4.9 GEOLOGY AND PALEONTOLOGY

4.9.1 INTRODUCTION

This section provides setting information and impact analyses related to geology, seismic safety, soils, and paleontology.

4.9.2 ENVIRONMENTAL SETTING

REGIONAL GEOLOGIC SETTING

The project site is located in the San Joaquin Valley, which forms the southern half of the Central or Great Valley—a large, northwest-trending, sediment-filled trough that extends more than 400 miles from the Tehachapi Mountains in the south to the Cascade Range in the north. The Central Valley is a forearc basin composed of thousands of feet of sedimentary deposits that have undergone alternating periods of subsidence and uplift over millions of years.

The Central Valley basin began to form during the Jurassic period as the Pacific oceanic plate was subducted underneath the adjacent North American continental plate. During the Jurassic and Cretaceous periods of the Mesozoic era (66–206 million years ago), the Central Valley existed in the form of an ancient ocean. By the end of the Mesozoic, the northern portion of the Central Valley began to fill with sediment as tectonic forces caused uplift of the basin. Geologic evidence suggests that the Sacramento Valley and San Joaquin Valley gradually separated into two separate water bodies as uplift and sedimentation continued. By the time of the Miocene epoch (approximately 24 million years ago), sediments deposited in the Sacramento Valley were mostly of terrestrial origin. In contrast, the San Joaquin Valley continued to be inundated with water for another 20 million years, as indicated by marine sediments dated to the late Pliocene (approximately 5 million years ago). By the Pleistocene epoch, the San Joaquin Valley had emerged from the water and was enclosed by the Sierra Nevada to the east and the Coast Ranges to the west (Bartow 1991). Most of the surface of the San Joaquin Valley is covered with Pleistocene and recent (Holocene) alluvium. This alluvium is composed of sediments from the Sierra Nevada to the east and the Coast Ranges to the west, which were carried by water and deposited on the valley floor.

LOCAL GEOLOGIC SETTING

The project site is located approximately 6 miles east of the Sacramento–San Joaquin Delta (Delta), the confluence of the Sacramento and San Joaquin Rivers, which drain the northern third and the southern two-thirds of the Central Valley, respectively. The Stockton area is underlain by sequences of interbedded clay, silt, sand, and gravel deposits as much as 6 miles thick that were deposited both on land and under water during relatively recent geologic times.

During the late Quaternary period the Delta underwent several cycles, related to fluctuations in regional and global climate, in which periods of deposition alternated with periods of subsidence and erosion. Thus, the Delta region during the Pleistocene epoch consisted of wetlands and floodplains created as tidewaters rose in the valley from the west, areas of erosion caused as tidewaters receded, alluvial fans that were reworked by wind to create extensive sand dunes, and alluvial fans from streams flowing down from the adjacent mountain ranges (Atwater 1982, Bartow 1991).

The project site is located within the U.S. Geological Survey (USGS) Stockton East 7.5-Minute Quadrangle. The site's topography is nearly flat, at an elevation of 35–45 feet above mean sea level. The project site is located in Pleistocene-age alluvial deposits of the Modesto Formation (Wagner et al. 1991), as discussed in greater detail below.

In the San Joaquin Valley and at the project site in particular, the Modesto Formation forms alluvial fans of the San Joaquin River and can be divided into upper and lower members. The age of this formation has been placed at approximately 12,000–42,000 years Before Present (B.P.) by Marchand and Allwardt (1981), and 9,000–73,000 years B.P. by Atwater (1982). The upper member is composed primarily of unconsolidated, unweathered, coarse sand and sandy silt. This unit may range in age from 9,000 to 26,000 years B.P. The lower member of the Modesto Formation is composed of consolidated, slightly weathered, well-sorted silt and fine sand, silty sand, and sandy silt. Age estimates for the lower member range from 29,000 to 73,000 years B.P.

The Modesto Formation is underlain by older sediments of Pliocene age (5–9 million years B.P.), which, like the Modesto, consist of consolidated alluvium.

SEISMICITY AND RELATED ISSUES

No active or potentially active faults are located on the project site or project vicinity as mapped under the Alquist-Priolo Earthquake Fault Zone Act (Fugro 2007:7). The Stockton area is subject to seismic shaking from fault features located 20–30 miles west of the city, and, according to the *San Joaquin County General Plan 2010* (San Joaquin County 1992:III.A-7), shaking intensities on these faults may reach Modified Mercalli Intensity IX in Stockton. The Modified Mercalli Scale measures the intensity of physical effects associated with earthquakes. Intensity VIII earthquakes can damage wood frame and masonry structures built before seismic safety regulations and can cause chimneys, towers, columns, monuments, and walls to fall. Intensity IX earthquakes can break underground pipes, damage foundations, and shift buildings off of foundations (Alfors et al. 1973).

