APPENDIX B

Preliminary Geotechnical Investigation Report – Kleinfelder

PRELIMINARY
GEOTECHNICAL INVESTIGATION REPORT
PALMDALE POWER PROJECT
PALMDALE, CALIFORNIA

Prepared For:

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Kleinfelder Project No. 82300

March 27, 2008

KLEINFELDER
An employee owned company

March 27, 2008
File No. 82300

Mr. Arrie Bachrach
Program Manager
ENSR
1220 Avenida Acaso
Camarillo, California 93012

Subject: **Preliminary Geotechnical Investigation Report**
Palmdale Power Project
Palmdale, California

Dear Mr. Bachrach:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this report summarizing the findings of our preliminary geotechnical investigation for the referenced project. The project site is located adjacent to the northwest side of the Palmdale Air Force Base in Palmdale, California.

The purpose of our preliminary geotechnical investigation was to evaluate the suitability of the subsurface conditions for construction of the proposed hybrid power plant (which integrates combined-cycle and solar thermal generating technologies). Based on the results of our subsurface exploration, laboratory testing, geotechnical analyses conducted for this investigation, and our current understanding of the project, it is our professional opinion that the proposed site is geotechnically suitable for construction of the proposed project, provided the recommendations presented in this report are incorporated into the project design and construction. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 6.0.

We appreciate the opportunity to be of service on this project. Please do not hesitate to contact the undersigned if you have any questions, comments, or require additional information.

Respectfully submitted,

KLEINFELDER WEST, INC.

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SUMMARY OF DEFINITIONS

g =	Force of gravity; defined as the gravitational force per unit mass.
Km =	Kilometers
MW =	Megawatts
FEMA =	Federal Emergency Management Agency
DWR =	California Department of Water Resources
CGS =	California Geological Survey
USGS =	United States Geological Survey
USA =	Underground Service Alert
N/A =	Not Applicable
psf =	Pounds per square foot
pci =	Pounds per cubic inch
pcf =	Pounds per cubic foot
Kh =	Horizontal seismic acceleration coefficient

EXECUTIVE SUMMARY

This report presents the results of our preliminary geotechnical investigation program for the proposed Palmdale Power Project located in Palmdale, California. The purposes of this investigation were to evaluate the general subsurface soil conditions, seismicity and other geologic hazards for the site, and to provide preliminary recommendations for design and construction of the foundations for the proposed power plant facilities.

Subsurface conditions at the locations for the proposed combined-cycle and solar thermal components of the Project were explored by drilling a total of 26 soil borings. We performed a laboratory testing program on selected representative soil samples obtained from the borings to assess the geotechnical and corrosivity characteristics of the subsurface soils.

Based on the results of our subsurface investigation, the project site is underlain by alluvial soil deposits, generally comprised of alternating layers of silty sand, sandy silt, silty sand to sandy silt, sand with silt, and occasionally sand. No groundwater was encountered within the limiting depths of the borings ranging from 21.5 to 76.5 feet below the existing ground surface. The historical high groundwater level within a nearby well was documented in 1922 to be 120 feet below the ground surface. The well data for three nearby wells to the site show groundwater depths of 321 to 419 feet below the existing ground surface. This well data dates from 1963 to 2000. The referenced California Geological Survey, 2005 Seismic Hazard Report evaluated all available well data within this region and has reported a general groundwater depth within this area at approximately 400 feet below the existing ground surface. Due to the nature and volume of groundwater pumping within the project area, groundwater levels on and near the project site are expected to remain consistent with or at levels deeper than those levels observed from 1963 to the present.

The proposed project site does not lie within an officially designated California Earthquake Fault Hazard Zone (also known as an Alquist-Priolo Special Studies Zone) (Hart and Bryant, 1997). No active faults are known to transect the proposed project site. The nearest fault is the Cemetery fault, which is located at a distance of approximately 4.2 miles (7 km) from the site. However, the closest active fault is the San Andreas which is approximately 5.8 miles (9.4 km) from the site. Based on the subsurface soil and groundwater data, the potential for liquefaction and liquefaction induced settlement at the site is considered low.

The site is located within the seismically active Southern California region. The primary seismic hazard at the site is a potential for moderate to severe shaking. California Seismic Shaking Hazard Maps (2003) obtained from California Geologic Survey (CGS) website, indicates a Peak Horizontal Ground Acceleration (PHGA) with 10% probability of exceedance in 50 years of 0.58 times the acceleration due to gravity, g, (0.58g) for the site. We recommend that the proposed structures be designed and constructed in accordance with the requirements of the California Building Code (2001) for Seismic Zone 4. Our recommendations for seismic design parameters are presented in Section 4.3.

We understand that, at this stage of the project, information regarding structural loads is not available. However, based on assumed loads from similar projects, we anticipate that the proposed structures will be founded on shallow foundations. Our preliminary foundation recommendations include recommendations for conventional shallow footings and mat foundations. Our preliminary recommendations for foundation design are presented in Sections 4.4 and 4.5. Recommendations for retaining wall and below-grade structures are presented in Section 4.6.

Alluvial soils in arid and semi arid regions present a potential for collapsible conditions upon increase in moisture content. Collapse potential tests on 11 samples collected from 6 to 26 feet below the existing ground surface indicated a moderate to high collapse potential. To reduce the potential for collapse and excessive settlement, the site should be prepared in accordance with our recommendations presented in Section 4.8.

We anticipate the on-site soils encountered during our investigation, excluding organics, debris, and/or other deleterious materials, are considered suitable for use as engineered fill.

The executive summary presented herein briefly summarizes the results of our geotechnical investigation for the subject project and should be used only in conjunction with recommendations presented in the attached report.

1.0 INTRODUCTION

1.1 GENERAL

The Palmdale Power Project (PPP) includes construction of a hybrid (natural gas-fired combined-cycle and solar) electric power generating facility northwest of United States Air Force Plant 42 in Palmdale, California. Kleinfelder West, Inc. (Kleinfelder) was retained by ENSR to provide preliminary geotechnical engineering services for the proposed project. The location of the proposed power plant site is shown on Plate 1, *Site Vicinity Map*. The scope of our services was presented in a proposal entitled *Revised Proposal to Conduct Geotechnical Engineering Investigation, Palmdale Power Project, Palmdale, Los Angeles County, California*, dated March 29, 2007.

1.2 PROJECT DESCRIPTION

The subject site is located to the northwest side of Air Force Plant 42 and is bounded on the west by vacant land, on the south by Avenue M-12, on the east by E 15th street, and on the north by Avenue M. The proposed hybrid power plant will generate approximately 570 Megawatts of electrical power. Approximately 520 Megawatts (MW) will be generated using natural gas-fired, combined-cycle equipment and approximately 50 MW will be generated using solar thermal technology (parabolic troughs). The combined-cycle equipment will utilize up to approximately 23 acres, while the solar array will utilize approximately 325 acres. Based on the plot plan prepared by Bibb and Associates (dated June 8, 2007), the major structures in the combined-cycle area will include two combustion turbines, one heat recovery steam generator, one steam turbine generator, one switchyard, one cooling tower, one water treatment building, several tanks including clarifier tanks, storage tanks, settling tanks, one administrative and control building and one warehouse. The design loads of the proposed structures were not available during preparation of this report.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this preliminary geotechnical investigation program was to explore the subsurface conditions at the proposed site and to provide evaluations and recommendations for design and construction of the proposed power generating facilities. Kleinfelder's scope of services for this project consisted of the following:

Task 1 – Literature Review and Utility Clearance

- Reviewed available flood hazard map on the Federal Emergency Management Agency (FEMA) website.
- Reviewed available historical groundwater data on the California Department of Water Resources (DWR) website.
- Reviewed soil and geologic data including fault and geologic maps prepared by the California Geological Survey (CGS), the U.S. Geological Survey (USGS), the County of Los Angeles, and other governmental agencies.
- Reviewed previous geotechnical engineering investigation reports prepared for the Victorville 2 Hybrid Power Project (a sister plant of the same size using the same technologies as the PPP proposed in the City of Victorville and currently in the California Energy Commission licensing process), two nearby site investigations and the preliminary geotechnical/geologic constraints evaluation prepared for the subject site.
- Contacted Underground Service Alert (USA) to identify potential conflicts between planned geotechnical boring locations and existing underground utilities.

Task 2 – Field Exploration

Kleinfelder retained a drilling subcontractor to perform a total of 26 exploratory soil borings. Drilling operations including in-situ testing, soil sampling and backfilling of boreholes were directed by a Kleinfelder staff engineer, who also maintained logs of subsurface materials encountered and obtained samples for visual classification and laboratory testing. The approximate locations of the borings advanced for this investigation are shown on Plate 2 (Power Block Area) and Plate 3 (Solar Area).

Task 3 – Laboratory Testing

Laboratory testing was performed on selected representative samples to evaluate the in-situ moisture content and dry unit weight (ASTM D2216 and ASTM D2937), sieve analyses (ASTM D422), maximum dry density and optimum soisture (ASTM D 1557), direct shear (ASTM D3080), resistance value (CTM 301), sand equivalent (ASTM

D2419), collapse potential (ASTM D5333), pH (CTM 532), resistivity (CTM 643), sulfate content (CTM 417) and chloride content (CTM 422) of the subsurface materials encountered during this subsurface exploration.

Task 4 – Analysis and Report

Conducted an engineering evaluation and prepared this report, which includes the following:

- A general description of the project.
- Discussion of the regional geologic settings, geologic features and hazards including potential of ground rupture due to surface faulting, liquefaction potential, and seismically induced settlement.
- Description of the subsurface investigation program and laboratory testing program, subsurface soil conditions, and groundwater conditions.
- Discussion of the potential for collapsible soil conditions at the site and proposed mitigation measures.
- Evaluation of the seismic hazard conditions and recommendations for seismic design parameters based on 2001 California Building Code.
- Preliminary foundation recommendations for shallow foundations and static and dynamic soil parameters for vibrating machine foundations.
- Preliminary recommendations for retaining walls and below grade structures.
- Preliminary recommendations for earthwork including site preparation, engineered fill, anticipated post-construction settlement, guidelines for temporary excavations, pipe bedding and trench backfill, shrinkage and subsidence, stockpiling of excess materials.
- Preliminary recommendations for asphalt concrete pavement.
- Presentation of corrosion test results.
- Limitations and references.
- Plates including Site Vicinity Map and Boring Location Maps for the power block area and the solar area.
- Appendices including boring logs and laboratory testing results.

2.0 GEOLOGIC CONDITIONS

2.1 REGIONAL GEOLOGY

The site is located in the western Mojave Desert which is part of the greater Mojave Desert Geomorphic Province of California. The Mojave Desert Province occupies approximately 25,000 square miles and consists of broad alluvial basins, in-filled by alluvial deposits derived from the surrounding mountains. The western Mojave is a wedge-shaped area bordered on the southwest by the San Gabriel and San Bernardino Mountains and on the northwest by the Tehachapi Mountains. These surrounding mountains range up to 10,080 and 7,900 feet in altitude, respectively, while the interior desert has relatively low relief. The geologic map of the site and nearby surrounding areas is shown on Plate 4, *Regional Geologic Map.*

The structural geology and fault patterns within the western Mojave Desert are relatively uniform and internally consistent, comprised of a series of northwest-southeast trending faults, in contrast to the fault patterns north and south of the province. Major faults in the study area include the San Andreas and Garlock fault zones to the southwest and northwest, respectively.

Lithologically, the region is dominated by alluvial-filled basins overlying Paleozoic and Mesozoic igneous and metamorphic basement rocks. The site is underlain Quaternary-age alluvium which is anticipated to be in excess of 500 feet thick. The basement rocks are exposed at the surface in isolated mountain ranges throughout the desert.

2.2 FAULTING AND SEISMICITY

The site is not located within a currently delineated State of California Earthquake Fault Hazard Zone (also known as an Alquist-Priolo Zone) (Hart and Bryant, 1997). No known active faults have been identified on the site; thus, the potential for future surface fault rupture at the site is considered to be "low". While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

An active fault is a fault that has experienced seismic activity during historic time (since roughly 1800) or exhibits evidence of surface displacement during Holocene time (Hart and Bryant, 1997). The definition of "potentially active" varies. A generally accepted definition of "potentially active" is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, "potentially active" is no longer used as criteria for zoning by the California Geologic Survey (CGS), formerly known as the Division of Mines and Geology (DMG). The terms "sufficiently active" and "well-defined" are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Zoning Act. A "sufficiently active fault" is a fault that shows evidence of Holocene surface displacement along one or more of its segments and branches, while a "well-defined fault" is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition "inactive" generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old).

There is a potential that the proposed power plant structures may experience one or more moderate to severe ground shaking events during the design life of the project. A map showing historic seismicity for the period 1977-2005 is shown on Plate 5, *Historic Seismicity Map*.

According to the California Building Code (CBC) 2001 (Volume 2), faults are classified as Seismic Source Type A, B, and C based on Maximum Moment Magnitude (M) and Slip Rate (SR). Generally, a 'Type A' fault has $M \geq 7.0$ and $SR \geq 5$ mm/year, a 'Type B' fault has $M \geq 7.0$ and $SR < 5$ mm/year *or* $M < 7.0$ and $SR > 2$ mm/year *or* $M \geq 6.5$ and $SR < 2$ mm/year, a 'Type C' fault has $M < 6.5$ and $SR \leq 2$ mm/year. Both maximum moment magnitude and slip rate conditions must be satisfied concurrently when determining the seismic source type.

