

SECTION 4.5
GEOLOGY AND SOILS

4.5 GEOLOGY AND SOILS

This section is based on the Hushmand and Associates (HAI) *Geotechnical Investigation for the Residence Inn by Marriott, Goleta, Santa Barbara County, California* (Appendix F); HAI *Addendum I – Geotechnical Investigation for the Residence Inn by Marriott, Goleta, Santa Barbara County, California* (Appendix E); the Pacific Materials Laboratory *Preliminary Foundation Investigation for the Proposed Residence Inn by Marriott, 6300 Hollister, City of Goleta, California* (Appendix G); Pacific Materials Laboratory *Soil Corrosivity Report* (Appendix H); the Dudek *Archaeological Resource Impacts, Hollister Avenue Improvements Memo* (Appendix D); and the *Dudek Revised Soils Geomorphology for Supplemental Extended Phase 1 Geoprobe Excavations at CA-SBA-58* (June 7, 2010, Mitch Bornyasz, Project Geomorphologist).

4.5.1 Existing Conditions

4.5.1.1 Regional Physiography and Topography

The project site is located within the Transverse Ranges Geomorphic Province of Southern California. The Transverse Ranges are a complex series of mountain ranges and valleys distinguished by an anomalous dominant east-west trend, which contrasts the northwest-southeast trend of the majority of North American mountain ranges, including the neighboring Coast and Peninsular ranges. The area consists of a southerly-dipping east-west trending homocline, similar in character to the geologic structure of the Santa Ynez Mountains to the north.

A major topographic/bathymetric feature in the western part of the province is the Santa Barbara Channel, which is a major trough between the Santa Ynez Mountains and the Channel Islands. The coastal area of the Santa Barbara Channel consists of a series of low-elevation mesas and plains along the southern margin of the Santa Ynez Mountains. The site is located in the Goleta Valley, a broad and flat alluvial plain bordered on the south by the Pacific Ocean coastline and on the north by foothills and terraces, which lie in the foreland of the Santa Ynez Mountains.

4.5.1.2 Regional Geological Structure and Stratigraphy

The strong east-west trend of the western Transverse Ranges province is a result of north-south to north-northeast folding and faulting due to crustal compression. The mountain ranges consist largely of sedimentary rocks with major faults and folds aligned east-west.

Structurally, the Santa Barbara-Goleta coastal plains are dominated by the Santa Barbara fold and fault belt, an east-west trending zone of Quaternary, partly active folds, and blind and exposed reverse faults. Most of the map-scale faults in the coastal plain area are moderately to steeply dipping and have most recently experienced reverse or reverse-oblique slip.

The regional geologic structure includes Tertiary rocks and Quaternary sediments. The Tertiary rocks underlying the Goleta Valley include undifferentiated Eocene strata (Matilija sandstone, Cozy Dell Shale, and the Coldwater Formation), the Sespe Formation, the Vaqueros Formation, the Rincon Formation, the Monterey Formation, and the Sisquoc Formation. The Quaternary sediments overlying the Tertiary rocks include the Santa Barbara Formation, terrace deposits, older alluvium, and younger alluvium.

4.5.1.3 Seismicity

The rugged physiography of the Transverse Ranges is due to recent tectonic uplift. The feature seen today developed primarily in Pliocene to Middle Pleistocene time (i.e., the past 1 to 3 – 4 million years). Numerous faults in the province have had late-Quaternary displacement and many are still active.

There are numerous major active faults in the region capable of causing strong ground shaking in the project area if a major earthquake were to occur. The More Ranch Fault is located approximately 1 mile to the south of the project site. It is part of a long regional fault zone comprising the Mission Ridge Fault and Arroyo Parida Fault System that extends easterly north of More Mesa, across the Santa Barbara Plain and into the Santa Ynez Mountains. The More Ranch Fault is composed of two branches, one along the north edge of the Isla Vista coastal mesa and one within the mesa. Other faults in the area include the Glen Annie Fault and the Carneros Fault. None of these area faults intersect the project site.

