4.7 GEOLOGY AND SOILS

This section describes the regulatory framework and existing conditions in the Specific Plan Area related to geology and soils, and the potential impacts resulting from implementation of the proposed Specific Plan.

Information in this Section is based in part on the following documents:

- City of Madera General Plan Update/Environmental Impact Report, May 2009
- City of Madera General Plan, October 7, 2009
- Madera Regional Groundwater Management Plan, December 2014
- Madera Subbasin Sustainable Groundwater Management Act (SGMA) Joint Groundwater Sustainability Plan, January 2020
- Madera County Local Hazard Mitigation Plan Update, October 2017

4.7.1 Environmental Setting

This setting section is adapted from the results, background information, and summaries provided in previously cited technical report(s) and the City's General Plan.[1]

4.7.1.1 Specific Plan Area

The Specific Plan Area is located within the Great Valley Geomorphic Province, an asymmetrical structural trough containing Mesozoic and Cenozoic sediments to an approximate depth of 30,000 feet.[2] The Great Valley is comprised of two large valleys: the southern San Joaquin Valley and the northern Sacramento Valley. The site is in the San Joaquin Valley which represents the lower two-thirds of the Great Valley Province and is surrounded by the Sierra Nevada to the east, the Coast Ranges to the west, the Tehachapi and San Emigdio Mountains to the south, and the Sacramento Valley and Sacramento-San Joaquin Delta to the north.

The San Joaquin Valley is approximately 200 miles long and up to 70 miles wide.[3] The valley is filled with thick sequences of alluvial sediment deposits derived from weathering of the adjacent mountain ranges combined with surface water flows and flooding resulting in a stratigraphic section of continental deposits.[4,5] Accumulated deposits were formed from alluvial (river), lacustrine (lake), and former marine (ocean) environments throughout the San Joaquin Valley[6] and accumulated at

1 Madera, City of. 2009. *City of Madera General Plan*. October 7.
2 Provost & Pritchard. 2014. *Madera Regional Groundwater Management Plan.* December.
3 Ibid.
4 Ibid.
5 Davids Engineering, Inc., et al. 2020. Madera Subbasin Sustainable Groundwater Management Act, *Joint Groundwater Sustainability Plan*. Prepared for the Madera Subbasin Coordination Committee. January.
6 Madera, City of. 2009. *City of Madera General Plan Update/Draft Environmental Impact Report*. May.

depths of thousands of feet. Alluvial deposits are recognized as Younger Alluvium deposited in the Quaternary, and Older Alluvium deposited between Late Tertiary to the Quaternary.[7]

Younger Alluvium is relatively shallow (<50 feet thickness estimated) and most prevalent along the Fresno and San Joaquin Rivers as well as an area immediately south and west of the City of Madera. Deposits consist of poorly sorted to well sorted clay and silt varieties, fine to coarse grained sand, contain no hard-pan, and are typically unsaturated except near streams and channels.[8,9] Older Alluvium consists of interbedded clay, silt, sand and gravel that grades finer with depth with an approximate thickness of 1,000 feet. The Older Alluvium is considered mostly oxidized, contains hardpan throughout the area, and is considered the primary water bearing unit.[10,11]

Madera and the Specific Plan Area are approximately in the middle of California, on the eastside of the San Joaquin Valley. There is an average of 500 feet of alluvium deposits beneath the City of Madera, with depths increasing from east to west.[12] The Madera Metropolitan area is set on gently southwest-sloping alluvial fans and plains formed by the San Joaquin River and Kings River.

4.7.1.2 Faulting

No active faults are mapped within the City of Madera. Active faults are those showing evidence of surface displacement within the last 11,000 years.[13] The nearest fault is the Clovis Fault,[14] approximately 21 miles southeast which has been mapped as pre-Quaternary in age, or older than 1.6 million years, and is not considered an active fault. There are five major active faults that surround the Specific Plan Area mapped by the California Geological Survey. The San Andreas Fault, San Joaquin Fault, and Ortigalita Fault are all located approximately 79, 40, and 47 miles west of the Specific Plan Area, respectively. The Owens Valley Fault is located approximately 105 miles east of the Specific Plan Area, and the Melones fault is located approximately 165 miles north. The nearest Alquist-Priolo Earthquake Fault Zone to the Specific Plan Area is along the Ortigalita Fault, approximately 50 miles to the west of the Specific Plan Area.[15]

4.7.1.3 Specific Plan Area Geology

The Specific Plan Area has a southwest slope of 0-3 percent grade with some undulating slopes. Elevations on-site range from about 230 feet above mean sea level (amsl) at the western Specific Plan Area boundary to 260 feet amsl at the south-eastern corner of the Specific Plan Area. The Specific Plan Area is primarily underlain by Holocene flood-basin deposits.

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7 Provost & Pritchard. 2014, op. cit.
8 Davids Engineering, Inc., et al. 2020, op. cit.
9 Mitten, H.T., G.L. Bertoldi, and R.A. LeBlanc. 1970. *Geology, Hydrology and Quality of Water in the Madera Area, San Joaquin Valley, California, USGS Open File Report 70-228*.
10 Davids Engineering, Inc., et al. 2020, op. cit.
11 Mitten, H.T., G.L. Bertoldi, and R.A. LeBlanc. 1970, op. cit.
12 Madera, City of. 2009 op. cit.
13 California Department of Conservation. Alquist-Priolo Earthquake Fault Zones. Website: www.conservation.ca.gov/cgs/alquist-priolo (accessed April 1, 2020).
14 California Department of Conservation. Fault Activity Map of California (2010). Website: maps.conservation.ca.gov/cgs/fam (accessed April 1, 2020).
15 California Department of Conservation, Earthquake Zones of Required Investigation. Website: maps.conservation.ca.gov/cgs/EQZApp/app (accessed April 1, 2020).

