

**PRELIMINARY GEOTECHNICAL EVALUATION  
PROPOSED COMMERCIAL SHOPPING CENTER  
THE COMMONS AT QUARTZ HILL  
NORTHWEST CORNER OF  
60<sup>TH</sup> STREET WEST AND AVENUE L  
LANCASTER, CALIFORNIA**

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August 31, 2007  
Project No. 207106001

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Subject: Preliminary Geotechnical Evaluation  
Proposed Commercial Shopping Center  
The Commons at Quartz Hill  
Northwest Corner of 60<sup>th</sup> Street West and Avenue L  
Lancaster, California

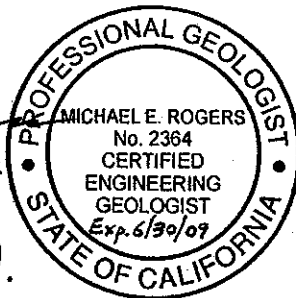
Dear Mr. Zacuto:


In accordance with your request and authorization, Ninyo & Moore has performed a preliminary geotechnical evaluation for a proposed commercial shopping center at the northwest corner of 60<sup>th</sup> Street West and Avenue L in Lancaster, California. Our study was conducted in accordance with the scope of services presented in our subconsulting services agreement dated May 23, 2007. We understand that the results of this study will be utilized in the preparation of an Environmental Impact Report (EIR) for the proposed project.


We appreciate the opportunity to provide geotechnical consulting services to you.

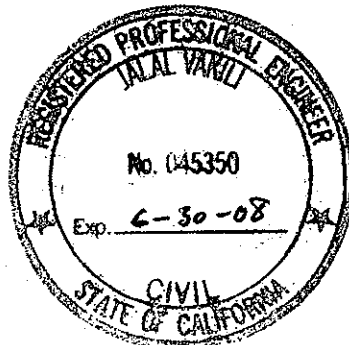
Sincerely,  
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## TABLE OF CONTENTS

	<u>Page</u>
1. INTRODUCTION.....	1
2. SCOPE OF SERVICES.....	1
3. PROJECT DESCRIPTION .....	2
4. SITE DESCRIPTION AND BACKGROUND.....	2
5. GEOLOGY.....	3
5.1. Regional Geology.....	3
5.2. Site Geology .....	4
5.3. Groundwater .....	4
6. FAULTING AND SEISMICITY .....	5
6.1. Regional Seismicity.....	5
6.2. Principal Regional Faults .....	6
6.2.1. San Andreas Fault Zone.....	7
6.2.2. San Gabriel Fault Zone .....	7
6.2.3. Garlock (West) Fault Zone .....	7
6.2.4. Sierra Madre Fault Zone .....	8
6.2.5. Santa Susana Fault.....	8
6.2.6. Northridge (East Oak Ridge) Fault.....	8
6.2.7. San Cayetano .....	9
6.2.8. Clamshell-Sawpit Fault.....	9
6.2.9. Puente Hill Blind Thrust Fault.....	9
6.2.10. Newport Inglewood (Los Angeles Basin) Fault .....	10
6.2.11. White Wolf Fault .....	10
6.2.12. Whittier Fault (Elsinore Fault Zone) .....	10
7. METHODOLOGY FOR GEOLOGIC IMPACT AND HAZARD ANALYSES .....	11
8. THRESHOLDS OF SIGNIFICANCE .....	11
9. POTENTIAL GEOLOGIC AND SEISMIC IMPACTS/HAZARDS.....	12
9.1. Surface Fault Rupture.....	12
9.2. Seismic Ground Shaking .....	13
9.3. Liquefaction.....	14
9.4. Landslides and/or Mudflows .....	14
9.5. Soil Erosion .....	14
9.6. Subsidence.....	15
9.7. Compressible/Collapsible Soils.....	15
9.8. Expansive Soils .....	16
9.9. Corrosive Soils .....	16
9.10. Groundwater .....	17
9.11. Distinctive Geologic or Topographic Features .....	17

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9.12. Excavations .....	18
9.13. Dam Inundation .....	18
9.14. Seiches and Tsunamis .....	19
9.15. Mineral Resources .....	19
10. MITIGATION OF POTENTIAL GEOLOGIC IMPACTS/HAZARDS .....	20
10.1. Seismic Ground Shaking .....	20
10.2. Soil Erosion .....	20
10.3. Compressible/Collapsible Soils.....	21
10.4. Corrosive Soils .....	21
10.5. Excavations .....	21
11. LIMITATIONS .....	22
12. SELECTED REFERENCES.....	23

**Tables**

Table 1 – Principal Regional Active Faults .....	6
Table 2 – Summary of Potential Geologic Impacts/Hazards.....	11

**Figures**

Figure 1 – Site Location Map	
Figure 2 – Geologic Map	
Figure 3 – Fault Location Map	

## 1. INTRODUCTION

In accordance with your request and authorization, we have performed a preliminary geotechnical evaluation for a proposed commercial development located at the northwest corner of 60<sup>th</sup> Street West and Avenue L (The Commons at Quartz Hill) in Lancaster, California (Figure 1). The City of Lancaster has requested an Environmental Impact Report (EIR) for the planned development. In accordance with the California Environmental Quality Act (CEQA), the EIR should include geotechnical evaluation of the impacts associated with potential geologic and seismic hazards.

Our geotechnical evaluation was based on review of readily available published geotechnical literature pertinent to the project site and site reconnaissance to develop preliminary conclusions regarding the proposed project's impact on the geologic environment and the potential geologic hazards that may affect the project. Where appropriate, measures to mitigate potential geologic hazards, as noted in this report, have been provided.

## 2. SCOPE OF SERVICES

Ninyo & Moore's scope of services has included review of background materials and geologic reconnaissance of the study area. Specifically, we have performed the following tasks:

- Review of readily available geologic maps, seismic data, published literature, aerial photographs, and geotechnical aspects of the City of Lancaster Draft Master Environmental Assessment.
- Review of a geotechnical engineering investigation report by Krazan & Associates, Inc. dated December 28, 2005.
- Geotechnical site reconnaissance by a representative from Ninyo & Moore conducted on May 16, 2007, to observe and document the existing surface conditions at the project site.
- Assessment of the general geologic conditions and seismic hazards affecting the area and evaluation of their potential impacts on the project.
- Compilation and analysis of existing geotechnical data pertaining to the site.
- Preparation of this report presenting the results of our study, as well as our conclusions and recommendations relative to the geotechnical aspects of the project's conceptual design and construction to be included in the EIR.

### 3. PROJECT DESCRIPTION

The City of Lancaster has requested an EIR for development of a commercial project located at the northwest corner of 60<sup>th</sup> Street West and Avenue L. Development of the approximately 40-acre site is proposed to consist of an approximately 353,000-square-foot commercial shopping center known as The Commons at Quartz Hill (The Commons). Current plans show that the proposed shopping center would include two large anchor stores and seven smaller building pads for shops, restaurants and banks. In addition to these planned building pads, we anticipate that the project will also include construction of underground utilities, pavements, and associated hardscape and landscape improvements.

