

CONSOLIDATED FINAL RESTORATION PROJECTS STATEWIDE ORDER
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flow from opposite ends of the Central Valley into the Sacramento–San Joaquin Delta and San Pablo Bay. Surrounding this ecoregion are other regions that consist of hilly or mountainous topography. More than half of the Central California Valley Ecoregion is cropland, about three-quarters of it irrigated (Griffith et al. 2016).

Southern California Mountains

The Southern California Mountains Ecoregion has a Mediterranean climate of hot, dry summers and moist, cool winters. This ecoregion extends 200 miles and includes coastal and alluvial plains, marine terraces, and some low hills in coastal areas of Southern California. Elevations are higher, with slightly cooler summers and more precipitation than in adjacent ecoregions. Mountains within this range are composed progressively of older rocks from the west to east, which is one of the ecoregion's defining characteristics. This characteristic is emphasized by faults and folds that control the trend and shape of the mountains, valleys, and coastline. Sedimentary rocks are predominantly in the west, and older igneous and metamorphic rocks predominate in the east (Sharp 1994). In parts of this ecoregion, a slope effect causes distinct ecological differences: The south-facing slope receives more precipitation (30–40 inches per year) than the northern slope (15–20 inches) (Griffith et al. 2016).

Eastern Cascades Slopes and Foothills

This ecoregion is found within the rain shadow of the Cascades Ecoregion, and it experiences greater temperature extremes and less precipitation, along with frequent fires. The Eastern Cascades Slopes and Foothills Ecoregion was formed through tectonic uplift and is characterized by its common volcanic cones, plateaus, and buttes. Historically, creeping ground fires burned through accumulated fuel, and devastating crown fires were less common in dry forests.

Central Basin and Range

The Central Basin and Range Ecoregion is a large region that encompasses most of the western U.S.: southern Oregon, eastern California, the southern portions of Arizona and New Mexico, western Texas, and most of Nevada. The ecoregion is approximately 132,498 square miles, with only about 3.7 percent of its area falling within California (Soulard 2012). It contains alternating north-south trending faulted mountains and valley floors through the region.

This ecoregion is distinguished by its rugged desert country, with high topographic relief and subparallel fault-bounded mountain ranges (State Parks 2015). Playas at the lowest elevations in the Lahontan Basin are the terminus or “sink” of rivers that flow east from the Sierra Nevada. The ecoregion also contains California's lowest point of elevation (282 feet below sea level in Death Valley), and the highest point is 14,252 feet above sea level at White Mountain Peak.

There are three separate physiographic areas in California's Basin and Range Ecoregion: the northernmost portion, bounded by the Modoc Plateau and Nevada border; the middle portion, bounded to the north by the Modoc Plateau and to the south by the Sierra Nevada region; and the largest, southernmost portion, bounded to the west by the Sierra Nevada region, to the south by the Mojave Desert, and to the east by

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the Nevada border. The region is distinctly cut off by the Garlock Fault to the south. The mountain ranges and intervening valleys are 50–100 miles long and 15–20 miles wide (Sharp 1994). Soils in this region grade upslope from mesic Aridisols to frigid Mollisols.

Mojave Basin and Range

The Mojave Basin and Range Ecoregion stretches across southeastern California, southern Nevada, southwestern Utah, and northwestern Arizona. It is composed of broad basins with scattered mountains that are generally lower, warmer, and drier than in the Central Basin and Range Ecoregion. The ecoregion is bounded on the north by the Central Basin and Range Ecoregion, on the east by the Colorado Plateaus and the Arizona/New Mexico Plateau Ecoregions, on the south by the Sonoran Basin and Range Ecoregion, and on the west by the Southern California Mountains and the Sierra Nevada Ecoregions. The highest elevation in the ecoregion is 7,292 feet at Clark Mountain, with valley bottoms ranging from 2,000 to 4,000 above sea level. The Mojave Desert is bordered by the Garlock Fault to the north, the San Andreas Fault to the southwest, and the southern part of Death Valley fault zone to the east (Walker et al. 2002).

Precambrian to late Cenozoic age rocks are exposed across the ecoregion. The basin's soils mostly comprise Entisols and Aridisols that typically have a thermic temperature regime. Soils are susceptible to wind and water erosion because of heavy human interference.

Klamath Mountains/California High North Coast Range

The Klamath Mountains/California High North Coast Range Ecoregion covers an elongated north-trending area in Northern California and southern Oregon. In California, it consists of several mountain ranges with features such as accordant summit levels, highly dissected old land surfaces, and high-elevation glacial topography. Most precipitation in this ecoregion drains westerly through deeply incised canyons of the Klamath and Trinity Rivers, with the easternmost areas draining toward the east and then south to the Sacramento River. Rocks in this ecoregion range in age from Ordovician to Late Jurassic and comprise greywacke sandstones, mudstones, greenstones, radiolarian cherts, limestone, and igneous intrusive rocks (Irwin 1966). Concentric belts from the east to the west, referred to as the Eastern Klamath, Central Metamorphic, Western Paleozoic and Triassic, and Western belts, are responsible for its pattern of distribution.

