

3.2 LAND RESOURCES

This section describes existing land resource conditions for the Wilfred site, the Stony Point site and the Lakeville site. Issues appearing in this section include geological setting, topography, soil and soil conditions, seismic considerations and mineral resources. The following provides a general discussion and site-specific analyses of these issues. The geotechnical studies supporting the data below appear in **Appendix F**. The Wilfred site and the Stony Point Site are differentiated from each other by boundary configurations and total acreages. They do, however, share the same general location, and as such their boundaries have considerable overlap as discussed in **Section 1.0**. Therefore, they are substantially similar in soils, geomorphology and regional seismic considerations.

3.2.1 GENERAL ISSUES

The Wilfred site, Stony Point site and the Lakeville site lie within Sonoma County, which is situated in the Coast Ranges Geomorphic Province (**Figures 3.2-1, 3.2-2**). This province is characterized by a trend of northwest-southeast longitudinal mountain ranges and valleys influenced by faulting, folding, and other tectonic forces. Seismic hazards specific to the project alternatives are identified along with project impacts in **Section 4.2**.

SONOMA COUNTY SOIL SURVEY

The Natural Resource Conservation Service, or NRCS (formerly the Soil Conservation Service [SCS]) published a soils survey for the Sonoma area in 1972. The survey maps soil units, and provides a summary of major physical characteristics for each unit, with management recommendations. General data on Capability Classes is presented immediately below. Soil characteristics specific to the Wilfred site, the Stony Point site and the Lakeville site are presented in the following sections.

In the Land Capability Classification System used by the NRCS, soils are grouped according to Soils Capability Class. A Soils Capability Class indicates limitations for practical use for food, fiber, or forage production. Classes are designated by Roman numerals I through VIII, with additional coding by subclass indicated by lower case letters. Class I is the least restricted with Class VIII being severely limited and nearly precluded from use for commercial crop production. Prime soils are those located on land which has a combination of physical and chemical characteristics best suited to produce forage, feed, food, and other crops. Soils Capability Class I and II typically form prime crop and pasture land, which under provisions of the Farmland Protection Policy Act of 1980, must be evaluated in implementation of NEPA for potential environmental effects if they are to be used for non-agricultural development.

Figure 3.2-1, West Coast Geomorphic Provinces

Figure 3.2-2, West Coast Geomorphic Provinces - Topography

The Land Capability Classification System reflects a degree of limitation on soils for the suitability of most kinds of field crops. The soils in one capability unit are enough alike to require similar management. Adding a small letter to the Capability Class designation designates the restrictions in the soil groups.

SEISMIC CONSIDERATIONS

Seismic Intensity: the Modified Mercalli Intensity Scale

The Modified Mercalli Intensity (MMI) scale (**Table 3.2-1**) is a common measure of earthquake effects due to ground shaking intensity. The MMI values for intensity range from I (earthquake not felt) to XII (damage nearly total), and intensities ranging from IV to X could cause moderate to significant structural damage. The damage level represents the estimated overall level of damage that will occur for various MMI intensity levels. The damage, however, will not be uniform. Some buildings will experience substantially more damage than this overall level, and others will experience substantially less damage. Not all buildings perform identically in an earthquake. The age, material, type, method of construction, size, and shape of a building all affect its performance (ABAG, 1998). In addition, the physical characteristics of the soil and or rock that a structure rests upon have a major influence on the damage that may result from ground shaking. Maximum peak ground acceleration intensities at the Wilfred site, the Stony Point site and the Lakeville site are expected to cause between MMI VIII and IX ground shaking. Site-specific ground acceleration analyses are presented in **Section 3.2.2**, **Section 3.2.3** and **Section 3.2.4** below.

Magnitude

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Earthquakes with magnitude of about 2.0 or less are usually called microearthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or greater are strong enough to be recorded by sensitive seismographs all

over the world. Great earthquakes, such as the 1964 Good Friday earthquake in Alaska, have magnitudes of 8.0 or higher. The Richter scale is not used to express damage.

