5.1 GEOTECHNICAL

5.1.1 INTRODUCTION

Purpose

The County of Los Angeles Department of Regional Planning Environmental Checklist Form, which has been prepared pursuant to the California Environmental Quality Act (CEQA), requires that geology and soils issues be evaluated as part of the environmental documentation process. The impacts of the proposed development on the Project site are analyzed at a project-level of detail; direct and indirect impacts are addressed for each threshold criterion for both the on-site and off-site Project features. Growth-inducing impacts and cumulative impacts are described in Sections 6.0 and 7.0, respectively.

Summary

With implementation of Project Design Feature (PDF) 1-1, the Project would not expose people or structures to potential substantial adverse effects (including the risk of injury, or death) involving strong seismic ground shaking, seismic-related ground failure (e.g., liquefaction, settlement, lateral spreading), or location on an unstable geologic unit (e.g., collapse, expansive soils). The Project has been designed with a Geologic Safety Zone so that areas with potential geologic and seismic constraints are not developed with habitable structures and are planned so that buildings near faults have a minimum 100-foot setback in either direction from the fault line (PDF 1-1). Therefore, the Project would not expose people or structures to potential adverse effects (including the risk of injury or death) from surface rupture of a known earthquake fault with implementation of PDF 1-1. Additionally, in accordance with California Department of Education's Title 5 and current building codes, no sensitive uses (i.e., schools, hospitals, or public assembly sites) would be located on sites presenting a significant geotechnical hazard, as determined by the site-specific geological and soils engineering study. Therefore, there would be less than significant impacts related to fault rupture, seismic ground shaking, and ground failure with implementation of PDF 1-1.

Development of the Project may require localized blasting associated with excavation on site, and this would have the potential to result in geotechnical instability. However, with implementation of MM 12-7 in Section 5.12, Noise, potential impacts would be reduced to a less than significant level.

There would be less than significant impacts associated with off-site Project features since no off-site features would include habitable structures; and since all off-site features would be required to comply with County and State geotechnical review and building code requirements as applied to the Project.

Development of the Project would result in less than significant impacts related to erosion or loss of topsoil with compliance with County subdivision specifications; County building code requirements; the Project's Hillside Design Guidelines, and existing and future, tract map-level geotechnical recommendations for the Project.

Section Format

As described in Section 5.0, Environmental Setting, Impacts, and Mitigation, and in accordance with State CEQA Guidelines Article 9 (Contents of Environmental Impact Reports), each topical environmental analysis includes a description of the existing setting; identification of thresholds of significance; analysis of potential Project effects and identification of significant impacts; identification of mitigation measures, if required, to reduce significant impacts; and level of significance after mitigation, if any. This information is presented in the following format (please refer to Section 2.0, Introduction, and Section 5.0 for descriptions of each of these topics):

- Introduction
  - Purpose
  - Summary
  - Section Format
  - References
- Relevant Plans, Policies, and Regulations
- Environmental Setting
- Project Design Features
- Threshold Criteria
- Environmental Impacts—A separate analysis is provided for each of the following categories of potential impacts:
  - On-Site Impacts
  - Off-Site Impacts
- Mitigation Measures
- Level of Significance After Mitigation
- References

References

Although all references cited for preparation of this analysis are listed in Section 5.1.9, the primary technical reference for this section is listed below. This report defines the geologic and seismic characteristics at the site and identifies preliminary recommendations for site development that minimize existing geotechnical constraints.

1. Geocon, Inc. 2015 (August). *Preliminary Geotechnical Summary Report; Centennial – Tejon Ranch, Los Angeles County, California*. San Diego, CA: Geocon (Appendix 5.1-A).

Between 1999 and 2006, several geotechnical investigations were performed for the Project site and adjacent areas by Geocon. The *Preliminary Geotechnical Summary Report* (2015 Geocon Report) includes a preliminary geotechnical analysis of the Project areas located between 300th Street West and 285th Street West, which was not studied in previous reports, and a review and compilation of the previous Project site investigations. The previously completed geotechnical studies prepared for the Project site, and referenced in the 2015 Geocon Report are listed in the Report's List of References Appendix (see Appendix 5.1-A).

5.1.2 RELEVANT PLANS, POLICIES, AND REGULATIONS

Federal

International Building Code

The International Building Code (IBC) is the national model building code. The 2015 IBC is the most recent edition of the International Building Code, which was incorporated into the 2016 California Building Code, and currently applies to all structures being constructed in California. The national model codes are incorporated by reference into the building codes of local municipalities, such as the California Building Code and County Building Code discussed below.

State

California Building Code

The California Building Code is promulgated under Title 24 of the *California Code of Regulations* (CCR), Parts 1 through 12 (also known as the "California Building Standards Code" or CBC) and is administered by the California Building Standards Commission (CBSC). The national model code standards adopted into Title 24 apply to all occupancies in California except for modifications adopted by State agencies and local governing bodies. The 2016 triennial edition incorporates the 2015 IBC, discussed above, and applies to all occupancies that apply for a building permit on or after January 1, 2017. The CBC may be adopted wholly or with revisions by local municipalities, such as the County of Los Angeles Building Code, described below.

Alquist-Priolo Act of 1972

The Alquist-Priolo (AP) Earthquake Fault Zoning Act (AP Act) was adopted by the State of California in 1972 after the 1971 San Fernando Earthquake in order to mitigate the hazard of surface fault rupture along known active faults (California Public Resources Code [PRC], Section 2621 et. seq.). The purpose of the AP Act is to reduce the threat to life and property, specifically from surface fault rupture, by preventing the construction of buildings used for human occupancy on the surface trace of active faults. Under this Act, the State has defined an "active" fault as having had surface displacement during the past 11,000 years (Holocene time). This law directs the State Geologist to establish Earthquake Fault Zones (known as "Special Studies Zones" prior to January 1, 1994) in order to regulate development within designated hazard areas. City and County jurisdictions must require a geologic investigation to demonstrate that a proposed development project, which includes structures for human occupancy, is adequately set back (usually at least 50 feet) from an active fault prior to permitting. In accordance with the AP Act, the State has delineated "Earthquake Fault Zones" along identified active faults throughout the state.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (Act) was passed in 1990 and directs the State Department of Conservation to identify and map areas subject to earthquake hazards, such as liquefaction, earthquake-induced landslides, and amplified ground shaking (PRC 2690–

2699.6). Passed by the State legislature after the 1989 Loma Prieta Earthquake, the Act was aimed at reducing the threat to public safety and minimizing potential loss of life and property in the event of a damaging earthquake event. Seismic Hazard Zone Maps are a product of the resultant Seismic Hazards Mapping Program and are produced to identify Zones of Required Investigation; most developments designed for human occupancy in these zones must conduct site-specific geotechnical investigations to identify the hazard and to develop appropriate mitigation measures prior to permitting by local jurisdictions.

California Department of Education Standards (Title 5)

The California Department of Education (CDE) has instituted standards for school siting and construction that are promulgated through the *California Code of Regulations* (CCR, Title 5, Article 1). These standards are implemented by individual school districts (in coordination with the CDE) and describe detailed procedures and requirements for school siting and land acquisition; development and approval of plans and specifications; and goals for the operation and maintenance of schools. Section 14001(f) of Title 5 requires that planned educational facilities are "designed to meet federal, State, and local statutory requirements for structure, fire, and public safety", and Section 14011(g) of Title 5 requires compliance with Sections 17212 and 17212.5 of the *California Education Code,* which describe requirements for the "geological and soils engineering study". These standards would apply to the proposed public school facilities on the Project site.

County

County of Los Angeles Building Code

The County of Los Angeles Building Code (County Building Code) is promulgated under Title 26 of the Los Angeles County Code. The County Building Code incorporates (and adopts by reference) the 2016 CBC described above, which, in turn, incorporates the 2015 IBC. Section 101.3 of Title 26 (Chapter 1) states that, "The provisions of this Code [the County Building Code] shall apply to the construction, alteration, moving, demolition, repair, use of any building or structure, and grading within the unincorporated territory of the County of Los Angeles and to such work or use by the County of Los Angeles in any incorporated city". This would include the Project. Certain chapters or sections of the County Building Code specifically pertain to construction in areas that present seismic risks and would apply to the Project. These requirements are described below.