Quaternary aged[16] (within the last approximate 2.59 million years) river deposits of granitic sand and silt from the Modesto Formation (Great Valley Sequence) were transported by rivers and streams emerging from the Sierra Nevada.[17]

Non-marine sedimentary deposits of granitic sand, silt, and clay from the Riverbank Formation (Great Valley Sequence) transported to the San Joaquin Valley.[18] Deposits are from the Pleistocene Epoch, approximately 11,700 to 2.59 million years before present (ybp).[19]

4.7.1.4 Subsurface Soils in the Madera Region

Based on the Madera General Plan, and in conjunction with the USDA National Resources Conservation Service Soil Survey, there are 20 different soil types located within the Specific Plan Area. The four most common types of soil in the Specific Plan Area are Grangeville, Madera, Pachappa, and the San Joaquin. These four soil types comprise approximately 51 percent of the Specific Plan Area and are described below. Other soil types include Greenfield, Hanford, and Lewis, but the uppermost three feet of soils in the entire Specific Plan Area are very fine sandy loam[20] that is friable when moist, with a stratified portion consisting of fine sandy loam and loamy sands. Soils are generally weak and very fine with granular structure and are easily compressible. An iron-silica hardpan layer can be found between 9 to 19 inches below surface up to 10 inches thick. Gritty sandy loam can be found beneath the hardpan layer. Grangeville fine sandy loam covers nearly 13 percent of the Specific Plan Area and covers mostly the southern portion of the site, next to the Fresno River. The soil has poor drainage but permeates moderately rapid and has low shrink/swell potential.

Madera Loam covers nearly 16 percent of the Specific Plan Area and dominantly covers the northern portion next to the Madera Municipal Golf Course. The soil has moderate to good drainage but permeates very slowly due to the soil's high shrink/swell potential.

Pachappa fine sandy loam covers approximately 15 percent of the Specific Plan Area and is dispersed between the central portion of the Plan Area and the southeast portion of the site next to the Fresno River. The Pachappa soil has good drainage, moderate permeability and shrink/swell potential.

San Joaquin sandy loam covers approximately 7 percent of the Specific Plan Area and is dispersed throughout the entire Specific Plan Area. Drainage in the San Joaquin is moderate to good, while permeability is very slow as due to the high shrink/swell potential the San Joaquin has.

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16 U.S. Geological Survey. 2013. Divisions of Geologic Time--Major Chronostratigraphic and Geochronologic Units. Website: pubs.usgs.gov/fs/2007/3015 (accessed April 1, 2020). January 9.

17 California Geological Survey. 1958. Monterey Sheet, Geologic Map of California. Website: www.conservation.ca.gov/cgs/maps-data/rgm (accessed April 1, 2020).

18 Ibid.

19 U.S. Geological Survey. 2013, op. cit.

20 United States Department of Agriculture. 1962. Natural Resources Conservation Service. *Soil Survey Madera Area California*. Available online at: www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/maderaareaCA1962/maderaareaCA1962.pdf (accessed April 1, 2020).

4.7.1.5 Geologic Hazards

The following description of geologic hazards is based partly on the geological hazards included in the 2025 General Plan for the City of Madera, the Madera County Local Hazard Mitigation Plan Update prepared for Madera County by Foster Morrison in 2017, and the 2011 Madera County Local Hazard Mitigation Plan prepared by URS. Information presented in the following subsections is a region-wide summary, and not site-specific, of conditions within the Specific Plan Area. Site-specific geotechnical investigations would be required for each development project considered for approval under the proposed Specific Plan.

4.7.1.6 Ground Shaking

Ground shaking is the product of a fault suddenly slipping, or an earthquake. What we feel on the surface of the Earth is the energy released when the fault slips. Earthquakes produce various degrees of damage; ground shaking is among the most serious seismic hazards. Ground shaking is caused by seismic waves travelling in Earth's interior, or along the surface and can be measured by the severity or intensity of the earthquake.[21]

The Modified Mercalli Intensity (MMI) Scale is a 12-point scale that ranges from imperceptible with an intensity of I, to catastrophic destruction with an intensity of XII. The MMI is calculated using the amount of energy released from the earthquake which is proportional to the size of the earthquake, and the distance from the releasing fault.[22]

The Specific Plan Area is located within the valley portion of Madera County, which is susceptible to greater ground shaking intensities. Because the valley is located on alluvium deposits, structures would suffer greater damage from grounds shaking than structures located in the foothills and mountainous areas.[23]

The City of Madera has a relatively low probability of shaking[24] and has historically been subject to low to moderate ground shaking. The City of Madera experienced the effects of ground shaking for several earthquakes with a magnitude of 6.0 or greater. The most recent (July 6, 2019) Ridgecrest[25,26] earthquake had a magnitude of 7.1 and generated a weak (III) ground shaking intensity in the region.[27] No earthquake with a magnitude of 5.5 or greater has ever been recorded

