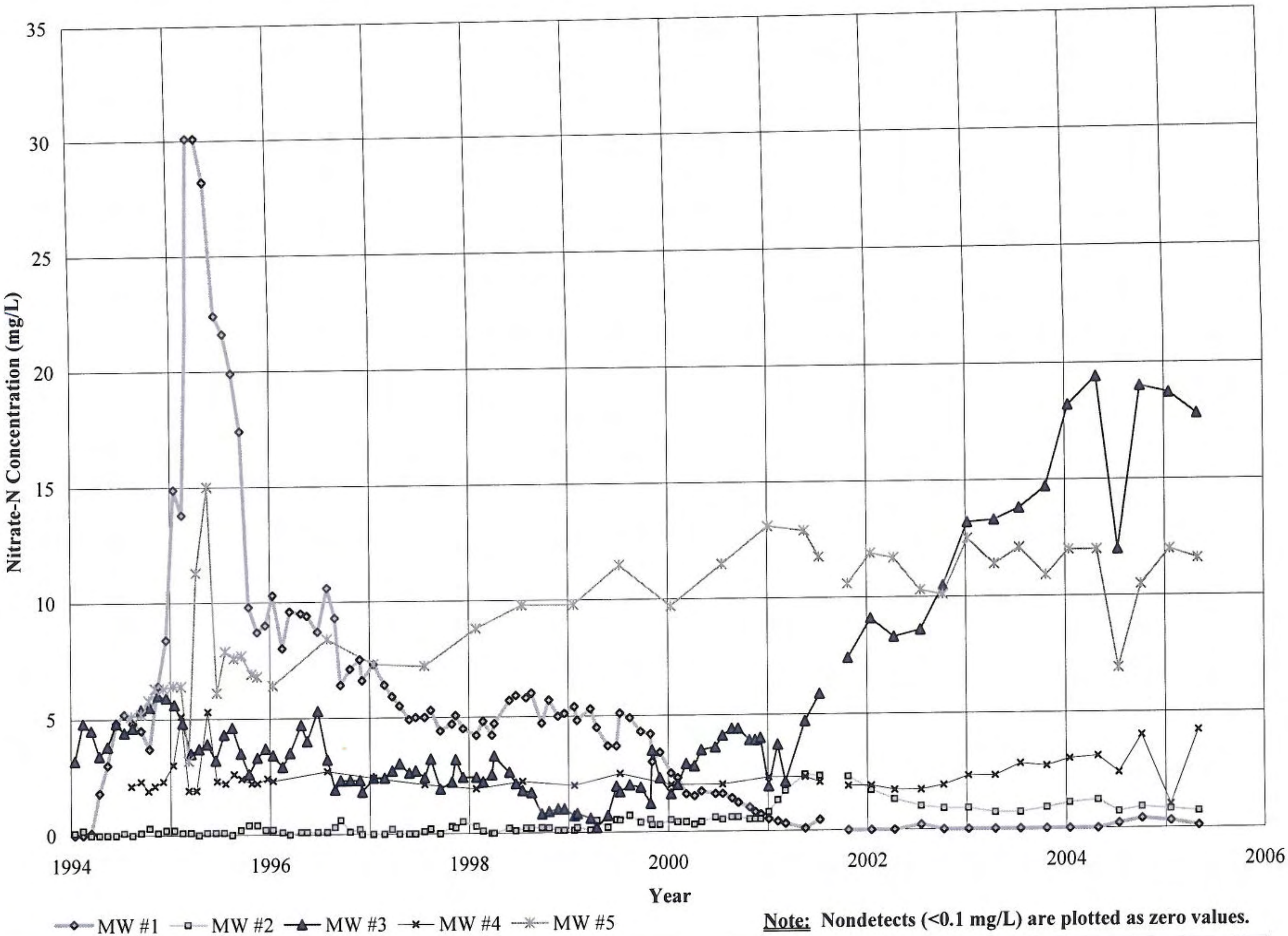
Figure 10
pH in Shallow Monitoring Wells
EWWTP - Vacaville, California



Note: Nondetects (<0.1 mg/L) are plotted as zero values.

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Figure 11
Nitrate Concentrations in Shallow Monitoring Wells
EWWTP - Vacaville, California

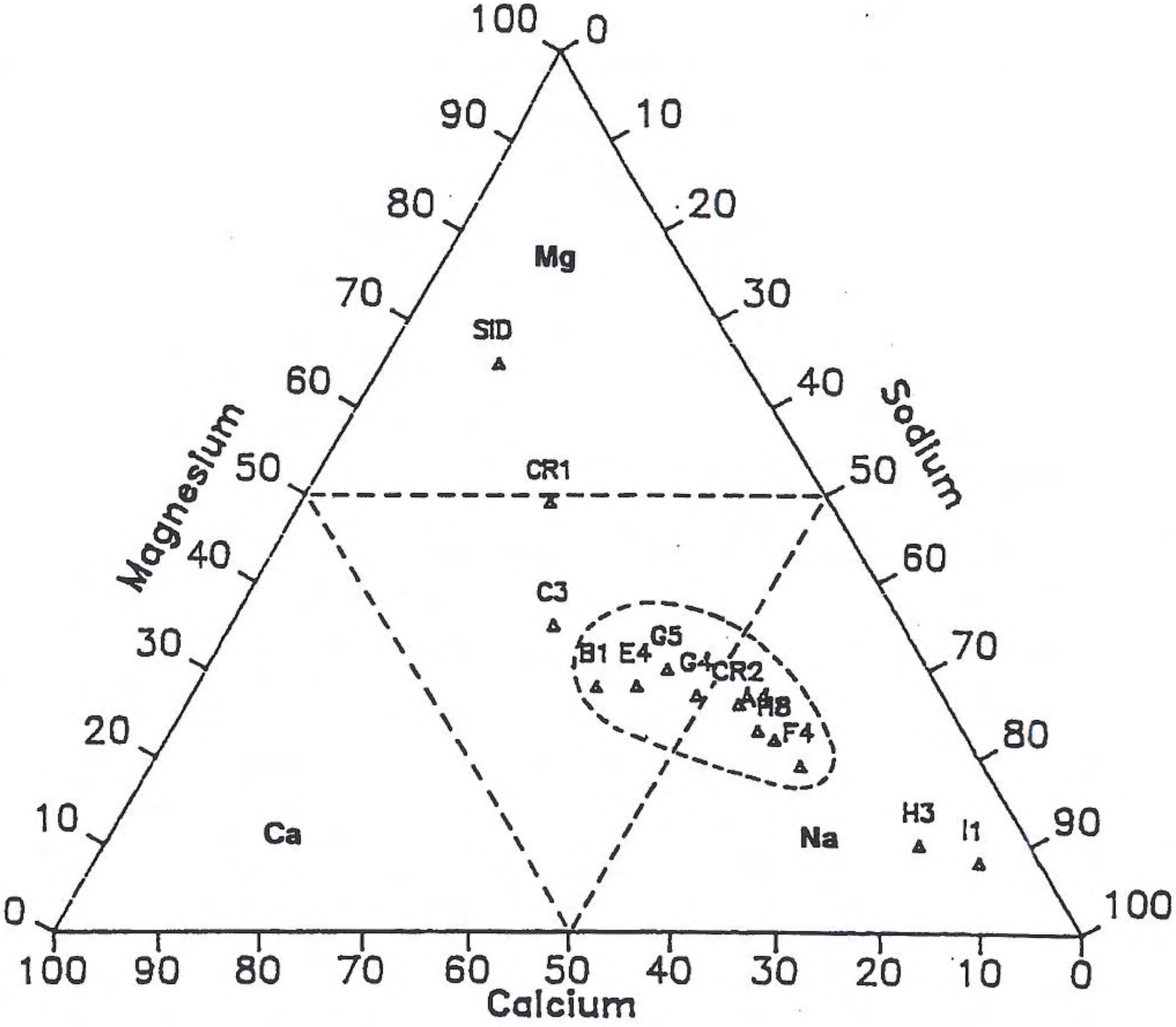

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Figure 12
Trilinear Plot of Relative Cation Concentrations
EWWTP - Vacaville, California

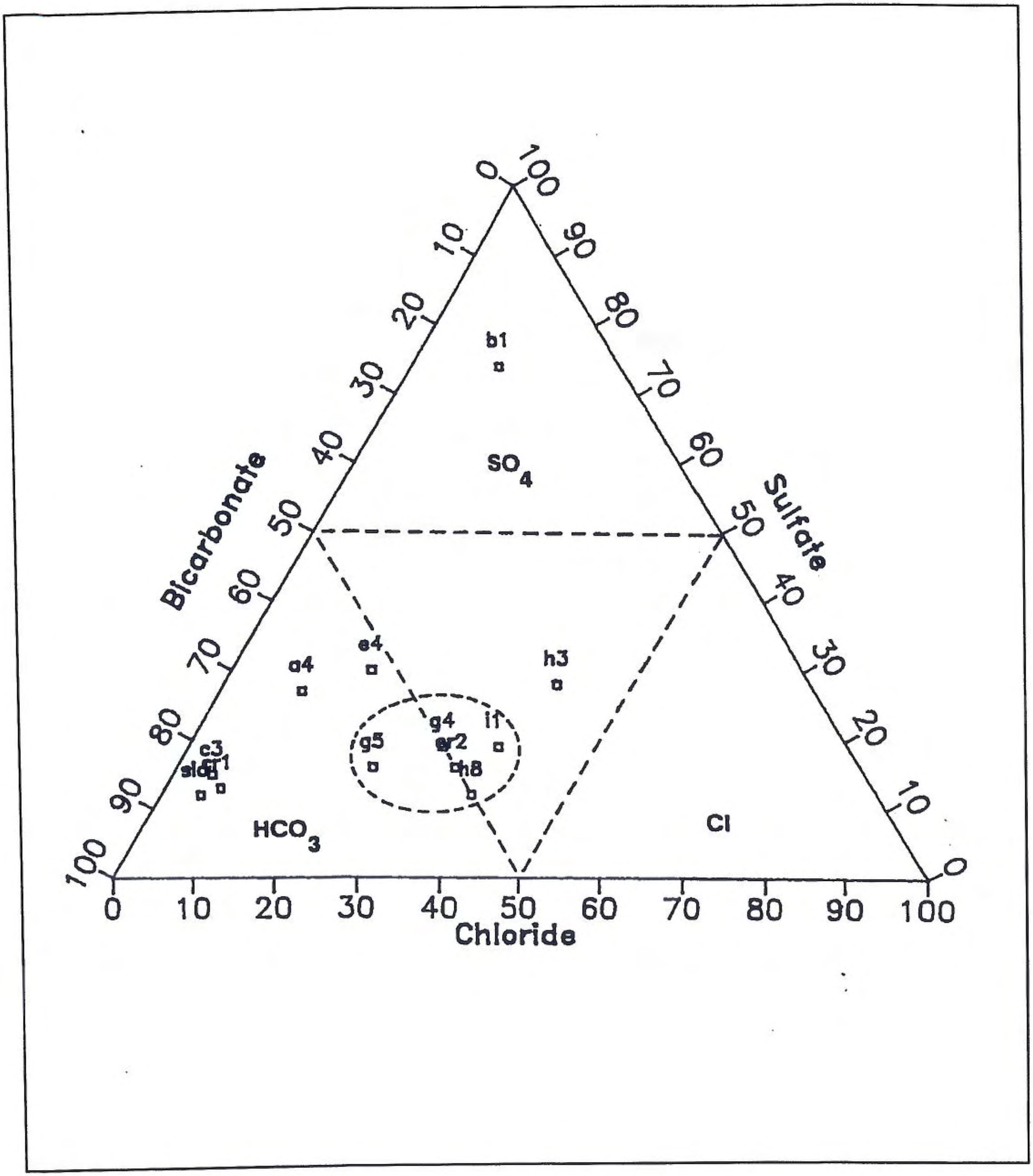

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Figure 13
Trilinear Plot of Relative Anion Concentrations
EWWTP - Vacaville, California

