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February 1, 2011

A2PP2011-005CH2M

Mr. Dale Rundquist, CPM
(09-AFC-2C)
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

SUBJECT: TID A2PP (09-AFC-2C) CUL-2, Geomorphology and Subsurface Cultural Potential of the A2PP Gas Pipeline Reinforcement Segment

Dear Mr. Rundquist:

Please find attached the Geomorphology and Subsurface Cultural Potential of the A2PP Gas Pipeline Reinforcement Segment for the TID A2PP project pursuant to COC CUL-2.

Should you have any questions regarding this submittal, please do not hesitate to contact me at 916-286-0249. Thank you.

Sincerely,
CH2M HILL

Sarah Madams
Project Manager

Attachment: Geomorphology and Subsurface Cultural Potential of the A2PP Gas Pipeline Reinforcement Segment

Cc: Susan Strachan, Strachan Consulting
Brian LaFollette, Turlock Irrigation District
George Davies, Turlock Irrigation District




SUBMITTED TO

California
Energy Commission

FOR

TID Almond 2 Power Plant

(09-AFC-02)

SUBMITTED BY

Turlock Irrigation District

TECHNICAL ASSISTANCE BY

CH2MHILL

February 2011

Geoarchaeological Pre Excavation Research Report

Report

Geoarchaeological Pre-Excavation Research Report

Prepared for

Turlock Irrigation District

February 2011

CH2MHILL
2485 Natomas Park Drive, Suite 600
Sacramento, CA 95833

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Acronyms and Abbreviations

A2PP	Almond 2 Power Plant
CEC	California Energy Commission
COC	Condition of Certification
CRHR	California Register of Historical Resources
kV	kilovolt
ma	million years ago
MLD	most likely descendant
MW	megawatt
NAHC	Native American Heritage Commission
PG	project geoarchaeologist
PG&E	Pacific Gas and Electric Company
ROW	right-of-way
TID	Turlock Irrigation District

Glossary

Alluvial Fan: Fan-shaped deposits of water-transported material

Alluvium: Sedimentary materials deposited by running water

Central Valley: See Great Valley.

Eolian deposits: Wind-transported sediment

Geological formation: A lithologically distinctive stratigraphic unit that is large enough in scale to be mappable at the surface or traceable in the subsurface

Geological units: See geological formation

Geomorphology: The science concerned with understanding the surface of the Earth and the processes by which it is shaped

Great Valley: A flat alluvial plain covering about 19,200 square miles between the Sierra Nevada and the Coast Ranges. Synonymous with the Central Valley.

Historic fill: Sediment deposited as part of historical construction.

Holocene: 10,000 B.P. to present. For the purpose of this report divided into the early Holocene (10,000 to 7,000 B.P.), the middle Holocene (7,000 to 4,000 B.P.), and the late Holocene (4,000 B.P. to present).

Levee: A linear berm or topographic high that normally runs parallel to a river channel. It is elevated above both the stream and its floodplain.

Modesto Formation: Composed of mainstream arkosic sediment and associated deposits of local derivation laid down during the last major series of aggradational events in the eastern San Joaquin Valley.

Pleistocene: 1.7 to 2.8 million years ago [ma] to 0.01 ma, or 10,000 B.P.

Pliocene: The epoch immediately preceding the Pleistocene, from about 5.3 ma to 1.7 to 2.8 ma.

Project vicinity: The area within one-quarter mile (about 1,300 feet or 400 meters) of the "reinforcement segment" right-of-way as defined in this report.

Physiography: The processes and patterns in the natural environment, which includes geomorphology.

Quaternary: A term referring to both the Pleistocene and the Holocene; useful in geological mapping when terminal Pleistocene and early Holocene sediments may be indistinguishable. In this report Quaternary sediments identified by Sowers et al. (1993) in the project vicinity are divided into four units:

Qhfl Holocene fan and terrace deposits of Little Salado Creek, ranging from gravels to silts

Qhr Basin rim and distal fan deposits; typically characterized by sands, silts, and clays and saline or alkaline soils

Qhlj Levee deposits of the San Joaquin River; unconsolidated sands and silt

Qhb Basin deposits of the San Joaquin River; flood-plain sediments representing the distal portion of overbank flows.

Riverbank Formation: Arkosic sediment, predominantly sand but containing scattered pebbles, gravel lenses, and some interbeded fine sand and silt; incises into and fills paleotopographic lows in the Turlock Lake Formation, and is incised by the Modesto Formation.

Sedimentary unit: See geological formation

Slough: A channel characterized by standing or slowly moving water, usually in a floodplain setting. The term is informally applied to a range of channel types, but they all share the characteristic of sluggish water.

Specimen preparation: The removal of excess rock and sediment from a fossil so that the fossil can be identified. Preparation may also include stabilization of the fossil using stabilizing agents such as Glyptal™.

