Revised Supplemental Response to CEC Data Requests Set Two: Data Request No. A151

Amended Application for Certification for HYDROGEN ENERGY CALIFORNIA (08-AFC-8A) Kern County, California

Prepared for:
Hydrogen Energy California LLC

hydrogen energy california

Submitted to:

California Energy Commission

U.S Department of Energy

Prepared by:

URS

March 2013

**REVISED SUPPLEMENTAL RESPONSE TO DATA REQUEST A151
FROM CALIFORNIA ENERGY COMMISSION (CEC)**

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LIST OF ACRONYMS AND ABBREVIATIONS USED IN RESPONSES

AFC	Application for Certification
ARSA	Archaeological Resources Study Area
BP	years before present
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CO_2	carbon dioxide
CRHR	California Register of Historical Resources
CRMMP	Cultural Resources Monitoring and Mitigation Plan
DOE	(U.S.) Department of Energy
DPR	Department of Parks and Recreation
EHOF	Elk Hills Oil Field
HDD	horizontal directional drilling
HECA	Hydrogen Energy California
IGCC	Integrated Gasification Combined Cycle
NEPA	National Environmental Policy Act
OEHI	Occidental of Elk Hills, Inc.

Technical Area: Cultural Resources
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INTRODUCTION

All responses to these Data Requests containing references to specific archaeological site location or information, or cultural resources of concern to Native Americans, should be submitted under a request for confidentiality.

BACKGROUND

The detailed geoarchaeological study provided as Data Response 77 convincingly argues that much of the proposed project is to be located in areas with high sensitivity for buried cultural resources. The project footprint, process water pipeline, and transmission line are all planned for Quaternary Alluvium (Qa), which has high cultural resources sensitivity. The CO_2 pipeline would cross three soil types (Qb, Qa, and QTt), which have high, medium, and low sensitivity, respectively. The new natural gas pipeline route would also extend across multiple soil types (Qb and Qoa), resulting in one-third of the route crossing areas of high sensitivity and the remainder in areas of low sensitivity (Data Response 77, Table 77-1 and Fig. 77-5). Based on previous archaeological survey and excavation in the HECA project vicinity, it is clear that as-yet- unidentified buried sites are likely to be prehistoric village sites with human remains.

Staff assumes parts of the project site and project linear facilities rights-of-way (ROWs) have been disturbed by agriculture to a depth of 3 feet, but considerable proposed project ground disturbance would exceed that depth. The ground disturbance resulting from the construction of equipment installations at the plant site would be likely to extend as deep as 10 feet below the surface. The CO_2, natural gas, and process water pipelines would be installed at least 5 feet below grade. The amount of relatively deep ground disturbance proposed in an area sensitive for archaeological resources is considerable.

Because of the high archaeological sensitivity through much of the project site and along project linear facilities rights-of-way (ROWs), staff expects that archaeological monitoring will be required during construction. During the April, 2010 Workshop, staff proposed selected geoarchaeological field sampling within the project area to obtain more project-specific information. Energy Commission staff believes this would help focus the monitoring effort and would result in better protection for the resources (per the State Historic Preservation Office).

The applicant should also be aware that once geoarchaeological field sampling has refined our understanding of the parts of the project area with the highest archaeological sensitivity, a subsurface inventory survey employing backhoe trenches may be required in some of these areas to identify extremely sensitive resources.

The applicant agreed to design a plan and conduct geoarchaeological field sampling “once a development plan has been finalized for the Project Site” (April, 2010 Workshop Response 23). As of the date of this filing, staff has not received this plan. While staff understands that some of the project elements are still being refined, staff considers most of the project elements to be sufficiently developed for a plan to be prepared and field sampling to take place. Staff must establish a factual basis for the assessment of potential effects to buried deposits within the project impact areas and development of monitoring conditions for the project.

DATA REQUEST

A151. Please prepare a primary geoarchaeological field study research plan for the project plant site and linear facility corridors. The plan must be prepared by a prehistoric archaeologist who, at a minimum, meets the U.S. Secretary of Interior's Professional Qualifications Standards for prehistoric archaeology, as published in Title 36, Code of Federal Regulations, part 61, and whose résumé includes the completion of graduate-level coursework in geoarchaeology, physical geography, geomorphology, or Quaternary science, or education and experience acceptable to cultural resources staff. A résumé demonstrating the geoarchaeologist's qualifications should be included with the proposed plan. The plan shall include soil profiling within the Project Site where the deepest trenching would occur and along the linear facilities at old stream or water crossings. Submit the research plan for staff approval.

REVISED SUPPLEMENTAL RESPONSE

As presented in the previous response to Data Request A151 submitted to the California Energy Commission (CEC) on October 10, 2012, and as further explained when discussing Data Request A195 with CEC staff, the Applicant still questions the value of a geoarchaeological investigation given the high archaeological and/or geoarchaeological sensitivity of the entire Project area, and the ultimate necessity of complete archaeological monitoring for the duration of project-related ground-disturbing activities. Nevertheless, to accommodate staff's desire for this information, the Applicant has prepared a plan outlining our proposed approach for conducting the requested geoarchaeological investigation.

