4.7 GEOLOGY, SOILS, AND PALEONTOLOGICAL RESOURCES

This section evaluates the geology, soils, and paleontological resources impacts of the proposed Plan.

4.7.1 Existing Conditions

GEOLOGY AND SOILS

Geologic Conditions

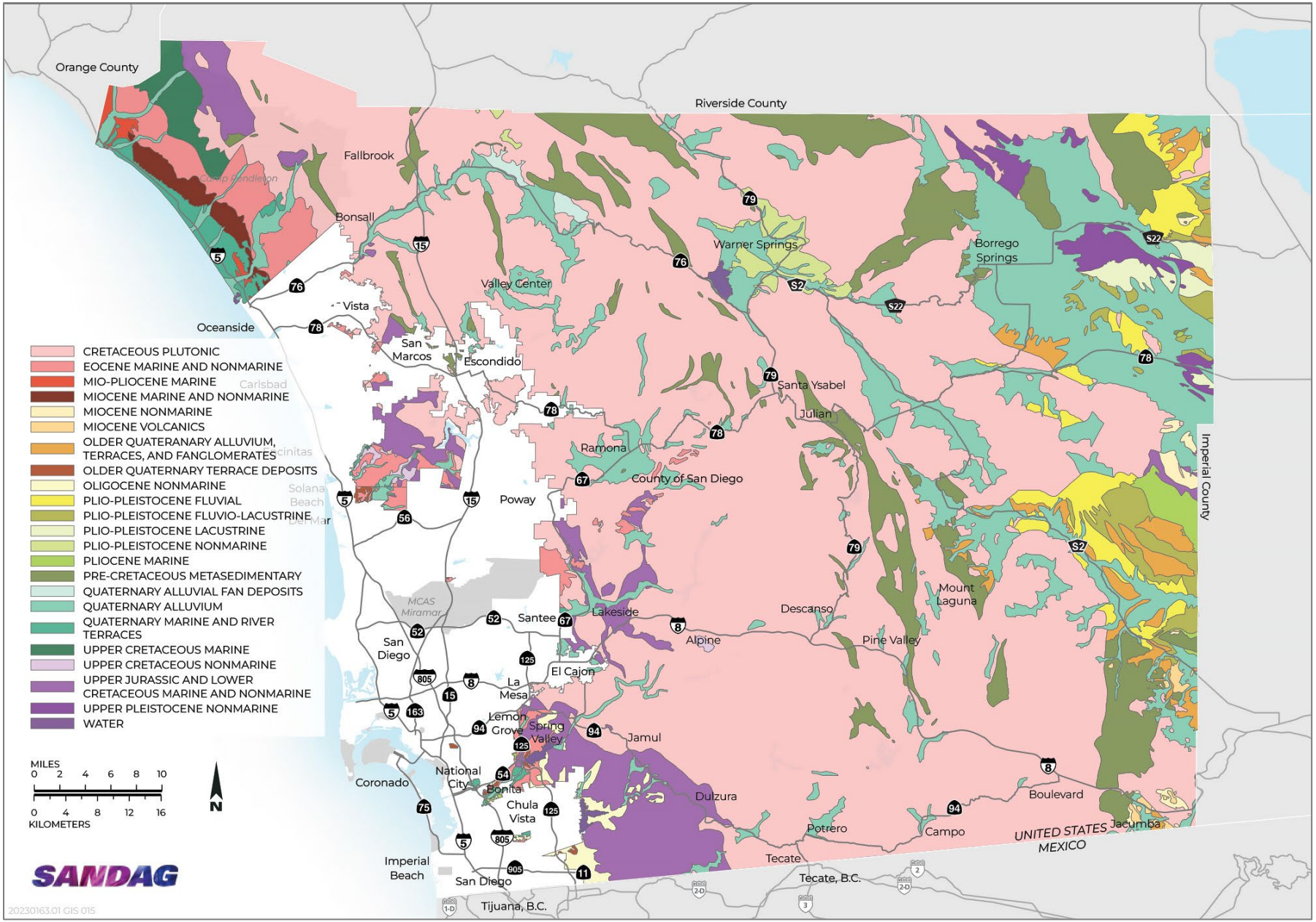
The San Diego region lies across two California geomorphic provinces: (1) the Peninsular Ranges and (2) the Colorado Desert, which contains the Salton Trough. The majority of the region is in the Peninsular Ranges. The Peninsular Ranges encompass an area that roughly extends from the Transverse Ranges and the Los Angeles Basin, south to the Mexico border, and another approximately 775 miles into Mexico forming the Baja California peninsula (Jones et al. 2025). Extending east of Julian and Jacumba, the Peninsular Ranges province abruptly ends along a series of faults. The geomorphic province varies in width from approximately 30 to 100 miles in the San Diego region, most of which is characterized by northwest-trending mountain ranges separated by subparallel fault zones. In general, the Peninsular Ranges are underlain by Jurassic-age metavolcanic and metasedimentary rocks and by Cretaceous-age igneous rocks of the southern California batholith. Geologic cover over the basement rocks in the westernmost portion of the province in the San Diego region generally consists of Upper Cretaceous-, Tertiary-, and Quaternary-age sedimentary rocks (Figure 4.7-1).

Structurally, the Peninsular Ranges are traversed by several major active faults. The Elsinore, San Jacinto, and San Andreas Faults are major active fault systems located northeast of metropolitan San Diego, and the Rose Canyon, San Diego Trough, Coronado Bank, and San Clemente Faults are major active faults located within or west-southwest of metropolitan San Diego. Major tectonic activity associated with these and other faults within this regional tectonic framework is generally right-lateral strike-slip movement. The area to the east of the faults is known as the Salton Trough–Gulf of California depression, which formed during the separation of Baja California from the Mexico mainland. The Salton Trough, being lower than the surrounding landscape, became an area of deposition with sediments being carried to the depressed area by drainages of the Peninsular Ranges and the Colorado River. Occasionally, the Salton Trough was inundated with marine waters from the Gulf of California, adding marine deposits to the sediment (Peterson 1977), and has been repeatedly filled by floods from the Colorado River.

The coastal plain province extends from the western edge of the Peninsular Ranges to the coastline. The coastal plain ranges in elevation from sea level to approximately 600 feet above mean sea level. Most of the incorporated cities in the San Diego region are in the coastal plain. The province is composed of dissected, mesa-like terraces that graduate inland into rolling hills. The terrain is underlain by sedimentary rocks composed mainly of Late Mesozoic, Tertiary, and Quaternary sandstone, shale, and conglomerate beds, reflecting the erosion mountain ranges to the east prior to the uplift of the Peninsular Ranges (Figure 4.7-1) (Peterson 1977).

Seismic Setting

Primarily northwest-to-southeast trending faults traverse Southern California and mark the boundary between the North American and Pacific tectonic plates. The majority of the plate motion is taken up on the San Andreas Fault Zone. The remaining plate motion is taken up by subsidiary faults, many of which are located across the San Diego region and the nearshore Pacific Ocean. These faults have the potential for generating strong ground motions in the San Diego region. Most recorded earthquakes and fault ruptures in Southern California have occurred along faults associated with the San Andreas Fault Zone. The San Andreas Fault Zone and the associated faults that define the plate boundary are called the San Andreas Fault System.



Source: Data downloaded from SanGIS in 2025; adapted by Ascent in 2025.

Figure 4.7-1 Generalized Geologic Map of the Region

The entire San Andreas Fault Zone is more than 800 miles long. In detail, the fault is a complex zone of crushed and broken rock from a few hundred feet to a mile wide (USGS 2016). It is located to the east of the San Diego region, along the east side of the Coachella and Imperial valleys. Since high-magnitude shocks transmit energy over large areas, faults located outside of the San Diego region (such as the San Andreas) can cause ground shaking inside the region during earthquakes. The nearest inhabited sections of the San Diego region are approximately 30 miles from the San Andreas fault.

Known active faults and Alquist-Priolo Fault Zones in the San Diego region are shown on Figure 4.7-2. Earthquakes in the San Diego region occur when the plate motion causes the ground to move in opposite directions on either side of a fault deep in the earth. Most earthquakes in the San Diego region originate at least 10 miles below the ground surface. That movement creates shock waves that move through the ground, causing it to shake. In general, the larger the earthquake, the more intense the ground shaking and the more potential for damage. Because earthquake shaking decreases in intensity with distance from the epicenter of the earthquake, knowing the locations and seismic history of individual faults is important for designing earthquake-resistant structures.

The San Jacinto Fault is the largest of the active faults in the San Diego region. The fault extends 125 miles from the Imperial Valley to San Bernardino. The Elsinore Fault represents a serious earthquake hazard for most of the populated areas of the San Diego region. This fault is approximately 135 miles long and is located approximately 40 miles north and east from Downtown San Diego. The Rose Canyon Fault Zone is an active offshore/onshore fault located partially offshore as part of the Newport/Inglewood Fault Zone and parallels the San Diego north county coastline within approximately 2 to 6 miles until coming ashore near La Jolla Shores. In addition, the La Nacion Fault Zone runs parallel to the Rose Canyon Fault Zone and San Diego Bay, approximately 5 miles inland from the bay (City of San Diego 2024a). Modeling results suggested that rupture along the entire the Newport-Inglewood/Rose Canyon Fault system is possible and would produce a magnitude 7.3 earthquake for rupture of the offshore segments or a magnitude 7.4 if it included the northern onshore segment, which extends to Culver City. The results suggested an even larger magnitude earthquake would result if the southern onshore Rose Canyon Fault Zone, which extends through the San Diego metropolitan area, ruptured as well (DeFrisco 2021).

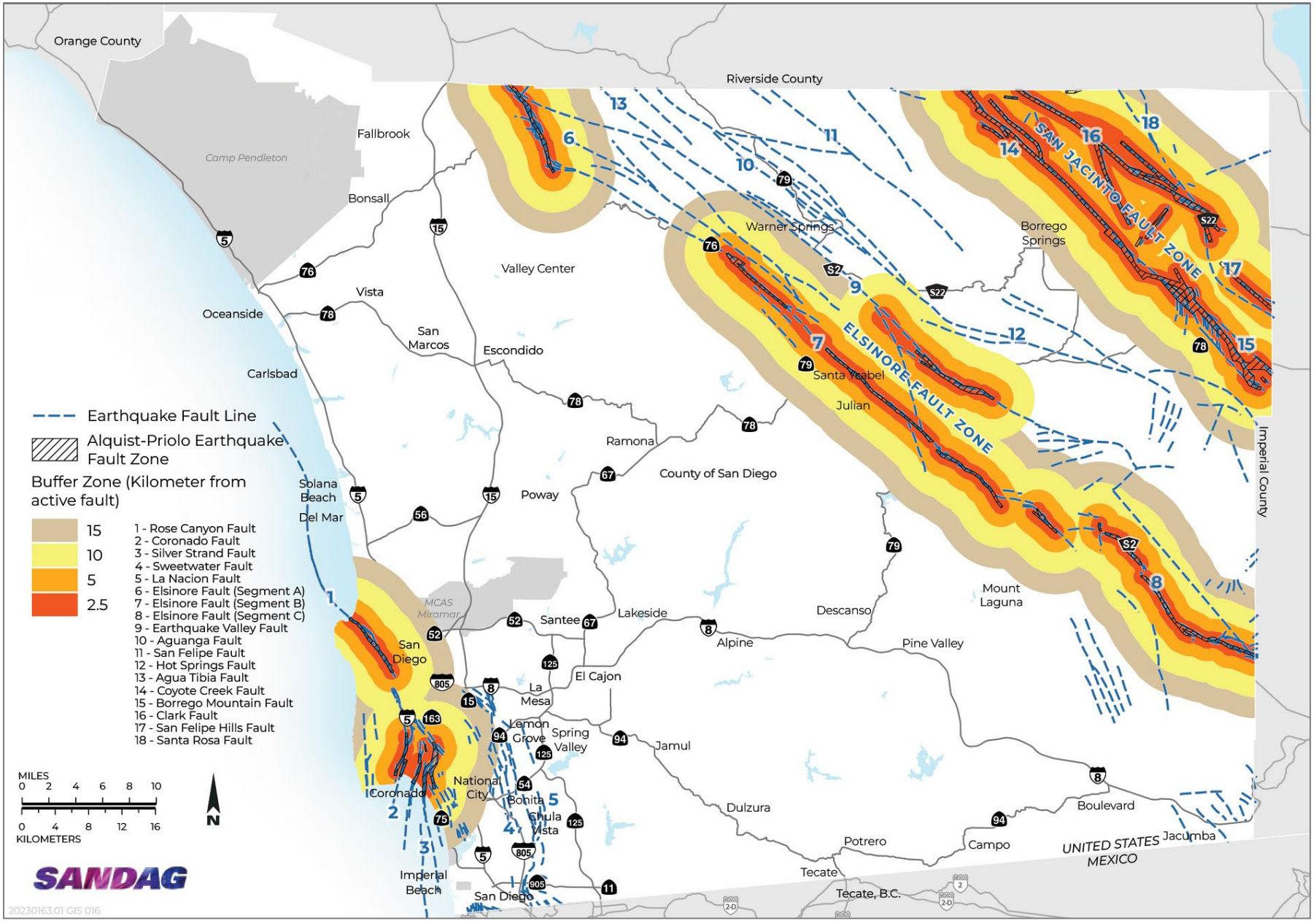
The major offshore fault zones are the San Clemente, San Diego Trough, and Coronado Bank. The San Clemente Fault Zone, located approximately 40 miles off La Jolla, is the largest offshore fault. Tsunamis are a potential hazard associated with seismic setting and fault zones and are described in Section 4.10, "Hydrology and Water Quality."

Fault Rupture

If an earthquake is large enough, the motion on the fault can propagate up to the ground surface. Fault rupture is defined as the breakage of ground along the fault at the intersection of the fault with the earth's surface. Earthquakes can cause large vertical or horizontal displacement of the ground along the fault. Ground rupture can severely damage structures straddling active faults by rupturing foundations or by tilting foundation slabs and walls, as well as damage buried and aboveground utilities. Drinking water can be lost, and the loss of water lines or water pressure can affect emergency services, including firefighting ability. Research of historical earthquakes has shown that, although only a few structures have been ripped apart by fault rupture, this hazard can produce severe damage to structures built across active fault lines (Figure 4.7-2) (California Geological Survey 2018).

Ground Shaking

Ground shaking produces the vast majority of damage in an earthquake. Several factors control how ground motion interacts with structures, making the hazard of ground shaking difficult to predict. Seismic waves propagating through the earth's crust are responsible for the ground vibrations normally felt during an earthquake. Seismic waves can vibrate in any direction and at different frequencies, depending on the content of the earthquake rupture mechanism and the path and material through which the waves are propagating. The earthquake rupture mechanism is the distance from the earthquake source, or epicenter, to an affected site. The potential damage to public and private buildings and infrastructure from seismic ground shaking can threaten public safety and result in significant economic loss.



Source: Data downloaded from SanGIS in 2025; adapted by Ascent in 2025.

Figure 4.7-2 Earthquake Fault Zones and Seismic Conditions

Slope Failure/Landslides

Slope failure, also referred to as mass wasting, is the downslope movement of soil and rock material in response to gravitational stresses. Landslides are the most common naturally occurring type of slope failure in the San Diego region (City of San Diego 2007). The term landslide describes a wide variety of processes that result in the downward and outward movement of slope-forming materials. Landslides are categorized by the type of material (rock or soil), and landslide movement is categorized by the type of movement (falls, topples, slides, or flows). Earthquakes can intensify or activate an unstable slope. Loosely and weakly consolidated soils, steepened slopes caused by either human activities or natural causes, and saturated earth materials create a fragile situation easily affected by an earthquake. Landslides in the San Diego region generally occur in sedimentary rocks, such as sandstone, siltstone, mudstone, and claystone. Heavy rainfall can exacerbate conditions for landsliding. The most common landslides triggered by winter storms are debris flows (popularly called mudslides), which are shallow landslides of water-saturated soil and rock fragments that travel downslope rapidly as muddy slurries. The flowing mud carries rocks, vegetation, and other natural and human-made debris as it rushes down the slopes (USGS 2005).

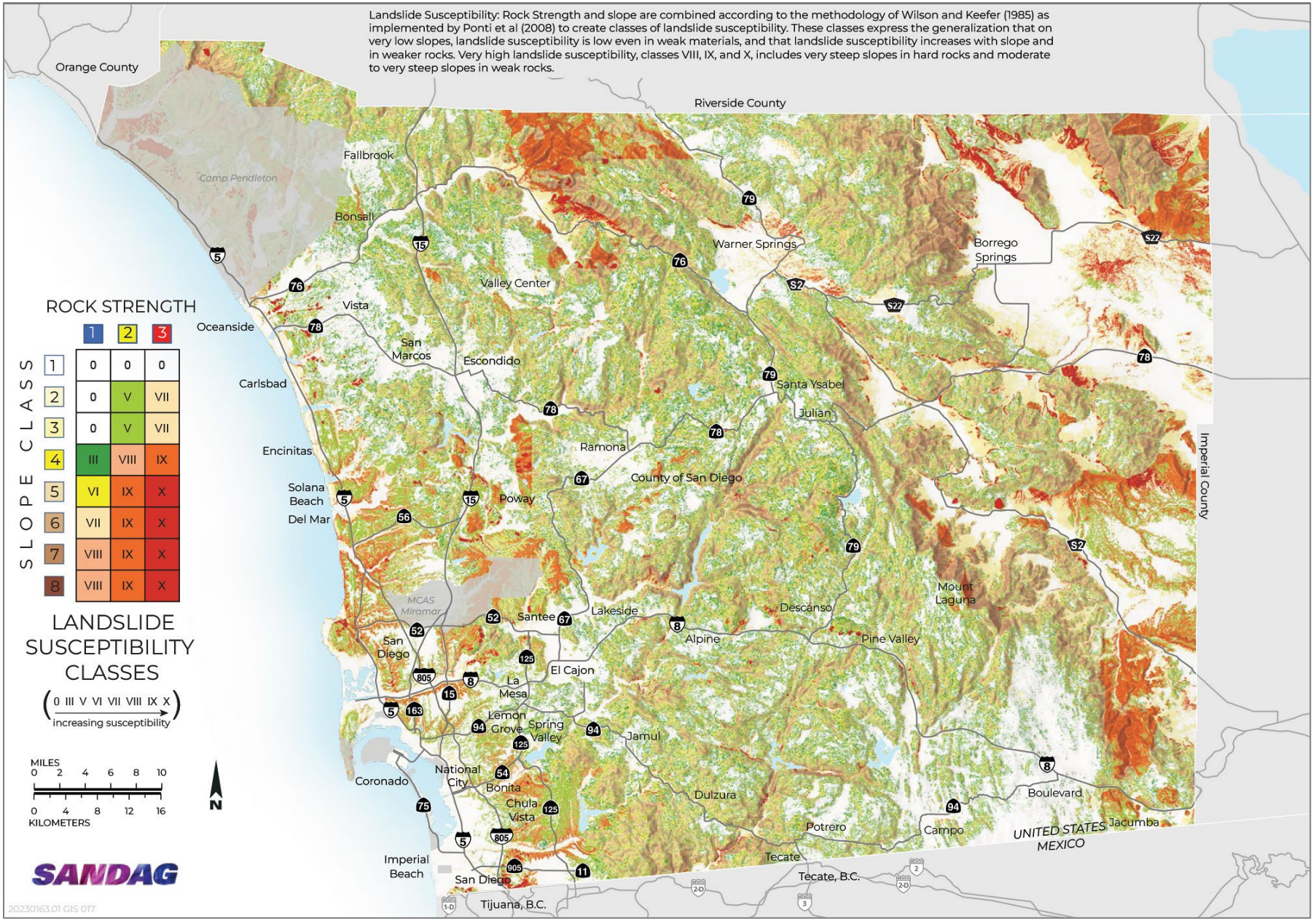
Major landslides have occurred within the incorporated cities of the region that are located on hillside terrain or on coastal bluffs. Previous landslides and landslide-prone sedimentary formations are mostly located in the western portion of the region. Landslides have also occurred in the granitic terrain in the eastern portion of the San Diego region. Reactivations of existing landslides can be triggered by a variety of factors, such as heavy rainfall or irrigation, seismic shaking, and grading (Peterson 1977).