Based on a list of significant California earthquakes prepared by the California Geological Survey, a chronology of significant earthquakes that occurred within a 62-mile (100 km) radius of the site between 1800 and 2005 is presented in Table 1. The distances between the epicenters of these earthquakes and the proposed project site are estimated using the software EQSEARCH Version 3.0 (Blake, 2000-2005). The search of historic earthquakes also indicated that 668 earthquakes with magnitude equal or greater than 4 occurred within 62 miles (100 km) of the project site between 1800 and 2005.

Table 1
Significant Earthquakes (M ≥ 5.5) Near Project Vicinity

Date	Magnitude	Location	Approximate Distance from the Site Miles (Km)
January 16, 1857	6.3	Palmdale	9.1 (14.7)
May 12, 1880	5.9	Gorman-Palmdale	17.3 (27.8)
February 9, 1971	6.6	San Fernando	23.2 (37.3)
June 28, 1991	5.8	Sierra Madre	26.9 (43.3)
May 1803	5.5	San Gabriel Mission	30.4 (49.0)

The nearest fault is the Cemetery fault, which is located at a distance of approximately 4.2 miles (7 km) south of the project site. However, the closest active fault is the San Andreas Fault (1857 Rupture and Mojave) which is approximately 5.8 miles (9.4 km) south of the site based on Maps of Active Fault Near-Source Zones in California and Adjacent Portions of Nevada (Uniform Building Code, 1987) and EQSEARCH/ EQFAULT. According to these references, the San Andreas Fault is capable of generating an earthquake with Maximum Moment Magnitude of 7.8 for the 1857 Rupture and 7.1 for the Mojave segment. The Mojave segment has a slip rate of 30 mm/year. The San Andreas Fault is considered a Type A fault. Results of our search using the software EQFAULT Version 3.0 (Blake, 2000-2005) identified 47 active faults within a radius of 62 miles (100 km) of the proposed power plant site. The data file in EQFAULT Version 3.0 includes the faults that are identified by the California Geological Survey. Table 2 presents a list of 12 of these significant faults within the search radius of 31 miles (50 km) of the proposed project site that, in our opinion, will have the greatest impact on the site. Other active faults without surface expression (blind faults) that are capable of generating an earthquake or other potentially active seismic sources may be present that are not currently mapped.

Table 2
Significant Faults Near Project Vicinity

Fault Name	Approximate Distance from Site Miles (Km)	Maximum Moment Magnitude	Slip Rate (mm/yr)	Seismic Source Type
San Andreas-1857 Rupture	5.2 (8.3)	7.8	N/A	A
San Andreas-Mojave	5.2 (8.3)	7.1	30.0	A
Sierra Madre	21.3 (34.2)	7.2	2.0	B
Sierra Madre-San Fernando	21.6 (34.8)	6.7	2.0	B
San Andreas-Carrizo	23.4 (37.6)	7.4	34.0	A
San Gabriel	23.9 (38.5)	7.2	1.0	B
Clamshell-Sawpit	24.0 (38.6)	6.5	0.5	B
Verdugo	25.1 (40.4)	6.9	0.5	B
Santa Susana	28.2 (45.4)	6.7	5.0	B
Holser	29.6 (47.7)	6.5	0.4	B
Northridge-East Oak Ridge	30.6 (49.2)	7.0	1.5	B

2.3 OTHER GEOLOGIC HAZARDS

2.3.1 Collapsible Soils

Collapsible soils deposits generally exist in regions with moisture deficiency. Collapsible soils are generally defined as soils that have potential to suddenly decrease in volume upon increase in moisture content even without increase in external loads. Soils susceptible to collapse include loess, which are weakly cemented sands and silts where the cementing agent is soluble (e.g. soluble gypsum, halite), valley alluvial deposits within semi-arid to arid climate, and certain granite residual soils. Collapse potential tests on 11 samples collected from 6 to 26 feet below the existing ground surface indicated a moderate to high collapse potential. Provided that the mitigation measures for sub-grade improvements are implemented in accordance with the recommendations presented in Section 4.8 below, potential for damage due to collapsible soils is considered low at the proposed project site.

2.3.2 Flooding

Based on the Flood Hazard Maps provided by Federal Emergency Management Agency (FEMA), the proposed power plant is not located within the 100-year or 500-year flood zones. A 100-year flood is defined as the flood elevation that has 1 percent probability of being equaled or exceeded each year and a 500-year flood is defined as the flood elevation that has 0.2 percent probability of being equaled or exceeded each year.

2.3.3 Landslide

Based on the United States Geological Survey (USGS) topographic map for the Palmdale Quadrangle and our site reconnaissance, the ground surface within the combined-cycle and solar array areas is generally flat. The potential for landsliding within the combined-cycle and solar array areas is considered low. Future structures planned in areas adjacent to the ravine require additional consideration. The location of the structures in the project site should follow the setback requirements for sloping conditions in accordance with the CBC 2001, Figure 18-I-1.

2.3.4 Liquefaction

Liquefaction is a phenomenon that may occur because of earthquake shaking at locations where loose sandy soils are present and groundwater levels are shallow. Potential liquefaction hazards are estimated to be limited to areas where shallow groundwater and loose sandy soils are anticipated. Based on the subsurface investigation program, the proposed site is generally underlain by medium dense to dense sand and silty sand deposits except the upper strata of potentially collapsible soils. During the subsurface investigation program, groundwater was not encountered within the maximum explored depths of the borings ranging from 21.5 to 76.5 feet below the existing ground surface. Therefore, the potential for liquefaction is considered low.

2.3.5 Seismically Induced Settlement

Seismically induced settlement occurs where earthquake shaking causes densification of relatively loose sediments. Sediments that are sufficiently loose are subject to such densification, which can cause surface settlement and damage to surface and near-surface structures. Provided that the mitigation measures for sub-grade improvements are implemented as recommended in Section 4.0, the potential for damage due to seismically induced settlement is considered low at the project site.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 GENERAL

The proposed PPP site is nearly rectangular in shape, mostly undeveloped, and occupies approximately 348 acres. The subject site is located in the City of Palmdale northwest of Air Force Plant 42, east of Sierra Highway, north of Avenue M-12, west of East 15th Street, and south of Avenue M. The site is relatively flat. A brief summary of our field investigation program, laboratory testing program, and groundwater conditions are presented in this Section of the report.

3.2 FIELD INVESTIGATION PROGRAM

Drilling was performed on the 13th through 15th, and 29th of August 2007, by California Pacific Drilling of Calimesa, California under contract to Kleinfelder. All drilling and sampling operations were directed during this period by a Kleinfelder staff engineer. A total of 26 hollow-stem auger borings, identified as B-1 through B-26, were advanced including 20 borings within the proposed power block area and the remaining 6 borings within the proposed solar array area. The borings were performed using a track-mounted drill rig utilizing an 8-inch diameter hollow-stem auger to final depths ranging from 21.5 to 76.5 feet below the existing ground surface. Approximate boring locations are shown on Plate 2, *Boring Location Map for Power Block Area*, and Plate 3, *Boring Location Map for Solar Area*.

Soil samples were obtained from the borings using techniques and equipment in general accordance with the American Society for Testing and Materials (ASTM) Standard Specification D1586-Standard Penetration Test (SPT) and D3550-Standard Practice for Thick-Walled, Ring Lined, Split-Barrel Drive Sampling of Soils. The SPT consists of driving a 2-inch O.D. split spoon sampler with repeated blows of a 140-pound hammer falling freely from a distance of 30 inches. The Standard Penetration, or N-value, is determined as the number of blows required advancing the sampler the next 12 inches after an initial 6-inch penetration. California Sampling consists of driving a 3.0–inch O.D. sampler consisting of 2.38-inch I.D. rings with repeated blows of a 140-pound hammer free falling a distance of 30 inches. Soil samples were obtained at a maximum interval of 5 feet utilizing either SPT or California samplers. Each soil sample was classified in accordance with the Unified Soil Classification (USCS) system. Rock was not encountered in any of the borings. Logs of the borings are attached in Appendix A, *Field Exploration*.

3.3 LABORATORY TESTING PROGRAM

Laboratory testing of selected soil samples obtained from the test borings was performed at Kleinfelder Soil and Material Testing Laboratory in Redlands, California. Corrosion testing on two samples was performed at AP Engineering and Testing, Pomona, California. The purpose of the testing was to verify the field visual classifications and obtain information for subsequent engineering evaluations. The results of the laboratory testing program are attached in Appendix B, *Laboratory Testing*.

3.4 SUBSURFACE SOIL CONDITIONS

The subsurface soil encountered in the test borings consisted of alluvial deposits of sandy silt, silty sand, silty sand to sandy silt, sand with silt, and occasional sand. Alluvial soil was encountered to the maximum explored depth of 76.5 feet below the existing ground surface in boring B-3. The SPT N-values in the borings varied from 17 to 66. The SPT N-values in the borings indicate a medium dense to very dense soil condition with the exception of occasional upper 5 feet of loose soil (SPT N-values less than 10). Based on the laboratory test results, the dry unit weight of the soil varies from 96 to 141 pounds-per-cubic-foot (pcf) with moisture content ranging from 0.1 to 10.3 percent.

3.5 GROUNDWATER

At the time of our investigation, groundwater was not encountered within the exploratory borings ranging in depths from 21.5 feet to 76.5 feet below the existing ground surface. Based on Kleinfelder's experience with other projects in Palmdale and review of historical groundwater data from the Department of Water Resources website, a well located at a distance of approximately one mile from the subject site had a shallow groundwater depth of 120 feet in 1922. Well data for three other nearby wells show groundwater depths of 321 to 419 feet below the existing ground surface. This well data dates from the year 1963 up to 2000. The referenced California Geological Survey

2005 Seismic Hazard Report evaluated all available well data within this region and reported a general groundwater depth within this area at approximately 400 feet below the existing ground surface. Due to the nature and volume of groundwater pumping within the project area, groundwater levels on and near the project site are expected to remain consistent with or at levels deeper than those levels observed from the year 1963 to the present. However, fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas can also cause a fluctuation of localized groundwater levels.

4.0 PRELIMINARY EVALUATIONS AND RECOMMENDATIONS

4.1 GENERAL

Based on the results of our subsurface investigation, laboratory testing, geotechnical analyses, and our current understanding of the project, it is our opinion that the proposed site is geotechnically feasible for construction of the proposed electrical generating facilities, provided the recommendations presented in this report are incorporated into the project design and construction. In general, the primary geotechnical constraint for development of this site as identified by our preliminary investigation is the potential for partial collapse of the alluvial soil within approximately 10 to 20 feet of the existing ground surface. Our preliminary evaluations and recommendations based on the subsurface investigation program and our current understanding of the proposed PPP are presented in the following sections of this report.

4.2 COLLAPSIBLE SOIL CONDITIONS

The degree of collapse of a soil is defined by the Collapse Potential (CP) value, which is expressed as a percent of collapse of the total sample using the Collapse Potential Test (ASTM D5333). Based on Naval Facilities Engineering Command (NAVFAC) Design Manual 7.1, the severity of collapse potential is commonly evaluated by the following Collapse Potential Values, as shown in Table 3, below.

Table 3
Collapse Potential Values

Collapse Potential Value	Severity of Problem
0-1%	No Problem
1-5%	Moderate Problem
5-10%	Trouble
10-20%	Severe Trouble
> 20%	Very Severe Trouble

Table 3 can be combined with other factors such as the probability of ground wetting to occur on-site and the extent or depth of potential collapsible soil zone to evaluate the potential hazard by collapsible soil at a specific site. A hazard ranking system associated with collapsible soil as developed by Hunt (1984) is presented in Table 4, below.

Table 4

Collapsible Soil Hazard Ranking System

Degree of Hazard	Definition of Hazard
No Hazard	No hazard exists where the potential collapse magnitudes are non-existent under any condition of ground wetting.
Low Hazard	Low hazards exist where the potential collapse magnitudes are small (CP values 0-1%) and tolerable or the probability of significant ground wetting is low.
Moderate Hazard	Moderate hazards exist where the potential collapse magnitudes are undesirable (CP values 1-5%) or the probability of substantial ground wetting is low, or the occurrence of the collapsible unit is limited.
High Hazard	High hazard exist where potential collapse magnitudes are undesirably high (CP values 5-20%) and the probability of occurrence is high.

The proposed Project site is located in a geologic environment where the potential of collapsible soil exists. The results of collapse potential tests performed on 11 selected samples from different depths within 26 feet below the existing ground surface indicated a range of collapse potential values from 1.6 to 6 percent at applied vertical stress of 2,000 pounds-per-square-foot (psf).

Based on our laboratory test results and geotechnical analyses conducted for the site, it is our opinion that the site generally has a low to moderate potential for collapsible soil conditions. We recommend overexcavation within the structural areas to competent soils below the bottom of the proposed shallow foundations or the lowest adjacent grade to reduce the potential for collapsible soil conditions at the site. Our recommendations for overexcavation and compaction are discussed in Section 4.8.

Since the introduction of water into the soils can initiate collapse, proper measures should be taken to reduce potential for future pipe leakage and/or water from possible landscape irrigation to enter the soils within the specific locations of the proposed equipment and other Project structures. It is very important that storm water runoff be directed from roofs and other improvements to appropriate storm water collection systems. Diligent efforts should be made to provide an efficient means of transport of runoff water to collection devices, preventing runoff water from infiltrating soils within approximately 30 feet of the structures.

4.3 SEISMIC DESIGN RECOMMENDATIONS

The site is located within seismically active Southern California region and will likely be subjected to ground shaking from movement along one or more of the active or potentially active faults in the region. We anticipate that the primary seismic hazard to the project site is a potential for moderate to severe shaking.

