4.6 GEOLOGY AND SOILS

Would the project:	Potentially Significant Impact	Less Than Significant Impact With Mitigation Incorporated	Less Than Significant Impact	No Impact
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
1) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.			✓	
2) Strong seismic ground shaking?			✓	
3) Seismic-related ground failure, including liquefaction?			✓	
4) 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 or collapse?			✓	
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?			✓	
e. Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?				✓

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

1) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

Less Than Significant Impact. Southern California, including the project area, is subject to the effects of seismic activity due to the active faults that traverse the area. Active faults are defined as those that have experienced surface displacement within Holocene time (approximately the last 11,000 years) and/or are in a State-designated Alquist-Priolo Earthquake Fault Zone. The Alquist-Priolo Earthquake Fault Zoning Act, enacted in 1973 and amended several times since, address the hazard of surface faulting to structures for human occupancy. Local agencies must enforce the Alquist–Priolo Earthquake Fault Zoning Act in the development permit process by requiring a geologic investigation prepared by a licensed geologist to demonstrate that buildings will not be constructed across active faults.

Based on the *2010 Fault Activity Map of California*[1] and Figure 2, *Fault Map with Special Study Zones*, of the *Seismic Safety Element* of the *General Plan*, the northwestern portion of the Newport-Inglewood fault zone (Alquist-Priolo Special Study Zone) traverses Segment 5 of the conveyance facilities. However, the Alquist-Priolo Earthquake Fault

[1] State of California Department of Conservation, *2010 Fault Activity Map of California*, http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html, accessed on May 11, 2017.

Zoning Act is intended to prohibit the construction of developments and other structures for human occupancy across active faults. Segment 5 is a proposed conveyance facility that would be designed to carry urban runoff to the MUST facility, and there would be no structures for human occupancy within this segment. In addition, this conveyance facility would convey minor amounts of dry weather urban runoff, and would not involve acutely hazardous materials (such as a petroleum or natural gas pipeline). The project would be required to comply with California Building Code (CBC) standards in order to minimize the potential for damage and major injury during a seismic event. Moreover, design and construction of the proposed project shall comply with existing City standards, including Chapter 18.68 (Earthquake Hazard Regulations) of Title 18 (Buildings and Construction), of the *LBMC*. Through compliance with CBC standards and *LBMC* regulations, impacts associated with fault rupture would be less than significant.

Mitigation Measures: No mitigation is required.

2) Strong seismic ground shaking?

Less Than Significant Impact. Southern California has numerous active seismic faults subjecting residents to potential earthquake and seismic-related hazards. Seismic activity poses two types of potential hazards for residents and structures, categorized either as primary or secondary hazards. Primary hazards include ground rupture, ground shaking, ground displacement, subsidence, and uplift from earth movement. Primary hazards can also induce secondary hazards such as ground failure (lurch cracking, lateral spreading, and slope failure), liquefaction, water waves (seiches), movement on nearby faults (sympathetic fault movement), dam failure, and fires. Both primary and secondary hazards pose a threat to the community as a result of the project's proximity to active regional faults.

The region surrounding the Long Beach area is characterized by a relatively high seismic activity. The greatest damage from earthquakes results from ground shaking. Ground shaking is generally most severe near quake epicenters and generally become weaker further out from the epicenter. Based on *2010 Fault Activity Map of California*[2], and Figure 2*, Fault Map with Special Study Zones*, of the *General Plan*, a number of active faults occur within the region, including the Newport-Inglewood fault which transects Segment 5 of the project. As such, the project site would be subject to strong seismic shaking during a seismic event, as is the case with the vast majority of areas throughout southern California.

Implementation of the proposed project would install a MUST facility and associated conveyance facilities. Due to the location of the project site, which is within seismically-active region, there is potential for seismic ground shaking. However, the project would be required to comply with CBC standards and Chapter 18.68 of the *LBMC* in order to minimize the potential for damage and major injury during a seismic event. The CBC includes design requirements for construction practices, foundation design, structural seismic resistance, and site classifications to minimize hazards during a seismic event. Through compliance with CBC standards and *LBMC* regulations, impacts associated with strong seismic ground shaking would be less than significant.

Mitigation Measures: No mitigation is required.

3) Seismic-related ground failure, including liquefaction?

Less Than Significant Impact. Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Liquefaction is characterized by a loss of shear strength in the affected soil layers, thereby causing the soils to behave as a viscous liquid. Susceptibility to liquefaction is based on geologic and geotechnical data. River channels and floodplains are considered most susceptible to liquefaction, while alluvial fans have a lower susceptibility. Depth to groundwater is another important element in the susceptibility to liquefaction. Groundwater shallower than 30 feet results in high to very high susceptibility to liquefaction, while deeper water results in low and very low susceptibility.

[2] State of California Department of Conservation, *2010 Fault Activity Map of California*, http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html, accessed on May 11, 2017.