Landslide-susceptible areas are characterized by steep slopes and downslope creep of surface materials. Debris flows consist of a loose mass of rocks and other granular material that, if saturated and present on a steep slope, can move downslope. The rate of rock and soil movement can vary from a slow creep over many years to a sudden mass movement. Landslides occur throughout California, but the density of incidents increases in active fault zones. Slope stability can depend on a number of complex variables. The geology, structure, and amount of groundwater in the slope affects slope failure potential, as do external processes (i.e., climate, topography, slope geometry, and human activity). The factors that contribute to slope movements include those that decrease the resistance in the slope materials and those that increase the stresses on the slope. Slope failure under static forces occurs when the forces initiating failure overcome the forces resisting slope movement. For example, a soil slope may be considered stable until it becomes saturated with water (e.g., during heavy rains or because of a broken pipe or sewer line). Under saturated conditions, the water pressure in the individual pores within the soil increases, reducing the strength of the soil.

Figure 4.7-3 shows the relative likelihood of deep landsliding based on regional estimate of rock strength and steepness of slopes.

Liquefaction

Liquefaction is a phenomenon whereby unconsolidated or near-saturated soils lose cohesion as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary, fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations. Research and historical data indicate that loose granular soils and nonplastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction. Sites underlain by relatively loose sandy soils and saturated deposits of fill combined with a shallow groundwater table, which typically are located in alluvial river valleys/basins, floodplains, beach and bay shorelines, and hydraulic fills, are susceptible to liquefaction. Due to the active faults in the region, and the presence of geologically young, unconsolidated sediments, and hydraulic fills, there is the potential for liquefaction to occur in the San Diego area. The regions of San Diego Bay and vicinity are thought to be especially vulnerable. The potential exists in areas of loose soils and shallow groundwater in earthquake fault zones throughout the San Diego County (County of San Diego 2023). Potential liquefaction areas in the region are shown in Figure 4.7-4. Large areas within the region known to be subject to liquefaction are, for the most part, found in the eastern parts of the region. However, liquefaction-prone areas are also associated with hydraulic fills along the shorelines of San Diego Bay, Mission Bay, and the estuaries along the San Diego coastline.



Source: Data downloaded from SanGIS in 2025 and California Geologic Survey in 2020; adapted by Ascent in 2025.

Figure 4.7-3 Landslide Susceptibility

Expansive Soils

Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When they absorb water, they increase in volume. The more water they absorb, the more their volume increases. Soil volume may expand 10% or more as the clay becomes wet. This change in volume can exert enough force (e.g., 20,000 pounds per square foot or greater) on a building or other structure to cause damage (Colorado Geological Survey 2025).

Expansive soils also shrink when they lose moisture or dry out. This shrinkage can remove support from structures and result in damage when structures are not designed to withstand changing soil pressures. Fissures in the soil can also develop. These fissures can facilitate dispersion of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures. Expansive soils occur throughout the San Diego region. Areas with potential to have expansive soils within the region occur predominately in the coastal plains, an area of dissected marine terraces and uplands. They can also be found in valleys and on slopes in the foothills and mountains of the Peninsular Ranges province and, to a lesser extent, in the desert portions of the San Diego region (Peterson 1977).

Expansive soils primarily consist of clay soils that have a potential for significant volume changes (shrinking and swelling) with moisture fluctuations. According to the National Geologic Map Database's Swelling Clays Map of the conterminous United States, coastal San Diego lies in an area described as "part of the unit, generally less than 50%, consists of clays of slight to moderate swelling potential." The remaining areas of the San Diego region are typically underlain by soils with little or no clays with swelling potential (Olive et al. 1989).

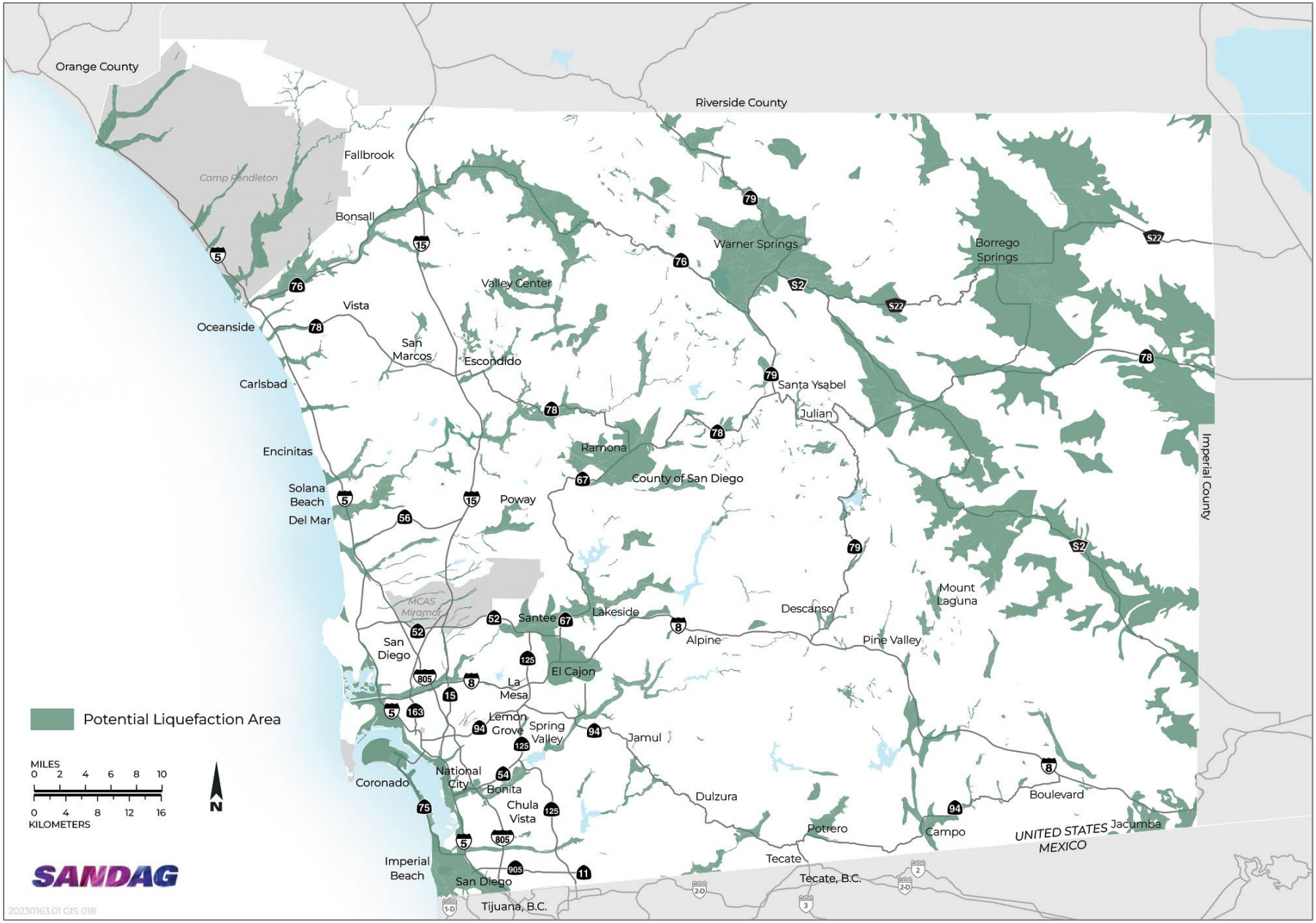
Erosion and Loss of Topsoil

Erosion is defined as a combination of processes in which the materials of the earth's surface are loosened, dissolved, or worn away, and transported from one place to another by natural agents. Erosion potential in soils is influenced primarily by loose soil texture and steep slopes. Steep slopes and bluffs resulting from beachside erosion and wave action are found along the coastal cities in the northern part of the San Diego region, particularly in and near La Jolla Del Mar, Solana Beach, and Encinitas (Kuhn and Shepard 1984). Areas of potential slope failure or high erodibility are potentially hazardous. Loose soils and topsoil can be eroded by water or wind forces, whereas soils with high clay content are generally susceptible only to water erosion. The potential for erosion and loss of topsoil generally increases due to human activity, primarily through construction activities, the development of structures and impervious surfaces, and the removal of vegetative cover (NRCS 2000).

Soil with high amounts of silt can be easily eroded, while sandy soils are less susceptible to erosion. Excessive soil erosion can eventually damage building foundations, roadways, and dam embankments. Erosion is most likely to occur on sloped areas with exposed soil, especially where unnatural slopes are created by cut-and-fill activities. Soil erosion rates can, therefore, be higher during the construction phase. Typically, the soil erosion potential is reduced once the soil is graded and covered with vegetation, concrete, structures, or asphalt.

Septic Systems

Areas not serviced by wastewater districts typically have septic systems, also referred to as on site wastewater treatment systems (OWTS), for wastewater disposal. The most common type of septic system found in the San Diego region consists of a septic tank connected to leach lines (County of San Diego 2025). Areas with OWTS, rather than sewer connections, include the unincorporated county communities of North Mountain, Ramona, Rainbow, San Dieguito, Spring Valley, Sweetwater, Valley Center, Alpine, Bonsall, Fallbrook, Central Mountain, North County Metro, Mountain Empire, Julian, Desert, and Crest/Dehesa.



Source: Data downloaded from SanGIS in 2025; adapted by Ascent in 2025.

Figure 4.7-4 Potential Liquefaction Areas

PALEONTOLOGICAL RESOURCES

Paleontological resources represent a limited, nonrenewable, and impact-sensitive scientific and educational resource. Paleontological resources (i.e., fossils) are defined herein as the remains or traces of prehistoric plant and animal life. Fossils, such as bones, teeth, shells, and leaves, are found in geologic deposits (rock formations) within which they were originally buried. Paleontological resources include not only fossils themselves, but also the associated rocks or organic matter.

Paleontological resources vary widely in their relative abundance and distribution, and not all are regarded as significant. One of the questions listed in the CEQA Environmental Checklist is: "Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?" However, CEQA does not include a definition for "unique paleontological resource." Absent specific agency guidelines, most professional paleontologists in California adhere to guidelines set forth by the Society of Vertebrate Paleontology (SVP), which defines a significant paleontological resources as "fossils and fossiliferous deposits…consisting of identifiable vertebrate fossils, large or small, uncommon invertebrate, plant, and trace fossils, and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information" (SVP 2010).

Known paleontological resources found in regions of moderate to high paleontological sensitivity throughout the San Diego region are presented in Table 4.7-1. San Diego County assigns a high paleontological sensitivity to geologic units known to contain paleontological localities with rare, well-preserved, critical fossil materials for stratigraphic or paleoenvironmental interpretation, and fossils providing information about the paleoclimatic, paleobiological, or evolutionary history (phylogeny) of animal and plant groups (County of San Diego 2009). A moderate paleontological sensitivity is assigned to geologic units known to contain paleontological localities and that have been judged to have a strong, but often unproven, potential for producing unique fossil remains (County of San Diego 2009).

Table 4.7-1 Geologic Units with Moderate or High Potential for Paleontological Resources

Geomorphic Region	Geologic Unit Name	Age	Examples of Previously Documented Paleontological Resources
Coastal Plain Region	Unnamed River Terrace Deposits	Pleistocene	▶ Terrestrial vertebrates (e.g., mammoths, mastodons, deer, bison, camels, tapirs, horses, ground sloths, rodents, birds, lizards, turtles, frogs)
	Unnamed Marine Terrace Deposits	Pleistocene	▶ Marine and estuarine invertebrates ▶ Marine vertebrates
	Bay Point Formation	Pleistocene	▶ Marine invertebrates (e.g., snails, bivalves, crustaceans, echinoderms) ▶ Marine vertebrates (e.g., sharks, rays, bony fish) ▶ Terrestrial vertebrates (e.g., horses, rodents, rabbits, moles, birds, reptiles)
	Lindavista Formation	Pleistocene	▶ Marine invertebrates (e.g., snails, bivalves, echinoderms) ▶ Marine vertebrates (e.g., rays, sharks, dolphins) ▶ Terrestrial vertebrates (e.g., horses, deer, antelopes)
	San Diego Formation	Pliocene	▶ Marine invertebrates (e.g., snails, bivalves, echinoderms) ▶ Marine vertebrates (e.g., whales, dolphins, seals, walruses, sea turtles, rays, sharks, bony fish) ▶ Terrestrial vertebrates (e.g., horses, camels, bovids, rabbits, rodents, skunks, birds, tortoises, snakes, lizards) ▶ Plants (e.g., wood, leaf impressions)

Geomorphic Region	Geologic Unit Name	Age	Examples of Previously Documented Paleontological Resources
	San Mateo Formation	Pliocene to Miocene	▶ Marine invertebrates (e.g., snails, bivalves, shrimp) ▶ Marine vertebrates (e.g., whales, sea cows, dolphins, sharks, rays, bony fish) ▶ Terrestrial vertebrates (e.g., camels, deer, rabbits, birds)
	Capistrano Formation	Pliocene to Miocene	▶ Marine invertebrates (e.g., mollusks, shrimp) ▶ Marine vertebrates (e.g., whales, sea lions, sharks, eels, bony fish) ▶ Terrestrial vertebrates (e.g., camels)
	San Onofre Breccia	Miocene	▶ Marine invertebrates ▶ Terrestrial vertebrates (e.g., tortoises)
	Monterey Formation	Miocene	▶ Marine invertebrates (e.g., bivalves) ▶ Marine vertebrates (e.g., bony fish)
	Otay Formation	Oligocene	▶ Terrestrial vertebrates (e.g., canids, rhinoceroses, camels, rodents, birds, lizards, snakes, tortoises)
	Sweetwater Formation	Eocene	▶ Invertebrates (e.g., snails) ▶ Terrestrial vertebrates (e.g., primates, marsupials, rodents, reptiles, artiodactyls)
	Pomerado Conglomerate	Eocene	▶ Marine invertebrates (e.g., bivalves, snails) ▶ Marine vertebrates (e.g., sharks) ▶ Terrestrial vertebrates (e.g., primates, artiodactyls, tapirs, horses, false saber-toothed cats, marsupials, rodents, birds, crocodiles, tortoises)
	Mission Valley Formation	Eocene	▶ Marine invertebrates (e.g., bivalves, snails, sea urchins) ▶ Marine vertebrates (e.g., sharks, bony fish, sea turtles) ▶ Terrestrial vertebrates (e.g., artiodactyls, camels, primates, marsupials, shrews, rodents, bats, birds, lizards, snakes, crocodiles, tortoises) ▶ Plants (e.g., wood)
	Stadium Conglomerate	Eocene	▶ Terrestrial invertebrates (e.g., snails, bivalves, beetles) ▶ Terrestrial vertebrates (e.g., rodents, marsupials, primates, perissodactyls, artiodactyls, bats, lizards) ▶ Plant (e.g., wood, leaf impressions)
	Friars Formation	Eocene	▶ Marine and estuarine invertebrates ▶ Terrestrial and estuarine vertebrates (e.g., perissodactyls, artiodactyls, rodents, shrews, insectivores, lizards, crocodiles, birds, snakes, turtles, frogs) ▶ Plants (e.g., leaf impressions)
	Scripps Formation	Eocene	▶ Marine and estuarine invertebrates ▶ Marine and estuarine vertebrates (e.g., sharks, rays, bony fish, crocodiles) ▶ Terrestrial vertebrates (e.g., brontotheres, rhinoceros, extinct hyenas, rodents, snakes, lizards, turtles) ▶ Plants (e.g., wood)

Geomorphic Region	Geologic Unit Name	Age	Examples of Previously Documented Paleontological Resources
	Santiago Formation	Eocene	▶ Marine invertebrates (e.g., bivalves, snails, crustaceans, echinoderms) ▶ Terrestrial vertebrates (e.g., opossums, insectivores, bats, prosimian primates, miacid and creodont carnivores, tapirs, brontotheres, amynodonts, protoreodonts, leptoreodonts, birds, snakes, lizards, turtles, crocodiles) ▶ Plants (e.g., leaf impressions)
	Ardath Shale	Eocene	▶ Marine invertebrates (e.g., bivalves, snails) ▶ Marine vertebrates (e.g., sharks, rays, bony fish)
	Torrey Sandstone	Eocene	▶ Marine invertebrates ▶ Marine and estuarine vertebrates (e.g., sharks, rays, bony fish, crocodiles) ▶ Terrestrial vertebrates (e.g., rodents, birds, lizards) ▶ Plants
	Delmar Formation	Eocene	▶ Marine vertebrates (e.g., sharks, rays, bony fish) ▶ Terrestrial vertebrates (e.g., tillodonts, rhinoceroses, rodents, turtles)
	Mount Soledad Formation	Eocene	▶ Marine invertebrates (e.g., bivalves, snails, echinoderms) ▶ Plants (e.g., pollen)
	Unnamed Formation	Eocene	▶ Terrestrial vertebrates (e.g., teeth) ▶ Plants (e.g., leaf impressions)
	Cabrillo Formation	Cretaceous	▶ Marine invertebrates (e.g., bivalves, snails, ammonites) ▶ Marine vertebrates (e.g., sharks, turtles)
	Point Loma Formation	Cretaceous	▶ Marine invertebrates (e.g., bivalves, gastropods, ammonites, crabs, sea urchins) ▶ Marine vertebrates (e.g., mosasaurs, sharks, fish, sea turtles, eels) ▶ Terrestrial vertebrates (e.g., ankylosaurs and hadrosaurs) ▶ Plants (e.g., leaf impressions)
	Lusardi Formation	Cretaceous	▶ No identifiable fossils have been previously recovered; however, significant terrestrial vertebrate fossils may be present based on the age and depositional setting.
	Santiago Peak Volcanics*	Jurassic	▶ Marine invertebrates (e.g., belemnites, ammonites, bivalves) ▶ Plant (e.g., permineralized wood)
Peninsular Ranges Region	Older Quaternary Alluvial and Alluvial Fan Deposits	Pleistocene	▶ Terrestrial vertebrates (e.g., horses)
	Pauba Formation	Pleistocene	▶ Terrestrial vertebrates (e.g., mammoths, camels, horses, rodents, shrews, birds, reptiles)
	Temecula Arkose	Pleistocene to Pliocene	▶ Terrestrial vertebrates
	Jacumba Volcanics*	Miocene	▶ Terrestrial vertebrates (e.g., rodents)
	Table Mountain Gravels	Miocene	▶ Terrestrial vertebrates (e.g., pigs, camels, deer)
	Santiago Peak Volcanics*	Jurassic	▶ Marine invertebrates (e.g., belemnites, ammonites, bivalves) ▶ Plants (e.g., permineralized wood)

Geomorphic Region	Geologic Unit Name	Age	Examples of Previously Documented Paleontological Resources
Salton Trough Region	Later Quaternary Alluvium	Holocene	▶ Subfossils from the Lake Cahuilla beds (e.g., freshwater invertebrates, bony fish)
	Older Terrace, Fanglomerates, and Valley Fill Alluvium	Holocene to Pleistocene	▶ Terrestrial vertebrates (e.g., horse)
	Brawley Formation	Pleistocene	▶ Freshwater invertebrates (e.g., bivalves) ▶ Freshwater vertebrates (e.g., bony fish)
	Ocotillo Conglomerate	Pleistocene	▶ Freshwater invertebrates (e.g., mollusks) ▶ Terrestrial vertebrates ▶ Plants
	Borrego Formation	Pleistocene	▶ Freshwater invertebrates (e.g., bivalves, ostracod) ▶ Freshwater vertebrates (e.g., bony fish)
	Canebrake Conglomerate	Pleistocene to Pliocene	▶ No identifiable fossils have been previously recovered; however, significant terrestrial vertebrate fossils may be present based on the age and depositional setting.
	Palm Springs Formation	Pleistocene to Pliocene	▶ Terrestrial vertebrates (e.g., ground sloths, camels, llamas, horses, tapirs, jaguars, wolves, bears, rodents, rabbits, shrews, bats, birds, snakes, lizards, tortoises, frogs)
	Imperial Formation	Pliocene to Miocene	▶ Marine invertebrates (e.g., corals, bivalves, gastropods, crabs, sea urchins) ▶ Marine vertebrates (e.g., whales, dolphins, walruses, sea cows, sharks, rays, bony fish)
	Split Mountain Formation	Pliocene to Miocene	▶ Marine invertebrates
	Alverson Volcanics	Miocene	▶ Terrestrial vertebrates (e.g., rodents, unknown mammal and vertebrate bone fragments)

Source: County of San Diego 2009, 2011a; City of San Diego 2007, 2024a; San Diego Natural History Museum 2025; University of California Museum of Paleontology 2025.

