This section describes the geology of the County and analyzes issues such as potential exposure of people and property to geologic hazards, landform alteration, and erosion. In addition, potential seismic/geologic hazards such as earthquakes/ground shaking, liquefaction and mass soil erosion are discussed.

4.10.1 EXISTING SETTING

TOPOGRAPHY AND LOCAL GEOLOGY

Existing Setting

Napa County is located in the Coast Ranges Geomorphic Province. This province is bounded on the west by the Pacific Ocean and on the east by the Great Valley geomorphic province. The Coast Ranges Province extends several hundred miles northward from southern California to near the Oregon border. The province, including Napa County, is the general northwest-southeast orientation of physiographic features such as valleys and ridgelines.

The County’s highest topographic feature is Mount St. Helena, which is located in the northwest corner of the County and whose peak elevation reaches 4,343 feet. Principal ridgelines have maximum elevations that roughly vary between 1,800 and 2,500 feet to sea level. These elevations decrease in the southern part of the County. This physiography has influenced the local climate (creating several microclimates), the development of soils, and the existence and location of geologic features, including hazards as landsliding. The combination of physiography, soils, and climate has helped give rise to the production of premium wine grapes and other agricultural products for which the County is famous.

GEOTECHNICAL CONDITIONS

Structural Support

Unconsolidated surficial deposits generally consist of unstratified, geologically very young materials (clay, silt, sand, rock fragments and gravel, and organic material) lying on bedrock (or older deposits or other sedimentary materials) at or near the Earth’s surface (see Figure 4.10-1). They are of Quaternary age (the last 2 million years). Relative to the underlying rock, they are most often weak, soft, loose, and generally susceptible to erosion. They are the product of weathering, erosion, and deposition. These deposits are of variable thickness and comprise valley alluvium, alluvial fans, levee deposits, estuarine deposits, colluvium, stream channel and terrace deposits, and various types of landslide deposits, and the soil horizons that have developed upon them. Within the County the larger and thicker of these deposits are principally found within the major valleys—Napa, Chiles and Pope.

GEOLOGIC HAZARDS, FAULTS, AND SEISMICITY

Faults

Earthquakes are generally expressed in terms of intensity and magnitude. Intensity is based on the observed effects of ground shaking on people, buildings, and natural features. An earthquake’s intensity varies from region to region, depending on the location of the observer with respect to the earthquake epicenter. Table 4.10-1 provides a description and a comparison of intensity and magnitude.
The Modified Mercalli (MM) Intensity Scale is used in the United States to evaluate earthquake movements. The MM scale is composed of 12 increasing levels of intensity designated by Roman numerals. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and, finally, total destruction. The levels range from imperceptible shaking to catastrophic destruction. The MM scale does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects. The lower numbers of the intensity scale generally deal with the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. Table 4.10-2 describes the typical effects observed at locations near the epicenter of earthquakes of different magnitudes.
FIGURE 4.10-1
SURFICIAL DEPOSITS

LEGEND
- Surficial Deposit
- Evaluation Areas
- Lakes
- Streams
- Major Roads

Surficial Deposits
Napa County

1 inch = 22,000 feet

Horizontal Datum: NAD 83
CA State Plane Coordinates, Zone H, feet
Source: Napa County, 2004; Jones & Stokes 2005
Graymer et al. 2002, Graymer et al. unpublished

Source: Jones & Stokes, EDAW
**Table 4.10.2**

**Typical Effects of Earthquake Activity**

<table>
<thead>
<tr>
<th>Typical Maximum Modified Mercalli Intensity</th>
<th>Typical Effects of Earthquake Activity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.</td>
</tr>
<tr>
<td>IV</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably</td>
</tr>
<tr>
<td>V</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
<tr>
<td>XI</td>
<td>Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.</td>
</tr>
<tr>
<td>XII</td>
<td>Damage total. Lines of sight and level are distorted. Objects thrown into the air.</td>
</tr>
</tbody>
</table>

Source: USGS.

Notes: *Abbreviated Modified Mercalli Intensity Scale.

By comparison, an earthquake’s magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake. Magnitude is based on the amplitude of the earthquake waves recorded on instruments, which have a common calibration. The magnitude or strength of earth movement associated with seismic activity is typically quantified using the Richter scale. This scale is a measure of the strength of an earthquake or strain energy released by it, as determined by seismographic observations. This is a logarithmic value originally defined by Charles Richter (1935). An increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismogram, or approximately a 30-fold increase in the energy released. In other words, a magnitude 6.7 earthquake releases over 900 times (30 times 30) the energy of a 4.7 earthquake.

In accordance with the severity zones, the California Geological Survey (CGS) defines the following:
4.10 GEOLOGY AND SOILS

- Fault - a fracture or zone of closely associated fractures along which rocks on one side have been displaced with respect to those on the other side;

- Fault Zone - a zone of related faults, which commonly are braided, and sub parallel, but may be branching and divergent. A fault zone has a significant width (with respect to the scale at which the fault is being considered, portrayed, or investigated), ranging from a few feet to several miles;

- Potentially Active Fault - a fault that showed evidence of surface displacement during Quaternary time (last 1.6 million years). The purpose of this designation indicates the evaluation of possible zonation. No longer used;

- Sufficiently Active Fault - a fault that has evidence of Holocene (10,000 years) surface displacement along one or more of its segments or branches; and,

- Well-Defined Fault - a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The geologist should be able to locate the fault in the field with sufficient precision and confidence to indicate that the required site-specific investigations would meet with some success.

A large number of faults have been mapped within the County. Only a very small number of these faults have been designated encompassed by regulatory zones by the California Geological Survey (formerly the California Division of Mines and Geology). To be designated as an active fault, it must be judged as “sufficiently active and well defined.” That is, it must have undergone movement during the Holocene (the last 11,000 years), and the trace of the fault must be clearly detectable by a trained geologist as a physical feature at or just below the ground surface. When a fault meets these criteria it is zoned as active according to the mandates of the Alquist-Priolo Earthquake Fault Zoning Act of 1972. Such zones are known as earthquake fault zones.

Faults considered active are identified in Table 4.10-3 and fault locations are shown in Figure 4.10-2. As noted in Table 4.10-3, there are four faults (West Napa, Hunting Creek, Green Valley, and Cordelia) that are of concern to Napa County. The West Napa Fault has identified to have the potential capacity to generate a 6.8 to 7.1 magnitude earthquake (Napa County, BDR, 2005). The Association of Bay Area Governments’ “Earthquake Hazard Map for the Entire Bay Area Scenario: West Napa Fault” identifies that the southern portion of the County could potentially be subject to Violent (Modified Mercalli IX) and Very Strong (Modified Mercalli VIII) movement as a result of a 6.5 magnitude event from the West Napa Fault. Based on historic records cited in the BDR, earthquake magnitudes experienced County-wide from 1900 to 2005 have ranged in magnitude from 5.0 to 8.25 (1906 earthquake). There is a 67% chance for a 6.7 or larger magnitude earthquake to occur in the San Francisco Bay area by the year 2032.
FIGURE 4.10-2
NAPA COUNTY FAULT FEATURES

Legend

- Alquist Priolo Fault Zones

- Normal Fault - Certain

- Normal Fault - Approximate

- Normal Fault - Approximate, Queried

- Normal Fault - Concealed

- Normal Fault - Concealed, Queried

- Normal Fault - Uncertain

- Normal Fault - Uncertain, Queried

- Thrust Fault - Certain

- Thrust Fault - Approx. Located

Source: California Geological Survey; Napa County; ESRI

3 0 3
Miles

PMC
### Table 4.10-3
**Faults in the Vicinity of Napa County**

<table>
<thead>
<tr>
<th>Fault Name</th>
<th>General Information</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting Creek-Berryessa, Hunting Creek section (medial Section)</td>
<td>This fault has 3 segments in Napa County. Section boundaries are based on a change in geomorphic expression of the fault.</td>
<td>Active</td>
</tr>
<tr>
<td>Hunting Creek-Berryessa, Lake Berryessa section</td>
<td>Extends from the vicinity of Wilson Valley south-southeast to the Cedar Roughs area west of Lake Berryessa.</td>
<td>Active</td>
</tr>
<tr>
<td>Hunting Creek-Berryessa, Wilson section (northern section)</td>
<td>Probably transfers dextral slip to the Bartlett Springs fault system. The whole system is expressed as a zone of discontinuous fault traces as much as 3.5km wide.</td>
<td>Active</td>
</tr>
<tr>
<td>West Napa fault Napa County Airport section (southern section)</td>
<td>Delineated by northwester-striking dextral slip faults that exhibit geomorphic evidence of Holocene displacement.</td>
<td>Active: Exhibits geomorphic evidence of Holocene displacement</td>
</tr>
<tr>
<td>West Napa fault, Browns Valley section (northern section)</td>
<td>Delineated by a zone of north-northwestern-striking late Pleistocene faults that generally lack geomorphic evidence of Holocene displacement.</td>
<td>No</td>
</tr>
<tr>
<td>Green Valley fault: This dextral fault borders the eastern side of the Sulphur Springs Mountains</td>
<td>Holocene Active. Slip rate category: between 1.0 and 5.0 mm/yr.</td>
<td>Active</td>
</tr>
<tr>
<td>Saint Johns Fault</td>
<td>No activity in last 700,000 years.</td>
<td>No</td>
</tr>
<tr>
<td>Soda Creek Fault</td>
<td>Northern part of County.</td>
<td>No</td>
</tr>
<tr>
<td>Camerros Fault</td>
<td>Angled from northwest to southeast, parallel through the Camerros Valley. Pre-quaternary: not active for last 5 million years.</td>
<td>No</td>
</tr>
<tr>
<td>Possibly a section of the Cordelia fault</td>
<td>A road on the north end, but the fault ends at the Solano County line. Not listed as part of Napa County, but should be evaluated on a case-by-case basis.</td>
<td>Possibly Active</td>
</tr>
</tbody>
</table>

Source: Napa County, BDR 2005; California Geological Survey 2006

### Ground Shaking

The greatest potential for loss of life and property damage would be the result from severe ground shaking by a nearby earthquake in populated areas. The degree of damage depends on many interrelated factors. Among these factors are the magnitude, focal depth, distance from the causative fault, source mechanism, duration of shaking, high rock accelerations, type of surficial deposits or bedrock, degree of consolidation of surficial deposits, presence of high ground water, topography, and design, type, and quality of building construction.

