5.8 Paleontological Resources

This section summarizes the potential effects on paleontological resources (fossils) from the construction and operation of the Mariposa Energy Project (MEP). MEP will be a nominal 200-megawatt (MW) peaking facility consisting of four new General Electric (GE) LM6000 PC-Sprint natural gas-fired combustion turbine generators and associated equipment. The project consists of a new generation facility and connection of the facility to fuel gas, water, and electrical transmission interties.

The facility will be located in northeastern Alameda County, California, on a 10-acre portion of a 158-acre parcel (known as the Lee Property) immediately south of the Pacific Gas & Electric Company (PG&E) Byron Compressor Station and 230-kilovolt (kV) Kelso Substation. The proposed power plant site is in the southern portion of the parcel, between two small hills. The legal description of the project site is provided in Appendix 1A. The site is located in Township 2S, Range 3E, Section 1 (Mount Diablo Base and Meridian). This site is non-irrigated grazing land. Access to the site is via an access road that runs east from Bruns Road to the site within the larger parcel.

The site and surrounding area on the southern portion of the 158-acre parcel exhibit remnants of prior wind turbine development that has been removed except for minor debris. Additionally, an existing power generation facility is located on the parcel; the 6.5-MW Byron Power Cogen Plant currently occupies 2 acres of the property north of the proposed MEP site.

Figure 2.1-1 shows the project site plan and proposed offsite linear facilities. MEP will interconnect to the PG&E Kelso Substation via a new 0.7-mile, 230-kV transmission line that will run north on the property, then across Kelso Road to the existing Kelso Substation. The fuel gas line interconnection for the proposed power plant entails constructing 580 feet of new 4-inch-diameter pipeline directly northeast from the project site to the point of interconnection with PG&E's existing high-pressure natural gas pipeline (Line 2). Service water will be provided from a new connection to the Byron Bethany Irrigation District (BBID) via a new pump station and a 6-inch-diameter, 1.8-mile pipeline placed in or along the east side of Bruns Road, from existing Canal 45 in Contra Costa County south to the plant site.

Temporary construction facilities will include a 5-acre worker parking and laydown area immediately east of the project site, a 1-acre water supply pipeline parking and laydown area at the BBID headquarters facility on Bruns Road, and a 0.6-acre laydown area along the transmission line route adjacent to the PG&E Kelso Substation and Byron Compressor Station.

Section 5.8.1 discusses the affected environment, including the resource inventory and its results; Section 5.8.2 presents the environmental analysis and impact assessment; Section 5.8.3 considers cumulative impacts on paleontological resources; Section 5.8.4 presents mitigation measures; Section 5.8.5 discusses applicable laws, ordinances, and regulations; Section 5.8.6 lists involved agencies and permits; and Section 5.8.7 provides the references used to prepare this section.

This section of the Application for Certification (AFC) meets all siting regulations of the California Energy Commission (CEC) (2000, 2007) and conforms with the recommendations of the Society of Vertebrate Paleontology (SVP, 1991; 1995; 1996) that address mitigating impacts on paleontological resources resulting from earth-moving activities. This paleontological resources inventory and impact assessment was conducted by W. Geoffrey Spaulding, Ph.D., a senior paleontologist with CH2M HILL. Dr. Spaulding has advanced degrees in geology with emphases in paleobiology and is a recognized expert on the glacial-age environments of the American West. He has completed paleontological resource surveys and prepared paleontological resource impact assessments in support of energy generation and other large construction projects in central California, including projects in the San Joaquin Valley where the project is located.

5.8.1 Affected Environment

5.8.1.1 Physiographic Setting

The proposed MEP site is in the northern and lowest portion of the San Joaquin Valley of California. It lies along the boundary between the Coast Ranges to the west and south, and the Great Valley (Central Valley) physiographic province to the east and north. This region is known as the Coast Ranges–Sierran Block boundary zone and is delineated by a series of low hills and complex thrust/reverse faults. The Great Valley and the adjacent Sierra Nevada form a relatively stable crustal block (Sierran block) composed of Mesozoic crystalline basement that dips gently to the west. The western edge of the Sierra Nevada block is buried beneath the sediments of the Great Valley, and its terminus at great depth is generally thought to be coincident with the western margin of the Great Valley (Wahrhaftig and Birman, 1965).

The Great Valley physiographic province separates the Coast Ranges to the west from the Sierra Nevada to the east (Fenneman, 1931). This province is comprised of two elongated northwest- to southeast-trending basins: the Sacramento basin to the northwest and the San Joaquin basin to the southeast. This province is approximately 435 miles (700 kilometers) long and 44 to 56 miles (70 to 90 km) wide, and characterized by a thick, relatively undeformed sequence of alluvium and volcanic deposits. The present-day basin evolved from a late Jurassic to middle Tertiary (40–150 million years ago [Ma]) marine fore-arc basin. During the Jurassic and Cretaceous, much of the area was a deep abyssal plain, in the range of 10,000 feet below sea level (e.g., Dickinson and Rich, 1972). Sediments of the resultant Great Valley Sequence, as these Mesozoic sediments are called usually lack megafossils (Dickinson and Rich, 1972; Haggart and Ward, 1984), and are differentiated based on their lithological characteristics and subdivided into units.

