CALIFORNIA HIGH-SPEED TRAIN

Project Environmental Impact Report / Environmental Impact Statement

DRAFT

Fresno to Bakersfield

Paleontological Resources Technical Report

May 2011

CALIFORNIA High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

California High-Speed Train Project EIR/EIS

Paleontological Resources Technical Report

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Table of Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

Authority	California High-Speed Rail Authority
bgs	below ground surface
BNSF	BNSF Railway
B.P.	before present
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act of 1970
C.F.R.	Code of Federal Regulations
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
HMF	heavy maintenance facility
HST	high-speed train
LACM	Natural History Museum of Los Angeles County
LORS	laws, ordinances, regulations, and standards
NALMA	North American land-mammal age
NEPA	National Environmental Policy Act of 1969
OCS	overhead catenary system
PG	professional geologist
P.L.	Public Law
PRC	PaleoResource Consultants
ROD	record of decision
RTP	Regional Transportation Plan
SR	State Route
STIP	State Transportation Improvement Program
SVP	Society of Vertebrate Paleontology
TPS	traction power substation

UCMP	University of California Museum of Paleontology
UPRR	Union Pacific Railroad Company
U.S.C.	United States Code

Section 1.0
Introduction

1.0 Introduction

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain an electric-powered high-speed train (HST) system in California. When completed, the nearly 800-mile train system would provide new passenger rail service to more than 90% of the state's population. More than 200 weekday trains would serve the statewide intercity travel market. The HST would be capable of operating at speeds of up to 220 miles per hour (mph), with state-of-the-art safety, signaling, and automated train control systems. The system would connect and serve the major metropolitan areas of California, extending from San Francisco and Sacramento in the north to San Diego in the south.

In 2005, the Authority and the Federal Railroad Administration (FRA) prepared a Program Environmental Impact Report/Environmental Impact Statement (Statewide Program EIR/EIS) evaluating HST's ability to meet the existing and future capacity demands on California's intercity transportation system (Authority and FRA 2005). This was the first phase of a tiered environmental review process (Tier 1) for the proposed statewide HST system. The Authority and the FRA completed a second Program EIR/EIS in July 2008 to identify a preferred alignment for the Bay Area to Central Valley section (Authority and FRA 2008).

The Authority and FRA are now undertaking second-tier, project environmental evaluations for sections of the statewide HST system. This Paleontological Resources Technical Report is for the Fresno to Bakersfield Section. The Fresno to Bakersfield Section begins at the proposed Fresno HST station in downtown Fresno and extends east past the proposed Bakersfield HST station in downtown Bakersfield for approximately 1 mile to Oswell Street. Information from this report is summarized in the project EIR/EIS for the Fresno to Bakersfield HST Section and will be part of the administrative record supporting the environmental review of the proposed project.

For the HST system, including the Fresno to Bakersfield Section, the FRA is the lead federal agency for compliance with the National Environmental Policy Act of 1969 (NEPA) and other federal laws. The Authority is serving as a joint-lead agency under NEPA and is the lead agency for compliance with the California Environmental Quality Act of 1970 (CEQA). The U.S. Army Corps of Engineers (USACE) is serving as a cooperating agency under NEPA for the Fresno to Bakersfield Section.

The purpose of this report is to provide an assessment of potential adverse impacts on scientifically significant paleontological resources (i.e., fossils [the remains of prehistoric plants and animals]) resulting from earth moving associated with the proposed construction of the California HST system by the Authority. The California HST program consists of a more than 800-mile-long HST system capable of speeds in excess of 220 miles per hour on a dedicated, fully grade-separated track with state-of-the-art safety, signaling, and automated train control systems. The California HST system is designed to connect and serve the major metropolitan centers of California, extending from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego. This technical report specifically addresses the proposed alignment from the Fresno urban area to the Bakersfield urban area in Fresno, Kings, Tulare, and Kern counties, California. Excavations for the proposed project could potentially affect scientifically important paleontological resources. The purpose of this investigation was to identify any paleontological resources that might be impacted by project excavations.

URS Corporation retained PaleoResource Consultants (PRC) to do the assessment, which is presented below. This technical report presents the results of the assessment of the potential adverse impacts of the construction of the Fresno to Bakersfield Section of the California HST system (the project) on known and suspected paleontological resources. This paleontological resource impact assessment meets all requirements of NEPA and CEQA and the standard measures for mitigating adverse construction-related environmental impacts on paleontological resources established by the Society of Vertebrate Paleontology (SVP) (SVP 1995, 1996). Background research and a paleontological survey were conducted to identify paleontological resources that may be affected by the proposed Fresno to Bakersfield Section of the California HST system. The paleontological study area for this assessment was a 1-mile radius around the proposed right-of-way and any potential facilities. The background research included the identification of potentially impacted geologic units and the analysis of their paleontological sensitivity. The research and analysis was based on published and unpublished geological and paleontological literature, museum records, and a field survey.

The background research revealed that six geologic units may be impacted by the project, and five of these geologic units are paleontologically sensitive, based on SVP (1995) criteria. The sensitive geologic units are the Kern River Formation, Turlock Lake Formation, Riverbank Formation, Modesto Formation, and Tulare Lake beds. The research determined that each of these geologic units has, in the past, produced scientifically important paleontological resources.

The literature review was supplemented by archival records searches conducted at the University of California Museum of Paleontology (UCMP) in Berkeley, California; the Natural History Museum of Los Angeles County (LACM); and the San Bernardino County Museum. The archival records searches yielded additional information regarding the occurrence of fossil sites and remains in and near the paleontological study area. The museum records did not show any recorded fossil localities within the project footprint, though they did provide information regarding the sensitivity of some formations from localities elsewhere in those geological units.

All portions of the paleontological study area for which permission to enter had been obtained were surveyed by a team of PRC paleontologists between November 2009 and April 2010. This field survey, which included visual inspection of exposures of potentially fossiliferous strata in the paleontological study area, was conducted to document the presence of sediments suitable for containing fossil remains and the presence of any previously unrecorded fossil localities. The survey documented several previously unrecorded fossil localities within the paleontological study area.

Section 2.0
Project Description

2.0 Project Description

2.1 Project Introduction

The Fresno to Bakersfield Section of the HST project would extend from Fresno to Bakersfield and lie within Fresno, Kings, Tulare, and Kern counties, California. Depending on which route alternatives are selected, the Fresno to Bakersfield Section would be approximately 115 miles long and cross both urban and rural lands. To comply with the Authority's guidance of using existing transportation corridors when feasible, the Fresno to Bakersfield Section would primarily sited adjacent to the existing BNSF Railway (BNSF) corridor. Alternative alignments are being considered where engineering constraints require deviation from the existing railroad corridor and to avoid environmental impacts.

As indicated in Chapter 1.0, the HST alignment would be entirely grade-separated, meaning that crossings with roads, railroads, and other transport facilities would be located at different heights (overpasses or underpasses) so that the HST would not interrupt or interface with other modes of transport. To achieve this, the Fresno to Bakersfield Section would include approximately 100 grade-separation road crossings. Right-of-way for the HST would be fenced to prohibit public or automobile access. The project footprint would primarily consist of the train right-of-way, which would typically be 100 feet wide and consist of a northbound and a southbound track. Additional project footprint would be required to accommodate stations, multiple tracks at stations, power substations, and maintenance facilities. The Fresno to Bakersfield Section would include a station in Fresno, a station in Bakersfield, and a potential Kings/Tulare Regional Station in the vicinity of Hanford to provide service to Hanford, Tulare, Visalia, and Corcoran.

The Fresno to Bakersfield Section would include both at-grade and elevated track segments. At-grade track would be laid on an earthen rail bed topped with rock ballast with a total height of approximately 6 feet; fill and ballast for the rail bed would be obtained from permitted borrow sites and quarries. Elevated track segments would be used to pass over long sections of urban development or elevated road structures, and would consist of viaduct or guideway structures made from cast reinforced-concrete columns, box girders, and platforms. The height of elevated track sections would range from 40 to 90 feet, and columns would be spaced 60 to 120 feet apart.

2.2 Project Alternatives

2.2.1 Alternative Alignments

This section describes the HST project alternatives, including the No Action/No Project Alternative. As described in the Final Program EIR/EIS for the Proposed California High-Speed Train System (Statewide Program EIR/EIS) the Authority selected the BNSF Railway corridor for the HST route from Fresno to Bakersfield and the Union Pacific Railroad Company (UPRR) corridor for the urban area through Fresno (Authority and FRA 2005). The project EIR/EIS for the Fresno to Bakersfield HST Section examines alternative alignments and stations within the general BNSF Railway corridor. For clarity, a single alignment (the BNSF Alignment Alternative) from Fresno to Bakersfield that most closely follows the preferred alignment identified in the Record of Decision (ROD) for the Statewide Program EIR/EIS is described; it is followed by descriptions of alternative alignments that deviate from the BNSF Alternative in specific areas of the BNSF Railway corridor.

2.2.1.1 No Action/No Project Alternative

Under the No Action/No Project Alternative, the HST System would not be built. The No Action/No Project Alternative represents the condition of the Fresno to Bakersfield Section as it existed in 2009 (when the Notice of Preparation was issued), and as it would exist without the HST project at the planning horizon (2035). To assess future conditions, it was assumed that all currently known programmed and funded improvements to the intercity transportation system (highway, rail, and transit), and reasonably foreseeable local development projects (with funding sources identified), would be developed by 2035. The No Project Alternative is based on a review of Regional Transportation Plans (RTPs) for all modes of travel, the State of California Office of Planning and Research CEQAnet Database, the Federal Aviation Administration (FAA) Air Carrier Activity Information System (ACAIS) and Airport Improvement Plan (AIP) grant data, the State Transportation Improvement Program (STIP), airport master plans and interviews with airport officials, intercity passenger rail plans, and city and county general plans and interviews with planning officials.

2.2.1.2 BNSF Alternative Alignment

The BNSF Alternative Alignment would extend 115 miles from Fresno to Bakersfield and would lie adjacent to the BNSF Railway route to the extent feasible (Figure 2-1). Several minor deviations from the BNSF Railway corridor would be necessary to accommodate engineering constraints, namely wider curves necessary to accommodate the higher-speed HST (as compared with the existing lower-speed freight line track alignment). The BNSF Alternative would not follow the BNSF Railway right-of-way between approximately Elk Avenue in Fresno County and Nevada Avenue in Kings County, but rather the alignment would curve to the east on the north of the Kings River and away from Hanford, and would rejoin the BNSF Railway corridor near Corcoran. The BNSF Alternative would be elevated in three locations in Fresno County: (1) in the city of Fresno to East Central Avenue, (2) between Mountain View Avenue and Fowler Street, and (3) over Kings River.

In Kings County, the BNSF Alternative would be elevated for 2 miles east of Hanford to accommodate the potential Kings/Tulare Regional Station, and where the alignment spans Cross Creek and runs through Corcoran. In Tulare County, the BNSF Alternative would be elevated at the crossing of the Tule River and at the crossing of the Alpaugh railroad spur that runs west from the BNSF Railway mainline. In Kern County, the BNSF Alternative would be elevated across Poso Creek, and through Wasco, Shafter, and Bakersfield.

2.2.1.3 Alternatives to the BNSF Alternative

In addition to the BNSF Alternative, the Authority is considering five alternative alignments for portions of the Fresno to Bakersfield Section. Each of these alternative alignments was selected to avoid environmental, land use, or community issues identified for portions of the BNSF Alternative.

<u>Fresno West Alternative Alignment</u>

The Fresno West Alternative would run through the city of Fresno along the western side of the UPRR from the northern terminus of the project to the East Jenson bypass. The length of the Fresno West Alternative would be approximately 7 miles, and the distance between the Fresno West Alternative and the BNSF Alternative is approximately 500 feet. The Fresno West Alternative would also be elevated through the city of Fresno and would cross the same roads as the BNSF Alternative.

Corcoran Bypass Alternative Alignment

The Corcoran Bypass Alternative would diverge from the BNSF Alternative at approximately Kansas Avenue and swing east of Corcoran, rejoining the BNSF Railway route at Avenue 136. The total length of the Corcoran Bypass would be approximately 13 miles. Unlike the corresponding segment of the BNSF Alternative, the majority of the Corcoran Bypass Alternative would be at-grade. However, two elevated structures would carry the HST over Cross Creek and the Tule River. This alternative alignment would cross the Whitley Avenue/State Route (SR) 137 and Eighth Avenue intersection, Oregon Avenue, and Avenue 152. The Whitley Avenue/SR 137 and Eighth Avenue intersection would be grade-separated from the HST with an overcross. Oregon Avenue and Avenue 152 would be closed at the HST right-of-way.

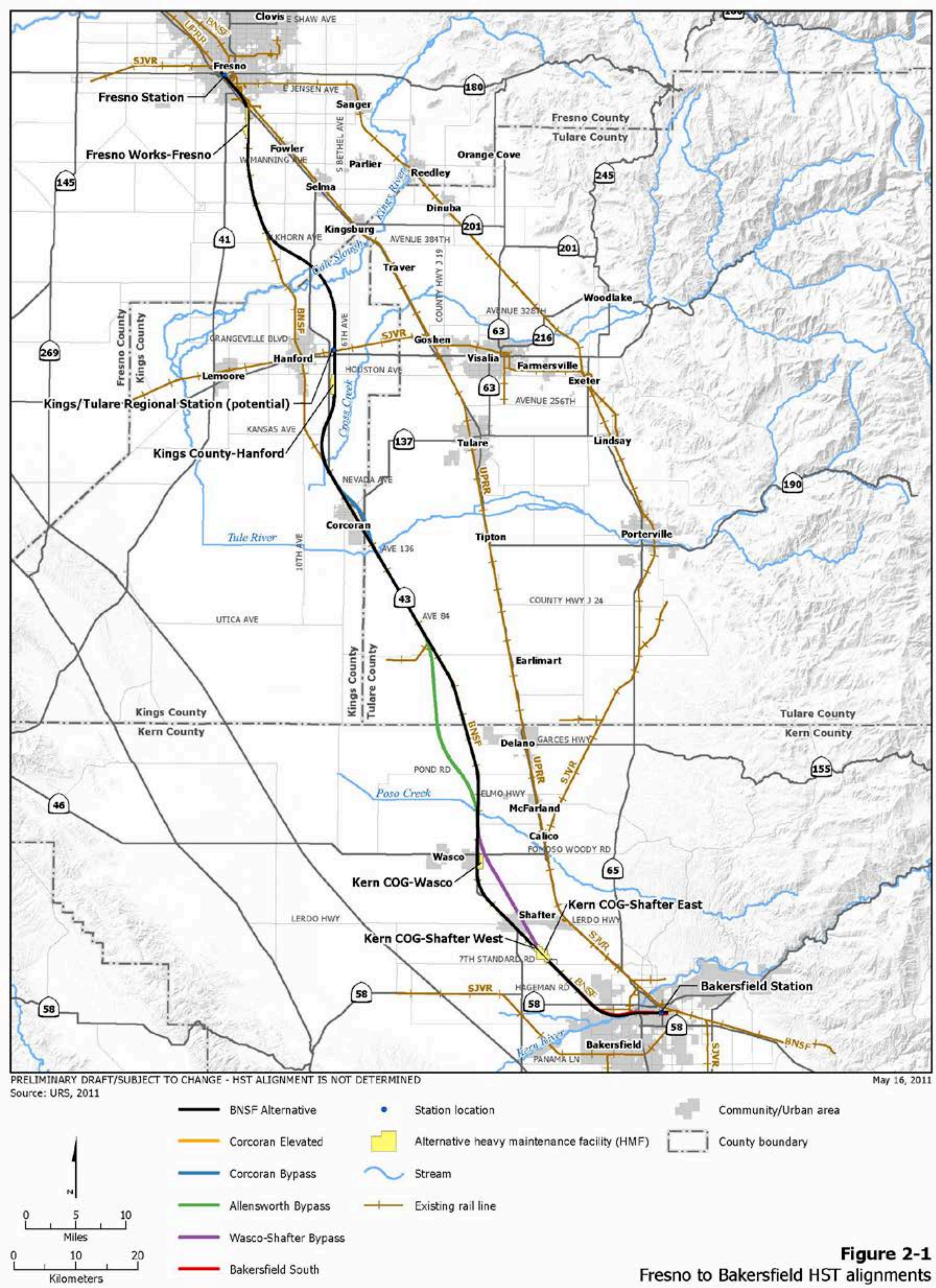


Figure 2-1
Fresno to Bakersfield HST alignments

Allensworth Bypass Alternative Alignment

This alignment passes west of the BNSF Alternative, avoiding the Allensworth Ecological Reserve and Allensworth State Historic Park. The total length of the Allensworth Bypass Alternative would be approximately 22 miles, beginning at Avenue 84 and rejoining the BNSF Alternative at Elmo Highway. The Allensworth Bypass Alternative would be constructed on an elevated structure where the alignment crosses the Alpaugh railroad spur. The majority of the alignment would pass through Tulare County at-grade. The wildlife crossing structures described for the Allensworth area of the BNSF Alternative would also be used for the Allensworth Bypass Alternative.

The Allensworth Bypass Alternative would cross Road 80/Avenue 16, Garces Highway/Magnolia Avenue, Palm Avenue, Airport Avenue, Pond Road, and Peterson Road. Garces Highway/Magnolia Avenue and Palm Avenue would be closed at the HST right-of-way, and the other roads would be grade-separated from the HST with overcrossings.

Wasco-Shafter Bypass Alternative Alignment

The Wasco-Shafter Bypass Alternative would diverge from the BNSF Alternative between Sherwood Avenue and Fresno Avenue, bypassing Wasco and Shafter to the east. The total length of this alternative alignment would be 18 miles, and the alignment would be at-grade. The Wasco-Shafter Bypass would cross SR 43, SR 46, and 10 local roads. McCombs Avenue in Wasco, and Fresno Avenue and East Los Angeles Avenue in Shafter, would be closed at the HST right-of-way. The other roads would be grade-separated from the HST with overcrossings.

Bakersfield South Alternative Alignment

From the Rosedale Highway (SR 58) in Bakersfield, the Bakersfield South Alternative Alignment parallels the BNSF Alternative, approximately 250 feet to the north. At Chester Avenue, the Bakersfield South Alternative curves south and parallels California Avenue. This alternative alignment would be approximately 11 miles long and include the Bakersfield Station–South Alternative. The Bakersfield South Alternative Alignment would be elevated from 50 to 70 feet throughout its length, and would cross the same roads as the BNSF Alternative.

2.2.2 Station Alternatives

The Fresno to Bakersfield Section of the HST would include a new station in Fresno and a new station in Bakersfield. An optional third station, the Kings/Tulare Regional Station, is under consideration.

