6.5 GEOLOGY, SOILS AND HYDROGEOLOGY

This section describes existing geology, soils and hydrogeology conditions and evaluates the stability of soils and proposed landfill slopes at Scholl Canyon Landfill (SCLF) under the proposed project for both final fill variations. The analysis in this section was summarized from the *Geotechnical Report Proposed Landfill Expansion, Scholl Canyon Landfill* (Geo-Logic Associates (GLA), March 2012). This report is included as Appendix I of the Draft Environmental Impact Report (DEIR).

6.5.1 EXISTING CONDITIONS

6.5.1.1 Landfill History

The SCLF is located in the San Rafael Hills in Glendale, California just north of the Ventura Freeway (State Route (SR) 134). The landfill property, which is situated on 535 acres, was constructed by filling two steeply sloping, sinuous canyons: the east-west trending Scholl Canyon that forms the southern portion of the landfill; and an unnamed tributary canyon that forms the northern portion.

These two canyons were incised into bedrock and were infilled with shallow alluvial/colluvial soils prior to landfill operations. The original drainage pattern consisted of two streams within the canyons which conveyed runoff from the surrounding slopes. Some grading of these canyons occurred prior to waste placement, which has been placed directly on the graded alluvium/colluvium/bedrock ground surface within the canyons without conventional compacted clay and/or synthetic liners. The placement of landfill waste has largely displaced/interrupted the original drainage courses. Current site drainage generally consists of sheet flow to engineered collection devices for ultimate conveyance off site.

Landfill operations began in 1961 at the base of Scholl Canyon and then proceeded to the unnamed tributary canyon towards the north. Waste material was placed in both canyons concurrently. Waste operations were completed in the northern canyon in 1975, when the canyon was filled to capacity. This canyon was subsequently developed as the Scholl Canyon Golf Course and is currently maintained by the City of Glendale. Since then, landfilling within the Scholl Canyon has continued to date.

Due to concerns about possible leachate contamination of water bearing strata of the Los Angeles River flood plain to the west, separate cement-bentonite trench subsurface barriers were installed across each of the two canyons within Scholl Canyon Park in 1987. These subsurface barriers were installed through alluvium, 5 to 24 feet into weathered bedrock. In addition, numerous monitoring and extraction wells were installed between 1987 and 1998. Groundwater is pumped from extraction wells on the upstream side of the subsurface barriers for treatment, and groundwater levels are recorded in piezometers and monitoring wells both upstream and downstream of the subsurface barriers.

6.5.1.2 Regional Geology

The SCLF is located in the Transverse Ranges Geomorphic Province of California. The landfill is located within Scholl Canyon of the San Rafael Hills which comprise the southeastern part of the Verdugo Mountains. Though separated from the San Gabriel Mountains by the La Canada Valley, the Verdugo Mountains are composed of many of the same rock types and are essentially an extension of the San Gabriel Mountains Terrane. This area marks the southeastern border of the San Fernando Valley and the northwestern border of the San Gabriel Valley.

The Verdugo Mountains are composed of many individual rock types, including Precambrian gneiss, Mesozoic plutonic rocks, Tertiary sedimentary and hypabyssal intrusive rocks, which are all juxtaposed along many complex faults, intrusive boundaries, and non-conformable sedimentary deposition. Crystalline basement rocks typical of the San Gabriel Mountains Terrane make up the preponderance of the San Rafael Hills along with fewer small exposures of overlying sedimentary rocks. The extreme southern portion of the Verdugo Mountains south of the Verdugo fault are comprised predominantly of Tertiary sedimentary rocks typical of the Los Angeles Basin and Santa Monica Mountains.

The Transverse Ranges are uplifted along a left-stepping bend on the San Andreas fault. Numerous east-west oriented faults accommodate some of the compression with a substantial reverse sense of motion and some incidental lateral slip. The Verdugo Mountains are separated from the San Gabriel Mountains by the Sierra Madre Fault System. The Verdugo fault separates the southern side of the Verdugo Mountains from the Santa Monica Mountains. Although past evidence suggested that the Verdugo fault had at least 3,300 feet of vertical offset, other researchers suggest the fault motion is primarily strike-slip.