Attachment

MONITORING WELL AND SURFACE WATER ELEVATIONS

	10/13/87	10/19/87	10/22/87	11/01/87	11/16/87	12/1/87	12/23/87	1/20/88	2/04/88
WELL	Elev	Elev	Elev	Elev	Elev	Elev	Elev	Elev	Elev
A-1	58.63	58.69	58.71	58.54	58.16	58.67	60.87	N/A	60.69
A-2	59.50	59.54	59.70	59.44	59.09	59.68	61.61	N/A	61.63
A-3	60.15	60.23	60.29	60.11	59.78	60.05	62.25	N/A	62.51
A-4	60.85	61.70	61.96	61.91	61.89	62.23	62.97	N/A	64.5
B-1	58.18	58.10	58.08	58.00	57.75	57.98	60.58	N/A	61.02
B-2	59.45	59.42	59.43	59.32	58.88	59.10	60.71	N/A	62.03
B-3	60.51	60.46	60.44	60.28	59.85	60.10	61.83	N/A	62.77
B-4	62.04	61.78	61.85	61.61	61.61	61.61	63.61	66.22	64.65
B-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C-1	58.85	58.84	58.81	58.81	58.45	59.31	60.42	62.08	60.65
C-2	59.92	59.97	59.96	59.76	59.51	59.91	61.29	63.29	61.63
C-3	60.81	60.77	60.73	60.46	60.19	60.31	61.88	64.23	62.52
C-4	61.78	61.65	61.39	N/A	N/A	N/A	62.45	64.89	63.31
C-5	62.86	N/A	62.86	N/A	N/A	N/A	64.56	67.03	65.32
D-1	59.74	59.18	59.18	N/A	N/A	N/A	60.48	62.2	60.92
D-2	60.57	59.95	59.78	59.39	N/A	59.33	60.97	62.89	61.53
D-3	61.07	60.60	60.40	60.40	60.40	60.40	61.47	63.48	62.16
D-4	61.96	61.62	61.37	60.85	60.63	60.80	63.80	64.88	63.44
E-1	59.03	58.90	58.84	58.73	58.33	58.51	60.41	N/A	60.9
E-2	59.68	59.49	59.50	59.25	59.00	59.05	60.98	N/A	61.47
E-3	58.43	59.06	59.29	59.70	59.65	60.53	62.80	N/A	62.59
E-4	61.07	60.89	60.79	60.52	60.29	60.71	63.36	63.98	63.26
F-1	58.21	58.15	58.10	57.96	57.72	58.02	60.15	N/A	60.59
F-2	58.57	58.45	58.44	58.40	58.37	58.57	61.28	N/A	61.62
F-3	59.70	59.70	59.73	59.70	59.65	59.99	62.16	N/A	61.99
F-4	60.60	60.50	60.50	60.16	59.83	60.38	59.90	63.41	63.16
G-1	57.49	57.45	57.40	57.33	57.02	57.54	59.47	N/A	59.34
G-2	58.53	58.44	58.43	58.34	57.98	58.76	60.12	N/A	60.11
G-3	59.43	59.29	59.29	59.14	58.76	59.61	61.21	N/A	61.06
G-4	60.40	60.31	60.31	60.06	59.69	60.20	62.52	63.03	62.6
G-5	60.82	60.71	60.70	60.49	60.16	60.14	62.15	64.07	63.46
G-6	61.49	61.40	61.46	61.19	60.81	60.79	62.73	65.53	65.11
G-7	62.17	62.31	62.32	62.20	61.74	61.71	65.20	66.54	66.1
G-8	N/A	N/A	N/A	N/A	61.58	62.38	64.01	67.57	67.22
H-1	57.14	57.07	57.07	57.04	56.78	57.72	59.32	N/A	59.27
H-2	58.06	58.01	58.03	57.92	57.61	58.26	59.92	N/A	59.93
H-3	58.92	58.85	58.83	58.74	58.36	58.61	60.92	N/A	60.84
H-4	59.34	59.25	59.29	59.09	58.74	58.87	61.57	62.03	61.64
H-5	60.42	60.34	60.34	60.16	59.76	59.77	62.45	N/A	63.05
H-6	61.30	61.31	61.20	61.09	60.64	60.93	64.64	N/A	65.07
H-7	61.87	61.90	61.91	61.75	61.25	61.26	63.07	N/A	65.17
H-8	N/A	N/A	N/A	N/A	61.73	61.95	64.21	66.9	66.39
I-1	56.95	56.90	56.90	56.82	56.59	56.76	58.85	N/A	59.05
J-1	56.53	56.49	56.51	56.40	56.02	56.18	58.52	N/A	58.9
X-1	N/A	N/A	N/A	65.46	N/A	N/A	N/A	N/A	N/A
X-2	64.00	63.84	63.82	63.56	62.97	63.20	68.34	68.65	68.53
X-3	N/A	N/A	N/A	N/A	N/A	63.40	69.22	70.349	69.91
X-4	N/A	N/A	N/A	N/A	63.26	63.45	65.25	N/A	68.86
BM11	60.37	60.49	60.59	60.16	60.19	60.24	60.24	N/A	60.26
BM8	61.42	N/A	N/A	N/A	N/A	N/A	N/A	N/A	61.31
BM5	63.47	N/A	N/A	N/A	N/A	N/A	N/A	N/A	63.4
BM12	63.57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	63.71
SID-1	66.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	66.72
SID-2	66.71	65.22	65.17	N/A	N/A	N/A	N/A	N/A	66.71
SID-3	66.92	65.44	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SID-4	69.62	67.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SID-5	69.64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WPEAST	68.98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WPWEST	68.89	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

MONITORING WELL AND SURFACE WATER ELEVATIONS

WELL	3/05/88 Elev	3/26/88 Elev	4/8/88 Elev	4/13/88 Elev	5/9/88 Elev	5/17/88 Elev	7/05/88 Elev
A-1	59.03	58.34	58.34	59.54	59.38	59.18	58.56
A-2	60.07	59.39	59.59	60.46	60.45	60.34	59.71
A-3	60.93	60.67	61.41	62.01	61.75	N/A	N/A
A-4	62.94	61.8	64.04	63.16	62.99	62.79	62.13
B-1	59.59	58.67	58.35	58.7	59.66	59.51	59.43
B-2	60.65	59.84	59.43	59.77	60.82	60.73	60.37
B-3	61.28	60.46	60.77	61.07	61.62	61.43	61.2
B-4	62.92	62	62.77	62.7	62.88	62.57	62.46
B-5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C-1	59.37	N/A	N/A	N/A	N/A	N/A	N/A
C-2	60.46	59.92	60.28	60.5	61.13	60.96	60.48
C-3	61.2	60.6	60.98	61.22	61.92	61.66	61.5
C-4	61.98	N/A	N/A	61.66	62.21	61.93	61.94
C-5	63.65	62.8	62.8	62.93	63.18	N/A	N/A
D-1	59.49	59.51	59.9	60.23	60.97	60.92	N/A
D-2	60.04	N/A	N/A	N/A	N/A	N/A	N/A
D-3	60.66	60.45	60.9	61.15	61.63	61.41	60.9
D-4	61.57	61.67	61.94	62.02	62	61.81	61.68
E-1	59.2	58.78	59.01	59.17	60.18	60.13	59.63
E-2	60.17	60.15	60.13	60.14	60.48	60.42	60.23
E-3	60.91	59.81	59.65	59.67	60.14	60.19	59.98
E-4	61.41	60.96	60.93	61.06	61.37	61.23	61.48
F-1	58.79	58.15	58.22	58.31	59.46	59.53	N/A
F-2	59.83	59.06	59	59	59.23	59.29	59.9
F-3	60.09	N/A	N/A	N/A	N/A	N/A	N/A
F-4	61.44	60.22	60.11	60.01	60.08	60.21	60.96
G-1	58.05	57.54	57.38	57.57	58.26	58.41	58.03
G-2	59.08	58.34	58.14	58.21	59.1	59.09	58.91
G-3	59.9	59.31	59.31	59.31	59.46	59.48	N/A
G-4	60.82	63.04	59.97	59.99	60.21	60.15	60.52
G-5	61.28	N/A	60.33	60.4	60.51	60.38	61.06
G-6	61.99	N/A	61	61	61.03	60.91	61.69
G-7	63.4	N/A	61.89	61.93	61.85	61.73	62.62
G-8	64.14	N/A	62.85	62.08	62.51	62.4	63.37
H-1	58.02	57.14	56.95	57.08	58.06	58.2	57.85
H-2	58.61	57.92	57.62	57.76	58.43	58.45	58.54
H-3	60.06	61.12	58.36	58.55	58.83	58.84	59.13
H-4	59.75	62.29	58.83	58.93	59.07	59.01	59.5
H-5	60.86	N/A	59.91	59.92	59.98	59.91	60.64
H-6	62.41	N/A	61.31	60.81	60.69	60.54	61.56
H-7	62.44	N/A	61.38	61.46	61.32	61.23	62.23
H-8	63.41	N/A	62.26	62.3	62.11	62.02	63.09
I-1	57.45	56.75	56.4	56.57	57.3	57.61	57.42
J-1	57.04	56.42	56.02	56.23	56.75	57.81	56.82
X-1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
X-2	64.79	64.77	64.77	N/A	64.77	N/A	N/A
X-3	66.85	66.85	66.85	N/A	66.85	N/A	N/A
X-4	66.62	65.96	65.96	N/A	65.96	N/A	N/A
BM11	60.35	60.36	60.19	60.41	60.34	60.65	60.34
BM8	61.51	61.4	61.4	61.5	61.33	61.5	61.35
BM5	63.02	62.37	62.77	62.89	62.53	62.9	62.32
BM12	63.5	N/A	64.65	65.05	64.11	65.1	63.55
SID-1	N/A	N/A	66.43	66.68	66.53	66.85	66.7
SID-2	N/A	N/A	66.47	66.73	66.54	66.86	66.67
SID-3	N/A	N/A	66.34	66.84	66.52	66.85	66.69
SID-4	N/A	N/A	69.39	68.85	68.17	68.44	68.42
SID-5	N/A	N/A	69.37	68.9	68.15	68.56	68.54
WPEAST	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WPWEST	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 3

