4.8 GEOLOGY AND SOILS

This section describes the geologic and seismic conditions within the proposed project area and evaluates the potential geologic hazards, and/or seismic impacts that could result from implementation of the proposed project. Mitigation measures for potential impacts are identified where applicable. This section summarizes the *Preliminary Geotechnical Engineering Report* for the *Nevada County Housing Element Rezone* prepared by Holdrege & Kull (H&K) on June 8, 2012 and an addendum dated December 28, 2012 and included in Appendix G.

4.8.1 ENVIRONMENTAL SETTING

REGIONAL GEOLOGY

The Housing Element rezone sites are generally located in the Sierra Nevada Foothills, on the western side of the Sierra Nevada geomorphic province. The Sierra Nevada province is an elongate, north-west/south-east trending structural block that is tilted upward to form a steep scarp above the adjacent Basin and Range province to the east. The western slope of the Sierra Nevada dips gently westward, and extends beneath sediment of the Great Valley province. Sediment within the Great Valley is derived from continual uplift and erosion of the Sierra Nevada. Since the proposed project sites cannot be summarized in one geologic summary, geologic descriptions are provided by site or in groups of similar sites below.

SITE GEOLOGY

The Geologic Map of the Chico Quadrangle, California; the California Mineral Land Classification of Nevada County, California, Special Report 164 (California Department of Conservation, Division of Mines and Geology, 1990); and the unpublished thesis Structural and Stratigraphic Relations in the Grass Valley Colfax Area of the Northern Sierra Nevada foothills, California were used to determine the geology of each site. According to the geologic maps, the geology of the proposed project sites primarily consists of Mesozoic aged plutonic and metavolcanic rocks. The Mesozoic era spans the time between the 65 and 230 million years before present. A brief description of the geology of each site is provided below. H&K reviewed historical mining maps to determine whether mining claims or ore processing facilities were depicted on the project sites.

GRASS VALLEY AREA

Site 1

Site 1 is located in an area with other successful development. The site gently slopes toward McCourtney Road with no notable landforms, drainage features, or vegetation. This site has previously been cleared and the exposed surface consisted primarily of gravel with a finer matrix soil. The geology of Site 1 consists of early Mesozoic Lake Combie Complex, massive diabase. These rocks occur as discordant plutonic masses intrusive into all other Lake Combie Units. No mining features were identified on this site; however, this site is near the northwestern boundary of the historic North Star group of mines, and numerous unrecorded workings are known to exist in the site vicinity.

Site 2

Site 2 is moderately sloping, with areas of dense blackberry bushes which may be indicative of seasonal shallow groundwater conditions. Exposed surface soils consisted of red, silty sand, with a few granitic cobbles strewn across the site. An ephemeral drainage swale was observed in the southern portion of the site; however, evidence of large flow was not observed. The surface of the drainage swale was largely covered in plant litter.

Potential evidence of past mining activity was observed in the southern portion of the site, as hummocky surfaces (tailings piles), exploratory excavations (glory holes), and berms which are potentially associated with water conveyance. The geology of this site consists of Mesozoic massive granitic intrusives that are referred to as the La Barr Meadows quartz diorite.

Sites 3-9

Sites 3 through 9 are located on a hilltop location and are forested with madrone, incense cedar, ponderosa pines, and chaparral. Blackberry bushes and other plants associated with moist soil conditions were observed in the lower portions of the sites, particularly on sites 3, 4, 6, and 9. The surface soil at the sites was typically obscured by forest litter, recent timber harvest debris, and surface vegetation. However, where observed, the surface soil appeared to typically consist of reddish brown fine sandy silt with common gravel-size rock fragments. H&K noted an increase in the gravel content of the surface soil in the upper portions of Sites 4, 5, 6, and 9 which may be indicative of a thinner soil profile at these hilltop locations and shallower depths to resistant rock.

H&K also observed minor apparent rock outcrop at isolated areas on the western parcels (Sites 3, 4, 5, 6, and 9) which may indicate the potential for relatively shallow soil and resistant, variably weathered rock conditions. They also observed an abandoned small wood structure in the eastern, downslope portion of Site 3, near an abandoned irrigation ditch alignment. Areas of shallow irregular topography were also observed in the southern portion of Site 3, which appears to be the result of past excavation or trenching in the area.