The severity of the shaking damage at a particular location within the County depends on the factors described above (e.g., on the magnitude of the earthquake and the distance to its epicenter), but also on other factors including the nature and thickness of the deposits at the location.
Liquefaction

Liquefaction is the sudden loss of soil shear strength during strong ground shaking, due to increased pore water pressure and decreased effective stress, that portion of the total stress on the soil that is borne by the soil grains. As a result, sufficiently liquefied soils can no longer support structures built on them or maintain buoyant structures placed beneath them. Liquefied soils on sloping ground may flow in a semi-fluid or plastic state (a lateral spreading), disrupting the original ground surface and damaging improvements in their path.

Relative to the total area of the County, alluviated valleys (e.g., Napa Valley and the interior valleys) represent a relatively small percentage; roughly about 20% or somewhat less. Therefore, on a Countywide basis, the potential for liquefaction induced ground failures is relatively low (see Figure 4.10-3). However, most of the County's developed areas are within parts of these alluviated valleys. As a result, this localized development (mainly within the County's incorporated areas), liquefaction that may occur presents a commensurately higher risk of causing damage. Estuarine (marshlands) areas generally present a uniformly higher potential for liquefaction. More information on liquefaction and its effects can be found on the USGS Earthquake hazards website, Shake Maps. USGS Open File Report (OFR 00-444) shows regional liquefaction susceptibility.

Expansive Soils

Certain clay-rich soils can cause considerable damage to structures, streets, and roads as they shrink and swell in response to seasonal changes in their moisture content. Such soils are referred to as expansive. In late summer, expansive soil shrinks and cracks (up to 1 to 4 inches wide) as the soil dries and hardens. In the wet season, swelling of the clay closes the cracks, and the soil then is plastic and weak. The forces exerted during expansion and contractions are sufficient to heave and distort buildings and to crack shallow foundations and pavements.

Expansive soils exist at a number of locations in the County. Such conditions are typical of much of the San Francisco Bay Area. In the event of a large earthquake, the County could locally experience some or all of the above listed ground failures. The potential for highly damaging failures of this type within the County ranges from moderate to low in the unconsolidated deposits of colluvium, alluvium, and marsh/bay mud (hill-front, valley, and near bay front areas, respectively) to remote in areas underlain by bedrock (primarily hill-slopes). Failure potential is moderate in undocumented fill areas that are or might be subject to development at some future time.
Other Potential Geologic Hazards

Napa County may be subject to several seismic and geologic hazards. In accordance with the State Government Code Section 65302 (g), the geologic hazards to be evaluated include slope instability leading to mudslides and landslides, expansive soils, seismically induced surface rupture, ground shaking, ground failure, dam failure, seiches and tsunamis, and subsidence. A study of bedrock geology has recently been completed (1:24,000 scale) of the southern parts of the County by the California Geological Survey.

Landsliding is generally considered the most potentially damaging cumulative geologic hazard in the County because of the widespread and frequent occurrence of damaging events. All the major ridge and hills systems within the County have experienced landsliding to varying degrees (see Geological Resources Chapter of the BDR for further details on landslide potential in the County). Because of similar geology, terrain and climate, this condition is common to the entire Bay Area. Numerous GIS-based and hard copy landslide maps of the County have been developed. Most landslides present a risk that is limited to property damage. However, rapid slides such as debris flows and debris avalanches, often referred to as mud slides, also present the risk of injury and death.

Tsunamis are ocean waves generated by certain undersea earthquakes, volcanic eruptions, or landslides and seiches are waves created in closed bodies of water, such as lakes, by geologic instability. Potential for damage caused by tsunamis is considered low given the County is not directly exposed to the open ocean and lack of bay front. Currently, risk analysis of tsunamis has been limited to the evaluation of the ocean sides of San Francisco and San Mateo counties. Seiches would be limited to the larger reservoirs in the County (e.g., Lake Berryessa, Bell Canyon Reservoir, Lake Hennessey, Rector Reservoir and Miliken Reservoir). However, the potential for the loss of life and damage to structures is considered low given that development is largely restricted immediately along the shorelines of these reservoirs given their use as municipal water supply sources.

According to the BDR, there are approximately 51 known dams of various sizes and ages in the County, with most of these believed to be earth-fill structures. Dams with structures that are or will be 25 feet or more in height or have an impounding capacity of 50 acre-feet or more are regulated by the Division of Safety of Dams of the California Department of Water Resources. These dams are highly regulated during their design and construction and are routinely inspected during their impoundment life, which includes monitoring for compliance with seismic stability standards. As an example, Milliken Reservoir water levels have been reduced as a result of seismic stability concerns by California Department of Water Resources. However, dams that are not subject to regulation by the state could have potential to fail during earthquake event.

In addition to the potential to dam failure, there is potential for levee failure from an earthquake event along the Napa River, especially in the southernmost portion of the County where older levees exist (e.g., older levees in the Cuttings Wharf area). As identified in Section 4.11 (Hydrology and Water Quality), both the City of Napa and the City of St. Helena have flood improvement projects that include levee improvements.

**SURFICIAL DEPOSITS AND SOIL TYPES**

Characteristics and properties of geologic surficial deposits and soil types in the County are described below by subregion. Soil behavior properties for the County from the Natural Resources Conservation Service includes engineering classification, erosion potential, erosion class, and excavation difficulty. **Figure 4.10-4** presents a soil complex map of the County.
Napa Valley

Soil types and their characteristics in the Napa Valley subregion are controlled in part by location, i.e., valley or hillside. The principal soil series in the Napa Valley is Bale-Cole-Yolo. Soils of this series have formed on the nearly level to gently sloping, deep alluvium of the Valley. The soils are well drained to somewhat poorly drained loams, silt loams, and clay loams on flood plains, alluvial fans and terraces. These soils are among the most agriculturally productive in the County.

The principal soil series on the ridge system to the west of the Valley are Maymen-Lodo-Felton, Forward-Boomer-Felton, Bressa-Dibble-Sobrante, and Forward-Aken. On the ridge system to the east, the principal soil series are Rock Outcrop-Kidd-Hambright, and Bressa-Dibble-Sobrante, and Forward-Aiken.

Soils present on the ridge systems to either side of the Valley have formed from a wide range of parent materials under varying conditions of slope steepness and stability, slope aspect, time, and annual rainfall. Therefore, it is not surprising that the properties of these soils, including their hazards, are more variable than those formed on the more uniformly flat Valley floor (stable geomorphic surface), with its more homogeneous parent materials (alluvium).

Interior Valleys

Soil types and their characteristics in the interior valleys subregion are controlled in part by valley versus hillside location. The principal soil series in the named valley areas are Bressa-Dibble-Sobrante (Pope Valley), Tehama (Chiles Valley), Bale-Cole-Yolo (Wooden, Gordon and Foss Valleys), and Henneke-Montara (Capell Valley).

The principal soil series on the hills and ridge system on the west side of the subregion are Forward-Aiken, Rock Outcrop-Kidd-Hambright, and Bressa-Dibble-Sobrante. On the east side the soil series are Henneke-Montara, Bressa-Dibble-Sobrante, Forward-Aiken, and Tehama.

Berryessa/Knoxville Area

The principal soil series of the Berryessa/Knoxville subregion are few in number; in the north-northwest part of the subregion they consist of the Henneke-Montara Series, and in the north-northeast of the Bressa-Dibble-Sobrante Series. The Maymen-Lodo-Felton Series is found long the top of Blue Ridge (County Line). The Tehama series occupies part of the eastern shore of Lake Berryessa. In the south part of the subregion, the predominating soil series are Bressa-Dibble-Sobrante and Maymen-Lodo-Felton.

Soil Types

A listing of their physical constraints, hydrologic capacities and engineering characteristics are discussed below:

Bale-Cole-Yolo

- Nearly level to gently sloping, well drained and somewhat poorly drained loams, silt loams, and clay loams on flood plains, alluvial fans, and terraces.
This unit is mainly in Napa Valley on flood plains and alluvial fans along the Napa River, Dry Creek, Conn Creek, and Napa Creek. Smaller areas are on the flats around Camerons south of State Route 12. Slope is 0 to 5 percent. Elevation ranges from 100 to 500 feet. The soils formed in deep deposits of alluvium derived mainly from basic igneous and rhyolitic bedrock. The plant cover consists of annual grasses, forbs, willows, blackberry, and scattered oak. Average rainfall is 25 to 40 inches, and average annual air temperature is 58° to 62° F. The frost-free season is 220 to 270 days.

This unit makes up about 6 percent of the County. It is about 45 percent Bale soils, 25 percent Cole soils, and 15 percent Yolo soils. The remaining 15 percent is mainly Clear Lake, Coombs, Cortina, and Pleasanton soils and frequently flooded Riverwash.

These soils are among the most productive in the County. They are used for many kinds of wine grape vineyards and orchards. Some areas, particularly those adjacent to the major waterways, are subject to occasional flooding.

Maymen-Lodo-Felton

Steep to very steep, somewhat excessively drained and well drained gravelly loams and loams on uplands.

