

4.7 GEOLOGY, SEISMICITY, AND SOILS

A. SUMMARY

A number of geotechnical studies of the campus have been prepared. The potential geologic, seismic and soils hazards most relevant to Master Plan development include liquefaction, slope failure, and the presence of expansive soils. The potential liquefaction hazard is limited to the site of the proposed Community Health & Wellness Center, and possibly, the embankments of the Balboa Reservoir; the slope failure hazard is limited to areas of non-engineered fill or sandy subsurface materials. The potential for expansive soils is considered low to moderate, but applies to the fill and native materials present. These potential hazards are identified as significant mainly because the engineering designs for the proposed buildings have not been developed yet, and because information on conditions at the Balboa Reservoir is inconclusive. Compliance with the California Building Code and standard engineering practice would provide an adequate level of protection and would reduce the potential impacts to less-than-significant levels. Potential impacts related to erosion would be effectively mitigated through implementation of standard controls.

B. INTRODUCTION

B1. Definitions

- **Cretaceous:** A Period of geologic time that extends between 135 million and 65 million years ago.
- **Jurassic:** A Period of geologic time that extends between 190 million and 135 million years ago.
- **Maximum Credible Earthquake:** Maximum earthquake predicted to affect a given location based on the known lengths of the active faults in the vicinity.
- **Metamorphic rocks:** Rocks created from pre-existing rocks by chemical and other changes in response to changes in temperature, pressure, chemical environment, and other factors.
- **Moment Magnitude:** A logarithmic scale that measures the energy released by an earthquake.
- **Quaternary:** A Period of geologic time that constitutes the last two million years.
- **Right-lateral fault:** A fault on which the side opposite the observer appears to have moved to the right.
- **Sedimentary rocks:** Layered rocks created through the consolidation of sediment.
- **Strike-slip fault:** A fault on which the movement is parallel to the fault's strike (direction).
- **Tertiary:** A Period of geologic time that extends between 65 million and about 2 million years ago.

The information presented in this section of the EIR is based on the following: "Draft Preliminary Geotechnical Investigation, Facilities Master Plan, City College of San Francisco," Treadwell & Rollo, October 28, 2003 (on file and available for review at the CCSF Administrative Offices, 33 Gough Street, San Francisco, during normal business hours). Treadwell & Rollo interpreted geologic conditions at the Main Campus based on a limited geologic reconnaissance, and review of aerial photographs and borehole

data from previous investigations (shown on **Figure 4.7-1, Boring Locations**). They investigated subsurface conditions at the campus in March 2003 by drilling six test borings, designated as B-1 through B-6 at the locations shown on **Figure 4.7-1**. Four borings (B-1 through B-4) were located within the eastern portion of the South Reservoir. Boring B-5 was located within the parking lot of the existing North Gymnasium and boring B-6 was located on Marston Avenue, north of the former nursery property.

C. EXISTING CONDITIONS

C1. Regional Geology and Seismicity

The CCSF Main Campus is within the Coast Ranges geomorphic province of California. This province is generally characterized by northwest-trending mountain ranges and intervening valleys that are controlled by right-lateral strike-slip faulting along the San Andreas fault zone. The San Andreas fault and its roughly parallel subsidiary faults, which are characterized by similar movement, have cut California into elongated northwest trending blocks. Bedrock in the campus vicinity consists of Cretaceous-Jurassic Franciscan Complex, overlain by Quaternary deposits.

C2. Site Topography and Geology

Topographic elevations across the campus vary by about 125 feet, from the eastern edge of the campus to the prominent hilltop at Cloud Hall and the Science Building. The topography can be described as falling within three broad zones: (1) the hilltop (about 350 feet above mean sea level, or msl), (2) the mid level (about 295 to 350 feet above msl), structured around Cloud Circle, and (3) the lower levels (240 to 260 feet above msl) along the campus periphery. Steep slopes tend to separate these areas.

The Main Campus is underlain by four geologic units: the Franciscan Complex Melange, consisting of small to large fragments of hard rock; the Colma Formation, consisting primarily of sands; Colluvium, consisting of a veneer over bedrock; and Artificial Fill. **Figure 4.7-2, Geologic Map**, shows the estimated location and extent of the geologic units identified at the campus.