MONITORING WATER QUALITY RESULTS

LOZANO
PROJECT: 87-7-51

WELL IDENTIFICATION	DATE	EC umhos/cm	pH	Hardness as CaCO3	Ca	Mg	Na	SO4	Cl	HCO3 as CACO3	HCO3 as HCO3	NO3-N	NO3-NO3
LOZCR1	4/13/88	334	7.45	150	21.2	23.6	21.6	24.5	10.2	156	190	<1	<1
LOZCR2	4/13/88	773	7.10	181	31.6	24.7	95.6	66.8	104.0	186	227	8.1	35.9
LOZSID	4/13/88	287	8.10	155	16.8	27.5	9.0	20.8	5.7	144	176	<1	<1
LOZC3	4/9/88	820	7.62	446	63.9	39.9	69.3	69.6	16.2	362	442	4.3	19.0
LOZE4	4/9/88	1080	7.49	423	86.5	50.2	149.0	162.0	69.8	244	298	15.0	66.4
LOZG4	4/9/86	1060	7.35	619	50.9	35.0	122.0	101.0	122.0	280	342	<1	<1
LOZA4	5/9/88	988	6.87	235	44.3	30.1	143.0	134.0	38.2	320	390	<1	<1
LOZB1	5/9/88	3640	7.20	1380	297.0	155.0	397.0	1650.0	183.0	324	395	5.6	24.8
LOZF4	5/9/88	5120	7.30	992	190.0	126.0	771.0	IS	IS	286	349	IS	IS
LOZG5	5/9/88	993	6.85	300	54.7	39.7	109.0	79.6	86.6	312	381	<1	<1
LOZH3	5/9/88	1600	7.42	173	36.2	20.1	290.0	256.0	272.0	288	351	<1	<1
LOZH8	5/9/88	1150	7.05	240	44.8	31.2	161.0	67.9	163.0	296	361	1.4	6.2
LOZI1	5/9/88	1210	7.03	83	13.7	11.8	242.0	110.0	165.0	260	317	2.1	9.3

WELL IDENTIFICATION	F	TDS	Fe	Mn	Ca %	Mg %	Na %	SO4 %	Cl %	HCO3 %	NO3 %	WATER TYPE	SAR
LOZCR1	.2	187	.72	.045	27	49	24	13	7	80	0	MgHCO3	.8
LOZCR2	.8	468	.24	.026	20	26	54	16	34	43	7	NaHCO3Cl	3.1
LOZSID	.1	149	.13	.015	24	65	11	12	5	83	0	MgHCO3	.3
LOZC3	N/A	600	2.90	2.0	34	35	32	15	5	77	3	MgCaNaHCO3	1.7
LOZE4	N/A	860	3.00	1.4	29	28	43	30	17	43	10	NaHCO3SO4	3.2
LOZG4	N/A	631	17.70	9.1	24	27	49	19	31	50	0	NaHCO3Cl	3.2
LOZA4	N/A	876	.36	<.01	20	23	57	27	10	62	0	NaHCO3	4.1
LOZB1	N/A	2930	.27	.014	33	28	39	74	11	14	1	NaCaMgSO4	4.7
LOZF4	N/A	3840	.72	<.01	18	19	63	N/A	N/A	N/A	N/A		10.6
LOZG5	N/A	612	.40	.018	25	30	44	16	24	60	0	NaHCO3	2.7
LOZH3	N/A	1120	1.50	<.01	11	10	78	28	41	31	0	NaClHCO3SO4	9.6
LOZH8	N/A	863	10.30	.088	19	22	59	12	38	49	1	NAHCO3	4.5
LOZI1	N/A	83	.56	<.01	6	8	86	19	38	42	1	NAHCO3CL	11.6

Note: Concentrations mg/l unless otherwise noted

Appendix C
Boring Logs and Field Notes

CH2MHILL

PROJECT NUMBER: **378565.VE.01.01**

BORING NUMBER: **Boring A-1**

SHEET 1 OF 1

SOIL BORING LOG

PROJECT NAME: **Vacaville Energy Center Phase II**

LOCATION: **Vacaville, CA**

TOP OF CASING ELEV. ____ CEMENT PAD RIM ____

DRILLING CONTRACTOR: **Gregg Drilling**

DRILLING METHOD AND EQUIPMENT: **Geoprobe Direct Push Rig**

WATER LEVELS, DATE, AND TIME:

DRILLING START DATE **09/18/08**

DRILLING FINISH DATE **09/18/08**

LOGGER: **E. Haas**

DEPTH BELOW SURFACE (FEET)	SPT BLOW COUNT 6"-6"(N)	LENGTH OF RECOVERY OF CORE (FEET)	SAMPLE NAME & TYPE E.G.cuttings	SYMBOLIC LOG	CORE DESCRIPTION SOIL NAME, (USCS SYMBOL), COLOR (STAINING), MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY, ODOR, PRESENCE OF NON AQUEOUS PHASE LIQUID, OTHER CONTAMINANTS	WELL SYMBOLIC LOG	WELL DRILLING RATE, DRILLING FLUID LOSS CIRCULATION ZONES, TESTS CONDUCTED WATER LEVELS, WELL INSTRUMENTATION
1_		8" of 48"		▨	SILTY CLAY (CL), dark olive brown (2.5Y 3/3), dry, hard, non-plastic, no odor	**CL**	
2_				▨			
3_				▨			
4_				▨			
5__		40" of 48"		▥	SILT (ML), dark yellowish brown (10YR 4/6), damp, firm to hard, little clay, non-plastic, no odor.	**ML**	
6_				▥			
7_				▥			
8_				▥			
9_				░	SILTY SAND (SM), dark yellowish brown (10YR 4/6), wet, loose, fine grained, poorly graded, no odor.	**SP**	
10__				░			
11_				░			
12_				░			
13_					End of boring at 12' bgs		
14_							
15__							
16_							
17_							
18_							
19_							
20__							
21_							
22_							
23_							
24_							
25__							

SYMBOLS

GW	░
GP	░
GM	░
GC	░
SW	░
SP	░
SM	░
SC	░
ML	▥
CL	▨
OL	▦
MH	▥
CH	▨
OH	▨
Pt	Pt

CH2MHILL

PROJECT NUMBER: **378565.VE.01.01**

BORING NUMBER: **Boring B-3**

SHEET 1 OF 1

SOIL BORING LOG

PROJECT NAME: **Vacaville Energy Center Phase II**

LOCATION: **Vacaville, CA**

TOP OF CASING ELEV. ____ CEMENT PAD RIM ____

DRILLING CONTRACTOR: **Gregg Drilling**

DRILLING METHOD AND EQUIPMENT: **Geoprobe Direct Push Rig**

WATER LEVELS, DATE, AND TIME:

DRILLING START DATE **09/18/08**

DRILLING FINISH DATE **09/18/08**

LOGGER: **E. Haas**

DEPTH BELOW SURFACE (FEET)	SPT BLOW COUNT 6"-6"(N)	LENGTH OF RECOVERY OF CORE (FEET)	SAMPLE NAME & TYPE E.G.cuttings	SYMBOLIC LOG	CORE DESCRIPTION SOIL NAME, (USCS SYMBOL), COLOR (STAINING), MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY, ODOR, PRESENCE OF NON AQUEOUS PHASE LIQUID, OTHER CONTAMINANTS	WELL SYMBOLIC LOG	WELL DRILLING RATE, DRILLING FLUID LOSS CIRCULATION ZONES, TESTS CONDUCTED WATER LEVELS, WELL INSTRUMENTATION
1_		36" of 48"			NO RECOVERY ORGANIC SILTY CLAY (OL), very dark grey (7.5YR 3/1), damp, firm to hard, low plasticity, trace organics (root material), no odor.	**OL**	
2_							
3_							
4_							
5__		48" of 48"			SILTY SAND (SM), dark yellowish brown (10YR 4/6), wet, loose, fine grained, poorly graded, no odor.	**SP**	
6_							
7_							
8_							
9_		43" of 48"					
10__							
11_							
12_							
13_					End of boring at 12' bgs		
14_							
15__							
16_							
17_							
18_							
19_							
20__							
21_							
22_							
23_							
24_							
25__							

SYMBOLS
GW
GP
GM
GC
SW
SP
SM
SC
ML
CL
OL
MH
CH
OH
Pt Pt

CH2MHILL

PROJECT NUMBER: **378565.VE.01.01**

BORING NUMBER: **Boring D-2**

SHEET 1 OF 1

SOIL BORING LOG

PROJECT NAME: **Vacaville Energy Center Phase II**

LOCATION: **Vacaville, CA**

TOP OF CASING ELEV. ____ CEMENT PAD RIM ____

DRILLING CONTRACTOR: **Gregg Drilling**

DRILLING METHOD AND EQUIPMENT: **Geoprobe Direct Push Rig**

WATER LEVELS, DATE, AND TIME:

DRILLING START DATE **09/18/08**

DRILLING FINISH DATE **09/18/08**

LOGGER: **E. Haas**

DEPTH BELOW SURFACE (FEET)	SPT BLOW COUNT 6"-6"(N)	LENGTH OF RECOVERY OF CORE (FEET)	SAMPLE NAME & TYPE E.G.cuttings	SYMBOLIC LOG	CORE DESCRIPTION SOIL NAME, (USCS SYMBOL), COLOR (STAINING), MOISTURE CONTENT, RELATIVE DENSITY, CONSISTENCY, SOIL STRUCTURE, MINERALOGY, ODOR, PRESENCE OF NON AQUEOUS PHASE LIQUID, OTHER CONTAMINANTS	WELL SYMBOLIC LOG	WELL DRILLING RATE, DRILLING FLUID LOSS CIRCULATION ZONES, TESTS CONDUCTED WATER LEVELS, WELL INSTRUMENTATION
1		45" of 48"		▥	SILT (ML), dark olive brown, (2.5Y 3/3), damp, hard, non-plastic, no odor	**ML**	
2				▥			
3				▥			
4				▥			
5		46" of 48"		▥			
6				▥			
7				▥			
8				▥			
9		47" of 48"		░	SILTY SAND (SM), brown (7.5YR 4/4), moist, loose to medium dense, fine grained, no odor.	**SM**	
10				░			
11				░	SAND (SP), dark yellowisn brown (10YR 3/6), wet, loose, fine grained, no odor.	**SP**	saturated at 10.5' bgs
12				░			
13					End of boring at 12' bgs		
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

SYMBOLS

GW	░
GP	░
GM	░
GC	░
SW	░
SP	░
SM	░
SC	░
ML	▥
CL	▨
OL	▦
MH	▦
CH	▨
OH	▨
Pt	Pt

GROUNDWATER SAMPLING
FIELD DATA SHEET

SITE VEC WELL NUMBER MW-5

DATE 9/18/08 CLIENT

JOB NUMBER

FIELD CONDITIONS Sunny, ~60°F, Calm

INITIAL OVM: WELL CASING — BREATHING ZONE —

PURGE INFORMATION

START TIME 828 END TIME

INITIAL DEPTH TO WATER ~6.2 SCREEN INTERVAL TO

PURGE METHOD Geopump PUMP DEPTH (ft) PURGE RATE (gpm)