Stations would be designed to address the purpose of the HST, particularly to allow for intercity travel and connection to local transit, airports, and highways. All stations would contain the following elements:

- Passenger boarding and alighting platforms.
- A station head house with ticketing, waiting areas, passenger amenities, vertical circulation, administration and employee areas, and baggage and freight-handling service.
- Vehicle parking (short-term and long-term) and “kiss and ride”.
- Motorcycle/scooter parking.
- Bicycle parking.
- Waiting areas and queuing space for taxis and shuttle buses.
- Pedestrian connections.

2.2.2.1 Fresno Station Alternatives

Three alternative sites are under consideration for the Fresno Station.

Fresno East Station Alternative

This station would be located in downtown Fresno, less than half a mile east of SR 99 along the BNSF Alternative. It would be situated on five parcels bordered by H Street on the north, G Street on the south, Merced Street on the west, and Inyo Street on the east (Figure 2-2). The station building would be 60,000 square feet with a maximum height of 95 feet. The 20-acre site would include 12 acres dedicated to the station, bus transit center, short-term parking, and kiss-and-ride. The additional 8 acres would be divided between four parking structures, each with five levels and each with a capacity of 1,250 cars. The UPRR tracks would traverse the station site. The station, kiss-and-ride, and short-term parking would be sited northeast of the UPRR tracks. The parking structures and bus transit center would be sited southwest of the UPRR tracks.

Fresno West Station–Tulare Alternative

The Fresno West Station–Tulare Alternative would be located in the vicinity of the East Station Alternative but shifted two blocks east, with the northern border at Tulare Street and the southern border at Santa Clara Street (Figure 2-3). The station building would be 60,000 square feet with a maximum height of 90 feet. The 20-acre site would include 12 acres dedicated to the station, bus transit center, short-term parking, and kiss and ride. Three of the four parking structures would each sit on 2 acres, and each would have a capacity of 1,250 cars. The fourth structure would be slightly smaller in footprint (1.7 acres) and have a capacity of 1,050 cars. The UPRR tracks would traverse the station site. Under the Fresno West Station–Tulare Alternative, the majority of the facilities, including the parking structures, short-term parking, and kiss-and-ride, would be located northeast of the HST tracks, and the bus transit center would be located southwest of the tracks.

Fresno West Station–Kern Alternative

The Fresno West Station–Kern Alternative would be similar to the Fresno West Station–Tulare Alternative in location, total acreage, parking structure placement and configuration, and platform size. However, the station would front on Kern Street instead of Tulare Street. The station building would be 52,000 square feet with a maximum height of 90 feet (Figure 2-4). Under the Kern Alternative, the bus transit center and kiss-and-ride would be southwest of the HST tracks, and the UPRR tracks would traverse the station site.

2.2.2.2 Kings/Tulare Regional Station

The potential Kings/Tulare Regional Station would be located east of SR 43 (Avenue 8) and north of the Central Valley Rail Line (San Joaquin Valley Railroad) (Figure 2-5). The station building would be 40,000 square feet with a maximum height of 75 feet. The entire site would be 28 acres, including 8 acres designated for the station, bus transit center, short-term parking, and kiss-and-ride. An additional 20 acres would support a surface parking lot with approximately 1,600 spaces.

2.2.2.3 Bakersfield Station Alternatives

Two options are under consideration for the Bakersfield Station.

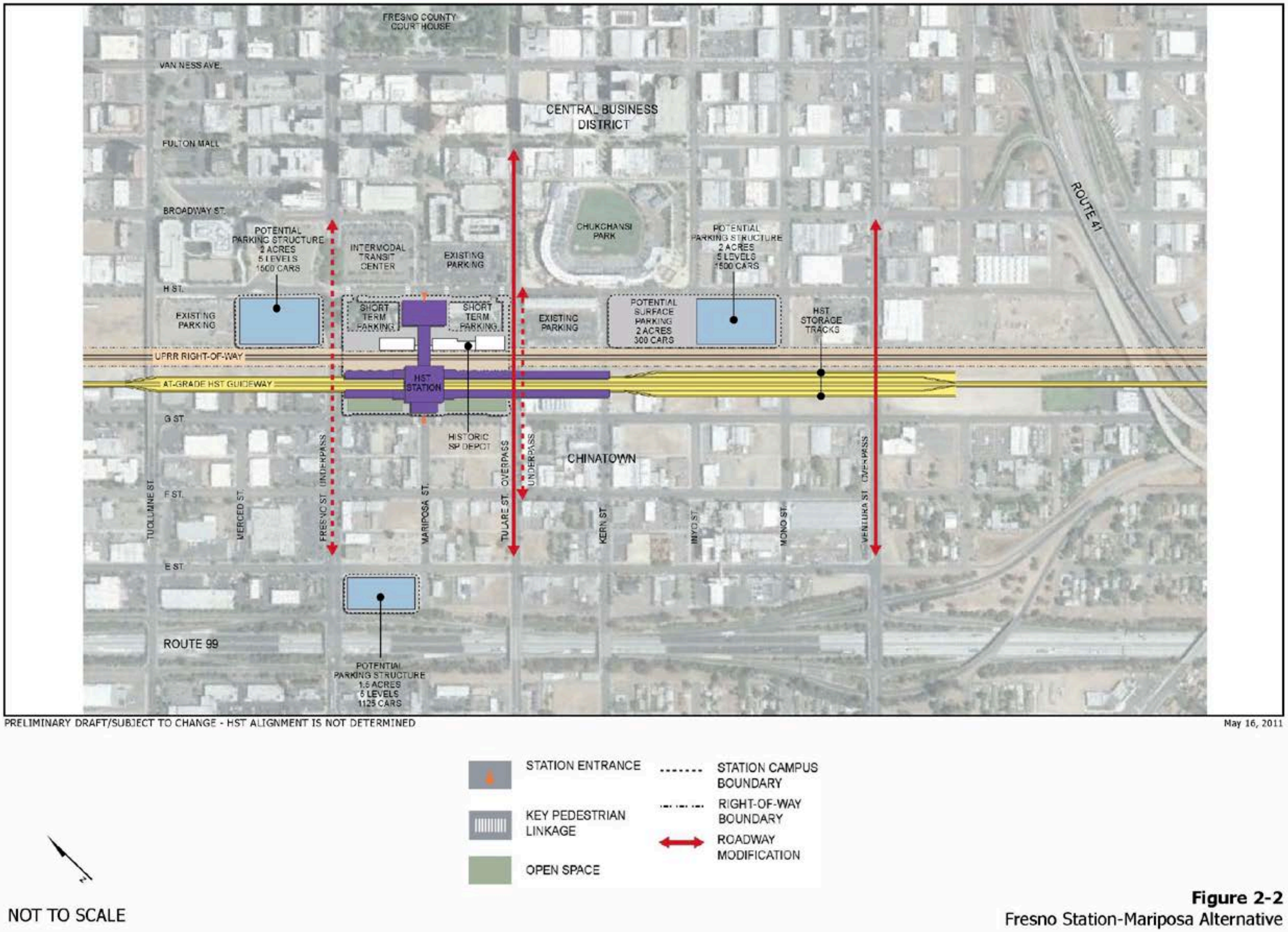


Figure 2-2
Fresno Station-Mariposa Alternative

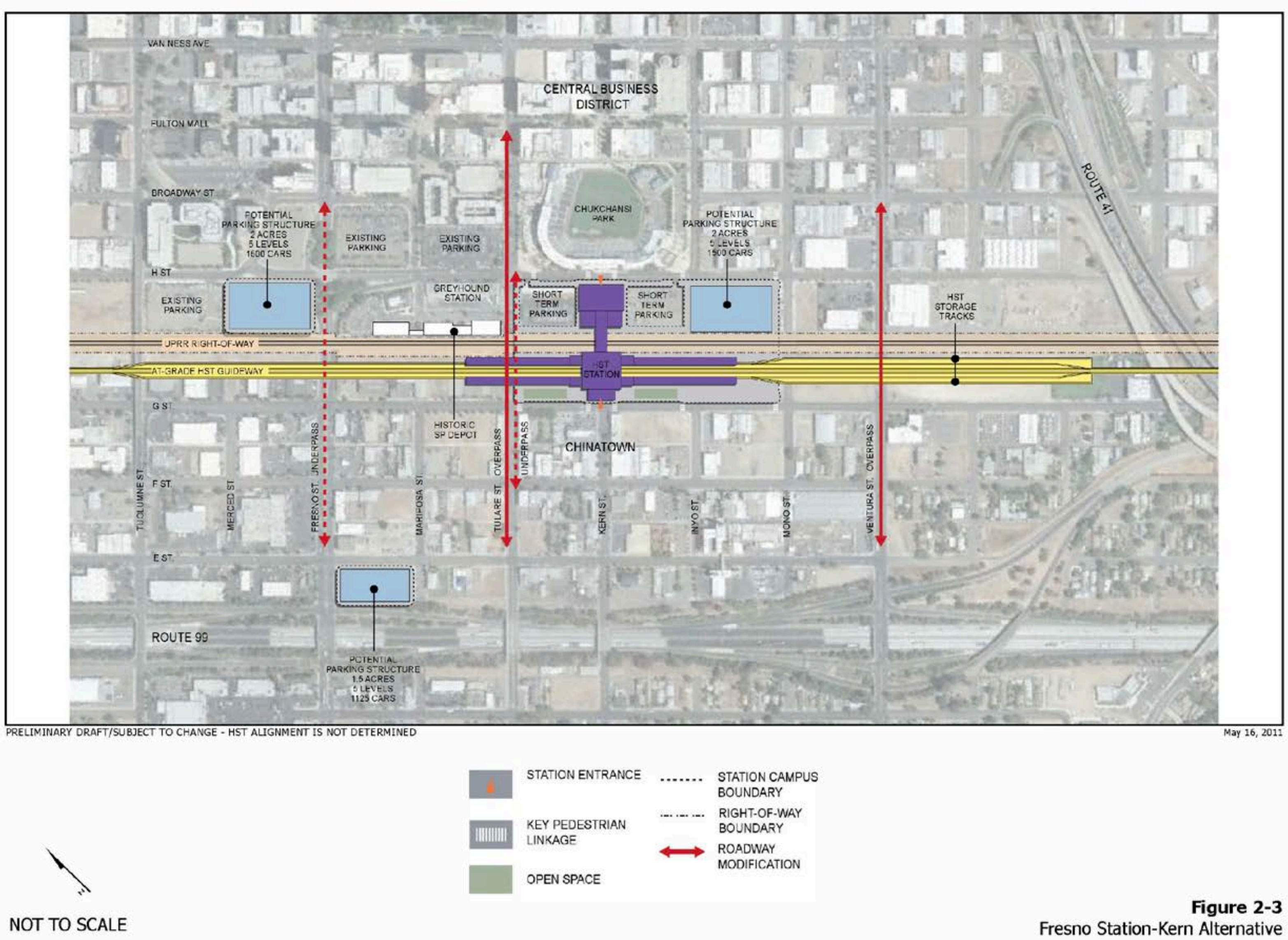
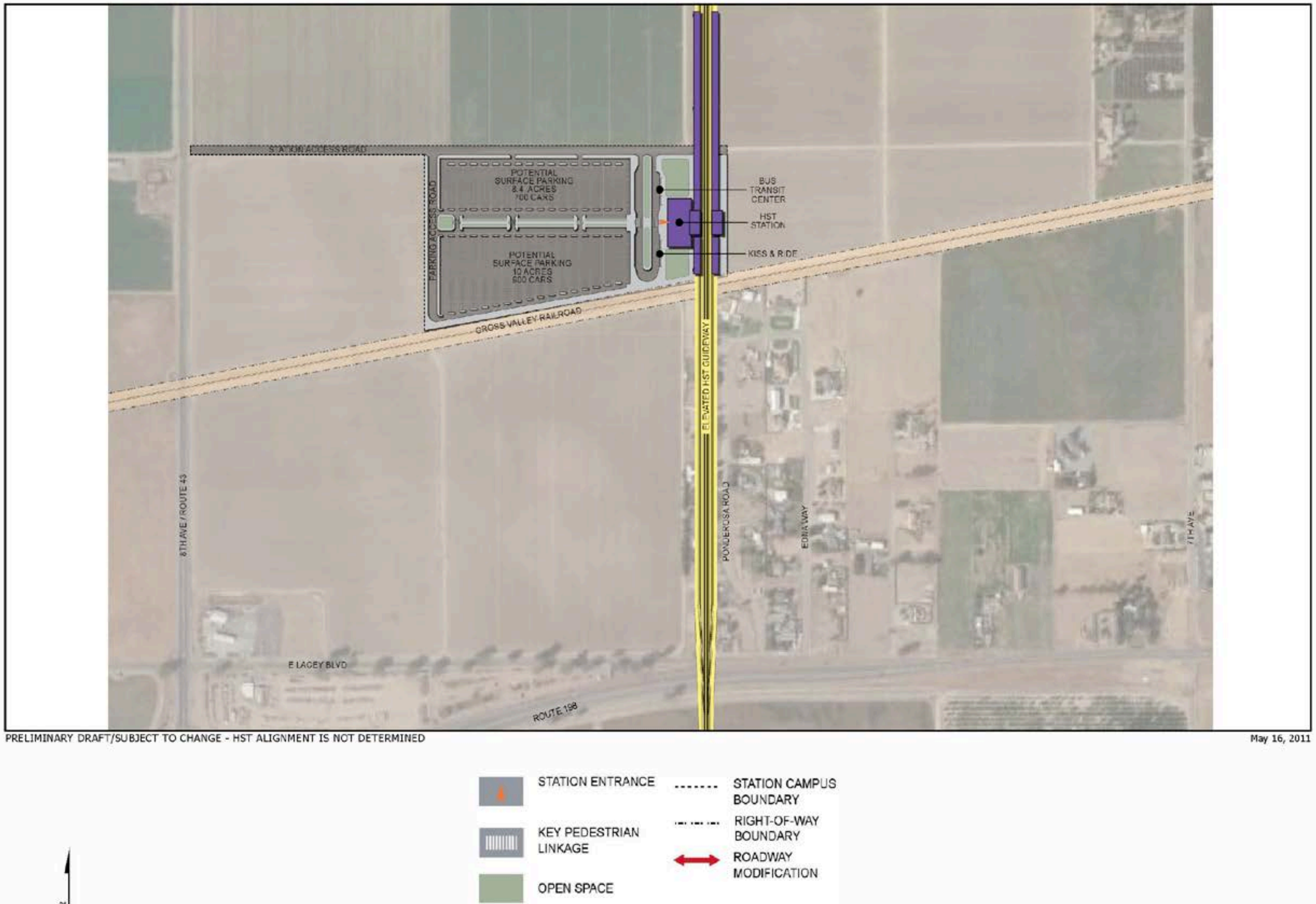
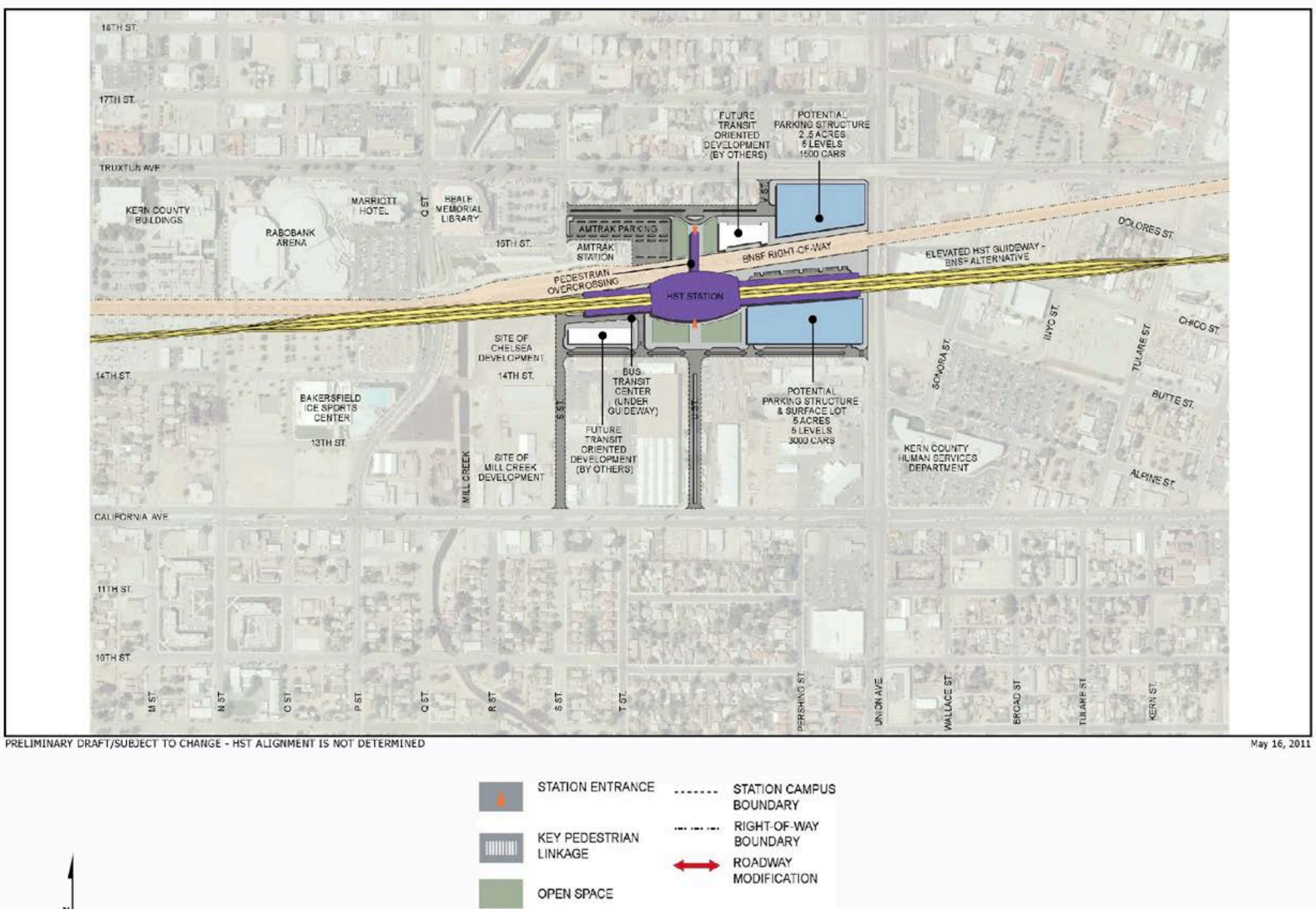


Figure 2-3
Fresno Station-Kern Alternative



NOT TO SCALE

Figure 2-4
Kings/Tulare Regional Station (potential)



NOT TO SCALE

Figure 2-5
Bakersfield Station-North Alternative

Bakersfield Station–North Alternative

The North Station Alternative would be located at the corner of Truxtun and Union Avenue/SR 204 (Figure 2-6). The station building would be 56,000 square feet with a maximum height of 95 feet. The entire site would consist of 19 acres, with 9 acres designated for the station, bus transit center, short- term parking, and kiss-and-ride. An additional 7.5 acres would house two parking structures that could accommodate approximately 4,500 cars. Under this alternative, the station building would be located at the western end of the parcel footprint. Two new boulevards would be constructed to access the station and the supporting facilities. The bus transit center and the smaller of the two parking structures (2.5 acres) would be located north of the HST tracks. The BNSF Railway line would also run through the station site.

