E. GEOLOGY

Existing Conditions

Geologic Units and Structure

The Project site is located in Century City, which is situated on the southern side of the Santa Monica Mountains near the intersection of two geologic provinces: the Transverse Ranges and the Peninsular Ranges. The Santa Monica Mountains and associated east-west trending "frontal fault system" (including the Malibu, Santa Monica, Hollywood, and Elysian Park faults) form the southern boundary of the Transverse Ranges geologic province. The Transverse Ranges are named for this east-west trend, which is 'transverse' to the dominant northwest-southeast trending mountain ranges in the region.

The site is located within the northernmost portion of the geologic area known as the Los Angeles Basin (Basin). A thick sequence (several thousand feet) of Tertiary age sedimentary rocks underlies this portion of the Basin.[21] From oldest to youngest, these rocks are represented by the Topanga Formation, Monterey Formation (also known as the lower Modelo Formation), Modelo Formation, and Fernando Formation (Dibblee, 1991; Lamar, 1970). Each formation is comprised of rock layers alternating between sandstone, conglomerate and siltstone.

Erosion of Tertiary rocks resulted in the formation of relatively flat areas in the Basin. Deposition during Quaternary (Recent and Pleistocene) time covered these geologic structures with alluvial deposits from local mountains.[22] Beneath the surface these older alluvial deposits (Qoa) merge with the Upper Pleistocene Lakewood Formation, and reach a thickness of approximately 40 feet or more in the Project area (Department of Water Resources (DWR), 1961). DWR (1961) designates surface exposures at the site as Lakewood Formation. Younger surficial alluvial deposits (Qa of Dibblee, 1991) are found immediately west of the site. These younger deposits range in thickness from 5 to 35 feet and are composed of primarily unconsolidated and uncemented gravels, sands, silts, and clays (DWR, 1961).

The Lakewood Formation is an aquifer at depth.[23] Its initial layers are composed of upper Pleistocene older alluvium. The Lakewood Formation consists of primarily unconsolidated discontinuous gravel and sand layers, interbedded with silt or clay layers. The Exposition Aquifer, present in the upper (shallow subsurface) part of the Lakewood Formation, is comprised of sand and gravel beds, which are separated by silt and clay deposits.

Soils at the Project site have been modified and disturbed during excavation associated with construction of the subterranean parking structure. It is unlikely that undisturbed native soils are present at the site.

Stratigraphy

In October, 2001, Law Crandall (**Appendix 7**) conducted a report of geotechnical consultation for the proposed development at the Project site. Subsequently, a report of geologic-seismic hazards

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21 Geologic time since the formation of the Earth is divided into several periods each of which is characterized by the formation of a distinctive rock system. The Tertiary Period began approximately 65 million years before present and ended approximately 1.6 million years before present.

22 The Quaternary Period began approximately 1.6 million years before present and extends to the present day. Geologic periods are divided into epochs, each of which is characterized by the formation of a distinctive rock system. The Pleistocene Epoch formed the earlier part of the Quaternary Period and extended from approximately 1.6 million years to 11,000 years before present. The Recent Epoch, also known as the Holocene Epoch, formed the latter part of the Quaternary Period, began at the end of the last Ice Age, and has extended from approximately 11,000 years before present to the present day.

23 California Department of Water Resources (DWR), 1961. Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County, Appendix A, Ground Water Geology. Bulletin No. 104.

evaluation was prepared by LAWGIBB Group (November 2001) (**Appendix 7**) for the subject property.

Thirty-seven borings were drilled as part of prior investigations conducted at the site in 1967 and 1969. The borings indicated that artificial fill materials had mantled and were removed during the construction of the existing buildings and the parking garage. The Project site is primarily underlain by Pleistocene age alluvial deposits (California Division of Mines and Geology, 1998). Alluvial deposits below the parking garage are primarily fine sand with varying amounts of gravel and cobbles. Pleistocene age alluvial deposits were found 50 to 85 feet thick and are underlain by approximately 650 feet of Pleistocene age sediments of the San Pedro Formation. The San Pedro Formation is underlain by Tertiary age sedimentary rocks estimated to extend to a depth of 13,000 feet beneath the site (Yerkes, 1965; California Department of Water Resources, 1961; Poland, 1959). Cemented layers up to five feet in thickness were encountered at various depths.

