12 SOILS, GEOLOGY, AND SEISMICITY

This chapter describes the physical characteristics of the Village at Squaw Valley Specific Plan (VSVSP) area, focused on topography, geology, soils, seismicity, and geologic hazards, and presents an analysis of the potential geologic hazards and soils impacts associated with implementation of the proposed project.

12.1 ENVIRONMENTAL SETTING

Information for the environmental setting is drawn primarily from the *Preliminary Geotechnical Engineering and Geologic Review for Squaw Valley Development Project* (Holdrege & Kull 2011), *Geotechnical Engineering Report for Lot 4 Poulsen Property* (Holdrege & Kull 2012a), *Preliminary Fault Evaluation Report* (Holdrege & Kull 2012b), *Fault Evaluation Report* (Holdrege & Kull 2015), the *Village at Squaw Valley Specific Plan Avalanche Hazard Study* (Heywood 2014), the *Placer County General Plan* (Placer County 2013), the *Squaw Valley General Plan and Land Use Ordinance* ([SVGPLUO] Placer County 1983), and the *Design Basis Report: Squaw Creek Restoration, Squaw Valley Specific Plan, Placer County, California* (Balance Hydrologics 2014).

12.1.1 Topography

The plan area is located at the west end of the 4,700-acre Squaw Valley (also known as Olympic Valley). Squaw Valley is a classic alpine glacial valley northwest of Lake Tahoe in the Sierra Nevada of California. The valley floor is at an elevation of approximately 6,200 feet, surrounded by steep mountain slopes that rise to peaks over 9,000 feet elevation.

The main Village area is at the base of the mountain slopes on relatively level ground (including many previously disturbed, graded surfaces) (Exhibit 12-1). The side slopes to the north are relatively steep with forest cover and some adjacent residential development. To the west are the nearly vertical bedrock outcrops under the tramway, and the south side abuts the base of several Squaw Valley Ski Resort ski runs. On its east end, the area opens onto the broad, gently sloping valley floor. Nearly all of the main Village area lies between 6,200 and 6,400 feet in elevation. Some lower elevations occur along Squaw Creek and the Olympic Channel.

The East Parcel is located down valley where Squaw Creek crosses the glacial deposits (moraine) that form a broad ridge looping around the east end of the meadow. Much of the East Parcel, including its southern edge along Squaw Valley Road, has been disturbed, graded, and is relatively level. Natural irregular topography including swales and depressions are located along the northern edge of the site adjacent to Squaw Creek.

12.1.2 Geology

The bedrock underlying the valley floor and exposed in the hillslopes is primarily Cretaceous age intrusive granitic rocks (abbreviated as hbg in Exhibit 12-2) and Late Tertiary age (Pliocene) basaltic andesite and pyroclastic volcanic rocks (Tsd, Tsp, Tsha, Tsi, and Tsb, these abbreviations correspond to various categories of geologic formations shown in Exhibit 12-2). Cretaceous aged granitic rock is mapped along the western slopes adjacent to and above the project area. The granitic rocks consist of granite and granodiorite, and form the steep slopes west of the project area and draining to the north fork of Squaw Creek. Tertiary volcanic rocks are more dominant in the south fork drainage and comprise the southern boundary of the watershed (i.e., Squaw Peak, KT22) (Balance Hydrologics 2014). Miocene aged volcanic rock primarily composed of andesite is upslope of glacial till on the slopes to the north and south. The volcanic rocks in the project area generally consist of highly weathered andesitic flows mixed with pyroclastic deposits that form rugged cliffs and resistant ledges.

Glaciation helped carve tributary valleys, erode headwalls, ridge crests, rock-faced cliffs, and avalanche chutes, and form the bedrock trough underlying Olympic Valley. The valley bottom fill is comprised of poorly sorted glacial deposits (till), glacial meltwater stream sands and gravels (outwash), and fine-grained lake

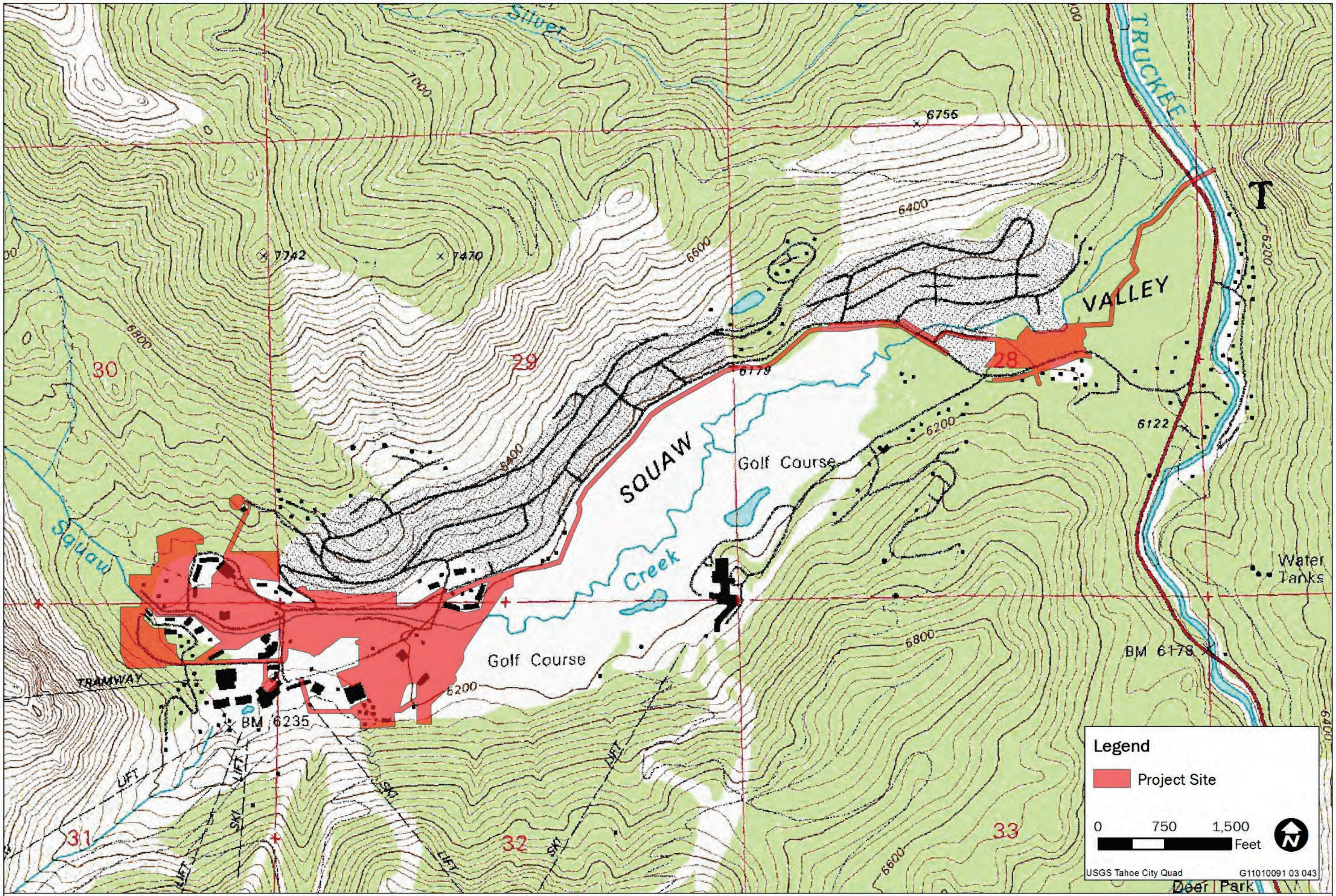
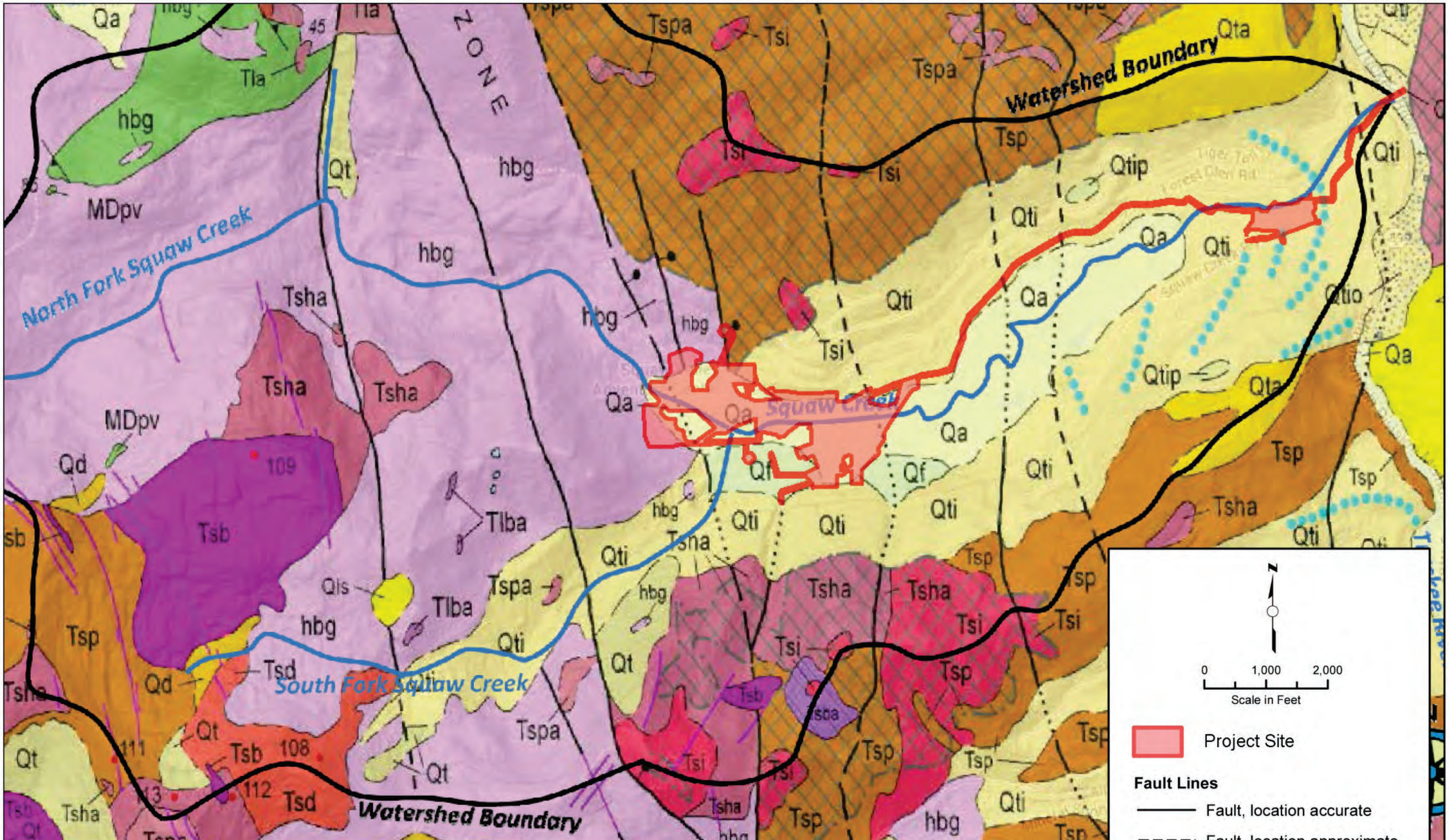


Exhibit 12-1 **Topography of the Squaw Creek Watershed Surrounding the Plan Area**



The geology of the North Fork of Squaw Creek is primarily underlain by granodiorite (hbg) and differs from the South Fork and Olympic Channel watersheds, which include a mix of glacial till (Qti), volcanics (Tsd, Tsp, Tsha, Tsi, and Tsb) and granodiorite (hbg). Also note the presence of alluvial fans (Qf) at the confluence of the South Fork and Olympic Channel. Erodibility of these units varies and results in differing rates of sediment production and transport from tributaries.