This unit is in the Dry Creek-Oakville Grade area near Zin-Zim Creek west of Knoxville-Berryessa Road, and in the area due west of Spanish Flat around Lake Berryessa. Slope is 30 to 75 percent. Elevation ranges from 300 to 2,500 feet. The soils formed in material weathered from sandstone and shale. The plant cover consists of chaparral, chamise, manzanita, scrub oak and Douglas-fir, ponderosa pine, fern, bay, and annual grasses. Average annual precipitation is 25 to 40 inches, and average annual temperature is 54° to 62° F. The frost-free season is 220 to 260 days.

This unit makes up 10 percent of the County. It is about 40 percent Maymen soils, 15 percent Lodo soils, and 15 percent Felton soils. The remaining 30 percent is Millsholm soils and some areas of Forward, Kidd, and Sobrante soils.

These soils are used for timber, wildlife habitat, recreation, and watershed. Some small grassy areas are used for cattle browse on a very limited basis.

Forward-Boomer-Felton

Gently sloping to very steep, well-drained loams, gravelly loams, and very gravelly loams on uplands.

This unit is on the uplands bordering Sonoma County, between Spring Mountain and Petrified Forest Road. Slope is 2 to 75 percent. Elevation ranges from 300 to 3,500 feet. The soils formed in material weathered from acidic and basic igneous rocks and in gravelly old alluvium that was uplifted in volcanic areas.

The plant cover consists of Douglas-fir, ponderosa pine, black oak, manzanita, poison-oak, madrone, and sparse grasses. Average annual precipitation is 30 to 50 inches, and average annual air temperature is 53° to 62° F. The frost-free season is 200 to 260 days.
4.10 GEOLOGY AND SOILS

- This unit makes up about 8 percent of the County. It is about 40 percent Forward soils, 30 percent Boomer soils, and 15 percent Felta soils. The remaining 15 percent is Kidd and Aiken soils.

- These soils are used for timber, wildlife habitat, recreation, and watershed.

**Bressa-Dibble-Sobrante**

- Moderately sloping to very steep, well drained loams, silt loams, and silty clay loams on uplands.

- This unit is east, north, and northwest of Lake Berryessa. It also is near Wooden Valley and south of Browns Valley. Slope is 5 to 75 percent. Elevation ranges from 200 to 2,000 feet. The soils formed in material weathered from sandstone and shale. The plant cover consists of annual grasses, forbs, and scattered oak. Average annual precipitation is 25 to 35 inches, and average annual air temperature is 59° to 64° F. The frost-free season is 220 to 260 days.

- This unit makes up 29 percent of the County. It is about 60 percent Bressa soils, 15 percent Dibble soils, and 15 percent Sobrante soils. The remaining 10 percent is Contra Costa, Lodo, Los Gatos, and Millsholm soils. The Bressa and Dibble soils are so intermingled that they are mapped as complexes.

- These soils are used mostly for range. Small areas of the more gently sloping soils are used for varietal vineyards and orchards.

**Forward-Aken**

- Gently sloping to steep, well drained gravelly loams and loams on uplands.

- This unit is in the Angwin-Los Posadas Forest area. Slope is 2 to 50 percent. Elevation ranges from 300 to 3,500 feet. The soils formed in material weathered from basic and acidic igneous bedrock. The plant cover generally consists of conifers, madrone, poison oak, tan oak, and manzanita. Redwoods are in draws that have surplus moisture. Brush has encroached on some cleared areas. Average annual precipitation is 30 to 50 inches, and average annual air temperature is 54° to 56° F. The frost-free season is 200 to 250 days.

- This unit makes up about 5 percent of the County. It is about 45 percent Forward soils and 35 percent Aiken soils. The remaining 20 percent is mainly Boomer, Kidd, and Sobrante soils.

- These soils are used mainly for timber. At lower elevations, some small areas are used for vineyards or orchards.

**Rock Outcrop-Kidd-Hambright**

- Rock outcrop and gently sloping to very steep, well drained very stony loams and loams on uplands.

- This unit is around Blue Ridge bordering Yolo County, in the Oat Hill-Palisade Ridge area in the northwestern part of the County, and in the Soda Canyon-Atlas Peak area.
area. Slope is 2 to 75 percent. Elevation ranges from 400 to 4,300 feet. The soils formed in material weathered from rhyolite and basic igneous rocks. The plant cover consists of small shrubs, lichens, scattered brush, and patches of annual grasses and forbs. Average annual precipitation is 20 to 60 inches, and average annual temperature is 50° to 62° F. The frost-free season is 200 to 260 days.

- This unit makes up 9 percent of the County. It is about 60 percent Rock outcrop, 15 percent Kidd soils, and 15 percent Hambright soils. The remaining 10 percent is Lodo, Maymen, and Millsholm soils.

- These soils and Rock outcrop are used for watershed, wildlife habitat, and recreation.

**Tehama**

- Nearly level to gently sloping, well drained silt loams on flood plains and alluvial fans.

- This unit is mainly in Pope Valley and on flats bordering the east side of Lake Berryessa. Slope is 0 to 5 percent. Elevation ranges from 200 to 500 feet. The soils formed in deep alluvium derived from sedimentary rock. The plant cover consists of annual grasses, forbs, and scattered oak. Average annual precipitation is 25 to 35 inches, and average annual air temperature is 59° to 62° F. The frost-free season is 250 to 260 days.

- This unit makes up about 3 percent of the County. It is about 80 percent Tehama soils. The remaining 20 percent is Cole, Pleasanton, Maxwell, and Contra Costa soils.

- Tehama soils are well drained. The surface layer is pale brown silt loam. The subsoil extends to a depth of 60 inches or more. It is brown and dark grayish brown silty clay loam.

- These soils are used mainly for pasture, some vineyards, and irrigated pasture.

**Henneke-Montara**

- Moderately sloping to very steep, excessively drained and well drained gravelly loams and clay loams on uplands.

- This unit is near Butts Canyon south of Snell Valley around Cedar Valley and Adams Ridge west of Knoxville-Berryessa Road, and in Soda Valley. Slope is 5 to 75 percent. Elevation ranges from 500 to 4,000 feet. The soils formed in material weathered from serpentine. The plant cover consists of digger pine, scrub oak, manzanita, muskbush, toyon, and a few annual grasses. Average annual precipitation is 20 to 45 inches, and average annual air temperature is 59 to 62 F. The frost-free season is 220 to 260 days.

- This unit makes up about 18 percent of the County. It is about 75 percent Henneke soils and 10 percent Montara soils. The remaining 15 percent is Bressa, Dibble, Guenoc, Lodo, Los Gatos, and Maymen soils.

- These soils are used for watershed, wildlife habitat, and recreation. Where adjoining soils are grazed, these soils are used for limited grazing.
MINERAL RESOURCES

Most of the following mineral information is based on “Mines and Mineral Resources of Napa County, California” from the California Journal of Mines and Geology, Volume 44, No. 1, January (Napa County, BDR 2005). The economy of Napa County has traditionally been dominated by agriculture and a few manufacturing industries. Mineral wealth has historically been prominent in the northern part of the County. At the peak of Napa’s mining era, a few minerals dominated mining in the County. Historically, the two most valuable mineral commodities have been mercury, or quicksilver, and mineral water, and silver accounted for a relatively small portion of mineral resources. The minerals produced in the 1940s included quicksilver, mineral water, pumice, sandstone, and miscellaneous stone. More recently, building stone and aggregate produced from hard-rock quarries have been the most valuable mineral commodity in the County. Other mineral products that have been mined historically in Napa County are asbestos, chromite, clay, copper, gold, lead, limestone, magnesite, manganese, onyx, paving blocks, sand and gravel, and petroleum. The following quarries are located within the County. Only one of the quarries—Syar Quarry—is currently a significant mining operation:

- Homestake Mining Company—26775 Morgan Valley Road, Lower Lake, 95457 (in reclamation, no longer active).
- American Canyon Quarry—Syar Industries, Inc., 2301 Napa/Vallejo Highway, Napa (idle, not active).
- Pope Creek Quarry—Don Wesner, Inc., 7193 Pope Valley Road, Pope Valley.
- Oat Hill Quarry—Napa Vallejo Waste Management Authority, City of American Canyon. (not active)

Asbestos

In its natural state, asbestos occurs throughout much of the earth’s surface. Serpentine is a common rock type in California and was identified by the California Air Resources Board (ARB) as having the potential to contain naturally occurring asbestos. The ARB has identified asbestos as a toxic air contaminant. Under the ARB’s Air Toxics Control Measure (ATCM) for Construction, Grading, Quarrying, and Surface Mining Operations (California Code of Regulations, Title 17, Section 93015), prior to any grading activities at the site, a geologic analysis will be necessary to determine if serpentine rock is present. Grading projects in serpentine rock larger than 1 acre will require prior District approval of an Asbestos Dust Mitigation Plan and an Asbestos Health and Safety Program. All project applicants should complete a Construction and Grading Project form. If naturally occurring asbestos is not present, an Exemption form must also be filed with the Bay Area Air Quality Management District (BAAQMD). The reader is referred to sub-section 4.10.2 (Regulatory Framework) below regarding further details on the regulation of naturally occurring asbestos.
4.10.2 REGULATORY FRAMEWORK

STATE

California Geological Survey

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (prior to January 1, 1994 known as the Alquist-Priolo Special Studies Zones Act - CCR, Title 14, Section 3600) sets forth the policies and criteria of the State of California in regards to building within active fault zones. The Alquist-Priolo Earthquake Fault Zoning Act outlines cities and counties' responsibilities in prohibiting the location of developments and structures for human occupancy across the trace of active faults. The policies and criteria are limited to potential hazards resulting from surface faulting or fault creep within Earthquake Fault Zones delineated on maps officially issued by the State Geologist.

Uniform Building Code and California Building Code

The Uniform Building Code (UBC) was first enacted in 1927 and has been revised approximately every three years since then. The function of the UBC is to promote and ensure the development of improved building construction and greater safety to the public by uniformity in building laws. The UBC is founded on broad-based principles that make possible the use of new materials and new construction systems. It is designed to be compatible with related publications to provide a complete set of documents for regulatory use.