Franciscan Complex Melange (Kju)

Bedrock underlying the site is mapped as Cretaceous sheared (deformed) rocks (melange) of the Franciscan Complex. The Franciscan Complex is a group of metamorphic and sedimentary rocks that were added to the North American continent along the boundary between the North American and Farallon plates during late Cretaceous to early Tertiary time. The melange consists of small to large fragments of hard rock in a matrix of generally coherent and firm to occasionally soft, sheared rock that is derived mostly from claystone and mudstone; some serpentine may be present. Bedrock is dark gray where fresh and yellowish-brown where weathered. The blocks were typically intensely fractured. The melange was observed in numerous borings in the southeast portion of the campus. Outcrops of

greenstone near Conlan Hall were also observed, indicating the *mélange* contains a variety of block types throughout the site. Bedrock crops out on site, or is overlain by the Colma Formation (described in the following subsection). Localized zones of cut and fill slopes (i.e., the existing Practice Field and Stadium) expose bedrock on the upslope part of the bench and fill (consisting of sandy clay or clayey sand and fragments of claystone) at the down slope part of the bench.

Colma Formation (Qc)

Based on available borehole data, the Colma Formation consists primarily of sand, clayey sand, and silty sand with occasional gravel. The sand ranges from fine- to medium-grained. Colma Formation sediments are moderately cemented (bound together with mineral material) and typically medium dense to very dense.

Colluvium(Qco)

Colluvium (slope debris and ravine fill) generally occurs as a veneer over bedrock and is expected to be a few feet thick over most of the areas mapped as *mélange* (KJu) on **Figure 4.7-2**. Where anticipated to be greater than five feet thick, colluvium is mapped as a separate unit on **Figure 4.7-2**. Logs of previous exploratory borings do not distinguish colluvium as a separate layer or series of layers that form a geologic unit; however, soil consisting of a few feet of stiff sandy clay overlying bedrock is likely to be colluvium.

Artificial Fill (Qat)

Artificial fill has been placed at several locations throughout the campus during the mid- to late-1900s. Based on the age of the various fills, little if any of the fill is believed to have been engineered. The thickness and composition of the fill are expected to vary widely between and within fill areas. Soft/loose silty clay, gravel and sand with rubble and organic debris was encountered in previous exploratory borings at the shop and warehouse, located in the southeast corner of the campus. Fill beneath the practice field in the southern part of the campus was comprised mostly of sandy clay and clayey sand.

C3. Site Soils

According to the Soil Conservation Service Soil Survey, the soil at the Main Campus is described as urban-land Orthents that consists mainly of well-drained, gently rolling to steep soils that have been cut and filled for home site and urban development. The properties and characteristics of these soils are highly variable because of the differences in the kind and amounts of fill material used. This characterization of campus soils is at a general interpretation/planning level, but is validated by the site-specific investigations done for this and other reports.

Those investigations conclude that the Main Campus and Balboa Reservoir are generally blanketed by a sand layer, with the exception of localized areas of cut and fill. The sand layer consists of variable amounts of silt and clay and varies from loose to medium dense near the ground surface to very dense with depth. The total thickness of this sand layer varies across the site, with the thickest layer extending over 50 feet. Beneath the sand layer is residual soil consisting of very stiff to hard clay underlain by bedrock of the Franciscan Complex Melange (as described earlier in this section).

C4. Landslides

The geotechnical investigation observed no evidence of past or ongoing landslide activity except near the Lath House. Evidence of a surficial landslide was visible in the 1972 aerial photographs on a fill slope south of the Lath House. The scar from that landslide was still visible but heavily vegetated at the time of the site reconnaissance.

C5. Seismicity and Seismic Hazards

The Main Campus is within a region characterized by the seismically active San Andreas fault system, which is the principal tectonic element of the North American/Pacific plate boundary in California. The San Andreas fault zone is located approximately 3.5 miles southwest of the Main Campus. Other major active faults in the region include the San Gregorio, Hayward, Calaveras, and Rodgers Creek faults. A list of major active faults in the region, including their distances from the site and maximum moment magnitudes, is provided in **Table 4.7-1, Regional Active Faults And Seismicity**. Major faults in the San Francisco Bay Area are shown on **Figure 4.7-3, Major Regional Faults**.

The northwest trending City College Fault is roughly parallel to the regional fault structures and is mapped crossing the center of the Main Campus. This fault has no recognized Quaternary displacement, shows evidence of no displacement in Quaternary time, and/or has not associated seismicity (movements triggered by events on nearby faults). Therefore, the City College fault is not considered to be an active fault (see further discussion later in this section).