In the mid-Tertiary (25–30 Ma), a change in the relative motion between the Pacific and North American plates resulted in the gradual uplift of the Coast Ranges and the eventual isolation of the basin of the Central Valley from the ocean. More recent Miocene through Pleistocene sediments were derived from the bounding Coast Ranges and the Sierra Nevada. By the late Pliocene (2–3 Ma), subaerial depositional conditions prevailed and Sierra Nevada–derived sediments dominated basin deposition (Wahrhaftig and Birman, 1965).

The Coast Ranges are a north-northwest- to northwest-trending series of mountains and intervening valleys extending for 597 miles (960 km) from the Oregon border south to the

Santa Ynez River near Santa Barbara. Physiographically, the Coast Ranges can be divided into two subprovinces, the northern and southern subprovinces, separated by the San Francisco Bay and the Sacramento River Delta. The Coast Ranges to the west of the project are composed of Cretaceous marine rocks of the Great Valley Sequence (Graymer et al., 1996) with Tertiary sediments stratigraphically above those. The youngest deformed sediments are older Quaternary deposits that are often correlated with the Tulare Formation of the San Joaquin Valley. MEP lies among the easternmost outcrops of Cretaceous bedrock, which form the low hills to the north and south of the proposed plant site. The project linears extend farther east onto the gently sloping alluvial fan to the west of the San Joaquin River. Isolated low ridges composed of older Quaternary sediments occur throughout this area (Figure 5.8-1).

5.8.1.2 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the project area and surrounding lands, and to assess the potential paleontological productivity of the stratigraphic units that may be present, published and available unpublished geological and paleontological literature was reviewed. Sources included geological maps, in particular that of Graymer and others (1996), satellite photography, technical and scientific reports, and electronic databases. An updated paleontological resource record review was conducted for the project using the online database maintained by the University of California Museum of Paleontology at Berkeley (UCMP).

The project paleontologist conducted field reconnaissance of the proposed plant area and rights-of-way for the project linears. Field reconnaissance rather than a formal survey was made because the areas are characterized by highly disturbed topsoil, created chiefly by agricultural activities, and no undisturbed fossiliferous sediments could be observed within the potential area of effect of project construction. Geological exposures that could be located within about 1,000 feet of the project were also examined to better understand local geology.

5.8.1.3 Resource Inventory Results

5.8.1.3.1 Geological Units in the Vicinity

In the vicinity of the project site, the surface slopes gently at about a 2 percent grade to the northeast, with steeper slopes encountered on the sides of the adjacent hills. The elevation of the site varies from about 110 to 150 feet above mean sea level (amsl), with the water supply pipeline extending lower to an elevation of about 50 feet amsl. The San Joaquin River floodplain lies about a mile to the northeast and represents local base level.

The local area is underlain by a complex series of sedimentary rocks ranging in age from Cretaceous to Quaternary. Since their deposition, the pre-Quaternary rocks have been extensively deformed by repeated episodes of folding and faulting associated with the orogeny of the Coast Ranges. Valleys in the region, including the swale hosting the project site, are generally filled with unconsolidated sedimentary deposits of Quaternary age. A thick sequence of alluvial fan deposits forms the west side of the Great Valley province in the project area. These sedimentary deposits consist of interbedded sand, gravel, silt, and clay, and the site is immediately underlain by this Quaternary alluvium, mapped as Unit Qu by Graymer and others (1996); see Figure 5.8-1 for details of the geology within 2 miles of

the project site, and confidential Figure PAL-1 for the geology and paleontological sites in the project area.

The foothills of the Coast Range, including the small hills to the north and south of the proposed plant site, are composed primarily of Cretaceous marine rocks (Table 5.8-1). Tertiary marine sediments of the Neroly Formation and continental sediments of the Oro Loma Formations also occur in the vicinity of the project. The older, coarse, lithified alluvium comprising the terraces that stand out farthest into the San Joaquin Valley has been identified as the Tulare Formation by some authors (e.g., Wahrhaftig and Birman, 1965).