Stratigraphic unit: See geological formation

SECTION 1

Introduction

As part of its proposed Conditions of Certification (COC) for the Almond 2 Power Plant (A2PP) project, the California Energy Commission (CEC) requires a detailed study of the geoarchaeology of a 1.8-mile-long segment of Pacific Gas and Electric Company's (PG&E) Line #215—referred to as the "reinforcement segment"—because of its proximity to the San Joaquin River, and because a prehistoric archaeological site had been recorded nearby. Riverine habitats such as those offered by the historic San Joaquin River and its floodplain were an important focus of prehistoric subsistence activities, and early authors emphasized that prehistoric settlements were frequent along the banks of these linear resource corridors. COC CUL-2 was therefore developed to address this information need for the A2PP project, and is summarized below:

> The project geoarchaeologist (PG) shall conduct geoarchaeological fieldwork research on the Reinforcement Segment construction right-of-way (ROW) and the San Joaquin River fluvial system landforms (floodplain, alluvial terraces, and various overbank deposits) in the immediate vicinity, using available geoarchaeological technical literature, remote imagery, site records, and observations from a field reconnaissance of the area. Review of the cultural resources data compiled during the AFC review process shall precede the field reconnaissance.
>
> 1. The results of the pre-excavation geoarchaeological research and field reconnaissance shall be submitted to the CPM in a Geoarchaeological Pre-Excavation Research Report that shall also include:
>   - A large-scale (• pipeline trench and surrounding landforms,
>   - Descriptions of identified landforms in and immediately around the construction ROW of the Reinforcement Segment,
>   - The geomorphic history of the study area,
>   - The hypothesized distribution of potentially sensitive subsurface conditions,
>   - The age, to the extent feasible, of the landforms on which the Reinforcement Segment would be located,
>   - The postulated distribution of Modesto Formation (Pleistocene and possible early Holocene) landforms versus post-Modesto Formation (postglacial or Holocene) landforms,
>   - Recommendations for the optimal location of pre-construction geoarchaeological excavations of a portion of the Reinforcement Segment pipeline trench (CUL-3) and
>   - A research design for these excavations, to follow the guidance below.

The research design shall include, but is not limited to the following elements:

- Geoarchaeological preconstruction excavations shall be located along the pipeline centerline to avoid additional impacts to buried cultural resources beyond that which would occur during construction along the Reinforcement Segment ROW.
- Unless otherwise specified in the approved Geoarchaeological Pre-Excavation Research Report, the excavations shall consist of backhoe trenches.
- The total depth of excavations shall be to the water table, or to the anticipated depth of the proposed pipeline installation, whichever is encountered first. The number of backhoe trenches appropriate to this study shall in no case exceed 4 trenches. Excavation methods shall include:
    a. the recordation of one measured profile from each backhoe trench to include reasonably detailed written descriptions of each lithostratigraphic and pedostratigraphic unit, a measured profile drawing, and a profile photograph with a metric scale and north arrow;
    b. the screening through ¼-inch hardware cloth of a small (three 5-gallon buckets) sample of sediment from the major lithostratigraphic units in each profile or from two arbitrary levels in each profile;
    c. collection of radiocarbon or TL (thermoluminescence) samples to date and/or correlate stratigraphic units and time horizons, with processing of these samples at the discretion of the PG, in consultation with the CPM; and
    d. implementation of a protocol to immediately inform the project owner of any buried prehistoric archaeological deposits encountered during geoarchaeological data collection and to facilitate informing the CPM.

2. At the conclusion of reconnaissance and initial data review, a meeting or teleconference with the CPM, the PG, and the project owner shall be held to review the results of the Geoarchaeological Pre- Excavation Research Report.

In response, this geoarchaeological assessment is being developed to address the possibility that prehistoric archaeological material may occur at depth along the reinforcement segment right-of-way (ROW), particularly that portion of the ROW closer to the river.

SECTION 2

Project and Area Description

The A2PP will be a nominal 174-megawatt (MW) facility consisting of three General Electric Energy LM6000PG SPRINT natural-gas-fired turbine generators and associated equipment. The facility will be located in Ceres, Stanislaus County, California, on an approximately 4.6-acre parcel (Figure 1).

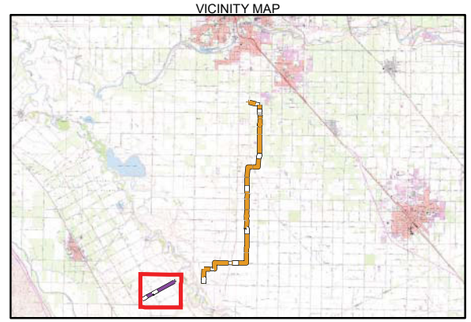
The power plant site is adjacent to the existing 48-MW Almond Power Plant to the south, a WinCo distribution warehouse to the west, a farm supply facility to the north, and various industrial facilities (mobile building distributor and drilling equipment storage laydown areas) to the east. It is located within the city limits of Ceres and is approximately 2 miles from the Ceres city center. Modesto is approximately 5 miles to the north. An approximately 6.4-acre parcel will be used for both construction parking and laydown areas.

