3.9 Geology and Soils

This section describes the geologic and seismic setting of the Project site, including regional and local geology, soils, and groundwater, and the regulatory framework relevant to the Facebook Campus Expansion Project (Project). The potential environmental effects of the Project related to geology and soils are also described. The impacts examined include risks related to geologic hazards, such as earthquakes, landslides, liquefaction, and expansive soils, and impacts on the environment related to soil erosion and sedimentation. This section identifies Project-level and cumulative environmental impacts and explains how compliance with the applicable regulations would reduce or avoid the identified impacts. Two geotechnical feasibility investigations were prepared for the Project site. The information and conclusions from these documents are incorporated into this section. Additional information was obtained from government agency websites and publications.

Issues identified in response to the Notice of Preparation (NOP) (Appendix 1) were considered in preparing this analysis. Applicable issues that were identified pertain to cumulative impacts in the context of other bayland projects.

Existing Conditions

Regulatory Setting

Federal

Earthquake Hazard Reduction Act of 1977

Federal laws codified in the United States Code Title 42, Chapter 86, were enacted to reduce the risks to life and property from earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. Implementation of these requirements are regulated, monitored, and enforced at the state and local level. Key regulations and standards are summarized below.

State

California Building Standards Code

California Code of Regulations (CCR) Title 24, Part 2, the California Building Standards Code, provides minimum standards for building design in the state. The current 2013 California Building Standards Code, effective January 1, 2014, is based on the 2012 International Building Code (IBC).

Each jurisdiction in California may adopt its own building code, based on the 2013 California Building Standards Code. Local codes are permitted to be more stringent than the 2013 California Building Standards Code but, at a minimum, are required to meet all state standards and enforce the regulations of the 2013 California Building Standards Code, beginning January 1, 2014. The City of Menlo Park (City) has adopted the 2013 California Building Standards Code and local amendments.

Chapter 16 of the California Building Standards Code deals with structural design requirements governing seismically resistant construction (Section 1604), including, but not limited to, factors and coefficients used to establish seismic site class and seismic occupancy category for the soil/rock at the building location and the proposed building design (Sections 1613.5 through 1613.7). Chapter 18 includes, but is not limited to, the requirements for foundation and soil investigations (Section 1803); excavation, grading, and fill (Section 1804); allowable load-bearing values of soils (Section 1806); the design of footings, foundations, and slope clearances (Sections 1808 and 1809), retaining walls (Section 1807), and pier, pile, driven, and cast-in-place foundation support systems (Section 1810). Chapter 33 includes, but is not limited to, requirements for safeguards at work sites to ensure stable excavations and cut or fill slopes (Section 3304). Appendix J of the California Building Standards Code includes, but is not limited to, grading requirements for the design of excavations and fills (Sections J106 and J107) and for erosion control (Sections J109 and J110). Construction activities are subject to occupational safety standards for excavation, shoring, and trenching, as specified in California Occupational Safety and Health Administration (Cal/OSHA) regulations (CCR, Title 8).

Alquist-Priolo Earthquake Fault Zoning Act

California's Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (Public Resources Code [PRC] Section 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act and renamed in 1994, is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy[1] across the traces of active faults and strictly regulates construction in the corridors along active faults (earthquake fault zones). It also defines criteria for identifying active faults, giving legal weight to terms such as *active*, and establishes a process for reviewing building proposals in and adjacent to earthquake fault zones.

Under the Alquist-Priolo Act, faults are zoned, and construction along or across them is strictly regulated if they are "sufficiently active" and "well defined." A fault is considered *sufficiently active* if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the act as approximately the last 11,000 years). A fault is considered *well defined* if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface using standard professional techniques, criteria, and judgment.[2]

Seismic Hazards Mapping Act

Similar to the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690–2699.6) is intended to reduce damage resulting from earthquakes. Although the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong ground shaking, liquefaction, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act. The state is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped seismic hazard zones.

A primary purpose of the Seismic Hazards Mapping Act is to assist cities and counties in preparing the safety elements of their general plans and encourage land use management policies and regulations that reduce seismic hazards. The intent of this act is to protect the public from the effects of strong ground

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1 With reference to the Alquist-Priolo Act, a *structure for human occupancy* is defined as one "used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year" (California Code of Regulations, Title 14, Division 2, Section 3601[e]).

2 Hart, W. A., and E. W. Hart. 2007. *Fault-Rupture Hazard Zones in California*. California Geological Survey Special Publication 42, Interim Revision, 2007. Available: <ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf>. Accessed: September 2015.

shaking, liquefaction, landslides, ground failure, or other hazards caused by earthquakes. Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites within seismic hazard zones until appropriate site-specific geologic and/or geotechnical investigations have been carried out and measures to reduce potential damage have been incorporated into the development plans. In addition, California Geologic Survey (CGS) Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California, provides guidance for the evaluation of earthquake-related hazards for projects in designated zones of required investigations and for recommending mitigation measures, as required by PRC Section 2695(a).[3] Liquefaction hazards mapping has been prepared for the west side of San Francisco Bay (Bay), including the Menlo Park area. As discussed under *Liquefaction,* below, the Project site is within a mapped liquefaction hazard zone.

National Pollutant Discharge Elimination Program Construction General Permit

Under the authority of the federal Clean Water Action Section 402 (National Pollutant Discharge Elimination Program [NPDES]), the State Water Resources Control Board (SWRCB) permits all regulated construction activities under Order No. 2009-0009-DWQ (adopted September 2, 2009), which requires, prior to beginning any construction activities, the permit applicant to obtain coverage under the Construction General Permit by preparing and submitting a Notice of Intent (NOI) to the SWRCB and preparing and implementing a Stormwater Pollution Prevention Plan (SWPPP), in accordance with the Construction General Permit requirements, for all construction activities that disturb one or more acres of land surface. Construction activities that are subject to the Construction General Permit include clearing, grading, and disturbances to the ground, such as stockpiling or excavation, that result in soil disturbances of at least 1 acre of the total land area. The SWPPP has two major objectives: (1) to help identify the sources of sediment and other pollutants that affect the quality of stormwater discharges and (2) to describe and ensure the implementation of best management practices (BMPs) to reduce or eliminate sediment and other pollutants in stormwater as well as non-stormwater discharges (refer to Section 3.10, *Hydrology and Water Quality*, for additional information on the Construction General Permit and the SWPPP).

Local

City of Menlo Park General Plan

The following policy from the Land Use Element of the City of Menlo Park General Plan (General Plan) pertains to the Project.

> *Policy I-H-9:* Urban development in areas with geological and earthquake hazards, flood hazards, and fire hazards shall be regulated in an attempt to prevent loss of life, injury, and property damage.

The following policies of the Safety Element of the General Plan are relevant to the Project.

