PALEONTOLOGICAL RESOURCES ASSESSMENT REPORT FOR THE MONTEREY PENINSULA LIGHT RAIL PROJECT

SUBMITTED TO: Transportation Agency for Monterey County (TAMC).

BY **PARSONS**

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EXECUTIVE SUMMARY

Parsons was retained by the Transportation Agency for Monterey County (TAMC) to evaluate paleontological resources for the Monterey Peninsula Light Rail Project located between the unincorporated community of Castroville and the City of Monterey, County of Monterey, California. The project entails re-initiating passenger rail service along an existing railroad right-of-way known as the Monterey Branch Line and includes track replacement, bridge / structure repair, right-of-way acquisitions, street grade improvements, maintenance and operation facility (former Fort Ord area) and station platforms.

Based on data obtained from local geologic maps the Project area is underlain by the following geologic units, from oldest to youngest: Miocene-age marine sedimentary rocks (Monterey and Santa Margarita Sandstone Formations), (2) Pleistocene-age alluvial deposits, and (3) Holocene-age alluvial deposits. Records maintained by the University of California Museum of Paleontology (UCMP) indicate that there is one paleontological locality within the study area (a one-mile radius around the area while the other locality is outside of the study area, but inside the City of Monterey.

Paleontological resources are considered to be significant if they provide new data on fossil animals, distribution, evolution or other scientifically important information. Holocene-age alluvium is deposited throughout the Project area but is geologically too young to contain fossils, and is therefore assigned a low paleontological sensitivity. However, within the Project area, Holocene-age alluvium overlies Pleistocene-age alluvium, which has a high paleontological sensitivity potential. The Miocene deposits are composed the paleontologically sensitive Monterey and Santa Margarita Sandstone Formations. These formations have yielded scientifically significant fossil resources, including the remains of Miocene-age vertebrates and are considered to have a high paleontological sensitivity potential.

The mitigation plan recommends that a Qualified Paleontologist be retained to design and implement a paleontological monitoring, unanticipated discovery plan, and mitigation plan to be used during construction excavations associated with any development of the project site that may occur in paleontologically sensitive sediments (estimated to be present at 10 feet in depth or greater). All fossils and pertinent data recovered during construction monitoring will be arranged to be prepared, identified, analyzed, and reposited in a public museum (such as the UCMP) or other county-and state-approved curation facilities. The final report by the Qualified Paleontologist will meet Caltrans standards for a Paleontological Mitigation Report.

PROJECT SUMMARY

Purpose and Scope

Parsons was retained by the Transportation Agency for Monterey County (TAMC) to evaluate paleontological resources for the Monterey Peninsula Light Rail Project located between the unincorporated community of Castroville and the City of Monterey, County of Monterey, California.

The scope of services included a museum records search and literature review, and preparation of this technical report which includes recommendations for project-specific mitigation measures.

Dates of Investigation

The museum records search was performed on October 18, 2010. This technical report was completed on November 3, 2010.

Results of the Investigation

Based on data obtained from local geologic maps (Clark, Dupre' and Rosenberg 1997, Clark et al, 1984, and Wagner et al 2002), the Project area is underlain by the following geologic units, from oldest to youngest: Miocene-age marine sedimentary rocks (Monterey and Santa Margarita Sandstone Formations), (2) Pleistocene-age alluvial deposits, and (3) Holocene-age alluvial deposits. Records maintained by the University of California Museum of Paleontology (UCMP) indicate that there is one paleontological locality within the study area (a one-mile radius around the area while the other locality is outside of the study area, but inside the City of Monterey.

Holocene-age alluvium is deposited throughout the Project area; however, these deposits are geologically too young to contain fossils, and are therefore assigned a low paleontological sensitivity. However, within the Project area, Holocene-age alluvium overlies Pleistocene-age alluvium, which has a high paleontological sensitivity potential. The Miocene deposits are composed the paleontologically sensitive Monterey and Santa Margarita Sandstone Formations. These formations have yielded scientifically significant fossil resources, including the remains of Miocene-age vertebrates (Holroyd 2010), and are considered to have a high paleontological sensitivity potential.

Recommendations

Parsons recommends that a Qualified Paleontologist be retained to design and implement a paleontological monitoring, unanticipated discovery plan, and mitigation plan to be used during construction excavations associated with any development of the project site that may occur in paleontologically sensitive sediments (estimated to be present at 10 feet in depth or greater). All fossils and pertinent data recovered during construction monitoring should be arranged to be prepared, identified, analyzed, and reposited in a public museum (such as the UCMP) or other county-and state-approved curation facilities.

Disposition of Data

This report will be filed with Parsons along with all other records relating to the project.

INTRODUCTION

This report presents the findings of a comprehensive literature review and museum records search conducted on behalf of the Transportation Agency for Monterey County (TAMC).for the Monterey Peninsula Light Rail Project located between the unincorporated community of Castroville and the City of Monterey, County of Monterey, California. This study was performed to evaluate the paleontological sensitivity of the project area and vicinity, assess potential project-related impacts on paleontological resources, and provide recommendations for project-specific mitigation measures. This study was conducted in accordance with the professional guidelines established by the Society of Vertebrate Paleontology (SVP) (1995).

Definition and Significance of Paleontological Resources

Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the prehistory of life on earth. Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years (Gould 2000). Fossils are considered nonrenewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced. As defined by SVP 1995, fossils are an important scientific and educational resource because they are used to:

- Study the phylogenetic relationships between extinct organisms, as well as their relationships to modern groups;
- Elucidate the taphonomic (the scientific study of fossilization), behavioral, temporal, and diagenetic (the changes that take place in a sediment that, cause solid rock to form) pathways responsible for fossil preservation, including biases in the fossil record;
- Reconstruct ancient environments, climate change, and paleoecological relationships;
- Provide a measure of relative geologic dating, which forms the basis for biochronology and biostratigraphy, and which is an independent and supporting line of evidence for isotopic (forms of a chemical element with the same atomic number but different numbers of neutrons) dating;
- Study the geographic distribution of organisms and tectonic movements of landmasses and ocean basins through time;
- Study patterns and processes of evolution, extinction, and speciation; and
- Identify past and potential future human-caused effects to global environments and climates.