These faults are not identified as active Earthquake Fault Zones by the California Geological Survey. However, the More Ranch Fault is considered active in the Santa Barbara County Comprehensive Plan Seismic Safety and Safety Element (County of Santa Barbara 2010). Aerial photographs show strong lineaments along the fault to the east that suggest young surface rupturing, supporting the interpretation that the fault should be considered active. On the other hand, the lack of scarp along the southern margin of the Goleta Slough indicates that if the fault is active, the recurrence interval is long and on the order of more than a thousand years. The estimated maximum magnitude earthquake is 6.7. Figure 4.5-1 shows the geologic hazards in the city.

4.5.1.4 Site Geology

The project site is within a flat alluvial plain known as the Goleta Valley. This valley is bordered on the south by low-elevation mesas such as Ellwood Mesa, Isla Vista, and More Mesa. The northern limit of the Goleta Valley is defined by the foothills of the Santa Ynez Mountains. Most of the creeks in the valley drain into Goleta Slough, a coastal salt marsh located mostly within the Santa Barbara Municipal Airport (SBMA). The Goleta Slough empties to the Pacific Ocean (Santa Barbara Channel) through a gap in the coastal mesas south of the project site between Isla Vista and More Mesa.

The slough was once more extensive and the elevation was generally in the 5–10 feet above mean sea level (msl) range. The size and extent of the Goleta Slough has been substantially modified by filling associated with both historic and more recent activities. These activities include episodes of extensive sedimentation and subsequent infilling of the slough basin during the 19th century, and earthwork associated with agricultural activities, the airport, the railroad, Highway 101, and urban development. The natural courses of several of the streams and creeks that convey water to the slough from the Santa Ynez Mountains have also been blocked or diverted by the railroad tracks and Highway 101, both of which are just north of the project site.

Specific grading/fill activities that have directly affected the elevation of the project site include historic agricultural activities, Hollister Avenue construction activities, development of the existing building on Parcel 1, and development of other properties to the north of the project site. In addition to altering the elevation of the project site, grading activities have resulted in redistribution of native soils from the project site and nearby properties at a variety of depths

across the site. Prior to the above noted natural and manmade changes, the margins of the Goleta Slough most likely extended further north into the western and south-southwestern margins of the site.

The regional geological map shows that the site is composed of two geological units: 1) Holocene-Pleistocene Alluvium and Colluvium; and 2) Pleistocene Intermediate Alluvial Deposits. Field investigations indicate a considerably more complicated stratigraphy because the upper layers of soil are predominantly artificial fill composed of native soils that have been graded and reworked to level the site and surrounding properties for development. The depth of artificial fill in various portions of the site generally ranges from approximately 1.5–8 feet according to the Dudek Soil Geomorphology Report (Appendix D). However, the HAI Geotechnical Investigation (Appendix F) identifies fill material at depths of up to 15 feet. Soils underlying the fill soils include peats, clays, silts, and sands.

The present elevation of the site is approximately 12–14 feet above msl. A manmade earthen channel, approximately 3 feet deep, runs diagonally across the western portion of the site. Prior to grading activities in the area, the drainage pattern was southerly across the site toward Goleta Slough. The natural drainage flow across the site to the Goleta Slough has since been modified and drainage is now directed under Hollister Avenue to an engineered channel, which runs westerly along the south side of Hollister Avenue to Tecolotito Creek, which enters the Goleta Slough from the northwest.

4.5.1.5 Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated granular and non-plastic fine grained soils lose their structure/strength when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density non-plastic soils; and 3) high intensity ground motion. These conditions are present at the project site and the foundation soils may be subject to liquefaction. Loose granular soil can also settle (compact) during liquefaction and as pore pressures dissipate following an earthquake.

4.5.1.6 Landslides

Slope-failure hazards such as landslides and rockfalls are generally confined to areas with steep (greater than 25 percent) slopes and unstable soils. Areas within Goleta that may be susceptible to slope failure include coastal bluffs, steep stream banks, railroad and road cuts, and areas north of Cathedral Oaks Road with steep ground slopes. The Rincon geologic formation is susceptible to landslides, but outcrops of this formation are limited to portions of northwestern and northeastern Goleta. The nearly level project site is not associated with landslide potential or rockfalls.

