8.0 GEOPHYSICAL CONDITIONS

This section addresses potential geologic, seismic, and geotechnical impacts of the proposed project. Information presented in this section is based on a technical study titled *Geotechnical Assessment for the Environmental Impact Report of the Proposed Redevelopment of Santa Barbara Cottage Hospital, City of Santa Barbara, California* prepared by Leighton Consulting, Inc., September 22, 2004 (Leighton 2004). The complete report is presented in Appendix E. This section also includes information from the Seismic Safety Element of the City General Plan. The Leighton report is based on a review of previous geotechnical studies of the site performed by Fugro West, Inc. (Fugro) and Geotechnical Professionals, Inc. (GPI).

8.1 GEOPHYSICAL CONDITIONS - IMPACT SIGNIFICANCE GUIDELINES

In accordance with the City of Santa Barbara's environmental review guidelines, project geologic and seismic impacts are significant if any of the following conditions result:

- Exposure to, or creation of, unstable earth conditions due to seismic conditions, such as earthquake faulting, ground shaking, liquefaction, or seismic waves.
- Exposure to, or creation of, unstable earth conditions due to geologic or soil conditions, such as landslides, settlement, expansive or compressible soils, or creation of substantial manufactured slopes.
- Extensive grading on slopes exceeding 20 percent, substantial topographic changes, or destruction of unique physical features.
- Substantial erosion of soils, overburden, or sedimentation of a water course.

In accordance with the City of Santa Barbara General Plan Seismic Safety Element, the impacts of the projects on geology and soils, or impacts to the projects due to geology and seismicity in the project area, are considered to be significant if implementation of the proposed project results in the following:

- In the event of a design earthquake, the most critical facilities, such as hospitals, do not remain standing and are not able to operate at peak efficiency.

8.2 GEOPHYSICAL CONDITIONS - METHODOLOGY

A geotechnical assessment was conducted for this EIR by Leighton Consulting, Inc., in accordance with guidelines for preparing geologic and environmental impact reports published by the California Geological Survey (CGS), formerly known as the California Division of Mines and Geology (CDMG) and in accordance with CEQA guidelines. The geotechnical assessment was conducted as follows:

- Review of available published and unpublished technical documents and reports, including consultant reports covering the known geologic and geotechnical conditions at the project site and vicinity. These data were analyzed with respect to the proposed redevelopment. The literature search also included a review and analysis of historical aerial photographs from numerous flights within the time period between 1972 and 1999. The references and aerial photographs reviewed are provided in the geotechnical report provided in Appendix E.

- Review of data collected during previous geologic and geomorphic surveys, and geotechnical studies of the site by Fugro and GPI. The Fugro studies included a geophysical survey, off-site field mapping, and the excavation of five sonic core drill holes and other geotechnical borings. Representative geologic data of the project site and vicinity were compiled on a geologic map by Fugro, provided herein as Figure 8.2. CGS has approved previous Fugro studies (Fugro 2003a, 2003b, and 2003c) with respect to the engineering geologic and seismic conditions in the location of the proposed Central Plant (CGS 2004).

Data obtained from the above mentioned sources were evaluated for potential impacts related to the geologic, seismic, groundwater, and soil engineering aspects of the site, and mitigation measures were formulated to reduce the potential impacts to less than significant levels.

8.3 GEOPHYSICAL CONDITIONS - REGULATORY FRAMEWORK

The City General Plan Seismic Safety Element (Page 28) states that the most critical facilities, such as hospitals, should not only remain standing in the event of a substantial earthquake, but should be able to operate at peak efficiency in the event of a disaster. The proposed new hospital buildings would incorporate standards for hospitals according to the Uniform Building Code (UBC), Office of Statewide Hospital Planning and Development (OSHPD), numerous other building and infrastructure mandates in State Senate Bill (SB) 1953, and the Alfred E. Alquist Hospital Facilities Seismic Safety Act (HSSA). The final authority to construct the new hospital buildings would be issued by OSHPD. Design and construction plans are undergoing concurrent review by OSHPD. The City Building and Safety Division has permitting authority over all nonhospital buildings and structures, including parking structures, child care buildings, parking lots, utilities, and landscaping.

➢ Uniform Building Code

The descriptions of proposed project activities and governing measures described in this section refer to the requirements of the 1997 UBC and the 2001 California Building Code (CBC) with Title 24 amendments (which is based on the UBC). Specific reference is made to those sections of the CBC dealing with seismic design and construction requirements for hospitals, including Chapter 16A, Structural Design Requirements, and Chapter 18A, Foundations and Retaining Walls. Adherence to the requirements of the CBC and UBC is assumed in this analysis to render less than significant any potential environmental impacts related to geology and soils that would otherwise expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death when the UBC or CBC directly address the prevention of those impacts through their standards and requirements.

➢ Senate Bill 1953

SB 1953 was intended to ensure that all licensed acute care hospitals are compliant with the HSSA by January 1, 2030, in order to be reasonably capable of providing services to the public after a major seismic event. The intent of SB 1953 is threefold: (1) to ensure that the expected earthquake performance of hospital buildings is disclosed to public agencies that need to know;

(2) to encourage structural retrofit or replacement of hospital buildings that have the potential for collapse in an earthquake; and (3) to encourage retrofit and enhancement of nonstructural systems.

By January 1, 2008, SBCH is required to use all buildings that pose potential risk of collapse for non-acute care hospital and would have to obtain an extension of time from OSHPD or the State legislature. If this deadline is not met, SBCH could be at risk of losing its State Operating License as a general acute care hospital. This deadline can be extended to January 1, 2013, if a hospital chooses to comply with the new standards by rebuilding its facility, as is being requested by SBCH. By January 1, 2030, SBCH is required to have all hospital buildings not in substantial compliance with the standards demolished, replaced, or changed to non-hospital use. SBCH proposes to comply with SB 1953 by demolishing and rebuilding all non-conforming buildings or converting them to non-acute care by January 1, 2013, as described in the project description of this EIR (Chapter 3.0). Compliance with the requirements of SB 1953 is assumed in this analysis to render less than significant any potential environmental impacts related to geology and soils that would otherwise expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, when SB 1953 directly addresses the prevention of those impacts through its standards and requirements.

All of the proposed structures would be required to adhere to the following applicable codes and standards:

- 2001 California Building Code with Title 24 Requirements
- 1997 Uniform Building Code
- American Concrete Institute (ACI) 318-99
- American Welding Society (AWS) D1.1, D1.4
- American Institute of Steel Construction, Inc. (AISC) American Steel Design (ASD)–Ninth Edition (1989)
- Title 24 Part 7, California Elevator Safety Construction Code
- Recommended Lateral Force Requirements and Commentary–Seismology Committee, Structural Engineers Association of California (SEAOC)—1999
- California State Interpretive Manual (IR Manual, Latest Edition)

Hospital buildings would be required to adhere to the following additional applicable codes and standards:

- SB1953, in accordance with the requirements for a new hospital building (Section 16B Division III)
- Special Hospital Design Requirements of the CBC (Chapter 16A and Chapter 18A)

8.4 GEOPHYSICAL CONDITIONS - EXISTING SETTING

8.4.1 PROJECT SITE GEOPHYSICAL CONDITIONS

The project site is located in the low-lying Santa Barbara coastal plain region, immediately east of Mission Creek near downtown Santa Barbara. Mission Creek originates from the local Santa Ynez Mountains to the north and flows through the alluvial plain southeast toward the ocean. The alluvial plain contains generally unconsolidated stream channel, flood plain, and fanglomerate deposits. Artificial fills are also present at the site as a result of previous site improvements. The Santa Barbara Formation bedrock is exposed in the coastal hill area to the south of the site. No active faults are known to be present on site, and the site is not in an Alquist-Priolo Earthquake Fault Zone. Santa Barbara Cottage Hospital (SBCH) is located on a relatively flat portion of the plain in an area that ranges from approximately 135–155 feet above mean sea level (msl).

