5.17 PALEONTOLOGICAL RESOURCES

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. 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; (3) determining the relative ages of the strata in which they occur; and (4) determining the geologic events that resulted in the deposition of the sediments in which they were buried (Orr & Orr, 1999).

This section assesses the potential that earth-moving activities associated with construction of the Project will impact scientifically important fossil remains.

The analysis presented in this section meets all requirements of the California Energy Commission (CEC, 2009) and incorporates the Society of Vertebrate Paleontology (1991, 1995, 1996) standard measures for mitigating adverse construction-related environmental impacts on significant paleontological resources.

5.17.1 Affected Environment

5.17.1.1 Geographic Location and Physiographic Environment

The project area, including the solar facility and associated linear facilities, are located within the northern margin of the Chuckwalla Valley, 25 miles west of Blythe, California. The Project site is within the Mojave Desert which is part of the Basin and Range Physiographic Province of the western United States (Dibblee, 1954). This area is characterized by linear north/south trending mountain chains separated by broad, nearly flat, dry valleys. Natural erosion has ground down the mountain peaks leaving only the crests showing while depositing thick sequences of regolith in the valleys floored today with a xeric biota of desert plants and animals (Morton, 1977). The project site is directly south of the Palen and McCoy Ranges (Jennings, 1967). Alluvial fans from these ranges merge here on a gentle slope and the site covers the distal margins of the fans immediately north of Ford Dry Lake which forms a natural playa of aeolian sandsheets and dunes (Strand, 1962; Stone, 1990).

5.17.1.2 Geologic Setting and Formations

The Basin and Range topography dominates the geologic setting of the entire Mojave Desert. Intense crustal stretching during the Miocene epoch, approximately 15 million years ago, proceeded to failure over vast areas of the Great Basin, imposing a fault-block landscape of up-thrown mountain ranges with down-dropped wide valleys (Miller, 1944). A thick apron of rock debris or “fanglomerates” began to form at the lower slopes of the ranges due to intense erosion of the mountain crests. The signature of fanglomerate sediments is a profound size gradation from extremely coarse against the mountain source rock to extremely fine or even sand sized out in the centers of the valleys.

Roughly two million years after the block fault topography was imposed in late Miocene to Pliocene epochs, a shallow marine seaway invaded the lower Mojave vicinity from the south as Baja California split off from North America (Downs and Woodward, 1961). A narrow gulf began to form which would become the “Sea of Cortez.” Sediments in this new seaway formed the rocks known formally as the Bouse formation (Metzger et. al., 1973). The Bouse Formation is represented by marine shelf limestones and sands rich in fossils of every description. With continuing motion of large crustal slabs in the Southern California margin, the Bouse seaway withdrew to the south and the natural cycle of Basin and Range erosion/deposition resumed.

The last and most recent phase of sedimentation here was the development of an alluvial fan complex derived from the McCoy/Palen Mountains extending southward towards Ford Dry Lake. This latter episode is ongoing today and a final touch is the secondary erosion of the alluvial fan surface by wind and fluvial slope wash to remove the fine sands and silts and create a desert pavement atop the distal margins of the coalescing fans. In this final erosion stage, the fan surface degrades from a vegetation rich sandy surface to a near sterile, armored stony expanse of desert floor. The sand removed from the fan surface was deposited on Ford Dry Lake as dunes and sand sheets covering lacustrine sediments that record the Pleistocene history of that pluvial body of water. Of these four geologic units, only the alluvial fan sediments are exposed in and around the Project site today. The buried lower portions of the fan reach to upper or middle Pleistocene intervals, while surface exposures date back to the early Holocene or even latest Pleistocene epochs several thousand years in the past (Longwell, 1954).The Bouse Formation.

