3.6 Geology and Soils

As a result of the analysis undertaken in the Initial Study for the proposed 2009 Master Plan, LACCD determined that the proposed project may result in environmental impacts to geology and soils. Therefore, this issue is being carried forward for detailed analysis in this EIR. This analysis was undertaken to identify opportunities to avoid, reduce, or otherwise mitigate potential significant impacts to geology and soils and to identify potential alternatives.

The analysis of geology and soils consists of a summary of the regulatory framework that guides the decision-making process, existing conditions at the proposed 2009 Master Plan area, thresholds for determining if the proposed 2009 Master Plan would result in significant impacts, anticipated impacts (direct, indirect, and cumulative), mitigation measures, and level of significance after mitigation. The potential for impacts to geology and soils at the proposed 2009 Master Plan site have been evaluated in accordance with Appendix G of the California Environmental Quality Act (CEQA) Guidelines,[1] the California Geological Survey (CGS) Guidelines, the Alquist-Priolo Earthquake Fault Zone Act of 1972, the Seismic Hazards Mapping Act of 1990, and the California Building Code.

3.6.1 Setting

3.6.1.1 *Regulatory Setting*

Federal

There are no federal rules and regulations pertinent to the geology and soils section.

State

California Geological Survey

The California Geological Survey (CGS) identifies several earth resource issues that should be taken into consideration when evaluating whether the proposed 2009 Master Plan is likely to be subject to geologic hazards, particularly hazards related to earthquake damage. These considerations include both the potential for existing geologic and soil conditions to pose a risk to the proposed project and the potential for the proposed project to result in an impact to the existing geologic and soil conditions by creating or exacerbating a geologic hazard.

The CGS conducts studies related to geologic hazards (e.g., faulting, liquefaction, seismically induced landslides, and ground shaking) as they affect people and structures. These studies relate to the Alquist-Priolo Earthquake Fault Zone (APEFZ) Act[2] and Seismic Hazards Mapping Act.[3] The CGS also issues guidelines for the evaluation of geologic and seismic factors that may impact a project or that a project may affect:

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1 California Code of Regulations, Title 24, Division 6, Chapter 3, Sections 15000-15387. Avalable at. http://ceres.ca.gov/topic/env_law/ceqa/guidelines/

2 State of California. 1972. Alquist-Priolo Earthquake Fault Zoning Act. California Public Resources Code, Section 2621 et seq. Available at: http://www.leginfo.ca.gov/calaw.html.

3 State of California. 1990. Seismic Hazards Mapping Act. California Public Resources Code. Section 2690 et seq. Available at: http://www.leginfo.ca.gov/calaw.html.

- CDMG Special Publication No. 42, Fault-Rupture Hazard Zones in California[4];
- CDMG Special Publication No. 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California.[5];
- CDMG Special Publication No. 99, Planning Scenario for a Major Earthquake on the Newport-Inglewood Fault Zone (Los Angeles and Orange Counties, California)[6]; and
- CDMG Open File Report 88-14, Recently Active Traces of the Newport- Inglewood Fault Zone, Los Angeles and Orange Counties, California[7].

Each set of guidelines provides checklists and outlines to help ensure a comprehensive report of geologic/seismic conditions. Although not mandatory, these guidelines characterize the standards for technical and procedural adequacy in the characterization of geology, soils, and related environmental hazards.

Alquist-Priolo Earthquake Fault Zone Act of 1972

The CGS has delineated earthquake fault zones along known active or potentially active faults in California pursuant to the APEFZ Act of 1972.[8] Construction of habitable structures is not permitted over potential rupture zones.

While the southern portion of the Health, Fitness and Athletics Building is located within an Alquist Priolo fault zone as shown in Figure 3.6-2,[9] this building is not part of the proposed project. A fault evaluation study was previously performed for this portion of the site.[10] The results of this study provided recommended setbacks for habitable structures from features observed to be active faulting.

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4 California Department of Conservation, Division of Mines and Geology. Revised 1997 (Supplements 1 and 2 added 1999). *Fault-Rupture Hazard Zones in California.* Special Publication No. 42. Contact: California Department of Conservation, Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3531.

5 California Department of Conservation, Division of Mines and Geology. 1997. *Guidelines for Evaluating and Mitigating Seismic Hazards in California.* Special Publication No. 117. Contact: California Department of Conservation, Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3531.

6 California Department of Conservation, Division of Mines and Geology. 1988. Planning Scenario for a Major Earthquake on the Newport-Inglewood Fault Zone (Los Angeles and Orange Counties, California). Special Publication No. 99. Contact: California Department of Conservation, Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3531.