*Only the metasedimentary portions of the Santiago Peak Volcanics and volcaniclastic/sedimentary portions of the Jacumba Volcanics have a moderate or high potential for paleontological resources.

UNIQUE GEOLOGIC FEATURES

A unique geologic feature may be the best example of its kind locally or regionally; it may illustrate a geologic principle, it may provide a key piece of geologic information, it may be the "type locality" of a fossil or formation, or it may have high aesthetic appeal. Unique geologic features may be exposed or created from natural weathering and erosion processes or from human-made excavations. These unique geological features provide aesthetic, scientific, educational, and recreational value. Unique geological features throughout the San Diego region were documented in the 1975 San Diego County General Plan. This inventory from the 1975 General Plan is listed in Table 4.7-2 and provides more detailed information than the more recent General Plan Update adopted in 2011.

Table 4.7-2 Unique Geologic Features

Unique Geological Features	Location
Indian Mountain Leucogranodiorite	Banks of San Luis Rey River, a few miles southwest of Pala
Pliocene San Mateo Formation	Along San Mateo Creek
San Onofre Breccia	San Onofre Hills
Monterey Shale	Along sea cliffs southeast of San Onofre
Bonsall Tonalite	Bonsall, west central San Luis Rey Quad
Petrified forest with logs in exposures of the prebatholithic volcanics and sedimentary rocks containing leaf imprints	Lusardi Canyon near Rancho Santa Fe near junction with San Dieguito River
Prebatholithic folded slates	Lusardi Canyon near Rancho Santa Fe near junction with San Dieguito River
The Lusardi Formation consisting of a conglomerate unit	Lusardi Canyon near Rancho Santa Fe near junction with San Dieguito River
Lake Wohlford Leucogranodiorite	Lake Wohlford, between Escondido and Lake Wohlford
San Marcos Gabbro	San Marcos Mountains, San Luis Rey Quad
Woodson Mountain Granodiorite	Woodson Mountain, a few miles southwest of Ramona
Swarm of distinctly oriented inclusion in Lakewood Mountain Tonalite composing outer ring dike; core is Green Valley Tonalite	East of Ramona
Area of prebatholic metamorphics, quartzite exhibiting swirls of magnitite and biotite, which may represent relic crossbedding	Vicinity Highway 78 and San Pasqual
Green Valley Tonalite	Southeast San Luis Rey Quad; Green Valley between State Route (SR) 395 and Ramona
Elsinore Fault, canyon eroded along fault, and tributaries offset in a right-lateral sense; typical exposure of Julian Schist	Julian, Santa Ysabel Quadrangle
Split Mountain Formation	Split Mountain Gorge, south of Ocotillo, west side of Imperial Valley
Localities indicating age of peak volcanics: at (a) Buchia piochii belemnoids, and ammonite were found; at (b) there are belemnoids, flame structures, flute castes, and graded bedding	(a) Los Peñasquitos; (b) San Santiago Dieguito, vicinity of San Dieguito River
Eocene vertebrate fossil locality	Bank of San Diego River near Grantville
Eocene vertebrate fossil locality	Bank of San Diego River near Friars Road and Ulric Street
Exposures of fossiliferous Eocene and Pliocene strata; the Pliocene rocks are preserved by down faulting and contain sharks teeth, whale bones, and delicate *Glottidia albida*	Tecolote Creek
Bay Point Formation	West shore of Bay Point Mission Bay
Type area of the Rose Canyon	Shale Rose Canyon
Eocene foraminifera area	Old Murray Canyon Quarry
Green Eocene mudstones, containing large leaf imprints, petrified logs, and pelecypod molds	Black Mountain
Black Mountain Volcanics, greenstones with primary structures; quartzose pseudomorphs of gastropods	Black Mountain
Exposure of San Diego Formation containing whole bones and sharks teeth	Vicinity of Miramar Reservoir
Type locality of Spatangus rarus Israelsky; known only from type locality	Pacific Beach
Type localities of Pecten (patinopecten) healeyi, Pecten (Pecten) stearsi, Pecten (argopecten) subdolus, and Pecten (Pecten) bellus hemphilli	Pacific Beach

Unique Geological Features	Location
Delmar Formation	Sea cliff and short canyon in Del Mar
Mount Soledad Formation	West of intersection of Ardath Road and I-5
Mission Valley Formation	South wall of Mission Valley on west side of SR 163 at the junction of I-8
Stadium Conglomerate	North wall of Mission Valley west of Murphy Canyon Road from Friars Road
Scripps Formation	Torrey Pines Grade
Friars Formation	North wall of Mission Valley along Friars Road
Torrey Sandstone	Torrey Pines Grade
Ardath Shale	East side of Rose Canyon south of intersection of Ardath Road and I-5
Exposures of Santiago Peak Volcanics showing unique stratigraphic and structural relationships between many units typical of formation; also, type locality when first named Black Mountain Volcanics	North of Black Mountain, La Jolla Quadrangle
Exposure of an old "unnamed" fanglomerate composed of metamorphic rocks, one of the highest surfaces of the "high terrace" cut into Stadium Conglomerate, and a "contact breccia" migmatite zone	Vicinity of I-8, west of San Vicente Reservoir
Basal contact of Ballena Gravels eastward; mechanically just folded border of Woodson Mountain Granodiorite against narrow screen of metamorphic rocks and banded structures in gabbro on other side	Vicinity of Wildcat Canyon Road sloping just east of San Vicente Creek
An unusual occurrence of dumortierite, similanite, and associated minerals	Dehesa Toad and Tavern Road, Alpine
An unusual occurrence of orbicular gabbro	Dehesa Road west of the Harbison Canyon Road intersection Alpine
Prebatholithic metavolcanics, in selected places coarse pyroclastic and blastoporphyritic fabrics as well as original bedding are visible; often very gneissic	Vicinity of I-8 south of Lake Jennings
Mixed and roof pendants in the prebatholithic metavolcanics	Vicinity of La Cresta Road, El Cajon
Contact of Woodson Mountain Granodiorite and Green Valley Tonalite	Vicinity of La Cresta Road, El Cajon
Roof pendant of metavolcanics in the Green Valley Tonalite	Vicinity of San Diego River west of El Capitan Reservoir
Stonewall Quartz Diorite	Stonewall Peak in Cuyamaca Region
Exposure of Bay Point Formation fauna	Vicinity of the U.S./Mexico border, 1/4 mile from the coast
Pliocene San Diego Formation fossils	Vicinity of the U.S./Mexico border, 2 miles from the coast
Cabrillo Formation	Sea cliff in Point Loma
Point Loma Formation	Along Point Loma Peninsula at southern end
La Posta Quartz Diorite	La Posta Valley
Stratigraphic relationship between Jacumba volcanic rock (Alverson Andesite) and "Table Mountain Gravels" and reworked younger gravels	West of Jacumba

Note: I = Interstate; SR = State Route.

Source: County of San Diego 1975.

4.7.2 Regulatory Setting

FEDERAL LAWS, REGULATIONS, PLANS, AND POLICIES

Earthquake Hazards Reduction Act

In 1977, Congress passed the Earthquake Hazards Reduction Act (EHRA, amended 2004) (Public Law 95-124) establishing the National Earthquake Hazards Reduction Program as a long-term earthquake risk reduction program for the United States. The program initially focused on research, led by the USGS and National Science Foundation, toward understanding and ultimately predicting earthquakes. The current program activities are focused on four broad areas:

- Developing effective measures to reduce earthquake hazards.
- Promoting the adoption of earthquake hazard reduction activities by federal, state, and local governments; national building standards and model building code organizations; and engineers, architects, building owners, and others who play a role in planning and constructing buildings, bridges, structures, and critical infrastructure or "lifelines."
- Improving the basic understanding of earthquakes and their effects on communities, buildings, structures and lifelines through interdisciplinary research involving engineering; natural sciences; and social, economic, and decision sciences.
- Developing, operating, and maintaining the Advanced National Seismic Research and Monitoring System, established under section 13 of EHRA of 1977 (42 U.S. Code [USC] 7707), the George E. Brown Jr. Network for Earthquake Engineering Simulation established under section 14 of that act (42 USC 7708), and the Global Seismographic Network.

U.S. Geological Survey Landslide Hazard Program

The USGS created the Landslide Hazard Program in fulfillment of the requirements of Public Law 106-113 (1999). The primary objective of the program is to reduce long-term losses from landslide hazards by improving the understanding of the causes of ground failure and suggesting mitigation strategies. The federal government takes the lead role in funding and conducting this research, whereas the reduction of losses due to geologic hazards is primarily a state and local responsibility.

Antiquities Act of 1906

The Antiquities Act of 1906 (16 USC 431–433) states, in part:

> That any person who shall appropriate, excavate, injure or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States, without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, shall upon conviction, be fined in a sum of not more than five hundred dollars or be imprisoned for a period of not more than ninety days, or shall suffer both fine and imprisonment, in the discretion of the court.

Although there is no specific mention of natural or paleontological resources in the act itself, or in the act's uniform rules and regulations (Code of Federal Regulations [CFR] Title 43, Part 3), the term "objects of antiquity" has been interpreted to include fossils by the National Park Service, the Bureau of Land Management, the Forest Service, and other federal agencies. Permits to collect fossils on lands administered by federal agencies are authorized under this act. However, due to the large gray areas left open to interpretation due to the imprecision of the wording, agencies have moved away from reliance on the act for governing paleontological resources (Congressional Research Service Report for Congress 1998).

Archaeological and Paleontological Salvage

The Archaeological and Paleontological Salvage Statute (23 USC 305) amends the Antiquities Act of 1906. Specifically, it states:

> Funds authorized to be appropriated to carry out this title to the extent approved as necessary, by the highway department of any State, may be used for archaeological and paleontological salvage in that state in compliance with the Act entitled "An Act for the preservation of American Antiquities," approved June 8, 1906 (Pub. L. 59-209; 16 USC 431–433), and State laws where applicable.

This statute allows funding for mitigation of paleontological resources recovered pursuant to federal aid highway projects, provided that "excavated objects and information are to be used for public purposes without private gain to any individual or organization" (FHWA 1981).

Paleontological Resources Preservation Act

The Paleontological Resources Preservation Act (PRPA) (Title VI, Subtitle D in the Omnibus Public Lands Act of 2009, Public Law 111-011) establishes that the Secretary of Interior and Secretary of Agriculture must manage and protect paleontological resources on federal land using scientific principles and expertise. With the passage of the PRPA, Congress officially recognized the importance of paleontological resources on federal lands owned by U.S. Department of the Interior and U.S. Department of Agriculture by declaring that fossils from federal lands are federal property that must be preserved and protected using scientific principles and expertise. The PRPA provides:

- uniform definitions for "paleontological resources" and "casual collecting"
- uniform minimum requirements for paleontological resource use permit issuance (terms, conditions, and qualifications of applicants), uniform criminal and civil penalties for illegal sale and transport, and theft and vandalism of fossils from Federal lands
- uniform requirements for curation of federal fossils in approved repositories

STATE LAWS, REGULATIONS, PLANS, AND POLICIES

Alquist-Priolo Earthquake Fault Zoning Act

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (renamed in 1994), Public Resources Code (PRC) Section 2621 et seq., is "to regulate development near active faults so as to mitigate the hazard of surface fault rupture." The state geologist and chief of the Division of Mines and Geology (DMG) is required to delineate Alquist-Priolo Earthquake Fault Zones (formerly known as "Alquist-Priolo Special Studies Zones") along known active faults. As defined by the DMG, an active fault is one that has had surface displacement within Holocene time (roughly the last 11,000 years) or has an instrumental record of seismic activity. Potentially active faults are those that show evidence of surface displacement during Quaternary time (roughly the last 2 million years), but for which evidence of Holocene movement has not been established. The DMG evaluates faults on an individual basis to determine whether a fault will be classified as an Alquist-Priolo Earthquake Fault Zone. In general, faults must meet certain DMG criteria, including seismic activity, historic rupture, and geologic evidence to be zoned as an Alquist-Priolo Earthquake Fault Zone. Cities and counties affected by the zones must regulate certain development within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. Typically, structures for human occupancy are not allowed within 50 feet of the trace of an active fault. If a property within a zone is not currently developed, a fault study may be required prior to the subdivision of the property or prior to any structure being permitted on the property.

Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act (SHMA) of 1990 (PRC Sections 2690–2699.6) directs the California Geological Survey to identify and map areas prone to earthquake hazards of liquefaction, earthquake-induced landslides, and amplified ground shaking. The purpose of the SHMA is to reduce the threat to public safety and to minimize the loss

of life and property by identifying and mitigating these seismic hazards. The SHMA was passed by the legislature following the 1989 Loma Prieta earthquake. Staff geologists in the Seismic Hazard Mapping Program gather existing geological, geophysical, and geotechnical data from numerous sources to compile the Seismic Hazard Zone Maps. They integrate and interpret these data regionally to evaluate the severity of the seismic hazards and designate Zones of Required Investigation for areas prone to liquefaction and earthquake-induced landslides and determine whether structural design or modification of the project site is necessary to ensure safer development. Site-specific geotechnical investigations are conducted to identify and evaluate seismic hazards and formulate mitigation measures prior to permitting most development designed for human occupancy. Cities and counties are then required to use the Seismic Hazard Zone Maps in their land use planning and building permit processes.

California Building Code

The California Building Code (CBC) is updated every 3 years. The most recent update to CBC was in 2022, with the code becoming effective on January 1, 2023. Chapter 16A, Division IV of the CBC, titled "Structural Design," states that the "purpose of the earthquake provisions herein is primarily to safeguard against major structural failures or loss of life." The CBC regulates the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system height, and seismic zoning. Seismic zones are mapped areas that are based on proximity to known active faults, the potential for future earthquakes, and the potential intensity of seismic shaking. Seismic zones range from 0 to 4, with areas mapped as Zone 4 being potentially subject to the highest accelerations due to seismic shaking and the shortest recurrence intervals. According to the CBC, the entire San Diego region is within seismic Zone 4.

The CBC also contains (1) specific provisions to classify soils as expansive, (2) exploratory boring procedures, (3) soil boring reporting procedures, and (4) special building foundation and investigation requirements. Section 1613A.1 describes earthquake loads and states that "every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions." Additionally, structures that require special consideration of their response characteristics and environment that are not addressed by this code and for which other regulations provide seismic criteria include vehicular bridges, electrical transmission towers, hydraulic structures, buried utility lines and their appurtenances, and nuclear reactors.

Construction General Permit

Dischargers whose projects disturb 1 or more acres of soil, or less than 1 acre but are part of a larger common plan of development that in total disturbs 1 or more acres, are required to obtain coverage under the State Water Resources Control Board (SWRCB) Order 2022-0057-DWQ, the Construction General Permit (SWRCB 2022). Construction and demolition activities subject to this permit include clearing, grading, grubbing, and excavation, or any other activity that results in a land disturbance equal to or greater than 1 acre.

Permit applicants are required to submit a notice of intent to the SWRCB and to prepare a Storm Water Prevention Pollution Plan (SWPPP). The SWPPP must identify best management practices (BMPs) that are to be implemented to reduce construction impacts on receiving water quality based on potential pollutants. The SWPPP also must include descriptions of the BMPs to reduce pollutants in storm water discharges after all construction phases are completed at a site (post-construction BMPs). The Construction General Permit also includes requirements for risk-level assessment for construction sites, a storm water effluent monitoring and reporting program, rain event action plans, and numeric action levels for pH and turbidity.

California Coastal Act

The California Coastal Act (PRC Section 30253) provides for the minimization of adverse impacts, including assuring stability and structural integrity, and neither creating nor contributing significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way requiring the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs. The California Coastal Commission

has found that siting new development away from eroding bluffs is the preferred means of assuring compliance with this section of the act so developments will not be endangered by erosion nor require the construction of coastal armoring to protect them from erosion over their design life (Johnsson 2003).

Water Quality Control Policy for Siting, Design, Operation, and Maintenance of On Site Wastewater Treatment Systems

On June 19, 2012, SWRCB adopted Resolution No. 2012-0032, adopting the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of OWTS. This policy establishes a statewide, risk-based, tiered approach for the regulation and management of OWTS installations and replacements and sets the level of performance and protection expected from OWTS. The policy includes a conditional waiver of waste discharge requirements for systems in compliance with the policy, which by law expires after 5 years. SWRCB renewed the conditional waiver in 2018 and 2023.

In accordance with Water Code Section 13290 et seq., the policy sets standards for OWTS that are constructed or replaced, that are subject to a major repair, that pool or discharge waste to the surface of the ground, and that have affected, or will affect, groundwater or surface water to a degree that makes it unfit for drinking water or other uses or cause a health or other public nuisance condition. The OWTS Policy also includes minimum operating requirements for OWTS that may include siting, construction, and performance requirements; requirements for OWTS near certain waters listed as impaired under Section 303(d) of the Clean Water Act; requirements authorizing local agency implementation of the requirements; corrective action requirements; minimum monitoring requirements; exemption criteria; requirements for determining when an existing OWTS is subject to major repair; and a conditional waiver of waste discharge requirements.