Based on the California Seismic Shaking Hazard Maps (2003) obtained from the California Geologic Survey (CGS) website, the Peak Horizontal Ground Acceleration (PHGA) at the site with 10% probability of exceedance in 50 years is 0.58g for deep alluvial soil condition. The California Seismic Hazard Maps are based on USGS/CGS seismic hazards assessment (PSHA) model 2002 (revised in April, 2003). In accordance with the 2001 California Building Code (CBC), the proposed site is located within Seismic Zone 4. The seismic design parameters for the proposed structures in accordance with the 2001 CBC are presented in Table 5, below.

Table 5
Seismic Design Parameters

Seismic Design Parameter	Value
Seismic Zone Factor (Table 16A-I)	0.40
Soil Profile Type (Table 16A-J)	S_D
Seismic Source Type (Table 16A-U)	A
Near-Source Factor, N_a (Table 16A-S)	1.02
Near-Source Factor, N_v (Table 16A-T)	1.25
Seismic Coefficient, C_a (Table 16A-Q)	0.45
Seismic Coefficient, C_v (Table 16A-Q)	0.80

4.4 PRELIMINARY FOUNDATION RECOMMENDATIONS

4.4.1 General

We understand that at this stage of the project, detailed information regarding structural loads is not available. Based on our experience with similar projects, we anticipate that the proposed structures will be supported on shallow foundations. Our preliminary foundation recommendations include recommendations for both shallow footings and mat foundations. Deep foundation recommendations may be provided at a later date if needed, following review of more detailed design-level plans.

4.4.2 Conventional Shallow Foundations

The proposed structures can be supported on conventional continuous strip footings and isolated spread footings. Footings should have a minimum width of 12 inches and a minimum embedment depth of 18 inches below the lowest adjacent final grade and underlain by engineered fill prepared as discussed in Section 4.8 of this report. Shallow foundations constructed in accordance with the recommendations stated in this report may be designed using a maximum allowable soil bearing pressure of 2,000 pounds per square foot (psf). The allowable bearing pressure provided above is a net value; therefore, the weight of the foundation (which extends below grade) may be neglected when computing dead loads. The allowable bearing pressure may be increased by one-third for short-term loading due to wind or seismic loads.

The total settlement of an individual foundation will vary, depending on the depth of fill materials, the plan dimensions of the foundation and the actual load supported. Based on the anticipated foundation dimensions and loads, we estimate that the total settlement of foundations designed and constructed in accordance with the recommendations stated in this report should be on the order of 1 inch or less. Differential settlement between similarly loaded, adjacent footings is expected to be less than ½ inch, provided footings are founded on similar materials. Differential settlement of footings founded on dissimilar materials may approach the maximum estimated settlement of 1 inch. In the event that the foundation soils become saturated, settlement greater than one inch could occur due to the presence of isolated collapsible soils.

Footings may experience an overall loss of bearing capacity or an increased potential to settlement where located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the footings on the utility lines may cause cracking, collapse, and/or a loss of serviceability. To reduce this risk, footings should extend below a 1:1 plane projected upward from the closest bottom corner of the trench.

At the completion of grading, representative samples of the sub-grade materials at footing grade should be evaluated for expansion potential and corrosivity.

4.4.3 Slab-On-Grade

Concrete slab-on-grade should be placed on compacted engineered fill that is uniform in composition and at least 3 feet in thickness. Concrete floor slabs should be reinforced as required by the structural engineer. The structural engineer should design all slabs for any specific loading, settlement, or expansive soil conditions.

We anticipate that most of the proposed floor slabs will be covered with moisture-sensitive floor coverings. Thus, we recommend that interior concrete slabs supported-on-grade be underlain by a capillary break to reduce the potential for soil moisture migrating upwards toward the slab.

Within areas where moisture-sensitive flooring will be placed, we recommend the placement of an impermeable membrane such as visqueen (or equivalent), to act as a moisture barrier to reduce the potential for upward migration of water through the slab. The vapor barrier should have a thickness of at least 10 millimeters. To promote uniform curing of the slab and provide protection of the membrane during construction, clean, fine to medium grained sand, 2 inches thick, should be placed on top of and below the membrane, for a 4-inch thick sand blanket, prior to the placement of concrete. This sand should be moistened immediately prior to concrete placement.

Clean sand should conform to the specifications for concrete sand in the Standard Specifications for Public Works Construction (Green Book, 2000). Generally, the gradation range of clean sand should consist of 100% passing the No. 4 sieve to less than 5% passing the No. 200 sieve. In general, the on-site soils do not appear to meet this requirement. All areas adjacent to the building, including planters, should be designed to drain away from the structure to avoid an accumulation of water beneath the slab.

Concrete should not be placed if sand overlying the membrane has been allowed to become wet (due to precipitation or excessive moistening) or if standing water is present above membrane. Excessive water beneath interior floor slabs could result in significant moisture transmission through the slab, adversely affecting moisture-sensitive floor coverings.

Although moisture barrier systems are currently the industry standard, this system may not be completely effective in preventing floor slab moisture problems. These systems typically will not necessarily ensure that floor slab moisture transmission rates will meet floor-covering manufacturer standards or that indoor humidity levels will be appropriate to inhibit mold growth. In many cases, floor moisture problems are the results of either improper curing of floor slabs or improper application of flooring adhesives.

Our evaluations have not included services to address the influence of moisture vapor transmission through building floor slabs. Slab and flooring system design experts should be retained to provide design recommendations consistent with the maximum allowable moisture transmission rate as it may affect flooring performance and indoor humidity levels.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking, or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI). At the completion of grading, representative samples of the materials at pad grade should be evaluated for expansion potential and corrosivity.

4.4.4 Mat Foundations

Mat foundations may be considered as an alternative foundation system for the proposed project structures. The proposed mat foundations should be underlain by a minimum of 3 feet of compacted engineered backfill. The compacted fill blanket should extend laterally at least 5 feet beyond the mat foundation perimeter. Mat foundations constructed in accordance with the recommendations stated in this report may be designed using a maximum net allowable soil bearing pressure of 2,000 psf and modulus of sub-grade reaction of 100 pounds per cubic inch (pci).

The modulus of sub-grade reaction presented above is appropriate for foundation design considering static loading and elastic settlement. The settlement of a mat foundation designed using the criteria recommended above is expected to be on the order of 1 inch or less. Differential settlement or 'mat rotation' should be negligible, assuming that structural loads are uniformly distributed over the entire structure footprint area. The allowable bearing pressure may be increased by one-third for short term loading due to wind or seismic loads.

4.4.5 Footing, Slab-On-Grade and Mat Foundation Observation

Prior to placing steel and concrete, footing excavations should be cleaned of all debris, loose or soft soil, and water. All footing excavations should be observed by a qualified geotechnical engineer just prior to placing steel or concrete to verify that the recommendations contained herein are implemented during construction. Sub-grade soils beneath slab-on-grade or mat foundation should also be observed during pre-moistening operations to verify that the recommendations contained herein are implemented during construction.

4.4.6 Deep Foundations

As mentioned previously, although shallow foundations are considered more likely, it is conceivable that deep foundations may be required based on the structural load requirements of the proposed project. If a deep foundation alternative is selected, we recommend Cast-In-Drilled-Hole (CIDH) piles or driven piles to support the proposed structures. Analysis and design of deep foundation systems is not included in the scope of Kleinfelder's services at this stage of the project.

4.5 SOIL PARAMETER RECOMMENDATIONS

4.5.1 Physical Soil Characteristics

Our recommendations for soil strength parameters and unit weight are presented in the following Table 6:

Table 6
Physical Soil Parameters

Soil Type	Total Unit Weight (pcf)	Angle of Internal Friction (degrees)	Cohesion (psf)
Silty SAND to Sandy SILT (SM/ML)	110	28	200

4.5.2 Static and Dynamic Soil Parameters for Vibrating Machine Foundations

Our recommendations for static and dynamic soil parameters for vibrating machine foundations are presented in the following Table 7:

Table 7
Static and Dynamic Soil Parameters for Vibrating Machine Foundations

Soil Type	Poisson's Ratio μ	Maximum Dynamic Shear Modulus G_{max} (psi)	Material Damping Ratio	Static Horizontal Subgrade Modulus K_h (pci)	Static Vertical Subgrade Modulus K_v (pci)
Silty SAND to Sandy SILT (SM/ML)	0.30	17,000	0.02	90	100

4.6 RECOMMENDATIONS FOR RETAINING WALLS AND BELOW-GRADE STRUCTURES

We recommend that soil pressure values for calculating active lateral earth pressures developed from horizontal backfills behind retaining walls or below-grade structures that are free to rotate at least 0.1 percent of the wall height use an equivalent fluid pressure of 40 pounds per cubic foot (pcf). Walls that are restrained against movement or rotation at the top should be designed for an at-rest equivalent fluid pressure 60 pcf. The above values are applicable if the on-site soils are used for level backfill behind the walls. The recommended values do not include compaction or truck-induced wall pressures.

We recommend a coefficient of sliding resistance value of 0.3 for sliding stability analysis. This value is applicable for friction between cast-in-place concrete foundations and underlying soil. Passive pressure available in engineered fill may be taken as equivalent fluid pressure of 300 pounds per cubic foot (pcf), not to exceed 2,500 psf.

For seismic loading conditions, additional seismic/dynamic earth pressure should be added to the static active earth pressure. Seismic wall pressures for cantilever walls are generally estimated by the simplified approximation of Mononobe-Okabe Method proposed by Seed and Whitman (1970). In accordance with AASHTO (1992) seismic design guidelines, we used a horizontal seismic acceleration coefficient, k_h, equal to one-half the peak horizontal ground acceleration ($k_h = 0.29$). Using this approach, we recommend a dynamic earth pressure of 24 psf per foot of depth. This additional pressure should be taken to act at a distance of 0.6H, where H is the wall height in feet. Note that the active earth pressure has a triangular distribution with the largest load occurring at the bottom of the wall, while the seismic earth pressure has an inverted triangular distribution with the largest load at the top of the wall.

In case of traffic coming closer than one-half of the height of the wall, we recommend a live load surcharge pressure equal to not less than 2 feet of soil surcharge with an average unit weight of 120 pcf.

Care must be taken during the compaction operations not to overstress the walls. Heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are being placed. Hand-operated compaction equipment should be used to compact the backfill soils within a 3-foot wide zone adjacent to the walls. This zone should be free of materials greater than 3 inches in diameter.

The recommended lateral earth pressures assume that drainage is provided behind the walls to prevent the accumulation of hydrostatic pressures. Walls should be provided with backdrains to reduce the potential for the accumulation of hydrostatic pressures. Backdrains may consist of a 1 foot wide zone of Caltrans Class 2 permeable material located immediately behind the wall, extending to within 1 foot of the ground surface.

Weep holes should be installed in the wall or a perforated pipe (Schedule 40 PVC) wrapped in filter fabric should be installed at the base of the backdrain and sloped to discharge to a suitable collection facility. A proprietary drainage board, approved by the geotechnical engineer, may also be used in lieu of drainage material (Class 2 permeable base material). If sufficient drainage is not provided, walls should be designed to resist equivalent fluid pressures of 95 pcf and 110 pcf for the active and at rest cases, respectively.

4.7 CORROSIVITY

Chemical analyses were performed on three samples of near surface soils (1-5 feet below the ground surface) to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with California Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). Test results indicated a minimum resistivity of 3,600 to 13,000 Ohm-cm, pH values of 7.2 and 7.3, sulfate contents from 6 parts per million (ppm) to 121 ppm, and chloride contents from 60 ppm to 368 ppm. The corrosivity test results are presented in Appendix B. These tests are only an indicator of potential soil corrosivity for the samples tested. Other soils found on the site may be more, less, or of a similar corrosive nature.

Kleinfelder does not practice corrosion engineering. We recommend that a competent corrosion engineer be retained to evaluate the corrosion potential of the site to the proposed project, to recommend further testing as required, and to provide specific corrosion mitigation methods appropriate for the project. In general, the soil samples tested are considered as having a negligible sulfate exposure towards concrete and a moderate corrosion potential towards ferrous metals. We recommend that specific testing be performed once site-grading activities are near completion to provide a better assessment of the actual soils present in the areas of interest.

4.8 SITE PREPARATION

4.8.1 Stripping and Grubbing

Prior to general site grading, existing vegetation, weeds, organic matter, and debris should be stripped and disposed outside the construction limits. We estimate the average depth of stripping to be approximately 6 to 12 inches over most portions of the site. Deeper stripping and grubbing may be required where higher concentrations of organic soil or vegetation are encountered. Areas where there are concentrations of tree roots and in the vicinity of natural drainage areas are two examples of areas requiring deeper stripping and grubbing. Stripped topsoil (less any debris and organic matter) may be stockpiled and reused for landscape purposes; however, this material should not be incorporated into any engineered structural fill.

4.8.2 Overexcavation

Overexcavation and recompaction are recommended beneath the structures founded on the shallow foundation system and beneath pavement (e.g. parking lot) to improve the existing soil and to reduce the potential for soil collapse or excessive settlements. Care should be taken during overexcavation operations to maintain sidewall stability and personal safety. In addition, the grading should result in the overexcavation of soils beyond the perimeter of foundations extending laterally to a minimum distance equal to the thickness of the fill or at least 5 feet, whichever is deeper.

To reduce the potential for adverse differential settlement of the proposed structures all overexcavation should extend to a depth where competent soils are encountered and the project geotechnical engineer or project geologist has deemed the exposed soils as being suitable for receiving compacted fill. Kleinfelder's general recommendations for overexcavation are as follows:

- Fill: Prior to placing any additional fill, the area to receive fill should be overexcavated a minimum of 3 feet below the existing ground surface.