Data Source: Balance Hydrologics 2014

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Exhibit 12-2 **Geology of the Squaw Creek Watershed Surrounding the Plan Area**

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sediments (e.g., lacustrine deposits) from the bedrock to depths of 100 to 150 feet (Hecht and Jett 1988). The lower unit, which comprises most of the basin fill, consists of both Tioga (Qti) and Tahoe (Qta) aged glacial deposits (Exhibit 12-2). The valley bottom fill of Quaternary alluvium (Qa) consists of silt, sand, and gravel sediments that are coarser in the west and fine towards the northeastern part of the valley, including thin clay and silt lenses (Holdrege & Kull 2011). The southwest end of the valley has a combination of alluvial fan and deltaic sediments (Hecht and Jett 1988). The upper unit is about ten to twenty feet thick, consisting of unconsolidated stream channel sands and fine (clay/silt) overbank deposits associated with the post-glacial meadow processes.

The main Village area is sited on alluvial deposits, including some of the coarser fan deposits (Qf) that extend along the base of the mountain front from side slope chutes (Exhibit 12-2). The northern margin of the site and the infrastructure corridor along Squaw Valley Road is at the contact between glacial till (Qti) and the meadow alluvium (Qa), and the East Parcel is within the glacial moraine ridges (recessional moraines) forming the downstream boundary of the meadow.

12.1.3 Soils

Soils surrounding the main Village area include several different soil types (Exhibit 12-3). Most of the hillslope soils are minimally developed and formed from the underlying parent bedrock. Hillslope soils are dominated by Tallac (THF) series to the south and the Waca (WAE) and Meiss (MKE) series to the north. These soils are highly susceptible to erosion and therefore more sensitive to changes in land use or disturbance. The valley floor in the existing developed areas, parking lots, and along the Squaw Creek corridor and at the East Parcel is dominated by Tallac Series (TAE) soils, corresponding to areas mapped as alluvial fans (Sylvester et al. 2012) or lower slope glacial deposits. Tallac soils are very non-cohesive gravelly and very gravelly, sandy loams, and very susceptible to erosion. These soils typically form coarse gravel bars and other stream deposits. Along the Olympic Channel and throughout most of the downstream meadow, Aquolls and Borolls (AQB) dominate. These soils are stratified, with textures ranging from coarse sand to clay, and they have high water tables associated with the low gradient topography and poor to very poor drainage. They have a high erosion hazard.

Geotechnical borings completed for design of earlier development at the main Village area (Holdrege & Kull 2011) were drilled to depths of about 27 to 37 feet below the ground surface (bgs). These data indicate that artificial fill was placed over native soil materials in the Village parking area prior to the 1960 Olympics. However, some of these borings, in areas proposed for structures under the VSVSP, did not encounter existing fill (Holdrege & Kull 2011). Subsurface conditions encountered in the borings consisted of medium dense to dense granular soil (sand, gravel, and cobbles) with localized silt and clay lenses. Loose granular soils were encountered beneath the proposed commercial/residential structures located in the gently sloping paved parking lot (within creek alluvium).

Holdrege & Kull (2011) reported sediments in the proposed Squaw Creek restoration area are stratified loamy sands, silts, and some gravel, consistent with soils mapping described above, and geologic maps that show this area as the downstream end of the alluvial/colluvial fan near the headwater stream confluence. In general, Holdrege & Kull (2011) describe the site as underlain by granular soil or near-surface rock that should provide suitable support for anticipated structures on conventional shallow spread foundations or relatively deep foundations.

12.1.4 Erosion and Sedimentation

The steep topography, geologic materials, mountain climate, geomorphic processes, historic land use, and vegetation cover conditions in the Squaw Creek watershed have contributed to erosion and sedimentation problems including stream channel instability and sedimentation impacts to water quality. Sediment source estimates from the Squaw Creek Total Maximum Daily Load (TMDL) studies (Lahontan Regional Water Quality Control Board 2006) indicate that approximately 60 percent of the sedimentation affecting the creek is related to human disturbances. However, the developed areas (Residential/Commercial and Road Traction Sand) account for just two percent of the total annual sediment delivery; most of the sediment originates from upslope natural and disturbed areas (Undisturbed [37 percent], Dirt Roads [25 percent], and Graded Ski Runs [24 percent]). Erosion of the stream channel(s) is estimated to deliver about 11 percent of the annual load. Upland sources of stream sediment include fines from the volcanic rocks and glacial deposits in the South Fork and sand-sized particles from granitic rocks in the North Fork (Woyshner and Hecht 1988).

Sound Watershed (2013) compiled a bank condition inventory for Squaw Creek in the meadow reaches from numerous field visits during 2010 through 2013. This inventory reported that 23 percent of the channel has rip rap treatment on banks in the study area, and a small percent (4 percent) of those areas are unstable. Twenty four percent of remaining banks (without riprap) are unstable.

12.1.5 Faults and Seismicity

REGIONAL SEISMICITY

Similar to much of California, the project site is located in a potentially active seismic area and has experienced moderate ground shaking from historic earthquakes. Eastern Placer County is in the seismically active border with the Basin and Range province (Placer County 2010). The project site lies within the Western Nevada Seismic Zone (WNSZ), a poorly defined 150-mile-long shear zone with a system of strike slip and dip slip faults. The WNSZ covers the eastern portion of the Sierra Nevada, and the western portion of Nevada and is designated as a Type C source (i.e., with low rate of slip and low rate of recurrence) (California Geological Survey 2002).

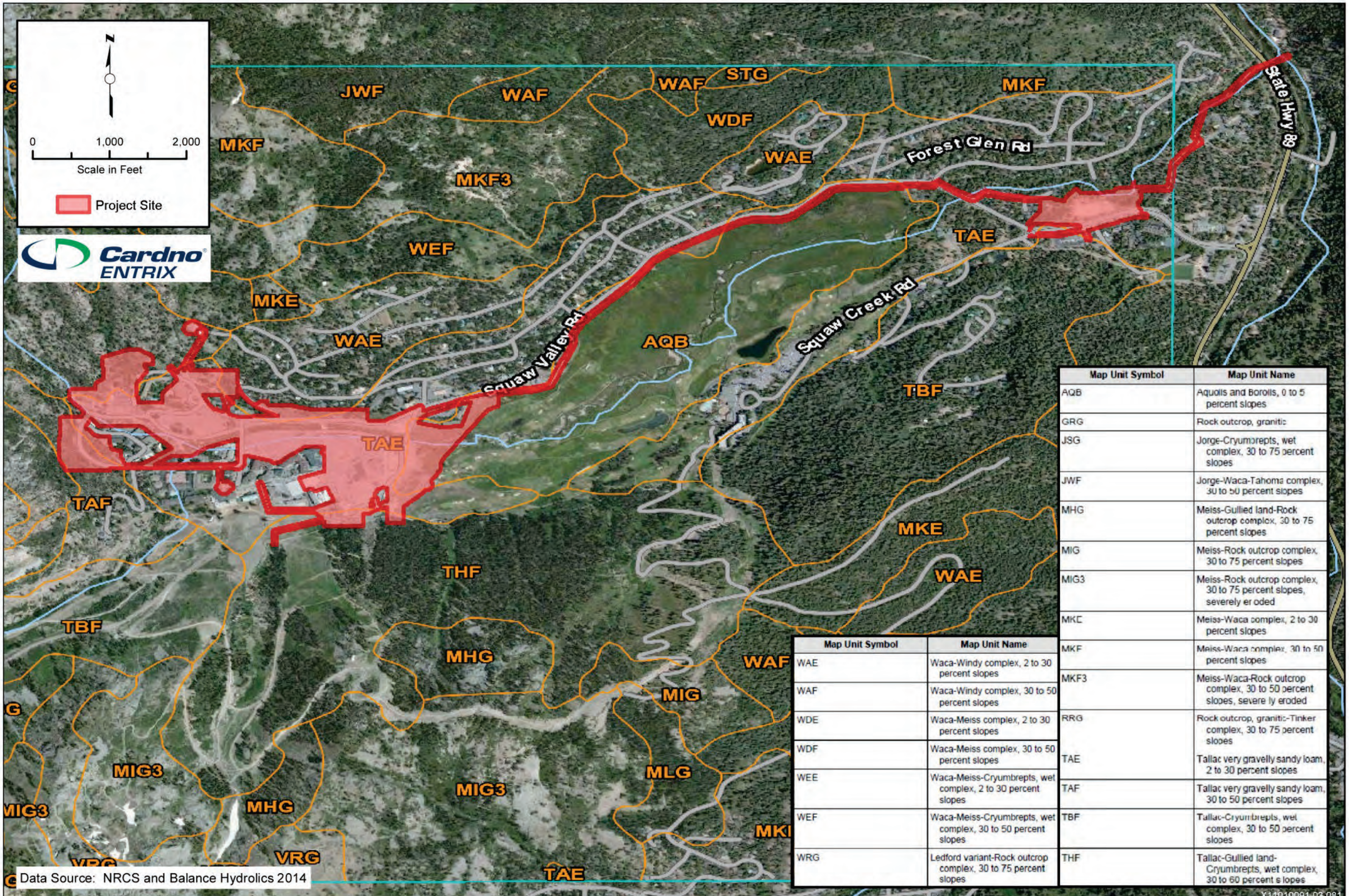
LOCAL SEISMICITY

The project site is not located in a designated Alquist-Priolo active fault zone (Holdrege & Kull 2011); however, several active and potentially active faults are located in the region (Table 12-1), and four unnamed fault traces that cross Olympic Valley have been identified near and possibly through the main Village area (Exhibits 12-2 and 12-4; Holdrege and Kull 2015). No faults are mapped as crossing or trending towards the East Parcel, so the surface rupture potential at that location is considered low (Holdrege & Kull 2012a:4).