Sites 3 through 9 are underlain by early Mesozoic Lake Combie Complex, gabbroic rocks that occur as massive to undifferentiated gabbro to quartz diorite. No mining features were previously mapped on these sites; however, site observations identified an exploratory excavation or glory hole in the western portion of Site 6, near the boundary of Site 4. Sites 7 and 8 are located to the east of Brunswick Road and are also forested with estimated slope gradients ranging from approximately 20 percent in the northeastern portion of the sites to relatively flat in the west and southwestern portions of the sites, near Brunswick Road. The soils on Sites 7 and 8 consist of dark reddish brown silty fine sand. Shallow seepage or groundwater conditions were observed at Site 7, which may be attributable in part to intense thunderstorms the day prior to the site observation and are likely compounded by recent disturbance of the surface soil from timber harvest activities. An area of rock outcrop in the western portion of Site 7 was observed as well as the presence of a bench that appeared to alter the natural surface water drainage.

PENN VALLEY AREA

Sites 10-13

Site 10 is undeveloped and very gently slopes to the northeast. This site is topographically lower than the surrounding properties and appears to have poor drainage. This was

evidenced by drainage courses meandering throughout the property that were likely runoff from the surrounding properties. Site 11 gently slopes toward Site 10 and is vegetated primarily with grasses and a few oak trees. There were a few scattered granitic boulders ranging from three to six feet in diameter found on the site. Site 12 is largely undeveloped and generally flat lying. Vegetation on this site consists of grasses and a few large oak trees. There was one large granitic boulder on the south side of the site that appeared to have been placed during previous development. Site 13 is also undeveloped and has gently rolling terrain with two indistinct seasonal drainage swales that flow toward Squirrel Creek to the south.

The geology of Sites 10 through 13 consists of Mesozoic gabbroic rock associated with the Penn Valley Pluton. No mining features are mapped on these sites and no evidence of historic mining activities on the sites was observed.

LAKE OF THE PINES AREA

Sites 14-18

Generally, the geology of Sites 14 through 18 consists of early Mesozoic Lake Combie Complex, metavolcanics. No mining features are mapped on these sites, and H&K did not observe evidence of historic mining activities on the sites.

Site 14 is an undeveloped parcel near an area of other successful development, however the site is characterized by shallow soils and rock outcrops that may need to be considered during design. Sites 15 and 16 are partially developed and occupy moderately sloping terrain that is vegetated with grasses, shrubs, oak and pine trees. Site 17 is undeveloped on moderately sloping terrain and with very dense vegetation that obscures most of the site. The site was inaccessible because of the dense vegetation; therefore, observations were made from the west side of the property.

Site 18 is undeveloped on moderately to steeply sloped terrain. A rock outcrop was observed in the southern portion of the site centered on the topographic high and extending southwest along the ridge. Tree trunks on the northwest slope of Site 18 have a notable curvature, which may be an indication of soil creep on the relatively steep slopes in the area. Shallow soil and rock outcrop may limit development of this site, and slope instability should be addressed in a design-level geotechnical investigation prior to development.

SITE SOILS

H&K reviewed the Soil Survey of Nevada County Area, California (USDA Soil Conservation Service, 1975, reissued 1993) and the USDA's online Websoil Survey in May 2012. Soil classifications for each site are listed in Table 4.8-1. The soil series characteristics are also summarized below.

Ahwahnee Series

The soil survey describes the Ahwahnee Series soils as consisting of well-drained soil underlain by weathered granodiorite. Permeability is moderately rapid. The surface soil layer typically consists of dark grayish brown sandy loam to an approximate depth of two inches below ground surface (bgs). The surface soil is typically underlain by brown sandy loam to an approximate depth of 16 inches bgs. The sandy loam is typically underlain by yellowish brown to reddish yellow, heavy sandy loam to an approximate depth of 38 inches bgs. Below

38 inches bgs, weathered granodiorite is generally encountered. Noted limitations to site development are severe shallow soils for septic tank filter fields.

Aiken Series

The soil survey describes the Aiken Series soils as consisting of well-drained soil underlain by cobbly andesitic tuff and conglomerate. Permeability is moderately slow. The surface layer is littered with forest debris such as pine needles, oak leaves, and other vegetative material. Similar material below the surface becomes more decomposed as depth increases. The mineral surface layer typically consists of dark brown to yellowish-red loam and heavy loam to an approximate depth of 21 inches bgs. The loam to heavy loam is typically underlain by yellowish-red and reddish-yellow heavy loam to heavy clay loam and clay to an approximate depth of 64 inches bgs. The heavy loam to heavy clay loam and clay is typically underlain by weathered andesitic tuff typically at depths greater than 64 inches bgs.

