3.4 - Geology and Soils

This section describes the potential geology and soils effects of project implementation on the project site and its surrounding area. Descriptions and analysis in this section are based on information contained in the November 9, 2012 Geotechnical Review prepared by Leighton Consultants, Inc. and the February 12, 2013 Geotechnical Investigation Report prepared by Converse Consultants. The 2012 Geotechnical Review was prepared for the recharge facility site, while the 2013 Geotechnical Investigation Report was prepared for the pipeline and service connection site. The Geotechnical Review and the Geotechnical Investigation Report are included in this Draft EIR as Appendix E.

3.4.1 - Existing Conditions

Regional Setting

The project area is located in the northwestern portion of the San Gorgonio Pass area of southern California, near the intersection of the San Bernardino Mountains of the Transverse Range Geomorphic Province and the San Jacinto Mountains of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges province extends approximately 900 miles southward from the Santa Monica Mountains to the southern end of the Baja California peninsula. This province is characterized by elongate northwest-trending mountain ridges separated by intervening, sediment-floored valleys. However, the most dominant structural features of the province are the northwest-trending fault zones, most of which either merge with or terminated at the steep reverse faults at the southern margin of the Transverse Ranges province.

The dominant structural feature within the general project region is the active San Andreas transform system, which consists of several major northwest-trending, right-lateral, strike-slip faults. The San Andreas Fault Zone (SAFZ) is located approximately seven miles northeast of the project. The active Banning Fault Zone, which is considered a branch of the SAFZ, is located approximately 1.5 miles north of the project. The San Jacinto Fault Zone is located approximately six miles southwest of the project.

Project Sites Settings

Surface and Subsurface Conditions

Recharge Facility Site

The recharge facility site is underlain by alluvial soils generally consisting of sand and silty sand with gravel. Onsite soils encountered within borings and test pits excavations during a previous study generally consisted of silty sand and well-graded sand to the maximum explored depth of 51.5 feet below ground surface (bgs). Isolated sandy silt layers and poorly graded sand layers were observed, generally at depths greater than 25 feet bgs. The fines content of the soils (percent passing a No. 200 sieve) ranged from 14 to 43 percent, with the soils encountered near the southeast corner of the recharge facility site containing a higher proportion of silt than borings conducted elsewhere onsite, especially at depths greater than 30 feet bgs. Otherwise, the site’s soil profile appeared relatively consistent throughout. The soil was generally described as loose near the surface, becoming medium dense to dense with depth. The moisture content of the soil ranged from 2 to 10 percent.

Pipeline Alignment and Service Connection Site

The pipeline alignment and service connection site are located on a south-sloping Pleistocene alluvial fan composed of material derived from the San Bernardino Mountains, located to the north. The fan is formed of weakly indurated sand and gravel. Relatively thin, unconsolidated deposits of Holocene alluvium, colluvium, or other surficial soils may mantle the denser Pleistocene deposits. The fan surface has been dissected by active drainage channels, including Nobel Creek, which crosses the alignment north of Brookside Avenue.

Soils along the pipeline alignment and the bore and jack locations predominantly consist of sand and silty sand mixtures to the maximum explored depth of 26.5 feet bgs. The upper 10 to 15 feet bgs consists of relatively loose to medium dense, fine to coarse grained sand and silty sand with scattered gravel up to 2.5 inches in diameter. Below 15 feet bgs, the soils consist of dense to very dense, fine to coarse grained with gravel up to 2 inches in diameter. Auger refusal in two separate boring locations indicate that cobbles or boulders and/or high percentages of gravel may be present.

Groundwater

Recharge Facility Site

Groundwater was not encountered during borings excavated to a maximum explored depth of 51.5 feet bgs. Groundwater is expected to be deeper than 200 feet bgs in the immediate vicinity of the recharge facility site. According to the County of Riverside, the recharge facility site is located within an area with deep groundwater.