- Shallow Foundations: Shallow footing areas should be overexcavated at least 5 feet below the bottom of the proposed footings.

- Slab-on-Grade/Mat Foundation: Slab-on-grade and/or mat foundation areas should be overexcavated at least 3 feet below the bottom of the proposed foundations.

- Pavement and Miscellaneous Improvements: Pavement and other miscellaneous improvement (e.g., sidewalks, parking lot) areas should be overexcavated at least 2 feet below the bottom of the proposed pavement sections.

The overexcavation depths may be modified once final grading plans are prepared for the proposed improvements and reviewed by qualified professionals.

Borings were advanced using a track-mounted, hollow-stem auger drill rig with little to moderate effort through the existing soil deposits. Conventional earth moving equipment is expected to be capable of performing the excavations required for site preparation.

4.8.3 Scarification and Compaction

Following site stripping and any required grubbing and/or overexcavation, we recommend all areas to receive engineered fill or to be used for support of structures, concrete slabs, and pavements be scarified to a minimum depth of 8 inches, uniformly moisture-conditioned to near optimum moisture content, and compacted to at least 90 percent of the maximum dry density obtained using ASTM D1557.

4.8.4 Engineered Fill

The on-site soils encountered during our investigation, excluding organics, debris, and/or other deleterious materials, are considered suitable for use as engineered fill. When adequately compacted at an appropriate moisture content, the materials can be expected to possess suitable bearing and settlement characteristics for the proposed Project. If potentially expansive soils are encountered near ground surface during grading, the project geotechnical engineer or project geologist should be notified so that proper mitigation measures can be taken, such as blending with low expansive soils or placement outside of buildings and pavement areas.

All import soils should be free from deleterious material and debris and should be documented to be free of hazardous materials including petroleum or petroleum byproducts, chemicals, and harmful minerals. In general, well graded mixtures of gravel, sand, and non plastic silt are suitable for use as engineered fill. Import materials, if required, should have a low expansion potential, i.e. have an expansion index of less than 20 in accordance with UBC Standard 18-2. All imported fill should be compacted to the general recommendations provided for engineered fill.

4.8.5 Pipe Bedding and Trench Backfill

Pipe zone backfill (i.e. material beneath and in the immediate vicinity of the pipe) should consist of sand or similar material having a minimum Sand Equivalent (SE) of 30. Tests on four samples indicated a minimum SE value of less than 30 in three tests. Therefore, we recommend that imported soil or screened on-site soil with a minimum SE of 30 be used as pipe zone backfill. If screening of on-site soil is performed, we recommend that a Sand Equivalent Test be performed on screened soil before using it as pipe zone backfill material. Trench zone backfill (i.e. material placed between the pipe zone backfill and finished sub-grade) may consist of native or import soil, which meets the requirements for engineered fill provided in Section 4.8.4.

If imported material is used for pipe or trench zone backfill, we recommend it consist of fine-grained sand with a SE of 30. In general, coarse grained sand and/or gravel should not be used for pipe or trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel.

Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local building requirements and/or bedding requirements for specific types of pipes. We recommend the Project Civil Engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

4.8.6 Compaction Criteria

All fill soils, either native or imported, required to bring the sites to final grade should be compacted as engineered fill. Native or imported soils intended for engineered fill should be uniformly moisture-conditioned to near optimum moisture content, placed in horizontal lifts no greater than 8 inches in loose thickness, and compacted to at least 90 percent of relative compaction, based on ASTM D1557. The sub-grade soil within pavement areas should be compacted to a minimum of 95 percent relative compaction (ASTM D1557). Additional fill lifts should not be placed if the previous lift did not meet the required dry unit weight or if soil conditions are not stable.

The pipe bedding material should be compacted to a minimum of 90 percent relative compaction (ASTM D1557). Trench backfill above pipe bedding should be native or imported soils intended for engineered fill, moisture conditioned to near moisture content, placed in horizontal lifts no greater than 8 inches in loose thickness, and compacted to at least 90 percent of relative compaction (ASTM D1557).

The post-construction settlement of fills following site preparation and fill construction is estimated to be approximately 0.2 percent of the fill thickness for fills compacted to 90 percent of the maximum dry density at moisture contents at or slightly above optimum moisture content.

4.9 TEMPORARY EXCAVATIONS

4.9.1 General

All excavations must comply with applicable local, state, and federal safety regulations including the current the Occupational Safety & Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

4.9.2 Temporary Slopes

Near-surface soils encountered during our field investigation consisted predominantly of sand and silty sand. In our opinion, these soils would be considered as a Type C soil with regard to OSHA regulations. According to OSHA regulations, the maximum allowable slopes for Type C soil is 1.5:1 (horizontal:vertical) for excavations less than 20 feet deep. Steeper cut slopes may be utilized for excavations less than 5 feet deep, depending on strength, moisture content, and homogeneity of the soils as observed during construction.

4.9.3 Shoring

Shoring may be required where space or other restrictions do not allow a sloped excavation. A braced or cantilevered shoring system maybe used. A temporary cantilevered shoring system should be designed to resist an active earth pressure equivalent to a fluid weighing 40 pcf. Braced excavations should be designed to resist a uniform horizontal soil pressure of 30H psf, where H is the excavation depth in feet. The values provided above assume a level ground surface adjacent to the top of the shoring.

Fifty percent of an areal surcharge placed adjacent to the shoring may be assumed to act as a uniform horizontal pressure against the shoring. Special cases such as combinations of slopes and shoring or other surcharge loads (not specified above) may require an increase in the design values recommended above. These conditions should be evaluated by the project geotechnical engineer on a case-by-case basis.

Cantilevered shoring must extend to a sufficient depth below the excavation bottom to provide the required lateral resistance. We recommend that required embedment depths be determined using methods for evaluating sheet pile walls and based on the principles of force and moment equilibrium. For this method, the allowable passive pressure against shoring, which extends below the level of excavation, may be assumed to be equivalent to fluid weighing 300 pcf. Isolated shafts spaced at a distance less than 3D, where D is the width of the shaft, may be designed for an allowable passive pressure equivalent to a fluid weighing 600 pcf. Additionally, we recommend a factor of safety of 1.2 be applied to the calculated embedment depth and that passive pressure is limited to 2,000 psf. The Contractor should be responsible for the structural design and safety of all temporary shoring systems.

4.10 PRELIMINARY PAVEMENT SECTIONS

The appropriate pavement design sections for on-site roadways depends primarily on the shear strength of the sub-grade soil exposed after grading and anticipated traffic over the design life of the pavement. Flexible (i.e. asphalt concrete) pavement sections are recommended based on the soil conditions encountered during our field investigation, laboratory testing, and anticipated design traffic indexes. We recommend representative roadway sub-grade samples be obtained during grading and R-Value tests be performed. Should the results of these tests indicate a significant difference, the design pavement sections provided below may need to be revised.

To reduce potential settlement, excess soil material, and/or fill material removed during any footing or utility trench excavation, should not be spread or placed over compacted finished grade soils unless subsequently compacted to at least 95 percent of the maximum dry unit weight, as evaluated by ASTM D1557 test procedure, and at or near optimum moisture content, if placed under areas designated for pavement.

Our pavement design recommendations are not based on any heavy construction traffic on the finished pavement sections.

4.10.1 Asphalt Concrete Pavement

Our recommendations for the asphalt concrete pavement sections were prepared in accordance with the Caltrans Highway Design Manual (2006). We performed two R-Value tests on samples recovered during our subsurface investigation and selected a design R-value of 40 for preliminary design purposes. Table 8 presents the recommended pavement sections for a range of anticipated Traffic Index (TI) values between 5 and 10. We recommend that the project civil engineer evaluate the appropriateness of the TI values used for the anticipated traffic.

Table 8

Recommended Minimum Asphalt Concrete Sections

Traffic Index	Asphalt Concrete Thickness (inches)	Class 2 Aggregate Base Thickness (inches)
5	3.0	4.0
6	3.5	5.5
7	4.0	7.0
8	5.0	8.0
9	5.5	9.5
10	6.5	10.5

Pavement sections provided above are contingent on the following recommendations being implemented during construction.

- Asphalt concrete and base materials should be underlain by at least 2 feet of engineered fill compacted to at least 95 percent relative compaction (ASTM D1557).
- Subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted.
- Asphalt concrete paving, aggregate base materials, and placement methods should conform to the latest edition of the Standard Specification for Public Works, referred to as the Green Book.
- Aggregate base materials should be compacted to at least 95 percent relative compaction (ASTM D1557).
- Within the structural pavement section areas, positive drainage (both surface and subsurface) should be provided. In no instance should water be allowed to pond on the pavement. Roadway performance depends greatly on how well runoff water drains from the site. This drainage should be maintained both during construction and over the entire life of the Project.

5.0 ADDITIONAL GEOTECHNICAL INVESTIGATIONS

5.1 PLANS AND SPECIFICATION REVIEW

We recommend Kleinfelder West, Inc. be retained to review preliminary foundation and earthwork plans and specifications. It has been our experience that this service provides an opportunity to review whether or not our recommendations have been properly interpreted and to correct possible misunderstandings of our recommendations prior to the start of construction. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

5.2 CONSTRUCTION OBSERVATION AND TESTING

We recommend that Kleinfelder West, Inc. be retained to provide observation and testing services during site earthwork and construction of foundations. This will allow us the opportunity to compare actual subsurface soil conditions with those encountered during our field exploration and, if necessary, to provide supplemental recommendations, if warranted due to unanticipated subsurface conditions.

6.0 LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil conditions vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction, including structural locations, changes from that described in this report, our recommendations should also be reviewed. We have not reviewed the final grading plans or foundation plans for the project.

Our corrosion recommendations are preliminary. Kleinfelder is not a corrosion engineering consultant. Specific recommendations for corrosion protection should be obtained from a corrosion specialist.

Our evaluation of subsurface conditions at the site has considered subgrade soil and groundwater conditions present at the time of our investigation. The influence(s) of post-construction changes to these conditions such as introduction of water into the subsurface will likely influence future performance of the proposed project. Whereas our scope of services addresses present groundwater conditions; future irrigation, broken water pipelines, etc. may adversely influence the project and should be addressed and mitigated, as needed, by specialized slab and flooring system designers having local knowledge.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference", as the latter term is used relative to contracts or other matters of law.

We have strived to present the findings, conclusions and recommendations in this report in a manner consistent with the standards of care and skill ordinarily exercised by members of this profession practicing under similar conditions in Los Angeles County, California, and at the time the services were performed. No warranty, express or implied, is made. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by Kleinfelder during project construction in order to evaluate compliance with our recommendations and/or to provide supplemental recommendations, as needed, if anticipated subsurface conditions are encountered.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials. Kleinfelder will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

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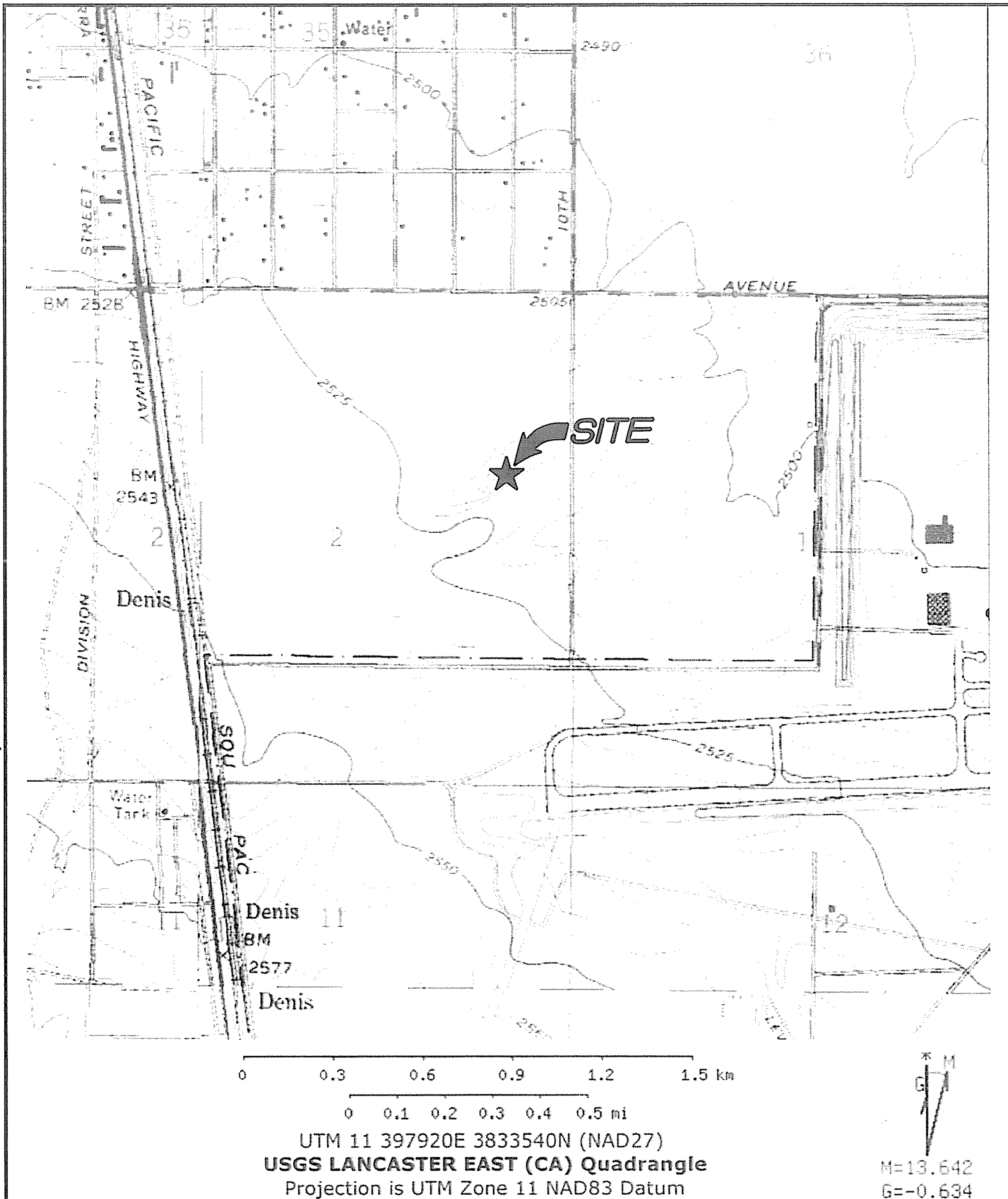
PLATES