Alluvial Land, Clayey

The soil survey describes the Alluvial Land, Clayey soils as narrow areas of alluvial material consisting of mostly dark-gray to dark grayish-brown clay loam to clay to an approximate depth of 30 to 45 inches bgs. This clay to clay loam is in places overlain by a sandy loam or loam to an approximate thickness of 3 to 10 inches. Permeability is moderately slow.

Alluvial Land, Loamy

The soil survey describes the Alluvial Land, Loamy soils as narrow areas of recent alluvial material along stream channels. The material is typically stratified and consists of coarse sandy loam to loam with gravels, to approximate depths of 30 to 45 inches bgs. This sandy loam to loam is typically underlain by gravel, cobblestones, or underlying bedrock. Permeability is moderate.

Argonaut Series

The soil survey describes the Argonaut Series soils as well-drained and underlain by metabasic or basic rock. Permeability is very slow. The typical soil profile consists of approximately 2 inches of brown, gravelly loam. The surface soil is generally underlain by an 8-inch thick stratum of reddish brown, gravelly loam. Reddish brown gravelly loam is typically underlain by 7 inches of reddish-brown gravelly clay which is underlain by 11 inches of light yellowish-brown clay loam and weathered diabase. Weathered basic rock is encountered at depths greater than 28 inches bgs.

Auburn Series

The soil survey describes the Auburn Series soils as well-drained and underlain by weathered diabase and metabasic rock. Permeability is moderate. The typical soil profile consists of approximately 9 inches of brown and reddish-brown loam and heavy loam. The surface soil is generally underlain by a 7-inch thick stratum of yellowish-red light clay loam. The light clay loam is typically underlain by weathered diabase or metabasic rock at depths greater than 16 inches bgs.

Boomer

The soil survey describes the Boomer soils as well-drained and underlain by weathered basic rock. The typical soil profile consists of approximately 11 inches of brown, dark brown and

reddish brown loam. The surface soil is generally underlain by a 26-inch thick stratum of reddish brown, heavy loam and yellowish red, clay loam. Reddish yellow loam and weathered diabase is generally encountered at depths greater than 37 inches bgs. Fractured diabase is typically encountered at a depth of 47 inches bgs. The Boomer-Rock Outcrop Complex generally has rock outcrop covering between 10 percent and 25 percent of the ground surface. Noted limitations to site development include rock outcrop, moderate corrosion potential of uncoated steel, and moderate shrink-swell potential.

Mariposa – Rock Outcrop Complex

The soil survey depicts Mariposa Rock Outcrop Complex (MkE) as being located in the northeastern portion of Site 8, generally within the low-lying area between Bubbling Wells Road and an unnamed surface water drainage on Site 8.

The Mariposa series soil is described as well-drained residual soil underlain by slightly weathered slate and shale. The surface soil typically consists of 3 inches of brown gravelly loam. The surface soil is typically underlain by yellowish brown gravelly heavy loam and reddish yellow gravelly clay loam. Slightly weathered slate or shale are typically encountered at a depth of 20 inches bgs. The soil survey notes that the soil series possesses a moderate corrosion rating for uncoated steel and a moderate shrink-swell potential.

Musick Series

The soil survey describes the Musick Series soils as consisting of well-drained soil underlain by weathered granodiorite. Permeability is moderately slow. The surface soil layer typically consists of brown and reddish-brown sandy loam to an approximate depth of 25 inches bgs. The sandy loam is typically underlain by yellowish-red and red heavy clay loam to an approximate depth of 98 inches bgs. The heavy clay loam is typically underlain by weathered granodiorite rock at depths greater than 98 inches bgs.

Placer Diggings

The soil survey describes the Placer Diggings deposits as remnants of Tertiary river deposits. These are hydraulically mined areas, placer-mined areas along stream channels, areas of natural deposits and areas of exposed bedrock. The deposits are highly variable consisting of 90 to 100 percent stones, cobblestones, or gravel with some varying percentages of soil material. The deposits range from 6 inches to 10 feet thick.

Rescue Series

The soil survey describes the Rescue Series soils as well-drained and underlain by weathered basic rock. The typical soil profile consists of approximately 3 inches of brown, loam. The surface soil is generally underlain by a 30-inch thick stratum of brown, heavy loam and reddish-brown, clay loam. The heavy loam and clay loam are typically underlain by 17 inches of brownish-yellow heavy loam that is slightly acid. Slightly weathered or fractured diabase is generally encountered at depths greater than 50 inches bgs. The Rescue-Rock Outcrop Complex generally has rock outcrop covering between 10 percent and 25 percent of the ground surface. Noted limitations to site development include rock outcrop, moderate corrosion potential of uncoated steel, and moderate shrink-swell potential.