Pipeline Alignment and Service Connection Site

Groundwater was not encountered during borings drilled to a maximum depth of 26.5 feet bgs. A well (USGS 335807116582201) located approximately 0.25 miles east of the central portion of the pipeline alignment was monitored from 1991 to 2012. The depth to groundwater during that time was at least 530 feet bgs, with the most recent measurements approximately 565 feet bgs.

Several wells located 0.25 to 0.5 miles north of the pipeline alignment contained groundwater as shallow as approximately 50 feet bgs within the past several years. All wells that reported shallow groundwater are located north of the Beaumont Fault. As such, it is likely that the fault acts as a groundwater barrier, resulting in an accumulation of groundwater on the northern side.

Faulting

Recharge Facility Site

The recharge facility site is not located within a State-designated Alquist-Priolo Earthquake Fault Zone. However, a County-designated Earthquake Fault Zone for the Beaumont Plains Fault Zone is mapped through the southwest portion of the recharge facility site. The fault zone is mapped as a series of north to northwest trending faults in the general vicinity of the site. An investigation of this fault was conducted for a previous, unrelated project on the adjacent property located west of the recharge facility site in 2007. Based on a current review of the available data gathered during this prior investigation, there is no indication that the fault extends on the recharge facility site.

The two principal seismic considerations for most sites in southern California are (1) surface rupture along active fault traces and (2) damage to structures due to seismically induced ground shaking. An active fault is one that has moved in the Holocene period (i.e., last 11,000 years). No known active faults have been mapped on the recharge site and no evidence of faulting has been observed onsite. The closest mapped, previously known, active fault that has been studied in sufficient detail to evaluate the potential for strong seismic shaking is the San Jacinto-San Jacinto Valley segment fault, located approximately 5.6 miles northeast of the recharge facility site.

The San Jacinto-San Jacinto Valley fault is capable of producing a maximum moment magnitude of 6.9 (Mw) with an average slip rate of 12.0 ±6 millimeters per year. Other known regional active faults that could affect the recharge facility site include the San Andreas, Banning, and Elsinore-Glen Ivy faults. The largest fault in southern California, the San Andreas Fault System, is located approximately 14.3 kilometers northeast of the recharge facility site.

Pipeline Alignment and Service Connection Site

The inferred surface trace of the west to northwest-trending Beaumont Fault is located immediately north of the intersection of Orchard Street and Beaumont Avenue. The Beaumont Fault is not designated as an active fault by the State of California; however, it is designated as active by the County of Riverside. The County has established a fault hazard zone that includes the service connection site, the portion of the pipeline alignment along Orchard Street, and the portion of the alignment along Beaumont Avenue to approximately 600 feet south of Orchard Street. The County has also established several northwest-trending fault hazard zones to the southwest of the pipeline alignment. The closest of these zones is approximately 0.3 miles southwest of the southern end of the pipeline alignment.

Liquefaction

Liquefaction refers to the loss of soil strength due to a buildup of pore-water pressure during severe ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine- to medium-grained, clean cohesionless soil. As the shaking action of an earthquake progresses, the soil grains are rearranged and the soil density increases within a short time period. Rapid densification of the soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, the soil reduces greatly in strength and temporarily behaves similarly to a fluid.

The effects of severe liquefaction can include sand boils, settlement, and bearing capacity failures below structural foundations. There are several requirements for liquefaction to occur, including:

soils must be submerged, soils must be primarily granulars, soils must be loose to medium-dense, ground motion must be intense, and duration of shaking must be sufficient for the soils to lose shear resistance.

Recharge Facility Site

According to the County of Riverside, the recharge facility site is located within an area of deep groundwater with sediments considered to have low to very low susceptibility to liquefaction. Regional groundwater data indicates that shallow groundwater conditions do not exist locally, nor have they existed historically.

Pipeline Alignment and Service Connection Site

Similar to the project area as a whole, the pipeline alignment and service connection site are located within an area designated by the County of Riverside as being susceptible to liquefaction. Like the recharge facility site, regional groundwater data indicates that shallow groundwater conditions do not exist locally, nor have they existed historically.