21 Foster Morrison. 2017. *Madera County Local Hazard Mitigation Plan Update*. October 2017.
22 Ibid.
23 Ibid.
24 California Emergency Management Agency and Earthquake Country Alliance. 2010. Central Valley (South) ShakeOut Area, Probability of Shaking. Southern California Earthquake Center, USC. Website: www.shakeout.org/california/ (accessed April 1, 2020). June 7.
25 Earthquake Track. Recent Earthquakes Near Madera, California, United States. Website: www.earthquaketrack.com/us-ca-madera/recent?mag_filter=6 (accessed April 1, 2020).
26 United States Geological Survey (USGS) Ridgecrest EQ Paper July 6, 2019. Available online at: www.usgs.gov/media/images/ridgecrest-eq-pager-6-july-2019 (accessed April 1, 2020).
27 United States Geological Survey. 2019. Earthquake Hazards Program, M 7.1 - 2019 Ridgecrest Earthquake Sequence. Website: www.earthquake.usgs.gov/earthquakes/eventpage/ci38457511/dyfi/intensity (accessed April 1, 2020).

in the Madera area, nor has any damage from earthquakes of magnitude 5.5 or greater ever been recorded in Madera County.[28]

4.7.1.7 Liquefaction

Liquefaction refers to saturated, unconsolidated soils or sand that is behaves as a liquid due to the intense vibration of an earthquake. As the soils are shifted, they lose their load supporting capability of the overlying sediments or structures. A shallow groundwater table less than 30 feet below the surface and relatively uniform sands of loose to medium density are susceptible to liquefaction.

In Madera County, depth to groundwater can be relatively deep, however groundwater has been measured as shallow as 30 feet or less below the surface. Soils in the Madera region range from gravel to clay. Shallow soil within the Madera County valley are highly compactable while deeper soils may encounter a strong hardpan layer and are typically moderately strong and slightly compressible.[29] The native soil type in Madera County has a low potential for liquefaction.

4.7.1.8 Seismic Ground Settlement

Ground shaking caused by earthquakes can cause unconsolidated sediments to settle, or differential settlement. Differential settlement is a less stable alignment of the individual minerals which can cause significant structural damage. This can occur with rapidly deposited soils or improper structure foundations. Due to the history of ground shaking in the Madera County area and the native soils underlying the city, differential settlement is not considered a significant hazard in the region.

Additionally, the City of Madera has adopted the Uniform Building Code and the California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code or California Building Code (CBC). These adoptions ensure structures are engineered to resist soil movement and contain adequate drainage for surface and seasonal fluctuations in soil moisture.[30]

4.7.1.9 Landslides – Lateral Spreading

Landslide is a general term used to describe the downslope movement of a rock, soil, or earth mass. Landslides can occur when gravitational forces and other shear stresses exceed the earth's resistance to shearing. Landslides typically occur in areas that experience ground shaking, are typically wet and/or have steep slopes.[31]

Lateral spreading is a type of landslide that commonly forms on gentle slopes and would have rapid fluid-like movement, similar to water. Lateral spreading is triggered by liquefaction in the subsurface layer.

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28 Madera, City of. 2009, op. cit.

29 United States Department of Agriculture. 1962, op. cit.

30 Madera, City of, and PMC. 2009. *City of Madera General Plan Update/Draft Environmental Impact Report*. May.

31 United States Geological Survey. Natural Hazards, "What is a landslide and what causes one?" Website: www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news_science_products=0#qt-news_science_products (accessed April 1, 2020).

The Specific Plan Area and surroundings are not subject to landslides. The site slopes to the southwest with an average grade of about 0.2 percent.

4.7.1.10 Erosion

Erosion is the process in which earth materials are worn away and transported. Erosion naturally occurs by wind and flowing water and can be accelerated by humans and ground disturbance when effective erosion control measures are not in use. Soil carried off construction sites or bare land by wind and water is a common example of erosion. When sediments are carried by water, the water can become cloudy, or turbid and can cause biological harm such as clogged fish gills, reduced spawning habitats, lower survival rates of young aquatic organisms, smother bottom-dwelling organisms, and suppress aquatic vegetation growth.

4.7.1.11 Ground Subsidence

Subsidence is the gradual settling or sudden sinking of surface soils due to movement of subsurface earth materials. A major cause of ground subsidence is the excessive withdrawal of groundwater and the withdrawal of petroleum. Soils generally affected by subsidence tend to have high silt or clay content.

The San Joaquin Valley has been subject to subsidence of 20+ feet over the past 50 years.[32] There has been approximately three feet of subsidence within the Madera Subbasin since 1920.[33] The risk of subsidence is considerably low in Madera County compared to other parts of the San Joaquin Valley as the water table is relatively deep in majority of the county; however, Madera is not immune to potential subsidence.

4.7.1.12 Collapsible Soils

Collapsible soils are unsaturated soils that undergo a radical rearrangement and greatly decrease in volume when wet.[34] Shallow soils within the Specific Plan Area to a depth of at least 3 to 5 feet below grade surface (bgs) would have varying degrees of compressibility that generally increase near the surface.

4.7.1.13 Expansive Soils

Expansive soils contain substantial amounts of clay minerals, such as smectite, that absorbs and swells when wet and shrinks when dried.[35] When water is absorbed, the clay swells or increases in volume upwards of 10 percent. When expansive soils are dried, the soil can shift, crack, or remove support from overlying structures.