TOTAL VOLUME PURGED (gal)

TIME	VOLUME PURGED (gal)	pH	COND. (ms/cm)	TEMP. (C)	TURBIDITY (ntu)	DO (mg/l)	REDOX (mV)	WATER LEVEL (ft btoc)
829	0.1	6.53	1.35	18.3 ~~4.60~~	0.0	460	181	
832	0.2	6.92	1.33	18.1	0.0	3.91	171	
835	0.4	7.60	1.32	18.1	0.0	3.64	156	
838	0.7	7.21	1.32	18.0	0.0	3.51	146	
841	0.9	7.24	1.32	18.0	0.2	3.45	139	
844	1.1	7.26	1.31	18.0	0.2	3.40	134	
847	1.4	7.29	1.31	18.0	0.5	3.32	132	
850	1.6	7.29	1.30	17.9	0.2	3.32	130	
853	1.9	7.30	1.30	17.9	0.3	3.31	129	
856	2.1	7.28	1.30	17.9	0.4	3.33	131	
858	SAMPLE							

ADDITIONAL FIELD COMMENTS

TIME	COMMENTS

FIELD TEAM (initials)

Appendix D
Summary of Results

Table D-1. Summary of Soil Sample Analytical Results, Phase II Environmental Site Assessment, CPV Vaca Station, Vacaville, California

Sample ID	PRGs[1] Industrial Soil (mg/kg)	CHHSL's[2] Industrial Soil (mg/kg)	TTLC[3] Wet wt basis (mg/kg)	A1-06SB	A1-03SB	A1-05SB	A1-10SB A1-05SB-FD	A2-06SB	A2-03SB	A3-06SB	A3-03SB	A3-10SB A3-03SB-FD	A4-06SB	A4-03SB	B1-06SB	B1-03SB	B2-06SB	B2-03SB	B3-06SB	B3-03SB	B2-10SB B3-03SB-FD	B3-05SB	B4-06SB	B4-03SB
% Moisture (SW3550)				4	17	17	16	3	18	3	11	14	5	16	3	17	4	12	4	17	13	17	5	11
Metals (SW6010B)																								
Antimony	410 n	380	500	1.0 U	**0.18 J**	0.19 U	0.22 U	0.94 U	0.21 U	0.97 U	0.18 U	0.21 U	0.97 U	0.19 U	0.96 U	0.20 U	0.92 U	0.20 U	0.90 U	0.20 U	0.16 U	0.19 U	0.96 U	0.20 U
Arsenic	1.6 c	0.24	500	**6.7**	**9.55**	**13.8**	**8.96**	**7.3**	**11.3**	**8.8**	**8.56**	**11.2**	**11.1**	**10.7**	**7.6**	**10.4**	**7.6**	**9.89**	**7.1**	**11.3**	**8.98**	**10.9**	**8.3**	**10.4**
Barium	190,000 nm	63,000	10,000	**179**	**301**	**115**	**266**	**162**	**423**	**168**	**162**	**182**	**307**	**372**	**165**	**337**	**168**	**211**	**169**	**292**	**437**	**135**	**211**	**226**
Beryllium	2,000 n	1,700	75	**0.83**	**0.83**	**0.76**	**0.61**	**0.71**	**0.78**	**0.74**	**0.78**	**0.82**	**0.77**	**0.86**	**0.79**	**0.79**	**0.76**	**0.85**	**0.69**	**0.77**	**0.78**	**0.70**	**0.81**	**0.84**
Cadmium	810 n	7.5	100	0.51 U	**0.31 J**	**0.18 J**	0.011 U	0.47 U	0.011 U	0.49 U	**0.14 J**	0.011 U	0.48 U	**0.11 J**	0.48 U	**0.12 J**	0.46 U	**0.13 J**	0.45 U	**0.064 J**	**0.13 J**	**0.081 J**	0.48 U	**0.15 J**
Chromium *(based on III)*	1,400 c	10,000	2,500	**45.9**	**41.5**	**35.4**	**35.8**	**39.2**	**33.4**	**40.4**	**36.7**	**39.4**	**39.7**	**37.1**	**44.5**	**38.8**	**41.5**	**39.7**	**38.4**	**35.4**	**35.6**	**25.5**	**44.2**	**41.2**
Chromium *(based on VI)*	200 c*	37	500	**45.9**	**41.5**	**35.4**	**35.8**	**39.2**	**33.4**	**40.4**	**36.7**	**39.4**	**39.7**	**37.1**	**44.5**	**38.8**	**41.5**	**39.7**	**38.4**	**35.4**	**35.6**	**25.5**	**44.2**	**41.2**
Cobalt	300 n	3,200	8,000	**11.4**	**9.28**	**14.8**	**5.68**	**9.4**	**13.2**	**10.9**	**10.3**	**12.5**	**39.5**	**50.8**	**10.7**	**11.6**	**10.9**	**22.0**	**9.7**	**14.9**	**8.36**	**13.5**	**12.9**	**11.8**
Copper	41,000 nc	38,000	2,500	**45.1**	**34.9**	**35.5**	**27.4**	**48.0**	**31.2**	**42.8**	**32.6**	**34.9**	**37.8**	**32.8**	**44.9**	**34.1**	**39.9**	**38.2**	**38.7**	**34.9**	**32.4**	**28.7**	**44.1**	**47.6**
Lead	800 n	3,500	1,000	**12.7**	**8.86**	**11.5**	**6.05**	**12.5**	**11.8**	**13.1**	**9.22**	**9.71**	**14.5**	**13.3**	**13.2**	**10.3**	**10.8**	**11.9**	**11.5**	**10.1**	**9.58**	**8.72**	**12.5**	**13.8**
Mercury (SW7471A)	28 ns	180	20	**0.11**	**0.053**	**0.071**	**0.039**	**0.11**	**0.054**	**0.086**	**0.034**	**0.039**	**0.10**	**0.046**	**0.076**	**0.048**	**0.071**	**0.057**	**0.071**	**0.018 J**	**0.046**	**0.015 J**	**0.080**	**0.037**
Molybdenum	5,100 n	4,800	3,500	2.6 U	0.17 U	0.18 U	**0.30 J**	2.4 U	**0.26 J**	2.4 U	**0.20 J**	**0.27 J**	2.4 U	**0.23 J**	2.4 U	**0.26 J**	2.3 U	**0.37 J**	2.3 U	**0.68 J**	0.16 U	**0.24 J**	2.4 U	**0.32 J**
Nickel *(assumed soluble salts)*	20,000 n	16,000	2,000	**32.2**	**37.0**	**33.1**	**25.1**	**26.5**	**31.6**	**28.0**	**30.0**	**33.7**	**33.2**	**42.2**	**30.5**	**29.6**	**31.2**	**36.6**	**26.2**	**40.9**	**26.2**	**30.0**	**31.9**	**31.3**
Selenium	5,100 n	4,800	100	3.10 U	**4.42**	**2.32 J**	1.32 U	2.8 U	**3.81**	2.9 U	**4.52**	1.31 U	2.9 U	**4.64**	2.9 U	**3.91**	2.8 U	1.24 U	2.7 U	1.24 U	**2.63**	1.16 U	2.9 U	**2.31 J**
Silver	5,100 n	4,800	500	**1.40**	0.046 U	0.050 U	0.39 U	**1.7**	**0.28 J**	**1.4**	**0.053 J**	**0.46 J**	**1.6**	**0.20 J**	**1.6**	0.053 U	**1.2**	**0.47**	**1.4**	**0.50 J**	0.043 U	**0.22 J**	**1.2**	**0.80 J**
Thallium	66 n	63	700	2.10 U	0.52 U	**0.66 J**	0.64 U	1.9 U	0.64 U	1.9 U	0.52 U	0.64 U	1.9 U	0.56 U	1.9 U	0.59 U	1.8 U	0.60 U	1.8 U	0.61 U	0.49 U	0.57 U	1.9 U	0.58 U
Vanadium	5,200 n	6,700	2,400	**85.9**	**70.0**	**71.0**	**53.7**	**69.7**	**63.1**	**74.3**	**67.1**	**73.5**	**78.9**	**67.5**	**81.8**	**67.2**	**76.8**	**72.3**	**69.6**	**68.1**	**61.9**	**54.3**	**81.7**	**71.6**
Zinc	31,000 nm	100,000	5,000	**84.2**	**70.4**	**68.6**	**57.8**	**80.0**	**62.8**	**80.9**	**64.3**	**67.3**	**75.4**	**62.5**	**80.2**	**65.9**	**73.8**	**70.4**	**74.8**	**71.1 J**	**60.0**	**57.7**	**82.9**	**83.2**
Pesticide Organics (SW8081A)																								
alpha-BHC (based on Lindane)	0.27 c	2.0	4.0	0.21 U	0.23 U	0.23 U	0.24 U	0.21 U	0.23 U	0.21 U	0.23 U	0.23 U	0.20 U	0.25 U	0.19 U	0.23 U	0.21 U	0.21 U	0.21 U	0.24 U	0.22 U	0.24 U	0.20 U	0.22 U
gamma-BHC (Lindane)	2.1 c	2.0	4.0	0.11 U	0.12 U	0.12 U	0.13 U	0.11 U	0.12 U	**0.12 J**	0.12 U	0.12 U	**0.34 J**	0.13 U	0.10 U	0.12 U	0.11 U	0.11 U	0.11 U	0.13 U	0.12 U	0.13 U	0.11 U	0.12 U
beta-BHC (based on Lindane)	0.96 c	2.0	4.0	0.095 U	0.10 U	0.11 U	0.11 U	0.094 U	0.10 U	0.095 U	0.10 U	0.11 U	0.092 U	0.11 U	0.086 U	0.11 U	0.093 U	0.097 U	0.093 U	0.11 U	0.098 U	0.11 U	0.091 U	0.099 U
delta-BHC (based on Lindane)	0.96 c	2.0	4.0	0.27 U	0.29 U	0.30 U	0.31 U	**0.31 J**	0.29 U	**0.28 J**	0.29 U	0.30 U	**0.40 J**	0.31 U	0.24 U	0.29 U	0.26 U	0.27 U	**0.34 J**	0.30 U	0.28 U	0.30 U	**0.45 J**	0.28 U
Heptachlor	0.38 c	0.52	4.7	**0.092 J**	0.093 U	0.095 U	0.098 U	0.084 U	0.094 U	**0.096 J**	0.093 U	0.095 U	0.082 U	0.10 U	0.077 U	0.094 U	0.083 U	0.087 U	0.084 U	0.097 U	0.088 U	0.096 U	0.082 U	0.089 U
Aldrin^	0.13^	0.13^	1.4	0.13 U	0.14 U	0.14 U	0.15 U	0.12 U	0.14 U	0.13 U	0.14 U	0.14 U	0.12 U	0.15 U	0.11 U	0.14 U	0.12 U	0.13 U	0.12 U	0.14 U	0.13 U	0.14 U	0.12 U	0.13 U
Heptachlor epoxide	0.19 c*	0.52	4.7	**0.27 J**	0.26 U	0.26 U	0.27 U	0.23 U	0.26 U	0.24 U	0.26 U	0.26 U	0.23 U	0.28 U	0.21 U	0.26 U	0.23 U	0.24 U	0.23 U	0.27 U	0.24 U	0.27 U	0.23 U	0.25 U
gamma-Chlordane	6.5 c*	1.7	2.5	0.28 U	0.31 U	0.32 U	0.33 U	0.28 U	0.32 U	0.28 U	0.31 U	0.32 U	0.28 U	0.34 U	0.26 U	0.32 U	0.28 U	0.29 U	0.28 U	0.33 U	0.30 U	0.32 U	0.27 U	0.30 U
alpha-Chlordane	6.5 c*	1.7	2.5	**0.27 J**	0.051 U	0.052 U	0.054 U	0.38 U	0.052 U	**0.29 J**	0.051 U	0.11 U	**0.87**	0.055 U	**0.21 J**	0.052 U	**0.18 J**	0.048 U	**0.21 J**	0.053 U	0.049 U	0.053 U	**0.16 J**	**0.091 J**
4,4'-DDE	5.1	6.3	1.0	**0.93**	0.058 U	0.059 U	0.061 U	**0.75**	0.059 U	**1.2**	0.058 U	0.059 U	**1.6**	0.062 U	**0.57**	0.059 U	**0.37 J**	0.054 U	**0.84**	0.060 U	0.055 U	0.060 U	**1.1**	**0.39 J**
Endosulfan I	3,700 n	NA	NA	0.056 U	0.061 U	0.062 U	0.065 U	0.056 U	0.062 U	0.056 U	0.062 U	0.063 U	**0.097 J**	0.066 U	0.051 U	0.062 U	0.055 U	0.057 U	0.055 U	0.064 U	0.058 U	0.063 U	0.054 U	0.058 U
Dieldrin^	0.11^ c	0.13	8.0	**0.056 J**	0.060 U	0.061 U	0.064 U	0.054 U	0.061 U	**0.14 J**	0.060 U	0.061 U	**0.097 J**	0.064 U	**0.090 J**	0.061 U	0.054 U	0.056 U	0.054 U	0.063 U	0.057 U	0.062 U	0.053 U	0.057 U
Endrin	180 n	230	0.2	0.081 U	0.089 U	0.091 U	0.094 U	0.081 U	0.090 U	0.081 U	0.090 U	0.091 U	0.079 U	0.096 U	0.074 U	0.090 U	0.080 U	0.083 U	0.080 U	0.093 U	0.085 U	0.092 U	0.078 U	0.085 U
4,4'-DDD	7.2	9	1.0	0.19 U	0.20 U	0.21 U	0.21 U	0.18 U	0.21 U	0.19 U	0.20 U	0.21 U	0.18 U	0.22 U	0.17 U	0.21 U	0.18 U	0.19 U	0.18 U	0.21 U	0.19 U	0.21 U	0.18 U	0.19 U
Endosulfan II	3,700 n	NA	NA	**0.22 J**	0.052 U	0.053 U	0.055 U	**0.28 J**	0.053 U	**0.18 J**	0.053 U	0.053 U	**0.31 J**	0.056 U	**0.19 J**	0.053 U	**0.059 J**	0.049 U	**0.13 J**	0.055 U	**0.12 J**	0.054 U	**0.072 J**	**0.071 J**
4,4'-DDT	7.0	6.3	1.0	0.26 U	0.29 U	0.30 U	0.31 U	0.26 U	0.29 U	**0.29 J**	0.29 U	0.30 U	0.26 U	0.31 U	**0.25 J**	0.29 U	0.26 U	0.27 U	0.26 U	0.30 U	0.27 U	0.30 U	0.25 U	0.28 U
Endrin aldehyde (based on Endrin)	180 n	230	0.2	0.052 U	0.057 U	0.058 U	0.060 U	0.052 U	0.058 U	0.052 U	0.057 U	0.058 U	0.050 U	0.061 U	0.047 U	0.058 U	0.051 U	0.053 U	0.051 U	0.059 U	0.054 U	0.059 U	0.050 U	0.054 U
Methoxychlor	3,100 n	3,800	100	0.29 U	0.32 U	0.33 U	0.34 U	0.29 U	0.33 U	0.29 U	0.32 U	0.33 U	0.28 U	0.35 U	0.27 U	0.33 U	0.29 U	0.30 U	0.29 U	0.34 U	0.31 U	0.33 U	0.28 U	0.31 U
Endosulfan sulfate	3,700 n	NA	NA	**0.21 J**	0.098 U	0.10 U	0.10 U	**0.16 J**	0.099 U	**0.15 J**	0.098 U	0.10 U	**0.29 J**	0.11 U	**0.26 J**	0.099 U	**0.38 J**	0.091 U	**0.14 J**	0.10 U	0.093 U	0.10 U	**0.14 J**	0.093 U