Since 1800, four major earthquakes have been recorded on the San Andreas fault in the greater San Francisco Bay and Monterey Bay areas. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (a measure of earthquake intensity as experienced by people and structures) occurred east of Monterey Bay on the San Andreas fault. The estimated moment magnitude (M_w) for this earthquake is approximately 6.25. In 1838, an earthquake occurred with an estimated MM intensity of about VIII-IX, corresponding to a M_w of about 7.25. The San Francisco earthquake of 1906 caused the most significant damage in the history of the San Francisco Bay area in terms of loss of lives and property damage. This earthquake created a 430-kilometer surface rupture along the San Andreas fault from Shelter Cove to San Juan Bautista. It had a maximum MM intensity of XI, a M_w of about 7.9,

and was felt 560 kilometers away in Oregon, Nevada and Los Angeles. The most recent large earthquake to affect the Bay Area was the Loma Prieta earthquake in 1989, with a M_w of 6.9.

**Table 4.7-1
Regional Active Faults And Seismicity**

Fault Name	Distance from Center of Campus (miles)	Direction from Site	Maximum Moment Magnitude
San Andreas (peninsula)	3.7	West	7.1
San Gregorio	6	West	7.3
San Andreas (north coast)	9	Northwest	7.6
Hayward (northern segment)	13	West	6.9
Calaveras (north of reservoir)	23	East	6.8
Rodgers Creek	25	North	7.0
Point Reyes	25	Northwest	6.8
Concord-Green Valley	27	Northeast	6.9
Maacama (southern segment)	27	Southeast	7.1
Hayward (southern segment)	29	Southeast	6.9
Greenville	31	East	6.9
West Napa	32	Northeast	6.5
Montezuma Hills	41	Northeast	6.1
Calaveras (south of reservoir)	41	Southeast	6.2

Source: Treadwell & Rollo, 2003.

The U.S. Geological Survey's Working Group on California Earthquake Probabilities has compiled the earthquake fault research for the San Francisco Bay area in order to estimate the probability of fault segment rupture. They have determined that the overall probability of moment magnitude 6.7 or greater earthquake occurring during the period 2003 to 2032 is 62 percent. The highest probabilities are assigned to the San Francisco Peninsula segment of the San Andreas fault and the northern Hayward/Rodgers Creek faults. These probabilities are 21 and 27 percent, respectively.

Strong Ground Shaking

Based on the proximity of the Main Campus to the San Andreas and other major active faults in the San Francisco Bay Area, there is a high potential for the campus to experience moderate to strong ground shaking during a major earthquake on one of these faults. The intensity of earthquake ground motion at

the campus will depend on the characteristics of the generating fault, the distance to the earthquake epicenter, the magnitude and duration of the earthquake, and site geologic conditions.

A separate geotechnical investigation of the site for the proposed Community Health & Wellness Center considered as the “design earthquake” an earthquake scenario of a moment magnitude 7.9 earthquake on the San Andreas Fault with a peak ground acceleration (PGA, a measure of ground shaking during an earthquake) of 0.79g.¹ The PGA was determined through a probabilistic seismic hazard analyses and is considered the upper bound earthquake representing a 10 percent probability of exceedance in 100 years.²

Seismically Induced Ground Failure

Strong ground shaking caused by large earthquakes can induce ground failure such as liquefaction, compaction settlement, and slope movement. The susceptibility of the Main Campus to these hazards is a function of the site topography, soil conditions, and/or depth to groundwater.

Seismically induced liquefaction is a phenomenon whereby sediments temporarily lose shear strength and collapse. This is caused by cyclic loading during earthquake shaking that generates high pore water pressures within the sediments. The requisite condition for liquefaction is the presence of loose, saturated, cohesionless, granular soil within the upper 50 feet of the ground surface. Liquefaction can result in loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, and differential settlement of affected deposits. The Main Campus is not located in liquefaction hazard zones designated for the City and County of San Francisco. However, areas of the campus underlain by sandy uncemented Colma Formation sediments and, more likely, loose sandy fills are susceptible to liquefaction if groundwater is sufficiently shallow.

Based on the draft results of the geotechnical investigation at the site of the proposed Community Health & Wellness Center, the liquefaction potential at the site is judged to be moderate to high. The anticipated settlements vary across the site due to the thickness of the potentially liquefiable material and the depth of groundwater measured during the geotechnical exploration. Settlement within liquefiable areas ranges from less than one inch for a two-foot thick liquefiable layer to a maximum of 3.6 inches for a maximum liquefiable layer of about 24 feet. These results should be considered preliminary and may change based on the assessment of the groundwater level and thickness of the liquefiable layers.

A separate liquefaction evaluation of the eastern and western embankments of the North Reservoir concluded that although the foundation materials are not liquefiable, the eastern and western

¹ G=gravity, expressed as a percentage.