The A2PP will be interconnected to the Turlock Irrigation District (TID) system via a 115-kilovolt (kV) transmission line, which will extend south to the proposed Grayson Substation North. The project will also require that TID re-rate 2.9 miles of an existing 69-kV sub-transmission line from the Almond Power Plant to the TID Crows Landing Substation that currently serves parts of the cities of Ceres and Modesto as well as surrounding rural areas.

Natural gas will be supplied to the A2PP from a new natural gas pipeline and reinforcement of an existing pipeline, which will be constructed and owned by PG&E. The new natural gas pipeline includes an 11.6-mile-long natural gas line that would extend in a southerly direction from the existing Almond Power Plant boundary and will join with PG&E's existing natural gas pipeline, Line #215, at W. Bradbury Road. The construction ROW for the pipeline will be 85 feet wide, and the permanent pipeline easement will be 50 feet wide. To cross under the Harding Drain and Crows Landing Road and other TID and improvement district canals, drains, and pipelines, a trenchless construction method will be used.

In addition, PG&E will reinforce a 1.8-mile long existing segment of Line #215 along the western side of the San Joaquin River. This "reinforcement segment" will require approximately 2 miles of trenching that, at its eastern limit, will approach to within approximately 2,000 feet of the San Joaquin River. The reinforcement segment ROW will parallel Prune Avenue, and will be offset southeast of the centerline of Prune Avenue (Figure 1). At its eastern terminus, the reinforcement segment will connect to the pre-existing pipeline that continues to and under the San Joaquin River. This work will occur about 600 feet southwest of the end of Prune Avenue at Paradise Avenue, and 300 feet from the edge of an unnamed slough that runs from southeast to northwest along the western edge of the San Joaquin River floodplain (Figure 1).

VICINITY MAP



LEGEND

PG&E NG ROUTES

- REINFORCEMENT SEGMENT
- OPEN CUT

ROW's

- GAS PIPELINE PROJECT BOUNDARY
- 200 FT. BIOLOGICAL STUDY CORRIDOR
- 85 FT. CONSTRUCTION CORRIDOR
- GEOLOGICAL UNITS

Qhfl = Holocene fan and terrace deposits of Little Salado Creek, ranging from gravels to silts
Qhr = Basin rim and distal fan deposits; typically characterized by sands, silts, and clays and saline or alkaline soils
Qhlj = Levee deposits of the San Joaquin River; unconsolidated sands and silt
Qhb = Basin deposits of the San Joaquin River; flood-plain sediments representing the distal portion of overbank flows.
Qhfo = Holocene fan and terrace deposits of Orestimba Creek (including Qhfo1)

Geological Data Reference:
Sowers, J. M., J. S. Noller, and W. R. Lettis. 1993. Preliminary maps showing Quaternary geology of the Patterson and Crows Landing 7.5-minute Quadrangles, California. U.S. Geological Survey Open-file report 93-223. Menlo Park, CA.

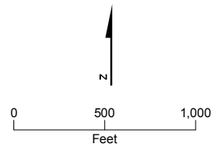


FIGURE 1
SURFICIAL GEOLOGICAL UNITS IN THE VICINITY OF THE REINFORCEMENT SEGMENT
ALMOND 2 POWER PLANT REINFORCEMENT SEGMENT
CERES, CALIFORNIA

SECTION 3

Prior Work and Archaeological Context

A comprehensive cultural resources records review for the vicinity of the reinforcement segment ROW was completed for this project, and those results are summarized in the final *Staff Assessment Almond 2 Power Plant Project (09-AFC-2)* (CEC, 2010). In addition, a detailed assessment of available studies of the surficial geology and geomorphology of the area was completed (Spaulding, 2010). The results of these studies are summarized in this section.

3.1 Late Quaternary Geology

For the east side of the San Joaquin River, the works of Atwater et al. (1986) and Marchand and Allwardt (1981) provide relatively detailed characterization of the surficial geology and geomorphology. Depositional sequences on the eastern side of the river are dominated by episodic mass wasting of debris from the Sierra Nevada more than 25 miles to the east, and accumulation appears to have been relatively slow to the extent that many surficial sediments are interpreted as being of Late Pleistocene age (i.e., the Upper Modesto Formation). On the west side of the river, where the reinforcement segment work will occur, deposition is most strongly affected by erosion from the foothills of the Diablo Range (Sowers et al., 1993), which are about 4 miles to the west of the western terminus of the ROW, and are composed of relatively soft marine sediment possessing intrinsically high erosion rates (Bull, 1963). Therefore, instead of the Pleistocene-age surfaces that occur on the east side of the river, surfaces on the west side of the river are younger and chiefly of Holocene age (the last 10,000 years [Bull, 1963; Sowers et al., 1993]).