Sierra Series

The soil survey describes the Sierra Series soils as consisting of well-drained soil underlain by weathered granodiorite. Permeability is moderately slow. The surface soil layer typically consists of dark brown to brown sandy loam to an approximate depth of 9 inches bgs. The sandy loam is typically underlain by reddish brown, heavy sandy loam to an approximate depth of 16 inches bgs. The heavy sandy loam is generally underlain by yellowish red to reddish yellow sandy clay loam to an approximate depth of 45 inches bgs. The sandy clay loam is typically underlain by light yellowish brown, weathered granodiorite, typically at depths greater than 45 inches bgs.

Sites Series

The soil survey describes the Sites Series soils as consisting of well-drained soil underlain by tilted metasedimentary and metabasic rock. Permeability is moderately slow. The surface soil layer typically consists of brown and yellowish red heavy loam to an approximate depth of 12 inches bgs. The heavy loam is typically underlain by yellowish-red clay loam and red clay, and light clay to an approximate depth of 68 inches bgs. The heavy loam is generally underlain by yellowish red clay loam to an approximate depth of 78 inches bgs. The clay loam is typically underlain by weathered metasedimentary and basic rock at depths greater than 78 inches bgs.

Table 4.8-1
Site Soils

Site Number	USDA Soil Map Symbol	Map Unit Description
Grass Valley		
1	SIB	Sites loam, 2 to 9 percent slopes
2	SID	Sites loam, 15 to 30 percent slopes
	MrE	Musick sandy loam, 15 to 20 percent slopes
	Ao	Alluvial land, clayley
	MrC	Musick sandy loam, 5 to 15 percent slopes
	SmE	Sites very stony loam, 15 to 20 percent slopes
3	SID	Sites loam, 15 to 30 percent slopes
	Ao	Alluvial land, clayley
	SIB	Sites loam, 2 to 9 percent slopes
4	SID	Sites loam, 15 to 30 percent slopes
	Ao	Alluvial land, clayley
	SIB	Sites loam, 2 to 9 percent slopes
5	SID	Sites loam, 15 to 30 percent slopes
	SIB	Sites loam, 2 to 9 percent slopes
6	SID	Sites loam, 15 to 30 percent slopes
	SIB	Sites loam, 2 to 9 percent slopes
	SmC	Sites very stony loam, 2 to 15 percent slopes
7	Ao	Alluvial land, clayley
	SIC	Sites loam, 9 to 15 percent slopes
	SID	Sites loam, 15 to 30 percent slopes
8	MkE	Sites stony loam, 2 to 50 percent slopes
	Ao	Alluvial land, clayley
	SID	Sites loam, 15 to 30 percent slopes
	SIC	Sites loam, 9 to 15 percent slopes
9	SID	Sites loam, 15 to 30 percent slopes
	SIB	Sites loam, 2 to 9 percent slopes

Table 4.8-1, continued

Site Number	USDA Soil Map Symbol	Map Unit Description
Penn Valley		
10	Am SfB	Alluvial land, loamy Sierra sandy loam, 2 to 9 percent slopes
11	SfB Am	Sierra sandy loam, 2 to 9 percent slopes Alluvial land, loamy
12	SfB BoC	Sierra sandy loam, 2 to 9 percent slopes Bloomer loam, 5 to 15 percent slopes
13	AdB Am Pr AfC	Ahwahnee sandy loam, 2 to 9 percent slopes Alluvial land, loamy Placer diggins Aiken loam, 9 to 15 percent slopes
Lake of the Pines		
14	BrD BoC	Boomer-Rock outcrop complex, 5 to 30 percent slopes Boomer loam, 5 to 15 percent slopes
15	BrD BoC	Boomer-Rock outcrop complex, 5 to 30 percent slopes Boomer loam, 5 to 15 percent slopes
16	BrD	Boomer-Rock outcrop complex, 5 to 30 percent slopes
17	BoC BrD	Boomer loam, 5 to 15 percent slopes Boomer-Rock outcrop complex, 5 to 30 percent slopes
18	SmE RkD Awc	Sites very stony loam, 15 to 50 percent slopes Rescue-Rock outcrop complex, 5 to 30 percent slopes Auburn-Argonaut complex, 2 to 15 percent slopes Auburn part Argonaut part

Source: Soil designations are from the Soil Survey of Nevada County Area, California (USDA Soil Conservation Service, 1975, reissued 1993) and the USDA's online Websoil Survey (http://websoilsurvey.nrcs.usda.gov/ Accessed [May 2012]).

