4.6 GEOLOGY AND SOILS

4.6.1 INTRODUCTION

This section discusses natural hazards including seismic hazards such as erosion and subsidence that may affect implementation of the Hyatt Place project (project) or occur on or near the project site, and proposes mitigation measures to reduce potentially significant impacts associated with geological and soil impacts. Sources of information used to prepare the analysis in this section include:

- Association of Bay Area Governments (ABAG), San Mateo County Hazard Map, 2013
- City of Half Moon Bay, General Plan, *Safety Element,* 1991
- City of Half Moon Bay Local Costal Program & Land Use Plan, Chapter 6, *Natural Resources*, 2021
- City of Half Moon Bay, City of Half Moon Bay Existing Conditions Report, 2014
- Cornerstone Earth Group, Geotechnical Investigation: Hyatt House – Half Moon Bay, 2016, (see **Appendix F)**
- Federal Emergency Management Agency (FEMA). FEMA Flood Map Service Center, 2019
- United States Geologic Survey (USGS), Earthquake Outlook for the San Francisco Bay Region 2014-2013
- United States Geologic Survey (USGS), Half Moon Bay Quadrangle, 2018

Project consistency with the 2021 Local Coastal Land Use Plan (LCLUP) is analyzed and included below. The LCLUP was updated and adopted by City Council in October 2020 and certified by the California Coastal Commission (CCC) in April 2021. The updated LCLUP comprises the City's reexamined and updated policy approach for carrying out the Coastal Act in a manner that addresses changed conditions since certification of the 1996 LCLUP.

All documents referenced in the draft EIR are available via CD or weblink upon request. The location of the other reference materials is cited at the end of this section. Hard copies of the draft EIR are located at the City of Half Moon Bay, Planning Division, 501 Main St, Half Moon Bay, CA 94019.

Comments were received in response to the Notice of Preparation for this Environmental Impact Report (EIR), these comments were received regarding geology and soils:

- Concerns that implementation of the project would result in loss of agricultural topsoils
- Requests that the EIR address existing geologic, and groundwater conditions, as well as relevant regulatory framework, including local building codes

4.6.2 EXISTING CONDITIONS

Regional Characteristics

Regional Geology

The city is primarily underlain by a broad, gently sloping marine terrace consisting of poorly consolidated shallow marine sand, silts, and gravels resting on top of an ancient wave-cut bedrock platform. Most soils are derived from alluvial sources. The general geology is defined by the ocean, seismic faults, wetlands and waterways. The City generally slopes downward in a westerly direction toward the Pacific Ocean. Prominent geologic features include the Santa Cruz mountain range and its foothills immediately east of the city limits; various creek basins including Pilarcitos Creek and Arroyo Leon; and the shoreline including the steep coastal bluffs.[1]

Erosion

Along the coast in the project vicinity, waves cause erosion by washing away bluffs and cliffs. In contrast, the inland area of the project vicinity is subject to erosion from surface runoff, land disturbance or development. Soils in the project vicinity are generally considered to have low to moderate erosion potential, except for the shoreline and bluff area, and the creek banks, drainages and other water courses.[2] However, the project site is not influenced by erosion from the ocean or creeks in the vicinity.

Soil Expansion

The shrink-swell potential of soils, or expansion potential, denotes the amount the volume of a soil type will respond to presence or lack of moisture.

[1] Half Moon Bay (City). 2014. City of Half Moon Bay Existing Conditions Report.
[2] Ibid.

Expansion and contraction of soils over time can damage buildings if not designed properly or if the site is not adequately prepared. The expansion potential of soils underlying the City varies from very low to high, depending on the clay content.[3]

Regional Seismicity

The City is located along the Pacific Coast in close proximity to the San Francisco Bay Area, one of the most seismically active areas in the country. U.S. Geologic Survey (USGS) estimates that there is a 72 percent chance of at least one magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area by 2043. As demonstrated by the damage in San Francisco and Oakland due to the 1989 Loma Prieta earthquake that was centered about 50 miles South of San Francisco along the San Andreas fault, significant damage can occur at considerable distances.[4] Higher levels of shaking and damage would be expected for earthquakes occurring at closer distances. Because the project vicinity is located within 6.1 miles of the San Andreas fault and within 50 miles of other San Francisco Bay Area faults, the project vicinity could be impacted by earthquakes within this region.