6.5.1.3 Local Geology

The San Rafael Hills, which represent the southeastern portion of the Verdugo Mountains, are an area of high relief exposing Tertiary sedimentary rocks south of the Verdugo fault and igneous and metamorphic rocks to the north. Scholl Canyon is a westward draining tributary of the Los Angeles River within the San Rafael Hills. Within the landfill property, the site is underlain primarily of early Cretaceous Wilson Diorite. Precambrian gneiss and Precambrian to Paleozoic siliceous metamorphic rocks and large dikes of Tertiary hypabyssal igneous rocks are exposed on the slopes above the landfill property. Smaller localized, late-stage intrusive pegmatite and aplitic dikes are also found throughout the Precambrian gneiss and Wilson Diorite.

Geologic exposures are limited primarily to road cuts and cut slopes along the perimeter of the landfill. Mapping of the rock types shows a slight variation in rock compositions ranging from weakly- to moderately-well-foliated diorite to granodiorite of the Wilson Diorite. Foliation within the Wilson Diorite is expressed as banding caused by the preferential alignment of micaceous minerals and the segregation of alternating bands of more mafic segregations of hornblende and biotite against more plagioclase and quartz rich bands. The Precambrian gneiss is composed of a fine- to medium-grained, moderately- to well-foliated, biotite and hornblende rich potassium feldspar gabbro to diorite with minor amounts of quartz.

The rock in the upper 10 to 50 feet of the native ground surface is moderately oxidized with many feldspar and iron-rich minerals weathered to clay and iron oxide minerals. Oxidation and weathering of the rock is very pronounced within 10 feet of the native ground surface with colluvial soils approximately 2 feet thick overlying shallow dipping slopes.

Rock outcrops exist in the cut slopes north of the existing waste fill, and are slightly to moderately fractured, with fractures typically spaced from 4 inches to 3 feet apart. Although minor faults can be observed on existing cut slopes and road cuts, they are few in number relative to the joints and fractures and can only be mapped for short distances due to colluvial soil cover and minor offset. Many of the faults and shears do not appear to have generated gouge in appreciable quantities. Most joints and fractures show little or no accumulation of weathering products and have a rough appearance with apertures that are small or are completely closed.

6.5.1.4 Structural Geology

The geologic history of the San Rafael Hills is very complex with many stages of igneous rock emplacement ranging from the Precambrian to the Tertiary with multiple episodes of orogeny.

6.5.1.5 Site Hydrogeology

Groundwater flow at the SCLF generally follows topography and is primarily within unconsolidated alluvium along the pre-development canyon bottom, with substantially lesser flows in the colluvium and weathered bedrock along the slopes and the fractured bedrock beneath (Sanitation Districts, 1988). Given the topography of the SCLF site and the previously constructed drainage improvements for the landfill and adjacent golf course, groundwater recharge from seasonal precipitation within Scholl Canyon occurs primarily in undeveloped ridges and slopes surrounding the landfill. Bedrock fracture flow is constrained by the tight joint spacing, which limits recharge.

Previous hydrogeologic studies conducted for the SCLF have been focused in Scholl Canyon Park, which is located downgradient of the landfill. These previous studies focused on this area because two subsurface barriers were installed at Scholl Canyon Park in 1987 to limit off site water quality impacts from the landfill. Numerous soil borings, piezometers, and monitoring wells were installed prior to construction of the barriers. Since 1999, pumping of extraction wells upgradient of Subsurface Barrier #1 has dropped groundwater levels generally to below the top of bedrock in this area, though the base of the alluvium is occasionally saturated. Extraction wells in the vicinity of Subsurface Barrier #1 are set to start pumping when groundwater rises to elevation 945, which is just above or below the top of bedrock for the various extraction wells in this area (Sanitation Districts, 2010).