4.5.1.7 Soil Compressibility

The area surrounding the site is known to be susceptible to settlement due to compressible soils. Several parts of this area, including the project site, were former marshes, ponds, and poorly drained coastal lowlands. These areas were favorable for dense vegetation growth, which in turn trapped more sediment leading to extensive deposits of organic muds, silts, clays, and peats. These deposits are common in the upper few feet of material at the site. The subsurface materials include soft to medium stiff fine grained soils and organic muds that are highly compressible and sandy deposits that have low to medium compressibility when they are subjected to additional load.

4.5.1.8 Expansive Soils (Shrink/Swell)

Expansive soils have a high shrink/swell potential. Clay minerals in these soils expand when moisture content increases and shrink when moisture content decreases. This alternating expansion and contraction are primarily associated with damage to foundations, walls, and buried utilities. Both intact and artificial fill soils on the project site contain clay soils. These soils commonly have a potential for shrink/swell.

4.5.2 Regulatory Framework

4.5.2.1 Federal

The Uniform Building Code (UBC) defines different regions of the United States and ranks them according to their seismic hazard. There are four types of these regions, including Seismic Zones 1 through 4, with Zone 1 having the least seismic potential and Zone 4 having the highest seismic potential. The project site is within Seismic Zone 4; accordingly, any future development would be required to comply with all design standards applicable to Seismic Zone 4.

4.5.2.2 State

Development in the state of California is governed by the 2010 California Building Code (CBC). These regulations include provisions for site work, demolition, grading, excavation, and construction as well provisions for foundation, retaining walls, and soil conditions.

The California Seismic Safety Commission was established by the Seismic Safety Commission Act in 1975 with the intent of providing oversight, review, and recommendations to the Governor and State Legislature regarding seismic issues. The Commission's name was changed to the Alfred E. Alquist Seismic Safety Commission in 2006. Since then, the Commission has adopted several documents based on recorded earthquakes, such as:

- Research and Implementation Plan for Earthquake Risk Reduction in California 1995 to 2000, report dated December 1994.
- Commercial Property Owner's Guide to Earthquake Safety, report dated October 2006.

The Alquist-Priolo Geologic Hazards Zone Act was enacted by the State of California in 1972 to address the hazard and damage caused by surface fault rupture during an earthquake. The act has been amended 10 times and renamed the Alquist-Priolo Earthquake Fault Zoning Act, effective January 1, 1994. The act requires the State Geologist to establish earthquake fault zones along known active faults in the state. Cities and counties that include earthquake fault zones are required to regulate development projects within these zones.

The Seismic Hazard Mapping Act of 1990 was enacted, in part, to address seismic hazards not included in the Alquist-Priolo Act, including strong groundshaking, landslides, and liquefaction. Under this act, the State Geologist is assigned the responsibility of identifying and mapping seismic hazards zones.

The State of California Geologic Survey (CGS), previously known as the Division of Mines and Geology (CDMG), has also adopted seismic design provisions in Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California on March 13, 1997. These guidelines also provide direction for evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations. The CGS also provides

guidance with regard to seismic hazards. Under the CGS's Seismic Hazards Mapping Act, seismic hazard zones are to be identified and mapped to assist local governments in planning and development purposes. The intent of this publication is to protect the public from the effects of strong groundshaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes.

4.5.2.3 Local

The City of Goleta Planning and Environmental Services Department and Public Works Department/Engineering Division have the responsibility for land development review and engineering approvals of all private development within the city to ensure compliance with City codes, ordinances, and policies, and the preparation/enforcement of conditions of approval for development projects. The City has adopted the 2010 CBC to use as its own building code.

Further, the City's grading regulations pertain to new grading, excavations, fills, cuts, borrow pits, stockpiling, and compaction of fill "where the transported amount of materials.....exceeds 50 cubic yards or the cut or fill exceeds 3 feet in vertical distance to the natural contour of the land" (Goleta Municipal Code, Title 15, Chapter 15.09).