### 4. SITE DESCRIPTION AND BACKGROUND

The site of the proposed project is located in a relatively level portion of the Antelope Valley approximately 5 miles west of State Highway 14 on the west side of the City of Lancaster. The property is situated in the western corner of the Mojave Desert on an alluvial fan/flood plain north of the Sierra Pelona Mountains. Topography of the site is relatively level and slopes gently down to the north, varying from an approximate elevation of 2,420 feet above mean sea level (MSL) near the south side of the site to approximate elevation 2,410 MSL near the north side of the site.

The project site is a rectangular parcel of approximately 40 acres bounded by Avenue L to the south, 60<sup>th</sup> Street West to the east, residential development to the north, and an undeveloped parcel to the west (Figure 1). The site is currently vacant, but has reportedly had some grading operations performed. No surface water was observed on the project site. Vegetation on the site consists of grasses, a few bushes, and scattered trees.

A geotechnical engineering investigation report by Krazan & Associates, Inc. (Krazan) dated December 28, 2005 was reviewed as part of our project scope. The following general items were noted in the report, and are discussed in further detail along with other reported information in the following sections:

- Krazan's investigation included site reconnaissance, review of published geotechnical literature; a field investigation consisting of drilling one hundred fifteen (115) borings to depths ranging from 10 to 51 feet; laboratory testing of soil samples; engineering analyses with respect to the geotechnical aspects of structural design, site grading and paving; and presentation of conclusions and recommendations pertaining to construction of proposed site improvements.
- During their investigation, two house structures and a few outbuildings were located on the site near Avenue L. Site topography at the time of their investigation included gently sloping surface gradients.
- Soil conditions encountered during their investigation consisted of approximately ½ to 1½ feet of loose, disturbed fill soils underlain by natural alluvial soils.
- Grading of the site for the proposed improvements is anticipated to entail cuts and fills on the order of 5 to 6 feet below existing grades.

## 5. GEOLOGY

### 5.1. Regional Geology

The proposed project site is located within the western corner of the Mojave Desert Geomorphic Province. The Mojave Desert Geomorphic Province is characterized by mountain ranges and hills of moderate relief that are partially buried and separated by broad alluviated basins like the Antelope Valley. The western part of the province in the project vicinity forms a wedge-shaped block bounded by the San Andreas fault zone on the southwest and the Garlock fault zone on the northeast; the province extends eastward to the Colorado River. The Antelope Valley comprises the wedge-shaped corner of this province, surrounded by the uplifted Tehachapi Mountain range to the north/northwest and the uplifted Liebre Mountains, Sierra Pelona, and San Gabriel Mountains to the south/southwest (City of Lancaster, 2007b).

The geology of the region consists of older, pre-Tertiary age crystalline basement rocks comprising granite, quartz monzonite, gabbro, schist, gneiss, and other igneous and metamorphic rocks. Younger Tertiary age volcanic and sedimentary formations of marine and non-marine origin overlie the basement rocks. These formations contain units of sandstone, siltstone, shale, conglomerate, and undifferentiated pyroclastic and intrusive volcanic rocks.

Younger Quaternary age alluvial sediments overlie the bedrock in the Antelope Valley area, deposited as a result of uplift and erosion of the surrounding mountains. The alluvial sediments in the Antelope Valley may exceed depths of 2,000 feet in some areas (City of Lancaster, 2007b).

## **5.2. Site Geology**

Regional geologic mapping indicates that the near-surface earth materials underlying the project area consist primarily of sand, silt, and gravel soils from alluvial deposits in the Antelope Valley. More detailed surficial mapping by the California Geological Survey (CGS, 2005b) indicates that the project site is covered by two different alluvial units: Q4c, the predominant unit which covers much of the site, and Q6m, which is mapped along the eastern part of the site (Figure 2). The Q4c unit is described as late-Pleistocene alluvial fan deposits that are unconsolidated, uplifted, and slightly dissected. Alluvial fan deposits are typically comprised of sand and gravel sediments. These coarse materials are further described as having moderately developed soils with distinct soil horizons and clay accumulations (CGS, 2005b). The Q6m unit is described as late-Pleistocene to Holocene alluvial fan and wash sediments that are unconsolidated, mainly medium-grained sands. Soils developed on the Q6m alluvial materials are described as weakly developed (CGS, 2005b).

Soil conditions encountered by Krazan during their investigation consisted of approximately ½ to 1½ feet of loose, disturbed fill soils underlain by natural alluvial silty sand, sand and silt. Surface soils observed at the site during reconnaissance by Ninyo & Moore consist of light brown, gravelly sand to silty sand.

## **5.3. Groundwater**

According to the City of Lancaster's Draft Master Environmental Assessment (2007), the site is located within the Antelope Valley Groundwater Basin. The general plan reports the depth to groundwater at 100 feet or more below the ground surface in the general site vicinity. The historic high groundwater level in the vicinity of the site is reported by the CGS to be at a depth of approximately 225 feet (CGS, 2005b). Krazan reported that they did not en-



counter groundwater in their borings at the site to the depth explored of 51 feet below existing grade. Groundwater levels may be influenced by seasonal variations, precipitation, irrigation, soil/rock types, groundwater pumping, and other factors and are subject to fluctuations. Shallow perched conditions may be present in places.

## 6. FAULTING AND SEISMICITY

### 6.1. Regional Seismicity

The proposed commercial site is located in a seismically active area, as is the majority of southern California. The numerous faults in southern California include active, potentially active, and inactive faults. As defined by the CGS, active faults are faults that have ruptured within Holocene time, or within approximately the last 11,000 years. Potentially active faults are those that show evidence of movement during Quaternary time (approximately the last 1.6 million years), but for which evidence of Holocene movement has not been established. Inactive faults have not moved in the last approximately 1.6 million years.

Based on our background review and site reconnaissance, the ground surface in the vicinity of the proposed commercial site is not transected by known active or potentially active faults. The site is not located within a State of California Seismic Hazard Zone (CGS, 2005c) or Earthquake Fault Zone (Alquist-Priolo Special Studies Zone, Hart and Bryant, 1997). However, the site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion at the site is considered significant. Figure 3 shows the approximate site location relative to the principal faults in the region.

Based on our document review, the active San Andreas fault is located approximately 4 miles southwest of the site. Known active faults within approximately 30 miles of the project site include the San Andreas, San Gabriel, Garlock, Sierra Madre, Santa Susana, and Northridge (Table 1). These and other principal nearby active faults are discussed in further detail in the following sections. Based on the proximity and number of known active and potentially active faults within the general region, it is reasonable to expect a strong ground

motion seismic event during the lifetime of structures for the proposed project. In general, potential hazards associated with seismic activity include strong ground motion, ground surface rupture, seismically induced liquefaction, and landsliding. These hazards are discussed in further detail below.