The faults considered capable of generating significant earthquakes are generally associated with the well-defined areas of crustal movement, which trend northwesterly. **Table 4.6-1** presents the stated considered active faults within 15.5 miles of the site.

Table 4.6-1 Approximate Fault Distances

Fault Name	Distance	
	Miles	Kilometers
San Gregorio	2.0	3.2
San Andreas (1906)	6.1	9.8
Monte Vista-Shannon	10.4	16.8

Source: Cornerstone Earth Group, 2016.

[3] Ibid.

[4] United States Geologic Survey (USGS), 2016. Earthquake Outlook for the San Francisco Bay Region 2014-2043. Available: https://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf. Accessed: May 23, 2019.

Groundshaking

Groundshaking is a general term referring motion of the earth's surface resulting from an earthquake and is normally the major cause of damage during seismic events. The City is within an area with the most potential for groundshaking in the nation. Development within the City would likely be exposed to strong ground shaking. Groundshaking in the City would be very strong to violent during a major event along the San Andreas or San Gregorio Fault systems and would likely cause severe structural damage.[5]

Liquefaction

Liquefaction is the condition by which saturated soils lose cohesion during seismic events and settle, lose stability or amplify the effects of groundshaking. Liquefaction is most associated with alluvium and other young soil types with high sand content.[6] The City's soils include deposits ranging from low to high susceptibility to liquefaction.[7]

Seismic Settlement

Seismic settlement is the displacement of surface geologic structures associated with a seismic event. Settlement can cause unexpected changes in grade, interrupt utilities, and damage structures. The potential for seismic settlement has not been mapped for the City, however, considering the alluvial nature of most soils within the City, there is potential for seismic settlement.[8]

Tsunami/Seiche

Tsunamis are large waves cause by seismic or landslide events in the ocean floor. Tsunamis can result from off-shore earthquakes near the City's coastline or from far distant events. Local tsunamis may result from strike-slip faults along the San Andreas fault running along the coast of the San Francisco Peninsula. In general, tsunamis along the west coast are rare. Most of the recorded tsunami events in the vicinity of the City have been small with many possibly misinterpreted from other wave-related phenomena such as storm-generated waves. Seiches are oscillating waves in enclosed or partly enclosed waterbodies caused by landslides or storms. Water bodies

[5] Half Moon Bay (City). 2014. City of Half Moon Bay Existing Conditions Report.

[6] Half Moon Bay (City). 2014. City of Half Moon Bay Existing Conditions Report.

[7] Association of Bay Area Governments (ABAG), 2013. San Mateo County Hazard Map. Available: https://abag.ca.gov/our-work/resilience/data-research/earthquake. Accessed: January 17, 2022.

[8] Half Moon Bay (City). 2014. City of Half Moon Bay Existing Conditions Report.

capable of producing seiches in San Mateo County (County) include, Upper Crystal Springs Reservoir, Lower Crystal Springs reservoir, San Andreas Lake, Pilarcitos Lake, and San Francisco Bay.[9]

4.6.3 REGULATORY SETTING

Federal

U.S. Geological Survey

In accordance with the Seismic Hazard Mapping Act, the USGS, in coordination with the California Geological Survey, provides up-to-date maps denoting seismic zones and associated motion information to inform the development of engineering requirements for structures. The Seismic Hazard Mapping Act was adopted by the California Legislature in 1990 to reduce public health and safety treats and to minimize property damage caused by earthquakes. The act directs the California Geological Survey to identify and map areas prone to earthquake hazards, such as liquefaction, earthquake induced landslides, and ground shaking. The act requires site-specific geotechnical investigations to identify potential seismic hazards and formulate mitigation measures prior to permitting most developments designed for human occupancy within Zones of Required Investigation.

Project Consistency

The California Geological Survey has released a final seismic hazard zone for the City's vicinity in 2021. However, the project site is not within a Zone of Required Investigation, and is not subject to the requirements of the Seismic Hazards Mapping Act.

State

Alquist-Priolo Earthquake Fault Zoning Act

The California Legislature passed the Alquist-Priolo Earthquake Fault Zoning Act in 1972 to mitigate the hazard of surface faulting to structures. The Alquist-Priolo Earthquake Fault Zoning Act's main purpose is to prevent the construction of buildings used for human occupancy astride the surface trace of active faults, and to require adequate structure setbacks from active faults.

[9] Ibid.