8.4.2 SURROUNDING GEOPHYSICAL CONDITIONS

➢ Geologic Setting and Topography (Existing Conditions)

SBCH is located in the coastal plain region of southern Santa Barbara County, in the western Transverse Ranges Geomorphic Province (TRGP). The western TRGP consists of the east-west trending Santa Ynez Mountain Range and coastal lowlands, both of which are comprised almost entirely of late Cretaceous to Holocene age (11,000 to 200 million years old) marine and nonmarine sedimentary rocks and unconsolidated sediments. The coastal plain region of Santa Barbara County is a relatively flat alluvial plain area bounded by the Santa Ynez Mountains to the north and by the Santa Barbara Channel to the south. The low-lying coastal plain area contains younger and older surficial alluvial deposits. Older Miocene, Pliocene, and Pleistocene marine sedimentary rocks are exposed in the foothills of the Santa Ynez Mountains to the north and the coastal hills to the south and southwest. The TRGP is characterized by east-west trending landforms, such as mountain ranges, intervening valleys, and geologic faults and folds. The generally east-west trending Santa Ynez Fault and Mission Ridge Fault System have this characteristic east-west trend. The TRGP is crossed to the east by the northwest trending San Andreas Fault.

➢ Seismic Environment (Existing Conditions)

Southern California is a seismically active area subject to seismic hazards from numerous sources. The severity of the potential seismic hazards is related to the geology of the area, distance to the seismic source, and the magnitude of the earthquake generated by the seismic source. Principal seismic hazards include the potential for surface rupture along active or potentially active fault traces, the intensity of seismic shaking, and the potential for ground failure (such as liquefaction, lurching, and seismically induced slope failure).

➢ Fault Rupture (Existing Conditions)

A fault is a break in the earth's crust along which movement can take place, causing an earthquake. Fault rupture occurs when movement on a fault deep within the earth displaces the ground surface, causing a steep break along the fault (fault scarp). A fault rupture can cause damage to structures and expose people to a physical hazard within the vicinity of the fault. 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.

Under the Alquist-Priolo Act, the California Geological Survey (CGS) delineated Earthquake Fault Zones along active and potentially active faults. A fault is considered active if there is either directly observable or inferred evidence of movement along one or more of its segments in the last 11,000 years. A well-defined fault is one in which its trace can be clearly detectable by a trained geologist as a physical feature at or just below the ground surface. If a site is located within an Earthquake Fault Zone, a detailed fault investigation is required prior to construction. The project site is not located within an Alquist-Priolo Earthquake Fault Zone, and there are no active or potentially active faults known to cross the site. There are, however, active and potentially active faults within the region that create other fault-related seismic hazards, as described further below.

➢ Ground Shaking (Existing Conditions)

The probability that the site would be subject to strong seismic shaking from a moderate to large earthquake on a major active fault in the Santa Barbara region is high. The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, faulting mechanism, distance from the source (epicenter), and the response characteristics of the soils or bedrock units underlying the site. The California Building Code (CBC) specifies that probabilistically determined peak horizontal ground acceleration (PHGA) values are to be used in the design of structures. Two levels of ground motion are required for the design of structures: (1) the Design-Basis Earthquake ground motion (DBE), which is defined to have 10 percent chance of exceedance in 50 years (with a statistical return period of approximately 475 years) and (2) the Upper-Bound Earthquake ground motion (UBE), which is defined to have 10 percent chance of exceedance in 100 years (with a statistical return period of approximately 949 years). To check for structural collapse, seismic compression of alluvial soils, and liquefaction analysis, the UBE ground motion is used for hospitals and the DBE ground motion is used for nonhospital structures.

Another level of ground motion is the Maximum Considered Earthquake (MCE). The MCE ground motion is defined to have 2 percent chance of exceedance in 50 years, with a statistical return period of approximately 2,475 years. The MCE is generally used for seismic retrofit of older hospital facilities and older state-owned buildings. Table 8.A identifies the PHGA values for the design basis, upper bound and maximum considered earthquake event.

TABLE 8.A: PEAK HORIZONTAL GROUND ACCELERATION

Earthquake Event	Risk Of Exceedence	Return Period (Years)	PHGA in percent gravity (g)
Design Basis	10% in 50 years	475	0.49
Upper Bound	10% in 100 years	949	0.61
Maximum Considered	2% in 50 years	2,475	0.83

All structures in California are required to conform to the requirements of the current CBC. For hospitals, the CBC includes special versions of Chapter 16, *Structural Design Requirements*; and Chapter 18, *Foundations and Retaining Walls*. These special chapters are designated Chapters 16A and 18A, respectively. Among the special design provisions in Chapter 16A is the requirement that the building be designed to not collapse from the motions from an "upper bound earthquake."

The site is located within Seismic Zone 4 as delineated in the CBC. There are two seismic zones in California, Zone 3 and Zone 4. All coastal portions of California are within Zone 4. The zones are based on the expected peak ground accelerations in rock with a 10 percent probability of being exceeded in 50 years (same probability criteria as the Design Basis Earthquake). Zone 4 has the highest seismicity of the zones, with an expected peak ground acceleration of 0.3g or greater.

➢ Regional Active Faults (Existing Conditions)

California Geological Survey (CGS) requires identification of faults within 100 kilometers of a site that could affect the site or the proposed project. A listing of the active and potentially active faults within 100 kilometers is provided in Table 8.B. The major active and potentially active fault systems that could produce significant ground shaking at the site include the Mission Ridge, Red Mountain, Santa Ynez, and North Channel Slope Faults. The locations and distance of these faults with respect to the site are shown on the Regional Fault Map (Figure 8.1). Characteristics of these individual fault systems are discussed below.

North Channel Slope Fault. The North Channel Slope Fault, located about 6.5 miles (10.4 kilometers) south of the site, is an east-west trending reverse fault that extends approximately 60 kilometers in length (Peterson et al., 1996). This northern dipping reverse fault is an offshore fault located in the channel between the Channel Islands and the Santa Barbara coastline. The North Channel Slope Fault is estimated to be capable of generating a maximum earthquake of M_w 7.1.

Mission Ridge Fault Zone. The Mission Ridge Fault System (MRFZ) includes several fault segments that flank the coastal plain region of Santa Barbara. The three discontinuous east-west trending and south-dipping reverse fault segments that make up the Mission Ridge Fault Zone include the Arroyo Parida segment in the east, the Mission Ridge segment in the central region, and the Moore Ranch segment in the west. The Arroyo Parida segment extends approximately 37 kilometers west from its intersection with the San Cayetano Thrust Fault. The Mission Ridge segment, the closest segment to the site, extends east-west approximately 8 kilometers through the Santa Barbara urban corridor, and the Moore Ranch segment extends approximately 14 kilometers near the coast south of Goleta (Peterson et al., 1996). The MRFZ is approximately one mile (1.6 kilometers) north of the site. This fault system has an estimated maximum moment magnitude of M_w 6.7.