These fault traces have been mapped (Saucedo 2005, Jennings and Bryant 2010, Sylvester et al. 2012) as approximately located (dashed) and/or concealed (buried beneath alluvium, alluvial fan, and glacial till deposits). The *Placer County Local Hazard Mitigation Plan* (Placer County 2010: Annex M) indicates that one of the four unnamed faults crossing the Olympic Valley floor has documented evidence of “recent” movement (“recent” is not defined in the document).

Holdrege & Kull prepared preliminary and final Fault Evaluation Reports for the project in 2012 and 2015, respectively (Holdrege & Kull 2012b, 2015). Based on the results of those studies, the latter of which included new published literature and data, it was determined that seven faults or possible faults cross Olympic Valley, four of which may affect the proposed project based on their locations as previously mapped (Holdrege & Kull 2015). Those four faults are designated Faults 2, 3, 4, and 5 and are shown in Exhibit 12-4.

Two (Faults 3 and 4) of the four previously mapped faults or possible faults shown as crossing the project site are considered to be pre-Holocene faults based on their poor geomorphic expression, irregular surface trace, relatively short and discontinuous extent, and lack of indications of Quaternary movement (the Quaternary Period extends from approximately 2.5 million years ago to present). Pre-Holocene faults show no signs of surface displacement within the Holocene epoch [past 11,000 years] and are not considered “active faults.” Also see Table 12-1 and the discussion of the Alquist-Priolo Earthquake Fault Zoning Act, below, for more information on the definition of active faults as well as potentially active faults. Faults 2 and



Map Unit Symbol	Map Unit Name
AQB	Aquolls and Borolls, 0 to 5 percent slopes
GRG	Rock outcrop, granitic
JSG	Jorge-Cryumbrepts, wet complex, 30 to 75 percent slopes
JWF	Jorge-Waca-Tahoma complex, 30 to 50 percent slopes
MHG	Meiss-Gullied land-Rock outcrop complex, 30 to 75 percent slopes
MIG	Meiss-Rock outcrop complex, 30 to 75 percent slopes
MIG3	Meiss-Rock outcrop complex, 30 to 75 percent slopes, severely eroded
MKE	Meiss-Waca complex, 2 to 30 percent slopes
MKF	Meiss-Waca complex, 30 to 50 percent slopes
MKF3	Meiss-Waca-Rock outcrop complex, 30 to 50 percent slopes, severely eroded
RRG	Rock outcrop, granitic-Tinker complex, 30 to 75 percent slopes
TAE	Tallac very gravelly sandy loam, 2 to 30 percent slopes
TAF	Tallac very gravelly sandy loam, 30 to 50 percent slopes
TBF	Tallac-Cryumbrepts, wet complex, 30 to 50 percent slopes
THF	Tallac-Gullied land-Cryumbrepts, wet complex, 30 to 60 percent slopes

Map Unit Symbol	Map Unit Name
WAE	Waca-Windy complex, 2 to 30 percent slopes
WAF	Waca-Windy complex, 30 to 50 percent slopes
WDE	Waca-Meiss complex, 2 to 30 percent slopes
WDF	Waca-Meiss complex, 30 to 50 percent slopes
WEE	Waca-Meiss-Cryumbrepts, wet complex, 2 to 30 percent slopes
WEF	Waca-Meiss-Cryumbrepts, wet complex, 30 to 50 percent slopes
WRG	Ledford variant-Rock outcrop complex, 30 to 75 percent slopes

Exhibit 12-3 **Soils of the Squaw Creek Watershed Surrounding the Plan Area**

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Table 12-1 Active and Potentially Active Faults near Olympic Valley, California

Fault	Relative Location	Slip Rate	Max Magnitude	Type[1]
Unnamed Traces (may be associated with Tahoe-Sierra Frontal Fault Zone)	On-site	Unknown	Unknown	Unknown
Dog Valley Fault	4.6 miles northeast			Active (Historic 1966 Truckee)
Unnamed Faults (Southern Last Chance Fault Zone)	6.5 to 8 miles northeast			Potentially Active (Quaternary)
West Tahoe – Dollar Point Fault Zone (WTDP)	6.8 miles south	0.4 to 0.8 mm/year	Large	Active (Holocene)
Tahoe-Sierra Frontal Fault Zone				Potentially Active (Quaternary)
Polaris Fault	10 miles northeast (Martis Valley to west side Stampede res)	0.4 (+- .1) mm/year	6.4 to 6.9	Active (Holocene; part of WTDP?)
Agate Bay Fault				Potentially Active (Quaternary)
North Tahoe Fault (and Incline Village Fault Zone)	10.5 miles southeast		6.5	Active (Holocene)
Genoa Fault Zone (Carson Valley Fault)	25-30 miles southeast	50 feet displaced in 2000 years	Large/very large	Active (Holocene)
East Tahoe Fault			7.0	Active
Unnamed Fault (between Genoa and Antelope Valley faults)	30-35 miles southeast			Potentially Active (Late Quaternary and/or Holocene)
Mohawk Valley Fault Zone (southern end)	35 miles north			Potentially Active (Late Quaternary)
Antelope Valley Fault Zone	45 miles south			Active (Holocene)
Unnamed Fault (Last Chance Fault Zone)	Northeast			Potentially Active (Late Quaternary)
Honey Lake Fault Zone	50 miles north			Active (Holocene)
Fort Sage Fault	Northeast			Active (Historic 1950)
Warm Springs Valley Fault	Northeast			Active (Holocene)

Notes:

[1] Active = Faults that have experienced surface displacement within the Holocene (past 11,000 years); Potentially Active = Faults that have experienced rupture between 11,000 and 1.6 million years ago.

Sources: California Geological Survey Open File Report 96-08, Probabilistic Seismic Hazard Assessment for the State of California, and the on-line revisions and California Geological Survey updates to the report, 2002 California Fault Parameters categorizes faults as Type A, B, or C. Type A faults are capable of producing large magnitude events, and have a high rate of slip. Type C faults are not capable of producing large magnitude earthquakes, and have a relatively low slip rate. Type B faults are all other type faults.

EXPLANATION

- Specific plan boundaries
- Proposed development area

Fault 7 Mapped or postulated fault crossing Squaw Valley and discussed in report text

Fault * Faults 2 and 5 require further study

Geology from Saucedo (2005)

Qls	Landslide deposits (Holocene and Pleistocene)
Q	Alluvium (Holocene and Pleistocene)
Qf	Alluvial fan deposits (Holocene and Pleistocene)
Qti	Tioga glacial till (Pleistocene)
Qta	Tahoe glacial till (Pleistocene)
Pva	Andesite and basaltic andesite flows (Pliocene)
Pia	Andesite dikes and intrusives (Pliocene)
Mva	Andesitic and dacitic lahars, flows, breccias and volcaniclastic sediments (Miocene)
Mvaf	Andesite and dacite flows (Miocene)
KJgr	Granite (Cretaceous and/or Jurassic)
KJgd	Granodiorite (Cretaceous and/or Jurassic)

Fault - solid where well located; dashed where approximately located; short dash where inferred; dotted where concealed; queried where continuation or existence is uncertain. Ball and bar on downthrown side

Geology from Sylvester, et al (2012)

Fault - solid where accurately located; dashed where approximately located; short dash where inferred; dotted where concealed; queried where uncertain. Ball and bar on downdropped block

0 300 600 1,200 Feet

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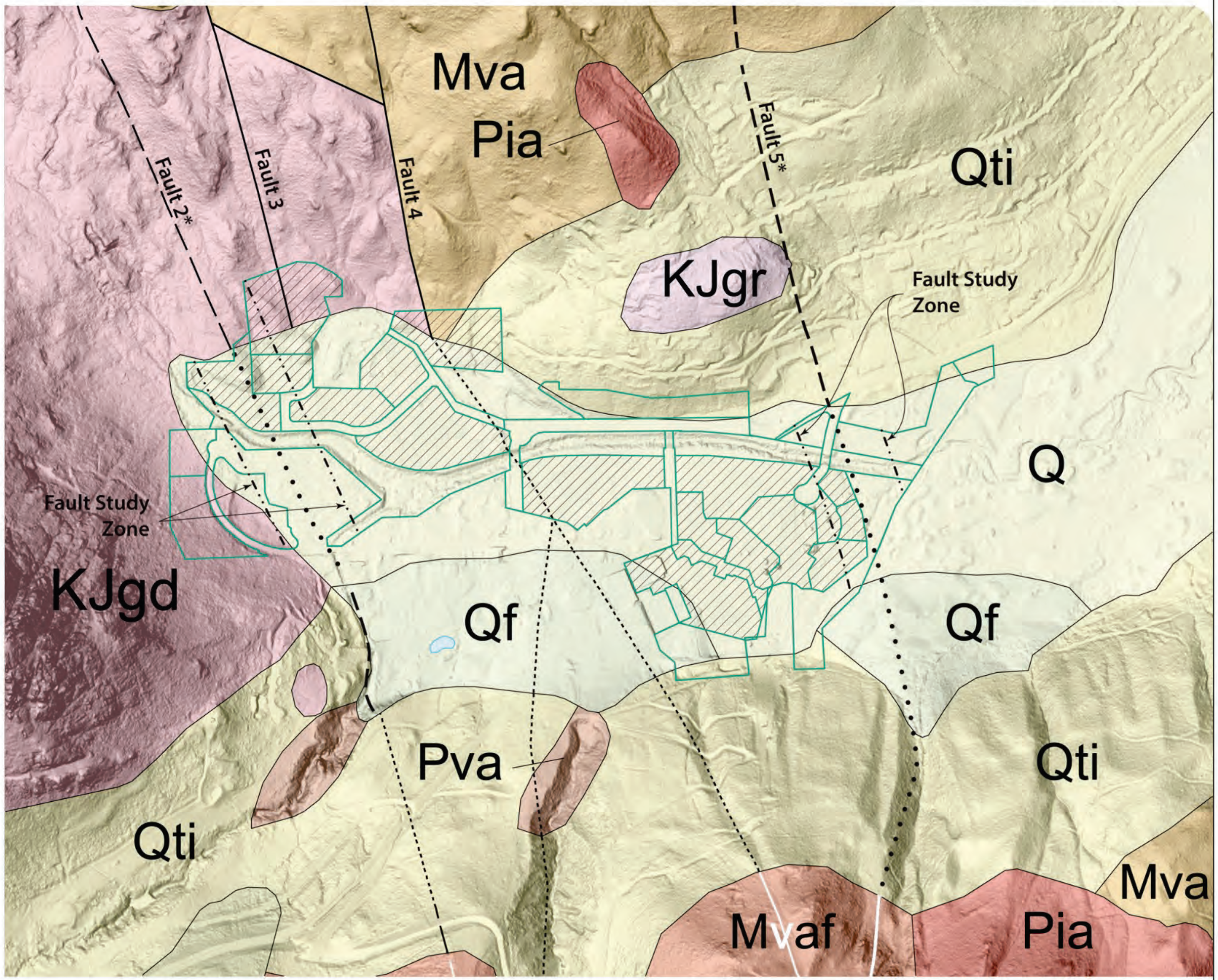

Source: Holdrege & Kull 2015

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Exhibit 12-4 **Squaw Valley Faults and Geology**

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5, which also are shown as crossing the project site based on previous mapping, may also be pre-Holocene, but require further evaluation (Holdrege & Kull 2015).