The plan set forth below provides details regarding field study and reporting activities and is accompanied by Revised Figure A151-2 and Figure A151-3. These figures depict the locations of known archaeological resources, and therefore are submitted under confidential cover. The Applicant is currently approaching landowners along the Project linears to obtain approval for conducting subsurface activities at 22 proposed trenching locations along the Project linears. Subsurface work and access to most of the Project linears has not been granted; therefore, Revised Figure A151-2 currently only depicts 10 proposed trenching locations within the Project Site and Controlled Area (eight are proposed on the Project Site and two are proposed on the carbon dioxide [CO_2] linear in the Controlled Area) and one location along the natural gas linear / railroad spur (Figure A151-2 has been revised to show this trench location). If additional approvals are obtained from the landowners along the Project linears, the Applicant will submit a revised figure showing additional trenching locations. The activities described below are intended to apply to all trenching locations, including the locations within the Project Site and Controlled Area, and the locations along the Project linears (where and when access is granted).

Per CEC staff request, the following geoarchaeological field study has been designed to meet staff's needs to better understand subsurface conditions, and the process geomorphology that comprises the Project area.

SECTION 1 INTRODUCTION

The purpose of the proposed investigation is primarily to provide key information necessary to the understanding of two related aspects of the historic character of Project area landforms: (1) the potential for each landform to harbor intact buried archaeological deposits, greater than 1 meter in depth (i.e., geoarchaeological sensitivity); and (2) the potential for surface archaeological sites, identified through pedestrian surveys, to have an associated shallowly buried component, based on the near-surface developmental characteristics of the landform on which each site is situated. In each of these cases, the level of effort and methodology should be commensurate with the degree of potential Project-related impacts to archaeological resources. Subsurface field investigations will be targeted to assess those areas with the highest potential for containing buried archaeological deposits and/or stratigraphic units of appropriate age to better refine our understanding of the post-terminal Pleistocene geomorphic evolution of the Project area.

This research plan includes the Project description, the definition of the geoarchaeological study area, the fieldwork methods, and the research design, which is intended to guide the identification of potentially archaeologically sensitive landforms and any associated cultural resources. For background information relevant to the Project and this research plan, please refer to the previously submitted archaeological technical report (Hale et al., 2012) which includes a geoarchaeological assessment by URS Senior Geoarchaeologist Jay Rehor. Relevant background discussions found in the report include: Environmental Setting, Geologic and Geomorphic Setting, Hydrology and Paleoclimate, Project Area Soils and Geoarchaeology, and a preliminary Landform Sensitivity Assessment. This final background section of the geoarchaeological analysis includes a discussion of the processual landform development of the Project area. The technical report analyzed existing data sources, including geologic and soils mapping of the Project area, previous geoarchaeological studies, and the results and implications of archaeological excavations.

This research plan is intended to address a range of geomorphic features that occur within the Project area and provide a preliminary basis for determining the possibility of the Project to affect subsurface cultural resources as well as provide a context for documented surficial archaeological sites.

1.1 PROJECT DESCRIPTION

Hydrogen Energy California LLC (HECA LLC) is proposing an Integrated Gasification Combined Cycle (IGCC) polygeneration project (HECA or Project). HECA LLC is owned by SCS Energy California LLC. The HECA Project will gasify a 75 percent coal and 25 percent petroleum coke fuel blend to produce synthesis gas (syngas). Syngas produced via gasification will be purified to hydrogen-rich fuel, which will be used to generate low-carbon baseload electricity in a Combined Cycle Power Block, low-carbon nitrogen-based products in an integrated Manufacturing Complex, and CO_2 for use in enhanced oil recovery (EOR). CO_2 from HECA will be transported by pipeline for use in EOR in the adjacent Elk Hills Oil Field (EHOF), which is owned and operated by Occidental of Elk Hills, Inc. (OEHI). The EOR process results in sequestration (storage) of the CO_2.

The 453-acre HECA Project Site is approximately 7 miles west of the city of Bakersfield, and approximately 2 miles northwest of the unincorporated community of Tupman in western Kern County, California. The HECA Project Site is adjacent to the EHOF. HECA has an agreement to purchase the HECA Project Site, as well as an additional 653 acres adjacent to the HECA

Project Site, herein referred to as the Controlled Area. The HECA Project Site and Controlled Area are currently used for farming purposes, including the cultivation of cotton, alfalfa, and onions.

The HECA Project includes the following linear facilities, which extend off the Project Site:

- **Electrical transmission line.** An approximately 2-mile-long electrical transmission line will interconnect the Project to a future Pacific Gas and Electric Company (PG&E) switching station east of the Project Site.

- **Natural gas supply pipeline.** An approximately 13-mile-long natural gas interconnection will be made with PG&E natural gas pipelines north of the Project Site.

- **Water supply pipelines and wells.** An approximately 15-mile-long process water supply line and up to five new groundwater wells will be installed by the Buena Vista Water Storage District to supply brackish groundwater from northwest of the Project Site. An approximately 1-mile-long water supply line from the West Kern Water District east of the Project Site will provide potable water.

- **Rail Spur**. A new rail spur will be constructed to the Project Site to facilitate feedstock and equipment delivery, as well as product and by-product off-take. The rail spur will extend approximately 5 miles from the existing San Joaquin Valley Railroad to the Project Site.

OEHI Project

OEHI will be installing the CO_2 pipeline from the HECA Project Site to the EHOF, and installing the EOR Processing Facility, including any associated wells and pipelines needed in the EHOF for CO_2 EOR and sequestration. The following items briefly describe the OEHI Project:

- **CO_2 EOR Processing Facility.** The CO_2 EOR Processing Facility and 13 satellites are expected to occupy approximately 136 acres within the EHOF. The facility will use 720 producing and injection wells: 570 existing wells and 150 new well installations. Approximately 652 miles of new pipeline will also be installed in the EHOF.