Table 1 lists selected principal known active faults that may affect the subject site, the maximum moment magnitude ( $M_{max}$ ) as published by the CGS (Cao, 2003), and significant historic earthquakes that have occurred on the fault. The approximate fault to site distance listed in the table was calculated by the computer program FRISKSP (Blake, 2001).

**Table 1 – Principal Regional Active Faults**

Fault	Approximate Fault to Site Distance miles (km) <sup>1</sup>	Maximum Moment Magnitude ( $M_{max}$ ) <sup>2</sup>	Significant Historic Earthquakes <sup>3</sup>
San Andreas – 1857 Rupture	4.0 (6.5)	7.4	M7.9 Fort Tejon, 1/9/1857
San Gabriel	22.4 (36.1)	7.2	-
Garlock (West)	26.7 (43.0)	7.3	-
Sierra Madre (San Fernando)	26.5 (42.7)	7.2	-
Santa Susana	27.5 (44.2)	6.7	M6.6 San Fernando, 2/9/71
Northridge (East Oak Ridge)	27.9 (44.9)	7.0	M6.7 Northridge, 1/17/94
San Cayetano	33.7 (54.2)	7.0	-
Clamshell – Sawpit	35.2 (56.6)	6.5	M5.8 Sierra Madre, 6/28/91
Puente Hills Blind Thrust	41.6 (66.9)	7.1	-
Newport-Inglewood (Los Angeles Basin)	43.4 (69.8)	7.1	M6.4 Long Beach, 3/10/1933
White Wolf	46.5 (74.9)	7.3	M7.5 Kern County, 7/21/52
Whittier (Elsinore Fault Zone)	48.1 (77.4)	6.8	M5, 5/15/1910
<b>Notes:</b>			
<sup>1</sup> Blake, 2001.			
<sup>2</sup> Cao, et al., 2003.			
<sup>3</sup> Southern California Earthquake Center (SCEC), 2004.			

## 6.2. Principal Regional Faults

Principal active faults in the region that may affect the site are described in detail in the following sections.

### **6.2.1. San Andreas Fault Zone**

The San Andreas fault zone has long been recognized as the dominant seismotectonic feature in California. This right-lateral, strike-slip fault is over 700 miles long and strikes northwest through the state from the Gulf of California to north of San Francisco. Two of California's three largest historic earthquakes, the 1906 San Francisco earthquake and the 1857 Fort Tejon earthquake, occurred along the San Andreas fault. The segment of the San Andreas fault that ruptured during the 1857 earthquake is located approximately 4 miles southwest of the project site. Ground surface offset as much as 30 feet was recorded across the fault due to the 1857 earthquake. The slip rate of the fault is estimated to be 30 millimeters (mm) per year. The fault is considered capable of producing earthquakes in excess of  $M_{max}$  7.4, and the average frequency of earthquakes along this segment of the San Andreas fault is approximately 140 years (Southern California Earthquake Center [SCEC], 2004).

### **6.2.2. San Gabriel Fault Zone**

Segments of the San Gabriel fault zone are described as potentially active, and a portion of the fault between Castaic and Saugus is described as active (Jennings, 1994). This right-lateral, strike-slip fault is considered capable of producing a  $M_{max}$  7.2 earthquake. The San Gabriel fault has a total length of approximately 87 miles, and the slip rate of the fault is estimated to be 1 millimeter (mm) per year. The San Gabriel fault zone is located approximately 22 miles southwest of the project site.

### **6.2.3. Garlock (West) Fault Zone**

The Garlock (West) fault zone is a prominent fault feature in southern California and strikes northeast across the northern part of the Mojave Desert province. Although this fault has not produced large earthquakes historically, geomorphic and stratigraphic evidence indicates that it has done so in the past. The Garlock (West) fault is considered capable of generating about a  $M_{max}$  7.3 earthquake. A portion of the Garlock fault zone ruptured due to 1952 Kern County Earthquake that occurred on the White Wolf Fault (SCEC, 2004). A total of about 30 to 40 miles of left-lateral, strike slip has been docu-

mented across the Garlock (West) fault, and the slip rate is estimated to be 6 mm per year. The Garlock (West) fault is located approximately 27 miles northwest of the project site.

#### **6.2.4. Sierra Madre Fault Zone**

The Sierra Madre fault zone is composed of a series of active reverse faults. The approximately 35-mile-long fault zone is located approximately between the cities of Sunland and Azusa along the foothills of the San Gabriel Mountains. The Sierra Madre fault is considered capable of generating about a  $M_{\max}$  7.2 earthquake. The slip rate of the fault is estimated to be 2 mm per year. The Sierra Madre fault is located approximately 26 miles south of the project site.

#### **6.2.5. Santa Susana Fault**

The Santa Susana fault is a thrust fault approximately 23 miles long located near the communities of Piru, Sylmar, and San Fernando. A short segment of the fault ruptured slightly during the 1971 San Fernando earthquake (SCEC, 2004). The Santa Susana fault is considered capable of generating about a  $M_{\max}$  6.7 earthquake. The slip rate of the fault is estimated to be 5 mm per year. The Santa Susana fault is located approximately 27 miles southwest of the project site.

#### **6.2.6. Northridge (East Oak Ridge) Fault**

The Northridge (East Oak Ridge) fault is an active reverse thrust fault located on Oak Ridge near the communities of Santa Paula and Fillmore, northwest of the community of Northridge. This fault was associated with the 1994 M 6.7 Northridge earthquake. The Northridge (East Oak Ridge) fault is considered capable of generating about a  $M_{\max}$  7.0 earthquake. The fault is approximately 56 miles long, and the slip rate of the fault is estimated to be 1.5 mm per year. The Northridge (East Oak Ridge) fault is located approximately 28 miles southwest of the project site.

### **6.2.7. San Cayetano**

The San Cayetano fault is a thrust fault approximately 28 miles long located near the communities of Piru, Fillmore, and Ojai. The San Cayetano fault is considered capable of generating about a  $M_{\max}$  7.0 earthquake. The slip rate of the fault is estimated to be 6 mm per year. The San Cayetano fault is located approximately 34 miles southwest of the project site.

### **6.2.8. Clamshell-Sawpit Fault**

The Clamshell-Sawpit fault is a reverse fault located near the communities of Sierra Madre and Monrovia. The 1991 M 5.8 Sierra Madre earthquake probably originated on the Clamshell-Sawpit fault (SCEC, 2004). The fault is approximately 11 miles long, and the slip rate of the fault is estimated to be 0.5 mm per year. The Clamshell-Sawpit fault is considered capable of generating about a  $M_{\max}$  6.5 earthquake. The Clamshell-Sawpit fault is located approximately 35 miles southeast of the project site.