Northern Basin and Range

The Northern Basin and Range Ecoregion is characterized by its dissected lava plains, rocky uplands, valleys, alluvial fans, and scattered mountain ranges. Aridisols are common within this range. Temperatures tend to be cooler and have more available moisture than in the Central Basin and Range Ecoregion and are higher and cooler than in the Snake River Plain Ecoregion to the northeast in Idaho.

Sonoran Basin and Range

The Sonoran Basin and Range Ecoregion has similar topography to the Mojave Basin and Range Ecoregion. It is characterized by scattered low mountains and contains large tracts of federally owned land. The Sonoran Basin and Range Ecoregion is slightly hotter

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than the Mojave Range. Precipitation in this ecoregion during the winter decreases from west to east, with summer precipitation decreasing from the east to west. This ecoregion contains harsh environments for plant growth because of the dominant Aridisols and Entisols with hypothermic soil temperatures and highly aridic soil moisture regimes.

Southern California/Northern Baja Coast

The Southern California/Northern Baja Coast Ecoregion, extending more than 200 miles south into Baja California, contains coastal and alluvial plains, marine terraces, and a few low hills in the coastal area of Southern California.

3.9.3 Regulatory Setting

This section discusses federal, state, and regional and local plans, policies, regulations, and laws, and ordinances pertaining to geological resources and soils.

Future permitted restoration projects that would be implemented under the Order may be subject to the laws and regulations listed below, as well as other local or individual restoration projects requirements, depending on the project location.

Federal

U.S. Geological Survey Quaternary Faults

The U.S. Geological Survey (USGS) maintains a database of Quaternary fault and fold parameters (USGS 2019). The database is periodically updated to reflect the latest data available and current understanding of fault behaviors. These fault parameters were used to develop the National Seismic Hazard Maps.

U.S. Geological Survey National Seismic Hazard Maps

USGS publishes probabilistic seismic hazard maps for the 48 conterminous states (USGS 2009). These maps depict contour plots of peak ground acceleration and spectral accelerations at selected frequencies for various ground motion return periods. The maps were developed for a reference site condition with an average shear-wave velocity of about 2,500 feet per second in the top 100 feet. Ground motions in the Sacramento–San Joaquin Delta may be as much as two to four times higher than elsewhere as a result of soft soil amplification.

The USGS National Seismic Hazard Maps are updated periodically and have been adopted by many building and highway codes.

U.S. Geological Survey Landslide Hazard Program

USGS provides information on the causes of ground failure and mitigation strategies to reduce long-term losses from landslide hazards. The information is useful for understanding the nature and scope of ground failures and for improving mitigation strategies.

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Federal Regulatory Design Codes for Buildings, Highways, and Other Structures

Federal standards for minimum design regulate the construction of any buildings and other structures and include the following:

- ◆ American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-10, 2013
- ◆ U.S. Army Corps of Engineers (USACE) (CESPK-ED-G), Geotechnical Levee Practice, SOP EDG-03, 2004
- ◆ USACE Design and Construction of Levees, EM 1110-2-1913, 2000
- ◆ USACE Engineering and Design, Earthquake Design and Evaluation for Civil Works Projects, ER 1110-2-1806, 2016
- ◆ USACE Engineering and Design—Earthquake Design and Evaluation of Concrete Hydraulic Structures, EM 1110-2-6053, 2007
- ◆ USACE Engineering and Design—Response Spectra and Seismic Analysis for Concrete Hydraulic Structures, EM 1110-2-6050, 1999
- ◆ USACE Engineering and Design—Stability Analysis of Concrete Structures, EM 1110-2-2100, 2005
- ◆ USACE Engineering and Design—Structural Design and Evaluation of Outlet Works, EM 1110-2-2400, 2003
- ◆ USACE Engineering and Design—Time-History Dynamic Analysis of Concrete Hydraulic Structure, EM 1110-2-6051, 2003
- ◆ USACE Slope Stability, EM 1110-2-1902, 2003
- ◆ U.S. Department of the Interior and USGS Climate Change and Water Resources Management: A Federal Perspective, Circular 1331

These standards establish the minimum design criteria and construction requirements, including design, for concrete and steel structures, levees, buildings, pumping stations, excavation and shoring, grading, and foundations. Standards issued by the state are listed in the following section.

National Earthquake Hazards Reduction Act (U.S. Code Title 42 Section 7704)

In 1977, the U.S. Congress enacted the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124) to “*reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program.*” The National Earthquake Hazards Reduction Program was also enacted in 1977, to accomplish the goals of the act. The Earthquake Hazards Reduction Act and National Earthquake Hazards Reduction Program were amended in 1990 to refine the description of agencies’ responsibilities, program goals, and objectives. The Earthquake Hazards Reduction Act was amended as the National Earthquake Hazards Reduction Program Act. The four general goals of the National Earthquake Hazards Reduction Program are:

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- ◆ Develop effective practices and policies to reduce losses of life and property from earthquakes and accelerate their implementation.
- ◆ Improve techniques for reducing seismic vulnerabilities of facilities and systems.
- ◆ Improve earthquake hazards identification and risk assessment methods, and their use
- ◆ Improve the understanding of earthquakes and their effects.

The National Earthquake Hazards Reduction Program Act designates the Federal Emergency Management Agency as the program's lead agency. Other supporting agencies include the National Institutes of Standards and Technology, the National Science Foundation, and USGS.