- **CO_2 pipeline.** An approximately 3-mile-long CO_2 pipeline will transfer the CO_2 from the HECA Project Site south to the OEHI CO_2 EOR Processing Facility.

1.2 FEDERAL AND STATE AGENCIES

The U.S. Department of Energy will be the lead agency under the National Environmental Policy Act (NEPA) because the Department of Energy is providing financial assistance to the HECA Project under the Clean Coal Power Initiative Round 3. The CEC is the lead agency under California Environmental Quality Act (CEQA) and has a certified regulatory program under CEQA. This work plan has been designed to provide information relevant to Federal Section 106 of the National Historic Preservation Act and CEQA cultural resources compliance.

1.3 GEOARCHAEOLOGICAL STUDY AREA

The geoarchaeological study area is currently assumed to be equivalent to the Archaeological Resources Study Area (ARSA) as defined in the aforementioned archaeological technical report

(Hale et al., 2012). The delineation of the ARSA was determined based on the CEC Rules of Practice and Procedure and Power Plant Site Regulations and Designation of Transmission Corridor Zones, Appendix B (g)(2)(C) (CEC, 2008). For the purpose of this Project, both the ARSA and the geoarchaeological study area are equivalent to an Archaeological Area of Potential Effects in compliance with the Section 106 process (36 CFR §800.16 [d]).

SECTION 2 SUMMARY OF PROJECT AREA LANDFORMS AND GEOARCHAEOLOGICAL SENSITIVITY

As discussed in Section 1, the geoarchaeological assessment presented in the previously submitted archaeological technical report (Hale et al., 2012) provides substantial background on the nature and development of the landforms within the Project area, and the broad presumed sensitivity of those landforms based on existing data sources. Rather than reiterating the extensive background information and supporting data relevant to conclusions made in the report, this section provides a summary of the major findings and conclusions pertinent to the research questions and work plan outlined in the following sections of this plan.

An assessment of available literature and comparison with high-resolution aerial photography and a digital elevation model identified five major landforms within the HECA Project geoarchaeological study area. These landforms are generally coincident with the Quaternary geology units mapped by Dale, French, and Gordon (1966) and shown on Revised Figure A151-2. These landforms, and their presumed potential to harbor buried archaeological deposits, are summarized in Table A151-1.

The five major landforms within the Project area are:

1. **The Elk Hills uplands (QTt)** are formed by a structural anticline which has elevated older deposits above the surrounding valley floor and exposed them to erosion. This unit is largely composed of the Tulare Formation, which is of Plio-Pleistocene age. Given its age and erosional nature, this landform is not considered sensitive for buried archaeological resources, and any prehistoric resources present at the surface are unlikely to have a significant subsurface component.

2. **The Alluvial Fan Piedmont (Qa)** forms the middle and lower portion of the Elk Hills, and is composed of a series of alluvial fans, formed through the erosion and redeposition of sediments from the upper portions of the Elk Hills by numerous small ephemeral drainages. Based on soil series descriptions and radiocarbon dates, the surface of the fans are interpreted as dating to the Late Holocene (<4,000 BP). However, based on numerous excavations and observations of subsurface stratigraphy within the alluvial fans of the Project area, it appears that the sensitivity for buried archaeological sites is greatly reduced by consistently observed erosional subsurface contacts. Therefore, the sensitivity for buried archaeology—with no surface manifestation—within the Elk Hills fan piedmont is considered low. Increased sensitivity can probably be anticipated for the lowest portions of the fans (within about 500 meters from their termination at Buena Vista Slough) because of two factors: (1) proximity to the slough, its increased resource productivity, and greater likelihood of related archaeological deposits; and (2) increased sediment accretion at the fan toe, with moderate potential for site burial and preservation.

Table A151-1
Summary of Anticipated Geoarchaeological Sensitivity of Landforms within the HECA Project Area

Landform (map unit)	Surface Age	Depositional Regime	Sensitivity
Elk Hills Uplands (QTt)	Pliocene to Pleistocene	Erosional	Very Low
Elk Hills Alluvial Fan Piedmont (Qa)	Late Holocene	Variable	Low to Moderate
Basin/Slough Deposits (Qb)	Late Holocene	Depositional	High
Uplifted and Preserved Older Valley Deposits (Qoa)	Pleistocene	Erosional (?)	Very Low
Kern River Alluvial Fan (Qya)	Late Holocene	Depositional	High

3. **Buena Vista Slough (Qb)** is composed of basin sediments that have filled the structural syncline between the Elk Hills and Buttonwillow Ridge. The vast majority of sediments within this portion of the geoarchaeological study area are likely very fine organic-rich sediments, related to deposition associated with episodic overflow from Buena Vista Lake and filling of the Buena Vista Slough; which stretched to the south shore of Tulare Lake during wet periods. Sensitivity of this landform for buried archaeological resources is likely highly variable. In general, wet marshlands are not amenable to prehistoric habitation. However, the extent of the marshlands likely varied seasonally and from year to year, with the possibility of drier elevated areas within the slough that would have been available for occupation. Even more likely, however, is the potential occupation of the edge of the slough, to the east and west, on the Qa and Qoa (see below) landforms, which then may have been buried by fine-grain marsh sediments during wetter periods. This type of depositional history was observed at archaeological site CA-KER-116, along the edge of Buena Vista Lake.