> *Policy S1.1: Location of Future Development.* Permit development only in those areas where potential danger to the health, safety, and welfare of the residents of the community can be adequately mitigated.

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[3] California Geological Survey. 2008. Guidelines for Evaluating and Mitigating Seismic Hazards in California. (Special Publication 17A.) Available: <http://www.conservation.ca.gov/cgs/shzp/webdocs/documents/sp117.pdf>. Accessed: September 2015.

Policy S1.5: New Habitable Structures. Require that all new habitable structures incorporate adequate hazard mitigation measures to reduce identified risks from natural and human-caused hazards.

Policy S1.7: Hazard Reduction. Continue to require new development to reduce the seismic vulnerability of buildings and susceptibility to other hazards through enforcement of the California Building Standards Code and other programs.

Policy S1.10: Safety Review of Development Projects. Continue to require hazard mitigation, crime prevention, fire prevention, and adequate access for emergency vehicles in new development.

Policy S1.13: Geotechnical Studies. Continue to require site-specific geologic and geotechnical studies for land development or construction in areas of potential problem land instability, as shown on the state and/or local geologic hazard maps or identified through other means.

Policy 1.14: Potential Land Instability. Prohibit development in areas of potential land instability identified on state and/or local geologic hazard maps, or identified through other means, unless a geologic investigation demonstrates hazards can be mitigated to an acceptable level, as defined by the State of California.

ConnectMenlo General Plan Update. The City General Plan (Land Use and Circulation Elements) and M-2 Area Zoning Update, also known as ConnectMenlo, is under way. Although not yet adopted, the following draft policy in ConnectMenlo pertains to the Project and is identified for informational purposes.

Policy LU-7.7: Hazards. Avoid development in areas with seismic, flood, fire, and other hazards to life or property when potential impacts cannot be mitigated.

Earthquake Emergency Response

The City is a participant in the Association of Bay Area Governments (ABAG) multi-jurisdictional planning process for natural disaster emergencies. The City has adopted an Emergency Operation Plan that assesses the potential losses associated with earthquakes (among other disasters) and identifies responsibilities for City departments and coordination with San Mateo County and regional emergency response providers.[4] The City has also prepared a Disaster Preparedness Manual that is available to the public. The manual describes actions that residents and businesses can take in the event of an earthquake.

Municipal Code

The following chapters of the City's Municipal Code pertain to the Project:

Building Code. Chapter 12.06 of the City's Municipal Code implements the 2013 California Building Standards Code and local amendments thereto.

Grading and Drainage Control Guidelines. The City Engineering Division requires a grading and drainage (G&D) plan whenever more than 500 gross square feet (gsf) of the surface of a lot is to be affected by a building project. The basis for the G&D plan requirement is City development policy, Stormwater Ordinance 859 (Chapter 7.42), and the SWRCB Municipal Regional Stormwater Permit issued on October 14, 2009 (Order R2-2009-0074, NPDES Permit No. CAS 612008). The focus of these guidelines is to control eroded sediment from construction sites before it enters waterways.

[4] City of Menlo Park. 2011. *Emergency Operation Plan*. Version 2. January.

The City also requires the G&D plan to include "construction erosion and sedimentation control" notes and plans, which must address the timing of grading activities during dry months, if feasible, and minimization of land disturbance, among other items.

Environmental Setting

Regional Setting

Geology

The Project site is situated along the San Francisco Peninsula, which separates the Bay from the Pacific Ocean. The San Francisco Peninsula is a ridge of rocks and sediments in the Santa Cruz Mountains portion of the Coast Ranges geomorphic province, which forms a rugged barrier between the Pacific Coast and inland California.[5] (Geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform.)

The Coast Ranges province, which extends approximately 600 miles, from the Santa Ynez River in Santa Barbara County to the Oregon border, owes much of its physiographic character to the San Andreas fault system (in the San Francisco Bay Area [Bay Area]). This fault system is a 44-mile-wide zone of fracturing and folding rock where two adjoining tectonic plates that form Earth's surface (the Pacific plate on the west and the North American plate on the east) are moving past each other in opposite directions. One result of this tectonic plate movement is the regional rock deformation and the general northwest trend of valleys and ridges throughout the Coast Ranges. The sedimentary rocks that form most of the plate boundary area were deposited during successive geologic intervals as layers of marine and terrestrial sediments, between 70 million (Cretaceous Period) and 200 million years ago (Jurassic Period).

Quaternary alluvial sediment derived from the Santa Cruz Mountains overlies older Cretaceous and Jurassic sedimentary rocks. The youngest of this alluvial material consists of Holocene-age (11,000 years or younger) unconsolidated clay, which is interbedded with sand and fine gravel. This unit is generally less than 15 feet thick. It forms in poorly drained interfluvial basins, usually at the margins of tidal marshlands on the edge of San Francisco Bay where it interfingers with Bay Mud. Overlying this material that covers much of the Project site is artificial fill, which consists of a combination of poorly consolidated gravel, sand, and silt, and rock fragments. The Project site thus consists of Quaternary alluvial sediment on the southwest and southeast corners of the site and artificial fill on the remainder of the site.[6]

Faults

The Bay Area, one of the world's most seismically active regions, is near several active faults. Faults are geologic zones of weakness. Earthquakes are caused by the violent and abrupt release of strain that builds up along faults. Fault rupture almost always follows preexisting faults. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. Sudden displacements are more damaging to structures because they are accompanied by shaking. Surface rupture occurs when movement on a fault deep in the earth breaks through to the ground surface.

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[5] California Geological Survey. 2002. *California Geomorphic Provinces*. California Department of Conservation. California Geological Survey Note 36. Available: <http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_36/Documents/note_36.pdf>. Accessed: September 2015.

[6] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

Figure 3.9-1 shows the locations of regional faults in proximity to the Project site.[7] The closest active and potentially active faults are the Monte Vista–Shannon fault (5 miles southwest), the San Andreas fault (7 miles southwest), and the Hayward fault (12 miles northeast). Other nearby active Bay Area faults include the San Gregorio fault, about 15 miles southwest of the Project site, and the Calaveras fault, about 17 miles northeast of the Project site. Potentially active, concealed faults of the Quaternary are the Palo Alto and Stanford faults, a few miles southwest of the Project site. The trace of the San José fault is northeast of the site, extending from west San José through Sunnyvale and East Palo Alto to its apparent terminus just northeast of the Project site.[8] These faults do not show evidence of recent surface displacements (i.e., during the last 10,000 years) that would cause the state to categorize them as active.

Seismicity

Earthquake Magnitude

The classification of earthquakes is based on the amount of energy released, using scales known as the Richter scale and the Moment Magnitude (MM) scale. Each whole number of magnitude of the logarithmic scale represents a tenfold increase in the wave amplitude (earthquake size) generated by an earthquake as well as a 3.16-fold increase in energy released. Thus, a magnitude 6.3 earthquake is 10 times larger than a magnitude 5.3 earthquake and releases 31.6 times more energy. In contrast, a magnitude 7.3 event is 100 times larger than magnitude 5.3 and releases 1,000 times more energy.