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32 United States Geological Survey. Land Subsidence in the San Joaquin Valley. Website: www.usgs.gov/centers/ca-water-ls/science/land-subsidence-san-joaquin-valley?qt-science_center_objects=0#qt-science_center_objects (accessed April 1, 2020).

33 Davids Engineering, Inc., et al. 2020, op. cit.

34 United States Department of the Interior Bureau of Reclamation. 1992. Characteristics and Problems of Collapsible Soils. Available online at: www.usbr.gov/tsc/techreferences/rec/R9202.pdf (accessed April 1, 2020). February.

35 Osman K.T. 2018. Expansive Soils. In: Management of Soil Problems. Website: www.doi.org/10.1007/978-3-319-75527-4_6 (accessed April 1, 2020).

Soils underlying the Madera County contain some clay and are considered slightly to moderately expansive. Based on the soil types within the Specific Plan Area, including Grangeville, Madera, Pachappa, and the San Joaquin soil types, there is a moderate expansion potential.

4.7.1.14 Regulatory Context

Federal Regulations

Uniform Building Code (UBC). UBC ensures all buildings maintain the public health and safety by regulating the design, construction, quality of materials, certain equipment, location, grading, use, occupancy, and maintenance of all buildings and structures. UBC standards address foundation design, shear wall strength, and other structurally related conditions.

State Regulations

Alquist-Priolo Earthquake Fault Zoning. The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Sections 2621 et seq.) requires the California Geologic Survey to compile maps of traces of Active faults and requires a state geologist to delineate earthquake fault zones along faults that are "sufficiently active" and "well defined." The act requires disclosure in real estate transactions and requires cities and counties to withhold development permits for a site in an earthquake fault zone until geologic investigations demonstrate that the site is not threatened by surface displacements from future faulting. An active fault is one showing expression of surface rupture within the last 11,000 years. Pursuant to this act, structures for human occupancy are not allowed within 50 feet of the trace of an active fault. Single family wood-frame or steel-frame dwellings up to two stories high and not part of a development of four or more dwelling units is the only exemption to this Act.

Seismic Hazard Mapping Act. The Seismic Hazard Mapping Act (SHMA) was adopted by the State in 1990 in response to the Loma Prieta Earthquake in 1989. This Act protects the public from the effects of non-surface fault rupture earthquake hazards, including strong ground shaking, liquefaction, seismically induced landslides, or other ground failure caused by earthquakes. The goal of the act is to minimize loss of life and property by identifying and mitigating seismic hazards. The California Geological Survey has been required under this Act to prepare "seismic hazard zone" maps available to local governments. These maps identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures. Buildings designed for human occupancy proposed to be built within a "seismic hazard zone" require a geotechnical investigation and mitigation measures to be implemented. SHMA requires responsible agencies to only approve projects within seismic hazard zones following a site-specific investigation to determine if the hazard is present, and if so, the inclusion of appropriate mitigation(s). Reports must be stamped by a Registered Civil Engineer or Certified Engineering Geologist with a specialty in seismic hazard evaluation. In addition, the SHMA requires real estate sellers and agents provide full disclosure if the property is within a seismic hazard zone at the time of sale. Single family dwellings up to two stories high and part of a development of no more than three units are the only exemption to this Act.

2019 California Building Code (CBC). Current law states that every local agency enforcing building regulations, such as cities and counties, must adopt the provisions of the California

Building Code (CBC) within 180 days of its publication. The publication date of the CBC is established by the California Building Standards Commission, and the code is updated every three years. The CBC is in Title 24, Part 2, of the California Code of Regulations. The most recent building standard adopted by the legislature and used throughout the state is the 2019 CBC, which took effect on January 1, 2020. Local jurisdictions may add amendments based on local geographic, topographic, or climatic conditions. These codes provide minimum standards to protect property and people by regulating 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 CBC's provisions for earthquake safety are based on factors such as occupancy type, the types of soil and rock on-site, and the strength of ground motion with a specified probability at the site.

California Building Code Section 1803 (CBC; Requirements for Geotechnical Investigations). Requirements for geotechnical investigations for subdivisions requiring tentative and final maps and for other types of structures are in California Health and Safety Code, Sections 17953 to 17955, and in Section 1803 of the CBC.[36] Testing of samples from subsurface investigations is required, such as from borings or test pits. Investigations must be conducted by a registered design professional and involve in situ-testing, laboratory testing, or engineering calculations.[37] Studies must be done as needed to evaluate slope stability, soil strength, position, and adequacy of load-bearing soils, the effect of moisture variation on load-bearing capacity, compressibility, liquefaction, differential settlement, and expansiveness.

Local Regulations

Madera County Municipal Code. Madera County has incorporated and adopted the 2019 CBC with the County's amendments as Madera County Municipal Code Chapter 14.08.[38] Within the Municipal Code, Section 17.06.060 requires a preliminary soil report be provided for each subdivision under the responsibility of the engineering department while reviewing, processing and approving land divisions in Madera County. Grading and erosion control requirements are set forth in Chapter 14.50.

Madera County Local Hazard Mitigation Plan Update. Madera County and three participating jurisdictions (cities of Chowchilla and Madera, and the North Fork Rancheria of Mono Indians) developed this Local Hazard Mitigation Plan (LHMP) update to make the County and its residents less vulnerable to future hazard events by reducing or eliminating long-term risk to people and property from hazards such as localized and stormwater flooding, subsidence, agriculture hazards (severe weather/insects), and dam failure.