The geotechnical report prepared for the project by Fugro West (Fugro) (2007), which is included as Appendix G of this DEIR, documented general geology, faulting, and seismicity data for the project site and vicinity, as well as specific information on regional faulting, seismic activity, and potential ground acceleration associated with seismic events. The findings of the Fugro report are described below.

Faulting and Surface Rupture

Fugro identified 40 potentially active faults considered to be seismic sources within a 63-mile radius of the site. The closest identified “active” fault to the project site is the Great Valley fault, located 20.8 miles to the southwest and with a maximum earthquake magnitude of 6.7. The Great Valley Zone is a relatively recently recognized seismic source, within which faulting is not well defined at the surface; however, numerous earthquakes along the boundary between the Coast Ranges and the Central Valley have been noted since the 1892 Vacaville-Winters earthquake, with approximate Richter magnitudes ranging from 5.5 to 6.4. The zone is considered to comprise thrust faults that do not necessarily cause surface rupture. The most recent significant event within this zone is the 1983 Coalinga earthquake of Richter magnitude 6.7 (moment magnitude of approximately 6.2) (Fugro 2007:7).

Because the project site does not lie within or immediately adjacent to an Alquist-Priolo Earthquake Fault Zone, as described in the discussion of state regulations below (Fugro 2007:7), surface rupture from faulting is not expected to occur.

Ground Acceleration

Based on present knowledge of the geologic conditions within the site, the primary effect of seismic activity would be some degree of ground motion resulting from activity on nearby faults. The most severe ground motion would be expected to occur if there were substantial activity along the Great Valley Zone. Using the Probabilistic Seismic Hazards Assessment (PSHA) Models of the California Geological Survey (2008), there is a 1-in-10 probability that an earthquake will occur within 50 years that would result in a peak horizontal ground acceleration exceeding 0.24*g* for alluvial site conditions (Fugro 2007:12).

Liquefaction and Lateral Spreading

Liquefaction can occur when loose to medium dense, granular, saturated soils, generally located within 50 feet of the surface, are subjected to ground shaking. The site is underlain by medium dense to very dense sands and very stiff to hard silts and, with the exception of some isolated occurrence of perched groundwater, groundwater is greater than 50 feet below ground surface (bgs). Based on the site's soil and groundwater conditions, the soils underlying the site are not considered liquefiable (Fugro 2007:12). Because the potential for liquefaction is low, the potential for lateral spreading of creek, canal, lake, and basin embankments would also be low.

Soil Settlement

During a seismic event, ground shaking can cause soil to become more dense, resulting in settlement of the ground surface. Because the soils underlying the site are typically medium dense to very dense and very stiff to hard, the potential for seismically induced settlement is low (Fugro 2007:13).

MINERALS

The project site is located within the Stockton-Lodi production-consumption region for Portland cement concrete–grade aggregate established by the California Division of Mines and Geology, and is designated as MRZ-1 (CDC 1988:Plate 10). An MRZ-1 designation means that adequate information indicates that no significant mineral deposits are present, or that it is judged that little likelihood exists for their presence.