Based on the *Earthquake Zones of Required Investigation Long Beach Quadrangle* prepared by the State of California Department of Conservation, the project site is subject to the potential for liquefaction.[3] According to Figure 7, *Liquefaction Potential Area*, of the *Seismic Safety Element* of the *General Plan*, the northern portion of the project site is located within "liquefaction potential minimal" area, the central portion of the project site ranges is located within "liquefaction potential moderate" area, and the southern portion of the project site is located within "liquefaction potential significant" area. Based on the *General Plan*, the consequences for liquefaction in areas designates as having a significant potential for liquefaction includes possible horizontal failure by lateral spreading and instability of containment dikes where they are present, the occurrence of sand boils and differential settlements of the order of several inches to a foot or more. In areas where liquefaction is rated as moderate, the consequences would likely be more subtly characterized by settlement of a few inches and possible sand boils. Notwithstanding, the State Division of Mines and Geology has designated all areas within the City within a liquefaction hazard zone, which requires geotechnical reports for construction projects to mitigate the potential undermining of structural integrity during earthquakes. As stated above, compliance with the CBC and *LBMC* would minimize risks related to liquefaction to a less than significant level.

Mitigation Measures: No mitigation is required.

4) Landslides?

Less Than Significant Impact. Landslides are a geologic hazard, with some moving slowly and causing damage gradually, and others moving rapidly and causing unexpected damage. Gravity is the force driving landslide movement. Factors that commonly allow the force of gravity to overcome the resistance of earth material to landslide movement include saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, and seismic shaking.

Based on the State of California Department of Conservation, *Earthquake Zones of Required Investigation Long Beach Quadrangle*, the project site is not subject to potential for ground displacement and landslide. Additionally, according to the *General Plan*, slope stability in Long Beach is not a major problem as slopes generally are neither high nor steep. While slope instability is not a major consideration in overall land planning, it is a factor in designing individual sites.

In addition, there are no landforms in the project vicinity capable of producing a significant landslide event. Consequently, there is a low potential for landslides to occur on or near the proposed project site as a result of the proposed project. Therefore, there would be a less than significant impact associated with the exposure of people or structures to potential substantial adverse effects involving landslides.

Mitigation Measures: No mitigation is required.

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

Less Than Significant Impact. The primary concern in regards to soil erosion or loss of topsoil would be during the construction phase of the project. Grading and earthwork activities associated with project construction activities would expose soils to potential short-term erosion by wind and water. All demolition and construction activities would be subject to compliance with the CBC. Further, the project would be subject to compliance with the requirements set forth in the National Pollutant Discharge Elimination System (NPDES) Storm Water General Construction Permit for construction activities; refer to Response 4.9(a). The NPDES Storm Water General Construction Permit requires preparation of a Storm Water Pollution Prevention Plan (SWPPP), which would identify specific erosion and sediment control Best Management Practices (BMPs) that would be implemented to protect storm water runoff during

[3] State of California Department of Conservation, *Earthquake Zones of Required Investigation Long Beach Quadrangle*, http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/LONG_BEACH_EZRIM.pdf, accessed on May 3, 2017.

construction activities. Following compliance with the CBC and NPDES requirements, project implementation would result in a less than significant impact regarding soil erosion.

Mitigation Measures: No mitigation is 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 an on-site or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

Less Than Significant Impact. The project site is located within a seismically-active area. As stated within Response 4.6(a)(3), impacts related to liquefaction would be less than significant and, as demonstrated in Response 4.6(a)(4), the project site would not be subject to earthquake-induced landslides.

As stated in Response 4.6(a)(4), according to the *Public Safety Element* of the *General Plan*, slope stability in the City of Long Beach is not a major problem as slopes generally are neither high nor steep. Project improvements would conform to the requirements of the CBC and *LBMC* in order to minimize the potential for hazards due to unstable soils, which would reduce impacts in this regard to less than significant levels.

Mitigation Measures: No mitigation is required.

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?

Less Than Significant Impact. Expansive soils are defined as soils possessing clay particles that react to moisture changes by shrinking (when dry) or swelling (when wet). According to Figure 3, *Soil Profiles*, of the *Seismic Safety Element* of the *General Plan*, the project site is underlain by fill and alluvial deposits. The fill material is predominantly man-made fill, which is generally composed of fine sand and silt. The Los Angeles Channel filling sediments are composed of a basal sand and gravel aquifer (Gaspur Aquifer) overlain by less permeable flood plain and tidal marsh deposits of fine-grained soils. These near surface soils (upper 50 feet) are characterized as consisting of alternating layers of cohesionless and cohesive soils. The cohesionless soils consist generally of silty sand and sandy silt and are typically loose to medium dense. The cohesive soil layers are generally clayey silts and silty clays of soft to stiff consistency. Clayey soil could be subject to settlement and/or instability. However, the proposed project would comply with the CBC and *LBMC* to minimize the potential for hazards related to expansive soil, reducing impacts to less than significant levels.

Mitigation Measures: No mitigation is required.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

No Impact. No septic tanks or alternative wastewater disposal systems would be constructed as part of the project, and no impacts would occur in this regard.

Mitigation Measures: No mitigation is required.