Appendix F

Geological and Seizmic Assessment

Geologic & Seismic Hazards Assessment
New Elementary School
Northwest Corner of
19th and Cinnamon Avenues
Lemoore, California

BSK JOB 03-23-0063

Submitted to:

Lemoore Elementary School District

October 19, 2002

BSK

BSK

567 W. Shaw Ave., Ste. B
Fresno, CA 93704
(559) 497-2880
FAX (559) 497-2886

October 19, 2002

BSK Job 03-23-0063

Mr. Ron Meade, Superintendent
Lemoore Elementary School District
100 Vine Street
Lemoore, California 93245

SUBJECT: Geologic and Seismic Hazards Assessment
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

Dear Mr. Meade:

The enclosed geologic and seismic hazards assessment for the subject site has been prepared by BSK Associates, pursuant to your request and authorization and in accordance with BSK's Proposal 03-23-0063, dated August 19, 2002. A companion geotechnical engineering report for the school site, has been submitted under separate cover. These reports complete BSK's scope of services.

BSK appreciates the opportunity to be of service to Lemoore Elementary School District. Please contact us if you have questions or need additional information.

Respectfully submitted,
BSK ASSOCIATES

John H. Kirk C.E.G.
Senior Engineering Geologist

CERTIFIED ENGINEERING GEOLOGIST
JOHN KIRK
No. 964
GEOLOGY
STATE OF CALIFORNIA

JHK/cle

Enclosure

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EXECUTIVE SUMMARY

This report presents the results of BSK Associates geologic and seismic hazard assessment for a new elementary school to be located at the northwest corner of 19th Avenue and Cinnamon Drive. Residences are located east and south of the site. Agricultural properties are located west and north of the site.

Numerous active and potentially active faults are present within the 100-mile search radius of the site and considered capable of causing significant ground motion. The greatest occurrence of earthquakes has been and likely will continue to be associated with the active San Andreas Fault System located 74 kilometers southwest of the site, as well as with seismic activity occurring in the Coast Ranges.

No faults have been mapped crossing the site and the potential for ground rupture is low. The property does not lie within a Fault-Rupture Hazard Zone as identified under the Alquist-Priolo Geologic Hazards Zones Act.

The estimated peak horizontal acceleration at the site due to earthquake ground motion is 0.22 g for the Design Basis Earthquake and 0.26 g for the Upper Bounds Earthquake. The Design Basis Earthquake is used for school design and is the Maximum Probable Earthquake as defined by the 1998 California Building Code, Section 1631A.2 (10% probability of exceedance in 50 years). The Upper Bounds Earthquake is the ground motion more typically used in hospital design and is defined by the California Building Code as the ground motion having a 10% probability of exceedance in 100 years. Ground conditions are conducive to the propagation of destructive seismic waves and the potential hazard of strong ground motion in the vicinity of the site is high.

BSK's preliminary liquefaction analysis indicates that certain portions of the subsurface materials at the site are potentially liquefiable. Seismic settlement is estimated at 0.1 to 0.2 inches.

The site lies within the limits of inundation in the event of a catastrophic failure of Pine Flat Dam.

Based on site location and topographic characteristics, slope failure, ground lurching and volcanic eruption would not likely impact the site.

GEOLOGIC AND SEISMIC HAZARDS ASSESSMENT REPORT
NEW ELEMENTARY SCHOOL
NORTHWEST CORNER OF 19TH AND CINNAMON AVENUES
LEMOORE, CALIFORNIA

1.0 INTRODUCTION

This report presents the geologic and seismic hazards assessment prepared in accordance with Title 24, Chapter 16 requirements for an Engineering Geologic Report. The assessment has been prepared for a new elementary school. The report was prepared by BSK Associates (BSK) on behalf of Lemoore Elementary School District (Owner and Client).

1.1 Objective and Scope of Services

The objective of the geologic and seismic hazards assessment is to provide the Client with an evaluation of potential geologic or seismic hazards which may be present at the site or due to regional influences. BSK's scops of services for this assessment included the following: a review of published geologic literature; an evaluation of the data collected; Deterministic Seismic Hazards Assessment (DSHA); and Probabilistic Seismic Hazards Assessment (PSHA); liquefaction and seismic settlement analyses.

1.2 Site Location

The site is situated at the northwest corner of 19th Avenue and Cinnamon Drive, in Lemoore, California. It is located one-half mile north of Houston Avenue. The site is located in the northeast one-quarter of section 4, township 19 south, range 20 east, Mount Diablo Baseline and Meridian (see Figure 1.1, Vicinity Map and Figure 1.2, Air Photo).

1.3 Site Description and History

Currently the relatively flat site is a vacant disced field. The site is bound by a vacant field to the north, farm land to the east , existing Lemoore Elementary School District Office to the south and residential homes to the west.

The site is located at the western edge of the community of Lemoore, in an area of mixed residential and agricultural properties.

1.4 Project Description

The proposed structures will be one-story, slab-on-grade, wood frame construction, with wood trusses and built-up roofing. We understand that there will be parking areas. A minor amount of grading is anticipated to provide a relatively level pad and proper drainage.

1.5 Latitude and Longitude

The site is centered at latitude 36.3066 and longitude 119.8000, as shown on the "Lemoore, California" U.S.G.S. 7.5 minute topographic quadrangle map (dated 1954, see Figure 1.2).

2.0 PHYSIOGRAPHY, SOIL AND GROUNDWATER CONDITIONS

The following sections describe the physiography, soil and groundwater conditions regionally and for the school site.

2.1 Site Physiography

Site topography is essentially flat, with an average ground surface elevation of approximately 222 feet, USGS datum (as interpolated from the 7.5-Minute Lemoore Quadrangle).

2.2 Soil Conditions

BSK performed a field investigation which consisted of performing a site reconnaissance and subsurface exploration. Fourteen borings were drilled during our field investigation conducted on September 5, 6, 9 and 10, 2002 using a truck-mounted drill rig equipped with an 8-inch diameter hollow-stem auger and a 5-inch mud rotary rig. Maximum explored boring depth was 51.5 feet. Standard penetration tests were performed in accordance with ASTM D1586 test procedures. The number of blows required to drive the last 12 inches was recorded as Penetration Resistance (blows/foot) on the logs of borings. Based on the soil boring data, generally, the upper 5 feet of the on-site soils consist of fine to coarse grained silty sand with trace of clay. The upper one (1) foot is considered to be loose. Below 5 feet generally, layers of sand, silty sand, clayey sand and sandy clay were encountered to maximum explored depth of 51. feet.

2.3 Groundwater Conditions

Groundwater was encountered at depths of 10 to 16 feet below ground surface in the borings placed on the school site. To ascertain groundwater levels for use in the liquefaction analyses which follow, a number of sources of information were reviewed. These included information from BSK files and California Department of Water Resources (DWR) water table maps.

BSK has performed a number of geotechnical and environmental engineering investigations in the Lemoore and Lemoore Naval Air Station areas. The nearest of these projects to the site is a service station located approximately one-quarter of a mile to the southwest. This project included test hole borings, the installation of monitoring wells and monitoring water levels on a quarterly basis since 1992. Water surface elevations have ranged from 204.30 to 209.26, equivalent to depths of 12.26 to 7.30 feet below ground surface. DWR water table hydrographs of water levels for the shallow and deeper regional groundwater levels are presented as Figure 2.3.

3.0 SEISMIC HAZARD ASSESSMENT

The following sections present background information and data leading to a determination of ground motion (peak ground acceleration), duration of shaking, and probability of occurrence of future earthquake activity producing ground motion at the Site. A determination of ground motion is made using earthquake history of a region (seismicity); the potential for earthquake activity along one or more "controlling" earthquakes using a deterministic approach; the probability of occurrence of ground motion at the Site from a fault occurring within a pre-determined radius (in this case, 100 miles) using a probabilistic approach; and, ground motion in an area from published sources such as probabilistic seismic hazard maps produced by the California Geological Survey (CGS).

3.1 Geologic Setting

The site is located in the south central portion of the San Joaquin Valley, a broad topographic and structural trough in Central California. The Valley is bordered on the east by the Sierra Nevada and on the west by the Coast Ranges. The structural floor of the Valley is asymmetrical, sloping westward to its greatest depth near the western margin of the Valley. The valley fill consists of a sequence of marine and overlying continental sediments, Jurassic to Holocene in age, that reach a thickness of as much as 28,000 feet on the southwest side of the Valley (Page, 1986). Figure 2.1, Regional Geologic Map, shows the distribution of geologic units in the site region. Figure 2.2, Geologic Cross-Section, indicates subsurface geologic conditions perpendicular to the long axis of the valley trough.

The site is situated on Recent age alluvial fan sediments of the Kings River, derived from the Sierra Nevada to the east. These sediments are classified as Younger Alluvium.

3.2 Faults

The State Fault Map of California (Jennings, 1994) shows faults in the region, including the major strike-slip faults associated with the San Andreas Fault System, fault of the California Coast Ranges and faults of the eastern Sierra Nevada. Each of the active faults shown on the fault map (see Figure 3.1 for the Regional Fault Map), occurring within a distance of 100 miles, has been incorporated in the analyses which follow.

A database of fault parameters such as fault geometry (dip slip, strike slip or blind fault), fault length, slip rate, return interval and maximum moment magnitude, used in the seismic hazards analyses, is shown on Table 3.1. The database includes the most current fault parameter information from the CDMG, found on their Internet web site.

For this analysis, a search radius of 100 miles was used. Distances to the faults are shown on Table 3.3. Faults with the greatest potential to produce strong ground motion at the Site are described below.

Basin and Range - Sierra Nevada Faults

Active and Potentially Active faults on the east side of the Sierra Nevada (associated with continuing mountain building of the Sierra) include the Owens Valley Fault, the Sierra Nevada Fault Zone, the White Mountains Fault Zone and a number of smaller faults with tectonically related activity, including the Independence, Hartley Springs, Hilton Creek, Panamint Valley, Deep Springs, Round Valley, Robinson Creek and faults and earthquake activity associated with potential volcanism in the Long Valley Caldera, the Mono Craters Caldera and Inyo Craters. The Owens Valley Fault was responsible for generating the 8+ magnitude earthquake occurring in 1872.

Owens Valley Fault length:	*121 km*
Fault slip rate:	*1.5 mm/year*
Earthquake return interval:	*4,000 years*

Great Valley Fault System

The Great Valley Fault System is a topic of ongoing research which primarily commenced with the Coalinga Earthquake of 1983, attributed to the system. Fault plane solutions for the Coalinga Earthquake sequence suggest a northwest strike with either a steep northeast dip or shallow northwest dip (Eaton et al., 1983). Eaton (1985b) proposed that the main Coalinga earthquake, as well as the 1985 North Kettleman Hills earthquake (1985a), occurred on a shallow westward dipping thrust fault and slip was induced on northeast and southwest dipping reverse faults in the plate overlying the thrust fault. Namson and Davis (1988) interpret an approximately 200 km long zone of folds (anticlines and synclines) along the southwestern margin of the San Joaquin Valley as an actively developing fold and thrust belt. Namson and Davis (1988) attribute the seismically active Coalinga and Kettleman Hills North Dome anticlines to fault-bend folding above a thrust fault, which does not reach the surface (blind thrust).

Wong et al. (1988) indicated that geologic evidence suggests that the Boundary is not a single fault but a complex zone of faulting with the potential of generating large earthquakes (such as the Richter Magnitude 6.7 Coalinga earthquake) over most of its length.

Great Valley Fault Segment 14 length:	*24 km*
Fault slip rate:	*1.5 mm/year*
Earthquake return interval:	*414 years*

White Wolf Fault

The approximately 67 kilometer long White Wolf Fault is traceable in the southern San Joaquin Valley from Tehachapi Canyon southwestward along the base of the northwest face of Bear Mountain to a point where it disappears beneath alluvium near Wheeler Ridge. Subsurface data indicate that it is overridden by the Pleito Thrust Fault (Wesnousky, 1986). Displacement is left-lateral and reverse with a maximum vertical displacement of 10,000 feet near Sycamore Canyon.

The initial shock and subsequent aftershocks associated with a Magnitude 7.7 earthquake on the White Wolf Fault in 1952 effected all of Kern County and parts of Los Angeles and Santa Barbara Counties. The earthquake caused many landslides and damaged highways, bridges, and railroads. Destruction was extensive in cities near the fault. The initial shock and aftershocks caused significant damage to structures in Bakersfield. The 1952 Arvin-Tehachapi Earthquake was the largest earthquake in California since 1906 and the largest in Southern California since 1857. According to Iacopi (1972):

> It was felt over an area of some 160,000 square miles and awakened people (4:52 a.m.) throughout the southern part of the state. The surface of the earth was ruptured for 17 miles between Arvin and Caliente. There were only twelve deaths; ten were in Tehachapi. The general low-population density of the area and the early hour of the shock are responsible for this surprisingly small total. The maximum intensity was confined to a small area southeast of Bealville. The towns of Tehachapi and Arvin suffered heavy structural damage, but it was mostly confined to older brick and adobe buildings that were not adequately reinforced. Most wood-frame buildings in good structural condition withstood the shocks with very little damage, regardless of the type of rock foundation on which they stood...Several hundred aftershocks were recorded over a period of months; more than twenty had a magnitude of five or greater. The most severe of these occurred on August 22; its magnitude was only 5.8, but the epicenter was close to Bakersfield and the intensities in that town were greater than during the July 21 shock. In addition, this aftershock struck an area of downtown Bakersfield that had been substantially weakened by earlier quakes. The result was two more deaths and millions of dollars of property damage within the city.

White Wolf Fault length:	*67 km*
Fault slip rate:	*2.0 mm/year*
Earthquake return interval:	*839 years*

San Andreas Fault Zone

The San Andreas Fault System is one of California's most prominent structural features, with a length of approximately 1,000 miles extending from Cape Mendocino to the Salton Sea. The System has been divided into segments by several authors (e.g., Wallace, 1970; Sieh and Jahns, 1984) based on tectonic behavior, trace configuration and long-term slip rates. Three partially overlapping segments presented by Wesnouski (1986) pose earthquake hazards to the site. These segments extend southeastward from Slack Canyon, which represents the closest portion of the fault segments to the site. The portion of the San Andreas Fault system north of Slack Canyon is considered to be creeping and aseismic (Burford and Harsh, 1980). The first segment extends from Slack Canyon to Chalome. Wesnouski (1986) indicates that this fault segment is capable of generating an earthquake of Magnitude 6.6. The second segment extends from Cholame to Highway 58 and is believed to be capable of generating an earthquake of Magnitude 7.0. The third and longest segment is located between Highway 58 and Cajon Pass. This segment is described as capable of generating a Magnitude 7.7 earthquake.

San Andreas Fault length:	*345 km*
Fault slip rate:	*34.0 mm/year*
Earthquake return interval:	*206 years*

"Unrecognized Seismic Systems"

Several of the more destructive earthquakes occurring in the last several decades have resulted from fault activity on previously unknown faults. Examples include the Coalinga and North Ridge Earthquakes. The Division of Safety of Dams (DSOD) and other state agencies attempt to account for future earthquakes arising on unforseen and unmapped faults by providing minimum earthquake which may occur near any site in California. The criteria used is a Magnitude 6.5 earthquake producing a ground motion of 0.20g arising from a fault located 8 miles from the site. These ground motion parameters were used in the liquefaction analyses described below.

3.3 Seismicity

Figure 3.3 and Table 3.2 provide the location, earthquake magnitude, Site to earthquake distances, dates and the resulting Site peak horizontal acceleration and the estimated Modified Mercalli Scale of Intensity for the period 1800 to 2002. The Modified Mercalli Scale is presented as Figure 3.2. The table shows that the Site has experienced peak horizontal accelerations up to 0.20g from the Coalinga earthquake of 1983, 0.19g from the San Andreas Fault, and 0.13g from the Owens Valley earthquake of 1872 from the Owens Valley Fault and Site intensities up to VIII.

3.4 Upper Bounds Earthquake (UBE)

The Upper Bound Earthquake (UBE), is defined in Section 1629B.2.6 of the 1998 California Building Code (CBC) as "the motion having a 10% probability of being exceeded in a 100-year period or maximum level of motion which may ever be expected at the building Site within the known geological framework." The UBE, which represents a return period of 949 years, is typically used for hospital design. The UBE, formerly known as the Maximum Credible Earthquake (MCE), is the largest rational and believable magnitude earthquake that can occur within the presently known tectonic framework (CDMG Note 43). The UBE can be determined in a number of ways, including: reviewing the available current literature to determine what research has been done on a specific fault, performing an intensive field investigation (typically more comprehensive than the CDMG Note 49 guidelines for the investigation of a fault), or through the use of empirical relationships which have been developed between the length of surface fault rupture resulting from historic earthquakes and earthquake magnitude (such as Bonilla and others, 1984). The faults in the region have been intensively studied and there is a considerable body of information available to estimate the UBE. The primary reference source in defining the UBE is "California Fault Parameters" data published in CDMG Open-File Report 96-08 (and regularly updated by the CDMG on their WWW site).

3.5 Maximum Probable Earthquake (MPE)

The Maximum Probable Earthquake or MPE is defined in Section 1629A.2 of the 1998 CBC as "the motion having a 10% probability of being exceeded in 50 years. This is also known as the Design Basis Earthquake (DBE). The MPE is typically used for school design. The return period for the MPE is 475 years. It is also understood that the magnitude shall not be lower than the maximum that has occurred within historic time (DMG Note 43).

3.6 Results of the Seismic Hazards Analysis

Deterministic Seismic Hazards Analysis Ground Motion

A Deterministic Seismic Hazards Analysis (DSHA) includes the evaluation of potentially damaging earthquake sources and deterministic selection of one or more suitable "controlling" sources and seismic events. The earthquake event magnitude for a fault is taken as the maximum value that is specific to that seismic source. Ground motion at the site is then obtained from published ground motion attenuation curves for the effects of seismic travel path using the shortest distance from the source to the site. To estimate ground motions from controlling earthquakes, a computer database of faults and attenuation relationships is used. The database includes locations and fault parameters for more than 150 faults in California and includes the most current fault data and locations. The database includes a number of attenuation relationships. The relationship selected as most appropriate for this site is from Boore et al., 1993.