Slope Stability

The slopes of the recharge basins are planned for construction at inclinations of 3:1 (horizontal to vertical) or flatter. With the proposed design, the upper portion of the slope would be constructed of compacted fill, while the lower portion will be cut into alluvial soils consisting of sand and silty sand with gravel. Onsite slopes would be designed and constructed to be stable under static, pseudo-static, and rapid drawdown conditions.

3.4.2 - Regulatory Setting

Federal

National Earthquake Hazards Reduction Program

The National Earthquake Hazards Reduction Program (NEHRP) was established by the U.S. Congress when it passed the Earthquake Hazards Reduction Act of 1977, Public Law (PL) 95–124. In establishing NEHRP, Congress recognized that losses due to earthquakes could be reduced through improved design and construction methods and practices, land use controls and redevelopment, prediction techniques and early-warning systems, coordinated emergency preparedness plans, and public education and involvement programs. The four basic NEHRP goals remain unchanged:

- Develop effective practices and policies for earthquake loss reduction and accelerate their implementation.
- Improve techniques for reducing earthquake vulnerabilities of facilities and systems.
- Improve earthquake hazards identification and risk assessment methods, and their use.
- Improve the understanding of earthquakes and their effects.

Several key federal agencies contribute to earthquake mitigation efforts. There are four primary NEHRP agencies:

- National Institute of Standards and Technology (NIST) of the Department of Commerce
- National Science Foundation (NSF)
- United States Geological Survey (USGS) of the Department of the Interior
- Federal Emergency Management Agency (FEMA) of the Department of Homeland Security

Implementation of NEHRP priorities is accomplished primarily through original research, publications, and recommendations to assist and guide state, regional, and local agencies in the development of plans and policies to promote safety and emergency planning.

State

California Building Code

The (2009) Uniform Building Code (UBC) is published by the International Conference of Building Officials (ICBO), and serves as the widely adopted model building code in the United States. The (2010) California Building Code (CBC) is another name for the body of regulations known as the California Code of Regulations (CCR), Title 24, Part 2, which is a portion of the California Building Standards Code (CBSC). The CBC incorporates by reference the UBC requirements with necessary California amendments. Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24, or they are not enforceable. Compliance with the 2010 CBC requires that, with extremely limited exceptions, structures for human occupancy be designed and constructed to resist the effects of earthquake motions. The Seismic Design Category for a structure is determined in accordance with either CBC Section 1613 - Earthquake Loads, or American Society of Civil Engineers (ASCE) Standard No. 7-05, Minimum Design Loads for Buildings and Other Structures. In brief, based on the engineering properties and soil type(s) of a site, the site is assigned a Site Class ranging from A to F. The Site Class is then combined with Spectral Response (i.e., ground acceleration induced by earthquake) information for the location to arrive at a Seismic Design Category ranging from A to D, with A being the least and D being the most severe conditions. The classification of the site and related calculations must be determined by a qualified person and are site-specific.

Alquist-Priolo Earthquake Fault Zoning Act

The 1972 Alquist-Priolo Earthquake Fault Zoning Act was passed to mitigate the hazard of surface faulting to structures for human occupancy. The Act's primary purpose aims at preventing the construction of buildings for human occupancy upon the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards (e.g. strong ground shaking). The Act requires the State Geologist to establish and map regulatory zones, known as Earthquake Fault Zones, around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected local, regional, and State agencies for use during planning and controlling new or renewed construction.

Seismic Hazards Mapping Act (SHMA)

Following the 1989 Loma Prieta earthquake, the California Legislature enacted the 1990 Seismic Hazards Mapping Act (SHMA) to protect the public from the effects of strong ground shaking, liquefaction, landslides and other seismic hazards. The SHMA established a statewide mapping program to identify areas subject to violent shaking and ground failure. The program is intended to assist local and regional agencies in protecting public health and safety. The SHMA requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones. As a result, the California Geologic Survey is mapping SHMA Zones and has completed seismic hazard mapping for the portions of California most susceptible to liquefaction, ground shaking, and landslides; primarily the San Francisco Bay area and Los Angeles basin.

