4.5 Geology and Soils

This section describes the existing geology, soils, and seismic conditions on the proposed project site and analyzes the potential physical environmental effects from implementation of the proposed project related to seismic hazards, underlying soil characteristics, slope stability, erosion, and excavation of soils. Potential effects of soil conditions on air and water quality as a result of construction-related activities are discussed in Section 4.2 (Air Quality) and Section 4.8 (Hydrology and Water Quality), respectively. Information contained in this section is based upon the Geotechnical Investigation (CHJ 2010) for the proposed project, included as Appendix E of this EIR and the Northern Foothills Implementation Program - Program Environmental Impact Report (NF-PEIR) (RBF 1999).

4.5.1 Environmental Setting

4.5.1.1 Topography

The proposed project site is located in the Northern Foothills area, which is topographically represented by a semicircular shaped landform that protrudes southward from the linear base of the San Gabriel Mountains, which is part of the Transverse Ranges physiographic province of southern California. The Transverse Ranges province includes several discreet mountain ranges and intervening valleys including the Santa Monica, San Gabriel, and San Bernardino Mountains. This province gets its name because structural trends, such as the Sierra Madre fault zone are oriented east-west in relation to the dominant northwest-southeast trend of adjoining provinces. The Transverse Ranges province extends from the Channel Islands eastward to the Eagle and Cottonwood Mountains of the Mojave Desert.

The topographic “protrusion” of the San Gabriel Mountains foothill region where the proposed project site is located is generally bounded by San Dimas Canyon on the east, Big Dalton Canyon on its broad alluvial fan on the west, and on the south by the San Dimas Wash and the adjacent Los Angeles Basin. This area of the San Gabriel Mountains is underlain by Pliocene and Miocene age sedimentary and volcanic rocks. These rocks have been folded and tilted by tectonic action. The most prominent features of the Northern Foothill area is Johnstone Peak, 3,178 feet above mean sea level (AMSL), and the steep sided, deeply entrenched Sycamore and Ham Canyons, which drain the majority of the Northern Foothills area.

The topography of the project site is formed in a sedimentary and volcanic bedrock upland area that is dissected by several natural drainages flanked by steep-sided slopes. The project site also includes areas of relatively flat-lying topography formed on ridgelines and within a canyon area previously utilized for corrals. Natural drainages within the site include west and east branches of Shuler Canyon and several short tributaries that drain the majority of the southern portion of the site. Shay Canyon drains the eastern portion of the site and Wildwood Canyon and small tributaries drain the northwestern portion of the site. Local relief within canyons is on the order of 200 to 225 feet. A portion of Sycamore Canyon is located within the northeast corner of the site, in the approximately 83-acre remainder parcel outside of the area proposed for development. Natural slopes within the site exhibit typical gradients ranging from 2 horizontal to 1 vertical to 1.5 horizontal to 1 vertical. Natural slopes also include areas as steep as 1.25 horizontal to 1 vertical and locally steeper in areas of erosion and debris flow formation underlain by steep-standing bedrock. Several prominent hills and ridges with elevations as high as 1,357

AMSL and 1,450 feet AMSL are included within the proposed development area. A maximum site elevation of 1,880 feet AMSL occurs in the northeastern corner of the site outside of the development area and a minimum site elevation of 1,010 feet AMSL occurs near the southwestern site boundary.

4.5.1.2 Soils and Geologic Formations

The proposed project site is underlain by two bedrock units separated by an inactive fault that trends approximately east-west through the central portion of the site. The bedrock units include sedimentary rocks of the Puente Formation and extrusive rocks of the Glendora Volcanics. The bedrock units are composed by fill, young alluvium, colluvium, debris flow deposits, older terrace deposits, and landslide debris of variable thickness. The soils that underlie the proposed project site are described below and identified in Figure 4.5-1.

Puente Formation

The Puente Formation (unit symbol Tp) consists primarily of whitish to tan, thin and well-bedded siltstone and more thick bedded sandstone. The siltstone and sandstone weather to a dark gray clay bearing soil mantle and erode to form a more subdued topography relative to the volcanic materials. Figure 4.5-1 identifies the location of Puente Formation on the proposed project site.

Glendora Volcanics

The Glendora Volcanics (unit symbol Tgv) includes andesite flows, tuff breccia and fine-grained basalt that together comprise a steep-weathering formation exposed in road cut and limited natural outcrops. Andesite is fine-grained with primarily discontinuous, pervasive joints. Tuff breccia contains abundant rounded cobbles and angular andesite rock fragments and forms durable outcrops that stand at steep angles. Basalt is limited in natural exposures and appears more regularly jointed than the other volcanic units appear. Glendora Volcanics weather to clay-bearing, slope-mantling sandy sediments that form the soil cover within the northern portion of the site. Large boulders (up to five feet in size) from the volcanic unit are present locally as rock fall below steep outcrops within the project site. Figure 4.5-1 identifies the location of Glendora Volcanics on the proposed project site.

Alluvium

Alluvium (unit symbol Qya) is present on the proposed project site and consists of unconsolidated loose to medium silty sand and clayey sand. This soil unit is isolated and occurs only at the mouth of Shuler Canyon, in the southern portion of the project site. Alluvium soils contain gravel up to three inches in size. Figure 4.5-1 identifies the location of alluvium on the proposed project site.

Colluvium

Colluvium (unit symbol Qcol) is the most widely distributed soil within the proposed project site and consists of loose to medium sandy silty clay and silty clayey sand. Colluvium soils are derived from weathering and gravity transport of bedrock materials. In the proposed project site, these soils are present on ridge tops, on slopes, and in ravines and drainages. Thick accumulations of colluvium occur locally within the narrow drainage/ravine bottoms in the site and unconsolidated colluvium is subject to gravity creep on slopes and is considered a typical source for debris flow-type slope failures triggered by heavy precipitation events. Due to its wide distribution and limited thickness, the location of colluvium soils are only shown on Figure 4.5-1 in areas where thicker accumulations are present.