State

Liquefaction and Landslide Hazard Maps (Seismic Hazards Mapping Act)

The Seismic Hazards Mapping Act of 1990 (Public Resources Code Sections 2690 to 2699.6) was enacted following the Loma Prieta earthquake to reduce threats to public health and safety by identifying and mapping known seismic hazard zones in California. The act directs the California Geological Survey (formerly known as the California Division of Mines and Geology) to identify and map areas prone to earthquake hazards of liquefaction, earthquake-induced landslides, and amplified ground shaking. The maps assist cities and counties in fulfilling their responsibilities for protecting public health and safety.

As of April 2019, more than 100 official seismic hazard zone maps showing areas prone to liquefaction and landslides had been published in California, and more maps are scheduled for publication. Most mapping has been performed in Southern California and the San Francisco Bay Area.

A development permit review is required for sites in the mapped seismic hazard zones. Site-specific geologic investigations and evaluations are carried out to identify the extent of hazards, and appropriate mitigation measures are incorporated in the development plans to reduce potential damage.

Alquist-Priolo Earthquake Fault Zones

The Alquist-Priolo Earthquake Fault Zoning Act (then called the Alquist-Priolo State Special Studies Zone Act) was enacted in 1972 (Public Resources Code Section 2621 et seq.). Similar to the Seismic Hazards Mapping Act, the Alquist-Priolo Act's main purposes are to identify known active faults in California and to prevent the construction of buildings for human occupancy on the surface trace of active faults.

State Regulatory Design Codes for Buildings, Highways, and Other Structures

State standards for minimum design regulate the construction of any buildings and other structures and include the following:

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- ◆ California Amendments to American Association of State Highway and Transportation Officials Load and Resistance Factor Design Bridge Design Specifications, Fourth Edition, 2008
- ◆ California Building Code, 2007 (California Code of Regulations Title 24)
- ◆ California Department of Transportation Seismic Design Criteria, latest edition
- ◆ California Department of Water Resources Division of Safety of Dams Guidelines for Use of the Consequence-Hazard Matrix and Selection of Ground Motion Parameters, 2002
- ◆ California Department of Water Resources Interim Levee Design Criteria for Urban and Urbanizing Area State-Federal Project Levees, 2009

California Building Code

California's minimum standards for structural design and construction are provided in the California Building Code (California Code of Regulations Title 24). The California Building Code provides standards for various aspects of construction, including excavation, grading, and fill. It provides requirements for classifying soils and identifying corrective actions when native soil properties could lead to structural damage (e.g., expansive soils).

Surface Mining and Reclamation Act of 1975

The State Mining and Reclamation Act of 1975 (Public Resources Code Section 2710 et seq.) required the California State Geologist to implement a mineral land classification system to identify and protect mineral resources of regional or statewide significance in areas where urban expansion or other irreversible land uses may occur, thereby potentially restricting or preventing future mineral extraction on such lands. The intent of this law is for this information to be considered in local land use planning activities through the adoption of mineral resource management policies in general plans (Public Resources Code Section 2762). The California State Mining and Geology Board (SMGB) classifies such urban and non-urban lands according to a priority list, or when the board is otherwise petitioned to classify a particular land area.

As mandated by the State Mining and Reclamation Act, the SMGB classifies aggregate mineral resources in the state by applying the Mineral Resource Zone (MRZ) system. The MRZ system maps all mineral commodities within identified jurisdictional boundaries; priority is given to areas where land use compatibility issues may prevent or restrict future extraction of mineral resources, or where mineral resources may be mined during the 50-year period following their classification. The system classifies lands that contain mineral deposits and identifies the presence or absence of substantial sand and gravel deposits and crushed rock source areas (i.e., commodities used as, or in the production of, construction materials).

The State Geologist classifies MRZs in a region based on the following factors:

- ◆ **MRZ-1:** Areas where adequate information indicates that no significant mineral deposits are present, or where little likelihood exists for their presence.

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- ◆ **MRZ-2:** Areas where adequate information indicates that significant mineral deposits are present, or where a high likelihood exists for their presence.
- ◆ **MRZ-3:** Areas containing mineral deposits for which the significance cannot be determined from available data.
- ◆ **MRZ-4:** Areas where available information is inadequate for assignment of any other MRZ category.

Mining operations and mine reclamation activities must be performed in accordance with laws and regulations adopted by the SMGB, as contained in Section 3500 et seq. of Title 14 of the California Code of Regulations. The California Department of Conservation's Office of Mine Reclamation oversees reclamation requirements.

California Geological Survey

The California Geological Survey assists in the identification and proper use of mineral deposits, and in the identification of fault locations and other geological hazards.

Regional and Local

The study area encompasses multiple counties with multiple cities throughout California. Each county and city has local regulations and a general plan with unique goals and policies that guide development and encourage the consideration of geology, soils, seismicity, and mineral resources. These may include protection of soils, adherence to building codes, and protection of mineral resources.