The UBC recognizes that nearly all of western California is seismically active, and that within this broad region there are areas underlain by deeper unconsolidated deposits that are subject to higher amplitude, longer duration shaking motions. Thus, while these shaking impacts are potentially more damaging, implementation of UBC criteria tend to reduce their effects. From the standpoint of earthworks construction and seismic criteria, the UBC and the California Building Code (CBC) are nearly identical. The UBC includes a seismic zone map to determine applicable seismic standards for proposed structures. Seismic zones range from 0 to 4, with Zone 0 being the least active and Zone 4 the most active. All of Napa County is located in Seismic Zone 4. All structures built in the County must comply with requirements for this zone, which include provisions for buildings to structurally survive an earthquake without collapsing and include such measures as anchoring to the foundation and structural frame design.

Seismic Hazards and Mapping Act

The Seismic Hazards Mapping Act of 1990 (Public Resources Code, Chapter 7.8, Section 2690-2699.6) directs the Department of Conservation, California Geological Survey to identify and map areas prone to earthquake hazards of liquefaction, earthquake-induced landslides, and amplified ground shaking. The purpose of the act is to reduce the threat to public safety and to minimize the loss of life and property by identifying and mitigating these seismic hazards. The act was passed by the state Legislature following the 1989 Loma Prieta earthquake. This pertains to seismic hazards other than the fault surface rupture hazard regulated by the Alquist-Priolo Earthquake Fault Zoning Act of 1972.

The maps produced per the Seismic Hazards Mapping Act are the Seismic Hazard Zone Maps, prepared by California Geological Survey geologists in the Seismic Hazard Mapping Program (Program). The program will ultimately map all of California's principal urban and major growth areas. Each map covers an area of approximately 60 square miles and uses a scale of 1 inch = 2,000 feet (1:24,000 scale). The Seismic Hazard Zone maps include designated "Zones of
Required Investigation" for areas prone to liquefaction and earthquake-induced landslides. Once a map becomes available for a certain area, cities and counties within that area are required to withhold development permits for projects proposed within a Zone of Required Investigation until geologic and soil conditions are investigated and appropriate mitigations, if any, are incorporated into development plans.

**California Water Code-Division 3, Dams and Reservoirs**

Since 1929, the State of California has supervised dams to prevent failure in order to safeguard life and protect property. The legislation resulted from the failure of St Francis Dam in March of 1928. Legislation enacted in 1965, as a result of the failure of Baldwin Reservoir in 1963, revised the statutes to include off stream storage. This legislation is regulated by the California Department of Water Resources, Division of Safety of Dams. Two classifications of dam types are covered: (1) dam structures that are or will be in the future 25 feet or more in height from the natural bed of the stream or water course at the downstream toe of the barrier and (2) dams that have an impounding capacity of 50 acre feet or more (California Department of Water Resources 2004).

Implementing the legislation involves use of geology and geotechnical engineering over the entirety of the dam’s useful life for site selection, dam design and construction, and on-going inspection of the impounding structures.

**Surface Mining Reclamation Act**

All mining operations in the county and throughout the state are subject to the California Surface Mining and Reclamation Act (SMARA) (Public Resources Code, Section 2710 et seq). The objective of SMARA is to identify and protect areas containing significant mineral resources. To accomplish this objective, SMARA regulates surface mining operations to assure that adverse environmental effects are prevented or minimized and requires reclamation of mined lands to a usable condition that is readily adaptable to alternative land uses. SMARA encourages consideration of values relating to recreation, watershed, wildlife, range and forage, and aesthetics in the production and conservation of minerals. The act also requires elimination of hazards to the public health and safety. Mining activities must comply with SMARA through all phases of a project, including reclamation.

**Regional**

**Bay Area Air Quality Management District - Asbestos Regulations**

The BAAQMD enforces the Asbestos Airborne Toxic Control Measures for Construction, Grading, Quarrying and Surface Mining Operations (California Code of Regulations, Title 17, Section 93015). The intent of this regulation is to control naturally occurring asbestos emissions from construction, grading, quarrying, and surface mining operations to the lowest achievable rates by using Best Available Control Technology (BACT). The BAAQMD requires Asbestos Dust Mitigation Plans be prepared when naturally occurring asbestos is present and would be disturbed by project operations. In addition, an Asbestos Air Monitoring Plan may be required to monitor project emissions if any residences, schools, daycare centers, industrial facilities, businesses, parks, playgrounds or hospitals exist within one quarter mile of any boundary of an area to be disturbed. BAAQMD implements and enforces compliance with asbestos regulations through its “Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying and Surface Mining Operations Inspection Guidelines”.

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County of Napa
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LOCAL

Napa County Code

Conservation Regulations (County Code Chapter 18.108)

Napa County Conservation Regulations (County Code Chapter 18.108) address erosion control and protection of the County’s streams and waterways. The intent of these regulations is to protect lands from excessive soil loss and maintain or improve water quality of watercourses by minimizing soil erosion from earthmoving, land disturbing and grading activities. Compliance with the regulations is site specific and required prior to initiating any earthmoving or land disturbing activities, and may take the form of an erosion control plan, standard erosion control measures or exemption. Erosion control plans are required for all projects which involve a proposed change of land use, or replant, on sites of 5% slope or greater.

Stormwater Management and Discharge Control (County Code Chapter 16.28)

As part of the County’s compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) stormwater permitting program, the County adopted Ordinance No. 1240 (Stormwater Management and Discharge Control) on June 22, 2004. The purpose of this ordinance is to protect water resources and improve water quality through the use of BMPs and meet the requirements of the Clean Water Act, Porter-Cologne Water Quality Act and the Basin Plan. Specifically, Section 16.28.100 requires the identification and use of BMPs to control the volume, rate and potential pollutant discharge (including soil erosion) from construction, new development and redevelopment projects, existing businesses and other activity that may cause or contribute to stormwater pollution. The County currently accepts the California Stormwater Quality Association (CASQA) California Stormwater Best Management Practice Handbooks as effective standards for implementation and installation of stormwater pollution prevention measures, which provides detailed information on BMPs associated with use and design for maximum treatment effectiveness.

Sewage Systems (County Code Title 13, Division II)

County Code includes provisions that regulate the siting, design and operation of public, private and individual sewage systems in the unincorporated area of the County. This includes required site evaluations on soil conditions, percolation tests, depth to groundwater (sewage disposal areas must have a three foot separation from the seasonal high groundwater levels, and distances from wells, creeks, slopes and reserve areas. In addition, County Code includes required details regarding operation and maintenance of sewage facilities.

Geological Risk Combination District (County Code Chapter 18.88)

This chapter of County Code consists of the use of zoning combining district that its purpose is to minimize risk to life and property from geologic hazards (e.g., severe erosion and mass earth movement), seismic hazards (e.g., ground shaking) and seismically induced hazards (e.g., land failure and flooding from tsunamis, seiches and dam and levee failure). This provision of the County Code requires geologic and seismic evaluation reports associated with proposed development requests and minimizes development potential (e.g., siting restrictions for emergency service structures [fire, police and hospital facilities] within 1/8 of a mile from identified active faults [Section 18.88.060]).
4.10 GEOLOGY AND SOILS

4.10.3 IMPACTS AND MITIGATION MEASURES

STANDARDS OF SIGNIFICANCE

A geology, or soils impact is considered significant if implementation of the General Plan would result in any of the following (based on State CEQA Guidelines Appendix G):

1) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:
   i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence or other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42);
   ii) Strong seismic ground shaking;
   iii) Seismic-related ground failure, including liquefaction; or
   iv) Landslides.
2) Result in substantial soil erosion or the loss of topsoil (refer to Section 4.11, Hydrology and Water Quality for a detailed discussion of soil erosion impacts);
3) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;
4) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property;
5) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater; and,
6) Exposure of a substantial number of people or structures to a significant risk of loss, injury, or death involving flooding as a result of a failure of a levee or dam or inundation by a seiche or tsunami.

A project’s mineral resources impacts are considered significant if project implementation would result in any of the following:

1) Result in the substantial loss of availability of a known mineral resource that would be of value to the region and the residents of the state; or,
2) Result in the substantial loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

The geologic features of Napa County provide a variety of resources and present many hazards. The physiography of the County is strongly influenced by its bedrock geology, geologic structure, and the mountain building and erosion processes operative during the Quaternary (the last two million years). The soils within the County offer unique and plentiful agricultural opportunities. Soil erosion impacts are addressed in Section 4.11 (Hydrology and Water Quality),
while potential public health impacts to airborne naturally occurring asbestos is addressed in Section 4.8 (Air Quality).

The County’s mineral resources have produced a variety of mineral and rock commodities in the past and present. A “substantial impact” to these resources is one that limits availability and productive use for future generations. It is important to protect and conserve these resources in order to maintain the viability of the County’s agricultural and mineral resources. The County’s steep hillsides and flat valleys create geologically hazardous landscapes that would be impacted by new development, weather events and seismic activity. The County exists in a highly active seismic region. Numerous faults throughout the Bay Area as well as near or within the County, present a variety of hazards that are intensified by the County’s physiographic conditions. Seismic related impacts are considered “substantial” if people or structures are exposed to potential substantial adverse effects of seismic related events, including the risk of loss, injury or death.

**METHODOLOGY**

The geology and soils analysis is based on a review of published information, surveys, and reports regarding regional geology, soils, and mineral resources. Information was primarily obtained from the BDR.