Red Mountain Fault. The Red Mountain Fault is located about 5.7 miles (9.1 kilometers) southeast of the site in the Santa Barbara Channel and extends approximately 39 kilometers to the east (Peterson et al., 1996). This northerly dipping reverse fault extends from the Ventura area offshore and into the Santa Barbara Channel. The Red Mountain Fault is estimated to be capable of generating a maximum earthquake of M_w 6.8.

TABLE 8.B: ACTIVE AND POTENTIALLY ACTIVE FAULTS WITHIN 100 KILOMETERS OF SBCH

	Approximate Distance[1]		Maximum Earthquake Magnitude
Fault Name	**Miles**	**Kilometers**	**Mw**
North Channel Slope	0.0[2]	0.0	7.1
Mission Ridge Arroyo Parida-Santa Ana	1.1	1.7	6.7
Red Mountain	3.8	6.1	6.8
Santa Ynez (West)	4.7	7.5	6.9
Santa Ynez (East)	6.0	9.6	7.0
Montalvo–Oak Ridge Trend	7.1	11.4	6.6
Channel Island Thrust (Eastern)	11.0	17.7	7.4
Ventura–Pitas Point	11.4	18.4	6.8
Oak Ridge (Blind Thrust Offshore)	17.9	28.8	6.9
Anacapa–Dume	22.9	36.8	7.3
Los Alamos–West Baseline	23.9	38.4	6.8
Big Pine	24.4	39.3	6.7
Santa Cruz Island	28.3	45.5	6.8
Santa Rosa Island	30.0	48.2	6.9
San Cayetano	31.6	50.8	6.8
Oak Ridge (Onshore)	32.1	51.6	6.9
Lions Head	34.5	55.6	6.6
Simi–Santa Rosa	34.7	55.9	6.7
Pleito Thrust	37.8	60.8	7.2
San Andreas–1857 Rupture	39.5	63.6	7.8
San Andreas–Carrizo	39.5	63.6	7.2
San Luis Range (S. Margin)	41.2	66.3	7.0
Casmalia (Orcutt Frontal Fault)	45.7	73.6	6.5
Malibu Coast	51.1	82.3	6.7
San Juan	51.4	82.7	7.0
San Gabriel	52.1	83.8	7.0
Garlock (West)	53.6	86.3	7.1
Northridge (East Oak Ridge)	54.5	87.7	6.9
White Wolf	54.6	87.9	7.2
Santa Susana	54.7	88.0	6.6
Holser	55.2	88.9	6.5
Los Osos	60.0	96.5	6.8
San Andreas–Cholame	61.3	98.7	6.9

1 Approximate distance to closest fault plane.
2 The North Channel slope fault surface expression is located 6.5 miles (10.4 kilometers) south of the project site in the Santa Barbara Channel, but the fault plane extends beneath the proposed project site.

Santa Ynez Fault. The Santa Ynez Fault is made up of two east-west trending reverse fault segments that extend approximately 130 kilometers along the Santa Ynez Mountains north of the Santa Barbara Cottage Hospital (Peterson et al., 1996). The western segment comes to within 6.0 miles (9.7 kilometers) of the site, and the eastern segment comes to within 6.8 miles (11 kilometers) of the site. The western segment of the Santa Ynez fault has an estimated maximum moment magnitude of M_w 6.9. The eastern segment has an estimated maximum moment magnitude of M_w 7.0.

➢ Geologic Materials (Existing Conditions)

Artificial Fill, Undocumented (Afu). Undocumented artificial fill is present at the site as a result of previous site improvements. This fill material consists of silty sand to sandy clay. Previous geotechnical investigations performed by Fugro West, Inc. (Fugro 2003b) identified approximately four feet (1.2 meters) of artificial fill near the surface in the vicinity of the project site. A geotechnical investigation of the proposed parking structures and day care facility (GPI 2004) identified up to 7.5 feet (2.3 meters) of fill at the proposed Pueblo parking structure site. There is no record or available documentation of the placement of this fill material.

Younger and Older Alluvium (Map Symbols: Qal, Qf_1, and Qf_{2-}). The surficial alluvium consists of stream channel deposits, alluvial fan deposits, and sediments that have been deposited in a floodplain environment. The alluvial units are broken into three separate units based on age and are shown on Figure 8.2. The youngest Holocene age alluvial unit (Qal) is found along the active Mission Creek to the west of the project site. The next younger Holocene to late Pleistocene age alluvial deposits (Qf_1) consist of unconsolidated floodplain and alluvial fan deposits. The near surface alluvial deposits in this region generally range in grain size from silt to gravel; however, the near surface alluvium on site consists primarily of interlayered silty sand, silty gravel, sandy clay, and clay. A fairly prominent conglomeratic layer of gravel to boulder size clasts in a matrix of predominately silty sand (fanglomerate) is also a part of Qf_1. The oldest unit is the late Pleistocene age (11,000 to 1 million years old) Alluvium (Qf_{2-}) that, in this region, generally ranges in grain size from silt to cobble and boulder. At the site, this earth unit is underlain by the younger alluvial deposits and generally consists of silty sands, silty gravels, sandy clays, and conglomeratic units of gravel to boulder in a matrix of silty sand, sand, and silt.

Santa Barbara Formation (Map Symbol: Qsb). The middle Pleistocene age (around 1 million years old) Santa Barbara Formation bedrock in this area is a shallow marine formation consisting primarily of massive to bedded sandstones and siltstones with occasional conglomerate beds. These rocks are typically tan to yellow and poorly to moderately consolidated. The Santa Barbara Formation is exposed in the coastal hills south of the project site (Figure 8.2).

➢ Geologic Structure (Existing Conditions)

The project site is located within the Santa Barbara Fold Belt (SBFB). The SBFB is an active linear belt of generally east-west trending folds and reverse faults located in the coastal plain of Santa Barbara and offshore in the Santa Barbara Channel. These folds and faults are the result of the ongoing crustal shorting across the western Transverse Ranges, which is associated with the right-slip and contraction in the vicinity of the "Big Bend" of the San Andreas fault. The

Mission Ridge Fault System and associated folds are the most prominent structural features within the SBFB.

➢ Subsidence (Existing Conditions)

In California, subsidence related to human activities has been attributed to withdrawal of subsurface fluids such as oil and groundwater. Ground surface effects related to subsidence can include earth fissures, sinkholes or depressions, and disruption of surface drainage. No oil fields or groundwater pumping wells are located within the general area of the site, and differential subsidence as a result of oil and water withdrawal has not been documented to have occurred in this area.

➢ Landslides (Existing Conditions)

Marginally stable slopes (including existing landslides) may be subject to landsliding caused by seismic shaking. The seismically induced landslide hazard depends on many factors, including existing slope stability, shaking potential, and the presence of existing landslides. There are no existing slopes on or directly adjacent to the project site. The site is located in an area designated as having a very low landslide potential (Bezore and Wills 2000).