3.9.4 Impacts and Mitigation Measures

Methods of Analysis

Geological and soil impacts from the types of restoration projects permitted under the Order are evaluated in terms of how typical construction and operation of project components could impact geological hazards and soil resources and is dependent on where individual restoration projects would be located relative to known or potential soil resources, geological hazards, and paleontological resources in the study area. However, the precise locations and detailed characteristics of potential future individual restoration projects are yet to be determined. Therefore, this geological resources and soils analysis focuses on reasonably foreseeable changes from implementation of the types of projects and actions that might be taken in the future consistent with the level of detail appropriate for a program-level analysis.

Permanent impacts are considered those that would continue through the life of a proposed restoration project as a result of the environmental conditions created by the project (e.g., implementation of channel stabilization and native revegetation that would increase channel bank stability). Temporary impacts are considered those that would be temporary in nature (e.g., construction related activities).

The approach to assessing geological and soil impacts was to identify and review existing environmental studies, data, model results, and other information for projects that are consistent with those identified in Section 2.6, *Categories of Restoration*

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Projects in the Order, and Section 2.7, *Typical Construction, Operation, and Maintenance Activities and Methods*.

Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, an impact related to geologic, soils, or paleontological resources is considered significant if the types of restoration projects that would be permitted under the Order would do any of the following:

- ◆ 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 of a known fault. (Refer to Division of Mines and Geology Special Publication 42)
 - Strong seismic ground shaking
 - Seismic-related ground failure, including liquefaction
 - Landslides
- ◆ Result in substantial soil erosion or the loss of topsoil
- ◆ Be located on a geologic unit or soil that is 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
- ◆ Be located on expansive soils, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property
- ◆ 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
- ◆ Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature

Potential impacts on mineral resources are addressed in Section 3.13 of this PEIR.

Impacts Not Analyzed Further

The types of restoration projects permitted under the Order would not include the use of septic tanks or alternative wastewater disposal because the projects would not increase the demand for wastewater disposal from construction or operation crews or occupied structures. Therefore, impacts related to this threshold of significance are not addressed further.

Impacts and Mitigation Measures

Table 3.9-1 summarizes the impact conclusions presented in this section by proposed project type under the Order for easy reference.

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As part of the State Water Board or Regional Board’s issuance of a NOA for a restoration project under the Order, compliance with the general protection measures and mitigation measures listed below would be required when applicable to a given project. Not all general protection measures and mitigation measures would apply to all restoration projects. The applicability of the general protection measures and mitigation measures would depend on the individual restoration activities, project location, and the potentially significant impacts of the individual restoration project. Implementation of the mitigation measures would be the responsibility of the project proponent(s) under the jurisdiction of the State Water Board, appropriate Regional Board, or other authorizing regulatory agency.

**Table 3.9-1
Summary of Impact Conclusions—Geology and Soils**

Impact Statement	Construction Activities	Constructed Facilities and Operations and Maintenance
3.9-1: Implementing future restoration projects permitted under the Order could cause direct or indirect adverse effects on people or structures related to risk of loss, injury, or death due to a fault rupture.	LTSM	LTSM
3.9-2: Implementing future restoration projects permitted under the Order could directly or indirectly result in adverse effects on people or structures related to risk of loss, injury, or death due to strong seismic ground shaking.	LTSM	LTSM
3.9-3: Implementing future restoration projects permitted under the Order could directly or indirectly cause adverse effects on people or structures from unstable soil conditions.	LTSM	LTSM
3.9-4: Implementing future restoration projects permitted under the Order could result in substantial soil erosion or loss of topsoil.	LTSG	LTSG
3.9-5: Implementing future restoration projects permitted under the Order could directly or indirectly result in the loss of a unique paleontological resource or geological resource.	SU	SU

SOURCE: Data compiled by Environmental Science Associates in 2019 and 2020
NOTES: LTSG = less than significant with implementation of general protection measures; LTSM = less than significant with mitigation; SU = significant and unavoidable

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Impact 3.9-1: Implementing future restoration projects permitted under the Order could cause direct or indirect adverse effects on people or structures related to risk of loss, injury, or death due to a fault rupture.

Effects of Project Construction Activities, Constructed Facilities (Natural or Artificial Infrastructure), and Operations and Maintenance of those Facilities

Construction of restoration projects, constructed facilities (natural or artificial infrastructure), and operations and maintenance of those facilities permitted under the Order could result in significant adverse effects on people or structures from fault rupture. Reconnecting historical stream and river channels, freshwater deltas with floodplains, and historical estuaries to tidal influence by removing, setting back, and breaching levees could improve seismic stability compared to existing conditions; however, fault rupture could damage these structures. Damage to these features could result in their failure, causing flooding in otherwise protected areas. The degree of impact would depend on the location of activities and structures relative to areas with potential for fault rupture.

For example, a restoration project involving hydraulic reconnection, levee setbacks, and floodplain restoration could be located in a seismically active region, near several known active and potentially active faults, and could expose people or structures to potential fault rupture hazards. However, levees would be designed according to federal, state, and local standards, taking into consideration site conditions and geologic hazards.

Construction of facilities such as fish screens, water control structures, stream crossings, offstream storage ponds, and tanks on or adjacent to a known fault could expose them to risks of fault rupture. Damage to the facilities could result in flooding of otherwise protected areas. For example, water control structures or stream crossings placed in areas subject to fault rupture could be damaged during an earthquake, which could lead to flooding in the areas surrounding the structures. The degree of impact would depend on the location of activities and structures relative to areas with the potential for fault rupture.