Groundwater

The Santa Monica Mountains represent the northern boundary of the Los Angeles County Coastal Plain. Along the base of the Santa Monica Mountains, Quaternary sedimentary layers are faulted and folded. East of the Project area, sedimentary layers are folded downward into a geologic structure known as the Hollywood Syncline. East of the Newport-Inglewood fault zone, this syncline forms the Hollywood Basin, a groundwater basin parallel to the Santa Monica Mountain front. The Santa Monica Basin extends from the Pacific Ocean, east to the Newport-Inglewood fault zone and from the Santa Monica Mountains south to the Ballona Escarpment (DWR, 1961). The Project site overlies the Santa Monica Hydrologic Subarea of the Los Angeles County Coastal Plain Hydrologic Subunit.

Groundwater in the Santa Monica Subarea is recharged from percolating precipitation, and from streams originating in the Santa Monica Mountains flowing into the Quaternary alluvial sands and gravels. The interbedded nature of clayey zones in the area would inhibit percolation and vertical migration of surface water, thus allowing groundwater accumulation in shallow perched zones. Urban development now covers much of the land surface with structures and pavement, thus limiting groundwater recharge from precipitation sources.

According to the California Division of Mines and Geology (1998), the historic high ground-water level beneath the site ranges in depth from 30 to 40 feet below the existing ground surface. However, groundwater was not encountered during the previous borings at the site, which were drilled to a maximum depth of approximately 45 feet below the lowest parking level. Ground water was also not encountered in the previous borings at the adjacent site of the Century Plaza Towers, which was drilled to a maximum depth of 105 feet below the lowest level of the parking garage. Although ground water was not encountered, water seepage was observed in several borings drilled within the Project site and the adjacent Century Plaza Towers area. Within the Project site, seepage was observed in two previous borings, approximately five and 16 feet below the bottom of the lowest parking level. Water seepage was observed mostly near and above the lowest parking level in several borings at the adjacent Century Plaza Towers. Although water seepage below the lowest parking level was not noted in most of the previous borings, the majority of borings extending to such depths were drilled using drilling mud that makes it difficult to establish ground water levels and areas of seepage.

In northern and eastern portions of the Santa Monica Subarea, groundwater was present in unconfined aquifers (such as the Exposition Aquifer). In other areas of the basin, as well as in deeper aquifers, groundwater is confined. Flowing wells from deeper Miocene[24] sediments were once known to exist in the eastern part of the Hollywood Basin (DWR, 1961).

24 The Miocene Epoch formed part of the upper Tertiary Period and extended from approximately 24 to 5 million years before present.

Faulting and Seismicity

Faults are fractures or lines of weakness in the earth's crust, along which rocks on one side of the fault are offset relative to the same rocks on the other side of the fault. Sudden movement along a fault results in an earthquake. Faults that allow plates or landmasses to move horizontally past each other are called strike-slip fault zones (e.g. San Andreas, San Jacinto, Elsinore, and Newport-Inglewood). In contrast, mainly vertical movement occurs along normal, reverse and thrust fault zones. Buried low angle thrust faults that do not rupture the surface are known as blind thrusts (Elysian Park and Compton Blind Thrusts). Faults exhibiting both vertical and horizontal movement are oblique faults (e.g. Santa Monica-Hollywood, Cucamonga, Palos Verdes, and Raymond).

Plate tectonics, and the forces that cause these plates to move within the earth's crust, affect geology and seismicity throughout Southern California. The San Andreas Fault system forms the boundary between two of these major plates, the North American and Pacific plates. These two plates are in constant motion, with the Pacific Plate moving northwest relative to the North American Plate.

The tectonic regime of Southern California is marked by the interaction between two distinct systems of geologically young fault systems, the northwest trending San Andreas Fault System and the west trending faults of the Transverse Ranges. A major bend in the San Andreas fault occurs northwest of Los Angeles. As a result, a major zone of north-south compression exists in the Southern California region, creating the mountains within the Transverse Ranges. The most obvious local features are the Santa Monica and San Gabriel Mountains.