6.5.1.6 Seismicity

The SCLF is located in the Los Angeles region, an area of high seismicity that has a documented history of strong earthquakes. Active local and regional faults of potential major significance to the SCLF area include the Verdugo fault, the Raymond fault, the Sierra Madre fault, the Hollywood fault, the Elysian Park fault, and the Puente Hills fault.

The project vicinity has experienced strong shaking from earthquakes during historic times, notably the 1971 San Fernando earthquake on the San Fernando section of the Sierra Madre fault (magnitude M_w 6.4), the 1987 Whittier Narrows earthquake on the Puente Hills fault (magnitude M_w 5.9), and the 1994 Northridge earthquake on the Northridge fault (magnitude M_w 6.7).

6.5.2 THRESHOLDS OF SIGNIFICANCE

Based on Appendix G of the GEQA Guidelines, implementation of the proposed project would result in a significant adverse impact on the environment related to geology, soils, and hydrogeology if it would:

- Expose people or structures to potential substantial adverse effects including risk of loss, injury or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure (including liquefaction) or landslides.
- Result in substantial soil erosion or the loss of topsoil.
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off site landslide, lateral spreading, subsidence, liquefaction or collapse.
- Be located on expansive soil, as defined in Table 18-1-B of the California Building Code (2001), creating substantial risks to life or property.

Title 27 of the California Code of Regulations (CCR) sets rules and guidelines for the siting, design, construction, management, and closure and post-closure maintenance of all Class III municipal solid waste landfills. These rules are enforced by the California Department of Resources Recycling and Recovery (CalRecycle), its local enforcement agency (LEA) and the California State Water Resources Control Board. Title 27 requires that stability analyses performed for a Class III landfill be based on the expected peak ground acceleration at the site associated with the maximum probable earthquake (MPE). The MPE has been defined by the California Division of Mines and Geology (now known as the California Geological Survey) as the "maximum earthquake that is likely to occur during a 100-year interval" (CDMG, 1975). There has been a recent trend by some of the Regional Water Quality Control Boards (RWQCB), however, to require the use of the maximum credible earthquake (MCE) in such analyses. The MCE is defined as "… the maximum earthquake that appears capable of occurring under the presently known tectonic framework." (CDMG, 1975). At the Sanitation Districts' direction, ground motion parameters for the SCLF site have been estimated for an MCE event.

In the current standard of practice, a horizontal seismic coefficient of 0.15 is applied during stability analyses. If the factor of safety against slope failure involving landfill containment systems is not equal to or greater than 1.5, then a more rigorous method of stability analysis must be employed. The more rigorous dynamic stability analysis consists of calculating the amount of displacement that is expected to occur as a result of seismic forces acting on the site. The seismic forces are calculated either deterministically or probabilistically and the amount of displacement of the slope or landfill liner system is calculated.

6.5.3 METHODOLOGY

6.5.3.1 Seismic Force Calculations

The seismic hazard assessment for the SCLF was deterministically based. The average of four Next Generation Attenuation (NGA)-based attenuation relationships were used to estimate the 5-percent damped bedrock motion acceleration response spectra (ARS) curves for an MCE-event on all faults in the USGS/CGS 2008 Fault Model (Wills et al., 2008) within a 100-kilometer radius of the SCLF site. The four NGA relationships used were: Abrahamson & Silva (2008), Boore & Atkinson (2008), Campbell and Bozorgnia (2008), and Chiou & Youngs (2008). These deterministic calculations were performed with the computer program EZ-FRISK (Risk Engineering, Inc., 2010). For the faults most significant to the SCLF site, these calculations were manually verified using fault data from the USGS/CGS 2008 Fault Model (i.e. trace endpoint coordinates, dip angle, maximum magnitude, and rupture depth and width), a spreadsheet coded with the NGA relations, and source-to-site distances based on the SCLF site coordinates and determined using AutoCAD (Autodesk, 2011). The SCLF site latitude/longitude coordinates used for these calculations were taken from the State's CalRecycle Solid Waste Information System database; this location corresponds roughly to the edge of the existing/proposed waste fill southwest of Debris Basin #1. NGA ground motion calculations are presented in Appendix C-1 of Appendix I of the DEIR.