**PROJECT IMPACTS AND MITIGATION MEASURES**

**Seismic Ground Shaking**

**Impact 4.10.1** Land uses and development under the proposed Napa County General Plan Update may expose people, structures, and development to ground shaking as a result of earthquakes resulting in the risk of loss, injury, or death. *(Significant and Unavoidable - All Alternatives)*

The hazards related to ground shaking include the risk of loss, injury or death. Buildings that were constructed within the County prior to 1930, including unreinforced masonry (URM) buildings that have not been seismically retrofitted are most likely to have structural failure or collapse occur. Buildings that have been seismically retrofitted would have a decreased chance of failure. However, even structurally enhanced buildings and newer buildings could still experience significant damage and present a hazard to occupants.

The San Francisco Bay Area has a 62% chance of experiencing a magnitude 6.7 or larger earthquake by the year 2032 (Napa County, BDR 2005). Smaller magnitude earthquakes (between magnitudes 6.0 and 6.7), capable of considerable damage depending on proximity to urban areas, have about an 80% chance of occurring in the San Francisco Bay Area by 2032. A large earthquake in the San Francisco Bay Area would have a regional effect and could impact the future development and land uses that would occur in the County irrelevant of the adoption of the proposed General Plan Update. The largest area where greater shaking damage is anticipated is within the various valleys of the County. Deeper, unconsolidated alluvial deposits occupy these areas, especially the lower part of the Napa Valley, which is underlain by saturated, estuarine deposits, including the very weak compressible bay muds. Deep, unconsolidated deposits associated with valleys are subject to higher amplitude, longer duration shaking motions (ground shaking amplification), which can cause more damage to improvements than those sited on firmer, shallower deposits.

The severity of the shaking damage at a particular location within the County depends not only on the magnitude of the earthquake and the distance to its epicenter, but also on other factors.
including the nature and thickness of the surficial deposits at the location. For example, the Napa Earthquake of 2000 resulted in unusually strong ground accelerations (relative to its magnitude) in the City of Napa with attendant damage to structures, while nearer the epicenter in the Town of Yountville damage was minimal, even to older buildings. These stronger accelerations and related damage appear to have been contributed to by the apparently much deeper alluvial fill beneath the valley at the City of Napa than at the Town of Yountville, which intensified or amplified shaking damage.

While deep unconsolidated deposits have greater potential for stronger earthquake shaking, this greater potential is recognized in the Uniform Building Code (UBC) and the California Building Code (CBC). These codes provide for more stringent earthquake resistant design parameters for such areas. Thus, while these shaking impacts are potentially more damaging, they also will tend to be reduced in their structural effects due to UBC or CBC criteria that recognize this potential. This includes provisions for buildings to structurally survive an earthquake without collapsing and include such measures as anchoring to the foundation and structural frame design. In addition, County Code Section 18.88 (Geological Risk Combination District) would further restrict development in close proximity to active faults.

The extent of potential exposure to seismic events for each of the three alternatives is further described below:

**Alternative A**

As identified in Section 3.0 (Project Description), this alternative would retain the existing land use designations under the current General Plan Land Use Map as well as the policy guidance set forth under the existing General Plan. Between the year 2005 and 2030, it is projected that there would be an additional 2,235 dwelling units and 16,014,000 square feet of non-residential uses in the unincorporated portion of the County, as well as additional agricultural development (e.g., 10,000 to 12,500 acres of new vineyard development by year 2030 and associated wineries). This increase in population, employment and development could expose people, structures, and development to ground shaking as a result of seismic activity. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

**Alternative B**

This alternative would generally retain the existing land use designations under the current General Plan Land Use Map similar to Alternative A. However, this alternative would provide for additional growth within currently General Plan designated areas for rural and urban development (such as within the unincorporated community of Angwin) as well as re-use of the Pacific Coast/Boca site and Napa Pipe site. Between the year 2005 and 2030, it is projected that there would be an additional 3,885 dwelling units and 14,636,000 square feet of non-residential uses in the unincorporated portion of the County, as well as additional agricultural development (e.g., 10,000 to 12,500 acres of new vineyard development by year 2030 and associated wineries). In addition to the proposed land use map, Alternative B would include roadway improvements (associated with the proposed General Plan Update Circulation Element) and the extension of recycled water to Coombsville and Carneros that could be damaged by seismic events. This increase in population, employment and development could expose people, structures, and development to ground shaking as a result of seismic activity. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.
Alternative C

Between the year 2005 and 2030, it is projected that there would be an additional 7,635 dwelling units and 12,990,000 square feet of non-residential uses in the unincorporated portion of the County under this alternative. Alternative C would involve some additional land use changes beyond Alternative B that would allow for additional development/redevelopment (e.g., redesignation of Napa Pipe and Pacific Coast/Boca sites, potential expansion of the rural and urban uses in Angwin and establishment of a new RUL for the City of American Canyon). However, this Alternative would have similar infrastructure provisions as Alternative B that could be damaged by seismic events. This increase in population, employment and development could expose people, structures, and development to ground shaking as a result of seismic activity. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Mitigation Measures

The following mitigation measure would apply to all three alternatives:

**MM 4.10.1**

The County shall provide a policy in the General Plan that requires detailed geologic/seismic evaluation for all public and private projects (including modifications to existing projects and structures) located in or near known geologic/seismic hazards. The evaluation shall identify site design (such as setbacks from active faults and avoidance of on-site soil/geologic conditions that could become unstable or fail during a seismic event) and structural measures to prevent injury, death and catastrophic damage to structures and infrastructure improvements (such as pipelines, roadways and water surface impoundments not subject to regulation by the Division of Safety of Dams of the California Department of Water Resources) from seismic events or failure from other natural circumstances. This may include additional structural provisions beyond what is required by the Uniform Building Code (UBC) and the California Building Code (CBC).

Implementation of the above mitigation measure in addition to the provisions of UBC and CBC and County Code Chapter 18.88 would reduce the potential hazards associated with seismic ground shaking. During small and moderate seismic events the impacts seismic ground shaking would be reduced to a less than significant impact for new development consistent with the General Plan Update. These measures would require specific standards for the location and development of residential and other uses that are in close proximity to known active seismic faults. Implementation of these measures would not completely eliminate impacts resulting from seismic ground shaking from severe seismic events. In the event of severe seismic activity impacts could be significant in some locations. As a result, Alternatives A, B, and C would result in a significant and unavoidable impact.

Seismic Related Ground Failure

**Impact 4.10.2**

Land uses and development under the proposed Napa County General Plan Update may expose people, structures, and development to seismic-related ground failures including surface fault rupture, lateral spreading, lurching, liquefaction, as well as potential failure of dams and levees resulting in the risk of loss, injury, or death. (Significant and Unavoidable - All Alternatives)
Seismic related ground failures include, surface fault rupture, lateral spreading, lurching, and liquefaction. As discussed in Impact 4.10.1 the San Francisco Bay Area has a 62% chance of experiencing a magnitude 6.7 or larger earthquake by the year 2032 and would result in region-wide effects. Various kinds of seismic related ground failures can result from major earthquakes. The type of resulting ground failure depends on several factors including earthquake magnitude, duration and amplitude of seismic energy at the failure site, soil type, soil saturation, groundwater depth, steepness and topography. Seismic related ground failure can result in damage to structures, infrastructure, and nonstructural building elements. The specific impacts of different types of seismic related ground failures are discussed in further detail below.

Surface Fault Rupture

The highest potential for surface fault rupture is along the three known, active faults within the County, the West Napa, Green Valley and Hunting Creek faults. These faults are zoned (at least in part) for special investigation according to the provisions of the Alquist-Priolo Earthquake Fault Zoning Act of 1972. Unlike ground shaking, which has the potential to damage broad areas, surface fault rupture is confined to the relatively narrow zone that brackets the trace of the breaking fault. Extensive damage from fault rupture within the County is judged to have a lower probability of occurring than shaking damage. Fault creep, which is a very slow form of surface faulting, is documented to be occurring along the Green Valley fault, but it is not known if it occurs along the northernmost part of this fault that extends into the County. The potential for seismically induced failures of dams, and levees is generally presumably low, but requires site-by-site evaluation. The more likely candidates for failure damage of this type are older, smaller dams not under the jurisdiction of the Division of Dam Safety of the California Department of Water Resources.

Surface fault rupture occurs when a fault breaks through to the ground surface as a result of an earthquake. The movement is essentially instantaneous (several kilometers per second) and one side of the fault is displaced relative to the other. The sense of movement can be horizontal, vertical, or a combination of these. The amount of the displacement can vary from a few inches or less to several feet, depending on the characteristics of the fault and the specific event. The length of the rupture varies widely, again depending on fault characteristics. For example, the Great San Francisco Earthquake of 1906 had a magnitude of about 8.0 and broke for a length along the fault of about 430 kilometers (287 miles). Typically, shorter faults correspondingly experience lower maximum magnitude earthquakes and undergo less rupture length. The width of the ground breakage associated with fault rupture depends on a number of factors, including the movement and type and thickness of material the fault breaks through as it nears the ground surface. The surface pattern of mapped faults in the Coast Ranges is typified by those encountered in the County and consists of a series of parallel to sub-parallel traces of varying length comprising a zone that may be up to several hundred or, in some cases, thousands of feet wide. The traces partially overlap their neighboring trace or traces and this pattern is referred to as en echelon. Structures built astride a fault that experience the effects surface fault rupture can be severely damaged or undergo collapse from the nearly instantaneous stress imposed by the fault displacement. Such damage presents high risk for injury and death. Although there is a body of developing research and application for minimizing the surface rupture effects on structures built across active faults, it is still evolving, is relatively expensive compared to standard foundation design, and does not necessarily mitigate all risk of damage. In the majority of cases at this time, the simplest, least expensive, and safest approach is to avoid the active fault trace. This is done by exposing the fault trace(s) at the project location through trenching and detailed logging. As necessary, this is followed by the development of setback recommendations of human-habitation structures to avoid the trace(s).
Lateral Spreading

Lateral spreading is a ground failure in which a subsurface layer of soil liquefies (the liquefaction process has been described above), resulting in the overlying soil mass deforming laterally toward a free face. This is a type of landsliding triggered by shaking. Most of the County is not susceptible to lateral spreading. Limited lateral spreading could occur in alluvial areas adjacent to open stream channels where a bank or terrace face exists.

