

**Geology
and Soils**

SECTION 4.5

4.5 GEOLOGY AND SOILS

This section assesses the Project's potential to result in, or expose people or property to, adverse geologic and seismic conditions or hazards. This analysis is based on the geotechnical engineering studies prepared by the Applicant's geotechnical engineer (Albus-Keefe & Associates (2010a and 2010b; 2013); information from previous environmental and geotechnical documents prepared for the site (County of Santa Barbara, 1984 and 1991; Fugro West, Inc., 2003); data from the Goleta General Plan/Coastal Land Use Plan (GP/CLUP) documents (2006) and GP/CLUP Supplemental Final EIR (2009); and published information for the Goleta-Santa Barbara area from various sources, including the U.S Geological Survey (USGS) and California Geological Survey (CGS, Division of Mines and Geology). The geotechnical reports prepared by Albus-Keefe & Associates were submitted with the Project application and subsequently updated to accompany submission of the Project's grading plans for "at risk" plan check in advance of entitlements.

In preparing this section, Envicom Corporation's California-certified engineering geologist, Kenneth Wilson, peer reviewed and augmented the 2010 Albus-Keefe studies. As part of the that review process, Albus-Keefe & Associates prepared a response letter to address certain concerns and subsequently updated its reports to reference the current set of Project plans (Comstock, 2011) and the Preliminary Drainage Report for the Project (Penfield & Smith, 2011). The final Albus-Keefe study was completed in 2013 and was submitted to the City Department of Public Works together with engineered grading plans. The geotechnical reports and review correspondence are provided in Appendix E.

The adjacent business park component of the Project (Component 2) has already been constructed and previously subject to geotechnical and environmental review to the satisfaction of the City and is, therefore, not included in this analysis. The term "Project" and "Project site," when used in this analysis, refers exclusively to the undeveloped residential Project Component 1 (Village at Los Carneros), comprised of Lots 2, 4, 5, 6 and 7 of Tract 14,500.

4.5.1 Existing Conditions

Topography/Slope

The topography of the Project site is generally subdued and the underlying geologic formations are not layered in a manner that would make them prone to landslide activity. Previous grading activities on the site for projects that were either off-site, not built, or that were constructed on Lots 1 and 3 of Tract 14,500 have created certain man-created features. These include:

1. Cut slopes along the north edge of the Village at Los Carneros site.
2. A 19,000 cubic yard dirt stockpile in Lot 5 and a smaller dirt stockpile on Lot 7.
3. A fill slope on the east site of the Villages at Los Carneros site adjacent to the elevation of the adjacent roadway as it becomes an overpass that crosses the UPRR tracks and U.S. 101 freeway.
4. Engineered slopes along Tecolotito Creek in the western portion of the site.
5. A drainage ditch constructed from Lot 3, a part of the developed business park uses, to Tecolotito Creek.
6. Over-excavation and recompaction of Lot 2.

The north property slope and existing stockpile slopes show evidence of severe erosion (rills/gullies and sediment deposition) of the old alluvium and artificial fill due to inadequate surface drainage control and a lack of anchoring vegetation.¹

Existing Project site elevations range from about 50-feet (top of slope) amsl approximately midway along the north edge of the site to about 17-feet amsl along the southwest edge (Comstock Homes, 2011, Sheet C-9, C-10, and TM-2; Albus-Keefe & Associates, 2010a and 2010b).

Before being disturbed by grading, the topography of the west side of the Project site trended south/southwest toward Tecolotito Creek. According to information provided in the Albus-Keefe reports and Wilson peer review, the site was crossed by northwest to southeast and north to south trending drainages and swales that drained southward into Tecolotito Creek or southeast toward Los Carneros Creek, both of which ultimately discharge into the Goleta Slough. The historic outline of Goleta Slough (UCSB, 2012) approached the Project area from the south, but is believed to have remained south of the current alignment of Los Carneros Road (Gurrola, 2004) except for a limited incursion into a drainage under what is now the parking lot area for the Amgen Medical building. Subsequent grading maintained the general slope direction but substantially lowered the gradient as a result of excavation along the south edge of the railroad tracks.

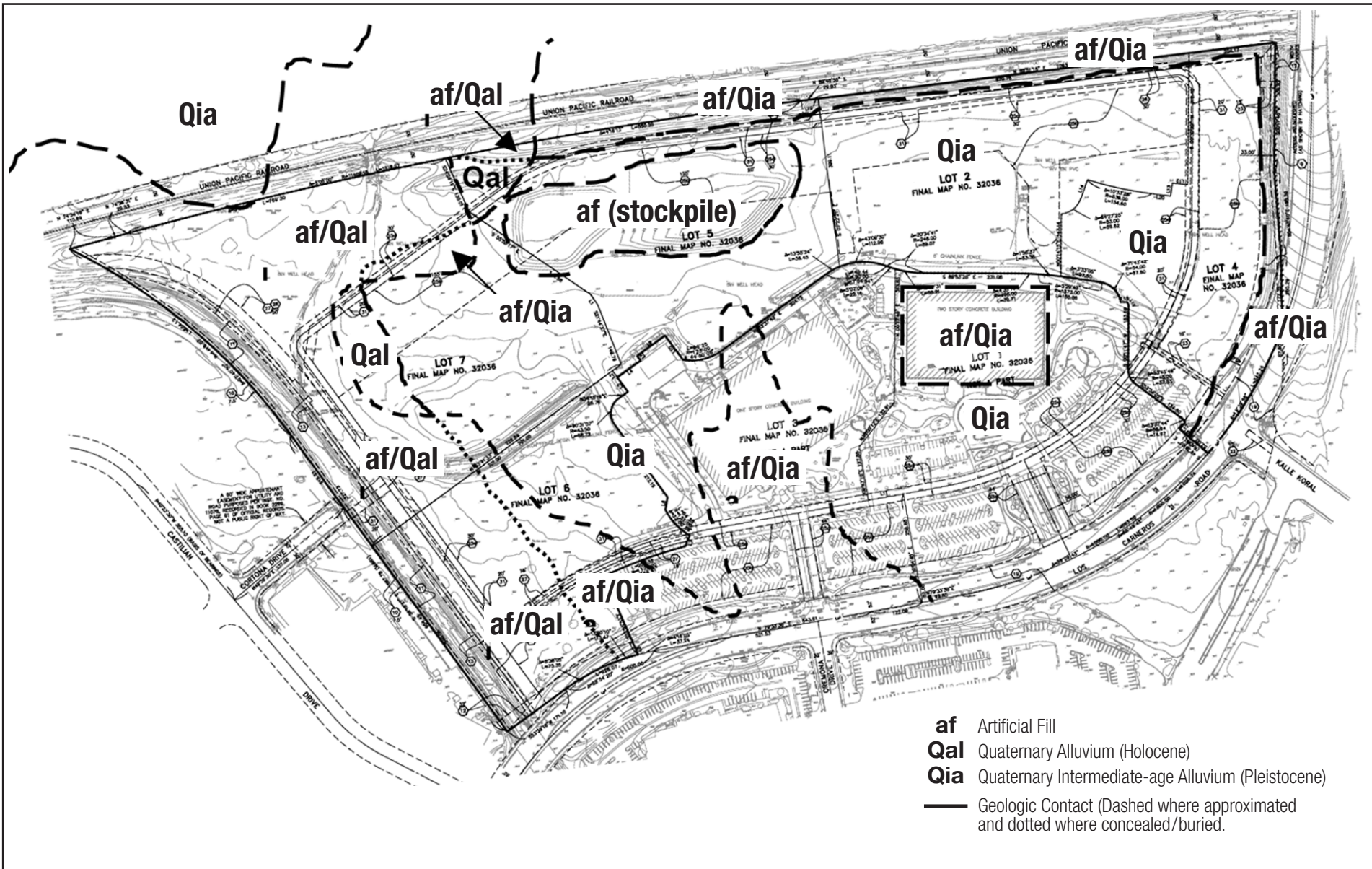
Grading on Lot 2, which lowered its elevation relative to Lot 5, and the grading for the existing development of Lots 1 and 3 resulted in topographic changes to portions of the remaining vacant property so it they sloped away from the railroad tracks to the south at a low gradient and merging with an asphalt roadway at the site's south boundary. The eastern portion of the site slopes away from Los Carneros Road. The western portion of the site slopes to the southwest and west toward Tecolotito Creek. Soil stockpiles created on Lots 5 and 7 are believed to date to the period when Lots 1 and 3 were developed.

Except for the steep cut/fill slopes along the north property line and western edge of Los Carneros Road, and the elevations of the stockpile mounds on existing Lots 5 and 7 (peak elevations of 48 and 42 feet amsl, respectively), the Village at Los Carneros site elevations range from approximately 35 feet amsl at the northeast corner at the base of the slope adjacent to Los Carneros Road, to about 17-feet amsl at its southwest corner of (*Existing Conditions Plan*, Penfield & Smith 2011).