The OWTS policy was incorporated into the Water Quality Control Plan for the San Diego Basin (Basin Plan) through Basin Plan Amendment (Resolution No. R9-2015-0008), which added implementation measures for areas where surface and groundwater are interconnected and made some other nonsubstantive changes to the Basin Plan.

State Laws Protecting Paleontological Resources

PRC Sections 5097 and 30244 include state-level requirements for the assessment and management of paleontological resources. These statutes require reasonable mitigation of adverse impacts on paleontological resources resulting from development on state lands and define the excavation, destruction, or removal of paleontological "sites" or "features" from public lands without the express permission of the jurisdictional agency as a misdemeanor. As used in Section 5097, "state lands" refer to lands owned by, or under the jurisdiction of, the State of California or any state agency. "Public lands" is defined as lands owned by, or under the jurisdiction of, the State of California, or any city, county, district, authority, or public corporation, or any agency thereof.

Conservation and Safety Elements

Under Government Code Section 65302(d)(1), a general plan must include "[a] conservation element for the conservation, development, and utilization of natural resources including water and its hydraulic force, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals, and other natural resources." Under Government Code Section 65302(g)(1), a general plan must include "[a] safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence; liquefaction; and other seismic hazards…, and other geologic hazards known to the legislative body... The safety element shall include mapping of known seismic and other geologic hazards." The cities and county government within the San Diego region include these elements within their general plans, and most contain additional information on disaster relief and emergency preparedness for geologic and seismic hazards (see the "Local Jurisdictions' Protection Policies for Protecting against Geologic and Seismic Hazards" section below).

REGIONAL AND LOCAL LAWS, REGULATIONS, PLANS, AND POLICIES

County Septic Tank Regulations

The San Diego Regional Water Quality Control Board (RWQCB) authorizes the County of San Diego Department of Environmental Health to issue septic system (OWTS) permits throughout the San Diego region. The County Board of Supervisors approved the updated OWTS (septic systems) ordinance on September 11, 2024, which went into effect on October 11, 2024. The San Diego RWQCB unanimously approved Resolution R9-2024-0130 for San Diego County's 2025 Local Agency Management Program (LAMP) for OWTS on November 13, 2024, and it went into effect on February 1, 2025. The purpose of the LAMP is to implement minimum standards to allow the continued use of OWTS or other sanitation facilities while protecting water quality and public health. The OWTS installation permitting process and the prescribed standards contained in the LAMP are designed to protect groundwater sources and surface water bodies from pollution through the proper siting, design installation, operation, and maintenance of individual new and replacement OWTS and other sanitation facilities in accordance with the provisions of the OWTS Policy and San Diego County Regulatory Code.

Grading and Erosion Regulations

Consistent with state law, local jurisdictions contain grading and erosion-control regulations in their municipal codes. These regulations establish minimum requirements for grading, including clearing and grubbing of vegetation. These regulations ensure compatibility of graded land development sites with surrounding land forms and land uses and prevent unnecessary and unauthorized grading.

Additionally, local jurisdictions have grading and erosion control ordinances that are intended to control erosion and sedimentation caused by construction activities. A grading permit is typically required for construction-related projects. As part of the permit, project applicants usually must submit a grading and erosion-control plan, vicinity and site maps, and other supplemental information. Standard conditions in the grading permit include a description of BMPs similar to those contained in a SWPPP.

Seismic Standards

Many geologic and seismic hazard goals, policies, and mitigation measures are listed in the safety elements of local general plans, and aim to minimize injury, loss of life, and damage to property resulting from potential geologic and seismic disasters. For example, the San Diego County General Plan Safety Element contains goals and policies to minimize personal injury and property damage resulting from seismic hazards (County of San Diego 2011a).

Additionally, the Alquist-Priolo Earthquake Fault Zoning Act, described above, requires that before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults.

County of San Diego, Grading Ordinance

Section 87.430 of the Grading Ordinance states that a qualified paleontologist may be required by the county official to be present during all grading activities for monitoring purposes. If a fossil greater than 12 inches in any diameter is found, all grading operations must be suspended, and the county official must be notified immediately. The county official will analyze the resource and determine the proper course of action, to be carried out by the permittee, prior to the county official's authorization to resume normal grading operations.

Local Jurisdictions' Protection Policies for Protecting against Geologic and Seismic Hazards

To comply with Government Code Section 65302, a general plan must include "A safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence; liquefaction; and other seismic hazards identified pursuant to Chapter 7.8 (commencing with Section 2690) of Division 2 of the PRC, and other geologic hazards known to the legislative body. The safety element shall include mapping of known seismic and other geologic hazards" (GCS 65302[g]). The incorporated cities and

county government within San Diego region contain safety elements within their general plans, and most contain additional information on disaster relief and emergency preparedness for geologic and seismic hazards.

Selected local government policies related to safety and geological hazards are listed in Table 4.7-3.

Table 4.7-3 Local Policies Concerning Geologic and Seismic Hazards

Jurisdiction	Policies
Carlsbad	The Public Safety Element of the Carlsbad General Plan was updated and adopted in 2024. The Public Safety Element contains Policy 6-P.20 through Policy 6-P.31 related to geology and seismicity. These policies establish guidelines for geotechnical requirements and evaluation for development.
Chula Vista	The Environment Element of the Chula Vista General Plan contains Policy E 14.1 through E 14.5 to protect against injury, loss of life, and major property damage through engineering analyses of potential seismic hazards; prohibit subdivision, grading, or development of lands subject to potential geologic hazards; require site-specific geotechnical investigations; promote programs to identify buildings and structures that would be at risk during seismic events; and to discontinue, remove, or relocate structures determined to be unsafe from geologic hazards.
Coronado	The Safety Element of the Coronado General Plan contains goals and policies related to fault zone development, inundation hazard from tsunami or seiche, an emergency warning system, and public education for disaster preparedness.
Del Mar	The Environmental Management Section of the Del Mar Community Plan contains discussion about floodplain overlay and bluff, slope, and canyon overlay zones used by the city to protect the public safety and welfare from hazards such as fire, flooding, landslides, and erosion. The Safety Element of the Community Plan also contains the Sea Level Rise Adaptation Plan, which is intended to guide policy decisions related to future development in areas that are identified as vulnerable to projected sea-level rise, flooding, and erosion. In addition, the City of Del Mar's Municipal Code contains the city's Local Coastal Program Implementing Ordinances related to geology and soils. Specifically, Del Mar Municipal Code Chapter 30.52, Bluff, Slope, Canyon Overlay Zone, is designed to protect the health, safety, and general welfare, and to protect downstream resources. Del Mar Municipal Code Chapter 30.55, Coastal Bluff Overlay Zone, is intended to protect Del Mar's fragile coastal bluffs as a visual resource and avoid the risks to life and property associated with bluff failure and shoreline erosion. Del Mar Municipal Code Chapter 30.56, Floodplain Overlay Zone, is intended to avoid hazards related to flood hazards. Finally, Del Mar Municipal Code Chapter 23.33, Land Conservation Ordinance, which regulates soil disturbances of existing or natural terrain and vegetation, and does not create soil erosion, silting of lower slopes, slide damage, flooding problems, or severe cutting or scarring.
El Cajon	The Safety Element of the City of El Cajon General Plan contains Policy 3.5, which requires enforcing development standards to reduce geologic risk. Policy 3.6 prioritizes retrofits of buildings that pose the greatest risk.
Encinitas	The Public Safety Element of the Encinitas General Plan contains policies to prevent and respond to geologic hazards.
Escondido	The Community Protection Element of the Escondido General Plan contains goals and policies including Policy 7.1 through Policy 7.5 to minimize adverse effects to residents, property, and critical facilities caused by geologic and seismic hazards.
Imperial Beach	The Safety Element of the City of Imperial Beach General Plan and Local Coastal Plan contain policies specific to geologic hazards including Policy S-1 which requires geotechnical investigations and recommendations; Policy S-5 which restricts construction near fault traces; and Policy S-6 which restricts cliff top development.
La Mesa	The Safety Element of the La Mesa General Plan contain goals, objectives, and policies to offer protection from risks associated with geologic and seismic hazards.
Lemon Grove	The Safety Element of the Lemon Grove General Plan contains Policies 1.1, 1.2, and 1.3 to minimize risk of injury and property from seismic and other geologic conditions.
National City	The Safety Element of the National City General Plan contains Policies SE-1.1 through SE-1.6 to minimize risk of injury and property from seismic and geologic hazards.
Oceanside	The Public Safety Element of the Oceanside General Plan contains goals and objectives to ensure an acceptable level of public safety for prevention and reduction of loss of life and personal property at risk from seismic and geologic hazards. The General Plan for Oceanside is being updated. The 2024 public review draft of the General Plan contains Policies 6-41 through 6-53 related to geologic and seismic hazards.
Poway	The Emergency Services Element of the City of Poway General Plan contains Policy B to protect against hazards associated with geologic formations through proper land use policies and mitigation, and Policy C to control seismic hazards to a level of acceptable risk through the identification and recognition of potentially hazardous conditions and areas.

Jurisdiction	Policies
City of San Diego	The Public Facilities, Services, and Safety Element of the City of San Diego General Plan includes Policy PF-Q.1 to protect public health and safety through the application of effective seismic, geologic and structural considerations. Policy PFQ.2 maintains or improves the integrity of structures to protect residents and preserve communities.
San Marcos	The Safety Element of the City of San Marcos General Plan includes Policy S-1.1 which reduces the risk of impacts from geologic and seismic hazards by applying current and proper land use planning, development engineering, building construction, and retrofitting requirements. Policy S-1.2 includes the investigation specific groundwater levels and geologic conditions underlying all new development or redevelopment proposals in areas where potential fault rupture, liquefaction, or other geologic hazards are suspected. The General Plan for San Marcos is being updated as of January 2025; however, these policies will be unaffected according to the draft document.
Santee	The Safety Element of the Santee General Plan includes Policies 2.1, 2.2, and 2.3 which minimize the loss of life and destruction of property in Santee caused by seismic and geologic hazards.
Solana Beach	The Safety Element City of Solana Beach General Plan contains Objective 1.0 to ensure that geologic hazards in all areas for human use or habitation are mitigated properly or avoided prior to or during development. Policies 1.a through 1.e require geotechnical investigations; review of geotechnical reports; require construction to be in conformance with the Uniform Building Code; increased awareness of seismic and geologic hazards; and encourage programs to abate or modify structures deemed hazardous to human habitation. In addition, Chapter 4 of the Solana Beach Local Coastal Program Land Use Plan includes policies to minimize risks related to life and property from geologic, flood, or fire hazards; shoreline management strategies; shoreline erosion and protection; and beach sand replenishment and retention.
Vista	The Public Safety, Facilities, and Services Element of the City of Vista General Plan contains PSFS Goal 3 to reduce damage, losses, and the risk to the community caused by seismic and other geologic hazards. The General Plan contains PSFS Policies 3.1 through 3.9 to minimize geologic hazard risks.
County of San Diego	The San Diego County General Plan Goal S-8 and S-9 in the Safety Element require minimized personal injury and property damage resulting from seismic hazards, and damage caused by mudslides, landslides, or rock falls.

Sources: City of Carlsbad 2024; City of Chula Vista 2021; City of Coronado 2005; City of Del Mar 1985, 2024; City of El Cajon 2021; City of Encinitas 1995; City of Escondido 2012; City of Imperial Beach 2024; City of La Mesa 2013; City of Lemon Grove 1996; City of National City 2024; City of Oceanside 2002, 2024; City of Poway 1991; City of San Diego 2024b; City of San Marcos 2012; City of Santee 2003; City of Solana Beach 2014, 2019; City of Vista 2012; County of San Diego 2011a.

Local Jurisdictions' Protection Policies for Unique Geological and Paleontological Features

Selected local government policies protecting unique geological and paleontological features are listed in Table 4.7-4.

Table 4.7-4 Local Policies Concerning Unique Geologic and Paleontological Features

Jurisdiction	Policies
Carlsbad	The Arts, History, Culture, and Education Element of the City of Carlsbad General Plan contains five policies related to cultural resources, including paleontological resources. The policies require the implementation of the City of Carlsbad Cultural Resources Guidelines to avoid or substantially reduce impacts (Policy 7-P.1); construction monitoring by a qualified professional during ground-disturbing activities for specific development projects (Policy 7-P.8); treatment of any cultural resource discoveries during site grading in compliance with the City of Carlsbad Cultural Resource Guidelines (Policy 7-P.9), consultation with appropriate organizations and individuals to minimize potential project impacts (Policy 7-P.10); and submittal of a cultural resources monitoring report prior to the occupancy of any building (Policy 7-P.11). The Open Space, Conservation, and Recreation Element of the City's General Plan also includes one policy pertaining to paleontological resources, which is to designate areas that preserve historic, cultural, archaeological, paleontological, and educational resources as open space (Policy 4-P.32). Additional paleontological requirements for projects within the coastal zone are included in the City of Carlsbad Local Coastal Program that require impact reviews and the development and implementation of mitigation measures.
Chula Vista	The Environmental Element of the City of Chula Vista General Plan contains one objective and two policies pertaining to paleontological resources. Objective E 10 is to protect important paleontological resources and support and encourage public education and awareness of such resources. Policy 10.1 is to continue to assess and mitigate the potential impacts of private development and public facilities and infrastructure to paleontological resources in accordance with CEQA. Policy 10.2 is to support and encourage public education and awareness of local paleontological resources, including the establishment of museums and educational opportunities accessible to the public.

Jurisdiction	Policies
Coronado	The Conservation Element of the City of Coronado General Plan requires the preservation, documentation, and recovery of paleontological resources that are threatened by new development and contains objectives to protect significant natural resources by mitigating erosion along coastal and bay shorelines. The Local Coastal Program Land Use Plan also requires the reasonable mitigation of adverse impacts to paleontological resources as a result of new development.
Del Mar	The Del Mar Community Plan contains objectives to preserve the integrity of the coastal bluffs and prevent erosion on steep slopes. The Bluff, Slope, and Canyon Specific Plan provides the implementation strategy to protect these natural resources. In addition, Del Mar Municipal Code Chapter 30.52, "Bluff, Slope, Canyon Overlay Zone," is designed to protect the health, safety, and general welfare, and to control the development of properties within the designated zone in order to preserve the scenic sandstone bluffs and related canyons and steep slopes that characterize the area within the zone; Chapter 30.60, "Open Space Overlay Zone," is intended, in part, to preserve scenic vistas and particularly unique natural features in specific neighborhoods; and Chapter 30.92, "Housing Element Implementation Overlay Zone," includes paleontological resources mitigation, monitoring and reporting protocol.
El Cajon	The City of El Cajon General Plan does not include any goals, objectives, policies, or implementation programs related to paleontological resources or unique geological features.
Encinitas	The Resource Management Element of the Encinitas General Plan contains policies to document and preserve paleontological resources and unique natural resources.
Escondido	The Land Use and Community Form and Resource Conservation Elements of the Escondido General Plan contain policies to conserve hillsides, ridgelines, and paleontological resources.
Imperial Beach	The City of Imperial Beach General Plan and Local Coastal Plan contains goals to preserve irreplaceable natural resources such as beaches and ocean shoreline, and notes that there are geologic units in the city that are locally fossiliferous.
La Mesa	The Conservation and Sustainability Element and Recreation and Open Space Element of the La Mesa General Plan contain policies and conservation objectives to protect natural landforms and significant physical features. The Historic Preservation Element notes that paleontological sites may be eligible for designation as a historic landmark.
Lemon Grove	The Conservation and Recreation Element of the Lemon Grove General Plan includes environmental review requirements to protect significant fossils and prehistoric artifacts from development impacts.
National City	The Open Space and Agriculture Element of the National City General Plan contains Policy OS-1.1, which protects and conserves the landforms and open spaces that define the city's urban form, provide public views/vistas, serve as core biological areas and wildlife linkages, or are wetland habitats, and Policy OS-8.8, which requires monitoring for subsurface cultural and paleontological resources during grading and construction activities for all development projects.
Oceanside	The Environmental Resource Management Element of the Oceanside General Plan contains implementation strategies and policies for reducing erosion and other environmentally damaging impacts, and the Land Use Element contains objectives and policies for the evaluation and recovery of paleontological resources, erosion control, and coastal preservation.
Poway	The Natural Resources Element of the City of Poway General Plan and the City of Poway's Habitat Conservation Plan contain descriptions of geological features and landforms and related policies that include the preservation of rock outcroppings, open space, hillsides, ridgelines, and cultural resources.
City of San Diego	The Conservation Element of the City of San Diego General Plan includes a goal for the preservation and long-term management of the natural landforms and open spaces that help make San Diego unique. Policies CE-B.1 to CE-B.9 include procedures to protect and conserve important landforms, canyon lands, and open spaces.
San Marcos	The City of San Marcos General Plan Conservation Element includes Policy COS-2.5, which requires paleontological resources to be analyzed and conserved in compliance with CEQA requirements. Policy COS-3.1 is to preserve prominent landforms through conservation and management policies. Implementing strategies establish provisions for limiting environmental impacts on landforms, reducing erosion, and utilizing techniques for open space conservation.
Santee	The Santee General Plan Conservation Element includes Policy 1.1, which encourages significant natural landforms to be maintained during development whenever possible, and Policy 10.2, which encourages the preservation of significant natural features, such as watercourses, ridgelines, steep canyons, and major rock outcroppings through the development review process. Municipal Ordinance 564 Section 11.40.575 requires that grading operations be halted in the event of a paleontological resource discovery and that grading not recommence until the permittee has received written authority from the city engineer.

Jurisdiction	Policies
Solana Beach	The City of Solana Beach General Plan Conservation and Open Space Element contains Policy 6.b, which requires paleontological resources evaluation of proposed development sites and implementation of appropriate mitigation. The General Plan Land Use Element contains Policy LU-5.1, which requires the City of Solano Beach to maintain ordinances that preserve lands with sensitive geologic features.
Vista	The City of Vista General Plan Sustainability and Conservation Element contains RCS Goal 13 and Policies 13.1 and 13.2 to provide for the protection of paleontological resources by adopting procedures to mitigate impacts during preconstruction and construction phases, including paleontological monitoring and fossil salvage programs. The Land Use and Community Identity Element also contains an Open Space land use designation which was established to preserve portions of the City of Vista in their natural state, including unique geological features.
County of San Diego	The San Diego County General Plan includes Goal COS-9 in the Conservation and Open Space Element, which requires the conservation of paleontological resources and unique geologic features. Policy COS-9.1 requires the salvage and preservation of unique paleontological resources when exposed to the elements during excavation or grading activities or other development processes. Policy COS-9.2 requires future development to minimize impacts on unique geologic features.

Sources: City of Carlsbad 2015a, 2015b; City of Chula Vista 2021; City of Coronado 1994, 2005; City of Del Mar 2021; City of El Cajon 2001; City of Encinitas 2012; City of Escondido 2012; City of Imperial Beach 2024; City of La Mesa 2013; City of Lemon Grove 1996; City of National City 2011; City of Oceanside 2002; City of Poway 1996, 2002;City of San Diego 2024b; City of San Marcos 2012; City of Santee 2003; City of Solana Beach 2010; City of Vista 2012; County of San Diego 2011b.