The occurrence of archaeological materials in anything but latest Pleistocene (12,000 to 10,000 B.P.) sediment is very uncommon and frequently subject to dispute regarding stratigraphic context and/or anthropogenic origin (e.g., Morratto, 1986). In contrast, the record of prehistoric humans during even the early Holocene is clearly established. Therefore, consistent with the fact that sediments of sufficiently young age to be culturally sensitive appear to be limited to the east side of the river, and pursuant to COC CUL-2, the remainder of this reconnaissance report is restricted to the reinforcement segment ROW and vicinity on the west side of the San Joaquin River.

Surficial geological mapping on the west side of the San Joaquin River was completed by Sowers et al. (1993). The following geological units recognized by Sowers et al. (1993) are crossed by the reinforcement segment ROW or lie immediately adjacent to it:

Qhfl	Holocene fan and terrace deposits of Little Salado Creek, ranging from gravels to silts
Qhr	Basin rim and distal fan deposits; typically characterized by sands, silts, and clays and saline or alkaline soils
Qhlj	Levee deposits of the San Joaquin River; unconsolidated sands and silt

Qhb Basin deposits of the San Joaquin River; flood-plain sediments representing the distal portion of overbank flows.

For most of its distance the ROW crosses fan and terrace deposits of Little Salado Creek (Qhfl; Figure 1), and these alluvial sediments are derived from the Diablo Range to the west. This alluvium consists of unconsolidated silts, sands and gravels from the poorly lithified, easily eroded rocks comprising the Diablo Range within the catchment of Little Salado Creek. The distal portion of this limited alluvial fan is truncated by basin rim and distal fan deposits (Qhr) associated with the toe of the Little Salado Creek fan and overbank floods of the prehistoric San Joaquin River (Figures 1 and 2; Sowers et al., 1993). Closest to the river, the easternmost approximately 1,600 feet of ROW crosses sediment mapped as levee deposits of the San Joaquin River (Qhlj; ibid.; Figure 2). All of these units are Holocene age, although the fan deposits of Little Salado Creek also likely include terminal Pleistocene strata. These older alluvial facies would relate to the period of major geomorphic readjustment and slope destabilization that accompanied climatic changes at the end of the last Ice Age (e.g., Bull, 2001).

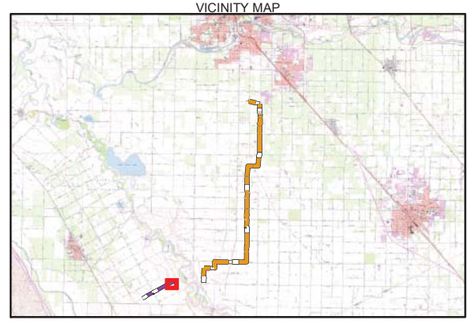
Sediments closer to the river are characterized as San Joaquin River basin deposits (Qhb) by Sowers et al. (1993). These lie chiefly east of the slough that marks the eastern terminus of the reinforcement segment ROW (Figure 2), and are floodplain deposits representing the distal facies of overbank flow. These and the levee deposits immediately to the west of the slough (Qhlj; Figure 2) are chiefly sediment from the San Joaquin River, and not the Diablo Range to the east.

3.2 Known Archaeological Record in the Vicinity

The known archaeological record in the immediate vicinity (less than one-quarter mile) of the reinforcement segment ROW consists of prehistoric site P-50-000218 (CA-STA-133). As recorded in 1962 (see CEC, 2010*)* this Native American archaeological site was likely the remnant of a larger site, and appears to have been located on a former levee that ran parallel to the slough near the eastern terminus of the ROW (Figure 2). In the mid-20th century the site consisted of midden material suggesting domestic refuse, and approximately six burials. The midden included fractured stone, shell, and animal and human bone, exposed on the surface of a cultivated field. The presumed abandoned levee that formed a topographic high upon which the cultural deposit rested, was destroyed by grading in 1952 and portions of the undisturbed subsurface midden, including the burials, were excavated circa 1962 (CEC, 2010). The original extent of the site, and whether any part of the site remains intact, is unknown.

The record for site P-50-000218 provides three sets of azimuths and distances from named roads and the slough immediately beyond the eastern end of the reinforcement segment ROW. Based on that record, the approximate location of site P-50-000218 was reconstructed as shown in Figure 2. It lies about 150 feet west of the historic slough, as well as on the margin of the San Joaquin River floodplain ("Qhb" by Sowers et al., 1993). The reconstructed position of this site is approximately 900 feet southeast of the eastern terminus of the reinforcement segment ROW (Figure 2).