TABLE 3.2-1
MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description	Average Peak Acceleration
I.	Not felt except by a very few persons under especially favorable circumstances.	< 0.0015 g ^a
II.	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	< 0.0015 g
III.	Felt quite noticeably indoors, especially on upper floors of buildings, but many persons do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to a passing of a truck. Duration estimated.	< 0.0015 g
IV.	During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.	0.015 g-0.02 g
V.	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.	0.03 g-0.04 g
VI.	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.	0.06 g-0.07 g
VII.	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.	0.10 g-0.15 g
VIII.	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.	0.25 g-0.30 g
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.50 g-0.55 g
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	> 0.60 g
XI.	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	> 0.60 g
XII.	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	> 0.60 g

NOTE: ^a g is gravity = 980 centimeters per second squared.

SOURCE: Bolt, Bruce A., 1988

Liquefaction

Soil liquefaction can occur during ground shaking in soils under structures saturated with high groundwater. Liquefaction is a temporary condition wherein saturated granular soils near the

ground surface experience a substantial loss of strength between grains during a seismic event. Liquefaction transforms the soil condition to a liquefied state as a result of increased soil pore water pressure. Soil pore water pressure is the water pressure between soil particles. Liquefaction can occur if three factors are present: seismic activity, loose sand or silt, and shallow ground water. Liquefaction potential has been found to be greatest where the ground water is within a depth of 50 feet or less, and submerged loose, fine sands occur within that depth. The potential for liquefaction is diminished by the presence of soils that have larger grain sizes, higher clay content (i.e. provides more cohesion between soil grains), and the presence of gravel. Site-specific liquefaction analyses appear in **Section 3.2.2**, **Section 3.2.3** and **Section 3.2.4** below.

Lateral Spreading

Lateral spreading typically occurs during a seismic event in the form of horizontal ground displacement, and is typical where the ground surface is relatively flat, and comprised of alluvium or depositional sediment. This movement in soils is generally due to failure along a weak sublayer that is formed within an underlying liquefied layer. Cracks develop within the weakened material, while blocks of soil move laterally toward the free face. Site-specific analyses on lateral spreading appear in **Section 3.2.2**, **Section 3.2.3** and **Section 3.2.4** below.

MINERAL RESOURCES

Regional Late Mesozoic eugeosynclinal rocks of the Franciscan Formation, Late Mesozoic shelf and slope sedimentary rocks, Cenozoic marine sedimentary rocks, Cenozoic nonmarine sedimentary rocks and alluvial deposits, Cenozoic volcanic rocks, granitic rocks chiefly of Mesozoic age, and ultramafic rocks chiefly of Mesozoic age characterize the rock types with their associated mineral assemblages which are common in Sonoma County (USGS, 1966). The rock types described here support regional operations of limited mining facilities for the production of granitic and sandstone gravel. No mining activity has been reported on or in the vicinity of the Wilfred site, the Stony Point site or the Lakeville site.

3.2.2 WILFRED SITE

The Wilfred Site is situated within the Santa Rosa Plain, also known as the Cotati Valley, which is bounded by the Sonoma Mountains and Mayacama Mountains to the east, and the Mendocino Range to the west. The geomorphology of surface features in the Cotati Valley is characterized by fluvial and alluvial deposits, as well as basin sediment.

TOPOGRAPHY

With the exception of depressed drainage channels for flood control, the Wilfred site is generally flat and level. The major drainage depressions occur at the Bellevue-Wilfred Channel and the Laguna de Santa Rosa (**Figure 3.2-3**). The former traverses the larger, western portion of the

Wilfred site in a northeasterly direction, while the latter forms a portion of the southern boundary of the same portion. Both channels intersect at the southwest corner of the Wilfred site.

SOILS

The Wilfred site is comprised of areas consisting of three soil classifications (**Table 3.2-2** and **Figure 3.2-4**). The majority of the site is classified as Clear Lake clay (CeA), with portions classified as Wright loam, shallow, wet (WoA), and a small portion of Wright loam, wet (WhA).