### **6.2.9. Puente Hill Blind Thrust Fault**

The Puente Hills Blind Thrust (PHT) is an active reverse thrust fault that does not reach the surface (blind) and extends for more than 25 miles in the northern Los Angeles Basin from downtown Los Angeles east to northern Orange County. The fault consists of three distinct segments. From west to east, the segments are known as the Los Angeles, Santa Fe Springs, and Coyote Hills segments. Studies have indicated that the PHT generated the 1987 Whittier Narrows earthquake which occurred on the Santa Fe Springs segment of this fault system. Although not presently designated an Earthquake Fault Zone due to the lack of a well-defined surface trace, this fault is considered active (Shaw, 2002) and capable of generating moderate (M 6.5-6.6) earthquakes every approximately 400 to 1,320 years for single-segment earthquakes and strong earthquakes (M 7.1) every approximately 780 to 2,600 years for multi-segment earthquakes (Shaw, 2002). The slip rate of the fault is estimated to be 0.7 mm per year. The PHT is located approximately 42 miles south/southeast of the project site.

#### **6.2.10. Newport Inglewood (Los Angeles Basin) Fault**

The Newport-Inglewood fault zone is a major tectonic structure in the Los Angeles Basin area and consists of a series of northwest-trending, right-lateral, strike-slip fault segments that extend from the southern edge of the Santa Monica Mountains southeast to offshore from Newport Beach. The Newport-Inglewood fault zone was the source of the 1933 Long Beach earthquake with a measured magnitude of  $M_w$  6.4. The Newport-Inglewood fault is considered capable of generating about a  $M_{max}$  7.1 earthquake. The fault is approximately 46 miles in length and has a slip rate of approximately 1 mm per year. The project site is located approximately 43 miles from the northwestern end of the Newport-Inglewood fault.

#### **6.2.11. White Wolf Fault**

The White Wolf fault is a left-lateral reverse fault located northwest of the project site near the community of Tehachapi. The White Wolf fault was the source of one of the largest earthquakes in Southern California history, the 1952 M 7.5 Kern County earthquake (SCEC, 2004). The White Wolf fault is considered capable of generating about a  $M_{max}$  7.5 earthquake. The fault is approximately 37 miles in length and has an estimated slip rate of 2 mm per year. The White Wolf fault is located approximately 46 miles northwest of the project site.

#### **6.2.12. Whittier Fault (Elsinore Fault Zone)**

The Whittier fault is a right-lateral, strike-slip fault zone that extends approximately 24 miles from Whittier Narrows in Los Angeles County, southeast to Santa Ana Canyon where it merges with the Elsinore fault zone. The Whittier fault zone is considered capable of generating a  $M_{max}$  6.8 earthquake and has a slip rate of approximately 2.5 mm per year. The Whittier fault is located approximately 48 miles southeast of the project site.

## 7. METHODOLOGY FOR GEOLOGIC IMPACT AND HAZARD ANALYSES

The proposed project has been evaluated with respect to its potential impacts on the geologic environment, as outlined by the CEQA. Additionally, the impacts of potential geologic hazards on the proposed project have been evaluated. Potential project impacts and geologic hazards are based on our geologic and seismic review of readily available published geotechnical literature pertinent to the proposed project. These include, but are not limited to, the safety element of the General Plan for the County of Los Angeles, aerial photographs, State of California Earthquake Fault Zone Maps (Alquist-Priolo Special Studies Zone Maps), State of California Seismic Hazards Zones Maps, geologic and topographic maps, and other publications by the CGS and United States Geological Survey (USGS).

## 8. THRESHOLDS OF SIGNIFICANCE

According to Appendix G of the CEQA guidelines (2005), a project is considered to have a geologic impact if its implementation would result in or expose people/structures to potential substantial adverse effects, including the risk of loss, injury, or death involving hazards involving one or more of the geologic conditions presented in Table 2 below. Table 2 also presents the impact potential as defined by CEQA associated with each of the geologic conditions discussed in the following sections.

**Table 2 – Summary of Potential Geologic Impacts/Hazards**

Geologic Condition	Impact Potential <sup>1</sup>			
	Potentially Significant Impact	Less than Significant with Mitigation Incorporation	Less than Significant Impact	No Impact
Surface Fault Rupture				x
Seismic Ground Shaking	x			
Seismic Ground Failure, Including Liquefaction				x
Landslides or Mudflows				x
Soil Erosion or Loss of Topsoil		x		
Subsidence			x	
Compressible/Collapsible Soil		x		
Expansive Soil			x	
Corrosive Soil		x		

**Table 2 – Summary of Potential Geologic Impacts/Hazards**

Geologic Condition	Impact Potential <sup>1</sup>			
	Potentially Significant Impact	Less than Significant with Mitigation Incorporation	Less than Significant Impact	No Impact
Shallow Groundwater			x	
Distinctive Geologic or Physical Feature				x
Excavations		x		
Dam Inundation				x
Seiches and Tsunamis				x
Loss of Mineral Resources				x
<b>Note:</b>				
<sup>1</sup> Reference: CERES, 2005, Appendix G – Environmental Checklist Form, Final Text, dated October 26. Website: <a href="http://ceres.ca.gov/topic/envlaw/ceqa/guidelines/appendices.html">http://ceres.ca.gov/topic/envlaw/ceqa/guidelines/appendices.html</a>				

## 9. POTENTIAL GEOLOGIC AND SEISMIC IMPACTS/HAZARDS

Based on our review of geologic and seismic background information, and geotechnical site reconnaissance, the proposed project is not anticipated to have a significant impact on the geologic environment. However, the proposed project may be subjected to potential impacts from geologic and seismic hazards. Potential impacts on the proposed project based on our geologic and seismic review are provided in the following sections.

### 9.1. Surface Fault Rupture

Surface fault rupture is the offset or rupturing of the ground surface by relative displacement across a fault during an earthquake. The San Andreas fault zone is the closest active earthquake fault to the site and is located approximately 4 miles southwest of the site. Based on current published fault studies and geologic maps, as well as site reconnaissance, the proposed project site is not crossed or underlain by a known active fault and, therefore, would not likely result in, or expose people to, significant impacts related to ground surface rupture.



## 9.2. Seismic Ground Shaking

The seismic hazard likely to impact the project is ground shaking during an earthquake on one of the nearby or distant active faults. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The size and type of construction also affects how a particular structure performs during ground shaking.

Our evaluation of the ground shaking hazard included review of a probabilistic seismic hazard assessment that consisted of statewide estimates of peak horizontal ground accelerations conducted for California (Peterson, et al., 1996). In addition, for the purposes of evaluating seismically induced geotechnical hazards at the site, a site-specific probabilistic seismic hazard analysis was performed to evaluate anticipated peak ground accelerations (PGAs) using the computer program FRISKSP developed by Blake (2001). FRISKSP calculates the probability of occurrence of various ground accelerations at a site over a period of time and the probability of exceeding expected ground accelerations within the lifetime of the proposed structure from the significant earthquakes within a specific radius of search. For this project site, a search radius of 62 miles (100 kilometers) was selected.