7 California Department of Conservation, Division of Mines and Geology. 1988. Recently Active Traces of the Newport-Inglewood Fault Zone, Los Angeles and Orange Counties, California. Open File Report 88-14. Contact: California Department of Conservation, Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3531.

8 State of California. 1972. Alquist-Priolo Earthquake Fault Zoning Act. California Public Resources Code, Section 2621 et seq. Available at: http://www.leginfo.ca.gov/calaw.html.

9 State of California, 1979, Special Studies Zones, San Fernando Quadrangle.

10 URS, 2009, Los Angeles Mission College Facilities Master Plan, Final Program Environmental Impact Report – Addendum.

Seismic Hazards Mapping Act of 1990

The CGS also has identified seismic hazard zones that are delineated in accordance with the seismic hazards mapping program (SHMP) of the Seismic Hazards Mapping Act of 1990.[11] The Seismic Hazards Mapping Act provides for the following:

> *"...a statewide seismic hazard mapping and technical advisory program to assist cities and counties in fulfilling their responsibilities for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other seismic hazards caused by earthquakes."*

The Athletic Fields and the easternmost portion of the Health, Fitness and Athletics Building are located in a zone identified as "Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in *Public Resources Code* Section 2693(c) would be required."[12] This indicates that an investigation is required to evaluate liquefaction in these portions of the proposed 2009 Master Plan site. The proposed 2009 Master Plan site is not located within zones delineated as requiring investigation to mitigate earthquake-induced landslides.

California Building Code

Most of the State of California, including the proposed project site, lies within Seismic Zone 4, the highest level hazard zone designated by the current Uniform Building Code (UBC). The California Building Standards Code, or California Building Code (CBC), augments and supersedes the UBC with stricter requirements to reduce the risks associated with building in Seismic Zone 4 to the maximum extent practicable. The CBC[13] sets standards for the investigation and mitigation of the site conditions related to fault movement, liquefaction, landslides, differential compaction/ seismic settlement, ground rupture, ground shaking, tsunami, seiche, and seismically induced flooding.

Regional

There are no regional regulations pertinent to geology and soils.

Local

City of Los Angeles regulations of the City Municipal Code are not applicable to LACCD facilities because the LACCD is a political subdivision of the state.

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[11] State of California. 1990. Seismic Hazards Mapping Act. California Public Resources Code. Section 2690 et seq. Available at: http://www.leginfo.ca.gov/calaw.html.

[12] State of California, 1999, Seismic Hazard Zones, San Fernando Quadrangle.

[13] California Building Standards Commission, November 1, 2002a. California Code of Regulations, Title 24: "California Building Standards Code." Sacramento, CA: California Building Standards Commission. Available at: http://www.bsc.ca.gov

3.6.1.2 *Environmental Setting*

Regional Geologic Setting

Southern California is a seismically active area dominated by numerous active faults that have formed along a tectonic plate boundary known as the San Andreas transform zone. The San Andreas transform zone, which separates the North American plate to the east from the Pacific plate to the west, is dominated by northwest-trending, right lateral, strike-slip faults of the San Andreas fault system. In the Los Angeles Basin and adjacent Transverse Ranges, the right lateral strike-slip environment of the San Andreas fault system is substantially altered by a north-south component of compression. This north-south directed compression, which is in part caused by a convergent left bend of the San Andreas fault, is generally expressed by thrust, reverse or oblique slip faults, and folds that trend approximately east-west.

The project area lies within the Transverse Ranges Geomorphic Province. As a result of regional compression along the plate boundary, the mountains, valleys, and faults within this tectonically active region generally follow a similar east-west trending fabric. Extensive faulting in the province has resulted in numerous, irregular fault-bounded blocks.

The proposed 2009 Master Plan area is situated within the transition between the southern margin of the San Gabriel Mountains and the northern margin of the San Fernando Valley. To the north and northeast of the site, the San Gabriel Mountains rise abruptly from the valley floor, similar to the Santa Susanna Mountains further to the west. South of the site, the gradient drops off gently down into the San Fernando Valley (Figure 3.6-1, Geologic Map and Geologic Map Legend).