Project Consistency

The project is not located within a State-designated Alquist-Priolo Earthquake Fault Zone, and there are fault traces on the site. Therefore, fault rupture is not a significant hazard at the site.

California Building Standards Code

The Building Standards Commission is authorized by California Building Standards Law (1953) (Health and Safety Cody sections 18901 through 18949.6) to administer the process related to the adoption, approval, publication, and implementation of California's building codes. These building codes serve as the basis for the design and construction of buildings in California including within the City.

California establishes and updates building standards and every local agency enforcing building regulations, must adopt the provisions of the California Building Code (in Title 24, California Code of Regulations) within 180 days of its publication. Currently, the 2019 California Building Code contains provisions for earthquake safety based on factors including occupancy type, soil and rock profile, the strength of the ground, and distance to seismic sources.

Project Consistency

The project design takes into account the seismic risks to the site as identified in the Geotechnical Investigation (**Appendix F**), and conforms to the California Code of Regulations' criteria for the seismic design of buildings.

California Coastal Act

The Coastal Act provides specific standards for the consideration and approval of alterations to the natural shoreline, including revetments, seawalls, and similar methods employed to reduce bluff and shoreline erosion. In general, the Coastal Act, and the California Coastal Commission, discourage alteration to the natural shoreline unless it is "required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply."

Project Consistency

The project is not located along the shoreline and therefore would not alter natural shoreline processes.

Local

Half Moon Bay General Plan and Local Coastal Program

The General Plan (1991) and Local Coastal Program (LCP) contains goals and policies relating to the safety for developments building upon potentially hazardous geological features in the City. Relevant policies from the LCLUP, which is the policy component of the LCP, are included in **Table 4.6-2**.

Table 4.6-2 Project Consistency with Relevant Local Coastal Plan Policies

General Plan Policy Number	General Plan Policy	Project Consistency
Health and Safety Element		
8	Geologic reports, building plans, and environmental impact reports prepared for major construction projects (i.e., all critical facilities or uses with large human occupancies in recognized or suspected hazard areas) shall be prepared by registered civil engineers and structural engineers and review by the City Engineer.	**Consistent.** Geotechnical engineers prepared a Geotechnical Investigation for the project.
LCLUP Chapter 6 Natural Resources		
6-89: Grading Permit	Require grading or earthmoving exceeding 50 cubic yards (total including cut and fill) and/or on any portion of a site with a slope greater than 20 percent to apply for a grading permit as a condition of approval for a coastal development permit, with the exception of tilling or other earthmoving customarily related to existing agricultural operations. The City shall have discretion to require a grading permit based on site-specific conditions and unusual circumstances for grading or earthmoving of less than 50 cubic yards. Grading plans shall meet the requirements of the local implementation plan with respect to maximum quantities, maximum cuts and fills, remedial grading, grading for safety purposes, and maximum heights of cut or fill. Any grading proposed in or adjacent to an ESHA shall be minimized and any disruption shall be repaired and restored to at least an equivalent condition.	**Consistent.** A Grading Permit will be required prior to construction.

General Plan Policy Number	General Plan Policy	Project Consistency
6-90: Seasonal Grading	Prohibit earthmoving during the rainy season (extending generally from October 15 to April 15) for development that is located within or adjacent to ESHA or that includes grading on slopes greater than 25 percent. In such cases, approved grading shall not be undertaken unless there is sufficient time to complete grading operations before the rainy season. If grading operations are not completed before the rainy season begins, grading shall be halted and temporary erosion control measures shall be put into place to minimize erosion and sedimentation until grading resumes after April 15, unless the City determines that completion of grading would be more protective of resources. Grading during the rainy season may be permitted to remediate hazardous geologic conditions that endanger public health and safety.	**Consistent.** Grading shall be scheduled outside of the rainy season; however, project grading is intended to benefit ESHA and may be required subject to biological and engineering review.
6-91: Erosion Control Measures	Ensure that where grading is permitted during the rainy season (extending generally from October 15 to April 15), erosion control measures shall be implemented prior to and concurrent with grading operations. Such measures shall be maintained through final grading and until landscaping and permanent drainage is installed and established.	**Consistent.** Site control measures shall be required for any rainy season construction activities.

Source: City of Half Moon Bay General Plan, 1991, Local Coastal Program, 2021.