Stratigraphy

Based on regional mapping (Minor, and others, 2009) and site-specific geotechnical analysis (Albus-Keefe & Associates, 2010a, 2010b, and 2013; Fugro West, Inc., 2003; and Hoover & Associates, 1983), alluvial formations exposed on the Project site area include the units summarized in **Table 4.5-1** and depicted with detail in **Figure 4.5-1** (Site Geology Map), although this figure is not considered to be an entirely accurate depiction of actual onsite fill locations.

1. Comstock Homes, 2011, sheet C-9, C-10 and TM-2; Albus Keefe & Associates, 2010a and 2010b.



Source: Artificial fill contact is from Hoover, 1983. Quaternary alluvium contact is from Albus-Keefe (March 2010) and Minor and others (2009).

Albus-Keefe & Associates (2010a and 2010b; 2013) summarizes work previously performed by Fugro West, Inc. (2003) at the site in 2000 through 2003 and subsequently updated to include the entirely entirety of the residential Project site consolidated in a single report (2013), combined the its two prior studies and incorporated information taken from the Penfield Smith Preliminary Hydrology Report, which was previously reviewed and approved by the City Department of Public works. The Albus-Keefe & Associates work and the earlier Fugro West studies relied in part upon work performed by other geology and geotechnical firms in 1983 (Hoover & Associates) and 1987 (Dames & Moore). Based on regional mapping and site-specific geotechnical analysis,² alluvial formations exposed on in the Project area include the units summarized in **Table 4.5-1** and depicted generally in Figure 4.5-1 and more site specific focus depicted in **Figure 4.5-2** (Site Geology Map).

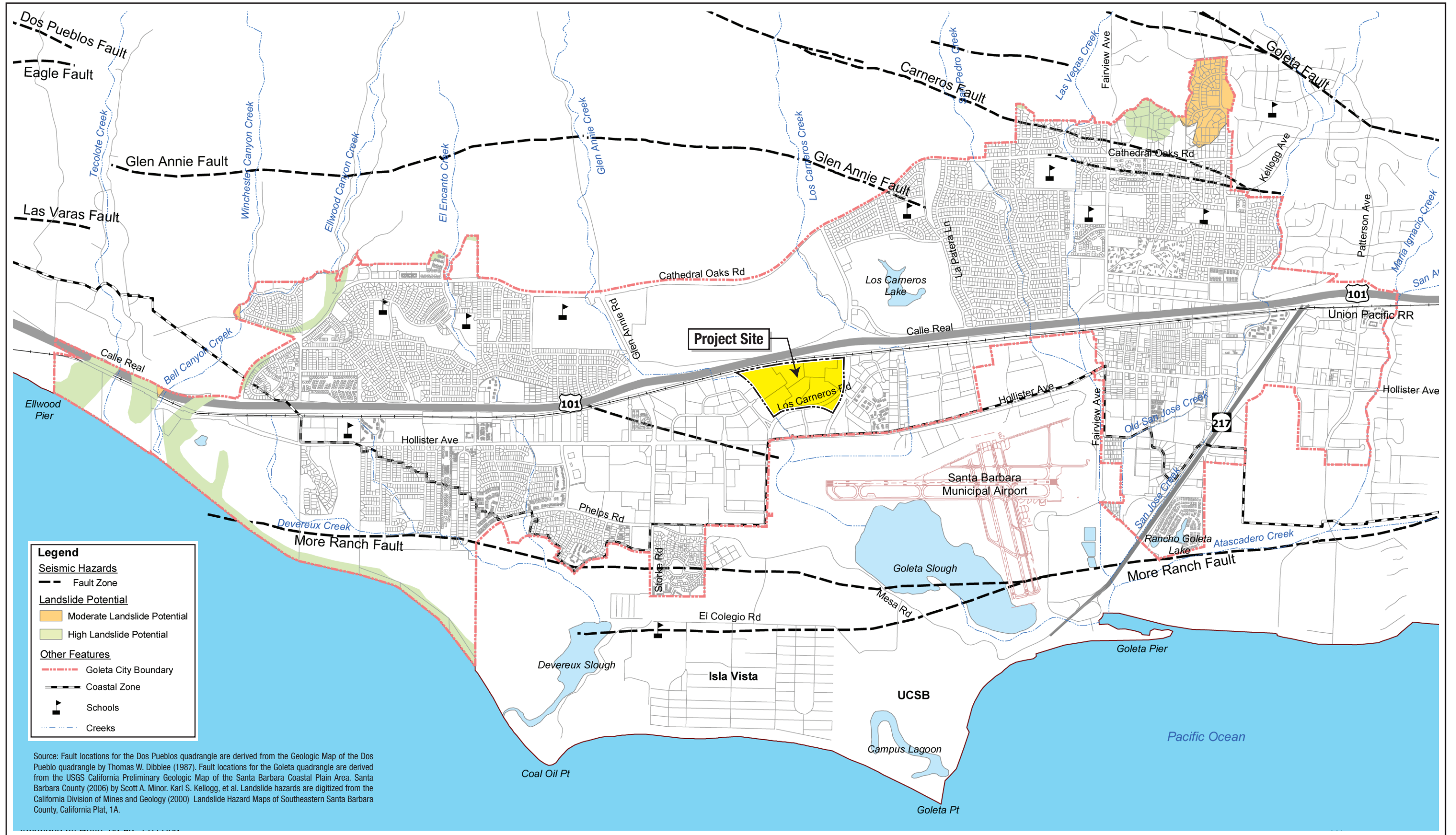
Table 4.5-1
Artificial Fill and Geologic Formations Exposed Within the Project Site

Formation	Map Symbol	Age
Artificial Fill ¹	AF	Recent (Historic)
Younger Alluvium ²	Qac	Holocene and upper Pleistocene
Intermediate-Age Alluvium ²	Qia	Upper Pleistocene
¹ Not mapped, but believed to be present based on grading performed within the Project area (Hoover & Associates, 1983) ² Minor, and others, 2009 (Figures 4.5-1 and 4.5-2). Qia and Qac are equivalent to Qoal (older alluvium) and Qal (younger alluvium), respectively, of Albus-Keefe & Associates (2010a and 2010b).		

Artificial Fill (AF)

The various contiguous lots that comprise all but Lot 8 of Tract 14,500, were previously subject to cut and fill grading (i.e., excavation within native soil and placement of the soil on top of native soil). Graded cuts up to 10 feet deep were made in 1962, lowering the overall site grade and revising its gradient. Most of this work occurred along the northern boundary of the site adjacent to the UPRR right-of-way. Artificial fill was placed south of the cut area and may be as much as 8-feet deep in the southern portion of Lot 4. This suggests that a cut and a fill contact line is present, trending roughly parallel to the railroad tracks through the proposed Village at Los Carneros development area, but this line is not shown on any of the source maps referenced by the Project's geologist and would need to be established through additional geotechnical work before grading. At the same time, drainages that crossed the site prior to 1962 have been filled to a depth of several feet. The County (1984) shows that minor non-engineered fill, predating 1962, is present within the far west edge and south portion of the development area to a depth of approximately four to five feet under portions of presently proposed building footprints. Approximately 19,000 cubic yards of soil was stockpiled within Lots 5 and 7 when construction occurred on Lots 1 and 3. Artificial fill is also present along the east bank of Tecolotito Creek, where portions of the channel were engineered for flood control purposes and the course of the creek modified. The Hoover & Associates (1983) map (used in

² Minor, and others, 2009, Albus-Keefe & Associates, 2010a and 2010b; Fugro West, Inc., 2003; Hoover & Associates, 1983 from Fugro West, Inc. 2003.



General Plan/Coastal Land Use Plan, November, 2009. Amended by Reso. 09-59, 11/17/09.

Figure 4.5-1) is the best available representation of artificial fill within the Project site. Albus-Keefe & Associates describes the artificial fill within the Project building areas originally considered for development of the originally proposed Village of Los Carneros (i.e., Lots 2 and 5) as consisting of materials derived on-site; specifically, intermediate-age (older) alluvium (Qia/Qoal). Generally, the fill consists of brown to dark brown, dry to moist, soft to medium stiff silty clay, sandy clay, and medium dense clayey sand. In Lot 2, where removal and recompaction was performed for the previously graded pad, Albus-Keefe reports the presence of approximately two feet of silty sand over 3-feet of clay-rich material, based on the prior engineering reports prepared by Fugro West, which supervised the grading. Based on the Fugro descriptions the general characteristics of the artificial fill include:

- Moderately to highly erodible;
- Portions may be suitable if processed for engineered fill;
- Generally stable in low slopes with a gradient shallower than 20 percent;
- Susceptible to slope failures during strong earthquake shaking; and
- Potentially expansive and may have poor foundation characteristics.