SEISMIC GROUND SHAKING

There is a high potential for the proposed project to be subject to at least moderate shaking from earthquake activity one or more times over the next century. The probability of earthquake shaking (1 sec frequency) in the next 50 years in eastern Placer County along the SR 89 corridor between Lake Tahoe and Truckee is estimated to be 21 to 30 percent (Placer County 2010).

In 1996, the California Geological Survey released a probabilistic seismic hazard assessment to aid in the assessment of seismic ground-shaking hazards in California (Peterson et al. 1996). The report contains a probabilistic seismic hazard map that depicts the peak ground acceleration (Pga) values exceeded in a given region of California at a 10 percent probability in 50 years (i.e., 0.2 percent probability in 1 year). The peak horizontal ground acceleration values depicted on the map represent probabilistic estimates of the groundshaking intensity likely to occur in a given area as a result of characteristic earthquake events on active faults, and can be used to assess the relative seismic ground-shaking hazard for a given region. Pga values range from a low of <0.1g to a high of >0.8g (g = acceleration due to gravity). For the region in which the project is located, Pga values are shown to be between 0.2g and 0.3g (Peterson et al. 1996).

SECONDARY SEISMIC HAZARDS

Secondary seismic hazards result from ground shaking and may include liquefaction, lateral spreading, slope instability, and rock fall. Holdrege & Kull (2011) describe the near-surface soil on the valley floor in the eastern portions of the main Village area as consisting of loose to dense granular soil types that may be prone to heaving and have a moderate potential for liquefaction. Lateral spreading is the lateral movement of fractured rock or soil resulting from liquefaction of adjacent/underlying materials. Because the project site has a low to moderate potential for liquefaction, Holdrege & Kull (2011) also describe the potential for lateral spreading as low to moderate.

12.1.6 Landslide/Avalanche Hazards

The project site is in an alpine setting surrounded by steep slopes subject to landslides, debris flows, rock fall, and snow avalanches. Debris flows and avalanches have occurred within Squaw Valley during large storm events historically and could occur in the future.

LANDSLIDES AND DEBRIS FLOWS

Landslides may be triggered by natural and/or human-induced changes to slope stability and are affected by many variables. They are often associated with other natural hazards such as floods, wildfires, or earthquakes, but can occur slowly or very suddenly. While most of eastern Placer County is not identified as having risk of major landslides, the vicinity of Squaw Valley has a history and likelihood of future minor landslides, which could cause damage to roads, infrastructure, and/or structures and persons. For example, landslides associated with the January 1997 flood event resulted in damages to roads, homes, and the Squaw Valley Lodge (Placer County 2010). The debris flows in the south fork of Squaw Creek during the 1997 New Year's storm carried a significant amount of sand and cobbles that caused damage to structures along with flood waters. While the probability and predictability of such events are low, similar hazards could affect the project site, particularly during or following earthquakes, floods, or wildfire.

AVALANCHES

Information in this section is primarily drawn from the project-specific Avalanche Hazard Study prepared by Larry Heywood (2014), unless otherwise cited.

Snow avalanches occur when load stress from accumulating new snow increases faster than strength develops in the underlying snow pack; commonly on steep slopes and especially where wind-drifting snow accumulates. Snow avalanches can occur either as loose slides or as slabs (which require a snow structure including a slab overlying a weak layer).

Squaw Valley is in the coastal zone of the three snow avalanche climate zones of the western United States. It is characterized by mild temperatures, abundant heavy snowfall, a high density snowcover, and low temperature gradient in the snowpack (Mock and Birkeland 2000). Coastal climates tend to have avalanches resulting from large snowfalls, but involve only the new snowfall (Mock and Birkeland 2000). The maritime climate and snowpack pose a primary avalanche risk from large direct action avalanches resulting from intense, extended storms with both high rates and large amounts of precipitation and snowfall and accompanying high winds. Mid-winter rain on new snow layers over a deep snowpack could also produce deep slabs with both wide fracture lengths and long runout distances.

Several avalanche events associated with property loss, deaths, and injuries were reported in Placer County between 1960 and 2005, including a February 21, 2001 avalanche at Squaw Valley that resulted in two fatalities (Placer County 2010). Historically, avalanches in Placer County have occurred between December and March, following large snowstorms, and primarily on hill slopes between 30 and 45 degree angles. Several historic avalanche incidents have been recorded at Squaw Valley (Table 12-2), but only the Poulsen Gully and Tram Face avalanche paths (Exhibit 12-5) have produced avalanches that reached the valley bottom.

Table 12-2 Historic Avalanche Incidents in Squaw Valley, California

Avalanche Path	Historical Large Avalanche Events
Poulsen Gully	Mid 1960s, 2012
Ski Jump	Unknown
Red Dog	Mid 1960s, 2000s
Exhibition Gully	Mid 1960s, 1980, 1982
Powderhorn	
Funitel	
Tram Face	1960s

Source: Heywood 2014

There is a long history of avalanche study and mitigation at Squaw Valley by the Professional Ski Patrol. The concept of active avalanche mitigation involves frequently triggering small slides to help reduce the potential build-up of snow that would result in large avalanches. Passive avalanche mitigation or protection involves avoidance of development or activities in avalanche areas or construction of snow stabilizing, resisting, or deflecting structures. The Squaw Valley comprehensive and detailed Avalanche Mitigation Program (AMP) conducted by the ski patrol includes detailed weather and snowpack observations, avalanche hazard assessment and forecasting, and avalanche mitigation measures (i.e., explosive triggering of small avalanches, skier compaction, and snow cat compaction). The Squaw Valley AMP is one of the most complex avalanche programs in the U.S., uses the most explosives of any avalanche program in North America, and has recorded the triggering of the most avalanches in a winter season for ski areas in the U.S. (Heywood 2014).

Heywood (2014) notes that decades of explosive mitigation and skier compaction has reduced the occurrence and frequency of large avalanches. At the same time, the routine use of explosives for pre-emptive mitigation has increased the occurrence and frequency of small to moderate size avalanches. This suggests that the Squaw Valley AMP has lengthened the return interval (decreased the probability in any given year) of large and full path avalanches, but not eliminated their possibility.

Heywood (2014) identified five Potential Avalanche Hazard Areas (PAHAs) sourced off the south slopes and two off the western end of the Squaw Valley study area (Exhibit 12-5). The proposed PAHA's developed by Heywood (2014) identify areas subject to avalanche occurrence with a probability greater than one in one hundred (100) per year and include dry and wet snow avalanches and rain-on-snow triggered avalanche events. These PAHAs were delineated according to the criteria used by Norm Wilson in developing the current Placer County PAHA map (Placer County 1982):

- Red (high hazard) Zones: Areas where avalanches that could damage standard wood-frame structures and/or bury automobiles are expected to occur with a probability of one chance in twenty per year.
- Blue (moderate hazard) Zones: Areas where avalanches that could damage standard wood-frame structures and/or bury automobiles are expected to occur with a probability of less than one chance in twenty per year, but more than one chance in one hundred per year.

The current Placer County PAHA map (Exhibit 12-6) uses the same criteria, but was developed from a prior avalanche hazard study (Placer County 1982).

Heywood (2014) applied a combination of methods for determining runout distances and return periods of potential avalanches at Squaw Valley, including: (1) analysis of historic aerial photography; (2) terrain and forest cover analysis; (3) vegetation analysis; (4) weather and climate analysis; (5) Squaw Valley historic avalanche records supplemented with oral history and photographs from avalanche personnel; (6) empirical runout distance calculations; and (7) consideration of the Squaw Valley Avalanche Mitigation Program measures. The Squaw Valley avalanche paths (Exhibit 12-5, Table 12-3) have diverse starting zone, flow path, and runout zone characteristics, reflecting both natural and managed conditions, and they have changed over the decades since initial ski run clearing associated with the 1960 Olympics.

Table 12-3 Squaw Valley Avalanche Path Descriptions

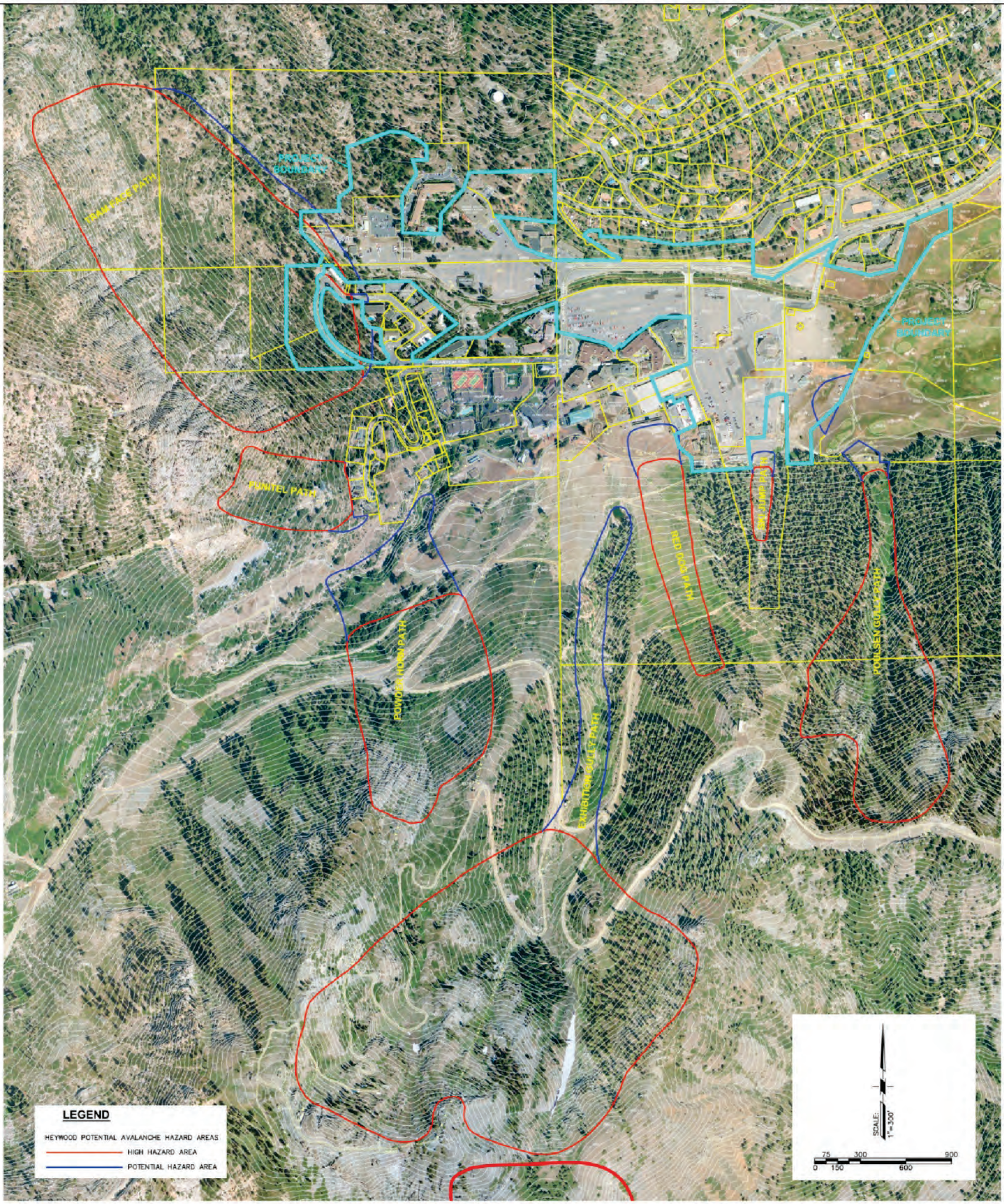
Path Name	Starting Zone	Flow Path	Runout Zone
Poulsen Gulley	Complex cirque with ridge up to 7,500 feet; heavily treed.	Heavily skied, narrow gully from 6,700 to 6,300 feet.	No large avalanches reaching below gully for decades, but extremely large event may runout to valley floor.
Ski Jump	Created by clearing for 1960 Olympics; slowly reforested over the decades.	Treed ski runs with considerable skier traffic.	May still produce avalanches, but no longer expected to runout to valley floor.
Weather Station*	No slab avalanches for decades.	Heavily skied small gully in dense trees.	No longer expected to produce avalanches, or to reach valley floor.
Red Dog	Ridge up to 6,940 feet. Cleared for 1960 Olympics, but allowed to reforest in last couple decades.	Considerable skier traffic, but profile, smoothness, lack of trees allows long runout even from low volumes.	Anticipate potential runout distances to decrease, but still extends to 6,220 feet (south side of present 'Squaw Kids' building).
Exhibition Gully	Very large, entire cirque spanning both sides of Olympic Lady lift with multiple starting zones.	Directed along lift to gully then 2,000 feet of 10 degree profile to an earthen dam.	Not expected to extend below beyond the dam at 6,350 feet.
Powderhorn	West of the KT22 chair lift up to ridge.	Large and complex path, but runs northerly to the south fork of Squaw Creek and to the west, uphill of the base of KT22.	Modified path based on new analysis ends at the south fork of Squaw Creek.
Funitel	East-facing rocky slope with scattered trees ranging from 6,700 to 6,800 feet.	Directly under the Funitel, but not skied; open slope with scattered trees.	Large avalanches could extend to terminate near Granite Chief Way at 6,340 feet.
Tram Face (AKA 'Rock Pile')	Very steep, complex starting area.	Steep track under and north of the Tram, but not skied.	Possible for runout to dam Squaw Creek.