² That is, over a 100- year period, there is a 10 percent chance that an earthquake would exceed a moment magnitude of 7.9 at the site.

embankments are liquefiable. However, it is unclear what conditions were assumed for that analysis. Because the existing embankments are well above the groundwater levels at the reservoir, the embankments are unlikely to be saturated.

In the remaining areas of the campus (except for the Community Health & Wellness Center site), the groundwater levels measured indicate the presence of groundwater at about 25 feet below the ground surface and within dense material. The Treadwell & Rollo geotechnical investigation judges the potential for liquefaction in the remaining areas of the campus to be low.

Compaction settlement, or seismic densification, occurs when loose granular soils above the water table increase in density as a result of earthquake shaking. The soil densification can result in differential settlement because of variations in soil composition, thickness and initial density. Areas of a site underlain by loose sandy fill are considered most susceptible to compaction settlement. At the CCSF Main Campus, the native materials (bedrock, Colma Formation sediments, and colluvium) are generally too clayey or dense for compaction settlement to occur.

Results of compaction settlement analysis at the site of the proposed Community Health & Wellness Center indicate less than 0.1 inch of settlement for the design earthquake described above. An assessment is under way of compaction settlement in the northwest corner of the campus (the sites of the proposed Health and Child Development Centers). It is expected that the results of the analyses will be similar to the analyses performed for the Community Health & Wellness Center. The Treadwell & Rollo geotechnical investigation judges the potential for compaction settlement in the remaining areas to be low.

The Main Campus is not mapped within an area defined as being susceptible to seismically induced landsliding.

Fault Rupture

There are no active faults that cross the Main Campus. The northwest trending City College fault is mapped crossing the center of the site. This fault is defined as a pre-Quaternary fault (older than 1.6 million years) and, therefore, lacks seismicity and recognized Quaternary displacement or shows evidence of no displacement during Quaternary time. Treadwell & Rollo observed no evidence of active faulting at the site during its aerial photograph review and site reconnaissance. Faults older than 10,000 years are not considered active; however, locations that have experienced fault rupture at some time do have a greater potential for future movement.

Observations of historic ground failures in northern California triggered by major earthquakes from 1800 to 1970 indicate that no movement on the City College fault at the site was observed and/or recorded during that time. Based on the lack of evidence for active faulting along the City College fault, the potential for surface rupture at the Main Campus is judged to be low.

D. EXISTING PLANS, POLICIES AND REGULATIONS

D1. State Requirements

Alquist-Priolo Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures.

The law requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults and to issue appropriate maps. ("Earthquake Fault Zones" were called "Special Studies Zones" prior to January 1, 1994.)

The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones.

Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (by generally 50 feet). The CCSF Main Campus is not in an Earthquake Fault Zone.

State Requirements for Colleges

As a State facility and a public college, CCSF is subject to certain State of California requirements, including requirements relating to structural engineering and seismic safety. Structures on the Main Campus must meet the requirements of the California Building Code (Title 24, Part 1 and Part 2). The California Building Code is similar to the 1997 Uniform Building Code, but incorporates California amendments. In addition, the State has more stringent safety standards for public school buildings.³ Individual projects processed as part of the Main Campus Master Plan would be subject to review by the California Division of Mines and Geology and the Division of the State Architect.

³ Chauhan, Nat, S.E., Regional Manager, Division of the State Architect, telephone conversation, July 20, 1999.

D2. San Francisco General Plan

As an entity within the State California Community Colleges system, CCSF is generally not subject to local regulations. In addition, CCSF may choose to exempt itself from local planning and zoning requirements with respect to classroom uses. Therefore, the following information regarding the *San Francisco General Plan* is not necessarily applicable to the Master Plan, and is presented for informational purposes. (Project consistency with relevant General Plan policies is discussed in **Section 4.1, Land Use and Planning.**)

Community Safety Element

Policy 2.1: Assure that new construction meets current structural and life safety standards.

Policy 2.3: Consider site soils conditions when reviewing projects in areas subject to liquefaction or slope instability.

Policy 2.9: Consider information about geologic hazards whenever City decisions that will influence land use, building density, building configurations or infrastructure are made.

E. SIGNIFICANCE THRESHOLDS

For purposes of this EIR, thresholds were used from both the City and County of San Francisco Initial Study Checklist and Appendix G of the CEQA Guidelines (Environmental Checklist Form).