Although highly fossiliferous, there are three reasons why the Bouse Formation can be ignored in the present study:

- In situ rock exposures (outcrops) of the formation do not occur anywhere on the site. Furthermore, even after intensive searching, no float from the formation was identified.
- The closest occurrence of the Bouse Formation is on the order of several hundred feet below the Project site.
- The only vertebrates reported to date in the literature from the Bouse formation are fossil fish. Owing to his graduate work in Southern California, as well as experience on several construction projects where the Bouse Formation was encountered, the lead paleontologist has never seen salvageable fish remains from the Bouse Formation.

The Genesis site and ancillary facilities are located on materials mapped as (Qiaf) intermediate alluvial fan deposits, (Qyaf) younger alluvial fan deposits, and (Qvaa) youngest valley axial alluvium that is actively undergoing deposition (Tietze, 2009).

5.17.1.3 Paleontological Resource Inventory Methods

A stratigraphic inventory and paleontological resource inventory were completed to develop a baseline paleontological resource inventory of the Project site and surrounding area by rock unit, and assess the potential paleontological productivity of each rock unit. Research methods included a review of published and unpublished literature and a cursory field survey. These tasks complied with CEC (2009), (COHP, 1983) and Society of Vertebrate Paleontology (1995) guidelines.

Stratigraphic Inventory

Published literature (*e.g.* geological maps and reports) covering the geology of the project site and area were reviewed to determine the exposed rock units and delineate their respective aerial distributions in the project area (Hay, 1927). This literature search included a check of records at the Los Angeles County Museum, the San Bernardino County Museum, the Geology Museum at the University of California at Riverside, the Anza Borego Museum, and the University of California Museum of Paleontology at Berkeley (Jefferson, 1991, 1991a, b). Both local and regional records were reviewed for known fossil localities that may be incidental to the proposed site. In addition, paleontological scientific professionals who are knowledgeable in the local geology, stratigraphy, and paleontology of the region were consulted (Orr & Linder, 2002). The result of this literature search, as well as inquiry to local museums and professionals, was no finding of significant fossils in the vicinity of the Project site.

Field Survey

The field reconnaissance was conducted to document the presence of any previously unrecorded fossil sites and strata that might contain fossil remains. The field survey was performed on July 21 to 25, 2009 during an interval of comparatively mild, cloudy weather with intermittent light rain. For periods of the survey, water was standing in shallow depressions on the site. The field survey was conducted by William Orr, Ph.D. and Sheila Alfsen, M.A.

Reconnaissance was limited to inspection of the visible ground surface at the Project site as well as the linear facilities. The survey included surface observations of over a score of various locations representative of desert pavement, local washes, and vegetated desert surfaces surrounding and within the project area. Maps and aerial photography were used to confirm the results of the literature search and check the accuracy of the published stratigraphy and regional geology. In several days of survey work, no identifiable clasts of the Bouse formation were observed and the unit is not known to crop-out within 25 miles of the Project site.

Remains of the desert tortoise, *Gopherus. agassizii,* include a variety of specimens from very young to old individuals. Wear and poor condition of the fragments, as well as the lack of whole carapaces, suggest transport some distance. The lack of detectable organic content to the bone and permineralization with calcite, gypsum and opaline silica in the pore spaces suggest considerable antiquity of thousands or more years for the remains. Tortoise remains are regarded here as a thanatocoenosis (death assemblage) wholly transported downslope to the present site.

5.17.1.4 Paleontological Resource Assessment Criteria

The potential paleontological importance of an area can be assessed by identifying the paleontological importance of exposed rock units within the Project area. Since the lithology and aerial distribution of a rock unit can be easily delineated on a geologic map, this method is central in identifying parts of the project that are of higher and lower sensitivity for paleontological resources and determining the level of monitoring during construction. A pedestrian survey is then conducted to assess the accuracy of the information on the maps and comb the area for any fossils that may be exposed at the surface.

The monitoring levels that may be assigned to sections of the Project area are as follows:

- Continuous monitoring
- Spot monitoring
- No monitoring

A paleontologically important rock unit is one that: 1) has a high potential paleontological productivity rating, and 2) is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at the project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site. However, well-developed and documented fossil-bearing formations are unlikely to yield a unique paleontological resource.