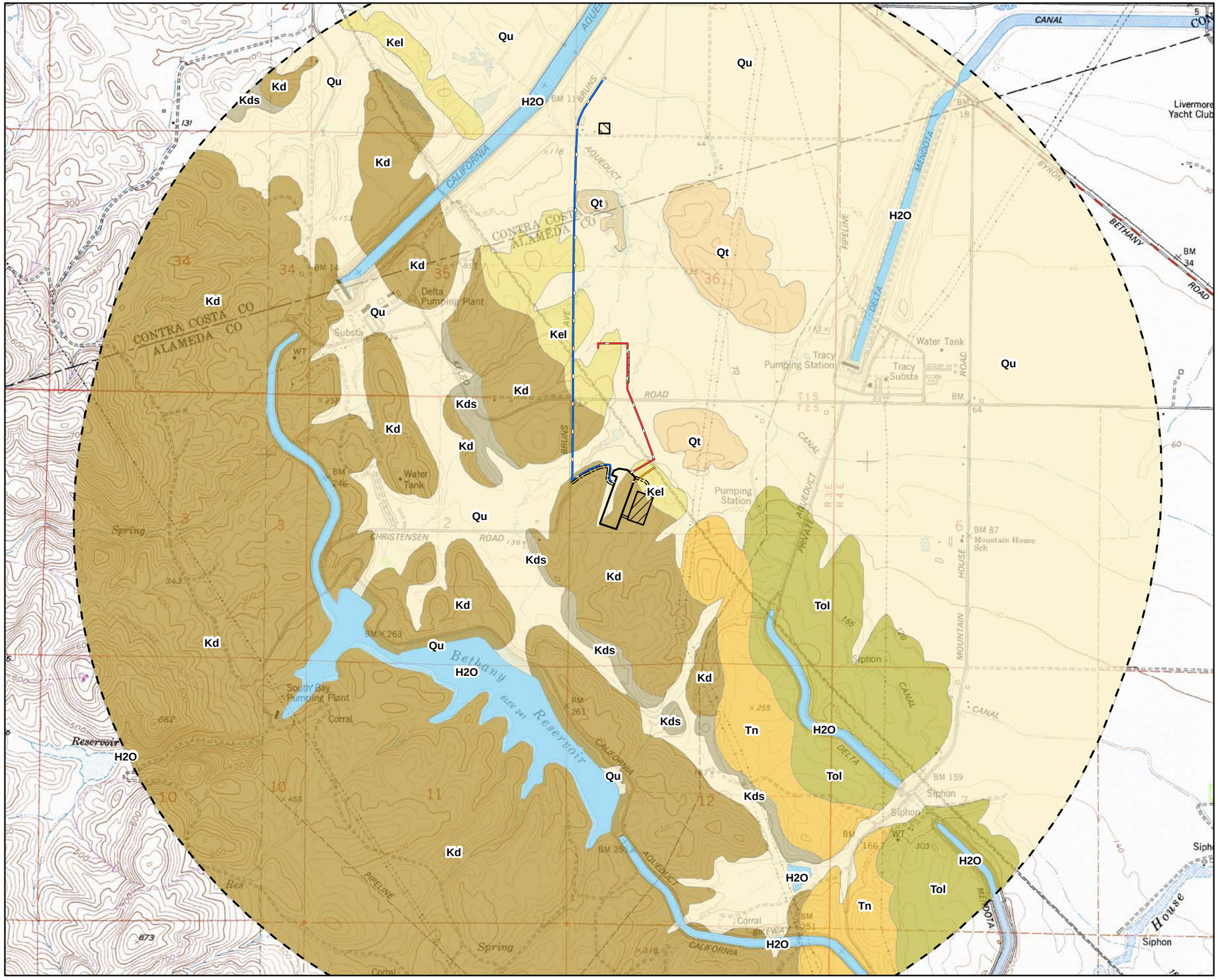
TABLE 5.8-1
Geological Units within 1 Mile of MEP, Including Offsite Laterals

Formation[a]	Age	No. Fossil Localities[b]	Notes
Undifferentiated Alluvium (Qu)	Late Quaternary - Holocene	123/68	Includes the unconsolidated sediment underlying the plant site itself
Older Alluvium (Qt)	Quaternary		Comprising the topographic highs extending farthest east; includes the Tulare Formation identified by some authors
Oro Loma (Tol)	Pliocene	0/0	Reddish silt, sand, and gravel; terrestrial sediments; no fossil localities per UCMP database
Neroly (Tn)	Late Miocene	17/10	Also known as the Neroly Sandstone; near-shore marine sediments
Great Valley Sequence (Kd/c)	Cretaceous	40/5	Includes Unit D Sandstone and Shale members (Kd and Kds respectively), and Upper Unit C Shale (Kcu)

[a]Source: Graymer et al. (1996); there is no formation name given to Quaternary-age sediments.
[b] Source: UCMP Database, Alameda County records. First number identifies the total of all localities, the second is the number of plant megafossil and vertebrate fossil sites.

5.8.1.3.2 Results of the Record Search

A search of the UCMP database on December 29, 2008, and again on March 16, 2009, queried records for the formations listed in Table 5.8-1 and for any site records of Quaternary age within Alameda County. The results can be used as a general guide to the paleontological potential (the likelihood of yielding scientifically significant fossils) of the subject formations, with allowance for the nature of the data. There have been several microfossil studies (e.g., pollen, radiolaria, diatoms, foraminifera) conducted in this area on Cretaceous and Quaternary sediments, in particular, and these microfossil localities are also listed in the UCMP database. Many sediments that yield microfossils or isolated invertebrate remains are largely devoid of plant or vertebrate megafossils. Additionally, many invertebrate and microfossil localities in the UCMP database have no associated catalogued specimens (UCMP, n.d.). Invertebrate localities include sites where molluscan fauna can yield important data, but also sites where only sponge spicules or echinoderm plates were noted. When microfossil and invertebrate localities are excluded, the resultant number of plant megafossil and vertebrate fossil sites is smaller (Table 5.8-1) and more reflective of the paleontological potential of the sedimentary unit.



LEGEND

- ACCESS ROAD
- NATURAL GAS PIPELINE ROUTE
- TRANSMISSION LINE ROUTE
- WATER SUPPLY PIPELINE ROUTE
- TWO MILE BUFFER
- CONSTRUCTION LAYDOWN/PARKING AREA
- TRANSMISSION LINE LAYDOWN AREA
- WATER SUPPLY PIPELINE LAYDOWN AREA
- PROJECT SITE

GEOLOGY TYPES

- H2O, WATER
- Kd, UNIT D SANDSTONE
- Kds, UNIT D SHALE MEMBER
- Kel, LOWER UNIT D SILTSTONE
- Qt, TERRACE DEPOSTIS
- Qu, UNDIFFERENTIATED
- Tn, NEROLY FM. BLUE SANDSTONE
- Tol, ORO LOMA FORMATION - REDDISH SILT, SAND AND GRAVEL

Notes:

1. Source: USGS OFR 94-622. Preliminary Geologic Map Emphasizing Bedrock Formations in Contra Costa County, California: A Digital Database, 1994. USGS OFR 96-252 Preliminary Geologic Map Emphasizing Bedrock Formations in Alameda County, California: A Digital Database, 1996.

