6.5 Geologic Resources and Hazards

6.5.1 Introduction

Riverside Public Utilities (RPU) proposes to build and operate a nominal 96-megawatt (MW) simple-cycle power plant on a 12-acre fenced site within the City of Riverside, California. This proposed facility is referred to as the Riverside Energy Resource Center (RERC) Project (Project). RPU will develop, build, own and operate the facility. RERC will supply the internal needs of the City of Riverside during summer peak electrical demands and will serve the City's minimum emergency loads in the event RPU is islanded from the external transmission system. No power from RERC will be exported outside of the city.

The RERC Project site is located at the northern terminus of Acorn Street in the City of Riverside, Riverside County, California. The Project would also require rebuilding a transmission line approximately 1.75 miles long. This section discusses potential impacts to geologic resources related to the proposed Project during construction and operation. This document presents a summary of relevant laws, ordinances, regulations and standards (LORS), the Project's setting, potential environmental impacts and proposed mitigation measures affecting these resources. Required permits and permitting agencies are also identified.

6.5.1.1 Project Description

The proposed site is owned by the City of Riverside and is located adjacent to the City of Riverside's Wastewater Treatment Plant (WWTP) in a light industrial/manufacturing area. The RERC will consist of two aero-derivative combustion turbine generators with SCRs, an on-site substation, approximately 1.75 miles of 69kV transmission line, natural gas and water supply interconnection, and on-site administration building and warehouse. The power plant and associated administration building and warehouse will occupy approximately 8 of 12 acres with the additional 4 acres reserved for equipment storage and construction parking. The entire plant perimeter will be fenced with a combination of chain-link fencing and architectural block walls.

6.5.2 Laws, Ordinances, Regulations and Standards

LORS applicable to geologic resources and hazards are summarized in Table 6.5-1.

Table 6.5-1 Geologic Resources and Hazards

Jurisdiction	Authority	Administering Agency	Compliance
State/Local	California Building Code (CBC), 2001	City of Riverside	Design criteria for structures regarding seismic design and load bearing capacity
State/Local	California Government Code, Section 53091	City of Riverside	Exempts project facilities for the generation and production of electrical energy by a local public agency from County and City building ordinances
Local	City of Riverside General Plan	City of Riverside	To the extent not exempted by Section 530091, The City shall require compliance with applicable elements of the General Plan

6.5.3 Setting

6.5.3.1 Regional Geology

RERC is located near the northern end of a large geomorphic province of southern California characterized by the presence of numerous, northwestern trending, small mountain ranges and intervening plains and valleys, referred to in the geologic literature as the Peninsular Ranges geomorphic province. The nearest of these northwest trending ranges of the Peninsular Ranges are the San Jacinto Mountains to the east, with the Santa Ana Mountains to the southwest. The Peninsular Ranges province abuts to the north against a series of east-west trending mountain ranges, which comprise the Transverse Ranges geomorphic province and extends southeastward into the Baja California peninsula. The east-west trending mountain ranges consist of the San Gabriel and San Bernardino Mountains to the north of the site.

The intervening valley between the Santa Ana and San Jacinto Mountains is the Perris Plain, a mass of igneous rocks consisting of island-like hills of plutonic rocks surrounded by valleys filled with various ages of alluvium derived from erosion of the surrounding mountain ranges. The plutonic rocks of the Perris Plain consist predominately of tonalite, granodiorite and quartz diorite, with many similar igneous rock varieties and lesser amounts of metamorphic and volcanic rocks. Long term erosion of the Perris plain has resulted in the more resistant rock types elevated above the remaining elevation, and the infilling of these areas with various types and ages of alluvium. The Pedley Hills, approximately 1.9 kilometers (1.2 miles) north of the site, and the Jurupa Mountains, approximately 5.6 kilometers (3.5 miles) north of the site, are an example of the more resistant bedrock composed of granodiorite and older metamorphic rocks.

The Perris plain is considered to be internally stable, however it is bounded on the north, west and east by active faults. These are the Cucamonga fault, on the north, the San Jacinto fault on the east, and the Whittier-Elsinore fault on the western margin.

The nearest known active earthquake fault, in relation to the subject site, is the San Jacinto fault located approximately 17.2 kilometers (10.7 miles) to the northeast. Approximately 7 kilometers (4.3 miles) north-northwest of the site there is a linear cluster of small seismic events occurring along what is suspected to be a northeast trending fault. This fault has no known surface trace and is only suspected due to the seismicity and an elevation difference in groundwater levels noted on either side of this feature. Other faults in the region include the Whittier-Elsinore fault, the Cucamonga fault and the San Andreas Fault.