The degree of engineering control and compaction of these artificial fill accumulations appears to be variable with the exception of Lot 2, where Fugro West, Inc. controlled the placement during grading in 2003. It appears that other fill masses within Lot 5, Lot 7 and the offsite roadway areas were not placed in accordance with present engineering standards and in general, non-engineered fill and underlying weak soils are not considered suitable for construction purposes.

Alluvium/Colluvium (Qal)

Holocene- to Upper Pleistocene-age alluvium and colluvium mapped by Minor and others (2009) is termed younger alluvium (Qal) by Albus-Keefe & Associates (2010a and 2010b; 2013). As shown on Figure 4.5-1, Qal underlies the western edge of the Project site. Minor and others describe the material as unconsolidated to weakly consolidated and poorly to moderately sorted silt, sand, and gravel deposits of modern drainages, and piedmont alluvial fans and floodplains. They conclude that the maximum exposed thickness of the unit locally is approximately 10 meters (33-feet). Qal overlies Qia, described below, and is covered by artificial fill materials in most areas of the western portion of the Project Component 1 area. Albus-Keefe & Associates (2010a and 2010b; 2013) describes the younger alluvium as locally approximately four to 35 feet thick and describes it as consisting of yellowish brown to black, moist to very moist, medium stiff to stiff silty clay. Where deep younger alluvium was encountered, the silty clay was found to be medium stiff to stiff sandy clay with interbeds of silty sand and clayey sand below a depth of approximately 15 to 20 feet.

The engineering properties Qal are considered marginal to unacceptable for most construction purposes. The silty sand units may be subject to liquefaction during a strong earthquake. Based on the descriptions from Minor (2009) and Albus-Keefe & Associates (2010a and 2010b; 2013), the alluvium/colluvium is likely to be:

- Moderately to highly erodible;
- Suitable for most construction purposes only if processed for engineered fill and blended with materials having low expansion potential;

- Generally unstable on slopes greater than 20 percent;
- Susceptible to slope failures during strong earthquake shaking; and
- Potentially moderately to very highly expansive with poor foundation characteristics.

Intermediate-Age Alluvium (Qia)

Intermediate-age Quaternary (Upper Pleistocene) alluvium (Qia), mapped by Minor and others (2009), is identified as older alluvium (Qoal) by Albus-Keefe & Associates (2010a and 2010b; 2013). As shown on Figure 4.5-2, Qia/Qoal underlies most of the Project site. Minor describes this material as orange-brown, unconsolidated layers of silt, sand, and cobble conglomerate with well-rounded clasts up to about 10-inches long. The County of Santa Barbara concluded that the unit is greater than 20 meters (65-feet) thick locally (a maximum of 100 feet. (1984). Albus-Keefe & Associates (2010a and 2010b; 2013) describes the this alluvium as consisting predominantly of damp to moist and stiff to very stiff silty clay, sand clay, and sandy silt approximately 10 to 15 feet thick underlain by an approximately 15-foot thick layer of damp to saturated and dense to very dense sand and silty sand.

Fugro West, Inc. (2003) describes the older alluvium taken from bore hole data as stiff fat clay, sandy lean clay, lean clay, medium-dense to very dense clayey sand, silty sand, and fine-grained sand. The clay-rich soils have low to moderate compressibility and generally very high expansion indices (i.e., high shrink-swell potential). The County (1984) indicates the sand and gravel lenses are approximately 5 to 15 feet thick.

The engineering properties the Qia/Qoal layers are marginal to acceptable for most construction purposes, but the medium-dense sandy units may be subject to liquefaction during a strong earthquake. This intermediate-age alluvium is considered:

- Moderately erodible;
- Suitable for most construction purposes if processed for engineered fill;
- Generally unstable on slopes greater than 20 percent;
- Susceptible to slope failures during strong earthquake shaking; and
- Potentially highly to very highly expansive with poor to adequate foundation characteristics.

The degree of engineering (i.e., control and compaction) of these artificial fill accumulations is considered variable, except for Lot 2 where Fugro West, Inc. controlled the placement during grading in 2003 (Albus-Keefe & Associates, 2010a and 2010b; 2013). As previously noted, it is assumed that other fill masses within Lot 5 and the offsite roadway areas were not placed in accordance with present engineering standards and, in general, the non-engineered fill and the underlying weak soils are not considered suitable for construction purposes.

It is most likely that the Qia/Qoal alluvium described above overlies the claystone bedrock of the Santa Barbara Formation, which is about 2000-feet thick. Albus-Keefe & Associates describe the bedrock from two borings within Lot 6 as clayey siltstone with occasional interbeds of sand.

General Soil Conditions

Fugro West, Inc. (2003) performed geotechnical engineering evaluations within the property between 2000 and 2003. These evaluations included several borings from which samples were taken for laboratory testing. Fugro West also reported on data developed by other consultants from 1983, 1986, and 1987 studies. Descriptions of the geologic units are considered representative of site soils conditions. While additional grading has taken place within the Village at Los Carneros component of the Project site since 2003, when the Fugro West report was published, Albus-Keefe considered the Fugro West report to be sufficiently reliable for use in developing a soils profile to accompany the current submittal for the Village at Los Carneros. Based on these reports, artificial fill, Qal, and Qia/Qoul alluvium soils would be encountered during grading, trenching, and other excavation activities undertaken in the course of the construction process in the primary building areas of the Village site. Overall, these units are clay-rich and have layers of sand, silty sand, and cobble-rich horizons. The clay-rich areas within the natural deposits will have moderate to very high expansion potential.

Data for the site of the Project's Cortona Drive bridge over Tecolotito Creek is not presently available. Accordingly, additional geotechnical and soils analysis will be required to establish the most appropriate locations for bridge support pilings. Based on what is known of this particular area, and the Mitigation Measures contained in Section 4.3 (Biological Resources), the bridge pilings would be required to avoid the bed and bank of the creek. In addition, the 2013 Albus-Keefe geotechnical update and consolidated report suggests that additional geotechnical work may be required to support the proposed location of the most westerly subsurface detention/water quality basin. ~~The 2013 Albus-Keefe report includes the recommendation that additional soils and geotechnical work be done at this location,~~ which recommendation is consistent with the City-reviewed and approved Penfield and Smith Preliminary Drainage Review, discussed in detail in Section 4.8, Hydrology. The EIR assumes that the currently available geotechnical reports are sufficient to support the environmental analysis of geotechnical effects on Project site and that that remaining geotechnical or soils issues, if any, will be addressed as recommended in the course of the standard plan check process and resolved pursuant to the City's building codes and policies. Any open issues would be mitigated to the satisfaction of the City through engineering and/or relocation of the westerly basin.

Geologic and Seismic Structure

Bedding Plane Attitudes (Dip Angles), Faults, and Folds

Strike (the compass direction of a horizontal line on a plane) and dip (slope angle of original sedimentary layering relative to horizontal) are the two measurements used to describe the geometry of a bedding plane or fault. Because no bedrock formations are exposed within or immediately adjacent to the Project site, there are no bedding plane attitudes to report. The Project site is located within the western Santa Barbara fold belt, which is characterized by northwest trending strike-slip faults (predominantly lateral movement) in the Santa Ynez Mountains and south-dipping reverse-left oblique thrust faults (predominantly south over north movement). The reverse faults are considered, or have been proven to be, active based on earthquake locations in the Santa Barbara Channel and limited onshore examples of dated Holocene faulting and uplift/folding.

Regional Faults

A geologic fault is a discontinuity in the earth's crust along which earth materials on one side of the fault have moved vertically or horizontally relative to the other side. Based on criteria established by the State Mining and Geology Board (SMGB) in 14 California Code of Regulations §§ 3600, *et seq.*, and as summarized in the *Special Publication 42 Fault Rupture Hazard Zones* in California, published by the State of California Geological Survey (CGS), faults can be classified as active, potentially active, or inactive.³

The State of California *Alquist-Priolo Earthquake Fault Zoning Act* (2007), Public Resources Code §§ 2621, *et seq.*, defines an active fault as one with surface displacements within Holocene time, or approximately within the last 11,000 years. ~~A fault is deemed sufficiently active if there is evidence of Holocene surface displacement.~~ A fault is considered well defined if its trace is clearly detectable by a geologist as a physical feature at or just below the ground surface. Inactive faults have no evidence of movement within the last 1.6 million years. The term *non-active fault* is sometimes used for faults with no evidence of Holocene movement and that are considered unlikely to move during the life of an engineered structure.