An individual vertebrate fossil specimen may be considered unique or 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; and/or 9) a skeletal element different from, or a specimen more complete than, those now available for its species.

For example, identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare. In contrast, the value or importance of different fossil groups varies, depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions such as part of a research project. Marine invertebrates are generally common, well developed, and well documented. They would generally not be considered a unique paleontological resource. Under certain circumstances, fossil leaves, wood, and shells as mollusks, arthropods (crabs), and echinoderms (starfish, sea urchins, and sand dollars) are often salvaged because of their excellent preservation or potential as teaching specimens.

The assessment of fossils in the field as unique or significant and/or “salvageable” requires a qualified paleontologist who is familiar with the local geology and fossil record. Fossils encountered during construction of the project should be documented. While it is doubtful a significant, unexpected discovery of large mammal remains will be made, any fossil, however small or fragmentary, could be useful to further understanding of the prehistory of the Chuckwalla Valley and southern Mojave area (Agenbroad et. al, 1992; Savage and Downs, 1954).

5.17.1.5 Resource Inventory Results

No exposures of potentially fossiliferous strata were observed in the Project area. A complete pedestrian survey of the entire Project area of potential effect for paleontological resources was considered unnecessary and no subsurface exploration was conducted. A more detailed survey was considered unnecessary because the Project site is located in a lowland, depositional environment consisting of the surface of very recent Holocene alluvium. In several days of survey work, no identifiable clasts of the Bouse formation were observed and the unit is not known to crop-out within 25 miles of the Project site.

The survey resulted in the identification of fossil tortoise bones in stream worn, fragmentary condition. Carapace remains of *G.. agassizii* were scattered with specimens representing young to old individuals. Stream wear evident on the fragments and the absence of intact body skeletons show considerable transport. With no organic component to the bone and clear permineralization by calcite, gypsum, and opaline silica in the pores, the age of the specimens can be estimated at thousands or more years. The observations of the taphonomy point to an assemblage transported some distance to the present site post mortem.

In addition, plants and plant microfossils (diatoms) and ostracods (arthropod microfossils) were observed during preliminary survey work and laboratory analysis of Project site sediments. Each of these categories has some potential, albeit limited, to add to scientific knowledge, although the constraint here of the sedimentological environment of cyclical deposition, exhumation and redeposition limits the significance to only a qualitative impact. These scraps of fossils all reflect a late Pleistocene/early Holocene environment of increasing sub-aerial aridity and alkaline water.

5.17.2 Environmental Consequences

5.17.2.1 Significance Criteria

Appendix G, Environmental Checklist Form, of CEQA provides guidance for determining significance criteria with respect to paleontological resources (Public Resources Code Sections 21000 et seq.). Appendix G (V)(c) indicates an impact could be significant if the project would "directly or indirectly destroy a unique paleontological resource or site or unique geologic feature."

Potential impacts are based upon the "paleontological sensitivity" of geologic formations that would be encountered during construction of project alignments.

Paleontological sensitivity is an estimate of the likelihood that fossils would be discovered during excavations in a given area. However, this estimate does not measure the significance of individual fossils that may be present or discovered in an area. Specifically, significance of fossil remains encountered at the Project site could hold potential data to add to the understanding of the geologic history or evolution of climate in the southern Mojave in the Pleistocene/early Holocene interval. Climate in this area at this geologic interval is an equation that includes the evolution of Basin and Range topography, the history of the proto-Gulf of California (Sea of Cortez), and the waning effects of Pleistocene glacial withdrawal and onset of desert conditions to the province. Individual fossils that may be discovered must be examined to determine the nature, age, and value of the fossil to the paleontological record (*e.g.* understanding of regional paleo-environments).

5.17.2.2 Construction

This section presents the potential adverse impacts on the paleontological resources resulting from construction of each portion of the Project.