Regulatory Framework

Paleontological resources are limited, nonrenewable resources of scientific, cultural, and educational value and are afforded protection under federal (National Environmental Policy Act [NEPA]), state (California Environmental Quality Act [CEQA]), and local (Monterey County, City of Marina, City of Sand City, City of Seaside and, City of Monterey) laws and regulations as well as other regional or local development plans and projects (Fort Ord Reuse Authority, Fort Ord Dunes State Park and the California Coastal Commission). The CEQA Lead Agency is the Transportation Agency for Monterey County while the NEPA Lead Agency is the Federal Transit Administration. This study satisfies project requirements in accordance with CEQA (13 Public Resources Code [PRC] 2100 et seq.) and PRC Section 5097.5 (Stats 1965, c. 1136, p. 2792). This analysis also complies with guidelines and significance criteria specified by the SVP (1995) and the applicable General Plans for jurisdictions located within the study area.

Federal

Federal protection for scientifically significant paleontological resources applies to projects if any construction or other related project impacts occur on federally owned or managed lands, involve the crossing of state lines, or are federally funded. The following federal protections may apply to paleontological resources within portions of the project area:

- American Antiquities Act of 1906 1 (6 United States Code [USC] 431–433). Establishes a penalty for disturbing or excavating any historic or prehistoric ruin or monument or object of antiquity on federal lands as a maximum fine of $500 or 90 days in jail;
- The National Environmental Policy Act of 1969, as amended (Public Law [PL] 91-190, 42 USC 4321-4347, January 1, 1970, as amended by PL 94-52, July 3, 1975; PL 94-83, August 9, 1975; and PL 97-258 Section 4(b), September 13, 1982). Recognizes the continuing responsibility of the federal government to “preserve important historic, cultural, and natural aspects of our national heritage....” (Section 101 [42 USC Section 4321]) (No. 382);
- National Historic Preservation Act of 1966 (PL 89-665; 80 Stat. 915, 16 USC 470 et seq.). Provides for the survey, recovery, and preservation of significant paleontological data when such data may be destroyed or lost due to a federal, federally licensed, or federally funded project;
- Federal Land Management and Policy Act of 1976 (43 USC 1712[c], 1732[b]); Section 2, Federal Land Management and Policy Act of 1962 [30 USC 611]; Subpart 3631.0 et seq.);
- Federal Register Vol. 47, No. 159, 1982. Defines significant fossils as unique, rare or particularly well-preserved; an unusual assemblage of common fossils; being of high scientific interest; or providing important new data concerning (1) evolutionary trends, (2) development of biological communities, (3) interaction

between or among organisms, (4) unusual or spectacular circumstances in the history of life, or (5) anatomical structure and;

- Omnibus Public Land Management Act of 2009 (Subtitle D – Paleontological Resources Preservation. The Omnibus Public Land Management Act (OPLMA) of 2009, Public Law 111-011. P.L. 111-011, Title VI, Subtitle D on Paleontological Resources Preservation (OPLMA-PRP) (123 Stat. 1172; 16 U.S.C. 470aaa) requires the Secretaries of the Interior and Agriculture to manage and protect paleontological resources on Federal land using scientific principles and expertise. The OPLMA-PRP includes specific provisions addressing management of these resources by the Bureau of Land Management (BLM), the National Park Service (NPS), the Bureau of Reclamation (BOR), the Fish and Wildlife Service (FWS), and the U.S. Forest Service (USFS) of the Department of Agriculture.

State

Guidelines for the Implementation of CEQA, as amended March 29, 1999 (Title 14, Chapter 3, California Code of Regulations [CCR] 15000 et seq.), define procedures, types of activities, persons, and public agencies required to comply with CEQA, and include as one of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section XIV, Part a) the following: “Will the proposed project directly or indirectly destroy a significant paleontological resource or unique geologic feature?”

Other state requirements for paleontological resources management are included in PRC (Chapter 1.7) Sections 5097.5 and 30244. These statutes prohibit the removal of any paleontological site or feature on public lands without permission of the jurisdictional agency, define the removal of paleontological sites or features as a misdemeanor, and require reasonable mitigation of adverse impacts to paleontological resources from developments on public (state) lands.

Local

<u>County of Monterey</u>

The County of Monterey encourages the conservation and identification of the county’s paleontological resources as defined by the following policies in the County’s General Management Plan:

- OS-7.1 Important representative and unique paleontological sites and features shall be identified and protected. Developers shall be required to complete Phase I (reconnaissance level) paleontological reviews in any formation known to yield important elements of the fossil record. If significant fossil deposits are found during grading activities, data recovery shall be required to obtain a sample of materials from such deposits prior to their systematic destruction;
- OS-7.2 Information on the location and significance of the County’s paleontological resources shall be compiled and used in the environmental and

development review process. This compilation process shall involve consulting with knowledgeable academic professionals;

- OS-7.3 Development proposed within high and moderate sensitivity zones and known fossil bearing formations shall require a paleontological field inspection prior to approval. Routine and ongoing agricultural activities are exempted from this policy in so far as allowed by state or federal law;
- OS-7.4 Development proposed in low sensitivity zones are not required to have a paleontological survey unless there is specific additional information that suggests paleontological resources are present and;
- OS-7.5 Policies and procedures shall be established that encourage development to avoid impacts to sensitive paleontological sites including: designing or clustering development to avoid paleontological deposits; dedicating permanent conservation easements shall be required where subdivisions and other developments can be planned to provide for such protective easements.

City of Marina

The General Management Plan for the City of Marina (2000) does not specifically address protection and management of paleontological resources; however the City does defer to CEQA and the CEQA Guidelines to provide the necessary guidance to implement policy and procedures.

City of Monterey

The City of Monterey General Plan (2003) evaluates development proposals for potential impacts to sensitive historic, archaeological, and paleontological resources pursuant to the California Environmental Quality Act (CEQA). CEQA Guidelines Appendix G indicates that a project may have a significant effect on the environment if it would:

- Cause a substantial adverse change in the significance of an archaeological or historic resource pursuant to section 15064.5;
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature; and/or
- Disturb any human remains, including those interred outside of formal cemeteries.