[36] California Building Code. 2016. Chapter 18 Soils and Foundations, Section 1803 Geotechnical Investigations. Website: www.up.codes/viewer/california/ca-building-code-2016-v2/chapter/18/soils-and-foundations#1803 (accessed April 1, 2020).

[37] Ibid.

[38] Madera County Code of Ordinances. Chapter 14.08 California Building Code. Website: www.library.municode.com/ca/madera_county/codes/code_of_ordinances?nodeId=TIT14BUCO (accessed April 1, 2020).

City of Madera Code of Ordinances. The City of Madera County has also incorporated and adopted the 2019 CBC with the Code of Ordinances[39] that includes amendments to the 2019 CBC under Title IX. § 9-1.02 discusses the sections deleted, amended or added to the Code of Ordinances. In general, this section discusses masonry, various types of permit fees, foundation elevations, exempted work, fill placement, and various types of grading. Section (§) 10-2.402.3 states a "City Engineer may require a preliminary soils report. If the preliminary soils report indicates the presence of critically expansive soils or other soil problems, which, if not corrected, would lead to structural defects, the soils report accompanying the final map shall contain an investigation of each lot within the subdivision." Appendix J109, § 10-3.4.0104, and § 10-3.4.0113 briefly discusses grading and erosion control. § 10-3.4.0110 emphasizes the need for site plan review process to include environmental review.

City of Madera General Plan. The City of Madera General Plan is the City's primary policy planning document. Through its ten elements, the General Plan provides the framework for the management and utilization of the City's physical, economic, and human resources. Each element contains goals, policies, and implementation measures that guide development within the City. The General Plan strives to maintain and improve Madera's quality of life and implement the community's shared vision for the future. The General Plan is the official policy statement of the City Council to guide development (both public and private), as well as the City's operations and decisions. Geology and soil related goals, objectives, and policies specific to the city are included in the General Plan.

Table 4.7.A includes General Plan policies related to geology and soils.

4.7.2 Impacts and Mitigation Measures

The following section presents a discussion of the impacts related to geology and soils that could result from implementation of the proposed Specific Plan. The section begins with the criteria of significance, which establish the thresholds to determine if an impact is significant. The latter part of this section presents the impacts associated with implementation of the proposed Specific Plan and the recommended mitigation measures, if required. Mitigation measures are recommended, as appropriate, for significant impacts to eliminate or reduce them to a less-than-significant level. Cumulative impacts are also addressed.

4.7.2.1 Significance Criteria

The thresholds for impacts related to geology and soils used in this analysis are consistent with Appendix G of the State CEQA Guidelines. Development of the proposed Specific Plan would result in a significant impact related to geology and soils if it would:

[39] Madera, City of. Code of Ordinances, Chapter 1 Building Regulations. Website: codelibrary.amlegal.com/codes/madera/latest/madera_ca/0-0-0-4752 (accessed April 1, 2020).

Table 4.7.A: General Plan Policies Related to Geology and Soils

Policy/Action Item Number	Policy
Policy HS-7	The City supports efforts by federal, state, and other local organizations to investigate local seismic and geological hazards and support those programs that effectively mitigate these hazards.
Policy HS-8	The City shall seek to ensure that new structures are protected from damage caused by earthquakes, geologic conditions, or soil conditions.
Policy CD-8	In order to improve and protect the quality of neighborhoods and commercial districts, the City will enforce established building codes and community standards.
Policy HC-1	The City encourages the preservation and enhancement of existing historical and archaeological resources in the City.
Policy HC-9	The City will endeavor to protect and preserve prehistoric and historic archaeological resources, cultural resources (particularly those of importance to existing tribes), and fossils. Action Item HC-9.2 Impose the following conditions on all discretionary projects which may cause ground disturbance: • "The Planning Department shall be notified immediately if any prehistoric, archaeologic, or fossil artifact or resource is uncovered during construction. All construction must stop and an archaeologist that meets the Secretary of the Interior's Professional Qualifications Standards in prehistoric or historical archaeology shall be retained to evaluate the finds and recommend appropriate action." • "All construction must stop if any human remains are uncovered, and the County Coroner must be notified according to Section 7050.5 of California's Health and Safety Code. If the remains are determined to be Native American, the procedures outlined in CEQA Section 15064.5 (d) and (e) shall be followed."

Source: City of Madera General Plan (October 2009).

Threshold 4.7.1 **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 of a known fault. Refer to Division of Mines and Geology Special Publication 42;

b. Strong seismic ground shaking;

c. Seismic-related ground failure, including liquefaction; or

d. Landslides.

Threshold 4.7.2 **Result in substantial soil erosion or the loss of topsoil.**

Threshold 4.7.3 **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.**

Threshold 4.7.4 **Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.**

Threshold 4.7.5 **Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.**

Threshold 4.7.6 **Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.**

4.7.2.2 Project Impacts

The following discussion describes the potential impacts related to geology and soils that could result from implementation of the proposed Specific Plan.

Threshold 4.7.1 **Would the project 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 of a known fault. Refer to Division of Mines and Geology Special Publication 42;

b. Strong seismic ground shaking;

c. Seismic-related ground failure, including liquefaction;

d. Landslides;

Buildout of the proposed Specific Plan would not subject people or structures to hazards from surface rupture of a known active fault. The nearest fault is the Clovis Fault,[40] approximately 21 miles southeast which has been mapped as pre-Quaternary in age, and not considered active. The nearest Alquist-Priolo Earthquake Fault Zone to the Specific Plan Area is along the Ortigalita Fault,[41] approximately 47 miles west of the Specific Plan Area. A less-than-significant impact would occur due to the distance of the Specific Plan Area from the nearest known active fault.