- Chapter 1, Section 110.2, "Geotechnical Hazards", of the County Building Code restricts building and grading activities in areas where geotechnical hazards of landslide, settlement, and slippage may be activated or increased as a result of project activities. Project applicants are required to submit an Engineering Geology and/or Soils Engineering Report to indicate how the hazard will be eliminated or mitigated prior to the use or occupancy of the land.
- Chapter 1, Section 111, "Engineering Geology and Soils Engineering Reports", of the County Building Code gives the Building Official the authority to require an Engineering Geology Report, a Soils Engineering Report, or both in cases where such reports are considered essential for the evaluation of the site's safety. The Engineering Geology

and/or Soils Engineering Reports must be prepared by a California-certified engineering geologist or California-licensed civil engineer, respectively, and must contain a finding regarding the safety of the site of the proposed work against hazard from landslide, settlement, or slippage and a finding regarding the effect that the proposed work will have on the geotechnical stability of the area outside the proposed work.

- Chapter 16, Structural Design, of the County Building Code describes requirements for construction of structures based on earthquake loads, including modifications to requirements defined in ASCE 7[1]/2016 CBC Section 1613 related to Seismic Design Categories (formerly Seismic Zones[2]) to reflect County conditions. The Seismic Design Categories consider building location, building use, and underlying soil conditions while Seismic Zones considered only building location. These County-specific building requirements are in addition to all other requirements of the 2016 CBC.
- Chapter 17, Structural Tests and Special Inspections, of the County Building Code requires an applicant to "submit a statement of special inspections prepared by the registered design professional in responsible charge in accordance with Section 106.4.2, as a condition for permit issuance" when specified seismic conditions are met. Section 1709 includes requirements for use of the registered design professional responsible for the structural design, or another registered design professional, to perform structural observations for those buildings included in Seismic Design Category D, E, or F (as determined in Section 1613).

Los Angeles County General Plan and Antelope Valley Area Plan

The *Los Angeles County General Plan* and the *Antelope Valley Area Plan* (AVAP), part of the County General Plan, include goals and policies that address geotechnical issues in the unincorporated County. The AVAP goals and policies applicable to the analysis of geologic and seismic issues with Project implementation are listed below. Section 5.8, Land Use, Entitlements, and Planning, presents a more in-depth analysis of the Project's consistency with relevant plans, policies and regulations.

Goal LU 3: A land use pattern that minimizes threats from hazards.

> **Policy LU 3.1:** Except within economic opportunity areas, prohibit new development on fault traces and limit the amount of development in Seismic Zones, through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.
>
> **Policy LU 3.4:** Except within economic opportunity areas, limit the amount of potential development on steep slopes identified as Hillside Management Areas, through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.
>
> **Policy LU 3.5:** Except within economic opportunity areas, limit the amount of potential development in landslide and liquefaction areas, through appropriate land

1 American Society of Civil Engineers (ASCE) 7-05 "Minimum Design Loads for Buildings and Other Structures"
2 Seismic Design Categories A through F have replaced Seismic Zones 0 through 4.

use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.

Goal PS 2: Protection of the public through geological hazard planning and mitigation.

Policy PS 2.1: Limit the amount of potential development in Seismic Zones and along the San Andreas Fault and other fault traces, through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.

Policy PS 2.2: Limit the amount of development on steep slopes (Hillside Management Areas) and within landslide and liquefaction areas, through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.

Policy PS 2.3: Prohibit the construction of new structures on or across a fault trace.

Policy PS 2.4: Ensure that new development does not cause or contribute to slope instability.

5.1.3 ENVIRONMENTAL SETTING

Overview

The Project site is situated in the western portion of Antelope Valley and in the foothills of the Tehachapi Mountains. The western portion of the site is characterized by moderate to steep hills and drainages, and the eastern portion of the site is characterized by open, gently sloping mesas that are dissected by a network of arroyos and drainages. Agricultural production occurs in the far eastern portion of the Project site on either side of 300th Street West. Elevations range from approximately 3,635 feet above mean sea level (msl) along a ridge overlooking Quail Lake to approximately 2,975 feet above msl in the alluvial drainage area in the east portion of the site. The Project site excludes both State Route (SR) 138 and the West Branch of the California Aqueduct.

Soil and Geologic Conditions

Surficial units are deposits of loose sediment on the surface while geologic units are layers of solidified material (i.e., rocks) that have been given individual names. Surficial deposits on the site include previously placed fill, topsoil, alluvium, colluvium, and shallow landslide debris. Geologic units across the site include Older Alluvium, Hungry Valley Formation, Oso Canyon Formation, Quail Lake Formation, and Neenach Volcanic Formation. The surficial and geologic units mapped on the Project site and the relevant constraints of each unit, are described below. Please refer to Appendix 5.1-A for geologic maps and cross-sections. These maps illustrate the locations of surficial and geologic units, topography, limits of fault setback zones, trench and boring locations, and cross-section locations, all overlain on the Project site's Preliminary Grading Plan Map.

Surficial Units

Previously Placed Fill (Qpf). Isolated areas of previously placed fill exist in localized areas throughout portions of the Project site and are generally associated with the construction of existing roadways. Fills associated with dirt roadways are generally uncompacted; and fills associated with the Cement Plant Road and 300th Street West have received compaction, but are underlain by unconsolidated surficial soils. These fill soils are not suitable in their present condition to support additional fill and/or structural loading.

Topsoil (unmapped). A relatively thin blanket of topsoil (typically on the order of one to four feet thick) covers the natural hillsides on the site and is composed, in general, of loose, dry to humid, dark brown, silty to clayey sand. The topsoil is compressible (i.e., collapsible under weight) and not suitable for loading.

Alluvium (Qal). Alluvium exists in major canyons and low-lying areas throughout the site. The alluvium encountered in small-diameter borings and in exploratory trenches generally consists of dry to saturated, silty to clayey, fine- to coarse-grained sand and is often indistinguishable from thick colluvium deposits. The alluvium encountered on site varies in thickness from approximately 4 feet to 65 feet, and becomes denser with depth. Typically, the upper 5 to 15 feet of soil is dry and loose, and is not suitable for loading. Below 15 feet, the soil moisture content and density increase. Consolidation tests performed on samples of alluvium indicate that, below a depth of 15 feet the alluvium has low compressibility potential and relatively minor volume change characteristics upon saturation (i.e. low hydroconsolidation [collapse upon the addition of water] potential).

Colluvium (Qc). Colluvial soils were encountered beneath gently to moderately inclined slopes and semicircular bowl-shaped areas near the heads of arroyos and canyon drainages. In general, colluvium consists of loose, porous, dry to humid, dark brown to reddish brown, silty, gravelly, medium- to coarse-grained sand. The thickness of the colluvium varies greatly from approximately 3 feet to more than 50 feet. Anticipated average thicknesses range between 15 and 20 feet, but in tributary canyons to major drainages the thicknesses can be substationally greater, equaling or exceeding alluvial thicknesses. The colluvium is poorly consolidated, porous, has low moisture content, and is subject to collapse upon wetting (i.e. hydroconsolidation) and settlement from loading (i.e., compressibility).

Landslide Debris (Qls). A large ancient landslide was encountered over a large area in the northwestern portion of the Oso Canyon area. This area is entirely avoided and is located within the SEA No. 17; therefore, this landslide area is not identified on the Appendix 5.1-A geologic maps and cross-sections for the Project, which only include areas within the preliminary grading plan. The landslide area is designated to remain in open space. The landslide was mapped and partially delineated with exploratory trenches as well as a single large-diameter boring. Mapped landslide debris associated with this slide covers an area over 1 mile in length; is 1,000 to 3,000 feet in width; and is estimated to be as much as 200 feet thick. Previous mapping of the landslide suggests that the head of the landslide was in granitic bedrock approximately 500 feet west of the Project site's western property line. Exploratory excavations and mapping indicates that the landslide initially failed within the adversely dipping claystones and shale of the Quail Lake Formation (discussed below).

A small, shallow landslide was mapped along a north-facing arroyo slope. Several other small, shallow slumps and erosional sloughing were observed during on-site geotechnical investigations along the more steeply eroded arroyos. These features do not exceed widths of 50 feet and, while noted in the geotechnical studies for the site, are not mapped due to their small size and geotechnical insignificance. Observations and exploratory excavations indicate the shallow landslides on the relatively steep slopes initially failed in permeable cohesionless gravelly sands of Older Alluvium.

Geologic Units

Older Alluvium (Qoal). Older Alluvium, composed of Pleistocene-age (11,700 years old to 2.5 million years old), terrace deposits, cap the upper portions of mesas and ridges across the majority of the Project site and is one of the major deposits anticipated to be encountered during grading. Thicknesses of Older Alluvium encountered during geotechnical investigations ranged from 8 feet to 74 feet. This unit is generally composed of medium dense to very dense, humid to moist, reddish brown, silty to clayey, medium- to coarse-grained sand with lenses of coarse gravel and clean sands. Except for surficial, weathered portions or thin interbedded clayey layers, the Older Alluvium displays high shear strength characteristics and low expansion potential. Given the in situ density of the Older Alluvium, it is considered suitable for support of additional fill and/or structural loading. However, some localized layers consist of unconfined clean, gravelly sand that are subject to erosion and surficial landslides under seasonal heavy rains or perched groundwater conditions. The loose Older Alluvium overlies the solid bedrock formations listed below.