The geology of the site and surrounding region is mapped by Morton and Cox (2001).

6.5.3.2 Local Geology

Subsurface exploration and previous published literature indicate that igneous bedrock deposits underlie the subject site. A thin layer of fill materials occurs across portions of the site. These units are described in further detail in the following sections.

6.5.3.3 Surficial Deposits

<u>*Fill:*</u> As observed within six of 29 exploratory borings placed across the site, fill materials were noted to be exposed at the surface and were encountered to depths of approximately 1.5 feet below the existing ground surface. These fills primarily consist of silty sand that was observed to be light brown, dry and loose. These materials appear to be the result of past grading activities at the site as well as site discing for weed abatement.

<u>*Bedrock:*</u> Underlying the fill at the site as observed within six of 29 exploratory borings and exposed at the surface within the remainder of borings, was igneous bedrock. Igneous bedrock was encountered to the maximum depth explored of approximately 36.5 feet below the existing ground surface. The bedrock materials were noted primarily to consist of coarse-grained quartz diorite. These materials were slightly to moderately weathered at the surface and became much less weathered quickly with depth. However, several areas of rooted and stockpile cornerstones or "floaters" were observed across the site. These areas were noted to be slightly weathered and very hard. It appears that the past grading conducted at the site worked around the rooted boulders while the numerous corestone or "floaters" present were unrooted during the grading and stockpiled around the rooted boulders. Within borings, the bedrock typically recovered as silty sand to well graded with silt. These units were typically damp to moist and gray to speckled gray-white in color. Equivalent Standard Penetration Test data, in-place density test data and

CPT data indicated that these units become hard to very hard beginning at a depth of approximately 0.75 to 1.5 feet. Refusal was experienced within three of our 29 exploratory borings ranging from depths of approximately 11.5 to 33 feet beneath the existing ground surface.

6.5.3.4 Groundwater Hydrology

Perched groundwater was encountered within 15 of 29 exploratory borings at the site. Depths ranged from approximately 11 to 25.8 feet beneath the ground surface. This corresponds to elevations ranging from approximately 695.5 feet above mean sea level (msl) to 715 feet above msl. The groundwater levels recorded were at the time of the borings and were not monitored. Data indicates that the groundwater follows the regional topography and is generally to the north-northwest towards the Santa Ana River. No groundwater seepage was observed during site reconnaissance.

The City of Riverside Public Utilities, Water Department was contacted to establish the hydrologic conditions at the site. The City of Riverside, Public Utilities, Water Department that would supply water to the site indicated they have no wells in the area of the site. They referred questions on groundwater to the Western Municipal Water District, (WMWD). WMWD has indicated there are no wells in the area of the site. WMWD also indicated there is no true groundwater table at the site due to the shallow bedrock. Groundwater would be encountered as infilling of cracks and fissures.

6.5.3.5 Mass Movement

The majority of the site is comprised of a relatively flat surface. The occurrence of mass movement failures such as landslides, rockfalls or debris flows within such areas are generally not considered common and no evidence of mass movement was observed on the site.

6.5.3.6 Faulting

No active or potentially active faults are known to exist at the subject site. In addition, the subject site does not lie within a current State of California Earthquake Fault Zone (Hart, 1997).

The closest known active fault is the San Bernardino segment of the San Jacinto fault zone, located approximately 17.2 kilometers (10.7 miles) to the northeast. In addition, other relatively close active faults include the Whittier-Elsinore fault zone located approximately 18.8 kilometers (11.7 miles) to the southeast, the Cucamonga fault, located approximately 21.9 kilometers (13.6 miles) to the north, and the San Bernardino segment of the San Andreas fault zone, located approximately 28.2 kilometers (17.5 miles) to the northeast.

The San Jacinto fault zone is a sub-parallel branch of the San Andreas Fault zone, extending from the northwestern San Bernardino area, southward into the El Centro region. This fault has been active in recent times with several large magnitude events. It is believed that the San Jacinto fault is capable of producing an earthquake magnitude on the order of 6.5 or greater.

The Whittier-Elsinore fault zone is one of the largest in southern California. At its northern end, it splays into two segments and at its southern end, it is cut by the Yuba Wells fault. The primary sense of slip along the Elsinore fault is right lateral strike-slip. It is believed that the Elsinore fault zone is capable of producing an earthquake magnitude on the order of 6.5 to 7.5.