Possible earthquakes from controlling faults were used for our analysis: the San Andreas and Great Valley. A review of other faults found within 100 miles of the site (see Table 3.1 for a list and Table 3.3 for distances) indicate a low potential for generating strong ground motion at the site due either to distance to the site or low activity of the fault.

Table 3.3 and Figure 3.5 provide estimated UBE and DBE magnitudes resulting from earthquakes occurring on active and potentially active faults and fault systems within approximately 100 miles of the site. The table indicates that the peak horizontal ground acceleration from the deterministic analysis is 0.21 g, corresponding to a site Mercalli Intensity of VIII. The San Andreas and Great Valley Faults generate similar ground motions.

Probabilistic Seismic Hazards Analysis Ground Motion

The Probabilistic Seismic Hazards Analysis (PSHA) differs from the DSHA in considering fault activity and the probability of occurrence from multiple fault sources. In this way, low activity faults are considered to have a lower potential for generating ground motion at a site than higher activity faults.

The PSHA computes ground accelerations for various probability of exceedance values. A graph of Probability of Exceedance vs. Acceleration computed from the PSHA is presented as Figure 3.6. This shows that the peak ground acceleration from the Design Basis Earthquake is approximately 0.22 g, and the PGA for the Upper Bounds Earthquake is approximately 0.26 g.

3.7 State of California - Probabilistic Seismic Hazards Map

The California Division of Mines and Geology, in cooperation with the U.S. Geological Survey, performed a probabilistic seismic hazards study for the entire State. Their computed results are summarized on a map reproduced here as Figure 3.7. Figure 3.7 shows that the site area is in a region of relatively moderate ground motions, in the range of 0.20 to 0.30 g. This is consistent with the findings of our site-specific Deterministic Seismic Hazards Assessment, described in previous sections, which derived a peak ground acceleration of 0.22g for 10% in 50 year recurrence interval earthquake.

3.8 Summary of Methods to Determine Ground Motion

Following is a summary of peak ground accelerations for the Site determined by the methods described above.

Seismicity:	0.20g (Coalinga Earthquake of 1983)
DSHA:	0.21g (UBE)
DSHA:	0.17g (DBE)
PSHA:	0.22g (10% in 50 year exceedance)
CDMG PSHA Map:	0.20g to 0.30g (10% in 50 year exceedance)
Minimum for Central Valley Sites:	0.20g

3.9 Duration of Strong Ground Motion

The duration of strong ground motion can have a strong influence on earthquake damage and liquefaction potential. The degradation of stiffness and strength of structures and the buildup of porewater pressures in loose, saturated sands, are correlated with the number of stress reversals that occur during an earthquake. As the length of fault rupture increases, the time required for rupture increases. Consequently, the duration of strong motion increases with increasing earthquake magnitude. With increase in distance from the source, the accelerations decrease and, hence the duration. At sufficient distance from the earthquake source, the duration strong ground motion reduces to zero. An earthquake accelerogram typically contains a record of accelerations from the time the earthquake begins until the time the motion has returned to the level of background noise.

For engineering purposes, only the strong-motion portion of the accelerogram is of interest. The "bracketed" duration is defined as the time between the first and last exceedances of a threshold acceleration (usually 0.05 g). The bracketed duration for deep soil sites is usually longer than that for shallow rock sites. Using a 0.05g threshold acceleration, Chang and Krinitszky (1977) estimated the bracketed durations. Based on the bracketed durations of strong ground motions for earthquakes arising on faults of interest, as shown on Table 3.4, the anticipated bracketed duration for strong ground motion is up to 19 seconds.

4.0 GEOLOGIC/SEISMIC HAZARDS

The types of geologic and seismic hazards assessed include surface ground fault rupture, liquefaction, seismically-induced settlement, slope failure, volcanic hazards, flood hazards, inundation hazards and tsunamis.

4.1 Fault Rupture Hazard Zones in California

The purpose of the Alquist-Priolo Geologic Hazards Zones Act, as summarized in CDMG Special Publication 42 (SP 42), is to "prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture."

As indicated by SP 42, "the State Geologist is required to delineate "earthquake fault zones" (EFZs) along known active faults in California. Cities and counties affected by the zones must regulate certain development 'projects' within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. SP 42 also provides definitions of certain terms which are important to the evaluation of seismic hazards. These include the definitions for a fault and a fault trace, as follows:

> *Active Fault:* One which has had surface displacement within Holocene time (about the last 11,000 years), hence constituting a potential hazard to structures located across it.
>
> *Potentially Active Fault:* Initially, faults were defined as *potentially active*, and were zoned, if they showed evidence of surface displacement during Quaternary time (last 1.6 million years). The term "recently active" was not defined, as it was considered to be covered by the term "potentially active."...the term "potentially active" continued to be used as a descriptive term on map explanations on EFZ maps until 1988.

The site lies in the "Lemoore, California" 7.5 minute U.S.G.S. quadrangle. There are no Fault-Rupture Hazard Zone Maps associated with this quadrangle.

4.2 Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained, granular soils subjected to high intensity ground shaking behave like a fluid, losing essentially all strength. Liquefaction occurs when three general conditions exist simultaneously: 1) shallow groundwater; 2) low-density silty or fine sandy soils; and 3) high-intensity ground motion. Since the existing groundwater level at the site is relatively shallow, and sands and silty sands were encountered in the depth of investigation in a 50-foot deep boring conducted by BSK at the site, liquefaction calculations were performed for the site.

Liquefaction analyses were performed assuming the shallowest groundwater depth of 10 feet and incorporating information from the boring logs. Three possible earthquake events were modeled. The first was a Magnitude 8.0 earthquake occurring on the San Andreas Fault at a distance of 46 miles with a peak ground acceleration of 0.26 g (peak acceleration from the PSHA); The second was a Magnitude 6.4 earthquake occurring on the Great Valley Fault; and, the third was the Division of Safety of Dams (DSOD) minimum earthquake of Magnitude 6.5 with a ground motion of 0.20g arising from "unrecognized seismic systems" from a fault located 8 miles from the site.

Maximum settlement was encountered during an earthquake event on the San Andreas afault and liquefaction analyses corresponding to this event was performed, with computations and findings presented in Appendix B. Seismic settlement of the saturated soil layers was found to be approximately 0.1 to 0.2 inches.

4.3 Seismically-Induced Dry Sand Settlement

The previous section described the settlement potential of soils in the saturation zone. This section describes conditions for soils lying above the water table. Settlement of the ground surface with consequential differential movement of structures is a major cause of seismic damage for buildings founded on alluvial deposits. Vibration settlement of relatively dry and loose granular deposits beneath structures can be readily induced by the horizontal components of ground shaking associated with even moderate intensity earthquakes. Silver and Seed (1971) have shown that settlement of dry sands due to cyclic loading is a function of 1) the relative density of the soil, 2) the magnitude of the cyclic shear stress, and 3) the number of strain cycles.

Computer analyses were performed to estimate potential seismically-induced settlement. The analyses were based on the work of Youd (1993) and were performed using two Upper Bounds Earthquake events. These included the Upper Bounds Earthquakes occurring on the San Andreas and Great Valley Faults. Settlement of the non-saturated soils due to earthquake ground motion is negligible.

4.4 Slope Stability and Potential for Slope Failure

The site and surrounding areas are essentially flat and the potential hazard due to landslides from adjacent properties is nil.

4.5 Volcanic Hazards

Volcanism in California is typically associated with the Cascade Ranges and the eastern side of the Sierra Nevada. Although a minor threat, the closest source of potential future volcanic hazards is from the Long Valley Caldera and the Inyo-Mono Craters volcanic chain located near Mammoth Lakes, California. The area of eastern California where these potential volcanic hazards are located has a long history of geologic activity including both earthquakes and volcanic eruptions. This activity is likely to continue into the future. The Long Valley Caldera was created in a violent eruption 760,000 years ago. Clusters of smaller volcanic eruptions have occurred in the area at approximate 200,000 year intervals. Volcanoes in the Mono-Inyo Craters volcanic chain have erupted often over the past 40,000 years. The U.S. Geological Survey (USGS) notes that during the last 5,000 years, an eruption has occurred somewhere along this chain every 250 to 700 years; the most recent eruptions along the volcanic chain took place in the mid-1700s and mid-1800s at Paoha Island in Mono Lake. The next eruption in the Long Valley area will most likely happen somewhere along the Mono-Inyo volcanic chain. The probability of such an occurrence is less than 1% per year, similar to the annual chance of the Upper Bounds Earthquake occurring along the San Andreas Fault.

The USGS forecasts the next eruption to be small and similar to previous eruptions along the Mono-Inyo volcanic chain during the past 5,000 years. They conclude that "if magma reaches the surface, gases trapped within it can escape explosively, hurling volcanic ash as high as 6 miles or more into the air. Airborne volcanic ash can be carried hundreds of miles downwind. Thin accumulations of ash pose little threat to life or property; however, even a light dusting of fine volcanic ash can close roads and seriously disrupt communications and utilities for weeks or months after an eruption. Although the chance of volcanic eruption in any given year is small, future eruptions will occur in the Long Valley area. Volcanic unrest can escalate to an eruption within a time frame of a few weeks or less.

The USGS, in its publication *Potential Hazards from Future Volcanic Eruptions in California*, concludes that the most probable future potential hazard from the Mono Lake - Long Valley Area is for the development of small to moderate volume eruptions that will form flows and small to moderate volumes of ash. "Ash and gases from eruptions are carried away from the vent by prevailing winds. The location and extent of hazard zones for air-fall deposits are determined by the volume of the eruption, the height of the eruption column, and the direction and speed of prevailing winds. The majority of ash beds erupted at volcanoes lie east of their source vents. Winds in the western United States blow toward a direction that is east of a north-south line about 85 percent of the time." The Site is upwind of potential volcanic activity (based on prevailing wind direction). It is unlikely that smaller events will produce ash fallout in the area of the Site. During the violent eruption which occurred 760,000 years ago, the Lemoore area received several feet of ash.

4.6 Flood and Inundation Hazards

An evaluation of flooding at the site includes hazards from flooding during periods of heavy precipitation and flooding due to a catastrophic dam breach from upgradient surface impoundments.

Flood Hazards

A review of the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA) was performed to obtain information regarding the potential for flooding at the site. According to the FIRM that encompasses the site (Community Panel Number 060086 0050 B, dated 1988, the site does not lie within a designated flood zone area. Zone "A" lies adjacent to the property on the west. Zone "A" is defined as areas of 100-year flooding.

Inundation Hazards

Inundation Maps prepared by the U.S. Army Corps of Engineers show that the site lies within the limits of inundation in the event of a catastrophic breach (dam failure) from Pine Flat Dam on the Kings River, the main surface impoundment upgradient from the site. Significant flood waters for a catastrophic breach are defined as water greater than 3 feet deep or moving with a velocity sufficient to sweep a person off their feet (taken as faster than 3 feet/second). It is unlikely that such a failure of the dam would occur.

4.7 Tsunamis and Seiches

A tsunami is a series of ocean waves generated in he ocean by an impulsive disturbance. This disturbance includes earthquakes, submarine or shoreline landslides, volcanic eruptions, and explosions. Tsunamis are not a consideration for this site since the site is so far inland from the ocean. Seiches are standing waves in larger bodies of water. No large body of water is near the site and the hazard is nil.

4.8 County Seismic Safety Element

Earthquake research in the past 20 years has provided a considerable body of new data, making the County Seismic Safety Element inappropriate for use at this site.

5.0 1998 CBC SITE CATEGORIZATION PROCEDURE - DSA/SS Structures

The site categorization procedure typical for schools for Division of the State Architect - Structural Safety (DSA/SS) structures is provided below.

5.1 Site Geology and Soil Characteristics (CBC Section 1629A.3)

Each site shall be assigned a soil profile type based on properly substantiated geotechnical data using the site categorization procedure set forth in Division VI, Section 1636A and Table 16A-J.

5.2 Soil Profile Type (CBC Section 1629A.3.1)

Site Categorization Procedure: Section 1629A.3.1 lists the various soil profile types. Section 1636.2.5 requires that sites with Soil Profile Types S_C, S_D and S_E be classified by using either shear wave velocity or Standard Penetration Test blow count measurements within the upper 100 feet on site. For this project, Standard Penetration Test blow counts were used to establish the Soil Profile Type. Standard Penetration Blow counts were used to aid in soil classification. Soils show a slight trend toward increasing density and penetration resistance with depth. It is concluded that the most appropriate soil profile for this site would be S_D, described as a stiff soil with a shear wave velocity between 600 and 1,200 feet per second or with standard penetration test blow counts between 15 and 50 blows per foot.

5.3 Site Seismic Hazard Characteristics (CBC Section 1629A.4)

"Seismic hazard characteristics for the site shall be established based on the seismic zone and proximity of the site to active seismic sources, site soil profile characteristics and the structure's importance factor."

5.4 Seismic Zone (CBC Section 1629A.4.1)

The site lies in seismic zone 3. The seismic zone factor Z for this zone is 0.30.

5.5 Seismic Zone 4 Near-Source Factor (CBC Section 1629A.4.2)

The site does not lie near an active fault and does not lie within Seismic Zone 4; therefore, the near-source factor and seismic source type do not apply.

5.6 Seismic Response Coefficients (CBC Section 1629A.4.3)

Based on soil profile type and seismic zone, the Seismic coefficient, C_a (from Table 16A-Q) is 0.36 and the seismic coefficient C_V (from Table 16A-R) is 0.54.

6.0 LIMITATIONS

The evaluation of geologic/seismic hazards submitted in this report is based upon the data obtained from a review of geologic and seismic literature for the site area and the geotechnical investigation performed for the site. This report is issued with the understanding that it is the responsibility of the site owner, or his representative, to ensure that the information and findings contained herein are brought to the attention of the design consultants for the project and incorporated into the plans, where applicable.

The findings and recommendations presented in this report are valid as to the present and for the proposed construction. If site conditions change due to natural processes or human intervention on the site or adjacent to the site, or changes occur in the nature or design of the project, or if substantial time lapse between the date of this report and the start of work at the site, the findings contained in our report will not be considered valid unless the changes are reviewed by BSK and the findings of the report are modified or verified in writing.

BSK has prepared this report for the exclusive use of the site owner and project design consultants. The report has been prepared in accordance with generally accepted engineering geology practices within Kings County. No other warranties, either express or implied, are made as to the professional advice provided under the terms of our agreement and included in this report.

BSK Associates

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Table 3.1 Fault Parameters
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

Fault Name	Fault Geometry	Fault Length (km)	Fault Slip Rate (mm/year)	Maximum Moment Magnitude	Earthquake Return Interval (years)	Fault Plane Dip
Birch Creek	n-60E	15	0.7	6.4	945	60
Calaveras (S.of Calaveras Res)	rl-ss	106	15.0	6.2	33	90
Foothills Fault System	n-rl-o	360	0.1	6.5	974	90
Great Valley 8	r-15W	41	1.0	6.6	483	15
Great Valley (9)	r-15W	39	1.5	6.6	508	15
Great Valley (10)	r-15W	22	1.5	6.4	451	15
Great Valley (11)	r-15W	25	1.5	6.4	397	15
Great Valley (12)	r-15W	17	1.5	6.3	413	15
Great Valley (13)	r-15W	30	1.5	6.5	467	15
Great Valley (14)	r-15W	24	1.5	6.4	414	15
Hilton Creek	n.60E	29	2.5	6.7	386	60
Hosgri	rl-ss	172	2.5	7.3	646	90
Independence	n.60E	49	0.2	6.9	5696	60
Los Osos	r, 45 SW	44	0.5	6.8	1925	45
Monterey Bay - Tularcitos	r-rl-o	84	0.5	7.1	2841	90
Ortigalita	n.60E	26	2.5	6.6	305	60
Owens Valley	rl-ss	121	1.5	7.6	4000	90
Pleito thrust	r	44	2.0	7.2	706	20
Quien Sabe	rl-ss	23	1.0	6.4	647	90
Rinconada	rl-ss	189	1.0	7.3	1764	90
Round Valley	n.60E	42	1.0	6.8	94	60
San Andreas (1906)	rl-ss	470	24.0	7.9	210	90
San Andreas (Creeping)	rl-ss	125	34.0			90
San Andreas (Cholame)	rl-ss	62	34.0	6.9	437	90
San Andreas (Parkfield)	rl-ss	37	34.0	6.7	25	90
San Andreas (1857)	rl-ss	345	34.0	7.8	206	90
San Juan	rl-ss	68	1.0	7.0	1338	90
San Luis Range (S. Margin)	r, 45 N	64	0.2	7.0	6600	45
Sargent	rl-r-o	53	3.0	6.8	1200	90
White Mountains	rl-ss	105	1.0	7.1	1224	90
Zayante - Vergeles	r-ll-o.60S	67	2.0	7.2	839	60

Notes: Data shown on table is from the California Division of Mines and Geology, California Fault Parameters web page.
(ss) strike slip, (r) reverse, (n) normal, (rl) right lateral, (ll) left lateral, (o) oblique.