Older Terrace Deposits (Qt)

Older terrace deposits (unit symbol Qt) occur on two ridge top locations in the central portion of the proposed project site. Older Terrace Deposits consist of weathered, well-rounded gravel and cobbles of volcanic and gneissic lithologies in an orange-brown sandy matrix. The elevation difference between these two areas suggests deposition by a west-flowing drainage system. Figure 4.5-1 identifies the location of the Older Terrace Deposits on the proposed project site.

Fill

Fill (unit symbol f) is present on the project site and is associated with past grading of roads and prior development of a horse corral on the project site. Roadway fill is composed of local materials including the bedrock units and colluvium and is limited to the area immediately adjacent to roads within the site. Fill in the existing horse corral area includes abundant concrete and asphalt debris with lesser metal, glass, and wood debris. Some undocumented fill is also present on the proposed project site and generally consists of silty sands, clayey sands, and silts and range from loose to medium dense states. Figure 4.5-1 identifies the location of fill on the proposed project site in the area of proposed Lots 1, 2 and 3. Undocumented fill is considered unsuitable for the support of structures.

Landslide Deposits

Landslide deposits (unit symbol Qls) were observed in approximately 16 locations on the project site in the northwest, west-central and southwestern portions of the proposed project site (Figure 4.5-1). Landslide debris was determined to be derived from the Glendora Volcanics unit and the Puente Formation unit. Landslide debris derived from the Glendora Volcanics unit consists of materials ranging in composition from pervasively crushed and sheared rock material that is highly weathered to relatively intact, hard and durable angular boulder-size clasts that are difficult to excavate. Landslide debris derived from the Puente Formation is anticipated to consist of a mixture of angular siltstone and sandstone fragments in a matrix of sandy clayey silt. Figure 4.5-1 identifies the location of landslide deposits on the proposed project site.

Debris Flow Deposits

Debris flow deposits (unit symbol Qdf) of variable age (based on degree of cementation) were observed in the northeastern portion of the proposed project site, near the Wildwood Canyon area. Debris flow materials consist of clast-supported, poorly sorted, subrounded to angular gravel and cobble clasts in a silty sand matrix. The debris flow deposits exposed in the road cut include boulder size clasts of Glendora Volcanics up to five feet in size. In addition to debris flow deposits, a number of debris flow scar areas (unit symbol df) are present in the northeastern and southwestern portion of the proposed project site. Figure 4.5-1 identifies the locations of debris flow deposits and debris flow scar areas on the proposed project site.

4.5.1.3 Faulting and Seismicity

Ground shaking as a result of earthquakes is a potential hazard throughout southern California. The intensity of ground shaking at any particular site and the relative potential for damage from this hazard depends on the earthquake magnitude, distance from the source (epicenter), and the site response characteristics (ground acceleration, predominant period, and duration of shaking). The following

discussion identifies earthquake faults in relation to the proposed project site. Due to their vicinity, the faults listed below have produced, and have the potential for producing, seismic shaking at the proposed project site.

One unnamed, inactive bedrock fault separates the Puente Formation (Tp) from the Glendora Volcanics (Tgv) soils on the proposed project site. This fault is shown in Figure 4.5-1 and trends roughly east-west through the central area of the proposed project site. This fault is considered inactive for planning purposes because it is overlain with thick soil profiles and highly weathered channel deposits that lack evidence of shear planes or faulting. This lack of evidence within the soil profile and channel deposits indicates the fault has not ruptured since before Holocene time.

The Sierra Madre fault is considered active and occurs within the southern boundary of the proposed project site (see Figure 4.5-1). The Sierra Madre fault is part of the Transverse Ranges Frontal Fault system (TRFFS) that extends from the Santa Monica Mountains on the west to the Cucamonga fault zone and eastern San Gabriel Mountains. In 1991, a 5.8 magnitude earthquake occurred seven miles west of the proposed project site on an offshoot of the Sierra Madre fault. In 1971, a 6.6 magnitude earthquake occurred on the San Fernando fault; also a member of the TRFFS.

The Cucamonga fault is located approximately four miles east of the proposed project site. This fault is part of a series of east-west trending, predominantly reverse and thrust faults coincident with the southern margin of the San Gabriel Mountains. The Cucamonga fault has evidence of recent activity, attributed to a 6.7 magnitude earthquake in 1971 on the San Fernando fault, which is connected to the Cucamonga fault.

The San Jose fault is located approximately five miles south of the proposed project site and trends from the southwestern San Jose Hills northeastward to the Upland-Claremont region. The San Jose fault was the source of a 4.7 magnitude earthquake in 1988 and a 5.4 magnitude earthquake in 1990.

Other faults in the southern California region with a potential for producing seismic shaking at the proposed project site include the Chino-Central Avenue fault, located eight miles southeast of the proposed project site; the Puente Hills blind thrust, located nine miles southwest of the proposed project site; the Raymond fault, located ten miles west of the proposed project site; and the Whittier fault, located 13 miles south of the proposed project site.

The Mojave segment of the San Andreas fault zone is located along the northeast margin of the San Gabriel Mountains, approximately 18 miles northeast of the proposed project site. The 1857 Fort Tejon earthquake of approximate 7.9 magnitude occurred on the Mojave segment of the San Andreas fault. The Working Group on California Earthquake Probabilities (1995) tentatively assigned a 28 percent (± 13 percent) probability to a major earthquake (magnitude 7.0 to 7.9) occurring on the San Bernardino Mountains segment of the San Andreas fault between 1994 and 2024.

4.5.1.4 Geologic Hazards

Primary hazards associated with seismicity include surface rupturing and ground shaking. Secondary effects of groundshaking include landslides, subsidence, and liquefaction. These hazards are discussed below.

Surface Rupture and Groundshaking

Unlike damage from ground-shaking, which can occur at great distances from a fault, damage due to surface rupture is limited to the location of the fault-line break. Under the Alquist–Priolo Earthquake Fault Zoning Act, the State Geologist is required to delineate "Earthquake Fault Zones" along known active faults in California. The purpose of the act is to regulate development near active faults so as to mitigate the hazard of surface fault-rupture. In compliance with the Act, no structure for human occupancy is permitted to be placed across or within 50 feet of an active fault. The proposed project site does not lie within or immediately adjacent to a designated Alquist-Priolo Earthquake Fault Zone.