4.6.4 IMPACTS AND MITIGATION MEASURES

Thresholds of Significance

The following thresholds of significance for geology and soils were derived from the *Environmental Checklist in the California Environmental Quality Act (CEQA) Guidelines Appendix G*. These thresholds of significance have been amended or supplemented, as appropriate, to address lead agency requirements and the full range of potential impacts related to this project.

An impact of the project would be considered significant and would require mitigation if it would meet one of the following thresholds of significance:

G&S a) 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

G&S b) Result in substantial soil erosion or the loss of topsoil;

G&S c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and result in on or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;

G&S d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life and property;

G&S e) 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.

G&S f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Discussion of Impacts

G&S a) Would the project 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.

No Impact. The project site is not located within a state-designated Alquist-Priolo Earthquake Fault Zone. Furthermore, the Geotechnical Investigation did not identify any surface expression of fault traces on the project site. Therefore, implementation of the project would not expose people or structures to potential substantial direct or indirect adverse effects from surface fault rupture of known active faults. No impact would occur.

Strong seismic groundshaking?

Less than Significant. Although the project site is not located in a Zone of Required Investigation per the ABAG Hazards map, it is located close enough to active faults to experience moderate to severe ground shaking. ABAG classifies the City as an area that will experience violent groundshaking.

The California Building Code has established seismic structural analysis guidelines for sites located near active seismic sources. As required by law, the project design would conform with current applicable residential standards for seismic stability as presented in the 2019 California Building Code, or the version in effect at the time of building permit issuance. In addition, the Geotechnical Investigation prepared for the project has specific seismic recommendations for excavation, structural footings, foundations, concrete slabs and other soil and geotechnical stability topics. Refer to **Appendix F** for the specific recommendations.

The project proponent is required to design structures and foundations to withstand expected seismic sources in accordance with the applicable version of the California Building Code, as adopted by the City. Prior to the issuance of a building permit, the City shall verify that plans incorporate seismic site categorization and design coefficients in conformance with the most recent version of the California Building Code. The project sponsor shall be required to provide evidence that a qualified geotechnical engineer has reviewed final grading, drainage, and foundation plans for consistency with California Building Code and Uniform Building Code design standards, and verify that all pertinent recommendations of the Geotechnical Investigation (**Appendix F**) are incorporated into final building plans. Therefore, the impact would be less than significant.

Seismic-related ground failure, including liquefaction?

Less than Significant. Although the project site is underlain by soils with a moderate potential for liquefaction[10], the Geotechnical Investigation screened the site for liquefaction by retrieving soil samples. The soil samples revealed layers of sand at the site, but determined that these layers would be unlikely to liquefy during a seismic event. The Geotechnical Investigation concluded that the risk of liquefaction and ground failure at the site is very low. This impact would be less than significant. No mitigation measures would be required.

[10] Association of Bay Area Governments (ABAG), 2013. San Mateo County Hazard Map. Available: http://resilience.abag.ca.gov/earthquakes/sanmateo/. Accessed: August 1, 2019.

Landslides?

No Impact. Based on review of existing topographic maps and field observations, the area is relatively flat, without steep or unstable slopes, and does not have an irregular surface.[11] As such, natural slope instability does not affect the project site. No impact would occur.

***G&S b) Would the project* result in substantial soil erosion or the loss of topsoil?**

Less than Significant. Refer to **Section 4.10, Hydrology and Water Quality** for a detailed description of stormwater drainage on the project site during construction and operation. BMPs required for NPDES compliance would be applied during project construction to ensure that during construction, good housekeeping techniques would be employed to prevent soil erosion and siltation impacts as part of the stormwater pollution prevention plan. During project operation, stormwater would be directed to treatment areas and would be directed away from areas that could be subject to erosion. This impact would be less than significant. No mitigation measures would be required.

G&S c) 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 result in on or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Impact G&S-1. The project would be located on soil that is unstable, resulting in on-site subsidence, liquefaction, or collapse.

Less than Significant with Mitigation. As described above, the project vicinity is mostly flat, and therefore landslides would not threaten any structures on the project site or project vicinity. The project site and vicinity's flat topography would also prevent lateral spreading from posing a threat on or off-site. The Geotechnical Investigation did not identify any conditions that would lead to collapse of geologic units on or off-site. The Geotechnical Investigation concluded that the risk of liquefaction and seismic settlement at the project site would be very low based on soil samples taken as part of this report.