General Site Geology

The proposed 2009 Master Plan area are situated on a gently sloping alluvial fan surface extending southward from the San Gabriel Mountains range front. The immediate site topography slopes to the south on the Nursery Property and southeast toward the Pacoima Wash along Eldridge Avenue and on the proposed Athletics Fields. The topography ranges from an elevation of approximately 1360 to 1400 feet, mean sea level (MSL) on the LAMC Main Campus and Nursery Property and 1310 to 1350 feet MSL on the Health, Fitness and Athletics Building and Athletics Field area. These sites are underlain by localized fills, surficial stream terrace and active channel deposits, and alluvial fan deposits of varying age. At depth, the sites are underlain by sandstones, conglomerates, siltstones, and mudstones associated with the Saugus Formation, which overlies the crystalline basement rock. The aerial distribution of the surficial materials within the general proposed 2009 Master Plan area is shown on the Geologic Map, and descriptions of the mapped units are presented on the Geologic Map legend (Figure 3.6-1, Geologic Map and Geologic Map Legend).[14] [15]

[14] Barrows, A.G., and others. 1975. Geologic Map of the San Fernando Earthquake Area. California Division of Mines and Geology, Bulletin 196, Plate 2, 1:18,000 scale.

[15] Proctor, R.J., and others. 1972. Relation of Known Faults to Surface Ruptures, 1971 San Fernando Earthquake, Southern California. Geological Society of America Bulletin, Vol 83, p. 1601-1618.

Figure 3.6-1 Geologic Map and Geologic Map Legend

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Subsurface Conditions

Previous geotechnical investigations were performed by Lowney Associates (Lowney) in 2003[16] and Wilson Geosciences (Wilson) in 2003[17] on the Main Campus and Athletics Fields sites. The investigations indicated that the subsurface of the LAMC Main Campus are constituted predominantly of surficial fill soils, generally consisting of stiff to very stiff sandy silt and sandy clay, with occasional fine gravels ranging in thickness from approximately 3.5 to 9.5 feet, which generally increase in the downslope direction to the southwest. Very loose to medium-dense sandy fill deposits are present in the southern portion of the campus. The investigations indicated that the Athletics Fields site consists of a surface with dumped piles of debris with relatively loose silty sands with gravel and cobbles up to depths of 12 feet.

Underlying the surficial fills, the alluvial fan deposits consist of medium-dense silty sand and stiff to very stiff sandy silts, and dense to very dense sands. Geophysical surveys performed by Wilson suggest the contact between the fan deposits and underlying Saugus Formation range between approximately 55 to 74 feet below ground surface (bgs) and that the Saugus Formation continues to a depth of at least 120 to 140 feet bgs.

A geotechnical investigation performed by Lowney in 2005 on the Health, Fitness, and Athletics Building encountered loose to medium dense, silty sand alluvial deposits approximately 3 to 5 feet thick and a localized area of undocumented fills. The surficial deposits are underlain by alluvial fan deposits consisting of medium dense to very dense, fine to coarse sand and silty sand to sandy silt, with interbedded gravels and cobbles. Geophysical surveys performed by Wilson at the Health, Fitness, and Athletics Building in 2005 suggest that the contact between the fan deposits and underlying Saugus Formation range between approximately 25 to 35 feet bgs. Crystalline basement rock underlies the site at depths of approximately 77 to 120 feet.[18] [19] [20] [21] [22]

Groundwater was not encountered within any of the previous investigations at the proposed 2009 Master Plan area to the maximum depths explored (51.5 feet and 70 feet bgs, respectively). Based on historic groundwater data within the general project area, the CGS OFR 98-06 has estimated that the groundwater is about 110 feet deep, or deeper, within the vicinity of the LAMC Main Campus and 70 to 90 feet deep at the Health, Fitness, and Athletics Building, depending on high groundwater

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16 Lowney Associates, 2003. Geotechnical Summary, Proposed Master Plan Expansion of Los Angeles Mission College, 13356 Eldridge Avenue, Sylmar, California. Prepared for Los Angeles Community College District, Project No. 1479-1E, dated January 27.

17 Wilson Geosciences, Inc., 2003. An Investigation to Determine the Potential for Active Faulting within the Los Angeles Mission College Expansion Area, Sylmar, California. Prepared for Lowney Associates, dated September 12.

18 Lowney Associates, 2004a. Geotechnical Investigation, Los Angeles Mission College High Density Feasibility Study, Sylmar, California. Prepared for Los Angeles Community Colleges District, Project No. 1479-1J, dated May 25.

19 Lowney Associates, 2004b. Preliminary Response to Review Comments, Los Angeles Mission College, Parking Structure "A", Sylmar, California. Project No. 1479-1K, emailed to the California Geological Survey Reviewer on December 5.

20 Wilson Geosciences, Inc., 2003. An Investigation to Determine the Potential for Active Faulting within the Los Angeles Mission College Expansion Area, Sylmar, California. Prepared for Lowney Associates, dated September 12.