The Cucamonga fault is considered part of the Sierra Madre fault system, which marks the southern boundary of the San Gabriel Mountains. This is a north dipping thrust fault, which is believed to be responsible for the uplift of the San Gabriel Mountains. It is believed that the Cucamonga fault is capable of producing an earthquake magnitude on the order of 7.0 or greater.

The San Andreas Fault is considered the major tectonic feature of California, separating the Pacific Plate and the North American Plate. While estimates vary, the San Andreas fault is generally thought to have an average slip rate on the order of 24mm/yr and capable of generating large magnitude events on the order of 7.5 or greater.

Past standards of practice included a discussion of all potential earthquake sources within a 100-kilometer (62 mile) radius. However, while there are other large earthquake faults within a 100-kilometer (62 mile) radius of the site, none of these is considered as relevant to the site as the faults described above, due to their closer distance and larger anticipated magnitudes.

6.5.3.7 Historical Seismicity

In order to obtain a general perspective of the historical seismicity of the site and surrounding region a search was conducted for seismic events at and around the area within various radii. This search was conducted utilizing the historical seismic search program by EPI Software, Inc. This program conducts a search of a user selected cataloged seismic events database, within a specified radius and selected magnitudes, and then plots the events onto an overlay map of known faults. For this investigation the database of seismic events utilized by the EPI program was obtained from the Southern California Seismic Network (SCSN) available from the Southern California Earthquake Center. At the time of our search, the database contained data from January 1, 1932, through December 23, 2003.

A search regarding the general seismicity of the region was conducted by selecting an epicenter map listing all events of magnitude 4.0 and greater, recorded since 1932, within a 100-kilometer (62-mile) radius of the site, in accordance with guidelines of the California Division of Mines and Geology. This map illustrates the regional seismic history of moderate to large events. The site lies within a relatively active region associated with the Elsinore and San Jacinto fault zones trending northwest to southeast. Of these events, the closest was a magnitude 4.0 located approximately 9 kilometers (5.6 miles) to the southeast of the site.

A second regarding the micro seismicity of the area lying within a 15 kilometer (6.2 mile) radius of the site was examined by selecting an epicenter map listing events on the order of 0.0 and greater since 1978. In addition, only the "A" events, or most accurate events were selected. Caltech indicates the accuracy of the "A" events to be approximately 1 km. The result of this search is a map that presents the seismic history around the area of the site with much detail, not permitted on the larger map. The reason for limiting the events to the last 25 years on the detail map is to enhance the accuracy of the map. Events recorded prior the mid 1970s are generally considered less accurate due to advancements in technology. The San Jacinto fault appears to be the source of numerous events. In addition to these events, there is a distinct band of very small seismic events trending northeast to southwest approximately 7 kilometers (4.3 miles) to the north-northwest of the site. While this very wide band nearly 5 to 7 km (3 to 4 miles) is not known to be associated with any surface fault features, it may represent the far northwestern end of a buried fault believed to be associated with a groundwater barrier that lies to the north-northwest in the Fontana region.

6.5.4 Impacts

The historical seismicity of the site entails numerous small to medium magnitude earthquake events occurring around the subject site, predominately associated with the presence of the San Jacinto fault. Any future developments at the subject site should anticipate that moderate to large seismic events could occur very near the site.

Other secondary seismic hazards generally associated with severe ground shaking during an earthquake include liquefaction, seiches and tsunamis, earthquake induced flooding, landsliding and rockfalls, and seismic-induced settlement.

Liquefaction: The potential for liquefaction generally occurs during strong ground shaking within fine-grained loose sediments where the groundwater is usually less than 50-feet. As the site is underlain at very shallow depths by hard to very hard, igneous bedrock, based on our subsurface field investigation, the possibility of liquefaction at the site is considered nil.

Seiches/Tsunamis: The potential for the site to be effected by a seiche or Tsunamis (earthquake generated wave) is considered nil due to absence of any large bodies of water near the site.

Flooding (Water Storage Facility Failure): There are no large water storage facilities located on or near the site, which could possibly rupture during in earthquake and effect the site by flooding.

Seismically Induced Landsliding: Due to the low relief of the site and surrounding region and presence of igneous bedrock, the potential for landslides to occur at the site is considered nil.