Potential impacts on paleontological resources resulting from construction of the solar facility can be divided into construction-related impacts and impacts related to plant operation. Construction-related impacts to paleontological resources primarily involve ground disturbance (excavations and drainage diversion measures).

Because the probability of unexpected discovery of large scale fossil remains is remote for the Project site, the vicissitudes of construction operations as grading, shallow trenching, and boreholes are unlikely to significantly damage or destroy fossil resources. Furthermore, the lack of demonstrateable highly significant fossil resources here argues against avoidance of particular areas during construction. The poor consolidation of sediments over the site suggest that, should an unexpected discovery occur, its exposure, stabilization, packaging, and removal for salvage would present few problems of cost or time expenditure.

5.17.2.3 Operation

Project operation will not cause additional ground disturbance, and therefore will not affect paleontological resources.

5.17.3 Cumulative Impacts

If paleontological resources are encountered during Project-related ground disturbance, the potential cumulative effect on paleontological resources will be low, as long as the mitigation measures proposed in Section 5.17.4 are implemented to recover the resources. When properly implemented, these mitigation measures will effectively recover the scientific value of significant fossils encountered

during Project construction. Thus, the proposed Project will not cause or contribute to significant cumulative impacts to paleontological resources.

The effects of construction on fossils preserved in unconsolidated or poorly consolidated alluvial fan deposits are notably minimal. Any damage to fossils due to percolating groundwater related to construction would have already occurred or would be of such a long term nature as to be nil. Similarly, damage to unexhumed fossils due to vibration, shock, or crushing during construction operations would be minimal or negligible based on previous experience with similar settings in the southern California region.

5.17.4 Mitigation Measures

This section describes the measures to reduce or mitigate potential Project-related adverse impacts to significant paleontological resources, should any such resources be discovered during construction.

- **Paleontological Mitigation Plan—**The paleontological resource mitigation program will include the preparation of a mitigation and monitoring plan for construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; preconstruction coordination; and reporting.
- **Paleontological Monitoring**—Prior to construction, the Applicant will retain a qualified paleontologist to design and implement a mitigation program during project-related earth-moving activities for deep excavation at the Project site, and construction of the linear facilities. The paleontologist will monitor earth-moving construction activities where this activity will disturb previously undisturbed sediment. Monitoring will not take place in areas where the ground has been previously disturbed, in areas underlain by artificial fill, or in areas where exposed sediment will be buried but not otherwise disturbed.
- **Construction Personnel Education—**Prior to the start of construction, construction personnel involved with earth-moving activities will be informed of the possibility of encountering fossils, how to recognize fossils, and proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist and be part of the project Worker Environmental Awareness Program (WEAP).

Implementation of these mitigation measures will reduce the potentially significant adverse environmental impact of project earth-moving activities on paleontological resources to an insignificant level. These measures will allow for the recovery of fossil remains and associated specimen data and corresponding geologic/stratigraphy and geographic locality data that otherwise might have been destroyed by construction and unauthorized fossil collecting.

5.17.5 Laws, Ordinances, Regulations, and Standards (LORS)

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal and state statutes. Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established for vertebrate fossils by the Society of Vertebrate Paleontology (1995, 1996). Design, construction, and operation of the solar facility, including pipelines and ancillary facilities, will be conducted in accordance with all LORS applicable to paleontological resources. Federal, state, and local LORS applicable to paleontological resources are summarized in Table 5.17-1 and discussed briefly below.