Local

As discussed previously in Section 1 of this Draft EIR, the SGPWA is exempt from local land use policies and ordinances in accordance with California Government Code Sections 53091(d) and 53091(e). Although exempt for the proposed project, SGPWA has chosen to provide a discussion of the local land use policies and ordinances.

City of Beaumont General Plan

The City of Beaumont General Plan contains the following policies that address geology and soils.

Safety Element

Goal 1. The City of Beaumont will make every effort to mitigate the seismic hazards that are present within the Planning Area.

> **Policy 1.** The City of Beaumont will continue to promote seismic safety through comprehensive land use planning.
>
> **Policy 4.** The City of Beaumont will require special soils and structural investigations for all proposed structures of large scale or involving large groups of people.

County of Riverside General Plan

The County of Riverside General Plan contains the following policies that address geology and soils.

Safety Element

> **Policy S 2.1.** Minimize fault rupture hazards through enforcement of Alquist-Priolo Earthquake Fault Zoning Act provisions and the following policies:

a. Require geologic studies or analyses for critical structures, and lifeline, high-occupancy, schools, and high-risk structures, within 0.5 miles of all Quaternary to historic faults shown on the Earthquake Fault Studies Zones map.

b. Require geologic trenching studies within all designated Earthquake Fault Studies Zones, unless adequate evidence, as determined and accepted by the County Engineering Geologist, is presented. The County may require geologic trenching of non-zoned faults for especially critical or vulnerable structures or lifelines.

c. Require that lifelines be designed to resist, without failure, their crossing of a fault, should fault rupture occur.

d. Support efforts by the California Department of Conservation, Division of Mining and Geology to develop geologic and engineering solutions in areas of disseminated ground deformation due to faulting, in those areas where a through-going fault cannot be reliably located.

e. Encourage and support efforts by the geologic research community to define better the locations and risks of County faults. Such efforts could include data sharing and database development with regional entities, other local governments, private organizations, utility agencies or companies, and local universities.

Policy S 2.2. Require geological and geotechnical investigations in areas with potential for earthquake-induced liquefaction, landsliding or settlement as part of the environmental and development review process, for any structure proposed for human occupancy, and any structure whose damage would cause harm.

Policy S 2.3. Require that a State-licensed professional investigate the potential for liquefaction in areas designated as underlain by "Susceptible Sediments" and "Shallow Ground Water" for all general construction projects.

Policy S 2.4. Require that a State-licensed professional investigate the potential for liquefaction in areas identified as underlain by "Susceptible Sediments" for all proposed critical facilities projects.

Policy S 2.5. Require that engineered slopes be designed to resist seismically-induced failure. For lower-risk projects, slope design could be based on pseudo-static stability analyses using soil engineering parameters that are established on a site-specific basis. For higher-risk projects, the stability analyses should factor in the intensity of expected ground shaking, using a Newmark-type deformation analysis.

Policy S 2.6. Require that cut and fill transition lots be over-excavated to mitigate the potential of seismically-induced differential settlement.

Policy S 2.7. Require a 100% maximum variation of fill depths beneath structures to mitigate the potential of seismically-induced differential settlement.

Policy S 2.8. Encourage research into new foundation design systems that better resist the County's climatic, geotechnical, and geological conditions.

Policy S 3.3. Before issuance of building permits, require certification regarding the stability of the site against adverse effects of rain, earthquakes, and subsidence.

Policy S 3.5. During permit review, identify and encourage mitigation of onsite and offsite slope instability, debris flow, and erosion hazards on lots undergoing substantial improvements.

Policy S 3.6. Require grading plans, environmental assessments, engineering and geologic technical reports, irrigation and landscaping plans, including ecological restoration and revegetation plans, as appropriate, in order to assure the adequate demonstration of a project's ability to mitigate the potential impacts of slope and erosion hazards and loss of native vegetation.