Table 3.9-1 shows the nearby active faults; their maximum credible earthquake, expressed in MM; and their distance from the Project site.

The U.S. Geological Survey's 2014 Working Group on California Earthquake Probabilities estimated that there is a 72 percent probability that one or more MM 6.7 or greater earthquakes will occur in the Bay Area in the next 30 years.[9]

Earthquake Intensity

The Modified Mercalli Intensity scale is used to describe the intensity of an earthquake. The scale relates an earthquake to its effects on humans, nature, and human-made structures on a scale of I through XII, with I denoting a weak earthquake and XII an earthquake that causes almost complete destruction. Table 3.9-2 provides abbreviated definitions of the scale ratings. This scale is not employed by engineers when designing seismic-resistant structures. The safety standards to which structures must be designed are set forth in the California Building Standards Code and take into account numerous factors and criteria. However, this scale is useful in describing earthquake effects for the general public and can serve to interpret earthquake magnitude qualitatively.

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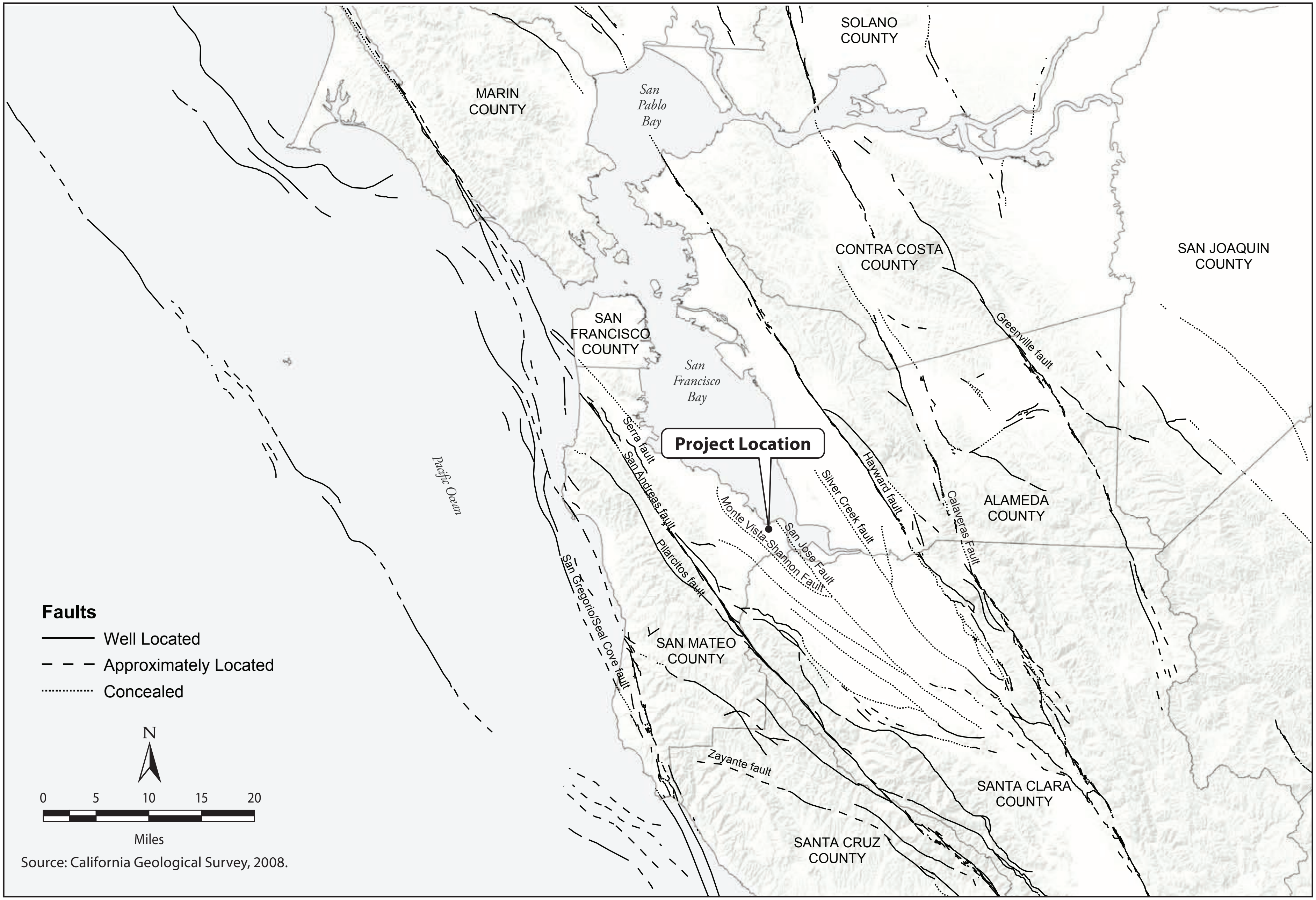
[7] Well-located faults are those faults whose location is well known. Approximately located faults are those faults whose location is not precisely known but may be inferred. Concealed faults are those faults whose location is concealed by younger rocks or bodies of water.

[8] Jennings, C.W., and W.A. Bryant. 2010. *2010 Fault Activity Map of California*. California Department of Conservation. Available: <http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html>. Accessed: September 2015.

[9] U.S. Geological Survey. 2014. *UCERF3: A New Earthquake Forecast for California's Complex Fault System.* Available: <http://www.wgcep.org/sites/wgcep.org/files/fs2015-3009.pdf>. Accessed: October 7, 2015.



ICF INTERNATIONAL

Figure 3.9-1
Regional Faults
Facebook Campus Expansion Project Draft EIR

Table 3.9-1. Maximum Credible Earthquake (MCE) for Principal Active Faults in Project Vicinity

Fault	MCE Magnitude[a]	Distance from Project Site (miles)
Monte Vista–Shannon	6.2[b]	5[e]
San Andreas (1906)	7.0–7.9[b]	7[e]
Hayward (Total Length)	7.2[b,c]	12[e]
San Gregorio	7.5–7.7[b,d]	15
Calaveras	6.8–7.5[b,c]	17

Note:

a. MCE magnitude is the maximum credible earthquake measured using the Moment Magnitude scale.