Bakersfield Station–South Alternative

The South Station Alternative would be located along Union and California avenues (Figure 2-7). The station building would be the same size as the North Station Alternative. The entire site would be 20 acres, with 15 acres designated for the station, bus transit center, short-term parking, and kiss-and-ride. An additional 5 acres would support one six-level parking structure with a capacity of 4,500 cars. Access to the site would be from two new boulevards, one branching off from California Avenue and the other from Union Avenue. Unlike the North Station Alternative, the station site would be located entirely south of the BNSF Railway right-of-way.

2.2.3 Heavy Maintenance Facility (HMF)

The HMF would be located on the main trunk line of the HST system. Before the startup of initial operations, the HMF would support the assembly, testing, commissioning, and acceptance of high-speed rolling stock. During regular operations, the HMF would provide maintenance and repair functions, activation of new rolling stock, and train storage. The HMF concept plan indicates that the site would encompass approximately 154 acres to accommodate shops, tracks, parking, administration, roadways, power substation, and storage areas. The HMF would include tracks that allowed trains to enter and leave on their wheels under their own power or under tow. The HMF would also have management and administrative facilities and employee support services (e.g., restrooms, cafeteria). Up to 1,500 employees could work at the HMF during any 24-hour period.

The Authority has determined that one HMF would be located between Merced and Bakersfield. However, a single location has not been identified. Four sites are under consideration for the HMF in the Fresno to Bakersfield Section:

- The HMF Fresno Works– Fresno site encompasses 696 acres and is in the southern limits of the city of Fresno and county of Fresno next to the BNSF Railway right-of-way.
- The HMF Kings County–Hanford site includes about 880 acres and is located southeast of the city of Hanford.
- The HMF Kern Council of Governments–Wasco site is located directly east of Wasco between SR 46 and Filburn Street. It includes 421 acres.
- The HMF Kern Council of Governments–Shafter site includes 421 acres and is located in the city of Shafter next to the BNSF Alternative and the Wasco-Shafter Bypass Alternative.

NOT TO SCALE

Figure 2-6
Bakersfield Station-South Alternative

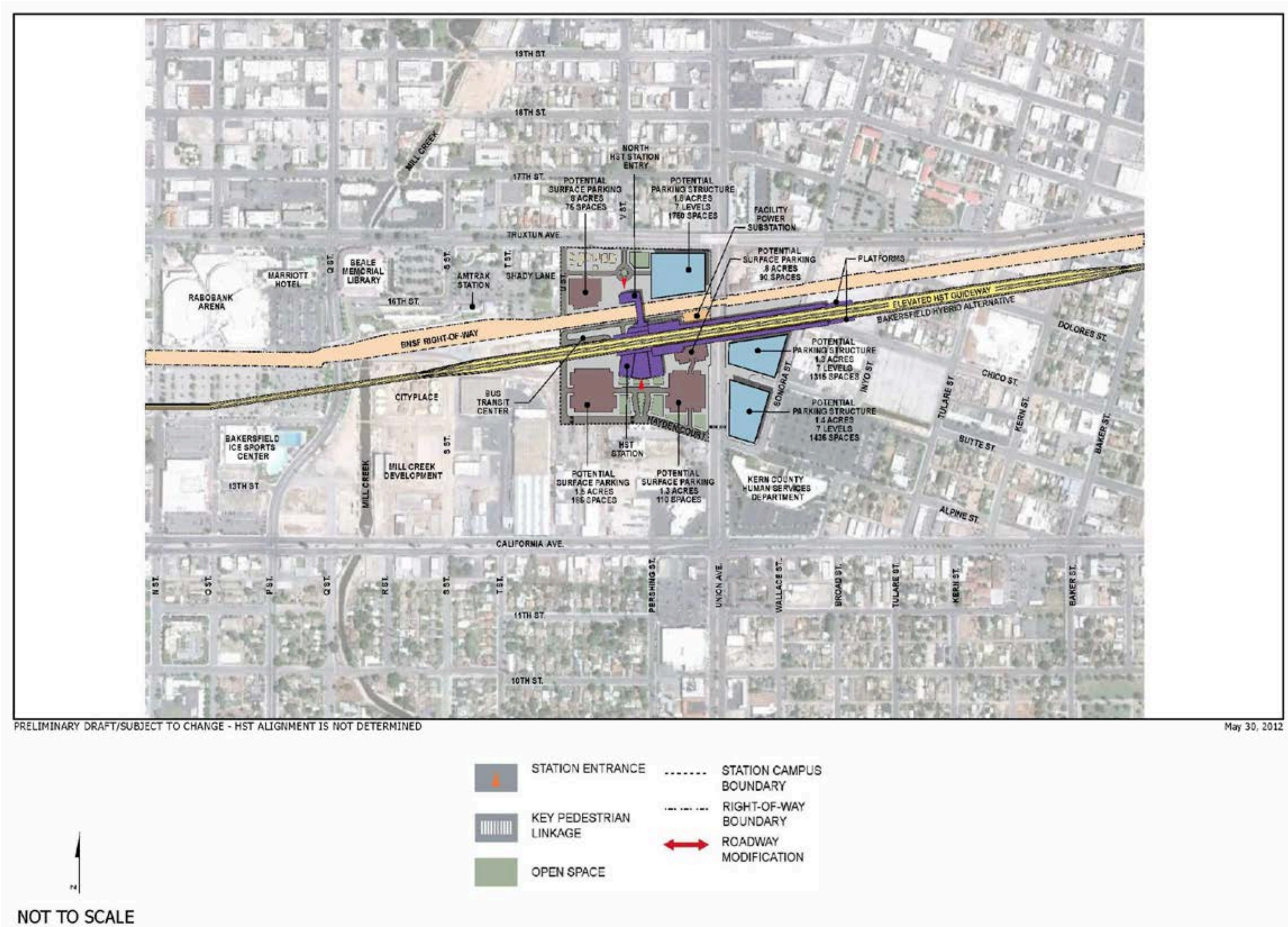


Figure 2-7
Bakersfield South Station Alternative

2.3 Power

To provide power for the HST, high-voltage electricity at 115 kV and above would be drawn from the utility grid and transformed down to 25,000 volts. No new transmission lines would be constructed to provide power to the project. The voltage would then be distributed to the trains via an overhead catenary system (OCS). The transformation and distribution of electricity would occur in three types of stations:

- Traction power substations (TPSs) transform high-voltage electricity supplied by public utilities to the train operating voltage. TPSs would be sited adjacent to existing utility transmission lines and the HST right-of-way, and would be located approximately every 30 miles along the route. Each TPS would be 200 feet by 150 feet.
- Switching stations allow adjacent power sections to be electrically connected to one another in the event of power outage or certain operational conditions. Switching stations would be located midway between, and approximately 15 miles from, the nearest TPS. Each switching station would be 120 feet by 80 feet and located adjacent to the HST right-of-way.
- Paralleling stations, or autotransformer stations, provide voltage stabilization and equalize current flow. Paralleling stations would be located every 5 miles between the TPS stations and the switching stations. Each paralleling station would be 100 feet by 80 feet and located adjacent to the HST right-of-way.

2.4 Project Construction

At-grade track sections would be built using conventional railroad construction techniques. A typical sequence includes clearing, grubbing, contouring, and compacting of the rail bed; application of ballast; laying track; and installing electrical and communications systems. The precast segmental construction method is proposed for elevated track sections. In this construction method, large concrete bridge segments would be mass-produced at an onsite temporary casting yard. Precast segments would then be transported atop the already completed portions of the elevated track and installed using a special gantry crane positioned on the viaduct. Although the precast segmental method is the favored technique for viaduct construction, other methods may be used, including cast-in-place, box girder, or precast span-by-span techniques. Construction is currently planned to commence in 2013 and conclude in 2018.

Section 3.0
Regulatory Framework

3.0 Regulatory Framework

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal, state, and local statutes (California State Historic Preservation Office 1983; Marshall 1976; West 1991; Fisk and Spencer 1994; Gastaldo 1999), most notably by the 2009 Paleontological Resources Preservation Act, NEPA, and other federal legislation and policies, and by the State of California's environmental regulations (California Environmental Quality Act Section 15064.5). Also, SVP has established professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established by the SVP (1995, 1996). Design, construction, and operation of the proposed project need to be conducted in accordance with the laws, ordinances, regulations, and standards (LORS) applicable to paleontological resources. Therefore, the LORS applicable to paleontological resources and this project are briefly summarized below in Table 3-1.

Table 3-1
Summary of LORS–Paleontological Resources

Jurisdiction	LORS	Requirements	Conformance Section	Administering Agency
Federal				
	Antiquities Act of 1906	Protects paleontological resources on federal lands	3.1	BLM
	NEPA, 1969	Protects paleontological resources on federal lands	3.1	EPA
	Paleontological Resources Preservation Act, 2009	Protects paleontological resources on federal lands	3.1	BLM
State				
	CEQA	Protects paleontological resources on state lands	3.2	
	Public Resources Code Sections 5097.5/5097.9	Protects paleontological resources on state lands	3.2	
Local				
	Fresno County General Plan	Protects paleontological resources on county lands	3.3	
	Kern County General Plan	Protects paleontological resources on county lands	3.3	
	City of Fresno General Plan	Protects paleontological resources on city lands	3.3	

BLM Bureau of Land Management
CEQA California Environmental Quality Act of 1970
EPA U.S. Environmental Protection Agency
LORS laws, ordinances, regulations, and standards
NEPA National Environmental Protection Act of 1969

3.1 Federal LORS

Federal legislative protection for paleontological resources began with the Antiquities Act of 1906 (Public Law [P.L.] 59-209; 16 United States Code [U.S.C.] 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 land. The Antiquities Act forbids disturbance of any object of antiquity on federal land without a permit issued by the responsible agency. This Act also establishes criminal sanctions for unauthorized appropriation or destruction of antiquities. NEPA (P.L. 91-190, 31 Stat. 852, 42 U.S.C. 4321-4327) requires that important natural aspects of our national heritage be considered in assessing the environmental consequences of any proposed project. Paleontological resources are also afforded federal protection under Title 40 Code of Federal Regulations (C.F.R.) Section 1508.27 as a subset of scientific resources.

In addition to the above-cited acts and regulations, the Federal-Aid Highways Act of 1958 specifically extended the Antiquities Act to apply to paleontological resources and authorized the use of funds appropriated under the Federal-Aid Highways Act of 1956 to be used for paleontological salvage in compliance with the Antiquities Act and any applicable state laws. The language in the Highways Act makes it clear that Congress intended that, to be in compliance with the Antiquities Act, highway construction projects must protect paleontological resources.

Additional federal statutes to protect fossils include the following. The Historic Sites Act of 1935 (P.L. 74-292; 49 Stat. 666, 16 U.S.C. 461 et seq.) declares it national policy to preserve objects of historical significance for public use and gives the Secretary of the Interior broad powers to execute this policy, including criminal sanctions. The Federal Land Policy Management Act of 1976 (P.L. 94-579; 90 Stat. 2743, U.S.C. 1701-1782) requires that public lands be managed in a manner that will protect the quality of their scientific values, and the Paleontological Resources Preservation Act (Title VI, Subtitle D of the Omnibus Land Management Act of 2009) furthers the protection of paleontological resources on federal lands by criminalizing the unauthorized removal of fossils.

3.2 State LORS

The primary California state environmental law that protects fossils is CEQA (Public Resources Code Section 21000 et seq.). CEQA requires that public agencies and private interests identify the significance of the impacts of their proposed projects on any object or site of significance to the scientific annals of California (CEQA Section 15064.5 [a][3]), and this requirement applies to paleontological resources. Administrative regulations for the implementation of CEQA are set forth in California Code of Regulations Section 15000 et seq., commonly known as the "CEQA Guidelines." The CEQA Guidelines define the procedures and types of activities, persons, and public agencies required to comply with CEQA. Appendix G of the CEQA Guidelines contains 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 this Environmental Checklist (California Code of Regulations Section 15063; Appendix G, Section V, Part c) is the following: "Would the project directly or indirectly destroy a unique paleontological resource or site…?"

The CEQA lead agency with jurisdiction over a project is responsible to ensure that paleontological resources are protected in compliance with CEQA and other applicable statutes. The Authority is both the project sponsor and the lead agency for purposes of the CEQA requirements. CEQA Section 21081.6 requires that the lead agency demonstrate compliance with mitigation measures developed during the environmental impact review process.

Other state requirements for the management of paleontological resources are contained in California Public Resources Code Chapter 1.7, Section 5097.5 (Statutes 1965, Chapter 1136, Page

2792) under the heading of “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 publicly owned lands to preserve or record paleontological resources. California Public Resources Code Section 30244 requires reasonable mitigation of adverse impacts to paleontological resources on state-owned land.

3.3 Local LORS

California planning and zoning law requires each county and other jurisdiction to adopt a comprehensive, long-term general plan for its development. The general plan is a policy document designed to give long-range guidance to those making decisions affecting the future character of the planning area. The general plan represents the official statement of the community's physical development and its economic, social, and environmental goals. The general plan also acts to clarify and articulate the relationship and intentions of local government to the rights and expectations of the general public, property owners, and prospective investors. Through the general plan, the local jurisdiction informs these groups of its goals, policies, and development standards, thereby communicating what must be done to meet the objectives of the general plan.

Fresno County: The Fresno County General Plan specifically calls for the identification and protection of paleontological resources. Goal OS-J is “to identify, protect, and enhance Fresno County’s important…paleontological…sites and their contributing environment.” Policy OS-J.1 states that “The County shall require that discretionary development projects, as part of any required CEQA review, identify and protect important … paleontological … sites and their contributing environment from damage, destruction, and abuse to the maximum extent feasible.”

Kings County: Kings County does not have regulations that specifically address paleontological resources. However, Kings County has adopted CEQA (County of Kings Resolution 96-048) and the administrative regulation entitled “CEQA Guidelines” (California Code of Regulations, Title 14, Division 6, Chapter 3, Section 1500 et seq.) and is legally responsible to ensure that paleontological resources are protected in compliance with this statute and guidelines.

Tulare County: Tulare County does not have regulations that specifically address paleontological resources. However the Tulare County General Plan recognizes that it is bound by CEQA to conduct environmental mitigation in accordance with CEQA guidelines.

Kern County: The Kern County General Plan provides for the protection of paleontological resources. General Provision 1.10.3 Policy 25 calls on the County to “…promote the preservation of cultural and historic resources which provide ties with the past and constitute a heritage value to residents and visitors.” Implementation Measure M requires that “in areas of known paleontological resources, the County should address the preservation of these resources where feasible.”

City of Fresno: The Fresno City Council adopted the 2025 Fresno General Plan in November 2002. The resource conservation chapter of the general plan includes as objective G-10 to “augment the body of scientific and historic knowledge through identification, appropriate recognition, and promotion of historic and cultural resources.” In the general plan, paleontological resources are included under the general title “cultural resources,” as they are under CEQA. Policy G-10-c states that “unique prehistoric resource sites shall be considered as those archaeological and paleontological sites which:

- contain information needed to answer important scientific research questions;
- have special quality or unique features, such as being the oldest, largest, or most complete example of a particular type of site or are directly associated with a scientifically recognized prehistoric or historic event or person."

City of Corcoran: The City of Corcoran General Plan 2025 lacks provisions that specifically refer to paleontological resources. However, the plan does list the preservation of "…important links to Corcoran's heritage, including…pre-historical resources" as its objective under the discussion of cultural resources. Policy 5.21 requires that "special consideration shall be paid to areas identified in the General Plan and elsewhere as likely to contain relics of the area's pre-historic past." Policy 5.22 sets the official policy of the City of Corcoran "…to avoid impacts to cultural resources (which include pre-historic remains) where feasible…" and when not feasible, "…to consult with an appropriate professional…to study the site and recommend appropriate measures to ensure the educational and cultural value are preserved."

City of Bakersfield: The current general plan for the City of Bakersfield (City of Bakersfield and Kern County 2007) does not have regulations that specifically address paleontological resources. However, the Metropolitan Bakersfield General Plan contains the following general statement: "Local guidelines for project processing shall reflect California Environmental Quality Act (CEQA) Guidelines which state that the environmental effects of a project must be taken into account as part of project consideration." Also, the "Mineral Resources" section of the 2010 General Plan Update (City of Bakersfield and Kern County n.d.) states as a policy that the City will "[e]ncourage preservation of any known deposits of gemstones and fossils."

3.4 Professional Standards

To ensure compliance with applicable laws, SVP, a scientific organization of professional vertebrate paleontologists, has established standard guidelines (SVP 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 museum curation. The SVP's standard guidelines were approved by a consensus of professional paleontologists and are the standard against which all paleontological monitoring and mitigation programs are judged. Most professional paleontologists in the United States adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically spelled out in these standard guidelines. Many regulatory agencies have either formally or informally adopted the SVP's standard guidelines for the mitigation of construction-related adverse impacts on paleontological resources. Federal agencies that have formally or informally adopted the SVP's standard guidelines include the Federal Energy Regulatory Commission (FERC), the U.S. Forest Service, the Bureau of Land Management, and the National Park Service. State of California agencies that have done so include the California Energy Commission, the California Public Utilities Commission, and the California Department of Transportation (Caltrans). Many county and city agencies have also formally or informally adopted SVP's standard guidelines. Briefly, SVP guidelines require that each project undertake literature and museum archival reviews, a field survey, and, if a high potential exists for disturbing significant fossils during project construction, a mitigation plan that includes monitoring by a qualified paleontologist to salvage fossils encountered, identification of salvaged fossils, determination of their significance, and placement of curated fossil specimens into a permanent public museum (such as the designated State of California repository for fossils, UCMP).

Appendix C provides the SVP's standard guidelines (SVP 1995); Appendix D provides the SVP's "Conditions of Receivership for Paleontological Salvage Collections.