City of Sand City

The City of Sand City does not specifically address protection and management of paleontological resources.

City of Seaside

Implementation Plan COS-5.1.1 Assess and Mitigate Impacts to Cultural Resources:

> The City of Seaside General Plan (2003) evaluates development proposals for potential impacts to sensitive historic, archaeological, and paleontological

> resources pursuant to the California Environmental Quality Act (CEQA). If the project involves earthworks, the City may require a study conducted by a professional paleontologist to determine if paleontological assets are present, and if the project will significantly impact the resources. If significant impacts are identified, the City may require the project to be modified to avoid impacting the paleontological materials, or require mitigation measures to mitigate the impacts.

Fort Ord Dunes State Park

Fort Ord Dunes State Park is designated as a Monterey County Planning Area within the framework of the Fort Ord Reuse Plan (1997). The Fort Ord Dunes State Park General Plan tiers off the hierarchical planning documents which indicate that potential impacts to unidentified paleontological resources are to be managed through the implementation of Guidelines CUL-1 and CUL-2 (construction related cultural resources prescriptions) and Mitigation Measure Cul-2. Because implementation information, such as locations of specific facilities and development of project-specific management plans, is not yet known, specific facilities and plans would be reviewed at the time they are proposed for implementation to determine the potential for project-specific impacts and to identify appropriate mitigation measures.

Under Mitigation Measure Cul-2, potential paleontological resources impacts would be reviewed at the project-level for specific facilities proposed under the Fort Ord Dunes State Park General Plan and mitigation measures shall be considered, including but not limited to:

> The Department shall notify qualified personnel of unanticipated discoveries and subsequently document the discovery as appropriate. In the event of an unanticipated discovery of a breas (asphalt seep), true, and/or trace fossil during construction, excavations shall be temporarily halted or diverted until the discovery is examined by qualified personnel. Appropriate procedures shall be followed before construction is allowed to resume at the location of the find.

Fort Ord Reuse Authority

The Fort Ord Reuse Authority was established on May 20, 1994 as a corporation of the State of California. Its purpose is to prepare, adopt, finance, and implement a plan for the land formerly occupied by Fort Ord, including the development of strategies for land use, transportation, conservation, and a five year capital improvement program (FORA, 1997). The General Management Plan for the Fort Ord Reuse Authority does not specifically address protection and management of paleontological resources.

California Coastal Commission

The California Coastal Commission is responsible for administering the state's coastal management program. Under the Coastal Act of 1976 (California Public Resources Code, 30000 et seq.), the Commission makes coastal development permit decisions and reviews local coastal programs prepared by local governments and submitted for Commission approval. The Coastal Act Section 30244 states:

> Where development would adversely impact archaeological or paleontological resources as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required (California Coastal Commission 2003).

RESOURCE ASSESSMENT GUIDELINES

The loss of any identifiable fossil that could yield information important to prehistory, or that embodies the distinctive characteristics of a type of organism, environment, period of time, or geographic region, would be considered a significant environmental impact under CEQA and SVP Guidance. Direct impacts on paleontological resources primarily concern the potential destruction of nonrenewable paleontological resources and the loss of information associated with these resources. This includes the unauthorized collection of fossil remains. If potentially fossiliferous bedrock or surficial sediments are disturbed, the disturbance could result in the destruction of paleontological resources and subsequent loss of information (significant impact). At the project-specific level, direct impacts can be mitigated to below a significant level through the implementation of paleontological mitigation.

The CEQA threshold of significance for a significant impact to paleontological resources is reached when a project is determined to "directly or indirectly destroy a significant paleontological resource or unique geologic feature." In general, for project areas that are underlain by paleontologically sensitive geologic units, the greater the amount of ground disturbance, the higher the potential for significant impacts to paleontological resources. For project areas that are directly underlain by geologic units with no paleontological sensitivity, there is no potential for impacts on paleontological resources unless sensitive geologic units which underlie the non-sensitive unit are also affected.

Professional Standards

The SVP has established standard guidelines (SVP, 1995) that outline professional protocols and practices for conducting paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation. Most practicing professional vertebrate paleontologists adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically provided in its standard guidelines. Most state regulatory agencies with paleontological laws, ordinances, regulations, and standards (LORS) accept and use the professional standards set forth by the SVP.

As defined by the SVP (1995:26), significant nonrenewable paleontological resources are defined as:

> Fossils and fossiliferous deposits here restricted to vertebrate fossils and their taphonomic and associated environmental indicators. This definition excludes invertebrate or paleobotanical fossils except when present within a given vertebrate assemblage. Certain invertebrate and plant fossils may be defined as significant by a project paleontologist, local paleontologist, specialists, or special interest groups, or by lead agencies or local governments.

As defined by the SVP (1995:26), significant fossiliferous deposits are defined as:

> A rock unit or formation which contains significant nonrenewable paleontologic resources, here defined as comprising one or more identifiable vertebrate fossils, large or small, and any associated invertebrate and plant fossils, traces and other data that provide taphonomic, taxonomic, phylogenetic, ecologic, and stratigraphic information (ichnites [fossilized footprint] and trace fossils generated by vertebrate animals, e.g., trackways, or nests and middens which provide datable material and climatic information.

Based on the significance definitions of the SVP (1995), all identifiable vertebrate fossils are considered to have significant scientific value. This position is adhered to as vertebrate fossils are relatively uncommon, and only rarely will a fossil locality yield a statistically significant number of specimens of within the same genus. Therefore, every vertebrate fossil found has the potential to provide significant new information on the taxon it represents, its paleoenvironment, and/or its distribution. Furthermore, all geologic units in which vertebrate fossils have previously been found are considered to have high sensitivity. Identifiable plant and invertebrate fossils are considered significant if found in association with vertebrate fossils or if defined as significant by project paleontologists, specialists, or local government agencies.

A geologic unit known to contain significant fossils is considered to be “sensitive” to adverse impacts if there is a high probability that earth-moving or ground-disturbing activities in that rock unit will either disturb or destroy fossil remains directly or indirectly.