4.7.3 Significance Criteria

Appendix G of the CEQA Guidelines provides criteria for determining the significance of a project's environmental impacts, in the form of initial study checklist questions. Unless otherwise noted, the significance criteria specifically developed for this EIR are based on the checklist questions that address the criteria in CEQA Guidelines Appendix G. In some cases, SANDAG has combined checklist questions, edited their wording, or changed their location in the document in an effort to develop significance criteria that reflect the programmatic level of analysis in this EIR and the unique characteristics of the proposed Plan and EIR.

Checklist questions for geology and soils are found in Section VII of the CEQA Guidelines. Sections that have been combined and modified are criterion VII(c) related to project location on unstable geologic units or soils and criterion VII(d) related to project location on expansive soils, which are combined as GEO-2 herein. VII(e) of the CEQA Guidelines is modified to include groundwater impacts in GEO-4.

For the purposes of this EIR, implementation of the proposed Plan would have a significant geologic or soils, impact if it would:

GEO-1 Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence showing an earthquake fault is active;
- Strong seismic ground shaking;
- Seismic-related ground failure, including liquefaction; and
- Landslides.

GEO-2 Locate projects on a geologic unit or soil that is expansive or unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse, creating substantial direct or indirect risks to life or property.

GEO-3 Result in substantial soil erosion or the loss of topsoil.

GEO-4 Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater, potentially causing adverse groundwater impacts.

GEO-5 Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

The analysis discloses impacts to geology, soils and paleontological resources. There is insufficient evidence to support a meaningful analysis of how the proposed Plan's geology, soils and paleontological resources impacts would be worsened by climate change. Therefore, a climate change analysis for geology, soils and paleontological resources impacts is not included in this section.

4.7.4 Environmental Impacts and Mitigation Measures

GEO-1 DIRECTLY OR INDIRECTLY CAUSE POTENTIAL SUBSTANTIAL ADVERSE EFFECTS, INCLUDING THE RISK OF LOSS, INJURY, OR DEATH INVOLVING (A) RUPTURE OF A KNOWN EARTHQUAKE FAULT, AS DELINEATED ON THE MOST RECENT ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING MAP ISSUED BY THE STATE GEOLOGIST FOR THE AREA, OR BASED ON OTHER SUBSTANTIAL EVIDENCE SHOWING AN EARTHQUAKE FAULT IS ACTIVE; (B) STRONG SEISMIC GROUND SHAKING; (C) SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION; OR (D) LANDSLIDES.

Analysis Methodology

This analysis acknowledges that the entire San Diego region is subject to strong ground shaking during an earthquake on a fault or fault zone inside or outside of the region. It identifies the location of forecasted regional growth and land use change and planned transportation network improvements as part of the proposed Plan in relation to known earthquake faults in the San Diego region, including Alquist-Priolo Earthquake Fault Zones. This analysis also identifies the location of forecasted regional growth and land use change or planned transportation network improvements in relation to areas subject to seismic-related ground failure, including liquefaction and seismically induced landslides. The analysis then qualitatively discusses the potential of the proposed Plan to directly or indirectly cause substantial adverse effects, including the risk of loss, injury, or death involving earthquakes and related seismic hazards as a result of forecasted development and planned transportation network improvements. Finally, the analysis assesses the ability of specific requirements of existing laws and regulations (as described in Section 4.7.2, "Regulatory Setting") to minimize any substantial adverse direct or indirect effects.

Impact Analysis

2035

Regional Growth and Land Use Change

As identified in Table 2-1 in Chapter 2, "Project Description," from 2022 to 2035, the region is forecasted to have an increase of 117,056 people (4%), 137,242 housing units (11%), and 67,297 jobs (4%). The 2035 regional SCS land use pattern is shown in Figure 2-4. Approximately 93.3% of the forecasted regional population increases between 2022 and 2035 are in the cities of San Diego (51.3%), Chula Vista (26.1%), and San Marcos (15.8%). Those same three jurisdictions would accommodate approximately 71.4% of new housing units in the region between 2022 and 2035, while the cities of San Diego, San Marcos, and Oceanside would accommodate more than 69.5% of new jobs in the region between 2022 and 2035.

As shown in Figure 4.7-2, several active fault lines and Alquist-Priolo Earthquake Fault Zones are located in areas that are currently developed and that are forecasted to develop between 2022 and 2035 (Figure 2-4 in Chapter 2, "Project Description"). Areas that contain or are in proximity to Alquist-Priolo Earthquake Fault Zones include Downtown San Diego, Coronado, and communities along Interstate (I) 5. Additionally, several earthquake fault lines are located in the western third of the region. New development and infrastructure planned to occur

between 2022 and 2035 would increase the number of people and structures located in or near areas containing Alquist-Priolo Earthquake Fault Zones, earthquake fault lines, and other geologic hazards. Earthquakes within 60 miles of the San Diego region are capable of generating strong ground shaking. This ground shaking could be generated along the San Clemente, San Diego Trough, Coronado Bank, Rose Canyon, Elsinore, San Jacinto, and Sweetwater Fault Zones. Surface rupture and severe ground shaking could cause catastrophic damage to new development associated with implementation of the proposed Plan, including catastrophic damage to structures.

As shown in Figure 4.7-3, very high landslide susceptibility zones (e.g., classes VIII, IX, and X) are scattered throughout the region. Additionally, areas prone to liquefaction also occur throughout the region (Figure 4.7-4). Some of these liquefaction- and landslide-susceptible areas are located in developed areas and areas that are forecasted to develop as a result of regional growth and land use changes between 2022 and 2035. Therefore, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

Long-term effects associated with earthquakes include phenomena such as regional subsidence or emergence of landmasses and regional changes in groundwater levels. As a result of forecasted regional growth and land use change, the proposed Plan would increase the risk of loss, injury, or death associated with earthquakes and seismic hazards.

Earthquake-resistant designs employed on new structures can minimize the impact on public safety from seismic events. There are numerous federal, state, and local laws; regulations; and policies in place to avoid or reduce impacts from earthquakes and other geologic hazards as discussed in Section 4.7.2, "Regulatory Setting." For example, the Alquist-Priolo Earthquake Fault Zoning Act requires that before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist, and if an active fault is found, a structure for human occupancy cannot be placed over the fault and must be set back, generally 50 feet from the fault.

Furthermore, all projects would be required to adhere to standard design, grading, and construction practices described in the CBC, which regulates the design and construction of excavations, foundations, building frames, retaining walls, and other building elements. The CBC requirements, along with all other standard geotechnical investigation, design, grading, and construction standards and practices, would mitigate the effects of seismic shaking and adverse soil conditions and avoid or reduce impacts from earthquake, ground shaking, ground failure, and landslides. Additionally, adherence to the SHMA would reduce threats to public safety by identifying and mitigating for seismic hazards.

Regulatory agencies with oversight of development associated with the proposed Plan have developed regulations and engineering design specifications to consider and compensate for site-level geological and seismic conditions. Adherence to these laws and regulations would ensure impacts from land use changes between 2022 and 2035 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction or seismically included landslides. Therefore, the impact would be less than significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2035 include new Managed Lanes and Managed Lane Connectors on SR 15, SR 52, SR 78, I-5, I-15, and I-805. The proposed Plan also includes ~~Reversible Managed Lane improvements on SR-75,~~ improvements to rural corridors on SR-67, SR 76, SR 79, SR 94, and I-8, as well as interchange and arterial operational improvements on SR 94 and SR 125. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as tolling equipment and Regional Border Management System investments on SR 11. Upgrades at certain locations on the Los Angeles–San Diego–San Luis Obispo (LOSSAN) Rail Corridor would be implemented during this period. Other major network improvements include grade separations at certain locations on the SPRINTER, Green line, Blue Line, and Orange Line. Double-tracking is also proposed on the SPRINTER.

The majority of improvements by 2035 (as shown in Figures 2-7, 2-10, and 2-13 in Chapter 2, "Project Description") would be located in proximity to several fault lines and Alquist-Priolo Earthquake Fault Zones (as identified in Figure 4.7-2 above), which would result in increased exposure of people and structures to risk of loss, injury, or death from earthquakes and other geologic hazards. Specific transportation facilities that would be most at risk for damage from seismic effects due to their proximity to fault lines include those in Downtown San Diego and improvements along the I-5, I-805, and SR 94 corridors. (*See, e.g.,* Fig. 4.7-2.) Due to historic activity of faults in the region, the potential for surface rupture and ground-shaking remains.

As discussed above, landslide-susceptible zones and areas prone to liquefaction occur throughout the region. Some of these liquefaction and landslide-susceptible areas are located in areas in which transportation network improvements are planned between 2022 and 2035; therefore, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

Federal, state, and local laws; regulations; and policies included in Section 4.7.2, "Regulatory Setting," would require future improvements and projects to be reviewed by appropriate regulatory agencies prior to construction and would require each improvement or project to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from geologic hazards. Adherence to these laws and regulations would ensure impacts from transportation network improvements in place between 2022 and 2035 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure including liquefaction or seismically included landslides. Therefore, the impact would be less than significant.

2035 Conclusion

Between 2022 and 2035, implementation of the proposed Plan would result in land use changes and the construction of transportation network improvements that would expose a greater number of people and structures to impacts from seismic activity, including earthquakes, ground shaking, ground failure, and landslides. However, adherence to the laws, regulations, and policies included in Section 4.7.2, "Regulatory Setting," would ensure people or structures would not be exposed to substantial adverse effects. Therefore, this impact (GEO-1) in the year 2035 is less than significant.

2050

Regional Growth and Land Use Change

As identified in Table 2-1 in Chapter 2, "Project Description," of this Draft EIR, from 2036 to 2050, the region is forecasted to decrease by 4,112 people (-0.1%), increase by 65,577 housing units (4.8%), and increase by 103,460 jobs (6.2%). The 2050 regional SCS land use pattern is shown in Figure 2-5. The majority of the forecasted regional population decrease between 2036 and 2050 is attributed to the unincorporated jurisdictions, the City of Carlsbad, and the City of El Cajon. Approximately 78.8% of new housing units would be developed in the City of San Diego (51.6%), City of Chula Vista (17.1%), and unincorporated jurisdictions. Similarly, these same three jurisdictions would accommodate approximately 70.3% of new jobs between 2036 and 2050. Similarly, these same three jurisdictions contribute to approximately 70.3% of new jobs between 2036 and 2050.

As discussed in the 2035 analysis above, regional growth and land use change resulting in the construction of new and redeveloped buildings would result in significant impacts regarding the exposure of people and structures to seismic activity, including earthquakes, ground shaking, ground failure, and landslides. These risks would continue to occur into 2050 as development increases and infrastructure is extended to accommodate forecasted growth. Land use change by 2050 would result in an increase in regional growth and development, and as shown in Figure 4.7-2, some of the developments would occur near an earthquake fault zone. Approximately 52% (33,865 units) of the housing units forecasted to be developed between 2036 and 2050 would occur in the city of San Diego, which lies in the Rose Canyon Fault Zone.

Landslide-susceptible zones and areas prone to liquefaction occur throughout the region, as shown in Figures 4.7-3 and 4.7-4. Some of these liquefaction- and landslide-susceptible areas are located in areas in which residential,

mixed use, and commercial development are forecasted between 2036 and 2050 (Figure 2-5 in Chapter 2 "Project Description"). As a result, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

As discussed in the 2035 analysis and in Section 4.7.2, "Regulatory Setting," the development and improvement of new structures would be required to adhere to existing federal, state, and local laws; regulations; and policies, including the design standards described in the CBC. Regional growth and land use change between 2036 and 2050 would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, including liquefaction or seismically induced landslides through compliance with existing regulations. Therefore, the impact would be less than significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2050 include new Managed Lanes and Managed Lane Connectors on SR 52, SR 56, ~~SR 75,~~ SR 94, SR 125, SR 163, I-15, and I-805, several of which will be a continuation of improvements from 2035. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as expansion of and improvements to existing port of entry facilities, which will continue during this period. Upgrades at certain locations on the LOSSAN Rail Corridor would continue during this period. Grade separations on the SPRINTER, Blue Line, Green Line, and Orange Line, as well as double-tracking on the SPRINTER would also continue during this period. See Tables 2-7 through 2-10 for a full list of proposed projects by subregion.

Similar to the 2035 analysis, some of the improvements would be located in areas containing Alquist-Priolo Earthquake Fault Zones and other earthquake faults, including the Rose Canyon, Coronado, Sweetwater, and La Nacion Faults. In these areas, additional people or structures would be at risk of loss, injury, or death from earthquakes and other geologic hazards.

As shown in Figures 4.7-3 and 4.7-4, landslide susceptibility zones and areas prone to liquefaction occur throughout the region. Some of these liquefaction- and landslide-susceptible areas are located in developed areas and areas that are forecasted to develop between 2036 and 2050 as a result of transportation network improvements; therefore, implementation of the proposed Plan would expose people and structures to the adverse effects of landslides and liquefaction.

As discussed above, existing federal, state, and local laws; regulations; and policies included in Section 4.7.2, "Regulatory Setting," would require improvements and projects to be reviewed by appropriate regulatory agencies prior to construction and would require each improvement or project to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from geologic hazards. Adherence to existing laws and regulations would ensure that the proposed transportation network improvements would not expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, including liquefaction or seismically induced landslides. Therefore, the impact would be less than significant.

2050 Conclusion

Between 2036 and 2050, implementation of the proposed Plan would result in land use change and the construction of transportation network improvements that would expose a greater number of people and structures to impacts from seismic activity, including earthquakes, ground shaking, ground failure, and landslides. However, adherence to the laws, regulations, and polices included in Section 4.7.2, "Regulatory Setting," would ensure people and structures would not be exposed to substantial adverse effects. Therefore, this impact (GEO-1) in the year 2050 is less than significant.

MITIGATION MEASURES

No mitigation measures are required for this impact.

GEO-2 LOCATE PROJECTS ON A GEOLOGIC UNIT OR SOIL THAT IS EXPANSIVE OR UNSTABLE, OR THAT WOULD BECOME UNSTABLE AS A RESULT OF THE PROJECT, AND POTENTIALLY RESULT IN ON- OR OFF-SITE LANDSLIDE, LATERAL SPREADING, SUBSIDENCE, LIQUEFACTION, OR COLLAPSE, CREATING SUBSTANTIAL DIRECT OR INDIRECT RISKS TO LIFE OR PROPERTY.

Analysis Methodology

This analysis identifies the location of forecasted regional growth and land use change or planned transportation network improvements in relation to geologic units and soils that are expansive or unstable or that would become unstable as a result of land development or a transportation network improvement. The analysis describes the risks associated with locating development projects and transportation network improvements on expansive or unstable geologic units or soils, including on site or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse. The analysis next assesses the ability of specific requirements of existing laws and regulations (as described in Section 4.7-2, "Regulatory Setting") to minimize these risks. (Impact GEO-1 separately addresses unstable soils or geologic units resulting in on or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse because of earthquakes or seismic events.)

Impact Analysis

2035

Regional Growth and Land Use Change

As shown in Table 2-1 in Section 2.0, "Project Description," of this Draft EIR, from 2022 to 2035, the region is forecasted have an increase of 117,056 people (4%), 137,242 housing units (11%), and 67,297 jobs (4%). The 2035 regional SCS land use pattern is shown in Figure 2-4. Approximately 93.3% of the forecasted regional population increases between 2022 and 2035 are in the cities of San Diego (51.3%), Chula Vista (26.1%), and San Marcos (15.8%). Those same three jurisdictions would accommodate approximately 71.4% of new housing units in the region between 2022 and 2035, while the cities of San Diego, San Marcos, and Oceanside would accommodate more than 69.5% of new jobs in the region between 2022 and 2035.

Lateral spreading is the movement of sloping ground as a result of liquefaction. Areas become more prone to liquefaction and lateral spreading during a large earthquake event. Conditions favorable for lateral spreading are frequently found along streams and waterfronts or in loosely placed, saturated, sandy fill. Constructed facilities of most types are vulnerable to heavy damage by lateral spreading, including being pulled apart, buckling, or suffering severe structural damage. In addition, liquefaction can also cause slumping of embankments or tilting of retaining walls that may be associated with regional growth and land use change. Forecasted regional growth and land use change may be located on soils that are prone to lateral spreading and liquefaction.

As regional growth and land use changes occur, a growing population between 2022 and 2035 would demand additional water supply. Additional housing units would draw additional groundwater. As discussed in Section 4.18, "Water Supply," implementation of the proposed Plan would comply with the adopted groundwater management plans in the Plan area for sustainable groundwater management. However, future growth could occur on land overlying 23 groundwater basins and rural aquifers that were identified by the County of San Diego as having an insufficient level of storage and would have insufficient storage under the 2011 General Plan buildout conditions (Impact WS-2). Increased groundwater drawing in these basins could cause land subsidence, which can result in unstable soils or cause ground failure.

Much of the population growth projected between 2022 and 2035 would occur in or adjacent to areas with existing development. Although these areas may already have been tested for slope failure, even developed areas, particularly those on or near mountains, hills, or the coast, can experience slope failure. New development in areas prone to slope failure would be at a higher risk, particularly development located in coastal communities. Redevelopment of existing areas or new development would likely require grading or earthwork, which may increase the propensity for soils to become unstable and cause slope failure.

Development may occur in areas containing expansive soils, thereby increasing the risk to people and structures of the deterioration of infrastructure, structures, and pavements. If the moisture content or soil type differs at various locations under the foundation of a structure, localized or nonuniform movement may occur. This movement can cause damage to the foundation and building structural system, evidenced by cracking of the slab or foundation, cracking in the exterior or interior wall coverings (indicating movement of support framing), uneven floors, or misaligned doors and windows. Damage caused by expansive soils can be slow and long term and not attributable to any particular event. Development that occurs near the coast would be more susceptible to damage caused by expansive soils due to the presence of clayey soils. Any structure developed in the western part of the San Diego region may also be at risk for being sited on expansive soils.

Development associated with the proposed Plan would be required to adhere to existing laws and regulations, including the design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce geologic hazards, including those associated with lateral spreading, subsidence, unstable soils, slope failure, and expansive soils as described in Section 4.7.2, "Regulatory Setting." Specifically, the CBC addresses the design and construction of excavations, foundations, and other building elements to mitigate adverse soil conditions by requiring structures and buildings are built to withstand potential hazards associated with unstable or problematic soils. Compliance with the CBC would minimize risks associated with locating future development on unstable geologic units or soils.

Although slope failure may not be completely avoidable, site-specific analyses would reduce risks associated with development as a result of regional growth. Corrective measures, such as structural reinforcement and using engineered fill to replace unstable and expansive soils, would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies.

The incorporated cities and county government within the region have, in their general plans, safety elements, which contain the requirements concerning the risks associated with expansive soils, landslides, subsidence, liquefaction, and other seismic and geologic hazards, as summarized in Table 4.7-3. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures for long-term stability, minimizing the risks that regional growth and land use changes on geologic units or soils that are expansive or unstable would become unstable as a result of the proposed Plan, or result in on or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Adherence to these laws, regulations, local plans, design standards, and practices would minimize risks to people and property. Therefore, the impact would be less than significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2035 include new Managed Lanes and Managed Lane Connectors on SR 15, SR 52, SR 78, I-5, I-15, and I-805. The proposed Plan also includes ~~Reversible Managed Lane improvements on SR-75,~~ improvements to rural corridors on SR-67, SR 76, SR 79, SR 94, and I-8, as well as interchange and arterial operational improvements on SR 94 and SR 125. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as tolling equipment and Regional Border Management System investments on SR 11. Upgrades at certain locations on the Los Angeles–San Diego–San Luis Obispo (LOSSAN) Rail Corridor would be implemented during this period. Other major network improvements include grade separations at certain locations on the SPRINTER, Green line, Blue Line, and Orange Line. Double-tracking is also proposed on the SPRINTER.