TABLE 3.2-2
PROJECT SOIL LIMITATIONS - WILFRED SITE

SOILS	FACTOR						
	Depth	Permeability	Drainage	Erosion	Shrink/Swell	Runoff	Capability Class ^a
Clear Lake Clay (CeA) 0-2% slope	72 Inches	Low	Drained	Slight	Low to moderate	Slow	IIs-5
Wright Loam, wet (WhA) 0-2% slope	70 Inches	Very low	Moderately poor	None to slight	Moderate to high	Very slow	IIIw-3
Wright Loam, shallow, wet (WoA) 0-2% slope	20 Inches	Very low	Moderately poor	None to slight	Moderate to high	Very slow	IVw-3

NOTE: ^a Capability Class: Class I soils have few limitations that restrict their use; Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices; Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both; Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both; Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use; Class VI soils have severe limitations that make them generally unsuitable for cultivation; Class VII soils have very severe limitations that make them unsuitable for cultivation. Capability subclasses: (e) erosion, (s) shallow, (d) droughty or rocky, (w) water interferes with plant growth. Subclasses: (3) limitation from slow or very slow permeability of subsoil or substratum, (5) limitation from fine or very fine surface soil.

SOURCE: NRCS, 1972.

The Clear Lake series generally consists of clays, formed under conditions of poor drainage. Beneath the upper layers are usually alluvial strata comprised of basic and sedimentary rock. The Clear Lake series is often found on plains and in flat basins. Acidity for this series ranges from neutral to strongly acidic. Clays in the Clear Lake series are characterized by slow permeability and runoff, and a slight erosion hazard. The Capability Class assigned by the NRCS to this soil is IIs-5, indicating a sum of limitations requiring moderate conservation, soil limitations due to being shallow, droughty, saline or stony, and limitations resulting from a fine-textured stature.

Figure 3.2-3, Wilfred Site Topography

Figure 3.2-4, Wilfred Site Soil Map

Soils classified under the Wright series are generally moderate to poor in drainage, due in part to a clay subsoil. Beneath Wright strata is often a layer of old valley alluvium from composite sources, such as volcanic and marine sediment. Wright soils are often found on low terraces and appear as undulated. Soils under both the WoA and WhA classification symbols share many characteristics in terms of appearance and plasticity, although WoA is considerably shallower than WhA. These soils are generally somewhat poor in drainage, with little to no erosion hazard. WhA soils have a Capability Classification of IIIw-3, indicating limitations requiring conservation measures, often requiring artificial drainage, and problems associated with slow to very slow permeability. The NRCS has assigned a Capabilities Class IVw-3 to WoA soils, indicating severe limitations to agricultural uses, a need for artificial drainage, and problems associated with slow to very slow permeability.

SEISMICITY

The Wilfred site is located within the San Francisco Bay Area, which is a seismically active area. Ten active fault lines have been identified within 33 miles of the Wilfred site (**Figure 3.2-5**), with several other faults influencing seismic factors in the San Francisco Bay Area. **Table 3.2-3** below lists the ten nearest faults to the Wilfred site, and indexes the magnitude and intensity for seismic events that may result.

TABLE 3.2-3
DETERMINISTIC SEISMIC CHARACTERISTICS – WILFRED SITE

Fault Name	Approximate Distance From Site (miles)	Maximum Considered Earthquake Moment Magnitude (Mw)	Peak Horizontal Ground Acceleration (g)
Rodgers Creek	4.8	7.0	0.36
San Andreas	14.9	7.9	0.26
Mayacama	15.0	6.9	0.17
West Napa	20.3	6.5	0.10
Point Reyes	25.1	6.8	0.12
Hayward	27.8	7.1	0.10
Hunting Creek – Berryessa	29.1	6.9	0.09
Collayomi	29.1	6.1	0.06
Concord – Green Valley	30.0	6.9	0.08
San Gregorio	32.4	7.3	0.10

SOURCE: GEOCON Consultants, Inc., AES, 2004.

Table 3.2-1 lists theoretical intensity levels alongside site acceleration factors and typical structural consequences to seismic events. As shown in **Table 3.2-3** above, the Rodgers Creek Fault is approximately 4.8 miles east of the Wilfred site, with a Maximum Moment Magnitude of 7.0, and a peak horizontal ground acceleration of 0.36g. The Rodgers Creek Fault is considered to be the source of the greatest seismic ground shaking at the Wilfred site.