Policy S 3.8. Require geotechnical studies within documented subsidence zones, as well as zones that may be susceptible to subsidence, as identified in Figure S-7 and the Technical Background Report, prior to the issuance of development permits. Within the documented subsidence zones of the Coachella, San Jacinto, and Elsinore valleys, the studies must address the potential for reactivation of these zones, consider the potential impact on the project, and provide adequate and acceptable mitigation measures.

Policy S 3.10. Encourage and support efforts for long-term, permanent monitoring of topographic subsidence in all producing groundwater basins, irrespective of past subsidence.

Policy S 3.13. Require buildings to be designed to resist wind loads.

Policy S 3.14. Educate builders about the wind environment and encourage them to design projects accordingly.

3.4.3 - Thresholds of Significance

According to the CEQA Guidelines' Appendix G Environmental Checklist, to determine whether impacts to geology and soils are significant environmental effects, the following questions are analyzed and evaluated. 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. (See Fault Rupture Impact GEO-1.)

ii. Strong seismic ground shaking? (See Seismic Ground Shaking Impact GEO-2.)
iii. Seismic-related ground failure, including liquefaction? (See Liquefaction Impact GEO-3)
iv. Landslides? (See Section 6.6.1, Earthquakes)

b) Result in substantial soil erosion or the loss of topsoil? (See Section 6.6.2, Soil Erosion or Topsoil Loss)

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 or collapse? (See Unstable Geologic Unit or Soil Impact GEO-4)

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property? (See Section 6.6.3, Expansive Soils)

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? (See Section 6.6.4, Wastewater Disposal Systems)

3.4.4 - Project Impact Analysis and Mitigation Measures

This section discusses potential impacts associated with the proposed project and provides mitigation measures where necessary.

Fault Rupture

Impact GEO-1	**The project would not 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.**

Impact Analysis

Recharge Facility Site

The recharge facility site is not located within a State-designated Alquist-Priolo Earthquake Fault Zone. However, a County-designated Earthquake Fault Zone for the Beaumont Plains Fault Zone is mapped through the southwest portion of the recharge facility site. The fault zone is mapped as a series of north to northwest trending faults in the general vicinity of the site. An investigation of this fault was conducted for a previous, unrelated project on the adjacent property located west of the recharge facility site in 2007. Based on a current review of the available data gathered during this prior investigation, there is no indication that the fault extends on the recharge facility site.

Due to the lack of active fault traces on or adjacent to the recharge facility site, impacts associated with earthquake fault rupture would be less than significant.

Pipeline Alignment and Service Connection Site

The inferred surface trace of the west to northwest-trending Beaumont Fault is located immediately north of the intersection of Orchard Street and Beaumont Avenue. The Beaumont Fault is not designated as an active fault by the State of California; however, it is designated as active by the County of Riverside. The County has established a fault hazard zone that includes the service connection site, the portion of the pipeline alignment along Orchard Street, and the portion of the alignment along Beaumont Avenue to approximately 600 feet south of Orchard Street. The County has also established several northwest-trending fault hazard zones to the southwest of the pipeline alignment. The closest of these zones is approximately 0.3 miles southwest of the southern end of the pipeline alignment on the recharge facility site.

Due to the lack of active fault traces on or adjacent to either the pipeline alignment or the service connection site, impacts associated with earthquake fault rupture would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

No mitigation measures are required.

Level of Significance After Mitigation

Less than significant impact.

Seismic Ground Shaking

Impact GEO-2	**The project could expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:** **ii) Strong seismic ground shaking.**

Impact Analysis

Recharge Facility Site

The closest mapped, previously known, active fault that has been studied in sufficient detail to evaluate the potential for strong seismic shaking is the San Jacinto-San Jacinto Valley segment fault, located approximately 5.6 miles northeast of the recharge facility site. The San Jacinto-San Jacinto Valley fault is capable of producing a maximum moment magnitude of 6.9 (Mw) with an average slip rate of 12.0 ±6 millimeters per year. Other known regional active faults that could affect the recharge facility site include the San Andreas, Banning, and Elsinore-Glen Ivy faults. The largest fault in southern California, the San Andreas Fault System, is located approximately 14.3 kilometers northeast of the recharge facility site.