21 Dames & Moore, 1980. "Report-Assessment of Geoseismic Hazards Proposed Community College Site, San Fernando, California." Prepared for Los Angeles Community College District, dated May 21.

22 Woodward-Clyde Consultants, 1987. "Geotechnical Investigation, Campus Center and Campus Service Buildings, L.A. Mission College – Phase II, San Fernando, California." Prepared for Los Angeles Community Colleges, Project No. 8743070A, dated November 9

fluctuations. Based on the subsurface conditions and seasonal conditions, a slightly higher groundwater table and/or localized perched zones or seeps should be anticipated at the project.[23]

Faults and Seismicity

The Transverse Ranges Geomorphic Province is known to be seismically active and characterized by numerous east-west trending thrust, reverse, or oblique slip faults and folds. Several historic earthquakes have occurred previously within the immediate project vicinity, the two most notable being the 1994 Northridge (Mw=6.7) and the 1971 Sylmar (Mw=6.6) earthquakes. As a result of the 1994 Northridge earthquake, several "blind" thrust faults (buried faults that do not cause surface rupture) were identified beneath the San Fernando Valley. Given the nature of faulting in the Northridge earthquake, most of the damage resulted from strong seismic shaking; surface rupture was not a significant hazard. Unlike the Northridge earthquake, the Sylmar earthquake caused significant surface rupture across the valley and ultimately resulted in the formation of the APEFZ by the CGS (previously the California Division of Mines and Geology). The APEFZ was formed to delineate zones of earthquake-induced, Holocene-age (last 11,000 years) surface rupture and, as described in the CGS Special Publication 42, to prevent the construction of buildings used for human occupancy on the surface trace of active faults.[24] Earthquake fault zones, as designated by the APEFZ Act within the vicinity of the project sites, are depicted in Figure 3.6-2, *Alquist-Priolo Earthquake Fault Zones*. As shown in Figure 3.6-2, the southern portion of the Health, Fitness and Athletics Building is located within such a fault zone. A fault evaluation study was previously performed for this portion of the site.[25] The results of this study provided recommended setbacks for habitable structures from features observed to be active faulting.

Erosion and Sedimentation

A geotechnical investigation performed by Leighton Consulting, Inc. (Leighton) in 2005 evaluated two washouts that occurred along the access roadway to the proposed Athletics Fields site. According to the Leighton study, the two washouts resulted from erosion of the access road embankment due to swift flowing water scouring the two areas and there was no visible evidence of bank instability resulting from slope instability or rapid drawdown failures.[26] The study concluded that the washouts were attributed to inadequate embank armoring and undermining of concrete surface protection.

3.6.2 Significance Thresholds

As noted in the Initial Study, for the purposes of this EIR, and in accordance with Appendix G of the CEQA Guidelines, an impact to geology and soils is considered significant if the proposed project would:

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[23] California Geological Survey (CGS) formerly California Division of Mines and Geology, 1998. "Seismic Hazard Evaluation of the San Fernando 7.5-Minute Quadrangle, Los Angeles County, California". CDMG OFR 98-06.

[24] California Geological Survey (CGS, formerly California Division of Mines and Geology), 1999. "Alquist-Priolo Earthquake Fault Zones of the San Fernando 7.5-Minute Quadrangle, Los Angeles County, California". CDMG map, revised 1979.

[25] URS, 2009, Los Angeles Mission College Facilities Master Plan, Final Program Environmental Impact Report – Addendum.

[26] Leighton Consulting, Inc., Geotechnical investigation, Proposed Ball Field Access Road Repari, March 2005.

- Expose people or structures to potential substantial adverse effects, including the risk of loss, or 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; and
    iv. Landslides.
- Result in substantial soil erosion or 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; and
- 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.

Since septic tanks or alternative waste disposal systems are not part of the proposed 2009 Master Plan, the following threshold question was found not to be applicable to this project in the Initial Study, and this topic does not need to be addressed further:

- Would the proposed project have soils incapable of adequately supporting the use of septic tanks or alternative waste disposal systems where sewers are not available for the disposal of wastewater?

3.6.3 Environmental Impact Analysis

3.6.3.1 *Methodology*

Geology and soils hazards associated with the development of the proposed 2009 Master Plan are analyzed in this section. Impacts are determined by reviewing geologic and geotechnical references and maps developed for the region and site; evaluating the likelihood of exposing people and structure to geologic hazards; and comparing projected hazards with significance thresholds described above.