VICINITY MAP



LEGEND

PG&E NG ROUTES
- REINFORCEMENT SEGMENT
- OPEN CUT

GEOMORPHIC FEATURES
- SITE 000218
- FEATURE 1 - LEVEE
- FEATURE 2 - BASIN MARGIN
- FEATURE 3- DROP IN ROAD GRADE
- FEATURE 4 - POSSIBLE PALEOCHANNELS
- FEATURE 3 - ROAD GRADE (50FT)
- FEATURE 4 - POSSIBLE PALEOCHANNELS

ROW's
- GAS PIPELINE PROJECT BOUNDARY
- 200 FT. BIOLOGICAL STUDY CORRIDOR
- 85 FT. CONSTRUCTION CORRIDOR
- GEOLOGICAL UNITS

Qhfl = Holocene fan and terrace deposits of Little Salado Creek, ranging from gravels to silts
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N

0 100 200
Feet

FIGURE 2
GEOMORPHIC FEATURES
ALMOND 2 POWER PLANT REINFOREMENT SEGMENT
CERES, CALIFORNIA

SECTION 4

Geomorphological Reconnaissance

4.1 Methods

The project geoarchaeologist (PG) conducted two field visits in the general vicinity of the reinforcement segment ROW. A pedestrian survey was conducted of the reinforcement segment ROW and a buffer area 100 feet to the south, and a "windshield reconnaissance" was conducted in the project vicinity within about 1 mile of the ROW to determine if additional information could be gleaned from minor topographic variations and changes in the physical characteristics of various surfaces. In addition, readily available remote imagery[1] was also used to identify geomorphic features that may be indiscernible on the ground, but visible from the air. This technique can be effective in areas where repeated tilling over the centuries has obliterated surface evidence of former geomorphic features, including larger archaeological sites. Although former topographic highs may have been flattened by agricultural practices, spatial variations in nutrients, chemical characteristics, and mineral content remain, and affect the vigor and color of new plant growth. These patterns can reflect the shape of otherwise indistinguishable surface features (e.g., Parcak, 2009).

4.2 Results of the Reconnaissance

The area lacks discernable geomorphic features because it is heavily cultivated. Figure 3 shows a view southeast to the reinforcement segment ROW. The approximate position of the ROW is marked by the power transmission poles, and the treeline beyond marks the location of the slough shown in Figure 2. The visibility of the ground surface was obscured because of crop growth, with an estimated 40 percent or less of the surface visible. However, contrasts in the color and lithology of the surface sediments could be easily seen, and matched the approximate places where Sowers et al. (1993) mapped the end of alluvial sediment and the beginning of fluvial sediment related to the San Joaquin River. Roadbed material (chiefly cobbles and gravel) could also be identified up to about 50 feet away from the edge of the pavement of Prune Avenue. No potential cultural material (such as fire-cracked rock, shell, bone) was noted on the surface during the pedestrian survey in the vicinity of the reinforcement segment ROW.

Remote imagery provided some indication of the presence of former geomorphic features in the immediate area. These features, along with a single feature detectable on the ground, are listed below and shown in Figure 2:

Feature 1: A darkened zone that parallels the course of the slough shown in Figure 2, along its western margin. As Prune Avenue and the reinforcement segment are approached, it can no longer be discerned. This is interpreted as the levee described in the site form for P-50-000218 that was flattened in 1952.

[1] To date, remote imagery examined has been that obtained through GoogleEarth™ and through commercial agreement with ESRI. The original images used to identify the relict landforms are available upon request.

Feature 2: A distinct zone of contrasting albedo (lower inboard, higher outboard) that is interpreted as the relict margin of a flood basin (see Feature 3). It is only discernable north of Prune Avenue.

Feature 3: A drop in grade of the Prune Avenue roadbed of approximately 2 feet over approximately 50 feet. This initially appeared incongruous but because it drops in an inboard direction it is now interpreted as reflecting the edge of the relict flood basin identified immediately to the north as Feature 2 (Figure 2). Additional considerations regarding this inferred geomorphic feature are discussed below.

Feature 4: In one remote image, two sinuous, darkened (low albedo) zones are visible in the agricultural field immediately southeast of Prune Avenue. These are provisionally interpreted as segments of paleochannels, based on their sinuosity, because they are evidently longer than wide, and because they possess boundaries that are distinct and relatively sharp on both "sides." Unfortunately, these segments are not long and their traces cannot be followed all the way north to Prune Avenue.