Paleontological Sensitivity

Paleontological sensitivity is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined by rock type, past history of the geologic unit in producing significant fossils, and fossil localities recorded from that unit. Paleontological sensitivity is derived from the known fossil data collected from the entire geologic unit, not just from a specific survey. In its “Standard Guidelines for the Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources,” the SVP (1995:23) defines four categories of paleontological sensitivity (potential) for rock units: high, low, undetermined, and no potential.

- High Potential. Rock units from which vertebrate or significant invertebrate fossils or suites of plant fossils have been recovered and are considered to have a high potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations that contain significant nonrenewable paleontologic resources anywhere within their geographical extent and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical, and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or

stratigraphic data. Areas that contain potentially datable organic remains, including deposits associated with nests or middens, and areas that may contain new vertebrate deposits, traces, or trackways are also classified as significant.

- Low Potential. Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections.
- Undetermined Potential. Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials.
- No Potential. Metamorphic and granitic rock units do not yield fossils and therefore have no potential to yield significant nonrenewable fossiliferous resources.

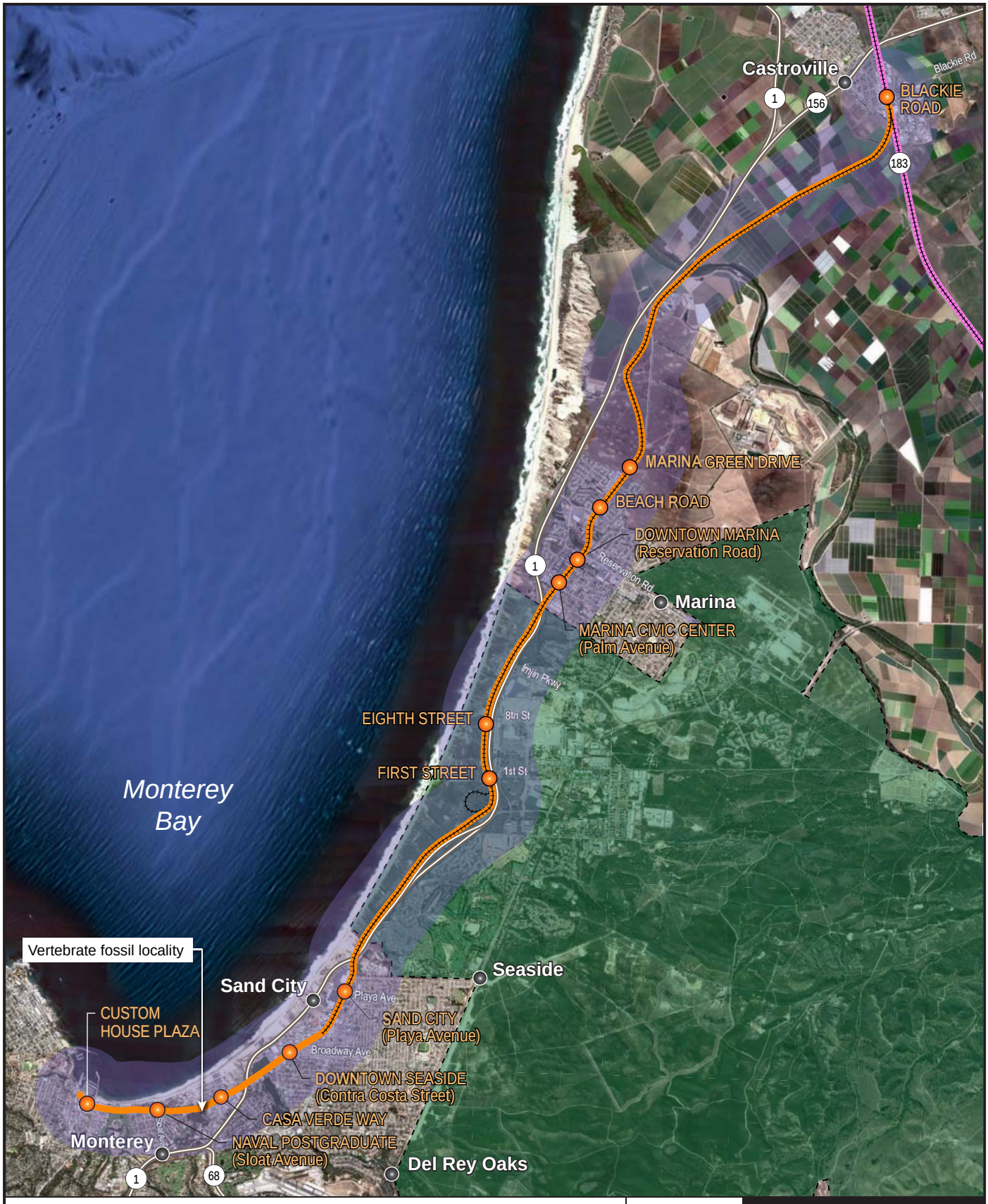
For geologic units with high potential, full-time monitoring is generally recommended during any project-related ground disturbance. For geologic units with low potential, protection or salvage efforts will not generally be required. For geologic units with undetermined potential, field surveys by a qualified vertebrate paleontologist should be conducted to specifically determine the paleontologic potential of the rock units present within the study area.

PROJECT LOCATION AND DESCRIPTION

The project entails re-initiating passenger rail service along an existing railroad right-of-way known as the Monterey Branch Line. The alignment (see the Project Location Layout in Figure 1) is 15.2 miles long and would include 12 stations:

- Custom House Plaza (City of Monterey)
- Naval Postgraduate (Sloat Avenue)
- Casa Verde Way
- Downtown Seaside (Contra Costa Street/West Broadway)
- Sand City (Playa Avenue)
- First Street
- Eighth Street
- Marina Civic Center (Palm Avenue)
- Downtown Marina (Reservation Road)
- Beach Road
- Marina Green Drive
- Blackie Road (unincorporated Monterey County community of Castroville)

The Monterey Branch Line right-of-way also travels along the coastline of Monterey Bay to the north, the southern boundary of Fort Ord Dunes State Park and through the former Fort Ord Reservation. Project features include track replacement, bridge/structure repair, right-of-way acquisitions, street grade improvements, maintenance and operation facility (former Fort Ord area) and station platforms. Standard construction methods would be employed and would largely occur within the existing right-of-way, although some construction outside of these areas may be needed.