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KLEINFELDER 1220 Research Drive, Suite B Redlands CA 92374 PH. (909) 793-2691 FAX. (909) 792-1704 www.kleinfelder.com	**SITE VICINITY MAP** PALMDALE POWER PROJECT PALMDALE, CALIFORNIA	DRAWN BY: M. GRIFFIN REVISED BY: M. GRIFFIN CHECKED BY: DH PLATE **1**
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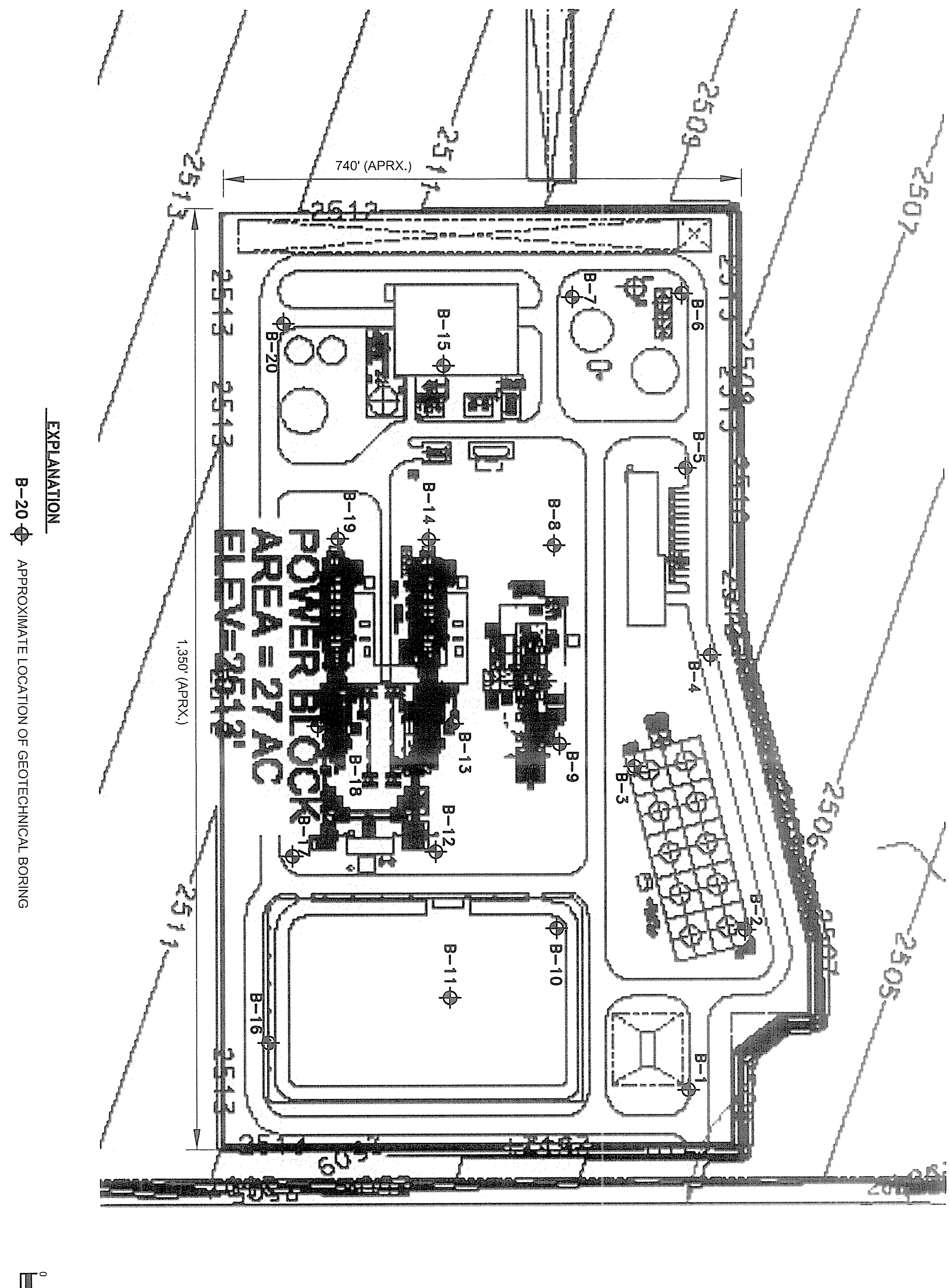

DRAWN BY: M. GRIFFIN	**BORING LOCATION MAP FOR POWER BLOCK AREA**		KLEINFELDER	PLATE
REVISED BY: M. GRIFFIN			1220 Research Drive, Suite B Redlands CA 92374 PH. (909) 396-0335 FAX. (909) 396-1324 www.kleinfelder.com	2
CHECKED BY: DH	PALMDALE POWER PROJECT PALMDALE, CALIFORNIA			
DATE: 03/26/08 APPROVED BY:	PROJECT NO. 82300	FILE NAME: 82300p2.dwg		

PLOTTED: 26 Mar 2008, 2:12pm, MGriffin

ATTACHED XREFS:
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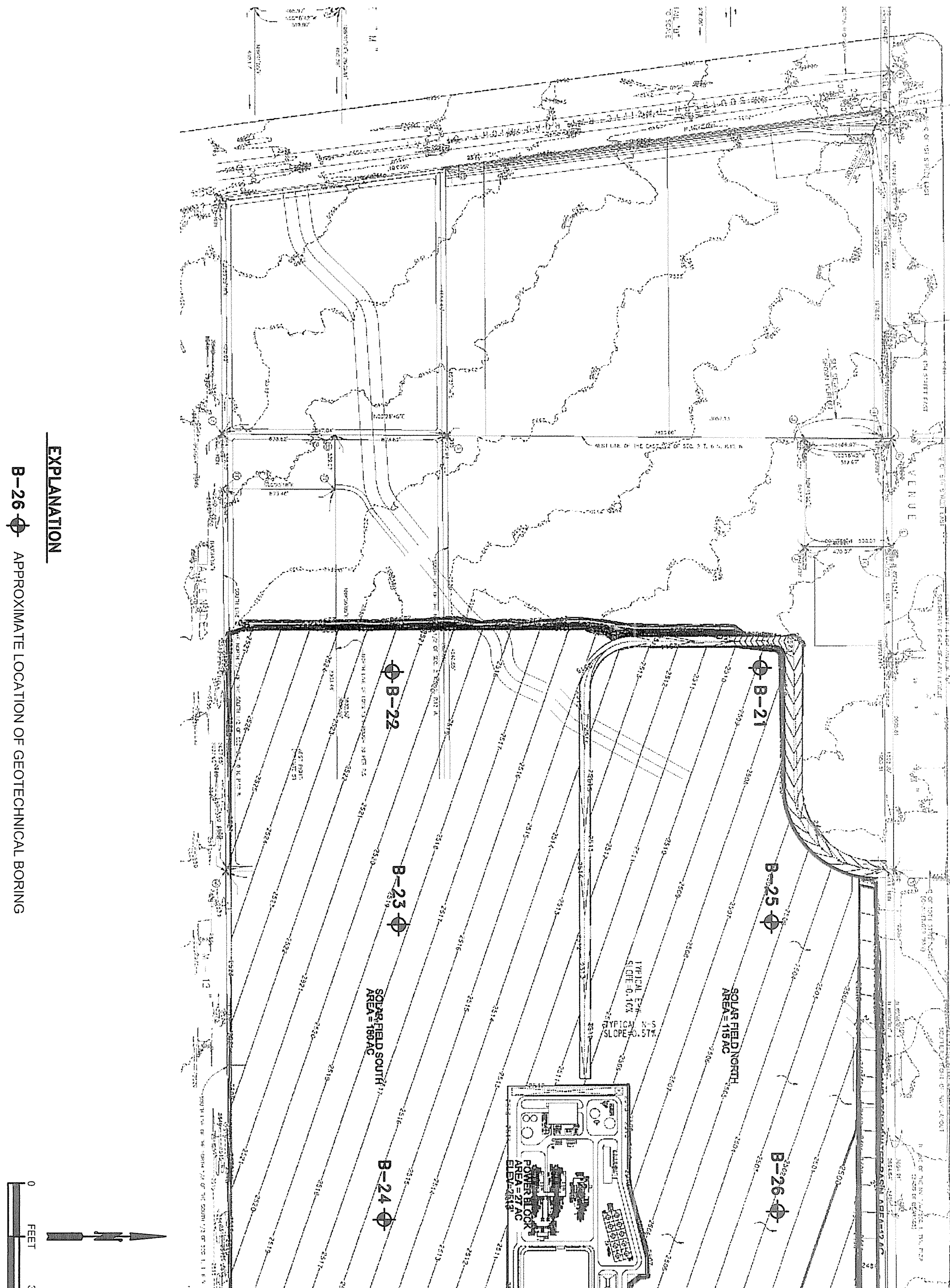
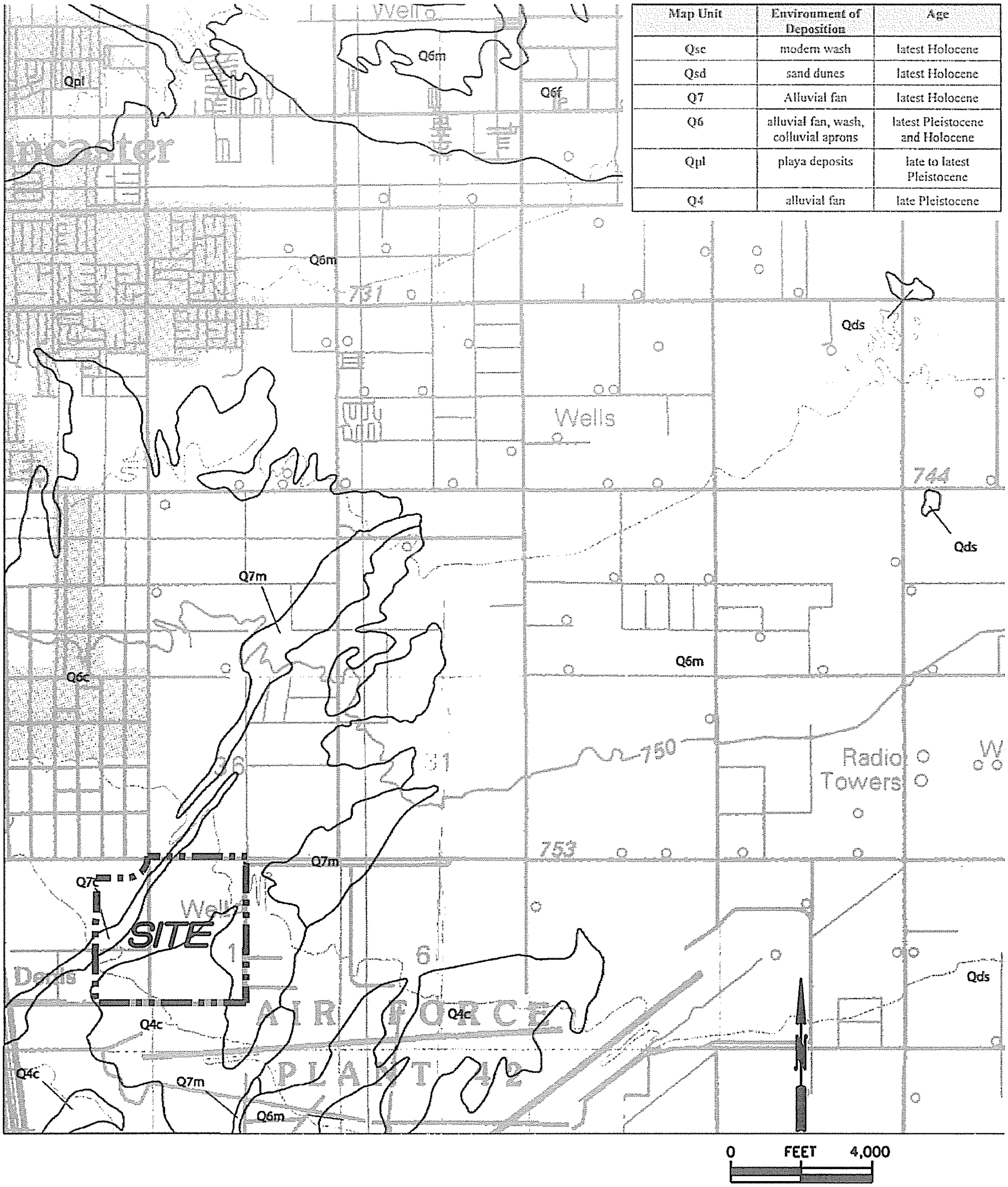
CAD FILE: U:\MGriffin\CADD\2008\82300\ LAYOUT: Layout1