Hungry Valley Formation (unmapped). The Hungry Valley Formation can be found in one small area in the southwestern corner of the Project site. Although not encountered during geotechnical investigations, it could occur in localized unconformable deposits located between the Quail Lake Formation and the Older Alluvium. This unit is composed of very stiff, very moist, silty to conglomeratic claystone with bentonite clay seams overlain by Older Alluvium and underlain by the Quail Lake Formation. No Project development would overlie this geologic unit.

Oso Canyon Formation (Toc). The Oso Canyon Formation consists of Miocene-aged (5.3 to 23 million years old), dense to very dense, partially to well-cemented, light brown to tan sandstone. This formation was encountered at shallow depths in arroyos and lower slopes along ridges and mesas in the southern and western portions of the site. The Oso Canyon Formation, and the Older Alluviumare both anticipated to comprise the bulk of cut materials generated by proposed grading. The Oso Canyon Formation is considered suitable to support of structural fill and/or loading in its present condition. Soil derived from the Oso Canyon Formation generally has a very low expansion potential, high shear strength, and satisfactory foundation engineering characteristics in either a natural or properly compacted condition.

The previous geotechnical investigations encountered strongly cemented zones up to three feet thick in this unit. Where encountered, excavations will likely require a very heavy effort with conventional heavy-duty grading equipment and/or localized breaking or possible blasting. Once ripped or broken up, numerous oversize rock fragments will be generated that will require special placement procedures and compaction when placed in fills.

Quail Lake Formation (Tql). The Quail Lake Formation consists of Miocene-age, hard to very dense, dark olive-brown to gray, lignitic (i.e., including coal) clayey siltstones to silty claystones with thin interbedded sandstones. This formation is exposed in the westernmost quadrant of the Project site. Several dipping bedding plane shears[3] or remolded clay seams were encountered in large-diameter borings. Bedding plane shears are notable in that they represent planes of weakness in a geologic unit. In addition, some portions of the formation have intersecting sets of clay-lined joints that could impact surficial slope stability. Cut slopes in areas of adversely dipping bedding-plane shears or intersecting joints may require buttressing and/or stabilization fills to provide long-term stability. Expansion testing on the Quail Lake Formation indicates a variable range of expansion indices from low to high. Highly expansive clay exposed at finish grade will require remedial grading to provide a select low expansive soil cap.

Neenach Volcanic Formation (Tva). The Neenach Volcanic Formation consists of Miocene-age, dark to reddish brown andesite flows (i.e., formed by lava flows on the surface) and tuff beds (i.e., consolidated pyroclastic rocks). A small exposure of this unit was mapped in the southeastern portion of the site.

Geologic Structure

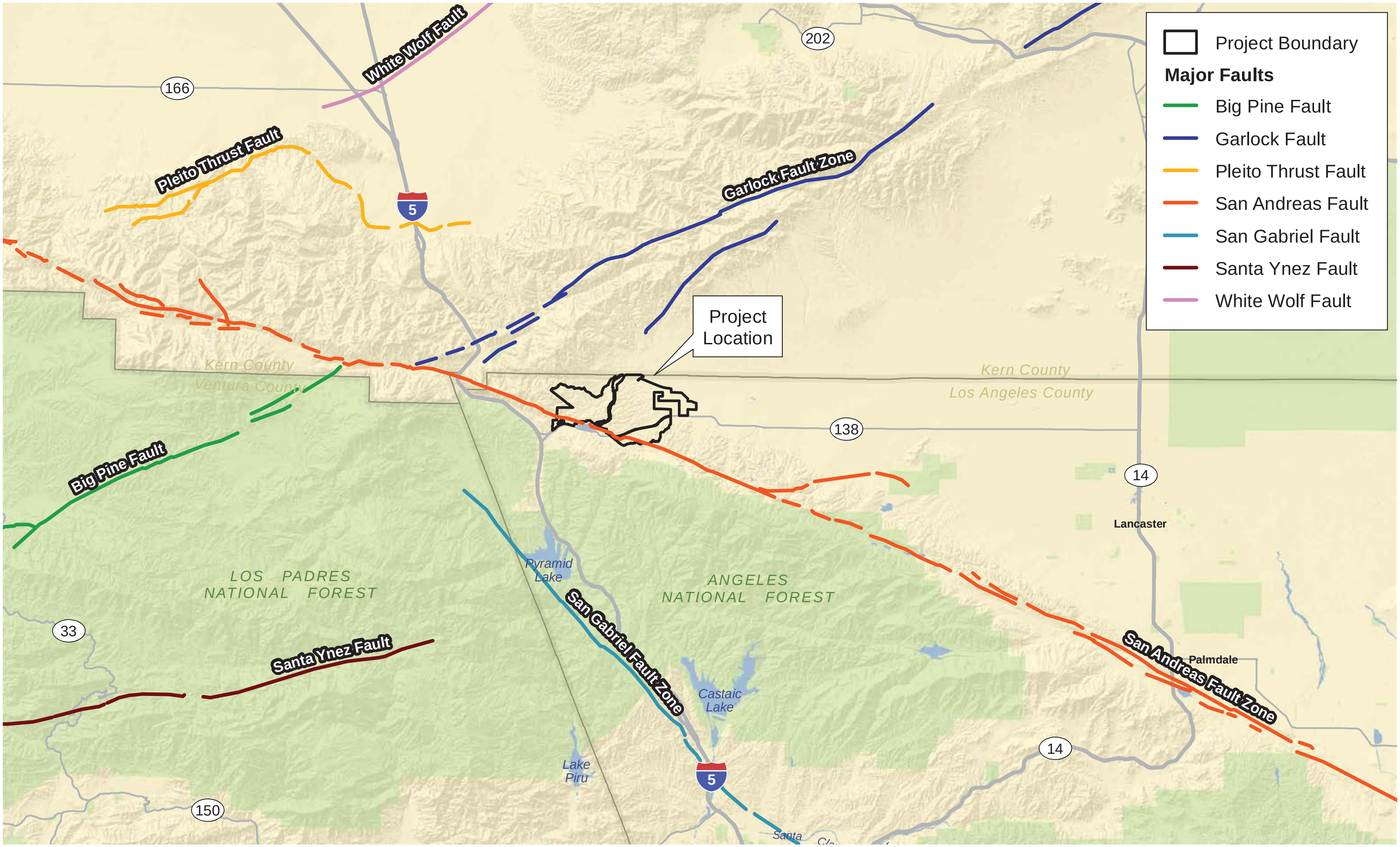
Bedding attitudes, or angles, in Older Alluvium vary from horizontal to gently dipping or undulatory. Typically, these deposits have massive (i.e., homogenous) bedding with very irregular scoured contacts on underlying units. Underlying units, principally the Oso Canyon Formation and the Quail Lake Formation, have bedding attitudes, or angles, that vary from gentle to steep to overturned, indicating a faulted and folded bedrock structure beneath the majority of the site. Outcrops and subsurface bedding attitudes in the Tertiary-age (2.6 to 66 million years old) units suggest northwest- to southeast-oriented folding in bedrock units throughout the site. Bedding plane shears or remolded clay seams were also encountered in the folded and faulted Oso Lake and Quail Lake Formations, and in bentonitic zones in the Hungry Valley Formation.

Faulting and Seismicity

The Project site, as with Southern California in its entirety, lies in a seismically active region. The California Geological Survey (CGS) defines faults as “active”, “potentially active”, or “inactive”. The CGS considers a fault seismically active when evidence suggests seismic activity within roughly the last 11,000 years. Exhibit 5.1-1, Regional Faults, depicts the locations of faults in the Project site’s vicinity and provides a regional context for potential seismic activity at the site. The site is located between the junction of the San Andreas and Garlock Fault Zones.

The only fault in the vicinity of the Project site within a designated Alquist-Priolo Earthquake Fault Zone is the San Andreas Fault (San Andreas Earthquake Fault Zone). The San Andreas

3 This term, bedding plane shears, describes a deformation of rock resulting from stresses that cause contiguous parts of a geologic body to slide in relation to each other in a direction parallel to their plane of contact (American Geologic Institute 1984).



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Regional Faults

Exhibit 5.1-1

Centennial Project

N W E S

8 4 0 8 Miles

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Fault Earthquake Fault Zone and fault line cross the southwestern edge and southernmost point of the Project site, as shown on Exhibit 5.1-2, Geologic Hazards.