Sources:

b. Mualchin, L. 1996. *A Technical Report to Accompany the Caltrans California Seismic Hazard Map, 1996 (Based on Maximum Credible Earthquakes).* Available: <http://www.dot.ca.gov/hq/esc/earthquake_engineering/seismology/MapReport.PDF>. Accessed: September 21, 2015.

c. Anderson, L. W., M. H. Anders, and D. A. Ostenaa. 1982. Late Quaternary Faulting and Seismic Hazard Potential, Eastern Diablo Range, California*.* Pages 197–206 in E. W. Hart, S. E. Hirschfeld, and S. S. Schulz (eds.), *Proceedings, Conference on Earthquake Hazards in the Eastern San Francisco Bay Area*. Special Publication 62. Sacramento, CA: California Division of Mines and Geology.

d. Weber, G.E., and W.R. Cotton. 1981. *Geologic Investigation of Recurrence Intervals and Recency of Faulting along the San Gregorio Fault Zone, San Mateo County, California.* U.S. Geological Survey Open File Report 81-263. Prepared for U.S. Geological Survey. Available: <http://pubs.usgs.gov/of/1981/0263/report.pdf>. Accessed: September 21, 2015.

e. Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California*. July 22. Project Number 254-8-3.

Table 3.9-2. Modified Mercalli Intensity Scale

Scale Rating	Description
I	Not felt.
II	Felt by persons at rest, on upper floors, or favorably placed.
III	Felt indoors; hanging objects swing; vibration like passing of light trucks; duration estimated; may not be recognized as an earthquake.
IV	Hanging objects swing; vibration like passing of heavy truck or sensation of a jolt like a heavy ball striking the walls; standing automobiles rock; windows, dishes, doors rattle; wooden walls and frame may creak.
V	Felt outdoors; direction estimated; sleepers wakened; liquids disturbed, some spilled; small unstable objects displaced or upset; doors swing; shutters, pictures move; pendulum clocks stop, start, change rate.
VI	Felt by all; many frightened and run outdoors; persons walk unsteadily; windows, dishes, glassware broken; knickknacks, books, etc., off shelves; pictures off walls; furniture moved or overturned; weak plaster; Masonry D cracked.
VII	Difficult to stand; noticed by drivers of automobiles; hanging objects quiver; furniture broken; weak chimneys broken at roof line; damage to Masonry D, including cracks, falling plaster, loose bricks, stones, tiles, and parapets; small slides and caving in along sand or gravel banks; large bells ring.
VIII	Steering of automobiles affected; damage to Masonry C (partial collapse); some damage to Masonry B; no damage to Masonry A; stucco and some masonry walls fall; chimneys, factory stacks, monuments, towers, elevated tanks twist or fall; frame houses move on foundations if not bolted down; loose panel walls thrown out; decayed pilings broken off; branches broken from trees; changes in flow or temperature of sprigs and wells; cracks in wet ground and on steep slopes.
IX	General panic; Masonry D destroyed; Masonry C heavily damaged, sometimes with complete collapse; Masonry B seriously damaged; general damage to foundations; frame structures, if not bolted, shifted off foundations; frames racked; serious damage to reservoirs; underground pipes broken; conspicuous cracks in ground; liquefaction.
X	Most masonry and frame structures destroyed with their foundations; some well-built wooden structures and bridges destroyed; serious damage to dams, dikes, embankments; large landslides; water thrown out of banks of canals, rivers, lakes, etc.; sand and mud shifted horizontally on beaches and flat land; rails bent slightly.
XI	Rails bent greatly; underground pipelines completely out of service.
XII	Damage nearly total; large rock masses displaced; lines of sight and level distorted; objects thrown in the air.

Source: Spangle, William E. 1987. Pre-Earthquake Planning for Post-Earthquake Rebuilding. *Journal of Environmental Sciences* 29(2):49-54.

Notes: Masonry A = Good workmanship and mortar; reinforced and designed to resist lateral force.
Masonry B = Good workmanship and mortar; reinforced.
Masonry C = Good workmanship and mortar; unreinforced.
Masonry D = Poor workmanship and mortar; weak materials, such as adobe.

Ground Shaking

The intensity of seismic shaking (ground shaking), or strong ground motion, during an earthquake depends on the distance and direction between a particular area and the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions underlying and surrounding the area. Earthquakes occurring on faults close to the Project site would probably generate the strongest ground motions.

An earthquake along the entire San Andreas fault is considered capable of generating a MM 7.9 earthquake (similar to the 1906 San Francisco earthquake). An earthquake of this magnitude would generate strong to very strong seismic shaking (Modified Mercalli Intensity VII and VIII) at the site.[10] Ground shaking of this intensity could result in damage to buildings and trigger ground failures, such as liquefaction, potentially resulting in foundation damage, disruption of utility service, and roadway damage.

Hydrogeology

The Project site is near the boundary between major units of two alluvial deposits, as defined by the California Department of Water Resources: San Francisquito Cone and Niles Cone. The San Francisquito Cone deposits are derived from the Santa Cruz Mountains to the southwest, and the Niles Cone deposits are derived from the Diablo Range along the northeastern boundary of the Bay.[11] The unconsolidated materials in both units consist of four hydrogeologic zones: shallow aquifer, aquitard, deep aquifer, and sediments below the deep aquifer. The shallow aquifer zone ranges in depth from 5 to approximately 100 feet below ground surface. The zone consists of silt and clay, with low-permeability interbedded with high-permeability coarse-grained channel deposits.[12]

Project Site

Site Topography

The Project site is relatively flat, and elevations on the site range from 7 to 10.5 feet North American Vertical Datum (NAVD). Some portions of the site have been graded to accommodate storm drain facilities. An 1899 map shows the area as an extensive marshland bordering the San Francisco Bay. By 1948, the site had been drained; by 1968, the site had been graded and sloughs and depressions had been filled. By 1974, Constitution Drive had been built.[13]

Constitution Drive serves as a private access road throughout the site. Structures at the site are surrounded by paved parking lots, driving lanes, and landscaped areas. Landscaping and other pervious materials currently cover 15 percent, or 8.5 acres, of the Project site. Asphalt concrete pavement ranges from 2 to 5 inches in depth and is in fair to good condition (some areas show severe alligator cracking). There are no adjacent hillsides.

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[10] Association of Bay Area Governments. 2003. *Earthquake Hazard Maps*. Last modified: April 18, 2003. Available: <http://resilience.abag.ca.gov/earthquakes/sanmateo/>. Accessed: September 21, 2015.

[11] San Francisco Bay Regional Water Quality Control Board. 2003. *South Bay Basins Groundwater Protection Evaluation*. Available: <http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/groundwater/sobayground.shtml>. Accessed: September 21, 2015.

[12] San Francisco Bay Regional Water Quality Control Board. 2003. *South Bay Basins Groundwater Protection Evaluation*. Available: <http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/groundwater/sobayground.shtml>. Accessed: September 21, 2015.

[13] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPK 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

Soils

The Project site is near the historic shoreline of the Bay. According to borings done at the Project site, the soils consist of undocumented artificial fill to a depth of 2.5 to 6 feet below ground surface (bgs) and stiff to very stiff clay with variable amounts of sand to a depth of between 9.5 and 11 feet bgs. Soils mapped at the Project site by the National Resources Conservation Service (NRCS) and their characteristics are shown in Table 3.9-3.