Rockfalls: No large, exposed, loose or unrooted boulders are present above the site that would affect the integrity of the site.

Seismically Induced Settlement: Settlement generally occurs within areas of loose, granular soils with relatively low density. Since the site is underlain at very shallow depths by hard to very hard igneous bedrock, the potential for settlement is considered low, however the earthwork operations during the development of the site will most probably mitigate any such loose soil conditions.

Table 6.5-2 summarizes results of the CEQA Environmental Checklist for geology.

Table 6.5-2 CEQA Environmental Checklist for Geology

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
Geology – Would the Project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving the following:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area based on other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42.				x
ii) Strong seismic ground shaking.		x[1]		
iii) Seismic-related ground failure, including liquefaction.				x
iv) Landslides.				x
b) Result in substantial soil erosion?				x
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse due to the loss of topsoil?				x

	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				x
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?				x
Mineral Resources - Would the Project:				
a) Result in the loss of availability of a locally important mineral resource that would be of value to the region and the residents of the state?				x
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?				x

1- Due to the site's location, there is a high potential for strong to very strong ground shaking from an earthquake on a nearby fault. Mitigation measures given in this report and in the California Building Code should be strictly adhered to.

6.5.5 Mitigation

Potential impacts related to strong seismic ground shaking should be minimized by employing the following measure: Design and construct the Project to conform to California Building Code (CBC) requirements for Seismic Zone 4. Effective implementation of this mitigation measure would reduce any reasonably foreseeable direct, indirect, or cumulative adverse impacts to an insignificant level.

6.5.6 Permits Required

No permits that specifically address geologic resources and hazards were identified.