3.6.3.2 *Campus Impacts*

Surface Rupture

Active or potentially active fault traces were identified by fault investigation of the southern portion of the LAMC Health, Fitness and Athletics Building, which is located within an APEFZ (Figure 3.6-2). No known active or potentially active fault traces have been mapped as crossing the other areas of the proposed 2009 Master Plan that are not located within an APEFZ. Based on the available geologic data, active or potentially active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward proposed 2009 Master Plan structures. The potential for surface rupture as a result of fault-plane displacement propagating to

the surface at the site during the design life of the proposed habitable structures is considered to be low, so impacts from surface rupture would be less than significant.

Surface Deformation

Surface rupture associated with the 1971 earthquake along the Sylmar segment of the San Fernando fault is located approximately 660 feet south and 870 feet west of the southern margin of the LAMC Health, Fitness and Athletics Building site, based on mapping performed by Dibblee, and is presented in Figures 3.6-1 and 3.6-2.[27] Previous site-specific investigations at the LAMC Main Campus and LAMC Health, Fitness, and Athletics Building sites concluded that there are no surface faults that cross the sites but that the general project area is subject to a broad zone of shearing and tensional cracking north of the fault. Based on these previous studies and proximity to the active fault, proposed 2009 Master Plan sites are considered to have the potential for minor surface deformation as a result of shearing and tensional cracking on nearby faults and are considered potentially significant seismic hazards.[28] [29] [30]

Ground Shaking

As indicated by the numbers and distribution of recorded earthquake epicenters shown in Figure 3.6-3, Regional Fault and Epicenter Map, the proposed 2009 Master Plan would continue to be subjected to periodic seismic shaking, perhaps of considerable intensity. The degree of shaking that is felt at a given site depends on the distance from the earthquake source and on the type of subsurface material on which the site is situated. A review of the ground motion Web page for the CGS regional, probabilistic seismic hazards map shows high levels of ground shaking for the proposed 2009 Master Plan sites. Estimates of peak acceleration are approximately 0.75g for the proposed 2009 Master Plan, with respect to a 10 percent probability of exceedance in a 50-year period.[31] A list of seismic sources, with approximate distances from the site and estimated maximum magnitudes is presented in Table 3.6-1. Based on our analysis, we anticipate that the highest levels of ground shaking at the proposed 2009 Master Plan sites would result from an earthquake on the nearby San Fernando and Sierra Madre fault zones. The proposed 2009 Master Plan project sites would be impacted by strong ground shaking, which would cause potentially significant impacts.

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[27] Dibblee, Jr., Thomas W., 1991. "Geologic Map of the San Fernando Quadrangle, Dibblee Geologic Foundation Map #DF-32.

[28] Wilson Geosciences, Inc. 2003. An Investigation to Determine the Potential for Active Faulting within the Los Angeles Mission College Expansion Area, Sylmar, California. Prepared for Lowney Associates, dated September 12, 2003.

[29] Wilson Geosciences, Inc. 2005. Seismic Refraction and Limited Engineering Geology Investigation for a Site South of the Intersection of Harding Street and Eldridge Avenue, Sylmar, California. Prepared for Lowney Associates, dated October 5, 2005.

[30] Jennings, C.W., 1994. "Fault Activity Map of California and Adjacent Areas, with Locations and Ages of Recent Volcanic Eruptions", California Department of Conservation, Division of Mines and Geology, Geologic Data Map Series, Map No. 6- Faults, Locations of Recent Volcanic Eruptions, Scale 1:750,000.

[31] http://www.conservation.ca.gov/cgs/rghm/pshamap/pshamap.asp.

Figure 3.6-2 Alquist-Priolo Earthquake Fault Zone Map

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Figure 3.6-3 Regional Fault and Epicenter Map

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Table 3.6-1 Summary of Potential Seismic Sources within 50 Kilometers of Site

Fault or Fault Segment	Fault Type[a]	Approximate Slip Rate (mm/year)[b]	Dip Direction	Approximate Fault Length (km)[c]	Approximate Closest Distance to Site (km)[d]	Approximate Maximum Magnitude Mw[e]
San Fernando	R	5	North	18	<1	6.7
Sierra Madre	R	0.36 to 4	North	55	2.5	7.2
Verdugo	R	0.5	Northeast	21	4	6.8
Northridge	R	uncertain	North	31	6	7.0
San Gabriel	RL	1 to 5	North	140	5.5	uncertain
Santa Susanna	R	5 to 7	North	38	8	6.7
Simi	R	uncertain	North	40	18	uncertain
Hollywood	R	0.33 to 0.75	North	15	21	6.5
Santa Monica	O/LL, R	0.27 to 0.39	North	24	24	6.6
Raymond	LL	0.1 to 0.22	North	26	28	7.0
Newport-Inglewood (on-shore)	RL	0.6	--	66	34	7.1
San Andreas	RL	20 to 35	--	1200	34	8.0
San Cayetano	R	1.3 to 9	North	45	35	7.3
Palos Verdes	RL, R	0.1 to 3.0	--	96	48	7.3
Whittier	O/RL, R	2.5 to 3	Northeast	38	49	6.8
Santa Ynez	R	0.1 to 0.7	South	130	50	7.5

Notes:

[a] RL = Right Lateral Strike-Slip Fault; LL = Left Lateral Strike-Slip Fault; O/LL = Oblique Left-Lateral Fault; R = Reverse Fault.

