3.6 GEOLOGY AND SOILS

This section describes existing geology and soils of the project site and is based on findings documented in the following reports:

- Geo-Logic Associates (GLA; 2012) Geotechnical Report – Proposed Landfill Expansion, March.
- Sanitation Districts of Los Angeles County – Planning Section and AECOM (2014) Draft Environmental Impact Report, March.
- Stantec (2016) Geotechnical Investigation Report, provided as Appendix D of this document.

3.6.1 Setting

Regional Hydrogeology

According to the California Department of Water Resources (CDWR) Bulletin 118 Report, the Project site is not located within a mapped groundwater basin. The closest groundwater basin is the San Fernando Valley Groundwater Basin of the South Coast Hydrologic Region (4-12), located to the west of the Project site. The basin is approximately 226 square miles and is bounded on the north and northwest by the Santa Susana Mountains, on the north and northeast by the San Gabriel Mountains, on the east by the San Rafael Hills, on the south by the Santa Monica Mountains and Chalk Hills, and on the west by the Simi Hills (DWR, 2004).

Regional Geology

The Project site is located in the northwestern portion of the Transverse Range Geomorphic Province in the southwestern part of California. The region is separated by an east-west trending series of steep mountain ranges and valleys, sub-parallel to faults branching from the San Andreas Fault. The Project site resides in the portion of the Province drained by the Los Angeles River.

California Highway 134 is located approximately 0.25~~4~~ miles southwest of the site, California Highway 210 is located approximately two miles east of the site, and the Los Angeles River is located approximately 4.9 miles west of the Project site. Based on interpretation of the ground surface elevation contour lines drawn on the topographic map, the Proposed Project site is located at an elevation of approximately 1,410 to 1,485 feet (1988, NAVD). The topography in the vicinity of the Project site is hilly, with a slope to the south then southwest toward the Los Angeles River (USGS, 1995).

Local Geology

Based on information depicted on the 2005 Geologic Map of Los Angeles, the Project site is underlain by Mesozoic age quartz diorite deposits composed of plagioclase feldspar (oligoclase- andesine, hornblende, biotite, and minor quartz). Sometimes referred to as the Wilson Diorite, this unit is the most widespread bedrock type in the Glendale area. The bulk of the Verdugo Mountains and the San Rafael Hills are comprised of quartz diorite. The color of the rock is typically a light gray to light brown. The texture is generally medium grained and the structure is massive. In the central part of the San Rafael Hills, just north of Highway 134, at the southeastern margin of Glendale, the mineral grains are aligned, giving the rock a distinct banding or "foliation" resulting in a somewhat layered structure. In this area, the structure dips 60 to 70 degrees to the east and northeast (Earth Consultants International, 2003).

Site Surface Conditions

The Project site is bordered by natural slopes on the south and southeast. The northern, western, and northeastern sides border the existing landfill.

Most of the area to be developed is relatively flat, at an elevation of approximately 1,410 feet. The surface begins to steepen in the northeastern portion of the site, rising to almost 1,500 feet east of the northeast corner of the site, where a cut slope is proposed. The ground surface has been cleared and is devoid of vegetation, except in limited areas in the northeastern part of the Project site, where portions of the landfill are exposed at the surface. Existing structures and equipment associated with operation of the landfill are located throughout the area.

Seismicity

The Project site, as is most of California, is located in a seismically active area. The estimated distances from the Project site to the nearest expected surface expression of nearby faults is presented in Table 3.6-1 below. The maximum moment magnitude is the measurement of maximum motion recorded by a seismograph; whereby "moment" is equal to the rigidity of the earth times the average amount of slip on the fault times the area of ground surface that slipped.