Impact Conclusion

The specific locations and scale of possible future restoration projects are not yet determined; therefore, the risk of a fault rupture cannot be determined. Factors needed to identify specific impacts include the project's design, its location relative to underlying soil and geotechnical conditions, and proximity to known earthquake faults. Because restoration projects permitted under the Order could cause direct or indirect adverse effects on people or structures related to the risk due to a fault rupture, this impact would be **potentially significant**. The Order does not include any general protection measures applicable to this impact.

As part of the State Water Board or Regional Board's issuance of a NOA for a restoration project under the Order, compliance with Mitigation Measure GEO-1 and GEO-2 would be required when applicable to a given project. Implementation of this mitigation measure would be the responsibility of the project proponent(s) under the jurisdiction of the State Water Board, appropriate Regional Board, or other authorizing regulatory agency.

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Mitigation Measure GEO-1: Include Geotechnical Design Recommendations

To minimize potential impacts from seismic events and the presence of adverse soil conditions, lead agencies shall ensure that geotechnical design recommendations are included in the design of facilities and construction specifications.

Recommended measures to address adverse conditions shall conform to applicable design codes, guidelines, and standards.

Mitigation Measure GEO-2: Comply with the Alquist-Priolo Act

For construction in an Alquist-Priolo Earthquake Fault Zone, a determination must be made by a licensed practitioner (California Certified Engineering Geologist) that no fault traces are present within structures, such as setback levees. The standard of care for such determinations includes direct examination of potentially affected subsurface materials (soil and/or bedrock) by logging of subsurface trenches. Levee structures may also be required to have heavier reinforcement against strong ground motion, in compliance not only with California regulations but, in many cases, with additional federal regulations.

Implementing Mitigation Measures GEO-1 and GEO-2 would reduce potentially significant impacts related to the potential exposure to people and structures to risk of loss, injury, or death due to a fault rupture to a **less-than-significant** level.

Impact 3.9-2: Implementing future restoration projects permitted under the Order could directly or indirectly result in adverse effects on people or structures related to risk of loss, injury, or death due to strong seismic ground shaking.

Effects of Project Construction Activities, Constructed Facilities (Natural or Artificial Infrastructure), and Operations and Maintenance of those Facilities

Construction of restoration projects, constructed facilities (natural or artificial infrastructure), and operations and maintenance of those facilities permitted under the Order could result in a variety of direct or indirect adverse effects on people or structures related to strong seismic ground shaking. Because of the presence of known and active faults found throughout the state, strong ground motion during a seismic event could occur in the study area.

Newly constructed fish screens, water control structures, stream crossings, offstream storage ponds and tanks, or other facilities could be located in areas that expose them to strong seismic groundshaking. Damage to the facilities could result in the flooding of otherwise protected areas. For example, water control structures or stream crossings placed in areas subject to strong seismic groundshaking could be damaged during an earthquake, which could lead to flooding of the areas surrounding the structures. The degree of impact would depend on the locations of the activities and structures relative to areas with the potential for groundshaking.

Some restoration projects permitted under the Order could have beneficial impacts related to seismic ground shaking. For example, a restoration project could stabilize embankment slopes by removing non-native vegetation that is in poor condition and poses safety hazards to surrounding areas in the event of severe seismic shaking. With

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removal of the non-native vegetation and implementation of channel stabilization and native revegetation, impacts related to strong seismic shaking would be beneficial by reducing the potential for injuries and increasing channel bank stability.

Impact Conclusion

The specific locations and scale of possible future permitted restoration projects are not known at this time; therefore, the risk associated with strong seismic ground shaking cannot be determined. Because restoration projects permitted under the Order could directly or indirectly result in adverse effects on people or structures related to strong seismic ground shaking, this impact would be **potentially significant**. The Order does not include any general protection measures applicable to this impact.

As part of the State Water Board or Regional Board's issuance of a NOA for a restoration project under the Order, compliance with Mitigation Measure GEO-3 would be required when applicable to a given project. Implementation of this mitigation measure would be the responsibility of the project proponent(s) under the jurisdiction of the State Water Board, appropriate Regional Board, or other authorizing regulatory agency.

Mitigation Measure GEO-3: Conduct Individual Restoration Project Geotechnical Investigation and Report

When a restoration project involves potentially significant grading activities and warrants consideration of geotechnical factors and/or constraints (e.g., work on flood control levees, work in areas with certain soil types subject to liquefaction), the project proponent shall conduct and prepare a geotechnical report to address potential issues and concerns. The geotechnical report shall include a quantitative analysis to determine whether excavation or fill placement would result in a potential for damage due to soil subsidence during and/or after construction. Project designs shall incorporate measures to reduce the potential damage to a less-than-significant level. Measures shall include but not be limited to:

- ◆ Removal and recompaction of existing soils susceptible to subsidence
- ◆ Ground improvement (such as densification by compaction or grouting, soil cementation)
- ◆ Reinforcement of structural components to resist deformation due to subsidence

The assessment of subsidence for specific projects shall analyze the individual restoration projects potential for and severity of cyclic seismic loading.