SOILS

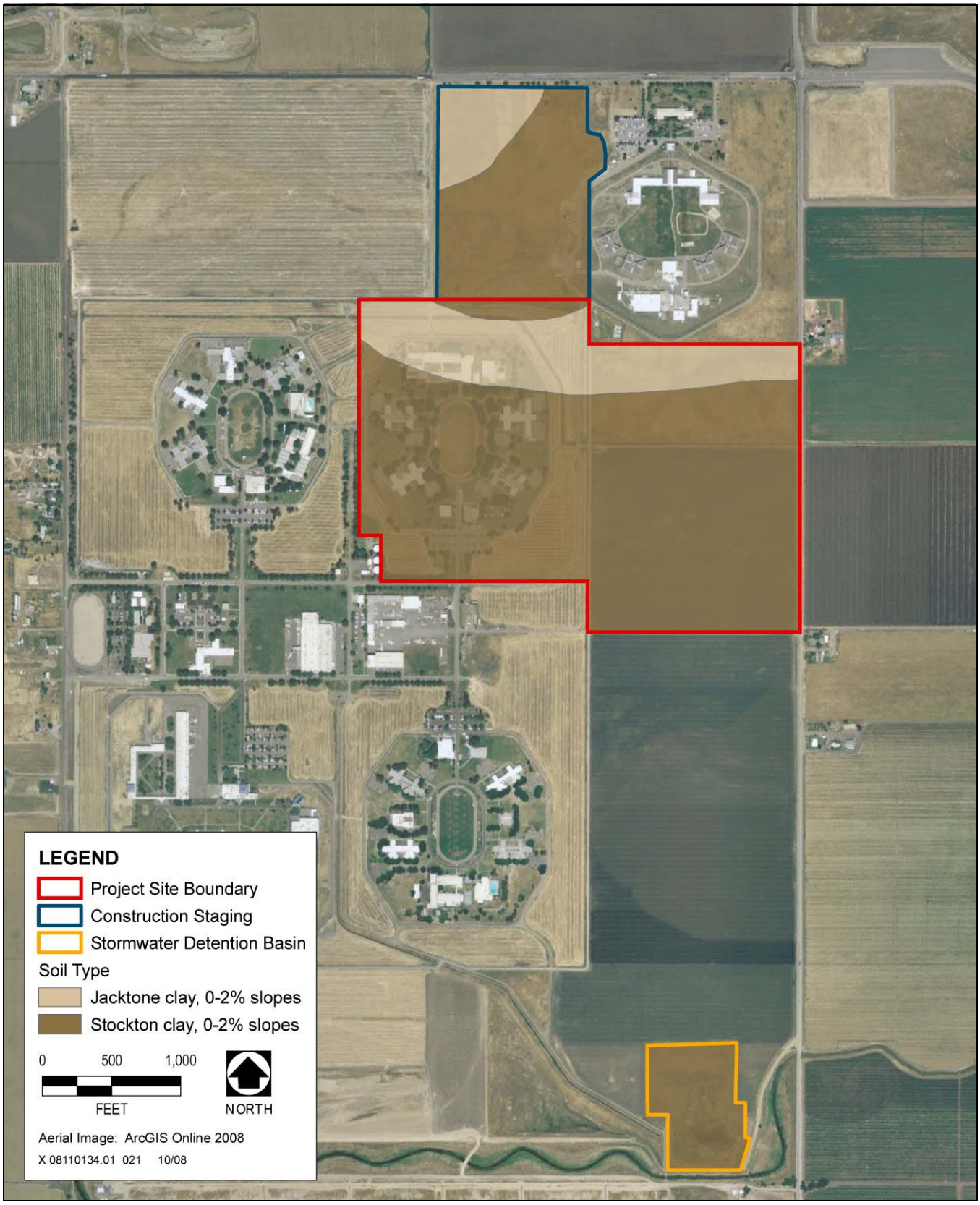
The project site has been modified from its native condition by grading for construction of the existing Karl Holton Youth Correctional Facility, and probably for agricultural purposes before that (Fugro 2007:7). However, native soil types on the project site, identified in Table 4.9-1, are described in the *San Joaquin County Soil Survey* (SCS 1992, 2008). Approximately 21% of the soils on the project site are classified as Jacktone clay and approximately 80% are classified as Stockton clay. As shown in Exhibit 4.9-1, the Jacktone clay soils are located in a band along the northern boundary of the project site, with Stockton clay soils both north and south of the Jacktone. Soils on the project site are typically clayey and deep with moderate to poor drainage and slow permeability. Most soils are subject to high shrink-swell hazards.

Table 4.9-1
Soils Data for the Project Site

Name	Erosion Hazard	Drainage	Permeability	Shrink/Swell Potential	Runoff
180 Jacktone Clay	Slight	Poorly drained	Slow	High	Slow
250 Stockton clay	Slight	Poorly drained	Slow	High	Slow

Sources: SCS 1992, 2008

The geotechnical report (Fugro 2007) addresses geotechnical conditions on the western portion of the project site. The scope of the Fugro investigation included site reconnaissance, literature review, and collection of soils data from 14 borings distributed throughout the project site. The borings ranged from approximately 5 to 75 feet in depth. Piezometers were installed in three of the borings to a depth of 75 feet bgs. Cone Penetrometer Tests were also completed to 75 feet bgs at three locations. The investigation also included laboratory analysis of soil samples and evaluation of the field and laboratory data.



Source: Adapted by EDAW 2008

Soils Map **Exhibit 4.9-1**

Fugro's general conclusion regarding the project site was that it should be suitable to support the proposed project from a geotechnical standpoint. The primary concerns were the shrink-swell (expansion) characteristics of the on-site soils, along with organic content and rodent burrows in surface soils. Fugro presented detailed recommendations for construction on and use of the available site soils.

Fugro found that the subsurface soils consist predominantly of silty sand and lean clay. Groundwater was encountered at about 66–67 feet bgs, or about 37 feet below sea level. Additional detailed soils analysis data are provided in the Fugro report (see Appendix G).

PALEONTOLOGICAL RESOURCES

Inventory of Paleontological Resources

Geologic maps and reports covering the geology of the project site and vicinity were reviewed to determine the exposed rock units and to delineate their respective areal distributions. In addition, published and unpublished geological and paleontological literature was reviewed to document the number and locations of rock units exposed on and near the project site, previously recorded fossil sites from those rock units, and the types of fossil remains each rock unit has produced. The literature review was supplemented by a search of the archives at the University of California Museum of Paleontology (UCMP) in Berkeley, California, on July 18, 2008.