Notes:

All analytical results for soil given in mg/kg on a dry weight basis.

-06SB Samples were collected in the 0 to 6 inch bgs depth interval
-03SB, -05SB, -10SB Samples were collected in the 3-foot, 5-foot, or 10-foot bgs depth 'interval, respectively

U = Not detected at specified reporting limit
J = Estimated value below reporting limit

Boldface entries indicate detected constituents/compounds (including those detected between MDL and RL - 'J' flagged)

🟦 Exceeds Title 22 Hazardous Waste Criteria

🟨 Exceeds one or more of the risk-based criteria (PRGs or CHHSLs)

☐ Exceeds the corresponding 95% Upper Confidence Limit on the geometric mean for Background Soils (using samples from all depths)

c = Cancer PRG
n = Noncancer PRG
c* = where: n screening level < 100x cancer screening level
m = concentration may exceed ceiling limit
^ = MDL's for this method are less than or equal to the screening level.

1 = USEPA Region IX Preliminary Remediation Goals (PRGs) 2008
2 = California Human Health Screening levels
3 = Total Threshold Limit Concentration (wet weight basis) that is hazardous waste criteria under California Code of Regulation, Title 22, Division 4.5, Chapter 11, Section 66261.24.

Table D-1. Summary of Soil Sample Analytical Results, Phase II Environmental Site Assessment, CPV Vaca Station, Vacaville, California