The Project site is located approximately 4,600 feet north of the North More Ranch fault, which is the western 10-mile segment of the 41-mile long active Mission Ridge-Arroyo Parida fault system. The consensus of most geologists who have investigated the area is that the More Ranch fault is a potentially active reverse-left oblique fault, dipping to the south and that it is mostly "blind" (i.e., rupture/offset does not penetrate to the ground surface). The estimated average slip rate is 0.2 to 0.6 millimeters per year (mm/year), the estimated maximum moment magnitude (M_w) earthquake is approximately 6.7, and the annual recurrence interval is approximately 1,076 years. A deterministic estimate of the potential for strong ground shaking was made by Fugro West in 2003 and indicates that the fault system may be capable of producing approximately 0.49g (equal to 49 percent of the force of gravity) at the Project site in a maximum earthquake event of magnitude (M) 6.7.

There are numerous other active and potentially active faults within 62 miles (100 kilometers) of the Project site. According to the City's General Plan Safety Element, these include (in addition to the More Ranch Fault) the Glen Annie fault and the Carneros fault. Of these nearby faults, only the More Ranch fault is considered active. Each of the most proximate faults was evaluated to establish its potential strong ground shaking affects at the Project site based on data contained in a widely used computer program EQFAULT. Active regional seismic source faults are shown in Figure 4.5-2 (Geologic Hazard Map). Figure 4.5-2 is from the City's General Plan Safety Element and illustrates the location of faults in the immediate area of Goleta. Faults capable of producing over 0.10 g acceleration at the site are listed below in **Table 4.5-2**.

³ The California Geological Survey was formerly called the California Division of Mines and Geology (CDMG).

Table 4.5-2
Earthquake Faults and Expected Earthquake Magnitudes/Accelerations Within
62-Miles of the Project Site

Fault Name	Approximate Site-to-Fault Distance	Estimated Maximum Earthquake	Estimated Mean Peak Horizontal Ground Acceleration
More Ranch	0	6.7	0.49
North Channel Slope	0	7.1	0.60
Santa Ynez (West)	7	6.9	0.25
Red Mountain	11	6.8	0.20
Channel Island Thrust	11	7.4	0.27
Montalvo-Oak Ridge Trend	13	6.6	0.16
Santa Ynez (East)	13	7.0	0.16
Los Alamos – W. Baseline	17	6.8	0.15
Ventura – Pitas Point	18	6.8	0.14
Oak Ridge (Blind Thrust Offshore)	21	6.9	0.13
Santa Cruz Island	26	6.8	0.11
Lions Head	28	6.6	0.09
Santa Rosa Island	29	6.9	0.10
Big Pine	30	6.7	0.07
San Andreas – 1857 Rupture	43	7.8	0.10

*The fault plane is postulated by CDMG to project beneath the Project site. Distance to the vertical projection of the rupture surface is assumed to be 0 mile for the purpose of estimating median PHGA values; Fugro West, Inc., 2003).

Based on aerial photograph interpretation, it is possible that an active fault occurs approximately 1,750-feet to the south and southwest of the site (Minor and others, 2009). The distance from the potential fault to the site would, however, preclude on site surface fault rupture.

A groundwater barrier, possibly related to the Las Varas fault, was mapped by Upson in 1951 and reported by Fugro West as trending northwest through the northeast portion of the Project site (County of Santa Barbara, 2010, figure on page 27). A 1983 Hoover study used seismic refraction and trenching techniques in an attempt to characterize the barrier, but concluded that there was no substantial evidence of a fault in this location and recommended no development limitations due to fault hazard. According to the Santa Barbara Seismic and Safety Element and the City of Goleta General Plan (GP/CLUP, 2006), no “active” or “potentially active” faults pass through, or are immediately adjacent to the Project site.

Co-Seismic Uplift and Active Folds

Based on study of the More Ranch fault, geologists have determined that a rupture on the More Ranch segments could produce surficial uplift associated with bending movement faulting along the anticlinal fold crests. Single or multiple segment ruptures could produce uplift of approximately one to three meters on the hanging wall block over the anticlinal crest and at least 0.5 meter of bending movement faulting. The nearest active anticline is approximately 0.25-mile to north of the Project site. Though unlikely to occur, were this anticline the focus of three meters of vertical uplift the tilt of the ground surface at the Project site would be less than

one percent and cause no additional damage at the site beyond what would be anticipated as the result of strong ground shaking.

Earthquakes and Ground Motion

Earthquake records in the Santa Barbara area have been kept since the late 1700s, during Mission Period. Since that time, three large earthquakes were recorded: one each in 1812, 1925, and 1978 (Gurrola, 2003). Based on strong shaking and damage records, the 1812 event was likely a magnitude 7.0. The seismic source is unknown. The City of Santa Barbara event on June 26, 1925 produced extensive damage to the downtown and surrounding areas with an estimated Modified Mercalli Intensity (MMI) of VII-IX, indicating a magnitude of M6.3 to 6.8; the source fault has not been identified. In 1978 the Mw 5.9 Santa Barbara earthquake produced local moderate damage in the area of Goleta.⁴ Historic seismicity in the Santa Barbara Fold Belt (SBFB) indicates that most seismic activity is located south of the Santa Ynez Mountains. A seismic map of the probability of seismic shaking for southern California, based on historic seismicity and produced by the Southern California Earthquake Center, suggests that the Santa Barbara/Goleta area can expect 3 to 4 earthquakes per century with shaking that will exceed 0.2 g, which is the level of activity where damage to older buildings begins.

Ground motion values with a 10 percent probability of being exceeded in 50 years at the Project site were obtained from the California Geological Survey (CGS; 2012) interactive website. These values are expressed as a fraction of the acceleration due to gravity (g). Three values of ground motion are provided by CGS and include peak ground acceleration (PGA), spectral acceleration at moderate (0.2 second), and short (0.1 second) periods. Ground motion values are modified to account for local site soil conditions, which in this case is soft rock (site category C as defined by the *2010 California Building Code*). The values for the Project site are provided in **Table 4.5-3**.

Table 4.5-3
Probabilistic Earthquake Site Parameters

Ground Motion (g)	Firm Rock	Soft Rock	Alluvium
Peak Horizontal Ground Acceleration (g)	0.36	0.37	0.41
Spectral Acceleration (0.2 second period)	0.86	0.89	0.97
Spectral Acceleration (0.1 second period)	0.32	0.39	0.48

These values are representative of the ground motion for the surrounding region and are moderate compared to levels in more seismically active parts of the State.

Albus-Keefe & Associates (2010a, 2010b, and 2013) used the 2010 California Building Code (CBC) to compute possible seismic design parameters for the Project site (Site Class D) and determined the Maximum Considered Earthquake (MCE) spectral response acceleration at a 1-

⁴ USGS Final Report, July 2000, Earthquake Hazard of the Santa Barbara Fold Belt, California at <http://www.scec.org/research/98research/98gurrolakeller.pdf>, accessed March 22, 2013.

sec. period (S_1) to be 0.649 g, which is somewhat higher than the value for alluvium, as shown in Table 4.5-3. Considering the possibility that the Project site could include both Site Class D and Class E areas, the Project geologist concluded that the design spectral acceleration at natural periods of 0.08 to 0.38 second for structures less than 4 stories in height would be 1.010g for Site Class E and 1.122g for Site Class D.

Groundwater and Liquefaction

In 2005, Fugro West provided a report on the groundwater elevations beneath the site based on the findings of groundwater observation wells in 2001, 2002, and 2003 in 2005. The observation wells were drilled to a depth of approximately 26 to 30 feet beneath the Project area (MW-1 MW-2, MW-3, MW4, MW-101, -102, and -103). Four of these wells were located in the western portions of Lots 6 and 7. The remaining wells were installed in Lots 2 and 5. MW-3 and MW-4 were located in Lots 7 and 6 respectively. MW-3 was destroyed in 2002, but the groundwater elevations recorded in January and December of 2002 were 11.3 and 11.0 ft. below ground surface (bgs). MW-4 on Lot 6 remained active through the date of the Fugro West report (2005). It recorded groundwater levels ranging from 11.3 (2002) to 13.0 (2005) bgs. The balance of the wells recorded elevations ranging from 13.0 bgs to 16.3 bgs respectively. Subsequent observations by Albus-Keefe & Associates in 2009 found depths to groundwater that varied from 19.6 ft. bgs in the eastern portion of the site to 25.4 feet bgs in the western portion of the site (the site, for purposes of the Albus-Keefe report, being defined as Lots 5 and 2 of Tract 14,500. Lots 6 and 7, located closest to Tecolotito Creek, were not included in the report). The groundwater depths identified by Albus-Keefe are below historic high water levels as indicated by the groundwater monitoring wells previously reported on by Fugro within the same area (MW-101, -102, and -103).

Two of the three elements that have potential to produce liquefaction are present at the Project site: strong earthquake ground shaking and shallow groundwater (CGS, 2008). However, the Pleistocene age of the intermediate-age alluvium, the presence of substantial clay in the formation, and the relatively high blow-counts (sand units classified as dense to very dense) achieved in drilling reported by Fugro West, Inc. (2003) suggest that liquefaction potential is low in the building areas, assuming the removal of liquefiable fill material. Albus-Keefe & Associates concluded that the granular soils below the groundwater elevations at the Project site are dense to very dense and, therefore, the potential for liquefaction at the site is considered to be low to very low with the exception of areas immediately adjacent to existing natural drainages.