Some of these improvements may involve significant grading or earthwork, which increases the likelihood of encountering unstable geologic units and increases the propensity for slope failure. Additionally, some of the transportation improvements would be located in, on, or near hills, coastal areas, canyons, and other places with steep slopes or unstable soils. Specific transportation facilities that would be susceptible to hazards associated with slope failure or the development of which more likely to cause slope failure include those near the coast and improvements to highways that would involve grading or tunneling through hills or mountains. In addition, transportation network improvements in the western part of the San Diego region would have the potential to be sited on expansive soils.

Transportation network improvements planned between 2022 and 2035 that are located in the coastal areas of the region would be subject to lateral spreading and liquefaction, which can cause the slumping of embankments or tilting of retaining walls associated with transportation network improvements. In addition, liquefaction can cause the failure of highway and railroad embankments built over liquefiable soils. Transportation network improvements in areas prone to lateral spreading and liquefaction would be at risk of damage to pavement, misalignment of railroad tracks, or the failure of bridge piers or abutments.

Transportation network improvements planned between 2022 and 2035 that are located on sloped areas with exposed soil or in areas with soils that have high erosion potential may result in greater risk for the effects of slope failure or cause soils to become unstable. Soil erosion and slope failure could damage roadways and weaken bridge foundations, which would cause risks to people or structures in proximity to these improvements.

Improvements to the transportation network implemented between 2022 and 2035 may be located in areas with expansive soils, particularly if they are located near the coast. The wetting and drying of soils from water application during construction, landscape irrigation, water pipe leaks, and storm events can cause significant movement in expansive soils. Transportation network improvements constructed on or adjacent to expansive soils may suffer infrastructure damage, such as weakening or cracking or bridges, concrete platforms, and other facilities.

As discussed previously, existing federal, state, and local laws; regulations; and policies included in Section 4.7.2, "Regulatory Setting," would require improvements and projects to be reviewed by appropriate regulatory agencies prior to construction and would require each improvement and project to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from geologic hazards, including unstable and expansive soils and slope failure. Adherence to grading and erosion regulations and seismic standards that include geologic investigations required by the Alquist-Priolo Earthquake Fault Zoning Act would reduce geologic hazards. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures to ensure long-term stability, minimizing the risks that soils that are expansive or unstable would become unstable as a result of the proposed Plan, or result in on site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, the impact would be less than significant.

2035 Conclusion

Between 2022 and 2035, implementation of the proposed Plan would result in land use changes and the construction of transportation network improvements that would expose a greater number of structures to risks from unstable and expansive soils, including landslides, lateral spreading, subsidence, liquefaction, or collapse, or cause soils to become unstable. Adherence to the laws, regulations, and programs included in Section 4.7.2, "Regulatory Setting," and project-specific investigations following state and local standards and practices would minimize risks to people and property. Therefore, this impact (GEO-2) in the year 2035 is less than significant.

2050

Regional Growth and Land Use Change

As shown in Table 2-1 in Section 2.0, "Project Description," of this Draft EIR, from 2036 to 2050, the regional is forecasted to decrease by 4,112 people (-0.1%), increase by 65,577 housing units (4.8%), and increase by 103,460 jobs (6.2%). The 2050 regional SCS land use pattern is shown in Figure 2-5. The majority of the forecasted regional population decrease between 2036 and 2050 is attributed to the unincorporated jurisdictions, the city of Carlsbad, and the city of El Cajon. Approximately 78.8% of new housing units would be developed the City of San Diego (51.6%), Chula Vista (17.1%) and the unincorporated jurisdictions. Similarly, these same three jurisdictions contribute to approximately 70.3% of new jobs between 2036 and 2050. Regional growth and land use change between 2036 and 2050 would result in increased housing units and employment opportunities in the region and population increase in Chula Vista.

As discussed above in the 2035 analysis, regional growth and land use change would result in the construction of new and redeveloped buildings that may be in areas with unstable soils or prone to slope failure and areas with expansive soils. Impacts would remain between 2036 and 2050 as development or redevelopment activities would

occur in coastal communities or near areas with canyons and hills. As mentioned above, slope failure may not be completely avoidable, but site-specific analyses would minimize risks associated with development in response to regional growth. Also, additional housing units would draw groundwater and could result in land subsidence.

All projects associated with regional growth would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce geologic hazards, including those associated with unstable soils, slope failure, and expansive soils. Regulatory agencies with oversight of development associated with the proposed Plan have developed regulations and engineering design specifications to consider and compensate for site-level geological and seismic conditions. Specifically, the Alquist-Priolo Earthquake Fault Zoning Act regulates development near active faults by prohibiting human occupancy structures within 50 feet of the tract of an active fault; the CBC regulates the design and construction of excavation, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions; and local jurisdictions provide geologic and seismic hazards protection goals policies in the safety elements within their general plans to protect the community from geologic hazards.

Corrective measures, such as structural reinforcement and using engineered fill to replace unstable and expansive soils, would be applied to the design of individual future projects. The incorporated cities and county government within the region have safety elements in their general plans which contain the requirements concerning the risks associated with landslides, subsidence, liquefaction, and other seismic and geologic hazards, as summarized in Table 4.7-3. Adherence to grading and erosion regulations and seismic standards that include geologic investigations required by the Alquist-Priolo Earthquake Fault Zoning Act would reduce geologic hazards, as discussed above. All site designs would be reviewed and approved by the appropriate agencies.

Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical measures for long-term stability, minimizing the risks that regional growth and land use change on geologic units or soils that are expansive or unstable would become unstable as a result of the proposed Plan or result in on site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Adherence to these laws and regulations and project-specific investigations would minimize risks to people and property. The impact would be less than significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2050 include new Managed Lanes and Managed Lane Connectors on SR 52, SR 56, ~~SR 75,~~ SR 94, SR 125, SR 163, I-15, and I-805, several of which will be a continuation of improvements from 2035. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as expansion of and improvements to existing port of entry facilities, which will continue during this period. Upgrades at certain locations on the LOSSAN Rail Corridor would continue during this period. Grade separations on the SPRINTER, Blue Line, Green Line, and Orange Line, as well as double-tracking on the SPRINTER would also continue during this period. See Tables 2-7 through 2-10 for a full list of proposed projects by subregion.

Similar to the 2035 analysis, transportation network improvements would occur in areas susceptible to slope failure and unstable soils, particularly improvements located in hilly or coastal areas. These improvements may be at a greater risk for effects of slope failure or cause greater risks to people or structures in proximity to these improvements. Specific transportation facilities prone to risks of slope failure or the development of which would be likely to cause slope failure include those in Downtown San Diego, improvements near the coast, and improvements to highways that would involve grading or tunneling through hills or mountains. In addition, transportation network improvements would be in areas with expansive soils, particularly improvements located near the coast.

As discussed above, existing federal, state, and local laws; regulations; and policies included in Section 4.7.2, "Regulatory Setting," would require improvements and projects to be reviewed by appropriate regulatory agencies prior to construction and would require each improvement and project to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce impacts from geologic hazards related to unstable and expansive soils and slope failure. Project-specific geotechnical investigations consistent with existing regulatory requirements would identify areas of damage and recommend geotechnical

measures to ensure long-term stability, minimizing the risks that geologic units or soils that are expansive or unstable would not become unstable as a result of the proposed Plan, or result in on site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, the impact would be less than significant.

2050 Conclusion

Between 2036 and 2050, implementation of the proposed Plan would result in regional growth development and transportation network improvements that would be constructed on expansive soils, expose a greater number of structures to risks from unstable soils—including landslides, lateral spreading, subsidence, liquefaction, or collapse—or cause soils to become unstable. Adherence to the laws and regulations and programs included in Section 4.7.2, "Regulatory Setting," and project-specific investigations consistent with local and state standards and practices would minimize risks to people and property. Therefore, this impact (GEO-2) in the year 2050 is less than significant.

MITIGATION MEASURES

No mitigation measures are required for this impact.

GEO-3 RESULT IN SUBSTANTIAL SOIL EROSION OR THE LOSS OF TOPSOIL.

Analysis Methodology

Some land use or transportation network improvement projects would require extensive cut-and-fill or grading and could result in manufactured slopes that become unstable over time and increase long-term erosion potential.

Unusually high volumes of storm water runoff can also cause slope failures, particularly in areas where native soils have a moderate to high erosion potential. In addition to soil erosion from long-term exposure to water, the analysis describes the routine soil erosion and loss of topsoil that may also result from construction activities (movement of soil or changes to drainage). This analysis discusses erosion and the loss of topsoil qualitatively in regard to regional growth and land use change or transportation network improvements.

The analysis assesses how adherence to state and local regulations and standards for the design and practice of grading, clearing, and filling of land would minimize impacts related to soil erosion and loss of topsoil.

Impact Analysis

2035

Regional Growth and Land Use Change

As shown in Table 2-1 in Section 2.0, "Project Description," of this Draft EIR, from 2022 to 2035, the region is forecasted to have an increase of 117,056 people (4%), 137,242 housing units (11%), and 67,297 jobs (4%). The 2035 regional SCS land use pattern is shown in Figure 2-4. Approximately 93.3% of the forecasted regional population increases between 2022 and 2035 are in the cities of San Diego (51.3%), Chula Vista (26.1%), and San Marcos (15.8%). Those same three jurisdictions would accommodate approximately 71.4% of new housing units in the region between 2022 and 2035, while the cities of San Diego, San Marcos, and Oceanside would accommodate more than 69.5% of new jobs in the region between 2022 and 2035.

Development associated with the proposed Plan would cause erosion due to a greater degree of exposed graded or disturbed surfaces, excavation, or stockpiling that would occur with development. This growth would mainly take place in areas of existing urban development, which may increase the susceptibility of soil erosion or loss of topsoil in erosion-prone areas, such as along the coast. New development may disturb soils in previously undisturbed areas. Increased development may also cause higher amounts of water runoff, which can cause or exacerbate erosion problems and slope failure. In addition, the potential for erosion is most common in beachside areas and coastal communities subject to wave action.

Slope instability or erosion problems in the San Diego region are primarily regulated through the CBC and the grading ordinances of local jurisdictions. The CBC requires special foundation engineering and investigation of soils on proposed development sites located in geologic hazard areas. Reports developed based on the findings of these investigations must demonstrate either that the hazard presented by the project will be eliminated or that there is no danger for the intended use. To minimize slide danger and erosion, a grading permit must be obtained for all major earth-moving projects. All local jurisdictions (county and cities) have grading ordinances designed in part to ensure that development in earthquake- or landslide-prone areas does not threaten human life or property. Many of the county's most slide-prone or erosion-prone areas occur along the coastal bluffs, which are regulated under the California Coastal Act and are within the jurisdiction of the California Coastal Commission (CCC). In addition to protecting unique recreational and natural resources, the CCC requires the inclusion of grading, drainage, and erosion-control plans with the submittal of a development application. The local geologic background and potential for geologic impacts are important components of local coastal programs under each coastal jurisdiction.

As discussed in Section 4.7.2, "Regulatory Setting," construction site storm water management is regulated by the Construction General Permit, which requires measures that reduce the effects of erosion. Under the Construction General Permit, permit applicants would be required to prepare a SWPPP, which identifies BMPs that must be implemented to reduce construction effects on receiving water quality based on pollutants. The BMPs are directed at implementing both sediment and erosion-control measures and other measures to control chemical contaminants.

Adherence to the CBC, coastal zone regulations, Construction General Permit requirements, and local grading and erosion-control ordinances would reduce the potential for substantial soil erosion or loss of topsoil. The impact would be less than significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2035 include new Managed Lanes and Managed Lane Connectors on SR 15, SR 52, SR 78, I-5, I-15, and I-805. The proposed Plan also includes ~~Reversible Managed Lane improvements on SR-75,~~ improvements to rural corridors on SR-67, SR 76, SR 79, SR 94, and I-8, as well as interchange and arterial operational improvements on SR 94 and SR 125. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as tolling equipment and Regional Border Management System investments on SR 11. Upgrades at certain locations on the Los Angeles–San Diego–San Luis Obispo (LOSSAN) Rail Corridor would be implemented during this period. Other major network improvements include grade separations at certain locations on the SPRINTER, Green line, Blue Line, and Orange Line. Double-tracking is also proposed on the SPRINTER.

Some of the transportation improvements included in the proposed Plan would be constructed on or in proximity to steep slopes and would increase the amount of impervious surfaces and the removal of additional vegetative cover. Some transportation or transit projects would require significant earthwork, including cuts into hillsides that can become unstable over time, increasing long-term erosion potential. Road cuts can expose soils to erosion over the life of the project, creating potential landslide and falling rock hazards. Engineered roadways can be undercut over time by storm water drainage and wind erosion. Some areas would be more susceptible to erosion than others due to the naturally occurring soils with higher erosion potential. Improvements to the transportation network implemented between 2022 and 2035 may cause or worsen soil erosion or loss of topsoil, particularly if those improvements require significant earthwork, such as below-grade transit line extensions or routes. Vibration from new or expanded highways or transit lines may also cause or exacerbate soil erosion along hillsides in canyons or coastal bluffs.

Improvements or projects associated with the proposed Plan would be reviewed by appropriate regulatory agencies prior to construction and would adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce soil erosion or loss of topsoil. Projects involving major ground-disturbing activities are subject to local grading and erosion control ordinances, which require implementation of erosion control measures during construction. Projects that result in more than 1 acre of

ground disturbance are subject to SWRCB's Construction General Permit, which require implantation of SWWP and BMPs to control sedimentation and erosion. Projects located within the jurisdiction of the CCC are required to apply for a coastal development permit, which require development of grading, drainage, and erosion control plans. Adherence to these regulations would reduce the potential for substantial soil erosion or loss of topsoil. For this reason, the impact would be less than significant.

2035 Conclusion

Between 2022 and 2035, implementation of the proposed Plan would result in land use changes and the construction of transportation network improvements, both of which would cause soil erosion or the loss of topsoil. However, adherence to the CBC design and construction standards and compliance with the Construction General Permit and other local ordinances would avoid or reduce soil erosion or loss of topsoil. Therefore, this impact (GEO-3) in the year 2035 is less than significant.

2050

Regional Growth and Land Use Change

As shown in Table 2-1 in Section 2.0, "Project Description," of this Draft EIR, from 2036 to 2050, the region is forecasted to decrease by 4,112 people (-0.1%), increase by 65,577 housing units (4.8%), and increase by 103,460 jobs (6.2%). The 2050 regional SCS land use pattern is shown in Figure 2-5. The majority of the forecasted regional population decrease between 2036 and 2050 is attributed to the unincorporated jurisdictions, the city of Carlsbad, and the city of El Cajon. Approximately 78.8% of new housing units would be developed in the City of San Diego (51.6%), Chula Vista (17.1%), and unincorporated jurisdictions. Similarly, these same three jurisdictions contribute to approximately 70.3% of new jobs between 2036 and 2050.

Although the regional population is forecasted to decrease from 2036 to 2050, the housing units and employment are forecasted to increase during the same period. The region would result in similar types of development (e.g., housing, commercial, and industrial development) through 2050 as with the development through 2035 throughout the region (Figures 2-4 and 2-5). Given that similar types of development would occur, the risk of erosion and loss of topsoil associated with land use development between 2036 and 2050 would be similar to the risk associated with land use development occurring between 2022 and 2035. As stated in the 2035 analysis, the potential for erosion and loss of topsoil increases with human activity and development or redevelopment. Activities such as grading, excavation, stockpiling, boring, and cut-and-fill grading can increase erosion potential and loss of topsoil. Additionally, as described in the 2035 analysis, an increase in volume or velocity of storm water can increase erosion potential and loss of topsoil.

Similar to the discussion in the 2035 analysis, adherence to the CBC, coastal zone regulations, Construction General Permit requirements, and local grading and erosion-control ordinances would reduce the potential for substantial soil erosion or loss of topsoil. For this reason, the impact would be less than significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2050 include new Managed Lanes and Managed Lane Connectors on SR 52, SR 56, ~~SR 75,~~ SR 94, SR 125, SR 163, I-15, and I-805, several of which will be a continuation of improvements from 2035. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as expansion of and improvements to existing port of entry facilities, which will continue during this period. Upgrades at certain locations on the LOSSAN Rail Corridor would continue during this period. Grade separations on the SPRINTER, Blue Line, Green Line, and Orange Line, as well as double-tracking on the SPRINTER would also continue during this period. See Tables 2-7 through 2-10 for a full list of proposed projects by subregion.

Similar to the discussion in the 2035 analysis, transportation network improvements would cause or worsen soil erosion or loss of topsoil, particularly if those improvements require significant earthwork, such as below-grade transit line extensions or routes. Vibration from new or expanded highways or transit lines may also cause or exacerbate soil erosion along hillsides in canyons or coastal bluffs. It is anticipated that transportation network

improvements would start between 2022 and 2035 and continue to be implemented between 2036 and 2050. Many significant earthwork (e.g., grading, excavation, and foundation building) would occur between 2022 and 2035. Other above-grade construction (roadways extension and bridge construction) would continue throughout 2050. Therefore, the greatest impacts from construction would likely occur by 2035.

Improvements or projects associated with the proposed Plan would be reviewed by appropriate regulatory agencies prior to construction and would adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce soil erosion or loss of topsoil. Adherence to these regulations would reduce the potential for substantial soil erosion or loss of topsoil. For this reason, the impact would be less than significant.

2050 Conclusion

Between 2036 and 2050, implementation of the proposed Plan would result in land use change and the construction of transportation network improvements, both of which would cause soil erosion or the loss of topsoil. Compliance with regulatory requirements and implementation of required design measures would ensure that regional growth and land use changes, as well as transportation network improvements and programs associated with the proposed Plan would avoid or reduce soil erosion or loss of topsoil. Therefore, this impact (GEO-3) in the year 2050 is less than significant.

MITIGATION MEASURES

No mitigation measures are required for this impact.

GEO-4 HAVE SOILS INCAPABLE OF ADEQUATELY SUPPORTING THE USE OF SEPTIC TANKS OR ALTERNATIVE WASTEWATER DISPOSAL SYSTEMS WHERE SEWERS ARE NOT AVAILABLE FOR THE DISPOSAL OF WASTEWATER, POTENTIALLY CAUSING ADVERSE GROUNDWATER IMPACTS.

Analysis Methodology

The analysis identifies the general locations of forecasted regional growth and land use change under the proposed Plan that would occur in areas without sewer systems and that thus rely on OWTS. It includes a discussion of the relevant regulations, including county policies for permitting septic systems and their ability to minimize impacts on groundwater quality.

Transportation network improvements and programs would not affect septic systems or OWTS because facilities associated with transportation network improvements and programs would not use septic systems; therefore, they are not addressed further in the impact analysis.