GROUNDWATER CONDITIONS

H&K anticipates that saturated soil conditions and seasonally shallow seepage will be encountered in drainage swales, shallow soils, and onsite excavations during or following extended periods of wet weather. Deeper groundwater conditions have not been documented at the majority of the sites. In general, depth to groundwater is highly variable dependent on site-specific conditions, and groundwater in the region is predominately governed by fracture flow. Site 16 is the only site with an existing monitoring well network, associated with the wastewater disposal field, with groundwater documented to occur at depths ranging from 56 to 75 feet bgs.

GEOLOGIC HAZARDS

Based on the results of the preliminary geotechnical investigation, H&K believe that residential development within any of the proposed project sites is feasible from a geotechnical standpoint. Generally, the sites are expected to contain relatively shallow residual soils derived from the weathering of underlying rock.

The primary concern regarding future development on the sites is the possible presence of potentially expansive, clay soil, particularly at the sites in the Lake of the Pines area. Provided that future residential development is restricted to areas with native slope gradients of 30 percent of less, H&K believes it is unlikely that large-scale slope instability would impact any of the sites. H&K also noted areas of saturated soil, standing water, and surface water drainage on Sites 7 and 8 in the Grass Valley area. The consideration of

appropriate surface water drainage improvements and potential subsurface drainage on these sites will be an important part of the successful development of low-lying areas, if proposed in the future.

Future development within any of the proposed sites would be required to comply with Best Management Practices (BMPs) for construction, applicable regulations, such as the California Building Code (CBC), Nevada County 1995 General Plan, and the Grass Valley General Plan 2020 Safety Element goals, objectives and policies listed below, as well as site-specific design-level geotechnical investigations that would be prepared once site-specific development plans have been prepared.

SEISMIC HAZARDS

Regional faulting is associated with the central area of the Foothill Fault System which includes the Spenceville Fault, Wolf Creek Fault Zone, Bear Mountains Fault Zone (Highway 49 lineament), Grass Valley Fault, Weimar Fault Zone, and the Cleveland Hill Fault. The Foothill Fault System is a broad zone of northwest trending east dipping normal faults formed along the margin of the Great Valley and the Sierra Nevada geologic provinces on the western flank of the Sierra Nevada and southern Cascade mountain ranges. The central part of the fault zone is split into branches: the Malones Fault Zone to the east, the Cleveland Hill fault to the northwest, the Spenceville Fault to the west, and the Wolf Creek Fault Zone in the area of the project sites.

H&K reviewed the 1997 version of Special Publication 42, Fault Rupture Hazard Zones in California, which describes active faults and fault zones (activity within 11,000 years), as part of the Alquist-Priolo Earthquake Fault Zoning Act. The document and the 1999 on-line update indicate that the sites are not located within an Alquist-Priolo active fault zone. According to the Fault Activity Map of California and Adjacent Areas, the closest known active fault which has surface displacement within Holocene time (about the last 11,000 years) is the Cleveland Hill Fault. The Cleveland Hill Fault is located approximately 24 to 38 miles northwest of the rezone sites and is associated with ground rupture during the Oroville earthquakes of 1975. There is a depiction of a fault trace along the east side of the current Brunswick Road alignment; however, the mapped fault is presented as pre-quaternary in the Fault Activity Map of California, indicating that there is no evidence of displacement in the past 1.6 million years.

H&K also reviewed the California Department of Conservation Division of Mines and Geology Special Report 164, Mineral Land Classification of Nevada County, California (1990) and Structural and Stratigraphic Relations in the Grass Valley Colfax Area of the Northern Sierra Nevada Foothills, California. There are no faults mapped within the site areas, with the exception of Sites 3 and 7. However, the faults are not considered to be active.

Landslides

Slope failures, commonly referred to as landslides, include many phenomena that involve the downslope displacement and movement of material, triggered either by static (i.e., gravity) or dynamic (i.e., earthquake) forces. Exposed rock slopes undergo rockfalls, rockslides, or rock avalanches, while soil slopes experience soil slumps, rapid debris flows, and deep-seated rotational slides. Slope stability can depend on several complex variables, including the geology, structure, topography, slope geometry, and amount of groundwater present, as well as external processes such as climate and human activity. Based on H&K's investigation, and

considering the distance to known active faults, the proposed project sites are considered to have a low potential for landslide hazard.