Sample ID	PRGs[1] Industrial Soil (mg/kg)	CHHSL's[2] Industrial Soil (mg/kg)	TTLC[3] Wet wt basis (mg/kg)	C1-06SB	C1-03SB	C2-06SB	C2-03SB	C3-06SB	C3-03SB	C4-06SB	C4-03SB	C4-05SB	C4-10SB C4-05SB-FD	D1-06SB	D1-03SB	D2-06SB	D2-03SB	D2-05SB	D3-06SB	D3-03SB	D4-06SB	D4-03SB	E1-06SB	E1-03SB
% Moisture (SW3550)				3	13	4	18	4	17	4	14	19	18	2	18	2	19	19	2	16	3	11	2	17
Metals (SW6010B)																								
Antimony	410 n	380	500	0.94 U	0.17 U	0.95 U	0.19 U	0.93 U	0.23 U	0.89 U	0.17 U	0.18 U	0.20 U	0.91 U	0.23 U	0.97 U	0.20 U	0.18 U	1.0 U	0.20 U	0.93 U	0.19 U	0.96 U	0.21 U
Arsenic	1.6 c	0.24	500	**10.5**	**10.6**	**7.6**	**10.6**	**7.5**	**7.96**	**8.9**	**6.74**	**12.4**	**19.0**	**8.3**	**12.5**	**8.4**	**11.4**	**11.8**	**10.1**	**10.1**	**6.5**	**9.09**	**6.2**	**10.8**
Barium	190,000 nm	63,000	10,000	**171**	**237**	**155**	**289**	**163**	**309**	**162**	**146**	**411**	**2830**	**194**	**386**	**135**	**374**	**79.8**	**158**	**577**	**148**	**464**	**159**	**285**
Beryllium	2,000 n	1,700	75	**0.79**	**0.85**	**0.79**	**0.87**	**0.70**	**0.80**	**0.77**	**0.71**	**0.76**	**0.73**	**0.79**	**0.86**	**0.73**	**0.83**	**0.79**	**0.75**	**0.76**	**0.65**	**0.83**	**0.60**	**0.96**
Cadmium	810 n	7.5	100	0.47 U	**0.32 J**	0.48 U	**0.20 J**	0.47 U	**0.03 J**	0.45 U	**0.11 J**	**0.26 J**	**0.032 J**	0.45 U	**0.071 J**	0.49 U	**0.11 J**	**0.057 J**	0.50 U	0.010 U	0.47 U	**0.056 J**	0.48 U	**0.14 J**
Chromium *(based on III)*	1,400 c	10,000	2,500	**43.7**	**41.3**	**45.4**	**42.3**	**40.1**	**36.8**	**44.2**	**36.1**	**38.0**	**37.2**	**43.3**	**42.4**	**42.2**	**36.0**	**27.5**	**37.9**	**37.8**	**34.3**	**40.7**	**33.4**	**48.0**
Chromium *(based on VI)*	200 c*	37	500	**43.7**	**41.3**	**45.4**	**42.3**	**40.1**	**36.8**	**44.2**	**36.1**	**38.0**	**37.2**	**43.3**	**42.4**	**42.2**	**36.0**	**27.5**	**37.9**	**37.8**	**34.3**	**40.7**	**33.4**	**48.0**
Cobalt	300 n	3,200	8,000	**11.3**	**24.7**	**10.6**	**20.3**	**9.7**	**28.4**	**11.1**	**10.7**	**15.4**	**11.8**	**11.4**	**16.4**	**11.2**	**15.0**	**21.5**	**11.5**	**9.69**	**12.5**	**14.1**	**11.6**	**9.74**
Copper	41,000 nc	38,000	2,500	**43.6**	**36.9**	**47.6**	**34.7**	**44.8**	**33.9**	**46.5**	**30.8**	**34.8**	**31.4**	**42.2**	**36.0**	**41.3**	**28.1**	**26.8**	**43.0**	**29.9**	**44.3**	**34.1**	**37.0**	**40.4**
Lead	800 n	3,500	1,000	**13.3**	**14.0**	**12.5**	**11.7**	**12.4**	**10.7**	**12.7**	**9.19**	**10.8**	**9.13**	**12.9**	**11.4**	**11.8**	**10.6**	**9.62**	**12.9**	**9.36**	**12.7**	**10.4**	**11.5**	**11.3**
Mercury (SW7471A)	28 ns	180	20	**0.097**	**0.041**	**0.091**	**0.058**	**0.088**	**0.036**	**0.091**	**0.045**	**0.064**	**0.091**	**0.11**	**0.042**	**0.058**	**0.036**	**0.018 J**	**0.062**	**0.052**	**0.092**	**0.036**	**0.095**	**0.036**
Molybdenum	5,100 n	4,800	3,500	2.4 U	**0.50 J**	2.4 U	**0.51 J**	2.3 U	**0.36 J**	2.2 U	0.16 U	0.17 U	0.19 U	2.3 U	**0.35 J**	2.4 U	**0.37 J**	**0.31 J**	2.5 U	**0.29 J**	2.3 U	**0.25 J**	2.4 U	**0.26 J**
Nickel *(assumed soluble salts)*	20,000 n	16,000	2,000	**30.5**	**31.9**	**31.0**	**39.7**	**26.0**	**41.2**	**30.4**	**27.1**	**42.5**	**39.5**	**30.9**	**33.6**	**27.3**	**31.0**	**28.5**	**26.9**	**31.1**	**25.0**	**26.8**	**23.2**	**31.7**
Selenium	5,100 n	4,800	100	2.8 U	**1.57 J**	2.9 U	**1.94 J**	2.8 U	1.40 U	2.7 U	**2.58 J**	**4.67**	1.21 U	2.7 U	1.38 U	**3.1**	**1.43 J**	**1.18 J**	**3.5**	**2.21 J**	2.8 U	1.16 U	**3.7**	**4.15**
Silver	5,100 n	4,800	500	**1.1**	0.044 U	**1.4**	0.050 U	**1.5**	**0.58 J**	**1.3**	0.045 U	0.046 U	**0.31 J**	**1.2**	**0.37 J**	**1.5**	**0.13 J**	**0.32 J**	**1.3**	**0.45 J**	**1.4**	**0.25 J**	**1.6**	**0.073 J**
Thallium	66 n	63	700	1.9 U	0.49 U	1.9 U	**0.67 J**	1.9 U	0.68 U	1.8 U	0.51 U	0.52 U	**0.99 J**	1.8 U	0.67 U	1.9 U	0.59 U	0.54 U	2.0 U	0.61 U	1.9 U	0.57 U	1.9 U	0.62 U
Vanadium	5,200 n	6,700	2,400	**82.1**	**77.2**	**82.6**	**77.1**	**71.1**	**65.5**	**80.5**	**61.2**	**75.7**	**72.2**	**81.4**	**77.4**	**74.8**	**64.6**	**59.4**	**68.2**	**67.4**	**61.4**	**73.6**	**56.3**	**86.5**
Zinc	31,000 nm	100,000	5,000	**83.7**	**72.7**	**82.4**	**71.3**	**79.2**	**69.8**	**82.4**	**59.5**	**64.6**	**62.1**	**81.3**	**70.7**	**74.5**	**57.4**	**54.8**	**79.9**	**63.7**	**74.6**	**64.1**	**66.1**	**77.8**
Pesticide Organics (SW8081A)																								
alpha-BHC (based on Lindane)	0.27 c	2.0	4.0	0.21 U	0.23 U	0.20 U	0.24 U	0.21 U	0.24 U	0.20 U	0.22 U	0.24 U	0.25 U	0.19 U	0.23 U	0.21 U	0.24 U	0.25 U	0.19 U	0.24 U	0.20 U	0.21 U	0.20 U	0.23 U
gamma-BHC (Lindane)	2.1 c	2.0	4.0	0.11 U	0.12 U	0.11 U	0.13 U	0.11 U	0.13 U	0.11 U	0.12 U	0.13 U	0.13 U	0.10 U	0.12 U	**0.14 J**	0.13 U	0.13 U	**0.12 J**	0.13 U	0.11 U	0.11 U	0.21 J	0.12 U
beta-BHC (based on Lindane)	0.96 c	2.0	4.0	**0.14 J**	0.10 U	0.092 U	0.11 U	0.095 U	0.11 U	0.090 U	0.10 U	0.11 U	0.11 U	0.086 U	0.10 U	0.093 U	0.11 U	0.11 U	0.085 U	0.11 U	0.092 U	0.096 U	**0.19 J**	0.10 U
delta-BHC (based on Lindane)	0.96 c	2.0	4.0	0.26 U	0.29 U	0.26 U	0.31 U	0.27 U	0.30 U	**0.28 J**	0.28 U	0.30 U	0.32 U	0.24 U	0.29 U	0.26 U	0.31 U	0.32 U	**0.28 J**	0.31 U	0.26 U	0.27 U	0.25 U	0.29 U
Heptachlor	0.38 c	0.52	4.7	**0.089 J**	0.092 U	0.083 U	0.098 U	0.085 U	0.096 U	0.081 U	0.090 U	0.097 U	0.10 U	0.077 U	0.094 U	**0.087 J**	0.098 U	0.10 U	0.076 U	0.098 U	0.083 U	0.086 U	0.081 U	0.092 U
Aldrin^	0.13^	0.13^	1.4	0.12 U	0.14 U	0.12 U	0.15 U	0.13 U	0.14 U	0.12 U	0.13 U	0.14 U	0.15 U	0.11 U	0.14 U	0.12 U	0.15 U	0.15 U	0.11 U	0.14 U	0.12 U	0.13 U	0.12 U	0.14 U
Heptachlor epoxide	0.19 c*	0.52	4.7	0.23 U	0.25 U	0.23 U	0.27 U	0.24 U	0.27 U	0.22 U	0.25 U	0.27 U	0.28 U	0.21 U	0.26 U	0.23 U	0.27 U	0.28 U	0.21 U	0.27 U	0.23 U	0.24 U	0.22 U	0.26 U
gamma-Chlordane	6.5 c*	1.7	2.5	0.28 U	0.31 U	0.28 U	0.33 U	0.29 U	0.32 U	**0.33 J**	0.30 U	0.32 U	0.34 U	0.26 U	0.32 U	0.28 U	0.33 U	0.34 U	0.26 U	0.33 U	**0.29 J**	0.29 U	0.27 U	0.31 U
alpha-Chlordane	6.5 c*	1.7	2.5	**0.20 J**	0.051 U	**0.27 J**	0.054 U	0.047 U	0.053 U	0.045 U	0.050 U	0.053 U	0.055 U	**0.18 J**	0.052 U	**0.34 J**	0.054 U	0.056 U	**0.22 J**	0.054 U	**0.44 J**	0.048 U	**0.28 J**	0.051 U
4,4'-DDE	5.1	6.3	1.0	**0.70**	0.057 U	**0.5**	0.061 U	**1.01**	0.060 U	**1.3**	0.056 U	0.060 U	0.063 U	**0.71**	0.059 U	**0.93**	0.061 U	0.063 U	**1.2**	0.061 U	**1.2**	0.054 U	**0.61**	0.057 U
Endosulfan I	3,700 n	NA	NA	0.055 U	0.061 U	0.055 U	0.065 U	0.056 U	0.063 U	0.053 U	0.060 U	0.064 U	0.066 U	0.051 U	0.062 U	0.055 U	0.065 U	0.066 U	0.050 U	0.064 U	0.055 U	0.057 U	0.053 U	0.061 U
Dieldrin^	0.11^ c	0.13	8.0	**0.15 J**	0.059 U	0.053 U	0.063 U	0.055 U	0.062 U	**0.055 J**	0.058 U	0.062 U	0.065 U	**0.069 J**	0.061 U	**0.10 J**	0.063 U	0.065 U	0.054 J	0.063 U	**0.12 J**	0.056 U	0.052 U	0.059 U
Endrin	180 n	230	0.2	0.080 U	0.088 U	0.079 U	0.094 U	0.082 U	0.092 U	0.078 U	0.087 U	0.093 U	0.097 U	0.074 U	0.090 U	**0.080 J**	0.094 U	0.097 U	0.074 J	0.094 U	0.079 U	0.083 U	0.078 U	0.088 U
4,4'-DDD	7.2	9	1.0	0.18 U	0.20 U	0.18 U	0.21 U	0.19 U	0.21 U	0.18 U	0.20 U	0.21 U	0.22 U	0.17 U	0.21 U	0.18 U	0.21 U	0.22 U	0.17 U	0.21 U	0.18 U	0.19 U	0.18 U	0.20 U
Endosulfan II	3,700 n	NA	NA	**0.12 J**	0.052 U	**0.16 J**	0.055 U	0.048 U	0.054 U	**0.24 J**	0.051 U	0.054 U	0.057 U	**0.11 J**	0.053 U	**0.17 J**	0.055 U	0.057 U	**0.17 J**	0.055 U	**0.35 J**	**0.11 J**	**0.13 J**	0.052 U
4,4'-DDT	7.0	6.3	1.0	**0.34 J**	0.29 U	0.26 U	0.31 U	0.27 U	0.30 U	**0.38 J**	0.28 U	0.30 U	0.31 U	**0.28 J**	0.29 U	0.26 U	0.31 U	0.31 U	**0.26 J**	0.30 U	0.26 U	0.27 U	**0.35 J**	0.29 U
Endrin aldehyde (based on Endrin)	180 n	230	0.2	0.051 U	0.056 U	0.051 U	0.060 U	0.052 U	0.059 U	0.050 U	0.056 U	0.059 U	0.062 U	0.047 U	0.058 U	0.051 U	0.06 U	0.062 U	0.047 U	0.060 U	0.051 U	0.053 U	0.050 U	0.057 U
Methoxychlor	3,100 n	3,800	100	0.29 U	0.32 U	0.29 U	0.34 U	0.29 U	0.33 U	0.28 U	0.31 U	0.34 U	0.35 U	0.27 U	0.33 U	0.29 U	0.34 U	0.35 U	0.26 U	0.34 U	0.29 U	0.30 U	0.28 U	0.32 U
Endosulfan sulfate	3,700 n	NA	NA	**0.22 J**	0.097 U	**0.11 J**	0.10 U	0.09 U	0.10 U	**0.18 J**	0.095 U	0.10 U	0.11 U	**0.15 J**	0.099 U	**0.22 J**	0.10 U	0.11 U	**0.19 J**	0.10 U	**0.13 J**	0.091 U	**0.10 J**	0.097 U

Notes:

All analytical results for soil given in mg/kg on a dry weight basis.

-06SB Samples were collected in the 0 to 6 inch bgs depth interval
-03SB, -05SB, -10SB Samples were collected in the 3-foot, 5-foot, or 10-foot bgs depth 'interval, respectively

U = Not detected at specified reporting limit
J = Estimated value below reporting limit

Boldface entries indicate detected constituents/compounds (including those detected between MDL and RL - 'J' flagged)

🟦 Exceeds Title 22 Hazardous Waste Criteria

🟨 Exceeds one or more of the risk-based criteria (PRGs or CHHSLs)

☐ Exceeds the corresponding 95% Upper Confidence Limit on the geometric mean for Background Soils (using samples from all depths)

c = Cancer PRG
n = Noncancer PRG
c* = where: n screening level < 100x cancer screening level
m = concentration may exceed ceiling limit
^ = MDL's for this method are less than or equal to the screening level.