DRAWN BY: M. GRIFFIN	**BORING LOCATION MAP FOR SOLAR AREA**	KLEINFELDER	PLATE
REVISED BY: M. GRIFFIN		1220 Research Drive, Suite B Redlands CA 92374 PH. (909) 396-0335 FAX. (909) 396-1324 www.kleinfelder.com	3
CHECKED BY: DH			
DATE: 03/26/08 — APPROVED BY:	PALMDALE POWER PROJECT PALMDALE, CALIFORNIA		
	PROJECT NO. 82300 — FILE NAME: 82300p3.dwg		

PLOTTED: 26 Mar 2008, 2:15pm, MGriffin



Map Unit	Environment of Deposition	Age
Qsc	modern wash	latest Holocene
Qsd	sand dunes	latest Holocene
Q7	Alluvial fan	latest Holocene
Q6	alluvial fan, wash, colluvial aprons	latest Pleistocene and Holocene
Qpl	playa deposits	late to latest Pleistocene
Q4	alluvial fan	late Pleistocene

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www.kleinfelder.com

REGIONAL GEOLOGIC MAP

PALMDALE POWER PROJECT
PALMDALE, CALIFORNIA

DRAWN BY:	M. GRIFFIN
REVISED BY:	M. GRIFFIN
CHECKED BY:	DH
PLATE	4

DRAWN: 03/26/08 | APPROVED BY:______ | PROJECT NO. 82300 | FILE NAME: 82300p4.dwg

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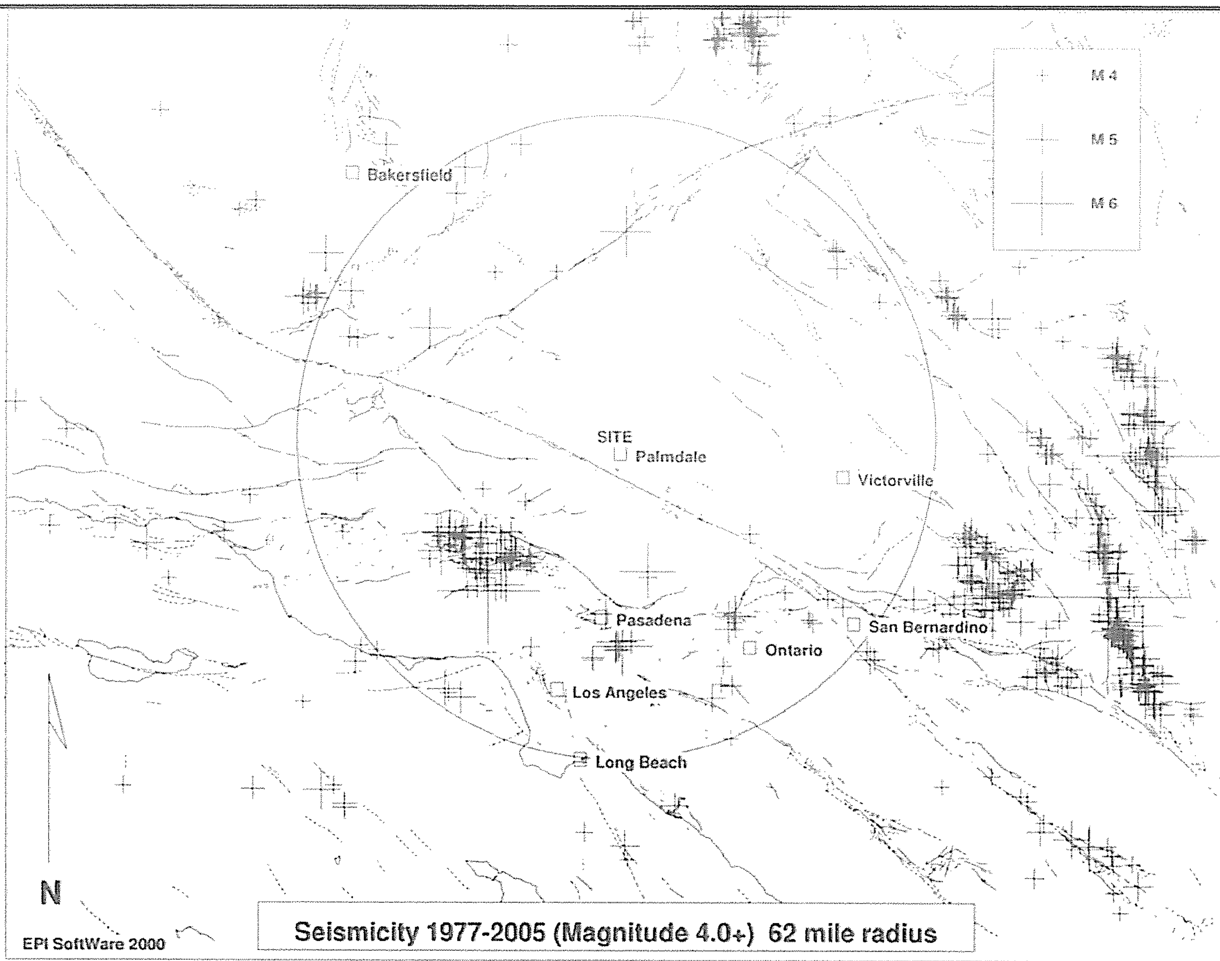
CAD FILE: U:\MGriffin\CADD\2008\82300\ LAYOUT: Layout1



SITE LOCATION: 34.6410 LAT. -118.1041 LONG.

MINIMUM LOCATION QUALITY: C

TOTAL # OF EVENTS ON PLOT: 548

TOTAL # OF EVENTS WITHIN SEARCH RADIUS: 126

MAGNITUDE DISTRIBUTION OF SEARCH RADIUS EVENTS:

4.0- 4.9 : 106
5.0- 5.9 : 19
6.0- 6.9 : 1
7.0- 7.9 : 0
8.0- 8.9 : 0

0 31 62
MILES
San Diego

CLOSEST EVENT: 4.2 ON SATURDAY, SEPTEMBER 24, 1977 LOCATED APPROX. 21 MILES SOUTHWEST OF THE SITE

LARGEST 5 EVENTS:

6.7 ON MONDAY, JANUARY 17, 1994 LOCATED APPROX. 38 MILES SOUTHWEST OF THE SITE
5.9 ON MONDAY, JANUARY 17, 1994 LOCATED APPROX. 33 MILES SOUTHWEST OF THE SITE
5.9 ON THURSDAY, OCTOBER 01, 1987 LOCATED APPROX. 40 MILES SOUTH OF THE SITE
5.8 ON FRIDAY, JUNE 28, 1991 LOCATED APPROX. 26 MILES SOUTH OF THE SITE
5.7 ON SATURDAY, JULY 11, 1992 LOCATED APPROX. 39 MILES NORTH OF THE SITE

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HISTORIC SEISMICITY MAP
1977 TO 2005

PALMDALE POWER PROJECT
PALMDALE, CALIFORNIA

DRAWN BY:	D. FAHRNEY
REVISED BY:	D. FAHRNEY
CHECKED BY:	DH
PLATE	5

DRAWN: 03/26/08	APPROVED BY:	PROJECT NO. 82300	FILE NAME: 82300p5.dwg

ATTACHED IMAGES: Images: SCN_20071030075747_001.jpg
ATTACHED XREFS:
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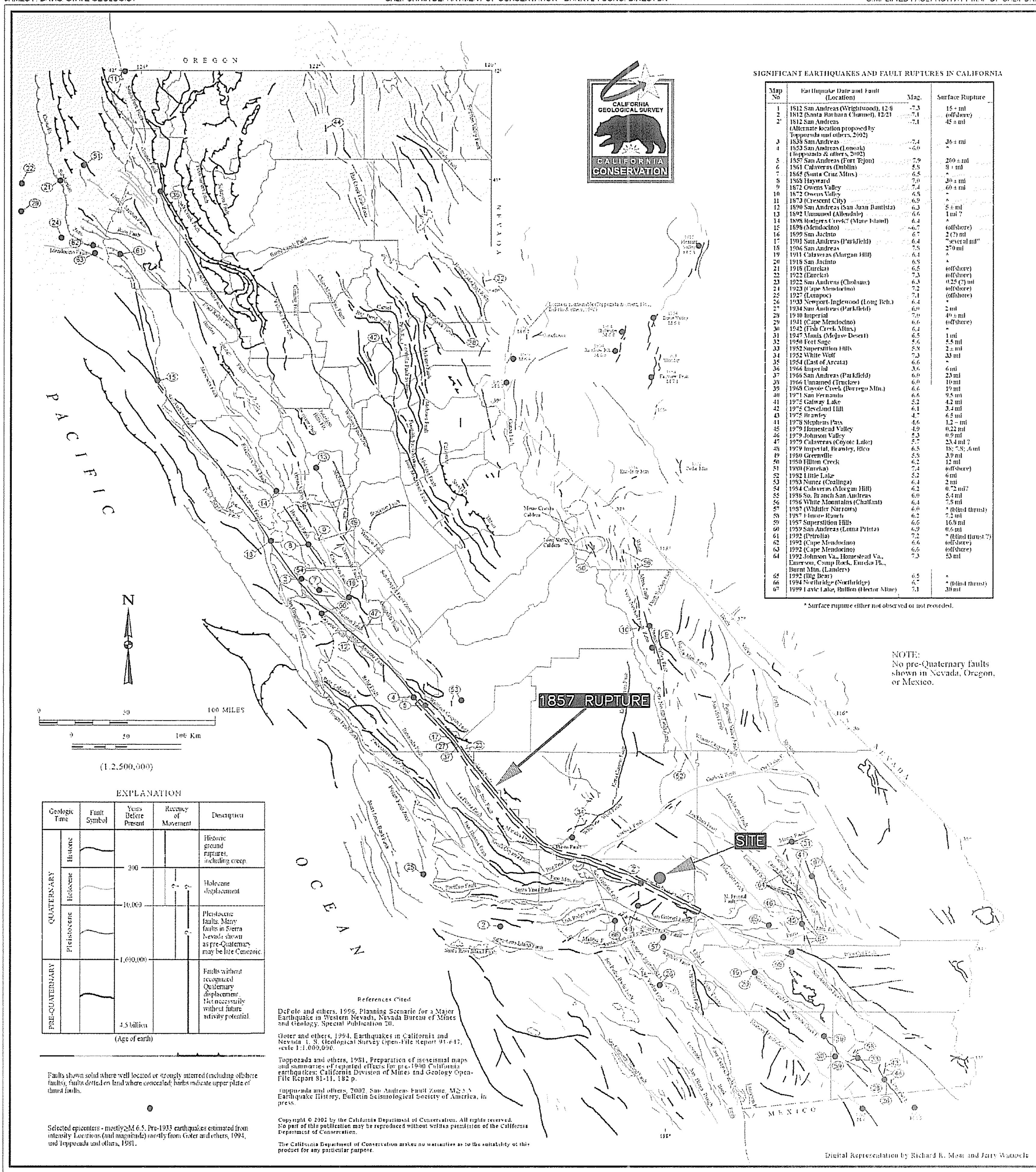
CAD FILE: U:\MGriffin\CADD\2008\82300\ LAYOUT: Layout1

STATE OF CALIFORNIA - GRAY DAVIS, GOVERNOR
THE RESOURCES AGENCY - MARY D. NICHOLS, SECRETARY
CALIFORNIA DEPARTMENT OF CONSERVATION - DARRYL YOUNG, DIRECTOR

MAP SHEET 54
SIMPLIFIED FAULT ACTIVITY MAP OF CALIFORNIA



SIMPLIFIED FAULT ACTIVITY MAP OF CALIFORNIA

Compiled by Charles W. Jennings and George J. Saucedo

1999 (Revised 2002, Tousson Toppozada and David Branum)

LEGEND

- - - - - APPROXIMATE LOCATION 1857 RUPTURE

DRAWN BY: DRD	**SAN ANDREAS 1857 FAULT RUPTURE MAP**	KLEINFELDER	PLATE
REVISED BY:		1220 RESEARCH DRIVE, SUITE B	6
CHECKED BY:	PALMDALE POWER PROJECT	REDLANDS, CALIFORNIA 92374	
DATE: 3-2008 / APPROVED BY:	PALMDALE, CALIFORNIA	PH. 909-793-2691 FAX. 909-792-1704	
	PROJECT: 82300 / FILE NAME:	www.kleinfelder.com	

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©

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program consisted of excavating and logging 26 hollow-stem auger borings that extended to depths ranging from approximately 21.5 to 76.5 feet below the existing ground surface. The exploratory borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers and an automatic hammer. Plates 2 and 3 show the approximate locations of the exploratory borings.

A legend to the logs is presented as Plate A-1. The logs of borings are presented as Plates A-2 through A-27. The logs of the borings describe the earth materials encountered, indicate the locations of the samples obtained, and show field and laboratory tests performed. The excavations were logged by a staff engineer from this firm using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and in-place samples of representative earth materials were obtained from the borings. The elevation of each boring has not been provided on our boring logs because the provided conceptual grading plan did not show the existing topographic lines within the subject site. Based on the adjacent topography the boring elevations should range from approximately 2,500 feet, above mean sea level (MSL) in the northeast corner to approximately 2,535 feet MSL in the southwest corner.