[b] Approximate slip rate from Southern California Earthquake Center (SCEC, 1999).

[c] Fault length from (CGS, 2003 and SCEC, 1999).

[d] Distances noted are the closest distance to the surface trace or surface projection of the fault as measured from International Conference of Building Officials (1998) (CGS, 2003 or Jennings, 1994).

[e] Maximum earthquake values reported as maximum moment magnitude (CGS, 2003 and SCEC, 1999).

km= kilometer

mm = millimeter

Liquefaction

Liquefaction is defined as a significant and relatively sudden reduction in stiffness and shear strength of saturated sandy soils caused by a seismically induced increase in pore-water pressures. Potential for seismically induced liquefaction exists whenever relatively loose, sandy soils exist with a high groundwater level and/or potential for long duration, high-seismic shaking. When liquefaction occurs, the site can experience damage induced by permanent ground movements resulting in differential settlement and the flotation of structures, tanks, and pipelines.

As mandated by the Seismic Hazards Zonation Program, the CGS has designated certain areas within California as potential liquefaction hazard zones. These are areas considered at greater risk of liquefaction-related ground failure during a seismic event, based on mapped surficial deposits and the presence of a relatively shallow groundwater table. The proposed 2009 Master Plan developments are not located in these areas.

Recent geotechnical studies at the LAMC Main Campus and Health, Fitness and Athletics Building sites encountered relatively dense materials and deep groundwater conditions. Because of the combination of dense sediments and deep groundwater in the area of the LAMC Main Campus,

including the adjacent Nursery Property, liquefaction is not considered to be a significant potential seismic hazard, therefore, impacts would be less than significant.

Seismic Settlement

Seismic settlement can occur when unconsolidated granular materials are subject to moderate to high levels of ground shaking. Some potential exists for seismic settlements within areas of granular fill deposits at all four sites. Such settlement can be a hazard if the magnitude of settlement is sufficiently large or if differential settlement occurs.

Differential seismic settlement occurs when seismic shaking causes one type of soil or rock to settle more than another type. It also may occur within a soil deposit with relatively homogeneous properties if the seismic shaking is uneven, which could occur as a result of variable geometry, for example, and variable depth of the soil deposit. Differential seismic settlement is most likely to occur in areas that transition between rock formations and more recently deposited alluvial soils or human-paced artificial fill. Within the proposed 2009 Master Plan sites, existing undocumented artificial fills underlie portions of the site that could be prone to differential settlement. Differential settlement in these localized areas represents a potential seismic hazard for the Nursery Property portion of the proposed 2009 Master Plan, which would be a significant impact.[32]

Landslides

The potential for landslides induced by seismic shaking or high groundwater is not anticipated to pose a significant seismic hazard to the development of the Nursery Property and the Eldridge Avenue Streetscape Improvement portions of the proposed 2009 Master Plan because it lies in a gently sloping area where landslides would not be expected to occur. The Seismic Hazards Zone map for the San Fernando quadrangle indicates that the proposed 2009 Master Plan does not lie within areas designated as having the potential for earthquake-induced landsliding or rockfall.[33] Therefore, the impact of landslides on this portion of the project would be less than significant.

Subsidence

The extraction of water or petroleum from sedimentary source rocks can cause the permanent collapse of the pore space previously occupied by the removed fluid. The compaction of subsurface sediment caused by fluid withdrawal will cause subsidence of the ground surface overlying a pumped reservoir. If the volume of water or petroleum removed is sufficiently great, the amount of resulting subsidence may be sufficient to damage nearby engineered structures. Significant quantities of water or petroleum are not currently being extracted in the area occupied by the proposed 2009 Master Plan. Given the depth to groundwater within the proposed 2009 Master Plan vicinity, temporary dewatering of the excavations during construction of the proposed 2009 Master Plan is not anticipated and does not present any potential impact that could result in potentially damaging subsidence adjacent to the construction area. Less-than-significant impacts would occur.