Landslides

The term landslide refers to deep-seated slope failures at least ten feet deep that involve movement of primarily bedrock materials. Landslides are typically related to the underlying structure of the parent material. The susceptibility of a geologic unit to landsliding is dependent upon various factors, including: 1) the presence and orientation of weak structures, such as fractures, faults or joints; 2) the height and gradient of the natural or cut slope; 3) the presence and quantity of groundwater; and 4) the occurrence of strong seismic shaking. The locations of existing landslides on the proposed project site are shown on Figure 4.5-1.

Debris Flow

Debris flows are a type of surficial shallow failure that affects the upper weathered soil formed from the parent material. Most debris flows occur during winter seasons with above normal rainfall, and the potential for occurrence can be enhanced in areas of recent land wildfires. Debris flow scars tend to become "absorbed" by the ambient topography within a relatively short time period from their occurrence compared with deep-seated landslides. The proposed project site is located in an area identified as having localized moderate to high potential for the generation of debris flow. The locations of debris flows on the project site are shown in Figure 4.5-1.

Subsidence

Subsidence is the downward settling of surface materials caused by natural or artificial removal of underlying support. Land subsidence may occur from several causes including withdrawal of fluids (oil, gas, or water) or the application of water to moisture-deficient unconsolidated deposits. Subsidence is a relatively slow process that may continue for several decades. The proposed project site does not show evidence of existing subsidence.

Liquefaction

Liquefaction is a process in which strong ground shaking causes saturated soils to lose their strength and behave as a fluid. Ground failure associated with liquefaction can result in severe damage to structures. The geologic conditions for increased susceptibility to liquefaction are: 1) shallow groundwater, generally less than 50 feet in depth; 2) the presence of unconsolidated sandy alluvium, typically Holocene in age; and 3) strong ground shaking. All three of these conditions must be present for liquefaction to occur. The proposed project site does not show evidence of existing liquefaction.

4.5.2 Regulatory Framework

4.5.2.1 Federal

U.S. Geological Survey Landslide Hazard Program

In fulfillment of the requirements of Public Law 106-113, the U.S. Geological Survey (USGS) created the Landslide Hazard Program (LHP) in the mid-1970s. According to USGS, the primary objective of the LHP is to reduce long-term losses from landslide hazards by understanding of the causes of ground failure and suggesting mitigation strategies (USGS 2008a). The federal government takes the lead role in funding and conducting this research, whereas the reduction of losses due to geologic hazards is primarily a State and local responsibility.

4.5.2.2 State

Alquist-Priolo Earthquake Fault Zoning Act

The California Legislature passed this law in 1972 to help identify areas subject to severe ground shaking. This State law requires that proposed developments incorporating tracts of four or more dwelling units investigate the potential for ground rupture within Alquist-Priolo (AP) zones. These zones serve as an official notification of the probability of ground rupture during future earthquakes. Where such zones are designated, no building may be constructed on the line of the fault, and before any construction is allowed, a geologic study must be conducted to determine the locations of all active fault lines in the zone.

2007 California Building Code

The 2007 California Building Code (CBC), adopted in 2008 and effective January 1, 2008, is based largely on the 2006 International Building Code (IBC). The CBC contains specific provisions for structures located in seismic zones. Chapter 23 contains specific requirements for seismic safety. Chapter 29 regulates excavation, foundations, and retaining walls. Chapter 33 contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 regulates grading activities, including drainage and erosion control. Construction activities are also subject to occupational safety standards for excavation, shoring, and trenching as specified in the California Division of Occupational Safety and Health (Cal/OSHA) regulations (Title 8 of the CCR and in Section A33 of the CBC). The 2007 CBC is currently undergoing code change considerations. When revised and adopted, the 2010 CBC will replace the 2007 CBC. The 2010 CBC is scheduled to take effect on January 1, 2011.

Seismic Hazards Mapping Act

This Act was passed by the State in 1990 to address non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. Guidelines for Evaluation and Mitigating Seismic Hazards in California (Special Publication 117) were adopted by the State Mining and Geology Board on March 13, 1997 (revised and re-adopted on September 11, 2008 as Special Publication 117a). The publication contains guidelines for evaluating seismic hazards other than surface fault rupture (landslides and liquefaction), and for recommending mitigation measures to minimize impacts. A lead agency may determine when the investigation required by the guidelines and the Seismic Hazards

Mapping Act would occur for a project. Investigation can occur before, during, or after the CEQA process.

4.5.2.3 Local

City of San Dimas General Plan Safety Element

The purpose of the San Dimas Safety Element is to reduce deaths, injuries, property damage, and economic and social dislocation resulting from natural hazards including flooding, mudslides and soil creep, tsunamis and seiches, land subsidence, earthquakes, avalanches, other geologic phenomena, levee or dam failure, certain types of urban and wildland fires, and building collapse. The Safety Element is the primary vehicle for identifying hazards that must be considered when making land use decisions.

City of San Dimas Specific Plan No. 25

Specific Plan No. 25 is the development control mechanism for the Northern Foothills area of the City. The purpose of Specific Plan No. 25 is to provide for managing environmental values and future development within the Northern Foothills area in order to protect the area's natural environment and existing resources and to ensure that the design of future hillside developments preserves sensitive resources in place, adapts to the natural hillside topography, and maximizes view opportunities to, as well as from, the developments. The proposed amendments to Specific Plan No. 25, as described in Chapter 3, Project Description, would result in revisions to some policies related to topics applicable to geology and soils.

4.5.3 Project Impacts and Mitigation

4.5.3.1 Issue 1 – Exposure to Seismic-Related Hazards

Geology and Soils Issue 1 Summary

Would implementation of the proposed project expose people or structures to potential substantial adverse effects of a rupture of a known earthquake fault, strong seismic groundshaking, seismic related ground failure, liquefaction, or landslides?

Impact: Implementation of the proposed project would result in significant impacts associated with seismically related fault rupture, groundshaking and landslides.