Table 3.9-3. Soils at the Project Site

	Erosion Hazard (Off-Road, Off-Trail)	Linear Extensibility	Risk of Corrosion, Steel	Risk of Corrosion, Concrete[a]	Ponding	Flooding
117 Novato clay, 0 to 1 percent slopes	Slight	7.5 (High)	High	High	Brief (4 to 48 hours), January through December	Frequent, January through December
134 Urban Land-Orthents, reclaimed complex, 0 to 2 percent slopes	Not rated	Not rated	High	High	Not rated	None

Sources:

National Resources Conservation Service. 2015. *Web Soil Survey*. U.S. Department of Agriculture. Available: <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>. Accessed: September 18, 2015.

Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

Notes:

a. Site investigation indicated that soluble soil sulfate contents are 50 to 810 parts per million; negligible corrosion potential to buried concrete.

Below approximately 11 feet bgs, clays were underlain by loose to dense, poorly graded sands with variable amounts of clay, silt, and gravel to depths of up to 22 feet. Below the sand was medium-stiff to very stiff clay with variable amounts of sand to depths ranging from 23.5 to 29.5 feet bgs. Below the clay was medium-dense to very dense, poorly graded sand with variable amounts of silt and gravel to 35 feet bgs. This was the maximum depth explored by boring.[14] The required 50-foot test was conducted with a Cone Penetration Test (CPT) instead of a typical hollow-stem auger boring to 50 feet, as required by the 2013 California Building Standards Code. The CPT was used because of contamination from volatile organic compounds in the upper aquifer layer. A traditional hollow-stem auger boring would have risked communication between the upper aquifer layer and the lower aquifer layer, which could have contaminated the lower layer. Therefore, the CPT approach was acceptable.

[14] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPK 21, 307, 308, and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

The CPT test was conducted to a maximum depth of 125 feet. The CPT test showed dense to very dense sand to 49 feet bgs, followed by stiff to very stiff clays and silts to 107 feet, very dense sand to 124 feet bgs, and stiff to very stiff clays and silts to the maximum depth explored (125 feet bgs).[15]

Fault Rupture

No known surface expression of fault traces cross the Project site. The site is neither in an Alquist-Priolo Earthquake Fault Zone nor adjacent to any known active fault.[16,17]

Ground Shaking

Because there are two faults within approximately 10 miles of the Project site, as well as other major faults, as indicated in Table 3.9-1, that are capable of generating very large earthquakes within 20 miles of the Project site, the site is expected to be subject to strong ground shaking.

Liquefaction

Liquefaction is a phenomenon in which uniformly sized, loosely deposited, saturated, granular soils (usually fine sand) with low clay content lose strength during strong ground shaking, which causes the soil to soften or behave as a fluid for a short time. Liquefaction generally occurs at depths shallower than 50 feet bgs. Soils may lose their ability to support structures, and this loss of bearing strength may cause structures founded on the liquefied materials to tilt or possibly topple over. Light structures such as pipelines, sewers, and empty fuel tanks that are buried in the ground can float to the surface when they are surrounded by liquefied soil. The susceptibility of a site to liquefaction is a function of the uniformity, depth, density, and water content of the granular sediments beneath the site and the magnitude of the earthquakes that are likely to affect the site. Specifically, soils that are most susceptible to liquefaction are loose, non-cohesive soils, such as sand and silt, that are saturated and bedded between other layers with poor drainage and a cohesive cap.[18]

Liquefaction-related phenomena can include loss of bearing strength, vertical settlement from densification (subsidence), buoyancy effects, and flow failures. Damage from liquefaction and lateral spreading is generally most severe when liquefaction occurs within 15 to 20 feet bgs. Foundations for structures and pipelines would be the components that would be most vulnerable to damage from liquefaction-related phenomena. Seismically induced settlement can occur in areas that are underlain by compressible or poorly consolidated sediments. Some artificial fills are susceptible to mobilization and densification, resulting in earthquake-induced subsidence.

[15] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPK 21, 307, 308, and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[16] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[17] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[18] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation. Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

The Project site is located in an area that has been mapped by CGS[19] and ABAG[20] as being subject to a high liquefaction hazard. Furthermore, as discussed above under *Soils*, layers of sand and silt are interbedded with clay at the Project site. These layers are within the high level of groundwater, as discussed below under *Groundwater*, and thus are saturated. The likelihood for liquefiable sediments being present is high, and thus the potential for liquefaction at the site is high.[21]

Lateral Spreading

Lateral spreading (or lurching) occurs as a form of horizontal displacement of relatively flat-lying material toward an open face, such as an excavation, channel, or body of water. Generally, in soils, this movement is due to failure along a weak plane and may often be associated with liquefaction.

Although liquefaction potential at the Project site is high, the nearest open faces[22] are in smaller unnamed feeder sloughs to Ravenswood Slough, which are at least 450 feet from the Project site. These sloughs are relatively shallow and too far away to pose a danger of lateral spreading at the Project site.[23,24] Therefore, the potential for lateral spreading to affect the site appears to be low.

Ground Rupture

Ground rupture can occur when the pore water pressure within liquefiable soil layers is great enough to break through the overlying non-liquefiable layer. Because the potential for liquefaction at the Project site is high, ground rupture is possible. However, at the eastern end of the Project site, there is a 23-foot cap above the liquefiable layer, which is enough to prevent ground rupture. Therefore, the risk of ground rupture is low at this portion of the Project site.[25] The thickness of the cap above the liquefiable layer west of this area has not been verified.[26] Because subsurface conditions can vary over short distances, it is unknown whether the cap is adequate for preventing ground rupture on the rest of the Project site.

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[19] California Geological Survey. 2006. *State of California Seismic Hazard Zones, Palo Alto 7.5-minute Quadrangle, San Mateo and Santa Clara Counties, California.* Available: <http://gmw.consrv.ca.gov/shmp/MapProcessor.asp?MapNavAction=&Action=IMap&Location=NoCal&FClass=Quad&FID=Palo%20Alto&Liq=false&Land=false&Bore=false&Road=true&City=false&x1=563047.544275949&y1=4150994.333972209&x2=580526.127726051&y2=4136428.8477637907#>. Accessed: September 21, 2015.

[20] Association of Bay Area Governments. n.d. *San Mateo County Hazards: Earthquake Liquefaction and Shaking.* Available: <http://planning.smcgov.org/documents/san-mateo-county-hazards-earthquake-liquefaction-shaking>. Accessed: September 21, 2015.

[21] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California*. Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[22] Examples of open faces are cliffs, banks, and ditches. (Cascade Crest Consulting Engineers. 2015. Landslide and Lateral Spread. Available: <http://www.cccengr.com/Landslide_Lateral_Spread.html>. Accessed: October 12, 2015.)