It is likely seismically induced ground shaking would occur within the design lifetime for buildings constructed for the Specific Plan Area. While the Specific Plan Area is not located within an Alquist-Priolo Earthquake hazard zone, some ground shaking may occur within the Specific Plan Area depending on the amount of energy released from the fault, or the magnitude of the earthquake. The Specific Plan Area is considered to have low ground shaking potential[42] and can experience a low severity of ground motion if an earthquake were to occur. There is a 10 percent chance in the

40 California Department of Conservation. Fault Activity Map of California. 2010, op. cit.
41 California Department of Conservation, Earthquake Zones of Required Investigation, op cit.
42 Madera, City of. 2009, op. cit.

next 50 years that grounds shaking will be felt in the City of Madera.[43] Additionally, new development within the Specific Plan Area would require buildings to conform to CBC seismic safety standards, which take multiple factors into account, such as occupancy type, soil type, and ground motion with a specified probability at the site. Every three years the CBC is updated; the most current version of the code became effective January 1, 2020.

Neither liquefaction nor lateral spreading have been observed in Madera from any historic earthquake. Liquefaction and lateral spreading potential in the City of Madera is considered very low as due to the nature of the underlying soils, relatively deep-water table, and history of low ground shaking potential.

Landslides are not expected to affect the Specific Plan Area as the City of Madera is not located near an area with steep slopes and has a relatively dry climate. The area is nearly level with a southwest slope of about 0.2 percent grade, which is not subject to landslides.

A geotechnical investigation is required by Mitigation Measure GEO-1.1 for subdivisions requiring tentative and final maps pursuant to California Health and Safety Code, Sections 17953 to 17955, and in Section 1803 of the CBC to adequately assess potential ground shaking, liquefaction, lateral spreading, and other earthwork specific to the Specific Plan Area.

Compliance with the UBC and CBC which requires the preparation of geotechnical investigations would ensure that significant damage from an active fault, seismic ground shaking, liquefaction, and landslides is addressed during project design. In addition, the following General Plan policies address potential seismic hazards and associated hazards:

Policy HS-7 The City supports efforts by federal, state, and other local organizations to investigate local seismic and geological hazards and support those programs that effectively mitigate these hazards.

Policy HS-8 The City shall seek to ensure that new structures are protected from damage caused by earthquakes, geologic conditions, or soil conditions.

In order to ensure compliance with the UBC and CBC, Mitigation Measure GEO-1.1 would be required prior to approval of a tentative subdivision map. Implementation of this Mitigation Measure and the General Plan policies listed above would reduce potential hazards to the public and environment. As a result, a less-than-significant impact would occur.

Mitigation Measure GEO-1.1: Consistent with Section 1803 of the California Building Code and Section 10-2.402.3 of the City of Madera Municipal Code, prior to approval of a tentative subdivision map and for other types of structures, a preliminary soils report shall be reviewed and approved by the City of Madera Community Development Director and City Engineer or their designees. As a part of the geotechnical investigations, testing of samples from subsurface investigations is

[43] Ibid.

required, such as from borings or test pits. Investigations shall be conducted by a registered design professional and involve in situ-testing, laboratory testing, or engineering calculations. Studies shall be done as needed to evaluate slope stability, soil strength, position, and adequacy of load-bearing soils, the effect of moisture variation on load-bearing capacity, compressibility, liquefaction, differential settlement, and expansiveness. The geotechnical investigation shall provide recommendations to be incorporated into final plans and/or improvement plans, if required, to ensure compliance with the UBC and CBC.

Level of Significance With Mitigation: Less than significant.

Threshold 4.7.2 Would the project result in substantial soil erosion or the loss of topsoil?

The potential for soil erosion within the Specific Plan Area would greatly increase as soil on-site would be disturbed and expose large amounts of soil with grading and site preparation activities. Additionally, water is generally used with construction activities and may further erode the topsoil as water moves through the Specific Plan Area.

Development within the Specific Plan Area that is larger than one acre would be required to comply with the State Water Resources Control Board (SWRCB) 2012 General Construction Permit, Order No. 2012-0006-DWQ which requires development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).[44] Implementation of a SWPPP would estimate sediment risk from construction activities and receiving waters and would specify to be used by a project to minimize pollution of stormwater. There are several categories of construction best management practices (BMPs). The following four categories of construction BMPs are relevant to erosion control:

- Erosion Controls: Cover and/or bind soil surface, to prevent soil particles from being detached and transported by water or wind. Examples include mulch, geotextiles, mats, hydroseeding, earth dikes, and swales

- Sediment Controls: Filter out soil particles that have been detached and transported in water. Examples include barriers such as straw bales, sandbags, fiber rolls, and gravel bag berms; desilting basin; and cleaning measures such as street sweeping.

- Tracking Controls: Minimize the tracking of soil off-site by vehicles. Examples include stabilized construction roadways and construction entrances/exits, and entrance/outlet tire wash.

- Waste Management and Controls (housekeeping): Management of materials and wastes to avoid contamination of stormwater. Examples include spill prevention and control, stockpile management, and management of solid wastes and hazardous wastes.