Section 4.0
Affected Environment

4.0 Affected Environment

4.1 Geographic Location

The proposed Fresno to Bakersfield Section of the California HST system is in Fresno, Kings, Tulare, and Kern counties, California. For much of its alignment, this section roughly follows the existing BNSF main track between Fresno and Bakersfield. The northern extent of the Fresno to Bakersfield Section is approximately at latitude 36°44'23"N and longitude 119°48'06"W at elevation 285 feet (87 meters), and the southern extent of this section is approximately at latitude 35°22'17"N and longitude 119°01'25"W at elevation 403 feet (123 meters). The topography of the paleontological study area is primarily flat; however, steep bluffs are encountered at stream crossings.

The Fresno to Bakersfield Section is in the San Joaquin Valley, which constitutes roughly the southern two-thirds of the major north-northwest-oriented synclinorium that is variously referred to as the Valle Grande (Clark 1929), the Great Interior Valley (Harradine 1950), the San Joaquin Valley (Jahns 1954), the Great San Joaquin Valley (Piper et al. 1939; Davis et al. 1957), the California Trough (Piper et al. 1939), and the Great Valley (Fenneman 1931; Jenkins 1938; Hackel 1966). The Great Valley Physiographic Province (Jenkins 1938) is between the Sierra Nevada Physiographic Province on the east and the Coast Ranges Physiographic Province on the west. The project is in the following U.S. Geological Survey 7.5-minute (1:24,000-scale) quadrangles, from north to south: Fresno North, Fresno South, Malaga, Conejo, Laton, Burris Park, Remnoy, Waukena, Corcoran, Taylor Weir, Alpaugh, Allensworth, Delano West, Pond, Wasco, Rio Bravo, Rosedale, Oildale, and Gosford.

4.2 Regional Geologic Setting

The general geology of the San Joaquin Valley has been described in some detail by Mendenhall (1908), Mendenhall et al. (1916), Piper et al. (1939), Hoots et al. (1954), Davis et al. (1957, 1959, 1964), Davis and Hall (1959), Hoffman (1964), Croft and Wahrhaftig (1965), Hackel (1966), Croft and Gordon (1968), Bull (1973), Page (1986), Marchand (1977), Bartow and Marchand (1979), Marchand and Allwardt (1981), Lettis (1988), Bartow (1987, 1991), Beyer and Bartow (1988), Callaway and Rennie (1991), and Lettis and Unruh (1991), among others. Other authors who have specifically described the geology in portions of the paleontological study area include Page and LeBlanc (1969), Muir (1977), Bartow and McDougall (1984), Mitten (1984), and Bartow (1986). Surficial geologic mapping of all or part of the paleontological study area has been provided by Mendenhall et al. (1916), Jenkins (1938), Troxel and Morton (1962), Smith (1964), Matthews and Burnett (1965), Page and LeBlanc (1969), Jennings (1977), Bartow and Doukas (1978), Bartow (1984), Bartow (1991), and Wahrhaftig et al. (1993).

The information in these geologic maps and published and unpublished reports form the basis of the following discussion. Individual maps and publications are incorporated into this report and referenced where appropriate. For obtaining the older geological literature for this area, the exhaustive compilation entitled “Geological Literature on the San Joaquin Valley of California” by Maher et al. (1973) was particularly helpful. The aspects of geology pertinent to this report are the types, distribution, and age of the sediments immediately underlying the paleontological study area and their probability of producing fossils during project construction. The site-specific geology in the vicinity of the project is discussed separately below.

The San Joaquin Valley is a great structural depression between the tilted Sierra Nevada block on the east and the complexly folded and faulted Coast Ranges on the west. The valley is filled with thick Mesozoic and Tertiary marine sediments and covered by a thin blanket of Quaternary alluvial sediments (Bailey 1966). The east side of the San Joaquin Valley is a nearly continuous series of coalescing alluvial fans; their apices occur where streams drain the west slope of the Sierra Nevada. These low-relief alluvial fans form a continuous belt between the dissected uplands of the Sierra Nevada and the nearly flat surface of the valley floor. These fans are composed of undeformed to only slightly deformed alluvial deposits laid down primarily during Plio-Pleistocene time by streams that drained the adjacent uplands of the Sierra Nevada. Each alluvial fan consists of a mass of coarse to fine rock debris that splays outward from the mouth of its primary stream channel onto the valley floor as a fan-like deposit of well-sorted sand and gravel encased in a matrix of finer sediments, which are chiefly poorly sorted fine sand and silt deposited away from the stream channels on the alluvial plain. Our current interpretations and understanding of the alluvial deposits of major Sierran rivers is based on Arkley's studies (1962, 1964) of the Merced, Tuolumne, and Stanislaus river fans; Janda's (1966) and Janda and Croft's (1965) studies of the alluvium of the upper San Joaquin River; Schlemon's (1967, 1972) studies of the American River fan; Atwater's (1980) studies of the Mokelumne River fan; and, most recently, the work of Weissmann et al. (2002, 2003) on the Kings River fan.

The alluvial deposits accumulated along the east side of the San Joaquin Valley consist of medium- to fine-grained sediment eroded from Tertiary and older volcanic, plutonic, and metamorphic rocks in the mountains to the east (Clark 1964). The alluvial fan deposits grade westward through gradually decreasing grain sizes from coarse pebble to cobble gravel at the Sierra Nevada foothills to clay-rich silt on the valley floodplain. The gravel, sand, and silt that compose these alluvial fans have in the past produced significant fossils, primarily large land mammals, such as mammoths, mastodons, camels, bison, and horses. These paleontological resources are discussed further below.

The Quaternary geological materials composing many alluvial fans along the east side of the San Joaquin Valley can be divided into three stratigraphic units, which from oldest to youngest are the weakly cemented brown to tan sandstone and siltstone, which are referred to as the early- to middle-Pleistocene Turlock Lake Formation; the cemented reddish brown sandstone, siltstone, and claystone of the middle-Pleistocene Riverbank Formation; and the slightly younger and less-consolidated late-Pleistocene and early-Holocene sedimentary sequence named the Modesto Formation.

In the Bakersfield and Kern River area, Tertiary marine and continental sedimentary rocks are exposed farther west into the San Joaquin Valley and closer to the paleontological study area and are partially overlain by Quaternary alluvial fan deposits created by rock debris deposited by the Kern River. The marine Tertiary Round Mountain silt is immediately overlain by interbedded marine and continental deposits referred to as either the Chanac Formation or the Santa Margarita Formation. Younger geological materials in the vicinity of Bakersfield are part of the alluvial fan deposited by the ancestral Kern River (the materials in this fan are referred to as the Kern River Formation) or the modern Kern River (these materials are referred to as Quaternary alluvium).

The limiting geologic ages of these stratigraphic units found along the east side of the San Joaquin Valley are still uncertain. New excavations have the potential to yield important new information, new fossils, or other field evidence that may add to, confirm, or require modifying previous age interpretations. This new information would also have the potential to provide a more complete and accurate understanding of both the geological and the paleobiological history of the area.

Section 5.0
Methods

5.0 Methods

5.1 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the paleontological study area (1 mile surrounding the project footprint) and to assess the potential paleontological productivity of each stratigraphic unit present, the published and available unpublished geological and paleontological literature was reviewed and stratigraphic and paleontologic inventories were compiled, synthesized, and evaluated (see below). These methods are consistent with SVP (1995) guidelines for assessing the importance of paleontological resources in areas of potential environmental effect. No subsurface exploration was conducted for this assessment.

Geologic maps and reports covering the bedrock and surficial geology of the project vicinity were reviewed to determine the exposed and subsurface rock units, to assess the potential paleontological productivity of each rock unit, and to delineate their respective areal distribution in the paleontological study area. Available aerial photographs of the study area were also examined to aid in determining the areal distribution of distinctive sediment and soil types.

The number and locations of previously recorded fossil sites from rock units exposed in and near the paleontological study area and the types of fossil remains each rock unit has produced were evaluated based on the published and unpublished geological and paleontological literature. The literature review was supplemented by archival records searches conducted at the UCMP, the LACM, and the San Bernardino County Museum for additional information regarding the occurrence of fossil sites and remains in and near the paleontological study area.

A field survey for this assessment was conducted in the paleontological study area to document the presence of sediments suitable for containing fossil remains and to record the presence of any previously unrecorded fossil sites. All properties within 1 mile of the project footprint were surveyed from public access roads and public access lands (Figure 6-1). During the survey, outcrops that were inaccessible or on privately owned property were documented, and access agreements were requested. Of the 23 properties for which access was requested, 10 of the properties were available to access, and those properties were later surveyed for paleontological resources. During the survey, stratigraphy was observed in road cuts, recent excavations, and the banks of drainage diversions, groundwater recharge basins, stormwater retention basins, streams, irrigation canals, ditches, and ponds.

Paleontological Resource Assessment Criteria

Under SVP (1995) criteria, a stratigraphic unit (such as a formation, member, or bed) known to contain significant fossils is considered to be "sensitive" to adverse impacts if there is a probability that earthmoving or ground-disturbing activities in that rock unit will either disturb or destroy fossil remains. This definition of sensitivity, as noted in the following excerpt taken from the SVP guidelines, differs fundamentally from that for archaeological resources, and merits discussion:

> It is extremely important to distinguish between archaeological and paleontological (fossil) resource sites when defining the sensitivity of rock units. The boundaries of archaeological sites define the areal extent of the resource. Paleontologic sites, however, indicate that the containing sedimentary rock unit or formation is fossiliferous. The limits of the entire rock formation, both areal and stratigraphic, therefore define the scope of the paleontologic potential in each case (SVP 1995).

This difference between archaeological sites and paleontological sites, which are also commonly known as paleontological localities, is an important distinction with regard to assessing paleontological sensitivity and is fundamental to the methodological considerations of such an assessment. Most archaeological sites have a surface expression that allows for their geographic location. Fossils, on the other hand, are an integral component of the rock unit below the ground surface and therefore are not observable unless exposed by erosion or human activity. Thus, a paleontologist cannot know either the quality or quantity of fossils present before the rock unit is exposed as a result of natural erosion processes or earth-moving activities. The paleontologist can only make conclusions on sensitivity to impact based on what fossils have been found in the rock unit in the past, along with a judgment about whether or not the depositional environment of the sediments that compose the rock unit is likely to result in the burial and preservation of fossils.

Because the presence or location of fossils within a rock unit cannot be known without exposure resulting from erosion or excavation, under the SVP (1995) standard guidelines, an entire rock unit is assigned the same level of sensitivity based on recorded fossil occurrences. Fossils are seldom uniformly distributed within a rock unit. Most of a rock unit may lack fossils, but at other locations within the same rock unit concentrations of fossils may exist. Even within a fossiliferous portion of the rock unit, fossils may occur in local concentrations. For example, Shipman (1977, 1981) excavated a fossiliferous locality using a three-dimensional grid and removed blocks of matrix of a consistent size. The site chosen was known before excavation to be richly fossiliferous, yet only 17% of the excavated blocks actually contained fossils. These studies demonstrate the physical basis for the difficulty in predicting the location and quantity of fossils in advance of actual project-related ground disturbance.

Because it is not possible to determine the locations of fossils before disturbing a rock unit, the monitoring of excavations by an experienced paleontologist during construction increases the probability that fossils will be discovered and preserved. Preconstruction mitigation measures (e.g., surface prospecting and collecting) will not prevent adverse impacts to fossils because many localities will be unknown in advance due to an absence of fossils at the surface.

The non-uniform distribution of fossils within a rock unit is essentially universal and many paleontological resource assessment and mitigation reports conducted in support of environmental impact documents and mitigation plan summary reports document similar findings (see for instance Lander 1989, 1993; Reynolds 1987, 1990; Spencer 1990; Fisk et al. 1994; and references cited therein). In fact, most fossil localities recorded in reports of impact mitigation (where construction monitoring has been implemented) had no previous surface expression.

Using SVP (1995) criteria, the paleontological importance or sensitivity (high, low, or undetermined) of a rock unit is the measure most amenable to assessing the significance of paleontological resources because the areal distribution of that rock unit can be delineated on a topographic or geologic map. The paleontological importance of a stratigraphic unit reflects (1) its potential paleontological productivity (and thus sensitivity), and (2) the scientific significance of the fossils it has produced. This method of paleontological resource assessment is the most appropriate because discrete levels of paleontological importance can be delineated on a topographic or geologic map.

The potential paleontological productivity of a stratigraphic unit exposed in a study area is based on the abundance or densities of fossil specimens and/or previously recorded fossil localities in exposures of the unit in and near the project footprint . The underlying assumption of this assessment method is that exposures of a stratigraphic unit in a project footprint are most likely to yield fossil remains both in quantity and density similar to those previously recorded from that stratigraphic unit in and near the project footprint.

The following tasks were completed to establish the paleontological importance and sensitivity of each stratigraphic unit exposed in the paleontological study area:

- The potential paleontological productivity of each rock unit was assessed based on the previously recorded and newly documented fossil sites it contains in the paleontological study area.
- The scientific importance of the fossil remains recorded from a stratigraphic unit exposed in the paleontological study area was assessed.
- The paleontological importance of a rock unit was assessed based on its documented or potential fossil content in the in the paleontological study area.

5.2 Significance

Paleontological resources (fossils) are the remains or traces of prehistoric plants and animals. 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) determining the relative ages of the strata in which they occur and of the geologic events that resulted in the deposition of the sediments that entombed them.

As defined by the SVP (1995), a paleontological resource can be significant if:

- It provides important information on the evolutionary trends among organisms, relating living organisms to extinct organisms.
- It provides important information regarding development of biological communities or interaction between botanical and zoological biota.
- It demonstrates unusual circumstances in biotic history.
- It is in short supply and in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and is not found in other geographic localities.

Under CEQA Guidelines (Public Resources Code Section 15064.5[a][2]), public agencies must treat all historical and cultural resources (including paleontological resources) as significant unless the preponderance of evidence demonstrates that they are not historically or culturally significant.

Similarly, and in common with other environmental disciplines such as archaeology and biology (specifically in regard to listed species), the SVP (1995) considers any fossil specimen significant, unless demonstrated otherwise, and, therefore protected by environmental statutes. This position is held because fossils are uncommon and only rarely will a fossil locality yield a statistically significant number of specimens representing the same species. In fact, vertebrate fossils are so uncommon that, in most cases, each fossil specimen found will provide additional important information about the characteristics or distribution of the species it represents.

An individual fossil specimen is considered scientifically important if it is:

- Identifiable.
- Complete.
- Well-preserved
- Age diagnostic.
- Useful in paleoenvironmental reconstruction.
- A type or topotypic specimen.
- A member of a rare species.
- A species that is part of a diverse assemblage.

- A skeletal element different from, or a specimen more complete than, those now available for that species.

Identifiable land-mammal fossils are considered scientifically important because of their potential use in providing accurate age determinations and paleoenvironmental reconstructions for the sediments in which they occur. Moreover, vertebrate remains are comparatively rare in the fossil record. Although fossil plants are usually considered of lesser importance because they are less helpful in age determination and more abundant, they are actually more sensitive indicators of their environment and thus, as sedentary organisms, more valuable than mobile animals for paleoenvironmental reconstructions. For marine sediments, invertebrate and marine algal fossils, including microfossils, are scientifically important for the same reasons that land-mammal and/or 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.

5.3 SVP Categories of Sensitivity

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined.

High sensitivity. Stratigraphic units in which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been previously found have a high potential to produce additional significant non-renewable fossils and are therefore considered to be highly sensitive. In keeping with the significance criteria of the SVP (1995), all stratigraphic units in which vertebrate fossils have previously been found have high sensitivity. Full-time monitoring is recommended during any project-related ground disturbance in stratigraphic units with high sensitivity.

Low sensitivity. Stratigraphic units that are not sedimentary in origin or that have not been known to produce fossils in the past are considered to have low sensitivity. Monitoring is usually not recommended and is not needed during project construction through a stratigraphic unit with low sensitivity.

Undetermined sensitivity. Stratigraphic units that have not had any previous paleontological resource surveys or any fossil finds are considered to have undetermined sensitivity. After reconnaissance surveys, observations of artificial exposures (such as road cuts) and natural exposures (such as stream banks), and possible subsurface testing (such as augering or trenching), an experienced professional paleontologist can often determine whether the stratigraphic unit should be categorized as having high or low sensitivity.

Section 6.0
Findings

6.0 Findings

6.1 Stratigraphic Inventory

Regional geologic mapping in the vicinity of the proposed project has been provided at a scale of 1:1,000,000 by Wahrhaftig et al. (1993); at a scale of 1:750,000 by Jennings (1977); at a scale of 1:500,000 by Mendenhall et al. (1916), Jenkins (1938), and Bartow (1991); at a scale of 1:320,000 by Troxel and Morton (1962); at a scale of 1:250,000 by Smith (1964) and Matthews and Burnett (1965); and at a scale of 1:125,000 by Page and LeBlanc (1969), Bartow and Doukas (1978), and Bartow (1984). These geologic maps were reviewed to determine the stratigraphic sequence of rocks that might be affected by project-related excavations. Unfortunately, in their geologic maps of the late Cenozoic deposits of the paleontological study area, these geologists have not always used formally named stratigraphic units and have not consistently used the same map units. For the purpose of this report, the mapping of Matthews and Burnett (1965; 1:250,000) and of Smith (1964; 1:250,000) is referenced below, with their map units correlated to individual geologic formations.

The project extends from Fresno to Bakersfield, California. Excavations in support of the project have the potential to affect a number of Miocene to Holocene sedimentary units. They are, from oldest to youngest, the late-Miocene to Pliocene Kern River Formation, the early- to middle-Pleistocene Turlock Lake Formation, the middle- to late-Pleistocene Riverbank Formation, the late-Pleistocene to early-Holocene Modesto Formation, the Pleistocene to Holocene Tulare Lake beds, and the Quaternary alluvium. Each of these formations is composed of arkosic alluvial sediments derived from the Sierra Nevada to the east. The northeastern and southeastern sections of the San Joaquin Valley have slightly different tectonic histories. Uplift of the Sierra Nevada began earlier in the south than in the north (Bartow 1991), producing older and thicker alluvial fan sequences in the south.

Piper et al. (1939) published one of the first detailed maps and descriptions of Quaternary sediments in the northeastern San Joaquin Valley. These authors grouped all the Pleistocene strata together and named them the “Victor Formation.” Working in Stanislaus and northern Merced counties, Davis and Hall (1959) subdivided Pleistocene sediments equivalent to the Victor Formation into the Turlock Lake, Riverbank, and Modesto formations, from oldest to youngest. In 1981, Marchand and Allwardt proposed that the name “Victor Formation” be abandoned and that the Turlock Lake, Riverbank, and Modesto formations be accepted as uniform stratigraphic nomenclature for Quaternary deposits in the area. These formation names have been adopted by many previous geologists (see for instance Marchand and Allwardt 1978; Bartow and Marchand 1979), and the recommendations of Marchand and Allwardt (1981) have been followed by later workers and are followed in this report.