Table 3.2 Historic Earthquakes Within 100 Miles of Site
Ground Motion Greater than 0.05 g, Sorted by Peak Ground Acceleration
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

File Code	Latitude North	Longitude West	Date	Quake Magnitude	Site Acceleration (g.)	Site Intensity (MM)	Approximate Site to Earthquake Distance	
							(mi.)	(km.)
BRK	36.220	120.290	5/2/1983	6.7	0.20	VIII	28	45
DMG	35.300	119.800	1/ 9/1857	7.9	0.19	VIII	69	112
PAS	36.151	120.049	8/4/1985	5.8	0.18	VIII	18	28
DMG	36.700	118.100	3/26/1872	7.8	0.13	VIII	98	158
DMG	35.750	120.250	3/10/1922	6.5	0.12	VII	46	74
BRK	36.220	120.400	7/22/1983	6.0	0.12	VII	34	55
BRK	36.220	120.290	5/2/1983	5.6	0.11	VII	28	45
BRK	36.220	120.260	9/9/1983	5.4	0.11	VII	26	42
PAS	36.286	120.413	10/25/1982	5.6	0.10	VII	34	55
DMG	35.800	120.330	6/8/1934	6.0	0.09	VII	46	74
BRK	36.240	120.290	5/9/1983	5.2	0.09	VII	28	45
BRK	36.110	120.160	1/14/1976	4.9	0.09	VII	24	39
PAS	36.182	120.268	2/14/1987	5.1	0.09	VII	28	44
PAS	36.131	119.997	8/5/1985	4.3	0.08	VII	16	26
BRK	36.260	120.400	7/9/1983	5.3	0.08	VII	34	54
T-A	36.170	119.320	7/25/1868	5.0	0.08	VII	28	45
DMG	36.000	120.500	2/ 2/1881	5.6	0.08	VII	44	72
PAS	36.145	120.052	8/4/1985	4.3	0.08	VII	18	29
DMG	36.400	121.000	4/12/1885	6.2	0.08	VII	67	108
DMG	35.980	120.040	9/19/1965	4.8	0.08	VII	26	42
PAS	36.220	120.136	9/24/1980	4.4	0.08	VII	20	32
DMG	36.170	120.320	12/27/1926	5.0	0.08	VII	31	49
PAS	36.052	119.978	8/4/1985	4.4	0.08	VII	20	32
BRK	36.210	120.380	7/25/1983	5.1	0.08	VII	33	53
DMG	36.000	120.500	3/3/1901	5.5	0.07	VII	44	72
BRK	36.250	120.290	5/3/1983	4.8	0.07	VII	28	44
PAS	36.119	119.989	8/4/1985	4.1	0.07	VII	17	27
DMG	35.950	120.500	6/28/1966	5.5	0.07	VI	46	74
PAS	36.062	120.163	1/14/1976	4.7	0.07	VII	26	42
BRK	36.270	120.330	5/3/1983	4.8	0.07	VI	30	48
BRK	36.460	120.340	8/3/1975	4.9	0.07	VI	32	51
BRK	36.200	120.400	7/22/1983	5.0	0.07	VI	34	55
DMG	36.900	118.200	3/26/1872	6.5	0.07	VI	98	157
BRK	36.130	120.190	5/3/1983	4.5	0.07	VI	25	40
BRK	36.250	120.470	6/11/1983	5.1	0.07	VI	38	60
GSB	36.003	119.916	9/16/1992	4.3	0.07	VI	22	35
BRK	36.260	120.330	5/4/1983	4.7	0.07	VI	30	48
PAS	36.027	120.056	8/7/1985	4.4	0.07	VI	24	39
PAS	36.250	120.267	5/3/1983	4.5	0.07	VI	26	42
PAS	37.464	118.823	5/27/1980	6.3	0.06	VI	96	155
BRK	36.130	120.250	5/3/1983	4.5	0.06	VI	28	45
BRK	36.180	120.120	8/12/1983	4.0	0.06	VI	20	32
BRK	36.250	120.280	5/3/1983	4.4	0.06	VI	27	44
BRK	36.250	120.310	5/24/1983	4.6	0.06	VI	29	46
BRK	36.150	120.250	5/12/1983	4.5	0.06	VI	27	44

Table 3.2 Historic Earthquakes Within 100 Miles of Site (cont'd)
Ground Motion Greater than 0.05 g, Sorted by Peak Ground Acceleration
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

File Code	Latitude North	Longitude West	Date	Quake Magnitude	Site Acceleration (g.)	Site Intensity (MM)	Approximate Site to Earthquake Distance (mi.)	(km.)
DMG	35.383	118.850	7/29/1952	6.1	0.06	VI	83	133
BRK	36.280	120.360	5/5/1983	4.6	0.06	VI	31	50
DMG	35.970	120.500	6/28/1966	5.1	0.06	VI	45	73
BRK	36.220	120.300	5/9/1983	4.4	0.06	VI	29	46
DMG	35.367	118.583	7/23/1952	6.1	0.06	VI	94	151
DMG	35.730	121.200	11/22/1952	6.0	0.06	VI	88	141
USG	36.154	120.232	5/2/1983	4.2	0.06	VI	26	42
PAS	36.205	120.176	5/3/1983	4.0	0.06	VI	22	36
BRK	36.100	120.180	5/3/1983	4.2	0.06	VI	26	41
PAS	36.091	120.208	8/4/1985	4.3	0.06	VI	27	44
GSB	36.007	119.940	9/27/1992	4.0	0.06	VI	22	36
GSP	36.181	120.301	3/31/1994	4.4	0.06	VI	29	47
DMG	35.950	120.470	11/16/1956	5.0	0.06	VI	45	72
PAS	36.177	120.175	5/3/1983	4.0	0.06	VI	23	37
PAS	36.274	120.331	2/19/1984	4.4	0.06	VI	30	48
MGI	35.300	120.700	12/7/1906	5.9	0.06	VI	86	138
DMG	35.800	120.330	6/5/1934	5.0	0.06	VI	46	74
DMG	35.800	120.330	6/8/1934	5.0	0.06	VI	46	74
DMG	35.930	120.480	12/24/1934	5.0	0.06	VI	46	74
DMG	35.800	120.330	12/28/1939	5.0	0.06	VI	46	74
PAS	36.219	120.264	5/8/1984	4.2	0.06	VI	27	43
GSB	35.917	120.465	12/20/1994	5.0	0.06	VI	46	74
DMG	36.700	118.300	8/17/1896	5.9	0.05	VI	88	141
DMG	36.230	120.650	2/5/1947	5.0	0.05	VI	48	77
DMG	36.000	120.000	11/8/1964	4.0	0.05	VI	24	39
DMG	35.950	120.530	6/29/1966	5.0	0.05	VI	48	77
DMG	36.602	119.375	9/15/1973	4.4	0.05	VI	31	50
BRK	36.500	120.400	8/15/1975	4.6	0.05	VI	36	58
PAS	36.260	120.259	5/3/1983	4.1	0.05	VI	26	42
USG	36.230	120.271	5/19/1983	4.2	0.05	VI	27	43
BRK	36.070	120.190	12/21/1983	4.2	0.05	VI	27	44
DMG	35.750	120.330	8/18/1922	5.0	0.05	VI	49	78
DMG	35.333	118.917	8/22/1952	5.8	0.05	VI	83	134
BRK	36.460	120.340	8/3/1975	4.4	0.05	VI	32	51
BRK	36.260	120.330	5/3/1983	4.3	0.05	VI	30	48
PAS	36.076	120.182	5/3/1983	4.1	0.05	VI	27	43
USG	36.134	120.204	5/5/1983	4.0	0.05	VI	26	41
USG	36.180	120.280	7/18/1983	4.2	0.05	VI	28	45
PAS	36.176	120.322	1/3/1985	4.3	0.05	VI	31	49
GSB	35.953	120.494	11/14/1993	4.9	0.05	VI	46	74
GSB	36.172	120.288	3/31/1994	4.2	0.05	VI	29	46
GSB	36.300	120.427	4/21/1994	4.5	0.05	VI	35	56
BRK	36.100	120.180	5/3/1983	4.0	0.05	VI	26	41
BRK	36.280	120.340	5/4/1983	4.3	0.05	VI	30	49
BRK	36.140	120.190	5/22/1983	4.0	0.05	VI	25	40

Table 3.2 Historic Earthquakes Within 100 Miles of Site (cont'd)
Ground Motion Greater than 0.05 g, Sorted by Peak Ground Acceleration
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

File Code	Latitude North	Longitude West	Date	Quake Magnitude	Site Acceleration (g.)	Site Intensity (MM)	Approximate Site to Earthquake Distance (mi.)	(km.)
DMG	36.583	120.333	11/30/1963	4.5	0.05	VI	35	57
BRK	36.140	120.210	6/7/1983	4.0	0.05	VI	26	41
DMG	35.750	119.617	4/15/1950	4.6	0.05	VI	40	64
DMG	36.220	120.330	10/22/1955	4.2	0.05	VI	30	49
USG	36.238	120.285	5/3/1983	4.1	0.05	VI	27	44
USG	36.180	120.260	5/3/1983	4.0	0.05	VI	27	44
BRK	36.230	120.380	9/11/1983	4.3	0.05	VI	33	53
PAS	36.313	120.396	10/25/1982	4.3	0.05	VI	33	54
BRK	36.210	120.350	5/3/1983	4.2	0.05	VI	31	51
BRK	36.240	120.280	5/3/1983	4.0	0.05	VI	27	44
BRK	36.230	120.280	9/9/1983	4.0	0.05	VI	27	44
GSB	36.192	120.293	2/2/1997	4.1	0.05	VI	29	46
T-A	35.250	120.670	0/ 0/1830	5.7	0.05	VI	88	141
T-A	35.250	120.670	12/17/1852	5.7	0.05	VI	88	141
DMG	36.900	121.200	3/ 6/1882	5.7	0.05	VI	88	141
DMG	35.917	119.917	7/14/1947	4.0	0.05	VI	28	45
DMG	35.333	118.600	7/31/1952	5.8	0.05	VI	95	153
BRK	36.000	120.560	9/13/1975	4.8	0.05	VI	47	76
BRK	36.250	120.400	5/3/1983	4.3	0.05	VI	34	54
DMG	36.080	118.820	5/29/1915	5.0	0.05	VI	57	91
DMG	35.820	120.370	7/31/1961	4.7	0.05	VI	46	75
DMG	36.420	120.620	4/15/1962	4.7	0.05	VI	46	75
DMG	36.417	120.617	4/15/1963	4.7	0.05	VI	46	74
USG	36.232	120.299	5/3/1983	4.0	0.05	VI	28	46
BRK	36.300	120.310	5/3/1983	4.0	0.05	VI	28	46
GSB	36.163	120.287	4/24/1984	4.0	0.05	VI	29	47
GSB	36.158	120.280	5/11/1985	4.0	0.05	VI	29	46
DMG	37.200	118.700	9/30/1889	5.6	0.05	VI	87	139
MGI	35.170	120.750	12/1/1916	5.7	0.05	VI	95	153
DMG	36.230	120.320	8/13/1940	4.0	0.05	VI	30	47
DMG	35.217	118.817	7/23/1952	5.7	0.05	VI	93	150
PAS	36.240	120.390	7/22/1983	4.2	0.05	VI	33	53
PAS	36.240	120.390	7/22/1983	4.2	0.05	VI	33	53
BRK	36.290	120.410	8/14/1983	4.2	0.05	VI	34	55
PAS	36.176	120.337	1/3/1985	4.1	0.05	VI	31	50
DMG	36.670	121.250	8/6/1916	5.5	0.05	VI	84	136
MGI	36.580	118.080	7/6/1917	5.7	0.05	VI	97	157
DMG	36.600	120.800	7/25/1926	5.0	0.05	VI	59	95
DMG	36.000	120.920	11/2/1955	5.2	0.05	VI	66	106
DMG	36.680	121.300	4/9/1961	5.6	0.05	VI	87	140

MAXIMUM SITE ACCELERATION DURING TIME PERIOD 1800 TO 1999: 0.20g
MAXIMUM MAGNITUDE ENCOUNTERED IN SEARCH: 7.9
NEAREST HISTORICAL EARTHQUAKE WAS ABOUT 16 MILES AWAY FROM SITE.
MAXIMUM SITE INTENSITY (MM) DURING TIME PERIOD 1800 TO 1999: VIII

Table 3.3 Deterministic Site Ground Motion
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

Fault Name	Approximate Fault to Site Distance (mi.)	Approximate Fault to Site Distance (km.)	Upper Bounds Earthquake: UBE Magnitude UBE	Upper Bounds Earthquake: Peak Site Acc. (g.) Site	Upper Bounds Earthquake: Site Intensity (MM) Intensity	Maximum Probable Earthquake: DBE Magnitude DBE	Maximum Probable Earthquake: Peak Site Acc. (g.) Site	Maximum Probable Earthquake: Site Intensity (MM) Intensity
Birch Creek	93	150	6.4	0.07	VI	5.1	0.03	V
Calaveras So.of Calaveras	80	128	6.2	0.06	VI	6.2	0.06	VI
Foothills Fault System	68	109	6.5	0.09	VII	5.2	0.05	VI
Great Valley 8	85	137	6.6	0.08	VII	5.7	0.05	VI
Great Valley 9	63	101	6.6	0.10	VII	5.6	0.06	VI
Great Valley 10	52	84	6.4	0.11	VII	5.5	0.07	VI
Great Valley 11	38	62	6.4	0.13	VIII	5.6	0.09	VII
Great Valley 12	31	49	6.3	0.15	VIII	5.4	0.09	VII
Great Valley 13	23	37	6.5	0.21	VIII	5.6	0.13	VIII
Great Valley 14	22	35	6.4	0.21	VIII	5.5	0.13	VIII
Hilton Creek	99	159	6.7	0.08	VII	5.9	0.05	VI
Hosgri	90	145	7.3	0.09	VII	6.2	0.05	VI
Independence	89	143	6.9	0.09	VII	4.8	0.03	V
Los Osos	88	141	6.8	0.09	VII	5.2	0.04	V
Monterey Bay - Tularcitos	96	155	7.1	0.09	VII	5.3	0.04	V
Ortigalita	69	111	6.9	0.09	VII	5.6	0.05	VI
Owens Valley	98	157	7.6	0.10	VII	5.7	0.04	V
Pleito Thrust	98	158	7.2	0.10	VII	6.1	0.06	VI
Quien Sabe	84	136	6.4	0.06	VI	5.3	0.03	V
Rinconada	69	111	7.3	0.11	VII	5.8	0.05	VI
Round Valley	92	149	6.8	0.08	VII	5.6	0.04	VI
San Andreas 1857 Rupture	46	74	7.8	0.20	VIII	7.5	0.17	VIII
San Andreas Cholame	47	76	6.9	0.12	VII	6.9	0.12	VII
San Andreas Creeping	47	76	6.5	0.10	VII	6.5	0.10	VII
San Juan	51	82	7.0	0.12	VII	5.6	0.06	VI
San Luis Range S. Margin	93	149	7.0	0.09	VII	4.8	0.03	V
Sargent	99	160	6.8	0.07	VI	6.1	0.05	VI
White Wolf	93	149	7.2	0.10	VII	6.0	0.05	VI
Zayante - Vergeles	98	158	6.8	0.07	VI	4.5	0.02	IV

-END OF SEARCH- 29 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.
THE Great Valley FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 38 MILES AWAY.

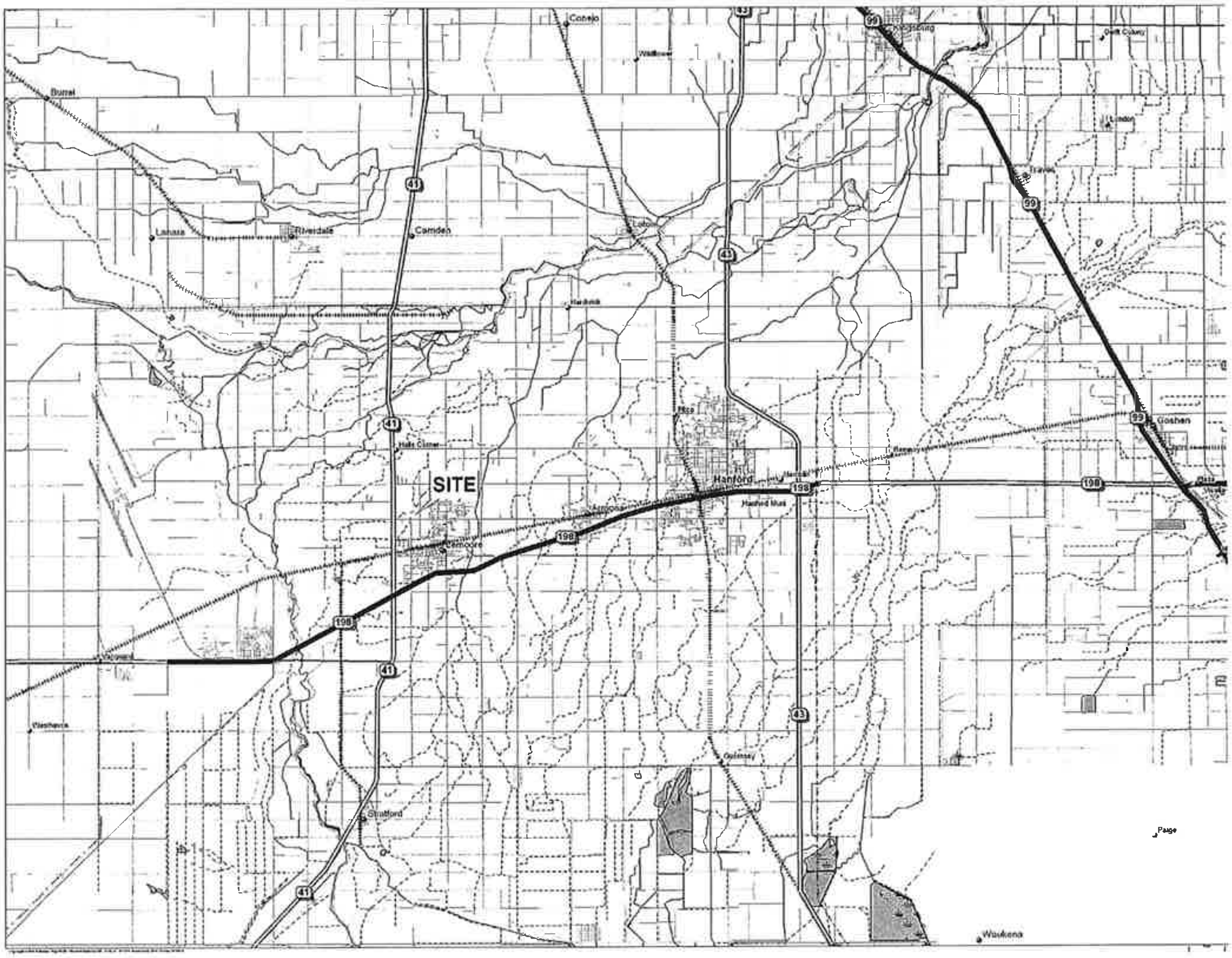
LARGEST UPPER BOUNDS EARTHQUAKE SITE ACCELERATION: 0.21 g
LARGEST MAXIMUM-PROBABLE SITE ACCELERATION: 0.17 g
ATTENUATION RELATION: 2 Boore et al. 1993a Horiz. - Random - Site Class C
UNCERTAINTY M=Mean S=Mean+1-Sigma: S