[44] State Water Resources Control Board. 2009. *Stormwater Pollution Prevention Plan.* Available online at: www.waterboards.ca.gov/water_issues/programs/stormwater/docs/constpermits/wqo2009_0009_dwq.pdf (accessed April 1, 2020).

The following General Plan policies address soil erosion hazards:

Policy CON-8 The City encourages Low Impact Development practices in all residential, commercial, office, and mixed-use discretionary projects and land division projects to reduce, treat, infiltrate, and manage runoff flows caused by storms, urban runoff, and impervious surfaces. Low impact development practices may include:

- Use of small-scale stormwater controls such as bioretention, grass swales and channels, vegetated rooftops, rain barrels and cisterns.
- Reduction of impervious surfaces through site design and use of pervious paving materials.
- Retention of natural features such as trees and ponds on site.
- The use of drought tolerant plant materials and/or water-conserving irrigation systems."

Policy CON-9 The City will evaluate existing city maintained landscaping, and will, as feasible, install or replace vegetation with drought-tolerant, low-maintenance native species.

Policy CON-10 The City will evaluate existing landscaping and options to convert reflective and impervious surfaces to landscaping, and will, as feasible, install or replace vegetation with drought-tolerant, low-maintenance native species that can also provide shade and reduce heat-island effects.

In addition to implementation of the policies listed above, Mitigation Measure GEO-1.1, and compliance with the 2012 General Construction Permit, which requires the implementation of a SWPPP, potential impacts related to soil erosion would be reduced to less-than-significant levels.

Level of Significance With Mitigation**:** Less than significant. Implementation of General Plan Policies and Mitigation Measure GEO-1.1 would reduce this potential impact.

Threshold 4.7.3 Would the project 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?

The Madera County LHMP states subsidence has a likely probability of future occurrences in Madera County. According to the LHMP, subsidence in Madera County has a moderate potential of occurring, but impacts but would be negligible (less than 10 percent property damage).[45] Compliance with the UBC and CBC and implementation of Mitigation Measure GEO-1.1, which requires the preparation of geotechnical investigations would be sufficient to reduce potential subsidence impacts to a less-than-significant level.

[45] Foster Morrison. 2017, op. cit.

Groundwater pumping the San Joaquin Valley has destabilized soils, however, conservative efforts have been made state-wide with the Sustainable Groundwater Management Act. As groundwater pumping decreases the likelihood of subsidence decreases.

Geotechnical investigations for projects developed under the proposed Specific Plan would be required and would determine the effects of subsidence within the Specific Plan Area while providing recommendations to minimize risks associated with subsidence.

Other factors associated with active faulting that would destabilize soils were discussed under Threshold 4.7.1, above, and would result in less-than-significant impacts.

The following General Plan policies address soil erosion and potential subsidence hazards:

Policy HS-7 The City supports efforts by federal, state, and other local organizations to investigate local seismic and geological hazards and support those programs that effectively mitigate these hazards.

Policy HS-8 The City shall seek to ensure that new structures are protected from damage caused by earthquakes, geologic conditions, or soil conditions.

Implementation of site-specific geotechnical analyses prior to approval of discretionary project, as required by the UBC and CBC, and implementation of the General Plan policies listed above would reduce impacts related to unstable soil to less-than-significant levels.

Level of Significance With Mitigation**:** Less than significant. Implementation of General Plan Policies and Mitigation Measure GEO-1.1 would reduce this potential impact.

Threshold 4.7.4 Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

Soils underlying Madera County contain some clay and are considered slightly to moderately expansive. Based on the soil types within the Specific Plan Area, expansion potential is considered slightly moderate. The City of Madera has adopted the UBC and CBC which requires geotechnical analyses to be completed prior to approval of future projects and includes special design requirements and construction methods to reduce or eliminate potential expansive soil related impacts. In addition, and implementation of Mitigation Measure GEO-1.1, which requires the preparation of geotechnical investigations would address expansive soil. Design and construction of future projects within the Specific Plan Area would be required to be consistent with the CBC. Additionally, the CBC requires adequate drainage to help mitigate surface drainage and seasonal soil moisture.

The following General Plan policies address expansive soil hazards:

Policy HS-7 The City supports efforts by federal, state, and other local organizations to investigate local seismic and geological hazards and support those programs that effectively mitigate these hazards.

Policy HS-8 The City shall seek to ensure that new structures are protected from damage caused by earthquakes, geologic conditions, or soil conditions.

Policy CD-8 In order to improve and protect the quality of neighborhoods and commercial districts, the City will enforce established building codes and community standards.

Policy HS-26 The City shall require all new urban development projects to incorporate runoff control measures to minimize peak flows of runoff and/or assist in financing or otherwise implementing comprehensive drainage plans. All such control measures will consider potential affects to adjacent property owners.

Compliance with the UBC and CBC which requires site-specific geotechnical analyses to address potential geotechnical impacts, and implementation of the General Plan policies listed above, would reduce potential impacts related to expansive soil to less-than-significant levels.

Level of Significance Without Mitigation**:** Less than significant. No mitigation is required.

Threshold 4.7.5 Would the project 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?

The proposed Specific Plan includes several proposed sewer improvements and installations. Developers are required to design and construct sewers sufficient to convey wastewater generated within the Specific Plan Area, and future projects would connect to the public sewer system. As a result, septic tanks would not be used, and no impact would occur.

Level of Significance Without Mitigation**:** No impact. No mitigation is required.