The published guidelines of CGS (2004) define a PGA with a 10 percent probability of exceedance in 50 years as the Design Basis Earthquake ( $PGA_{DBE}$ ) ground motion, and this value is typically used for residential and commercial structures. In evaluating the seismic hazards associated with the project site, we have considered a PGA that has a 10 percent probability of being exceeded in 50 years and used an attenuation relation for deep soil conditions present at the site. The PGA for the site was calculated as 0.80g (i.e., 80 percent of the acceleration due to gravity). This estimate of ground motion does not include near-source factors that may be applicable in the design of the proposed building structures. The requirements of the governing jurisdictions and the 2001 CBC should be considered in project design. The potential impacts due to ground shaking are significant, and the anticipated ground acceleration should be considered during the design and construction of the proposed project.

### **9.3. Liquefaction**

Liquefaction is a phenomenon in which soil loses its shear strength for short periods of time during an earthquake. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid increase in pore water pressure, causing the soil to behave as a fluid for short periods of time. The effects of liquefaction may include excessive total and/or differential settlement of structures founded on the liquefying soils. To be susceptible to liquefaction, a soil is typically cohesionless, with a grain-size distribution of a specified range (generally sand and silt), loose to medium dense, below the groundwater table, and subjected to a sufficient magnitude and duration of ground shaking.

According to Seismic Hazards Zones Maps published by the State of California (CGS, 2005c), the site is not mapped within an area considered susceptible to liquefaction. Additionally, shallow groundwater, which is a component of liquefaction susceptibility, is reported to be deeper than 100 feet below the ground surface. Therefore, the proposed project would not result in, or expose people to, significant impacts related to potential earthquake-induced liquefaction.

### **9.4. Landslides and/or Mudflows**

Landslides, slope failures, and mudflows of earth materials predominately occur where slopes are too steep and/or the earth materials too weak to support themselves. Landslides may also occur by seismic ground shaking, particularly where high groundwater is present.

There are no significant slopes within the boundaries of the proposed project site nor do we anticipate significant slopes proposed for project implementation. Therefore, the proposed project would not result in, or expose people to, significant impacts related to on- or off-site landslides or mudflows.

### **9.5. Soil Erosion**

Soil erosion refers to the process by which soil or earth material is loosened or dissolved and removed from its original location. Erosion can occur by many different processes and may

occur at the project site where bare soil is exposed to moving water or wind. Construction of the proposed project would result in ground surface disruption during excavation, grading, and trenching that would create the potential for erosion to occur. However, the erosion potential when the site is developed will be relatively minor due to the anticipated covering of bare areas with structures, pavements, and associated hardscape and landscaped areas. Surface drainage provisions would also reduce the potential for soil erosion at the site. Potential soil erosion is considered to have a less than significant impact during construction with mitigation incorporation.

#### **9.6. Subsidence**

According to the City of Lancaster's Draft Master Environmental Assessment (2007), portions of Lancaster are characterized by soils which exhibit subsidence. Areas of Lancaster that have experienced subsidence have developed sinkholes and/or ground fissures. Fissures are typically associated with faults or groundwater withdrawal, which results in the cracking of the ground surface. The General Plan has described areas of known fissuring and sinkholes. The project site is not located in an area of known ground fissures or sinkholes indicated in the City's plan. Therefore, potential subsidence of the project site is considered to have a less than significant impact.

#### **9.7. Compressible/Collapsible Soils**

The alluvial deposits underlying the site are generally described as unconsolidated (CGS, 2005b), reflecting a depositional history without substantial loading. Soil collapse is the phenomenon where the soils underlying a site settle or compress, resulting in a lower ground-surface elevation. Collapsible soils are distinguished by their potential to undergo a significant decrease in volume upon increase in moisture content, with or without an increase in external loads. Krazan has reported that the upper 5 to 6 feet of alluvial soils at the site are loose to medium dense, and are potentially moderately compressible.

Krazan also encountered loose, undocumented fill soils at the site during their investigation to a depth of approximately 1½ feet. Compressible alluvial soils and undocumented fills

pose the risk of adverse settlement under static loads imposed by new fill or structures. Differential settlement of soils can cause damage to project improvements, including foundations, structures, pavements, and other hardscape features. Since Krazan has recommended overexcavation and recompaction of these soils to mitigate the potential compressible conditions, potential compressible/collapsible soils at the project site are considered to have a less than significant impact with incorporation of these measures.

### **9.8. Expansive Soils**

Expansive soils generally result from specific clay minerals that have the capacity to shrink or swell in response to changes in moisture content. The ability of clayey soil to change volume can result in uplift or cracking to foundation elements or other rigid structures such as slabs-on-grade, rigid pavements, sidewalks, or other slabs or hardscape founded on these soils. Geologic references reviewed indicate that much of the alluvial deposits at the project site consist of coarse, sandy materials (CGS, 2005b). According to the City of Lancaster's Draft Master Environmental Assessment (2007), the project site is located in an area of low shrink-swell potential. Based on their laboratory testing, Krazan reported soil expansion potential at the site ranging from very low to low. Therefore, the potential for expansive soils at the project site is considered to have a less than significant impact.

### **9.9. Corrosive Soils**

The project site is located in a geologic environment that could potentially contain soil conditions that are corrosive to concrete and metals. Corrosive soil conditions may exacerbate the corrosion hazard to pipelines, foundations, and other buried improvements. Based on their laboratory testing, Krazan reported a negligible potential for sulfate attack of concrete in contact with site soils, and a relatively low potential for corrosion of buried metals at the site. However, they recommended that a qualified corrosion engineer evaluate the potential corrosive effects of on-site soils from building pad grades after site grading to check the results of their testing. Therefore, potential soil corrosivity is considered to have a less than significant impact during construction with mitigation incorporation.

### **9.10. Groundwater**

Based on our background review, the historic high groundwater table at the site is 100 feet or more below the ground surface. Groundwater was not reported by Krazean in borings conducted at the site to a depth of approximately 51 feet. Subsurface construction activities for the proposed project are anticipated to consist of relatively shallow excavations for building pads, foundations, and utilities. Based on the anticipated depth of these construction activities and reported depths to groundwater, shallow groundwater is considered to have less than a significant impact on the proposed project.

Groundwater levels may be influenced by seasonal variations, precipitation, irrigation, soil/rock types, groundwater pumping, and other factors and are subject to fluctuations. Shallow perched conditions or seepage may be present in places. Further study, including subsurface exploration, should be performed during the design phase to evaluate the presence of groundwater, seepage, and/or perched groundwater at the site and the potential impacts on design and construction of project improvements.

### **9.11. Distinctive Geologic or Topographic Features**

This potential geologic impact refers to the proposed project's potential to cover or modify one or more distinct prominent geologic or topographic features. Rock exposures or other prominent geologic features were not observed on the surface at the site and are not anticipated at shallow depth. The existing topography of the project site is comprised of gently sloping to relatively flat natural gradients. Prominent topographic features were not observed at the site. The proposed construction will result in minor grading and trenching activities, but will be matched with surrounding street gradients, and is not anticipated to significantly alter the existing topography. Therefore, the proposed project would not result in significant impacts related to the alteration or modification of prominent geologic or topographic features.