The Miocene to Pleistocene terrestrial sedimentary deposits of the southeastern San Joaquin Valley were first described in Anderson (1911), who grouped them together as the “Kern River Group.” Diepenbrock (1933) later divided the Kern River Group into the Kern River, Chanac, and Etchegoin formations. Usage of the Kern River Group has subsequently been abandoned (Bartow and Pittman 1983). The older Chanac and Etchegoin formations will not be affected by the proposed project and will not be considered further in this report.

6.2 Project Geology

This section describes the project geology of the Kern River Formation, the Turlock Lake Formation, the Riverbank Formation, the Modesto Formation, the Tulare Lake beds, and the Quaternary alluvium.

Kern River Formation: The Kern River Formation was first described by Diepenbrock (1933). There is no formally designated type section. However, the best exposures of the formation are in the canyons and bluffs along the southern side of the Kern River, and these exposures have generally been accepted as the type area of the formation (Bartow and Pittman 1983). The Kern River Formation is composed of poorly sorted, buff to brown arkosic sandstones, interbedded with lesser amounts of pebble to cobble conglomerates, siltstones, and mudstones representing fluvial sediments deposited on a low- to high-gradient alluvial fan. Mudstone interbeds represent quieter depositional environments (ephemeral lakes or ponds). Volcanic ash beds and paleosols also occur throughout the formation (Hackel and Krammes 1958; Bartow and Pittman 1983). As is the case with all of the Quaternary alluvial sediments described below, the primary source of the Kern River sediments is the rocks of the Sierra Nevada to the east.

Some uncertainty remains as to the age of the Kern River Formation. Troxel and Morton (1962) based their conclusion that the entire formation was deposited during the Pliocene primarily on its stratigraphic relationships. The formation overlies the Miocene Chanac Formation and is, in turn, overlain by Pleistocene alluvial deposits. The lower portion of the Kern River Formation has been interpreted to be stratigraphically equivalent to the Miocene to Pliocene marine Etchegoin Formation, which outcrops along the western San Joaquin Valley (Bartow and Pittman 1983). Fossils from the Kern River Formation indicate a late Miocene to Pliocene age. Fossil mammals salvaged from the lower Kern River Formation have been interpreted to be Hemphillian in age (late Miocene to early Pliocene; Savage et al. 1954).

Vertebrate fossils from the upper part of the formation are Blancan in age (Pliocene; Savage et al. 1954). However, Bartow and Pittman (1983) estimated the upper age limit of the formation to be early Pleistocene, a conclusion largely based on the stratigraphic relationships with overlying younger sedimentary units. More recently, Baron et al. (2008) reported that a prominent ash layer in the upper part of the formation was radiometrically dated to approximately 6 million years in age and correlated this ash through trace element analysis with the Volcano Hills/Silver Peak eruptive center in western Nevada. The authors (Baron et al. 2008) based their estimation that the uppermost Kern River Formation may be Pleistocene, as reported by previous workers, on the evidence of an erosional unconformity between the dated ash layers and the top of the unit.

Turlock Lake Formation: The Turlock Lake Formation was first described by Davis and Hall (1959), who designated a type section in road cuts within Turlock Lake State Park. This formation is composed of interbedded and poorly sorted, brown-to-tan and gray arkosic siltstones and sandstones, with lenses of pebbles and gravels. The sandstones tend to be fine- to coarse-grained and thicker than the beds of siltstones and gravels found elsewhere within the formation. All lithologies are poorly cemented with calcareous, siliceous, and/or hematite cements, except for tuffaceous units, which are locally well cemented so that these beds form ledges in road cuts, stream banks, and steep slopes. Turlock Lake sediments are primarily alluvial-fluvial (stream) deposits, but marsh-like lacustrine (lake) beds are common where streams merged with standing or slow-moving water. The depositional environment of the Turlock Lake Formation has been interpreted to be glacially (climatically) driven where the finer-grained, marsh-like, lacustrine deposits dominate the formation (Schlemon 1971). The conclusion that the Turlock Lake Formation is early Pleistocene in age (700,000 to 500,000 years B.P. [before present]) is based on stratigraphic superposition, radiometric dating of ash beds, and age-diagnostic fossils (Marchand and Allwardt 1981).

Riverbank Formation: The Riverbank Formation was first named by Davis and Hall (1959), who designated a type section along the south bluff of the Stanislaus River within the city of Riverbank. However, sedimentary strata referred to the Riverbank Formation are found along the eastern margin of the Great Valley from near Chico in the north to at least Fresno County in the south (Marchand and Allwardt 1981; Helley and Harwood 1985; Marchand 1976). The Riverbank

Formation consists of weakly consolidated reddish-brown to pink siltstones, sandstones, and pebble-to-cobble conglomerates with a few thin intervals of brick-red claystone. Where exposures were available in the project vicinity, Riverbank Formation sediments consist of predominantly interbedded red to orange siltstones and medium to fine sandstones; coarse sandstones and pebble conglomerates are present but rare. Marchand and Allwardt (1981) placed the age of the Riverbank Formation between 450,000 and 130,000 years B.P. (middle Pleistocene).

Modesto Formation: The late Pleistocene to early Holocene age Modesto Formation was also first named by Davis and Hall (1959), who designated a type section along the south bluff of the Tuolumne River at the south edge of the city of Modesto. The Modesto Formation is composed of interbedded, largely unconsolidated and poorly sorted, buff to yellowish-brown sandstones and siltstones with lesser amounts of pebble-to-cobble conglomerates. Alluvium assigned to the Modesto Formation is often lithologically indistinct from the underlying Riverbank Formation, but can be distinguished from it by stratigraphic position, degree of cementation (and therefore topographic expression), amount of deformation, and age. The older strata that constitute the Turlock Lake and Riverbank Formations have been deformed by tectonic activity related to uplift of the Sierra Nevada and can sometimes be recognized from the overlying Modesto Formation by their non-flat-lying attitude. Also, because of their greater cementation, the older stratigraphic units often have a distinct topographic expression. Marchand and Allwardt (1981) dated the Modesto Formation as between about 42,400 and 12,000 years B.P. (late Pleistocene).

Tulare Lake Beds: The Tulare Lake beds are the remnants of a large freshwater lake in the southern San Joaquin Valley that persisted into historic times. This lake was once fed by the Kaweah, Kern, Kings, and Tule rivers, but has been dry (except during exceptionally wet years) since the end of the nineteenth century. The lake beds consist of sands, silts, and clays, with the Chatom silt (26,000 – 13,000 years B.P.) and Blakeley Canal silt (younger than 13,000 years B.P.) comprising the upper lake beds (Davis 1999).

Quaternary Alluvium: Quaternary alluvium (mapped as Qb in Table 6-2) is composed primarily of fluvial sands and gravels reworked from older formations and transported from topographically high, adjacent areas. Within the paleontological study area, the alluvium generally occurs as modern stream deposits and/or forms a thin veneer over older geologic units.

6.3 Field Survey Results

The field survey for this assessment was conducted to document the presence of sediments suitable for containing fossil remains and to record the presence of any previously unrecorded fossil sites. The results of this survey are presented below, with a brief summary of the observed stratigraphy and fossils.

In the northern part of the paleontological study area, many groundwater recharge basins, stormwater retention basins, borrow pits, and canals were surveyed because they offered the best exposures of subsurface stratigraphy in the otherwise low-relief topography. In the Fresno area, the early- to middle-Pleistocene Turlock Lake Formation is typically overlain by the middle- to late-Pleistocene Riverbank Formation and/or the late-Pleistocene to early-Holocene Modesto Formation. The exposures inspected were not deep enough to expose sediments of the Turlock Lake Formation; therefore, no fossil localities were identified in that unit during the survey.

However, the Riverbank and Modesto formations were exposed at many locations. The Riverbank Formation was readily identified by the well-indurated, characteristic red and orange sandstones and siltstones. The Modesto Formation was identified by weakly indurated, buff to brown sandstones and siltstones. The Modesto Formation was seen at a number of localities as channel deposits in the underlying Riverbank Formation. Fossil localities observed in the northern paleontological study area/Fresno area included vertebrate, plant, and ichnofossils. Paleosols were consistently identified in both the Riverbank and Modesto Formations, and often contained root and burrow casts and molds, and plant fragments. Small-mammal bones were found in the upper Modesto Formation.

The largely rural area between Fresno and Hanford possessed fewer deep excavations in which the subsurface stratigraphy could be observed. Exposures that were found predominantly consisted of shallow irrigation ponds and canals, although some natural stream channels were observed as well. The majority of the ground surface was covered by agricultural lands, so most of these shallow excavations were partially filled or covered in soil and silt. Where exposures were available and accessible, the stratigraphy observed generally consisted of buff to brown, poorly indurated, fine sandstones and siltstones interpreted to be correlative with the Modesto Formation. Fossils observed through this stretch of agricultural land consisted of root and burrow casts and molds, and some freshwater mollusk fragments.

From Hanford south to west of Delano, sediments of the Tulare Lake beds were common and recognized as arkosic sands and silts. A large number of freshwater clams were found in deeper excavations throughout this stretch of the paleontological study area.

From west of Delano south to Bakersfield, the exposures and stratigraphy are similar to those found from Fresno to Hanford, with buff to brown, poorly indurated, fine sandstones and siltstones interpreted to be correlative with the Modesto Formation. Fossils observed in this section of the paleontological study area consisted of paleosols with ichnofossils.

The southernmost portion of the paleontological study area is in the urban Bakersfield area. Here, exposures of stratigraphy were found in groundwater recharge basins, excavations at construction sites, and road cuts. Generally, the stratigraphy observed was similar to the northern stretches of the right-of-way, although the proximity of the Kern River resulted in varying thicknesses of Quaternary alluvium overlying older alluvium interpreted to be correlative with the Modesto Formation. Few exposures were accessible for study, and no fossil localities were found in the Bakersfield urban area. During the field survey in the Bakersfield area, the Kern River Formation was not identified at the surface within the paleontological study area, though it is likely to underlie the footprint at depth near Bakersfield. Exposures of the Kern River Formation were observed in road cuts north of Bakersfield, where they were identified as well-indurated, poorly sorted sandstones to cobble conglomerates.

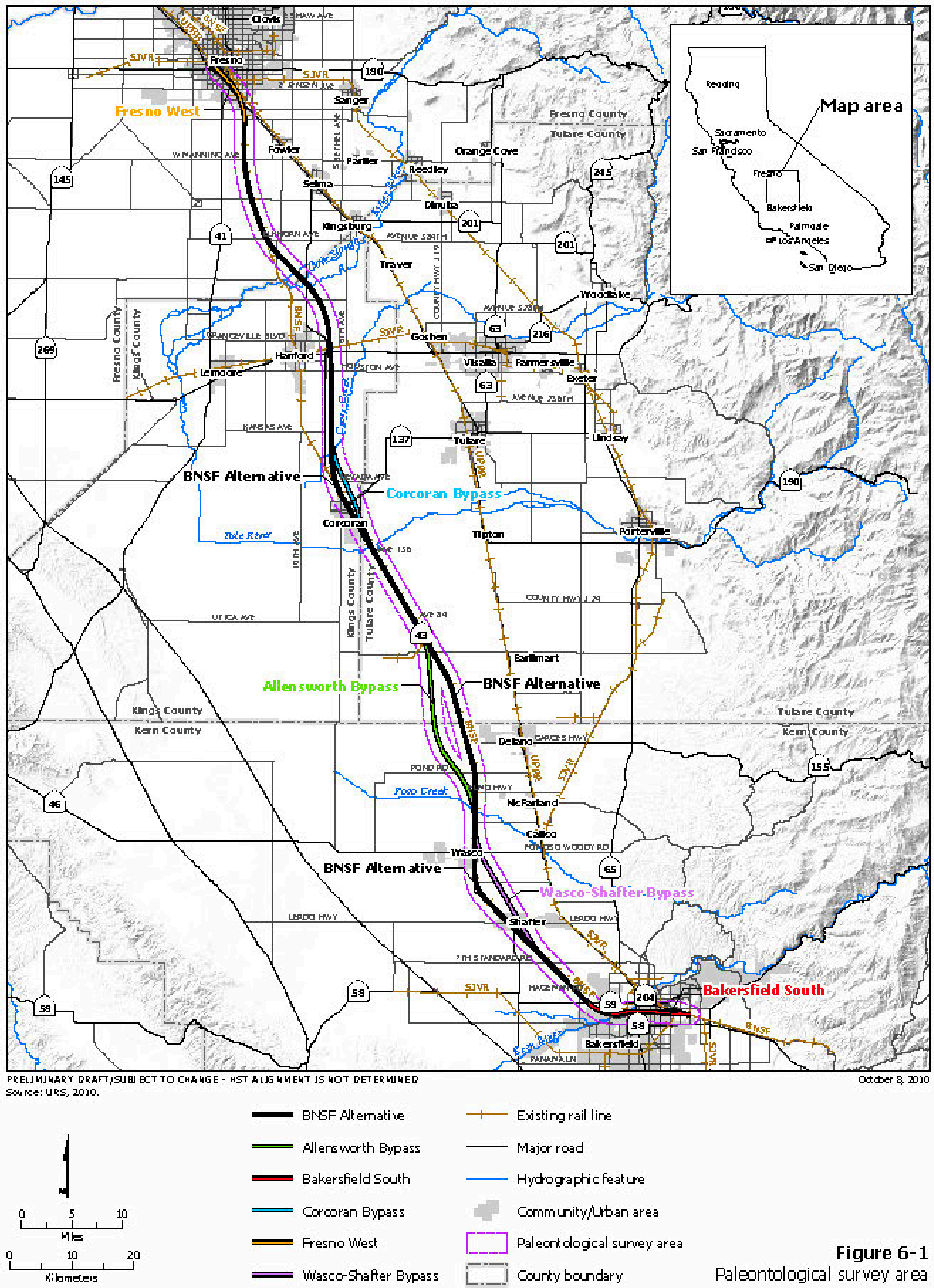


Figure 6-1
Paleontological survey area

6.3.1 Newly Recorded Paleontological Resource Localities

During the paleontological resource survey, a number of previously unreported fossil localities were identified. Each of these fossil localities is included in Table 6-1, along with a brief description of each locality.

Table 6-1
Newly Recorded Paleontological Resource Localities

Newly Recorded Resource Field Recording Number[a]	Geologic Formation[b]	Resource Description[b]	General Resource Location
DFM 15-11-09-01	Modesto equivalent	Root cast	West of Delano
SJB 16-11-09-01	Modesto equivalent	Paleosol, burrow casts	Southeast of Wasco
LHF 20-01-10-01	Modesto	Paleosol, roots, burrows, fish?	North-northwest of Bowles
LHF 20-01-10-02	Tulare Lake beds/Modesto equivalent	Clams	North of Corcoran
LHF 21-01-10-01	Tulare Lake beds	Clams	Southeast of Corcoran
LHF 21-01-10-02	Tulare Lake beds	Clams, snails, burrow casts	East of Alpaugh
LHF 21-01-10-03	Tulare Lake beds?	Clams, burrow casts	North of Allensworth State Historic Park
LHF 21-01-10-04	Tulare Lake beds	Clams	West of Delano
SJB 21-01-10-01	Modesto equivalent	Clams	North of Wasco
SJB 15-05-10-01	Modesto/riverbank	Bones, wood, roots, burrows	Southeast of Fresno
DFM 16-05-10-01	Modesto?	Burrows, bone?	Southeast of Hanford
DFM 17-05-10-01	Tulare Lake beds	Clams	Southwest of Delano

[a] The locality nomenclature used in the field survey is based on (1) the initials of the recorder,(2) the date fossil location was discovered, and (3) locality number of the day for that person (01 being the first discovery, 02 the second discovery, etc.).
[b] ? indicates that the specific formation or resource is likely as noted but uncertain.

DFM 15-11-09-01

This resource locality included one trace fossil consisting of a cemented burrow cast identified in a dry, shallow pit west of Delano. Sediment was buff, fine sand consistent with the Modesto Formation.

SJB 16-11-09-01

This resource locality was identified in a borrow pit/stormwater basin which contained several feet of interbedded buff sands and silts, correlative with the Modesto Formation, with a cemented paleosol at approximately 6 feet below ground surface (bgs). This paleosol had a mottled color with caliche nodules, and burrows filled with cemented caliche. The locality is southeast of Wasco.

LHF 20-01-10-01

This locality consisted of a paleosol approximately 5 feet bgs in a Fresno Irrigation District basin located north-northwest of Bowles, California. The paleosol was identified by the change in the erosional profile, which has created a small horizontal "bench" along the edge of the basin. Although not a well-preserved paleosol, small root and burrow molds were present in the matrix, and what may have been very poorly preserved small fish bone impressions. The buff sands and silts were consistent with the Modesto Formation.

LHF 20-01-10-02

This locality was identified in a borrow pit at the north edge of the city of Corcoran, where a section of more than 10 feet of alternating sand, silt, and clay is exposed. Fragments of clams were found at the surface, not in situ. A siltstone ledge at approximately 6 to 7 feet bgs contains hematite and clay cements. The upper 3 to 4 feet are tan sand and likely Tulare Lake deposits. The lower part of the section is older, and likely Pleistocene alluvium.

LHF 21-01-10-01

This resource locality was identified at an artificial pond southeast of Corcoran. Approximately 14 feet of section were exposed in the south bank of a pond composed of clayey silt and fine sand, likely Tulare Lake deposits. The fine sand contains freshwater clam fragments.

LHF 21-01-10-02

Freshwater clams, snails, and caliche cemented burrow casts up to 1 inch in diameter were identified in spoils from an irrigation pond east of Alpaugh. These were not in situ, although the presence of cemented casts indicates a paleosol or preserved lake bed at depth.

LHF 21-01-10-03

At this locality, located north of Allensworth State Historic Park within spoils of a deep irrigation pond was a granular-to-coarse sand unit with abundant burrow casts and freshwater clam fragments. These were not in situ, although the presence of cemented casts indicates a paleosol or preserved lake bed at depth.

LHF 21-01-10-04

This locality consisted of freshwater clam fragments contained within clayey silt with some coarse sand in a basin located west of Delano. The sediments are consistent with Tulare Lake beds.

SJB 21-01-10-01

This resource locality consisted of clam fragments in spoils from a recently excavated irrigation pond north of Wasco. The fossils were not in situ and were found in buff sandy silt. The sediments were consistent with those of the Modesto Formation, although the depth to this formation could not be determined because the sediment was disturbed.

SJB 15-05-10-01

This locality consisted of abundant fossil root casts and some fossil wood in a Fresno Metropolitan Flood Control District irrigation pond, southeast of Fresno. The sediments observed were Modesto Formation overlying Riverbank Formation. The upper unit consisted of interbedded buff fine sands and silts (Modesto Formation), whereas the lower unit consisted of red sandstones with some dark brown clay interbeds (Riverbank Formation). Paleosols were identified in both units at this locality, and small-mammal bones were found in the uppermost Modesto Formation, while fossil wood was found at approximately 15 feet bgs in the Riverbank Formation.