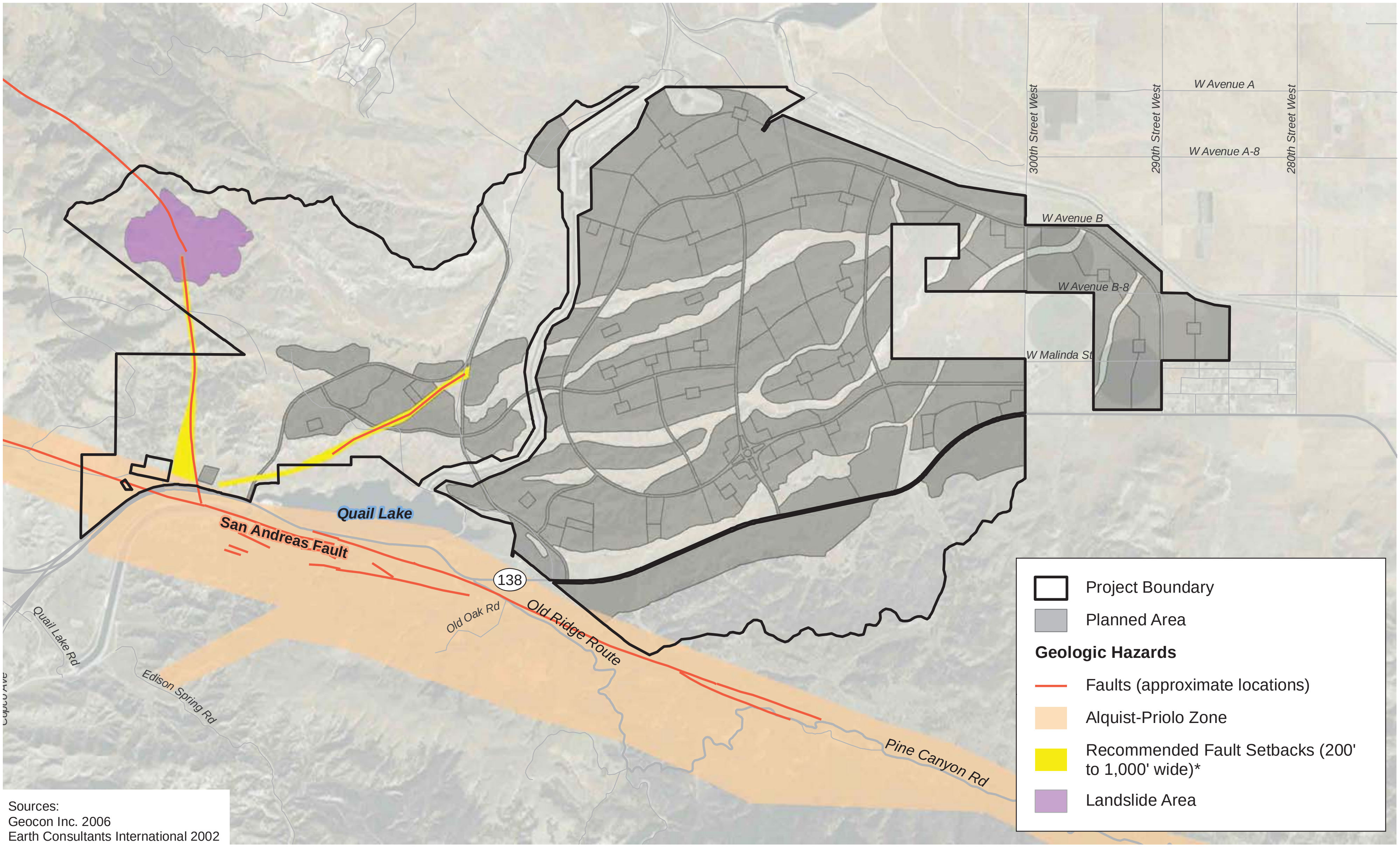
Due to the Project's proximity to the San Andreas and Garlock Fault Zones, Geocon retained Earth Consultants International (ECI)—a fault research company—to conduct a detailed fault investigation on the Project site (Appendix E of the 2015 Geocon Report in Appendix 5.1-A). ECI's study included a thorough review of published geologic literature and graduate thesis studies to assess known hypothetical faults and their locations on site. Once these proposed faults and locations were identified, detailed geologic mapping was conducted to assess if sufficient geology was exposed to verify faulting. Aerial photo review and mapping that showed exposures of continuous geologic strata across the proposed fault locations resulted in eliminating the majority of hypothetical faults or other linear features in the literature.

The subsequent field investigation consisted of logging 18 fault trenches and 21 soil pits. From this research, the two previously unidentified active faults were found within the boundary of the Project site. The westernmost of the two faults is located outside the development footprint. The other fault crosses the western portion of the development area in Village 9 and requires a minimum 100-foot building setback for site planning purposes, which may be reduced to 50 feet as discussed in PDF 1-1. The other active fault strand is located approximately 2,000 feet to the west of the proposed development area on the site. Site-specific fault conditions and associated setbacks are illustrated on Exhibit 5.1-2. It is noted that these faults are unnamed because they were only identified as part of the site-specific investigations. Therefore, they are not included in the Alquist-Priolo program, nor are they otherwise identified by the State; seismic characteristics are not known for these faults as they are for the known regional faults listed above.

The 2015 Geocon Report included site-specific seismic hazard analysis with both deterministic and probabilities methodologies (i.e., Deterministic Seismic Hazard Analysis [DSHA] and Probabilistic Seismic Hazard Analysis [PSHA]), using the EZ-FRISK™ (Version 7.65) earthquake ground motion estimation software. These methods and the results are described below.

Deterministic Seismic Hazard Analysis

The EZ-FRISK software indicates there are 29 known active faults are located within a search radius of 50 miles from the Project site. The analysis used coordinates generally correlating to the central portion of the site. Table 5.1-1 lists the estimated maximum earthquake magnitude (M) and peak ground acceleration (g, or percent of the force of gravity) for the most dominant faults in relationship to the central portion of the Project site, listed by increasing distance, for the three different acceleration-attenuation relationships (i.e., mathematical equations related to ground motion) applied in the DSHA.



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Geologic Hazards

Exhibit 5.1-2

Centennial Project

N W E S

1 0.5 0 1 Miles

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TABLE 5.1-1
DOMINANT FAULTS IN THE VICINITY OF THE PROJECT SITE (DSHA)

Fault Name	Approximate Distance From Central Portion of the Site (miles)	Maximum Earthquake Magnitude (M)	Peak Ground Acceleration[a] (g)		
Southern San Andreas	0.7	8.2	0.53 (59%)	0.46 (59%)	0.59 (59%)
Garlock	7	7.7	0.31 (35%)	0.26 (35%)	0.35 (35%)
San Gabriel	8	7.3	0.34 (40%)	0.28 (40%)	0.40 (40%)
Pleito	12	7.1	0.23 (24%)	0.19 (24%)	0.24 (24%)
Santa Ynez (East)	17	7.2	0.20 (20%)	0.14 (20%)	0.17 (20%)
Santa Ynez (Connected)	17	7.4	0.21 (21%)	0.15 (21%)	0.18 (21%)
San Cayetano	19	7.2	0.20 (20%)	0.14 (20%)	0.18 (20%)
White Wolf	23	7.2	0.11 (18%)	0.18 (18%)	0.15 (18%)

DSHA: Deterministic Seismic Hazard Analysis; g: ground movement as a percent of the force of gravity

[a] The three columns represent the results of the three different mathematical equations utilized to calculate the Peak Ground Acceleration, per standard practice for seismic assessment.

Source: Geocon 2015 (Appendix 5.1-A).

As shown, the nearest known active fault is the Southern San Andreas Fault, located less than one mile south of the central portions of the site and the dominant source of potential ground motion. Because the analysis used coordinates generally correlating to the central portion of the Project site, this fault is shown as 0.7 mile away; however, it is located along the southern boundary of the Project site (see Exhibits 5.1-1 and 5.1-2). Earthquakes that might occur on the San Andreas Fault Zone or other faults in the Southern California and Northern Baja California area are potential generators of significant ground motion at the site. The estimated deterministic maximum earthquake magnitude and peak ground acceleration for the Southern San Andreas Fault are 8.2g and 0.59g (i.e., 59 percent the force of gravity), respectively. While listing peak accelerations is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including frequency and duration of motion and soil conditions underlying the site. These other considerations are collectively addressed in the 2015 Geocon Report.