4. **Older Valley Deposits (Qoa)** are located to the north and east of Buena Vista Slough, and appear to represent the differential preservation of older alluvial deposits through tectonic uplift. Buttonwillow Ridge is likely formed by a deep structural anticline which has uplifted and preserved older valley deposits above the younger basin and fan deposits that surround the feature. This unit is composed of up to 250 feet of Pleistocene-age lenticular deposits of clay, silt, sand, and gravel that are loosely consolidated to cemented, and which are often indistinguishable from the Tulare Formation. These uplifted older sediments are mantled to the south and west by basin sediments of Buena Vista Slough, and to the north and east by younger alluvium of the Kern River Fan. A few areas of discrepancy between the quaternary landform mapping (Revised Figure A151-2) and soil-age association mapping (Figure A151-3) can be observed on the included figures. With regard to the Project area, these discrepancies are largely associated with areas mapped as Kimberlina series soils (e.g., at western portion of transmission line and switching station).

5. **The Kern River Alluvial Fan (Qya)** is the final major landform present within the Project area, and is the result of deposition by the Kern River as it spreads out from the confines of the Kern River Canyon onto the southern San Joaquin Valley. The change in slope, in conjunction with the large sediment load-carrying capacity of the river, results in a massive alluvial fan that stretches over 20 miles from the base of the Sierra foothills, across the valley, to the western terminus at the Elk Hills. The landform, within the Project area, is considered sensitive for buried archaeological resources, given the young age and actively accreting nature of the fan, as well as the proximity to the Buena Vista Lake outlet channel and the distinct environmental resources provided by both the Buena Vista Slough and Lake.

SECTION 3 RESEARCH DESIGN

A research design provides a framework and theoretical context for project goals, field methods, discussion and interpretations of geomorphic features, and recommendations for future studies (and data needs). The research design provided herein is for a geoarchaeological study conducted through geoarchaeological test excavations.

3.1 RESEARCH ISSUES

This section explicitly enumerates the research questions, data needs, and sampling strategy used to facilitate the development of refinements to the initial geoarchaeological study, to better assess the geoarchaeological sensitivity and developmental history of documented landforms.

3.1.1 Research Questions

The following research questions will guide the implementation of the research design to further refine our understanding of the landforms of the Project area, and to further document and refine the genetic and historical relationships among them. The research questions will also guide the documentation of each pertinent landform's particular stratigraphy; interpretation of the energy regimes that led to the sedimentary deposition of each landform; interpretation of the chronology and duration of pedogenic processes that may have occurred for each landform; and help discern whether the deposition of particular landform components was synchronous or may have been time transgressive.

Question 1: Can further refinement of landform designations and chronological associations developed in Rehor's initial geoarchaeological assessment (Hale et al., 2012) be achieved? Landforms within the Project area have been designated based on existing Quaternary geologic mapping and cross-verification with aerial photography and elevation models. The age of these landforms is derived from several sources, including previous geologic studies, geotechnical investigations, and previously published soil series/ radiocarbon age associations.

Each landform has been ascribed to a broad chronological sequence; however, the precise timing of local depositional events is unknown. For those landforms that fall within or near the latest Pleistocene (i.e., Qoa), exact timing of deposition, and subsequent stability (pedogenesis) or burial is crucial in determining the potential for buried archaeological deposits associated with the landform.

Question 2: Following from Question 1, there appears to be some discrepancy between existing age determinations within the Project area. In particular, areas mapped as Qoa within the vicinity of the electrical switching station and portions of the natural gas pipeline, are designated as Kimberlina soils on soils maps. Tentative radiocarbon dates associated with this soil series place it well within the latest Holocene (<2,000 BP). Are these areas of discrepancy the result of incorrect soils mapping, or does the quaternary mapping inaccurately depict the variability in surface age?

Question 3: For those landforms determined to have a depositional chronology and energy regime conducive to sensitivity for buried cultural resources (especially the contacts between the Qb and surrounding alluvial landforms), can the subsurface conditions be identified and documented? Specifically, can the lithostratigraphic and pedostratigraphic units that comprise the landforms, the age, duration and tempo of pedogenic processes, energy regimes and depositional environment, and subsequent preservation of those units be identified and documented? If so, this will allow for a refined assessment of the potential for buried archaeological deposits, and the likely nature, age, and depth of those deposits.

Question 4: In addition to refining the subsurface conditions of potentially sensitive depositional landforms (Question 3) can the variation across and within those landforms be established and documented, in order to better define spatial variability in the geoarchaeological sensitivity of each landform? Given the present understanding of regional landscape formation, there is high confidence that areas with the, for example, Qa or Qb landforms are internally similar to other such areas laterally across the Project area.

However, what is not well documented is the variability in deposition linearly across the broader landforms. For example, can buried portions of the Qb landform be identified which have subsurface sediments representative of stable dry land, rather than wetland-type sediments, which might be more conducive to human occupation? Alternatively, are there areas of deep sediments that were deposited too rapidly to have been likely to have preserved primary artifact associations, versus those areas with a slow processual deposition, which is conducive to site formation and the preservation of these primary associations?

Question 5: One issue raised in Rehor's initial geoarchaeological assessment (Hale et al., 2012) is the relationship between the occupation of identified archaeological sites, and the timing of Buena Vista Lake highstands, which would have correlated with increases in the size and, presumably, productivity of Buena Vista Slough. For example, widespread occupation of the Elk Hills appears to have occurred towards the end of the Medieval Climatic Anomaly and during the Little Ice Age (ca. 650 BP). These periods would have correlated with increased precipitation and resulted in more consistent and predictable wetlands within the slough, which would have favored the establishment of more long-term habitation and resource exploitation sites. Can periods of slough expansion be identified in the stratigraphic record, which could be correlated with existing and future archaeological investigations in the area?