Slumps or Land Subsidence

Land subsidence can occur in various ways during an earthquake. Movement that occurs along faults can be horizontal or vertical or have a component of both. As a result, a large area of land can subside drastically during an earthquake. Land subsidence can also be caused during liquefaction. Liquefaction can result in the settling and compacting of unconsolidated sediment in an event of a major earthquake. Based on the site observations and review of published references, H&K anticipates that the sites are generally underlain by relatively thin, medium dense soil derived from residually weathered rock. They anticipate that at many of the sites, variably weathered rock will be encountered at relatively shallow depths ranging from 10 to 30 feet bgs in the native soil profile. Based on these assumptions, the potential for liquefaction, ground lurching, surface rupture, or lateral spreading in native soil/rock onsite is considered to be minimal.

Expansive Soil

Problematic soils, such as those that are expansive, can damage buried utilities and increase maintenance requirements. Expansive soils are characterized by their ability to undergo significant volume change (i.e., to shrink and swell) as a result of variations in moisture content. Changes in soil moisture can result from rainfall, landscape irrigation, utility leakage, roof drainage, and/or perched groundwater. Expansive soils are typically very fine-grained and have a high to very high percentage of clay. Expansion and contraction of expansive soils in response to changes in moisture content can lead to differential and cyclical movements that can cause damage and/or distress to structures and equipment. Potentially expansive soil was typically not encountered in the preliminary geotechnical investigations of the project sites. However, all sites, and particularly the sites located in the Lake of the Pines area will require design-level geotechnical investigations to test for the presence of potentially expansive soil. Further geotechnical analysis will allow the developer to derive project-specific mitigation approaches, if possible.

Shallow Mining Excavation

The sites are located in the Sierra Foothills, a region associated with past and present mining. Based on H&K's research, Site 2 is the only location with documented historical mining activity. However, significant prospecting, exploratory excavation, and smaller-scale mining has occurred on multiple sites which may not be described in historical literature. Abandoned mining features such as glory holes, adits, or stockpiles may be encountered during the course of future investigations or grading and construction.

4.8.2 REGULATORY SETTING

STATE FRAMEWORK

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to prevent the construction of buildings used for human occupancy on the surface trace of active faults (those having evidence of surface displacement within about the last 11,000 years). It

requires the State Geologist to delineate earthquake fault zones around the surface traces of active faults and publish maps showing these zones.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was developed to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. The Act requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones. Before a development permit is granted for a site within a seismic hazard zone, a geotechnical investigation of the site must be conducted and appropriate mitigation measures incorporated into the project design.

California Building Code

The California Building Code (CBC) is contained in California Code of Regulations (CCR), Title 24, Part 2. Title 24 is assigned to the California Building Standards Commission, which is responsible for coordinating building standards. The purpose of the CBC is to establish minimum standards to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, and general stability by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all building and structures within its jurisdiction. The 2010 CBC is based on the 2009 International Building Code (IBC) published by the International Code Conference. In addition, the CBC contains necessary California amendments which are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general structural design and includes ways for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion into building codes.

LOCAL FRAMEWORK

Nevada County 2012 General Plan

The Nevada County 2012 General Plan (2012 General Plan) Soils Element includes several goals, objectives and policies that address geologic hazards and soils. The relevant goals, objectives, and policies are listed below.

Goal 12.1	Minimize adverse impacts of grading activities, loss of soils and soil productivity.
Objective 12.1	Minimize earth movement and disturbance.
Policy 12.1	Enforce Grading Ordinance provisions for erosion control on all new development projects by adopting provisions for ongoing monitoring of project grading. Project site inspection shall be required prior to initial site disturbance and grading to ensure all necessary control measures, including proper staking and tree protection measures, are in place. The installation, maintenance, and performance of erosion and sedimentation control measures shall be monitored by County or District staff (or their designee) and completely funded by a project applicant. All County projects shall comply with this policy.

Policy 12.3	Cooperate and encourage those activities dealing with techniques and practices to minimize erosion in cooperation with Nevada County Resource Conservation District, including provision of educational materials for the general public regarding techniques and practices to minimize erosion from construction activities.
Objective 12.2	Minimize erosion due to road construction and maintenance.
Policy 12.4	Require erosion control measures as an element of all County contracts, discretionary projects, and ministerial projects. Policy 12.5
Policy 12.5	Encourage the efforts of the Resource Conservation District and other related agencies to educate and assist the general public about techniques and practices to minimize private road maintenance related erosion.
Objective 12.3	Minimize vegetation removal.

City of Grass Valley 2020 General Plan

The City of Grass Valley 2020 General Plan (2020 General Plan) Safety Element includes several goals, objectives, and policies with respect to geologic hazards, as identified below.