Probabilistic Seismic Hazard Analysis

Probabilistic estimates of seismic risk are based on the premise that the potential for an earthquake in an area is a function of the combined annual probabilities for earthquakes on all faults capable of generating energy of a certain level in that area. This method assumes earthquakes occur randomly in time and that the annual probability for earthquake occurrences is the same from year to year. A higher frequency of small to moderate earthquake occurrence is also considered. By calculating the expected accelerations from considered earthquake sources, the EZ-FRISK program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value.

Table 5.1-2 presents the site-specific probabilistic seismic hazard parameters including the three different acceleration-attenuation relationships (i.e., mathematical equations related to ground motion) applied in the PSHA and the probability of exceedance.

TABLE 5.1-2
PROBABILISTIC SEISMIC HAZARD PARAMETERS (EZ-FRISK)

Probability of Exceedance	Peak Ground Accelerations (g)[a]		
2% in a 50-Year Period	1.19 (119%)	0.88 (88%)	1.18 (118%)
5% in a 50-Year Period	0.90 (90%)	0.69 (69%)	0.94 (94%)
10% in a 50-Year Period	0.69 (69%)	0.54 (54%)	0.73 (73%)

g: ground movement as a percent of the force of gravity

[a] The three columns represent the results of the three different mathematical equations utilized to calculate the Peak Ground Acceleration, per standard practice for seismic assessment.

Source: Geocon 2015 (Appendix 5.1-A).

In addition to the three relationships applied in the EZ-FRISK program, the CGS has a program that calculates the ground motion for a 10 percent of probability of exceedance in 50 years based on an average of several attenuation relationships. Table 5.1-3 presents the calculated results from the Probabilistic Seismic Hazards Mapping Ground Motion page from the CGS website.

TABLE 5.1-3
PROBABILISTIC SEISMIC HAZARD PARAMETERS (CGS)

Calculated Acceleration Firm Rock (g)	Calculated Acceleration Soft Rock (g)	Calculated Acceleration Alluvium (g)
0.72 (72%)	0.72 (72%)	0.72 (72%)

CGS: California Geological Survey; g: g: peak ground acceleration (ground movement) as a percent of the force of gravity

Source: Geocon 2015 (Appendix 5.1-A).

Secondary Seismic Effects

The secondary effects of seismic ground shaking from earthquakes that may affect the Project site include liquefaction and settlement. Liquefaction is a phenomenon in which loose, saturated, and relatively cohesionless soil deposits lose their strength during strong ground motion. Primary factors that control the development of liquefaction include intensity and duration of ground motion; characteristics of subsurface soil; in situ (i.e., in the position originally formed) stress conditions; and the depth to groundwater. Based on previous geotechnical studies on the Project site and experience with similar geologic conditions, the 2015 Geocon Report concludes that there is a potential for liquefaction occurring within the main alluvial drainages for the Project where shallow groundwater (less than 50 feet) and loose alluvium is present. In the event liquefaction occurs, the primary geotechnical constraint is associated with potential settlement due to seismic shaking. Groundwater depths across the site are discussed further below. Liquefaction potential is greatest along Oso Canyon, where relatively shallow groundwater was encountered during both the previous geotechnical investigations and the hydrogeologic investigation. However, no development is proposed in Oso Canyon.

Seismically induced settlement (i.e., liquefaction and settlement of dry sands) can occur during or after seismic shaking and results from rearranging of sand particles in the soil matrix. Settlement of dry sands, not related to liquefaction, has not been estimated throughout the Project site, but would be expected to occur in areas with alluvial deposits and/or known liquefaction potential.

Groundwater

Groundwater and/or seepage were encountered within several of the exploratory trenches and borings performed during the field investigations. Groundwater/seepage was found as shallow as 3 feet and as deep as 55 feet. However, due to the geologic conditions and the natural and artificial water sources inherent to the site, groundwater conditions are expected to fluctuate seasonally. Occasional seeps and springs were also observed during the investigations and were mapped.

Seven well logs with readings from 1956 to 1971, located approximately a mile to the south and west of the Project site, were obtained from the County of Los Angeles Department of Water Resources. Review of the data indicated a high groundwater table variance from 3,226 feet above msl to 3,385 feet above msl. Surface elevations varied from 3,350 feet above msl to 3,430 feet above msl, equating to 45 to 117 feet below ground surface (bgs). However, given the distance from the wells to the site and the noncontiguous drainages, application of these high groundwater elevations can only be general (Geocon 2015).

On-site groundwater studies performed between March 2004 and December 2005 were conducted by Bookman–Edmonston (a division of GEI Consultants) to evaluate groundwater as a source for on-site potable water. Their study included numerous borings and several monitoring wells (see Appendix F of the Geotechnical Report in Appendix 5.1-A). They identified two aquifers located along the northern and southeastern portion of the site; the highest groundwater elevation was measured at 35 feet bgs. Considering that the monitoring period covered two of the wettest years on record in California, this may not represent the normal groundwater elevations for area (i.e., normal elevations would be deeper).

5.1.4 PROJECT DESIGN FEATURES

PDF 1-1 A Geologic Safety Zone has been incorporated into the Project that establishes review procedures and setbacks for areas subject to potential surface fault rupture. This zone is applied to areas designated as Alquist-Priolo Earthquake Fault Zones and unnamed faults identified on the site as part of the Project's site-specific geotechnical investigations. Also, Section 2690 of the *California Public Resources Code*, specifies that no human-occupied structures can be located within an Alquist-Priolo Earthquake Fault Zone unless specific investigations prove these areas to be free of active faulting.

This Geologic Safety Zone institutes a minimum 100-foot setback (i.e., 100 feet in each direction) from the fault lines that traverse any development area. The width of the setback may potentially be reduced to 50 feet (in each direction), with the approval of the County, provided there is no evidence of fault activity from trenching performed as part of an additional fault investigation during the site development process.

The Project, through the use of a Geologic Safety Zone, requires that:

1. No habitable structures be built within the San Andreas Alquist-Priolo Zone unless specific geotechnical investigations determine there is no active faulting present.
2. Development be setback at least 50 feet from any identified active fault on site.
3. Development will not be adversely affected by geotechnical problems.

5.1.5 THRESHOLD CRITERIA

The following significance threshold criteria are derived from the County of Los Angeles Environmental Checklist. The Project would result in a significant impact if it would:

Threshold 1-1 Expose people or structures to 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 active fault trace. Refer to Division of Mines and Geology Special Publication 42.

Threshold 1-2 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic groundshaking.

Threshold 1-3 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction and lateral spreading.

Threshold 1-4 Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides.

Threshold 1-5 Result in substantial soil erosion or the loss of topsoil.

Threshold 1-6 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 1-7 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 1-8 Have soils incapable of adequately supporting the use of onsite wastewater treatment systems where sewers are not available for the disposal of wastewater.

Threshold 1-9 Conflict with the Hillside Management Area Ordinance (L.A. County Code, Title 22, § 22.56.215) or hillside design standards in the County General Plan Conservation and Open Space Element.

5.1.6 ENVIRONMENTAL IMPACTS

The Project was designed to avoid or minimize geotechnical constraints on the Project site. Several geotechnical investigations of the site have been conducted, and the results of the investigations were used to guide the site-planning process. Therefore, land uses were configured (1) to avoid designated setback zones for fault lines and the landslide located within the northwestern portion of the site and (2) in consideration of localized geotechnical conditions (see Exhibit 5.1-2).

The geologic investigations conducted across the Project site and incorporated within the 2015 Geocon Report determined that there is the potential for strong seismic ground shaking from on-site and regional active faults; there are also shallow groundwater areas, potentially liquefiable soils, compressible upper alluvial and surficial deposits, and some expansive soils. These are all common and easily remediated conditions. The 2015 Geocon Report concludes that there are no soil or geologic conditions present on or near the Project site that would preclude the safe development of all proposed land uses on the Project site (including homes, schools, commercial and industrial uses, community use and recreation areas, utility lines and other infrastructure, and water/wastewater treatment facilities) given incorporation of all existing and future, tract map-level, geotechnical recommendations into grading and construction plans and specifications; this includes compliance with County subdivision specifications, County zoning and building code requirements, and Project's Grading Plan, and the Specific Plan's Hillside Design Guidelines. All geotechnical recommendations found in the previously prepared and 2015 Geocon reports are standard engineering techniques, and the 2015 Geotechnical Report (Appendix 5.1-A) has determined the Project development is feasible provided the seismic and other geotechnical constraints identified within the Project site's grading boundaries are addressed, via future, tract map-level geotechnical studies to be performed as part of Project implementation consistent with County and State building code requirements.

It should be emphasized that, while the Project site has identified geotechnical constraints, the overall seismic risk at the Project site is the same as Southern California in its entirety. Compliance with geotechnical recommendations, which reflect building code requirements, would result in the construction of earthquake-resistant structures. However, in the event of a major seismic event, no structure is completely safe from damage. Incorporation of these measures reduces the potential risk from seismic and geotechnical conditions to the maximum extent practicable under current engineering practice.