Impact Analysis

2035

Regional Growth and Land Use Change

As shown in Table 2-1 in Section 2.0, "Project Description," of this Draft EIR, from 2022 to 2035, the region is forecasted to increase by 117,056 people (4%), 137,242 housing units (11%), and 67,297 jobs (4%). The 2035 regional SCS land use pattern is shown in Figure 2-4. Approximately 93.3% of the forecasted regional population increases between 2022 and 2035, are in the cities of San Diego (51%), Chula Vista (26%), and San Marcos (16%). Those same three jurisdictions would accommodate approximately 71.4% of new housing units in the region between 2022 and 2035, while the cities of San Diego, San Marcos, and Oceanside would accommodate more than 69.5% of new jobs in the region between 2022 and 2035.

As discussed in Section 4.7.1, expansive soils occur throughout the region, but predominately in the coastal plains. Expansive soils can expand when wet and drink when dry. If the moisture content or soil type differs at various locations supporting a septic tank or alternative wastewater disposal system, localized or nonuniform movement

may occur. This movement can cause damage to the septic tank or alternative wastewater disposal system. Damaged septic tanks can leak harmful substances such as nitrates, pathogens, and other pollutants into groundwater, thereby causing adverse groundwater impacts. Therefore, expansive soils are unstable and not suitable for septic tanks or OWTS. Regional growth and land use change associated with implementation of the proposed Plan would occur throughout the region as shown in Figure 2-4. Therefore, future development could occur in areas containing expansive soils that are incapable of supporting the use of septic tanks or OWTS. Damage to septic tanks or OWTS caused by expansive soils can be slow and long term, and not attributable to any particular event. The issue of expansive soils, or soils incapable of adequately supporting septic tanks or OWTS, is not as common in the San Diego region as in other parts of the country. however, septic tanks or OWTS that occurs near the coast would be more susceptible to damage caused by expansive soils than eastern areas of the region, where the use of septic systems is more common.

The most common type of septic system found in the San Diego region consists of a septic tank connected to leach lines (County of San Diego 2025). A leach line consists of a trench, rock or other approved filter materials, such as rock-less charmers, a perforated pipe, filter protecting fabric or paper, and soil cover (County of San Diego 2025). Leach lines would allow wastewater from the septic systems to percolate and filter through soil and prevent contamination of groundwater sources. Areas with OWTS, rather than sewer connections, include the unincorporated communities of North Mountain, Ramona, Rainbow, San Dieguito, Spring Valley, Sweetwater, Valley Center, Alpine, El Cajon, Bonsall, Fallbrook, Central Mountain, North County Metro, Mountain Empire, Julian, Desert, and Crest/Dehesa. Although not coastal communities, these areas have the potential for the presence of expansive soils. The North County Metro area has potential expansive soils mapped in the northern part of the community, whereas Fallbrook and Spring Valley both have potential expansive soils throughout their boundaries. Valley Center has potential expansive soils throughout the community, and Ramona has a concentration of potential expansive soils in the heart of the community surrounding SR 67 (County of San Diego 2011b). Between 2022 and 2035, the population in the unincorporated area is forecasted to decrease from 513,170 to 500,460 (Table 4.14-2) while the housing units are forecasted to increase from 178,774 to 185,014 (Table 4.14-3). Therefore, forecasted housing growth in the unincorporated area between 2022 and 2035 would have the potential to be located in communities with soils incapable of supporting septic tanks or OWTS.

Areas with high groundwater levels can also cause unstable soils and may not be able to support the use of septic tanks or alternative wastewater disposal systems. However, high groundwater levels occur mainly in the coastal communities of the region, where reliance on these systems is not common. As summarized in Table 4.14-3, housing development would occur between 2022 and 2035 in the coastal cities of Carlsbad, Coronado, Del Mar, Escondido, Imperial Beach, National City, and Solana Beach. Housing development in these coastal cities would have the potential to install septic tanks or OWTS. Therefore, regional growth and land use change associated with the proposed Plan in this area would have the potential to occur on soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems.

Regional growth and land use change associated with the proposed Plan would be required to adhere to design standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce adverse groundwater impacts associated with expansive soils, or soils incapable of adequately supporting the use of septic tanks and alternative wastewater disposal systems, as described in Section 4.7.2, "Regulatory Setting." Specifically, the CBC requires provisions to classify soils as expansive and measures to address expansive soils' potential impacts on structures, such as septic tanks. SWRCB Resolution No. 2012-0032 establishes siting, construction, performance requirements, corrective action requirements, monitoring requirements, and waste discharge requirements, which would ensure that septic tanks or OWTS would not affect groundwater or surface water to a degree that makes it unfit for drinking water or other uses. In addition, the San Diego County 2025 LAMP for OWTS, effective February 1, 2025, establishes an installation permitting process and prescribes standards to protect groundwater sources and surface water bodies from pollution through the proper siting, design installation, operation, and maintenance of individual new and replacement OWTS and other sanitation facilities.

Corrective measures would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies and consistent with regulatory requirements, which would minimize risks

that new septic tanks or alternative wastewater disposal systems associated with regional growth and land use change would result in adverse groundwater impacts due to unsuitable soils. The impact would be less than significant.

2035 Conclusion

Some regional growth and land use change associated with the proposed Plan would occur on expansive or unstable soils incapable of supporting the use of septic tanks or alternative wastewater disposal systems; however, adherence to the laws and regulations included in Section 4.7.2, "Regulatory Setting," and described above would minimize the potential for adverse impacts on groundwater. Therefore, this impact (GEO-4) in the year 2035 is less than significant.

2050

Regional Growth and Land Use Change

As shown in Table 2-1 in Section 2.0, "Project Description," of this Draft EIR, from 2036 to 2050, the region is forecasted to decrease by 4,112 people (-0.1%), increase by 65,577 housing units (4.8%), and increase by 103,460 jobs (6.2%). The 2050 regional SCS land use pattern is shown in Figure 2-5. The majority of the forecasted regional population decrease between 2036 and 2050 is attributed to the unincorporated jurisdictions, the city of Carlsbad, and the city of El Cajon. Approximately 78.8% of new housing units would be developed in the cities of San Diego (51.6%), City of Chula Vista (17.1%), and the unincorporated jurisdictions. Similarly, these same three jurisdictions contribute to approximately 70.3% of new jobs between 2036 and 2050.

The issue of expansive soils, or soils incapable of adequately supporting septic tanks or OWTS, is not as common in the San Diego region as in other parts of the country; however, development that occurs near the coast would be more susceptible to damage caused by expansive soils than eastern areas of the region, where the use of septic systems is more common. However, expansive soils are not confined to the coastal areas, as described in Section 4.7.1, "Existing Conditions." Areas with OWTS, rather than sewer connections, include the unincorporated communities of the county described above in the 2035 analysis. In certain parts of these unincorporated communities with forecasted housing unit growth between 2036 and 2050, development could occur on soils incapable of supporting septic tanks or OWTS.

Additionally, areas with high groundwater levels can also cause unstable soils and may not be able to support the use of septic tanks or alternative wastewater disposal systems. Because high groundwater levels occur mainly in the coastal communities of the region, where reliance on these systems is not common and where land use is not forecasted to change substantially between 2036 and 2050, regional growth and land use change associated with the proposed Plan in this area would not be likely to occur on soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

As mentioned above in the 2035 analysis, all projects associated with regional growth and land use change under the proposed Plan would be required to adhere to design standards described in the CBC and standard design, grading, and construction practices to avoid or reduce adverse impacts on groundwater from expansive soils or soils incapable of supporting the use of septic tanks or OWTS. Regulatory agencies with oversight of regional growth and land use change associated with the proposed Plan have developed regulations and engineering design specifications to reduce risks from expansive soils.

Corrective measures would be applied to the design of individual future projects. All site designs would be reviewed and approved by the appropriate agencies, and consistency with regulatory requirements, minimizing the risks that new septic tanks or alternative wastewater disposal systems associated with regional growth and land use change would result in adverse groundwater impacts due to unsuitable soils. The impact would be less than significant.

2050 Conclusion

Between 2036 and 2050, some regional growth and land use change associated with the proposed Plan would occur on expansive or unstable soils incapable of supporting the use of septic tanks or alternative wastewater disposal systems; however, adherence to the laws and regulations included in Section 4.7.2, "Regulatory Setting"

and described above would minimize the potential for adverse impacts on groundwater. Therefore, this impact (GEO-4) in the year 2050 is less than significant.

MITIGATION MEASURES

No mitigation measures are required for this impact.

GEO-5 DIRECTLY OR INDIRECTLY DESTROY A UNIQUE PALEONTOLOGICAL RESOURCE OR SITE OR UNIQUE GEOLOGICAL FEATURE.

Analysis Methodology

This section analyzes the potential for ground-disturbing construction activities associated with the implementation of the proposed Plan to impact unique paleontological resources and unique geologic features. For this analysis, implementation of the proposed Plan would result in a significant impact if it would directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Paleontological resources (i.e., fossil remains) are known to occur within the coastal plain, the desert, and alluvial deposits and other mountain formations (Table 4.7-1). Fossils are limited, nonrenewable resources and the loss of a single unique paleontological resource or site may result in the permanent unavailability of the resource and associated data to scientific research and education. Unique geologic features are not common in San Diego County (County of San Diego 2007). Those that are present (see Table 4.7-2) are primarily located in the eastern portion of San Diego County; however, there are some in the western portion of the County as well. Many of the unique geologic features are on a larger scale than is typical for paleontological resources, such as the full extent of a geologic unit in a region (e.g., the San Onofre Breccia in the San Onofre Hills). Depending on the nature of the unique geologic feature, preservation of the entirety of the feature is not necessarily needed as long as examples remain represented. Therefore, analyzing impacts on unique geologic features includes determining if a project, as designed, will materially impair the feature by destroying or altering those physical characteristics that convey the uniqueness of the resource.

Construction activities associated with both forecasted regional growth and land use change and planned transportation network improvements (deep excavation, trenching, tunneling, blasting, chiseling rock formations, altered hydrologic flow, vibration, or erosion) in previously undisturbed areas would have the highest likelihood for destroying unique paleontological resources and unique geologic features. This analysis compares areas identified for regional growth and land use change or transportation network improvements (Figures 2-4, 2-5, 2-7, 2-10, 2-13; Tables 2-1, 4.14-2, 4.14-3) with areas mapped or described as having paleontological sensitivity (Table 4.7-1; County of San Diego 2009; City of San Diego 2007, 2024a) and the locations of unique geologic features (Table 4.7-2; County of San Diego 1975) to assess the potential impacts on these resources.

Impact Analysis

2035

Regional Growth and Land Use Change

As shown in Table 2-1, in Section 2.0, "Project Description," of this Draft EIR, from 2022 to 2035, the region is forecasted have an increase of 117,056 people (4%), 137,242 housing units (11%), and 67,297 jobs (4%). The 2035 regional SCS land use pattern is shown in Figure 2-4. Approximately 93.3% of the forecasted regional population increases between 2022 and 2035 are in the cities of San Diego (51.3%), Chula Vista (26.1%), and San Marcos (15.8%). Those same three jurisdictions would accommodate approximately 71.4% of new housing units in the region between 2022 and 2035, while the cities of San Diego, San Marcos, and Oceanside would accommodate more than 69.5% of new jobs in the region between 2022 and 2035. As described in Section 4.7.1 and Table 4.7-1, geologic formations with moderate to high paleontological resource potential are present throughout the San Diego region, but particularly within the Coastal Plain Region, which is forecasted to have the highest proportion of regional population and housing unit increases from 2022 to 2035.

Excavation and grading activities associated with new development and redevelopment of the areas included in the proposed Plan, including the cities of San Diego, San Marcos, and Chula Vista and unincorporated communities, like Lakeside, North County Metro, and Otay, may result in impacts on unique paleontological resources and unique geologic features. Ground-disturbing activities in high- or moderate-sensitivity fossil-bearing geologic formations, such as those listed in Table 4.7-1, have the potential to damage or destroy unique paleontological resources that may be present below the ground surface.

The majority of unique geologic features described in Table 4.7-2 are located in the eastern portions of the region in areas that are not forecasted to change significantly between 2022 and 2035. Additionally, many of the unique geologic features are located in canyons, riverbanks, or other areas where construction would be infeasible or difficult. The policies and ordinances of local jurisdictions typically restrict construction on steep slopes to preserve hillsides and reduce hazards (e.g., City of San Diego Municipal Code Chapter 14, Article 3, Division 1 and City of San Marcos Policy COS-3.2). Therefore, the majority of identified unique geologic features would not be directly impacted from regional development associated with the proposed Plan land use pattern.

However, some of the identified unique geologic features listed in Table 4.7-2 are located in areas that would experience increased regional growth and land use change under the proposed Plan. Communities such as Mission Valley contain unique geologic features and are forecast to increase in population and housing unit densities between 2022 and 2035. These geologic features may experience direct impacts from construction associated with increased development, including impacts caused by changes to hydrology and water runoff. Features sensitive to the effects of erosion, such as geologically unique valley walls, may be impacted by runoff or vibration from construction activities.

Any future development projects implementing the proposed Plan, including those within areas with high sensitivity, would be required to adhere to the regulations and policies discussed in Section 4.7.2, "Regulatory Setting" (e.g., PRC Sections 5097 and 30244, City of Chula Vista Policy E 10.1, City of San Marcos Policies COS 2.5 and COS 3.1, City of San Diego Policies CE-B.1 to CE-B.9). These regulations and policies require protection of paleontological resources, with measures such as paleontological monitoring during grading projects and reduction of erosion and runoff in areas where unique paleontological resources and unique geologic features are located, and in some cases limiting development in those areas. These requirements would help reduce impacts on unique paleontological resources and unique geologic resources through avoidance and implementation of BMPs. However, because these requirements are not uniformly strict or enforceable, these measures do not guarantee reduced significant impacts for all future development projects. Therefore, impacts on unique paleontological resources and unique geologic features are considered significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2035 include new Managed Lanes and Managed Lane Connectors on SR 15, SR 52, SR 78, I-5, I-15, and I-805. The proposed Plan also includes ~~Reversible Managed Lane improvements on SR-75,~~ improvements to rural corridors on SR-67, SR 76, SR 79, SR 94, and I-8, as well as interchange and arterial operational improvements on SR 94 and SR 125. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as tolling equipment and Regional Border Management System investments on SR 11. Upgrades at certain locations on the Los Angeles–San Diego–San Luis Obispo (LOSSAN) Rail Corridor would be implemented during this period. Other major network improvements include grade separations at certain locations on the SPRINTER, Green line, Blue Line, and Orange Line. Double-tracking is also proposed on the SPRINTER.

Ground disturbances associated with the construction of transportation network improvements and programs would occur within geologic formations of moderate to high paleontological resource potential and areas containing unique geologic features during the 2022 to 2035 timeframe, including projects such as the Los Angeles–San Diego–San Luis Obispo (LOSSAN) Rail Realignment. Ground disturbance associated with roadway improvements, bridge replacements, new rail tracks, track reconfigurations, grade separations; and construction of facilities, such as commuter rail maintenance facilities, can directly impact unique paleontological resources in areas with high or moderate paleontological resource sensitivity, and can directly and permanently alter unique

geologic features, particularly in canyons, on coastlines, and on mountain passes. These direct impacts occur as a result of the physical destruction and alteration of the resources and features by construction equipment during grading, excavation, trenching, boring, pile driving, and tunneling activities. Construction and operation of these transportation network improvements would also produce vibration and contribute to the effects of erosion, which could indirectly impact unique paleontological resources and unique geologic features.

Upon implementation of the transportation network improvements and programs included in the proposed Plan, both unique paleontological resources and unique geologic features would likely be encountered. As discussed above, existing federal, state, and local laws; regulations; and programs included in Section 4.7.2 would help reduce impacts on unique paleontological resources and unique geologic features, but because these requirements are not uniformly strict or enforceable, these measures do not ensure less than significant impacts for future projects. Therefore, impacts on unique paleontological resources and unique geologic features are considered significant.

2035 Conclusion

Direct impacts to paleontological resources and unique geologic features would occur as a result of the physical destruction and alteration of the resources and features by construction equipment during ground disturbing activities such as grading, excavation, trenching, boring, pile driving, and tunneling activities. Indirect impacts to paleontological resources and unique geologic features would occur as a result of increased erosion effects that expose unique paleontological resources to destruction through mechanical and chemical weathering and destroy or alter the physical characteristics of unique geologic features. Therefore, implementation of the proposed Plan would result in regional growth and land use change as well as transportation network improvements and programs that would directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. Therefore, this impact (GEO-5) in the year 2035 is significant.

2050

Regional Growth and Land Use Change

As discussed in the 2035 analysis above, geologic formations with moderate to high paleontological resource potential are present throughout the San Diego region, particularly within the Coastal Plain Region, which is forecasted to have the highest proportion of regional population and housing unit increases from 2036 to 2050. As shown in Table 2-1 in Section 2.0 "Project Description," of this Draft EIR, from 2036 to 2050, the region is forecasted to decrease by 4,112 people (-0.1%), increase by 65,577 housing units (4.8%), and increase by 103,460 jobs (6.2%). The 2050 regional SCS land use pattern is shown in Figure 2-5. The majority of the forecasted regional population decrease between 2036 and 2050 is attributed to the unincorporated jurisdictions, the City of Carlsbad, and the City of El Cajon. Approximately 78.8% of new housing units would be developed in the City of San Diego (51.6%), City of Chula Vista (17.1%), and unincorporated jurisdictions.

Excavation and grading activities associated with new development and redevelopment of the areas included in the proposed Plan, including the cities of San Diego, and Chula Vista, may result in impacts on unique paleontological resources and unique geologic features. Ground-disturbing activities in high- or moderate-sensitivity fossil-bearing geologic formations, such as those listed in Table 4.7-1, have the potential to damage or destroy unique paleontological resources that may be present below the ground surface.

Although the regional population is forecasted to decrease from 2036 to 2050, the housing units and employment are forecasted to increase during the same period. The region would result in similar types of development (e.g., housing, commercial, and industrial development) through 2050 as with the development through 2035 throughout the region (Figures 2-4 and 2-5). Given that similar types of development would occur, the types of activities that would result in significant impacts on unique paleontological resources and unique geologic features (e.g., excavation and grading) between 2036 and 2050 would be similar to the impacts associated with land use development occurring between 2022 and 2035. In addition, with more construction planned within previously unearthed areas, or with an increase in the likelihood of impacts from erosion or changes to hydrology, the potential to physically destroy or alter unique paleontological resources and unique geologic features increases.

As discussed in the 2035 analysis, existing federal, state, and local laws; regulations; and programs included in Section 4.7.2 (e.g., PRC Sections 5097 and 30244, City of Chula Vista Policy E 10.1, City of San Diego Policies CE-B.1 to CE-B.9) would help reduce impacts on unique paleontological resources and unique geologic features, including in areas with high sensitivity. However, because these requirements are not uniformly strict or enforceable, these measures do not guarantee reduced significant impacts for all future projects. Therefore, impacts on unique paleontological resources and unique geologic features are considered significant.

Transportation Network Improvements and Programs

Major transportation network improvements by 2050 include new Managed Lanes and Managed Lane Connectors on SR 52, SR 56, ~~SR 75,~~ SR 94, SR 125, SR 163, I-15, and I-805, several of which will be a continuation of improvements from 2035. In addition, the proposed Plan includes increased roadway and transit connections to the United States–Mexico border, as well as expansion of and improvements to existing port of entry facilities, which will continue during this period. Upgrades at certain locations on the LOSSAN Rail Corridor would continue during this period. Grade separations on the SPRINTER, Blue Line, Green Line, and Orange Line, as well as double-tracking on the SPRINTER would also continue during this period. See Tables 2-7 through 2-10 for a full list of proposed projects by subregion.