Criteria for Assessing Paleontological Resources

The potential paleontological importance of the project site can be assessed by identifying the paleontological importance of exposed rock units within the project site. Because topographic maps can easily delineate the areal distribution of a rock unit, this method can be used to delineate parts of the project site that are of higher and lower sensitivity for paleontological resources or that may require monitoring during construction.

A paleontologically important rock unit is one that is rated high in potential paleontological productivity and is known to have produced unique, scientifically important fossils. A rock unit exposed at the project site is rated for potential paleontological productivity based on the abundance and densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit on and near the site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit on and near the project site.

An individual vertebrate-fossil specimen may be considered unique or significant if it is identifiable and well preserved and it is one of the following:

- a type specimen (i.e., the individual from which a species or subspecies has been described);
- a member of a rare species;
- a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) in which other species are also identifiable, and important information can be drawn about the life history of individuals;
- a skeletal element different from, or a specimen more complete than, those now available for its species; or
- a complete specimen (i.e., all or substantially all of the entire skeleton is present).

The following tasks were completed by EDAW to establish the paleontological importance of each rock unit exposed at or near the project site:

- The potential paleontological productivity of each rock unit was assessed, based on the density of fossil remains previously documented within the rock unit.
- The potential for a rock unit exposed at the project site to contain a unique paleontological resource was considered.

Inventory of Paleontological Resources and Assessment by Rock Unit

Assessing the fossils of vertebrate mammals has helped researchers to determine the relative age of sedimentary deposits in alluvial fans like those at the project site. Mammals inhabiting the Pleistocene alluvial fan and floodplain included mammoths, horses, mastodons, camels, ground sloths, and pronghorns.

The Pleistocene epoch, known as the "great ice age," began approximately 1.8 million years ago. Surveys of fossils of late-Cenozoic land mammals in northern California have been provided by Hay (1927), Lundelius et al. (1983), Jefferson (1991a, 1991b), Savage (1951), and Stirton (1939). On the basis of his survey of vertebrate fauna from the nonmarine late Cenozoic deposits of the San Francisco Bay region, Savage (1951) concluded that two major divisions of Pleistocene-age fossils could be recognized: the Irvingtonian (older Pleistocene fauna) and the Rancholabrean (younger Pleistocene and Holocene fauna). These two divisions of Quaternary Cenozoic vertebrate fossils are widely recognized today in the field of paleontology. The age of the later Pleistocene, Rancholabrean fauna was based on the presence of bison and on the presence of many species of mammals that inhabit the same area today. In addition to bison, larger land mammals identified as part of the Rancholabrean fauna include mammoths, mastodons, camels, horses, and ground sloths.

Modesto Formation

Remains of land mammals have been found in the project region at various localities in alluvial deposits referable to the Modesto Formation. Jefferson (1991a, 1991b) compiled a database of California late Pleistocene 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. He listed several sites in San Joaquin County that have yielded Rancholabrean vertebrate fossils that could be referable to the Modesto Formation. Jefferson's information corresponds with the records in the UCMP database.

A records search of the UCMP Paleontology Collections database yielded the following information: Locality V-5041 yielded two Pliocene-age horse specimens in sediments that underlie the Modesto Formation approximately 1 mile north-northeast of the project site. These specimens were recovered when a well was drilled. The well drilling operation went through the Modesto Formation and into sediments approximately 3 million years older than the Modesto Formation that underlie the project site at depth.

Locality V-5107, approximately 3 miles southwest of the project site at Mormon Slough, yielded seven specimens from a Rancholabrean-age Columbian mammoth, horse, and unidentified carnivore. Locality V-4822 in Stockton, approximately 10 miles northwest of the project site, yielded a Rancholabrean-age horse specimen. Hay (1927) reported remains of camel, horse, and mammoth at another site in Stockton.

Several fossil specimens from a Columbian mammoth were recovered during construction activities in the *Central Lathrop Specific Plan* area, approximately 11 miles southwest of the project site, from sediments of the Modesto Formation.

Specimens from sediments referable to the Modesto Formation have been reported at other locations throughout the Central Valley (UCMP 2008). For example, UCMP localities V-66150, V-3315, V-4809, V-4810, V-4808, V4819, and V-4807, along the Delta Mendota Canal west of Tracy, yielded numerous specimens from bison,

mammoth, ground sloth, horse, and gopher. In the same area, the Wagner's Aqueduct site, V-70122, yielded three specimens from the class Osteichthyes (bony fishes). Localities V-4804 and V-4867 from the Reiche Gravel Pit, west of the Delta Mendota Canal, yielded three specimens of horse and mammoth remains. Locality V-66150 at the Tracy Gravel Pit yielded a specimen of Jefferson's ground sloth, while locality V-3315 at the Hetch Hetchy Tunnel yielded remains from a Rancholabrean-age camel.