The environmental checklist used by the City and County of San Francisco includes the following criteria for determining whether a project could have a significant geology/topography impact:

Could the project:

- (a) Expose people or structures to major geologic hazards (slides, subsidence, erosion and liquefaction); or
- (b) Change substantially the topography or any unique geologic or physical features of the site.

Appendix G of the CEQA *Guidelines* (Environmental Checklist Form) lists the following items to be considered when determining whether a project could have a significant effect on the environment:

- 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 or other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42;
 - ii) Strong seismic ground shaking;
 - iii) Seismic-related ground failure, including liquefaction;

- iv) Landslides;
- b) Result in substantial soil erosion or the loss of topsoil;
- c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction 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; or
- 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.

If implementation of the project exceeds any of the standards outlined above, the project would result in a significant impact.

The following analysis addresses potential impacts related to seismic ground shaking, seismic-related ground failure, landslides, erosion, and expansive soils. As stated in the Setting, no active faults cross the Main Campus and the campus is not within an Earthquake Fault Zone; therefore, the potential for ground rupture is low. The geotechnical investigation of the campus found no issues related to unstable geologic units or soils (beyond the impacts discussed below).⁴ The Main Campus is already connected to the City wastewater system and additional development on the campus would connect to the system; therefore, there would be no impacts related to septic tanks or alternative wastewater disposal systems. The proposed Master Plan projects would be located in areas of the Main Campus that have already been developed; therefore, there would be no impacts to site topography or unique geologic features.

F. IMPACTS AND MITIGATION MEASURES

Geology-1 Seismic Ground Shaking

Impact

Master Plan Buildout

The Main Campus will be subject to moderate to strong seismic ground shaking in the event of a major earthquake in the San Francisco Bay Area. The shaking could pose a threat to the integrity of structures and associated infrastructure (roadways and utility lines), as well as the welfare and safety of students and employees. This impact would apply to use of proposed new buildings on the campus, as well as increased student and employee occupancy of existing buildings.

⁴ Hall, Craig, Treadwell & Rollo, personal communication, November 17, 2003.

The State of California requires that new structures on the Main Campus include seismic safety features to meet the requirements of the current version of the California Building Code. These requirements apply specifically to public school facilities, have been designed and determined by the State to avoid and prevent significant public safety impacts, and are more stringent than those for general structures. Compliance with these features would meet the public safety protection goals of the Code.

For these reasons, Master Plan buildout would not expose people or structures to substantial adverse effects involving seismic ground shaking (given compliance with all State requirements).

Near-Term Development

The public safety impacts related to ground shaking for individual building sites of the near-term projects - Community Health & Wellness Center, Student Health Center & Classroom Building (Health Center), Child Development Center, practice field, reservoir berm removal/wall construction, and replacement parking - would be the same as for the campus as a whole (less than significant).

Reservoir Configuration

The ground shaking impacts would be the same (less than significant) if the reservoir were not reconfigured and west campus development occurred on the southern half of the reservoir.

Mitigation

No mitigation is required.

Geology-2 Seismic-Related Ground Failure

Impact

Master Plan Buildout

As noted in the Setting, the geotechnical studies completed for the Main Campus Master Plan indicate that the potential for liquefaction in most areas of the Main Campus is low. The studies also indicate that the potential for compaction settlement in the entire campus is low. For these reasons, Master Plan development generally would not expose people or structures to potential substantial adverse effects involving seismic-related ground failure. (The potential for slope failure is addressed under Impact **Geology-3**.)

The geotechnical studies indicate the potential for liquefaction in two areas: the site of the Community Health & Wellness Center (discussed below under “Near Term Development”) and the embankments of the Balboa Reservoir. To allow for the development proposed on the eastern part of the reservoir, the eastern berms of both reservoir would be completely removed. The center berm between the two reservoirs would be removed to allow for additional surface parking in the near-term and allow for

Master Plan development in the long term. The interior slopes of the north and west berms of the North Reservoir and south and west berms of the South Reservoir would be removed to allow SFPUC to construct vertical walls. The exterior slopes of the south berm would be removed as part of the development of the Arts Center. The only remaining area that might have a potential for liquefaction would be the external embankment on the west side.

All structures on the reservoir (including any retaining structures) would be designed in compliance with the current version of the California Building Code; these requirements would provide adequate protection against potential liquefaction. However, the specific designs for the proposed development on the reservoir are not available at this time. Although the most recent geotechnical investigation concludes that the potential for liquefaction at the reservoir is low, it also recommends detailed study of the embankments because of the earlier study's conclusion that the embankments are liquefiable. In the absence of specific design information and without conclusive information regarding hazard potential, the potential effects involving liquefaction are considered to be significant.