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[32] Southern California Earthquake Center (SCEC), 1999. "Southern California Fault Index." Accessed at http://www.data.scec.org/fault_index/alphadex.html.

[33] California Geological Survey (CGS), formerly California Division of Mines and Geology, 1999. Seismic Hazard Zones, San Fernando Quadrangle Official Map. Based on CDMG OFR 98-06.

Tsunami

A tsunami is a great sea wave (commonly called a tidal wave) produced by a significant undersea disturbance, such as tectonic displacement of the seafloor associated with large, shallow earthquakes. Tsunamis can cause great damage in near-shore areas. Given the inland location and altitude of the site, a tsunami is not considered to be a significant seismic hazard for the proposed 2009 Master Plan. No impact would occur.

Soil Erosion

Soils within the proposed 2009 Master Plan area are characterized by surficial Holocene-age alluvium underlain by Pleistocene-age terrace and alluvial fan deposits. Based on previous subsurface investigations within the project area, the Main Campus, Health, Fitness, and Athletics Building, and Nursery Property sites are underlain by dense alluvial soils. Soils can contain very little fine-grained soil fraction and may be low in density, rendering them more susceptible to erosion when exposed to high-velocity flow of water or severe wind conditions. These soil units generally coincide with permeable and low-density soils such as young alluvium and other surficial deposits that may occur within the project area. Given the nature of the underlying soils, substantial soil erosion or loss of topsoil associated with development of the project sites is not anticipated at the Main Campus, Eldridge Avenue, Health, Fitness and Athletics Building, or Nursery Property sites. No impacts would occur.

Expansive Soils

Expansive soils are fine-grained soils (clay) that can undergo a significant increase in volume with an increase in water content and a significant decrease in volume with a decrease in water content. Changes in the water content of an expansive soil can result in severe distress to structures constructed upon the soil. Based on previous geotechnical investigations, the soils in the project area consist primarily of predominantly coarse-grained sands that are not susceptible to expansion. However, localized areas of expansive surficial soil were encountered during the subsurface investigation. Therefore, expansive soils would be a potentially significant hazard.

Cumulative Impacts

Geologic and soils impacts have the potential to combine with impacts of related past, present, and foreseeable future projects to result in cumulative impacts to geology and soils in certain areas. For example, cumulative impacts relating to fault rupture, ground shaking, liquefaction, landsliding, seiche, erosion, and expansive soils would generally be similar to what is described for project-specific impacts; however, with the implementation of proper engineering practices prior to and during site design, grading, and construction, as specified in site- and project-specific geotechnical recommendations for this project and others, cumulative impacts would be less than significant, and no mitigation measures would be required.

3.6.3.3 *Athletic Fields Impacts*

Geology and soils impacts at the proposed Athletic Fields would be similar to those described above for campus developments. Differences are described below.

Liquefaction

The proposed Athletic Fields area is located in a zone identified as "Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in *Public Resources Code* Section 2693(c) would be required."[34] This indicates that an investigation is required to evaluate liquefaction in these portions of the proposed 2009 Master Plan site prior to final design and construction. The Athletic Fields are located within the Pacoima Wash, which consists of loose sands and could experience shallow groundwater. As a result, potential impacts from liquefaction at the Athletics Fields would be considered to be significant.

Landslides

The same site conditions that are conducive to seismically induced landslides also are conducive to landslides associated with high rainfall or a rise in groundwater, and involve slopes underlain by both surficial deposits and bedrock. Up to 15-foot-high slopes separate the proposed Athletic Fields from the Pacoima Wash. These slopes are subject to slope instability from erosion and rises in groundwater. Due to the height and instability of this slope and the potential effects of seismic shaking during an earthquake event, the potential for landslides would be a significant hazard to the proposed 2009 Master Plan in this area.

Seiche

A seiche is an oscillation of a body of water in an enclosed or semi-enclosed basin, such as a reservoir, harbor, lake, or storage tank, resulting from earthquakes or other large environmental disturbances. The nearby Pacoima Reservoir, approximately 2 miles to the northwest, could be subject to a seiche during a seismic event. Overtopping of the Pacoima Dam would result in discharge into the Pacoima Wash drainage and into the Lopez Dam flood-control system, downslope to the southeast from the proposed 2009 Master Plan sites. Only the proposed Athletic Fields portion of the project is situated within the limits of the Lopez Canyon Flood Control Debris Basin inundation area and within the 100-year flood plain. Therefore, a seiche and the associated flooding would be considered a significant seismic hazard for the proposed Athletic Fields portion of the proposed 2009 Master Plan.[35] [36]

Soils and Erosion

The site of the proposed Athletic Fields is underlain by loose alluvial soils consisting of loosely consolidated to consolidated gravels, sands, and clay derived from the surrounding topographic highlands. Without mitigation, such as placement of revetments and use of best management practices during construction, the Athletic Fields would be adversely affected by periodic Pacoima Wash active drainage events and significant impacts from erosion would occur.