In determining that Features 2 and 3 reflect the same thing, the edge of a flood basin, the likely chronology of construction of Prune Avenue was considered. The road is depicted as paved in the U.S. Geologic Survey topographic map that accompanied the site form for site P-50-000218, and therefore it had to have been paved by at least the mid-20th century. It is likely that the pavement "sealed in" the original dip marking the edge of the flood basin, while all around the land has been leveled by more than 50 years of cultivation, obscuring all subtle elevational contrasts. Two of these three features, the relict levee associated with the slough (Feature 1) and the isolated channel segments (Feature 4), are proximal to the reconstructed position of site P-50-000218 (Figure 2).

4.3 Summary of Reconnaissance Findings

Neither field review nor remote imagery analysis revealed any paleotopographic features that could be associated with subsurface archaeological potential for most of the reinforcement segment ROW. However, in the last (easternmost) approximately 1,000 feet of the ROW, three geomorphic features were located in the immediate vicinity of the reinforcement segment ROW. While their identity cannot be confirmed at this point, their inferred nature (channel, flood-basin margin, and levee) is entirely consistent with their position on the edge of the historic floodplain of the San Joaquin River (Figure 1). Only the inferred flood-basin margin can be traced to the immediate vicinity of the ROW; the traces of the former levee and channels are not proximal to Prune Avenue (Figure 2), although they likely reached there before extensive agricultural disturbance occurred. The lack of features visible in remote imagery immediately south of the reinforcement segment ROW may be a result of extensive cut and fill activities near the end of Prune Avenue in historical times. It is reasonable to assume that the flood basin boundary (Features 2 and 3 in Figure 2) extended across both Prune Avenue and the reinforcement segment ROW. Other relict channel features, or extensions of those noted as Feature 4 in Figure 2, could also cross the reinforcement segment ROW. However, any detectable remains of the levee paralleling the slough (Feature 1 in Figure 2) may lie primarily east of where the reinforcement segment ROW terminates.

FIGURE 3
VIEW SOUTHEAST TO THE REINFORCEMENT SEGMENT ROW
ALMOND 2 POWER PLANT REINFORCEMENT SEGMENT
CERES, CALIFORNIA

EY012009003SAC Figure_3.ai 01.14.2010 tdaus

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SECTION 5

Research Design

5.1 Context

The identification of relict channels, and particularly the trace of a levee adjacent to the current slough, is consistent with the recorded topographic position and reconstructed location of prehistoric site P-50-000218 (Figure 2). These or similar topographic features are likely to have also occurred in the area crossed by the reinforcement segment ROW. The possibility that archaeological materials may be present at depth cannot be ruled out, even though the reconstructed position of site P-50-000218 lies well south of the ROW. There is consensus among archaeologists familiar with the site occurrences in the Central Valley that important prehistoric sites occurred in the vicinity of the San Joaquin River as well as other rivers, and logically (from the point of view of the exigencies of life in a seasonally inundated habitat) were sited on top of levees or other topographic highs in what is otherwise a relatively flat terrain (Figure 3). These types of features (levees, flood basin margins) can be expected to be most common in proximity to the current river course, and will be absent in areas away from the river, where geological processes are dominated by alluvium from the Diablo Range, which lies 5.6 miles to the west-southwest. Sowers et al. (1993) maps this transition from alluvial-fan dominated to river-dominated processes (and land forms) along the reinforcement segment ROW as lying about 1,600 feet east of Elm Avenue (the Qhfl/Qhr transition; Figure 1). Available remote imagery suggests that features such as floodbasin margins and levees are restricted to an area even closer to the river (Figure 2), or about a mile east of Elm Avenue and within the last (easternmost) 1,500 feet of the reinforcement segment ROW. This would be the substrate dominated by sediment described by Sowers et al. (1993) as "levee deposits of the San Joaquin River" (Qhlj; Figure 2). It is within this last 1,500 feet or so of the reinforcement segment ROW that it is recommended that geoarchaeological testing be focused. This is the portion of the reinforcement segment ROW that is closest to known site P-50-000218 (Figure 2).

5.2 Research Design Elements

5.2.1 Primary Data Sources

Excavation

Following COC CUL-2, the chief source of data for this research will come from geoarchaeological preconstruction excavations consisting of no more than three backhoe trenches along the planned centerline for the new pipeline reinforcement. The depth of these research excavations will be to the total depth of the planned reinforcement segment pipeline trench, assumed to be 1 foot deeper than the planned depth of the pipeline itself. If the water table is encountered before that depth is reached, the trench will be backfilled to the depth necessary to provide dry footing, and that will be the maximum depth of that particular trench.