Threshold 1-1 Would the project expose people or structures to 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 active fault trace? Refer to Division of Mines and Geology Special Publication 42.

On-Site Impacts

As described above, the nearest Alquist-Priolo active fault zone to the Project site is the San Andreas Fault Zone. As shown on Exhibit 5.1-2, the Project has been designed to avoid all designated fault buffer zones via the Geologic Safety Zone (PDF 1-1). Specifically, both the San Andreas Earthquake Fault Zone and the 100-foot setback (in both directions) placed on the unnamed faults on the Project site in accordance with the recommendation of the 2015 Geocon Report, are proposed as open space and drainage areas (see Exhibit 4-1 Centennial Project –Conceptual Land Use Plan). This is consistent with AVAP Policy LU 3.1 (although the Project is exempt from this policy due to location in an Economic Opportunity Area [EOA]), Policy PS 2.1, and Policy PS 2.3, related to limiting development on or near fault traces.

This Geologic Safety Zone institutes a minimum 100-foot setback (i.e., 100 feet in each direction) from the fault lines that traverse any development area. The width of the setback may be reduced to 50 feet (in each direction), with the approval of the County of Los Angeles Department of Public Works, provided there is no evidence of fault activity from trenching performed as part of an additional fault investigation during the site development process.

The Project would include the following types of sensitive land uses: schools, hospital, and public assembly sites. With respect to schools, the California Department of Education's (CDE's) Title 5 requirements would be implemented by local school districts and would ensure that school site location decisions and building designs meet all applicable seismic and public safety concerns. Hospitals are also required to reflect seismic safety concerns in their location decisions and building designs pursuant to building code requirements.

The Project must incorporate all applicable geotechnical recommendations identified in the geotechnical documents previously prepared for the Project. These recommendations include those reviewed and compiled in the *Preliminary Geotechnical Summary Report, Centennial – Tejon Ranch, Los Angeles County, California* prepared by Geocon Incorporated and dated June 2015, and those to be identified in the geotechnical reports for the Final Engineering and Grading Plans (which must incorporate the findings of all soils engineering and geologic studies) for individual tract maps and the associated final grading plans to be processed as the Project is implemented.

Implementation of the following would ensure impacts related to the proximity to active faults would be less than significant level: implementation of the Geologic Safety Zone (PDF 1-1); compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and existing and future tract map-level geotechnical recommendations identified for all development on the Project site; and the requirements of CDE Title 5 for proposed schools. Therefore, the Project would result in less than significant impacts related to fault rupture or other constraints related to proximity of the Project site to known active faults.

Off-Site Impacts

None of the off-site Project features, which include intersections with SR-138, utility connections, water wells, and California Aqueduct crossings, involve habitable structures or otherwise sensitive land uses. Also, all off-site Project features would be required to comply with County and State geotechnical review and building code requirements as applied to the Project, as applicable. For instance, the California Aqueduct bridge crossings would require structural engineering design that reflects the seismic conditions of the area, and the five new intersections along SR-138 and associated deceleration/acceleration lanes would require remedial grading to ensure a stable foundation. There would be less than significant impacts related to geologic and seismic conditions from implementation of required off-site Project features.

Impact Summary: There would be less than significant impacts from the Project site's proximity to active faults with implementation of the Geologic Safety Zone (PDF 1-1); implementation of the requirements of CDE's Title 5; and compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and existing and future, tract map-level, geotechnical recommendations for the Project, as described in Section 5.1.4.

Threshold 1-2 **Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic groundshaking?**

Threshold 1-3 **Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction and lateral spreading?**

On-Site Impacts

Ground Shaking. Similar to conditions in the nearby communities of Palmdale, Lancaster, Santa Clarita and most of Los Angeles County, the Project site could experience moderate to severe ground shaking due to a major earthquake generated on one or more active earthquake faults on or near the site and in the region within the life of the Project. The analysis of seismic risk at the Project site determines that, with incorporation of geotechnical recommendations presented in all existing and future, tract map-level, geotechnical reports (which include conformance with applicable building codes), there would be less than significant impacts related to seismic ground shaking.

Liquefaction and Lateral Spreading. Liquefaction is defined as the transformation of a granular material from a solid state into a liquefied state. Liquefaction is a phenomenon in which loose, saturated, and relatively cohesionless soil deposits lose their strength (the ability to bear the weight of overlying structures) due to saturation with water during strong ground motions. Primary factors that control the development of liquefaction include intensity and duration of ground motion, characteristics of subsurface soil, in situ[4] stress conditions, and the depth to groundwater. Lateral spreading is a liquefaction-related phenomena wherein lateral (i.e., horizontal) ground displacement occurs on gentle slopes due to liquefaction in underlying sediments.

Based on previous geotechnical studies on the Project site and experience with similar geologic conditions, the 2015 Geocon Report concludes there is a potential for liquefaction to occur within the main alluvial drainages on the Project site where shallow groundwater (less than 50 feet bgs) and loose alluvium are present. As discussed previously, on-site investigations have encountered groundwater levels ranging from 35 feet bgs to 55 feet bgs, not including seepage as shallow as 3 feet bgs. In the event liquefaction occurs, the primary geotechnical concern is associated with potential settlement and its effect on overlying structures or facilities (e.g., sidewalk, utility lines). Liquefaction potential is greatest along Oso Canyon, where relatively shallow groundwater was encountered during both the previous geotechnical investigations and the hydrogeologic investigation. However, no development is proposed within Oso Canyon. Accordingly, the Geotechnical Report directs that additional analysis be performed to evaluate liquefaction potential for each future tract map. These analyses would be performed in conformance with County/CBC standards in place at the time as each tract map is proposed.

The Project was designed such that the majority of proposed development areas are outside anticipated liquefiable zones. These Project areas are proposed to remain as open space or to become greenways, detention/infiltration basins, and/or hydromodification facilities. Where proposed development and/or habitable structures would overlie liquefiable sediments, the condition is remediated by either removing (overexcavating) the liquefiable soils and recompacting surficial sediments or by applying "ground modification techniques". Ground modification techniques provide in situ (i.e., without removal/in place) remediation of liquefaction potential by making the underlying granular materials more dense. Because one of the factors necessary for liquefaction to occur is loose soils (making the soils more dense), using techniques such as deep dynamic compaction, stone columns, and/or vibro-replacement remediates the potential for liquefaction. These are standard engineering techniques used to remediate unstable soils and would be specified and implemented, as appropriate for each future tract map prepared for the Project. This is consistent with AVAP Policy LU 3.5 (although the Project is exempt from this policy due to location in an EOA) and Policy PS 2.2, related to limiting development in landslide and liquefaction areas. With implementation of all applicable geotechnical recommendations, the Project would result in less than significant impacts related to the presence of liquefiable soils as well as lateral spreading potential.

Seismically induced settlement can occur during or after seismic shaking based upon rearrangement of sand particles in the soil matrix, either subsequent to liquefaction or in dry

4 This term is said of a rock, mineral, or fossil in its natural position (i.e., the situation in which it was originally formed or deposited) (American Geological Institute 1984).

sands. Settlement has not yet been estimated throughout the Project site, but settlement is expected to occur given the extensive alluvial deposits as well as known liquefaction potential in limited areas east of the Aqueduct. As discussed above, quantitative liquefaction and settlement analyses would be performed for the tract maps as development is proposed. Overexcavating and recompacting liquefiable and sandy soils to ensure stable foundations for proposed structures, in accordance with existing and future, tract map-level, geotechnical recommendations, would mitigate potential impacts related to seismically induced settlement. Therefore, there would be less than significant impacts related to seismically induced settlement.

Off-Site Impacts

None of the proposed off-site Project features—including intersections with SR-138, utility connections, water wells, and California Aqueduct crossings—involve habitable structures or otherwise sensitive land uses. Also, all off-site Project features would be required to comply with County and State geotechnical review and building code requirements as applied to the Project, as applicable. There would be less than significant impacts related to geologic and seismic conditions from implementation of required off-site Project features.

Impact Summary: There would be less than significant impacts related to seismicity with implementation of the Geologic Safety Zone (PDF 1-1) and compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and existing and future, tract map-level, geotechnical recommendations.

Threshold 1-4 **Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides?**

On-Site Impacts

A single existing landslide has been mapped on the Project site, located in the northwestern corner of the Project site in Oso Canyon (Exhibit 5.1-2, Geologic Hazards). This large ancient landslide was investigated using review of existing geologic maps of the area, a soil boring, and exploratory trenches (which are more informative than soil borings). The landslide and associated buffer zone are entirely within the proposed open space preserve, and there would be no development on the Project site on or adjacent to this landslide. Therefore, there would be no impact related to the presence of this landslide.