Near-Term Development

As noted in the Setting, the liquefaction potential at the proposed Community Health & Wellness Center is judged to be moderate to high. The anticipated settlements vary across the Community Health & Wellness Center site due to the thickness of the potentially liquefiable material and the depth of groundwater measured during the geotechnical exploration. Without mitigation, the Community Health & Wellness Center could be subject to loss of foundation support and settlement during an earthquake. Therefore, construction of the Community Health & Wellness Center could expose people or structures to substantial adverse effects associated with ground-failure; this potential impact would be significant.

As noted in the discussion of Master Plan buildout, the potential for liquefaction in other areas of the campus is low. Therefore, the other near-term projects (Health Care Center, Child Development Center, practice field relocation) would not expose people or structures to substantial adverse effects involving liquefaction. The discussion of Master Plan buildout also notes that the potential for other types of seismically-induced ground failure at the campus as a whole is low. Therefore, the near-term projects would not expose people or structures to substantial adverse effects involving other types of seismically-induced ground failure.

Reservoir Configuration

If the reservoir was not reconfigured, and west campus development occurred on the southern half of the reservoir, the potential impacts would be the same as if the reservoir were reconfigured (significant).

Mitigation

The potential impacts resulting from liquefaction would be adequately mitigated if the hazards to project-related structures (and persons using the structures) were reduced to a generally accepted level of risk,

based on standard engineering and geotechnical practices and methods. These practices and methods are embodied in the requirements of the California Building Code, which has been designed and determined by the State to avoid and prevent significant public safety impacts.

Geology-2: CCSF shall conduct a site-specific geotechnical investigation prior to construction of each Main Campus building project. The geotechnical investigation shall consider the potential for liquefaction hazards, in particular for the Community Health & Wellness Center and development on the Balboa Reservoir. CCSF shall implement all feasible measures identified in the geotechnical investigation to avoid or minimize liquefaction potential. The measures could include, but would not be limited to, minor shifting of the building footprint to avoid areas of identified liquefaction hazard, the use of piles supported in the underlying bedrock, in-situ soil improvement, and overexcavation of liquefiable soils. The use of piles and overexcavation could result in construction noise and air quality impacts. These potential impacts are addressed elsewhere in this EIR.

Significance After Mitigation

If implemented, Measure **Geology-2** would reduce the potential impacts resulting from liquefaction to a less- than- significant level.

Geology-3 Landslides (Slope Failure)

Impact

Master Plan Buildout

Geotechnical studies completed for the campus indicate that the Main Campus is not mapped within an area susceptible to seismically-induced landsliding. Site conditions observed from aerial photographs indicate that the site slopes at the Main Campus have performed adequately except for shallow failure of the fill slope south of Lath House in the northern part of the campus. However, the non-engineered condition of the site fill slopes suggests that they may be susceptible to failure during periods of prolonged intense rainfall, or if stormwater runoff is discharged to the slopes. Failure of the fill slopes could also be induced by improper grading, such as the addition of more fill at the top of the slopes or unretained cuts at the bottom of the slopes. For these reasons, Master Plan development could expose people or structures to substantial adverse hazards related to slope failure; the potential impacts are significant for the site as a whole.

An earlier seismic evaluation of the eastern and western embankments of the North Reservoir concludes that failure of portions of the slope may occur during a design seismic event. It was unclear whether the analysis assumed a full reservoir and/or a saturated embankment condition. A subsequent preliminary report indicates a sufficient safety margin of the slopes under static conditions, but suggests that portions

of the embankments could fail because of saturated ground conditions and/or seismic events. Both studies recommended further evaluation to assess overall embankment stability.

As noted earlier in this section, Master Plan development would involve removal of some of the reservoir berms; the only remaining berm would be the external embankment on the western side of the reservoir. All structures on the reservoir (including any retaining structures) would be designed in compliance with the current version of the California Building Code; these requirements would provide adequate protection against potential slope failure. However, no specific designs are available at this time. Due to the absence of specific design information and the identified possibility of slope failure under certain conditions, the potential for slope failure at the reservoir is a significant impact.

Near-Term Development

The proposed Community Health & Wellness Center would be constructed over an area of fill, and would be built into slopes of the Colma Formation. Surficial instabilities could occur in areas of sandy material; in the absence of a specific design, this potential impact is considered significant. The Health Center and Child Development Center would be constructed in a flat area of the campus, and the relocated practice field would be in the relatively flat area north of the stadium (flanked by Batmale Hall to the west, the stadium to the south, and mainly natural slopes to the north). Therefore, these near-term projects would not be subject to slope failure hazards. Removal of the center berm between the reservoirs would not cause substantial hazards because the remaining surfaces of the reservoir are covered by asphalt.