Figure 3.2-5, Regional Fault Map

Computerized probabilistic modeling estimates a 10percent chance of exceeding 0.36g ground acceleration in a seismic event within the next 50 years, with a predicted ground motion of 0.45g (GEOCON, 2004). As shown in **Table 3.2-1**, such an event would fall between Level VIII and Level IX in intensity. Predictable structural outcomes include moderate to considerable damage in specially designed structures; well-designed frame structures thrown out of plumb; considerable damage in substantial buildings, with partial collapse. Buildings may be shifted off foundations. Ground may become cracked conspicuously. Underground pipes may be severed.

A maximum probable earthquake (magnitude 7.9) on the San Andreas Fault, approximately 14.9 miles away from the Wilfred site, may produce a peak horizontal ground acceleration of 0.26g at the Wilfred site. On the Mayacama Fault, approximately 15 miles away from the Wilfred site, a maximum probable earthquake (magnitude 6.9) may produce a peak horizontal ground acceleration of 0.17g. Approximately 20.3 miles away, a maximum probable earthquake (magnitude 6.5) at the West Napa Fault may produce a peak horizontal ground acceleration of 0.10g at the Wilfred site. A maximum probable earthquake (magnitude 6.8) on the Point Reyes Fault, at a distance of 25.1 miles, may produce a peak horizontal ground acceleration of 0.12g at the Wilfred site. On the Hayward Fault, approximately 27.8 miles from the Wilfred site, a maximum probable earthquake (magnitude 7.1) may produce a peak horizontal ground acceleration of 0.10g.

Approximately 29.1 miles away, a maximum probable earthquake (magnitude 6.9) at the Hunting Creek-Berryessa Fault may produce a peak horizontal ground acceleration of 0.9g in the Wilfred site. A maximum probable earthquake (magnitude 6.1) on the Collayomi Fault, at a distance of 29.1 miles, may produce a peak horizontal ground acceleration of 0.06g in the Wilfred site. On the Concord-Green Valley Fault, approximately 30 miles from the Wilfred site, a maximum probable earthquake (magnitude 6.9) may produce a peak horizontal ground acceleration of 0.08g. Approximately 32.4 miles away, a maximum probable earthquake (magnitude 7.3) at the San Gregorio Fault may produce a peak horizontal ground acceleration of 0.1g in the Wilfred site.

Liquefaction

Based on geotechnical analysis performed by GEOCON (2004), the potential of liquefaction on-site varies from low to high (**Figure 3.2-6**). This potential results from the presence of isolated “lenses” of liquefiable soils. A more recent Blackman Consulting (2005) geotechnical analysis of the northwest corner of the Wilfred site found the potential for liquefaction to be low due to either the density of soil layers or the percentage of fine grained (clayey) soil.

Lateral Spreading

Based on the Blackman (2005) conclusion that the potential for liquefaction on-site is low and observed subsurface conditions at the Stony Point site (Geocon, 2004) that liquefiable sand layers

Figure 3.2-6, Wilfred Site Liquefaction Susceptibility Map

beneath the site are non-existent or isolated, the potential for lateral spreading on the Wilfred site is low.

Seismically Induced Flooding

Based on their spatial and topographical removal from the Pacific Ocean, the Wilfred, Stony Point, and Lakeville sites are well protected from a tsunami in the event of an offshore seismic event. Moreover, none of the sites considered is located downstream from any major dams or reservoirs in sufficient proximity to cause inundation in the event of seismically induced breakage.

3.2.3 STONY POINT SITE

As with the Wilfred site above, the Stony Point site is situated within the Santa Rosa Plain.

TOPOGRAPHY

With the exception of depressed drainage channels for flood control, the Stony Point site is generally flat and level. The major drainage depressions occur at the Bellevue-Wilfred Channel and the Laguna de Santa Rosa (**Figure 3.2-7**). The former traverses the center of the Stony Point site in a northeasterly direction, while the latter forms a portion of the southern boundary of the site. Both channels intersect at the southwest corner of the Stony Point site.