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

N

0 1,000 2,000
Feet

FIGURE 5.8-1
SURFICIAL GEOLOGY WITHIN TWO MILES OF PROJECT SITE
MARIPOSA ENERGY PROJECT
ALAMEDA COUNTY, CALIFORNIA

CH2MHILL

SAC\\ZION\SACGIS\PROJ\DIAMOND_376670\MAPFILES\AFC_MAPS\GEOLOGYMAP.MXD MHASKELL 5/8/2009 09:35:24

In addition to conducting the record search and literature review, the paleontological expert carried out a resource survey of the project area and linears on January 14, 2009. Mantling of disturbed agricultural soil and colluvium, vegetation, and fill over much of the project area prevented inspection of the underlying sediments. Therefore, the field survey was judgmental and focused on those road cuts, back dirt piles, and ditches in the project vicinity that might provide some exposure of paleontologically sensitive sediment. In particular, cuts on the south side of Bruns Road allowed inspection of the Cretaceous strata that underlie the project area. No fossil material was found during the survey.

Cretaceous Great Valley Sequence

The Cretaceous rocks at and near the project site are Units C and D of the Great Valley Sequence (Graymer et al., 1996). They represent abyssal marine sediments laid down many thousands of feet below the surface of an ocean that extended west from a volcanic island chain that occupied the area of the current Sierra Nevada. In part because of the abyssal depth of their origin, megafossils are rare throughout the Great Valley Sequence (e.g., Dickinson and Rich, 1972); the 40 Cretaceous megafossil localities for Alameda County (Table 5.8-1) include only one vertebrate locality and four plant fossil localities.

Mio-Pliocene Rocks

The next youngest geological formation in the project area is the Neroly Sandstone, which represents the sediments laid down in an increasingly shallow sea during the mid-Tertiary (late Miocene). This formation is well known for its paleobotanical record, and the Neroly leaf assemblage provides an important datum for reconstructing the paleotopography of the western United States during Middle to Late Miocene times (Wolfe et al., 1997). Of the ten localities from the Neroly Formation that are neither microfossil nor invertebrate sites, all are paleobotanical localities. No vertebrate fossils have been recovered from the Neroly Formation in Alameda County.

No fossil localities are recorded in the UCMP database for the Oro Loma Formation, not only for Alameda County but for the entire state of California. Furthermore, a Google™ search for the Oro Loma Formation associated with the key words fossil and paleontology yielded no hits for the Pliocene Oro Loma Formation as described by Graymer and others (1996).

Quaternary Sediments

On the edges of the Great Valley, older Early and Middle Quaternary sediments tend to be represented as topographic highs, erosional remnants that are elevated above the surrounding, younger alluvium of Late Quaternary age. There are two hills, or terrace remnants, east and northeast of the project site that were mapped by Graymer and others (1996) as older Quaternary sediments (Qt) (Figure 5.8-1). Definitive correlation of these sediments with those of the Tulare Formation (Wahrhaftig and Birman, 1965) is beyond the scope of this assessment, and apparently was not attempted by Graymer and others (1996), either. The older Quaternary sediments are lumped for the sake of the records review (Table 5.8-1) with the younger undifferentiated Quaternary sediments (Qu) mapped by Graymer and others (1996) in the project area in Alameda County and along the water supply line in Contra Costa County (Graymer et al., 1994). These sediments were mapped as Pleistocene alluvial fan deposits (Qpaf) by Helley and Graymer (1997), who did not discriminate between younger and older Quaternary sediments in the vicinity of the project area.

Alameda County is a geologically and environmentally diverse region, with a total of 123 fossil localities recorded by the UCMP database, a little over half (68) of the localities being megafossil sites. However, many are located on the west slope of the Coast Ranges in the Bay Area or in the intermontane valleys near Walnut Creek and Livermore. Only 17 out of 68 localities (25 percent) can be confidently located in the San Joaquin Valley. All are vertebrate fossil sites, and most were discovered during excavations for water conveyance systems in the area, particularly the Delta-Mendota and California Aqueduct canals. These are primarily fragmentary records of large vertebrates, including the extinct camel (Camelidae, probably *Camelops* sp.) and horse (*Equus* sp.), giant ground sloth (Xenarthra, probably *Megalonyx* sp.), extinct tapir (*Tapirus* sp.), and mammoth (*Mammuthus* sp.). The presence of mammoth, and other aspects of the vertebrate assemblage, suggests a Pleistocene (Quaternary excluding the last 10,000 years) age for this fossil assemblage. The positions of localities known to occur within 1 mile of the project site or its laterals are shown in confidential Figure PAL-1, filed separately under a request for confidentiality. Comparing these six localities to the available geological mapping, one apparently came from sediment mapped as undifferentiated Quaternary alluvium, and five from sediment mapped as the Oro Loma Formation (Graymer et al., 1996). However, these fossils are apparently Quaternary and not Pliocene in age, and therefore their recovery from sediments mapped as the Oro Loma Formation is problematic.