Goal 1-SG	Reduce the potential risk of death, injury, property damage, and economic and social dislocation resulting from hazards.
Objective 1-SO	Assurance of a high level of protection from geologic and seismic hazards for all residents, structures and vital services.
Objective 2-SO	Reduction of risk from exposure to hazards related to past and present mining, including shafts, tunnels, tailings and toxic materials.
Policy 1-SP	Adopt current uniform codes for new construction.
Policy 2-SP	Ensure seismic safety and structural integrity in housing and commercial/industrial facilities through code enforcement.
Policy 4-SP	Based on location or probable need, require development plans in mined areas to include in-depth assessments of potential safety, including mining-related excavations, and health hazards and accompanying mitigation measures.

4.8.3 ENVIRONMENTAL ANALYSIS

THRESHOLDS OF SIGNIFICANCE

According to Appendix G of the *CEQA Guidelines*, there would be a significant impact on geology and soils if:

- The proposed project exposes people or structures to potentially substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial

evidence of a known fault, strong seismic ground shaking, seismic-related ground failure (including liquefaction), or landslides

- The proposed project results in substantial soil erosion or the loss of topsoil
- The proposed project is located on a geologic formation unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on or offsite landslides, lateral spreading, subsidence, liquefaction , or collapse
- The proposed project is located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property
- The proposed project has 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

POTENTIAL IMPACTS AND MITIGATION MEASURES

Secondary Seismic Hazards

4.8-1 THE PROPOSED PROJECT COULD EXPOSE PEOPLE OR STRUCTURES TO POTENTIALLY SUBSTANTIAL ADVERSE EFFECTS INCLUDING THE RISK OF LOSS, INJURY, OR DEATH AS A RESULT OF SECONDARY SEISMIC HAZARDS (GROUND SHAKING, DIFFERENTIAL COMPACTION, LIQUEFACTION, SEISMICALLY INDUCED FLOWING AND LANDSLIDES).

Level of Significance Before Mitigation: Potentially Significant Impact

Impact Analysis

Future development within the proposed project sites would involve construction of structures in a seismically active area (24 to 38 miles northeast of the subject sites). While surface rupture from a known fault is unlikely to occur, the proposed project sites would likely experience moderate ground shaking as a result of earthquakes occurring on off-site faults. Earthquake-related ground shaking may cause concrete slabs, building walls, and pavement at the sites to crack, potentially threatening the integrity of the structures and the safety of the people present at the time of the earthquakes. Moreover, ground motions have the potential to initiate secondary events such as differential compaction, liquefaction, and seismically induced flooding and landslides, all of which could also threaten the integrity of the structures and safety of the people present on the sites.

The potential hazards of differential compaction, liquefaction, and seismically induced flooding and landslides at the project site are all low during a large earthquake. However, areas of loose soil or fill within the project site may be subject to seismically induced settlement or liquefaction.

The likelihood of secondary seismic hazard impacts can be reduced if future site grading is performed in accordance with the recommendations of a geotechnical engineering report and the CBC. Using standard construction techniques and following the recommendations of site-specific geotechnical investigations and applicable codes and requirements, structures can be designed and built to withstand the geologic hazards listed above. Although some structural damage is not typically avoidable, building codes and local construction requirements help to protect against building collapse and personal injury during seismic events. Future

developers within the Nevada County Housing Element Rezone area would be required to comply with applicable regulations, such as the CBC, the Nevada County 2012 General Plan and the Grass Valley General Plan 2020 Safety Element goals (for Sites 1-9), objectives, and policies listed above. The following mitigation measure requires a design-level investigation to ensure the findings of the *Preliminary Geotechnical Engineering Report for Housing Element Rezone, Nevada County, California* report has been incorporated in the project design to further reduce potential secondary seismic hazards to less than significant.

Mitigation Measure:

The following mitigation measure applies to all project sites.

4.8-1 Prior to issuance of grading permits for development projects (or as part of the annexation request for Sites 1-9) within the proposed project sites, a design-level investigation shall be performed to ensure the findings of the *Preliminary Geotechnical Engineering Report for Housing Element Rezone, Nevada County, California* have been incorporated in the project design.

Level of Significance After Mitigation: Less Than Significant Impact

Soil Erosion

4.8-2 THE PROPOSED PROJECT COULD RESULT IN SUBSTANTIAL SOIL EROSION OR THE LOSS OF TOPSOIL.

Level of Significance Before Mitigation: Potentially Significant Impact

Impact Analysis

Soils within the proposed project sites have various erosion potentials that can be dependent upon slope with at least one soil characterized as having moderate to high erosion potential, regardless of slope. Future development would be allowed on areas of primarily little to moderate slope, and would not be expected to result in substantial or excessive soil erosion or the loss of topsoil.