Due to the proximity of these known active faults to the recharge facility site, there is potential for the site to be subjected to strong ground shaking during the life of the project. To evaluate the ground motion and a peak level of ground acceleration that the project is likely to experience, a probabilistic analysis approach was used to estimate the expected peak ground acceleration level that has a 10 percent probability of exceedance over the approximate lifetime of the project (commonly 50 years). This approach took into account the historical seismicity of the region, the nature of nearby active faults, their distance to the recharge facility site, records of previous historical earthquakes, and the site-specific response characteristics.

The computer program FRISKSP was used for the analysis. The analysis indicated an average value for peak horizontal ground acceleration (PHGA) with a 10 percent probability of exceedance in 50 years of 0.61g.

PHGA for the recharge facility site was also estimated using California Geologic Survey (CGS) Probabilistic Seismic Hazards Mapping Ground Motion data, which uses a probabilistic seismic hazard analysis approach based on currently available earthquake and fault information. Based on information from the CGS, the PHGA with a 10 percent probability of being exceeded in 50 years is estimated to be approximately 0.62g.

Based on the findings of the outcome of the analysis, the November 2012 Geotechnical Review recommended that design and construction of the recharge facility be performed in accordance with the 2010 edition of the California Building Code (CBC). By complying with typical design requirements of the CBC, the construction and operation of the proposed recharge facility would not expose people or structures to potential substantial adverse effects, and therefore, less than significant impacts from strong seismic ground shaking would occur.

Pipeline Alignment and Service Connection Site

Buried pipelines are subject to dynamic stresses due to ground acceleration during seismic events. An earthquake event can affect buried pipelines in a number of ways, causing ground surface rupture, soil liquefaction, landslides, lateral spreading, differential settlement due to seismic shaking, and earthquake-induced flooding.

Similar to the recharge facility site, both the pipeline alignment and service connection site would be located with a seismically active region of southern California, with a number of nearby faults capable of producing significant ground shaking during a major seismic event. Earthwork associated with construction of both the pipeline and service connection site and the long-term use of the structure proposed at the service connection site could result in the exposure of people and the structure at the service connection site to potential substantial adverse effects. These effects are considered significant.

Level of Significance Before Mitigation

Potentially significant impact.

Mitigation Measures

MM GEO-1 The prefabricated service connection building shall be founded on dense, stable soils. The upper 12 inches of soils below the footing sub-grade shall be scarified and recompacted to a minimum of 90 percent of laboratory maximum dry density and within ±3 percent of optimum moisture density. Such scarification and recompaction shall extend horizontally outside the structure footprint to a distance of at least three feet.

MM GEO-2 Jack and bore pit excavations to receive backfill shall be free of trash, debris, or other unsatisfactory materials at the time of backfill placement. The bottoms of the excavations shall be scarified to a depth of at least 12 inches where possible. The scarified soils shall be brought to near-optimum moisture content and compacted to at least 90 percent of the laboratory maximum dry density to produce a firm and unyielding surface. Fill shall then be placed on the compacted soils in loose lifts of eight inches or less, moisture conditioned to within ±3 percent of optimum, and compacted to at least 90 percent of the laboratory maximum dry density determined by the ASTM D1557 test method. The project contractor shall select the equipment and processes to be used to achieve the specified density without damage to adjacent ground, facilities, utilities, and completed work.

MM GEO-3 Pipe design generally requires a granular material with a Sand Equivalent greater than 30. Bedding material for the pipes shall be free from oversized particles (greater than one inch). Migration of fines from the surrounding native and/or fill soils shall be considered in selecting the gradation of any imported bedding material. Pipe bedding material shall satisfy the following criteria:

$D_{15} < 2.5$ mm (0.098-inch) and $D_{50} < 19.0$ mm (0.75-inch)

Where D_{15} and D_{50} represent particle sizes of the bedding material corresponding to 15 percent and 50 percent passing by weight, respectively.