During the past 230 years (1769 to 1999), approximately 20 notable earthquakes (with a magnitude (M) of 6.0 or greater on the Richter Scale) were recorded in Southern California. Six of these events equaled or exceeded M7.0. The two largest earthquakes in the Los Angeles Basin during recent times are the January 1994 M6.7 Northridge and February 1971 M6.6 San Fernando (also commonly known as the Sylmar) earthquakes.

During Pliocene[25] and Quaternary times, tectonic stresses in the Los Angeles Basin caused compression, resulting in extensive folding and thrust faulting. Destructive compressional earthquakes, such as the 1971 San Fernando, the 1989 Whittier, and the 1994 Northridge earthquakes, along with numerous smaller compressional events, are reminders that active reverse and thrust faulting activity continues. The Elysian Park and other buried blind thrust faults, along with the frontal fault system and other oblique reverse fault zones have a high potential to generate large earthquakes in the Los Angeles Basin.

Historic occurrences of strike-slip style earthquakes in the Basin are less common, with the 1933 Newport-Inglewood (Long Beach) earthquake being the largest local event. The Whittier-Elsinore, San Andreas, and San Jacinto Fault Zones are strike-slip faults with the potential to generate major earthquakes within the region. Strike-slip fault zones caused several major earthquakes in Southern California during the 1800s. Hundreds of faults underlie much of the urban and rural areas of Southern California. The California Division of Mines and Geology (CDMG) has established the Alquist-Priolo Earthquake Fault Zoning program, which classifies the potential for a known earthquake fault to produce surface rupture. The Alquist-Priolo program has three classifications, which include: active, potentially active and inactive. An active fault has had surface displacement within the Holocene period, or approximately the last 11,000 years. A potentially active fault has had surface displacement within the Quaternary age deposits, or within the last 1.6 million years. Inactive faults have not produced surface displacement within the last 1.6 million years. As determined by the CDMG, many active, potentially active and inactive faults underlie the Los

25 The Pliocene Epoch was the most recent epoch of the Tertiary Period and extended from approximately five to two million years before present.

Angeles Basin. The subject property is not located within an Alquist-Priolo Earthquake Fault Zone for surface rupture hazards.

The nearest Alquist-Priolo Earthquake Fault Zone to the subject property is located approximately 2.75 miles (**Figure GS-1**) southeast of the Project site, along the Inglewood fault in the Newport-Inglewood fault zone. Based on a prior investigation by Law Crandall (2001), there are no known faults located on the subject property. The active Santa Monica fault is located approximately 0.28 miles (1,500 feet) to the north, and the Newport-Inglewood fault zone is approximately 1.1 miles east of the Project site. The Project site does not lie within an Alquist-Priolo Earthquake Zone. No known fault trace was identified on the site (Law Crandall, 2001).

The Santa Monica-Hollywood fault zone is comprised of two faults extending from the coastline in Santa Monica on the west to the Hollywood area on the east. The Hollywood fault is the eastern segment of the fault zone and trends east-west along the base of the Santa Monica Mountains, north of the Hollywood syncline and approximately 2.0 miles north of the site. The Santa Monica fault is the western segment of the Santa Monica-Hollywood fault zone and trends east-west from the Santa Monica coastline on the west to the Beverly Hills area on the east. Both faults are poorly defined near the surface, and have been located through collection of geophysical data, water level information and fault trenching studies. Due to insufficient data regarding the exact location of these faults at the ground surface, Alquist-Priolo Earthquake Fault Zones have not been established for these faults. However, both the Santa Monica fault and the Hollywood fault are considered active by the California State Geologist. City of Los Angeles Planning documents identify the Hollywood fault as an active fault for planning purposes.

The Northridge thrust is an inferred deep thrust fault that is considered the eastern extension of the Oak Ridge fault. The vertical surface projection of this thrust fault is located approximately 6.2 miles north of the site at the closest point. The Northridge Thrust is located beneath the majority of the San Fernando Valley and is believed to be the causative fault of the 1994 Northridge earthquake. This thrust fault is not exposed at the surface and does not present a potential surface fault rupture hazard. However, the Northridge Thrust is an active feature that could generate future earthquakes.

The Compton-Los Alamitos Thrust is an inferred blind thrust fault located within the south-central portion of the Los Angeles Basin. The closest edge of the vertical surface projection of the buried thrust fault is located about 7.4 miles southeast of the Project site. This thrust fault, like the Northridge Thrust, is not exposed at the surface and does not present a potential surface rupture hazard; however, this thrust fault is considered active and could also generate future earthquakes.