➢ Liquefaction (Existing Conditions)

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: (1) shallow groundwater, (2) low-density fine clean sandy soils, and (3) high-intensity ground motion. Effects of liquefaction on level ground can include sand boils, settlement, and bearing capacity failures below structural foundations. No State of California Seismic Hazard Zone Maps for the Santa Barbara area are available at this time. The Seismic Safety Element of the City General Plan indicates that the project site is not located within an area susceptible to liquefaction. Previous evaluations of portions of the site concluded that there is low potential for liquefaction at the site of the proposed Central Plant (Fugro 2003a) and the location of the proposed parking structures and child care center (GPI 2004). Comprehensive liquefaction studies have not yet been performed for the remainder of the SBCH site, though available data suggests that the liquefaction potential is low.

➢ Perched Groundwater (Existing Conditions)

Perched groundwater is a zone of saturation above the normal water table in an area. Perched groundwater can occur as a result of precipitation in the immediate vicinity or by percolation from nearby surface water. LeRoy Crandall and Associates (LCA 1982) reported that groundwater at the site was at 56 feet below ground surface in June 1982 and varied only about one foot from that elevation between 1979 and 1982. However, perched groundwater conditions were encountered locally at higher elevations (21-41 feet below surface) (LCA 1982, Fugro 2003b, and GPI 2004).

➢ Settlement (Existing Conditions)

Strong ground shaking can cause settlement by densification of loose to moderately dense soils. Seismically induced settlement can occur in dry soils, in partially saturated soils, and in saturated soils as a consequence of liquefaction. Unconsolidated soils are present on site.

➢ Soil Engineering Characteristics (Existing Conditions)

Corrosive Soils. Corrosive soils contain chemical constituents that may cause damage to construction materials such as concrete and ferrous metals. One such constituent is water-soluble sulfate, which, if high enough in concentration, can react with and damage concrete. Initial laboratory test results on a limited number of samples from the project site (Fugro 2003a) indicate the soils are below the minimum sulfate concentration considered by the CBC 2001 to be potentially damaging. Electrical resistivity, chloride content, and pH level are indicators of the soil's tendency to corrode ferrous metals. Initial laboratory test results on a limited number of samples from the project site (Fugro 2003a) indicate that the soils are at least mildly corrosive to ferrous metals.

Oversized Rock. A fanglomerate is composed of heterogeneous materials originally deposited in an alluvial fan that have been cemented into solid rock. A fairly prominent fanglomerate exists in the project area that contains numerous oversized boulders that would be encountered during excavations. Oversized rock is defined as rock fragments over about eight inches in diameter, though the oversized rock within the fanglomerate should be expected to be up to five feet in size (Fugro, 2003b). Rocks over eight inches in diameter are generally not considered suitable fill material and often require crushing or off-site disposal.

Compressible Soils. Alluvium and uncompacted fills are present on site and range from slightly to moderately compressible. Uncompacted fills are not suitable for support of fills or structures and can often contain trash and debris. Alluvial soils are generally suitable for fill provided organics and other deleterious materials are removed.

Expansive Soils. Soils expand and shrink with changes in their moisture content. Some clayey soils are expansive, while sandy soils are generally nonexpansive. In expansive soils, the volume changes with moisture content are significant and can cause damage to the structures, including cracking, heaving, and buckling of the foundations and differential movement in the building, resulting in damage to floors and walls. The on site alluvial soils contain variable amounts of clay with an expansion potential ranging from low to medium (Fugro 2003d and GPI 2004).

Erosion. Erosion is most prevalent in unconsolidated deposits such as alluvium and colluvium, which are prone to rills, sheet wash, and slumping and bank failures during and after heavy rainstorms. The site is currently developed with buildings, hardscape, and landscaping so the affected soils are not currently exposed.

➢ Mineral Resources (Existing Conditions)

Petroleum. Oil exploration and production has occurred in the Santa Barbara Channel region for hundreds of years. The onshore Mesa Oil Field is located to the south of the project site (Yerkes et al. 1969). However, no occurrences of oil production are known to have existed on the project site.

8.5 GEOPHYSICAL CONDITIONS - PROJECT FEATURES

The proposed new hospital buildings would incorporate standards for hospitals according to the UBC, OSHPD, and numerous other building and infrastructure mandates in SB 1953 and the

HSSA. Adherence to the design codes would minimize or avoid potential impacts from geophysical elements.

PF 8-1 Structural Design Elements—Hospital Buildings. All new hospital buildings would be designed in accordance with the special provisions for hospitals as described in Chapters 16A and 18A of the CBC to ensure that the new hospital buildings meet the seismic performance criteria set forth in SB 1953. The structural design elements of the proposed hospital buildings are described below.

- *Gravity Framing System.* The construction of the proposed hospital structures would be primarily structural steel. Gravity framing for the proposed Central Plant, Inpatient, and Diagnostic and Treatment buildings would consist of three-inch metal decks with varying thickness of light weight or normal weight concrete fill floor system. The decks would span to structural steel wide flange beams and girders. Bay size would range from 25 to 34 feet and floor-to-floor heights would range from 15 to 33 feet. The Diagnostic and Treatment Buildings would have a basement with a floor-to-floor height of 17 feet and the Central Plant would have a basement with a floor-to-floor height of 24 feet. All basements would consist of perimeter concrete walls. The roof level of the buildings would house heating and cooling equipment.
- *Lateral Force Resisting System.* The lateral force resisting system for the proposed hospital buildings would consist of steel Special Concentric Braced Frames (SCBF) in both of the principal directions. The SCBF configurations would vary from one bay to two bays, and the braced frames would be configured to be continuous from the foundation level to the roof. Three types of braced frame configurations would be used for the project: x- braces, chevron braces, and diagonal braces. The basement walls of the Diagnostic and Treatment Building and the Central Plant would behave as shear walls to transfer the lateral loads down to the foundations.
- *Foundations.* The foundation system for hospital structures would consist of individual concrete spread footings below the gravity framing columns and continuous concrete grade beam footings below the braced frames and basement walls.

PF 8-2 Structural Design Elements—Non-Hospital Buildings. All proposed non-hospital buildings (Knapp parking structure, Pueblo parking structure, and child care buildings) would be designed using materials and structural elements to ensure the new buildings meet the seismic performance criteria set forth in the 2001 CBC. The structural design elements of the non-hospital buildings are described below.

- *Parking Structures.* The proposed parking structures would be constructed using the long-span 36-inch-deep Cunningham beam system of reinforced concrete and post tensioning. The gravity system would consist of reinforced columns and foundations. The beams and concrete slabs would be post-tensioned, reinforced moment frames. The lower level of the structure would consist of a reinforced concrete slab with perimeter retaining walls constructed of reinforced concrete masonry or shotcrete. The exterior walls and foundations would extend to a maximum depth of 18 feet below the finished exterior ground level.
- *Child Care Center.* The proposed child care center would consist of three one-story structures of masonry or wood-frame construction. The foundations would consist of a concrete slab-on-grade at or near the existing ground elevation.