A geotechnical investigation shall also be performed by an appropriately licensed professional engineer and/or geologist to determine the presence and thickness of potentially liquefiable sands that could result in loss of bearing value during seismic shaking events. Project designs shall incorporate measures to mitigate potential damage to a less-than-significant level. Measures shall include but not be limited to:

- ◆ Ground improvement (such as grouting or soil cementation)

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- ◆ Surcharge loading by placement of fill, excavation, soil mixing with non-liquefiable finer-grained materials, and replacement of liquefiable materials at shallow depths
- ◆ Reinforcement of structural components to resist deformation due to liquefaction

An analysis of individual restoration projects probable and credible seismic acceleration values, conducted in accordance with current applicable standards of care, shall be performed to provide for a suitable project design. Geotechnical investigations shall be performed, and geotechnical reports shall be prepared in the responsible care of California licensed geotechnical professionals including professional civil engineers, certified geotechnical engineers, professional geologists, certified engineering geologists, and certified hydrogeologists, all of whom practice within the current standards of care for such work.

Mitigation Measure GEO-4: Adhere to International Building Code

Constructed facilities shall be required to adhere to the current approved version of the International Building Code (IBC), and to comply with the IBC for critical structures (e.g., levees).

Implementing Mitigation Measures GEO-3 and GEO-4 would reduce potentially significant impacts that could result in direct or indirect adverse effects on people or structures related to the risk due to strong seismic ground shaking to a **less-than-significant** level.

Impact 3.9-3: Implementing future restoration projects permitted under the Order could directly or indirectly cause adverse effects on people or structures from unstable soil conditions.

Effects of Project Construction Activities, Constructed Facilities (Natural or Artificial Infrastructure), and Operations and Maintenance

Construction of restoration projects, constructed facilities (natural or artificial infrastructure), and operations and maintenance of those facilities permitted under the Order could directly or indirectly expose people or structures to unstable soil conditions, including landslides, expansive soils, subsidence, high organic matter soils, or increased runoff. Expansive soils that express shrink-and-swell cycles are found throughout California; these soils could create unstable foundations for rigid structures by exerting pressure on building foundations or could cause surface cracking and runoff infiltration. Construction activities could expose or reduce vertical distance to expansive clays in ground layers beneath the surface and could cause soil fissures that could exacerbate the problem. Exposing expansive soils to moisture could result in upward heaving, especially differential heaving, which could damage improvements. Highly expansive soils are found throughout the state; however, they are more likely to be found in valley basins containing well-developed soils with high clay content than in more organic rich soils or younger alluvial soils near streams.

During the design and construction of restoration projects, it is important to identify and mitigate expansive soils because the potential for construction on expansive soils to

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cause structural problems may not become apparent for many years. For example, floodplain restoration projects permitted under the Order could require constructing new levees to facilitate the removal or breaching of existing levees and the creation of aquatic or riparian habitat. The new levees could be damaged if constructed on unstable soils, potentially exposing the surrounding areas to flooding.

Construction activities and constructed facilities for restoration projects permitted under the Order could be located on soils with high levels of organic matter. Construction on such soils could reduce stability and result in structural problems over time because of instable bearing surfaces. High organic soils generally settle and decrease in volume as organic matter decays. If design and construction of the restoration projects do not account for organic matter, soils with a high organic makeup could degrade structural integrity through the collapse of pore space between molecules or the compaction of saturated silts and sands. Construction activities that would involve placing fill could accelerate subsidence by causing the consolidation of surcharged loads of peat and other unconsolidated sediments, which could lead to differential subsidence after construction and result in distress to the improvements.

Restoration activities permitted under the Order could involve dewatering activities, such as temporary dewatering of a restoration project's construction site, or removal of small dams, which would involve using explosives in dry or dewatered conditions. Subsidence could occur during such activities, with effects similar to the effects of construction on soils with high organic matter, resulting in the collapse of pore space. However, these activities would be short-term and would not likely lead to conditions that would result in subsidence.

Liquefiable sands could be exposed if surficial layers were removed during construction, which would increase the risk of bearing value, soil settlement, and lateral spreading during earthquake-related seismic shaking. This could result in soil liquefaction, in which transient higher pore water pressures in groundwater would cause soils to liquefy. For example, a small dam may be removed in an area where shrink-swell potential is moderate as the result of expansive soils. However, this type of project would not include any habitable structures, nor would it expose people or structures to risks associated with expansive soils.

Restoration projects permitted under the Order could result in beneficial outcomes to the surrounding areas, such as the removal of structures (e.g., legacy structures), which can decrease soil loss and instability. For example, removing an instream legacy structure may potentially increase the area's stability by restoring channel form and preventing further erosion. Another example is a floodplain restoration project that may have beneficial impacts on levee bank stability. Berm construction and levee reconstruction components would reduce the potential for seepage and seepage-related levee failures by reducing hydrostatic exit gradients, and thus increasing bank and soil stability.

Impact Conclusion

To determine the effects of construction activities related to unstable soils, factors such as project design, location relative to underlying soils, and geotechnical conditions would need to be known. Because the potential exists for indirect or direct exposure of

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people or structures to adverse effects from unstable soils during restoration projects permitted under the Order, this impact would be **potentially significant**. The Order does not include any general protection measures applicable to this impact.