Locality V-81119, along Woodland Avenue near Modesto, yielded one specimen of a Rancholabrean-age camel. Locality V-3959, near the Tuolumne River, yielded one Rancholabrean-age horse specimen. UCMP site V-81120, listed as "North Avenue, Modesto," yielded one specimen of a Rancholabrean-age bison. Locality V-72007, approximately 3 miles north of the Modesto city center, yielded three Rancholabrean-age specimens of Jefferson's ground sloth and mammoth.

In addition, the Tranquility site in Fresno County (UCMP V-4401) has yielded more than 130 Rancholabrean-age fossils of fish, turtles, snakes, birds, moles, gophers, mice, wood rats, voles, jackrabbits, coyote, red fox, grey fox, badger, horse, camel, pronghorn antelope, elk, deer, and bison from sediments referable to the Modesto Formation.

4.9.3 REGULATORY CONSIDERATIONS

FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act (Public Law 95-124) to reduce the risks to life and property from future earthquakes in the United States. The act established the National Earthquake Hazards Reduction Program (NEHRP). This program was significantly amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA) (Public Law 101-614), which refined the description of agency responsibilities, program goals, and objectives.

The mission of the NEHRP is to improve understanding, characterization, and prediction of hazards and vulnerabilities; improve building codes and land use practices; reduce risk through postearthquake investigations and education; develop and improve design and construction techniques; improve mitigation capacity; and accelerate the application of research results. The NEHRPA designates the Federal Emergency Management Agency as the program's lead agency and assigns several planning, coordinating, and reporting responsibilities. Other NEHRPA agencies are the National Institute of Standards and Technology, National Science Foundation, and USGS.

STATE PLANS, POLICIES, REGULATIONS, AND LAWS

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Act (California Public Resources Code, Sections 2621–2630) was passed in 1972 to mitigate the hazard of surface faulting to structures designed for human occupancy. The law's main purpose is to prevent the construction of such structures on the surface trace of active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as "earthquake fault zones" around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected state agencies, counties, and cities for their use in planning efforts. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (Public Resources Code, Sections 2690–2699.6) addresses earthquake hazards from nonsurface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, landslide, strong ground shaking, or other earthquake and geologic hazards. The act also specifies that the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

National Pollutant Discharge Elimination System Permit

In California, the State Water Resources Control Board administers regulations issued by the U.S. Environmental Protection Agency (Title 55, Section 47990 of the Code of Federal Regulations [55 CFR 47990]) that require stormwater-generated pollution to be permitted under the National Pollutant Discharge Elimination System (NPDES). In turn, the board's jurisdiction is administered through nine regional water quality control boards. Under these federal regulations, an operator must obtain a general permit through the NPDES Stormwater Program for all construction activities that would disturb 1 acre or more. The general permit requires the operator to implement best management practices (BMPs) to reduce sedimentation into surface waters and control erosion. One element of compliance with the NPDES permit is preparation of a storm water pollution prevention plan (SWPPP) that addresses control of water pollution, including sediment, in runoff during construction. (See Section 4.6, "Hydrology and Water Quality," for more information about the NPDES and SWPPPs.)

California Building Standards Code

The State of California provides minimum standards for building design through the California Building Standards Code (California Code of Regulations, Title 24). The California Building Code is based on the Uniform Building Code, which is used widely throughout the United States and has been modified for California conditions with numerous more detailed and/or more stringent requirements.

The California Building Standards Commission coordinates, manages, adopts, and approves building codes in California. In July 2007, the commission adopted and published the 2006 International Building Code as the 2007 California Building Code (CBC). This new code became effective on January 1, 2008, and updated all the subsequent codes under Title 24 of the California Code of Regulations.

The state earthquake protection law (California Health and Safety Code, Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. Specific minimum requirements for seismic safety and structural design are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, and Appendix J of the 2007 CBC regulates grading activities, including drainage and erosion control, and construction on unstable soils, such as expansive soils and areas subject to liquefaction.

California Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act (SMARA) (Public Resources Code, Section 2710 et seq.) was enacted by the legislature in 1975 to regulate activities related to mineral resource extraction. The act requires local lead agencies with permitting responsibility for proposed mining projects to prevent adverse environmental effects caused by mining, ensure that mined lands are reclaimed for alternative land uses, and eliminate public health and safety hazards from the effects of mining activities. At the same time, SMARA encourages both the conservation and production of extractive mineral resources, requiring the State Geologist to identify and attach levels of significance to the state's varied extractive resource deposits. Under SMARA, mining operators must

adequately plan for the reclamation of mined sites for beneficial uses and provide financial assurances to lead agencies to guarantee that approved reclamation will actually be implemented.