Lurching

Ground lurching is a short-term ground failure caused by seismic forces exerted on the soil. Ground lurching can occur in areas underlain with soft, weaker surficial deposits and soils and often results in ground cracking and permanent displacements. The largest known area within the County underlain by soft, weak soils is the lower Napa Valley immediately south of the City of Napa. Weaker surficial deposits in the Napa area typically include the Bay Mud.

Liquefaction

As discussed above, liquefaction is the sudden loss of soil shear strength during strong ground shaking, due to increased pore water pressure and decreased effective stress, that portion of the total stress on the soil that is borne by the soil grains. As a result, sufficiently liquefied soils can no longer support structures built on them or maintain buoyant structures placed beneath them.

Experience gained from large earthquakes throughout the world has revealed that liquefaction effects are not random. They occur in areas underlain by loose, saturated, cohesionless (non-clayey) sand, silt, and gravel. Liquefaction prone deposits of this type are geologically young, relatively unconsolidated materials that are most commonly associated with alluviated valleys with high groundwater levels. Estuarine areas, and areas comprising unengineered, saturated, cohesionless fill are often considered to have relatively high liquefaction potential.

Alluviated valleys represent a relatively small percentage, roughly about 20% of the total area of the County. Countywide, the potential for liquefaction induced ground failures is relatively low. However, most of the County’s improved areas exist within parts these valleys. As a result, liquefaction that may occur presents a higher risk of causing damage. Estuarine (marshland) areas generally present a uniformly higher potential for liquefaction. The largest contiguous area within the County where liquefaction failures could occur is within the loose saturated estuarine deposits along the Napa River, south of the City of Napa. Other smaller areas with ground failure potential are scattered within valley areas throughout the County.

Levees and Dams

The seismically induced failure of levees, earth-fill dams (not regulated by the state), and other embankments can occur due to the direct failure of the embankment itself or due to seismic failure of the natural foundation materials beneath the embankment, leading to failure of the overlying embankment structure. As noted in the sub-section 4.10.1 (Existing Setting), dams regulated by the Division of Safety of Dams of the California Department of Water Resources and are routinely inspected during their impoundment life, which includes monitoring for compliance with seismic stability standards. As an example, Milliken Reservoir water levels have been reduced as a result of seismic stability concerns by California Department of Water Resources.
Due to generally weak foundation materials believed to be present in the southernmost part of the Napa Valley, the risk of levee failure resulting from seismic shaking could be moderate or higher. This is particularly the case for older levees that may not have been constructed to modern standards, including older levees in the Cuttings Wharf area just west of the Napa River. Such failures could result in localized flooding.

In the event of a large earthquake, the County could locally experience some or all of the above listed ground failures. Such failures can cause damage to structures, breaking of underground utilities, embankment failures, and differential settlement of structures, cracking in paved areas, and rising of buoyant buried facilities relative to ground level, such as empty or partially empty storage tanks. The potential for highly damaging failures of this type within the County ranges from moderate to low in the unconsolidated deposits of colluvium, alluvium, and marsh/bay mud (hill-front, valley, and near bay front areas, respectively) to remote in areas underlain by bedrock (primarily hill-slopes). Failure potential is moderate in undocumented fill areas that are or might be subject to development at some future time. Such fills are believed to be primarily present over bay mud and in existing landfill areas.

As noted above, the Uniform Building Code (UBC) and the California Building Code (CBC) provide building standards that includes provisions for buildings to structurally survive an earthquake without collapsing. In addition, County Code Section 18.88 (Geological Risk Combination District) restricts development in close proximity to active faults and the County Conservation Regulations (County Code Chapter 18.108) also includes provisions for the consideration of geologic stability.

The extent of potential exposure to seismic events for each of the three alternatives is further described below:

**Alternative A**

This alternative would retain the existing land use designations under the current General Plan Land Use Map as well as the policy guidance set forth under the existing General Plan. Between the year 2005 and 2030, it is projected that there would be an additional 2,235 dwelling units and 16,014,000 square feet of non-residential uses in the unincorporated portion of the County, as well as additional agricultural development (e.g., 10,000 to 12,500 acres of new vineyard development by year 2030 and associated wineries). This increase in population, employment and development could expose people, structures, and development to seismic related ground failure. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

**Alternative B**

This alternative would generally retain the existing land use designations under the current General Plan Land Use Map similar to Alternative A. However, this alternative would provide for additional growth within currently General Plan designated areas for rural and urban development (such as within the unincorporated community of Angwin) as well as re-use of the Pacific Coast/Boca site and Napa Pipe site. Between the year 2005 and 2030, it is projected that there would be an additional 3,885 dwelling units and 14,636,000 square feet of non-residential uses in the unincorporated portion of the County, as well as additional agricultural development (e.g., 10,000 to 12,500 acres of new vineyard development by year 2030 and associated wineries). In addition to the proposed land use map, Alternative B would include roadway improvements (associated with the proposed General Plan Update Circulation Element) and the extension of recycled water to Coombsville and Cameros that could be damaged by seismic events. Trail and open space for public access provisions associated with
proposed General Plan Update Recreation and Open Space Element would also allow for new development that could increase use in areas not currently frequented by visitors that could be exposed to seismic hazards described above. This increase in population, employment and development could expose people, structures, and development to seismic related ground failure. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Alternative C

Alternative C is projected to have an additional 7,635 dwelling units and 12,990,000 square feet of non-residential uses in the unincorporated portion of the County under this alternative. Alternative C would involve some additional land use changes beyond Alternative B that would allow for additional development/redevelopment (e.g., redesignation of Napa Pipe and Pacific Coast/Boca sites, potential expansion of the rural and urban uses in Angwin and establishment of a new RUL for the City of American Canyon). However, this Alternative would have similar infrastructure, trail and open space provisions as Alternative B that could be exposed to seismic hazards described above. This increase in population, employment and development could expose people, structures, and development to seismic related ground failure. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Mitigation Measures

The following mitigation measure would apply to all three alternatives:

**MM 4.10.2** The County shall provide a policy in the General Plan that the County shall not accept dedication of roads (a) on or jeopardized by landslides, (b) in hilly areas or (c) in areas subject to liquefaction, subsidence or settlement, which, in the opinion of the Napa County Public Works Department, would require an excessive degree of maintenance and repair costs.

Implementation of the above mitigation measure, Mitigation Measure MM 4.10.1 in addition to the provisions of UBC and CBC and County Code Chapters 18.88 and 18.108 would reduce the potential impacts associated with seismic related ground failures. These measures would require specific standards for the location and development of residential and other uses that are in close proximity to areas with potential for seismic related ground failures. Site specific geologic or seismic evaluations would be required and recommendations would be made to reduce potential hazards. During small and moderate seismic and rainfall events the impacts of seismic related ground failures would be reduced to a less than significant impact for new development consistent with the General Plan Update. Implementation of these measures would not completely eliminate impacts resulting from seismic related ground failures. In the event of severe seismic activity or unusually high rainfall over a short period of time, impacts would be significant in some locations. As a result, Alternatives A, B, and C would result in a significant and unavoidable impact.

Tsunamis and Seiches

**Impact 4.10.3** Land uses and development under the proposed Napa County General Plan Update is not expected to expose substantial numbers of people and structures to hazards associated with seismically induced tsunamis and seiches. (Less Than Significant - All Alternatives)
As noted above, tsunamis are ocean waves generated by certain undersea earthquakes, volcanic eruptions, or landslides and seiches are waves created in closed bodies of water, such as lakes, by geologic instability. Potential for damage caused by tsunamis is considered low given the County is not directly exposed to the open ocean and lack of bay front. Currently, risk analysis of tsunamis has been limited to the evaluation of the ocean sides of San Francisco and San Mateo counties. Seiches would be limited to the larger reservoirs in the County (e.g., Lake Berryessa, Bell Canyon Reservoir, Lake Hennessey, Rector Reservoir and Milliken Reservoir). However, the potential for the loss of life and damage to structures is considered low given that development is largely restricted immediately along the shorelines of these reservoirs given their use as municipal water supply sources and County General Plan land use designations and zoning.

Potential impacts specific to each of the three alternatives are further described below:

Alternative A

This alternative would retain the existing land use designations under the current General Plan Land Use Map as well as the policy guidance set forth under the existing General Plan. Alternative A does not propose any new rural or urban land uses at the southernmost portion of the County or adjacent to large reservoirs in the County. Alternative A would not expose substantial number of people to the low potential of danger associated with tsunamis or seiches, therefore this impact is less than significant.

Alternative B

Alternative B would result in similar land use pattern as Alternative A (though more development potential within rural and urban areas) and would not propose any new rural or urban land uses at the southernmost portion of the County or adjacent to large reservoirs in the County. Alternative B would not expose substantial number of people to the low potential of danger associated with tsunamis or seiches, therefore this impact is less than significant.

Alternative C

Alternative C would result in similar land use pattern as Alternative A (though more development potential within rural and urban areas and expansion of rural and urban uses at the unincorporated community of Angwin and the City of American Canyon) and would not propose any new rural or urban land uses at the southernmost portion of the County or adjacent to large reservoirs in the County. Alternative C would not expose substantial number of people to the low potential of danger associated with tsunamis or seiches, therefore this impact is less than significant.

Mitigation Measure

None required.