Threshold 4.7.6 Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Paleontological resources, if existent within the Specific Plan Area can potentially be damaged by ground-disturbing activities such as excavation, grading, and access road construction. The University of California, Berkeley Museum of Paleontology has one of the largest paleontological collections and has not identified paleontological resources within the Specific Plan Area.[46] Sensitivity of the area has not been assessed, nor has a formal paleontological investigation of the immediate area been conducted.

In compliance with Action Item HC-9.2, listed below, the City of Madera requires that the Planning Department be notified and construction cease if any prehistoric, archaeologic, or fossil artifacts or

[46] Madera, City of. 2009, op. cit.

resources are uncovered during construction. If these artifacts are found, an archaeologist that meets the Secretary of the Interior's Professional Qualification Standards would be retained and would evaluate the finds and recommend appropriate actions.

The following General Plan policies address paleontological resources:

Policy HC-1 The City encourages the preservation and enhancement of existing historical and archaeological resources in the City.

Policy HC-9 The City will endeavor to protect and preserve prehistoric and historic archaeological resources, cultural resources (particularly those of importance to existing tribes), and fossils.

Action Item HC-9.2:

Impose the following conditions on all discretionary projects which may cause ground disturbance:

- "The Planning Department shall be notified immediately if any prehistoric, archaeologic, or fossil artifact or resource is uncovered during construction. All construction must stop and an archaeologist that meets the Secretary of the Interior's Professional Qualifications Standards in prehistoric or historical archaeology shall be retained to evaluate the finds and recommend appropriate action."

- "All construction must stop if any human remains are uncovered, and the County Coroner must be notified according to Section 7050.5 of California's Health and Safety Code. If the remains are determined to be Native American, the procedures outlined in CEQA Section 15064.5 (d) and (e) shall be followed."

Compliance with General Plan policies and implementation of Mitigation Measure GEO-6.1, which is consistent and further implements General Plan Policy HC-9, would reduce potential impacts to paleontological resources to less-than-significant levels.

Mitigation Measure GEO-6.1 The following measures shall be implemented to reduce potential impacts to paleontological resources:

- In the event that unique paleontological/geological resources are discovered during excavation and/or construction activities, construction shall stop in the immediate vicinity of the find and a qualified paleontologist shall be consulted to determine whether the resource requires further study. The qualified paleontologist shall make recommendations to the City on the measures that shall be implemented to protect the discovered resources, including but not limited to, excavation of the finds and evaluation of the finds. If the resources are determined to be significant, mitigation measures shall be identified by the

monitor and recommended to the City. Appropriate mitigation measures for significant resources could include avoidance or capping or data recovery excavations of the finds. No further grading shall occur in the area of the discovery until the City approves the measures to protect the identified resources.

- If unique paleontological/geological resources are found during the field survey, the resources shall be inventoried and evaluated for significance. If the resources are found to be significant, mitigation measures shall be identified by the qualified paleontologist. Similar to above, appropriate mitigation measures for significant resources could include avoidance or capping, incorporation of the site in green space, parks, or open space, or data recovery excavations of the finds. In addition, appropriate mitigation for excavation and construction activities in the vicinity of the resources found during the field survey or literature review shall include a paleontological monitor. The monitoring period shall be determined by the qualified paleontologist. If additional paleontological/geological resources are found during excavation and/or construction activities, the procedure identified above for the discovery of unknown resources shall be followed.

Level of Significance With Mitigation: Less than significant.

4.7.2.3 Cumulative Impacts

The proposed Specific Plan would have a significant effect on the environment if it – in combination with other projects – would contribute to a significant cumulative impact related to geology and soils. For geology and soils, the cumulative study area consists of the area that could be affected by proposed project activities and the areas affected by other projects whose activities could directly or indirectly affect the geology and soils of the project site. Seismic hazards affecting the Specific Plan Area are expected to be moderate due to the low to moderate historic ground shaking in the region, and the distance to known active faults. Implementation of the proposed Specific Plan would comply with CBC seismic safety requirements and would have project-specific geotechnical investigations conducted and would comply with recommendations in the reports of such investigations. The City of Madera is relatively immune to some seismic hazards: to surface rupture of a known active fault due to the lack of such faults in the region; and to seismic ground settlement and lateral spreading due to the nature of the soils underlying the city and the history of low to moderate ground shaking.

Preparation of geotechnical investigation reports and compliance with recommendations in such reports would also minimize other geologic hazards, such as ground subsidence, and expansive soils within the Specific Plan Area. Soils adequate for sewer improvements and installations can be confirmed with a geotechnical investigation. Compliance with a SWPPP would minimize topsoil

erosion by ensuring BMPs are followed. The proposed project, as with all foreseeable projects, would be required to comply with the applicable state and local requirements, including the City of Madera Building Code. Therefore, the project's contribution to cumulative geotechnical and soil impacts is considered less than significant.

Lastly, there are no known paleontological resources within the area. If a paleontological resource is found, construction would cease and an evaluation would occur, consistent with Mitigation Measure GEO-6.1 In addition, all foreseeable projects would also be required to address and mitigate potential impacts to paleontological resources. Therefore, the project's contribution to cumulative paleontological impacts is considered less than significant.

Buildout of the proposed Specific Plan would result in a less-than-significant cumulative impact related to geology and soils.

Level of Significance With Mitigation: Less than significant. Refer to Mitigation Measure GEO-6.1.

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