Question 6: For those landforms that may contain surface archaeological sites, but are too old to contain buried archaeological deposits, can the subsurface relationship between the old landform and any adjacent younger landforms be defined, as there is the potential for buried archaeological sites at that subsurface contact? Specifically, for landforms that have been determined to be of latest Pleistocene (ca. 16,000 BP) age or older (i.e., the Qoa landform) and are buried by younger deposits (Qb and Qya), the nature of the buried contact (whether stable or erosional) is of particular importance to the potential for buried archaeology. The areas of contact between the major landforms also have a higher sensitivity because archaeological sites in California are very often associated with ecotones—ecological areas at the intersection of two or more biotic communities—which are themselves generally associated with variability in the underlying soils and geomorphology (Moratto, 1984:589).

Question 7: Finally, for landforms that contain surface archaeological sites, can the near-surface nature of the landform be characterized to understand the potential, or lack thereof, for subsurface components associated with the sites? For example, if a landform is shown to have been deposited in a very high energy setting, the potential for significant near-surface archaeological deposits is minimal; alternatively, if the surface of a landform can be shown to have accreted slowly through low-energy alluvial or eolian deposition, the potential is much higher.

3.1.2 Data Needs

The following sources of data are needed in order to address the research questions outlined above:

- Representative subsurface profiles of potentially sensitive depositional landforms, with adequate spacing to demonstrate lineal variation within each landform.

- Sufficient exposure and examination of profiles to delineate major pedostratigraphic units (e.g., paleosols and buried landforms), time-transgressive depositional sequences within units, and relevant unconformities within and between the major landforms within the geoarchaeological study area.

- A higher number of representative profiles at or near the intersection of different landforms, to demonstrate the relationship between those landforms and due to the increased geoarchaeological sensitivity of ecotones.

- Datable organic material (charcoal, shell, bulk organic sediments, etc.) to establish the chronology of Project landform evolution. The need for excessive radiometric dating of each landform is mitigated by the expected internal consistency within each landform. Particular marker beds are expected to have unique pedogenic signatures (grain size, color, structure, etc.) which can be easily correlated between excavation units and which allow for dates obtained from one profile exposure to be confidently correlated to other profiles.

3.1.3 Summary

The primary focus of the new phase of geoarchaeological research will be the excavation and exposure of representative profiles in those portions of the Project area where the sedimentary landforms identified during the initial geoarchaeological analysis were determined to have a potential for buried archaeological deposits, and where the construction and operation of the Project would disturb native ground to a depth of greater than 1 meter. In addition, a small portion of the excavations will be used to confirm assumptions of older landforms and/or clarify discrepancies between existing data sources.

This refined data set, and the interpretation of it, will allow for a more complete understanding of the geomorphic evolution of the Project area, and the association of surficial archaeological sites to that landform development, as well as the relative potential for the Project to impact buried archaeological resources.

SECTION 4 FIELD METHODS

The following sampling strategy and fieldwork protocols will guide the Applicant's implementation of the research plan to further refine the geographic extents of the Project area's constituent landforms, and to further document and refine the timing and evolution of those landforms. The strategy and protocols will also guide the documentation of each pertinent landform's particular stratigraphy; interpretation of the energy regimes that led to the sedimentary deposition of each landform; interpretation of the chronology and duration of pedogenic processes that may have occurred for each landform; and discernment about whether the deposition of particular landform components was synchronous or may have been time transgressive.

4.1 PROJECT DISTURBANCE AND ASSOCIATED LEVEL OF EFFORT

The primary purpose of the investigation is to provide key information necessary to our understanding of two related aspects of the historic character of Project area landforms: (1) the potential for each landform to harbor intact buried archaeological deposits more than 1 meter below surface (i.e., geoarchaeological sensitivity); and (2) the depositional history of the major landforms as it pertains to surface archaeological sites.

In each of these cases, the level of effort and methodology should be commensurate with the degree of potential project-related impacts to archaeological resources. Table A151-2 shows each of the Project elements, depicted on Revised Figure A151-2 and Figure A151-3, and the maximum depth of subsurface impact associated with those elements.

The largest single area of potential archaeological resource impact is associated with the HECA Project Site. The majority of impacts (approximately 90 percent) within this area are associated with foundations for facility equipment, which are expected to be between 5 and 10 feet deep. Excavations in areas such as the gasification structure, the cooling tower pump basin, and the feedstock unloading bunker will be to depths in the range of 15 to 50 feet below existing grade. Given the concentration of these impacts, and the location of the Project Site exclusively within sensitive Qb deposits, eight geoarchaeological excavation locations are proposed, in association with the locations of proposed facility elements identified in initial conceptual designs.

Table A151-2
Depths of Disturbance by Project Component

Project Component	Maximum Depth of Disturbance (feet)
HECA IGCC Polygeneration Facility (Project Site)	50
Rail Spur	3
Electrical Transmission Line	35
PG&E Switching Station	9
Natural Gas Supply	7
Water Supply Pipelines	5 (process water) 6 (potable water)
CO_2 Pipeline	7 (trenching) 50 to 100 (HDD)
CO_2 EOR Processing Facility	50

The excavation for the railroad spur bed is anticipated to be between 6 inches and 3 feet deep, with an average of 2 feet. The construction staging area may require minimal grading. As such, neither of these Project elements is considered to have a significant potential impact on archaeological resources that are not at least partially evident at the surface.