Mitigation: Compliance with Geotechnical Investigation (**Geo-1A**).

Significance Before Mitigation: Significant.

Significance After Mitigation: Less than significant.

Standards of Significance

Based on Appendix G of the CEQA Guidelines, implementation of the proposed project would have a significant adverse impact if it would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

1. 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;
2. Strong seismic groundshaking;
3. Seismic related ground failure, including liquefaction; or
4. Landslides.

Significant adverse geologic impacts not directly related to seismic activity including topsoil loss, soil stability, landslides, lateral spreading, subsidence, liquefaction, collapse, and expansive soils are discussed in Issues 2 through 4 below.

Impact Analysis

Fault Rupture

A surface rupture is a break in the ground's surface and the associated deformation resulting from the movement of a fault. Ground rupture can completely demolish structures by rupturing foundations or by tilting foundation slabs and walls, as well as damage buried and above ground utilities. Drinking water can be lost, and the loss of water lines or water pressure can affect emergency services, including fire fighting ability.

The AP Earthquake Fault Zoning Act identifies areas that are subject to fault rupture. The proposed project site does not lie within or immediately adjacent to an AP Earthquake Fault Zone. However, the San Dimas General Plan identifies portions of the city along the Sierra Madre fault zone as "potentially active" and susceptible to ground rupture. The Sierra Madre fault zone is located along the southern margin of the foothills within the extreme southern boundary of the proposed project site. As shown in Figure 4.5-1, the area of the proposed project site that is crossed by the Sierra Madre fault does not include proposed residential structures. The closest proposed residence would be located approximately one-quarter mile north of the fault. However, one of the proposed roadways on site, Brasada Lane, would cross the Sierra Madre fault. Therefore, although the proposed project would not subject persons to fault rupture associated with the Sierra Madre fault, structures, including Brasada Lane, would have the potential to be significantly impacted.

One unnamed, bedrock fault also trends approximately east-west through the central portion of the proposed project site. This unnamed, strike-dip fault has a thick overlying soil profile. Fault rupture is not considered a hazard for this fault because it does not show evidence of rupture since before Holocene time and is considered to be inactive, as determined by the geotechnical report for the proposed project.

Ground Shaking

Ground shaking from seismic activity has the potential to dislodge objects from walls, ceilings, and shelves, and to damage and destroy buildings and other structures. The proposed project site, like most areas of southern California, is located within a seismically active region and moderate to severe seismic shaking can be expected during the lifetime of the proposed project. Additionally, the San Dimas General Plan identifies ground shaking of moderate to severe intensity to be expected from seismic activity along the Sierra Madre fault, which is located within and adjacent to the proposed project site. Therefore, the proposed project would have the potential to expose persons and structures to adverse effects associated with seismic groundshaking. Impacts would be potentially significant.

Liquefaction

The proposed project site is not located within an area identified as having the potential for liquefaction by the California Geological Survey. Additionally, the site-specific Geotechnical Investigation determined that due to the groundwater conditions within the site and the dense nature of the sediments and bedrock underlying the site, liquefaction is not considered a potential hazard. Therefore, the proposed project would not have the potential to expose persons and structures to potential substantial adverse effects associated with liquefaction. Impacts would be less than significant.

Landslides

Portions of the proposed project site were identified in the site-specific Geotechnical Investigation as being susceptible to soil slip or having the potential for seismically induced landslides or slope failure. For example, the northwestern portion of the proposed project site is underlain by multiple mapped landslide deposits or suspected landslide deposits. These landslide deposits consist of west and southwest failing rock masses of moderately sloping topography. The rock formation in this area suggests that some of the identified landslides are undergoing continued rock creep. The identified landslides located in the northwestern portion of the proposed project site could impact proposed residential lots 49, 50 and 53 and the proposed Hidden Ridge Road. Landslides located in the northwestern portion of the proposed project site are shown in Figure 4.5-1.

In addition to the identified landslide deposits in the northwestern portion of the proposed project site, several landslide deposits exist within the southwestern portion of the proposed project site, in the east and west branches of Shuler Canyon. No homes are proposed in the location of the on-site southwestern landslides; however, these landslides could impact the southern portion of one proposed roadway, Brasada Lane. Landslide deposits located in the southwestern portion of the project site are shown in Figure 4.5-1.

The Geotechnical Investigation for the proposed project also identified that previously unrecognized landslide deposits may be encountered during project grading. Additionally, the Geotechnical Investigation determined that in some cases, excavation of a large landslide mass may lead to further destabilization of ground upslope. Due to the existence of documented and undocumented landslides on the project site, the proposed project would have the potential to expose persons and structures to potential substantial adverse effects associated with landslides. Impacts would be significant.

Summary

Implementation of the proposed project would result in potentially significant impacts associated with seismically related fault rupture, groundshaking and landslides. All project construction would comply with the California Building Code and the San Dimas Building Code. However, without implementation of site-specific geologic mitigation measures to further reduce seismically related fault rupture, groundshaking and landslides, impacts would be significant.

Mitigation Measures

The following mitigation measure would reduce impacts related to seismically-related fault rupture, groundshaking and landslides to a less than significant level. The physical impacts associated with implementation of this mitigation measure have been evaluated in the other environmental analysis sections of this EIR.

Geo-1A Prior to the issuance of a grading permit, the applicant shall demonstrate, to the satisfaction of the City of San Dimas City Engineer, implementation of all mitigation measures provided in the Geotechnical Investigation prepared for the proposed project site: Geotechnical Investigation Tentative Tract No. 70583 by CHJ Incorporated dated July 13, 2010. Mitigation measures shall be implemented to reduce the following potentially significant geologic conditions to a less than significant level: seismicity and groundshaking, slope stability, debris flow, erosion, expansive and corrosive soils, and settlement of exiting fill and proposed deep fill. Mitigation measures may include, but not be limited to, the following: seismic design considerations; general site grading; initial site preparation; removal and re-compaction of existing soils; preparation of fill areas; preparation of footing areas; compacted fills; oversized material; slope construction; slope creep; slope protection; subdrains; settlement monitoring; foundation design; post-tensioned slab foundations; slabs-on-grade; expansive soils; concrete flatwork; lateral loading; earth pressures; seismic earth pressure; trench excavation; trench bedding and backfills; shoring design parameters; potential erosion; chemical/corrosivity testing; and construction observation.