As noted previously, the reconnaissance results indicate that geoarchaeological sensitivity is greatest along the easternmost portion of the reinforcement segment ROW. Therefore, three trenches will be located along the last 1,800 feet of the ROW, the area closest to the San Joaquin River and a known archaeological site. The trenches will be numbered in ascending order from east to west and, for the purposes of planning, their positions are measured from the eastern termination of the ROW in feet. Each trench will be a minimum of 200 feet (~60 meters)[2] long, and may be extended (except for the eastern terminus of Trench 1) at the direction of the PG as a result of observations made during backhoe operations. Each end of each trench will be sloped for access on foot (and for animal escape), and because the trenches are anticipated to extend below a depth of 5 feet, they will be shored. The width of each trench will be a minimum of 30 inches to allow movement of researchers in the trench (see below). Their location will be south of and parallel to Prune Avenue along the pipeline centerline, and be as follows:

Trench 1	0 to 200 feet west of the eastern end of the reinforcement segment ROW to investigate possible levee deposits associated with the slough immediately to the east.
Trench 2	350 to 550 feet west of the eastern end of the reinforcement segment ROW to intercept the interpreted transition to floodbasin environments to the east (Features 2 and 3 in Figure 2).
Trench 3	1,600 to 1,800 feet west of the eastern end of the reinforcement segment ROW to investigate in the vicinity of Sowers et al. (1993) mapped geological boundary between units Qhr and Qhlj.

Figure 4 identifies the approximate location of the trenches. The exact beginning and end points of each trench will be established in the field by the PG the day before trench excavation. Excavation will be directed by the PG or his designate, and will be monitored by a CEC-approved cultural resources monitor. Because it is likely to take more than one day to complete data gathering in the three trenches, a barricade plan will be made to keep them open safely overnight.

Remote Imagery

In addition to the subsurface data gained through excavations, additional remote imagery will be obtained and examined. The objective will be to better understand the geomorphic context of the study area, and to determine whether a broader-scale understanding of local paleotopographic variability may be developed. This will include selected historical black-and-white photos, as well as more recent satellite imagery, including energy bands other than the visible spectrum, if available.

[2] The metric system will be employed during the collection of stratigraphic and other technical data from the excavations.

LEGEND

- TRENCHES (APPROXIMATE LOCATION)

PG&E NG ROUTES
- REINFORCEMENT SEGMENT
- OPEN CUT

GEOMORPHIC FEATURES
- SITE 000218
- FEATURE 1 - LEVEE
- FEATURE 2 - BASIN MARGIN
- FEATURE 3- DROP IN ROAD GRADE
- FEATURE 4 - POSSIBLE PALEOCHANNELS
- FEATURE 3 - ROAD GRADE (50FT)
- FEATURE 4 - POSSIBLE PALEOCHANNELS

ROW's
- GAS PIPELINE PROJECT BOUNDARY
- 200 FT. BIOLOGICAL STUDY CORRIDOR
- 85 FT. CONSTRUCTION CORRIDOR
- GEOLOGICAL UNITS

Trench 1	0 to 200 ft west of the east end of the Reinforcement Segment ROW to investigate possible levee deposits associated with the slough immediately to the east.
Trench 2	350 to 550 ft west of the east end of the Reinforcement Segment ROW to intercept the interpreted transition to flood-basin environments to the east (Features 2 and 3)
Trench 3	1600 to 1800 ft west of the east end of the Reinforcement Segment ROW to investigate in the vicinity of Sowers and colleagues' (1993) mapped geological boundary between units Qhr and Qhlj.

Qhfl = Holocene fan and terrace deposits of Little Salado Creek, ranging from gravels to silts
Qhr = Basin rim and distal fan deposits; typically characterized by sands, silts, and clays and saline or alkaline soils
Qhlj = Levee deposits of the San Joaquin River; unconsolidated sands and silt
Qhb = Basin deposits of the San Joaquin River; flood-plain sediments representing the distal portion of overbank flows.
Qhfo = Holocene fan and terrace deposits of Orestimba Creek (including Qhfo1)

Geological Data Reference:
Sowers, J. M., J. S. Noller, and W. R. Lettis. 1993. Preliminary maps showing Quaternary geology of the Patterson and Crows Landing 7.5-minute Quadrangles, California. U.S. Geological Survey Open-file report 93-223. Menlo Park, CA.

N

0 100 200
Feet

FIGURE 4
TRENCH LOCATIONS
ALMOND 2 POWER PLANT REINFOREMENT SEGMENT
CERES, CALIFORNIA

5.2.2 Data Collection

Excavation methods will include the recordation of one measured profile from each backhoe trench, and the preparation of detailed descriptions of each lithostratigraphic and pedostratigraphic unit, and profile photographs with appropriate metric scales.[3] All pertinent larger-scale data points will be recorded with a Trimble GPS to within ±1 meter, such as trench end points and midpoint, the position of any topographic features of interest, and geographic referents such as the edges of paved roads, nearby transmission poles, and the centers of nearby intersections. Stratigraphic profiles will be constructed with the use of a horizontal control line or lines established with either a line-level or laser-level, and graduated in centimeters from a trench datum. Methodology will generally follow Waters (1992).