For the electrical transmission line, foundations of on tangent towers (straight line towers) will be approximately 28 feet deep, and foundations of turning towers will be approximately 35 feet deep. The electrical transmission line extends for 2 miles east of the Project Site and is expected to include approximately 15 towers. The impacts will be confined to the specific tower footprints, and thus will be minimized.

Two geoarchaeological excavation are proposed to be placed where the transmission line is coincident with the Qb landform, and one where it crosses the Qoa landform. This number of trenches is considered to be sufficient to document lateral variability across the transmission line. The most easterly excavation unit, located on the Qoa landform, will also coincide with the electrical switching station, which will have a maximum excavation depth of 9 feet. This location also coincides with the area where soils and quaternary geologic mapping show some discrepancy, and will serve in addressing research Question 2. Lastly, prehistoric archaeological site HECA 2010-2 is adjacent to the switching station and the geoarchaeological trench, and will also serve the purpose of anticipating the potential for a subsurface component to be present within the prehistoric archaeological site.

The natural gas pipeline is approximately 13 miles long. The maximum excavation depth for the natural gas pipeline is expected to be approximately 7 feet. At the interconnection a metering station will be constructed; the metering station will be up to 100 feet square and will be excavated to approximately 6 feet deep. Approximately 7.4 miles of the pipeline is located on areas mapped as Qoa landform, 4.9 miles as Qb, and 0.7 mile as Qya.

Ten geoarchaeological excavation units are proposed along the natural gas pipeline. Six of those would be within the Qb landform, primarily where the pipeline runs parallel to and near the contact with Qoa; two within the Qya landform, near either contact zone with the Qoa; and two within the Qoa. The excavation units are proposed to confirm the antiquity and lack of geoarchaeological sensitivity of each landform. In addition, one of the proposed trenches is placed close to (within approximately 500 feet of) prehistoric archaeological site HECA 2012-1 to assess the potential for a subsurface component to appear within the prehistoric archaeological site.

Potable water for construction, drinking, and sanitary use will be delivered from a new West Kern Water District potable water production site approximately 1.3 miles east of the HECA Project Site. The potable water pipeline will be placed within a trench excavated to a depth of 6 feet. The alignment for the potable water line is entirely within the Qb landform and is coincident with the transmission line. As such, results from the transmission line excavations will be applicable to the potable water line.

The process water supply pipeline will be approximately 15 miles long. It will be in a trench expected to be up to 5 feet deep that will be excavated within the road atop the levee adjacent to the West Side Canal. The process water pipeline is entirely within the Qb landform, adjacent to and paralleling its contact with the alluvial fan piedmont (Qa). This area was determined to be very sensitive for buried archaeological resources (Hale et al., 2012). Ten geoarchaeological excavation units are proposed along the process water pipeline, approximately evenly spaced along its entire length, with some closer spacing in areas where a larger concentration of surface sites have been identified. Most of the proposed trench locations have been placed within close proximity (approximately 500 feet) of several archaeological resources (i.e., sites and isolated artifacts) and are intended to serve the dual purpose of anticipating the potential for a subsurface component to be present within each of those locales as well as retrieving geoarchaeological data. Beginning from the vicinity of the Buena Vista Water Storage District well field, the geoarchaeological trenches along the process water pipeline that will be placed near archaeological sites and isolated artifacts include:

- HECA 2009-10 and KRM-IF-007
- CA-KER-171 and HECA 2009-9
- BS-IF-005
- HECA-2008-1 and JM-IF-001
- CA-KER-5356/H and P-15-7176
- CA-KER-89/H and KRM-IF-006
- CA-KER-179, KRM-IF-002, KRM-IF-003, KRM-IF-004, and KRM-IF-005
- BS-BVWD-1
- CA-KER-2485 and BS-IF-003
- BS-IF-002 and BS-IF-001

The CO_2 pipeline is approximately 3 miles long. Most of this pipeline will be installed within a trench, excavated to a depth of 7 feet. Some sections will require the use of horizontal directional drilling (HDD) to avoid interference with water conveyance features including the California Aqueduct and the West Side Canal. The depth of these HDD crossings is expected to be 50 to 100 feet below current ground surfaces.

Two geoarchaeological excavation units are proposed for the portion of the CO_2 pipeline that is within the Qb landform. One of these proposed trenches has been placed near (within

approximately 500 feet of) prehistoric archaeological site HECA 2009-2 to also assess the potential for a subsurface component to be present within the prehistoric archaeological site.

The portion of the CO_2 pipeline on the Qa and QTt landforms were demonstrated in the archaeological technical report (Hale et al., 2012) to have a low sensitivity for intact buried archaeological resources. On December 20, 2012, CEC staff confirmed by telephone conversation that sufficient geomorphological and geoarchaeological data were present south of the aqueduct to make such a determination.

The OEHI CO_2 EOR Processing Facility and three satellite facilities are also situated on soils of low sensitivity for intact buried archaeological resources, in these cases all occurring on the QTt landform. As directed by CEC staff no geoarchaeological investigation is proposed for these Project components.

Aside from the Project Site, CO_2 pipeline within the Controlled Area and one trench along the natural gas pipeline/industrial railroad spur (Revised Figure A151-2) all proposed excavation units are pending permission from landowners. Exact numbers and locations will depend on permission being given to conduct the work on private property.