4.5.3 Project Impacts and Mitigation

4.5.3.1 Thresholds of Significance

Based on both the City's Initial Study Checklist (CEQA Appendix G; Environmental Checklist Form) and the City's *Environmental Thresholds and Guidelines Manual* (Thresholds Manual), a significant impact on geology and soils could occur, if the project would:

- a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - i. 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.)
 - ii. Strong seismic ground shaking.
 - iii. Seismic-related ground failure, including liquefaction.
 - iv. Landslides.
- b. Result in substantial soil erosion or the loss of topsoil.
- c. 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 offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.
- d. 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.
- e. 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.
- f. Be located on land having substantial geologic constraints.
- g. Result in potentially hazardous geologic conditions such as the construction of cut slopes exceeding a grade of 1.5 horizontal to 1 vertical.

- h. Result in a cut slope over 15 feet in height as measured from the lowest finished grade.
- i. Be located on slopes exceeding 20% grade.

Items a–e are from the Initial Study Checklist, and Items f–i are from the Thresholds Manual.

4.5.3.2 Project Impacts

Impact GEO-1. Seismicity¹

There are no Alquist-Priolo mapped earthquake faults or zones within the city of Goleta. Severe ground shaking during earthquakes is a hazard endemic to most of California, and all project construction would be subject to compliance with the seismic safety standards of the California Uniform Building Code Zone 4, which has been adopted by the City. Due to the distance between the project site and the More Ranch Fault (approximately 1 mile to the south), potential seismic risks are considered to be adverse but less than significant.

Impact GEO-2. Unstable, Hazardous Geologic Conditions/ Liquefaction/Compressible Soil/Expansive Soil²

Due to high ground water levels and soil characteristics on site, the project would be subject to potentially significant impacts from liquefaction.

The project area is known to be susceptible to settlement due to compressible soils; areas such as the project site that were historically part of the Goleta Slough include extensive deposits of organic muds, peats, silts, and clays. These subsurface materials on site are subject to potentially significant impacts associated with compressible soils, including subsidence and differential settlement.

HAI performed an expansion index test on one soil sample that indicated a very low expansion potential (Appendix F). Two additional expansion index tests were performed by Pacific Materials Laboratory that indicated the surficial soils on site have a low to medium expansion potential (Appendix G). As a result of these test results, HAI has recommended a medium expansion potential for the upper 5 feet of soil is recommended for project design. If the final grading and foundation plan does not properly incorporate the HAI recommendations or if the recommendations are not implemented during construction, expansion and contraction of the site's constrained soils can damage foundations and hardscape improvements. Therefore, impacts related to expansive soils are considered potentially significant.

HAI prepared an addendum (Appendix E) to address a revised foundation design and site grading to minimize the potential for impacting cultural resources. The 2010 Addendum addresses the revised foundation design for the building and swimming pool areas of the site. HAI's original recommendations for over-excavation and re-compaction were recommended to minimize undesirable surface settlements. However, the addendum concludes that the proposed design would not result in settlement in the building area, but that hardscape areas would be subject to ongoing settlement. The Report Addendum further concludes:

To avoid disturbance of the archeologically sensitive areas of the site, according to R.D. Olson, the buildings and swimming pool will be designed with structural slabs that can

¹ See Section 4.5.3.1, Thresholds a and f.

² See Section 4.5.3.1, Thresholds a, c, d, f, g, h, and i.

span between the pile foundations and grade beams without any soil support and thus, will not be adversely affected by potential settlements of the top soils (~ the upper 1 to 2 feet). Therefore, the overexcavation in the building and swimming pool areas may be eliminated. However, the effect of the lower compacted fill thickness (3 feet versus 4.5 feet) on the lateral support of the shallow foundations or pile caps should be considered in the design.