SITE COORDINATES:
LATITUDE: 36.3066 N
LONGITUDE: 119.8000 W

Table 3.4 Bracketed Earthquake Duration
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

Fault Name	Approximate Fault to Site Distance (mi.)	Approximate Fault to Site Distance (km.)	Upper Bounds Event: UBE Magnitude	Upper Bounds Event: *Bracketed Earthquake Duration (seconds)	Maximum Probable Earthquake: DBE Magnitude	Maximum Probable Earthquake: *Bracketed Earthquake Duration (seconds)
Birch Creek	93	150	6.4	< 5	5.1	< 5
Calaveras So.of Calaveras	80	128	6.2	< 5	6.2	< 5
Foothills Fault System	68	109	6.5	< 5	5.2	< 5
Great Valley 8	85	137	6.6	< 5	5.7	< 5
Great Valley 9	63	101	6.6	< 5	5.6	< 5
Great Valley 10	52	84	6.4	6	5.5	< 5
Great Valley 11	38	62	6.4	9	5.6	5
Great Valley 12	31	49	6.3	9	5.4	< 5
Great Valley 13	23	37	6.5	14	5.6	8
Great Valley 14	22	35	6.4	14	5.5	7
Hilton Creek	99	159	6.7	< 5	5.9	< 5
Hosgri	90	145	7.3	< 5	6.2	< 5
Independence	89	143	6.9	< 5	4.8	< 5
Los Osos	88	141	6.8	< 5	5.2	< 5
Monterey Bay - Tularcitos	96	155	7.1	< 5	5.3	< 5
Ortigalita	69	111	6.9	< 5	5.6	< 5
Owens Valley	98	157	7.6	< 5	5.7	< 5
Pleito Thrust	98	158	7.2	< 5	6.1	< 5
Quien Sabe	84	136	6.4	< 5	5.3	< 5
Rinconada	69	111	7.3	< 5	5.8	< 5
Round Valley	92	149	6.8	< 5	5.6	< 5
San Andreas 1857 Rupture	46	74	7.8	19	7.5	15
San Andreas Cholame	47	76	6.9	10	6.9	10
San Andreas Creeping	47	76	6.5	8	6.5	8
San Juan	51	82	7.0	10	5.6	< 5
San Luis Range S. Margin	93	149	7.0	< 5	4.8	< 5
Sargent	99	160	6.8	< 5	6.1	< 5
White Wolf	93	149	7.2	< 5	6.0	< 5
Zayante - Vergeles	98	158	6.8	< 5	4.5	< 5

*Bracketed Earthquake Duration is defined as ground motion exceeding a threshold of 0.05 g.
Reference: Chang and Krinitzsky, 1977



VICINITY MAP

New Elementary School

Northwest Corner of 19th and Cinnamon Avenues

Lemoore, California

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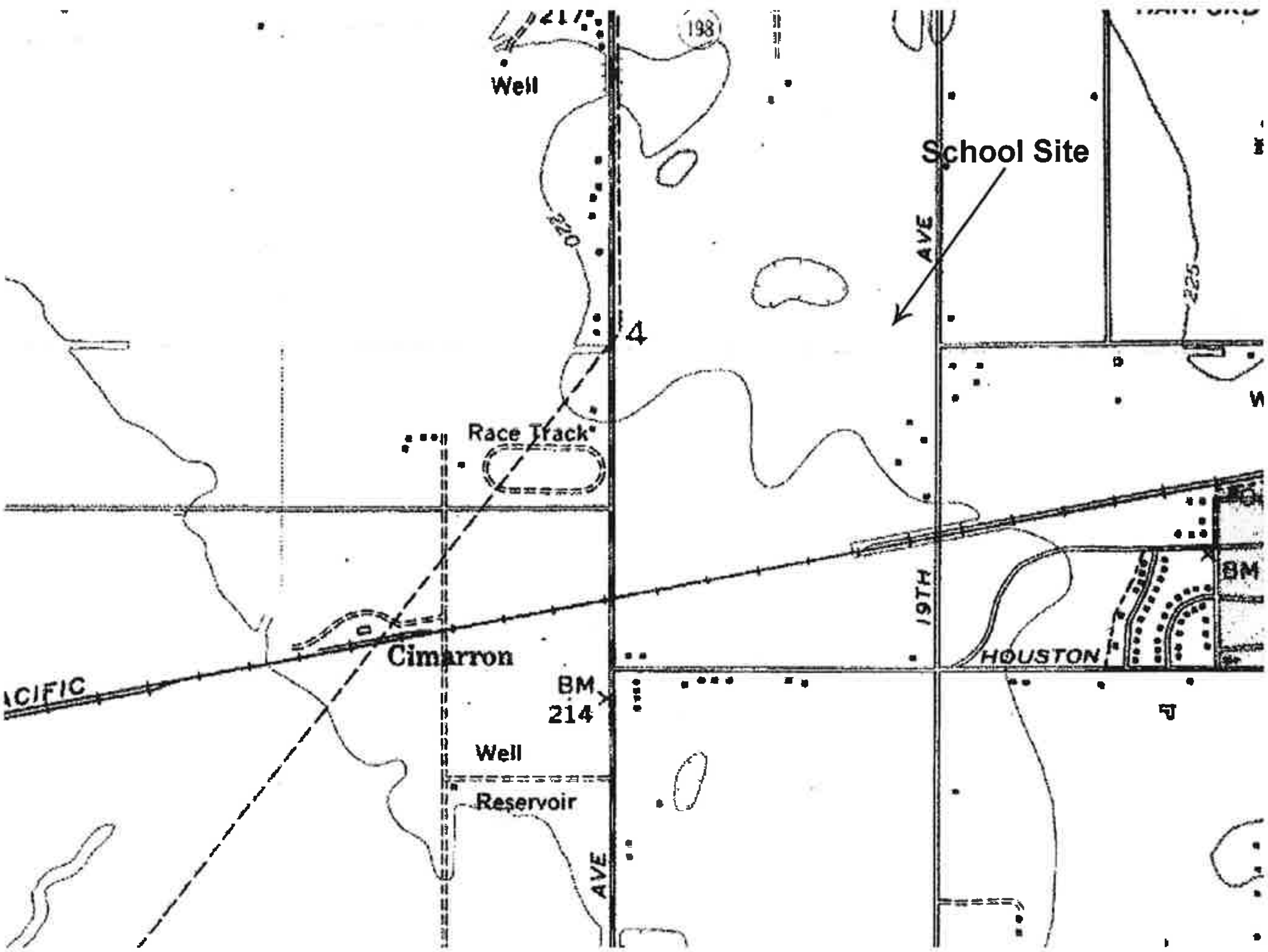
BSK 03-23-00633
Figure 1.2

AERIAL PHOTOGRAPH

New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

Reference: USGS 1998

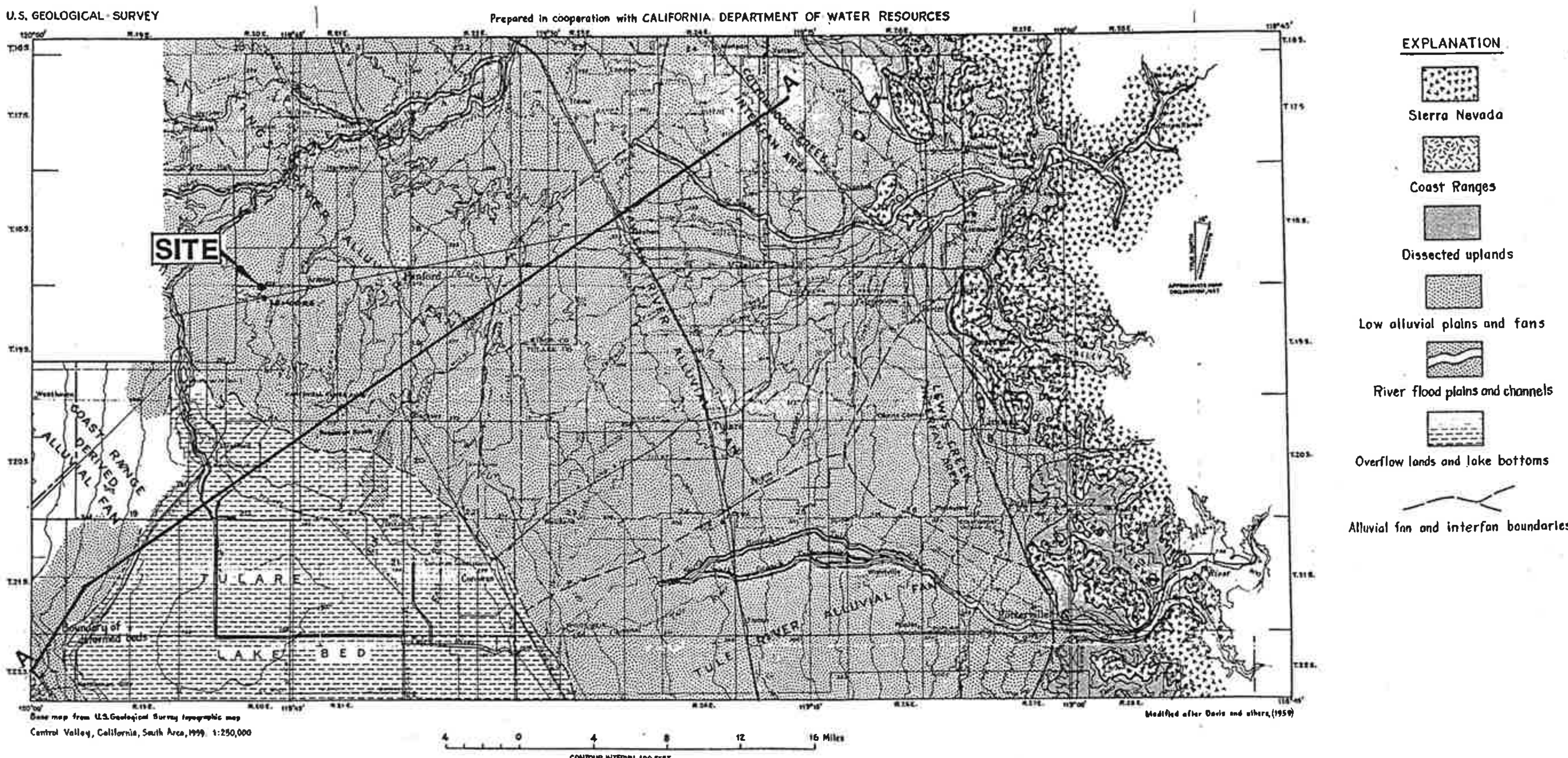
BSK



TOPOGRAPHIC MAP
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

BSK

BSK 03-23-0063
Figure 2.1



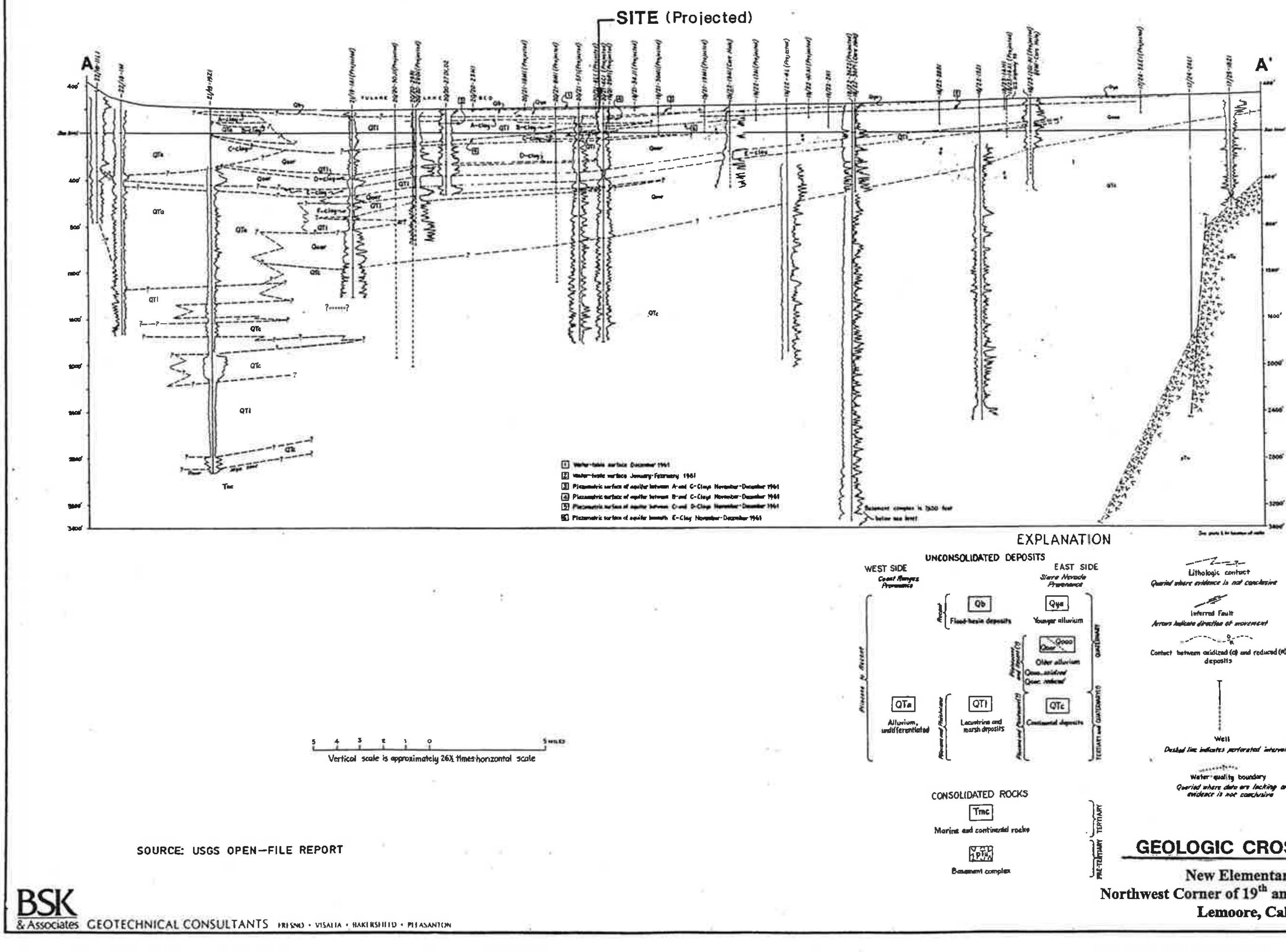
MAP SHOWING GEOMORPHIC FEATURES OF THE HANFORD-VISALIA AREA, SAN JOAQUIN VALLEY, CALIFORNIA

SOURCE: USGS OPEN-FILE REPORT SOURCE: USGS OPEN-FILE REPORT

REGIONAL GEOLOGIC MAP

New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

BSK & Associates GEOTECHNICAL CONSULTANTS FRESNO • VISALIA • BAKERSFIELD • PLEASANTON

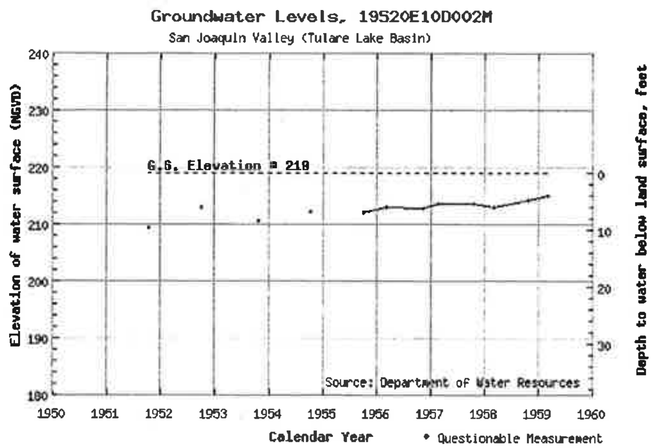


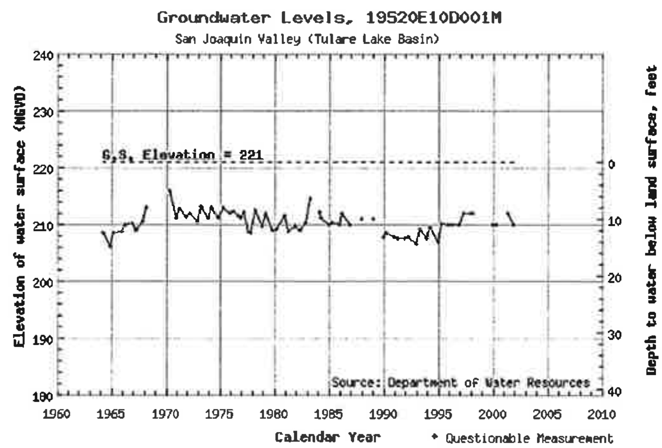
SOURCE: USGS OPEN–FILE REPORT

GEOLOGIC CROSS SECTION

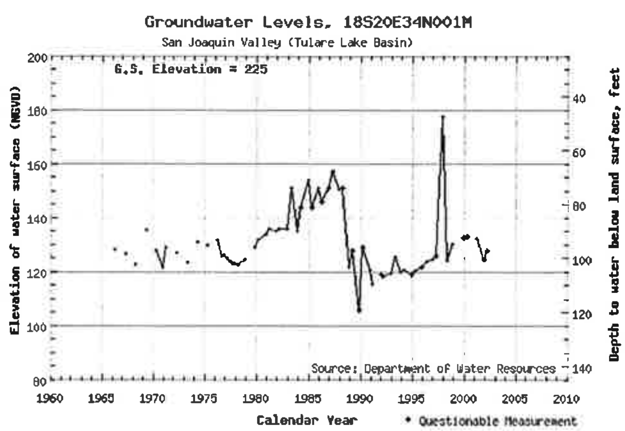
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