### **9.12. Excavations**

Earthwork associated with construction of the proposed project is anticipated to include excavations for the creation of building pads, parking areas, and trench excavations for utility lines. Potential deeper excavations may be anticipated for deeper foundation work for structures, if needed. Based on our background review and site reconnaissance, we anticipate that the materials encountered in excavations will be comprised predominantly of poorly consolidated sandy soils with various amounts of gravel and finer grained soils. We anticipate that excavations within the alluvial materials at the project site will be feasible with conventional grading equipment. Krazan has not reported the presence of cemented soils at the site, however, areas of cemented soils are present in some areas of the Antelope Valley (City of Lancaster, 2007b) and could present excavation difficulty if encountered at the project site. The excavatability of materials at the site would result in a less than significant impact to the proposed project.

Excavations for proposed project improvements adjacent to existing streets, sidewalks, or structures will need to be performed with care to reduce the potential for differential movement of existing improvements located near the excavations. With appropriate mitigation incorporation during construction, excavations at the project site would result in a less than significant impact to surrounding improvements.

We anticipate that the project site will be fenced during construction operations, such that the public will not be exposed to the impacts of excavations. Construction personnel may be exposed to the impacts of excavations, and appropriate mitigative safety measures would result in a less than significant impact to site personnel. Since excavations will be filled following construction, the proposed project would not result or expose people to impacts related to excavations after construction of the project.

### **9.13. Dam Inundation**

According to the County of Los Angeles Department of Regional Planning (1990), the proposed project site is not located within a potential dam failure inundation area. Therefore,

the proposed project would not result or expose people to impacts related to dam failure inundation.

#### **9.14. Seiches and Tsunamis**

A seiche is the seismically induced sloshing of water in a large enclosed basin, such as a lake, reservoir, or bay. There are no known reservoirs or lakes within approximately 10 miles of the site, thus, the potential for damage from seiches to the proposed project is considered low. Therefore, the proposed project would not result in, or expose people to, significant impacts related to seiches.

Tsunamis are open-sea tidal waves generated by earthquakes. Tsunami damage is typically confined to low-lying coastal areas. Water surge caused by tsunamis is measured by distance of run-up on the shore. The project site is not mapped within the area considered to be susceptible to tsunami inundation (County of Los Angeles, Department of Regional Planning, 1990). Therefore, the proposed project would not result in, or expose people to, significant impacts related to tsunamis.

#### **9.15. Mineral Resources**

The CGS and the State Mining and Geology Board (SMGB) classify the regional significance of mineral resources in accordance with the California Surface Mining and Reclamation Act of 1975 (SMARA). The SMGB uses a classification system that divides land into four Mineral Resource Zones (MRZ) that have been designated based on quality and significance of mineral resources (California Division of Mines and Geology [CDMG], 1983). According to the State of California (CDMG, 1994), the project site is located in an area classified as MRZ-3, which is defined as "...areas of known or inferred mineral occurrence." Due to the abundance of similar mineralogical materials in the City of Lancaster and surrounding region around the proposed project site, the potential of the project to result in the loss of availability of a known mineral resource is not considered a significant impact.

## **10. MITIGATION OF POTENTIAL GEOLOGIC IMPACTS/HAZARDS**

The potential geologic and seismic hazards described above may be mitigated by employing sound engineering practice in the design and construction of the new facilities. This practice includes the performance of site-specific geotechnical and seismic hazards analyses prior to the construction of the structures at the site. Typical measures to mitigate potential hazards that may be encountered during the construction of the improvements are described in the following sections.

### **10.1. Seismic Ground Shaking**

Mitigation measures to reduce the potential impacts of seismic ground shaking will be achieved through project design and construction. During the design phase, site-specific geotechnical evaluations will be performed to obtain detailed subsurface soil and geologic data, including evaluation of the site-specific ground motion anticipated for the site. Structural elements will then be designed to resist or accommodate appropriate site-specific ground motions and conform to the current Uniform Building Code (UBC) seismic design standards.

### **10.2. Soil Erosion**

The project site is relatively flat, and implementation of the project is not anticipated to significantly change the existing topography or accelerate existing erosional processes. Construction of the proposed project is anticipated to create the potential for soil erosion during excavation, grading, and trenching activities. However, with the implementation of appropriate procedures during construction, soil erosion can be limited to within the site boundaries. Examples of these procedures would include surface drainage measures for erosion due to water, such as the use of sandbags and plastic sheeting, and wetting of soil surfaces to mitigate wind-related erosion.



### **10.3. Compressible/Collapsible Soils**

To mitigate potential compressible soil conditions in areas of proposed buildings at the site, Krazan has recommended overexcavation and recompaction of soils to a depth of 6 feet below existing grade, 4 feet below proposed pad grade, or 4 feet below bottom of proposed footings, whichever is deeper. To mitigate potential compressible soil conditions in proposed flatwork and pavement areas at the site, they have recommended overexcavation and recompaction to a depth of 2 feet or more below existing grade or finished subgrade, whichever is deeper.

### **10.4. Corrosive Soils**

Although Krazan has concluded that there is a negligible potential for sulfate attack of concrete in contact with site soils, and a relatively low potential for corrosion of buried metals at the site, the project site is located in a geologic environment that could potentially contain soil conditions that are corrosive to concrete and metals. Krazan has recommended that a qualified corrosion engineer evaluate the potential corrosive effects of on-site soils from building pad grades after site grading to check the results of their testing.

Typical mitigation measures for corrosive soil include epoxy and metallic protective coatings, the use of alternative (corrosion resistant) materials, and selection of the type of cement and water/cement ratio. Concrete resistant to sulfate exposure and corrosion protection for metals will be used where appropriate for underground structures in areas where corrosive groundwater or soil could potentially cause deterioration. Specific measures to mitigate the potential effects of corrosive soils will be developed in the design phase.

### **10.5. Excavations**

Excavations along the property lines of the site may affect surrounding improvements, and protection of surrounding improvements may be appropriate. The potential for damage to surrounding improvements and structures resulting from excavation operations could be monitored for movement with a variety of instrumentation. If, during the course of construction, the instrumentation detects ground movement that exceeds a predetermined value, the

work would stop and the contractor's methods would be reviewed and changes would be made, as appropriate. Typical monitoring methods include installation of ground survey points around the outside of the excavation to monitor settlement and/or placing monitoring points on nearby structures to monitor performance of the structures.

Difficult construction excavation is not anticipated at the site due to the presence of poorly consolidated alluvial soils at the site. Krazan has not reported the presence of cemented soils at the site and could present excavation difficulty.

## 11. LIMITATIONS

The purpose of this study was to evaluate geologic and geotechnical conditions at the site using readily available data and to provide a preliminary geotechnical report which can be utilized in the preparation of planning and environmental impact documents for the project.