LOCAL PLANS, POLICIES, REGULATIONS, AND ORDINANCES

San Joaquin County General Plan 2010

The following objectives and policies in the *San Joaquin County General Plan 2010* (San Joaquin County 1992) relating to geology, soils, and mineral resources are applicable to the proposed project.

Public Health and Safety—Seismic and Geologic Hazards

- **Objective 1:** To reduce the risk to life and property and increased governmental cost from potential seismic occurrences.
- **Objective 2:** To minimize the adverse economic, social and physical impacts from geologic hazards.
  - **Policy 1:** The risk to human safety and property from seismic and geologic hazards shall be considered in determining the location and intensity of development and the conditions under which it may occur.
  - **Policy 2:** Facilities necessary for emergency services, major utility lines and facilities, manufacturing plants using or storing hazardous materials, high occupancy structures (such as multifamily residences and large public assembly facilities), and facilities housing dependent populations (such as prison, schools, and convalescent centers) shall not be located within one-eighth mile of any active fault.

Resources—Extractive Resources

- **Objective 1:** To protect extractive resources from urban development or encroachment.
  - **Policy 1:** Mineral deposits of significant quantity, value, or quality, as identified by the State Division of Mines and Geology reports as MRZ-2 Mineral Resource Zones, shall remain in open space uses until extraction of resources, unless the immediate area has been committed to other uses.

City of Stockton General Plan 2035

The following goals and policies in the *City of Stockton General Plan 2035* (City of Stockton 2007) relating to geologic resources are applicable to the proposed project.

Safety—Seismic and Other Geologic Hazards

- **Goal HS-3:** To protect the community from the hazards of expansive soils, seismic dangers, including threats from liquefaction potential of soils, and other geologic activity.
  - **Policy HS-3.1:** The City shall require that new structures intended for human occupancy, public facilities (i.e., treatment plants and pumping stations, major communication lines, evacuation routes, etc.), and emergency/disaster facilities (i.e., police and fire stations, etc.) are designed and constructed to minimize risk to the safety of people due to ground shaking.
  - **Policy HS-3.2:** The City shall require all proposed developments, reconstruction, utilities, or public facilities situated within areas subject to geologic-seismic hazards as identified in the soils engineering and geologic seismic analysis to be sited, designed, and constructed to mitigate the risk associated with the hazard (e.g., expansive, liquefaction, etc.).

- **Policy HS-3.3:** The City shall continue to update a comprehensive study of the potential geologic hazards within the entire planning area. This shall include Flood Insurance elevation zones.

- **Policy HS-3.4:** The City shall require that alterations to existing buildings and all new buildings be built according to the seismic requirements of the Uniform Building Code.

- **Policy HS-3.8:** The City shall not permit any structure for human occupancy to be placed within designated Earthquake Fault Zones (pursuant to and as determined by the Alquist-Priolo Earthquake Fault Zoning Act; Public Resources Code, Chapter 7.5) unless the specific provisions of the Act and Title 14 of the California Code of Regulations have been satisfied.

City of Stockton Grading and Erosion Control Ordinance

Chapter 3, Part V of the City of Stockton Municipal Code requires the project applicant to apply for a grading and erosion control permit. The contents of the application are determined by the City Engineer. In addition to the application, the project applicant must submit pertinent environmental documents, a SWPPP, and site grading plans.

PROFESSIONAL PALEONTOLOGICAL STANDARDS

No federal, state, or local plans, policies, regulations, or ordinances related to paleontological resources are applicable to the proposed project.

The Society of Vertebrate Paleontology (SVP) (1995, 1996), a national scientific organization of professional vertebrate paleontologists, has established standard guidelines that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, specimen preparation, analysis, and curation. Most practicing professional paleontologists in the nation adhere to the SVP assessment, mitigation, and monitoring requirements, as specifically spelled out in its standard guidelines. The criteria for determining sensitivity of paleontological resources are described below under “Significance Criteria.”

4.9.4 IMPACTS AND MITIGATION MEASURES

SIGNIFICANCE CRITERIA

Geology

In accordance with Appendix G of the State *CEQA Guidelines*, an impact of the proposed project related to geology would be considered significant if project implementation would:

- expose people or structures to potential substantial adverse effects including loss or injury from seismic hazards, including earthquake fault rupture, strong seismic ground shaking, liquefaction, or landslides;
- result in substantial soil erosion or loss of topsoil;
- be located on a geologic unit that is unstable or would become unstable as a result of the project;
- be located on expansive soil;
- have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available; or
- result in the loss of availability of known mineral resources that would be of future value to the region.