BSK 03-23-0063
Figure 2.3





Shallow Groundwater



Regional Groundwater

WATER TABLE HYDROGRAPHS

New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

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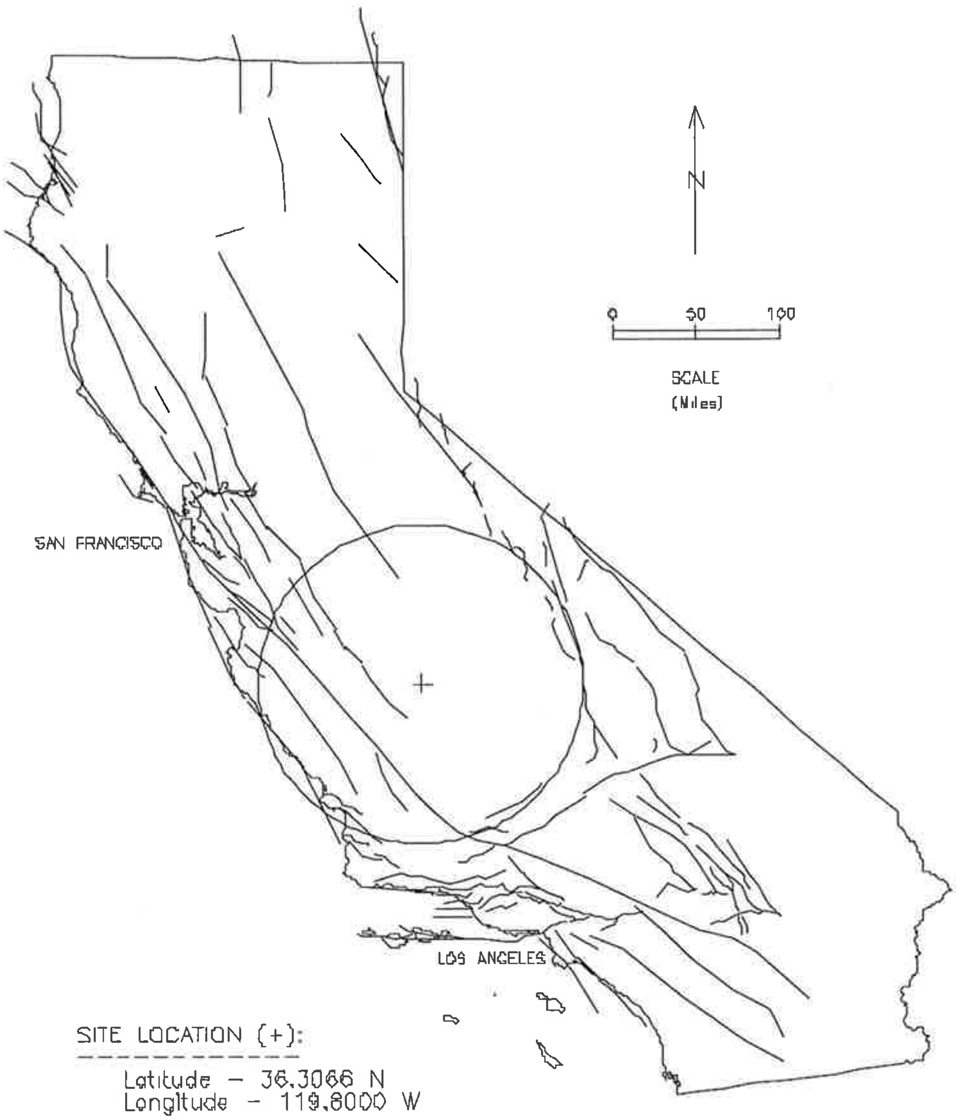
BSK 03-23-0063
Figure 3.1



REGIONAL FAULT MAP

New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

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Modified Mercalli Scale

Figure 3.2

Earthquake Magnitude	MMI Intensity	[1]Effects	[2]Perceived Shaking	[2]Potential Damage	[2]Peak Vel (cm/s)	[2]Peak Acc. (%g)
	I	Not felt. Marginal and long-period effects of large earthquake.	Not felt	None	<0.1	<0.17
3	II	Felt by persons at rest, on upper floors, or favorably placed.	Weak	None	0.1 to	0.17 to
	III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.	Light	None	1.1	1.4
4	IV	Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frames creak.	Moderate	None	1.1 - 3.4	1.4 - 3.9
	V	Felt outdoors, direction estimated. Sleepers wakened, liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters & pictures move. Pendulum clocks stop, start, change rate.				
5	VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring. Trees & bushes shaken (visibly or heard to rustle).	Strong	Light		
6	VII	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof lines. Fall of plaster, loose bricks, stones, tiles, cornices [also unbraced parapets and architectural ornaments-CFR]. Some cracks in masonry C. Waves on ponds, water turbine with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.	Very Strong	Moderate	16 - 31	18 - 34
	VIII	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.	Severe	Moderate to Heavy	31 - 60	34 - 65
7	IX	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged [general damage to foundations]. Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken, conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.	Violent	Heavy	60 - 116	65 - 124
8	X	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly	Extreme	Very Heavy	>116	>124
	XI	Rails bent greatly. Underground pipelines completely out of service.	Extreme	Very Heavy	>116	>124
	XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air	Extreme	Very Heavy	>116	>124

Notes: [1] Taken from "Modified Mercalli Scale (After Hunt, 1984)"

[2] Values taken from EERI Earthquake Spectra, Vol 15, No. 3, August 1999, pp 557-564

Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional Class A, B, C construction).

- Masonry A: Good workmanship, mortar, and design; reinforced, specially laterally, and bound together by using steel, concrete, etc; designed to resist lateral forces.
- Masonry B: Good workmanship and mortar, but not designed to resist lateral forces.
- Masonry C: Ordinary workmanship and mortar, no extreme weaknesses such as non-tied in corners, but masonry is neither reinforced nor designed against horizontal forces.
- Masonry D: Weak materials, such as adobe; poor mortar, low standards of workmanship.

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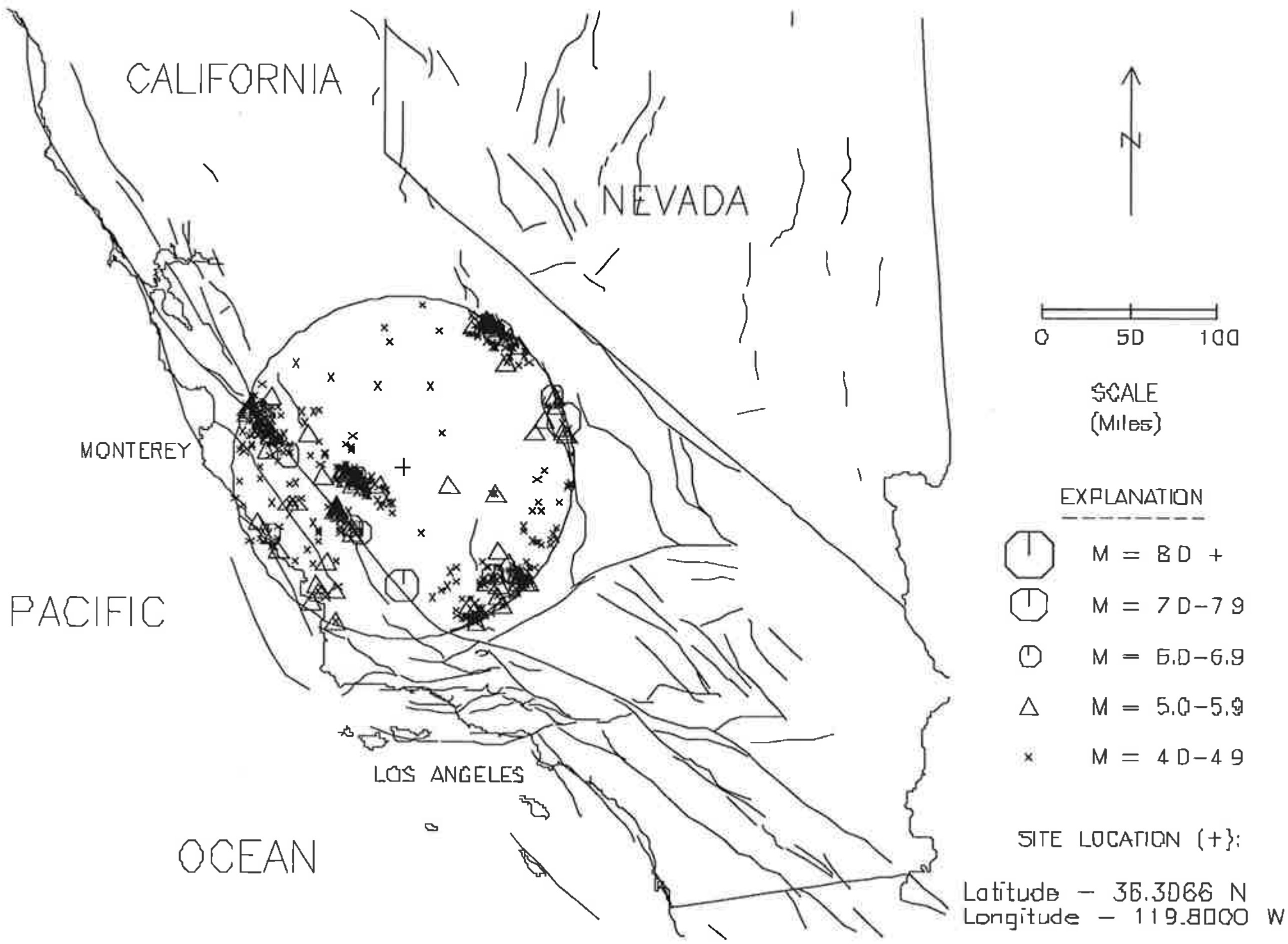

HISTORICAL EARTHQUAKES 1800 TO 2002

New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

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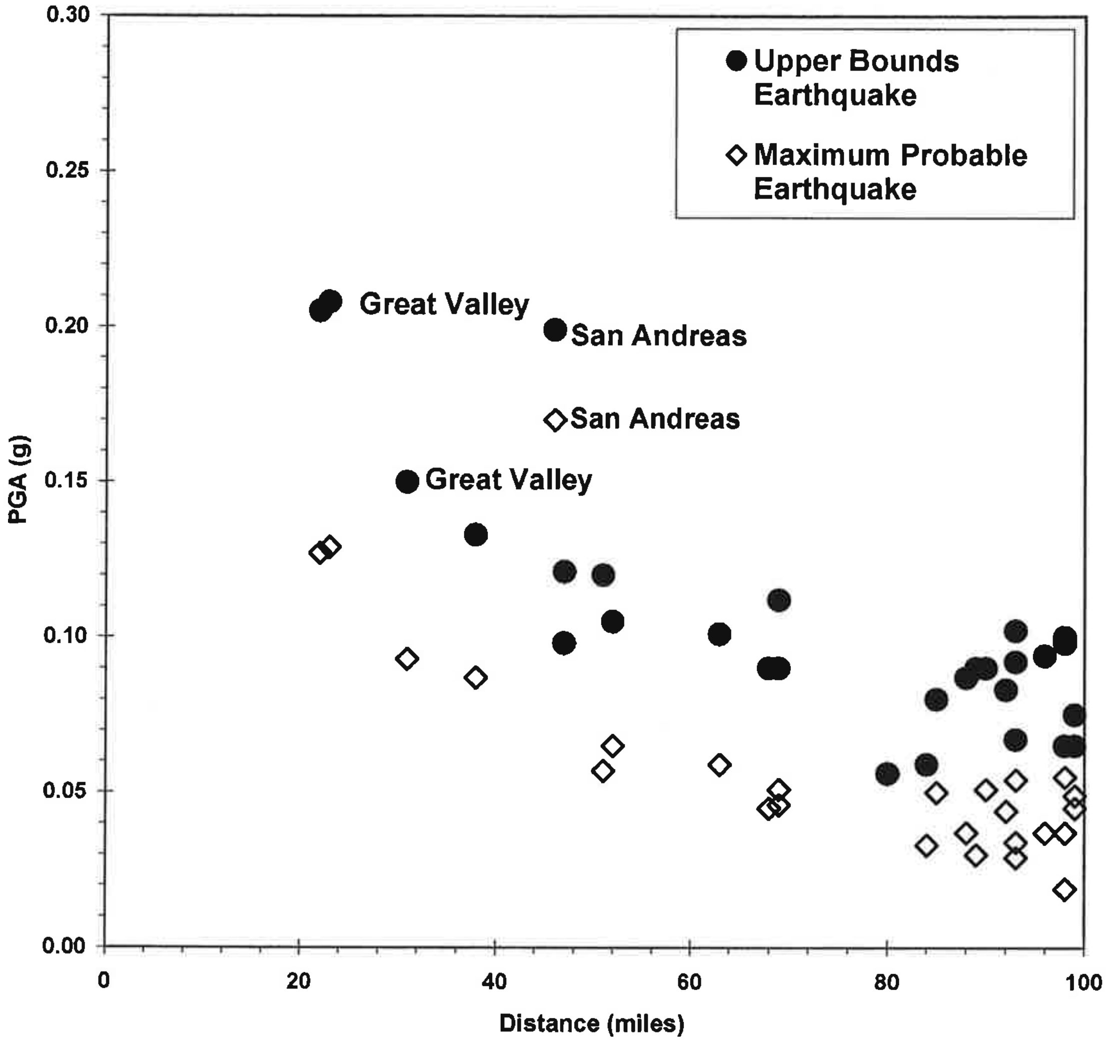
BSK 03-23-0063
Figure 3.4