DFM 16-05-10-01

This resource locality consisted of some scattered fossil burrow casts (not in situ) and potentially some fossil bone fragments at the Kings Waste Recycling Center, southeast of Hanford. The sediment at this locality consisted of buff-colored, fine sand and silt. The bone fragments were unidentifiable and may be imported.

DFM 17-05-10-01

This resource locality was identified in a large groundwater basin north of Wasco and southwest of Delano. The basin exposed more than 20 feet of Tulare Lake sands. Many clam shells and shell fragments were seen at nearly every sedimentary horizon.

6.4 Paleontological Resource Inventory

An inventory of known paleontological resources discovered in the vicinity of the proposed project is presented below and the paleontological importance of these resources is assessed. The literature review and museum archival search conducted for this inventory documented no previously recorded fossil sites within the actual project footprint. The LACM and the San Bernardino County Museum reports are provided as Appendices A and B, respectively. UCMP did not produce a detailed report, though its records search found only one pre-existing locality in the paleontological study area: UCMP locality V65101(email from Pat Holroyd of UCMP to David Hassel of PaleoResource on October 12, 2009**)** The UCMP database notes that this locality consists of two Pleistocene horse teeth that were found "6 miles from Corcoran in 19 feet of clay." The locality data did not designate a geologic formation, and the exact location is unknown. The Kern River, Turlock Lake, Riverbank, and Modesto formations and the Tulare Lake beds have all yielded fossilized remains of extinct species at numerous previously recorded sites throughout the San Joaquin Valley (see discussion below). Also, several previously unrecorded fossil localities were identified during the field survey within the paleontological study area.

Kern River Formation. The Kern River Formation has produced numerous significant fossils in the past. Hoots (1930) reported that Dr. Chester Stock had “made extensive collections” of land-mammal fossils from the Kern River “group,” but these fossils have apparently never been formally described. Drescher (1942) reported bones of a large horse and camel. Savage et al. (1954) described fossil mammals from several localities near the base of the formation. Bartow and Pittman (1983) reported paleosols (fossil soils) containing “tubules lined with clay or silica,” which probably represent burrow and/or root casts (ichnofossils). Other reported fossil specimens from the Kern River Formation include a mustelid (*Eomellivora wimani*), procyonid (*Bassariseus antiquus*), horse (*Pliohippus spectans*), field mouse (*Peromysus pliocenicus*), squirrel (*Spermophilus argonatus*), and rabbits (*Hypolagus edensis*, *Hypolagus limetus*) (McLeod 2009).

UCMP has records of more than a dozen fossil localities in the Kern River Formation. Several of these previously recorded fossil sites are reported as having been uncovered by earth moving associated with previous construction projects. Fossils recovered from these sites include the remains of fish, amphibians, reptiles, birds, and both small and large mammals. Most of the small fossils have been recovered through screen washing of fossiliferous sediments exposed by excavations at construction sites.

LACM also has several important vertebrate fossil localities in the Kern River Formation from north of the HST right-of-way. These localities have produced an important fauna including a vulture, weasel, and peccary. LACM Locality 49 has produced "*an extensive terrestrial fauna (and a couple marine specimens)*" (McLeod 2009). This locality produced the holotypes for several new species, including *Vultur kernensis* (vulture), *Brachypsalis angustidens* (mustelid carnivore), *Peromyscus pliocenicus* (deer mouse), and *Prosthennops kernensis* (peccary).

Because fossil vertebrates have previously been reported from the Kern River Formation, there is potential for additional significant paleontological resources to be found in sediments of the Kern River Formation. Therefore, using SVP (1995) criteria, the Kern River Formation is judged to have high sensitivity.

Turlock Lake Formation. The Turlock Lake has yielded fossil remains at numerous sites in the Great Valley. These remains include petrified wood and the bones and teeth of a diverse assemblage of extinct land mammals. Hay (1927) reported mammoths, horses, and a camel from sediments that Piper et al. (1939) interpreted as probably Turlock Lake equivalent. Both vertebrate and plant fossils have been reported from Turlock Lake Formation sediments exposed in the bluffs along the American River at Fair Oaks, California (UCMP records and personal observations). Fisk and Butler (2005) reported fossil fish, plant fragments, petrified wood, and ichnofossils in Turlock Lake Formation near Roseville, California. Dundas (1994), Dundas et al. (1996), and Dundas and Blades (1999) described a large fauna from the Turlock Lake Formation at the Fairmead Landfill site, approximately 30 miles (50 kilometers) northwest of Fresno. Harmsen et al. (2008) also reported *Camelops* sp. (camel) from excavations in the Fresno area.

Because fossil vertebrates have been previously reported from the Turlock Lake Formation, there is potential for additional significant paleontological resources to be found in sediments of the Turlock Lake Formation. Using SVP (1995) criteria, the Turlock Lake Formation is judged to have high sensitivity.

Riverbank Formation. Sediments of the Riverbank Formation have yielded the fossilized remains of middle Pleistocene plants and animals from numerous previously recorded fossil sites in the Great Valley (Fisk 2000). Fossil vertebrates of Irvingtonian to Rancholabrean North American land-mammal age (NALMA) have been reported from Riverbank Formation sediments near their type area (Garber 1989, Jefferson 1991b) and at numerous other scattered locations along the eastern margin of the Great Valley (Fisk and Lander 1999; Lander 1999; Fisk 2000, 2001a, 2001b; Scott 2010). Fossils previously reported from the Riverbank Formation include clams, fish, turtles, frogs, snakes, birds, bison (*Bison* sp.), mammoths (*Mammathus* sp.), mastodons (*Mammut* sp.), ground sloths (*Paramylodon* sp.), camels (Camelops sp.), horses (*Equus* sp.), pronghorns, deer, dire wolves (*Canis dirus*), coyotes (*Canis latrans*), rabbits (*Lepus* sp.), rodents (*Scapernus* sp.; *Neotoma* sp.), and land plant remains (including wood, leaves, and seeds).

Hilton et al. (2000) described a large fossil fauna from a paleosol in the Riverbank Formation discovered during excavations for the Arco Arena in Sacramento. The presence of paleosols in the Riverbank Formation indicates that scientifically important fossil specimens may be discovered from other paleosol horizons in the Riverbank Formation. Excavations for the Fairmead Landfill in Madera County have exposed fossiliferous sediments of the Riverbank Formation and significant vertebrate fossils have come from this stratigraphic unit (Dundas et al. 1996; UCMP records). Numerous fossil specimens have also been salvaged from the Riverbank Formation in the Fresno area as the result of paleontological mitigation, including mammoth bones and teeth and plant microfossils (Harmsen et al. 2008; Fisk and Mahan 2009). Also, during the field survey, several paleosols containing fossil burrows and root casts and molds were found in sediments of the Riverbank Formation.

Because fossil vertebrates have been previously reported from the Riverbank Formation and because depositional conditions observed in exposures in the paleontological study area appear to be favorable for the preservation of fossils, there is potential for additional significant paleontological resources to be found in this stratigraphic unit. Using SVP (1995) criteria, the Riverbank Formation is judged to have high sensitivity.

Modesto Formation. Numerous vertebrate fossil localities have been reported from sediments referable to the Modesto Formation in the San Joaquin and Sacramento valleys.

Many of these sites are documented in surveys of Quaternary land mammal fossils made by Hay (1927), Stirton (1939, 1951), Savage (1951), Lundelius et al. (1983), and Jefferson (1991b), or in surveys of Quaternary birds, reptiles, and amphibians made by Miller and DeMay (1953) and Jefferson (1991a). Mammalian fossils have been the most helpful in determining the relative age of alluvial and age-correlative lacustrine deposits (Louderback 1951; Savage 1951).

Fossil vertebrates of Rancholabrean age and fossil wood have previously been reported from sediments of the Modesto Formation near its type area (Marchand and Allwardt 1981; Garber 1989; Jefferson 1991b) and at numerous other scattered locations in the Great Valley (Richards and McCrossin 1991; Fisk and Lander 1999; Lander 1999; Fisk and Mahan 2009). Jefferson (1991a, 1991b) compiled a database of California Pleistocene (primarily Rancholabrean NALMA) vertebrate fossils from published records, technical reports, unpublished manuscripts, information from colleagues, and inspection of museum paleontological collections at more than 40 public and private institutions. Jefferson (1991a, 1991b) listed several sites in Fresno, Kings, Tulare, and Kern counties that yielded Rancholabrean vertebrate fossils. Most of these localities are likely referable to the Modesto Formation. They include specimens of Pleistocene megafauna such as mammoth, bison, horse, camel, dire wolf, and many others (Jefferson 1991a, 1991b). Also, during the field survey, vertebrate remains and several paleosols containing fossil burrows and root casts and molds were found in sediments of the Modesto Formation.

Because sediments referable to the Modesto Formation have yielded scientifically significant fossils in the past, and because depositional conditions appear to be favorable for the preservation of fossils, there is potential for additional significant paleontological resources to be found in sediments of the Modesto Formation. Because the Modesto Formation has produced significant fossils in the past, under SVP (1995) criteria this stratigraphic unit is judged to have high sensitivity.

Tulare Lake Beds. Numerous important fossils have been reported from sediments deposited in ancestral Tulare Lake. Jefferson (1991a, 1991b) listed four sites in Kings County that yielded Rancholabrean vertebrate fossils from Tulare Lake sediments. These localities produced specimens of Pleistocene megafauna such as mammoth, bison, horse, camel, dire wolf, and many others (Jefferson 1991a, 1991b). A locality known as the Witt Site has produced a diverse faunal assemblage representing late-Pleistocene to early-Holocene land mammals and fishes (Gobalet and Fenenga 1993). Mammalian specimens from this site include *Glossotherium harlani* (ground sloth), *Lepus californicus* (rabbit), *Thomomys* cf, T. *bottne* (gopher), *Castor canadensis* (beaver), *Canis latrans* (coyote), *Canis dirus* (dire wolf), *Felis atrox* (lion), *Mustella vison* (mink), *Mammathus columbi* (mammoth), *Equus occidentalis* and *Equus conversidens* (horses), *Camelops hesternus* (camel), *Cervus elaphus nannodes* (elk), *Odocoileus hemionus* (deer), *Antilocapra americana* (pronghorn), *Euceratherium collinum* (musk ox), and *Bison antiquus* (bison). Specimens from this assemblage have been radiometrically dated from over 60,000 to 7,000 years B.P. (Gobalet and Fenenga 1993). These authors also described nine species of fish from this site. Davis (1999) provided a pollen analysis of cores taken through Tulare Lake beds and has used the data to help reconstruct the climatic and floral history of the late Pleistocene to early Holocene of the San Joaquin Valley. Also, during the field survey for this assessment, several species of freshwater mollusks were found in Tulare Lake sediments.

Because sediments referable to the Tulare Lake beds have yielded scientifically significant fossils in the past, and because depositional conditions appear to be favorable for the preservation of fossils, there is potential for additional significant paleontological resources to be found in the sediments of the Tulare Lake beds. Because the Tulare Lake beds have produced significant fossils in the past, under SVP (1995) criteria this stratigraphic unit is judged to have high sensitivity.

Quaternary Alluvium. During the geological and paleontological literature review and museum archival records searches for this paleontological resource impact assessment, no previously recorded fossil sites were found in Quaternary alluvium in the paleontological study area. During the field survey of prospective fossiliferous sediments, no indications were found that the Quaternary alluvium might be fossiliferous. Therefore, under SVP (1995) criteria, this stratigraphic unit is judged to have low sensitivity.

A summary of the paleontological sensitivities of each of these formations are presented in Table 6-2.

Table 6-2

Paleontological Sensitivities of Geologic Formations That May Be Potentially Impacted by Construction of the Fresno to Bakersfield Section of the California High-Speed Train

Map Symbol[a]	Age and Map Legend Identification[b]	Formation[c]	Location	Lithology	Paleontological Sensitivity[d]
Qb	Quaternary basin deposits	Unnamed	San Joaquin Valley	Floodplain deposits sand, silt, and clay	Low
Ql	Quaternary lake deposits	Includes the Tulare Lake bed	San Joaquin Valley	Lacustrine fine sand, silt, and clay	High
Qf	Quaternary fan deposits: includes the late Pleistocene Modesto Formation	Modesto Formation	San Joaquin Valley	Interbedded, largely unconsolidated and poorly sorted, buff to yellowish brown sandstone and siltstone with lesser amounts of pebble to cobble conglomerate	High
Qc	Pleistocene nonmarine	Riverbank Formation	San Joaquin Valley	Weakly consolidated reddish-brown to pink siltstones, sandstones, and pebble to cobble conglomerates, with a few thin intervals of brick-red claystone	High
Qc	Pleistocene nonmarine	Turlock Lake Formation	San Joaquin Valley	Interbedded and poorly sorted, brown to tan and gray arkosic siltstones and sandstones, with lenses of pebbles and gravels	High

Table 6-2
Paleontological Sensitivities of Geologic Formations That May Be Potentially Impacted by Construction of the Fresno to Bakersfield Section of the California High-Speed Train

Map Symbol[a]	Age and Map Legend Identification[b]	Formation[c]	Location	Lithology	Paleontological Sensitivity[d]
QP	Plio-Pleistocene nonmarine	Kern River Formation	Western flank of Sierra Nevada: eastern San Joaquin Valley	Interbedded and poorly sorted, buff to brown sandstone, with lesser amounts of pebble to cobble conglomerate, siltstone, and mudstone	High

[a] Map units and symbols are from Geologic Map of California, Bakersfield Sheet (Smith 1964) and Geologic Map of California, Fresno Sheet (Matthews and Burnett 1965).
[b] The map legend identification is not entirely accurate as to the age of the geologic formations. The Kern River Formation is older than the map legend indicates (see discussion below).
[c] The Riverbank and Turlock Lake formations have been included in the same map units in maps of this scale (1:250,000).
[d] SVP (1995) describes sedimentary rock units as having (1) high potential for containing significant paleontological resources, (2) low potential for containing paleontological resources, or (3) undetermined potential.

In Figure 6-2, the HST section has been subdivided into five "zones" based on the geological formations likely to be encountered during project excavations.

Starting from the north, the five zones are:

- Zone 1 is in the Fresno urban area, where Pleistocene sediments of the middle- to late-Pleistocene Riverbank Formation and/or the late-Pleistocene to early-Holocene Modesto Formation are exposed at or near the surface, and are known to overlie the early- to middle-Pleistocene Turlock Lake Formation.
- Zone 2 is in the largely rural area between Fresno and Hanford, where Quaternary alluvium overlies sediments of the late-Pleistocene to early-Holocene Modesto Formation.
- Zone 3 is from Hanford south to approximately west of Delano, where sediments of the Tulare Lake beds are exposed at or near the surface.
- Zone 4 extends from Delano south to Bakersfield, where the stratigraphy is similar to those found from Fresno to Hanford, with buff to brown, poorly indurated, fine sandstones and siltstones interpreted to be correlative with the Modesto Formation. These sediments are overlain by Quaternary alluvium.
- Zone 5 is in the Bakersfield urban area, where Quaternary alluvium is interpreted to overlie the Kern River Formation at an unknown depth.

Zones 1, 3, and 5 are considered to have high paleontological sensitivity because of the high potential to encounter significant paleontological resources. Zones 2 and 4 contain Quaternary alluvium at the surface that is considered to have low paleontological sensitivity because this unit is too recent to preserve significant fossils. However, at shallow depths, Zone 2 is underlain by the Modesto Formation and Zone 4 is underlain by sediments correlative with the Modesto Formation, both of which have high paleontological sensitivities. Likewise, areas that have been previously disturbed are considered to have low paleontological sensitivity to the depth of the disturbance. Thus, depending on the depth of potential ground disturbance (e.g., no disturbance or only very shallow excavations of less than a few feet), Zones 2 and 4, along with urban areas, are considered to have low paleontological sensitivities in cases of no or only very shallow soil disturbance. For deeper soil disturbances, Zones 2 and 4, along with disturbed areas would be considered to have the same high paleontological sensitivity as Zones 1, 3, and 5.

Although no fossil localities are reported within the project footprint, the presence of fossils in sediments of the Kern River, Turlock Lake, Riverbank, and Modesto formations; in Tulare Lake sediments elsewhere in the area, and within the paleontological study area suggests that there is a high potential for additional similar fossil remains to be uncovered by excavations during project construction. Under SVP (1995) criteria these stratigraphic units have a high sensitivity to potential impacts. The Quaternary alluvium, as defined above, was not found to contain or have the potential to contain paleontological resources in the paleontological study area. Under SVP (1995) criteria, this stratigraphic unit has a low sensitivity to potential impacts. Excavations in sediments with low paleontological sensitivity are not expected to affect significant paleontological resources. Disturbance of sediments with high paleontological sensitivity could have impacts to paleontological resources that are significant but mitigable to a level below that of significant.