Table 5.17-1. Applicable LORS Regarding Paleontological Resources

LORS	Requirements	Administering Agency
Paleontological Resources Preservation Act (PL 111-011)	Requires the Secretaries of the Interior and Agriculture to manage and protect paleontological resources on Federal land using scientific principles and expertise.	BLM
Antiquities Act of 1906	Prohibits appropriation, excavation, injury, and destruction of "any historic or prehistoric ruin or monument, or any object of antiquity" located on lands owned or controlled by the federal government, without permission of the secretary of the federal department with jurisdiction.	BLM
Federal Land Policy and Management Act of 1976 as amended (PL 96-95)	Gives Federal land management agencies the authority and the mandate to protect public resources of scientific value such as fossilized paleontological specimens.	BLM
NEPA, 1969	Requires Federal agencies to take practicable measures to preserve important historic, cultural, and natural aspects of our national heritage including paleontology.	BLM
The Warren – Alquist Act of 1974, as amended	Requires the CEC to evaluate energy facility siting in unique areas of scientific concern (Section 25527). CEC guidelines for paleontological resources assessment follow the professional standards as set forth by the Society of Vertebrate Paleontology.	CEC
California Environmental Quality Act (CEQA), Appendix G	Paleontological resources are included in the definition of "historical resources" covered by the act. Impacts to "unique paleontological resource or site or unique geologic feature" are also listed as issues that must be evaluated.	CEC
Public Resources Code, Sections 5097.5/5097.9	Prohibits "knowing and willful" excavation, removal, destruction, injury, and defacement of any paleontologic feature on public lands (lands under state, county, city, district, or public authority jurisdiction, or the jurisdiction of a public corporation), except where the agency with jurisdiction has granted express permission.	CEC
County of Riverside General Plan, Multipurpose Open Space Element	Whenever existing information indicates that a site proposed for development may contain biological, paleontological, or other scientific resources, a report shall be filed stating the extent and potential significance of the resources that may exist within the proposed development and appropriate measures through which the impacts of development may be mitigated.	County of Riverside, Planning Department

5.17.5.1 Federal LORS

Federal protection for significant paleontological resources will apply to the Project since construction impacts will take place on federally owned or managed lands (see Table 5.17-1).

5.17.5.2 State LORS

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of CEQA (Public Resources Code Sections 15000 et seq.) with respect to paleontological resources. CEQA's Appendix G (Public Resources Code Sections 21000 et seq.) lists among its significant effects when a project will "disrupt or adversely affect...a paleontological site except as part of a scientific study" (see Table 5.17-1).

5.17.5.3 County LORS

The County of Riverside General Plan contains mitigation requirements that specifically address potential adverse impacts to paleontological resources in the Multipurpose Open Space Element.

5.17.6 Involved Agencies and Agency Contacts

Agencies and agency contacts relative to paleontological resources are provided in Table 5.17-2.

Table 5.17-2. Involved Agencies and Agency Contacts

Agency	Contact	Permits/Reason for Involvement
Bureau of Land Management Palm Spring Field Office 1201 Bird Center Drive Palm Springs, CA 92262-8001	Cheryl Martinez Paleontologist (760) 833-7147	BLM Consultation Services Permit; fossil remains could be encountered by earth-moving activities on federal land.

5.17.7 Permits Required and Permits Schedule

A BLM Consultation Services Permit issued under the Federal Antiquities Act and the Federal Land Management Policy Act would be required to allow for the recovery of fossil remains on federal (including BLM) land in the Project site. Up to 2 months could be required for the permitting process.

5.17.8 Qualifications of Preparers

The paleontology resources inventory and effect assessment was conducted by William Orr, Ph.D. and Sheila Alfsen, M.A.. Dr. Orr is a registered professional geologist and qualified paleontologist with several papers and publications in referenced scientific journals addressing fossils and paleoenvironmental analysis. He has also written several books on geology and paleontology. Since 1982, Dr. Orr has been director of the Oregon State Museum of Paleontology (The Condon collection) at the Museum of Cultural and Natural History at the University of Oregon in Eugene. Ms. Alfsen has a BA in geology and an MA in teaching, as well as extensive graduate course work in geology/paleontology. She has had 5 years of experience on over 15 construction jobs from gas pipelines to power plants and transmission lines. Ms. Alfsen is currently working toward a registration as a professional geologist. Both paleontologists are approved by the CEC.

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