In-place soil samples were obtained from the borings using either a Standard Penetration (SPT) or California-type Sampler driven a total of 18-inches (or until practical refusal) into the undisturbed soil at the bottom of the boring. The soil sampled by the SPT (2.0-inch O.D., 1.5- inch I.D.) or California-type sampler (3.0-inch O.D., 2.4-inch I.D.) was returned to our laboratory for testing. The samplers were driven using an autohammer with a 140-pound weight falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count and is recorded on the Logs of Borings. Bulk samples of the surface soils were retrieved directly from the auger blades. All borings were backfilled using the soil from cuttings.

Date Drilled	8/13/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/13/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2497 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand, trace roots.			
2495		1	20							
	5	2	20				--fine to coarse grained			
2490		3	22					110	1.1	
	10	4	32							
2485										
	15	5	67				--moist, dense	141	2.4	
2480										
	20	6	37				--trace gravel			

Boring terminated at 21.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

Palmdale Power Project
Palmdale, California

PLATE

A-2

PROJECT NO. 82300

LOG OF BORING B-1

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/13/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/13/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2495 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
				SM	**ALLUVIUM (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand, higher fines content, porous			
		1	20					
2490	5	2	14		--deccrease in fines content			
		3	19		--trace fine gravel			
2485	10	4	23		--moist			
2480	15	5	31					
				SP-SM	**Sand with Silt:** Brown, moist, dense, fine to coarse sand.			
2475	20	6	46					
2470	25	7	34					
2465	30	8	80					

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-2

PLATE A-3

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/13/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/13/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2496 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2495		1		SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand			COR, DS, MAX
		2	24					
2490	5	3	22		--trace coarse sand	108	6.3	CP
		4	76		--very dense, increase in fines content			
2485	10	5	23		--medium dense, trace fine gravel, decrease in fines content	109	5.3	CP
				SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to coarse grained sand			
2480	15	6	22					
2475	20	7	43					
				SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace gravel			
2470	25	8	23					
2465	30	9	58		--dense, porous	122	2.5	

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-3

PLATE A-4a

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2460		10	32		**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace gravel *(continued)* --medium dense			
2455	40	11	28, 50/3"		--very dense, higher fines content	108	10.3	
2450	45	12	52		--decrease in fines content			
2445	50	13	34, 50/5"			111	1.4	
2440	55	14	66		--Red brown, slightly cemented			
2435	60	15	27, 50/4"					
2430	65	16	59					
				SP-SM	**Sand with Silt:** Brown, moist, very dense, fine to coarse sand			
2425	70	17	80			108	1.9	

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

KLEINFELDER

Palmdale Power Project
Palmdale, California

PLATE A-4b

PROJECT NO. 82300

LOG OF BORING B-3

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2420	18	57				**Sand with Silt:** Brown, moist, very dense, fine to coarse sand *(continued)*			
						Boring terminated at 76.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-3

PLATE A-4c

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2496 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2495						SM	**Alluvium (Qal):** **Silty Sand:**Brown , moist, medium dense, fine grained sand, higher fines content			
		1	23							
2490	5	2	69			SM-ML	**Silty Sand to Sandy Silt:**Brown, moist, dense, slightly porous			
2485	10	3	22			SM	**Silty Sand:**Brown, moist, medium denser, fine to medium sand, higher fines content			
2480	15	4	17			ML	**Sandy Silt:**Brown, moist, very stiff			
2475	20	5	28			SM	**Silty Sand:**Brown, moist, medium dense, fine to coarse grained sand			
							Boring terminated at 21.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

KLEINFELDER

Palmdale Power Project
Palmdale, California

PLATE A-5

PROJECT NO. 82300

LOG OF BORING B-4

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2502 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2500					SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine grained sand, porous			
	1	28							
	2				SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, medium dense, porous			MAX
5	3	28							
2495									
10	4	33					105	2.5	
2490									
					ML	**Sandy Silt:** Brown, moist, very stiff			
15	5	19							
2485									
					SM	**Silty Sand:** Brown, moist, dense, fine to coarse grained sand, trace gravel			
20	6	41							
2480									
					SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, medium dense,			
25	7	30							
2475									
					SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand			
30	8	29							

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

Palmdale Power Project
Palmdale, California

PLATE A-6

PROJECT NO. 82300

LOG OF BORING B-5

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2505 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, loose, fine to medium grained sand			
		1	12							
2500	5	2	8							
2495	10	3	37			ML	**Sandy Silt:** Brown, moist, hard	122	3.2	CP
2490	15	4	31			SM	**Silty Sand:** Brown, moist, dense, fine to medium grained sand			
2485	20	5	37			SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to coarse sand, higher coarse fraction			
2480	25	6	28			SM	**Silty Sand:** Brown, moist, dense, fine to medium grained sand			
2475	30	7	59			ML	**Sandy Silt:** Brown, moist, hard			

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-6

PLATE

A-7a

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	8	37				**Sandy Silt:** Brown, moist, hard *(continued)*			
2465 40	9	62							
						Boring terminated at 41.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-6

PLATE

A-7b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2505 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine to medium grained sand, slightly porous			
		1	25							
		2	62			SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, dense			RV, SE
2500	5	3	22							
						SM	**Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
2495	10	4	25							
2490	15	5	25							
2485	20	6	36					113	1.0	
2480	25	7	26							
						SP-SM	**Sand with Silt:** Brown, moist, dense, fine to medium grained sand			
2475	30	8	51							

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-7

PLATE

A-8

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2498 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
				SM-ML	**Alluvium (Qal):** **Silty Sand to Sandy Silt:** Brown, moist, medium dense, slightly porous			
2495		1	31					
	5	2	14					
2490		3	24			108	3.2	
	10	4	25	ML	**Sandy silt:** Brown, moist, very stiff, slightly porous			
2485								
	15	5	19	SM	**Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
2480								
	20	6	30	SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, medium dense	107	1.1	
2475				ML	**Sandy Silt:** Brown, moist, very stiff			
	25	7	22					
2470				SM	**Silty Sand:** Brown, moist, dense, fine to coarse grained sand			
	30	8	46					

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-8

PLATE A-9

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/13/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/13/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2496 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2495						SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
		1	23							
2490	5	2	25							
2485	10	3	31				--fine to coarse sand	115	2.1	
2480	15	4	29				--trace clay lenses			
						SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to coarse sand			
2475	20	5	50							
						SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse sand			
2470	25	6	27							
2465	30	7	58							

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-9

PLATE

A-10

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2498 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
				SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
2495		1	16					
	5	2	14		--loose			
2490								
	10	3	47		--dense, trace clay			
2485								
	15	4	23					
2480								
	20	5	26					

Boring terminated at 21.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-10

PLATE A-11

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2502 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
		1	11	SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, loose, fine to medium grained sand			GS
2500		2	20		--medium dense			
	5	3	31			115	0.7	
2495		4	21	SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to coarse grained sand			
	10	5	24, 50/5"		--very dense	105	1.2	
2490								
	15	6	27	SM	**Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
2485								
	20	7	19					

Boring terminated at 21.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

GEOTECH TEMECULA 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-11

PLATE A-12

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2500 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
		1	19							
2495	5	2	28					101	0.6	
2490	10	3	46				--dense, slightly porous			
						SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to medium grained sand			
2485	15	4	20							
						SM	**Silty Sand:** Brown, moist, medium dense, fine to medium grained sand, higher fines content			
2480	20	5	39					110	2.0	
2475	25	6	30				--trace gravel			
						SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to coarse grained sand, trace gravel			
2470	30	7	52					107	1.0	
							Boring terminated at 31.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

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Palmdale Power Project
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LOG OF BORING B-12

PLATE A-13

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2497 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) / Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
0	1		SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand			
2495	2	25					
5	3	23	SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to medium grained sand	78	0.5	GS
2490			SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand			
	4	37		-- trace fine gravel			
10	5	70		--dense, slightly porous	119	2.8	DS
2485							
15	6	23	SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to medium grained sand			
2480			SP	**Sand:** Brown, moist, dense, fine to coarse grained sand, trace silt			
20	7	46					GS
2475			SM-ML	**Sandy Silt to Silty Sand:** Brown, moist, medium dense			
25	8	22					
2470							
30	9	63		--dense	112	2.9	
2465			SM	**Silty Sand:** Brown, moist, dense, fine to coarse grained sand			

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LOG OF BORING B-13

PLATE A-14a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	10	45				**Silty Sand:** Brown, moist, dense, fine to coarse grained sand *(continued)*			
2460									
40	11	61			SP-SM	**Sand with Silt:** Brown, moist, dense, fine to coarse grained sand, trace silt, trace gravel	108	0.1	GS
2455									
					SM	**Silty Sand:** Brown, moist, dense, fine grained sand			
45	12	64							
2450									
50	13	77				--very dense			

Boring terminated at 51.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

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LOG OF BORING B-13

PLATE A-14b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2501 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) / Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2500	1		SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand			COR, GS
	2	36					
5 / 2495	3	20			106	3.7	CP
	4	24	ML	**Sandy Silt:** Brown, moist, very stiff, slightly porous	102	6.5	
10 / 2490	5	24			106	4.8	CP
15 / 2485	6	19	SM	**Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand, higher fines content			
20 / 2480	7	36		--decrease in fines content	102	1.1	CP
25 / 2475	8	21	ML	**Sandy Silt:** Brown, moist, very stiff			
30 / 2470	9	60	SM	**Silty Sand:** Brown, moist, dense, fine to coarse grained sand	113	1.2	
			SP-	**Sand with Silt:** Brown, moist, dense, fine to medium grained sand			

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LOG OF BORING B-14

PLATE A-15a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
2465	10	43			SM	**Sand with Silt:** Brown, moist, dense, fine to medium grained sand *(continued)*			
40					SM	**Silty Sand:** Brown, moist, very dense, fine to medium grained			
2460	11	40, 50/5"					118	1.5	
45 / 2455	12	47				--dense			
50 / 2450	13	79				--slightly cemented	110	6.9	

Boring terminated at 51.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

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LOG OF BORING B-14

PLATE A-15b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2504 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
				SM-ML	**Alluvium (Qal):** **Silty Sand to Sandy Silt:** Brown, moist, medium dense, fine grained sand			
		1	35					
2500	5	2	29					
		3	18					
2495						111	2.8	
	10	4	26			110	2.9	
2490				SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace gravel			
	15	5	32					
2485				SP-SM	**Sand with Silt:** Brown, moist, dense, fine to medium grained sand			
	20	6	43				0.7	
2480				SM	**Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
	25	7	33					
2475				SP-SM	**Sand with Silt:** Brown, moist, dense, fine to medium grained sand			
	30	8	60					

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

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LOG OF BORING B-15

PLATE A-16

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2505 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine to medium grained sand, trace gravel			
		1	24							
2500	5	2	33							
2495	10	3	61				--dense, increase in fines, slightly porous	108	2.9	
2490	15	4	20				--medium dense			
2485	20	5	18							
							Boring terminated at 21.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

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LOG OF BORING B-16

PLATE A-17

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2500 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	1				SM-ML	**Alluvium (Qal):** **Silty Sand to Sandy Silt:** Red brown, moist, medium dense, porous			RV, SE
	2	21							
2495 5	3	57					102	1.8	
					SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace gravel			
2490 10	4	20							
2485 15	5	30							
					SP-SM	**Sand with Silt:** Brown, moist, dense, fine to coarse grained sand, higher coarse content			
2480 20	6	44							
2475 25	7	24				--medium dense, fine sand			
2470 30	8	54							
						Boring terminated at 31.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

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LOG OF BORING B-17

PLATE

A-18

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/14/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/14/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2501 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Depth	Elevation (approx.) (feet)	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	2500			SM	**Alluvium (Qal):** **Silty Sand:**Brown, moist, medium dense, fine grained sand, higher fines content, slightly porous			
		1	23					
5	2495	2	38, 50/3"	SM-ML	**Silty Sand to Sandy Silt:**Brown, moist, very dense	112	1.7	CP
		3	23	SM	**Silty Sand:**Brown, moist, medium dense, fine to coarse grained sand, trace fine gravel	113	1.4	
10	2490	4	41		--dense, increase in coarse grains	115	1.1	CP
15	2485	5	41		--higher fines content			
20	2480	6	65			110	2.1	
25	2475	7	27					
30	2470	8	85		--very dense, decrease in fines	109	0.9	

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

KLEINFELDER

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PLATE A-19

PROJECT NO. 82300

LOG OF BORING B-18

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2503 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
					SM-ML	**Alluvium (Qal):** **Silty Sand to Sandy Silt:** Brown, moist, medium dense, fine grained sand			
2500	1	19							
5	2	34			SM	**Silty sand:** Brown, moist, medium dense, fine to medium grained sand			
2495	3	31							
10	4	34			ML	**Sandy Silt:** Brown, moist, hard	96	6.2	
2490									
15	5	21			SM	**Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			
2485									
20	6	31			SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, medium dense	107	2.0	

Boring terminated at 21.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

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PLATE A-20

PROJECT NO. 82300

LOG OF BORING B-19

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/15/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/15/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2504 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
					SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine grained sand, higher fines content			
2500	1	47							
5	2	51			ML	**Sandy Silt:** Brown, moist, hard	112	3.0	
2495 / 10	3	18			SM	**Silty Sand:** Brown, moist, medium dense, fine grained sand			
2490 / 15	4	17			SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, medium dense			
2485 / 20	5	27			ML	**Sandy Silt:** Brown, moist, very stiff			