Other than the landslide described above, as discussed in Section 5.1.3, Environmental Setting, a small, shallow landslide was mapped along a north-facing arroyo slope and several other small, shallow slumps and erosional sloughing were observed during on-site geotechnical investigations along the more steeply eroded arroyos. These latter features do not exceed widths of 50 feet and, while noted in the geotechnical studies for the site, are not mapped due to their small size and geotechnical insignificance. Observations and exploratory excavations indicate the shallow landslides on the relatively steep slopes initially failed in permeable cohesionless gravelly sands of Older Alluvium. The 2015 Geocon

Report states the small surficial landslides and slumps are not considered an adverse impact with respect to site development, as these can be mitigated with standard remedial grading techniques (removal and recompaction). This is consistent with AVAP Policy LU 3.5 (although the Project is exempt from this policy due to location in an EOA) and Policy PS 2.2, related to limiting development in landslide and liquefaction areas. Therefore, incorporation of all existing and future, tract map-level geotechnical recommendations into any development in the vicinity of these small landslides/slumps would ensure that potential impacts from landslides would be reduced to a less than significant level.

Off-Site Impacts

None of the proposed off-site Project features, including intersections with SR-138, utility connections, water wells, and California Aqueduct crossings, involve habitable structures or otherwise sensitive land uses. Also, all off-site Project features would be required to comply with County and State geotechnical review and building code requirements as applied to the Project, as applicable. There would be less than significant impacts related to geologic and seismic conditions from implementation of required off-site Project features.

Impact Summary: There would be less than significant impacts from landslides with compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and other geotechnical recommendations for the Project.

Threshold 1-5 **Would the project result in substantial soil erosion or the loss of topsoil?**

The analysis below discusses the potential for erosion to affect the Project site subsequent to construction of proposed structures, and relates exclusively to the geologic units present on the site. Please refer to Section 5.2, Hydrology and Flood, and Section 5.4, Water Quality, of this EIR for a discussion of the potential for erosion resulting from grading during construction and impacts to hydrology and water quality, respectively.

On-Site Impacts

Localized layers of unconfined, clean, gravelly sand of the Old Alluvium Formation are subject to erosion and surficial landslides under seasonal heavy rains or if underlain by perched groundwater conditions. Cohesionless zones encountered at finish grade may require undercutting and, if encountered in cut slopes, may require stabilization fills to reduce the potential for slope erosion and shallow sloughage. Compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and existing and future, tract map-level, geotechnical recommendations for the Project, would reduce impacts related to soil erosion to a less than significant level.

Off-Site Impacts

None of the proposed off-site Project features, including intersections with SR-138, utility connections, water wells, and California Aqueduct crossings, involve habitable structures or otherwise sensitive land uses. Also, all off-site Project features would be required to comply with County and State geotechnical review and building code requirements applied to the Project, as applicable. There would be less than significant impacts related to geologic and seismic conditions from implementation of required off-site Project features.

Impact Summary: There would be less than significant impacts related to erosion potential in the Old Alluvium Formation with compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, Hillside Design Guidelines, and other geotechnical recommendations for the Project.

Threshold 1-6 **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 (including hydrocompaction/hydroconsolidation)?**

Threshold 1-7 **Would the project be located on expansive soil as defined in Table 18-1 of the Uniform Building Code (1994), creating substantial risks to life or property?**

Threshold 1-8 **Would the project site have soils incapable of adequately supporting the use of onsite waste water treatment systems where sewers are not available for the disposal of wastewater?**

There are a variety of natural soil characteristics that have the ability to adversely affect development of a site and for which specific engineering measures must be implemented to counteract the presence of such limitations. The analysis below discusses potentially adverse soil characteristics that could affect construction of proposed structures, including hydroconsolidation, expansive soils, rippability, and corrosivity. This analysis also discusses the potential for existing or induced subsidence to affect the Project site.

Liquefaction potential on the Project site is analyzed above under the discussion of Thresholds 1-2 and 1-3. Landslides are analyzed above under the discussion of Threshold 1-4.

Regarding Threshold 1-8, the proposed waterwater management for Project would involve on-site conveyance and treatment, via aboveground treatment units, which are addressed in the 2015 Geocon Report as part of the overall land use plan. However, wastewater management would not use septic tanks or underground, alternative, treatment systems such that the ability of soils to support the infrastructure is relevant Therefore, this threshold is not applicable to the Project and is not analyzed below.

On-Site Impacts

Hydroconsolidation (Compressible/Collapsible Soils). The Geotechnical Analysis concludes that topsoil, colluvium, and alluvium are susceptible to hydroconsolidation, a type of compressibility in soils. Removal of topsoil and colluvium with subsequent recompaction would be required where these sediments underlie proposed development areas; this is a standard engineering practice. Consolidation tests performed on samples of alluvium indicate that, below a depth of 15 feet, this material has low compressibility potential and relatively minor volume change characteristics upon saturation (i.e., hydroconsolidation) and that the upper 15 feet of alluvial soils would require removal and recompaction prior to placing fill. Where these soil conditions are encountered in the Project's development area, they would be remediated through incorporation of the standard engineering practices (generally overexcavation and recompaction) that would be specified in the tract map-level geotechnical reports to be prepared as the Project is implemented. Compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines , and existing and future tract map-level, geotechnical recommendations for the Project would reduce impacts related to hydroconsolidation to a less than significant level.

Expansive Soils. Expansion testing on the Quail Lake Formation indicates a variable range of expansion indices from low to high. Highly expansive clay exposed at finish grade would require remedial grading (i.e., overexcavation and replacement) to provide a low expansive soil cap. Other units present on site consist of topsoil, alluvium, colluvium landslide debris, Older Alluvium, the Oso Canyon Formation, and the Neenack Volcanic Formation. These materials exhibit a very low to low expansion potential and would not require remedial grading to reduce expansion potential. Compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines , and existing and future, tract map-level geotechnical recommendations for the Project, would reduce impacts related to the presence of expansive soils to a less than significant level.

Rippability. The rippability of a geologic material is a measure of its ability to be excavated with conventional excavation equipment, and is defined by the following levels of rippability: light, moderate, heavy, and very heavy effort. These are relative terms, expressing a continuum of effort needed to excavate underlying geologic formations on the Project site. The only areas of known substantial bedrock material are located in the Neenach and Oso Canyon formations. Excavations within the Oso Canyon Formation that encounter strongly cemented zones observed in this unit would likely require a very heavy effort with conventional heavy-duty grading equipment and/or localized breaking or possible blasting. Once ripped or broken up, numerous oversized rock fragments would be generated that would require special placement procedures and compaction, when placed in fills. The 2015 Geocon Report states that additional subsurface work would need to be performed on the Neenach Volcanic Formation to evaluate this unit's degree of weathering and rippability characteristics. Such additional geotechnical investigation would be performed for each tract map as the Project is implemented.

No development is planned within known areas (i.e., outcrops) of the Oso Canyon and Neenach Volcanic Formations. Existing bedrock outcrops are located in proposed open space areas. However, if bedrock is discovered in areas within the development footprint, heavy effort may be necessary, including blasting as noted above. Blasting can be precisely controlled by current standard procedures to limit the possibility of creating rock falls and damage due to vibration. A Blasting Plan would be required, to be reviewed and approved by the County of Los Angeles Fire Department, to conduct blasting on the Project site during construction, which would include procedures to limit rock falls, vibration, and other safety concerns to the maximum extent. In general, the blasting procedure would involve multiple days of pre-blast drilling and set up, followed by the "shot" event, which is the actual explosive use. Pre-blasting procedures vary depending on the size of the area to be blasted, depth of drilling, type of material, existing utilities, and development. Typically, only one "shot" event occurs per day.

In addition, vibration monitoring would be performed near existing structures to control and record ground vibration during blasting events. Impacts associated with blasting would be potentially significant, but would be reduced to a level considered less than significant with application of MM 12-7, which requires preparation and implementation of a Blasting Plan (see Section 5.12, Noise). The 2015 Geocon Report concludes that excavation in these two geologic units, while more constrained, is feasible and can be safely accomplished with incorporation of all geotechnical recommendations. All other geologic units mapped on the site would require light to moderate effort and only conventional equipment to excavate (i.e., they would not require implementation of MM 12-7). Therefore, the varying levels of rippability of the geologic and surficial units present within the Project site's development boundary would represent a less than significant impact with implementation of MM 12-7.