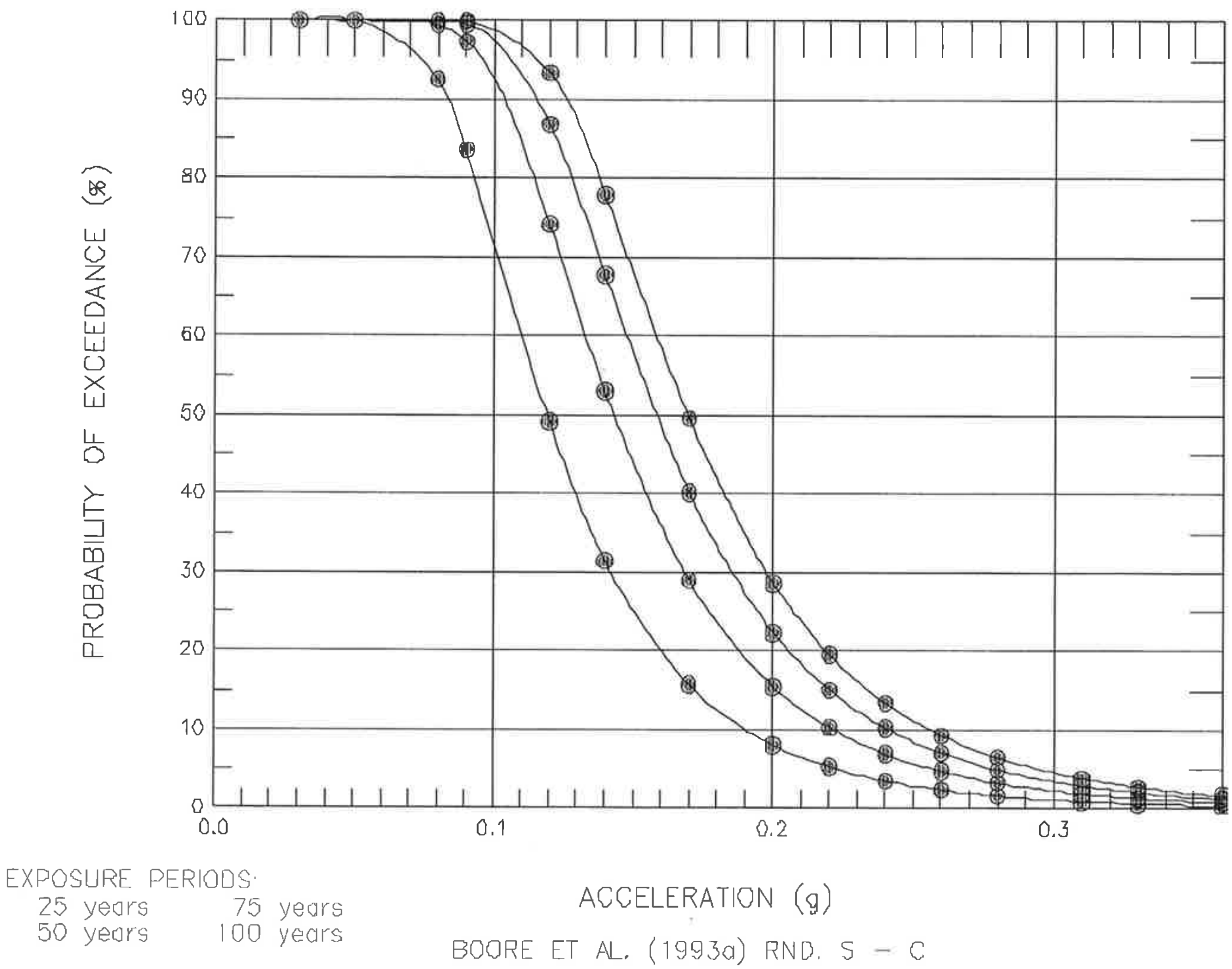


FAULT DISTANCE VS SITE GROUND MOTION

New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

BSK

BSK 03-23-0063
Figure 3.5



PROBABILITY OF EXCEEDANCE VS ACCELERATION

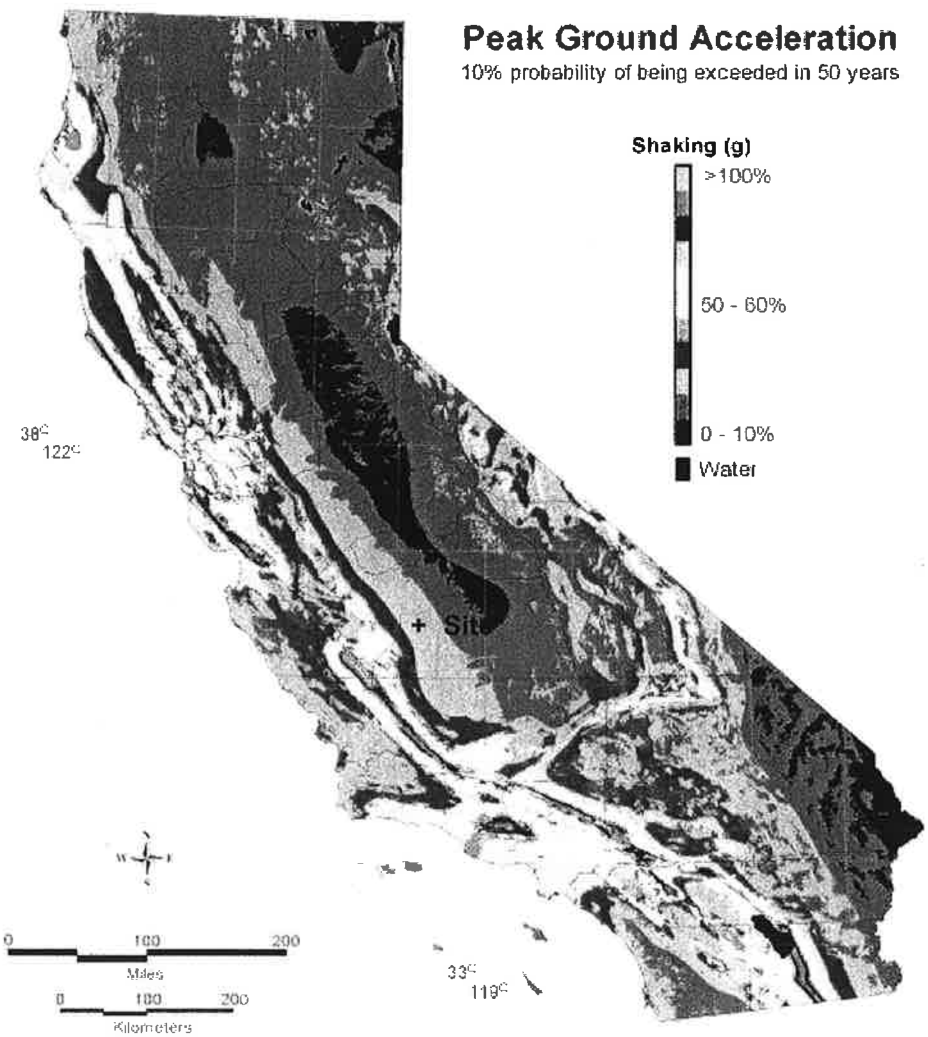
New Elementary School

Northwest Corner of 19th and Cinnamon Avenues

Lemoore, California

BSK

BSK 03-23-0063
Figure 3.6



CALIFORNIA PROBABILISTIC SEISMIC HAZARD MAP
New Elementary School
Northwest Corner of 19th and Cinnamon Avenues
Lemoore, California

Source: California Division of Mines and Geology

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APPENDIX A

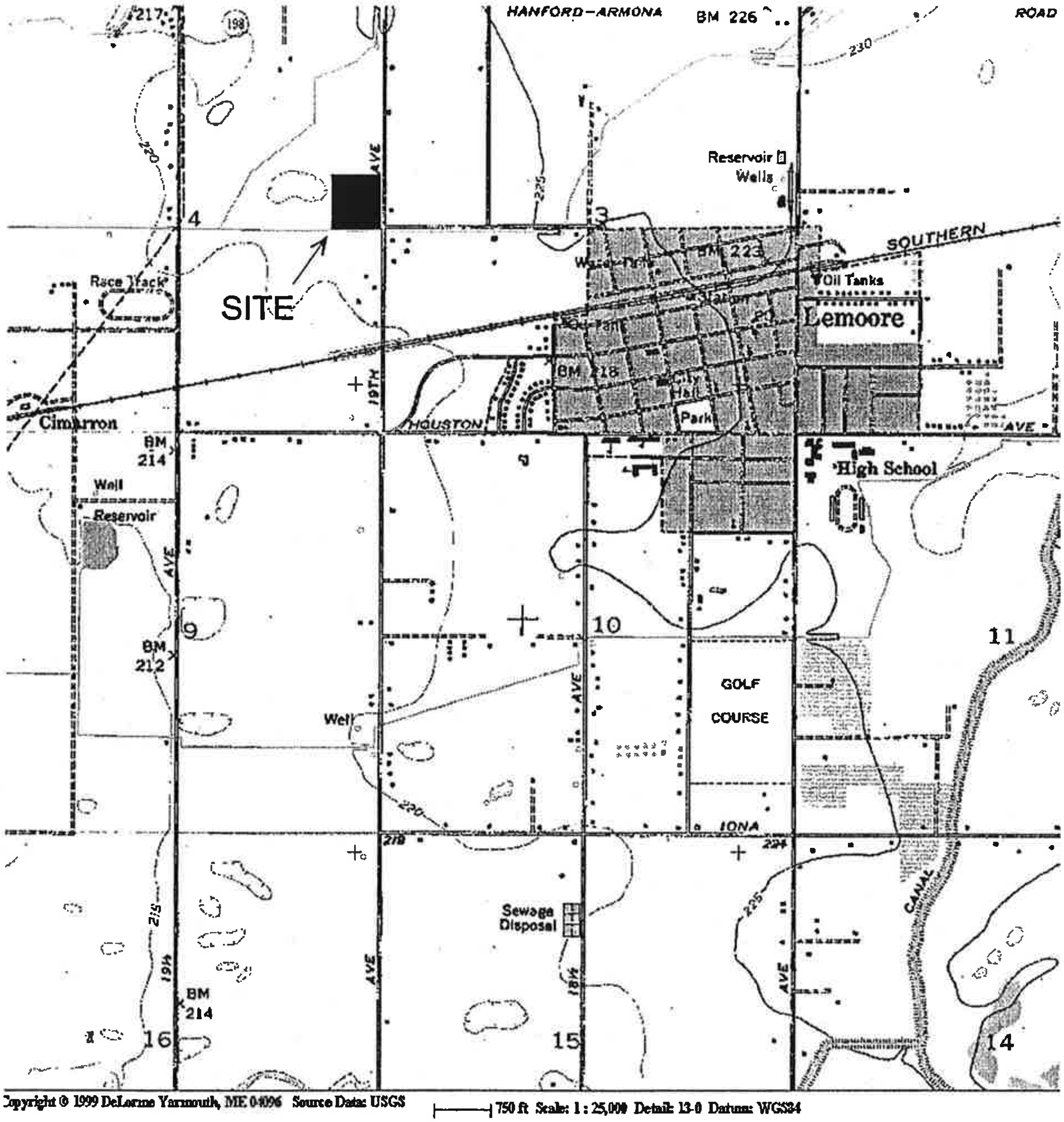
BORING LOGS

BSK

APPENDIX A
FIELD INVESTIGATION

BSK

BSK Job No. 03230063
September 2002
Figure A1



VICINITY MAP

SOIL AND FOUNDATION INVESTIGATION
NEW ELEMENTARY SCHOOL
NWC OF 19th AND CINNAMON AVENUES
LEMOORE, CALIFORNIA

BSK

FIELD INVESTIGATION

A.1 Test Hole Drilling

The field investigation was conducted on September 5,6, 9 and 10, 2002. Fourteen (14) borings were drilled with a truck-mounted drill rig using an 8-inch diameter hollow-stem auger and a 5-inch mud rotary rig. The approximate test boring locations are indicated on the Boring Location Plan, Figure A2.

The borings were located in the field by measuring from existing landmarks. Hence, boring location accuracy can be implied only to the degree that this method warrants.

Relatively undisturbed and bulk samples were obtained at various depths during test boring drilling. The undisturbed samples were generally obtained by driving a 2.4-inch inside diameter sampler into soils. The sampler was driven with a 140-pound hammer falling from a height of 30 inches. Field blow counts are recorded on the Logs of Borings.

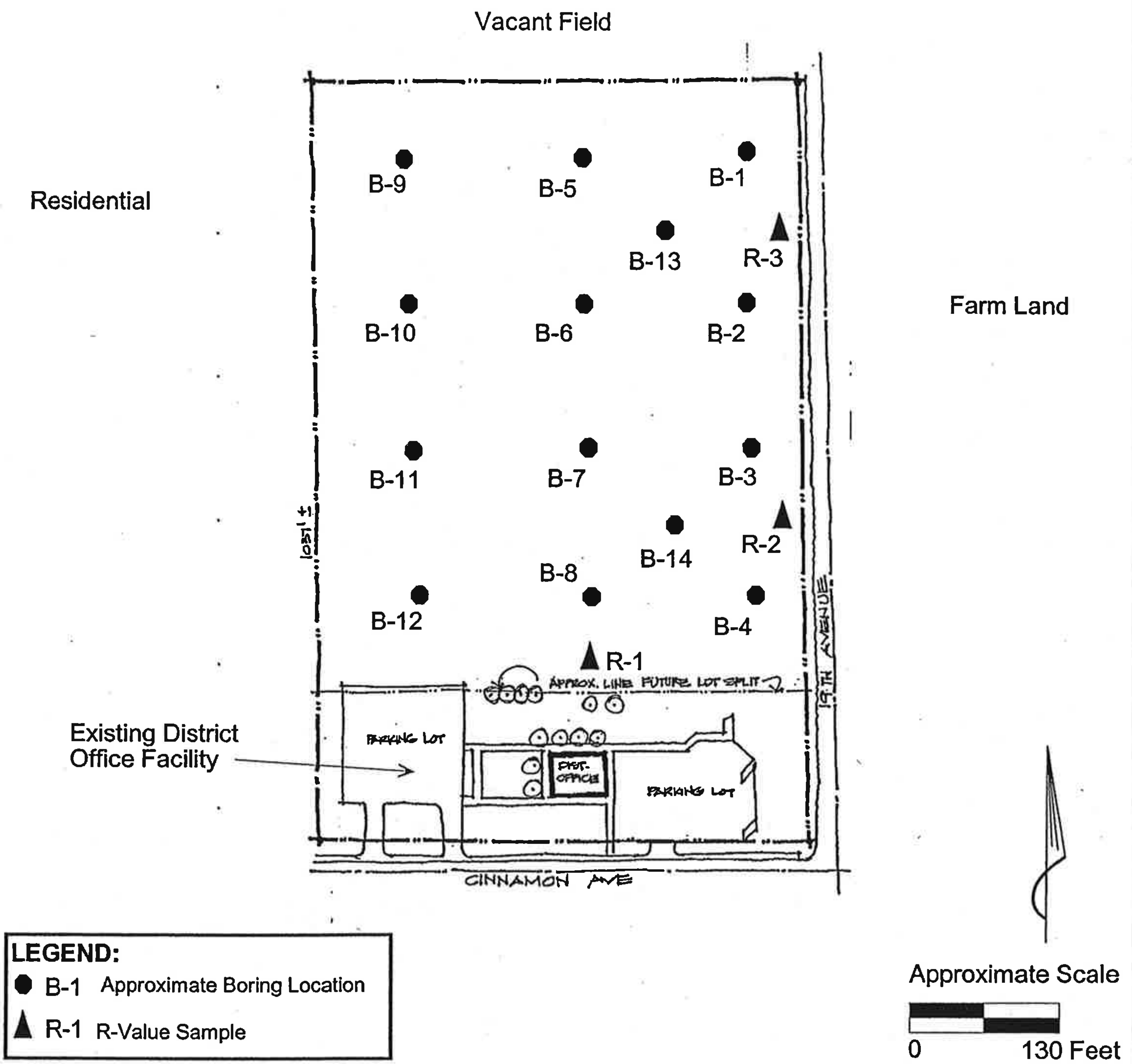
The borings were loosely backfilled with drilled soil cuttings.

A.2 Logs of Borings

A continuous log of soils encountered in the test borings was recorded at the time of the field investigation by our Engineer. The soils were classified based on field observations and laboratory test results. The classifications are in general accordance with the Unified Soil Classification System (see Soil Log Legend, Figure A3). Locations and depths of sampling, soil classifications, and in-place soil dry densities and moisture contents are indicated on the Logs of Borings shown on Figures A4 through A17.

Stratification lines on the logs represent approximate boundaries between predominant soil types. Layers of differing material may be contained within the strata. Transitions between strata may be either gradual or distinct.

BSK Job: 03230063
September 2002
Figure A2



Adapted From: Undated Site Plan prepared by Mangini & Associaties

BORING LOCATION MAP

SOIL AND FOUNDATION INVESTIGATION
NEW ELEMENTARY SCHOOL
NWC OF 19TH AND CINNAMON AVENUE
LEMOORE, CALIFORNIA

BSK

BSK JOB NO: 03230063
FIGURE NO: A3

SOIL LOG LEGEND

UNIFIED SOIL CLASSIFICATION SYSTEM

(Standard ASTM Test Method D2487 For Classification Of Soils For Engineering Purposes)

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No.4 sieve	CLEAN GRAVELS (Less than 5% fines)		GW	Well-graded gravel, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravel, gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES (More than 12% fines)		GM	Silty gravel, gravel-sand-silt mixtures
				GC	Clayey gravel, gravel-sand-clay mixtures
	SAND AND SANDY SOILS 50% or more of coarse fraction passes No.4 sieve	CLEAN SANDS (Less than 5% fines)		SW	Well-graded sand, gravelly sand, little or no fines
				SP	Poorly graded sand, gravelly sand, little or no fines
		SANDS WITH FINES (More than 12% fines)		SM	Silty sand, sand-silt mixtures
				SC	Clayey sand, sand-clay mixtures
FINE GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid Limit Less Than 50	INORGANIC		ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity
				CL	Lean clay-low to medium plasticity, gravelly clay, sandy clay, silty clay
		ORGANIC		OL	Organic silt and organic silty clay of low plasticity
	SILTS AND CLAYS Liquid Limit 50 or More	INORGANIC		MH	Elastic silt, micaceous or diatomaceous fine sand or silty soil
				CH	Fat clay-high plasticity
		ORGANIC		OH	Organic clay-medium to high plasticity; organic silt
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soil with high organic content

NOTE: Dual symbols are used to indicate borderline soil classifications

SAMPLER SYMBOLS

- Auger Cuttings
- Disturbed Sample
- Rock Core
- California Sampler
- No Recovery
- Shelby Tube
- Hand Auger/Sampler
- Standard Penetration Test
- Cone Penetration Test

BSK

LOG OF BORING B-1

BSK JOB NO: 03230063
FIGURE NO: A4
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 16 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						ML		**SANDY SILT: light olive brown; fine grained; moist.**	**Bulk Soil Sample at 0 to 5 Feet**
						SM		**SILTY SAND: light brown; fine grained; moist.**	**Expansion Index Test and Corrosion Tests**
	104	10		21					
5	103	7		20					
						SC		**CLAYEY SAND: light olive brown; very fine; moist.**	
10	105	16		28					
15				18		SP		**SAND: olive brown; fine grained; very moist.**	
									∇ **Groundwater**
20				17					**Boring Terminated at 20.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-2

BSK JOB NO: 03230063
FIGURE NO: A5
SHEET 1 of 1

DATE: 9/6/02
LOGGED BY: Justin Weibe
WATER LEVEL: 14 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		SILTY SAND: light brown; fine grained; dry.	Bulk Soil Sample at 0 to 5 Feet
	92	2		18				Slightly moist.	
						SP		SAND: greyish brown; fine to medium grained; slightly moist.	
5	92	2		18					
						ML		CLAYEY SILT: dark brown; fine to medium grained; trace of sand.	
10				16					
						SP		SAND: greyish brown; fine grained; very moist.	∇ Groundwater
15				18					
20				19					Boring Terminated at 21.5 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-3

BSK JOB NO: 03230063
FIGURE NO: A6
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 11 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						ML		SANDY SILT: light greyish brown; dry.	Bulk Soil Sample at 0 to 5 Feet.
						SM		SILTY SAND: brown; fine to medium grained; moist.	
	104	9		28					Direct Shear Test
	105	8		24					
5								Orangish brown.	
						SP		SAND: brown; fine to medium grained; moist.	
				10					
10									
									∇ Groundwater
				18					
15									
						SM		SILTY SAND: brown; fine grained; very moist.	
				11					Boring Terminated at 20.5 Feet
20									

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-4

BSK JOB NO: 03230063
FIGURE NO: A7
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 11 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: brown; fine to medium grained; moist.**	
				26					
5				20				**Grades to SAND**	
						SP		**SAND: brown; fine to medium grained; moist.**	
10				16				**Very moist; medium dense.**	**Groundwater**
						ML		**SANDY SILT: grayish olive; very fine grained.**	
15				19					
						SM-SP		**SILTY SAND/SANDY SILT: grayish olive; very fine grained.**	
20				4				**Heaving sand.**	**Boring Terminated at 20.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-5

BSK JOB NO: 03230063
FIGURE NO: A8
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 15 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						ML		SANDY SILT: light gray; fine grained; dry.	
						SP-SM		SAND/SILTY SAND: brown; fine to medium grained; moist.	
	97	18		17					Consolidation Test
5	108	13		16				Trace of CLAY; grades to SILTY SAND.	
						SC-CL		CLAYEY SAND/SANDY CLAY: olive brown; fine grained; moist.	
10	103	19		26					
						ML		CLAYEY SILT: yellowish brown; trace of very fine grained sand.	
15				15		SM		SILTY SAND: light gray; very fine grained; very moist.	∇ Groundwater
20				19				Grades to SAND.	Boring Terminated at 20.5 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-6

BSK JOB NO: 03230063
FIGURE NO: A9
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 13 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: brown; fine to medium grained; trace of clay.**	
				27					
5				20				**Interbedded SAND and SANDY SILT lens.**	
10				22		SC		**CLAYEY SAND: brown; fine to medium grained; moist.**	
						SM		**SILTY SAND: brown; very fine grained; very moist.**	**Groundwater**
15				20					
						SP		**SAND: brown; fine grained, trace of silt.**	
20				26					**Boring Terminated at 20.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-7

BSK JOB NO: 03230063
FIGURE NO: A10
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 10 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						ML		SANDY SILT: brown; fine grained; moist.	Bulk Soil Sample at 0 to 5 Feet
				32		SM		SILTY SAND: brown; fine to medium grained; moist.	
5				18		SP		SAND: light brown; fine to medium grained; slightly moist.	
10				10					Groundwater
15				9					
20				48					Boring Terminated at 20.5 Feet
						SC		CLAYEY SAND: olive brown; very fine grained.	