4.5.2 Regulatory Framework

State

California Building Codes

In 2010, the California Building Standards Commission (CBSC) adopted the 2009 IBC as amended by the CBSC as the 2010 *California Building Standards Code, California Code of Regulations, Title 24*. The 2010 California Building Standards Code is commonly referred to as the *2010 California Building Code* and became effective January 1, 2011. Development in the State of California is governed by the 2010 California Building Code (CBC; California Building Standards Commission, 2011), as amended and adopted by each local jurisdiction. These

regulations include provisions for site work, demolition, and construction, which include excavation and grading, as well as provisions for foundations, retaining walls and expansive and compressible soils. The State prepared the 2013 updates to all of the California Building Codes, which were approved in July 2013 and will become effective on January 1, 2014. It is anticipated that Project development and construction will be governed by the July 2013 Codes.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Geologic Hazards Zone Act, Public Resources Code §§ 2621, *et seq.*, was enacted by the State of California in 1972 to address the hazard and damage caused by surface fault rupture during an earthquake. The Act has been amended ten times and renamed the *Alquist-Priolo Earthquake Fault Zoning Act*, effective January 1, 1994. The Act, revised in 2007, defines an active fault as one that has had surface displacements within Holocene time.

The *Alquist-Priolo Earthquake Fault Zoning Act* requires the State Geologist to establish “earthquake fault zones” along known active faults in the State. Cities and counties that have earthquake fault zones within their jurisdictional area are required to regulate development projects within these zones.

Seismic Hazards Mapping Act

The *Seismic Hazard Mapping Act of 1990*, Public Resources Code §§ 2690, *et seq.*, was adopted, in part, to address seismic hazards not included in the *Alquist-Priolo Act*, including strong ground shaking, landslides, and liquefaction. Under this Act, the State Geologist is assigned the responsibility of identifying and mapping seismic hazards zones.

The State of California Geologic Survey (CGS) has also adopted seismic design provisions contained in *Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California* on March 13, 1997 and revised and readopted on September 11, 2008. The CGS provides guidance with regard to seismic hazards under *Seismic Hazards Mapping Act* for evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

Local

City of Goleta Building Code

The City’s grading regulations are contained in Goleta Municipal Code (GMC) Chapter 15.09, which regulates new grading, excavations, fills, cuts, borrow pits, stockpiling, and compaction of fill, “... where the transported amount of materials... exceeds 50 cubic yards or the cut or fill exceeds 3 feet in vertical distance to the natural contour of the land.”

City of Goleta General Plan/ Coastal Land Use Plan Safety Element

The City’s GP/CLUP Safety Element includes the following Policies related to geologic and seismic hazards:

SE 1.3 Site Specific Hazards Studies

Applications for new development shall consider exposure of the new development to coastal and other hazards. Where appropriate, an application for new development shall include a

geologic/soils/geotechnical study and any other studies that identify geologic hazards affecting the proposed Project site and any necessary mitigation measures. The study report shall contain a statement certifying that the Project site is suitable for the proposed development and that the development will be safe from geologic hazards. The report shall be prepared and signed by a licensed certified engineering geologist or geotechnical engineer and shall be subject to review and acceptance by the City.

SE 4.1 Information on Faults and Geologic Hazards

The City will maintain up- to-date information on faults and geologic hazards in and offshore of Goleta as provided in source documents from the California Division of Mines and Geology, the U.S. Geological Survey, and other agencies. As new information from geologic studies becomes available, the City shall incorporate this information into its maps and resources pertaining to seismic hazards.

SE 4.2 Potentially Active Faults

Potentially active faults shall be subject to the same requirements as active faults unless and until geological or geotechnical studies demonstrate that a given potentially active fault is not active.

SE 4.3 Geotechnical and Geologic Studies Required

Where appropriate, the City shall require applications for planning entitlements for new or expanded development to address potential geologic and seismic hazards through the preparation of geotechnical and geologic reports for City review and acceptance.

SE 4.4 Setback from Faults New development shall not be located closer than 50 feet to any active or potentially active fault line to reduce potential damage from surface rupture. Nonstructural development may be allowed in such areas, depending on how such nonstructural development would withstand or respond to fault rupture or other seismic damage.

SE 4.5 Adopted of Updated California Building Code Requirements The City shall review, amend, and adopt new California Building Code requirements, when necessary, to promote the use of updated construction standards. The City shall consider and may adopt new optional state revisions for Seismic Hazards.

SE 4.9 Safety Measures for Utilities

For certain utilities, such as gas, oil, sewer, and water pipelines, that are not or cannot be routed to avoid crossing faults, appropriate safety measures (valve shutoffs, leak detection, etc.) shall be required to minimize earthquake-related impacts and promote rapid post-event repair and cleanup.

SE 4.11 Geotechnical Report Required The City shall require geotechnical and/or geologic reports as part of the application for construction of habitable structures and essential services buildings (as defined by the building code) sited in areas having a medium-to-high potential for liquefaction and seismic settlement. The geotechnical study shall evaluate the

potential for liquefaction and/or seismic-related settlement to impact the development, and identify appropriate structural-design parameters to mitigate potential hazards.

SE 5.2 Evaluation of Soil-Related Hazards

The City shall require structural evaluation reports with appropriate mitigation measures to be provided for all new subdivisions, and for discretionary projects proposing new nonresidential buildings or substantial additions. Depending on the conclusions of the structural evaluation report, soil and geological reports may also be required. Such studies shall evaluate the potential for soil expansion, compression, and collapse to impact the development; they shall also identify mitigation to reduce these potential impacts, if needed.

SE 5.6 Streambed Stabilization Projects In stream areas susceptible to slope failure, the City shall pursue and implement streambed stabilization projects. For these projects, stabilization by restoration with native plantings and natural-looking, “soft” stabilization methods shall be preferred over concrete channelization, gabions, riprap, and other “hard” stabilization methods.

4.5.3 Thresholds of Significance

According to the City’s *Environmental Thresholds and Guidelines Manual* (City of Goleta, 2011) a project would result in a potentially significant impact on geological processes if the project, and/or implementation of required mitigation measures, could result in increased erosion, landslides, soil creep, mudslides, and/or unstable slopes. In addition, impacts are considered significant if a project would expose people and/or structures to major geological hazards such as strong seismic shaking, seismic related ground failure (including liquefaction), or expansive soils capable of creating a significant risk to life and property.

The City of Goleta’s *Environmental Thresholds and Guidelines Manual* includes Geologic Constraints Guidelines approved in August 1993 by the Santa Barbara County Board of Supervisors and revised through 2002.

The City of Goleta’s *Environmental Thresholds and Guidelines Manual* provides that impacts related to geology have the potential to be significant if the Project involves any of the following characteristics:

- a. The project site or any part of the project is located on land having substantial geologic constraints, as determined by the City of Goleta. Areas constrained by geology include parcels located near active or potentially active faults and property underlain by rock types associated with compressible/collapsible soils or susceptible to landslides or severe erosion.
- b. The project results in potentially hazardous geologic conditions such as the construction of cut slopes exceeding a grade of 1.5 horizontal to 1 vertical.
- c. The project proposes construction of a cut slope over 15-feet in height as measured from the lowest finished grade.
- d. The project is located on slopes exceeding 20 percent grade.

Mitigation measures may reduce impacts to a less than significant level. These measures could include project redesign and engineering recommended by licensed geologists and engineers subsequent to detailed investigation of the site required during or immediately preceding the Project's grading plan check.

Based on Appendix G of the CEQA Guidelines, the Project would result in a potentially significant impact relating to geologic resources if the Project, and/or implementation of recommended mitigation measures, would result in exposure of people or structures to potential substantial adverse effects, including risk of loss, injury, or death involving the following:

- a. Rupture of a known earthquake fault, as delineated on the most recent *Alquist-Priolo Earthquake Fault Zoning Map* issued by the State Geologist for the area based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42);
- b. Strong seismic ground shaking;
- c. Seismic-related ground failure, including liquefaction;
- d. Substantial soil erosion or the loss of topsoil; or
- e. 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.

4.5.4 Project Impacts

Implementation of the residential Village at Los Carneros Project component would involve mass grading of its site, construction of drainage control and water quality treatment structures, trenching for drainage and wet utilities with appropriate bedding and backfill, installation of dry utilities in a common trench, over-excavation, recompaction, and the installation of paving sections for roads, in addition to the construction of one- to three-story buildings on engineered pads.