8.6 GEOPHYSICAL CONDITIONS - LONG-TERM IMPACTS

8.6.1 PROJECT LONG-TERM GEOPHYSICAL IMPACTS

➢ Fault Rupture Impacts (Project Long-Term)

Fault rupture typically occurs along known active faults. Fault ruptures can cause significant structural damage to structures and persons within the fault rupture zone. The nearest known active or potentially active fault is the Mission Ridge Fault Rupture Zone, located approximately one mile (1.6 km) to the north of the site. The Mesa Fault is located approximately 0.5 mile southwest of the project site; however, this fault is not considered active and is not likely to be subject to an earthquake causing fault rupture. The proposed project is not located in an area delineated on the Alquist-Priolo Earthquake Fault Zoning maps or within a fault known to be capable of rupture on site. All previous geotechnical evaluations of the site concur that the proposed project area would not be subjected to ground rupture due to seismic activity from an active fault (Leighton 2004, Fugro 2003a, and GPI 2004). ***The potential impact of surface rupture on the project site is less than significant.***

➢ Ground Shaking Impacts (Project Long-Term)

The hazard posed by seismic shaking in the project area is considered to be high, due to the proximity of known active faults capable of generating strong ground motions. Strong seismic shaking can cause the collapse of structures, buckling of walls, and damage to foundations. Structural damage caused by seismic ground shaking is a potentially significant impact. Most areas of California are subject to significant hazards from seismic shaking. The exposure of the project site to future ground shaking is no greater than at other sites in the vicinity or in other parts of California. It is not considered to be reasonably feasible to make structures totally resistant to seismic shaking. However, current building codes require that structures, especially hospitals, survive moderately large ground shaking and not collapse even under severe ground shaking. The effects of ground shaking on structures can be reduced through conformance with the recommendations of the geotechnical engineer and geologist for the project, conformance with the CBC, particularly Chapters 16A and 18A, as previously discussed, and/or other local governing agencies' codes or requirements. In addition, Mitigation Measures GEO-2 and GEO-3, requiring geotechnical evaluation, implementation of soil stabilization measures, and monitoring during construction. ***With these measures potential ground shaking impacts would be reduced to a less than significant level.***

➢ Liquefaction Impacts (Project Long-Term)

The project site is underlain by alluvium, which may be susceptible to liquefaction, and Fugro (2003a) has identified potentially liquefiable layers at the site of the proposed central plant. However, these layers are expected to be above the level of the central plant foundations and therefore would not affect the foundation of the structure. CGS has reviewed the Fugro reports and concurs that the liquefaction potential at the central plant site is low. A geotechnical investigation of the proposed parking structures and child care center concluded that the potential for liquefaction is low in the areas where those structures are proposed (GPI 2004). However, the potential for liquefaction in other areas of the site has not been assessed and require further evaluation as confirmed by CGS (CGS, 2004b). Liquefaction can cause sand boils, settlement, and bearing capacity failures below structural foundations. Therefore, seismic-related ground failure caused by liquefaction is a potentially significant impact. ***Adherence to the CBC and SB 1953 requirements for new buildings, combined with geotechnical evaluation, implementation of soil stabilization measures, and monitoring during construction as described in Mitigation Measures GEO-2 and GEO-3 would reduce the potential for seismic-related ground failure created by liquefaction to a less than significant level.***

➢ Settlement Impacts (Project Long-Term)

The soils at the site are generally dense. However, significant seismic settlement can occur as a consequence of liquefaction. Liquefaction can cause ground failure, damage to structures, and foundation instability. Structural damage caused by settlement due to liquefaction is considered a potentially significant impact. ***Mitigation Measures GEO-2 and GEO-3, requiring geotechnical evaluation, implementation of soil stabilization measures, and monitoring during construction, would reduce the potential for structural damage to the proposed project created by settlement to a less than significant level.***

8.6.2 PROJECT LONG-TERM GEOLOGIC IMPACTS

➢ Landslide Impacts (Project Long-Term)

The project site is located in a low-lying alluvial plain with no moderately steep slopes on or surrounding the site. The site is located in an area designated as having a very low landslide potential (Bezore and Wills 2000). ***The potential impact from seismically induced landslides is less than significant***. No significant impact would be created, and no mitigation is required.

➢ Mudslide Impacts (Project Long-Term)

The surrounding area is developed and surface drainage is collected in a municipal storm drain system. ***There are no steep slopes or areas susceptible to mudslides in the surrounding area, and the potential impact from mudslides is less than significant***. No significant impact would be created, and no mitigation is required.

➢ Perched Groundwater Impacts (Project Long-Term)

The basement level of the proposed Central Plant and the proposed Pueblo parking structure would extend below elevations of previously encountered perched groundwater. Perched groundwater may also be encountered at the basement levels of the remainder of the proposed hospital buildings. Groundwater at the basement levels of buildings can cause seepage into structures, foundation instability, and corrosion of construction materials. Seepage and structural damage caused by perched groundwater at the basement level of proposed structures is a potentially significant impact. ***Permanent dewatering systems, or hydrostatic design for subterranean walls, according to recommendations in final geotechnical reports and as described in Mitigation Measure GEO-2 would reduce potential long-term impacts due to groundwater to less than significant levels.***

- **Corrosive Soil Impacts (Project Long-Term)**

Corrosive soils contain constituents or physical characteristics that attack concrete (water soluble sulfates) and/or ferrous metals (chlorides, ammonia, nitrates, low pH levels, and low electrical resistivity). Corrosive soils could potentially create a significant hazard to the project by weakening the structural integrity of the concrete and metal used to construct the building and could potentially lead to structural instability. Structural damage and foundation instability caused by corrosive soils is a potentially significant impact. Preliminary laboratory tests performed by Fugro (2002 and 2003a) for the proposed Central Plant facility and by GPI (2004) for the proposed parking structures and child care center indicate that the on-site soils have a negligible sulfate content and have a low potential to corrode ferrous metals. However, because preliminary testing was performed on a limited number of samples, there is not sufficient technical information to conclude that all of the soils at the site have a low corrosive potential. Further testing is required to safely conclude that the corrosion potential of the soils at the site is low. ***Mitigation Measure GEO-1, requiring a comprehensive corrosion analysis and implementation of corrective measures if corrosive soils are encountered, would reduce the potential long-term impacts of structural instability due to corrosive soils to a less than significant level.***

- **Oversized Rock Impacts (Project Long-Term)**

A fairly prominent fanglomerate exists in the project area that contains numerous oversized boulders that are expected to be up to five feet in diameter. Oversized rock is generally not suitable for use as a foundation in compacted fill soils and could cause structural damage and foundation instability if not properly mitigated. Structural damage and foundation instability caused by oversized rock in compacted fill areas is a potentially significant impact. ***The special handling of oversized rock as described in the final geotechnical reports, combined with geotechnical monitoring during construction as described in Mitigation Measures GEO-2 and GEO-3 would reduce potential long-term impacts related to oversized rock to a less than significant level.***

- **Compressible Soil Impacts (Project Long-Term)**

Alluvium and uncompacted fills are present on site and range from slightly to moderately compressible. Uncompacted fill and alluvial soils containing deleterious and organic material are not suitable for use as a foundation and could cause structural damage and foundation instability if not treated properly during construction, and is a potentially significant impact. ***Additional geotechnical investigation in areas not previously evaluated, removal of uncompacted fill soils down to competent native soils, and removal of deleterious organic materials from alluvial soils prior to use as fill combined with geotechnical monitoring, as described in Mitigation Measures GEO-2 and GEO-3, would reduce potential long-term impacts related to compressible soils to a less than significant level.***

- **Expansive Soil Impacts (Project Long-Term)**

The alluvium at the site contains variable amounts of clay and generally ranges in expansion potential from low to medium (Fugro 2003d and GPI 2004). Expansive soils could cause structural damage and foundation instability if not treated properly during construction and is a potentially significant impact***. Mitigation Measures GEO-2 and GEO-3, which require***

additional on-site investigation and the remedial treatment of expansive soils, combined with geotechnical monitoring, would reduce the potential long-term impacts related to expansive soils to a less than significant level.