Reservoir Configuration

If the reservoir was not reconfigured, and west campus development occurred on the southern half of the reservoir, the potential for failure of portions of the embankment slopes would still exist. Accordingly, potential impacts due to slope failure of the reservoir berms, however they are developed or modified, would be significant.

Mitigation

Geology-3: CCSF shall conduct a site-specific geotechnical investigation prior to construction of each Main Campus building project. The geotechnical investigation shall consider the potential for slope failure hazards, in particular for projects in areas of the campus with non-engineered fill slopes or sandy material and the reservoir. CCSF shall implement all feasible measures identified in the geotechnical investigation to avoid or minimize slope failure potential. The measures could include, but would not be limited to, strengthening embankments by soil improvement techniques, and constructing a retaining wall system around the side of berms (between the berm and the structure).

Significance After Mitigation

Implementation of Measure **Geology-3** would reduce potential slope failure impacts to a less- than-significant level.

Geology-4 Soil Erosion

Impact

Master Plan Buildout

During the construction phase of individual Main Campus Master Plan projects, construction activities would disturb or remove existing vegetation, thereby increasing potential erosion from certain parts of the campus. Urban-land Orthents soils found on site have a water erosion hazard of moderate to high if left uncontrolled. During the most recent on-site geotechnical investigation, observations were made of localized areas of the site where erosion was ongoing because of uncontrolled stormwater runoff, unvegetated cut slopes, and/or unpaved pedestrian trails. Under current site conditions, the potential for ongoing erosion is high. Potential construction-period impacts from the project due to erosion would be avoided through preparation and implementation of an erosion and sediment control plan and a Stormwater Pollution Prevention Plan (SWPPP).⁵ Assuming future site development includes hardscape, landscaped areas and control of stormwater runoff and the development of a SWPPP for certain Master Plan projects, the potential for future erosion at the site is expected to be low.

Although it is reasonable to assume that the College would follow standard erosion control practices for new construction, specific erosion control plans are not available at this time. Therefore, without mitigation, the potential impacts related to erosion would remain significant.

Near-Term Development

The potential for construction- phase erosion for the near-term projects would be the same as stated above (significant).

Reservoir Configuration

The existing reservoirs are covered in asphalt; stormwater runoff goes into a storm drain system at the base of the reservoir. The potential for erosion would be the same whether west campus development occurred as shown in the Master Plan or on the southern half of the reservoir.

⁵ Development and implementation of a Storm Water Pollution Prevention Plan, or SWPPP, is required to maintain project coverage under the National Pollution Discharge Elimination System (NPDES) General Permit for Construction Activities. The SWPPP details the site-specific Best Management Practices (BMPs) to control erosion and sedimentation and maintain water quality during project construction.

Mitigation

The potential erosion impacts during construction would be adequately mitigated if the impacts were minimized through the implementation of feasible standard erosion control practices.

Geology-4: Prior to development of any of the proposed Main Campus Master Plan projects, CCSF shall develop an erosion control plan. During each individual project, construction personnel shall implement all relevant and feasible measures of the plan during earthmoving and other construction activities. The plan shall include, but shall not be limited to, the following measures:

- a) To the extent feasible, restricting earth moving activities to the dry season and providing erosion protection measures for each project prior to the onset of winter rains;
- b) Minimizing the amount of soil exposed at any one time (through scheduling, prompt completion of grading, and use of staged stabilization);
- c) Preserving existing vegetation to the extent feasible (through marking and protection);
- d) Designating soil stockpile areas on the construction plans and covering and protecting soil stockpiles by a plastic membrane during the rainy season;
- e) Revegetating disturbed areas, utilizing such measures as planting of native grasses, plants and shrubs and the installation of jute netting and hydroseeding in areas of more difficult revegetation; and
- f) Implementing the dust control measures identified in **Section 4.5, Air Quality and Wind**.

Significance After Mitigation

If implemented, Mitigation Measure **Geology-4** would reduce the potential erosion impact to a less-than-significant level.