For purposes of this analysis it is assumed that geologic, seismic, and soil conditions raising environmental issues that would be adequately mitigated through compliance with the standard geotechnical study/review process required by the ~~Goleta Municipal Code (GMC, adopted California Building Code (CBC), as adopted by the Goleta Municipal Code (GMC)~~, and compliance with applicable existing government regulations, including recommendations made by the Project's geotechnical engineer in its ultimately approved geotechnical studies, are identified as having less than significant impacts. If resolution of identified geotechnical, soils, and/or seismic issues require addition comprehensive study and/or assessment and would require mitigation over and above the requirements of the CBC, then these impacts would be considered potentially significant and mitigation measures, if available, would be proposed. **Table 4.5-4** summarizes the types of geologic conditions and potential hazards present at the Project site.

Table 4.5-4
Summary of Project Site Geology/Seismic/Soil Conditions and Potential Hazards

Geologic/Seismic/Soil Conditions and Potential Hazards	Project Site	Geologic/Seismic/Soil Conditions and Potential Hazards	Project Site
A. Geology Units (with Map Symbol Figure 4.5-1)		C. Liquefaction Hazards	
af–Artificial fill	Yes	Within a defined liquefiable area or has soils potentially subject to liquefaction.	Yes
Qia–Marine Terrace deposits (upper Pleistocene)	Yes	Within a defined potential liquefiable area	Yes (Partial)
B. Fault and Earthquake Shaking Hazards (Figures 4.5-1, -2, and -3)		Historically highest groundwater depth range (in feet)	~11 to 26
Within an Alquist-Priolo Earthquake Fault Zone	No	Within or near past liquefaction areas per County or other sources	Yes
One or more faults are within the Project site	No	Lateral spread landslide conditions	Potential
Fault is active (A), or potentially active (PA), not active (NA)	NA	D. Landslide Hazards	
Potentially tectonic/Co-seismic deformation	No	Past landslides (except lateral spread) in the area	No
One or more nearby faults project toward Project site	No	Within a defined hillside area	No
Within a fault rupture study area	No	E. Oil and Gas Related Hazards	No
Estimated 10% in 50 years Peak Ground Acceleration (g)	0.41	Within a State-designated major drilling area or oil field	No
		Known abandoned wells	No

Surface Fault Rupture and Co-Seismic Uplift

Impact Geo 1: Would the Project be developed in the vicinity of potentially active faults and folds that could result in (1) surface fault rupture on the site or (2) surface uplift?

Significance Before Mitigation: Less than Significant

No active or potentially active faults have been identified on the Project site. The nearest known active fault identified within an Alquist-Priolo zone is the North More Ranch fault, located approximately 4,600 feet to the south of the Project site. Surface rupture on the North More Ranch fault would not be expected to result in surface rupture on the Project site. Potential impacts associated with fault rupture are, therefore, considered less than significant (**Class III**).

Potential active fold structures have been identified north and south of the site. A structure 1,280-feet north of the site could, under the most serious earthquake event projected for the Goleta area, cause one to three meters of uplift just over the crest of the fault anticline. Given the fold's distance from the Project site, the Project's geotechnical engineering study determined that ground tilt would be less than one degree at the Project, resulting in no greater

damage than would be caused by strong ground shaking alone. With implementation of seismic building codes designed to reduce this type of impact, the effect of co-seismic uplift at the Project site would be considered less than significant (**Class III**).

Seismic Ground Shaking

Impact Geo 2: Would the Project site be subject to strong seismic ground shaking?

Significance Before Mitigation: Less Than Significant

In common with the rest of southern California, the Project site is located in a seismically active region that is periodically subject to earthquakes that cause strong ground shaking that would affect the Project site. A potentially active fault is located approximately 4,600 feet south of the site and is capable of generating a moderate to large earthquake resulting in strong ground shaking at the site. The performance of residential structures during earthquake shaking is addressed, and the acceptable level of risk is inherently defined, by California Building Code requirements.

Project construction must comply with the seismic safety standards of the most current CBC adopted by the GMC. The geotechnical reports prepared for the Village at Los Carneros site state that the Project site area can feasibly support the proposed development. Preliminary seismic design recommendations are set forth in these reports.

A more detailed geotechnical investigation report may be required to specifically address the potential impacts of the proposed location of the most westerly subsurface detention/water quality basin as recommended in the 2013 Albus-Keefe Geotechnical Engineering Report Update and in the Penfield Smith Hydrology Study (2010). However, the City's Public Works Department has not yet requested any additional geotechnical studies. If required by the City in the course of plan check, before it issues grading permits, the Applicant's geotechnical engineer will conduct such studies and provide them to the City for review and approval. Compliance with the City's existing building codes and policies would ensure that the Village at Los Carneros would be appropriately engineered to protect its structures from collapse in the event of strong seismic ground shaking, and would protect structures, infrastructure, and people from substantial risk of injury involving rupture of a known earthquake fault, to the extent feasible. With enforcement of existing regulatory requirements, impacts from a fault rupture or from strong seismic ground shaking would be considered less than significant (**Class III**).

Soils and Slope Stability

Impact Geo 3: Would development within the Project site be subject to erosion, and slope stability impacts?

Significance Before Mitigation: Potentially Significant

Residential Development Area Slopes and Open Space:

In general, construction projects have the potential to increase short-term erosion and sedimentation in nearby watercourses due to construction activities that disturb soil and make it

more susceptible to erosion. These construction-induced erosion impacts are generally temporary and mitigation of such impacts as they pertain to surface water quality is discussed in Section 4.7 Hydrology and Water Quality.

To stabilize the slope along the *north edge* of the Project site, the Project would re-grade the area uniformly and construct a 2:1 engineered slope with proper compaction, support, and drainage. As required by the recommendations contained in the geotechnical reports prepared for the Village at Los Carneros, a retaining wall would be installed along the length of the north slope to provide proper support, drains would be installed to protect the slope from subsurface saturation that might weaken it, and the slope would be landscaped subsequent to construction to control erosion. The newly constructed slopes would be protected by hydro-mulching and/or straw blankets (based on the season and projected amount of precipitation) during the construction phase before the installation of landscaping. According to the current grading plan, the existing toe of the slope would be cut back, supported by a retaining wall, and the ground south of the retaining wall would be flattened to accommodate planned Village at Los Carneros improvements such as driveways and structures constructed along the site's northern boundary. Retaining wall height would range from approximately 1.0 to 6.5-feet, depending on the depth of cut needed to accommodate these improvements and the height of the slope. The Project's grading plans, including engineering for the retaining walls, have been submitted to and are being reviewed by the City's Engineering Division in advance of entitlements and will be revised pursuant to comments received from the City before the issuance of grading permits. The Project's landscape and irrigation plans would be submitted to and reviewed by the City's Department of Building and Safety and the Department of Planning and Environmental Review to ensure that the proposed landscape improvements meet the City's regulatory criteria. Subsequent to construction, the northern slopes would be maintained by the Applicant, or its successor in interest, for a period of five years pursuant to a maintenance agreement with the City. After the first five years, maintenance responsibility would transfer fully to the Village at Los Carneros Homeowner's or ~~Property Owner's~~ Association.

The engineered fill slope to the east, along Los Carneros Road, was constructed by Caltrans, and meets Caltrans criteria for adequate drainage, vegetation, and erosion control measures. Structures along the northeast slope would be setback from the toe of the existing slope and buffered by parking and driveway areas. A retaining wall would be constructed at the toe of the slope to ensure slope stability, and landscape would be supplemented as needed to prevent wash-off erosion into the adjacent parking area. The additional landscaping would include trees intended to provide screening for residents of buildings adjacent to the slope. A concrete swale would be constructed behind the retaining wall to carry runoff from the slope and direct it southerly into the Project's storm drain system. If the slope is located within Caltrans right-of-way, the proposed slope improvements, including landscape and drainage, would require review and approval by both the City and Caltrans before the issuance of permits, including Caltrans encroachment permits, for the slope work.

Landscaping of open space areas, including groundcover, shrubs, and trees, would be installed to reduce the potential for erosion of topsoil throughout the site subsequent to grading and construction of homes. During the construction phase, Best Management Practices (BMPs) would be used pursuant to the Project's approved Storm Water Pollution Protection Plan (SWPPP) to reduce the potential for construction phase erosion. These measures are discussed in detail in Section 4.8, *Hydrology*. Section 4.1, *Aesthetics*, includes Mitigation

Measure AES 3-1, 3-2, 3-7, and 3-8, which provide for landscaping and long-term maintenance of the Village's landscaping and grounds. Section 4.8 *Hydrology and Water Quality* provides additional discussion and mitigation for the effects of erosion during construction and long-term operations. Compliance with the Mitigation Measures specified in these EIR sections and compliance with the City's low impact development (LID) standards, landscape standards and slope stability standards, would reduce impacts related to slope stability and potential erosion to a less than significant level during both the construction and operational phases of the Project (**Class II**).