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[34] State of California, 1999, Seismic Hazard Zones, San Fernando Quadrangle.

[35] U.S. Army Corp of Engineers, 1986. Upstream Reservoir Inundation Map - Lopez Dam, Los Angeles County Drainage Area, Pacoima Wash, California. U.S. Army Engineer District, Los Angeles Corp of Engineers, Los Angeles California- District Reservoir Regulation Section dated 7/23/2001.

[36] Flood Insurance Rate Map (FIRM), 1980. Flood Insurance Rate Map - City of Los Angeles, California, Los Angeles County, Panel 7 of 112. Federal Emergency Management Agency, Federal Insurance Administration - Community Panel Number 060137 0007 C, dated December 2, 1980.

3.6.4 Mitigation Measures for Significant Impacts

The following measures are proposed to mitigate potentially significant geologic hazards to less-than-significant levels for the proposed 2009 Master Plan components. These mitigation measures would be incorporated into proposed 2009 Master Plan design and are presented here for clarity. Implementation of the recommended mitigation measures identified, combined with compliance with state and local building codes, the CBC, the City of Los Angeles Building Code (Section 7011.3), and the LACCD regulations, would ensure that potentially significant impacts related to geologic and soil hazards would be reduced to a less-than-significant level. It is anticipated that, at the time the proposed 2009 Master Plan construction is initiated, additional plan and site-specific geotechnical investigations would be performed, any project-specific geological and soil constraints would be verified, and appropriate recommendations would be provided. [37]

Impact Number	Impact	Mitigation Measure (MM) Number	Mitigation Measure	Post Mitigation Level of Impact
Construction				
Impact GEO-1	Surface Deformation and Ground Shaking from Earthquakes	MM GEO-1	Design and construct Nursery Property and Athletic Fields structures to the seismic design requirements for ground shaking specified in the CBC for Seismic Zone 4, at a minimum.[38]	Less than significant
Impact GEO-2	Adverse Effects from Seismic Settlement	MM GEO-2	Site-specific geotechnical and geological investigations that focus on potential seismic settlement, including differential settlement, should be performed as part of the design studies at the Nursery Property. Identified undocumented fills should be removed and recompacted according to standard earthwork recommendations before the construction of any proposed structures.	Less than significant
Impact GEO-3	Adverse Effects from Expansive Soils at Nursery Property	MM GEO-3	Potentially expansive materials should be removed or mixed with non-expansive soils during grading activities. Appropriate foundation designs shall be used if expansive soils are encountered.	Less than significant
Impact GEO-4	Adverse Effects from Liquefaction at Athletic Fields	MM GEO-4	Structures shall not be constructed within the limits of, or adjacent to, the Pacoima Wash on the LAMC Athletics Field site unless designs are based on a site-specific geotechnical and geological investigation, performed as part of the design studies, that focuses on potential liquefaction due to the potential for shallow groundwater and potentially liquefiable loose sands.	Less than significant
Impact GEO-5	Adverse Effects from Landslides	MM GEO-5	Site-specific geotechnical and geological investigations that evaluate slope stability should be performed for existing and proposed site slopes.	Less than significant

[37] California Building Standard Commission and International Conference of Building Officials. 2002. "2001 California Building Code".

[38] California Building Standard Commission and International Conference of Building Officials. 2002. 2001 California Building Code.

Impact Number	Impact	Mitigation Measure (MM) Number	Mitigation Measure	Post Mitigation Level of Impact
Impact GEO-6	Adverse Effects from Seiche Hazard	MM GEO-6	Site-specific geotechnical and geological investigations that focus on potential seiche hazards shall be performed as part of the design studies. Protection methods such as berms, dams and levees shall be evaluated for effectiveness or constructed.	Less than significant
Impact GEO-7	Adverse Effects from Erosion	MM GEO-7	To protect the slope between the Athletic Fields and Pacoima Wash from erosion, site-specific geotechnical, geological and hydrological studies that focus on erosion hazards, shall be performed as part of the design studies. Revetment material (riprap and concrete lining) shall be properly placed on the west bank of the Pacoima Wash adjacent to the site.	Less than significant

3.6.5 Level of Significance after Mitigation

Implementation of Mitigation Measures MM GEO-1 through MM GEO-7 would reduce the impacts to a less than significant level.