Landslides

Impact 4.10.4 Land uses and development under the proposed Napa County General Plan Update may expose people, structures, and development to slow or rapidly occurring down slope earth movement resulting in the risk of loss, injury, or death. This type of hazard can be triggered seismically, result from seasonal saturation of soils, erosion, or grading activities. (Significant and Unavoidable - All Alternatives)
Like other parts of the Coast Ranges, Napa County exhibits a wide variation in landslide types. This variation includes type of movement, size and depth, geometry, degree of activity, rate of movement, and density of landslide development. Based on these variations (namely by type of material and type of movement) landslides are classified and referred to by terms such as slump, earth flow, translational, fall, flow, and so forth. Not all landslides present the same level of risk to a given project, and different projects may have different levels of risk from the same landslide. Some bedrock formations and surficial deposits are more prone to landslide failure than others, and some slope types can be more prone to sliding or particular types of sliding than others.

Most landslide types usually present a greater risk of property damage than risk of physical injury or death, because most landslides proceed at a slow rate of movement. However, some types have a higher probability of causing physical injury or death. These latter slides are characterized by their rapid movement (up to several tens of feet per second) and long travel distance (runout) from point of origin. They are most commonly classified as debris flows and debris avalanches on the landslide maps. When their movement is reported to the public by the media, such failures are often referred to as mudslides or mudflows.

Landslides are most common on steep slopes with unstable soils, and both ancient and relatively recent landslide activity has been found throughout Napa County. According to the BDR Landslide Map (BDR Landslides Map 1-8), landslide deposits have been found most commonly on the slopes flanking the three subregions of Napa County, including the Napa Valley subregion, the Interior Valleys Subregion, and the Barryessa/Knoxville subregion.

Landslides in the Napa Valley subregion are predominantly located on the hillsides northeast of American Canyon. Areas that are prone to landslides around Napa Valley are generally located on the hillsides east of Yountville and St. Helena as well as the hillsides west of Conn Creek, particularly along SR 128. Landslides in the Interior Valleys subregion are predominantly located on the hillsides surrounding Pope Valley, Hardin Creek, Capell Creek, Atlas Peak Road, and SR 121. Landslides in the Barryessa/Knoxville subregion are predominantly located on the hillsides west of Lake Barryessa, and in the most northeastern portion of Napa County, which are among the most landslide prone hillsides in Napa County.

Section 18.108.060 of the County Code establishes standards to minimize the risks associated with project development in areas characterized by steep slopes, high erosion potential, unstable soils, combustible vegetation and other sensitive environmental resource areas. Generally, no construction, improvement, grading, earthmoving activity or vegetation removal associated with the development or use of land shall take place on those parcels or portions thereof having a slope of thirty percent or greater. Some exemptions to this standard are provided. However, most private development projects would not be subject to such exempted. The exemptions are provided in Section 18.108.050 and 18.108.055 of the County Code.

Potential impacts specific to each of the three alternatives are further described below:

Alternative A

While Alternative A would result in the least amount of development as is allowed under the existing 1983 General Plan, slow housing and development would still continue principally within the existing urban areas (though new vineyard development is anticipated to range between 10,000 to 12,500 acres by year 2030). However, the increase in population, employment and development (urban, rural and agricultural) could expose people, structures, and development to damage from landslides. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.
Alternative B

As identified in Section 3.0 (Project Description), Alternative B would have the same land use pattern as Alternative B. However, this alternative would provide for additional development opportunities in the community of Angwin as well as within and adjacent to the City of Napa. Alternative B would also see anticipated new vineyard development of 10,000 to 12,500 acres by year 2030 as well as other vineyard related and other agricultural operations. In addition to the proposed land use map, Alternative B would include roadway improvements (associated with the proposed General Plan Update Circulation Element), extension of recycled water to Coombsville and Cameros, as well as policy provisions for trails and public open space (proposed Recreation and Open Space Element in the General Plan Update). This increase in population, employment and development (urban, rural, agricultural and public facilities) could expose people, structures, and development to damage from landslides. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Alternative C

Alternative C would result in the same impacts as Alternative B, but would also provide opportunities for additional rural and urban development beyond the current General Plan Land Use Map associated with expansion of rural and urban uses in the unincorporated community of Angwin and the establishment of a RUL for the City of American Canyon. This increase in population, employment and development (urban, rural, agricultural and public facilities) could expose people, structures, and development to damage from landslides. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Mitigation Measures

The following mitigation measures would apply to all three alternatives:

**MM 4.10.4a** The County shall provide a policy in the General Plan that as part of the review and approval of development and public work projects, the planting of vegetation on unstable slopes to protect structures at lower elevations or other appropriate measures shall be incorporated into the project design. Native plants should be considered for landscaping in the hills, to eliminate the need for supplemental watering which can promote earth movement. This shall be done in combination with implementation of applicable County Code provisions (e.g., Conservation Regulations).

**MM 4.10.4b** The County shall provide a policy in the General Plan that (in combination with the implementation of County Code Chapter 18.108 [Conservation Regulations]) no extensive grading shall be permitted on slopes over 15 percent where landslides or other geologic hazards are present unless the hazard(s) are eliminated or reduced to a safe level to the satisfaction of the County.

**MM 4.10.4c** The County shall provide a policy in the General Plan that lots on hillsides formed for resale as lots, rather than as part of a subdivision development, shall be large enough to provide flexibility in finding a stable buildable site and driveway location.
Implementation of above mitigation measures, mitigation measures MM 4.10.1 and MM 4.10.2 and current County Code provisions described above would reduce the potential impacts associated with landsliding for some seismic and rainfall events. During small and moderate seismic and rainfall events the impacts associated with landsliding would be reduced to a less than significant impact. These measures would require specific standards for development in areas with slopes having an increased potential to fail during seismic and rainfall events. Development on slopes over 15% and other hillside areas that have experienced landslides would be subject to site specific review to identify potential hazards. Site specific geologic or seismic evaluations would be required and recommendations would be made to reduce potential hazards of proposed development. Implementation of these provisions would not completely eliminate impacts resulting from landsliding events. In the event of severe seismic activity or unusually high rainfall over a short period of time, impacts would be significant in some locations. As a result, Alternatives A, B, and C would result in a significant and unavoidable impact.

Subsidence and Settling

Land uses and development under the proposed Napa County General Plan Update may expose people, structures, and development to the damaging effects of ground subsidence resulting in the risk of loss, injury, or death. This type of hazard can be triggered seismically, result from seasonal saturation of soils, or result from by grading activities. (Significant and Unavoidable - All Alternatives)

Subsidence and settlement result from the same physical processes. Settlement is usually considered to occur within a relatively short time frame and within a small area, for instance on the project scale. Subsidence takes place over a longer time frame and a broader regional area. Subsidence/settlement can occur differentially; that is, one area or location subsides or settles more than another. The results of subsidence/settlement, especially when it occurs differentially, can be quite damaging.

Ground subsidence/settlement has two basic mechanisms: elastic settlement and consolidation. Elastic settlement occurs from structures and other loads that cause deformation of the subsurface soils. Elastic settlement from structures is usually minor and usually occurs during construction or within the first few weeks after construction.

Longer-term ground subsidence requiring months to decades also occurs as a result of the consolidation of natural surficial materials that are compressible. Differential settlement is most likely to occur in valleys where loose soils have deposited, and can occur due to seismic activity or structural compaction. A surficial geologic unit that is known to be quite prone to subsidence is the bay mud that underlies parts of the marsh area in the lower parts of the Napa Valley south of the City of Napa. When fill or structure loads are placed on these muds for development, flood control, or other purposes, significant settlement can result. It is expected that fills previously placed on these deposits are likely undergoing consolidation and settlement of the ground surface. Any new fill or structure loads will induce new settlement in addition to any ongoing settlement. Detailed geotechnical investigation is required in order to reduce the amount of settlement to acceptable levels. The time required to complete consolidation of the bay mud depends on the thickness of the bay mud and distance to a drainage layer (underlying sand lenses). The time required to complete settlement can range from a few months to many decades.

Subsidence may result in flooding as ground levels are lowered, including the freeboard of flood control levees. Subsidence can also cause damage to structures, utilities, and roadways from...
differential settlement. Foundation and walls can crack and the structure tilt out of level. Gravity-based utilities and storm drains can become inoperable due to differential settlement that causes sag in the lines or slope reversal.

Section 18.108.060 of the County Code establishes standards to minimize the risks associated with project development in areas characterized by unstable soils.

Potential impacts specific to each of the three alternatives are further described below:

Alternative A

While Alternative A would result in the least amount of development as is allowed under the existing 1983 General Plan, slow housing and development would still continue principally within the existing urban areas (though new vineyard development is anticipated to range between 10,000 to 12,500 acres by year 2030). However, the increase in population, employment and development could expose people, structures, and development to damage from subsidence and settling. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Alternative B

As identified in Section 3.0 (Project Description), Alternative B would have the same land use pattern as Alternative B. However, this alternative would provide for additional development opportunities in the community of Angwin as well as within and adjacent to the City of Napa. Alternative B would also see anticipated new vineyard development of 10,000 to 12,500 acres by year 2030 as well as other vineyard related and other agricultural operations. In addition to the proposed land use map, Alternative B would include roadway improvements (associated with the proposed General Plan Update Circulation Element), extension of recycled water to Coombsville and Cameros, as well as policy provisions for trails and public open space (proposed Recreation and Open Space Element in the General Plan Update). The increase in population, employment and development (urban, rural, agricultural and public facilities) could expose people, structures, and development to damage from subsidence and settling. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Alternative C

Alternative C would result in the same impacts as Alternative B, but would also provide opportunities for additional rural and urban development beyond the current General Plan Land Use Map associated with expansion of rural and urban uses in the unincorporated community of Angwin and the establishment of a RUL for the City of American Canyon. This increase in population, employment and development (urban, rural, agricultural and public facilities) could expose people, structures, and development to damage from subsidence and settling. The mitigation measures below would reduce the potential impact; however, significant damage could still occur, therefore the impact is still considered significant and unavoidable.