Notes: * Identified as a PAHA on the existing (1982) Placer County Avalanche Map, but not included in Heywood's proposed 2014 map.

Sources: Placer County 1982, Heywood 2014

UNCERTAINTY AND FUTURE AVALANCHE RISKS

Climate change influences on weather may directly modify the conditions controlling avalanche potential. While future conditions are uncertain or even speculative, the direction that most future climatologic and hydrologic scenarios point would tend to decrease the maximum runouts of avalanche paths (Heywood 2014). However, climate change effects on forest health and wildfire could damage or destroy significant



Data Source: Heywood, Larry March 2014 Avalanche Hazard Study: Village at Squaw Valley Specific Plan.

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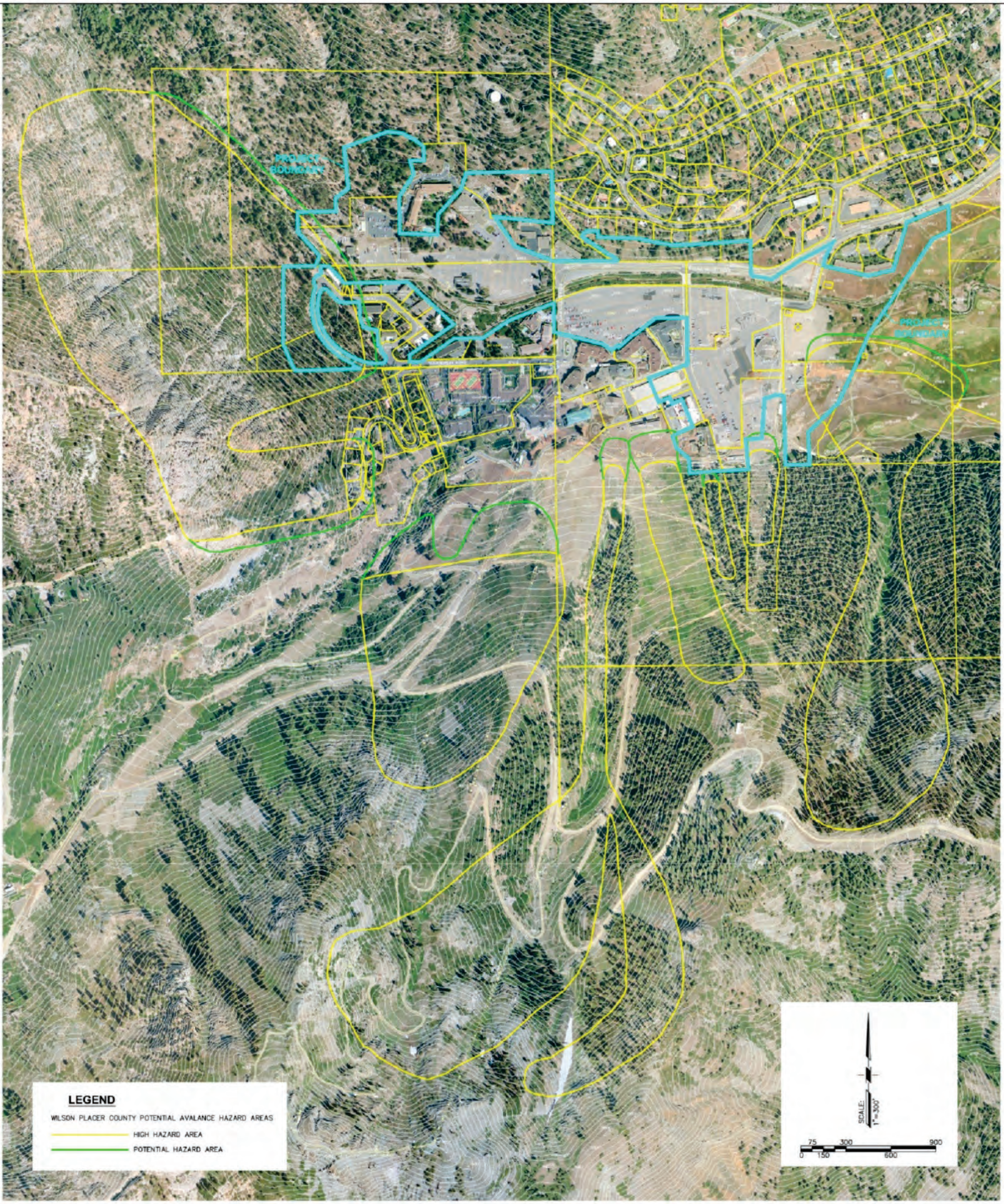
Exhibit 12-5 **Avalanche Hazard Zones**



Data Source: Heywood, Larry March 2014 Avalanche Hazard Study: Village at Squaw Valley Specific Plan.

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Exhibit 12-6 **Potential Avalanche Hazard Areas in Placer County (Wilson)**

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treed slopes and create additional openings in the forest that would be more prone to slab development (Heywood 2014). In addition to the uncertain effects of climate change on upslope forest conditions, direct management of forested slopes above the main Village area could also alter future avalanche potential. Removal of trees within existing avalanche paths and/or the creation of additional openings for other purposes could modify the avalanche potential and characteristics.

12.2 REGULATORY SETTING

12.2.1 Federal

EARTHQUAKE HAZARDS REDUCTION ACT

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the United States. To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). The mission of NEHRP includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and, accelerated application of research results. The NEHRPA designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities. Other NEHRPA agencies include the National Institute of Standards and Technology, National Science Foundation, and U.S. Geological Survey.

12.2.2 State

CALIFORNIA BUILDING CODE

The California Building Code (CBC) (California Code of Regulations, Title 24) is based on the International Building Code (IBC). The IBC Seismic Zone Map of the United States places Placer County, including the Project area, within Seismic Hazard Zone III, which corresponds to an area that may experience damage due to earthquakes having moderate intensities of V or more on Modified Mercalli Scale, which corresponds to maximum momentum magnitudes of 4.9 or greater. The CBC has been modified for California conditions with more detailed and/or more stringent regulations. Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design. Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, while Chapter 18A regulates construction on unstable soils, such as expansive soils and areas subject to liquefaction. Appendix J regulates grading activities, including drainage and erosion control.

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (Public Resources Code [PRC] Section 2621-2630) intends to reduce the risk to life and property from surface fault rupture during earthquakes by regulating construction in active fault corridors and prohibiting the location of most types of structures intended for human occupancy across the traces of active faults. The act defines criteria for identifying active faults, giving legal support to terms such as active and inactive and establishes a process for reviewing building proposals in Earthquake Fault Zones. Under the Alquist-Priolo Act, faults are zoned and construction along or across these zones is strictly regulated if they are “sufficiently active” and “well-defined.” A fault is considered sufficiently active if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the act as within the last 11,000 years). A fault is considered well defined if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface, using standard professional techniques, criteria, and judgment (Hart and Bryant

1997). Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards.

SEISMIC HAZARDS MAPPING ACT

The intention of the Seismic Hazards Mapping Act of 1990 (PRC Section 2690–2699.6) is to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong ground shaking, liquefaction, and seismically induced landslides. The act's provisions are similar in concept to those of the Alquist-Priolo Act: the State is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped Seismic Hazard Zones. Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for projects in Seismic Hazard Zones until appropriate site- specific geologic or geotechnical investigations have been carried out and measures to reduce potential damage have been incorporated into the development plans.

12.2.3 Local

PLACER COUNTY GENERAL PLAN

The relevant policies of the *Placer County General Plan* (2013) with respect to seismic and geologic hazards are listed below.