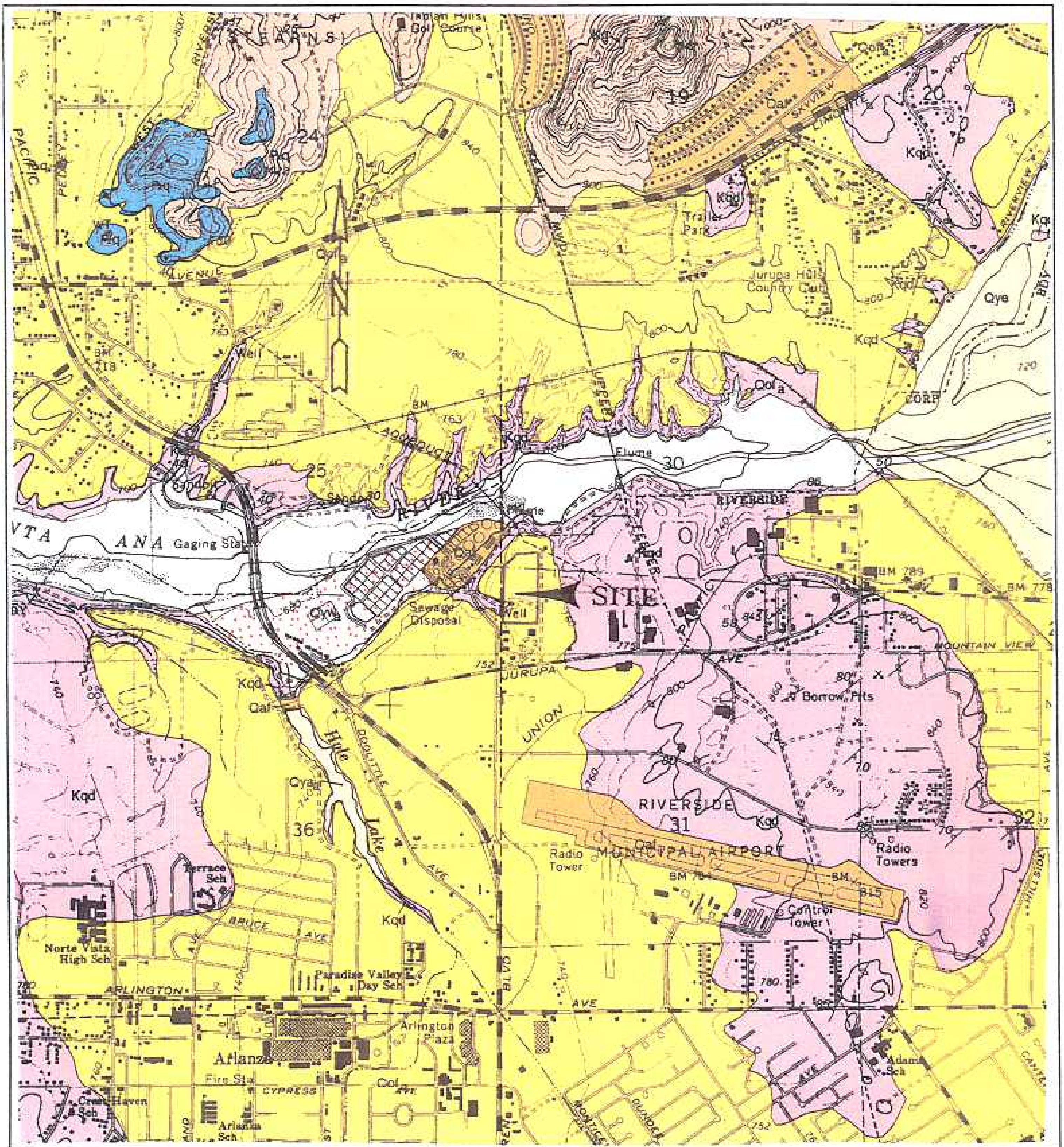
6.5.7 References

California Building Standards Commission and International Conference of Building Officials, 2001, California Building Code, 2001 edition.

Hart, E.W. and W.A. Bryant, 1997, Fault-rupture hazard zones in California, California Department of Conservation Division of Mines and Geology Special Publication 42.

International Conference of Building Officials, 1997, Uniform Building Code, 1997 edition.

Morton, D.M. and Cox, B.F., 2001, Geologic Map of the Riverside West 7.5' Quadrangle, Riverside County, California, v. 1.0, Open File Report 01-451.



REGIONAL GEOLOGIC MAP (Morton and Cox, 2001)

PROJECT:	ACORN GENERATION PROJECT, RIVERSIDE, CALIFORNIA	PROJECT NO.:	61833.1
CLIENT:	POWER ENGINEERS	ENCLOSURE:	A-3
LOR Geotechnical Group, Inc.		DATE:	JANUARY 2004
		SCALE:	1" = 2,000'

Qaf

Artificial fill (late Holocene)—Deposits of fill resulting from human construction or mining activities. Largest areas are in north-central part of quadrangle related to grading associated with residential development and airport runway construction

Qof

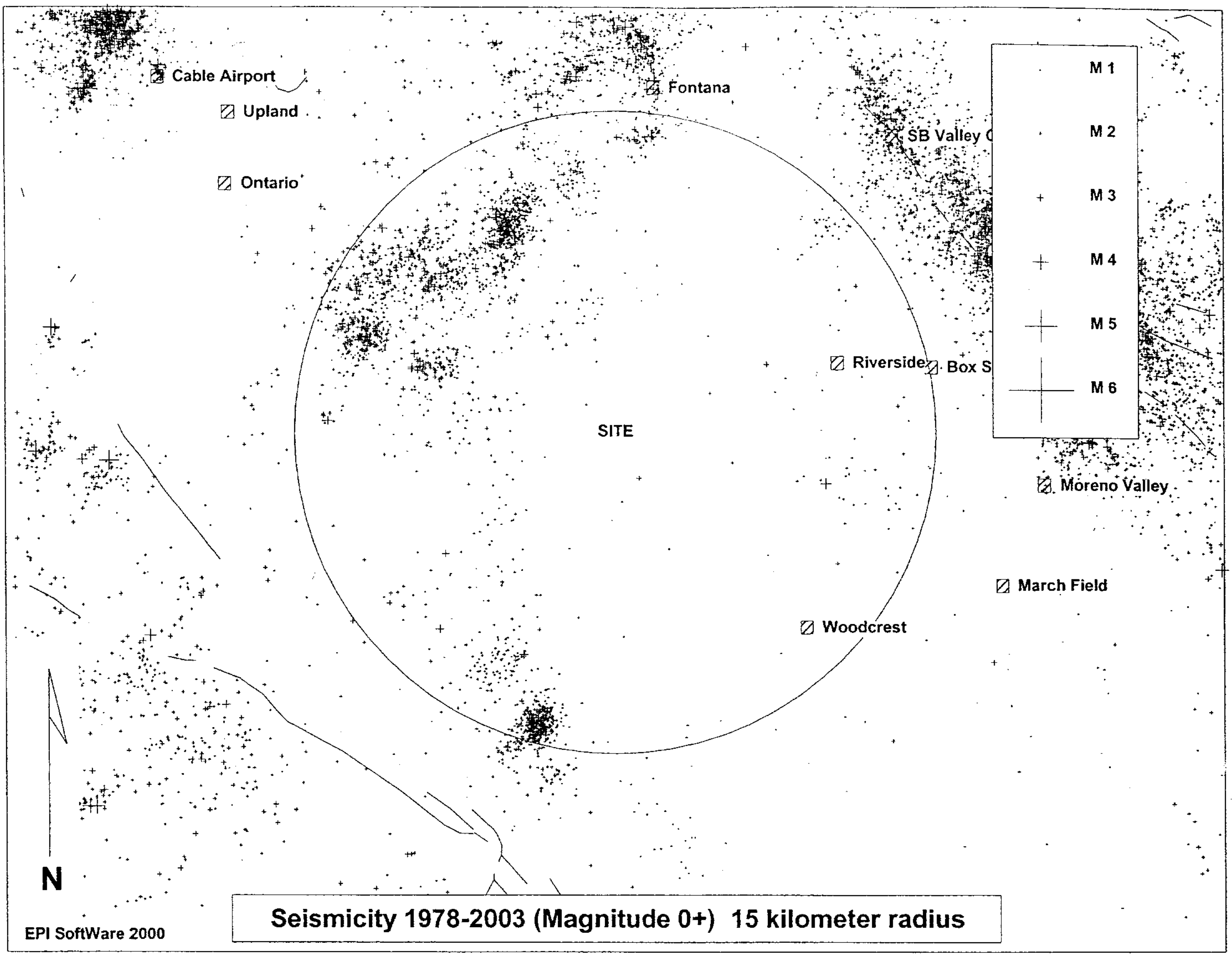
Old alluvial fan deposits (late to middle Pleistocene)—Indurated, to slightly indurated, sandy, alluvial fan deposits. Covers extensive areas north and south of Santa Ana River. Most of unit is slightly to moderately dissected and reddish-brown. Locally includes thin, discontinuous surface layer of Holocene alluvial fan material