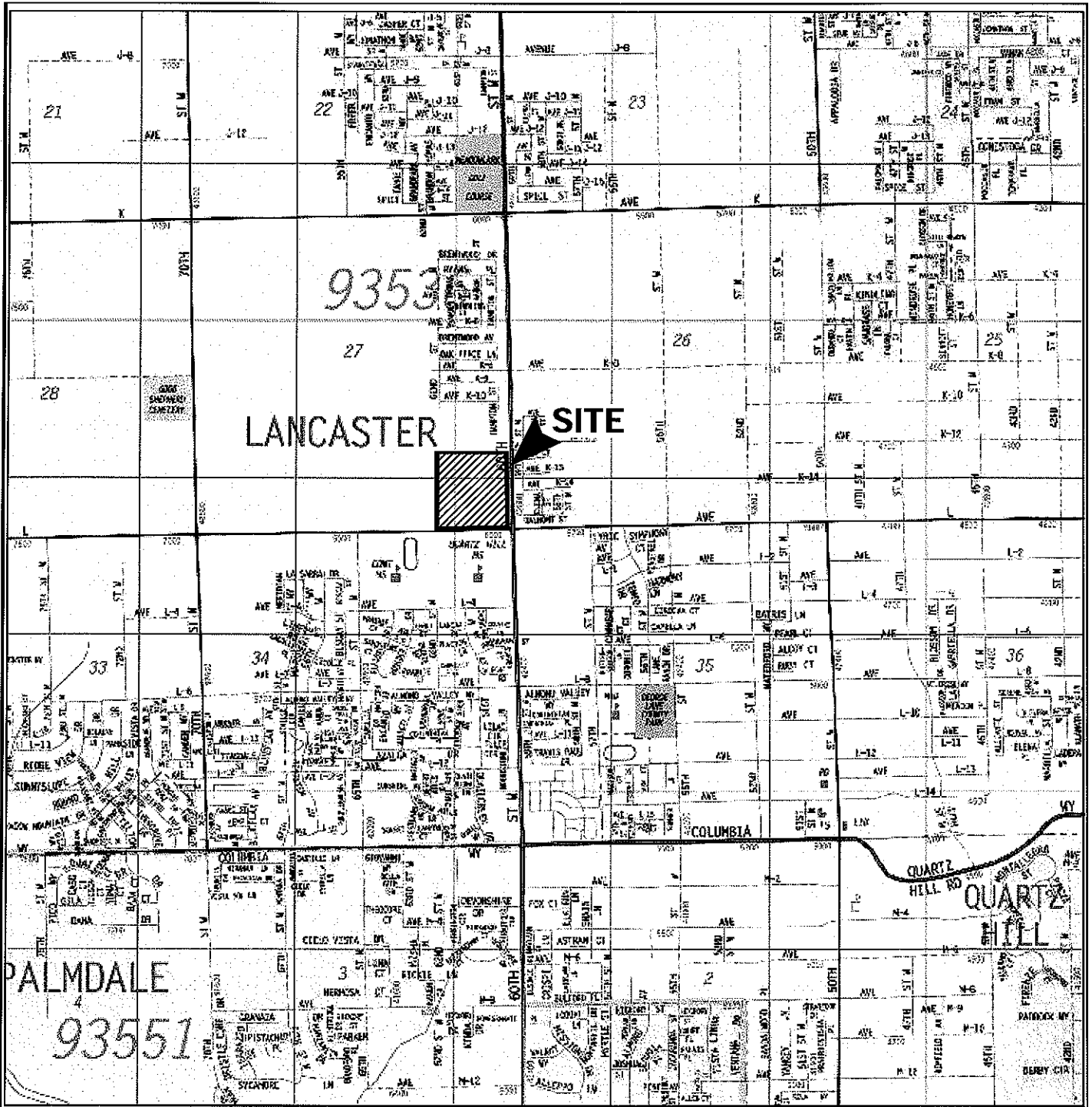
The geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Our preliminary conclusions and recommendations are based on a review of aerial photographs and readily available geotechnical literature, review of the referenced report by Krazan & Associates provided to us, and an analysis of the observed conditions. Variations may exist and conditions not observed or described in this report may be encountered.

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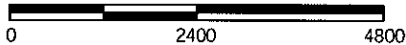
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REFERENCE: 2005 THOMAS GUIDE FOR LOS ANGELES/ORANGE COUNTIES, STREET GUIDE AND DIRECTORY

APPROXIMATE SCALE IN FEET



NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.



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**Ninyo & Moore**

**SITE LOCATION MAP**

FIGURE

PROJECT NO.