SOILS

The Stony Point site is comprised of areas consisting of three soil classifications (**Figure 3.2-8**). The majority of the site is classified as Clear Lake clay (CeA), with portions classified as Wright loam, shallow, wet (WoA), and a small portion of Wright loam, wet (WhA) (**Table 3.2-4**).

The Clear Lake series generally consists of clays, formed under conditions of poor drainage. Beneath the upper layers are usually alluvial strata comprised of basic and sedimentary rock. The Clear Lake series is often found on plains and in flat basins. Acidity for this series ranges from neutral to strongly acidic. Clays in the Clear Lake series are characterized by slow permeability and runoff, and a slight erosion hazard. The Capability Class assigned by the NRCS to this soil is IIs-5, indicating a sum of limitations requiring moderate conservation, soil limitations due to being shallow, droughty, saline or stony, and limitations resulting from a fine-textured stature.

Soils classified under the Wright series are generally moderate to poor in drainage, due in part to a clay subsoil. Beneath Wright strata is often a layer of old valley alluvium from composite sources, such as volcanic and marine sediment. Wright soils are often found on low terraces and appear as undulated. Soils under both the WoA and WhA classification symbols share many characteristics in terms of appearance and plasticity, although WoA is considerably shallower than WhA. These soils are generally somewhat poor in drainage, with little to no erosion hazard. WhA soils have a Capability Classification of IIIw-3, indicating limitations requiring

Figure 3.2-7, Stony Point Site Topography

Figure 3.2-8, Stony Point Site Soil Map

TABLE 3.2-4
PROJECT SOIL LIMITATIONS – STONY POINT SITE

SOILS	FACTOR						
	Depth	Permeability	Drainage	Erosion	Shrink/ Swell	Runoff	Capability Class ^a
Clear Lake Clay (CeA) 0-2% slope	72 Inches	Low	Drained	Slight	Low to moderate	Slow	IIs-5
Wright Loam, wet (WhA) 0-2% slope	70 Inches	Very low	Moderately poor	None to slight	Moderate to high	Very slow	IIIw-3
Wright Loam, shallow, wet (WoA) 0-2% slope	20 Inches	Very low	Moderately poor	None to slight	Moderate to high	Very slow	IVw-3

NOTE: ^a Capability Class: Class I soils have few limitations that restrict their use; Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices; Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both; Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both; Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use; Class VI soils have severe limitations that make them generally unsuitable for cultivation; Class VII soils have very severe limitations that make them unsuitable for cultivation. Capability subclasses: (e) erosion, (s) shallow, droughty or rocky, (w) water interferes with plant growth. Subclasses: (3) limitation from slow or very slow permeability of subsoil or substratum, (5) limitation from fine or very fine surface soil.

SOURCE: NRCS, 1972.

conservation measures, often requiring artificial drainage, and problems associated with slow to very slow permeability. The NRCS has assigned a Capabilities Class IVw-3 to WoA soils, indicating severe limitations to agricultural uses, a need for artificial drainage, and problems associated with slow to very slow permeability.

SEISMICITY

The Stony Point site is located within the San Francisco Bay Area, which is a seismically active area. During the life of the project, it is therefore expected that strong ground shaking could occur in the region. Ten active fault lines have been identified within 33 miles of the Stony Point site (**Figure 3.2-5** above), with several other faults influencing seismic factors in the San Francisco Bay Area. **Table 3.2-5** below lists the ten nearest faults to the Stony Point site, and indexes the magnitude and intensity for seismic events that may result.

TABLE 3.2-5
DETERMINISTIC SEISMIC CHARACTERISTICS – STONY POINT SITE

Fault Name	Approximate Distance From Site (miles)	Maximum Considered Earthquake Moment Magnitude (Mw)	Peak Horizontal Ground Acceleration (g)
Rodgers Creek	4.8	7.0	0.36
San Andreas	14.9	7.9	0.26
Mayacama	15.0	6.9	0.17
West Napa	20.3	6.5	0.10
Point Reyes	25.1	6.8	0.12
Hayward	27.8	7.1	0.10
Hunting Creek – Berryessa	29.1	6.9	0.09
Collayomi	29.1	6.1	0.06
Concord – Green Valley	30.0	6.9	0.08
San Gregorio	32.4	7.3	0.10

SOURCE: GEOCON Consultants, Inc., AES, 2004.