Kqd

Quartz diorite (Cretaceous)—Medium- to coarse-grained biotite-hornblende quartz diorite. Most is slightly to well foliated and contains discoidal to pancake-shaped melanocratic inclusions in foliation plane. Grades into diorite and biotite-hornblende tonalite. Exposed extensively in La Sierra Heights area and around Riverside airport

DESCRIPTION OF GEOLOGIC UNITS (Morton and Cox, 2001)

PROJECT:	ACORN GENERATION PROJECT, RIVERSIDE, CALIFORNIA	PROJECT NO.:	61833.1
CLIENT:	POWER ENGINEERS	ENCLOSURE:	A-4
LOR Geotechnical Group, Inc.		DATE:	JANUARY 2004
		SCALE:	NO SCALE



SITE LOCATION: 33.9624 LAT. -117.45282 LONG.

MINIMUM LOCATION QUALITY: A

TOTAL # OF EVENTS ON PLOT: 11136

TOTAL # OF EVENTS WITHIN SEARCH RADIUS: 3077

MAGNITUDE DISTRIBUTION OF SEARCH RADIUS EVENTS:

0.0- .9 : 306
1.0- 1.9 : 2445
2.0- 2.9 : 311
3.0- 3.9 : 15
4.0- 4.9 : 0
5.0- 5.9 : 0
6.0- 6.9 : 0
7.0- 7.9 : 0
8.0- 8.9 : 0

CLOSEST EVENT: 1.5 ON WEDNESDAY, JULY 24, 2002 LOCATED APPROX. 1.8 KILOMETERS NORTHWEST OF THE SITE

LARGEST 5 EVENTS:

3.6 ON SATURDAY, JANUARY 30, 1999 LOCATED APPROX. 13 KILOMETERS NORTH OF THE SITE
3.5 ON TUESDAY, JANUARY 24, 1995 LOCATED APPROX. 10 KILOMETERS EAST OF THE SITE
3.4 ON SUNDAY, MARCH 25, 2001 LOCATED APPROX. 14 KILOMETERS NORTHWEST OF THE SITE
3.4 ON WEDNESDAY, JULY 27, 1994 LOCATED APPROX. 11 KILOMETERS NORTHWEST OF THE SITE
3.2 ON TUESDAY, JANUARY 20, 1998 LOCATED APPROX. 11 KILOMETERS SOUTHWEST OF THE SITE