Paleontological Resources

In its standard guidelines for assessment and mitigation of adverse impacts on paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. Areas where fossils have been previously found are considered to have a high sensitivity and a high potential to produce fossils. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past typically are considered to have low sensitivity. Areas that have not had any previous paleontological resource surveys or fossil finds are considered to be of undetermined sensitivity until surveys and mapping are performed to determine their sensitivity. After reconnaissance surveys, observation of exposed cuts, and possibly subsurface testing, a qualified paleontologist can determine whether the area should be categorized as having high or low sensitivity. In keeping with the significance criteria of the SVP (1995), all vertebrate fossils are generally categorized as being of potentially significant scientific value.

In accordance with Appendix G of the State *CEQA Guidelines*, an impact of the proposed project would be considered significant if project implementation would directly or indirectly destroy a unique paleontological resource or site. For the purposes of this DEIR, a unique resource or site is one that is considered significant if it is identifiable and well preserved, and it is one of the following:

- a type specimen (i.e., the individual from which a species or subspecies has been described);
- a member of a rare species;
- a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) in which other species are also identifiable, and important information can be drawn about the life history of individuals;
- a skeletal element different from or a specimen more complete than those now available for its species; or
- a complete specimen (i.e., all or substantially all of the entire skeleton is present).

The value or importance of different fossil groups varies depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions (such as for a research project). Marine invertebrates are generally common; their fossil record is well developed and well documented, and they would generally not be considered a unique paleontological resource. Identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare.

Issues Not Discussed Further

Because of the site's generally low topographic relief (Fugro 2007:13), and because grading the project site would not create unstable slopes, landsliding is not expected to occur. This issue is not evaluated further in the DEIR.

No sources of potential volcanic hazards exist within the project vicinity, and the project site is some distance from any large body of water, the site would not be exposed to potential tsunami or seiche hazards. These issues are not evaluated further in the DEIR.

Because the proposed project would provide wastewater treatment via a public sewer system, the use of septic tanks or alternative wastewater disposal systems would not be necessary; therefore, there would be no impact, and this issue is not discussed further in this DEIR.

Lastly, because the project site is designated MRZ-1—meaning that adequate information indicates that no significant mineral deposits are present, or that it is judged that little likelihood exists for their presence—and

because the site's soils consist primarily of clay, there would be no impact related to loss of mineral resources, and this issue is not discussed further in this DEIR.

PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT GEO-1 Exposure of People to Injury and Structures to Damage Resulting from Seismic Hazards. *No active or potentially active faults are located on or near the project site, and the project site is not located in an Alquist-Priolo Earthquake Fault Zone. (Less than significant)*

New development could be exposed to ground shaking associated with earthquakes occurring on more distant fault systems, the closest of which is approximately 20 miles west of the project site. Because project design and construction would be required by law to conform to the CBC and other local planning regulations that contain specific design requirements to reduce damage from strong seismic ground shaking. As a result, the potential hazards to people or structures from strong seismic ground shaking would be less than significant. Based on the site's soil and groundwater conditions, the soils underlying the site are not considered liquefiable (Fugro 2007:12). For the same reason, the potential for lateral spreading of creek banks and other embankments is considered low. Therefore, impacts related to damage from seismic activity would be less than significant.

Mitigation Measure(s) for Impact GEO-1:

No significant impacts would occur, so no mitigation measures are required.

IMPACT GEO-2 Location of the Project on Expansive Soils. *The soils on the project site have a high clay content and are subject to development limitations associated with high shrink-swell potential, slow permeability, and low bearing strength. (Significant; less than significant with mitigation)*

Expansive soils shrink and swell as moisture levels change. Over time these volume changes can result in damage to any building foundations, roads, underground utilities, and other structures that are not designed and constructed appropriately to resist the changing soil conditions. Changes in the volume of expansive soils also can result in the consolidation of soft clays after the lowering of the water table or the placement of fill. Placing buildings on unstable soils can result in structural failure.

The Jacktone and Stockton soil associations have a high clay contact and are subject to development limitations associated with high shrink-swell potential, slow permeability, and low bearing strength. This impact would be significant.

Mitigation Measure(s) for Impact GEO-2:

CPR will retain a licensed geotechnical or soils engineer to prepare a soils report for each area of proposed development. The report will identify the site-specific engineering limitations of soils and provide engineering recommendations to reduce potential damage to planned improvements from shrink-swell potential. Recommendations may include actions such as structural enforcement, soil treatment, or replacement of existing soil with engineered fill. CPR will implement all feasible engineering and design recommendations contained in the report consistent with the standards identified in the California Building Code.