[23] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[24] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[25] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308, and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[26] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

Differential Compaction and Settlement

When near-surface materials vary in composition, either vertically or laterally, strong ground shaking can cause non-uniform compaction, resulting in movement of the materials and overlying structures. This can also occur gradually over time. Factors that influence differential compaction and settlement are soil composition and consistency, the presence of native soils versus artificial fill (in particular, uncompacted fill), the magnitude of loading from structures on the soil, the potential for liquefaction, and any other changes in thickness or consistency.[27] The risk of differential compaction and settlement at the Project site is moderate.[28]

Expansive Soils

Expansive soils can undergo a significant volume change with changes in moisture content. They shrink and harden when dried and expand and soften when wetted. Soil plasticity is an indicator of the shrink-swell potential of soil. Tests at the Project site indicate that the soils have a very high expansion potential, also referred to as linear extensibility.[29] Furthermore, NRCS rates the native soils at the site as having high linear extensibility potential (see Table 3.9-3).[30]

Compressible Surface Soils and Fills

Compressible soils can settle or subside as a result of ground shaking or as a result of the loads placed on top of them. As discussed above under *Soils*, undocumented artificial fill is present at the Project site. It is not known whether this fill has been compacted.[31] Therefore, there is the potential for compressible soils to be present at the Project site.

Landslide Hazards

The Project site is in a nearly flat area with gentle slopes. Because there are no steep slopes, the likelihood of landslide and debris flow is very low. [32]

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[27] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[28] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[29] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[30] National Resources Conservation Service. 2015. *Web Soil Survey*. U.S. Department of Agriculture. Available: <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>. Accessed: September 18, 2015.

[31] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[32] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

Groundwater

Groundwater at the Project site was measured from borings. Depths ranged from 6 to 9 feet bgs. Other studies recently completed at nearby sites have encountered similar depths to groundwater (e.g., 8 feet bgs and, somewhat less shallow, 9.5 to 15.5 feet bgs). Fluctuations in groundwater level depend on season, tidal fluctuation, regional fluctuation, and other factors.[33,34]

Environmental Impacts

This section describes the impact analysis related to geology and soils for the Project. It describes the methods used to determine the impacts of the Project and lists the thresholds used to conclude whether an impact would be significant. Impacts are determined to be no impact (NI), less than significant (LTS), less than significant with mitigation (LTS/M), or significant and unavoidable (SU). Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant impacts accompany each impact discussion, as needed.

Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, the Project would be considered to have a significant effect if it would result in any of the conditions listed below.

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving (1) 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; (2) strong seismic ground shaking; (3) seismically related ground failure, including liquefaction; or (4) landslides.
- Result in substantial soil erosion or the loss of topsoil.
- Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the Project and potentially result in an onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994),[35] creating substantial risks to life or property.
- Have soils that would be incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater.

For the purpose of this Draft EIR, a significant impact would result from soil and/or seismic conditions that are so unfavorable that they could not be overcome by reasonable design, construction, or maintenance practices.

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[33] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[34] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[35] The State CEQA Guidelines specifically reference this version of the Uniform Building Code.

Methods for Analysis

The preliminary geotechnical assessment describes and evaluates geologic and geotechnical conditions at the Project site to support preliminary planning and the conceptual-level design during the initial phases of Project planning. The geotechnical investigations prepared for the Project site provide a summary and compilation of the available geotechnical information that was used as part of the analysis of geologic, seismic, and geotechnical issues for this Draft EIR. Two geotechnical feasibility investigations have been prepared for the Project site. The geotechnical feasibility investigation for Building 23 included field and laboratory programs to evaluate surficial and subsurface soils; an exploratory program, with borings to 9.5 feet bgs, to investigate subsurface conditions; geologic site reconnaissance; and preliminary identification of seismic and geologic impacts and mitigation measures. The geotechnical investigation for 307–309 Constitution Drive included field and laboratory programs to evaluate surficial and subsurface soils; an exploratory program, with borings to 35 feet bgs and cone penetration tests to 125 feet bgs, to investigate subsurface conditions; and engineering analysis.

Design-level geotechnical studies would be completed during development of construction plans, in accordance with the 2013 California Building Standards Code[36] and City building permit requirements.

Impacts Not Evaluated in Detail

Loss of Topsoil. As discussed above, soils at the Project site are primarily of a type that is not a source of topsoil. Because the Project would not result in the loss of topsoil, this impact is not evaluated further.

Impacts on Septic Systems. The Project would not include any septic tanks or leach field systems. Wastewater generated at the Project site would be disposed through the existing sanitary sewer system. Because the Project would not require soils that would be capable of supporting septic systems, this impact is not evaluated further.

Fault Rupture. As shown in Figure 3.9-1 and Table 3.9-1, no faults cross the Project site, nor is the site within an Alquist-Priolo Earthquake Fault Zone.

Landslides. The Project site is nearly level. It is not adjacent to any hillsides where seismically induced landslides or other downslope movements of rock or soil material could pose a hazard. In addition, the Project would not cause or exacerbate landslide hazards.

Lateral Spreading. Because there are no steep, open faces or bodies of water adjacent to the Project site that could be conducive to lateral spreading, there would be no risk of lateral spreading.

Impacts and Mitigation Measures

Impact GEO-1: Strong Seismic Ground Shaking and Seismically Related Ground Failure. The Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving (1) strong seismic ground shaking and (2) seismically related ground failure, including liquefaction. (LTS)

Development of the Project site would involve construction and occupancy of new buildings in a location where strong seismic ground shaking can be expected to occur over the life of the Project. Based on previous investigations at the site, mapped soil conditions, and the existence of high groundwater, the

[36] City of Menlo Park. 2013. *2013 Building Standards Codes, Summary of Changes*. December. Available: <http://www.menlopark.org/DocumentCenter/Home/View/93>. Accessed: September 21, 2015.

potential for liquefiable sediments is high. As discussed above under *Liquefaction*, the County Hazards Mitigation maps and the CGS Seismic Hazard Zone maps both identify the Project site as being potentially subject to liquefaction. Liquefaction-related phenomena such as loss of bearing strength, differential settlement, and flow failures could damage proposed structures at the Project site. Although seismic hazards are present, the preliminary geotechnical investigation for the Project site concluded that development of the Project is feasible, provided the potential hazards are reduced through the implementation of standard design and construction methods. Specifically, all structures, roads, and utility lines must meet or exceed design criteria of the adopted California Building Standards Code for Seismic Zone D, which specifies that the site is in an area of high seismic vulnerability.[37] Design and construction of the structures and facilities at the Project site would be subject to the relevant sections of the 2013 California Building Standards Code.