Sample Collection

Generally, sample collection will follow the natural stratigraphy, and taking "mixed samples" (those that combine sediment from either side of stratigraphic break) will be avoided. Unless they are planned for immediately processing, all samples will be refrigerated to retard fungal growth, which can quickly destroy their scientific utility.

Criteria for sample collection (amount collected, post-collection treatment) vary depending on the intended purpose of the sampled material. In these geoarchaeological investigations most sample analyses are directed at paleoenvironmental or chronological reconstruction. In each case, the relative position (horizontal distance(s) and sampled interval) of the sample will be recorded in the field notes.

Bulk Screen Sampling: A 15-gallon (57-liter) bulk sample will be collected from each major lithostratigraphic unit in each trench and screened through ¼ inch (0.64 cm) hardware cloth. If the stratigraphy is homogenous, samples will be taken from two arbitrary levels in each measured profile.

Radiocarbon Sampling: Bulk samples for the extraction of radiocarbon (^{14}C) datable organic material will be collected under the direction of the PG. These samples will be first checked for macroscopic carbon (including charcoal) before being reduced to collect the detrital carbon for ^{14}C dating. All ^{14}C dates will be corrected for stable isotope (^{13}C) content, and the ^{13}C isotope content reported separately for the purposes of paleoenvironmental interpretation. Sample storage will be in plastic containers.

Other Bulk Sampling: At the discretion of the PG, other bulk sediment samples may be taken for laboratory processing for sediment characterization, or for processing for such remains as small vertebrate bone and plant material including charcoal. Sample storage will be in plastic containers.

[3] The COC calls for a north arrow but because this is a vertical profile drawing, horizontal orientation is moot. The orientation of the trench wall to within ±2° will be recorded.

Thermoluminescence Samples: Will be taken with appropriate shielded sampling devices from arkosic strata at the discretion of the PG. To the extent that the nature of the sediment allows, stratigraphic sequences (from top to bottom) of samples will be collected. Sample storage will be sample tubes contained in water-proof packing.

Incidental Samples: Exposed charcoal, shell, or other non-cultural organic material that may be useful for either paleoenvironmental or chronological reconstructions will be collected under the direction of the PG. In most cases, these samples will be stored first in aluminum foil, and then in a water-tight plastic bag.

The use of thermoluminescence technology will be dependent in part on the availability of service within the time frame required to accommodate a May 2011 completion of these investigations.

Notification Protocol

This research design includes a protocol to immediately inform the project owner of any buried prehistoric archaeological deposits encountered during geoarchaeological data collection, and to facilitate informing the Compliance Project Manager in coordination with the project owner.

If human remains are encountered, State Health and Safety Code Section 7050.5 states that no further disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code Section 5097.98. The County Coroner must be notified of the find immediately. If the remains are determined to be Native American, the County Coroner will notify the Native American Heritage Commission (NAHC), which will determine and notify a "most likely descendant" (MLD). The MLD may inspect the site of the discovery with the permission of the landowner, or his or her authorized representative. The MLD shall complete its inspection within 48 hours of its notification by the NAHC. The MLD may recommend scientific removal and analysis of human remains and items associated with Native American burials.

5.2.3 Analysis and Report

Analyses of the data gained will focus on developing a descriptive geomorphic history of the portion of the reinforcement segment ROW that lies closest to the San Joaquin River. The chief tools utilized will be the stratigraphic profiles and photographs, and the geochronological data provided by the ^{14}C and thermoluminescence samples. The report will include the following information:

- A master stratigraphic column that characterizes the stratigraphy of the subject portion of the reinforcement segment ROW, including a description and interpretation of the approximate age of the stratigraphic subdivisions reflecting shifts in depositional history and time ranges that correspond to the prehistory and history of the region

- The results of the study placed in the context of what is known of the area's Quaternary geomorphology and environmental history

If buried archaeological deposits are encountered during the geoarchaeological investigations, the final report will also include the following information:

- Descriptions of any encountered archaeological deposits, including an assessment of the lateral and vertical extents of each such deposit, descriptions of the material culture content, and the character of the sedimentary matrix for each deposit, and an assessment of the approximate age of each deposit
- A preliminary interpretation of the character of the prehistoric or historic land use that each encountered archaeological deposit represents, to the extent that data are available that speak to these questions
- Recommendations, on the basis of the data available, where and to what depth archaeological monitoring should be conducted during construction of the reinforcement segment
- An assessment of the potential necessity and the approximate cost of mitigating project impacts to any California Register of Historical Resources (CRHR) -eligible buried archaeological deposits found during the geoarchaeological study, and recommended options for project re-design to avoid any potential CRHR-eligible deposits found
- Copies of completed DPR 523 forms for any archaeological deposits encountered and recorded

SECTION 6

References

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