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-8

BSK JOB NO: 03230063
FIGURE NO: A11
SHEET 1 of 1

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 11 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: brown; fine to medium grained; moist.**	**Bulk Soil Sample at 0 to 5 Feet**
	110	**11**		**27**					
						SC		**CLAYEY SAND: olive brown; fine grained; moist.**	
5				**22**					
						SP		**SAND: brown; fine to medium grained; moist; some fines.**	
10				**13**					
									▽ **Groundwater**
						SP-SM		**SAND/SILTY SAND: brown; fine grained.**	
15				**19**					
20				**26**				**Grades to SAND.**	**Boring Terminated at 20.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-9

BSK JOB NO: 03230063
FIGURE NO: A12
SHEET 1 of 1

DATE: 9/6/02
LOGGED BY: Justin Weibe
WATER LEVEL: 11 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: light brown; fine grained; dry.**	
	101	9		17				**Dark brown; trace of clay, moist.**	
5	112	13		21					
10				14				**Sandier.**	
									∇ **Groundwater**
						SP		**SAND: grayish light brown; fine to medium grained.**	
15				16					
20				27					**Boring Terminated at 21.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-10

BSK JOB NO: 03230063
FIGURE NO: A13
SHEET 1 of 1

DATE: 9/6/02
LOGGED BY: Justin Weibe
WATER LEVEL: 14 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
0						SM		**SILTY SAND: light brown; fine grained; dry.**	**Bulk Soil Sample at 0 to 5 Feet**
	115	11		21				**Moist, trace of clay.**	
5	113	9		17					
						ML		**CLAYEY SILT: dark brown; very moist; trace of sand.**	
10				13					
						SP		**SAND: grayish brn; fine grained; very moist.**	∇ **Groundwater**
15				18					
						SC		**CLAYEY SAND/SANDY CLAY: olive brown; fine grained; moist.**	
20				34					**Boring Terminated at 21.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-11

BSK JOB NO: 03230063
FIGURE NO: A14
SHEET 1 of 1

DATE: 9/6/02
LOGGED BY: Justin Weibe
WATER LEVEL: 13 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
0						SM		SILTY SAND: light brown; fine grained; slightly moist.	Bulk Sample at 0-5 Feet
	110	9		18				Dark brown; moist.	
5	101	3		17		SP		SAND: grayish brown; fine grained, trace of medium; moist; trace of silt.	
10				18					
									∇ Groundwater
15				14				Brown; fine grained; very moist.	
20				28		CL		CLAY: gray; moist.	Boring Terminated at 21.5 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-12

BSK JOB NO: 03230063
FIGURE NO: A15
SHEET 1 of 1

DATE: 9/6/02
LOGGED BY: Justin Weibe
WATER LEVEL: 11 Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		SILTY SAND: light brown; fine grained; dry.	
	97	4		14					
5	98	8		25				More SILT.	
						SP		SAND: grayish brown; fine to medium grained; very moist.	
10				13					∇ Groundwater
15				12				Fine grained.	
20				26		CL		CLAY: gray; moist; trace of sand.	Boring Terminated at 21.5 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-13

BSK JOB NO: 03230063
FIGURE NO: A16
SHEET 1 of 3

DATE: 9/10/02
LOGGED BY: L. Suehiro
WATER LEVEL: 15 Feet
GROUND ELEVATION:
EQUIPMENT: BK-81, 5" Mud Rotary

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: laminated orangish brown and olive brown; fine to medium grained; moist.**	
	87	**17**		**24**	X				
5									
	104	**17**		**31**	X				
10								**Olive brown.**	
15	**94**	**30**		**29**	X			**Laminated orangish brown and grayish brown; very moist.**	▽ **Groundwater**
						ML		**SANDY SILT: laminated grayish brown and orangish brown; fine grained; stiff.**	
20	**93**	**30**		**37**	X				
								Olive brown; medium stiff.	
25									

Continued Next Page

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-13

BSK JOB NO: 03230063
FIGURE NO: A16

DATE: 9/10/02
LOGGED BY: L. Suehiro
WATER LEVEL: 15 Feet
GROUND ELEVATION:
EQUIPMENT: BK-81, 5" Mud Rotary

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
	90	31		13		ML		**SANDY SILT: brown.**	
						SP		**SAND: light gray; fine to medium grained.**	
30	81	29		39					
35	103	25		40					
40	86	35		35					
45	91	56		56					
						CL		**SILTY CLAY: bluish gray.**	
50									

Continued Next Page

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-13

BSK JOB NO: 03230063
FIGURE NO: A16

DATE: 9/10/02
LOGGED BY: L. Suehiro
WATER LEVEL: 15 Feet
GROUND ELEVATION:
EQUIPMENT: BK-81, 5" Mud Rotary

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
	90	34		17		CL		**SILTY CLAY: bluish gray.**	**Boring Terminated at 51.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-14

BSK JOB NO: 03230063
FIGURE NO: A17
SHEET 1 of 3

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 10 Feet
GROUND ELEVATION:
EQUIPMENT: BK-81, 5" Mud Rotary

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
0						SM		**SILTY SAND: brown; fine to medium grained.**	
	88	20		23	X				
5									
	108	8		26	X	SP		**SAND: Laminated light brownish gray and brown; fine to medium grained.**	
10									∇ Groundwater
15	105	23		21	X				
20	100	26		21	X				
25									

Continued Next Page

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-14

BSK JOB NO: 03230063
FIGURE NO: A17

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 10 Feet
GROUND ELEVATION:
EQUIPMENT: BK-81, 5" Mud Rotary

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
	97	25		22		SP		**SAND: brown; fine to medium grained.**	
30	97	25		32					
35	93	23		55				**Fine grained.**	
40	97	27		60					
45	108	22		57					
						CL		**CLAY: bluish gray.**	
50									

Continued Next Page

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-14

BSK JOB NO: 03230063
FIGURE NO: A17
SHEET 3 of 3

DATE: 9/9/02
LOGGED BY: L. Suehiro
WATER LEVEL: 10 Feet
GROUND ELEVATION:
EQUIPMENT: BK-81, 5" Mud Rotary

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
	81	40		17		CL		**CLAY: bluish gray.**	**Boring Terminated at 51.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

APPENDIX B

LABORATORY TESTING PROCEDURES

LABORATORY TESTING PROCEDURES

B.1 Moisture-Density Tests

The field moisture content, as a percentage of the dry weight of the soil, was determined by weighing samples before and after oven drying. Dry densities, in pounds per cubic foot, were also determined for the undisturbed samples. Results of these determinations are shown on the Logs of Borings, Figures A4 through A17, included in Appendix A.

B.2 Direct Shear Test

Direct shear test was performed on intact sample to determine strength characteristics of the soil. Test specimens were soaked with water prior to testing. Results of the shear strength test are shown on Figure B1.

B.3 Consolidation Tests

Consolidation characteristics of the site soils were determined by using intact soil samples subjected to dead weight loading increments in a consolidometer. The samples were soaked when loading reached the approximate overburden pressure. Test results are illustrated by curves indicating the percent volume change of the soil under various loads. Results of the Consolidation Tests are shown on Figures B2 and B3.

B.4 Soil Corrosivity Potential

Soil Corrosivity Potential was performed on a bulk soil sample obtained from Borings B-1 at 0 to 5 feet. Testing procedures were Caltrans 422 for chloride content, Caltrans 643 for pH, Caltrans 643 for resistivity and Caltrans 417 for sulfate. Test results are presented in the text in Section 8.5.

B.5 Expansion Test

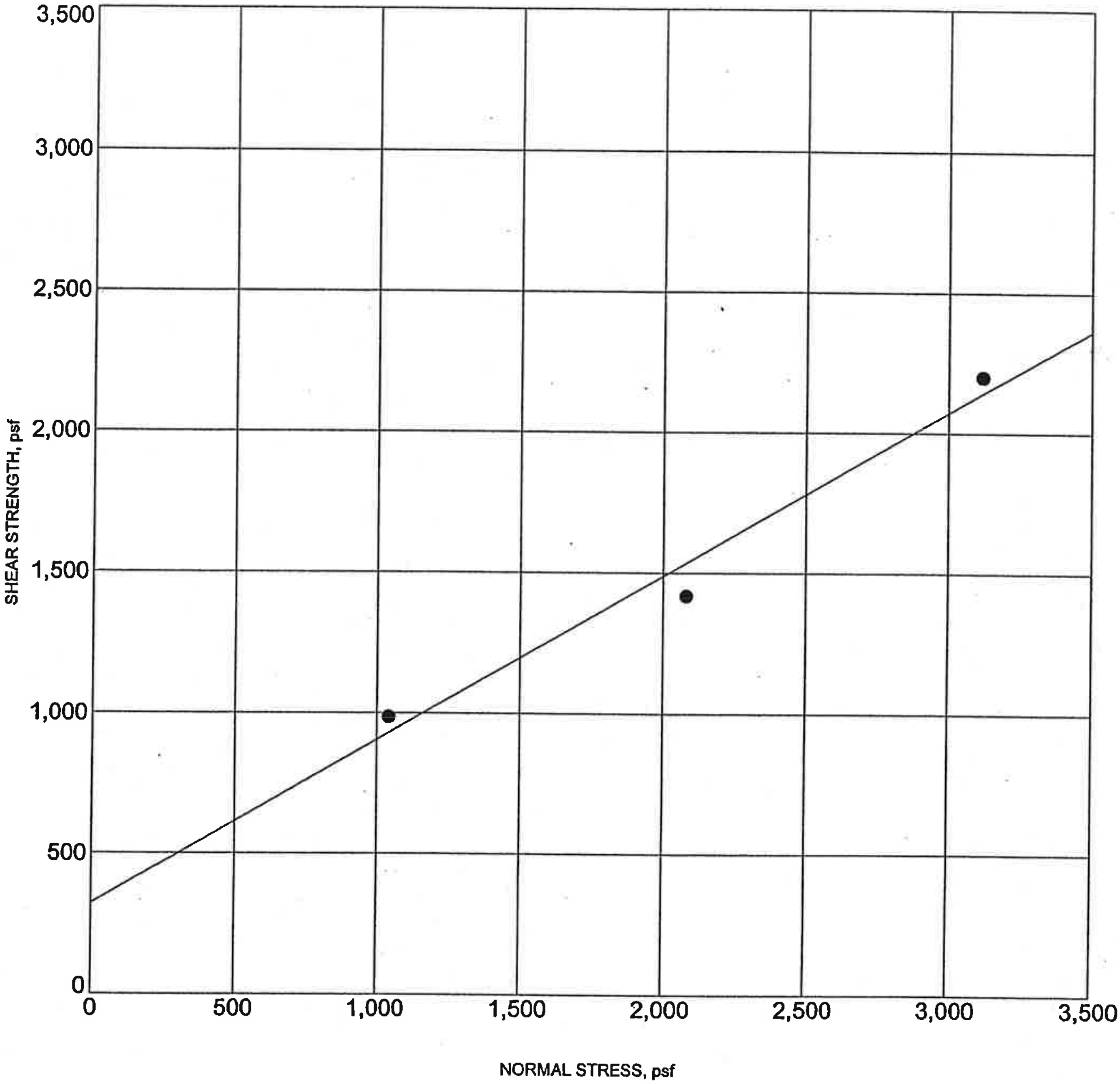
The expansion potential of a near-surface sample of the on-site soils was tested in accordance with Uniform Building Code criteria. Test results are presented in Table B.1.

B.6 Resistance-Value Tests

The Resistance-Value results of the samples of the surficial soils were obtained in accordance with California Department of Transportation's Test Method CA 301. Test results are presented in Table B.2.

BSK JOB: 03230063
Date: 9/10/02
Figure: B1

DIRECT SHEAR DIAGRAM



Boring No.: B-3

Friction Angle: 30 degrees

Dry Density: 104 pcf

Sample Depth: 3.0 ft.

Cohesion: 322 psf

Intact

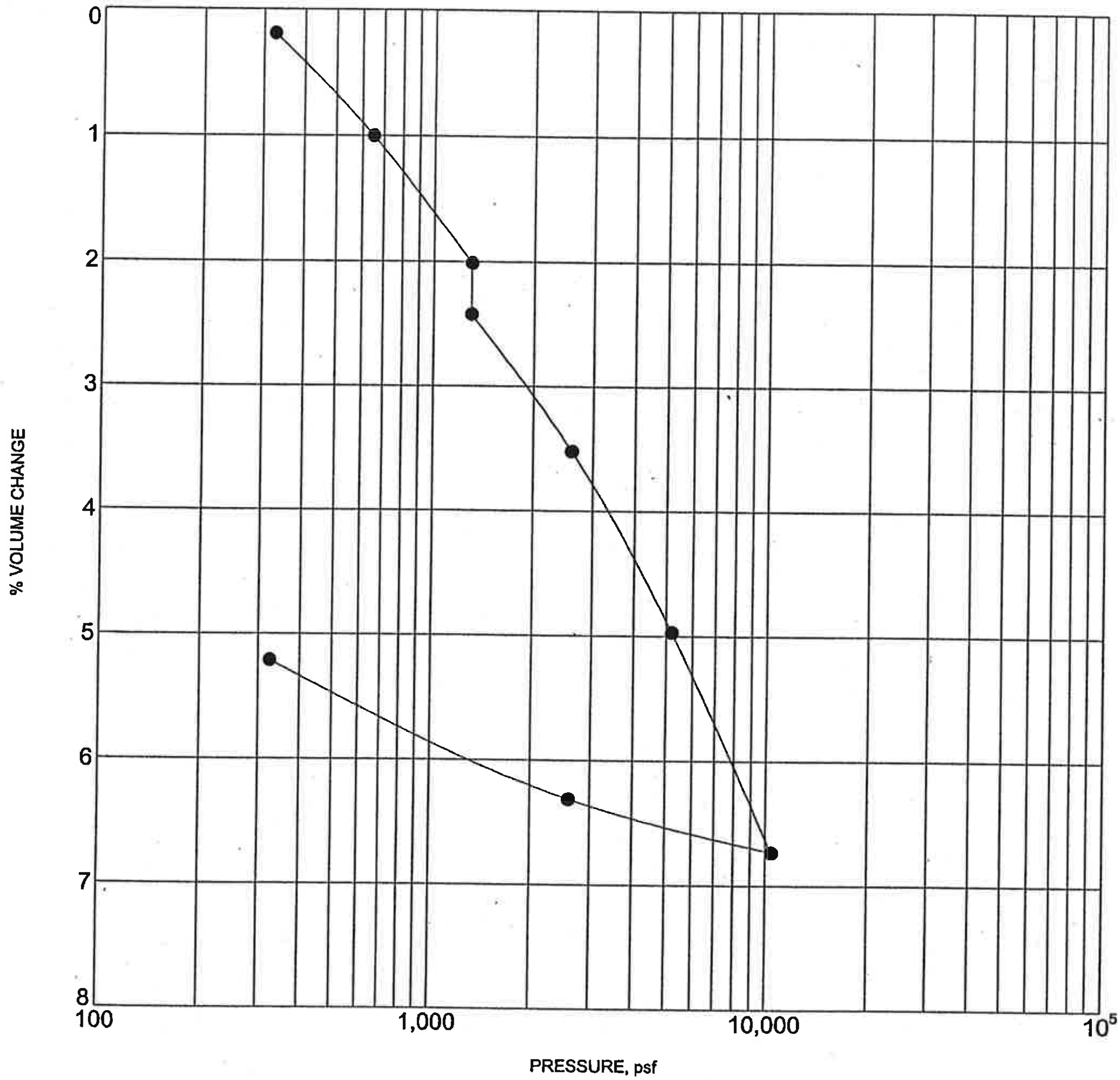
PROJECT: New Elementary School
NWC of 19th AND Cinnamon Avenues, Lemoore, California

BSK

CONSOLIDATION TEST

BSK JOB: 03230063
Date: 9/10/02
Figure: B2

% Volume Change vs. Pressure Curve



	Specimen Identification		Classification	Soaked psf	DD pcf	MC%
●	B-5	3.0 ft.	SILTY SAND: brown; fine to medium grained.	1300	97	18