Geology-5 Expansive Soils

Impact

Master Plan Buildout

Expansive soils shrink or swell significantly with changes in moisture content. Clay content and porosity of the soil also influence the change in volume. The shrinking and swelling caused by expansive clay-rich soil often results in damage to overlying structures. The presence of clayey soil within colluvium, Colma Formation sediments and fill at the Main Campus indicates these materials may be expansive. The locally high clay content of melange suggests bedrock may be locally expansive as well. The geotechnical investigation concludes that the expansion potential of the site soils to be low to moderate. Without mitigation, construction over expansive soils could create substantial risks to persons using the proposed buildings and to the structures themselves. Therefore, the potential impact would be significant.

Near-Term Development

The potential for expansive soils to affect the proposed near-term projects would be the same as for the entire Master Plan (significant).

Reservoir Configuration

The impact of expansive soils would be the same whether west campus development occurred as shown in the Master Plan or on the southern half of the reservoir.

Mitigation

The potential impacts related to soil expansion would be adequately mitigated if the hazards to project-related structures (and persons using the structures) were reduced to a generally accepted level of risk, based on standard engineering and geotechnical practices and methods.

Geology-5: For individual Main Campus Master Plan projects in areas of expansive soils, CCSF shall implement feasible measures to minimize the effects of expansive soils on new buildings, slabs and pavements. The measures shall be based on the recommendations of site-specific geotechnical investigations. These measures could include, but would not be limited to: deepening of foundations below the expansive soil zone; soil subgrade and fill moisture treatment to achieve a soil moisture content of two percent or greater above optimum; excavation and removal of expansive soils under slabs and buildings; or the use of drilled pier and grade beam foundation systems that obtain support below the zone of soil expansion and contraction. In addition, positive surface gradients shall be provided adjacent to building foundations to minimize saturation and soil volume changes in this area.

Significance After Mitigation

If implemented, Measure **Geology-5** would reduce the potential impacts related to soil expansion to a less- than- significant level.

Geology-6 Impacts of Citywide Master Plan Development

Impact

Geologic impacts are local and specific to each building project, whether on the Main Campus site or at the other CCSF campuses. Accordingly, the geologic impacts of Citywide Master Plan development would be particular to each individual building site. The geologic impacts associated with the Mission and Chinatown/North Beach campuses have already been analyzed in certified EIRs (see **Section 3.0, Project Description**, for full citations of these documents). That analysis has been incorporated into this EIR by reference.

The CEQA documents for the proposed Mission Campus and Chinatown/North Beach Campus do not identify any significant geology or soils impacts from those projects. Specifically, the 1998 EIR for the Chinatown/North Beach campus concluded that the direct and secondary results of both ground shaking and liquefaction would be reduced to acceptable levels with compliance to the existing California Building Code (CBC) regulations in force for the development of the campus. Thus, geologic impacts would be considered less than significant. The 1999 Addendum did not change these conclusions. Likewise, the Initial Study for the Mission Campus (incorporated into the 1998 EIR as an Appendix) concluded that adherence to requirements of the CBC and the lack of unique geologic features in the site indicated that impacts to geology and soils would be considered to be less than significant. At several of the other campuses, building strengthening is proposed that would help to reduce existing seismic hazards. For those reasons, there would be no combined geology or soils impacts from Citywide Master Plan development.

Mitigation

Individual building project geotechnical investigations would form the basis of the analysis of all site-specific design criteria. No mitigation is required.

Significance After Mitigation

Less than significant.

Geology-7 Cumulative Impacts

Impact

Geologic and soils impacts that are related to future development on the Main Campus could involve hazards related to ground shaking during earthquakes and site-specific soil conditions. With the exception of soil erosion, the site-specific impacts are not cumulative because the impacts on each site would not be common to or contribute to (or be shared with, in the additive sense) the impacts on other sites. Future use of the western part of the Balboa Reservoir is not known at this time, and analysis of potential impacts would be speculative. From a general standpoint, however, the reservoir itself and any potential uses constructed on top of it would be subject to geotechnical standards. Soil erosion from cumulative projects could increase turbidity and siltation in surface water bodies. However, runoff from the Main Campus and other construction projects in the City would be routed to the City's combined stormwater/wastewater treatment system.

Development of the Main Campus and other projects would be subject to uniform site development and construction standards relative to seismic risk, erosion potential, and other geologic conditions that are prevalent within the region. Therefore, the cumulative impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Significance After Mitigation

Less than significant.

G. CONCLUSION

Potential impacts related to liquefaction, slope failure, erosion, and expansive soils would be reduced to less-than-significant levels by the mitigation measures outlined in this section. All other potential impacts would be less than significant.

This page left blank intentionally.

Figure 4.7-1, Boring Locations p 21

Figure 4.7-2, Geologic Map p 23

Figure 4.7-3, Major Regional Faults p 25