Corrosivity. Water soluble sulfate testing performed on representative samples[5] of the soil and geologic units on the Project site indicate that the materials have low sulfate content and a corresponding negligible sulfate rating based upon Table 19-A-4 of the 1997 Uniform Building Code (UBC). Samples were tested from the various soil and geologic units present across the Project site to provide a representative composite of the corrosivity potential (i.e., negligible, as noted above). Potential of hydrogen (pH)[6] and resistivity on represented soil samples indicates pH values that vary from 5.2 to 8.3 and resistivity values that range from 800 ohm-cm to 9,338 ohm-cm.[7] These results indicate that the materials tested vary from low to moderate in overall corrosive potential. Overall, there is the potential for corrosion of buried ferrous (iron) metals. The lower the ohm value, the higher the corrosive potential. Regarding pH, soils that are generally either extremely alkaline (with a high pH) or extremely acidic (with a low pH) are likely to be corrosive to steel. Soils with a pH of 5.5 or lower (acidic) are likely to be corrosive to concrete (USDA NRCS 2017).

5 Because of the large size of the Project site, samples were taken of all surficial and geologic units present on the Project site to develop a representative composite of geotechnical conditions across the site, rather than to reflect conditions in any one place on the Project site. Therefore, the number of samples and the physical location of each sample is not relevant, nor is it depicted within the geotechnical reports.

6 Hydrogen potential (pH) is a measure of the strength of an acid or a base. A neutral solution has a pH of 7; acids a pH between 0 and 7; bases a pH from 7 to 14.

7 In physics, ohm is a measure of resistivity. Resistivity is measured in ohm-centimeters (cm).

However, because the presence of water-soluble sulfates is not a visually discernible characteristic, other soil samples could yield different sulfate concentrations elsewhere on the site. Therefore, the geotechnical investigation recommends that additional testing of finish-grade soil samples be performed to determine soluble sulfate contents of soils that would be in direct contact with concrete slabs and foundations. Such additional geotechnical investigation would be performed for each tract map as the Project is implemented. Existing and future, tract map-level, geotechnical recommendations must implemented during site development consistent with building code requirements. Compliance with County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and existing and future tract map-level, geotechnical recommendations for the Project related to corrosive soils would reduce impacts related to the presence of potentially corrosive soils to a less than significant level.

Subsidence. Subsidence is a sinking or downward settling of the surface that may be caused by natural geologic processes (e.g., solution, compaction) and/or by withdrawal of oil, natural gas, or groundwater. The hydrogeologic investigation performed by Bookman-Edmonston from 2004 through 2006 (see Appendix F of the Geotechnical Report in Appendix 5.1-A) reports that historical groundwater withdrawal in the Antelope Valley Groundwater Basin, within which the Project site is partially located, has resulted in subsidence within the northern portion of the Lancaster sub-basin approximately 25 miles north of the Project site . However, there has been no subsidence or a negligible amount of subsidence in the adjacent Nennach and other western Antelope Valley groundwater sub-basins in the Project site vicinity. The hydrogeologic investigation determines that increased groundwater pumping and recharge as part of site development would not result in adverse impacts to the underlying groundwater basins. Further discussion of the hydrogeologic conditions in the Antelope Valley Basin can be found in the Bookman-Edmonston report located in Appendix F of Appendix 5.1-A. Therefore, the Project would result no impacts related to current or future subsidence.

Off-Site Impacts

None of the proposed off-site Project features, including intersections with SR-138, utility connections, water wells, and California Aqueduct crossings, involve habitable structures or otherwise sensitive land uses. Also, all off-site Project features would be required to comply with County and State geotechnical review and building code requirements as applied to the Project, as applicable. There would be less than significant impacts related to geologic and seismic conditions from implementation of required off-site Project features.

Impact Summary: There would be less than significant impacts related to existing soil characteristics (i.e., hydroconsolidation, rippability, corrosivity, and subsidence) with compliance with (1) County subdivision specifications, County building code requirements, the Project's Grading Plan, the Specific Plan's Hillside Design Guidelines, and existing and future tract map-level, geotechnical recommendations for the Project, and MM 12-7.

Threshold 1-9 Would the project conflict with the Hillside Management Area Ordinance (L.A. County Code, Title 22, § 22.56.215) or hillside design standards in the County General Plan Conservation and Open Space Element?

On-Site Impacts

In accordance with Section 22.56.217, Hillside Management Areas- Additional Regulations, Subsection C.7., a conditional use permit is required for any development located wholly or partly in a Hillside Management Area, except for: development within any adopted Specific Plan, provided that such development complies with the provisions of that Specific Plan. Therefore, the Specific Plan implements the applicable requirements of the County's Hillside Management Areas Ordinance through Appendix 2-B, Hillside Design Guidelines, which supports the grading plan and goals provided in Chapter 3 of the Centennial Specific Plan. The Guidelines provide direction for site specific grading plans to minimize the height of visible slopes, provide for more natural-appearing manufactured slopes, minimize grading quantities, minimize slope maintenance and water consumption, increase non-motorized connectivity, and provide for stable slopes and building pads. Implementation of the Project's required Hillside Design Guidelines set forth in Appendix 2-B of the Specific Plan will ensure that Project implementation is consistent with the County's goals and policies related to hillside management.

The Hillside Design Guidelines include, but are not limited to, requiring that: at least 50 percent of the development footprint is located on the flattest portions of the site (i.e., those areas having slopes of less than 25 percent) when that area does not contain rare, sensitive, or State or federally listed threatened or endangered species; undulating banks for graded slopes be used to maintain the natural pattern of the topography to the greatest extent feasible; and undulating patterns and varying grades be used for roadway segments that exceed 1,000 feet in length. Project development would require grading of sloped areas as well as cutting and filling of some hillside areas. Slopes would not be graded at angles steeper than a 2:1 ratio (horizontal to vertical), in accordance with the Project's Grading Plan, County building code requirements, the Specific Plan's Hillside Design Guidelines, and all grading-related recommendations of the geotechnical reports to be prepared for each tract map as the Project is implemented.

The 2015 Geocon Report notes that because of the complexity of bedrock structure and masking by superposed Quaternary units (i.e., colluvium, alluvium, Older Alluvium), observation of excavations and cut slopes during grading by an engineering geologist will be required to map as-graded exposures and to recommend specific remediation, if warranted. Areas with slopes in excess of 25 percent generally occur west of the California Aqueduct. From a geotechnical safety point of view, the impact of topographic alterations for areas with slopes over 25 percent would not result in development hazards, nor would it adversely affect human health and safety given conformance with all geotechnical recommendations for grading in these slopes, which includes compliance with County subdivision standards, County building code requirements, the Project's Grading Plan, Specific Plan's Hillside Design Guidelines, as well as Occupational Safety and Health Agency (OSHA) requirements for construction safety. This is consistent with AVAP Policy LU 3.4 (although the Project is exempt from this policy due to location in an EOA) and Policy PS 2.2, related to development within Hillside Management Areas (although the Project is exempt from this policy due to development within any adopted Specific Plan complying with the provisions of that Specific Plan), as well as Policy PS 2.4, related to ensuring development does not result in slope instability.

In accordance with County procedures for tract map processing, a quantitative slope stability analysis would be performed at such time as tract-map-level development is proposed and when the locations and heights of proposed cut and fill slopes are known, and the design and construction of the Project would be required to incorporate all geotechnical recommendations. Therefore, there would be no conflict with the County's Hillside Management Ordinance. There would be less than significant impacts related to slope stability.

Off-Site Impacts

None of the proposed off-site Project features, including intersections with SR-138, utility connections, water wells, and California Aqueduct crossings, involve habitable structures or otherwise sensitive land uses. Also, all off-site Project features would be required to comply with County and State geotechnical review and building code requirements as applied to the Project, as applicable. There would be less than significant impacts related to geologic and seismic conditions from implementation of required off-site Project features.

Impact Summary: There would be less than significant impacts related to slope stability, including with designated Hillside Management Areas, with compliance with (1) County subdivision specifications, County building code requirements, the Project's Grading Plan, Specific Plan's Hillside Design Guidelines, and existing and future, tract map-level geotechnical recommendations for the Project.

5.1.7 MITIGATION MEASURES

With compliance with existing regulations and the implementation of PDF 1-1 and MM 12-7, no other mitigation measures are necessary.

5.1.8 LEVEL OF SIGNIFICANCE AFTER MITIGATION

All impacts from development of the Project related to geotechnical conditions would be less than significant with implementation of applicable County subdivision specifications, County building code requirements, the Project's Grading Plan, Specific Plan's Hillside Design Guidelines, and other geotechnical recommendations for the Project described in PDF 1-1 and MM 12-7 in Section 5.12, Noise, of this Draft EIR.

5.1.9 REFERENCES

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