8.6.3 LONG-TERM GEOPHYSICAL MITIGATION MEASURES

GEO-1 Corrosion Analysis. When final rough grades have been achieved on site, a qualified corrosion specialist shall perform a site-specific corrosion analysis to determine whether potentially adverse concentrations of sulfates or other corrosive constituents are present. Corrosion analysis is required in all areas not previously evaluated for corrosion potential, which includes the remainder of the site outside of the proposed Central Plant facility (Fugro 2002 and Fugro 2003a), the proposed parking structures, and the child care center (GPI 2004). The corrosion specialist shall summarize the results of the corrosion analysis in a letter report addressed to SBCH and the City Building and Safety Department and shall recommend corrective measures consistent with the California Building Code to mitigate any identified corrosion potential. Measures may include, but are not limited to, requiring sulfate-resistant cement, decreasing the water/cement ratio, designing the concrete mix for a higher compressive strength, and cathodic protection of metals. SBCH shall ensure that the corrosion analysis and identified corrective measures are implemented during each phase of the project prior to the construction of structures on site.

GEO-2 Final Geotechnical Investigations. Prior to the issuance of grading permits for Phase I (SBCH Phases 2A and 2B specifically), SBCH shall incorporate all recommendations in previously prepared final geotechnical reports for the proposed project into final grading and design plans to be submitted to and approved by OSHPD, CGS, and the City Building and Safety Department, as required. Previous final geotechnical reports include the *Fugro West Inc. Geotechnical Reports for the Proposed Central Plant* (Fugro 2002, 2003a,b,c,d), and the *Geotechnical Professional, Inc. Geotechnical Investigation of the Proposed Parking Structures and Daycare Facility* (GPI 2004).

Recommendations in the previous final geotechnical reports shall be incorporated into final grading and design plans for the proposed project. Recommendations from these reports include, but are not limited to:

- Oversized rock shall be removed from soil excavated from the site or shall be reduced to acceptable size for use in fill material
- Uncompacted fill soils shall be removed down to competent native soils prior to construction
- All organics and other deleterious materials shall be removed from on-site alluvial soils prior to use as fill
- Expansive soils shall be excavated from the site or treated accordingly
- Construction dewatering parameters, permanent dewatering systems, or hydrostatic design for subterranean walls shall be implemented

Prior to the issuance of grading permits for Phases II and III (SBCH Phases 3, 4, 5, and 6), SBCH shall submit final geotechnical investigation(s) of the project prepared by a qualified geotechnical engineer to OSHPD, CGS, and the City Building and Safety Department, as required, for all areas not covered by previous final geotechnical reports. Additional final geotechnical report(s) shall evaluate potential geotechnical hazards for all areas of the project not specifically addressed in previous final geotechnical reports (areas outside of the proposed Central Plant, parking structures, and child care center) and should, at a minimum, specify the treatment of the following hazards in detail: liquefaction, perched groundwater, oversized rock, expansive and compressible soils, corrosive soils, settlement, and slope stability during construction.

GEO-3 Geotechnical Monitor. A qualified geotechnical monitor shall be present during each phase of grading and construction of the project to ensure that on-site conditions are as anticipated in the final geotechnical report(s) and that construction methods conform to recommendations made in the report(s). The monitor shall test and observe soil conditions and shall submit these observations in regular reports to the City Building and Safety Department and SBCH. The monitoring reports shall include suggested modifications to the recommendations made in the geotechnical report based on observed field conditions.

8.6.4 SPECIFIC PLAN LONG-TERM GEOPHYSICAL IMPACTS

Because geology is regionally influenced, geology and soils impacts for the long term operation of future potential development allowed under the Specific Plan (SP-8) would essentially be the same as the proposed project. ***Any new buildings would be required to meet the same seismic safety standards described above, and similar mitigation measures would apply in order to reduce potentially significant geologic impacts to less than significant.***

8.6.5 CUMULATIVE LONG-TERM GEOPHYSICAL IMPACTS

The area considered for cumulative geophysical impact analysis is the Santa Barbara coastal plain. Implementation of the proposed project involves the demolition and reconstruction of existing hospital buildings and facilities to improve the seismic integrity of the hospital in accordance with State Senate Bill 1953. The constructed structures would meet or exceed all applicable regulatory standards and building codes for seismic safety. The modification of the area when compared to the overall configuration of the Santa Barbara coastal plain would not yield a cumulatively significant impact. The project's influence on geology and soils does not extend beyond the project boundaries. There are no other projects in the vicinity that could reasonably combine cumulatively to result in significant impacts. ***The proposed project, in combination with other projects or conditions, would not create cumulative impacts with regard to geology and soils, and no additional mitigation is required.***

8.7 GEOPHYSICAL CONDITIONS - CONSTRUCTION IMPACTS

8.7.1 PROJECT CONSTRUCTION GEOLOGIC IMPACTS

➢ Slope Instability Impacts (Project Construction)

Grading for the project would consist of overexcavation of the existing site material for the construction of building foundations, basements and underground utilities. A prolonged heavy rainfall, seepage from shallow ground water, or seismic shaking could potentially cause slope or side-wall failure in temporary excavations during construction. Slope instability during site grading and excavation is a potentially significant impact. Incorporating excavation and shoring safety practices as described in ***Mitigation Measure GEO-4 below would reduce potential impacts related to slope instability during construction to less than significant levels.***

- **Perched Groundwater Impacts (Project Construction)**

Excavation for the basement level of the proposed Central Plant and the Pueblo parking structure would extend below elevations of previously encountered perched groundwater. Excavation during construction of the remainder of the proposed medical buildings could also extend below perched groundwater levels. Groundwater encountered during construction can delay or stop construction if not removed. Delays caused by groundwater encountered during construction is a potentially significant impact. Dewatering according to the recommendations of a geotechnical engineer combined with monitoring during construction, as described in ***Mitigation Measures GEO-2 and GEO-3, would reduce potential impacts due to groundwater during construction to less than significant levels***.

- **Erosion Impacts (Project Construction)**

The site is currently developed with either buildings, hardscape, or landscaping, and the on-site soils are not exposed. However, the on-site soils would be locally exposed during various phases of the proposed construction and would potentially be subject to erosion. Because project construction would occur in phases, exposure of soils to erosion would be minimal and substantial erosion is not expected to occur at the site. However, construction activity on site would be subject to the provisions of the General Construction Permit as part of the National Pollutant Discharge Elimination System Program as discussed in Chapter 10.0 of this EIR. ***Mitigation Measures HYD-1 and HYD-2, which require implementation of construction site Best Management Practices specified in an Erosion Control Plan and a Storm Water Pollution Prevention Plan (SWPPP), would reduce any potential impacts related to soil erosion during construction to a less than significant level.***

8.7.2 PROJECT CONSTRUCTION GEOPHYSICAL MITIGATION

GEO-4 Excavation and Shoring Safety. Prior to construction, a qualified geotechnical engineer shall evaluate the site and provide parameters for use in the planning and design of shoring and temporary sloped excavations. During excavation, the geotechnical engineer shall observe the excavation and provide supplementary/revised recommendations as necessary. The geotechnical engineer shall provide monthly reports summarizing site evaluations and any remedial actions taken by SBCH, the City Building and Safety Department, and the Construction Contractor.