- **Policy 8.A.1.** The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., groundshaking, landslides, liquefaction, critically expansive soils, and avalanche).
- **Policy 8.A.2.** The County shall require submission of a preliminary soils report, prepared by a registered civil engineer and based upon adequate test borings, for every major subdivision and for each individual lot where critically expansive soils have been identified or are expected to exist.
- **Policy 8.A.3.** The County shall prohibit the placement of habitable structures or individual sewage disposal systems on or in critically expansive soils unless suitable mitigation measures are incorporated to prevent the potential risks of these conditions.
- **Policy 8.A.4.** The County shall ensure that areas of slope instability are adequately investigated and that any development in these areas incorporates appropriate design provisions to prevent landsliding.
- **Policy 8.A.5.** In landslide hazard areas, the County shall prohibit avoidable alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems; removal of vegetative cover; and steepening of slopes and undercutting the bases of slopes.
- **Policy 8.A.6.** The County shall require the preparation of drainage plans for development in hillside areas that direct runoff and drainage away from unstable slopes.
- **Policy 8.A.7.** In areas subject to severe groundshaking, the County shall require that new structures intended for human occupancy be designed and constructed to minimize risk to the safety of occupants.
- **Policy 8.A.9.** The County shall require that the location and/or design of any new buildings, facilities, or other development in areas subject to earthquake activity minimize exposure to danger from fault rupture or creep.

- **Policy 8.A.10.** The County shall require that new structures permitted in areas of high liquefaction potential be sited, designed, and constructed to minimize the dangers from damage due to earthquake-induced liquefaction.
- **Policy 8.A.11.** The County shall limit development in areas of steep or unstable slopes to minimize hazards caused by landslides or liquefaction.
- **Policy 8.A.12 and 8.H.3 (the same language is in each policy).** The County shall not issue permits for new development in potential avalanche hazard areas (PAHA) as designated in the Placer County Avalanche Management Ordinance unless project proponents can demonstrate that such development will be safe under anticipated snow loads and conditions of an avalanche.
- **Policy 8.H.2.** The County shall require new development in areas of avalanche hazard to be sited, designed, and constructed to minimize avalanche hazards.

SQUAW VALLEY GENERAL PLAN AND LAND USE ORDINANCE

The SVGPLUO addresses risks from snow avalanche that could affect development and incorporates County policies related to seismic safety (Placer County 1983). When adopted in 1983, the SVGPLUO included designated geologic hazard zones (Exhibit 12-7), including:

- high hazard zones (subject to frequent and powerful avalanches), and
- potential hazard zones (a transition area).

In high hazard zones (terrain exposed to frequent and powerful avalanches), no buildings or winter parking facilities should be permitted. In potential hazard zones (a transition area), some structures may be designed to withstand the potential avalanche forces. Lodges, schools, residences, or any buildings that encourage a gathering of people should not be constructed in either of these areas. Summer-only recreation facilities could be considered.

The SVGPLUO also requires that tree removal within avalanche zones be carefully planned to avoid the creation of long continuous openings that could enhance avalanche movement. Further, site-specific study and review is necessary for any developments on sites in potential avalanche hazard areas to determine the most appropriate type of development, if any, and the most effective protective systems for the site.

Other, less serious, considerations of the snow environment in the SVGPLUO include: design of structures to withstand snow loads, placement of facilities to avoid snow drifting problems and icing conditions, and provision of convenient snow clearing services.

PLACER COUNTY CODE AND ORDINANCES

Grading, Erosion, and Sediment Control Ordinances

The proposed project will be subject to the provisions of Placer County Code, Chapter 15, Article 15.48 (Grading, Erosion and Sediment Control) in effect at the time of tentative map submittal. All cut/fill slopes shall be at a maximum of 2:1 (horizontal:vertical) unless a soils report supports a steeper slope and the Engineering and Surveying Department (ESD) concurs with said recommendations. Fill slopes shall not exceed 1.5:1 (h:v).

The following summarizes various elements of this portion of the Placer County Code. The project applicant shall revegetate all disturbed areas and provide regular watering to ensure adequate growth. A winterization plan shall be provided and proper installation and maintenance of erosion control/winterization before, during, and after project construction. Soil stockpiling or borrow areas, shall have proper erosion control measures applied for the duration of the construction. The County requires a deposit to guarantee winterization and permanent erosion control work through a one-year maintenance period.

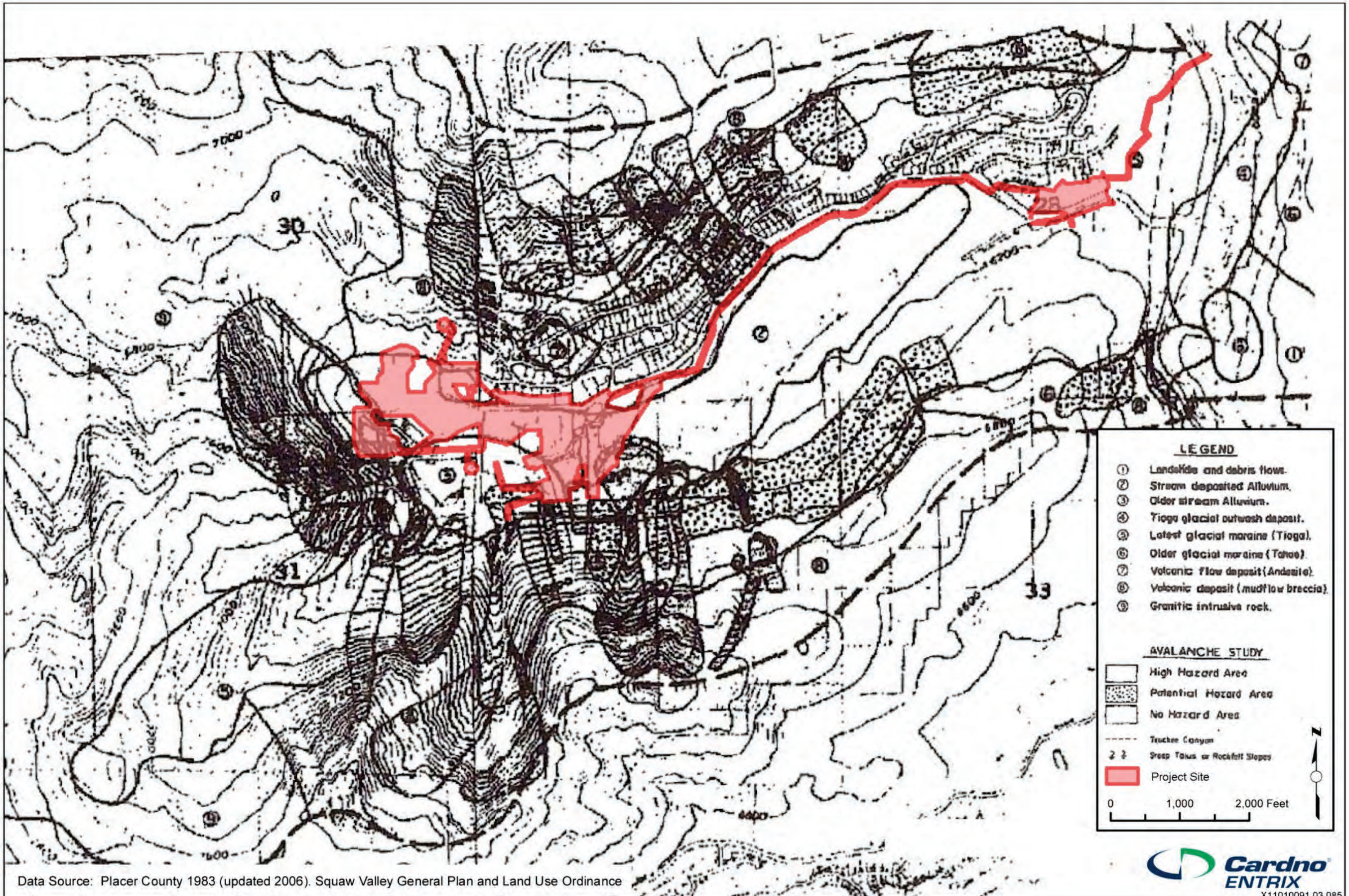


Exhibit 12-7 **Squaw Valley Avalanche Hazard Zones (1983 SVGPLUO EIR)**

Avalanche Management Ordinance

Article 12.40 of the Placer County Code addresses Avalanche Management Areas and establishes the Placer County Avalanche Management Ordinance. The Article describes PAHAs as those areas where, after investigation and study, the County finds that an avalanche potential exists because of steepness of slope, exposure, snow pack composition, wind, temperature, rate of snowfall, and other interacting factors. PAHA zones are established to identify those areas with avalanche potential based on approved studies that designate a minimum probability of occurrence greater than one in 100 per year, or where avalanche damage is documented.

Placer County limits construction in PAHAs and will not issue a building permit for construction in a PAHA without certifying that the structure will be safe under the anticipated snow loads and conditions of an avalanche.

Placer County Code (Section 12.40.040B) requires all persons who sell, rent, lease, or sublet any building within a PAHA, whether as an owner, agent, real estate salesperson, or broker representing an owner, shall:

- Prior to occupancy by such tenant, provide to such person a copy of the notice specified in Section 12.40.040A (*reproduced as Exhibit 12-8 below*).
- Prior to the sale of the property, provide full disclosure to the prospective buyer of the information contained in the notice specified in Section 12.40.040A (*reproduced as Exhibit 12-8 below*).
- As required by the Placer County Code (Section 12.40.040A), post the following notice (*reproduced as Exhibit 12-8 below*) at a prominent location within the main winter entries of any building constructed within a PAHA.

NOTICE TO OCCUPANT
This building is located within a Potential Avalanche Hazard Area.
Avalanche control work is carried out in some areas. Explosives are commonly used for this purpose. You may receive special advisories or instructions from avalanche control personnel during periods when such control work is being performed.
During times of severe snow storms or other weather conditions which may produce potential avalanche hazards, authorities may attempt to contact property owners to advise them of current conditions in avalanche zones. You must stay informed of weather conditions and rely ultimately on your own judgment.
Tune into local radio stations on your home or car radio for information.
For location information concerning avalanche control or local road closures, you may call: Office of Emergency Services Local Fire Department Sheriff
This notice must be posted in a prominent location within the main winter entry area of all buildings within a PAHA. Failure to post this notice, or the removing of a notice, is a misdemeanor punishable pursuant to Section 12.40.070.
You are urged to become better informed about avalanches by contacting the Placer County Office of Emergency Services or by reading the pamphlets available from the Placer County Planning Department and/or Building Department branch offices located at Tahoe City.

Source: Placer County Code (Section 12.40.040A) X11010091 03 103

Exhibit 12-8 **Potential Avalanche Hazard Area Required Notice**

12.3 IMPACTS

12.3.1 Significance Criteria

Based on the Placer County CEQA checklist and Appendix G of the State CEQA Guidelines, the proposed project would result in a potentially significant impact on soils, geology, and seismicity if it would:

- expose people or structures to potential 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;
  - landslides; or
  - unstable earth conditions or changes in geologic substructures.
- result in exposure of people or property to geologic and geomorphological (i.e., avalanche) hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards;
- result in substantial soil erosion or the loss of topsoil either on or off the project site;
- result in changes in deposition or erosion, or changes in siltation which may modify the channel of a river, stream, or lake;
- result in significant disruptions, displacements, compaction, or overcrowding of the soil or substantial changes in topography or ground surface relief features;
- result in the destruction, covering, or modification of any unique geologic or physical features;
- 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 offsite landslide, lateral spreading, subsidence, liquefaction or collapse;
- be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; or
- 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).