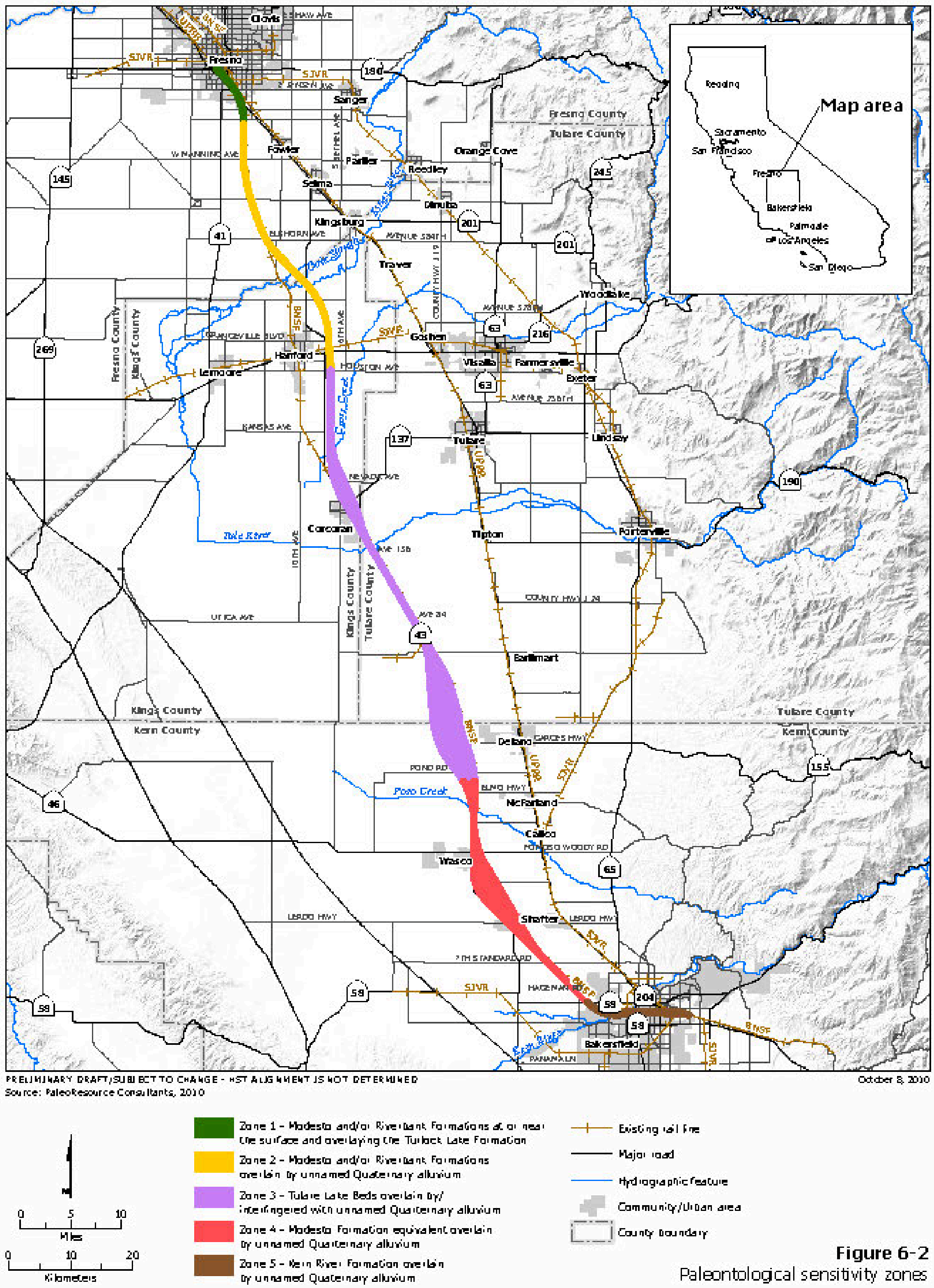


Figure 6-2
Paleontological sensitivity zones

6.5 Types of Impacts on Paleontological Resources

The potential impacts on paleontological resources from construction of the project can be divided into construction-related impacts and operation-related impacts. No impacts on paleontological resources are expected to occur from the continuing operation of the project or any of its related facilities. Construction-related impacts to paleontological resources primarily involve terrain modifications (clearing, grading, and excavations that encounter previously undisturbed sediment). Paleontological resources, including an undetermined number of fossil remains and unrecorded fossil sites; associated specimen data and corresponding geologic and geographic site data; and the fossil-bearing strata, can be adversely affected by (i.e., will be sensitive to) ground disturbance and earth moving associated with construction of the project. The construction of supporting facilities, such as temporary construction offices, laydown areas, and parking areas, also has the potential to cause adverse impacts to significant paleontological resources if this construction involves new ground disturbance. Thus, any project-related ground disturbance can have adverse impacts on significant paleontological resources. However, with a properly designed and implemented mitigation program, these impacts can be reduced to less-than-significant level.

6.6 Recommended Mitigation Measures

The mitigation measures proposed below are consistent with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP 1995, 1996).

Before the start of construction, a qualified paleontologist should be retained to both design a monitoring and mitigation program and implement the program during all project-related ground disturbances. The paleontological resource monitoring and mitigation program should include the following elements:

- Preconstruction coordination.
- Construction monitoring.
- Emergency discovery procedures.
- Sampling and data recovery, if needed.
- Preparation, identification, and analysis of the significance of fossil specimens salvaged, if any.
- Museum storage of any specimens and data recovered.
- Reporting.

Before the start of construction, the paleontologist will conduct a field survey of exposures of sensitive stratigraphic units that will be disturbed, and any fossils discovered will be salvaged. Earth-moving construction activities will be monitored wherever these activities will disturb previously undisturbed sediment. Monitoring will not be needed in areas where sediments have been previously disturbed or in areas where exposed sediments will be buried but not otherwise disturbed.

Before the start of construction, the construction personnel involved with earth-moving activities will be informed that fossils may be discovered during excavating and that these fossils are protected by laws. The construction personnel will also be informed about the appearance of common fossils and proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist. Implementation of these mitigation measures will reduce the potentially significant adverse environmental impact of project-related ground disturbance and earth moving on paleontological resources to a less-than-significant level by allowing for the salvage of fossil remains, the associated specimen data, and the corresponding geologic and geographic site data that otherwise might be lost to earth moving and unauthorized fossil collecting.

The identifiable fossil remains salvaged during project construction could represent new taxa or new fossil records for the area, for the state of California, or for these stratigraphic units and could be scientifically important and significant. They could also represent geographic or temporal range extensions. Moreover, discovered fossil remains could make it possible to more accurately determine the age, paleoclimate, and depositional environment of the sediments in which they were entombed. Fossil remains salvaged during project construction could provide a more comprehensive documentation of the diversity of animal and plant life that once existed in Fresno, Kings, Tulare, and Kern counties and could result in a more accurate reconstruction of the geologic and paleobiologic history of the San Joaquin Valley. The mitigation measures proposed above are consistent with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources to a less-than-significant level.

Section 7.0
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7.0 References

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Section 8.0
Preparer Qualifications

8.0 Preparer Qualifications

Lanny H. Fisk, PhD, PG

Dr. Fisk has over 25 years of experience as a professional paleontologist and 20 years as a paleontological consultant doing paleontological resource impact assessments and surveys, preparing CEQA and NEPA environmental documents and mitigation measures, managing environmental compliance monitoring programs, and coordinating and consulting with state and federal resource agencies to resolve environmental concerns regarding paleontological resources. He has supervised paleontological resource impact mitigation programs requiring monitoring of major earth-moving projects, recovery and collection of fossil remains and fossiliferous rock samples, supervision of field personnel, and preparation of progress and final reports. His projects have involved extensive coordination and consultation with project sponsors, other consulting firms, and permitting agencies; adherence to strict delivery schedules; and completion within specified budget limits. Dr. Fisk has supervised paleontological monitoring and salvaging of fossils, evaluated fossiliferous rock samples to determine need for microfossil processing, and identified fossil remains as part of paleontological monitoring and resource recovery programs for such major projects as the Pacific Gas and Electric Company–Pacific Gas Transmission Company Pipeline Expansion Project from Alberta, Canada, to Southern California; 360networks Northern California Fiber Optic Cable Project; Los Angeles Metro Rail Project; Eastern Transportation Corridor Tollway Project; Foothills Transportation Corridor Oso Tollway Project; Kettleman Hills Landfill; Sutter Energy Center Project; Newark Power Plant Project; Delta Energy Center Project; Los Medanos Energy Center Project; Blythe Energy Project; Gilroy Energy Center; Metcalf Energy Center; King City Energy Center; Pastoria Energy Facility; Otay Mesa Generating Project; Contra Costa Power Plant; Woodland Generating Station; Panoche Energy Center, Caltrans Highway 16 Excelsior Road Project, and Caltrans Highway 41 Reef Ridge Project.

David M. Haasl, PhD

Dr. David M. Haasl joined the PRC team with a PhD from the University of California, Davis, with a specialization in paleobiology and an M.S. from Western Washington University, specializing in invertebrate paleontology. Most recently he was Museum Scientist and Collections Manager at the University of California, Museum of Paleontology, in Berkeley, California, where he also served as Editor of the journal *PaleoBios*. He has published several scientific papers in paleontology and has others in preparation.

Stephen J. Blakely

Mr. Blakely is a Staff Paleontologist at PaleoResource Consultants. He is responsible for the management of paleontological resource assessment and monitoring projects and the preparation of proposals and technical reports. He has contributed to the preparation of several paleontological resource impact assessments, including several AFC documents for power plant projects (e.g., AUSRA-Carrizo Solar Farm, SES Solar Two, and Soda Mountain Solar Project). Mr. Blakely has also contributed on the preparation of paleontological mitigation and monitoring plans (e.g., Caltrans SR 24 Caldecott Improvement Project and Caltrans SR 180 Sequoia Freeway Segment 3 Project). In addition to project management duties, Mr. Blakely performs field surveys for assessments and has worked in the preparation laboratory and as a field paleontologist on monitoring projects. Mr. Blakely also has several years of experience working in the construction industry and worked at the University of California, Davis, sedimentology laboratory.

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Appendix A

Natural History Museum of Los Angeles County: Records Report

Natural History Museum of Los Angeles County
900 Exposition Boulevard • Los Angeles, CA 90007

Vertebrate Paleontology Section
Telephone: (213) 763-3325
FAX: (213) 746-7431
e-mail: smcleod@usc.edu

30 November 2009

PaleoResource Consultants
550 High Street, Suite 108
Auburn, CA 95603

Attn: Attn: Dr. David Haasl, Senior Paleontologist

re: Paleontological resources for the proposed Fresno to Bakersfield High Speed Rail Project, Fresno, Kings, Tulare, and Kern San Bernardino Counties, project area

Dear David:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for the proposed Fresno to Bakersfield High Speed Rail Project, Fresno, Kings, Tulare, and Kern Counties, project area as outlined on the portions of the Fresno North, Fresno South, Malaga, Conejo, Laton, Burris Park, Remnoy, Waukena, Corcoran, Taylor Weir, Alpaugh, Allensworth, Delano West, Pond, Wasco, Rio Bravo, Rosedale, Oildale, Gosford, Lamont, and Edison USGS topographic quadrangle maps that you sent to me on a CD 13 November 2009. We do not have any vertebrate fossil localities that lie directly within the proposed project boundaries, but we do have localities somewhat nearby from the same or similar sedimentary deposits as occur in the proposed project area, including those only found at depth rather than exposed.

In the northern part of the proposed project area, around Fresno south of the San Joaquin River, beneath the upper layers of soil there are late Pleistocene deposits of the Modesto Formation and possibly the older and sometimes underlying Riverbank Formation. Our closest vertebrate fossil locality to the proposed project area from these types of deposits is LACM 7254, quite to the northwest immediately northeast of Chowchilla on the south side of Ash Slough, that produced a fossil specimen of elephantoid, Proboscidea. Almost all of the proposed project area, from Fresno south to just west of Bakersfield, has surficial deposits composed of younger Quaternary Alluvium. These are basin deposits of the San Joaquin Valley derived generally from the Sierra Nevada Mountains to the east. These deposits typically do not contain significant vertebrate fossils, at least in the uppermost layers, and there have been few significant excavations in the central part of the valley to produce vertebrate fossils. In fact, our closest vertebrate fossil locality to this portion of the proposed project area, LACM (CIT) 117, near Pixley in Tulare County, produced a specimen of fossil horse, *Plesippus*, but at a depth of 425

"...to inspire wonder, discovery and responsibility
for our natural and cultural worlds."

feet in a well. Our other vertebrate fossil localities from somewhat similar deposits, LACM 4087 and 6701, occur near the base of the Sierra Nevada foothills to the east of the proposed project area at higher elevations. Locality LACM 4087, from a gravel pit due east of Terra Bella just south of east of locality LACM (CIT) 117 cited above, and locality LACM 6701, further southeast between Fountain Springs and the White River in clayey sand six feet below the surface, both produced specimens of fossil mammoth, *Mammuthus*.

In the southernmost portion of the proposed project area route, from the Kern River south to Edison, there are extensive exposures of the late Miocene Kern River Formation just north of the proposed project area and these deposits probably underlie the Quaternary Alluvium in this area at a relatively shallow depth, but deeper to the west. We have an extensive collection of specimens from the Kern River Formation in localities from north of the Kern River north of this portion of the proposed project area route. Our most prominent locality in the Kern River Formation, LACM (CIT) 49, situated north of this southern portion of the proposed project route area north of the Kern River, produce an extensive terrestrial fauna (and a couple of marine specimens) including the holotypes [name bearing specimens of species new to science] of a fossil vulture, *Vultur kernensis* (Miller, L. H. 1931), a fossil mustelid carnivore, *Brachypsalis angustidens* (Hall, E. R. 1930), a fossil mouse, *Peromyscus pliocenicus* (Wilson, R. W. 1937), and a fossil peccary, *Prosthennops kernensis* (Colbert, E. H. 1938). Additional published taxa from the Kern River Formation include the mustelid (weasel or skunk) *Eomellivora wimani* (see Stock and Hall 1933), the procyonid (raccoon) *Bassariscus antiquus* (see Hall 1930), the fossil horse *Pliohippus spectans* (see Stock 1935), the fossil rabbits *Hypolagus edensis* and *Hypolagus limetus* (see Wilson 1937; White 1988), the fossil field mouse *Peromyscus pliocenicus* (see Wilson 1937; Hoffmeister 1945), and the fossil squirrel *Spermophilus argonatus* (see Wilson 1937; Black 1963). A list of the scientific papers citing these specimens as well as others are provided in an appendix.

Surface grading or very shallow excavations in the upper layers of soil and younger Quaternary Alluvium exposed in most of the proposed project area in the San Joaquin Valley are unlikely to uncover significant vertebrate fossils. Excavations in the Quaternary Alluvium near the major drainages, e.g. the Kings River near Laton near the Fresno - Kings County boundary, the Tule River and associated drainages near Cocoran, and the Kern River near Bakersfield, have a greater chance of uncovering significant vertebrate fossils at shallow depth. Deeper excavations in those portions of the proposed project area that extend down into older Quaternary layers, including deposits of the Modesto Formation and the Riverbank Formation, as well as any excavations down into the Kern River Formation in the southernmost portion of the proposed project area, however, may well encounter significant fossil vertebrate remains. Any substantial excavations in the proposed project area, therefore, should be closely monitored to quickly and professionally collect any vertebrate fossils without impeding development. Any fossils recovered during mitigation should be deposited in an accredited and permanent scientific institution for the benefit of current and future generations.

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosures: attachment, draft invoice

Publications on specimens in the LACM collections
from the Kern River Formation

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Appendix B

San Bernardino County Museum: Records Report

SAN BERNARDINO COUNTY MUSEUM
2024 Orange Tree Lane • Redlands, California USA 92374-4560
(909) 307-2669 • Fax (909) 307-0539 • www.sbcountymuseum.org
TDD (909) 792-1462

COUNTY OF SAN BERNARDINO
ROBERT L. McKERNAN
Director

26 April 2010

PaleoResource Consultants
attn: David Haasl, Ph.D.
550 High Street, Suite #108
Auburn, CA 95603

re: **PALEONTOLOGY LITERATURE AND RECORDS REVIEW, CALIFORNIA HIGH-SPEED TRAIN: FRESNO - BAKERSFIELD SEGMENT, FRESNO, KINGS, TULARE, AND KERN COUNTIES, CALIFORNIA**

Dear Dr. Haasl,

The Division of Geological Sciences of the San Bernardino County Museum (SBCM) has completed a literature review and records search for the above-named linear project extending from Fresno southwards to Bakersfield, California. The proposed project corridor traverses portions of the following United States Geological Survey 7.5' topographic quadrangle maps:

Allensworth, CA (1969 photorevised edition)
Alpaugh, CA (1969 photorevised edition)
Burris Park, CA (1954 edition)
Conejo, CA (1978 photoinspected edition)
Corcoran, CA (1954 edition)
Delano West, CA (1969 photorevised edition)
Edison, CA (1973 photorevised edition)
Famoso, CA (1968 photorevised edition)
Fresno North, CA (1981 photorevised edition)
Fresno South, CA (1981 photorevised edition)
Gosford, CA (1973 photoinspected edition)
Lamont, CA (1992 edition)
Laton, CA (1953 edition)
Malaga, CA (1981 photorevised edition)
Oil Center, CA (1973 photoinspected edition)
Oildale, CA (1973 photoinspected edition)
Pixley, CA (1969 photorevised edition)
Pond, CA (1973 photoinspected edition)
Remnoy, CA (1954 edition)
Rio Bravo, CA (1973 photoinspected edition)
Rosedale, CA (1973 photoinspected edition)
Taylor Weir (1969 photorevised edition)
Wasco, CA (1973 photoinspected edition)
Waukena, CA (1954 edition)

Previous geologic mapping (Smith, 1964; Matthews and Burnett, 1965) indicates that the proposed project corridor traverses multiple geologic formations, some of which have high potential to contain significant nonrenewable paleontologic resources subject to adverse impact from development-related excavation. These formations include the Riverbank Formation, exposed at the surface in and around the City of Fresno; Pleistocene older alluvium in the vicinity of the City of Bakersfield; and lacustrine (= lake) sediments of Tulare Lake. Additional formations crossed by the proposed project alignment include recent fan and basin alluvium, but these units are too geologically young to have potential to contain significant fossil resources, and so are assigned low paleontologic sensitivity. However, it is important to note that these sediments may overlie older Pleistocene (or older) rock units in the subsurface; where present, these subsurface formations may have high paleontologic sensitivity.

The Riverbank Formation (after Matthews and Burnett, 1965) consists of reddish, semiconsolidated gravels, sands, and silts deposited during the later Pleistocene Epoch. The Riverbank Formation is highly fossiliferous throughout its extent (Jefferson, 1991; Dundas and others, 2009). Fossils identified from the Riverbank Formation include remains of *Paramylodon harlani* (extinct giant ground sloth), *Mammuthus columbi* (extinct Columbian mammoth), *Canis dirus* (extinct dire wolf), *Canis latrans* (coyote), *Equus* sp. (extinct horse), *Camelops hesternus* (extinct large camel), and *Bison* sp. (bison), as well as small mammals including *Scapanus latimanus* (mole), *Thomomys bottae* (gopher), and *Neotoma* sp. (wood rat). The presence of *Bison* is significant, because it indicates a late Pleistocene age for the fossils from this formation, at least in part. Bison first entered North America from the Old World less than 240,000 years ago (Bell and others, 2004; Scott and Cox, 2008). *Bison* is the index taxon for the Rancholabrean North American Land Mammal Age (NALMA), the last land mammal age prior to recent times. Recent studies stating an age of 450,000 to 130,000 for the Riverbank Formation (Dundas and others, 2009) are in close agreement with this age interpretation.

Undifferentiated Pleistocene older alluvium around Bakersfield also has potential to contain significant paleontologic resources, depending upon its lithology. Pleistocene older alluvium from throughout central and southern California has repeatedly been demonstrated to have potential to contain significant fossil resources (e.g., Jefferson, 1991; Scott and Cox, 2008). These Pleistocene sediments may also overlie older rocks of the fossiliferous Kern River Formation; if present in the subsurface, this formation has high paleontologic sensitivity. Terrestrial vertebrate fossils from several localities near the base of the formation were assigned by Savage and others (1954) to the Hemphillian North American Land Mammal Age (NALMA) of the later Miocene Epoch (Bartow and Pittman, 1983; Tedford and others, 1987, 2004). The recorded presence of vertebrate fossils of Miocene age from the Kern River Formation demonstrates the high paleontologic sensitivity of this formation.