MM GEO-4 Trench excavations to receive backfill shall be free of trash, debris, or other unsatisfactory materials at the time of backfill placement.

MM GEO-5 Trench backfill shall be compacted to at least 90 percent of the laboratory maximum dry density as per ASTM D1557 test method or as required by the local agency standards. At least the upper one foot of trench backfill underlying pavement shall be compacted to at least 95 percent of the laboratory maximum dry density as per ASTM D1557 test method.

MM GEO-6 Particles larger than one inch shall not be placed within 12 inches of the pavement sub-grade. No more than 30 percent of the backfill volume shall be larger than 0.75 inch in the largest dimension. Gravel shall be well mixed with finer soil. Rocks larger than three inches in the largest dimension shall not be placed as trench backfill.

MM GEO-7 Trench backfill shall be compacted by mechanical methods, such as sheepsfoot, vibrating, or pneumatic rollers or mechanical tampers, to achieve the density specified in the 2013 Geotechnical Investigation Report. The backfill materials shall be brought to within ±3 percent of optimum moisture content then placed in horizontal layers. The thickness of uncompacted layers shall not exceed eight inches. Each layer shall be evenly spread, moistened, or dried as necessary, and then tamped or rolled until the specified density has been achieved.

MM GEO-8 Trench backfill shall not be placed, spread, or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not resume until field tests by the project engineer indicate that the moisture content and density of the fill are in compliance with project specifications.

MM GEO-9 The prefabricated service connection building and pipeline shall be fitted with flexible couplings, automatic shut-off valves, or other similar measures.

MM GEO-10 Lightweight structures such as the prefabricated service connection building shall be supported on continuous (strip) and/or isolated spread footings. Continuous and isolated spread footings shall be at least 12-inches wide. The depth of embedment below lowest adjacent soil grade shall be at least 12 inches. Footings shall be founded on at least 12 inches of scarified and compacted soil. For shallow spread footings founded on scarified and compacted soil, an allowable net bearing capacity of 1,200 pounds per square foot (psf), plus 300 psf for each additional foot of depth, shall be used. The maximum allowable bearing capacity shall be limited to 2,500 psf.

MM GEO-11 Installation of the pipeline shall adhere to the required soil parameters for the pipeline as established in the California Building Code and identified in the 2013 Geotechnical Investigation Report.

Level of Significance After Mitigation

Less than significant with mitigation incorporated.

Implementation of Mitigation Measures GEO-1 through GEO-11 include specific design measures to reduce the potential for significant effects from strong seismic ground shaking during construction and operation of the pipeline and service connection site.

Ground Failure

Impact GEO-3	The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving: iii) Seismic-related ground failure, including liquefaction.

Impact Analysis

Liquefaction

Recharge Facility Site

Groundwater was not encountered during borings excavated to a maximum explored depth of 51.5 feet bgs. Groundwater is expected to be deeper than 200 feet bgs in the immediate vicinity of the recharge facility site. According to the County of Riverside, the recharge facility site is located within an area with deep groundwater.

According to the County of Riverside, the recharge facility site is located within an area of deep groundwater with sediments considered to have low to very low susceptibility to liquefaction. Regional groundwater data indicates that shallow groundwater conditions do not exist locally, nor have they existed historically. Therefore, impacts associated with liquefaction would be less than significant.

Pipeline Alignment and Service Connection Site

Groundwater was not encountered during borings drilled to a maximum depth of 26.5 feet bgs. A well (USGS 335807116582201) located approximately 0.25 miles east of the central portion of the pipeline alignment was monitored from 1991 to 2012. The depth to groundwater during that time ranged from approximately 530 to 610 feet bgs, with the most recent measurements approximately 565 feet bgs.