As part of the State Water Board or Regional Board's issuance of a NOA for a restoration project under the Order, compliance with Mitigation Measure GEO-3, GEO-6, GEO-7, and GEO-8 would be required when applicable to a given project. Implementation of this mitigation measure would be the responsibility of the project proponent(s) under the jurisdiction of the State Water Board, appropriate Regional Board, or other authorizing regulatory agency.

Mitigation Measure GEO-5: Conduct Expansive Clay Investigation

In areas where expansive clays exist, a licensed professional engineer or geologist shall perform a hydrogeological/geotechnical investigation to identify and quantify the potential for expansion, particularly differential expansion of clayey soils caused by leakage and saturation beneath new improvements. Measures could include but are not limited to removing and recompacting problematic expansive soils, stabilizing soils, and/or reinforcing the constructed improvements to resist deformation from expansion of subsurface soils.

Mitigation Measure GEO-6: Implement Measures for Waterway Construction Activities

For projects that involve the engineered subsurface structural components (e.g., of surface impoundments, levees, bridge footings/abutments) project design shall provide for protection from leakage to the subsurface. Measures could include but are not limited to rendering concrete less permeable by specifying concrete additives such as bentonite, designing impermeable liner systems, designing leakage collection and recovery systems, and constructing impermeable subsurface cutoff walls.

For restoration projects that could cause subsurface seepage of nuisance water onto adjacent lands, the following measures shall be implemented:

- ◆ Perform seepage monitoring studies by measuring the level of shallow groundwater in the adjacent soils, to evaluate baseline conditions. Continue monitoring for seepage during and after project implementation.
- ◆ Develop a seepage monitoring plan if subsurface seepage constitutes nuisance water on the adjacent land.
- ◆ If it is determined that seepage from the restoration project is responsible for making adjacent lands not usable, implement seepage control measures, such as installing subsurface agricultural drainage systems to avoid raising water levels into crop root zones. Cutoff walls and pumping wells can also be used to mitigate the occurrence of subsurface nuisance water.

Mitigation Measure GEO-7: Implement Measures for Levee Construction and Other Fill Embankment Designs

For projects that involve the construction of setback levees, surface impoundments, and other fill embankments, the project design shall place fill in accordance with

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state and local regulations and the prevailing standards of care for such work. Measures could include but are not limited to blending the soils most susceptible to landsliding with soils that have higher cohesion characteristics; installing slope stabilization measures; designing top-of-slope berms or v-ditches, terrace drains, and other surface runoff control measures; and designing slopes at lower inclinations.

Mitigation Measure GEO-8: Assess the Presence of Highly Organic Soils

For projects that would result in a significant or potentially significant risk to structures because of the presence of highly organic soils, the lead agencies shall require a geotechnical evaluation before construction to identify measures to mitigate organic soils. The following measures may be considered:

- ◆ Over-excavation and import of suitable fill material.
- ◆ Structural reinforcement of constructed works to resist deformation.
- ◆ Construction of structural supports below the depth of highly organic soils into materials with suitable bearing strength.

Implementing Mitigation Measures GEO-3, GEO-5, GEO-6, GEO-7, and GEO-8 would reduce potentially significant impacts related to indirect or direct adverse effects on people or structures associated with the risk from unstable soils to a **less-than-significant** level.

Impact 3.9-4: Implementing future restoration projects permitted under the Order could result in substantial soil erosion or loss of topsoil.

Effects of Project Construction Activities

Construction-related activities for restoration projects permitted under the Order could result in substantial soil erosion or the loss of topsoil by disturbing large volumes of soil through excavation, earthmoving, grading, filling, or stockpiling of soil material. These disturbed soils could be more susceptible to wind and water erosion, resulting in the loss of topsoil. Water erosion has a higher potential to occur on steep and/or organic sediment and could occur in many parts of the state.

For example, construction of a setback levee may have temporary and short-term erosion impacts on the soil surface. The removal of topsoil followed by replacement on-site after project construction may temporarily disturb the soil and could expose areas to winter or early storm events. Soil disturbance may also have the potential to result in substantial loss of topsoil due to wind erosion. However, implementation of standard best management practices (e.g., preparing and implementing a storm water pollution prevention plan and complying with the National Pollutant Discharge Elimination System) would reduce soil disturbance.

Impact Conclusion

Because the specific locations and scale of restoration projects permitted under the Order are not yet determined, this impact would be **potentially significant**.

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Projects implementing applicable general protection measures (Appendix E) included in the Order would further reduce impacts to geology and soil resources. The following general protection measures may apply to geology and soil resources:

- ◆ GPM-15: Revegetate Disturbed Areas
- ◆ WQHM-1: Staging Areas and Stockpiling of Materials and Equipment
- ◆ WQHM-2: Storm Water Pollution Prevention Plan
- ◆ WQHM-3: Erosion Control Plans
- ◆ WQHM-4: Hazardous Materials Management and Spill Response Plan
- ◆ VHDR-1: Avoidance of Vegetation Disturbance
- ◆ VHDR-3: Revegetation Materials and Methods
- ◆ VHDR-4: Revegetation Erosion Control Materials and Methods

Implementing the general protection measures identified above would reduce impacts related to substantial soil erosion or loss of topsoil to a **less-than-significant** level.