4.5.3.2 Issue 2 – Soil Erosion or Topsoil Loss

Geology and Soils Issue 2 Summary

Would implementation of the proposed project result in substantial soil erosion or the loss of top soil?

Impact: Implementation of the proposed project would result in substantial soil erosion or topsoil loss.	**Mitigation:** Compliance with Geotechnical Investigation **(Geo-1A);** and Erosion Control Measures **(Geo-2A).**
Significance Before Mitigation: Significant.	**Significance After Mitigation:** Less than significant.

Standards of Significance

Based on Appendix G of the CEQA Guidelines, implementation of the proposed project would have a significant adverse impact if it would result in substantial soil erosion or the loss of topsoil.

Impact Analysis

The Geotechnical Investigation for the proposed project determined that the native soils on the project site are moderately susceptible to erosion. Additionally, the Standard Urban Stormwater Mitigation Plan for the proposed project (included as Appendix J of this EIR) maintains that the proposed project must implement construction and post-construction Best Management Practices (BMPs) to reduce erosion on the project site and maintain compliance with the National Pollutant Discharge Elimination Permit (NPDES) issued by the Los Angeles Regional Water Quality Control Board.

Erosion can occur as a result of, and can be accelerated by, construction and operational activities associated with the proposed project. The following discussion describes potential wind and water erosion impacts from construction and operation of the proposed project.

Wind Erosion

Construction

The grading, excavation, on-site soils balancing and soil stockpiling operations associated with construction of the proposed project would have the potential to expose soils to wind erosion. Soil removal associated with grading and excavation activities would reduce soil cohesion, which could accelerate erosion. Excavated soils would be stockpiled and moved to different areas of the site as part of balanced cut/fill operations, which would be potentially exposed to erosive wind forces. Therefore, implementation of the proposed project would result in a potentially significant impact associated with wind erosion.

Operation

Upon completion of the proposed project, the project site would be developed with residential land uses, as well as roadways, water quality/debris basins, and landscaping. No exposed soils would remain on site that would be susceptible to the effects of wind erosion. Off-site areas exposed to wind may result in the transport of eroded soils onto the project site. However, these soils would be captured by the on-site water quality/debris basins and would not result in an adverse impact. Therefore, wind erosion associated with operation of the proposed project would be less than significant.

Water Erosion

Construction

Land-disturbing construction activities such as the grading and excavation for the construction of new residential building pads, home foundations, water quality/debris basins, a water tank, roads, driveways, and trenches for utilities, would increase the project site's susceptibility to substantial erosion or topsoil loss during a rain event. Increased erosion and soil loss could impact soil stability, in addition to indirect effects on communities and sensitive biological resources downstream of the proposed project site, including: the deposition of pollutants and sediment to the watershed outlets; an increase in polluted

runoff to surface and groundwater receiving bodies, and an increase in the flood potential downstream. This would be a potentially significant impact. Erosion from water runoff is discussed in greater detail in Section 4.8 (Hydrology and Water Quality, Issue 3 – Erosion or Siltation).

Operation

Erosion would also occur in connection with the altered hydrology of the proposed project site. Increases in surface water flow, typically associated with impermeable surfaces, can result in increased erosion in on-site and off-site drainage courses. Implementation of the proposed project would result in an increase in impervious surfaces on the project site from the development of the proposed residences, roadways and other associated structures. This increase in surface water flows could result in increased erosion in on-site and off-site drainage courses. The majority of soils from impervious surface flow would be captured by the on-site water quality/debris basins and would not result in an adverse impact. In addition, other post-construction BMPs, such as revegetation of disturbed areas, would be implemented to further reduce the potential for increased erosion. Therefore, water erosion associated with operation of the proposed project would be less than significant. Erosion from water runoff is discussed in greater detail in Section 4.8 (Hydrology and Water Quality, Issue 3 – Erosion or Siltation).

Summary

Although the proposed project would be required to comply with regulations that reduce soil erosion and topsoil loss, including the San Dimas Grading Ordinance, the fugitive dust control measures required by the South Coast Air Quality Management District, and the project specific Standard Urban Stormwater Mitigation Plan, the excavation and stockpiling of soils during construction would result in significant erosion impacts from wind. Additionally, construction and operation of the proposed project would result in potentially significant erosion and topsoil impacts from water. Therefore, the proposed project would result in a significant impact related to soil erosion and topsoil loss.

Mitigation Measures

In addition to mitigation measure Geo-1A, the following mitigation measure would reduce the impacts related to soil erosion and topsoil loss to a level of less than significant:

Geo-2A The applicant shall exercise special care during the construction phase of the project to prevent any off-site siltation. The applicant shall provide erosion control measures and shall construct temporary desiltation/detention basins of a type, size and location as approved by the City of San Dimas City Engineer. The basins and erosion control measures shall be shown and specified on the grading plan and shall be constructed prior to the start of any grading operations. Prior to the removal of any basins or erosion control devices so constructed, the area served shall be protected by additional drainage facilities, slope erosion control measures and other methods as may be required by the City Engineer. The applicant shall maintain the temporary basins and erosion control devices until the City Engineer approves the removal of the temporary facilities.

4.5.3.3 Issue 3 – Soil and Slope Instability

Geology and Soils Issue 3 Summary

Would implementation of the proposed project be located on a geologic unit or soil that is unstable or that would become unstable and potentially result in a landslide, lateral spreading, subsidence, liquefaction, or collapse?

Impact: The proposed project would be located on a geologic unit susceptible to debris flow, subsidence and slope instability.

Mitigation: Compliance with Geotechnical Investigation (**Geo-1A**); Erosion Control Measures (**Geo-2A**); Grading, Drainage and Retaining Wall Plan (**Geo-3A**); Slope Maintenance Agreement (**Geo-3B**).