The NGA relationships depend on the shear wave velocity in the upper 30 meters of the soil or rock profile ($V_{S\text{-}30}$), which was estimated to be approximately 500 meters per second (1,640 feet per second) based on geophysical measurements performed in and near Scholl Canyon Park as part of a geologic investigation for the subsurface barriers (Woodward-Clyde Consultants, 1986). Shear wave velocity calculations are presented in Appendix C-2 of Appendix I of the DEIR.

6.5.3.2 Liquefaction Assessment

An assessment of liquefaction triggering at the site using cone penetration test (CPT)-based procedures was performed by averaging the results from three different methods. The three methods used were Youd, et al. (2001), Moss, et al. (2006), and Idriss and Boulanger (2008). These analyses were based on an MCE event on the nearby Verdugo fault (magnitude M_w 6.9, PHGA (peak horizontal ground acceleration) = 0.67 g). Spreadsheets showing the results of these calculations for the three CPTs performed within Scholl Canyon Park at the toe of the waste fill (Plate 2) are presented in Appendix D-1 of Appendix I of the DEIR. Spreadsheets showing the results of alternative standard penetration test (SPT)-based liquefaction assessment calculations for SPTs performed in Scholl Canyon Park as part of previous investigations are presented in Appendix D-2 of Appendix I of the DEIR. The liquefaction factor of safety results for the three CPT-based methods is presented on Figures 5-1 to 5-3 of Appendix I of the DEIR. The calculated dynamic settlements of the saturated and non-saturated sandy soils in each of the three CPTs (to the total depth of exploration) are as follows: CPT-1 = <1 inch; CPT-2 = 2-1/2 inches; and CPT-3 = <1/4 inch. Refer to Section 5.1.1 and 5.1.2 of Appendix I of the DEIR for detailed descriptions of the liquefaction triggering assessment methods and results.

6.5.3.3 Slope Stability Analytical Methodology

Estimates of potential seismically-induced permanent deformations were made based on an MCE event on the nearby Verdugo fault (magnitude M_w 6.9, PHGA = 0.67 g). The stability evaluation for landfill slopes also included consideration of potential liquefaction of alluvial deposits near the toe of the existing waste fill in Scholl Canyon Park during the MCE design event. Given the potential failure modes unique to each type of slope, proposed waste fill and bedrock cut slopes were evaluated separately using different methods, such as the conventional limit-equilibrium methods and kinematic and wedge stability analyses. For a detailed description of the various assumptions, inputs, models, etc. of these methods, refer to Section 6.0 of Appendix I of the DEIR.

6.5.4 IMPACTS

6.5.4.1 Variation 1

<u>Seismicity</u>

The project site is located in a seismically active area and would experience strong ground motions during a large earthquake event. However, no evidence of surface traces of active faults[1] at the SCLF have been identified as part of the geotechnical investigation for the proposed project or in other previous geologic and faulting studies. Furthermore, the project site does not lie within or near a State of California Alquist-Priolo Earthquake Special Studies Zone (A-P Zone). A-P Zones are established by the State Geologist to regulate construction of buildings for human occupancy within narrow zones adjacent to active faults.

The deterministic seismic hazard assessment performed for the proposed project includes ground motion estimates from a postulated M_w 6.9 earthquake on the Verdugo fault per the USGS/CGS 2008 Fault Model. The Verdugo fault trace in this model actually comprises the Verdugo-Eagle Rock-San Rafael fault system, a northeast-dipping fault system that runs along the southwest base of the Verdugo Mountains and the San Rafael Hills. While the Verdugo fault proper is considered by the State of California to be Holocene-active (i.e., active within the last 10,000 years), the Eagle Rock and San Rafael

[1] An active fault is defined in the Alquist-Priolo Act as having experienced displacement within the Holocene period (i.e. in the last 10,000 years).

faults are considered as having last experienced fault displacement in the Late Quaternary period (i.e. within the past 700,000 years). So while the entire Verdugo-Eagle Rock-San Rafael fault system per the USGS/CGS 2008 Fault Model is considered in the ground motion estimates for the proposed project's geotechnical investigation, the southern portion of this fault system (i.e. the Eagle Rock and San Rafael faults) is not considered active. Furthermore, no evidence for surface rupture has been observed along Eagle Rock and San Rafael faults (Weber et al., 1980). As such, the probability of earthquake surface rupture affecting the SCLF site is considered very low.