In order to minimize undesirable surface settlements in the parking and hardscape areas, we have recommended overexcavating and recompacting a minimum thickness of 18 inches of onsite soils as engineered fill. In addition, we have recommended using geosynthetic layers in the fill placed in these areas to provide a 4.5-foot-thick mat of reinforced earth (see Section 7.2 of the HAI 2007 Geotechnical Investigation report [Appendix F] for the site for the grading requirements).

Layers of geosynthetic reinforcement (e.g., geogrids or geotextiles) should be inserted in the engineered fill to provide a mat of reinforced earth that would help to bridge any localized depression and minimize differential settlements. We also recommend placing a separator geosynthetic layer between onsite soils and the engineered fill.

We also understand that the 18-inch overexcavation for the parking and hardscape areas within the property archeologically sensitive zones, including the courtyard, will be eliminated. According to R.D. Olson, the property owner accepts the risk associated with settlements of the surficial soils in these areas and will repair any damage to the improvements in these areas that may occur as a result of ground settlements.

If the final grading plan does not incorporate the recommended grading/foundation design criteria recommended by HAI, the project would result in potentially significant impacts related to onsite geologic/soils constraints.

Impact GEO-3. Landslide³

Due to the flat topography of the project site, the potential for occurrence of landslides is considered less than significant.

Impact GEO-4. Erosion⁴

The project involves grading and excavation, which could result in sedimentation from air- (wind) and water- (rain, stormwater runoff) induced erosion of stockpiled soils and graded areas on site. Mitigation measures to address such potentially significant impacts associated with erosion and sedimentation are discussed in detail in Section 4.8, "Hydrology and Water Quality," of this EIR.

Impact GEO-5. Wastewater Disposal System Constraints⁵

Wastewater disposal would be provided by the Goleta Sanitary District (GSD). Therefore, the project would not result in significant impacts due to constrained soils for provision of onsite septic systems.

³ See Section 4.5.3.1, Threshold a.

⁴ See Section 4.5.3.1, Threshold b.

⁵ See Section 4.5.3.1, Threshold e.

4.5.4 Cumulative Impacts

Project soils/geologic impacts are limited to impacts affecting the project improvements (structures, hardscape), with the exception of the potential for increased sedimentation of the Goleta Slough. Therefore, the project's significant contribution to cumulative geologic impacts is primarily limited to the potential for erosion and sedimentation from grading activities during the construction period.

4.5.5 Mitigation Measures

Implement Mitigation Measure MM HYD-2b.

MM GEO-2a. Ensure Geotechnical and Soils Engineering Recommendations Meet Uniform Building Code and California Building Code Standards

The permittee will ensure that all geotechnical and soils engineering recommendations (Hushmand Associates Inc., *Geotechnical Investigation for the Residence Inn by Marriott, Goleta, Santa Barbara County, California* [Appendix F] and Pacific Materials Laboratory *Preliminary Foundation Investigation for the Proposed Residence Inn by Marriott, 6300 Hollister, City of Goleta, California* [Appendix G]) both as revised by Hushmand Associates Inc. *Addendum I* (Appendix E) meet Uniform Building Code and California Building Code standards and are incorporated into final project engineering, grading, and construction plans. All grading activities will be supervised by a Registered Civil Engineer or Certified Engineering Geologist.