All earthwork in each phase of project development will be monitored by a geotechnical or soils engineer retained by CPR. The geotechnical or soils engineer will provide oversight during all excavation, placement of fill, and disposal of materials removed from and deposited on the project site.

Significance after Mitigation

With implementation of the mitigation measure for Impact GEO-2, buildings and structures would incorporate design recommendations of a geotechnical engineer, and on-site monitoring by a geotechnical or soils engineer would provide for appropriate correction in grading activities if unexpected pockets of soils with engineering limitations were encountered. Therefore, implementation of this mitigation measure would reduce the significant impact of possible damage to structures from construction on expansive soils to a less-than-significant level.

IMPACT GEO-3 **Potential for Temporary, Short-term Erosion and Loss of Topsoil.** *Constructing site improvements in preparation for the planned development of medical facilities would extensively disturb an area of approximately 144 acres. Although the project site is relatively flat, construction activities, including demolition, would temporarily disturb soil and expose disturbed areas to storms.* ***(Significant, less than significant with mitigation)***

Constructing site improvements in preparation for the planned development of medical facilities would extensively disturb an area of approximately 144 acres. Although the project site is relatively flat, construction activities, including demolition, would temporarily disturb soil and would expose disturbed areas to storms. Rain of sufficient intensity could dislodge soil particles from the soil surface. Once particles are dislodged and the storm is large enough to generate runoff, localized erosion could occur. In addition, soil disturbance during the summer months could result in loss of topsoil because of wind erosion. This impact would be significant.

Mitigation Measure(s) for Impact GEO-3:

CPR will implement the mitigation measure for Impact HYDRO-1, “Implementation of the project could result in short-term, construction-related impacts on water quality,” as described in Section 4.6, “Hydrology and Water Quality.”

Significance after Mitigation

Implementation of the mitigation measure for Impact HYDRO-1 would reduce the potentially significant short-term, construction-related effects associated with soil erosion and loss of topsoil to a less-than-significant level by requiring preparation and implementation of a SWPPP with appropriate BMPs such as source control, detention basins, revegetation, and erosion control.

IMPACT GEO-4 **Potential Damage to Unknown, Potentially Unique Paleontological Resources.** *The entire project site is underlain by younger Pleistocene-age sediments of the Modesto Formation, which is considered a paleontologically sensitive rock unit under SVP guidelines (1995). The potential exists for damage to vertebrate fossils during construction-related activities, including demolition activities, at the project site.* ***(Significant, less than significant with mitigation)***

The project site is currently developed with the Northern California Youth Correctional Center and agriculture. Project-related earthmoving activities are not expected to be deep enough to encounter Pliocene-age rock formations that could contain fossils.

However, the entire project site is underlain by younger Pleistocene-age sediments of the Modesto Formation, which is considered a paleontologically sensitive rock unit under SVP guidelines (1995). As discussed in detail in Section 4.9.2, “Environmental Setting,” in addition to the three UCMP-recorded vertebrate fossil localities and two unrecorded fossil localities in the project vicinity, specimens from sediments referable to the Modesto Formation have been reported at other locations throughout the Central Valley (UCMP 2008). The fact that vertebrate fossils have been recovered near the project site and other recorded vertebrate fossil localities have been recorded throughout the San Joaquin Valley, and that all have been in sediments referable to the Modesto Formation, suggests that additional similar fossil remains could be uncovered during construction-related

earthmoving activities at the project site. Therefore, vertebrate fossils could be damaged during construction, including demolition, at the project site. This impact would be significant.

Mitigation Measure(s) for Impact GEO-4:

CPR will implement the following measures to minimize potential adverse impacts on unique, scientifically important paleontological resources:

- Before the start of grading, excavation, or demolition, CPR will retain a qualified paleontologist or archaeologist to train all construction personnel involved with earthmoving activities, including the site superintendent, regarding the possibility of encountering fossils, the appearance and types of fossils likely to be seen during construction, and proper notification procedures should fossils be encountered.

- If paleontological resources are discovered during earthmoving activities, the construction crew will be directed to immediately cease work in the vicinity of the find and notify CPR. CPR will retain a qualified paleontologist to evaluate the resource and prepare a mitigation plan in accordance with SVP guidelines (1996). The mitigation plan may include a field survey, construction monitoring, sampling and data recovery procedures, museum storage coordination for any specimen recovered, and a report of findings. Recommendations determined by CPR to be necessary and feasible will be implemented before construction or demolition activities can resume at the site where the paleontological resources were discovered.

Significance after Mitigation

Implementation of the mitigation measure for Impact GEO-4 would reduce potentially significant impacts related to potential damage to unique paleontological resources to a less-than-significant level because construction workers would be alerted to the possibility of encountering paleontological resources, and if resources were encountered, fossil specimens would be recovered and recorded and would undergo appropriate curation.