LEGEND

- Proposed Station
- Proposed Alignment
- Existing Railroads
- Major Roads
- Fort Ord Reuse Authority
- CalTrain Extension (Proposed)
- 1-mile Study Area

Source: Parsons October 2010

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MONTEREY PENINSULA LIGHT RAIL PROJECT

Figure 1
PROJECT LOCATION

PROJECT PERSONNEL

Parsons paleontologist Lee Monnens requested the museum records search, reviewed published and unpublished literature, and authored this technical report. Donald Jolly, (Parsons) Qualified Principal Paleontologist, provided quality assurance and quality control (QA/QC) review of this technical report. Per CEQUA and SVP a qualified Principal Paleontologist is an individual with:

- A graduate degree in paleontology, geology, or related field, with demonstrated experience in the vertebrate, invertebrate, or botanical paleontology of California or related topical or geographic areas; and
- At least one year full time professional experience, or equivalent specialized training in paleontological research (i.e., the identification of fossil deposits, application of paleontological field and laboratory procedures and techniques, and curation of fossil specimens), administration, or management; and
- At least four months of supervised field and analytic experience in general North American paleontology; and
- Demonstrated ability to carry research to completion.

METHODS

Due to the nature of the fossil record, paleontologists cannot know either the quality or quantity of fossils present in a given geologic unit within a given study area prior to natural erosion or human-caused exposure. A study area is defined as the area composed of a one-mile radius around the Project area analyzed for paleontological resources. No field surveys were conducted for this study; therefore, it is necessary to assess the sensitivity of rock units based on their known potential to produce scientifically significant fossils elsewhere within the same geologic unit (both within and outside of the study area) or a unit representative of the same depositional environment.

For this analysis, a review of local and regional museum collections records was performed for the purposes of determining whether there are any known vertebrate fossil localities within or nearby the project area, identifying the geologic units present in the project area, and determining the paleontological sensitivity ratings of those geologic units. A detailed review of museum collections records was performed by the UCMP for the purposes of (1) determining whether there are any known vertebrate fossil localities in or near the project area, (2) identifying the geologic units present in the project area, and (3) determining the paleontological sensitivity ratings of those geologic units to assess potential impacts to nonrenewable paleontological resources. In addition, a comprehensive literature search and geologic map review was performed to aid in the determination and analysis of the geology and paleontology within and in the vicinity of the project area.

GEOLOGY AND PALEONTOLOGY

Regional Geology

The study area includes the Monterey Peninsula and inland portions of the Monterey Bay Shoreline northeastward to the unincorporated community of Castroville, California (Clark, Dupre' and Rosenberg 1997; Clark et al, 1984 and; Wagner et al 2002). Geologically, this region is situated within the complexly deformed Salinian block between the active San Andreas Fault to the northeast and the San Gregorio fault zone to the southwest and is characterized by compressional tectonics related to the San Andreas fault system including many poorly understood subsidiary faults. A series of high-angle faults trends northwestward across the quadrangles. Most of the faults in the area are discontinuous, with some less than 1 km long; however, the Tularcitos fault zone continues across the entire mapped area. These faults displace the Monterey Formation and locally offset Quaternary deposits.

Site-specific Geology and Paleontology

In the project vicinity Tertiary rocks that overlie the basement in the region include the Miocene-age interbedded marine mudstone and sandstones of the Monterey Formation, the marine to brackish marine Santa Margarita Sandstone comprising of loose to weakly-cemented sandstone and medium-grained clean sand; Tertiary and Quaternary-age "continental deposits" consisting of a complex sequence of interbedded sand, gravel and clay deposits; and the sands, silts, and clays of the Aromas Sands and Older Dunes (Clark, Dupre` and Rosenberg 1997; Rosenberg 2001; Wagner et al 2002; and Yates et al 2005). Surficial deposits include Pleistocene-age river terrace deposits, Holocene-age dune and beach sands along the coast, alluvial deposits within river and stream drainages, and marsh deposits within the estuaries and sloughs. The units encountered at the surface along the project route are discussed in more detail below and depicted in Table 1 and Figure 2.

Monterey Formation (Tm)

The Monterey Formation consists of siliceous shale and minor chert. The shale weathers white to gray or pinkish brown, and is commonly laminated to thin bedded, variously micaceous, silty, porcelaneous, or cherty, and locally contains calcareous concretions or sandstone or siltstone interbeds. The chert is dark gray-brown and laminated with thin shale and sandstone interbeds; fish scales, carbonaceous material and molds of foraminifers, diatoms, and fish remains are variably present (Clark and Brabb 1997). This formation yields benthic foraminifers diagnostic of bathyal or greater depths and is of Luisian and Mohnian (middle and late Miocene) age with most of the Monterey being Mohnian (Clark et al, 1984).

The Monterey Formation consists of as much as 900 meters of siliceous and diatomaceous beds along Carmel Valley and on the Monterey Peninsula. Locally within the City of Monterey, the Monterey Formation rests directly on the granitic basement. The Monterey Formation locally outcrops within valleys that head from the proposed route within the City of Monterey (Clark, Dupre and Rosenberg 1997).

Santa Margarita Sandstone (Tsm)

Conformably overlying the upper diatomite of the Monterey Formation is a marine and brackish-marine, white, fine- to coarse-grained arkosic sandstone mapped as the Santa Margarita Sandstone (Rosenberg 2001). Color is commonly greenish where it contains 37 to 42 percent glauconite (Yates, Feeney and Rosenberg 2005). Stratigraphic relationships to the under- and overlying formations also indicate that the Santa Margarita is late Miocene age. The Santa Margarita Sandstone is exposed in a broad belt through much of central and southern California (Wagner et al 2002). Fossils of marine invertebrates, sharks, dolphins, baleen whales, walruses, fur seals and, sea cows are contained in this formation.

Continental Deposits, undivided (Qtc).