Several wells located 0.25 to 0.5 miles north of the pipeline alignment contained groundwater as shallow as approximately 50 feet bgs within the past several years. All wells that reported shallow groundwater are located north of the Beaumont Fault. As such, it is likely that the fault acts as a groundwater barrier, resulting in an accumulation of groundwater on the northern side.

Similar to the project area as a whole, the pipeline alignment and service connection site are not located within an area designated by the County of Riverside as being susceptible to liquefaction. Like the recharge facility site, regional groundwater data indicates that shallow groundwater conditions do not exist locally, nor have they existed historically. Therefore, impacts associated with liquefaction would be less than significant.

Slope Instability

Recharge Facility Site

The slopes of the recharge basins are planned for construction at inclinations of 3:1 (horizontal to vertical) or flatter. With the proposed design, the upper portion of the slope would be constructed of compacted fill, while the lower portion will be cut into alluvial soils consisting of sand and silty sand with gravel. Onsite slopes would be designed and constructed to be stable under static, pseudo-static, and rapid drawdown conditions. Additionally, these slopes would be designed to withstand the effects of a seismic event and to maintain structural integrity during strong seismic ground shaking. Therefore, seismic related ground failure associated with the proposed recharge facility would be less than significant.

Pipeline Alignment and Service Connection Site

No long-term slopes would occur with the implementation of the pipeline alignment or the service connection site. Therefore, no slope instability would occur along the pipeline or at the service connection site. As a result, no impacts from seismic related ground failure associated with the proposed pipeline and service connection site would occur.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

No mitigation measures are required.

Level of Significance After Mitigation

Less than significant impact.

Ground Failure

Impact GEO-4	**The project would not be located on a geologic unit or soil that is unstable, or that could become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.**

Impact Analysis

Landslide

The recharge facility would include earthen berms and embankments. However, all slopes created as part of the recharge facility would be engineered to ensure structural integrity and to prevent instability, reducing the potential for landslide. The pipeline, service connection site, and offsite triangular parcel are relatively flat; any improvements related to the project would not alter this flat topography. As a result, landslide activity is not anticipated following implementation of the project. Therefore, impacts associated with landslide would be less than significant.

Lateral Spreading

Lateral spreading involves lateral movement of earthen materials due to ground shaking. It differs from slope failure in that ground failure involving a large movement does not occur due to the flatter slope of the initial ground surface. Lateral spreading is characterized by near-vertical cracks with predominantly horizontal movement of the soil mass involved over the liquefied soils. The potential for lateral spreading on the project sites is considered low. Therefore, impacts associated with lateral spreading would be less than significant.

Subsidence

The County of Riverside has identified the entire project area as being susceptible to subsidence. Subsidence is typically caused by severe groundwater overdraft conditions similar to those currently experienced in the project region. While the primary purpose of the project is to promote groundwater recharge, replenishment of the underlying groundwater basin would be slow, but there would be steady process. As such, the project area would not be expected to be susceptible to subsidence for years to come, even after implementation of the project.

No evidence of subsidence such as substantial recorded reductions in historical elevations are present on or around the project sites. Although exposure to subsidence hazards cannot be entirely avoided, the California Building Code establishes engineering and construction criteria designed to reduce potential impacts associated with geotechnical issues, including subsidence, to acceptable levels. The design recommendations contained in the 2012 Geotechnical Review and the 2013 Geotechnical Investigation Report includes this California Building Code criteria. Therefore, potential subsidence impacts associated with the proposed project are considered less than significant.

Liquefaction

Like the project area as a whole, the project sites are not located within an area designated by the County of Riverside as being susceptible to liquefaction. Regional groundwater data indicates that shallow groundwater conditions do not exist locally, nor have they existed historically. Therefore, impacts associated with liquefaction would be less than significant.

Collapse

No natural or anthropogenic subsurface features that are known to promote surface collapse, including mines, aggregate extraction operations, or karst topography, are known to underlay or occur adjacent to the project sites. Therefore, impacts associated with collapse would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

No mitigation measures are required.

Level of Significance After Mitigation

Less than significant impact.