4.2 SAMPLING STRATEGY

As described above, a maximum of eight backhoe trenches will be excavated across the Project Site and an additional two along the CO_2 pipeline in the Controlled Area (Revised Figure A151-2). Within the Project Site, the placement of trenches is based on the proposed layout of the facility, with the areas of deepest soil disturbance being the focus. The Applicant is currently seeking approval to conduct trenching in 22 additional locations along the Project linears. Given the scale of the figure, the plotted trench locations on Revised Figure A151-2 are approximate and may be slightly adjusted to accommodate landowner requirements, while still addressing the requirements of the geoarchaeological analyses. The figure is intended for use by the CEC staff as a means to assess the Applicant's proposed geoarchaeological plan. The locations were selected based on their applicability to the research questions identified above, their association with landforms identified as potentially being of appropriate age and depositional nature to harbor buried resources, and the level of Project-related impacts anticipated for each given area.

Trenches are primarily focused on the landforms identified as Buena Vista Slough basin deposits (Qb) which is one of the younger potentially sensitive depositional units, and which has the greatest amount of proposed subsurface impacts. As discussed in the research questions and initial sensitivity assessment (Hale et al., 2012) the greatest potential for paleosols and associated buried archaeological deposits is at the interface between the Qb and adjacent landforms; 16 of the total proposed excavation units are within this ecotone. Excavation units proposed within the Qoa and Qya landforms will establish the timing of deposition of these landforms and the subsurface relationship between them, and attempt to resolve discrepancies between the soil age and Quaternary geology mapping. These locations are intended to document the subsurface interaction between the adjacent landform types and provide data on the nature of any subsurface contacts between the two units.

Two geoarchaeological excavation units have been proposed well within the Qoa landform to verify the age of the landform and subsurface conditions relative to understanding its geomorphic evolution. These excavations are proposed in locations where potential Project-related archaeological impacts will exceed 1 meter below surface, and will be used to assess

near-surface conditions and the veracity of assumptions regarding the lack of geoarchaeological potential.

4.3 EXCAVATION METHODS

The primary proposed mode of subsurface investigation is backhoe trenching. Depending on cohesiveness of sediments and other subsurface conditions, a backhoe can generally expose sediments up to 15 feet below surface. This depth has been demonstrated to be sufficient for exposing the majority of Holocene landforms within the San Joaquin Valley (Meyer, Rosenthal, and Young, 2010:143). Backhoe trenching is also an expedient means of exposing observable soil profiles and sufficient sediment to identify any archaeological materials that may be present in the vicinity of the excavation.

Each trench will be excavated to a maximum depth of approximately 4.5 meters (15 feet) below surface and will be approximately 15 feet long, using a 3-foot bucket. These trenches are the most expedient means of creating subsurface profiles useful in documenting stratigraphic units and depositional setting. In accordance with Occupational Safety and Health Administration standards, unshored trenches will not be entered after they have reached 5 feet in depth. The backhoe excavation of trenches and excavated spoils will primarily be observed from the surface and then be documented from the surface. If pedogenic or archaeological features are observed from the surface, and require closer inspection and/or sampling, the trench will be shored using hydraulic speed shoring, so that the Project Geoarchaeologist can enter the trench safely, document subsurface stratigraphy and pedogenic indicators in detail, and collect soil and dating samples. In addition, one trench on a given landform, or new section of a landform, will need to be shored and entered by the Project Geoarchaeologist, in order to more closely examine and better expose, document, and sample stratigraphic and pedogenic units. Once these units are understood and documented, correlation between similar units will most likely be possible from the surface. In cases where it becomes necessary to more closely inspect subsurface stratigraphy, possible archaeological features, or unclear stratigraphic contacts that cannot be discerned from the surface, the trench will be shored using hydraulic shoring so that the Project Geoarchaeologist can enter the trench, document stratigraphy and pedogenic indicators in detail, and/or collect soil and dating samples. The Project Geoarchaeologist shall meet CEC qualification standards.

For each excavated trench, the Project Geoarchaeologist will produce a measured representative profile drawing, using a metric scale. Observed stratigraphic units will be described based on physical characteristics such as composition (grain size, parent material), color, superposition, textural transitions, and pedogenic properties (i.e., relative soil development). Each profile, including all observable textural and soil transitions, will be logged on standard soil recordation forms, and photographed. These will include a detailed description of each lithostratigraphic and pedostratigraphic unit, and will be used to correlate units identified in other trenches. In trenches where archaeological features are observed in profile, or where cross-cutting or interfingered strata of different depositional units are present, a detailed profile drawing will be completed for one entire wall of the trench, to document the context of any unique features.

The information collected in the soil recordation forms will be used to produce detailed written descriptions, appropriate to the character of each lithostratigraphic and pedostratigraphic unit. Each trench will be photographed with a metric scale and north arrow.

A maximum of 14 radiocarbon samples will be submitted for analysis, to determine the depositional rates and approximate ages of the major landforms present, and to constrain the dates of any paleosols or archaeological deposits that are found. Discrete, in-place charcoal samples will be used for dating. In the absence of such deposits, bulk humate samples or other organic material (e.g., shell) will be submitted for Accelerator Mass Spectrometry analysis. As described above under the Data Needs section, there is expected to be, based on previous work in the southern San Joaquin Valley, relatively high internal consistency of subsurface conditions within each landform. This internal consistency allows for reliable correlation between pedostratigraphic units with demonstrated similar morphology, and the correlation of data units between trenches. Fourteen radiocarbon dates are considered more than adequate for establishing the age of the three major landforms to be tested (Qoa, Qb, Qya) as well as the depositional rates of the younger landforms (Qb and Qya), the age of any observed laterally extensive paleosols, and any internal variability observed.