The Maximum Credible Earthquake peak ground acceleration is 0.55g. Other site coefficients are available in the Project geotechnical investigation.[38] In addition, because the Project site is in a liquefaction Seismic Hazard Zone, the Project Sponsor would be required to comply with the guidelines set by CGS Special Publication 117, which outlines the protocol for analysis and treatment of liquefaction-related hazards and provides estimates regarding vertical settlement and lateral spreading.

Any prediction of liquefaction-related settlement is necessarily approximate, and related hazard assessment and development of recommendations for treatment of such hazards must be performed conservatively, as recommended by CGS Special Publication 117A. A similarly conservative approach is recommended, again by CGS Special Publication 117A, when estimating the amount of localized differential settlement that is likely to occur as part of overall predicted settlement. Localized differential settlement of up to two-thirds of the total settlement anticipated must be assumed until more precise predictions of differential settlements can be made.[39]

The 2013 California Building Standards Code requires geotechnical investigations to provide design criteria that minimize impacts associated with strong ground shaking during an earthquake. The 2013 California Building Standards Code also requires all foundations and other improvements (e.g., roads, driveways, utilities) to be designed by a licensed professional engineer. The designs shall be based on site-specific soil investigations performed by a California Certified Engineering Geologist or Geotechnical Engineer to ensure the suitability (especially when considering the existence of potentially liquefiable soils at the site) of the subsurface materials with respect to adequately supporting the proposed structures. This includes designing foundations that are able to tolerate or resist the anticipated total and differential settlement that can be caused by liquefaction. The City and the Project Sponsor would be responsible for ensuring that all recommendations from the investigations are incorporated in the Project, pursuant to state law.

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[37] Seismic Design Category D: Corresponds to buildings and structures in areas that are expected to experience severe and destructive ground shaking but NOT located close to a major fault. Sites with poor soils are a good example. (International Seismic Application Technologies. 2014. *Seismic Design Category Reference Information*. ASCE 7-05. Available: <http://www.isatsb.com/Seismic-Design-Category.php>. Accessed: October 12, 2015.)

[38] Cornerstone Earth Group. n.d. *Geotechnical Investigation: Building MPG 21, 307, 308 and 309 Constitution Drive, Menlo Park, California.* Project Number 254-8-7. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

[39] California Geological Survey. 2008. *Guidelines for Evaluating and Mitigating Seismic Hazards in California.* Special Publication 17A. Available: <http://www.conservation.ca.gov/cgs/shzp/webdocs/documents/sp117.pdf>. Accessed: October 8, 2015.

As evidenced by the level of development throughout the Bay Area, successful building construction is possible in a seismically active zone and can be readily accomplished even where seismic hazards are known to exist. The risks to public safety from seismic hazards can be mitigated to the extent required by law with implementation of proper design and construction methods, which are the responsibility of the City and the Project Sponsor. The City shall monitor design and construction and enforce the law through the building permit process. In addition, the City, along with other Bay Area jurisdictions, participates in a coordinated planning and emergency response program and has its own Emergency Operation Plan to respond to natural disasters. Consequently, the Project would have a ***less-than-significant*** impact with regard to the exposure of people or structures to seismic ground shaking or liquefaction-related hazards.

Impact GEO-2: Soil Erosion. The Project would result in less-than-significant soil erosion impacts. (LTS)

As discussed above under *Site Topography*, the Project site is nearly level. The Project would not involve development on hillsides or cut and fill. Thus, there would be no long-term topographic changes that could alter erosion potential. However, development of the Project site would involve grading to construct building foundations and trenching for utility installations, surface parking, and landscaping. Some minor modifications that would allow additional roadway and bicycle/pedestrian access points would also be implemented. These construction activities could temporarily expose soils to erosive effects from stormwater runoff.

If fill is imported and stockpiled at the Project site, the stockpiles could be eroded by wind or water unless properly protected. Because the Project site exceeds 1 acre in size, the Project Sponsor would be required to implement a SWPPP, in accordance with Chapter 7.42 of the City's Municipal Code, to reduce potential erosion and subsequent sedimentation in stormwater runoff. This SWPPP would include BMPs to control erosion associated with grading, trenching, and other surface-disturbing activities. The Project Sponsor would be required to submit a grading plan to the City before permits would be issued. In addition, the Project Sponsor would be required to prepare and submit a G&D plan, along with an Erosion and Sedimentation Control Plan, prior to obtaining a grading permit from the City. The Project Sponsor would also be required to implement the specifications in Appendix J of the 2013 California Building Standards Code, which regulates grading activities, including associated drainage and erosion control. Compliance with City requirements and the 2013 California Building Standards Code, which are within the authority of the City to enforce and monitor, would ensure that erosion impacts resulting from Project construction would be less than significant.

After construction, the Project site would be developed with buildings, parking areas, roadways, bicycle and pedestrian paths, an open space area, terraced garden area, and landscaping and hardscaping. Stormwater runoff would be managed and collected by a new stormwater drainage and management system that would connect to the City's storm drain system, as described in Chapter 2, *Project Description*. As a result of the Project, the impervious area would decrease from 86 percent of the site (approximately 303,400 gsf) to 70 percent of the site (approximately 662,200 gsf), keeping more water onsite and allowing percolation to groundwater reserves. The impact resulting from erosion under Project operation would be ***less than significant***.

Impact GEO-3: Soil Hazards. The Project would not 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 subsidence or collapse. (LTS)

Although subsidence was a concern in Santa Clara Valley in the early part of the twentieth century, it was effectively halted in the 1960s. The current risk of subsidence and associated differential settlement is low.[40] However, as discussed above, the preliminary geotechnical investigation anticipates that differential settlement resulting from seismically induced liquefaction may occur. If Project structures are improperly designed and constructed, differential settlement could undermine structural foundations, potentially exposing people onsite, including inhabitants and construction workers, to increased safety risks.

Construction activities such as excavation could introduce instability and cause slopes to collapse. Soil collapse is also associated with subterranean voids, such as tunnels or mine shafts, or with excessive loading. Soil collapse could result if utilities, pipes, or tanks that are currently extant at the Project site are abandoned in place and not appropriately backfilled, capped, or retrenched. Furthermore, the artificial, undocumented fill and native deposits that underlie the Project site are regarded as potentially weak soils that may be compressible or exhibit other characteristics that would make them unstable (e.g., differential compaction).

General excavation would occur at a depth of 5 to 10 feet. As discussed above under *Groundwater*, groundwater was measured at depths of 6 to 9 feet bgs. The presence of shallow groundwater could affect grading and underground construction and result in a wet and unstable pavement subgrade, difficult compactions, and difficult utility installations. Excavations less than 5 feet deep below existing grades that are backfilled the same day are likely to remain relatively dry. Dewatering and the shoring of utility trenches may be required for deeper work, such as utility installations. However, standard engineering practices could be used to reduce potential hazards associated with soils at the Project site. The preliminary geotechnical investigation concluded that development of the Project site is feasible from a geotechnical perspective. Section 3.10, *Hydrology and Water Quality*, discusses impacts associated with contaminated groundwater encountered during dewatering.