Prior to construction, the contractor shall retain a structural engineer to design any shoring that may be required. The shoring design shall be submitted to the geotechnical engineer for review for conformance with the geotechnical engineer's recommendations. The installation of the shoring and any testing required shall be performed by the Construction Contractor under the observation of the geotechnical engineer.

Prior to construction, the contractor shall determine the need for dewatering and, if dewatering is necessary, install and confirm the satisfactory operation of a dewatering system. The contractor shall survey the adjacent streets prior to and during dewatering operations. If excessive settlement of the streets occurs, the contractor shall arrange for design and implementation of appropriate mitigation measures.

All construction activity shall follow site safety requirements as specified by the Occupational Safety and Health Administration (OSHA) in Section 29 CFR Part 1926. The contractor shall be solely responsible for site safety. Any unsafe construction activity or hazardous conditions reported to the Construction Contractor shall be remediated immediately by the Construction Contractor or by the responsible parties under the direction of the Construction Contractor.

8.7.3 SPECIFIC PLAN CONSTRUCTION GEOPHYSICAL IMPACTS

The potential slope stability, groundwater and erosion project-specific impacts described above would apply also to potential future development allowed by the Specific Plan. ***The mitigation measures prescribed for the proposed project would reduce such impacts upon the proposed structures to less than significant, including those facing Bath Street where a future nursing pavilion could be developed.***

8.7.4 CUMULATIVE CONSTRUCTION GEOPHYSICAL IMPACTS

The area considered for cumulative impact analysis is the Santa Barbara coastal plain. Implementation of the proposed project involves the demolition and reconstruction of existing hospital buildings and facilities to improve the seismic integrity of the hospital in accordance with State Senate Bill 1953. The constructed structures would meet or exceed all applicable regulatory standards and building codes for seismic safety. The modification of the area when compared to the overall configuration of the Santa Barbara coastal plain would not yield a cumulatively significant impact. The project's influence on geology and soils does not extend beyond the project boundaries. There are no other projects undergoing construction in the vicinity that could reasonably combine cumulatively to result in significant impacts. ***Therefore, the proposed project, in combination with other projects or conditions, would not create cumulative construction geophysical impacts with regard to geology and soils, and no related mitigation is required.***

8.8 <u>SUMMARY OF GEOPHYSICAL IMPACTS</u>

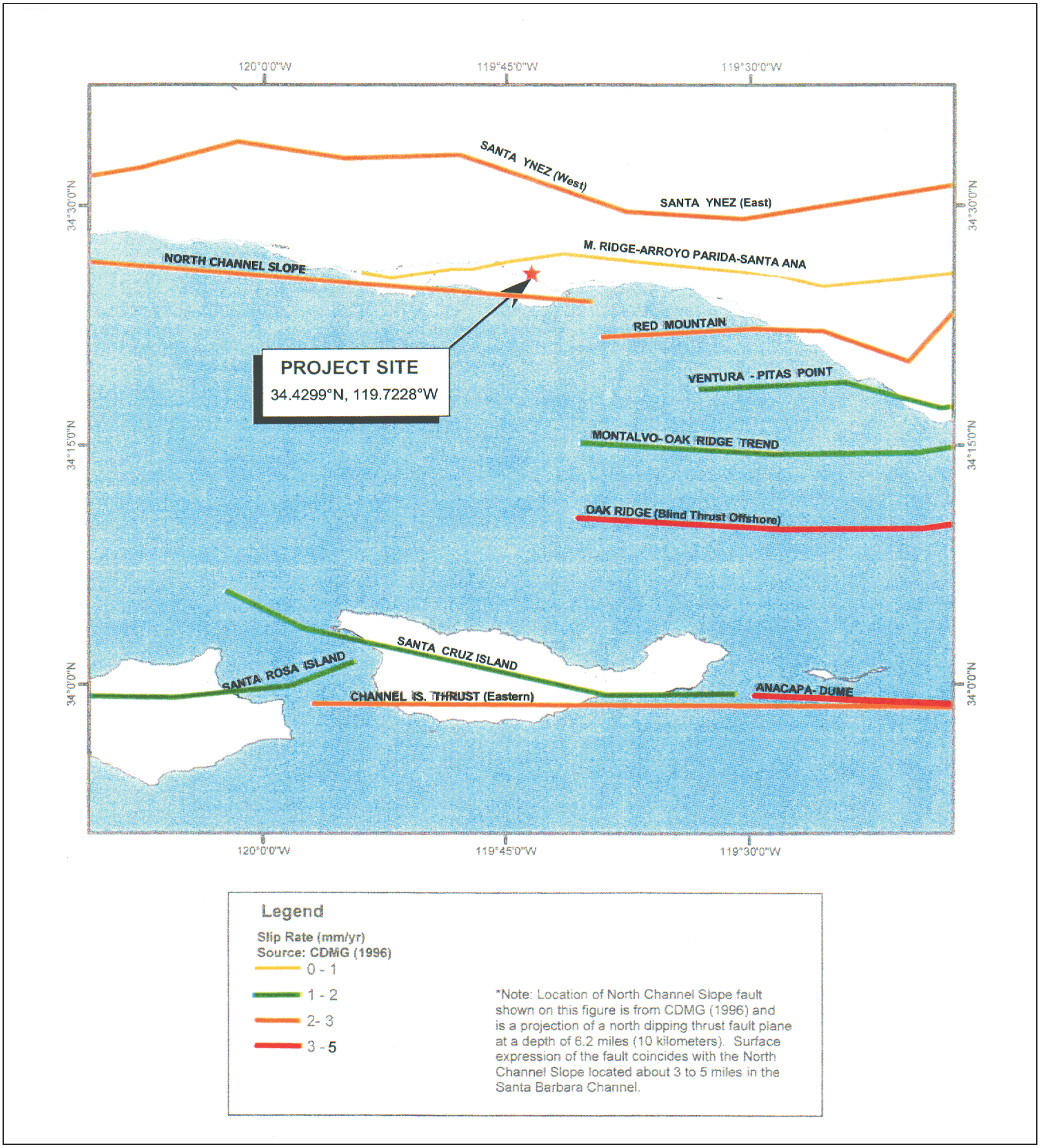
The proposed project and potential future reconstruction as allowed under the Specific Plan have the potential to result in the following long-term geophysical impacts:

- Exposure to or creation of unstable earth conditions due to seismically induced groundshaking, liquefaction, or settlement.
- Exposure to or creation of unstable earth conditions due to geologic or soil conditions, such as perched groundwater, corrosive soils, oversized rock, and compressible and expansive soils.

The proposed project and potential future reconstruction as allowed under the Specific Plan have the potential to result in the following temporary construction geophysical impacts:

- Exposure to or creation of unstable earth conditions due to geologic or soil conditions, such as slope instability during construction, perched groundwater, and erosion.

Conformance with special design criteria in the CBC combined with the geophysical mitigation measures prescribed in this chapter (Mitigation Measures GEO-1 through GEO-4), which require implementation of shoring and safety practices during construction, additional geotechnical investigation in areas not previously studied, soil stabilization and dewatering measures incorporated into the final grading plans, and geotechnical monitoring during construction, would reduce geophysical impacts associated with implementation of the proposed project to less than significant levels.