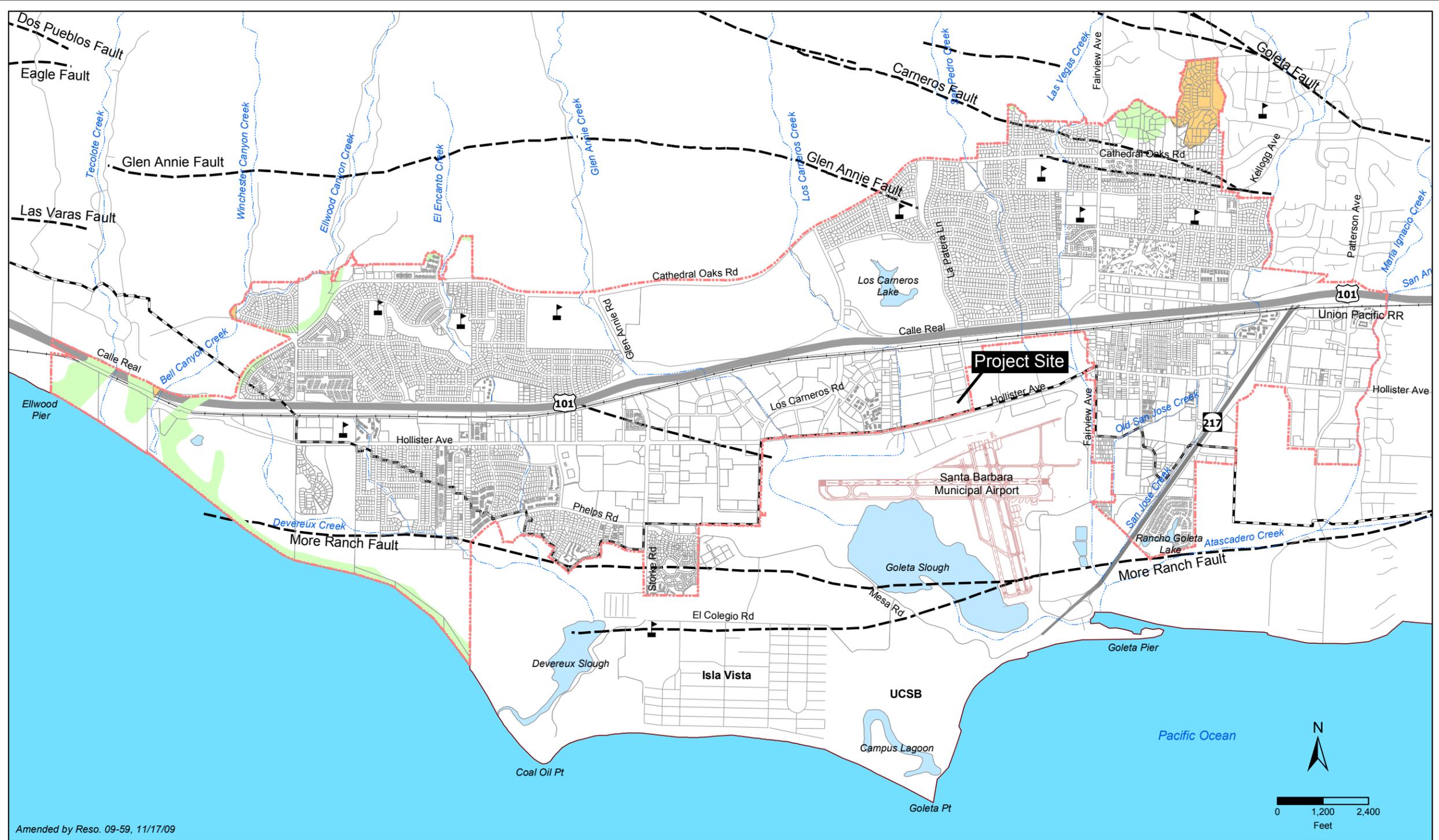
Plan Requirements and Timing: The permittee will ensure that final project engineering, grading, and construction plans incorporate the required geotechnical and soils engineering recommendations, including the revised recommendations included in the HAI Addendum (Appendix E). Plans will be submitted to City staff for review and approval prior to issuance of any Land Use Permit.

Monitoring: City staff will inspect the site to ensure supervision by a Registered Civil Engineer or Certified Engineering Geologist and will verify compliance with final plans during grading and construction.

4.5.6 Residual Impacts

With implementation of these mitigation measures, residual project specific and cumulative impacts on geology and soils are considered less than significant.

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Amended by Reso. 09-59, 11/17/09

Seismic Hazards	Landslide Potential	Other Features
--- Fault Zone	Orange Moderate Landslide Potential	--- Goleta City Boundary
	Green High Landslide Potential	--- Coastal Zone
		▲ Schools
		--- Creeks

GENERAL PLAN/COASTAL LAND USE PLAN
November 2009

Figure 4.5-1
Geologic Hazards
City of Goleta Marriott EIR