Therefore, impacts related to rupture of a known earthquake fault or strong seismic ground shaking are considered less than significant.

Liquefaction and Unstable Soils

Liquefaction is a phenomenon whereby loose, sandy soils below the water table lose strength in response to the cyclic build up of earthquake-induced groundwater pore pressures. In severe cases, liquefied soils can lose nearly all strength, causing slope failures, ground distortion and settlement, and damage to overlying structures. Within the vicinity of the SCLF, the aerial extent of potentially liquefiable alluvium is confined to the relatively narrow channel of the pre-development creek. Subsurface conditions near the toe of the landfill, in Scholl Canyon Park, generally consist of varying depths of alluvial materials overlying bedrock. Alluvial depths are highly variable, ranging from less than 5 feet along the flanks of the canyon to about 40 feet along the canyon axis (EarthTech, 1988). Alluvium generally consists of loose to very dense sand, silty sand, silty sand with gravel, gravelly sand, cobbles, and minor amounts of clayey sand. The ongoing groundwater pumping upstream of Subsurface Barrier #1, within Scholl Canyon Park, is expected to prevent or minimize potential liquefaction at the toe of the SCLF by depriving sediments of the groundwater necessary for liquefaction. In the very unlikely event of high groundwater, such as due to a cessation of pumping, in combination with the maximum credible earthquake (MCE = M_w 6.9, PHGA = 0.67 g), surface manifestations of liquefaction at the SCLF, such as differential settlement and sand boils, would generally be confined to Scholl Canyon Park. This extreme worst-case liquefaction scenario is not expected to cause significant stability failures of the waste mass, and in no case would any potential liquefaction-related failure extend very far up the landfill slope. Additionally, the potential for seismically-induced dynamic settlements within the sandy alluvial soils at Scholl Canyon Park were also calculated. Similarly, it was determined that estimated dynamic settlements during the MCE would not be expected to significantly impact the waste fill. In addition, according to the geotechnical report, no significant impacts related to expansive soils would occur. Therefore, impacts related to liquefaction and expansive and unstable soils (i.e., settlement, subsidence, and collapse) are considered less than significant.

Slope Stability

Static stability and seismic deformation analyses were performed for the proposed landfill slopes of the vertical expansion. The static factor of safety of all proposed slopes was found to be greater than 1.5, indicating that they meet the static stability requirements of Title 27 (refer to Appendix E-2 of Appendix I of the DEIR for landfill slope stability calculations). The results of the seismically-induced permanent displacement calculations for the proposed landfill slopes indicate tolerable displacements of under 6 inches for the MCE design event for all conditions. Because the MCE is more conservative than the MPE required by Title 27, the dynamic stability of the proposed landfill slopes exceeds Title 27 requirements (refer to Appendix E-3 of Appendix I of the DEIR for seismically-induced permanent deformation calculations). Therefore, impacts related to slope stability (i.e., landslides and lateral spreading) are considered less than significant.

Soil Erosion and Loss of Topsoil

As discussed in Section 6.8 (Surface Water Hydrology) of the DEIR, the Sanitation Districts would continue to design, construct, and operate adequate stormwater run-off control measures to minimize erosion. The final cover of the proposed project would be designed in accordance with applicable stormwater drainage regulations and approved by the RWQCB, CalRecycle, and the Local Enforcement Agency (Los Angeles County Department of Public Health). In addition to the continued rapid diversion of water into lined channels and pipes, vegetated final cover would reduce flow velocity, as well as bind the soil to prevent erosion. These measures, in combination with the dynamic stability of the proposed landfill slopes exceeding Title 27 requirements, would reduce potential impacts related to soil erosion and loss of topsoil to a level that is considered less than significant.