Overlying the Santa Margarita Sandstone is a series of interbedded non-marine, semiconsolidated, fine-grained, oxidized sand and silt beds with common gravel beds (Clark, Dupre and Rosenberg 1997, Rosenberg 2001 and Yates, Feeney and Rosenberg 2005). These beds are thought to be corollary with the Pleistocene/Pliocene-age Paso Robles Formation where in the Salinas Valley it consists of weakly indurated pebble gravel with minor sand and clay (Rosenberg 2001).

Quaternary Alluvial Deposits

Within the project area, there are numerous deposits of Quaternary alluvial units of Pleistocene to Recent age (Clark, Dupre` and Rosenberg 1997, Rosenberg 2001 and Yates, Feeney and Rosenberg 2005). Alluvial deposits of Pleistocene age in California are known to contain scientifically significant fossil localities, including vertebrate specimens representing extinct taxa such as mammoths, mastodons, ground sloths, dire wolves, short-faced bears, saber-toothed cats, horses, camels, and bison.

Summary of Pleistocene and Holocene Deposits within the Project Area

Described below are Pleistocene to Holocene-age deposits previously encountered along the project route/vicinity:

- Aromas Sands and Older Dunes (Qa). Overlying the undivided Continental Deposits is a mapped unit is comprised of a Pleistocene-age heterogeneous sequence of surficial eolian and fluvial sand, silt, clay, and gravel (Rosenberg 2001).
- Youngest Terrace Deposits of Antioch (Qfa). This unit is comprised of semi-consolidated, moderately well to poorly sorted Pleistocene-age sand, silt, and clay with inter-bedded gravel (Rosenberg 2001).
- Ocean View Coastal Terrace (Pleistocene) (Qcto). This unit is comprised of semiconsolidated, moderately well-sorted marine sand containing thin, discontinuous gravel-rich layers. Locally includes some terrace surfaces and debris flow deposits resting on terrace surfaces (Rosenberg 2001)

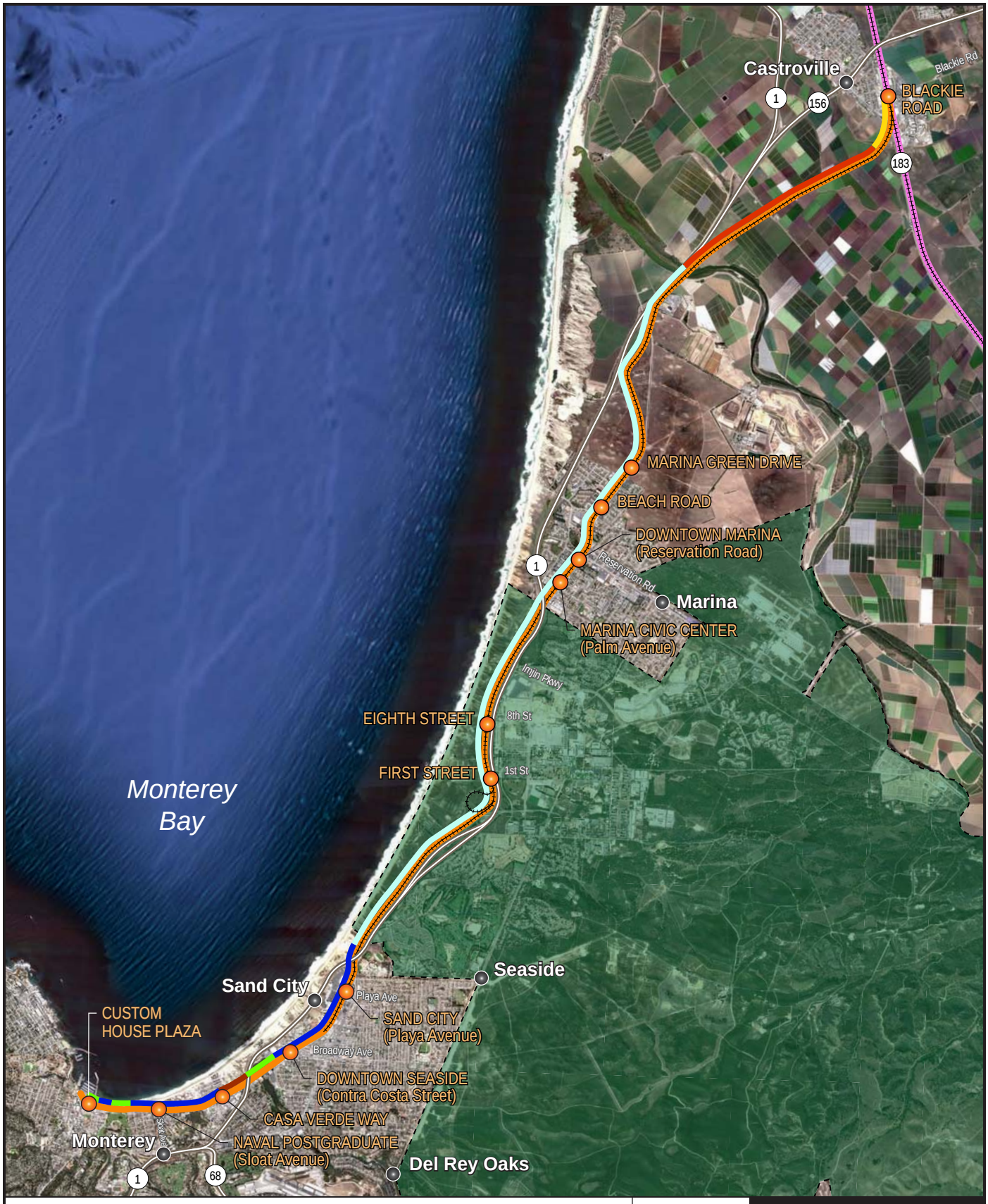
- Lighthouse Coastal terrace, Undivided (Pleistocene) (Qctl). Semiconsolidated, moderately well-sorted marine sand containing thin, discontinuous gravel-rich layers (Clark, Dupre' and Rosenberg1997).
- Older coastal dunes (Pleistocene) (Qod). These are comprised of weakly consolidated, well-sorted, fine-to medium-grained sand. Some geologic deposits are covered with a thin veneer of eolian deposits (Rosenberg 2001).
- Basin deposits (Holocene) (Qb). Basin deposits consist of unconsolidated, plastic clay and silty clay containing much organic material. These locally contain interbedded thin layers of silt and silty sand that are deposited in a variety of environments including estuaries, lagoons, tidal flats, marsh-filled sloughs, flood basins, and lakes (Clark, Dupre' and Rosenberg1997; Rosenberg 2001 and Wagner et al 2002).
- Flandrian dune deposits (Holocene) (Qfd). These are characterized as unconsolidated, well-sorted sand deposited in a belt of parabolic dunes (Rosenberg 2001).
- Flood-plain deposits, undifferentiated (Holocene) (Qfl). Flood-plain deposits are unconsolidated, relatively fine-grained, heterogeneous deposits of sand and silt that commonly include relatively thin, discontinuous layers of clay (Rosenberg 2001 and Wagner et al 2002).
- Artificial fill (Holocene) (Qaf). This consists of deposits of fill resulting from human construction or mining activities ranging from well-compacted sand and silt to poorly compacted sediment high in organic content; only locally delineated (Rosenberg 2001 and Wagner et al 2002).