At least one additional archaeologist will be on site to assist in monitoring and sorting spoils excavated from the geoarchaeological trenches. Rakes and other hand tools will be used to actively sort through material as it is excavated from each trench in order to identify any archaeological materials that may be present. The Project Geoarchaeologist will identify paleosols as they are excavated, and these will be targeted for monitoring. Additionally, a small amount of material (a 5-gallon bucket) from each identified lithostratigraphic unit or major process-related lithostratigraphic sequence, in each trench, will be removed from the profile wall and screened through 1/4-inch hardware mesh. Where lithostratigraphic units or major process-related lithostratigraphic sequences are demonstrably high-energy deposits of large gravel that range in size from pebbles to boulders, no screening will occur, because such deposits have virtually no potential to preserve primary artifact and ecofact associations. Where such lithostratigraphic units or sequences—or pedostratigraphic units—are not apparent, the same amount of material will be screened through the same size mesh from 50-centimeter (cm)-thick arbitrary levels down the wall of each profile.

The Project Geoarchaeologist shall mechanically excavate through any buried archaeological deposits encountered, unless such deposits contain human remains, using arbitrary levels no greater than 20-cm thick; screen the arbitrary levels through 1/4-inch hardware mesh; and provenience all artifacts, ecofacts, and other material culture finds to those arbitrary levels. Archaeological deposits found during the trenching activities will be recorded on Department of Parks and Recreation (DPR) 523 forms. As all of the proposed trenches are to occur within parcels currently not owned by the Applicant, it is anticipated that any identified archaeological materials will be returned to the trench from which they were recovered. In the event an artifact requires collection, it will be temporarily curated within one of URS's archaeological laboratories. At the close of the Project, any collected artifacts will be subsequently curated within a Federally approved curation facility. Formal evaluation of site eligibility and/or data recovery is beyond the current scope. The geoarchaeological study is not designed to assess eligibility of an archaeological site. Additional scoping and consultation with the CEC will be necessary to complete resource evaluations (i.e., National Register of Historic Places and/or California Register of Historical Resources [CRHR] eligibility) of any identified archaeological deposits.

4.4 REPORTING

A report describing the results of the geoarchaeological field study set out herein (dependent on landowner access), and of the implications of these results on the assumptions made during the initial geoarchaeological assessment, will be produced. This report will include: revised mapping of the surface geomorphology of the Project area (map scale of ≥1:12,000) where

trenches have been excavated; maps and descriptions of all excavated trench locations; graphic and written descriptions of the stratigraphic profiles of the Project area, including an analysis of the depth and extent of any potentially sensitive paleosols; a graphic showing the correlation of stratigraphic units across the Project area; a processual geologic interpretation and the approximate age of subdivisions of the master column that reflect shifts in local depositional regimes or depositional history, and that reflect time ranges that correspond to the prehistory and history of the region, as currently understood; DPR 523 forms; and descriptions and preliminary interpretations of any encountered archaeological deposits. Formal reporting of radiocarbon analysis results will be included as an appendix. The report will also provide an interpretation of the character of the prehistoric or historic land use that each encountered archaeological deposit represents; an interpretation, with reference to the information gathered and developed above, of the likelihood that buried archaeological deposits are present in each of the identified landforms or portions thereof; a summary, on the basis of the current understanding of the prehistory and history of the region, of what site types are most likely to be found; and recommendations, based on the present geoarchaeological study, for the locations and extent (horizontal and vertical) of potential mitigation measures that would be most consistent with California Environmental Quality Act requirements for mitigation of impacts through avoidance, when possible, and with the historic preservation goal of recovering valid scientific data from CRHR-eligible archaeological deposits whose destruction cannot be avoided.

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Hale, Mark, Leroy Laurie, and Jay Rehor 2012. Confidential Archaeological Reconnaissance, Hydrogen Energy California Study Area, Kern County, California. Prepared by URS for Hydrogen Energy California.

Meyer, Jack, D. Craig Young, and Jeffrey S. Rosenthal, 2010. Cultural Resources Inventory of Caltrans District 6 and 9 Rural Conventional Highways, Volume 1: A Geoarchaeological Overview and Assessment of Caltrans Districts 6 and 9. Far Western Anthropological Research Group, Inc. Report on File at the California Department of Transportation, District 6. Fresno.

Moratto, Michael J., 1984. California Archaeology. New York: Academic Press.

Figure A151-2 (Revised) Quaternary Landforms and Geoarchaeological Trench Locations (Submitted under confidential cover)

Figure A151-3 Landform Age Based on Soil Series – Radiocarbon Data Associations (Submitted under confidential cover)

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT
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AMENDED APPLICATION FOR CERTIFICATION FOR THE HYDROGEN ENERGY CALIFORNIA PROJECT

Docket No. 08-AFC-08A
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(Revised 3/4/13)

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DECLARATION OF SERVICE

I, Dale Shileikis, declare that on March 28, 2013, I served and filed copies of the attached Revised Supplemental Responses to CEC Data Requests Set Two: Data Request No. A151, dated March, 2013. This document is accompanied by the most recent Proof of Service, which I copied from the web page for this project at: http://www.energy.ca.gov/sitingcases/hydrogen_energy/.

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I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that I am over the age of 18 years.

Dated: 3/28/13