1 = USEPA Region IX Preliminary Remediation Goals (PRGs) 2008
2 = California Human Health Screening levels
3 = Total Threshold Limit Concentration (wet weight basis) that is hazardous waste criteria under California Code of Regulation, Title 22, Division 4.5, Chapter 11, Section 66261.24.

Table D-1. Summary of Soil Sample Analytical Results, Phase II Environmental Site Assessment, CPV Vaca Station, Vacaville, California

Sample ID	**PRGs^1 Industrial Soil (mg/kg)**	**CHHSL's^2 Industrial Soil (mg/kg)**	**TTLC^3 Wet wt basis (mg/kg)**	**E1-05SB**	**E1-10SB E1-05SB-FD**	**E2-06SB**	**E2-03SB**	**E3-06SB**	**E3-03SB**	**E4-06SB**	**E4-03SB**	**BG1-06SB**	**BG1-06.5SB**	**BG1-09.5SB**	**BG2-06SB**	**BG2-05SB**	**BG2-08SB**	**BG3-06SB**	**BG3-04SB**	**BG3-07SB**	**BG4-06SB**	**BG4-03SB**	**BG4-05SB**	**BG5-06SB**	**BG5-03SB**	**BG5-05SB**
% Moisture (SW3550)				17	16	2	17	3	20	3	16	2	16	17	2	22	17	Not collected	17	17	3	17	22	2	17	16
Metals (SW6010B)																										
Antimony	410 n	380	500	0.22 U	0.22 U	0.93 U	0.19 U	0.91 U	0.21 U	0.95 U	0.17 U	0.94 U	0.22 U	0.20 U	1.0 U	0.23 U	0.21 U		0.20 U	0.19 U	0.99 U	0.20 U	0.19 U	0.91 U	0.20 U	0.18 U
Arsenic	1.6 c	0.24	500	**14.1**	**13.2**	**8.5**	**11.9**	**7.4**	**11.3**	**8.5**	**9.94**	**9.0**	**9.51**	**13.0**	**7.4**	**9.79**	**12.0**		**11.2**	**7.06**	**9.0**	**10.4**	**11.5**	**9.8**	**9.52**	**11.7**
Barium	190,000 nm	63,000	10,000	**1360**	**499**	**136**	**277**	**150**	**228**	**149**	**233**	**169**	**309**	**133**	**174**	**142**	**185**		**225**	**63.6**	**230**	**191**	**135**	**157**	**177**	**127**
Beryllium	2,000 n	1,700	75	**0.77**	**0.75**	**0.57**	**0.82**	**0.71**	**0.80**	**0.61**	**0.83**	**0.72**	**0.81**	**0.84**	**0.67**	**0.73**	**0.79**		**0.73**	**0.61**	**0.69**	**0.83**	**0.76**	**0.71**	**0.82**	**0.73**
Cadmium	810 n	7.5	100	**0.062 J**	**0.055 J**	0.46 U	**0.17 J**	0.46 U	**0.19 J**	0.48 U	**0.033 J**	0.47 U	**0.047 J**	**0.14 J**	0.51 U	0.012 U	**0.24 J**		**0.041 J**	**0.029 J**	0.50 U	**0.069 J**	**0.20 J**	0.46 U	**0.046 J**	**0.22 J**
Chromium *(based on III)*	1,400 c	10,000	2,500	**40.3**	**36.9**	**30.8**	**39.4**	**38.9**	**43.3**	**33.7**	**32.0**	**38.1**	**39.5**	**44.0**	**36.6**	**37.7**	**40.5**		**38.0**	**39.0**	**34.8**	**40.1**	**44.9**	**38.4**	**41.3**	**39.3**
Chromium *(based on VI)*	200 c*	37	500	**40.3**	**36.9**	**30.8**	**39.4**	**38.9**	**43.3**	**33.7**	**32.0**	**38.1**	**39.5**	**44.0**	**36.6**	**37.7**	**40.5**		**38.0**	**39.0**	**34.8**	**40.1**	**44.9**	**38.4**	**41.3**	**39.3**
Cobalt	300 n	3,200	8,000	**13.3**	**18.2**	**9.1**	**7.49**	**11.3**	**18.8**	**10.7**	**11.3**	**10.9**	**10.3**	**16.3**	**11.0**	**8.51**	**12.4**		**10.7**	**10.2**	**24.0**	**8.37**	**11.6**	**11.3**	**12.4**	**14.6**
Copper	41,000 nc	38,000	2,500	**36.2**	**33.3**	**37.0**	**32.1**	**46.8**	**35.8**	**59.8**	**27.3**	**32.6**	**31.9**	**41.3**	**34.2**	**34.1**	**34.9**		**28.2**	**26.7**	**32.6**	**29.5**	**37.4**	**34.2**	**31.9**	**30.9**
Lead	800 n	3,500	1,000	**10.2**	**11.3**	**10.4**	**11.1**	**12.9**	**10.5**	**15.9**	**10.4**	**9.3**	**9.59**	**12.4**	**10.1**	**8.36**	**9.61**		**10.3**	**7.97**	**14.1**	**9.01**	**10.6**	**11.5**	**10.5**	**11.0**
Mercury (SW7471A)	28 ns	180	20	**0.044**	**0.07**	**0.063**	**0.088**	**0.11**	**0.045**	**0.22**	**0.077**	**0.090**	**0.036**	**0.067**	**0.093**	**0.029**	**0.055**		**0.059**	**0.036**	**0.035**	**0.066**	**0.06**	**0.037**	**0.036**	**0.025**
Molybdenum	5,100 n	4,800	3,500	**0.36 J**	**0.42 J**	2.3 U	0.18 U	2.3 U	0.20 U	2.4 U	**0.25 J**	2.4 U	**0.36 J**	**0.21 J**	2.5 U	0.22 U	**0.49 J**		**0.26 J**	0.18 U	2.5 U	**0.25 J**	**0.24 J**	2.3 U	**0.30 J**	0.17 U
Nickel *(assumed soluble salts)*	20,000 n	16,000	2,000	**35.3**	**34.1**	**22.9**	**35.7**	**26.5**	**32.6**	**24.4**	**31.6**	**36.9**	**32.1**	**54.1**	**33.0**	**26.8**	**39.5**		**27.3**	**36.8**	**29.4**	**38.1**	**34.0**	**29.3**	**28.0**	**37.8**
Selenium	5,100 n	4,800	100	1.35 U	1.32 U	2.8 U	**2.17 J**	2.7 U	**3.79**	2.9 U	**1.94 J**	2.8 U	1.33 U	**2.63 J**	3.0 U	1.38 U	**1.91 J**		**3.67**	1.17 U	3.0 U	1.25 U	**2.59 J**	2.7 U	**2.52 J**	**2.86**
Silver	5,100 n	4,800	500	**0.18 J**	**0.40 J**	**1.4**	0.050 U	**1.5**	**0.091 J**	**2.1**	**0.17 J**	**1.0**	**0.41 J**	0.053 U	**1.2**	**0.57 J**	**0.19 J**		**0.25 J**	**0.28 J**	**1.2**	**0.22 J**	0.050 U	**0.98**	**0.21 J**	**0.062 J**
Thallium	66 n	63	700	0.66 U	0.64 U	1.9 U	0.56 U	1.8 U	0.61 U	1.9 U	0.51 U	1.9 U	0.65 U	0.60 U	2.0 U	0.67 U	0.62 U		0.60 U	0.57 U	2.0 U	0.61 U	0.57 U	1.8 U	0.58 U	0.52 U
Vanadium	5,200 n	6,700	2,400	**73.9**	**73.5**	**54.6**	**72.4**	**64.3**	**76.8**	**57.5**	**59.8**	**69.1**	**70.5**	**79.8**	**61.9**	**69.5**	**73.0**		**67.5**	**58.7**	**65.9**	**70.8**	**76.8**	**69.6**	**71.7**	**72.2**
Zinc	31,000 nm	100,000	5,000	**74.9**	**69.5**	**67.3**	**65.3**	**80.4**	**67.0**	**89.4**	**52.1**	**65.2**	**59.3**	**71.4**	**61.6**	**69.2**	**68.0**		**56.8**	**58.0**	**68.0**	**54.7**	**78.0**	**69.0**	**61.6**	**16.5**
Pesticide Organics (SW8081A)																										
alpha-BHC (based on Lindane)	0.27 c	2.0	4.0	0.23 U	0.22 U	0.20 U	0.23 U	0.20 U	0.25 U	0.21 U	0.24 U	0.20 U	0.23 U	0.24 U	0.20 U	0.26 U	0.24 U		0.23 U	0.24 U	0.21 U	0.23 U	0.25 U	0.21 U	0.24 U	0.24 U
gamma-BHC (Lindane)	2.1 c	2.0	4.0	0.12 U	0.12 U	0.11 U	0.12 U	**0.13 J**	0.13 U	0.11 U	0.13 U	**0.13 J**	0.12 U	0.13 U	0.10 U	0.14 U	0.13 U		0.12 U	0.13 U	0.11 U	0.12 U	0.13 U	0.11 U	0.13 U	0.13 U
beta-BHC (based on Lindane)	0.96 c	2.0	4.0	0.10 U	0.10 U	0.091 U	0.10 U	0.091 U	0.11 U	0.096 U	0.11 U	0.090 U	0.10 U	0.11 U	0.088 U	0.12 U	0.11 U		0.10 U	0.11 U	0.094 U	0.10 U	0.11 U	0.093 U	0.11 U	0.11 U
delta-BHC (based on Lindane)	0.96 c	2.0	4.0	0.29 U	0.28 U	0.26 U	0.29 U	0.25 U	0.32 U	0.27 U	0.30 U	0.25 U	0.29 U	0.30 U	0.25 U	0.33 U	0.31 U		0.29 U	0.31 U	0.26 U	0.29 U	0.32 U	0.26 U	0.30 U	0.30 U
Heptachlor	0.38 c	0.52	4.7	0.093 U	0.091 U	0.082 U	0.093 U	**0.085 J**	0.1 U	0.086 U	0.097 U	0.081 U	0.092 U	0.096 U	0.079 U	0.10 U	0.098 U		0.093 U	0.098 U	0.085 U	0.093 U	0.10 U	0.083 U	0.097 U	0.097 U
Aldrin^	0.13^	0.13^	1.4	0.14 U	0.13 U	0.12 U	0.14 U	0.12 U	0.15 U	0.13 U	0.14 U	0.12 U	0.14 U	0.14 U	0.12 U	0.16 U	0.15 U		0.14 U	0.15 U	0.13 U	0.14 U	0.15 U	0.12 U	0.14 U	0.14 U
Heptachlor epoxide	0.19 c*	0.52	4.7	0.26 U	0.25 U	0.23 U	0.26 U	0.23 U	0.29 U	0.24 U	0.27 U	0.22 U	0.25 U	0.27 U	0.22 U	0.29 U	0.27 U		0.26 U	0.27 U	0.23 U	0.26 U	0.28 U	0.23 U	0.27 U	0.27 U
gamma-Chlordane	6.5 c*	1.7	2.5	0.31 U	0.30 U	0.27 U	0.31 U	0.27 U	0.35 U	**0.72**	0.32 U	**0.34 J**	0.31 U	0.32 U	**0.38 J**	0.35 U	0.33 U		0.31 U	0.33 U	0.28 U	0.31 U	0.34 U	0.28 U	0.33 U	0.32 U
alpha-Chlordane	6.5 c*	1.7	2.5	0.051 U	0.050 U	**0.32 J**	0.051 U	**0.52**	0.057 U	0.047 U	0.053 U	**0.42 J**	0.050 U	0.053 U	**0.50**	0.058 U	0.054 U		0.051 U	0.054 U	0.047 U	0.051 U	0.056 U	**0.050 J**	0.054 U	0.053 U
4,4'-DDE	5.1	6.3	1.0	0.058 U	0.057 U	**0.77**	0.058 U	**0.78**	0.064 U	**0.89**	0.060 U	**0.48**	0.057 U	0.060 U	**0.39 J**	0.065 U	0.061 U		0.058 U	0.061 U	**0.96**	0.058 U	0.063 U	**1.3**	0.061 U	0.060 U
Endosulfan I	3,700 n	NA	NA	0.061 U	0.060 U	0.054 U	0.062 U	0.054 U	0.068 U	0.056 U	0.064 U	0.053 U	0.060 U	0.063 U	0.052 U	0.069 U	0.065 U		0.061 U	0.065 U	0.056 U	0.061 U	0.067 U	0.055 U	0.064 U	0.064 U
Dieldrin^	0.11^ c	0.13	8.0	0.060 U	0.058 U	**0.13 J**	0.060 U	**0.099 J**	0.066 U	**0.24 J**	0.062 U	**0.12 J**	0.059 U	0.062 U	**0.21 J**	0.068 U	0.063 U		0.060 U	0.063 U	**0.11 J**	0.060 U	0.066 U	**0.14 J**	0.063 U	0.062 U
Endrin	180 n	230	0.2	0.089 U	0.087 U	0.078 U	0.090 U	0.078 U	0.099 U	0.082 U	0.093 U	0.078 U	0.088 U	0.092 U	0.076 U	0.10 U	0.094 U		0.089 U	0.094 U	0.081 U	0.089 U	0.098 U	0.080 U	0.093 U	0.093 U
4,4'-DDD	7.2	9	1.0	0.20 U	0.20 U	0.18 U	0.20 U	0.18 U	0.22 U	**0.20 J**	0.21 U	**0.21 J**	0.20 U	0.21 U	0.17 U	0.23 U	0.21 U		0.20 U	0.21 U	0.18 U	0.20 U	0.22 U	0.18 U	0.21 U	0.21 U
Endosulfan II	3,700 n	NA	NA	0.052 U	0.051 U	**0.24 J**	0.053 U	**0.30 J**	0.058 U	**0.27 J**	0.054 U	**0.22 J**	0.052 U	0.054 U	**0.14 J**	0.059 U	0.055 U		0.052 U	0.055 U	**0.39 J**	0.052 U	0.057 U	**0.097 J**	0.055 U	0.054 U
4,4'-DDT	7.0	6.3	1.0	0.29 U	0.28 U	**0.31 J**	0.29 U	0.25 U	0.32 U	0.27 U	0.30 U	**0.28 J**	0.29 U	0.30 U	0.25 U	0.33 U	0.31 U		0.29 U	0.31 U	**0.43 J**	0.29 U	0.32 U	0.26 U	0.30 U	0.30 U
Endrin aldehyde (based on Endrin)	180 n	230	0.2	0.057 U	0.056 U	0.050 U	0.057 U	0.050 U	0.063 U	0.053 U	0.059 U	0.050 U	0.056 U	0.059 U	0.049 U	0.064 U	0.060 U		0.057 U	0.060 U	0.052 U	0.057 U	0.063 U	0.051 U	0.060 U	0.059 U
Methoxychlor	3,100 n	3,800	100	0.32 U	0.31 U	0.28 U	0.32 U	0.28 U	0.36 U	0.30 U	0.33 U	0.28 U	0.32 U	0.33 U	0.27 U	0.36 U	0.34 U		0.32 U	0.34 U	0.29 U	0.32 U	0.35 U	0.29 U	0.34 U	0.34 U
Endosulfan sulfate	3,700 n	NA	NA	0.097 U	0.095 U	**0.16 J**	0.098 U	**0.11 J**	0.11 U	0.090 U	0.10 U	0.20 U	0.096 U	0.10 U	**0.21 J**	0.11 U	0.10 U		0.098 U	0.10 U	0.089 U	0.098 U	0.11 U	**0.16 J**	0.10 U	0.10 U