Table 3.6-1 Distance of Faults to Project Site and Maximum Magnitudes

Fault	Distance* (miles)	Maximum Moment Magnitude*
Verdugo	0.3	6.9
Raymond	2.3	6.8
Hollywood	3.3	6.7
Sierra Madre (connected)	3.9	7.2
Elysian Park Thrust	6.1	6.7
Santa Monica	6.2	7.4
Sierra Madre (San Fernando)	10.5	6.7
Clamshell-Sawpit	11.1	6.7
Puente Hills (LA Basin)	11.5	7.0
San Gabriel	12.4	7.3
Elsinore	13.7	7.8
Newport-Inglewood (LA Basin)	13.7	7.5
Santa Monica	13.9	7.3
Northridge	15.2	6.9
Puente Hills (Santa Fe Springs)	17.3	6.7
San Jose	19.6	6.7
Puente Hills (Coyote Hills)	19.9	6.9
Malibu Coast	21.0	6.7
Anacapa-Dume	22.7	7.2
Palos Verdes	24.4	7.7

* Measured from 2008 National Seismic Hazard Maps (USGS, 2008).

The Project site is not located within a currently mapped California Earthquake Fault Zone, as presented in the table above; the nearest fault is the Verdugo Fault, located approximately 0.3 miles to the southwest of the Project site. Based on available geologic data, there is low potential for surface fault rupture from the Verdugo Fault and other nearby active faults propagating to the surface of the Project site during design life of the proposed development.

The Scholl Canyon faults were mapped by Byer (1968), and Envicom (1975) suggested that this fault zone connects the Verdugo fault in the west to the Eagle Rock fault in the east. However, more recent mapping by Dibblee (1989) does not even show these faults, and there is no data available to indicate that these fault traces, if even present, are active. The Hazards Map in the GGP (Glendale General Plan) shows the Scholl Canyon Fault, as mapped by Byer, on Plate P-1 of the Safety Element of the GGP (City of Glendale, 2003).

Site Soils

Based on soil assessment work conducted by Stantec in December 2015, soils within the footprint of the proposed power generation facility consist of those presented in Table 3.6-2 below.

Table 3.6-2 Site Soils

Soil Symbol	Soil Type	Description
SM	Silty Sand with Gravel	Silty sand with gravel; 7.5 YR 3/3 dark brown; 15 percent fine gravel; 65 percent fine to coarse grained sand; 20 percent fines; moist; medium dense; no staining; no odor (FILL).
wqd	Wilson Quartz Diorite	Weathered dioritic-granitic bedrock; dark yellowish brown; dry; very dense; moderately fractured.
Qns	Natural Soil	Silty sand with gravel; brown; dry; loose; sand is very fine to coarse grained; rootlets (NATIVE)
Source: Stantec, 2016		

Expansive Soil Potential

The near-surface materials (upper eight feet) consist of silty sand with gravel and weathered quartz diorite bedrock. The predominantly granular soils and rock are not expansive. Design for expansive soils is not required.

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 (GLA, 2012).

Within the vicinity of the Project site, 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 five feet along the flanks of the canyon to about 40 feet along the canyon axis. Alluvium generally consists of loose to very dense sand, silty sand, silty sand with gravel, gravelly sand, cobbles, and minor amounts of clayey sand.

GLA evaluated the stability of the proposed landfill slopes and proposed cut slopes in bedrock of the adjacent property (SCLF) for their geotechnical report (2012). During this investigation it was established that, although the Project site would experience strong ground motions during the maximum considered earthquake design event, the calculated displacement of waste mass and potential liquefaction of alluvium at the toe of the waste fill, are considered to be tolerable (less than six inches) and in compliance with Title 27, Division 2, California Code of Regulations.

Ongoing groundwater pumping within Scholl Canyon Park, to the west of the SCLF, the proposed water line, and where the western portion of the proposed gas line would terminate, is expected to prevent or minimize potential liquefaction at the toe of the SCLF by depriving sediments of the groundwater necessary for liquefaction (AECOM, 2014). In the very unlikely event of high groundwater, such as due to a cessation of pumping, in combination with the maximum credible earthquake (MCE) (MCE = M_w[1] 6.9, PHGA[2] = 0.67 g[3]), 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 calculated based on Cone Penetration Test (CPT) soundings advanced on the SCLF property. 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 for the landfill expansion (Geo-Logic Associates, 2012), no significant impacts related to expansive soils would occur.

Subsurface conditions underlying the Project site consist mainly of dense to very dense silty sands over slightly weathered, hard bedrock. Groundwater was not encountered during soil assessment (maximum depth explored 36.5 feet below ground surface) and it is anticipated that the groundwater level is below a depth that would affect planned construction. The Project site is located in an area where water bearing soils are not present. Consequently, the potential for liquefaction beneath the Project site is negligible (Stantec, 2016).