Significance Before Mitigation: Significant.

Significance After Mitigation: Less than significant.

Standards of Significance

Based on Appendix G of the CEQA Guidelines, implementation of the proposed project would have a significant adverse impact if future development would be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and could potentially result in an on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. A significant impact would occur in cases where people or structures are exposed to potential substantial adverse effects due to soil instability including the risk of loss, injury, or death.

Impact Analysis

Seismic-related hazards are discussed in Issue 1 above. Non-seismic geological hazards discussed in this section include debris flow, subsidence, liquefaction, soil collapse and slope instability.

Debris Flow

The Geotechnical Investigation prepared for the proposed project identified the project site as having a moderate to high potential for the generation of debris flows. Debris flow is most likely to occur in areas of steep canyon topography, primarily in the "head" areas of drainages. Additionally, the areas on the proposed project site where unconsolidated colluvium is present are susceptible to gravity creep on slopes and are considered a typical source for debris flow-type slope failures triggered by heavy precipitation events. Therefore, the proposed project has a high potential for debris flows, which would have the potential to impact the project site and surrounding area.

Subsidence

The Geotechnical Investigation prepared for the proposed project determined that construction of the proposed residential structures may result in soil settlement up to nine inches in depth. In addition, the upper native soils and existing fills on the project site would not, in their present condition, provide uniform or adequate support for the proposed structures. These conditions would cause unacceptable differential and/or overall settlement upon application of the anticipated residential foundation loads. Site clearing during construction is expected to further aggravate the settlement-prone conditions. Therefore, the proposed project has the potential to result in subsidence.

Liquefaction

The proposed project site is underlain by bedrock formations at shallow depths and is not considered a groundwater production area. Additionally, the site is not located within an area identified as having a potential for liquefaction by the California Geological Survey (State of California Division of Mines and Geology, 1999). Therefore, based on the groundwater conditions within the proposed project site and the dense nature of the sediments and bedrock underlying the site, liquefaction is not considered a hazard and impacts would be less than significant.

Soil Collapse

The Geotechnical Investigation prepared for the proposed project determined that soils on the project site are generally medium dense to very dense or stiff to hard and are considered to have very low hydroconsolidation, or soil collapse, potential. Therefore, impacts related to soil collapse are considered less than significant.

Slope Instability

Multiple areas on the proposed project site have the potential for slope failure or collapse, due to naturally steep gradients. Therefore, impacts related to slope instability are considered significant.

Summary

The proposed project would be located on a geologic unit susceptible to debris flow, subsidence and slope instability. All project construction would comply with the California Building Code and the San Dimas Building Code. However, without implementation of site-specific geologic mitigation measures to further reduce debris flow, subsidence and slope instability, impacts would be significant.

Mitigation Measures

In addition to mitigation measures Geo-1A and Geo-2A, the following mitigation measures would be implemented to reduce the impacts related to debris flow, subsidence and slope instability to a less than significant level:

Geo-3A Prior to the issuance of a grading permit, the applicant shall submit a grading, drainage and retaining wall plan, in compliance with City standards, for review and approval by the City of San Dimas City Engineer. All grading work must be done in compliance with the approved plan and completed to the satisfaction of the City Engineer. All slopes within the project shall be graded no steeper than a 2:1 slope, excluding slopes with retaining walls, unless otherwise approved by the City Engineer.

Geo-3B Prior to the issuance of a grading permit, the applicant shall enter into a slope maintenance agreement with the City of San Dimas City Engineer. The slope maintenance agreement shall be subject to and consistent with the conditions identified in Sections 18.542.240 and 18.542.310(E) of Specific Plan No. 25, as amended.

4.5.3.4 Issue 4 – Expansive Soils

Geology and Soils Issue 4 Summary

Would implementation of the proposed project result in the construction of structures located on expansive soils?

Impact: Expansive soils occur in areas of the proposed project site where development is proposed.	**Mitigation:** Compliance with Geotechnical Investigation (**Geo-1A**); Erosion Control Measures (**Geo-2A**); Grading, Drainage and Retaining Wall Plan (**Geo-3A**); Slope Maintenance Agreement (**Geo-3B**); and Soil mixing (**Geo-4A**).
Significance Before Mitigation: Significant.	**Significance After Mitigation:** Less than significant.

Standards of Significance

Based on Appendix G of the CEQA Guidelines, implementation of the proposed project would have a significant adverse impact if it would result in the construction of structures located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994 or most current edition), creating substantial risks to life or property.

Impact Analysis

Expansive soils are those that are high in expansive clays or silts and that swell and shrink with wetting and drying, respectively. This shrinking and swelling can be detrimental to foundations, concrete slabs, flatwork, and pavement. The proposed project site has soils that include a wide range of expansion potential, from “very low” to “high” classifications, according to the 2007 CBC. Expansive soils are classified in a range from 18 to 101 with a rating of 21 or greater requiring special consideration for foundation design to mitigate potential detrimental effects of expansive soils. Expansive soils may occur in all areas of the project site and generally occur within upper soils. The site-specific geological investigation determined that soils with an expansion rating of 21 or greater would be encountered during grading activities. Therefore, implementation of the proposed project would result in a significant impact related to expansive soils.

Summary

Expansive soils occur on the proposed project site, which could create substantial risks to life or property. All project construction would comply with the California Building Code and the San Dimas Building Code. However, without implementation of site-specific geologic mitigation measures to further reduce risks associates with expansive soils, impacts would be significant.

Mitigation Measures

In addition to mitigation measures Geo-1A, Geo-2A Geo-3A and Geo-3B, the following mitigation measure would be implemented to reduce impacts related to expansive soils to a less than significant level.

Geo-4A Under the supervision of a qualified City-approved geologist, expansive soils and nonexpansive soils shall be mixed so that soils reach an expansive rating of less than 20 which would make them suitable for use on the project site. The depth of removal and replacement or mixing of the expansive soils below any proposed structures shall be approved and monitored by a qualified City-approved geologist to ensure constant moisture content in the remaining fill.