Notes:

All analytical results for soil given in mg/kg on a dry weight basis.

-06SB Samples were collected in the 0 to 6 inch bgs depth interval
-03SB, -05SB, -10SB Samples were collected in the 3-foot, 5-foot, or 10-foot bgs depth 'interval, respectively

U = Not detected at specified reporting limit
J = Estimated value below reporting limit

Boldface entries indicate detected constituents/compounds (including those detected between MDL and RL - 'J' flagged)

🟦 Exceeds Title 22 Hazardous Waste Criteria

🟨 Exceeds one or more of the risk-based criteria (PRGs or CHHSLs)

☐ Exceeds the corresponding 95% Upper Confidence Limit on the geometric mean for Background Soils (using samples from all depths)

c = Cancer PRG
n = Noncancer PRG
c* = where: n screening level < 100x cancer screening level
m = concentration may exceed ceiling limit
^ = MDL's for this method are less than or equal to the screening level.

1 = USEPA Region IX Preliminary Remediation Goals (PRGs) 2008
2 = California Human Health Screening levels
3 = Total Threshold Limit Concentration (wet weight basis) that is hazardous waste criteria under California Code of Regulation, Title 22, Division 4.5, Chapter 11, Section 66261.24.

Table D-2. Summary of Groundwater Analytical Results, Phase II Environmental Site Assessment, CPV Vaca Station, Vacaville, California

	PRGs^1 Tap Water (µg/L)	**Title 22 Hazardous Waste Toxicity Characteristic (µg/L)**	**Dissolved (filtered) metals**				
Sample ID			**A1-12GW**	**B3-12GW**	**B3-12GW-FD**	**D2-12GW**	**MW-05**
Metals (SW6010B)							
Antimony	15 n	NA	**3.34 J**	3.29 U	3.29 U	3.29 U	**6.11 J**
Arsenic^	0.045 c	5,000	11.6 U	11.6 U	11.6 U	11.6 U	11.6 U
Barium	7,300 n	100,000	**103**	**70.9**	**43.5**	**37.2**	43.3
Beryllium	73 n	NA	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Cadmium	18 n	1,000	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U
Chromium *(based on III)*	55,000 n	5,000	**2.34 J**	0.98 U	0.98 U	**2.48 J**	**2.63 J**
Chromium *(based on VI)*	110 n	5,000	**2.34 J**	0.98 U	0.98 U	**2.48 J**	**2.63 J**
Cobalt	11 n	NA	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U
Copper	1,500 n	NA	1.66 U	1.66 U	1.66 U	1.66 U	1.66 U
Lead	15 (MCL)	5,000	1.53 U	1.53 U	1.53 U	1.53 U	1.53 U
Mercury **(SW7470A)**	0.63 n	200	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
Molybdenum	180 n	NA	**4.95 J**	**9.06 J**	1.43 U	**1.50 J**	1.43 U
Nickel *(assumed soluble salts)*	730 n	NA	1.41 U	1.41 U	1.41 U	1.41 U	1.41 U
Selenium	180 n	1,000	25.4 U	**40.0**	25.4 U	25.4 U	**28.6 J**
Silver	180 n	5,000	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U
Thallium^	2.4 n	NA	9.91 U	9.91 U	9.91 U	9.91 U	9.91 U
Vanadium	180 n	NA	**1.34 J**	0.71 U	**1.66 J**	0.71 U	**1.73 J**
Zinc	11,000 n	NA	**4.96 J**	**5.20 J**	**5.15 J**	**4.96 J**	**6.35 J**
Pesticide Organics (SW8081A) MRL = 0.51							
alpha-BHC	0.011 c	400	0.0029 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U
gamma-BHC (Lindane)	0.061 c	400	**0.009**	**0.0045 J**	**0.0022 J**	0.0014 U	0.0014 U
beta-BHC	0.037 c	400	**0.0055**	0.0058 U	0.0058 U	0.0058 U	0.0058 U
delta-BHC (based on technical chlordane)	0.037 c	400	**0.0047 J**	0.0037 U	0.0037 U	0.0037 U	0.0037 U
Heptachlor	0.015 c	8	0.0018 U	0.0016 U	0.0016 U	0.0016 U	0.0016 U
Aldrin^	0.004	NA	0.0016 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U
Heptachlor epoxide (based on Heptachlor)	0.015 c	8	**0.026**	**0.0015 J**	0.0011 U	0.0011 U	**0.0015 J**
gamma-Chlordane	0.19 c*	30	0.0043 U	0.0040 U	0.0040 U	0.0040 U	0.004 U
alpha-Chlordane	0.19 c*	30	**0.0017 J**	0.00090 U	0.00090 U	0.00089 U	0.00089 U
4,4'-DDE	0.20 c	NA	**0.0031 J**	0.0012 U	0.0012 U	0.0012 U	0.0012 U
Endosulfan I	220 n	NA	0.0016 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U
Dieldrin^	0.0042 c	NA	0.0011 U	0.00099 U	0.00099 U	0.00098 U	0.00099 U
Endrin	11 n	20	0.0016 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U
4,4'-DDD	0.28 c	NA	0.0011 U	0.0010 U	0.0010 U	**0.0011 J**	**0.0026 J**
Endosulfan II	220 n	NA	0.0015 U	0.0014 U	0.0014 U	0.0014 U	0.0014 U
4,4'-DDT	0.20 c	NA	**0.0076**	**0.0057**	0.0048 U	0.0048 U	0.0048 U
Endrin aldehyde	11 n	20	0.0026 U	0.0024 U	0.0024 U	0.0024 U	0.0024 U
Methoxychlor	180 n	10000	0.0078 U	0.0072 U	0.0073 U	0.0072 U	0.0072 U
Endosulfan sulfate	220 n	NA	**0.0033 J**	0.0020 U	0.0020 U	0.0020 U	0.0020 U

Notes:

GW - Groundwater sample; FD- Field duplicate
NA - No criteria given for this analyte
U = Not detected at specified reporting limit
J = Estimated value below reporting limit (RL) but above the method detection limit (MDL)

Boldface entries indicate detected constituents/compounds (including those detected between MDL and RL - 'J' flagged)

🟨 Exceeds the risk-based criteria (PRGs)

c = Cancer PRG
n = Noncancer PRG
c* = where: n screening level < 100x cancer screening level
^ = MDL's for this method are less than or equal to the screening level.

1 = USEPA Region IX Preliminary Remediation Goals (PRGs) 2008 - based on drinking water maximum contaminant level (MCL) where noted