Landslides, Lateral Spreading, and Slope Stability Evaluation

Landslides are not listed in the Safety Element of the Glendale General Plan as an overlay constraint within Scholl Canyon (identified as "Low landslide incidence"). The SCLF is shown in the General Plan Slope Instability Map (Plate 2-4) as outside any areas identified as having slope instability (Low-Very High). 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 Maximum Possible Earthquake (MPE) required by Title 27 (combined State Water Resources Control Board/California Integrated Waste Management Board regulations for Solid Waste), the dynamic stability of the proposed landfill slopes exceeds Title 27 requirements.

The Proposed Project site is also outside of Liquefaction Hazard Zones identified on the GGP Hazards Map Plate P-1. Landslide Hazard Zones appear on Plate P-1 to be located directly to the south of the Proposed Project site, most likely on the steep slopes upon which Scholl Canyon Road is located.

[1] Magnitude weighted
[2] Peak horizontal ground acceleration
[3] Peak ground acceleration can be expressed in ***g*** (the acceleration due to Earth's gravity, equivalent to g-force) as either a decimal or percentage

3.6.2 Impact Analysis

Issues	Potentially Significant Impact	Less Than Significant Impact With Mitigation Incorporated	Less Than Significant Impact	No Impact
GEOLOGY AND SOILS: Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving?				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42?	☐	☐	☒	☐
ii) Strong seismic ground shaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv) Landslides?	☐	☐	☒	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) 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 of collapse?	☐	☐	☒	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building code (1997), creating substantial risks to life or property?	☐	☐	☒	☐
e) 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?	☐	☐	☐	☒

a) *Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving?*

   i. Rupture of a known earthquake fault, as delineated on the most recent AlquistPriolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault?

Less than Significant Impact

The SCLF and the approximately 2.2-acre site lying within the inactive portion of the landfill proposed for the Project, 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 (having experienced displacement within the Holocene period [i.e. in the last 10,000 years]) at the SCLF have been identified as part of the geotechnical investigation for the landfill expansion 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 (AECOM, 2014).

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/California Geological Survey (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 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 Project site is considered very low (AECOM, 2014).

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

Mitigation Measures

None required.

ii. Strong seismic ground shaking?

Less than Significant Impact

Please see response to i, above.

Mitigation Measures

None required.

iii. Seismic-related ground failure, including liquefaction?

Less than Significant Impact

Impact Discussion

Power Generation Plant

Due to the subsurface conditions underlying the Project site consisting mainly of dense to very dense silty sands over slightly weathered, hard bedrock, combined with very deep groundwater levels in an area where water bearing soils are not present, the potential for liquefaction beneath the Proposed Project site is negligible. Therefore, potential impacts related to liquefaction and expansive and unstable soils (i.e., settlement, subsidence, and collapse) are less than significant.

Gas and Water Lines

As described above, the extreme-worst-case liquefaction scenario is not expected to cause significant stability failures of the waste mass of the SCLF. Furthermore, the potential for seismically induced dynamic settlements within the sandy alluvial soils at Scholl Canyon Park during the MCE would not be expected to significantly impact the waste fill (AECOM, 2014). Therefore, impacts related to liquefaction and expansive and unstable soils (i.e., settlement, subsidence, and collapse) along the proposed water and gas lines are less than significant.

Mitigation Measures

None required.

iv. Landslides?

Less than Significant Impact

Power Generation Plant and Water Tanks

A cut native slope currently is proposed at the northeast end of the Project site. At present, the slope is configured at 1. 5:1 (horizontal:vertical). Erosion protection measures such as a drainage swale or bench (one at the top and one approximately mid-way down on the face of the slope) incorporated into the Project design will reduce the potential for sloughing and raveling from the face of the slope. Project compliance with design requirements set forth by Uniform Building Code and the City's Building and Safety code will ensure maximum slope steepness is not exceeded. Therefore, impacts would be less than significant.

Natural Gas and Water Pipelines

The proposed water line traverses the perimeter active landfill road and the southern boundary of the Scholl Canyon golf course to the northwest. The proposed gas line traverses and descends a terraced hillside into Scholl Canyon Park.