4.5.4 Cumulative Impacts and Mitigation

Geology and Soils Cumulative Issue Summary

Would implementation of the proposed project have a cumulatively considerable contribution to a cumulative geology and soils impact considering past, present, and probable future projects?

Cumulative Impact	*Cumulative Significance*	*Proposed Project Contribution*
Seismic Related Hazards: Cumulative development in the region would expose a greater number of people and structures to seismic-related hazards.	Significant.	Not cumulatively considerable.
Soil Erosion and Topsoil Loss: Cumulative development in the region could result in excessive erosion; however, development projects are subject to numerous regulations to prevent soil erosion.	Less than significant.	Not cumulatively considerable.
Soil and Slope Instability: Development occurring on unstable soils and slopes requires specific site preparation measures be applied to reduce hazards associated with unstable soils and slopes.	Less than significant.	Not cumulatively considerable.
Expansive Soils: Development occurring on expansive soils require specific site preparation measures be applied to reduce hazards associated with expansive soils.	Less than significant.	Not cumulatively considerable.

4.5.4.1 Seismic Related Hazards

The geographic context for the analysis of impacts resulting from seismic ground shaking is generally site-specific, rather than cumulative in nature, because each development site has unique geologic considerations that would be subject to uniform site development and construction standards. In this way, potential cumulative impacts resulting from geological, seismic, and soil conditions would be minimized on a site-by-site basis to the extent that modern construction methods and code requirements provide. Nevertheless, even though adequate study, design, and construction measures can be taken to reduce potential impacts, cumulative development in the region would contribute to the cumulative increase in the number of persons exposed to these hazards, assuming California's population continues to grow (e.g., the general seismic risk that exists throughout southern California). Therefore, there is an existing significant cumulative impact in terms of exposure of persons to seismic hazards.

As described above, the proposed project site is located in an area that is subject to seismic-related fault rupture, groundshaking, and landslides. However, with implementation of mitigation measure Geo-1A,

the proposed project's impact related to seismic-related hazards would be reduced to a less than significant level. Because seismically related hazards are generally site-specific, the project's cumulative contribution would not be considerable.

4.5.4.2 Erosion and Topsoil Loss

Impacts from erosion and loss of topsoil from project site development and operation can be cumulative in effect within a watershed. Therefore, the geographic context for the analysis of erosion and topsoil loss impacts associated with the proposed project is the San Gabriel River watershed. This analysis accounts for all anticipated cumulative growth within the geographic area as represented by full implementation of the San Dimas General Plan and the Glendora General Plan. Development at the proposed project site and throughout the Cities of San Dimas and Glendora would involve construction activities that could result in increased wind and water erosion from exposed soils. Cumulative development would also increase impermeable surfaces, which could alter the natural drainage of a site and result in excess siltation. However, cumulative projects would be subject to state and local runoff and erosion prevention requirements, including the applicable provisions of the General Construction Permit, BMPs, the NPDES, grading ordinances and fugitive dust control measures required by the South Coast Air Quality Management District. These requirements are implemented as conditions of approval for development projects and are subject to continuing enforcement. As a result, cumulative impacts on the San Gabriel River watershed due to runoff and erosion from cumulative development activity would be less than significant. Therefore, the project's cumulative contribution would be less than significant.

4.5.4.3 Soil and Slope Instability

The geographic context for the analysis of impacts of soil and slope instability on development is generally site specific. Nevertheless, when considering the impacts in a larger geographic context, CEQA requires a proposed project to undergo an analysis of the geologic and soil conditions applicable to the development site in question. As required by CEQA, measures would be implemented to mitigate potential impacts associated with unstable soils prior to implementation of a cumulative project. Typical measures to treat unstable soils involve removal and replacement with properly compacted fill, compaction grouting, or deep dynamic compaction. Additionally, cumulative projects would be required to comply with the CBC, which restricts and sets standards for development in areas subject to soil and slope instability. Due to CEQA requirements and CBC restrictions, cumulative impacts from development on soils subject to soil instability, liquefaction, and subsidence would be less than significant. Therefore, the project's cumulative contribution would be less than significant.

4.5.4.4 Expansive Soils

The geographic context for the analysis of impacts of expansive soils is generally site specific. Nevertheless, when considering the impacts in a larger geographic context, CEQA requires a proposed project to undergo analysis of the soil conditions applicable to the development site in question. As required by CEQA, measures would be implemented to mitigate potential impacts associated with expansive soils prior to implementation of a cumulative project. Typical measures to mitigate expansive soils involve removal, proper fill selection, and compaction. Additionally, cumulative projects would be required to comply with the CBC, which restricts and sets standards for development in areas subject to expansive soils. Due to CEQA requirements and CBC restrictions, cumulative impacts from development

on expansive soils would be less than significant. Therefore, the project's cumulative contribution would be less than significant.

4.5.5 Issues With No Potential to Have a Significant Effect on the Environment

All of the issues identified in the Geology and Soils section of CEQA Appendix G: Environmental Checklist Form are fully analyzed for potential impacts in EIR Sections 4.5.3 and 4.5.4, above; therefore, no issues are addressed in this section.

4.5.6 References

CHJ Incorporated (CHJ). 2010. Geotechnical Investigation for Tentative Tract No. 70583. August.

City of San Dimas. San Dimas Municipal Code. Chapter 18.542, Specific Plan No. 25. Available at http://www.qcode.us/codes/sandimas/

City of San Dimas. 1991. General Plan. September. Available at http://www.cityofsandimas.com/ps.developmentservices.cfm?ID=2404

Department of Conservation, Division of Mines and Geology. 1999. Special Publication 42: Fault-Rupture Hazard Zones in California.

Robert Bein, William Frost & Associates (RBF). 1999. Final Northern Foothills Implementation Program Program Environmental Impact Report. SCH # 98121072. June.

U.S. Geological Survey (USGS). 2008a. U.S. Department of the Interior. Landslide Hazards Program. Accessed April 1, 2008, available at www.landslides.usgs.gov

Geologic Units

f - fill derived from local materials, along roadways (not shown) and including imported concrete and asphalt debris at head of West Branch Shuler Canyon.