It is anticipated that transportation network improvements would start between 2022 and 2035 and continue to be implemented between 2036 and 2050. Many significant earthwork activities (e.g., grading, excavation, and foundation building) would occur between 2022 and 2035. Other above-grade construction (roadways extension and bridge construction) would continue throughout 2050. Therefore, the greatest impacts from construction would likely occur by 2035. However, ground disturbances associated with the construction of transportation network improvements and programs, such as shoulder widening and rail construction projects, would still occur within geologic formations of moderate to high paleontological resource potential and areas containing unique geologic features during the 2036 to 2050 timeframe. Other unique paleontological resources or unique geologic features could also be destroyed or altered by runoff or erosion.

As discussed in the 2035 analysis, existing federal, state, and local laws; regulations; and programs included in Section 4.7.2 would help reduce impacts on unique paleontological resources and unique geologic features, but because these requirements are not uniformly strict or enforceable, these measures do not guarantee reduced significant impacts for all future projects. Therefore, impacts on unique paleontological resources and unique geologic features are considered significant.

2050 Conclusion

Direct impacts to paleontological resources and unique geologic features would occur as a result of the physical destruction and alteration of the resources and features by construction equipment during ground disturbing activities such as grading, excavation, trenching, boring, pile driving, and tunneling activities. Indirect impacts to paleontological resources and unique geologic features would occur as a result of increased erosion effects that expose unique paleontological resources to destruction through mechanical and chemical weathering and destroy or alter the physical characteristics of unique geologic features. Therefore, implementation of the proposed Plan would result in regional growth and land use change as well as transportation network improvements and programs that would directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. This impact (GEO-5) in the year 2050 is significant.

MITIGATION MEASURES

GEO-5 DIRECTLY OR INDIRECTLY DESTROY A UNIQUE PALEONTOLOGICAL RESOURCE OR SITE OR UNIQUE GEOLOGICAL FEATURE.

2035, 2050

GEO-5a Identify the Potential for Unique Paleontological Resources or Unique Geologic Features for Development Projects or Transportation Network Improvements.

During planning, design, and project-level CEQA review of transportation network improvements or development projects, SANDAG shall, and other transportation project sponsors, the County of San Diego, cities, and other local jurisdictions can and should, assess the potential for disturbing unique paleontological resources (e.g., fossils and fossiliferous deposits consisting of identifiable vertebrate fossils, large or small; and uncommon invertebrate, plant, and trace fossils) or affecting unique geological features (i.e., a geologic feature that is the best example of its kind locally or regionally, illustrates a geologic principle, provides a key piece of geologic information, is the "type locality" of a fossil or formation, or has high aesthetic appeal) in the project area. For project sites with a high probability of these resources being present, SANDAG shall, and other transportation project sponsors, the County of San Diego, cities, and other local jurisdictions can and should, retain a qualified paleontologist to conduct a field survey and recommend subsequent steps to be taken during project construction to reduce or avoid impacts on these resources—as described in Mitigation Measure GEO-5b—in a report documenting the field survey, and with as-needed support from a registered geologist for unique geologic features not related to fossil localities or fossiliferous deposits.

GEO-5b Impacts on Unique Paleontological Resources or Unique Geologic Features for Development Projects or Transportation Network Improvements.

If it is determined during planning, design, and project-level CEQA review that transportation network improvements or development projects would be located within an area that likely contains unique paleontological resources or unique geologic features (based on results of the work done in Mitigation Measure GEO-5a), SANDAG shall, and other transportation project sponsors, the County of San Diego, cities, and other local jurisdictions can and should, avoid or reduce impacts on these resources when feasible.

If impacts to paleontological resources cannot be avoided, SANDAG shall, and other transportation project sponsors, the County of San Diego, cities, and other local jurisdictions can and should, retain a qualified paleontologist prior to construction to:

- Prepare a paleontological monitoring and mitigation plan, which will outline where monitoring should occur and procedures for discoveries, consistent with applicable regulations and guidelines. Such regulatory standards include the Antiquities Act of 1906, PRPA, and PRC requirements; regional and local policies of San Diego County and the cities of Carlsbad, Chula Vista, Coronado, Del Mar, Encinitas, Escondido, Imperial Beach, La Mesa, Lemon Grove, National City, Oceanside, Poway, San Diego, San Marcos, Santee, Solana Beach, and Vista; and guidelines of other transportation project sponsors, such as California Department of Transportation's *Standard Environmental Reference, Environmental Handbook: Volume 1: Guidance for Compliance,* "Chapter 8: Paleontology" (Caltrans 2025).
- Establish procedures for monitoring and the possible preconstruction salvage of exposed unique resources if fossil-bearing rocks or unique geologic features have the potential to be affected.
- Provide preconstruction coordination with contractors.
- Be on site to observe during grading operations and oversee original cutting in previously undisturbed areas of sensitive geologic formations, temporarily halt or redirect construction activities as appropriate to allow recovery of newly discovered fossil remains, recover scientifically valuable specimens or ensure avoidance of the unique paleontological resource, and oversee fossil salvage operations and reporting.

If impacts to unique geologic resources cannot be avoided, SANDAG shall, and other transportation project sponsors, the County of San Diego, cities, and other local jurisdictions can and should:

- Implement construction techniques or project features that minimize the potential for damage, if feasible.
- Establish procedures for the collection and preservation of important scientific data from the unique geologic feature prior to and, if warranted, during construction.

SIGNIFICANCE AFTER MITIGATION

2035, 2050

Implementation of regional growth and land use change as well as transportation network improvements and programs of the proposed Plan would result in significant impacts on a unique paleontological resource or unique geologic feature in 2035 and 2050, despite compliance with existing regulations. Implementation of mitigation measures GEO-5a and GEO-5b would protect these unique resources through the presence of a certified paleontologist; however, it cannot be guaranteed that these measures will reduce impacts to a less-than-significant level for projects under the proposed Plan. Therefore, this impact (GEO-5) is significant and unavoidable.

4.7.5 Cumulative Impacts Analysis

C-GEO-1 MAKE A CUMULATIVE CONSIDERABLE CONTRIBUTION TO ADVERSE EFFECTS ON GEOLOGICAL AND SOIL RESOURCES

C-PALEO-1 MAKE A CUMULATIVE CONSIDERABLE CONTRIBUTION TO ADVERSE EFFECTS ON PALEONTOLOGICAL RESOURCES

The area of geographic consideration for cumulative impacts is the Southern California and Northern Baja California region. While some geology and soil features can be very distinct to certain locations, geologic features can also have broad-reaching elements, such as faults and underlying bedrock formations. Geology, soils, and paleontological resources are not confined by jurisdictional boundaries. Thus, it is necessary to consider geologic resources, soils, and paleontological resources in Southern California and Northern Baja California as a whole region.

A projection approach for cumulative analysis of geologic, soils, and paleontological resources allows for an overarching discussion of regional and cross-border risks of seismic and geologic hazards, soil erosion or loss, and destruction of unique paleontological resources or unique geologic features associated with general patterns of regional urbanization, growth, and land use changes. A significant cumulative impact on geology, soils, and paleontological resources would occur if the proposed Plan's incremental effect would be cumulatively considerable when considered in combination with the effects on geology, soils, and paleontological resources resulting from implementation of approved regional planning documents. Significant cumulative impacts would occur if there were cumulative risks of exposure of people or structures to substantial seismic or geologic hazards, development on unstable geologic units, soil loss or erosion, or destruction of unique paleontological resources or unique geologic features in Southern California and Northern Baja California.

This cumulative impact assessment considers and relies on the impact analysis within this EIR for the proposed Plan, the Southern California Association of Governments (SCAG) 2024-2050 RTP/SCS EIR (SCAG 2024) for the Southern California region, the County of San Diego 2011 General Plan Update EIR (County of San Diego 2011b), and the California-Baja California Border Master Plan (Caltrans and SIDURT 2021). There are generally no regional plans pertaining to such resources for the Northern Baja California region.

Impacts of the Proposed Plan

Regional growth and land use change and the transportation network improvements associated with the proposed Plan would expose additional people and structures to seismic hazards, such as strong seismic ground shaking, fault rupture, liquefaction, and earthquake-induced landslides because development would occur in hazard areas within the San Diego region.

Future land development and transportation network improvements under the proposed Plan also would place structures at risk of impacts caused by unstable soils, including expansive, collapsible, or unstable soils; landslides; and erosion or loss of topsoil. Future development on soils that incapable of adequately supporting the use of septic tanks or OWTS would cause adverse groundwater impacts. Compliance with existing regulations discussed in Section 4.7.2, "Regulatory Setting," would ensure that these impacts would not be significant in 2035 or 2050. Compliance with regulatory requirements and implementation of required design measures would ensure that regional growth and land use change as well as transportation network improvements and programs associated with the proposed Plan would not cause substantial soil erosion or the loss of topsoil, and the impact would be less than significant in 2035 and 2050 (Impacts GEO-1 through GEO-4).

Areas throughout the region have distinct geologic rock formations with known paleontological sensitivity and areas with unique geologic features. Ground-disturbing activities, such as construction associated with development, redevelopment, and transportation network improvements, in some locations would directly or indirectly destroy a unique paleontological resource or site or unique geological feature. Existing federal, state, and local laws; regulations; and policies included in Section 4.7.2, "Regulatory Setting," would help reduce impacts on paleontological resources and unique geological resources, but they may not keep impacts from being significant. Therefore, impacts on paleontological resources and unique geologic features would be significant in 2035 and 2050 (Impact PALEO-1).

Impacts of Related Projects

Projects planned in the Southern California region, such as the Navy OTC Revitalization Project, San Diego International Airport (SDIA) Airport Development Plan, High-Speed Train (HST), Midway Rising Specific Plan, and City of San Diego Pure Water North City, would involve ground-disturbing activities that could result in impacts related to destruction or alteration of paleontological resources or unique geologic features. Other land development and infrastructure projects throughout the region, such as transportation infrastructure, energy generation and transmission corridors, and commercial and residential land development would also result in impacts if these projects occur in areas containing significant paleontological resources or unique geologic features.

For example, the HST project in the San Diego region would result in construction of track, bridges and elevated guideways, stations, and other features that may result in destruction or alteration of paleontological resources (HSRA 2005). The EIR/EIS prepared for the HST project determined that the project would result in significant cumulative impacts on paleontological resources. The EIR/EIS also determined that the project would result in a considerable contribution to the cumulative impact to geology and soils related to slope stability in areas susceptible to slope failure and the contributions to the cumulative impacts related to major geologic hazards such as major fault crossings, oil fields, and landslide areas, will be avoided through implementation of mitigation measures. The EIR for the SDIA Airport Development Plan did not identify significant impacts to paleontological resources (SDCRAA 2020). The SDIA Airport Development Plan, in combination with cumulative projects, would result in a less than significant impact related to geologic hazards such as ground rupture, ground acceleration, liquefaction, and settlements (SDCRAA 2020). The Navy OTC Revitalization Project would also not result in cumulatively considerable impacts related to paleontological resources and geologic hazards such as landslides, liquefaction, and soil stability characteristics (U.S. Department of the Navy 2021). The City of San Diego Pure Water North City Project concluded that impacts on paleontological resources and geology and soils would be less than significant with the implementation of mitigation measures (City of San Diego 2018). Impacts would similarly be cumulatively considerable, if these projects occur in proximity to one another within the same paleontologically sensitive geologic units or unique geologic feature.

Impacts of Projections in Adopted Plans

The EIR prepared for the SCAG 2024-2050 RTP/SCS analyzed impacts on the SCAG region up to 2050 and identified significant and unavoidable impacts related to implementation of that plan due to substantial soil erosion and loss of topsoil and the destruction of a unique paleontological resource or site or unique geologic feature. The EIR also found that the 2024-2050 SCAG RTP/SCS would contribute to a cumulatively considerable impact related to the geology, soils, and paleontological resources (SCAG 2024). The EIR prepared for the County of San Diego 2011 General Plan Update found that implementation of the updated General Plan would not result

in significant direct or cumulative impacts associated with the exposure to seismic-related hazards, soil erosion or topsoil loss, soil stability, or expansive soils; and with mitigation, the General Plan Update would result in less-than-significant direct or cumulative impacts on paleontological resources (County of San Diego 2011b).

Geology and Soils

Adopted plans for local jurisdictions in Southern California and Northern Baja California would support the construction of new development and redevelopment through policy changes, general plan updates, and zoning amendments that encourage and facilitate population growth and land use changes. Due to the seismically active nature of the Southern California and Northern Baja California region, these development projects would subject additional people and structures to ground shaking, fault rupture, liquefaction, and earthquake-induced landslides. Projects would also be susceptible to impacts caused by unstable soils, including expansive, collapsible, or unstable soils; and landsliding. The severity of these impacts would be determined by geographic location, soil type, and construction requirements, such as grading and excavation. Development associated with the implementation of regional planning documents in California would be required to adhere to the design standards described in the CBC and the Uniform Building Code (UBC), which regulate the design and construction of buildings and structures and effectively reduce the effects of seismic activity and geologic hazards at the project level.

Paleontological Resources

The California-Baja California Border Master Plan does not provide analysis of impacts on paleontological resources; however, projects included in the Master Plan could have adverse impacts on paleontological resources due to ground disturbance necessary for construction of infrastructure.

Cumulative Impacts and Impact Conclusions

2035

A significant cumulative impact in the year 2035 would result if the proposed Plan's incremental effect would be cumulatively considerable when considered along with the effects from adopted plans and cumulative projects within the Southern California and Norther Baja California region.

Geology and Soils

As described above, implementation of the regional growth and land use change and transportation network improvements associated with the proposed Plan would expose additional people and structures to seismic hazards, such as ground shaking, fault rupture, liquefaction, and earthquake-induced landslides, as development occurs in hazard areas within the San Diego region. Future development would also place structures at risk to impacts caused by unstable soils, including expansive, collapsible, or unstable soils; landsliding; and erosion or loss of topsoil. Whether from the proposed Plan or from cumulative projects or development associated with other approved plans, such as the SCAG 2024-2050 RTP/SCS, impacts would generally be confined to a specific project area, rather than result in an aggregated cumulative effect over the Southern California and Northern Baja California region. All development and infrastructure projects in the state of California would be required to adhere to the design standards described in the CBC and the UBC, which regulate the design and construction of buildings and structures and substantially reduce the effects of seismic activity and other geologic hazards at the project level, as described in Section 4.7.4 "Environmental Impacts and Mitigation Measures." Development of septic tanks in the region would be required to comply with standards described in the CBC and all standard design, grading, and construction practices to avoid or reduce adverse groundwater impacts associated with expansive soils, or soils incapable of adequately supporting the use of septic tanks and alternative wastewater disposal systems, as described in Section 4.7.2, "Regulatory Setting." Therefore, cumulative impacts related to geologic and seismic hazards or unstable soils would not be significant, and the proposed Plan would not result in cumulatively considerable impacts related to geologic and seismic hazards or unstable soils.

Paleontological Resources

As described above, any future development projects implementing the proposed Plan would be required to adhere to the regulations and policies discussed in Section 4.7.2, "Regulatory Setting"; however, these measures

do not guarantee reduced significant impacts for all future development projects. The proposed Plan's incremental impacts on unique paleontological resources and unique geologic features are significant. Implementation of the proposed Plan combined with other regional plans and cumulative projects in the Southern California and Northern Baja California region would result in a significant cumulative impact associated with paleontological resources and unique geological features from extensive grading, excavation, or other ground-disturbing activities. Development would be regulated by state and local laws and regulations, including CEQA and local jurisdictions' grading ordinances. However, cumulative growth and development located in Mexico would not be subject to compliance with such regulations. Additionally, the loss of paleontological resources or unique geological features on a regional level would not be adequately avoided or reduced through methods specified in these regulations because regulatory requirements are not uniformly strict or enforceable. According to the above analysis, cumulative impacts on paleontological resources and unique geological features would be significant. Because cumulative paleontological resource impacts throughout the Southern California and Northern Baja California region would be significant and because the proposed Plan's incremental impacts are significant, the proposed Plan's incremental paleontological resource and unique geological feature impacts are cumulatively considerable and therefore significant (Impact C-PALEO-1).

2050

A significant cumulative impact in the year 2050 would result if the proposed Plan's incremental effect would be cumulatively considerable when considered along with the effects from adopted plans and cumulative projects within the Southern California and Norther Baja California region.

Geology and Soils

By 2050, transportation and development projects associated with the proposed Plan and other development in Southern California and Northern Baja California region associated with cumulative projects and other regional plans would expose additional people and structures to geologic and seismic hazards, such as ground shaking, fault rupture, liquefaction, and earthquake-induced landslides; would also place structures at risk to impacts caused by unstable soils, including expansive, collapsible, or unstable soils, and landsliding and would cause erosion or loss of topsoil. Similar to the 2035 analysis, all development and infrastructure projects in the state of California would be required to adhere to the design standards described in the CBC and the UBC, which regulate the design and construction buildings and structures and substantially reduce the effects of seismic activity and other geologic hazards at the project level, as described in Section 4.7.4 "Environmental Impacts and Mitigation Measures." Therefore, cumulative impacts related to geologic and seismic hazards or unstable soils would not be significant, and the proposed Plan would not result in cumulatively considerable impacts related to geologic and seismic hazards or unstable soils.

Paleontological Resources

As described in the 2035 analysis, cumulative impacts on paleontological resources and unique geological features would be significant because there would be cumulative adverse changes in the significance of those resources due to the proposed Plan, cumulative projects, and development located in Southern California and Northern Baja California region associated with other regional plans. Because the proposed Plan's impacts on paleontological resources and unique geological features are significant, they are also cumulatively considerable and significant in 2050 (Impact C-PALEO-1).

MITIGATION MEASURES

C-PALEO-1 MAKE A CUMULATIVELY CONSIDERABLE CONTRIBUTION TO ADVERSE EFFECTS ON PALEONTOLOGICAL RESOURCES

Mitigation measure GEO-5a calls for project implementation agencies to assess impacts on unique paleontological resources or unique geological features prior to construction of individual projects associated with the proposed Plan. If a project is determined to be located within an area likely to contain unique paleontological resource sensitivity or unique geologic features, implementation of mitigation measure GEO-5b calls for avoidance where

feasible or provide a qualified paleontologist to be stationed on site of any future development to monitor construction; identify valuable paleontological specimens, if any; and recover and report on any significant resources found at the site. Additionally, when avoidance of unique geologic features is not feasible, mitigation measure GEO-5b calls for the implementation of construction techniques and project features that minimize damage, and for the collection and preservation of scientific data associated with the unique geologic feature.

Implementation of mitigation measures GEO-5a and GEO-5b would protect these resources through the presence of a certified paleontologist and compliance with existing regulations; however, it cannot be guaranteed that these measures will reduce impacts to a less-than-significant level for all projects. Therefore, the proposed Plan's incremental contributions to cumulative paleontological and unique geologic feature impacts in years 2035 and 2050 would remain cumulatively considerable and significant post-mitigation.

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