Static stability and seismic deformation analyses were performed for the Proposed Project EIR, which would border the proposed water line route. 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 landfill Draft EIR (AECOM, 2014) for landfill slope stability calculations). The results of the seismically-induced permanent displacement calculations for the Proposed Project slopes indicate tolerable displacements of less than six 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 Project slopes exceeds Title 27 requirements (refer to Appendix E-3 of Appendix I of the Draft EIR for seismically-induced permanent deformation calculations). The gas line would be routed above-ground except for road crossings, along existing landfill roadways and down a terraced, engineered slope on an existing pipe rack to an existing Southern California Gas Company meter. The terraced hillside down into Scholl Canyon Park is heavily landscaped and contains numerous water conveyance structures which serve to dissipate water flow and stabilize the slope. Therefore, impacts related to slope stability (i.e., landslides and lateral spreading) are considered less than significant.

Mitigation Measures

None required.

b) Result in substantial soil erosion or the loss of topsoil?

Less than Significant Impact

As discussed in Section 3.9, Hydrology and Water Quality, the Proposed Project would be designed, constructed, and operated with adequate stormwater run-off control measures to minimize erosion. In addition to diversion of surface water into conveyance features such as channels and culverts, other surface features would reduce flow velocities, as well as bind the soil to prevent erosion.

As recommended in the geotechnical report dated January 4, 2016 (Appendix D), drainage on the cut slope at the northeast end of the Project should be designed to prevent surface water from flowing over the face of the slope. At least one drainage swale or bench should be provided at the top of the slope and another one approximately mid-way down on the face of the slope. Weathered rock exposed on the face of the cut slope is expected to be erodible. Erosion protection such as erosion-resistant vegetation, commercial erosion control mats or other means should be provided to minimize sloughing and raveling. Incorporation of these Project design features would ensure soil erosion and/or loss of topsoil would be a less than significant level. Therefore, with incorporation of the aforementioned engineering methods, impacts would be less than significant.

Mitigation Measures

None required.

c) *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 of collapse?*

Less than Significant Impact

Power Generation Plant

Due to the subsurface conditions underlying the Project site consisting mainly of dense to very dense silty sands over slightly weathered, hard bedrock, combined with very deep groundwater levels in an area where water bearing soils are not present, the potential for landslides, lateral spreading, subsidence, liquefaction or collapse beneath the Proposed Project site is negligible. Therefore, potential impacts related to liquefaction and expansive and unstable soils (i.e., settlement, subsidence, and collapse) are less than significant.

Gas and Water Lines

As described above, the extreme worst-case liquefaction scenario is not expected to cause significant stability failures of the waste mass of the SCLF. Furthermore, the potential for seismically induced dynamic settlements within the sandy alluvial soils at Scholl Canyon Park during the MCE would not be expected to significantly impact the waste fill (AECOM, 2014). Therefore, potential impacts related to liquefaction and expansive and unstable soils (i.e., settlement, subsidence, and collapse) along the proposed water and gas lines are less than significant.

Mitigation Measures

None required.

d) *Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building code (1997), creating substantial risks to life or property?*

Less than Significant Impact

Power Generation Plant

Based on the subsurface investigation conducted as part of the subject site geotechnical evaluation (Stantec, 2016), the near-surface materials (upper eight-feet) consist of silty sand and quartz diorite bedrock. The predominantly granular soils and rock are not expansive. If imported soils are used for earthwork, the proposed materials for expansion potential prior to import, per Uniform Building Code and the Glendale Building and Safety Code 2016. Due to the absence of expansive soils within the subject site footprint, and regulations prohibiting the use of expansive soils, potential impacts associated with presence of expansive soils would be less than significant.

Natural Gas and Water Pipelines

Any native or imported soils used onsite during installation of the below-grade portion of the pipelines would be placed and compacted in accordance with Uniform Building Code and Glendale Building and Safety Code 2016. Potential impacts from expansive or collapsible soils would therefore be less than significant.

Mitigation Measures

None required.

e) *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?*

No Impact

The Proposed Project does not include the construction of new septic tanks or alternative wastewater disposal systems. Therefore, there would be no impact.

Mitigation Measures

None required.