Qya - Younger alluvium, limited to mouth of Shuler Canyon.

Qcol - Colluvium, areas of thicker colluvium derived from slope wash and gravity creep.

Qdf - Debris flow deposits, clast-supported cobble/gravel conglomerate, fine-to medium-grained silty sand matrix, buried by Qcol, exposed in test pits in Wildwood Canyon area.

Qt - Older terrace deposit, including rounded cobbles/gravel of volcanic and gneissic lithologies in sandy matrix capping Puente Formation.

Qls - Landslide deposits, identified based on evaluation of topography, aerial photographs, prior mapping by others, and observation of rock outcrops and geomorphology of the site.

Tp - Puente Formation siltstone, thinly bedded, white to orange brown, locally cemented, forms dark gray clayed colluvium (soil cover) with tabular siltstone fragments. Includes areas of colluvium at bottoms of ravines and drainages.

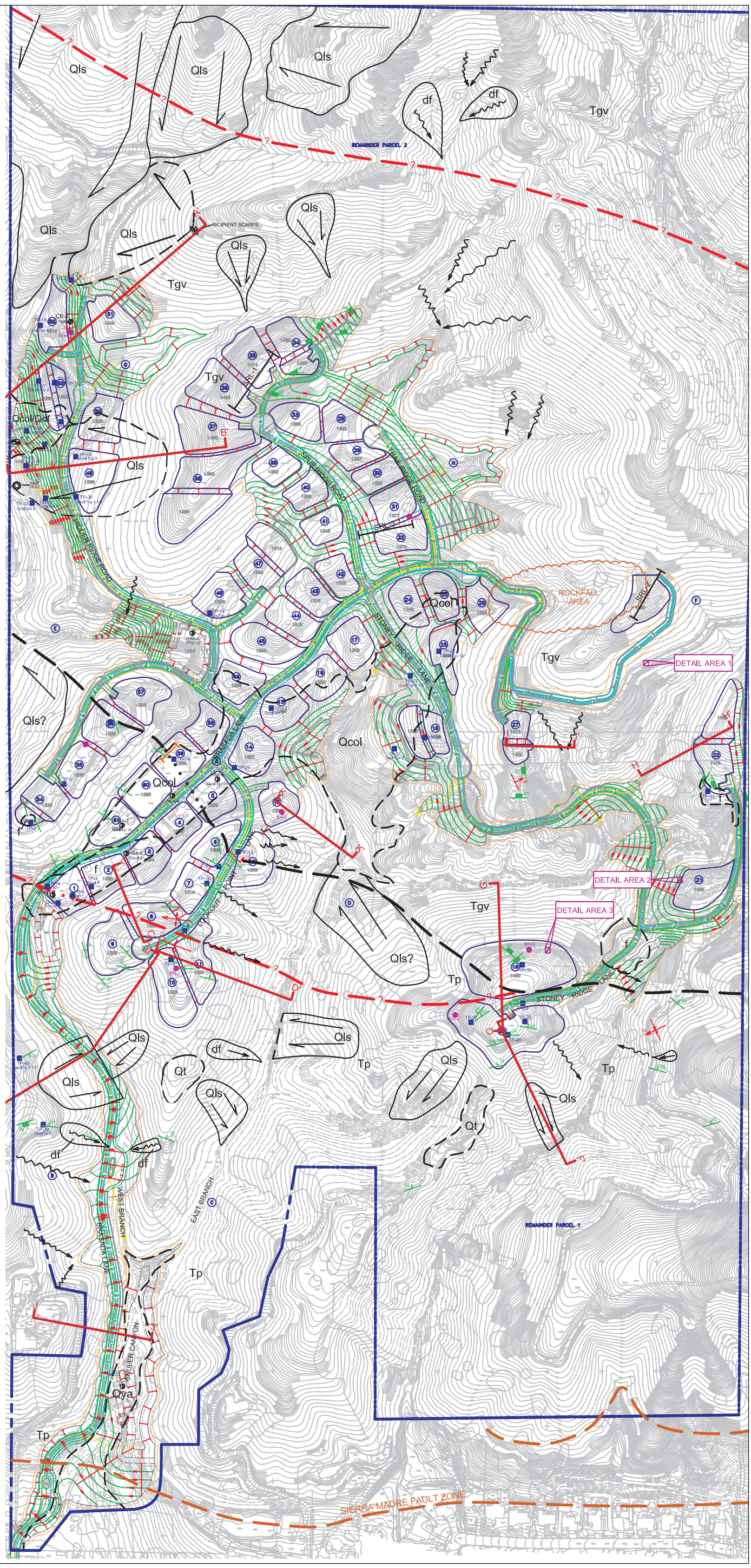
Tgv - Glendora Volcanics, andesite flows and flow breccias, dark gray to purple, locally regularly jointed, typically pervasively fractured. Forms red-brown clayey colluvium on slopes and in drainages.

Legend

- geologic contact
- Fault — Location based on FER map (not investigated for this project)
- Fault — Location based on field evidence
- Fault — Location based on USGS/CGS (2010)
- 68 — strike and dip of bedding
- 86 — strike and dip of joint
- 56 — strike and dip of shear plane
- 20 — Trend and plunge of syncline
- Trend and plunge of anticline
- Qls — approximate margins of landslide deposits based on photographic review, field mapping, interpretation of topographic contour map; queried where uncertain
- df — debris flow scar
- Area of steep topography associated with erosion along steep, narrow channels; defines areas of potential debris sources, based on photo review and field mapping, not all such areas shown.
- BH-7 — Bucket Auger Boring
- HSA-7 — Hollow Stem Auger Boring
- TP-40 — Backhoe Test Pit
- Qcol/Tgv 3' — depth to contact between indicated geologic units
- SRL-3 — Seismic Refraction Line
- K K' — Geologic Cross Section

Explorations by Leighton & Associates (1999)

- CB-2 — Core Boring
- T-7 — Test Pit
- FT-1 — Fault Trench



Source: CHJ Inc. 2010

PBSJ

0 180 360
Feet

N

GEOLOGIC FEATURES
FIGURE 4.5-1