Scour and Erosion of Span Bridge (Potentially Significant):

Construction of the Tecolotito Creek Bridge foundations has the potential to destabilize creek banks. Section 4.8, *Hydrology and Water Quality*, notes that ~~the SBCFCWCD would not~~, under most circumstances, the City would not allow the construction of bridge supports within the creek bed or on the creek banks based on current standards. Construction of bridge pilings and foundations outside of the creek and bank area, but within the 100-year flood plain, may or may not be allowed by the City District. If permitted, these structures would require adequate protection by wing walls and/or hardening to prevent undercutting by high velocity flows in flood conditions. However, Mitigation Measures in Section 4.3, Biological Resources, prohibit the construction of bridge foundations and pilings within or in proximity to the creek or creek bank and recommend their location close to the edge of the 100-year flood plain boundary in order to protect the creek's habitat and the surrounding SPA. While plans for the bridge have not yet been approved, bridge design will be subject to these requirements and constraints. Slope erosion impacts resulting from the construction of the Tecolotito Creek bridge are considered mitigated by avoidance of the creek banks pursuant to current regulations and proposed Mitigation Measures in Section 4.3 and would be reduced to a less than significant level (**Class II**).

Impact Geo 4: Would the geologic and geotechnical characteristics associated with surficial geologic units present at the Project site adversely affect the development due to expansive soils.

Significance Before Mitigation: ~~Less Than Significant~~ Potentially Significant

Based on the geotechnical reports cited in "Existing Conditions" potentially unstable artificial fill and Qia/Qoul alluvium soils would be encountered during grading, trenching, and other excavation activities undertaken in the course of the construction process in the primary building areas of the Village at Los Carneros site. Both Qia and Qoul units are clay-rich and have layers of sand, silty sand, and cobble-rich horizons. Clay-rich areas within the natural deposits will have moderate to very high expansion potential. Mitigation for expansive soils requires specific engineering solutions such as the installation of post-tension foundations and the over excavation and recompaction of native soils mixed with less expansive materials in constructing the engineered pad that will support structures. Current building codes require preparation of building-specific geotechnical/foundation reports and the provision of foundation specification by the Project's structural engineer where expansive soils are present before the issuance of grading and building permits.

For purposes of this analysis a “worst case” assumption is made that soils are moderate to highly expansive throughout the site and that foundations systems for buildings shall be designed and constructed in a manner that will minimize damage to the structure from movement of the soil, as provided in mitigation GEO 6-1. All foundations must be founded on firm and unyielding engineered fill compacted to a minimum of 90 percent. Removal of uncertified fill and replacement with more competent materials is a standard requirement of the City’s Grading Code. Compliance with all regulatory requirements and recommendations contained in the site-specific geotechnical reports and sound structural designs that meet current regulatory standards will ensure that impacts associated with expansive surficial geologic units would be less than significant (**Class II**).

Groundwater and Liquefaction

Impact Geo 5: Would the Project be adversely affected by shallow and/or perched groundwater and the potential for soil liquefaction and/or lateral spreading?

Significance Before Mitigation: Potentially Significant

Liquefaction and Lateral Spreading

The west side of the Village at Los Carneros Project area includes areas that may be subject to impacts created by perching groundwater and liquefaction.⁵ These areas include all of Lot 7, inclusive of Tecolotito Creek, its unnamed tributary, and the area between and adjacent to these two drainages. Similar conditions impact portions of Lot 6, particularly areas in close proximity to Tecolotito Creek within the 100-year flood plain. No structures are planned within the most vulnerable Lot 6 and 7 areas. Residential buildings would approach the boundaries of the liquefaction and flood-prone areas but would remain outside of the 100-year flood plain, where ground water is shallow and soils may be liquefiable. There is no indication, based on borings to date, that liquefiable soils underlay any of the proposed building pads. One definitively identified liquefaction-prone area at the southwest corner of the property near Los Carneros Road is avoided and no structures are proposed in that location.

A potential secondary impact of liquefaction is lateral spreading. The term refers to landslides that form on gentle slopes of .03 to 5 percent that are underlain by loose sands and a shallow water table and has rapid, fluid-like movement, similar to water. Liquefaction-induced lateral spreading occurs as the result of seismic ground shaking that results in the liquefaction of a subsurface layer. The geologic conditions that are conducive to lateral spreading are frequently found along streams in recent alluvial deposits. With horizontal displacements that range up to several yards in length, constructed facilities of all kinds within an area susceptible to lateral spreading are vulnerable to heavy damage.⁶ Structures at the head of the slide sometimes pull apart, while those at the toe are subject to buckling or compression.

⁵ Groundwater and Liquefaction, Santa Barbara County GIS, City of Goleta Annex to Santa Barbara County 2011 Multi-Hazard Mitigation Plan, City of Goleta Critical Facilities and Groundwater and Liquefaction Severity Figure.

⁶ Rauch, Alan F., Liquefaction Induced Lateral Spreading.

Linear infrastructure, such as utilities and transportation facilities, is particularly susceptible to damage in earthquakes due to lateral spreading. Damage can include the failure of bridge piers and abutments and pipelines. Requirements that bridge piers supporting the Tecolotito Creek bridge be located well away from the creek bank and as close to the outward edge of the 100-year flood plain as feasible ~~Because of~~ reduce the potential for liquefaction-induced lateral spreading along Tecolotito Creek, avoiding damage to the bridge piers supporting the Tecolotito Creek bridge and associated infrastructure. ~~will be located outside of the area that is potentially susceptible to this effect.~~ Before the approval of the Tecolotito Creek bridge both the City of Goleta Public Works Department and the SBCFCWCA will require geotechnical and seismic reports for the locations proposed for bridge foundations. ~~Since the SBCFCWCD will not permit bridge foundations within the creekbed or on its banks,~~ The issue to be resolved is the actual area beyond the creek bank that might be susceptible to liquefaction and lateral spreading. With completion of site-specific studies required by both Code and policy to determine the location of any soils that may be subject to lateral spreading the bridge design would avoid locating abutments in susceptible areas and potentially significant impacts associated with liquefaction and lateral spreading would be reduced to a less than significant level (**Class II**)

Groundwater

Shallow groundwater can affect floors, walls and foundations. Effects may include nuisance moisture, seepage causing ponded water, and structural impacts to foundations. At the Village at Los Carneros site, groundwater depths are as shallow as 13.6 feet bgs and historic levels may be several feet closer to the surface. The two subsurface infiltration basins (Preliminary Drainage Plan, Penfield & Smith, 2011) are proposed to mitigate post-construction stormwater runoff volumes. The basins will be designed to allow infiltration of retained storm flows and nuisance flows into the soil under the basins at a rate of approximately 4.25 inches per hour. In its 2013 report, Albus-Keefe commented that the location of the most westerly of these basins, in an area with historically higher groundwater, may lead to increased groundwater elevations (shallower depths) in areas immediately below, adjacent and down-gradient from the basin area, and increasing liquefaction potential in young alluvial materials in the western portion of the site. The same finding is contained in the above reference Penfield Smith Preliminary Hydrology Report. Finished floors of subterranean parking for the podium flats building immediately down gradient from the basin location are planned at approximately eight to 14 feet bgs based on current elevations, and could be adversely affected.

Albus-Keefe has recommended preparation of an additional geotechnical study to determine the potential impacts, if any, of storm water infiltration from the most westerly retention basin before its approval.

Various design measures are available to minimize liquefaction effects, to demonstrate adequate separation between groundwater levels, and to deal with the potential effects of down-gradient percolation and higher groundwater on subterranean parking structures and building foundations. Such design measures may include deep pile foundations, water-proofing, use of gravel base material, subdrains, or sump-pumps to remove water from beneath the parking garages or other important structures, or the relocation of subsurface detention basins. Albus-Keefe & Associates (2013) indicated that, assuming surface flow into future infiltration basins results in locally elevated groundwater profiles, the potential for liquefaction in the western portion of the Project site would need to be addressed in the final grading, hydrology, and

building design and geotechnical reports and engineering mitigation measures may be required in order to reduce impacts related to high groundwater on drainage facilities, utilities and foundations in susceptible areas to a less than significant level. Pending completion of those studies, groundwater impacts in the southwest portion of the site remain potentially significant (**Class II**), though mitigable. Other areas of the site do not appear to be affected by groundwater elevations or liquefiable soils (**Class III**).

Subsidence

Impact Geo 6: Would the Project site be adversely impacted by subsidence?

Significance Before Mitigation: Less than Significant

The Project site is not located within an area of oil or gas development where subsidence can often occur. Groundwater pumping has not produced documented ground surface subsidence in the site vicinity.