TABLE 1. PALEONTOLOGICAL ASSESSMENT AND RESOURCE SENSITIVITY SUMMARY FOR GEOLOGIC UNITS OCCURRING WITHIN THE MONTEREY PENINSULA RAIL PROJECT AREA

Geologic Unit	Age	Map Abbreviation	Known Fossil Types	Paleontological Sensitivity
Monterey* Formation	Miocene	Tm	Marine invertebrates and vertebrates	High
Santa Margarita* Sandstone	Miocene	Tsm	Marine invertebrates and vertebrates	High
Continental Deposits, undivided	Pleistocene/Pliocene	Qtc(3)	None	Low to high
Aromas Sands and Older Dunes	Pleistocene	Qa (3)	None	Low to high
Youngest Terrace Deposits of Antioch	Pleistocene	Qfa (2)	None	Low to high
Ocean View Coastal Terrace	Pleistocene	Qcto (1)	None	Low to high
Lighthouse Coastal Terrace, Undivided	Pleistocene	Qctl(1)	None	Low to High
Older Coastal Dunes	Pleistocene	Qod (2)	None	Low to high
Basin Deposits	Holocene	Qb (2)	None	Low to high
Flandrian Dune Deposits	Holocene	Qfd (1)	None	Low to high

Flood-plain Deposits, undifferentiated	Holocene	Qfl (2)	None	Low to high
Artificial Fill	Holocene	Qaf (1)	None	Zero

- *Not mapped at the surface
- (1) Clark, Dupre' and Rosenberg (1997)
- (2) Wagner et al (2002)
- (3) Rosenberg (2001)



LEGEND

- Proposed Station
- Proposed Alignment
- Existing Railroads
- Major Roads
- Fort Ord Reuse Authority
- CalTrain Extension (Proposed)

- Qfa Youngest terrace deposits of Antioch
- Qod Older coastal dunes
- Qfl Flood plain deposits, undifferentiated
- Qcto Ocean view coastal terrace
- Qaf Artificial fill
- Qctl Lighthouse coastal terrace, undivided

N

0 1

Mile

MONTEREY PENINSULA
LIGHT RAIL PROJECT

Figure 2
GEOLOGIC RESOURCES MAP

Source: Parsons *October 2010*


Castroville
Blackie Rd
BLACKIE ROAD
1
156
183
Low to high with increasing depth
MARINA GREEN DRIVE
BEACH ROAD
DOWNTOWN MARINA (Reservation Road)
Reservation Rd
Marina
MARINA CIVIC CENTER (Palm Avenue)
Imjin Pkwy
EIGHTH STREET
8th St
FIRST STREET
1st St
Monterey Bay
Low to high with increasing depth
Seaside
Sand City
Playa Ave
SAND CITY (Playa Avenue)
CUSTOM HOUSE PLAZA
Zero
Broadway Ave
DOWNTOWN SEASIDE (Contra Costa Street)
CASA VERDE WAY
Low to high with increasing depth
Monterey
NAVAL POSTGRADUATE (Sloat Avenue)
Del Rey Oaks
1
68
LEGEND
Proposed Station
Proposed Alignment
Existing Railroads
Major Roads
Fort Ord Reuse Authority
CalTrain Extension (Proposed)
Source: Parsons October 2010
N
0
1
Mile
MONTEREY PENINSULA
LIGHT RAIL PROJECT
Figure 3
PALEONTOLOGIC SENSITIVITY

RESULTS

The paleontological sensitivity of the units encountered at the surface along the project route are discussed in more detail below and in Table 1 and depicted in Figure 3.

UCMP Berkeley

Museum collections maintained by the UCMP recorded two vertebrate fossil localities within or near the project area. These two are within the City of Monterey. One locality, Locality V6226 is within one-mile of the Project route and the other, V68140 is approximately 1.8 miles to the southwest outside the one-mile radius of the Project study area (Holroyd 2010). Both of these sites contain cranial and post cranial skeletal elements of fish collected from the Miocene-age Monterey Formation. Locality V6226 contained elements of Perciforme fish of the genus *Paralabrax* and Locality V68140; skeletal elements of fish from the family Diodontidae, of the genus and species *Oligodiodon vetus* were collected.

Fort Ord Dunes State Park

No paleontological sites have been recorded within the boundaries of Fort Ord Dunes, while a number of sites have been identified in upland areas of the former Fort Ord military reservation (Fort Ord Dunes General Plan 2004). Given the dynamic state of the dunes and coastal erosion, significant deposits of fossil material in Fort Ord Dunes are unlikely. Nevertheless, significant assemblages of fossil remains are possible even in areas designated as having low-potential for resources.

Monterey County

Most of the fossils found in Monterey County are of marine life forms that have produced a record of the region's geologic history of advancing and retreating sea levels (Monterey County General Plan 2006). Fossil marine microorganisms such as foraminifers or diatoms or assemblages of mollusks and barnacles are commonly found in sedimentary rocks ranging from Cretaceous age (138 to 96 million years old [Ma]) to Pleistocene age (1.6 Ma to 11,000 before present [BP]) (Rosenberg 2001).