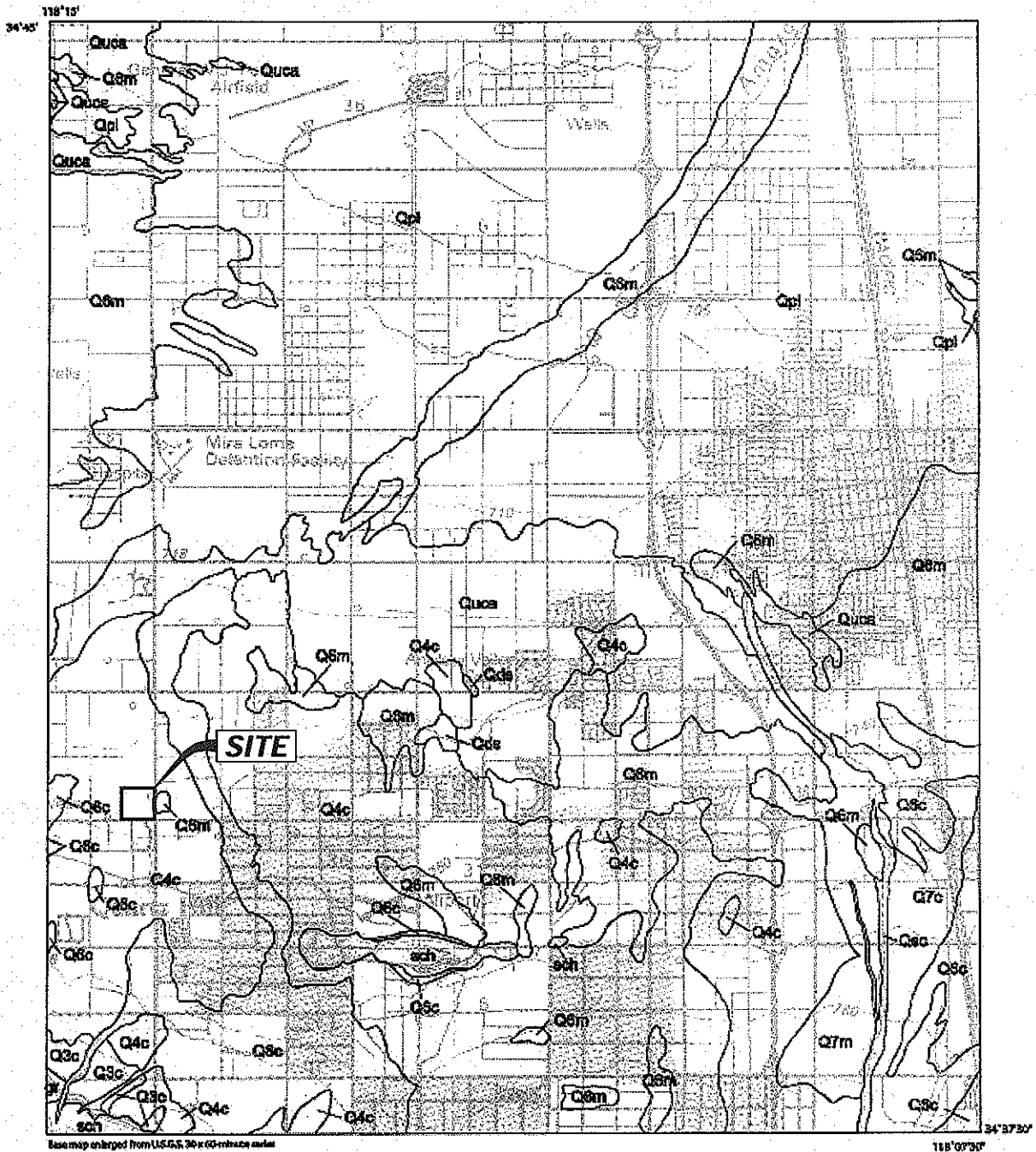
DATE

PROPOSED COMMERCIAL SHOPPING CENTER  
60TH STREET WEST AND AVENUE L  
LANCASTER, CALIFORNIA

207106001

8/07

**1**



Base map enlarged from U.S.G.S. 30 x 60-minute scale

LANCASTER WEST QUADRANGLE



See "Bedrock and Surficial Geology" in Section I of report for descriptions of units.  
 B = Pre-Quaternary bedrock.

- Q6m** LATE PLEISTOCENE AND HOLOCENE ALLUVIAL FAN AND WASH SEDIMENTS, UNCONSOLIDATED, MAINLY MEDIUM-GRAINED SEDIMENTS. SOILS ARE WEAKLY DEVELOPED.
  - Q4c** LATE PLEISTOCENE ALLUVIAL FAN MATERIALS; UNCONSOLIDATED, UPLIFTED AND SLIGHTLY DISSECTED. MODERATELY DEVELOPED SOIL HORIZONS.
- REFERENCE: SEISMIC HAZARD ZONE REPORT 095, CALIFORNIA GEOLOGICAL SURVEY, 2005.

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**Ninyo & Moore**

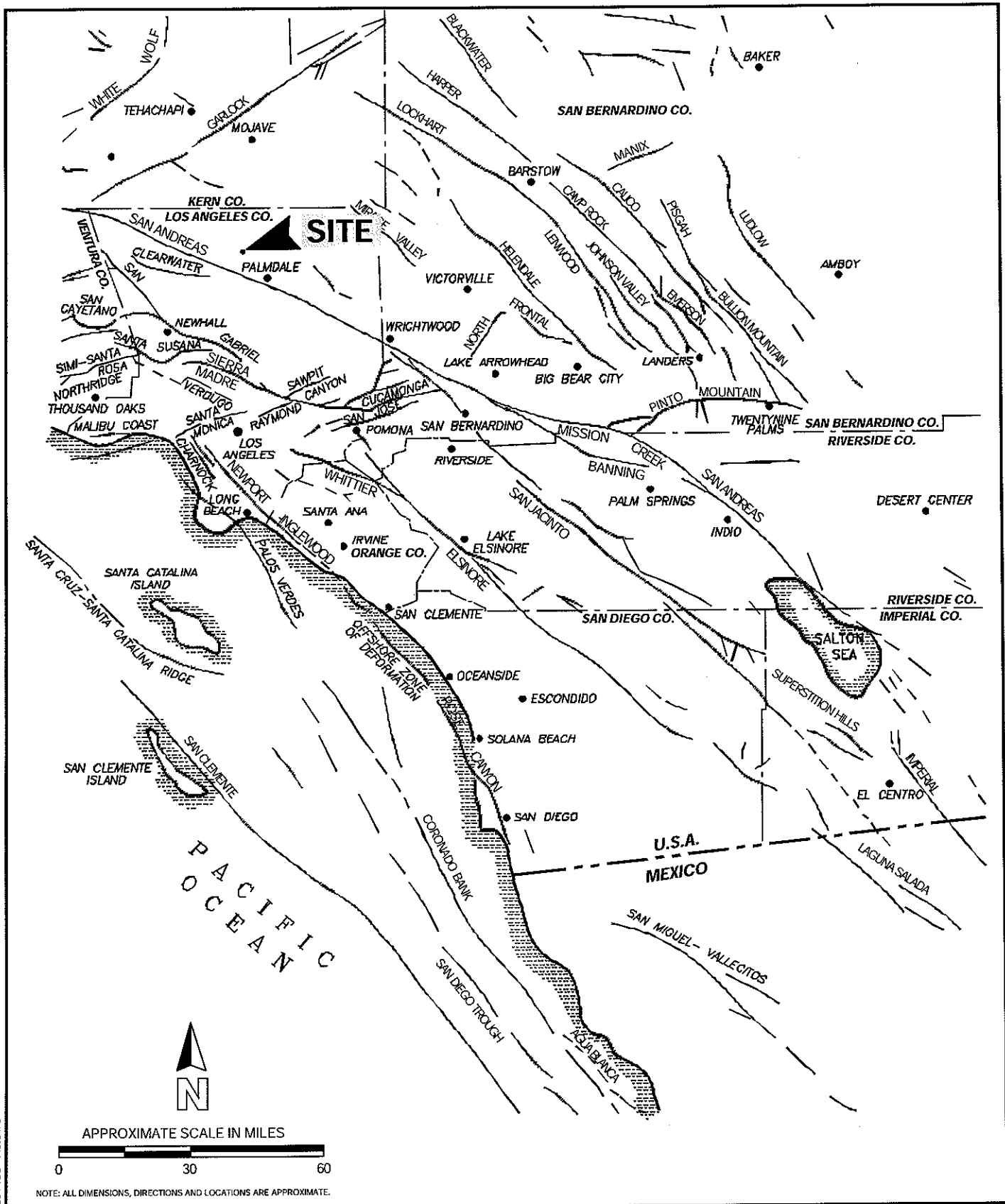
**GEOLOGIC MAP**

FIGURE

PROJECT NO.	DATE
207106001	8/07

PROPOSED COMMERCIAL SHOPPING CENTER  
 60th STREET WEST AND AVENUE L  
 LANCASTER, CALIFORNIA

**2**



207106-AG.DWG

**Ninyo & Moore**

**FAULT LOCATION MAP**

FIGURE

PROJECT NO.	DATE
207106001	8/07

PROPOSED COMMERCIAL SHOPPING CENTER  
60th STREET WEST AND AVENUE L  
LANCASTER, CALIFORNIA

**3**