6.5.4.2 Variation 2

Seismicity

Impacts related to seismicity would be similar to those discussed under Variation 1. Therefore, impacts related to rupture of a known earthquake fault or strong seismic ground shaking are considered less than significant.

Liquefaction and Unstable Soils

Impacts related to liquefaction and unstable soils would be similar to those discussed under Variation 1. Therefore, impacts related to liquefaction and expansive and unstable soils (i.e., settlement, subsidence, and collapse) are considered less than significant.

Slope Stability

Static stability and seismic deformation analyses were performed for the proposed landfill slopes of the vertical and horizontal expansions. The static factor of safety of all proposed slopes was found to be greater than 1.5, indicating that they meet the static stability requirements of Title 27 (refer to Appendix E-2 of Appendix I of the DEIR for landfill slope stability calculations). The results of the seismically-induced permanent displacement calculations for the proposed landfill slopes indicate tolerable displacements of under 6 inches for the MCE design event for all conditions. Displacements of 6 to 12 inches are considered the maximum tolerable deformation for landfills with synthetic liner components. Because the MCE is more conservative than the MPE required by Title 27, the dynamic stability of the proposed landfill slopes exceeds Title 27 requirements (refer to Appendix E-3 of Appendix I of the DEIR for seismically-induced permanent deformation calculations).

Specific to the horizontal expansion cut slopes, the primary areas of concern are rock rippability (i.e., the earth's ability to be excavated using conventional excavation equipment), slope stability, and groundwater flow.

Rock Rippability

The area of the proposed horizontal expansion was previously evaluated (Van Beveren & Butelo, 2006). Field work for that investigation consisted of advancing two bucket auger borings to a depth of 50 feet and field mapping of bedrock surface exposures. While boring logs indicate bedrock weathering to a depth of 20 to 30 feet, at least the upper 50 feet is moderately weathered as indicated by the ability to drill and sample with a truck-mounted 24-inch diameter bucket auger. As such, rock rippability is assumed to be locally rippable to a depth of 50 feet. It should be noted that the depth of the proposed cut slope excavation would exceed 150 feet at this location, where rippability of rock at these depths is unknown. However, as part of additional geophysical engineering at the design stage, geophysics and/or deeper borings in this area would be performed and any resulting additional geotechnical recommendations would be incorporated during construction and excavation.

Slope Stability

The previous evaluation of the horizontal expansion area was supplemented with a site reconnaissance and mapping effort performed by GLA in 2007. Assessment of the existing cut slopes and native exposures of bedrock to determine lithology and structure of the underlying bedrock was also performed. Specifically, mapping was focused on identifying discontinuities such as foliation, joints, faults, and shears, and recording the orientation of each feature. Rock foliation and discontinuities were measured in the field and compiled on a geologic map. Most of the discontinuities in the rock were joints showing no discernible offset and rough surfaces. The predominant geologic discontinuities in this slope area consist of joints and fractures. Joints and fractures are generally spaced approximately 4 inches to 3 feet apart and foliation was weakly to moderately expressed in most outcrops. The mapping of geologic structures was consistent with the previous investigation (Van Beveren & Butelo, 2006). Based upon available information, the subsurface conditions in the horizontal expansion area include uncontrolled stockpiled earth fill (i.e. fill placed without engineering oversight and compaction controls), colluvium, and granitic bedrock. Colluvium is more prevalent on shallow dipping slopes and within drainage swales. The colluvial materials consist of a thin veneer of loamy sand with silt derived from weathering of the underlying crystalline bedrock. Bedrock in the proposed north cut slope area consists of quartz diorite.