Fossils are found throughout the county because of the widespread distribution of marine deposits (Monterey County General Plan 2006). A review of nearly 700 known fossil localities was conducted by paleontologists in 2001 and twelve fossil sites were identified as having significant scientific value. All these sites are more than one mile from the Project route. For the most part, the fossils reflect the type of assemblages found throughout the county (microorganisms or invertebrates); however, each has special characteristics that make them unique or rare, or in some way provide important stratigraphic or historic information.

City of Marina

No unique paleontological resources have been identified within the Marina area (City of Marina, 2007). No paleontological resources are anticipated in the project area; therefore, project development would not result in direct or indirect impacts on any unique paleontological resources.

City of Monterey

As describe above the UCMP identified two vertebrate fossil localities within the City of Monterey. One is within one-mile of the Project Route and the other outside the one-mile radius in any direction of the Project Route (Holroyd 2010). Both of these sites contain vertebrates collected from the Miocene-age Monterey Formation.

City of Sand City

No readily obtained references concerning paleontological resources could be identified or reviewed. Given the dynamic state of the dunes and coastal erosion, significant deposits of fossil material in the vicinity are unlikely. However, significant assemblages of fossil remains are possible even in areas designated as having low-potential for resources.

City of Seaside

Many of the fossils found in the Seaside area are of marine life forms, including micro-organisms, mollusks, barnacles, and other aquatic species (Seaside general Plan EIR 2004). Such fossils dominate the local fossil record because of their proximity to the ocean. Fossils in the area are typically found within sedimentary rock. In Seaside, these rock layers may be at relatively great depths – up to 200 feet below the ground surface in places (Seaside general Plan EIR 2004).

Quaternary-Age deposits

Although Holocene-aged sediments often contain the remains of modern organisms, they are considered too young to contain significant paleontological resources (SVP, 1995). However, these younger sediments may overlie Pleistocene age (1.8 Ma to 10,000 years BP) alluvium at an unknown depth. Alluvial deposits of Pleistocene age in California are known to contain scientifically significant fossil localities, including vertebrate specimens representing extinct taxa such as mammoths, mastodons, ground sloths, dire wolves, short-faced bears, saber-toothed cats, horses, camels, and bison. Therefore, areas mapped as being underlain by Holocene-age alluvial deposits are assigned a paleontological sensitivity ranging from low to high (increasing with depth).

CONCLUSIONS

The destruction of fossils as a result of human-caused ground disturbance may have a significant cumulative impact, as it may make biological records of ancient life permanently unavailable for study by scientists. Implementation of proper mitigation measures can, however, reduce the potential impacts to the paleontological resources to below the level of significance. Very shallow excavations related to the project are unlikely to result in adverse impacts to significant paleontological resources; however, deeper excavations (10 feet deep or greater) within previously undisturbed sediments may have an adverse impact to paleontological resources unless proper mitigation measures are implemented.

RECOMMENDED MITIGATION MEASURES

No Action Alternative

The No Action Alternative, in which the project site would remain in its existing condition, would not result in impacts to paleontological resources because no ground disturbances would occur.

Locally Preferred Alternative

The Locally Preferred Alternative (the proposed project) has the potential to affect paleontological resources during construction period excavations in paleontologically sensitive areas. The following recommended mitigation measures have been developed in accordance with the SVP (1995) standards; Monterey County, cities of Marina, Sand City, Seaside and Monterey guidelines as well as information or guidance from the California Coastal Commission and Fort Ord Reuse Authority and meet the paleontological requirements of CEQA. These and similar mitigation measures have been used throughout California and have been demonstrated to be successful in protecting paleontological resources while allowing timely completion of construction.

PM-1:

A Qualified Paleontologist will be retained to supervise monitoring of construction excavations and to produce a Paleontological Monitoring and Mitigation Plan for the proposed project. CEQA defines a qualified vertebrate paleontologist as a person who holds an advanced degree (Master's or higher) in geology, paleontology, biology, or related discipline (exclusive of archaeology) with at least five years of professional experience with paleontologic resources including the collection, identification, and curation of fossil specimens (not including cultural resources.

PM-2:

All project-related ground disturbances that could potentially affect previously undisturbed older (Pleistocene-age) alluvial deposits and/or Monterey and Santa margarita Sandstone Formations will be monitored by a qualified paleontological monitor under the supervision of a Qualified Paleontologist. Project-related excavations that occur in surficial younger (Holocene-age) alluvial and fluvial deposits and/or topsoil (less than 10 feet in depth) will also be monitored a periodic basis to ensure that underlying paleontologically sensitive sediments are not being affected. Paleontological resource monitoring will include inspection of exposed rock units during active excavations within sensitive geologic sediments. The location of subsurface sensitive sediments will be determined by the Qualified Paleontologist upon review of project grading plans.

PM-3:

Paleontological monitors will have authority to temporarily divert grading away from exposed fossils to professionally and efficiently recover the fossil specimens and collect associated data. All efforts to avoid delays to project schedules will be made.

Monitors will be equipped with the necessary tools for the rapid removal of fossils and retrieval of associated data to prevent construction delays. This equipment will include handheld GPS receivers, digital cameras, and cell phones, as well as a toolkit containing specimen containers and matrix sampling bags, field labels, field tools (awl, hammer, chisels, shovel, etc.), and a plaster kit. At each fossil locality, field data forms will be used to record pertinent geologic data, stratigraphic sections will be measured, and appropriate sediment samples will be collected and submitted for analysis.

PM-4:

The collected fossils will be transported to a paleontological laboratory for processing, where they will be prepared to the point of curation, identified by qualified experts, listed in a database to facilitate analysis, and reposited in a public museum (such as the UCMP) or other county-and state-approved curation facilities.

PM-5:

The Qualified Paleontologist will prepare a final monitoring and mitigation report to be filed with the client, the lead agency, and the repository. The final report will include, but not be limited to, a discussion of the results of the mitigation-monitoring plan, an evaluation and analysis of the fossils collected (including an assessment of their significance, age, and geologic context), an itemized inventory of fossils collected, a confidential appendix of locality and specimen data with locality maps and photographs, an appendix of curation agreements and other appropriate communications, and a copy of the project-specific paleontological monitoring and mitigation plan.

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