Mitigation Measures

Implementation of mitigation measures MM 4.10.1 and MM 4.10.2 as well as compliance with current County Code provisions previously described would reduce the potential impacts associated with subsidence and settling for some seismic and rainfall events. During small and moderate seismic and rainfall events the impacts of settlement and subsidence would be
reduced to a less than significant impact. Implementation of these measures would not completely eliminate impacts resulting from severe seismic or maximum rainfall events. In the event of severe seismic activity or unusually high rainfall over a short period of time, impacts would be significant in some locations. This would be a significant and unavoidable impact. As a result, Alternatives A, B, and C would result in a significant and unavoidable impact.

Expansive Soils

Impact 4.10.6 Land uses and development under proposed Napa County General Plan Update could expose property improvements and new development to the potential adverse effects of expansive soils. (Less Than Significant Impact - All Alternatives).

As discussed above, certain clay-rich soils can cause considerable damage to structures, streets, and roads as they shrink and swell in response to seasonal changes in their moisture content. Such soils are referred to as expansive. In late summer, expansive soil shrinks and cracks (up to 1 to 4 inches wide) as the soil dries and hardens.

Expansive soils exist at a variety of locations through the County, as indicated in the BDR Soil Texture Classes map 1-16. In the Napa Valley subregion, clay-rich soils predominantly occur at low elevations near Yountville and the City of Napa. In the Interior Valleys subregion, clay-rich soils predominantly occur in the Pope Valley and surrounding Suisun Creek. In the Barryessa/Knoxville subregion, clay-rich soils predominantly occur east and southeast of Lake Barryessa. If expansive soils are initially anticipated through map review, their actual presence or absence should be determined prior to construction by site-specific geotechnical investigations. When this is done, special engineering methods can be used to reduce the stresses on buildings and utility lines. Once identified, the adverse effects of expansive soils can be avoided through proper drainage, subsoil preparation, and foundation design. When expansive soils occur on a hill slope, they undergo the slow seasonal downslope movement known as soil creep. This downslope process adds to the potential for these soils to damage improvements. Geotechnical investigations would identify this potential and engineering methods for structural development based on UBC and CBC standards will be implemented to avoid damage that would otherwise result from expansive soil hazards and soil creep. Site specific geotechnical investigations required by the County and adherence to the UBC and CBC would reduce the impacts of expansive soils on new development.

Potential impacts specific to each of the three alternatives are further described below:

Alternative A

While Alternative A would result in the least amount of development as is allowed under the existing 1983 General Plan, slow housing and development would still continue principally within the existing urban areas (though new vineyard development is anticipated to range between 10,000 to 12,500 acres by year 2030). This growth and development would be exposed to expansive soil constraints. However, site specific geotechnical investigations required by the County and adherence to the UBC and CBC would reduce the impacts of expansive soils on new development. Thus, this impact would be less than significant for Alternative A.

Alternative B

As identified in Section 3.0 (Project Description), Alternative B would have the same land use pattern as Alternative B. However, this alternative would include roadway improvements (associated with the proposed General Plan Update Circulation Element), extension of recycled
water to Coombsville and Cameros, as well as policy provisions for trails and public open space (proposed Recreation and Open Space Element in the General Plan Update). This growth and development would be exposed to expansive soil constraints. However, site specific geotechnical investigations required by the County and adherence to the UBC and CBC would reduce the impacts of expansive soils on new development. Thus, this impact would be less than significant for Alternative B.

Alternative C

Alternative C would result in the same impacts as Alternative B, but would also provide opportunities for additional rural and urban development beyond the current General Plan Land Use Map associated with expansion of rural and urban uses in the community of Angwin and the establishment of a RUL for the City of American Canyon. This growth and development would be exposed to expansive soil constraints. However, site specific geotechnical investigations required by the County and adherence to the UBC and CBC would reduce the impacts of expansive soils on new development. Thus, this impact would be less than significant for Alternative C.

Mitigation Measure

None required.

Septic System Operation

Impact 4.10.7 Land uses and development under the proposed Napa County General Plan Update could impact areas where soils may be incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems and result in impacts to surface or groundwater resources. (Less Than Significant - All Alternatives)

The impacts associated with the soils suitability of soils can be reduced or avoided through proper site inspection and project monitoring and maintenance on a project-by-project basis. Site inspection should include percolation testing to determine the soil suitability. When soil suitability is identified septic systems should be designed accordingly. Title 13, Division II of the County Code establishes specific design, location, capacity and testing standards for the installation of septic systems that ensure proper operation and avoidance of impacts to groundwater resources. When appropriate field-testing is conducted and current system location and design standards are used combined with post construction monitoring and maintenance, the potential adverse impacts to septic suitability of soils can be reduced to acceptable levels. Existing County regulations for septic systems would reduce the potential adverse impacts on surface and groundwater resulting from septic suitability of soils.

Potential impacts specific to each of the three alternatives are further described below:

Alternative A

While Alternative A would result in the least amount of development as is allowed under the existing 1983 General Plan, slow housing and development would still continue principally within the existing urban areas (though new vineyard development is anticipated to range between 10,000 to 12,500 acres by year 2030). This growth and development would involve the expanded use of septic systems in the County. However, compliance with the provisions of Title 13, Division II of the County Code would ensure that septic systems are designed and operated adequately to avoid system failures. Thus, this impact would be less than significant for Alternative A.
Alternative B

As identified in Section 3.0 (Project Description), Alternative B would have the same land use pattern as Alternative B. However, this alternative would include roadway improvements (associated with the proposed General Plan Update Circulation Element), extension of recycled water to Coombsville and Carneros, as well as policy provisions for trails and public open space (proposed Recreation and Open Space Element in the General Plan Update). This growth and development would be exposed to expansive soil constraints. This growth and development would involve the expanded use of septic systems in the County. However, compliance with the provisions of Title 13, Division II of the County Code would ensure that septic systems are designed and operated adequately to avoid system failures. Thus, this impact would be less than significant for Alternative B.

Alternative C

Alternative C would result in the same impacts as Alternative B, but would also provide opportunities for additional rural and urban development beyond the current General Plan Land Use Map associated with expansion of rural and urban uses in the community of Angwin and the establishment of a RUL for the City of American Canyon. However, compliance with the provisions of Title 13, Division II of the County Code would ensure that septic systems are designed and operated adequately to avoid system failures. Thus, this impact would be less than significant for Alternative C.

Mitigation Measure

None Required.

Mineral Resources

Impact 4.10.8 Land uses and development under the proposed Napa County General Plan Update would not result in the substantial loss of availability of aggregate resources, which are locally important due to their use by the construction community in development of the area. (Less Than Significant - All Alternatives)

According to the significance criteria, policies with a significant impact on mineral resources would result in the substantial loss of availability of a known mineral resource that would be of value to the region and the residents of the state or result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

As noted in sub-section 4.10.1 (Existing Setting), the only large active quarry is the Syar Quarry. Mining activities would be allowed to continue under General Plan Update. However, geologic opportunities for resource extraction in the future at alternate locations are not clearly known.

The California Geologic Survey produced Special Report 146 in 1986. The objective of this report was to classify land in the San Francisco-Monterey Bay region into mineral resource zones (MRZs) based on guidelines adopted by the California State Mining and Geology Board. Areas were designated as MRZs if they were identified as being within areas designated as subject to urbanization. This classification project assisted the board in adopting and designating lands needed for their mineral content. This designation process, in turn, has been designed to assist and guide local lead agencies, such as Napa County, in preserving essential mineral resources for future use through proper zoning ordinances. However, MRZ zone maps were not created for
the bulk of the County. These maps would provide insight into the potential for aggregate mineral extraction throughout the County. Recently, the California Geologic Survey has initiated the North San Francisco Bay Region classification study. Unlike the previous study (Special Report 146, part III), the pending report will classify all of Napa, Marin, and Sonoma Counties. In either event, implementation of the proposed General Plan Update (under all alternatives) would largely retain the current land use patterns and would not result in the expansion of substantial new rural or urban land uses in the County that would preclude future mineral extraction.

Potential impacts specific to each of the three alternatives are further described below:

**Alternative A**

While Alternative A would result in the least amount of development as is allowed under the existing 1983 General Plan, slow housing and development would still continue principally within the existing urban areas. This alternative would retain the current land use patterns and would not result in the expansion of substantial new rural or urban land uses in the County that would preclude future mineral extraction. Thus, this impact would be less than significant for Alternative A.

**Alternative B**

Alternative B would have the same land use pattern as Alternative B. However, this alternative would include roadway improvements (associated with the proposed General Plan Update Circulation Element), extension of recycled water to Coombsville and Cameros, as well as policy provisions for trails and public open space (proposed Recreation and Open Space Element in the General Plan Update). This alternative would largely retain the current land use patterns and would not result in the expansion of substantial new rural or urban land uses in the County that would preclude future mineral extraction. Thus, this impact would be less than significant for Alternative B.

**Alternative C**

Alternative C would result in the same impacts as Alternative B, but would also provide opportunities for additional rural and urban development beyond the current General Plan Land Use Map associated with expansion of rural and urban uses in the community of Angwin and the establishment of a RUL for the City of American Canyon. This alternative would largely retain the current land use patterns and would not result in the expansion of substantial new rural or urban land uses in the County that would preclude future mineral extraction. Thus, this impact would be less than significant for Alternative C.

**Mitigation Measure**

None required.
REFERENCES


Bryant, William. Senior Geologist. California Geologic Survey. July 21, 2006. Personal communication with County staff on comments regarding ADEIR.


The following references were listed by Jones & Stokes in the BDR report:


California Geological Survey, CD 2002-07, Geologic Map of the Cordelia and Fairfield South 7.5’ Quadrangle, Solano and Napa Counties, California. Database and Graphic files. GIS files are in Arc Info export format (uncompressed .e00).