Future development would involve vegetation removal, grading, and potentially earth excavation, which would expose soils and increase the potential for soil erosion from wind or stormwater runoff. Erosion can be controlled using standard construction practices, based on the Preliminary Geotechnical Engineering Report, and site-specific geotechnical investigations that are required by Mitigation Measure 4.8-1. In addition, adherence to applicable state and local regulations, codes and requirements, as identified in Section 4.10 (Hydrology and Water Quality), would ensure that impacts associated with construction-related soil erosion would be less than significant.

Future development allowed by the Nevada County Housing Element Rezone would cover currently pervious ground surfaces with impervious materials. This could increase stormwater runoff, which would have the potential to erode soils. Methods to reduce stormwater runoff impacts to less-than-significant levels are described in Section 4.10 (Hydrology and Water Quality), and are mitigated by implementing Mitigation Measures 4.10-1b and 4.10-1d.

Mitigation Measure:

The following mitigation measures apply to all project sites:

Implement Mitigation Measures 4.10-1b and 4.10-1d.

Level of Significance After Mitigation: Less Than Significant Impact

Unstable Soils

4.8-3 THE PROPOSED PROJECT COULD BE LOCATED ON A GEOLOGIC FORMATION UNIT OR SOIL THAT IS UNSTABLE, OR THAT WOULD BECOME UNSTABLE AS A RESULT OF CONSTRUCTION, AND POTENTIALLY RESULT IN LANDSLIDES OR SUBSIDENCE.

Level of Significance Before Mitigation: Potentially Significant Impact

Impact Analysis

As documented in the Preliminary Geotechnical Engineering Report, the landslide hazard at the project sites are generally low. However, the areas with steep slopes could be subject to landslides. An area with 30% slope was recorded on Site 18 and is mapped as an Environmentally Sensitive Area in Chapter 3.0. The Slope ESA should be avoided in all improvement and construction plans to minimize the potential for landslides. If landslides did occur they could potentially threaten the integrity of structures and the safety of individuals down slope. In addition, the majority of on-site soil would not typically be subject to liquefaction, but areas of loose soil or fill within the proposed project sites may be subject to seismically induced liquefaction. The proposed project sites are primarily underlain by soil originating from completely weathered rock. Such residual soil generally does not present a hazard of slumping or subsidence. However, subsidence may be possible in alluvial areas or areas of fill.

Future development allowed by the Nevada County Housing Element Rezone would require mitigation to establish Environmentally Sensitive Areas for areas with slopes greater than 30%. Additionally, the implementation of Mitigation Measure 4.8-1 would ensure that impacts associated with unstable soil were in conformance with the Preliminary Geotechnical Engineering Report for the project sites, which would make the impacts related to landslides and subsidence less than significant.

Mitigation Measure:

The following mitigation measures apply to all project sites:

Implement Mitigation Measure 4.8-1 and 4.8-3.

The following Mitigation Measure applies to Site 18:

4.8-3 Prior to approval of a Site Plan, grading plan, or any permit authorizing construction for a property within the RH Combining District, the project applicant shall to the satisfaction of the Director of the County Planning Department:

Establish areas with slopes greater than 30% as Environmentally Sensitive Areas. Prior to construction, slopes greater than 30% shall be designated as an Environmentally Sensitive Area (ESA) on all Site Plans, grading plans, or any plan authorizing construction for a property within the RH Combining District. No construction shall be permitted within the ESAs, unless as part of a mitigation plan approved by the County. The boundaries of the ESAs shall be clearly shown on all final plans and specifications.

Level of Significance After Mitigation: Less Than Significant Impact

Expansive Soil

4.8-4 THE PROPOSED PROJECT COULD 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.

Level of Significance Before Mitigation: Potentially Significant Impact

Impact Analysis

Potentially expansive soil was encountered in the geotechnical investigations of the sites in the Lake of the Pines area near the soil/weathered rock interface. This soil may not be suitable for use within proposed paved areas, building footprints, or any other improvements which may be susceptible to swell or expansive soil induced distress without mitigation. Therefore, a design-level investigation should be performed to ensure the recommendations of the geotechnical investigation are implemented in the project design, as identified by Mitigation Measure 4.8-1. Recommendations for mitigation of expansive soil would be based on the findings of the investigation(s).

Mitigation Measure:

The following mitigation measure applies to all project sites:

Implement Mitigation Measure 4.8-1.

Level of Significance After Mitigation: Less Than Significant Impact

This Page Intentionally Left Blank