5.8.1.3.3 Paleontological Sensitivity of the Project Site

Paleontological sensitivity is the qualitative assessment made by a professional paleontologist taking into account the paleontological potential of the stratigraphic units present, the local geology and geomorphology, and any other local factors that may be germane. According to SVP (1995) standard guidelines, sensitivity comprises (1) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or paleobotanical remains, and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecological, or stratigraphic data (Table 5.8-2).

TABLE 5.8-2
Paleontological Sensitivity Ratings Employed

Rating	Definition
High	Assigned to geological formations known to contain paleontological resources that include rare, well-preserved, and/or fossil materials important to ongoing paleoclimatic, paleobiological, and/or evolutionary studies. They have the potential to produce, or have produced, vertebrate remains that are the particular research focus of many paleontologists and also can represent important educational resources.
Moderate	Stratigraphic units that have yielded fossils that are but moderately well-preserved, are common elsewhere, and/or that are stratigraphically long ranging would be assigned a moderate rating. This evaluation also can be applied to strata that have an unproven but strong potential to yield fossil remains based on stratigraphy and/or geomorphologic setting.
Low	Sediment that is relatively recent, or that represents a high-energy subaerial depositional environment where fossils are unlikely to be preserved. A low abundance of invertebrate fossil remains, or reworked marine shell from other units, can occur, but the paleontological sensitivity would remain low because of their lack of potential to serve as significant scientific or educational purposes.

TABLE 5.8-2
Paleontological Sensitivity Ratings Employed

Rating	Definition
Marginal and Zero	Stratigraphic units with marginal potential include pyroclastic flows and soils that might preserve traces or casts of plants or animals. Most igneous rocks, however, have zero paleontological potential. Other stratigraphic units deposited subaerially in a high-energy environment (such as alluvium) also may be assigned a marginal or zero sensitivity rating. Manmade fill is also considered to possess zero (no) paleontological potential.

As noted above, within 1 mile of the project area are geological units ranging from Cretaceous to Quaternary (Pleistocene and Holocene) in age. The paleontological localities that have been recorded in the vicinity have yielded primarily fragmentary remains, rather than entire or partially articulated skeletons, of Late Pleistocene vertebrates.

The record search reported here shows that scientifically significant fossil records occur in the Quaternary and putative Pliocene (Oro Loma Formation) sediments in the vicinity of the project area. Therefore, a "high" sensitivity rating is warranted for the Quaternary and Pliocene (collectively, Plio-Pleistocene) sediments in the area. A "moderate" sensitivity rating is applied to the Neroly Formation, acknowledging that scientifically significant plant fossils have been found in this formation. A "low" sensitivity rating is applied to Cretaceous sediments of the Great Valley Formation because, with the exception of microfossils, these abyssal sediments are generally devoid of fossils.

The depth to undisturbed sediment is variable from place to place, but generally extends at least to the bottom of the "plow zone," 3 to 4 feet below the surface. Material above this depth has no potential to yield scientifically important fossils, and therefore possesses no paleontological sensitivity.

5.8.2 Environmental Analysis

The subsurface of the MEP site consists of Quaternary alluvium deposited between two hills that are erosional remnants of the Cretaceous Great Valley Sequence. The project linears also cross chiefly Quaternary alluvium. The environmental impacts on paleontological resources from construction and operation of MEP are presented in the following sections.

5.8.2.1 Paleontological Resource Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts on paleontological resources, the SVP (1995) notes that an individual fossil specimen is considered scientifically important and significant if it is: (1) identifiable, (2) complete, (3) well preserved, (4) age-diagnostic, (5) useful in paleoenvironmental reconstruction, (6) a type or topotypic specimen, (7) a member of a rare species, (8) a species that is part of a diverse assemblage, or (9) a skeletal element different from or a specimen more complete than those now available for that species. For example, identifiable land mammal fossils are considered scientifically important because of their potential use in determining the age and providing input to paleoenvironmental reconstructions for the sediments in which they occur. Moreover, vertebrate remains are comparatively rare in the fossil record. Fossil plants are also important in this regard and, as sedentary organisms, are actually more sensitive

indicators of their paleoenvironment and, thus, more important than mobile mammals for paleoenvironmental reconstructions. For marine sediments, invertebrate fossils, including marine microfossils, are scientifically important for the same reasons that land mammal and land plant fossils are valuable in terrestrial deposits. The value or importance of different fossil groups varies depending on the age and depositional environment of the stratigraphic unit that contains the fossils, their abundance in the record, and their degree of preservation.

Using the criteria of the SVP (1995) and the sensitivity ratings provided above, the significance of potentially adverse impacts of earth moving on the paleontological resources was assessed. Any unmitigated impact on a fossil site or a fossil-bearing rock unit of high or moderate sensitivity would be considered significant.

5.8.2.2 Paleontological Resource Impact Assessment

The significance of potential adverse impacts of project-related activities on the paleontological resources of each stratigraphic unit anticipated to be present at the project site is presented in this section. This assessment includes the entirety of the project area, including the water supply pipeline, the transmission interconnection, and the gas pipeline right of way identified in Figure 5.8-1.

TABLE 5.8-3
Paleontological Impacts by Formation and Facility

	Geological Formation			
Project Component	**Kd/c**	**Tn**	**Tol**	**Qt/Qu**
Facility Site	Yes	No	No	Yes
Parking and Laydown Area	No	No	No	No
Facility Site Access Road	Yes	No	No	No
Gas Right of Way	Yes	No	No	Yes
Transmission Interconnect	Yes	No	No	Yes
Water Supply Pipeline	Yes	No	No	Yes

Kd/c = Cretaceous Great Valley Formation
Tn = Neroly Formation
Tol = Oro Loma Formation
Qt/Qu = Quaternary sediments including older terrace deposits and undifferentiated alluvium

The analysis presented in Table 5.8-3 shows that impacts on paleontological resources are restricted to the rocks of the Great Valley Sequence and to Quaternary sediments; all facility components are expected to affect previously disturbed sediments at shallow depth in the plow zone, within 3 to 4 feet of the surface.