Table 3.2-1, above, lists theoretical intensity levels alongside site acceleration factors and typical structural consequences to seismic events. As shown in **Table 3.2-5** immediately above, the Rogers Creek Fault is approximately 4.8 miles east of the Stony Point site, with a Maximum Moment Magnitude of 7.0, and a peak horizontal ground acceleration of 0.36g. The Rodgers Creek Fault is considered to be the source of the greatest seismic ground shaking at the Stony Point site.

Computerized probabilistic modeling specific to the Stony Point site estimates a 10percent chance of exceeding 0.36g ground acceleration in a seismic event within the next 50 years, with a predicted ground motion of 0.45g (GEOCON 2004). As shown in **Table 3.2-1**, such an event would fall between Level VIII and Level IX in intensity. Predictable structural outcomes include moderate to considerable damage in specially designed structures; well-designed frame structures thrown out of plumb; considerable damage in substantial buildings, with partial collapse. Buildings may be shifted off foundations. Ground may become cracked conspicuously. Underground pipes may be severed.

A maximum probable earthquake (magnitude 7.9) on the San Andreas Fault, approximately 14.9 miles away from the Stony Point site, may produce a peak horizontal ground acceleration of 0.26g at the Stony Point site. On the Mayacama Fault, approximately 15 miles away from the Stony Point site, a maximum probable earthquake (magnitude 6.9) may produce a peak horizontal ground acceleration of 0.17g. Approximately 20.3 miles away, a maximum probable earthquake (magnitude 6.5) at the West Napa Fault may produce a peak horizontal ground acceleration of 0.10g at the Stony Point site. A maximum probable earthquake (magnitude 6.8) on the Point Reyes Fault, at a distance of 25.1 miles, may produce a peak horizontal ground acceleration of

0.12g at the Stony Point area. On the Hayward Fault, approximately 27.8 miles from the Stony Point site, a maximum probable earthquake (magnitude 7.1) may produce a peak horizontal ground acceleration of 0.10g.

Approximately 29.1 miles away, a maximum probable earthquake (magnitude 6.9) at the Hunting Creek-Berryessa Fault may produce a peak horizontal ground acceleration of 0.9g in the Stony Point site. A maximum probable earthquake (magnitude 6.1) on the Collayomi Fault, at a distance of 29.1 miles, may produce a peak horizontal ground acceleration of 0.06g in the Stony Point site. On the Concord-Green Valley Fault, approximately 30 miles from the Wilfred site, a maximum probable earthquake (magnitude 6.9) may produce a peak horizontal ground acceleration of 0.08g. Approximately 32.4 miles away, a maximum probable earthquake (magnitude 7.3) at the San Gregorio Fault may produce a peak horizontal ground acceleration of 0.1g in the Stony Point site.

Liquefaction

Based on-site-specific geotechnical analysis performed by GEOCON (2004), the potential of liquefaction on-site varies from low to high (**Figure 3.2-9**). This potential results from the presence of isolated “lenses” of liquefiable soils.

Lateral Spreading

Based on observed subsurface conditions on the Stony Point site, potentially liquefiable sand layers are non-existent (GEOCON, 2004). Therefore, the potential for lateral spreading is low.

Seismically Induced Flooding

Based on its spatial and topographical removal from the Pacific Ocean, the Stony Point site is well protected from a tsunami in the event of an offshore seismic event. Moreover, the site is not located downstream from any major dams or reservoirs that could inundate the site in the event of seismically induced breakage.