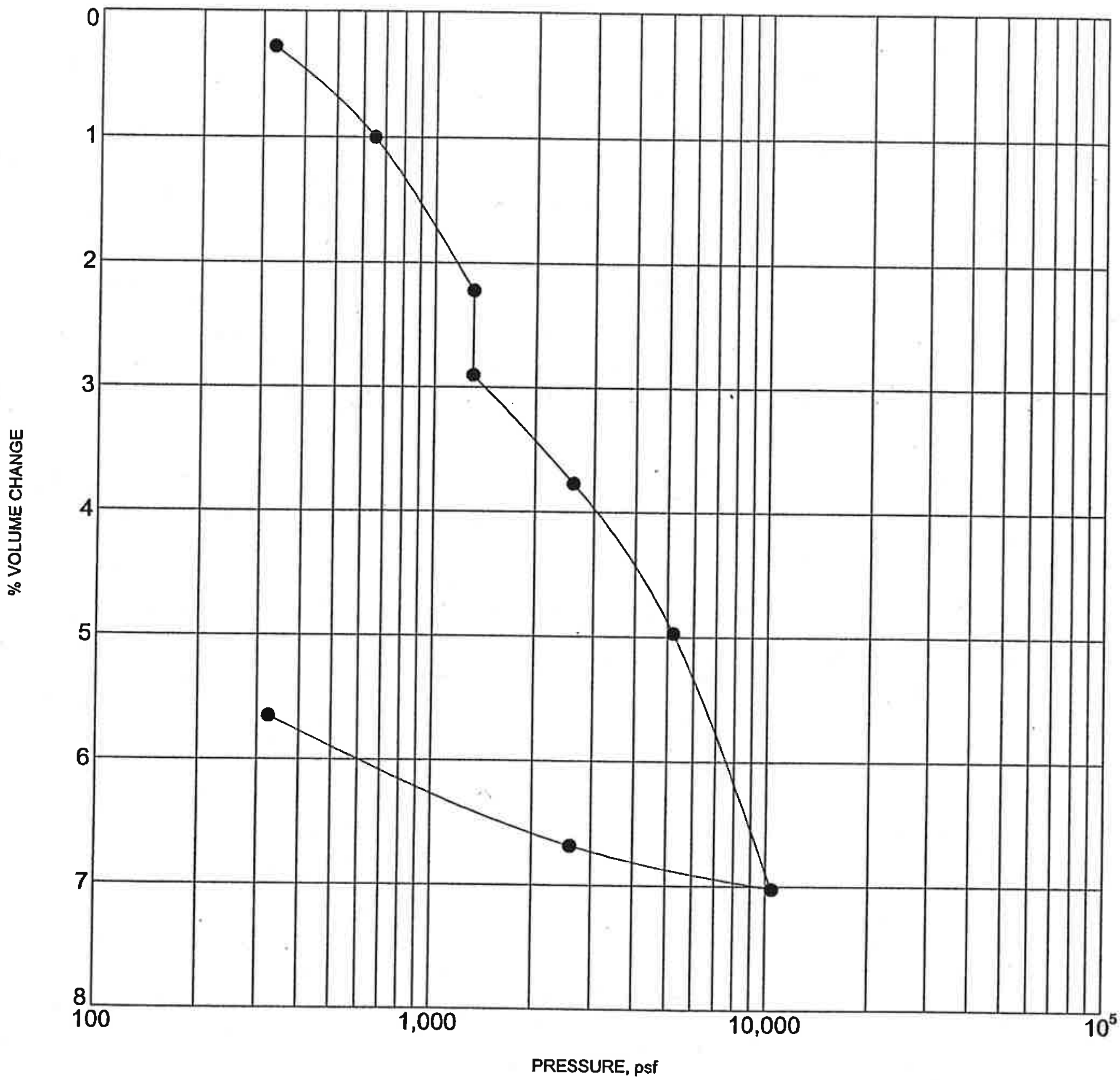
PROJECT: New Elementary School
NWC of 19th AND Cinnamon Avenues, Lemoore, California

BSK

BSK JOB: 03230063
Date: 9/10/02
Figure: B3

CONSOLIDATION TEST

% Volume Change vs. Pressure Curve



	Specimen Identification		Classification	Soaked psf	DD pcf	MC%
●	B-5	5.0 ft.	**SILTY SAND: brown; fine to medium grained.**	1300	108	13

PROJECT: New Elementary School
NWC of 19th AND Cinnamon Avenues, Lemoore, California

BSK

TABLE B.1 Expansion Index Test Results (1997 UBC Standard - 18-2)		
Test Location	**Moisture After Saturation, %**	**Expansion Index/ Potential**
Boring B-1 Bulk Sample at 0 to 5 Feet	16	4/very low

TABLE B.2 Resistance Value Test Results (CA301)	
Test Location	**R-Value**
R-1 at 0 to 1 Foot	59
R-2 at 0 to 1 Foot	73
R-3 at 0 to 1 foot	54

APPENDIX B

LIQUEFACTION AND SEISMIC SETTLEMENT ANALYSES

BSK

LIQUEFACTION ANALYSIS (Reference: Youd, 1993)

INPUT DATA:

Project Name:	Lemoore Elementary School	Water Table Depth:	10.0 (feet)
Location:	B-13	Ground Acceleration:	0.26 (g)
Job Number:	03230063	Fault Distance:	46 (mi)
Date:	10/01/2002	Earthquake Magnitude (M_W):	7.5
Causative Fault:	San Andreas	Number of Soil Layers:	13

INPUT DATA:					CHART DATA: (from Youd, Figure 2)		CONCLUSION:	
Layer Number	depth to bottom of layer (ft)	wet density (pcf)	SPT blow counts, N at mid-layer (bpf)	Fines (%)	$(N_1)_{60}$	CSRLiq τ_{ov}/σ'_0 (for M=7.5)	Safety Factor (F.S.)	Comments (See Notes)
1	4	102	24	35	75.1	2.00	>2	NA: Above water table
2	9	121	31	35	52.0	2.00	>2	NA: Above water table
3	15	122	29	35	37.5	2.00	>2	No liquefaction hazard
4	19	122	29	35	33.6	2.00	>2	No liquefaction hazard
5	20	119	37	45	40.9	2.00	>2	No liquefaction hazard
6	25	118	13	60	13.7	0.26	NA	NA for high fines content
7	28	118	13	60	12.9	0.25	NA	NA for high fines content
8	30	104	39	6	37.6	2.00	>2	No liquefaction hazard
9	35	129	40	6	36.8	2.00	>2	No liquefaction hazard
10	40	108	35	6	30.5	0.56	>2	No liquefaction hazard
11	45	114	56	6	46.7	2.00	>2	No liquefaction hazard
12	46	114	56	6	45.4	2.00	>2	No liquefaction hazard
13	50	120.2	17	60	13.5	0.26	NA	NA for high fines content

Notes: F.S. = Factor of Safety against liquefaction

California Division of Mines and Geology, Special Publication 117, notes that "a factor of safety against the occurrence of liquefaction greater than about 1.3 can be considered an acceptable level of risk. To form a basis for concluding that no hazard exists, a higher factor of safety (FS > 1.5) should be based on a realistic appraisal of the minimum soil strengths likely to be mobilized to resist bearing failure."

SETTLEMENT DUE TO LIQUEFACTION (Reference: Tokimatsu and Seed, 1987)

INPUT DATA:

Project Name:	Lemoore Elementary School	Water Table Depth:	10.0	(feet)
Location:	B-13	Ground Acceleration:	0.26	(g)
Job Number:	03230063	Fault Distance:	46	(mi)
Date:	10/01/2002	Earthquake Magnitude (MW):	7.5	
Causative Fault:	San Andreas	Number of Soil Layers:	13	

INPUT DATA:					CHART DATA: (from Tokimatsu and Seed, Figure 9)				CONCLUSION:	
Layer Number	depth to bottom of layer (ft)	wet density (dry density +moisture) (pcf)	SPT blow counts, N at mid-layer (bpf)	fines (%)	$(N_1)_{60}$ (bpf)	$^*(N_1)_{60}$ corrected for fines	**Cyclic Stress Ratio τ_{ov}/σ'_0	Volumetric Strain (%)	Settlement in Layer (in.)	Total (in.)
1	4	102	24	35	75.1	81.6	0.168	0.00	NA	
2	9	121	31	35	52.0	58.5	0.166	0.00	NA	
3	15	122	29	35	37.5	44.0	0.190	0.00	0.0	
4	19	122	29	35	33.6	40.1	0.217	0.00	0.0	
5	20	119	37	45	40.9	48.3	0.227	0.00	0.0	
6	25	118	13	60	13.7	22.8	0.236	0.26	0.0	
7	28	117.5	13	60	12.9	22.0	0.244	0.59	0.0	
8	30	104.1	39	6	37.6	38.4	0.248	0.00	0.0	
9	35	128.9	40	6	36.8	37.6	0.249	0.00	0.0	
10	40	107.8	35	6	30.5	31.3	0.248	0.00	0.0	
11	45	114	56	6	46.7	47.4	0.242	0.00	0.0	
12	46	114	56	6	45.4	46.2	0.235	0.00	0.00	
13	50	120.2	17	60	13.5	22.6	0.229	0.25	0.00	0.00

*Note: Blow counts corrected for fines content. Increased by a factor Δ N1= 0 for 5% fines, 4 for 15%, 6.5 for 35% and 8 for 50%
~~using~~: $N_{1effective} = N_{1measured} + \Delta N_1$

**Note: Cyclic stress ratio is corrected for problem earthquake magnitude.

SEISMIC SETTLEMENT (Dry Sands) (Reference: Tokimatsu and Seed, 1987)

INPUT DATA:

Project Name:	Lemoore Elementary School	Water Table Depth:	10.0	(feet)
Location:	B-13	Ground Acceleration:	0.26	(g)
Job Number:	03230063	Fault Distance:	46	(mi)
Date:	10/01/2002	Earthquake Magnitude (MW):	7.5	
Causative Fault:	San Andreas	Number of Soil Layers:	13	

INPUT DATA:				CHART DATA: (from Tokimatsu and Seed, Figure 11)			CHART DATA: (from Tokimatsu and Seed, Figure 13)				CONCLUSION: Settlement	
Layer Number	depth to bottom of layer (ft)	wet density (dry density +moisture) (pcf)	SPT, N at mid-layer (bpf)	γ_{eff} (G_{eff}/G_{max})	σ'_m (psf)	γ_{eff}	γ_{xy} (%)	$(N_1)_{60}$ (bpf)	ϵ_C M=7.5 (%)	ϵ_C M=7.5 (%)	in Layer (in.)	Total (in.)
1	4	102	24	3.53E-05	133	4.16E-05	0.004	75.1	0.001	0.001	0.00	
2	9	121	31	7.41E-05	462	1.05E-04	0.011	52.0	0.002	0.002	0.00	
3	15	122	29	1.17E-04	898	1.77E-04	0.018	34.9	0.008	0.008	NA	
4	19	122	29	1.49E-04	1295	2.25E-04	0.022	29.1	0.013	0.013	NA	
5	20	119	37	1.51E-04	1492	2.23E-04	0.022	34.5	0.010	0.010	NA	
6	25	118	13	2.34E-04	1722	4.22E-04	0.042	11.3	0.090	0.090	NA	
7	28	117.5	13	2.60E-04	2027	4.78E-04	0.048	10.4	0.111	0.111	NA	
8	30	104.1	39	1.91E-04	2210	2.87E-04	0.029	29.9	0.016	0.016	NA	
9	35	128.9	40	2.04E-04	2487	3.07E-04	0.031	28.9	0.018	0.019	NA	
10	40	107.8	35	2.33E-04	2871	3.63E-04	0.036	23.5	0.030	0.030	NA	
11	45	114	56	2.14E-04	3232	3.16E-04	0.032	35.5	0.013	0.013	NA	
12	46	114	56	2.23E-04	3454	3.32E-04	0.033	34.4	0.015	0.015	NA	
13	50	120.2	17	3.42E-04	3647	6.36E-04	0.064	10.1	0.150	0.150	NA	0.00

LIQUEFACTION ANALYSIS (Reference: Youd, 1993)

INPUT DATA:

Project Name:	Lemoore Elementary School	Water Table Depth:	10.0 (feet)
Location:	B-14	Ground Acceleration:	0.26 (g)
Job Number:	03230063	Fault Distance:	46 (mi)
Date:	10/01/2002	Earthquake Magnitude (M_W):	7.5
Causative Fault:	San Andreas	Number of Soil Layers:	12

INPUT DATA:					CHART DATA: (from Youd, Figure 2)		CONCLUSION:	
Layer Number	depth to bottom of layer (ft)	wet density (pcf)	SPT blow counts, N at mid-layer (bpf)	Fines (%)	$(N_1)_{60}$	CSRLiq τ_{ov}/σ'_0 (for M=7.5)	Safety Factor (F.S.)	Comments (See Notes)
1	4	105	23	35	70.8	2.00	>2	NA: Above water table
2	8	105	23	35	40.9	2.00	>2	NA: Above water table
3	9	116	26	6	38.7	2.00	>2	NA: Above water table
4	15	129	21	6	27.6	0.40	>2	No liquefaction hazard
5	20	126	21	6	24.1	0.28	1.3	Caution: Liquefaction potential
6	25	121	22	6	23.0	0.26	1.1	Caution: Liquefaction potential
7	30	121	32	6	31.1	1.03	>2	No liquefaction hazard
8	35	115	55	6	50.3	2.00	>2	No liquefaction hazard
9	40	123	60	6	51.9	2.00	>2	No liquefaction hazard
10	45	132	57	6	46.5	2.00	>2	No liquefaction hazard
11	48	132	57	6	44.5	2.00	>2	No liquefaction hazard
12	50	114	17	80	13.0	0.26	NA	NA for high fines content

Notes: F.S. = Factor of Safety against liquefaction

California Division of Mines and Geology, Special Publication 117, notes that "a factor of safety against the occurrence of liquefaction greater than about 1.3 can be considered an acceptable level of risk. To form a basis for concluding that no hazard exists, a higher factor of safety (FS > 1.5) should be based on a realistic appraisal of the minimum soil strengths likely to be mobilized to resist bearing failure."

SETTLEMENT DUE TO LIQUEFACTION (Reference: Tokimatsu and Seed, 1987)

INPUT DATA:

Project Name:	Lemoore Elementary School		
Location:	B-14	Water Table Depth:	10.0 (feet)
Job Number:	03230063	Ground Acceleration:	0.26 (g)
Date:	10/01/2002	Fault Distance:	46 (mi)
Causative Fault:	San Andreas	Earthquake Magnitude (MW):	7.5
		Number of Soil Layers:	12

INPUT DATA:					CHART DATA: (from Tokimatsu and Seed, Figure 9)				CONCLUSION:	
Layer Number	depth to bottom of layer (ft)	wet density (dry density +moisture) (pcf)	SPT blow counts, N at mid-layer (bpf)	fines (%)	$(N_1)_{60}$ (bpf)	$^*(N_1)_{60}$ corrected for fines	**Cyclic Stress Ratio τ_{ov}/σ'_0	Volumetric Strain (%)	Settlement in Layer (in.)	Total (in.)
1	4	105	23	35	70.8	77.3	0.168	0.00	NA	
2	8	105	23	35	40.9	47.4	0.167	0.00	NA	
3	9	116	26	6	38.7	39.5	0.166	0.00	NA	
4	15	129	21	6	27.6	28.4	0.191	0.00	0.0	
5	20	126	21	6	24.1	24.9	0.220	0.06	0.0	
6	25	121	22	6	23.0	23.8	0.235	0.15	0.1	
7	30	120.8	32	6	31.1	31.9	0.244	0.00	0.0	
8	35	114.8	55	6	50.3	51.1	0.248	0.00	0.0	
9	40	122.9	60	6	51.9	52.7	0.246	0.00	0.0	
10	45	131.5	57	6	46.5	47.3	0.238	0.00	0.0	
11	48	131.5	57	6	44.5	45.3	0.227	0.00	0.0	
12	50	113.6	17	80	13.0	25.2	0.221	0.06	0.00	0.13

*Note: Blow counts corrected for fines content. Increased by a factor Δ N1= 0 for 5% fines, 4 for 15%, 6.5 for 35% and 8 for 50% using: $N_{1effective} = N_{1measured} + \Delta N_1$

**Note: Cyclic stress ratio is corrected for problem earthquake magnitude.

SEISMIC SETTLEMENT (Dry Sands) (Reference: Tokimatsu and Seed, 1987)

INPUT DATA:

Project Name:	Lemoore Elementary School	Water Table Depth:	10.0	(feet)
Location:	B-14	Ground Acceleration:	0.26	(g)
Job Number:	03230063	Fault Distance:	46	(mi)
Date:	10/01/2002	Earthquake Magnitude (MW):	7.5	
Causative Fault:	San Andreas	Number of Soil Layers:	12	

INPUT DATA:				CHART DATA: (from Tokimatsu and Seed, Figure 11)			CHART DATA: (from Tokimatsu and Seed, Figure 13)				CONCLUSION: Settlement	
Layer Number	depth to bottom of layer (ft)	wet density (dry density +moisture) (pcf)	SPT, N at mid-layer (bpf)	γ_{eff} (G_{eff}/G_{max})	σ'_m (psf)	γ_{eff}	γ_{xy} (%)	$(N_1)_{60}$ (bpf)	ϵ_C M=7.5 (%)	ϵ_C M=7.5 (%)	in Layer (in.)	Total (in.)
1	4	105	23	3.66E-05	137	4.32E-05	0.004	70.8	0.001	0.001	0.00	
2	8	105	23	7.58E-05	411	1.10E-04	0.011	40.9	0.003	0.003	0.00	
3	9	116	26	9.20E-05	586	1.36E-04	0.014	38.7	0.004	0.004	0.00	
4	15	129	21	1.28E-04	876	2.01E-04	0.020	25.6	0.015	0.015	NA	
5	20	126	21	1.69E-04	1332	2.68E-04	0.027	20.7	0.025	0.025	NA	
6	25	121	22	1.97E-04	1734	3.20E-04	0.032	19.1	0.034	0.034	NA	
7	30	120.8	32	1.99E-04	2127	3.07E-04	0.031	25.0	0.023	0.023	NA	
8	35	114.8	55	1.84E-04	2509	2.67E-04	0.027	39.6	0.008	0.008	NA	
9	40	122.9	60	1.96E-04	2896	2.85E-04	0.028	40.2	0.008	0.008	NA	
10	45	131.5	57	2.16E-04	3309	3.20E-04	0.032	35.7	0.013	0.013	NA	
11	48	131.5	57	2.29E-04	3651	3.43E-04	0.034	34.0	0.016	0.016	NA	
12	50	113.6	17	3.55E-04	3853	6.65E-04	0.066	9.9	0.163	0.163	NA	0.00