Below are the potential impacts from the construction of MEP:

- **Previously Disturbed Sediment –** Construction-related excavations within the plow zone will not result in any adverse impacts on paleontological resources. Reworked and disturbed fossil material may be present in previously disturbed sediment, but lack of stratigraphic context and likely mechanical damage would compromise all scientific values. This would apply to all excavations within 3 feet of current ground surface and

operations such as grading and surface preparation for roads and parking areas. An exception to this is along the access road where previous cuts into the hillside have exposed undisturbed Cretaceous rocks. With this exception, no impacts on paleontological resources will occur from excavations within 3 feet of the surface or grading in previously disturbed sediment. This applies to the entire parking and temporary laydown area for this project.

- **Quaternary Alluvium –** Excavations, including drilling and trenching extending to depths below 3 feet in the current plant compound and all site linears except the access road[1] (Table 5.8-3), are likely to affect Quaternary-age alluvium. Quaternary sediments here possess high paleontological sensitivity because they have yielded significant fossil resources nearby. Uncontrolled excavation affecting identifiable and *in situ* fossils potentially present at depth in this unit would be an adverse impact. However there will be no uncontrolled excavation during the construction of MEP.
- **Mio-Pliocene Sediments –** Outcrops mapped by Graymer and others (1996) as the Oro Loma and Neroly Formations lie to the southeast of the project area, and will not be affected by any of the project linears (Figure 5.8-1). Therefore, no impacts on paleontological resources within Mio-Pliocene sediments in the project vicinity will occur, because none of these sediments will be affected by construction.
- **Cretaceous Great Valley Sequence –** The excavation, drilling, and trenching associated with all project components are likely to affect Cretaceous marine sediments identified by Graymer and others (1996) as Units C and D of the Great Valley Sequence. These rocks typically fail to yield scientifically significant megafossils and therefore have been assigned low paleontological sensitivity rating. Impacts on paleontological resources from excavations in the Great Valley Sequence may occur, but it is likely those impacts will not be significant because the formation's low paleontological sensitivity.

No impacts on paleontological resources are expected to occur from the operation and maintenance of the project. Because no excavations are anticipated from either the operation or maintenance of the project, no impacts on paleontological resources are expected from the operation and maintenance of MEP.

5.8.3 Cumulative Effects

Widespread development in the San Francisco Bay area and in the Central Valley has resulted in proportionately extensive impacts on paleontological resources, and this is anticipated to continue, albeit not at the rate that existed prior to the current economic recession. The extensive nature of these cumulative impacts is from extensive development combined with the widespread presence of numerous fossiliferous sedimentary units in the area (Graymer et al., 1994, 1996). However, measures typically implemented pursuant to state statutes serve to mitigate these impacts through the recovery of the scientific and educational potential of the affected paleontological resources. Although not all projects are subject to California Environmental Quality Act (CEQA) review, and only a proportion of those incorporate paleontological protection measures, application of paleontological

[1] Access road improvements are assumed to involve primarily fill operations, except for where cut may be required into outcrops of Great Valley Sequence rocks within several hundred feet of the entrance gate.

monitoring and mitigation measures is common and, therefore, mitigates the cumulative and direct impacts of continued development.

The potential contribution to cumulative impacts on paleontological resources from this project would be at most limited, given the limited areal extent of the current project, the low paleontological sensitivity of the Cretaceous sedimentary rocks, and the avoidance of Mio-Pliocene sedimentary outcrops. Thus, with the mitigation described below, the contribution of MEP to cumulative negative impacts on paleontological resources will be negligible. Moreover, the application of controlled scientific recovery methods to discovered paleontological resources is typically thought of as constituting a beneficial impact to the extent that new scientific specimens and knowledge are generated. Cumulatively, this also holds true; it can be argued that our knowledge of the Pleistocene fauna of the Great Valley has increased measurably as a result of the paleontological specimens recovered in the course of construction-related monitoring and mitigation.

5.8.4 Mitigation Measures

Guidelines for the Implementation of CEQA (Public Resources Code Sections 15000 et seq.) include among the questions to be answered in the Environmental Checklist (Section 15023, Appendix G) the following: "Would the project directly or indirectly destroy a unique paleontological resource or site?" and "Does the project have the potential to . . . eliminate important examples of the major periods of California . . . pre-history?" These questions are answered in the affirmative based on the data and considerations provided above. Because construction of MEP may have potential adverse impacts on significant paleontological resources, mitigation measures are described below.

This section describes the mitigation measures proposed by Mariposa Energy that will be implemented to reduce potential adverse impacts on significant paleontological resources resulting from project construction. These proposed paleontological resource impact mitigation measures will reduce, to an insignificant level, the direct, indirect, and cumulative adverse environmental impacts on paleontological resources that might result from project construction. The mitigation measures proposed below comply with CEC environmental guidelines (CEC, 2000; 2007) and with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP, 1991; 1995; 1996).