As part of the construction permitting process, the City requires completed reports from registered soil professionals to identify potentially unsuitable soil conditions. The reports must (a) identify potentially unsuitable soil conditions and (b) contain appropriate recommendations for foundation type and design criteria, conforming to the analysis and implementation criteria in the 2013 California Building Standards Code, Chapters 16 and 18 and Appendix J, to eliminate inappropriate soil conditions.

Adherence to the soil and foundation support parameters of the 2013 California Building Standards Code, as required by City and state law, will ensure that structures and their associated trenches and foundations will have the maximum practicable protection from soil failures available under static or dynamic conditions. The Project Sponsor would be required to incorporate these recommendations into the Project design. In view of these circumstances, hazards related to unstable geologic or soil units at the Project site are considered ***less than significant***.

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[40] Ingebritsen, S.E., and D.R. Jones. 1999. Santa Clara Valley, California: A Case of Arrested Subsidence. In D. Galloway, D.R. Jones, S.E. Ingebritsen (eds.), *Land Subsidence in the United States*. U.S. Geological Survey Circular 1182. Reston, VA. Available: <http://pubs.usgs.gov/circ/circ1182/>. Accessed: September 21, 2015.

Impact GEO-4: Expansive Soil. The Project would not be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating a less-than-significant risk to life or property. (LTS)

As discussed above, the geotechnical investigation for the Project site and NRCS data indicate that soils at the site have a high shrink-swell potential. Structural damage, warping, and cracking in parking areas and along roads, driveways, and sidewalks, as well as utility line ruptures, may occur if the potential for expansive soils and the nature of the imported fill is not considered during design and construction of Project improvements. However, standard engineering practices would be employed to reduce potential hazards associated with soils at the Project site. Furthermore, the geotechnical feasibility investigation concluded that development of the Project site is feasible from a geotechnical perspective.[41]

As part of the construction permitting process, the City would require completed reports regarding soil conditions to identify potentially unsuitable soil conditions. The evaluations must be conducted by registered soil professionals and (a) identify potentially unsuitable soil conditions and (b) contain appropriate recommendations for foundation type and design criteria, conforming to the analysis and implementation criteria described in the 2013 California Building Standards Code, Chapters 16 and 18 and Appendix J, to eliminate inappropriate soil conditions.

Adherence to the soil and foundation support parameters of the 2013 California Building Standards Code, as required by City and state law, will ensure that structures and their associated trenches and foundations will have the maximum practicable protection from soil failures available under static or dynamic conditions. The Project Sponsor would be required to incorporate these recommendations into the Project design. In view of these circumstances, impacts related to expansive soil units at the Project site are considered ***less than significant***.

Cumulative Impacts

There is a different geographic context for each of the cumulative impacts. The geographic context for the analysis of cumulative impacts associated with seismic hazards is the Bay Area. The geographic context for an analysis of impacts on development associated with the geotechnical aspects of erosion (i.e., permanent loss of soil or topographic changes that cause or exacerbate erosion) is generally site-specific, and impacts would not be compounded by additional development. From a watershed perspective, however, erosion can affect water quality by contributing sediment; thus, the geographic context for erosion impacts for the Project would include the San Francisquito Creek watershed (see Section 3.10, *Hydrology and Water Quality*). The geographic context for an analysis of impacts on development from unstable soil conditions, including expansive soils or other conditions that could cause structural problems, is limited to the site and would not be compounded by additional development.

Cumulative impacts are addressed only for those thresholds that would result in a Project-related impact, whether it be less than significant, significant, or significant and unavoidable. If the Project would result in no impact with respect to a particular threshold, it would not contribute to a cumulative impact. Therefore, no analysis would be required for the following thresholds:

- Fault rupture

[41] Cornerstone Earth Group. 2014. *Geotechnical Feasibility Investigation: Chilco Road Parcels, 300 Constitution Drive, Menlo Park, California.* Project Number 254-8-3. July 22. Prepared for Hibiscus Properties, LLC, Menlo Park, CA. Walnut Creek, CA.

- Landslides
- Lateral spreading
- Loss of topsoil
- Impacts on septic systems

This cumulative analysis examines the effects of the Project on the potentially affected geographic area in combination with other current projects, probable future projects, and projected future growth.

Impact C-GEO-1: Cumulative Seismic Hazards. The Project, in combination with other foreseeable development in the vicinity, would not substantially increase the risk of exposure to seismic hazards. (LTS)

Future population growth in the Bay Area, along with the Project and other foreseeable development, will increase the number of people and structures that will be exposed to seismic hazards. Given the risk from seismic activity associated with all development in seismically active areas, this impact would be significant if it were not mitigated by building code requirements. Construction in California is strictly regulated by the California Building Standards Code, as adopted and enforced by each jurisdiction, including the City, to reduce risks from seismic events to the maximum extent possible. Because the City uses and enforces the requirements of the California Building Standards Code as part of its own building code, new buildings and facilities in the City are required to be sited and designed in accordance with the most current geotechnical and seismic guidelines and recommendations. Other projects would implement all necessary design features recommended by site-specific geotechnical studies (required for all development applications) to reduce the risk from seismic activity, unstable slopes, and soil limitations. Because all future projects would be required to implement necessary design features to minimize exposure to seismic hazards, cumulative impacts related to seismic hazards would be ***less than significant***.

Impact C-GEO-2: Cumulative Soil Erosion. The Project, in combination with other foreseeable development in the vicinity, would not substantially increase the soil erosion potential. (LTS)

Development of other projects could expose soil surfaces and alter soil conditions. To minimize the potential for cumulative impacts related to erosion, all projects in the city are required to conform to the provisions of applicable City ordinances and state regulations pertaining to erosion and sedimentation control. This includes City Municipal Code Chapter 7.42 requirements, which implement the federal and state NPDES program. Therefore, cumulative impacts related to soil erosion would be ***less than significant***.

Impact C-GEO-3: Cumulative Soil Hazards. The Project, in combination with other foreseeable development in the vicinity, would not substantially increase soil hazards. (LTS)

Development is required to undergo an analysis of geological and soil conditions, as applicable to a specific individual project. Restrictions on development would be applied in the event that geological or soil conditions pose a risk to safety as a result of site-specific geologic or soil instability, subsidence, collapse, and/or expansive soil. Because the City uses and enforces the requirements of the California Building Standards Code as part of its own building code, new buildings and facilities in the City are required to be sited and designed in accordance with the most current geotechnical guidelines and recommendations. Accordingly, impacts with respect to soil hazards would be ***less than significant***.