Groundwater monitoring wells were installed at the site for the purpose of determining whether subterranean parking was feasible. The results of the findings from the monitoring wells were incorporated into the design of the Village of Los Carneros. According to the 2005 report from Fugro West, four observation wells were installed on Lots 6 and 7 in 2001 and three additional wells were installed on Lot 5 in 2003. The wells were not installed for the purpose of production and therefore would not be responsible for the withdrawal of groundwater that could result in onsite subsidence. While the site does overlay a groundwater basin, the area is non-producing and is used primarily for recharge (see Hydrology section). For these reasons, subsidence would be unlikely to occur and is considered a less than significant impact (**Class III**).

4.5.5 Cumulative Impacts

Significance Before Mitigation: Less Than Significant

Geologic impacts are generally Project-specific in nature, as they involve the land upon which the Project would be located and potentially Project-specific impacts upon its immediate surroundings. Impacts associated with the Project do not affect off-site areas where projects identified in Section 3.0 *Related Projects* or other growth is located. However, cumulative growth within the City increases the overall potential for increased exposure of people to seismic hazards, while biological resources would be potentially more susceptible to the effects of erosion and sedimentation. Also, there is the potential that the Project's subterranean detention basin(s) could result in down-gradient groundwater perching that could impact structures to the south, though not necessarily offsite.

Certain aspects of the Project would have a beneficial effect on erosion and sedimentation. The application of slope stability and erosion control measures along the north property line slope, and additional vegetation both within and adjacent to the Tecolotito Creek, its associated riparian corridor SPA, and the corridor of its unnamed tributary, would reduce the effects of sedimentation on the creek and downstream areas as compared to the existing condition.

Cumulative projects would be subject to established regulations, ordinances and building codes related to seismic safety and erosion control. Compliance with these regulations, ordinances

and building codes would be assured by the City's plan check and permitting process ~~as well as the plan check and permitting process of the SBCFCWCD~~. Based on that compliance, the Project would not make a ~~cumulatively~~ considerable contribution to any cumulative impact associated with geology and seismicity (**Class III**).

4.5.6 Mitigation Measures

Nearly all potential impacts associated with geological and seismic effects are addressed in the City's Building Code and in the ~~Codes followed by the Santa Barbara County Flood Control and Water Conservation District and Water Agency~~. The building code requires the preparation of detailed geotechnical studies sufficient to support engineering design for utility trenches, structural pads, grading and support for slopes and the placement of infrastructure and structures. The applicable Codes also require adherence to all recommendations contained in these reports. Regulatory requirements are not considered mitigation measures under CEQA.

See also Section 4.7, Hydrology and Water Quality, for potential erosion and sedimentation cumulative impacts.

Impact Geo 4: The Project could be adversely affected by expansive soils.

GEO 4-1: Foundation systems for buildings on expansive soils must be designed and constructed in a manner that will minimize damage to the structure from movement of the soils. The following mitigation measures, in whole or in part, would reduce effects to a less than significant level:

- a. Depth of footings below the natural and finish grades cannot be less than 24 inches for exterior and 18 inches for interior footings.
- b. Exterior walls and interior bearing walls must be supported on continuous footings.
- c. Footings must be reinforced with at least four 1/2-inch-diameter deformed reinforcing bars. Two bars must be placed within 4 inches of the bottom of the footings and two bars within 4 inches of the top of the footing with a minimum concrete cover per ACI 318, Section 7.7.1.
- d. On-grade concrete floor slabs shall be placed on a 4-inch fill of coarse aggregate or on a 2-inch sand bed over a moisture barrier membrane. The slabs must be at least 3 1/2 inches thick and shall be reinforced with 1/2-inch-diameter deformed reinforcing bars. Reinforcing bars must be spaced at intervals not exceeding 16 inches each way.
- e. The soil below an interior concrete slab must be pre-saturated to a depth of 18 inches before placing the concrete.
- f. All drainage adjacent to footings must be conducted away from the structure by a 3-foot-wide sloped apron draining into an approved non-erosive device.
- g. Slab-on-ground foundations such as a post-tensioned mat or raft will require a soils report and shall be designed to City Code standards.

Plan Requirements and Timing: ~~Before grading,~~ Before the City issues building permits the Permittee must submit a foundation plan for each lot, prepared by a licensed civil or geotechnical engineer and structural engineer. All foundation design must be approved by the Building and Safety Director, or designee, based on verified conformance with the recommendations contained in the soils report prepared for that location.

Monitoring: Grading/building inspectors must perform site inspections to ensure that foundations are constructed in accordance with approved plans and permits before the City issues permits for framing

Impact Geo 5: The Project be adversely affected by shallow and/or perched groundwater and the potential for soil liquefaction and/or lateral spreading.

GEO 5-1: ~~The applicant~~ Permittee must provide verification that all groundwater monitoring wells on the site, including those previously taken out of service, were properly decommissioned and capped according to standards developed by the State Department of Water Resources pursuant to Water Code § 13800 and adopted by the local agency in accordance with Water Code § 13801. The wells must be filled and capped to ensure that the abandoned wells do not pose a hazard to persons or provide a path for entry of hazardous substances into the ground or ground water. A permit for abandonment and capping shall be obtained from the City of Goleta or from the appropriate Regional Water Quality Control Board and a copy provided to the City if the work has already been completed.

Plan Requirements and Timing: Before grading, the Permittee must submit a work plan for the filling and capping of the groundwater monitoring wells, prepared by a licensed civil or geotechnical engineer. All well decommissioning will be conducted in accordance with State of California Department of Water Resources (DWR) standards (if applicable) and with conditions associated with a monitoring well destruction permit to be issued by the City of Goleta.

Monitoring: Grading/building inspectors must perform site inspections to ensure deconstruction occurs in accordance with approved plans and permits before the City issues any grading permit for the site.

Impact Geo 6: ~~The Project site would be adversely impacted by subsidence.~~

~~**GEO 6-1** Foundation systems for buildings on expansive soils must be designed and constructed in a manner that will minimize damage to the structure from movement of the soils. The following mitigation measures, in whole or in part, would reduce effects to a less than significant level:~~

- ~~h. Depth of footings below the natural and finish grades cannot be less than 24 inches for exterior and 18 inches for interior footings.~~
- ~~i. Exterior walls and interior bearing walls must be supported on continuous footings.~~
- ~~j. Footings must be reinforced with at least four 1/2 inch diameter deformed~~

reinforcing bars. Two bars must be placed within 4 inches of the bottom of the footings and two bars within 4 inches of the top of the footing with a minimum concrete cover per ACI 318, Section 7.7.1.

- ~~k. On grade concrete floor slabs shall be placed on a 4 inch fill of coarse aggregate or on a 2 inch sand bed over a moisture barrier membrane. The slabs must be at least 3 1/2 inches thick and shall be reinforced with 1/2 inch diameter deformed reinforcing bars. Reinforcing bars must be spaced at intervals not exceeding 16 inches each way.~~
- ~~l. The soil below an interior concrete slab must be pre-saturated to a depth of 18 inches before placing the concrete.~~
- ~~m. All drainage adjacent to footings must be conducted away from the structure by a 3 foot wide sloped apron draining into an approved non-erosive device.~~
- ~~n. Slab on ground foundations such as a post tensioned mat or raft will require a soils report and shall be designed to City Code standards.~~

~~**Plan Requirements and Timing:** Before grading, Prior to the issuance of building permits the Permittee must submit a foundation plan for each lot, prepared by a licensed civil or geotechnical engineer and structural engineer. All foundation design must be approved by the Building and Safety Director, or designee, based on verified conformance with the recommendations contained in the soils report prepared for that location.~~

~~**Monitoring:** Grading/building inspectors must perform site inspections to ensure that foundations are constructed in accordance with approved plans and permits before the City issues permits for framing.~~

4.5.7 Residual Impacts

Residual geological impacts related to fault rupture, seismic shaking, slope stability, surficial geologic units, and subsidence are less than significant less than significant (**Class III**).

Residual impacts related to liquefaction, high groundwater and lateral spreading as they pertain to the construction of the Tecolotito Creek bridge would be reduced to a less than significant level through the implementation of recommendation contained in a geotechnical study to be prepared by the applicant and approved by the ~~City Department of Public Works~~ Director, or designee, and the ~~Santa Barbara County Flood Control and Water Conservation District and Water Agency~~ before approval of plans and issuance of permit. Until those studies are completed and plans are approved pursuant to their recommendations, impacts remain potentially significant but are expected to be mitigated (**Class II**).

An additional study of the potential impacts of percolation of storm flows into the ground below the most westerly basin is recommended by the 2013 Albus-Keefe Geotechnical Engineering Report and the 2010 Penfield Smith Preliminary Hydrology Report. Until that study is completed and potential effects are known and mitigated to the satisfaction of the City Engineer, potential impacts associated with the effects of storm water percolation on groundwater elevation and associated potential liquefaction or other effects would remain potentially significant but are

expected to be mitigated by application of existing Code requirements, engineering, or if necessary, the relocation of the basin (**Class II**).