5.8.4.1 Paleontological Resources Monitoring and Mitigation Program

A Paleontological Resources Monitoring and Mitigation Program (PRMMP) will be developed for review and approval by the CEC prior to implementation. The PRMMP will include construction monitoring and coordination; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimens and data recovered; preconstruction coordination; and reporting. Reporting requirements will include monthly monitoring reports and a final report.

Implementation of these mitigation measures will reduce the potential impact from project-related ground disturbance on paleontological resources to an insignificant level by allowing for the recovery of fossil remains and associated specimen data, and corresponding geologic and paleoenvironmental data, that otherwise might be lost to earth moving or to unauthorized fossil collecting. These scientific and associated educational values constitute

the chief significance of the resource, and their recovery therefore mitigates the impacts on that resource.

With a well-designed and implemented PRMMP, project construction potentially could result in beneficial impacts on paleontological resources through the recovery of fossil remains that would otherwise not have been exposed and, therefore, would not have been available for study. This consideration is particularly applicable to this area, with its complex geological history and the paucity of fossil sites on this particular terrace surface compared to those farther inland. The recovery of fossil remains as part of project construction could help answer important questions regarding the geographic distribution, stratigraphic position, and age of fossiliferous sediments in the area.

5.8.4.1.1 Paleontological Monitoring

Prior to construction, a qualified paleontologist will be retained as project Paleontological Resource Specialist (PRS) to design and implement a monitoring program during project-related earthmoving activities. Prior to construction, the PRS will review excavation plans to determine where paleontologically sensitive stratigraphic units will be disturbed by project-related earth movement. Earth-moving construction activities in those areas will be monitored where they will potentially disturb previously undisturbed sediment. Monitoring will not be conducted in areas where the ground will not be disturbed, and only spot monitoring will be done where it appears that excavations will only affect previously disturbed sediment. Monitoring procedures will include measures to suspend monitoring should construction activities be restricted to previously disturbed fill and to adjust monitoring protocols based on updated evaluations of sensitivity subsequent to initial excavations.

5.8.4.1.2 Construction Personnel Education

Prior to working on the site for the first time, all personnel involved in earth-moving activities will be provided with Paleontological Resources Awareness Training. This training will be provided as a module in their worker environmental awareness training. They will be informed that fossils may be encountered, provided with information on the appearance of fossils, the role of paleontological monitors, and on proper notification procedures. This worker training will be prepared and initially presented by PRS. Subsequent training may be conducted via video presentation and hardcopy training materials.

5.8.4.1.3 Discoveries and Reporting

The PRMMP also will provide plans for the recovery and disposition of fossils should they be encountered during construction-related excavations. These will include preparation for analysis, initial analysis, identification and inventory, preparation for curation, and the delivery for curation of all significant paleontological resource materials encountered and collected during the data recovery, mapping, and mitigation activities related to the project. To complete the mitigation of impacts on paleontological resources, a report describing the finds and their geological and paleontological context will be prepared and submitted to the repository accepting the paleontological material for curation.

5.8.4.2 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts on paleontological resources are anticipated as a result of the construction and operation of MEP.

5.8.6 Laws, Ordinances, Regulations, and Standards

Paleontological resources (fossils) are the remains or traces of prehistoric plants and animals. They may range from the actual bones and shells of ancient organisms, to mineral replacements of a once-living organism, to simple impressions of plants or animals in soft sediments later transformed to rock. They range in size and abundance from many thousands per cubic centimeter for microfossils such as pollen, diatoms, and radiolaria, to very rare large-mammal bones exceeding a meter in length. Fossils are important scientific and educational resources because of their use in (1) documenting the presence and evolutionary history of particular groups of now-extinct organisms, (2) reconstructing the environments in which these organisms lived, and (3) in determining the relative ages of the strata in which they occur and the geologic events that resulted in the deposition of the sediments that formed these strata. In the project area, the fossils of marine organisms and those of terrestrial animals and plants are important in the paleontological record. They have helped define the age and sequences of deposition and uplift along the margins of the San Joaquin Valley, where fossiliferous marine and terrestrial sedimentary rock provide important data on the development and tectonics of California's complex geology.

Paleontological resources are non-renewable scientific resources and are protected by several federal and state statutes (California Office of Historic Preservation, 1983; Marshall, 1976; Fisk and Spencer 1994), most notably by the 1906 Federal Antiquities Act and other subsequent federal legislation and policies, and by the State of California's environmental regulations (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established by the SVP (1991, 1995, 1996). Design, construction, and operation of MEP will be conducted in accordance with all laws, ordinances, regulations, and standards (LORS) applicable to paleontological resources. Federal, state, and local LORS applicable to paleontological resources are summarized in Table 5.8-4 and discussed briefly in this section, along with professional standards for paleontological resources assessment and impact mitigation.

TABLE 5.8-4
Laws, Ordinances, Regulations, and Standards for Paleontological Resources

LORS	Applicability	AFC Reference	Project Conformity
Antiquities Act of 1906	Not applicable – No federal land involved, or federal entitlement required	—	—
National Environmental Policy Act of 1969	Not applicable – No federal land involved, or federal entitlement required	—	—
CEQA, Appendix G	Applicable – Fossil remains may be encountered by earth-moving activities	Sections 5.8.2, 5.8.3, and 5.8.5	Yes
Public Resources Code, Sections 5097.5/5097.9	Not applicable – Applies to state-owned land	—	—
Alameda County East Planning Area General Plan	Not applicable – Paleontological resources are not addressed per se	—	—

5.8.6.1 Federal LORS

Federal protection for significant paleontological resources would apply to MEP only if any construction or other related project impacts occur on federally owned or managed lands, or if a federal entitlement or other permit were required. Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (PL 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal lands. Additionally, the National Environmental Policy Act of 1969 (United States Code, Section 4321 et seq.; 40 Code of Federal Regulations, Section 1502.25), as amended, requires analysis of potential environmental impacts on important historic, cultural, and natural aspects of our national heritage. Because no federally owned or managed lands will be affected by this project, and no federal entitlement or other permit is required, these statutes do not extend to paleontological resources (see Table 5.8-4).