The Elysian Park Thrust, previously defined by Hauksson (1990) as the Elysian Park Fold and Thrust Belt, is another deep thrust fault located to the east of the subject property. Now believed to be smaller than originally estimated, the Elysian Park Thrust is located primarily in the central Los Angeles Basin, and the vertical surface projection of the fault is approximately 11.4 miles east-southeast of the subject property. The structure is not exposed to the surface and does not present a potential surface rupture hazard.

The Overland fault, located approximately 1.1 miles to the west, is the closest potentially active fault to the site. This fault trends northwest between the Charnock fault and the Newport-Inglewood fault zone. It extends from the northwest flank of the Baldwin Hills to Santa Monica Boulevard in the vicinity of Overland Avenue.

The Charnock fault is a northwest trending fault that runs parallel to the Overland fault and the Newport-Inglewood fault zone. The youngest deposits displaced by this fault are early Pleistocene age. Therefore, the fault is classified as potentially active by the CDMG. The closest segment of the Charnock fault to the Project site is approximately 3.3 miles to the south-southwest.

Insert Figure GS-1 RECENTLY ACTIVE FAULTS AND MAJOR EARTHQUAKE

Hill et al. (1979) conclude that movement occurred along the Santa Monica fault during part of the Pleistocene, and that movement during Holocene time cannot be excluded on the basis of present knowledge. Recent micro-seismic activity presents strong evidence that subsurface fault traces within the Santa Monica Fault Zone in the area are actively accumulating and releasing tectonic strain (Hill et al., 1979). Based on available data, this fault is classified as potentially active. If a surface scarp identified by Webber et al. (1980) were a surface expression of the Santa Monica fault that is disrupting Holocene deposits, this fault would be classified as active.

The Elysian Park Fold and Thrust Belt (hereinafter the Elysian Park fault) is a deeply buried low angle reverse or thrust fault that underlies the Los Angeles Basin. Its existence onshore, along with other related blind thrust faults, is inferred from the clustering of data from deep earthquakes, from oil well log data and from geophysical data. Offshore geophysical data also provides evidence for these low angle reverse faults. Biddle (1991) presents a geologic model, showing these low angle reverse faults.[26]

The Elysian Park fault's possible surface expression is located north and northeast of the site. It follows a line of hills extending from Whittier through Montebello, Elysian Park, the Cahuenga and Sepulveda Passes to Malibu and Point Dume (Reich, 1989). Both the M5.9 Whittier Narrows earthquake of October 1, 1987 and the M4.5 Montebello earthquake of June 12, 1989 resulted from movement on this fault.

It has been postulated that the Elysian Park fault and other related thrust faults are capable of generating earthquakes of M6.5 to M7.5, but the probability of any earthquake occurring is unknown. An earthquake of these magnitudes will generate very strong or intense ground motion at the site, similar to those experienced during the 1994 M6.7 Northridge earthquake.

Liquefaction

Strong ground motion can cause various types of ground failures, including liquefaction. Liquefaction occurs during extended periods of ground shaking, when pore water pressures increase and water-saturated sediments are temporarily altered from a solid to a liquid state. Liquefaction is most likely to occur in unconsolidated, granular sediments that are water saturated less than 30 feet below the ground surface (Tinsley et al., 1985).

Landslide and Subsidence

The proposed Project is located within an area susceptible to landslides, as determined by the City of Los Angeles Slope Stability Study and the County of Los Angeles Landslide Inventory Study. The subject property has this classification due to its location relative to the southern flank of the Beverly Hills portion of the Santa Monica Mountain Range. Regardless, the subject property and surrounding area are comprised of gentle sloping topography with no natural steep slopes located adjacent to the property.

The site is within the Beverly Hills Oil Field. The historic withdrawal of fluids (such as petroleum and ground water) has been known to cause ground subsidence. Documented subsidence associated with petroleum and groundwater extraction (and on-going tectonic processes in the Los Angeles Basin) has occurred within the boundaries of the Beverly Hills Oil Field.