LSA

FIGURE 8.1

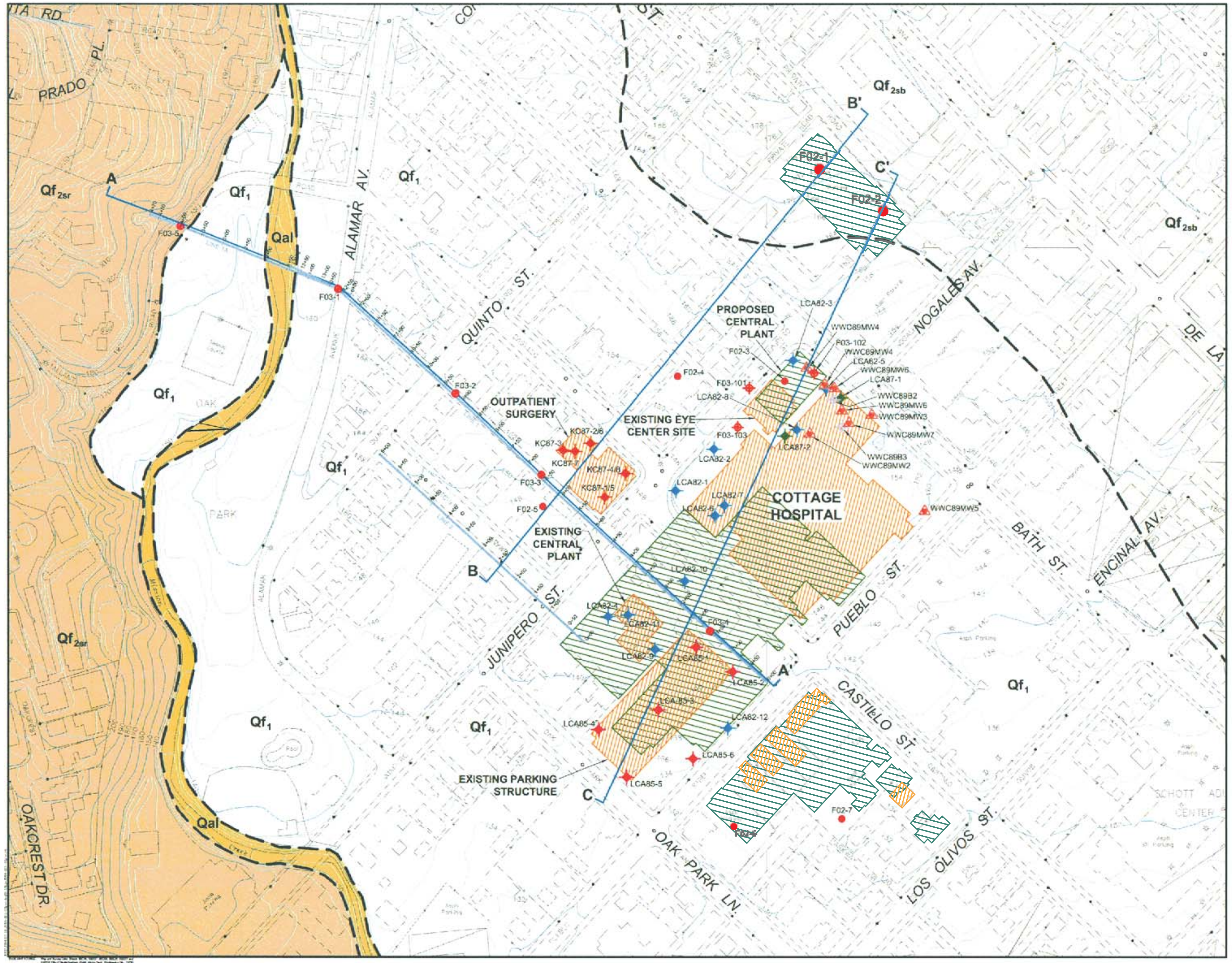
Santa Barbara Cottage Hospital
Seismic Compliance and Modernization Plan

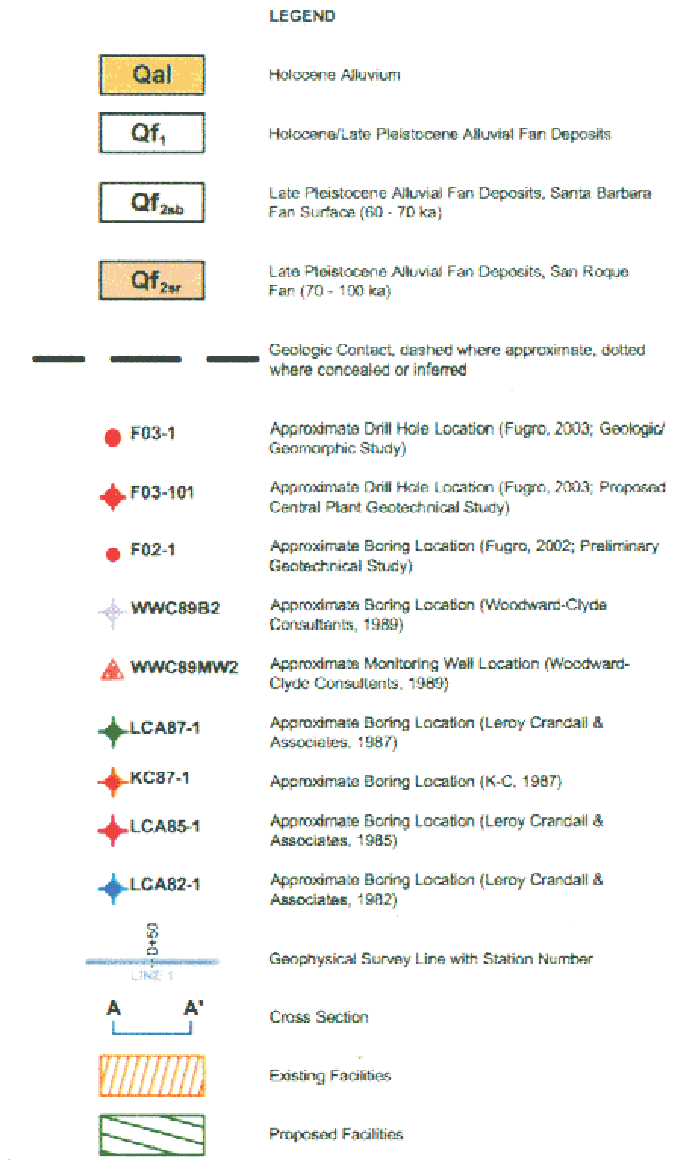
Regional Fault Map

0 5 10
MILES

SOURCE: Leighton Consulting, Inc. (7/2004)

I:\CSB430\G\Fault_map.cdr (9/17/04)





* ***NOTE: Please Refer to Fugro West, Inc. Report Dated March 28, 2003, (Volume 1), for the Cross-Sections, Boring Logs, and Geophysical Surveys Shown on this Map.***

LSA

FIGURE 8.2

0 150 300 FEET

Santa Barbara Cottage Hospital
Seismic Compliance and Modernization Plan
Geotechnical Map

SOURCE: Leighton Consulting, Inc (7/2004)

I:\CSB430\G\cottcb_map.cdr (9/17/04)