5.8.6.2 State LORS

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of CEQA (Public Resources Code Sections 21000 et seq.). CEQA requires that public agencies and private interests identify the environmental consequences of their proposed projects on any object or site of significance to the scientific annals of California (Division I, California Public Resources Code: 5020.1 [b]). *Guidelines for the Implementation of CEQA* (Public Resources Code Sections 15000 et seq.) defines procedures, types of activities, persons, and public agencies required to comply with CEQA. Appendix G in Section 15023 provides an Environmental Checklist of questions that a lead agency should normally address if relevant to a project's environmental impacts. One of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section V, part c) is the following: "Would the project directly or indirectly destroy a unique paleontological resource or site…?"

Although CEQA does not define "a unique paleontological resource or site," Section 21083.2 defines "unique archaeological resources" as "…any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information
- Has a special and particular quality such as being the oldest of its type or the best available example of its type
- Is directly associated with a scientifically recognized import prehistoric or historic event."

With only slight modification, this definition is equally applicable to recognizing "a unique paleontological resource or site." Additional guidance is provided in CEQA Section 15064.5 (a)(3)(D), which indicates "generally, a resource shall be considered historically significant if it has yielded, or may be likely to yield, information important in prehistory or history."

Section XVII, part a, of the CEQA Environmental Checklist asks a second question equally applicable to paleontological resources: "Does the project have the potential to . . . eliminate important examples of the major periods of California history or pre-history?" To be in compliance with CEQA, impact assessments must answer both these questions in the Environmental Checklist. If the answer to either question is "yes" or "possibly," a mitigation and monitoring plan must be designed and implemented to protect significant paleontological resources. The answer to these questions is "possibly" if not "yes," and therefore CEQA does apply to this project (Table 5.8-4).

The CEQA lead agency having jurisdiction over a project is responsible for ensuring that paleontological resources are protected in compliance with CEQA and other applicable statutes. The lead agency with the responsibility to ensure that fossils are protected during the construction of MEP is the CEC. California Public Resources Code Section 21081.6, Mitigation Monitoring Compliance and Reporting, requires that the CEQA lead agency demonstrate project compliance with mitigation measures developed during the environmental impact review process.

Other state requirements for paleontological resource management are in California Public Resources Code Chapter 1.7, Section 5097.5/5097.9 (Stats. 1965, c. 1136, p. 2792), Archaeological, Paleontological, and Historical Sites. This statute defines any unauthorized disturbance or removal of a fossil site or remains on public land as a misdemeanor and specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources. Public Resources Code, Sections 5097.5/5097.9, does not apply to MEP because construction or other related project impacts will not occur on state owned or managed lands and no state agency is intended to obtain ownership of project lands during the term of the project license (Table 5.8-4).

5.8.6.3 Local LORS

The Alameda County East County Area Plan (ECAP) (Alameda County, 2000) places emphasis on the preservation of historic and cultural resources, including heritage resources, but does not address paleontological resources per se. Nevertheless, county approval of projects includes review for CEQA compliance, and the CEQA Environmental Checklist employed does include the Appendix G, Section V, part c question regarding paleontological resources (see Section 5.8.6.2, above).

5.8.6.4 Professional Standards

The SVP, an international organization of professional paleontologists, has established standard guidelines (SVP, 1991; 1995; 1996) that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation. Most practicing paleontologists in the nation adhere to the SVP's guidelines and extend those to address other types of fossils of scientific significance, such as invertebrate fossils and paleobotanical specimens. Many federal and state regulatory agencies, including the CEC, have informally adopted the SVP standard guidelines.

5.8.7 Agencies and Agency Contacts

There are no agencies having blanket jurisdiction over paleontological resources. The CEC has jurisdiction over paleontological resources for this project. The ECAP places emphasis on the preservation of historic and cultural resources, including heritage resources. The Alameda County Planning Department was contacted on March 25, 2009, to confirm that the county has no specific requirements regarding paleontological resources. If encountered, scientifically significant fossil specimens and associated site records will be submitted to the UCMP (Table 5.8-5).

TABLE 5.8-5
Agency Contacts for Paleontological Resources

Issue	Agency	Contact
Alameda County Paleontological Resources Regulations	Alameda County Community Development Agency Planning Department	Dominic or Bruce* Alameda County Planning Department Hayward, CA 94544 (510) 670-5400
Paleontological Resources Documentation & Specimen Repository	UCMP	Dr. Patricia Holroyd Curator of Vertebrate Paleontology 1101 Valley Life Sciences Building Berkeley, CA 94720-4780 (510) 642-3733 pholroyd@berkeley.edu

*Planning Department staff prefer not to disclose last names.

5.8.8 Permits Required and Permit Schedule

No state, county, or city agency requires a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earth moving on this project site.

5.8.9 References

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