However, the Geotechnical Investigation did identify the presence of highly compressible surface soils, organic material, potentially shallow groundwater, moderately expansive soils, and potentially corrosive soils at the site. Compressible soils and organics at the surface of the project site could

[11] United States Geologic Survey (USGS), 2018. Half Moon Bay Quadrangle.

reduce in size as the result of proposed building loads. Decomposing organic material could leave voids in the soil. Shallow groundwater that may rise to depths as high as 12 feet could impact grading activities. Corrosive soils could negatively impact metallic piping. Implementation of **Mitigation Measure GEO-1** would ensure stability of the project site.

> **Mitigation Measure GEO-1:** The project design shall include all recommendations described in the Geotechnical Investigation including but not limited to:
>
> - Over-excavation of surface soil layers, and addition of compacted fill
> - Use of non-expansive fill
> - Shoring of utility trenches
> - The retention of a corrosion engineering specialist for corrosion protection recommendations
> - Retention of a licensed Geotechnical Engineer approved by the City to review geotechnical aspects of the project plans
> - Geotechnical observation and testing during earthwork and foundation construction

Significance after Mitigation. With implementation of **Mitigation Measure GEO-1**, Implementation of the project would result in less than significant impacts.

G&S d) Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life and property?

Impact G&S-2. The project would be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life and property.

Less than Significant with Mitigation. The Geotechnical Investigation determined that moderately expansive soils occur across the project site. These soils occur at the surface of the project site and are made up of clays.

Significance after Mitigation. The presence of expansive soils at the project site would be addressed by **Mitigation Measure GEO-1**. With implementation of this mitigation measure, implementation of the project would result in less than significant impacts.

G&S e) 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?

No Impact. The project design includes a connection to the Sewer Authority Mid-Coastside's sewer system, as discussed in **Section 4.16, Utilities and Service Systems**. Septic tanks or alternative wastewater systems would not be required. No impact would occur.

G&S f) Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature? [12]

Impact CUL-4. The project has the potential to directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Less than Significant with Mitigation. The Geotechnical Investigation did not identify any unique geologic features at the project site, finding deep alluvial soils at the project site (**Appendix F**). The project site is mostly flat with a gentle slope and consists of an empty field. The surrounding area is also flat and unlikely to significantly differ geologically from the project site. The project site is underlain entirely by alluvial fan deposits from the Holocene. Similar geologic units occur throughout the City.[13] As discussed in **Section 4.5, Cultural Resources,** there are no known historical, archaeological, tribal, or paleontological resources identified on the project site. To the extent that construction activities unearth previously undiscovered resources, implementation of **Mitigation Measure CUL-1,** would ensure their proper identification and treatment.

Significance after Mitigation. As described above, **Mitigation Measure CUL-1** would ensure that no adverse changes to the significance of an unknown/discovered paleontological resources occur by protecting the historical or cultural value of the resource through data recovery or preservation through consultation with the applicable professional. **Mitigation Measure CUL-1** would reduce potential impacts related to unknown paleontological resources to a less-than-significant level.

[12] This impact was discussed in **Section 4.5**, **Cultural Resources** as part of the archaeological and paleontological discussion. It is repeated and cross-referenced here because the Environmental Checklist includes it Geology and Soils as question "f."

[13] United States Geologic Survey (USGS), 2014. California State Waters Map Series—offshore of Half Moon Bay, California. Available: https://ngmdb.usgs.gov/ngm-bin/pdp/zui_viewer.pl?id=42733. Accessed: July 29, 2019.

4.6.5 CUMULATIVE IMPACTS

Cumulative impacts occur when two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. Other projects in the area include past and planned residential, commercial, and infrastructure development projects in the City as listed in **Chapter 4.0, Setting, Impacts, and Mitigation Measures.**

Due to the seismically active nature of the region, recent and future development within the project vicinity must conform to General Plan and Local Coastal Program regulations and building codes that ensure adequate performance during a seismic event. Incorporation of these design requirements into the project design would avoid cumulative hazards related to regional seismic events. For other cumulative effects, including natural slope instability, and liquefaction, the project would not contribute to a potential cumulative impact to geological resources due to the flatness of the site, lack of steep or unstable slopes, and does not have an irregular surface. Implementation of **Mitigation Measure GEO-1** would ensure that earthwork and foundation construction would be designed per the specifications and recommendations in Geotechnical Investigation. Therefore, the project in conjunction with past, present, and foreseeable projects, would not result in a cumulative impact.

4.6.6 REFERENCES

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