12.3.2 Methods and Assumptions

POLICIES PROPOSED IN THE SPECIFIC PLAN THAT COULD AFFECT PROJECT IMPACTS

The following policies from *The Village at Squaw Valley Specific Plan* (Squaw Valley Real Estate, LLC 2015) are applicable to the evaluation of soils, geology, and seismicity effects:

- **Policy AH-1**: No structures or winter parking areas shall be permitted in High Hazard avalanche areas.

- **Policy AH-2**: All structures constructed in areas identified as subject to a Moderate Hazard shall be designed to withstand avalanches, consistent with the Placer County Code.
- **Policy AH-3**: Outdoor gathering spaces, paths, and trails within the Moderate Hazard zone shall be designed so that access to those areas can be quickly and easily prohibited when there is a high risk of avalanche.
- **Policy AH-4**: Development shall cooperate with the Squaw Valley Ski Patrol as needed to disseminate information about avalanche risks and to limit access to areas that are considered to be of heightened risk of avalanche due to weather conditions.

IMPACT ANALYSIS METHODOLOGY

Evaluation of soils, geology, and seismicity impacts was based on a review of previous studies and project-specific studies that document the geologic and geological hazard conditions in the project area and address possible effects of the project. The information obtained from these sources was reviewed and summarized to establish existing conditions and to independently identify potential environmental impacts, based on the standards of significance presented above. In determining the level of significance, the analysis assumes that the proposed project would comply with relevant federal, State, and local ordinances and regulations.

12.3.3 Issues or Potential Impacts Not Discussed Further

Potential impacts related to deposition, erosion, or siltation which may modify the channel of a river, stream, or lake are addressed in Chapter 13, "Hydrology and Water Quality."

The project site is located on relatively level terrain on the floor of Olympic Valley and project implementation would not result in substantial changes in topography or ground surface relief features. This issue is not addressed further in this DEIR.

There are no unique geologic or related physical features on the project site and this issue is not considered further in this DEIR.

The project does not propose the use of septic tanks or alternative waste water disposal systems; it would connect to existing Squaw Valley Public Service District (SVPSD) wastewater transmission lines and the Tahoe-Truckee Sanitation Agency (T-TSA) would provide off-site wastewater treatment. Therefore, this issue is not discussed further in this DEIR.

12.3.4 Impact Analysis

Impact 12-1: Exposure of structures and persons to effects of ground rupture and shaking.

Implementation of the proposed project would include construction of structures in the vicinity of earthquake fault traces in the main Village area that are possibly active and in a region subject to moderately strong ground shaking in the event of an earthquake on regional faults. Additionally, the steep terrain and relatively unconsolidated geologic materials surrounding and underlying the project site indicate that secondary effects could include triggered landslides that might affect structures and/or persons present. While foundations and structures would be designed based on site-specific geotechnical information and in accordance with the seismic standards of the CBC, uncertainty regarding potential activity status of on-site fault traces limits the ability of standard practices to adequately assure minimization of the risk. Therefore, this would be a **significant** impact.

The Olympic Valley is in a seismically active region and could be subject to low or moderate ground acceleration in the event of an earthquake in the vicinity. While there are no Alquist-Priolo zones on the project site, prior geologic maps and studies have identified fault traces that cross Olympic Valley, including potentially active fault traces through the main Village area. Therefore, implementation of the proposed project would include construction of structures in the vicinity of earthquake fault traces that are possibly active, as well as in an overall region subject to moderately strong ground shaking in the event of an earthquake on regional faults. Additionally, the steep terrain and relatively unconsolidated geologic materials surrounding and underlying the project site indicate that secondary effects could include triggered landslides that might affect structures and/or persons present.

While foundations and structures on the project site would be designed based on site-specific geotechnical information and in accordance with the seismic standards of the CBC, the project's Fault Evaluation Report (Holdrege & Kull 2015) suggests that additional site-specific analysis be conducted prior to formulating final conclusions about whether there are any on-site sources of fault rupture. Therefore, the spatial uncertainty regarding the on-site fault traces could result in structures inadvertently being constructed over or near a previously unknown active fault. This could result in unanticipated, higher levels of seismic risks to persons visiting or residing on-site, including risk associated with fault rupture. The potential hazards to structures and persons would be a **significant** impact.

Mitigation Measure 12-1: Prepare final fault evaluation and implement recommendations.

As recommended by Holdrege & Kull's Preliminary Fault Evaluation Report (2012) and Fault Evaluation Report (2015), a focused study of the fault traces with uncertain activity status shall be made for any building or structure proposed within 200 feet of the mapped trace of Fault 2 or Fault 5, as identified in the Fault Evaluation Report. The focused study shall determine whether the on-site traces are 'active' and provide recommendations, including setbacks, or reconfigurations of building layouts if needed, and said recommendations shall be implemented during preparation of proposed Improvement Plans (see Mitigation Measure 13-2a in Chapter 13, "Hydrology and Water Quality," for more information on the content of Improvement Plans and the submittal and review process).

- Prior to the recordation of each Small Lot Tentative Map for any parcel that proposes a habitable building or structure within 200 feet of the mapped trace of Fault 2 or Fault 5, including podium parking and parking structures, the project applicant shall prepare and submit a Final Fault Evaluation Report produced by a California Registered Civil Engineer, Registered Geologist, Certified Engineering Geologist, or Geotechnical Engineer. The Final Fault Evaluation Report shall make recommendations which, at a minimum, include:
  - A written text addressing existing conditions, evidence suggesting geologically recent fault activity, all appropriate calculations, logs, cross sections, testing, and test results, fault trace location map(s) overlaid with proposed on- and off-site improvements, and site maps showing applicable building setbacks, or possible setbacks, based on various scenarios resulting from the final investigation.
  - In accordance with the Alquist Priolo Earthquake Fault Zoning Act and standard engineering practice, appropriate setbacks shall be established to reduce any hazards related with any determined surface rupture risks.
  - The maps shall be of a suitable scale to accurately locate structure setbacks. Corresponding building setbacks shall also be shown on Final Subdivision Map(s).
- Once approved by the Placer County Engineering and Surveying Division (ESD), two copies of the Final Fault Evaluation Report shall be provided to the ESD and one copy to the Building Services Division for its use.

<u>**Significance after Mitigation**</u>

Implementation of Mitigation Measure 12-1 would provide certainty about the potential for on-site fault rupture; improve the prediction of maximum ground acceleration and shaking hazards; provide a final design guidance for building layouts, foundation engineering, and structural standards that will be consistent with and adequate for the actual seismic hazards of the project site; and ensure that construction adheres to applicable seismic codes. While these measures would not eliminate the risks of earthquake rupture or shaking, these measures would lower the magnitude and probability of the impact to an acceptable level, consistent with other development in the region. This impact would be reduced to a **less-than-significant** level.

Impact 12-2: Exposure of structures and persons to risks of liquefaction and lateral spreading due to seismic shaking.

Implementation of the proposed project would include construction of structures in an area with subsurface materials subject to liquefaction and lateral spreading that could produce instability, structural damage, or risks of injury to persons if not properly anticipated and addressed. While all buildings would be constructed in accordance with seismic standards of the CBC, implementation of the project over the estimated 25-year buildout may include buildings on specific locations with varied soil conditions and a range of risks. This would be a **significant** impact.

Based on preliminary geotechnical information (Holdrege & Kull 2011), subsurface conditions at the project site are highly varied, stratified, and include areas of artificial fill, loose granular sands, and other materials that could be vulnerable to liquefaction and/or lateral spreading. Holdrege & Kull's general analysis of subsurface conditions suggests that structures built within the valley floor involving multi-story structures with the potential for limited sub-grade parking in some locations can be supported on deep foundations supported on glacial till deposits at 10 to 35 feet below the ground surface. Additionally, Holdrege & Kull anticipate that structures built within the southern, western, and northwestern portions of the project site may be supported on conventional shallow spread foundations bearing on compacted structural fill, native soil, and/or rock. However, the preliminary geotechnical study recognizes that without additional detailed site-specific information and geotechnical design guidance, foundation and structural integrity could not be assured. Therefore, because implementation of the proposed project could include construction of structures in areas with subsurface materials subject to liquefaction and lateral spreading that could produce instability, structural damage, or risks of injury to persons if not properly anticipated and addressed, this would be a **significant** impact.

Mitigation Measure 12-2: Prepare final geotechnical engineering report and implement recommendations.

The project applicant shall prepare and submit a site-specific geotechnical engineering report for each Improvement Plan submittal, to be produced by a California Registered Civil Engineer or Geotechnical Engineer for Engineering and Surveying Division (ESD) review and approval to confirm compliance with applicable seismic and building codes. The report shall address and make recommendations on the following:

- road, pavement, and parking area design;
- structural foundations, including retaining wall design;
- grading practices;
- erosion/winterization;
- special problems discovered on-site (i.e., groundwater, expansive/unstable soils, etc.);
- slope stability; and
- recommendations for areas potentially subject to debris flows, which could include relocation and/or layout modifications, off-site source area control, catchment structures, and/or deflection structures.

Once approved by the ESD, two copies of the final report shall be provided to the ESD and one copy to the Building Services Division for its use. The Building Services Division shall review all building permit applications to confirm that they incorporate the specifications of the corresponding Geotechnical Engineering Report. It is the responsibility of the project applicant to provide for engineering inspection and certification that earthwork has been performed in conformity with recommendations contained in the report.

Significance after Mitigation

Implementation of Mitigation Measure 12-2 would provide certainty about the potential for on-site secondary seismic hazards and provide a final design guidance for building layouts, foundation engineering, and structural standards that will be consistent with and adequate for the actual seismic hazards of the project site. While these measures would not eliminate the risks of secondary seismic hazards, these measures would lower the magnitude and probability of the impact to an acceptable level, consistent with other development in the region. This impact would be reduced to a **less-than-significant** level.

Impact 12-3: Exposure of structures and persons to effects of snow avalanche.

Implementation of the proposed project would include construction of structures within areas currently designated as snow avalanche hazard zones (PAHAs). Project implementation would also increase the frequency and number of persons present in PAHAs. Updated PAHAs developed for the proposed project are slightly smaller in extent than those adopted under the existing ordinance, in part because ongoing active avalanche control programs and related mountain operations are considered. The updated PAHAs would not encompass proposed building footprints, but would affect portions of buildable parcels designated for public uses. The project would comply with recommendations of additional studies to guide building design standards within the lower risk zone ('potential' PAHA), and prepare and implement an Avalanche Hazard Mitigation plan. However, if the proposed risk reduction measures and Avalanche Hazard Mitigation Plan are not properly developed and implemented, or current avalanche control practices and related mountain operations that affect avalanche risk are altered, project development could increase the number of persons at significant risk in the event of an avalanche. This impact would be **potentially significant**.