Effects of Constructed Facilities (Natural or Artificial Infrastructure) and Operations and Maintenance of those Facilities

Routine O&M activities for restoration projects permitted under the Order could result in impacts similar to those described under *Effects of Project Construction Activities*. In general, impacts related to the loss of topsoil (i.e., soil disturbance activities) would occur primarily as a result of construction activities, and the impact would not increase in severity once construction is complete. However, ongoing maintenance activities, such as adjustments to grading or soils composition, could expose soil to increased rates of erosion.

Some restoration projects under the Order would actually reduce soil erosion and result in a positive effect on topsoil and erosion levels. An example is a restoration project involving bioengineered bank stabilization that would improve aquatic and riparian habitat while reducing soil erosion and sedimentation of streams and wetlands by providing a revetment consisting of trees and native plant materials. Restoration projects involving the removal of non-native terrestrial and aquatic invasive species and revegetation with native plant species would also benefit soil health and reduce soil erosion. For this reason, some projects permitted under the Order could be beneficial to soil erosion and topsoil. However, because the potential exists for projects to result in substantial soil erosion or loss of topsoil, this impact would be **potentially significant**.

Implementing the general protection measures listed above would reduce impacts on soil erosion and the loss of topsoil to a **less-than-significant** level.

Impact 3.9-5: Implementing future restoration projects permitted under the Order could directly or indirectly result in the loss of a unique paleontological resource or geological resource.

Effects of Project Construction Activities, Constructed Facilities (Natural or Artificial Infrastructure), and Operations and Maintenance of those Facilities

Construction of restoration projects, constructed facilities (natural or artificial infrastructure), and operations and maintenance of those facilities permitted under the

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Order could result in the loss of a unique paleontological or geological resource. Impacts on paleontological resources would be permanent if construction activities would disrupt or destroy fossil remains or sites, or create the loss of information and the potential destruction of nonrenewable paleontological resources.

Impact Conclusion

To determine the effects of construction activities and constructed facilities, paleontological or geological resources would need to be known. Also, restoration projects permitted under the Order could directly or indirectly result in the loss of a unique paleontological resource or geological resource, if projects are located on or near areas where sediment with moderate to high paleontological sensitivity occurs. Because the potential exists for restoration projects permitted under the Order to result in adverse effects on paleontological or geological resources, this impact would be **potentially significant**. The Order does not include any general protection measures applicable to this impact.

As part of the State Water Board or Regional Board's issuance of a NOA for a restoration project under the Order, compliance with Mitigation Measure GEO-9 and GEO-10 would be required when applicable to a given project. Implementation of this mitigation measure would be the responsibility of the project proponent(s) under the jurisdiction of the State Water Board, appropriate Regional Board, or other authorizing regulatory agency.

Mitigation Measure GEO-9: Conduct a General Project-Level Analysis

Restoration projects implemented by other public proponents under the Order would be required to do a desktop search on whether the project site would be located in a paleontological sensitive unit. If the project site was determined to be located on a paleontological sensitive unit, then Mitigation Measure GEO-9 (and Mitigation Measure GEO-10, below, as applicable) would be implemented. If restoration projects implemented under the Order fall outside a paleontological sensitive unit, GEO-9 (and Mitigation Measure GEO-10, below) would be not required.

During project development and project-level analysis, a paleontological resource monitoring and recovery plan shall be developed and implemented for all actions determine by the project proponent to be located on a paleontological sensitive unit. The plan shall include protocols for paleontological resources monitoring in areas where construction-related excavation would affect sediment with moderate to high paleontological sensitivity.

The paleontological resource monitoring and recovery plan shall provide guidelines for the establishment of a yearly or biannual monitoring program led by a qualified paleontologist to determine the extent of fossiliferous sediment being exposed and affected by erosion, and determine whether paleontological resources are being lost. If the loss of scientifically significant paleontological resources is documented, then a recovery program should be implemented.

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Mitigation Measure GEO-10: Conduct Worker Training

For projects that are determined to have moderate to high paleontological sensitivity, before the start of any ground-disturbing activity (e.g., excavation or clearing), a qualified paleontologist shall prepare paleontological resources sensitivity training materials for use during project worker environmental training or equivalent. This training shall be conducted by a qualified environmental trainer under the supervision of the qualified paleontologist. For restoration projects that involve construction crew phases, additional trainings shall be conducted for new construction personnel. The paleontological resource sensitivity training shall focus on the types of resources that could be encountered within the individual restoration project site and the procedures to follow if they are found. Project proponents and/or project contractors shall retain documentation demonstrating that all construction personnel attended the paleontological resource sensitivity training before the start of work on the site, and shall provide documentation to the project manager upon request.

Mitigation Measures GEO-9 and GEO-10 would be implemented to reduce the impacts related to the loss of a unique paleontological resource or geological resource caused by restoration projects permitted under the Order. However, because the extent and location of such actions are not known at this time (e.g., location, sediment sensitivity of the area, and distance a restoration project might be from a known paleontological or geological resource), it is not possible to conclude that the mitigation measures, or equally effective mitigation measures, would reduce impacts to a less-than-significant level in all cases. Therefore, impacts would be **significant and unavoidable**.