Tsunami, Seiches and Seismically Induced Reservoir Failure

The site is not in a coastal area. Therefore, tsunamis (seismic sea waves) are not considered a significant hazard to the site.

26 Biddle, K. T., 1991. "The Los Angeles Basin - An Overview," Active Margin Basins. AAPG Memoir 52.

The site is not located downslope from any large bodies of water that could adversely affect the site in the event of an earthquake-induced dam failure or seiches (wave oscillations in an enclosed or semi-enclosed body of water). The site is in an area of minimal flooding potential (Zone C) as defined by the Federal Insurance Administration.

Threshold of Significance

Based upon criteria established in the City of Los Angeles Draft CEQA Thresholds Guide (1998), the proposed Project would normally result in a significant impact to geology if the Project:

- Would cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

Project Impacts

Surface Rupture

The site is not within a Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards. The closest Alquist-Priolo Earthquake Fault Zone, established for a portion of the Inglewood fault of the Newport-Inglewood fault zone, is located approximately 2.73 miles to the southeast of the site. Based on the available geologic data, active or potentially active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the site during the design life of the Project is considered low. No significant Project impact would occur.

Seismic Groundshaking

Due to the seismically active nature of Southern California, the site could potentially be subject to strong ground shaking from earthquakes produced by faults within the region. Potential impacts from seismic ground shaking are present throughout Southern California and would not be higher at the Project site than for most of the region. Also, the City of Los Angeles Uniform Building Code, revised since the 1994 Northridge earthquake contains construction requirements to ensure that habitable structures are built to a level of acceptable seismic risk. The proposed Project will be designed and built to provide life safety for occupants of the structure in the event of the strong ground motions, which are reasonably expected to occur in the vicinity of the Project site. As determined during the comprehensive geotechnical investigation for the proposed Project, Impacts associated with seismic shaking are considered potentially significant. However, Project compliance with applicable Uniform Building Code requirements would reduce impacts to a less than significant level.

Liquefaction

According to the California Division of Mines and Geology (1999), the City of Los Angeles Safety Element (1996), and the County of Los Angeles Seismic Safety Element (1990), the site is not within an area identified as having a potential for liquefaction. Groundwater was not encountered in previous borings within 50 feet of the ground surface. Additionally, the Pleistocene age sediments underlying the site are generally dense silty sand and firm clay and clay silts and are not considered prone to liquefaction. Therefore, the potential for liquefaction and the associated ground deformation beneath the site is considered to be low. The State Seismic Hazard Map (1999) for the Beverly Hills Quadrangle indicates that the immediate project vicinity is not susceptible to liquefaction.

Landslide and Subsidence

The lack of steep slopes located on and around the property precludes the potential for landslides. There are no known landslides in the area of the subject property, nor is there potential for other slope stability issues.

Between 1955 and 1970, documented subsidence beneath the site was approximately 0.2 feet (Hill et al., 1979). However, this subsidence is regional in nature and there is no evidence that differential settlement or damage to structures has occurred as a result of this phenomenon at the site or in the general area. Therefore, regional subsidence is not anticipated to adversely affect the structures at the site.

Mitigation Measures

G-1 To reduce seismic risks, Project structures shall be designed and built in conformance with the current City of Los Angeles Uniform Building Code at the time of the building permit. Information about ground motion parameters included in the site specific geotechnical report shall be used as input for seismic design of the proposed Project.

Significant Project Impacts After Mitigation

Based on City standards of acceptable risk reflected in the City of Los Angeles Building Code and the performance review procedures of the Bureau of Engineering and Building and Safety, no significant geology impacts would occur as a result of the proposed Project after mitigation of potential groundshaking impacts.

Cumulative Impacts

Projects included under the related projects list would require municipal government approvals of design, and the implementation of mitigation measures, where needed. Significant cumulative grading and geotechnical impacts resulting from the potentially concurrent construction of the related projects are not anticipated.

The proposed Project and related projects would be subject to potentially severe ground motion during a severe earthquake. Based on Project development which would be constructed to adhere to the building codes and other locally imposed plans, cumulative seismic impacts would be reduced to less than significant levels. Related projects would not be exposed to a greater than normal seismic risk than other areas in Southern California. The Project would not in any way compound the effects of the related projects. Therefore, cumulative geology, soils, and seismic impacts would not be considered significant.