3.2.4 LAKEVILLE SITE

TOPOGRAPHY

The Lakeville site is characterized as having lowland areas to the west, with higher elevations trending eastward (**Figure 3.2-10**). The southwestern portion of the site is mostly level, sloping slightly to the east from an elevation of approximately 5 feet above mean sea level (msl). The portions of the site adjacent to the Lakeville Highway and further east includes terrain elevating up to approximately 40 feet above msl.

Figure 3.2-9, Stony Point Site Liquefaction Susceptibility Map

Figure 3.2-10, Lakeville Site Topography

SOILS

The Lakeville site is comprised of areas consisting of three soil classifications (**Figure 3.2-11, Table 3.2-6**). The majority of the site is classified as Reyes silty clay (RmA), with portions classified as Haire gravelly loam (HbD2), and a small portion of Clear Lake clay loam (CcB).

The geologic formations found on the Lakeville site are classified (**Appendix F**) as Artificial Fill (Af, Abm), Quaternary Alluvium (Qal, Qhf, Qpf), Bay Mud (Qhbm), Younger Bay Mud, Alluvial Interface Sand Deposit, Older Bay Mud, and Upper Petaluma Formation (Tpu) (GEOCON, 2003).

Alluvial material found on the site is derived from adjacent areas. The classes of alluvium are standard alluvium (Qal), Holocene alluvial fan deposits (Qhf), and Pleistocene alluvial fan deposits (Qpf). These types are described as similar to each other by GEOCON (2003), and are generally comprised of dense, stiff mixtures of sand, silt, clay and gravels.

Holocene age Bay Mud (Qhbm) is found in the lowland areas of the site. Generally, the ground surface of these deposits is at, or just above, sea level. The degree of consolidation and stratigraphic position determines the subclassifications of Bay Mud soils. Younger Bay Mud generally consists of very soft, saturated silty clay (CH) with varying amounts of decomposed organics. Very little (if any) fine sand was observed within the samples of the Younger Bay Mud. The material is firm in the upper five to six feet below ground surface (bgs) due to drying. However, material has a high moisture content, low dry density, and is very weak and compressible. This material is sensitive to changes in moisture; it swells when wet and desiccates when dried. The soft consistency of this deposit was demonstrated by a Standard Penetration Test (SPT, see **Appendix F**) with blow counts of less than five (5) and by very little tip resistance during the Cone Penetrometer Test (CPT). The engineering properties of Younger Bay Mud are very poor. Furthermore, Younger Bay Mud loses approximately 50percent of its strength when disturbed.

The alluvial sand deposit located at the interface between the Younger and Older Bay Mud generally consisted of dense, gravelly, silty, clayey sand (SM, SC). In general, the engineering properties of this material are good. The granular nature provides increased shear strength. The Older Bay Mud at the site generally consists of stiff to very stiff, silty clay (CL, CH) and clayey silt (ML). Based on the CPT soundings, the Older Bay Mud extends to depths up to 140 feet bgs. Unlike the Younger Bay Mud, the engineering properties of this material are good. The material properties are usually adequate to support most pile foundations.

Figure 3.2-11, Lakeville Site Soil Map

TABLE 3.2-6
PROJECT SOIL LIMITATIONS - LAKEVILLE SITE

SOILS	FACTOR						
	Depth	Permeability	Drainage	Erosion	Shrink/ Swell	Runoff	Capability Class ^a
Clear Lake Clay (CcB) 2-5% slope	72 Inches	Low	Drained	Slight	Low to moderate	Slow	IIs-5
Reyes silty clay (RmA) 0-2% slope	70 Inches	Very low	Moderately poor	None to slight	Moderate to high	Very slow	IIIw-3
Haire gravelly loam (HbD2) 9-15% slope	20 Inches	Very low	Moderately poor	None to slight	Moderate to high	Very slow	IVw-3

NOTE: ^a Capability Class: Class I soils have few limitations that restrict their use; Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices; Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both; Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both; Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use; Class VI soils have severe limitations that make them generally unsuitable for cultivation; Class VII soils have very severe limitations that make them unsuitable for cultivation. Capability subclasses: (e) erosion, (s) shallow, droughty or rocky, (w) water interferes with plant growth. Subclasses: (3) limitation from slow or very slow permeability of subsoil or substratum, (5) limitation from fine or very fine surface soil.