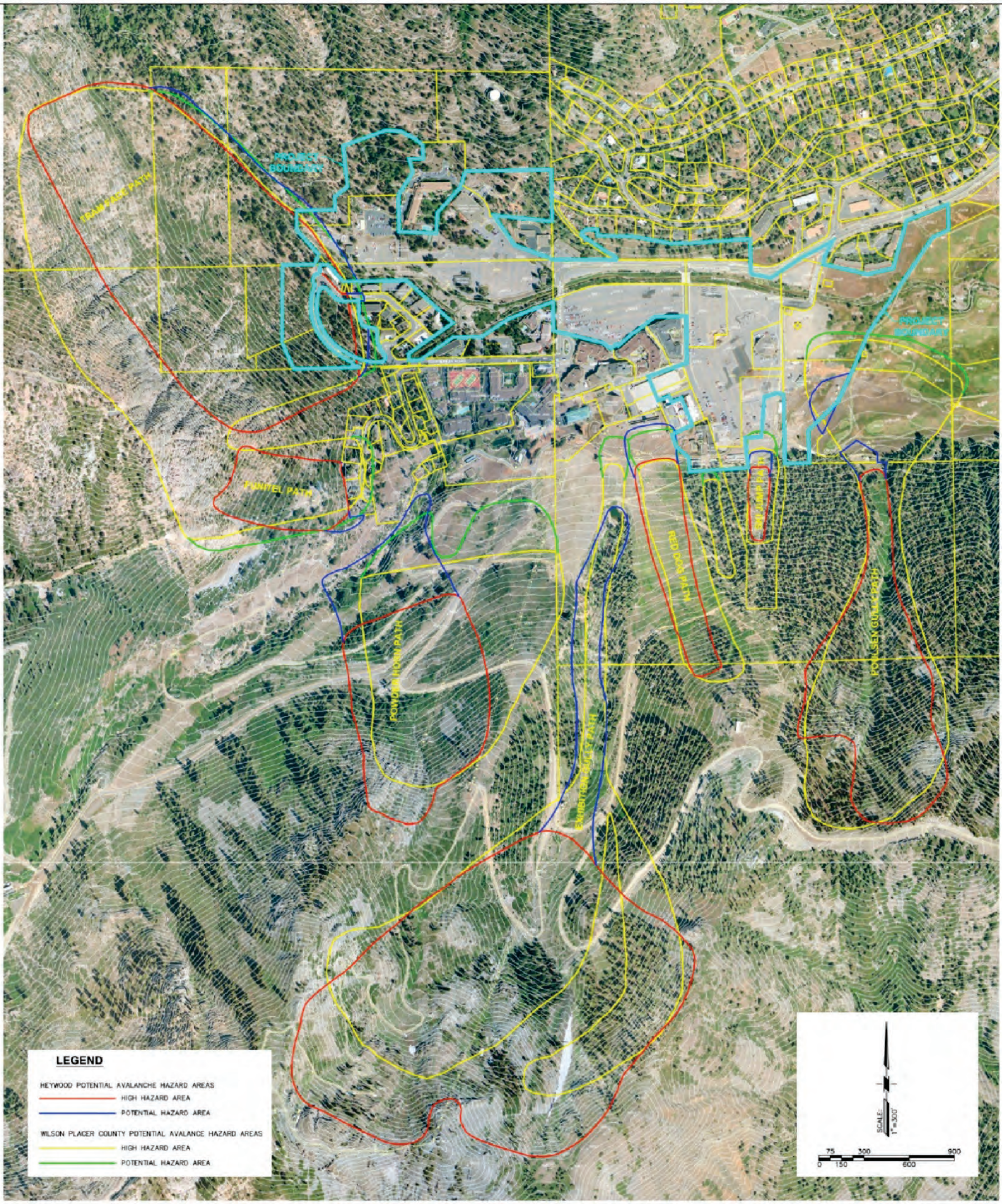
The project-specific Avalanche Hazard Study (Heywood 2014) proposes modified PAHA boundaries that reduce the area and extent of the 'high' and 'potential' hazard areas relative to the existing applicable Avalanche Hazard Map in the SVGPLUO (Exhibit 12-9). The reduction in PAHA area is due in large part to the updated study taking into account the active avalanche control program implemented by Squaw Valley ski patrol as well as site-specific analysis of historic avalanches, runout paths, and changes in forest area on and adjacent to mapped avalanche hazard areas.

As part of the project, the project applicant is requesting that Placer County adopt the proposed PAHAs (Exhibit 12-5) as a more precise and up-to-date reflection of hazard areas, and rezone to allow structures in the potential avalanche zone (run out of either the Tram Face or Poulsen Gully PAHAs). No structures would be allowed within the high hazard areas, but structures could be built within the moderate hazard areas. Buildable areas are identified for two parcels located partially within a PAHA (Heywood 2014):

- Parcel 9: Located on the eastern side of the plan area, a small portion of Parcel 9 (Specific Plan "Parcel" or "Lot" numbers) is located within the Poulsen Gully PAHA. This parcel would be zoned Village Commercial-Core, which would allow for the construction of lodging and/or other buildings.
- Parcel 19: Located in the western plan area, the Tram Face PAHA crosses the eastern portion of Parcel 19. This parcel would be zoned Village-Heavy Commercial, and would primarily house maintenance facilities.

An Avalanche Mitigation Plan is recommended in the project-specific Avalanche Hazard Study with guidance on the content of the plan included in Appendix J of the Avalanche Hazard Study (Heywood 2014). The plan, as described in Appendix J of the Avalanche Hazard Study, would include the following requirements:

- Prior to occupation of any building within a PAHA, the project applicant shall develop avalanche notification protocols in consultation with the Squaw Valley Fire Department (SVFD) and Squaw Valley Resort (SVR) operations. The protocols shall specify conditions that warrant consultation with the SVFD and SVR regarding potential avalanche risks.



Data Source: Heywood, Larry March 2014 Avalanche Hazard Study: Village at Squaw Valley Specific Plan.

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Cardno ENTRIX

Exhibit 12-9

Village at Squaw Valley Specific Plan
Exposure to Avalanche Hazard Areas

ASCENT ENVIRONMENTAL

- Building management for any building located within a PAHA shall confer with the SVFD and SVR operations after snowfall events as specified in the protocols to determine whether there is a substantial risk of an avalanche on the Tram Face and/or Poulsen Gully paths. If there is a substantial risk, then any public areas within the PAHA shall be closed to the public, and signs erected that explain that the closures are due to the avalanche risk. These areas shall be secured from entry until the risk of avalanche has abated.

- Provide the Notice to Occupant (required for buildings' main entry) in every room and/or provide the notice to guests upon check-in.

- Provide information/education to property owners, guests, public, and staff regarding the limited access to outdoor areas in the PAHA during periods where there is the substantial risk of avalanche, and procedures for remaining safe during extreme avalanche hazard periods.

- If applicable, maintain specified snow height clearances for buildings in PAHAs as specified by a site-specific determination. Any site-specific study shall consider the potential for PAHA impacts to outdoor use areas of development lots that encourage congregations of people within a PAHA. Protective measures, such as avalanche walls with minimum snow height clearances, may be specified.

While these requirements would significantly reduce the risk from avalanche to property owners, guests, public, and staff within PAHAs in the Specific Plan area, if not properly and consistently implemented, increased human activity in PAHAs generated by the proposed project could increase the number of persons at significant risk in the event of an avalanche.

While the recent site-specific study (Heywood 2014) has relied on up-to-date information and applied rigorous analytical methods to estimate the proposed PAHAs, the study also recognizes that there are uncertainties about future avalanche conditions, including runout distances. Some of these uncertainties include climate change effects that could lessen direct factors (e.g., snowfall) or, conversely, increase vulnerabilities (e.g., fire vegetation clearing). There are also continuing conditions that are outside of the County's or the project applicant's control that affect future avalanche risk related to management of the mountain slopes. The active management of ski slopes and implementation of avalanche hazard mitigation contributes beneficial effects related to the magnitude and frequency of future avalanches, but it is possible that vegetation management and tree clearing could produce adverse effects, such as if trees clearing is initiated in identified avalanche runout zones.

Implementation of the proposed project, while based on sound scientific evidence regarding the likely areas at risk of avalanche hazards and identifying measures to reduce structural risks and to minimize risks to persons, if the proposed risk reduction measures and Avalanche Hazard Mitigation Plan are not properly developed and implemented, or current avalanche control practices and related mountain operations that affect avalanche risk are altered, project development could increase the number of persons at significant risk in the event of an avalanche. This would be a **potentially significant** impact.

Mitigation Measure 12-3: Confirm implementation of avalanche hazard mitigation actions.

Prior to approval of a Tentative Small-Lot Subdivision Map that includes lands within a PAHA, the project applicant shall provide the County a complete Avalanche Hazard Mitigation Plan. The plan shall be subject to review and approval by the County and the SVFD, and map approval will be conditioned on ongoing implementation of the plan. The Avalanche Hazard Mitigation Plan shall be reflected in Improvement Plans for areas within PAHAs (see Mitigation Measure 13-2a in Chapter 13, "Hydrology and Water Quality," for more information on the content of Improvement Plans and the submittal and review process) and supported by special avalanche hazard studies within the Geotechnical Engineering Report (see Mitigation Measure 12-2, above, which requires submittal of a final Geotechnical Engineering Report). The plan shall include all elements identified in the project specific Avalanche Hazard Study (Heywood 2014), as well as the following additional element:

- On-site structures: The Building Services Division shall review building permit applications for structures within moderate PAHAs to confirm that they incorporate the structural specifications of the Geotechnical Engineering Report.
- Up-slope conditions: Policy procedures and necessary agreements and permissions shall be included to ensure that operations on the ski terrain of Squaw Valley continue to implement avalanche mitigation programs and that slope development and management avoids the creation of new long continuous openings that could increase the potential for avalanche release and movement that could affect Specific Plan developments. No new large openings shall be created on slopes steeper than 30 degrees that could influence avalanche runouts leading to the Specific Plan area.
- Persons in identified PAHA areas: Policy and practices shall be included to inform and educate workers, visitors and residents congregating in identified PAHA areas about the on-site geological hazards, particular snow avalanche, and to include mapped information and physical noticing in outside areas within a PAHA as well as indoor spaces as required by the existing County ordinance. Educational information shall include preparedness guidance and specific emergency response and evacuation instructions at locations within PAHAs. Plans and measures shall be instituted to effectively provide notice of any urgent warnings, watches, or evacuation orders using multiple media and/or venues to communicate.

Significance after Mitigation

Implementation of Mitigation Measure 12-3 would provide final design guidance for building layouts, foundation engineering, and structural standards that would be consistent with and adequate for the actual avalanche hazards of the project site; would ensure continued mountain operations that minimize and control avalanche risk; and would provide a more complete and comprehensive mitigation program to identify, inform, and instruct persons that would potentially be at additional risk due to the project. While these measures would not eliminate the risks due to snow avalanche, these measures would lower the magnitude and probability of the impact to an acceptable level. This impact would be reduced to a **less-than-significant** level.