Kinematic stability analyses, considering the potential for single-plane failure along any individually mapped discontinuity, were performed for each of the five slope geometries of the proposed horizontal expansion cut slopes. A potential for failure is considered when the pole to the plane of any discontinuity occurs within 20 degrees of the slope dip direction. In other words, when a discontinuity has a similar (within 20 degrees) dip direction as the slope, it has the potential to fail if the friction on the plane is insufficient to maintain stability. Of the five cut slope geometries, only one met this criterion. This discontinuity dips within 15 degrees of the dip direction of the slope and, thus, has the potential to fail. Therefore, implementation of the proposed project has the potential to result in significant adverse impacts related to a single-plane failure.

The intersection of two or more planes daylighting on a slope forms a wedge. Stability analyses were performed for each potential wedge formed by the intersection of two major discontinuity planes and a proposed cut slope face under both drained and saturated conditions. All slope and wedge combinations are stable under drained conditions, with factors of safety greater than 1.5 (and typically much greater). Under fully-saturated conditions, only four slope and wedge combinations have calculated factors of safety less than 1.5. For these four slope/wedge combinations, however, decreasing the degree of saturation from 100 percent to between 75 and 92 percent resulted in factors of safety in excess of 1.5. It should be noted that there is no evidence of high groundwater within the rock mass that would be excavated for the proposed cut slopes and, therefore, the probability of fractures up to the full height of the analyzed slopes becoming anywhere near 75 percent saturated is very, very low. Nonetheless, there is the potential for significant impacts related to the stability of wedges under saturated conditions.

Groundwater Flow

Given the topography of the SCLF site and drainage improvements for the landfill and adjacent golf course, groundwater recharge from seasonal precipitation within Scholl Canyon occurs primarily in undeveloped ridges and slopes surrounding the landfill. Bedrock fracture flow is constrained by the tight joint spacing, which limits recharge. Because of these conditions, only minor seepage was observed in bucket auger Boring 2 of the previous site investigation. The measured depth to groundwater in Monitoring Well M19B, which is about 500 feet north of this area, was 130 feet. During the supplemental site reconnaissance, springs and seeps were not observed on any of the native slopes around the proposed north cut slope, although a seep was observed on the lower portion of a cut slope beneath a swale descending from a green and fairway of the golf course. The upper portions of the slope were dry and suggested that fractures, though tight, are capable of draining away excess pore pressure from precipitation and golf course irrigation. Due to the low recharge, site drainage improvements, and ongoing groundwater pumping, it is not anticipated that the SCLF waste fill is saturated to any appreciable extent across the site. Therefore, potential slope stability impacts related to groundwater flow would be considered less than significant.

Soil Erosion and Loss of Topsoil

Impacts related to soil erosion and loss of topsoil would be similar to those discussed under Variation 1. Therefore, impacts related to soil erosion and loss of topsoil are considered less than significant.

6.5.5 MITIGATION MEASURES

6.5.5.1 Variation 1

No mitigation measures are required.

6.5.5.2 Variation 2

The following mitigation measures are required to ensure the stability of the foundation and slope of the proposed cut slopes:

G-1 Prior to construction of the landfill liner as part of Variation 2, soft, yielding material will be replaced with compacted, proof-rolled fill. Any fill placed beneath sections of the landfill to be lined should be compacted to 90% relative compaction per ASTM D 1557.

G-2 Stockpiled soils shall be excavated down to competent native material before liner construction.

G-3 During excavation of the cut slopes as part of Variation 2, a certified engineering geologist shall perform in-grading observation and mapping of the cut slope excavation to ensure that any potential adversely-oriented discontinuities, or other potential stability issues, are identified and mitigated, if necessary.

G-4 To prevent erosion or excessive groundwater infiltration, brow drains, or other methods, shall be installed to prevent concentrated flows onto newly cut slopes.

6.5.6 LEVEL OF SIGNIFICANCE AFTER MITIGATION

6.5.6.1 Variation 1

Implementation of Variation 1 would result in less than significant impacts related to geology, soils, or hydrogeology.

6.5.6.2 Variation 2

With implementation of the above mitigation measures, the potential for impacts to geology, soils and hydrogeology under Variation 2 would be considered less than significant.