SOURCE: Sonoma County Soil Survey – NRCS, 1972.

Within the eastern portion of the site, the Upper Petaluma Formation consists of severely weathered material generally comprised of stiff to hard, silty, sandy lean clay (CL). This material has likely weathered from sandstone and siltstone. The severe degree of weathering has eliminated any visible bedding strata within this material. This material exhibits rock-like structure below approximately six feet bgs; however, the material remained readily excavatable with a backhoe and exploratory drill rig. The upper one (1) to five (5) feet of this material consists of highly plastic flat clay (CH) residual soil. GEOCON anticipates that this material has a moderate to high potential for expansion due to seasonal moisture variations. In general, the plasticity of this material decreases with depth. Other than the expansive nature of the surficial residual soils, the engineering parameters of this material are quite good.

SEISMICITY

The area of Alternative F is located within the San Francisco Bay Area, which is a seismically active area. During the life of the project, it is therefore expected that strong ground shaking could occur in the region. **Table 3.2-7** below identifies five (5) active faults within 20 miles of the site for Alternative F. The active Rodgers Creek Fault Zone is located approximately 2.7 miles northeast of the site. The active Hayward Fault is located about 6.5 miles to the south and the active San Andreas Fault is located about 18 miles to the west. The Rodgers Creek Fault has a

Maximum Credible Earthquake (MCE) moment magnitude (M_w) of 7.0. This fault is considered to be the source of the greatest seismic ground shaking at the site.

TABLE 3.2-7
DETERMINISTIC SEISMIC CHARACTERISTICS - LAKEVILLE SITE

Fault Name	Approximate Distance From Site (Miles)	Maximum Considered Earthquake Moment Magnitude (M_w)	Peak Horizontal Ground Acceleration (g)	
			Lowland Areas	Upland Areas
Rodgers Creek	2.7	7.0	0.47	0.37
Hayward	6.5	7.1	0.33	0.26
West Napa	11	6.5	0.17	0.13
Concord – Green Valley	18	6.9	0.15	0.11
San Andreas	19	7.9	0.24	0.19

SOURCE: GEOCON Consultants, Inc., 2003, AES 2004.

As shown in **Table 3.2-7**, the maximum credible peak site acceleration is 0.47g for the lowland areas of the Lakeville site, while upland areas could sustain an acceleration of 0.37g. According to **Table 3.2-1**, such an event would fall between Level VIII and Level IX in intensity. Predictable structural outcomes include moderate to considerable damage in specially designed structures; well-designed frame structures thrown out of plumb; considerable damage in substantial buildings, with partial collapse. Buildings may be shifted off foundations. Ground may become cracked conspicuously. Underground pipes may be broken.

Lateral Spreading

Lateral spreading typically occurs during a seismic event in the form of horizontal ground displacement and is typical where ground surface is relatively flat, and comprised of alluvium or depositional sediment. This movement in soils is generally due to failure along a weak sublayer that is formed within an underlying liquefied layer. Cracks develop within the weakened material, while blocks of soil move laterally toward the free face. Subsurface conditions near the Lakeville site indicate that potentially liquefiable sand layers beneath ground surface are non-existent or relatively thin and isolated; therefore, the potential for lateral spreading is considered low.

Liquefaction

The upland portions of the Lakeville site along Lakeville Highway are expected to contain soils sufficiently dense and/or fine-grained so as not to present a liquefaction risk (**Appendix F**). Although not observed during GEOCON’s investigation in the area of the Lakeville site, Bay

Mud deposits within the lowland portion of the site may contain lenses of saturated, granular material. These materials may be subject to liquefaction during a seismic event.

Seismically Induced Flooding

San Pablo Bay is well protected from tsunamis (great sea waves produced by a submarine earthquakes) emanating from the Pacific Ocean. The Lakeville site, located north of undeveloped agricultural land that borders the San Pablo Bay, is unlikely to be affected by tsunamis and/or seiche waves. The site is not located downstream from any major dams or reservoirs that could inundate the site in the event of seismically induced breakage.