Lacustrine sediments of Tulare Lake are also paleontologically sensitive. Gobalet and Fenenga (1993) reported on the presence of fossil remains of late Pleistocene - early Holocene fishes from these sediments, albeit in an archaeological context. Nevertheless, the preservation of these remains demonstrates the potential of these lake beds to contain fossils.

For this review, I conducted a search of the Regional Paleontologic Locality Inventory (RPLI) at the SBCM. The results of this search indicate that no previously-known paleontologic resource localities are recorded by the SBCM from anywhere along the proposed project corridor, nor from within at least one mile of the proposed alignment in any direction.

Recommendations

The results of the literature review and the check of the RPLI at the SBCM demonstrate that excavation in surficial and subsurface sediments of the Riverbank Formation, Pleistocene older alluvium, and lacustrine beds of Tulare Lake – potentially including the Kern River Formation – has high potential to adversely impact significant nonrenewable paleontologic resources. A qualified vertebrate paleontologist must be retained to develop a program to mitigate impacts to nonrenewable paleontologic resources. This mitigation program must be consistent with the provisions of the California Environmental Quality Act (Scott and Springer, 2003), as well as with the proposed guidelines of the Society of Vertebrate Paleontology. This program should include, but not be limited to:

1. Monitoring of excavation into rock units having high potential to contain significant nonrenewable paleontologic resources. Based upon the results of this review, areas of concern would include any and all previously-undisturbed sediments of the Riverbank Formation, Pleistocene older alluvium, and the lacustrine beds of Tulare Lake. If present in the subsurface, sediments of the fossiliferous Kern River Formation would also require monitoring. Paleontologic monitors should be equipped to salvage fossils as they are unearthed, to avoid construction delays, and to remove samples of sediments that are likely to contain the remains of small fossil invertebrates and vertebrates. Monitors must be empowered to temporarily halt or divert equipment to allow removal of abundant or large specimens.

2. Preparation of all recovered specimens to a point of identification and permanent preservation, including washing of sediments to recover small invertebrates and vertebrates. Preparation and stabilization of all recovered fossils are essential in order to fully mitigate adverse impacts to the resources (Scott and others, 2004).

3. Identification and curation of specimens into an established, accredited museum repository with permanent retrievable paleontologic storage. These procedures are also essential steps in effective paleontologic mitigation (Scott and others, 2004) and CEQA compliance (Scott and Springer, 2003). The paleontologist must have a written repository agreement in hand prior to the initiation of mitigation activities. Mitigation of adverse impacts to significant paleontologic resources is not considered complete until such curation into an established museum repository has been fully completed and documented.

4. Preparation of a report of findings with an appended itemized inventory of specimens. The report and inventory, when submitted to the appropriate Lead Agency along with confirmation of the curation of recovered specimens into an established, accredited museum repository, would signify completion of the program to mitigate impacts to paleontologic resources.

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Please do not hesitate to contact us with any further questions you may have.

Sincerely,

Eric Scott, Curator of Paleontology
Division of Geological Sciences
San Bernardino County Museum

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Appendix C

Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontological Resources: Standard Guidelines

ASSESSMENT AND MITIGATION OF ADVERSE IMPACTS TO NONRENEWABLE PALEONTOLOGIC RESOURCES: STANDARD GUIDELINES

Society of Vertebrate Paleontology
Conformable Impact Mitigation Guidelines Committee
Robert E. Reynolds, Chairman

Society of Vertebrate Paleontology News Bulletin Number 163, pages 22-27

February 1995

INTRODUCTION

Vertebrate fossils are significant nonrenewable paleontological resources that are afforded protection by federal, state, and local environmental laws and guidelines. The potential for destruction or degradation by construction impacts to paleontologic resources on public lands (federal, state, county, or municipal) and land selected for development under the jurisdiction of various governmental planning agencies is recognized. Protection of paleontologic resources includes: (a) assessment of the potential for property to contain significant nonrenewable paleontologic resources which might be directly or indirectly impacted, damaged, or destroyed by development, and (b) formulation and implementation of measures to mitigate adverse impacts, including permanent preservation of the site and/or permanent preservation of salvaged materials in established institutions. Decisions regarding the intensity of the Paleontological Resource Impact Mitigation Program (PRIMP) will be made by the Project Paleontologist on the basis of the paleontologic resources, not on the ability of an applicant to fund the project.

ASSESSMENT OF THE PALEONTOLOGICAL POTENTIAL OF ROCK UNITS

Sedimentary rock units may be described as having (a) high (or unknown) potential for containing significant nonrenewable paleontologic resources, (b) low potential for containing nonrenewable paleontologic resources or (c) undetermined potential.

It is extremely important to distinguish between archaeological and paleontological (fossil) resource sites when defining the sensitivity of rock units. The boundaries of archaeological sites define the areal extent of the resource. Paleontologic sites, however, indicate that the containing sedimentary rock unit or formation is fossiliferous. The limits of the entire rock formation, both areal and stratigraphic, therefore define the scope of the paleontologic potential in each case. Paleontologists can thus develop maps which suggest sensitive areas and units that are likely to contain paleontological resources. These maps form the bases for preliminary planning decisions. Lead agency evaluation of a project relative to paleontologic sensitivity maps should trigger a “request for opinion” from a state paleontologic clearing house or an accredited institution with an established paleontological repository.

The determination of a site’s (or rock unit’s) degree of paleontological potential is first founded on a review of pertinent geological and paleontological literature and on locality records of specimens deposited in institutions. This preliminary review may suggest particular areas of known high potential. If an area of high potential cannot be delimited from the literature search and specimen records, a surface survey will determine the fossiliferous potential and extent of the sedimentary units within a specific project. The field survey may extend outside the defined project to areas where rock units are better exposed. If an area is determined to have a high potential for containing paleontologic resources, a program to mitigate impacts is developed. In areas of high sensitivity, a pre-excavation survey prior to excavation is recommended to locate surface concentrations of fossils which might need special salvage methods.

The sensitivity of rock units in which fossils occur may be divided into three operational categories.

High Potential

Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-renewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations which 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 (a) 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. Units which contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas which may contain new vertebrate deposits, traces, or trackways are also classified as significant.

Undetermined Potential

Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials. Field surveys by a qualified vertebrate paleontologist to specifically determine the potentials of the rock units are required before programs of impact mitigation for such areas may be developed.

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. These deposits generally will not require protection or salvage operations.

MEASURES TO MITIGATE ADVERSE IMPACTS RESULTING FROM DEVELOPMENT

Measures for adequate protection or salvage of significant nonrenewable paleontologic resources are applied to areas determined to have a high potential for containing significant fossils. Specific mitigation measures generally need not be developed for areas of low paleontological potential. Developers and contractors should be made aware, however, that it is necessary to contact a qualified paleontologist if fossils are unearthed in the course of excavation. The paleontologist will then salvage the fossils and assess the necessity for further mitigation measures, if applicable.

Areas Of High Potential

In areas determined to have a high potential for significant paleontologic resources, an adequate program for mitigating the impact of development should include:

1. a preliminary survey and surface salvage prior to construction;
2. monitoring and salvage during excavation:
3. preparation, including screen washing to recover small specimens (if applicable), and specimen preparation to a point of stabilization and identification;
4. identification, cataloging, curation, and storage; and
5. a final report of the finds and their significance, after all operations are complete.

All phases of mitigation are supervised by a professional paleontologist who maintains the necessary paleontologic collecting permits and repository agreements. The Lead Agency assures compliance with the measures developed to mitigate impacts of excavation during the initial assessment. To assure compliance with the start of the project, a statement that confirms the site's potential sensitivity, confirms the repository agreement with an established institution, and describes the program for impact mitigation, should be deposited with the Lead Agency and contractors before work begins. The program will be reviewed and accepted by the Lead Agency's designated vertebrate paleontologist. If a mitigation program is initiated early during the course of project planning, construction delays due to paleontologic salvage activities can be minimized or avoided.

RECOMMENDED GENERAL GUIDELINES

These guidelines are designed to apply to areas of high paleontologic potential.

Assessment Before Construction Starts

Preconstruction assessment will develop an adequate program of mitigation. This may include a field survey to delimit the specific boundaries of sensitive areas and pre-excavation meetings with contractors and developers. In some cases it may be necessary to conduct field surveys and/or a salvage program prior to grading to prevent damage to known resources and to avoid delays to construction schedules. Such a program may involve surface collection and/or quarry excavations. A review of the initial assessment and proposed mitigation program by the Lead Agency before operations begin will confirm the adequacy of the proposed program.

Adequate Monitoring

An excavation project will retain a qualified project paleontologist. In areas of known high potential, the project paleontologist may designate a paleontologic monitor to be present during 100% of the earth-moving activities. If, after 50% of the grading is completed, it can be demonstrated that the level of monitoring should be reduced, the project paleontologist may so amend the mitigation program.

Paleontologists who monitor excavations must be qualified and experienced in salvaging fossils and authorized to divert equipment temporarily while removing fossils. They should be properly equipped with tools and supplies to allow rapid removal of specimens.

Provision should be made for additional assistants to monitor or help in removing large or abundant fossils to reduce potential delays to excavation schedules. If many pieces of heavy equipment are in use simultaneously but at diverse locations, each location may be individually monitored.

Macrofossil Salvage

Many specimens recovered from paleontological excavations are easily visible to the eye and large enough to be easily recognized and removed. Some may be fragile and require hardening before moving. Others may require encasing within a plaster jacket for later preparation and conservation in a laboratory. Occasionally specimens encompass all or much of a skeleton and will require moving either as a whole or in blocks for eventual preparation. Such specimens require time to excavate and strengthen before removal and the patience and understanding of the contractor to recover the specimens properly. It is thus important that the contractors and developers are fully aware of the importance and fragility of fossils for their recovery to be undertaken with the optimum chances of successful extraction. The monitor must be empowered to temporarily halt or redirect the excavation equipment away from the fossils to be salvaged.

Microfossil Salvage

Many significant vertebrate fossils (e.g., small mammal, bird, reptile, or fish remains) are too small to be visible within the sedimentary matrix. Fine-grained sedimentary horizons and paleosols most often contain such fossils. They are recovered through concentration by screen washing. If the sediments are fossiliferous, bulk samples are taken for later processing to recover any fossils. An adequate sample comprises 12 cubic meters (6,000 lbs or 2,500 kg) of matrix for each site horizon or paleosol, or as determined by the supervising paleontologist. The uniqueness of the recovered fossils may dictate salvage of larger amounts. To avoid construction delays, samples of matrix should be removed from the site and processed elsewhere.

Preservation Of Samples

Oriented samples must be preserved for paleomagnetic analysis. Samples of fine matrices should be obtained and stored for pollen analysis. Other matrix samples may be retained with the samples for potential analysis by later workers, for clast source analysis, as a witness to the source rock Unit and possibly for procedures that are not yet envisioned.

Preparation

Recovered specimens are prepared for identification (not exhibition) and stabilized. Sedimentary matrix with microfossils is screen washed and sorted to identify the contained fossils. Removal of excess matrix during the preparation process reduces storage space.

Identification

Specimens are identified by competent qualified specialists to a point of maximum specificity. Ideally, identification is of individual specimens to element, genus, and species. Batch identification and batch numbering (e.g., “mammals, 75 specimens”) should be avoided.

Analysis

Specimens may be analyzed by stratigraphic occurrence, and by size, taxa, or taphonomic conditions. This results in a faunal list, a stratigraphic distribution of taxa, or evolutionary, ecological, or depositional deductions.

Storage

Adequate storage in a recognized repository institution for the recovered specimens is an essential goal of the program. Specimens will be cataloged and a complete list will be prepared of specimens introduced into the collections of a repository by the curator of the museum or university. Adequate storage includes curation of individual specimens into the collections of a recognized, nonprofit paleontologic specimen repository with a permanent curator, such as a museum or a university. A complete set of field notes, geologic maps, and stratigraphic sections accompany the fossil collections. Specimens are stored in a fashion that allows retrieval of specific, individual specimens by researchers in the future.

Site Protection

In exceptional instances the process of construction may reveal a fossil occurrence of such importance that salvage or removal is unacceptable to all concerned parties. In such cases, the design concept may be modified to protect and exhibit the occurrence with the project's design, e.g., as an exhibit in a basement mall. Under such circumstances, the site may be declared and dedicated as a protected resource of public value. Associated fragments recovered from such a site will be placed in an approved institutional repository.

Final Report

A report is prepared by the project paleontologist including a summary of the field and laboratory methods, site geology and stratigraphy, faunal list, and a brief statement of the significance and relationship of the site to similar fossil localities. A complete set of field notes, geological maps, stratigraphic sections, and a list of identified specimens accompany the report. The report is finalized only after all aspects of the program are completed. The Final Report together with its accompanying documents constitutes the goals of a mitigation project. Full copies of the Final Report are deposited with the Lead Agency and the repository institution.

Compliance

The Lead Agency assures compliance with measures to protect fossil resources from the beginning of the project by:

1. requesting an assessment and program for impact mitigation which includes salvage and protection during the initial planning phases;
2. by arranging for recovered specimens to be housed in an institutional paleontologic repository; and
3. by requiring the Final Report.

The supervising paleontologist is responsible for:

1. assessment and development of the program for impact mitigation during initial planning phases;
2. the repository agreement;
3. the adequacy and execution of the mitigation measures; and
4. the Final Report.

Acceptance of the Final Report for the project by the Lead Agency signifies completion of the program of mitigation for the project. Review of the Final Report by a vertebrate paleontologist designated by the Lead Agency will establish the effectiveness of the program and adequacy of the report. Inadequate performances in either field comprise noncompliance, and may result in the Lead Agency removing the paleontologist from its list of qualified consultants.

DEFINITIONS

A QUALIFIED VERTEBRATE PALEONTOLOGIST is a practicing scientist who is recognized in the paleontologic community and is proficient in vertebrate paleontology, as demonstrated by:

1. institutional affiliations or appropriate credentials;
2. ability to recognize and recover vertebrate fossils in the field;
3. local geological and biostratigraphic expertise;
4. proficiency in identifying vertebrate fossils; and
5. publications in scientific journals.

A PALEONTOLOGICAL REPOSITORY is a publicly supported, not-for-profit museum or university employing a permanent curator responsible for paleontological records and materials. Such an institution assigns accession and catalog numbers to individual specimens that are stored and conserved to ensure their preservation under adequate security and climate control. The repository will also retain site lists of recovered specimens, and any associated field notes, maps, diagrams, or associated data. It makes its collections of cataloged specimens available to researchers.

SIGNIFICANT NONRENEWABLE PALEONTOLOGIC RESOURCES are fossils and fossiliferous deposits here restricted to vertebrate fossils and their taphonomic and associated environmental indicators. This definition excludes invertebrate or botanical fossils except when present within a given vertebrate assemblage. Certain plant and invertebrate fossils or assemblages may be defined as significant by a project paleontologist, local paleontologist, specialists, or special interest groups, or by Lead Agencies or local governments.

A SIGNIFICANT FOSSILIFEROUS DEPOSIT is 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 and trace fossils generated by vertebrate animals, e.g., trackways, or nests and middens which provide datable material and climatic information). Paleontologic resources are considered to be older than recorded history and/or older than 5,000 years BP.

A LEAD AGENCY is the agency responsible for addressing impacts to nonrenewable resources that a specific project might generate.

PALEONTOLOGIC POTENTIAL is the potential for the presence of significant nonrenewable paleontological resources. All sedimentary rocks, some volcanic rocks, and some metamorphic rocks have potential for the presence of significant nonrenewable paleontologic resources. Review of available literature may further refine the potential of each rock unit, formation, or facies.

PALEONTOLOGIC SENSITIVITY is determined only after a field survey of the rock unit in conjunction with a review of available literature and paleontologic locality records. In cases where no subsurface data are available, sensitivity may be determined by subsurface excavations.

Appendix D

Conditions of Receivership for Paleontological Salvage Collections

CONDITIONS OF RECEIVERSHIP FOR PALEONTOLOGIC SALVAGE COLLECTIONS

Society of Vertebrate Paleontology
Conformable Impact Mitigation Guidelines Committee
Robert E. Reynolds, Chairman

Society of Vertebrate Paleontology News Bulletin Number 166, pages 31-32

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1. The repository museum and its curator maintain the right to accept or refuse the materials.

2. The materials received must fit with the repository museum's mission and policy statements.

3. All repository arrangements must be made with the curator in advance of receipt. All arrangements for inventory numbers and locality numbers must be made in advance. "Museums are not a dumping ground."

4. The museum will act as the trustee for the specimens. A deed of gift from the land owner or agent must be provided. A loan form or M.O.U. must be prepared for specimens from government lands.

5. Specimens must receive discrete locality numbers. Locality data must be to the maximum specificity available and plotted on 7.5 minute topographic maps, and as specific as allowed by stratigraphic collecting and field mapping. The repository may require the repositor to bear the cost of entering locality data into computerized data files.

6. All reports prepared to meet mitigation requirements, field notes, and photographs must be provided at the time of transfer to the repository museum.

7. Specimens must be delivered to the repository fully prepared and stabilized. Standards of stabilization and modern conservation techniques must be established prior to preparation and must be acceptable to the repository institution. Details of stabilizing materials and chemicals must be provided by the repositor. For microvertebrates, this means sorting and mounting. For large specimens, including whales, this means removal of all unnecessary materials and full stabilization. Fossiliferous matrix must be washed and processed. Earthquake-proofing includes inventory numbers on corks and in vials. In storage, specimens must be insulated or cushioned to protect each from contact or abrasion. Oversized specimens must be stored on shelves or on racks developed to fit existing constraints of the repository museum. The repositor must provide for all nonstandard materials for storage.

8. Specimens must be individually inventoried in accordance with the established system at the repository museum. The specimen inventory must be acceptable to and meet the requirements of the lead agency. Specimens must be identified to element and to maximum reasonable taxonomic specificity. Batch or bulk cataloging must be avoided.

9. Specimens must be cataloged in accord with the repository system so that specimens are retrievable to curators and to researchers. The repository museum may require that the

repositor bear the cost of having repository staff catalog specimens into computerized data bases.

10. The repository may require the repositor to bear the cost for completing preparation and stabilization, completing inventory, and completing cataloging.

11. There will be a one-time fee charged by the repository for permanent storage of specimens. This fee will be utilized to compensate the repository for storage space, cabinets or shelves, access or aisle space, a retrievable catalog system, additional preparation, specimen filing, and labor involved in the above. The repository reserves the right to charge the repositor for unpacking and placement of specimens in approved storage cabinets.