Boring terminated at 21.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

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LOG OF BORING B-20

PLATE A-21

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/29/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/29/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2515 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
		1		SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine grained sand.			COR, GS
		2	23					
2510	5	3	22		--trace gravel			
2505	10	4	47		--dense, fine to coarse grained sand, decrease in fines content	117	1.8	
				SP-SM	**Sand with Silt:** Brown, moist, dense, fine to coarse grained sand			
2500	15	5	45			113	1.2	
				SM	**Silty Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace gravel			
2495	20	6	26					GS
				SM-ML	**Sandy Silt to Silty Sand:** Brown, moist, dense, fine grained sand, slightly porous			
2490	25	7	70			119	2.6	CP
				SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to medium grained sand			
2485	30	8	38					GS
				SM	**Silty Sand:** Brown, moist, very dense, fine to medium grained sand			

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LOG OF BORING B-21

PLATE A-22a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	9	73				**Silty Sand:** Brown, moist, very dense, fine to medium grained sand *(continued)*	116	1.0	
						--dense			
2475 40	10	41							
						Boring terminated at 41.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

Date Drilled	8/29/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/29/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2520 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:**Brown, slightly moist, medium dense, fine to coarse grained sand, slightly porous, trace roots			
		1	29							
2515	5	2	22							
						SM-ML	**Sandy Silt to Silty Sand:**Brown, moist, medium dense,			
2510	10	3	28			SM	**Silty Sand:**Brown, moist, medium dense, fine to medium grained sand			
2505	15	4	47				--dense			
2500	20	5	21				--medium dense, trace clay lenses			
2495	25	6	42				--dense, fine to coarse grained sand			
						SP-SM	**Sand with Silt:**Brown, moist, dense, fine to coarse grained sand			
2490	30	7	36							
							Boring terminated at 31.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

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LOG OF BORING B-22

PLATE

A-23

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/29/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/29/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2514 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	1				SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine to medium grained sand.			MAX
2510	2	31							
5	3	17				--fine to coarse sand, trace fine gravel	109	1.6	
2505 / 10	4	24							
2500 / 15	5	42				--dense, fine to medium grained sand, increase in fines content	113	1.7	
2495					SM-ML	**Sandy Silt to Silty Sand:** Brown, moist, medium dense, trace gravel			
20	6	22							
2490					SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine to coarse grained sand			
25	7	40					103	0.8	
2485 / 30	8	28				--fine to medium grained sand			
2480					ML	**Sandy Silt:** Brown, moist, very stiff, porous			

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LOG OF BORING B-23

PLATE

A-24a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	9	35				**Sandy Silt:** Brown, moist, very stiff, porous *(continued)*			
2475 / 40	10	41			SM	**Silty Sand:** Brown, moist, dense, fine to coarse grained sand, trace gravel			

Boring terminated at 41.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/29/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/29/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2505 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
				SM	**Alluvium (Qal):** **Silty Sand:** Brown, slightly moist, medium dense, fine grained sand			
		1	22					
2500	5	2	20					
					--slightly porous, decrease in fines content	111	2.7	CP
		3	26					
2495	10	4	25	SP	**Poorly Graded Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace silt			
				SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, medium dense			
2490	15	5	26			109	5.8	CP
				ML	**Sandy Silt:** Brown, moist, very stiff			
2485	20	6	19					
				SM	**Silty Sand:** Brown, moist, dense, fine to medium grained sand			
2480	25	7	46					
2475	30	8	33		--medium dense, fine to coarse grained sand			

Boring terminated at 31.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

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LOG OF BORING B-24

PLATE

A-25

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/29/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/29/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2510 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, loose, fine to medium grained sand, trace fine gravel			
		1	13							
2505	5	2	22				--fine grained sand			
						SP-SM	**Sand with Silt:** Brown, moist, medium dense, fine grained sand			
2500	10	3	19							
						SP	**Sand:** Brown, moist, medium dense, fine to coarse grained sand, trace silt			
2495	15	4	32							
						SM	**Silty Sand:** Brown, moist, dense, fine grained sand			
2490	20	5	29							
2485	25	6	34							
						SP-SM	**Sand with Silt:** Brown, moist, dense, fine to coarse grained sand			
2480	30	7	34							
						SM	**Silty Sand:** Brown, moist, dense, fine to medium grained sand			

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-25

PLATE A-26a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	8	56				**Silty Sand:** Brown, moist, dense, fine to medium grained sand *(continued)*			
2470 40	9	33							
						Boring terminated at 41.5 feet. Groundwater was not encounterd. Hole backfilled using soil from cuttings.			

KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-25

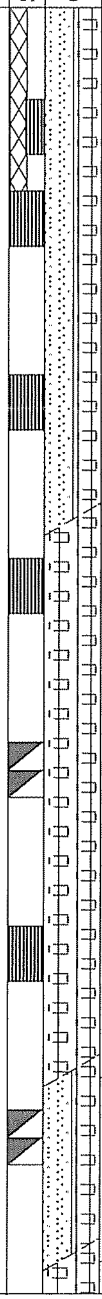
PLATE

A-26b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	8/29/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac	Date Measured:	8/29/07
Drilling Method:	8" Hallow Stem Auger	Elevation:	2495 feet (approx.)
Logged By:	M.Chirumalla	Datum:	MSL

Elevation (approx.) (feet)	Depth	Sample Number	Blows per Foot	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
		1		SP-SM	**Alluvium (Qal):** **Silty Sand:** Brown, moist, medium dense, fine to medium grained sand			GS
		2	26					
2490	5	3	23			106	3.1	
2485	10	4	20					
				SM	**Silty Sand:** Brown, moist, medium dense, fine grained sand			
2480	15	5	35			110	3.7	
2475	20	6	26					
2470	25	7	33			99	3.5	
					--higher fines content, porous			
				SP-SM	**Sand with Silt:** Brown, moist, dense, fine to coarse grained sand, trace gravel			
2465	30	8	31					
				SM	**Silty Sand:** Brown, moist, dense, fine to medium grained sand			



KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

LOG OF BORING B-26

PLATE A-27a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (feet) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (pcf)	Moisture Content (%)	Additional Tests & Remarks
	9	45				**Silty Sand:** Brown, moist, dense, fine to medium grained sand *(continued)*			
2455 40	10	33			SM-ML	**Silty Sand to Sandy Silt:** Brown, moist, dense			

Boring terminated at 41.5 feet.
Groundwater was not encounterd.
Hole backfilled using soil from cuttings.

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. All laboratory tests except the corrosion tests were performed at Kleinfelder soil and materials laboratory in Redlands, California. Corrosion tests were performed by AP Engineering, Pomona, California. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials (ASTM), the California Department of Transportation Standard Test Method (CTM), or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on fifty two samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM D2216; dry unit weight was evaluated using procedures similar to ASTM D2937. The test results are presented on the boring logs in Appendix A.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on nine soil samples to evaluate the gradation of the material and to aid in soil classification. Tests were performed in general accordance with ASTM D422. The results of these tests are presented on Plates B-1 through B-9.

MAXIMUM DRY UNIT WEIGHT/OPTIMUM MOISTURE CONTENT

Three maximum dry unit weight/optimum moisture content tests were performed on selected bulk samples of the on-site soils to determine compaction characteristics. The tests were performed in accordance with ASTM D1557. The test results are presented in Table B-1, below.

Table B-1
Maximum Unit Weight/Optimum Moisture Content Test Results

Location	Depth (ft)	USCS Soil Type	Maximum Unit Weight (pcf)	Optimum Moisture Content (%)
B-3	0-5	SM	127.9	8.0
B-5	4-8	SM-ML	130.0	9.2
B-23	0-5	SM	132.0	8.2

CORROSIVITY TESTS

Chemical analyses were performed on three samples of the near surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with CTM 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). Corrosivity tests were performed by AP Engineering, Pomona, California. The test results are presented in Table B-2, below.

Table B-2
Corrosivity Test Results

Location	Depth (ft)	Minimum Resistivity (Ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
B-3	0-5	13,000	7.2	113	367
B-14	0-5	11,000	7.2	121	368
B-21	0-5	3,600	7.3	6	60

DIRECT SHEAR TEST

Two direct shear tests were performed on two representative in-situ soil samples and two remolded samples to evaluate the drained shear strength of the soils. The samples were tested in a near-saturated condition in general accordance with ASTM D3080 (consolidated, drained, 3-point testing). The test results are summarized in Table B-3, below.

Table B-3
Direct Shear Test Results

Location	Depth (ft)	USCS Soil Type	Dry Density (pcf)	Cohesion (psf)	Angle of Internal Friction (degrees)
B-3*	0-5	SM	118	200	28
B-13	11	SM	109	400	27

* Remolded to 90% of Maximum Density (ASTM D1557)

R-VALUE TEST

Two resistance value (R-value) tests were performed on bulk soil samples to evaluate pavement support characteristics of the near-surface on-site soils. R-value testing was performed in accordance with CTM 301. The test results are presented in Table B-4, below.

Table B-4
R-Value Test Results

Location	Depth (ft)	USCS Soil Type	R-Value
B-7	4-8	SM-ML	68
B-17	0-5	SM-ML	72

SAND EQUIVALENT TEST

Two sand equivalent tests were performed on near-surface soil to determine the suitability of the onsite materials for use as engineered fill during construction. The test was performed in accordance with ASTM D2419. The test results are presented in Table B-5, below.

Table B-5
Sand Equivalent Test Results

Location	Depth (ft)	USCS Soil Type	Sand Equivalent (SE)
B-7	4-8	SM-ML	23
B-17	0-5	SM-ML	20

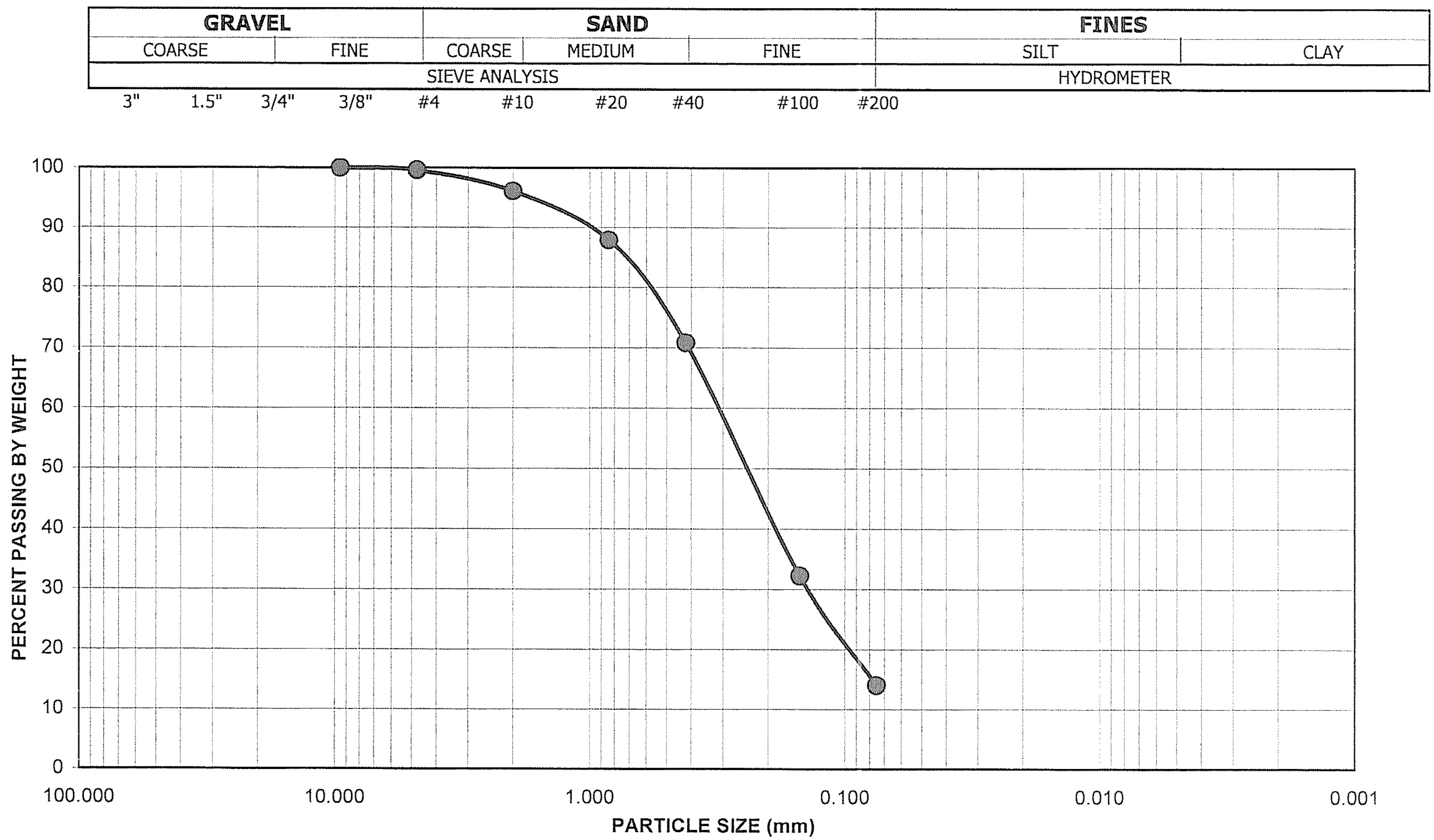
COLLAPSE POTENTIAL

Eleven collapse potential tests were performed on selected on-site soil samples to determine collapse potential of the soils. The test was performed in accordance with ASTM D5333. The test results are presented on Plates B-10 through B-20 and summarized in Table B-6, below.

Table B-6
Collapse Potential Test Results

Location	Depth (ft)	USCS Soil Type	Dry Density (pcf)	Moisture Content (%)	Collapse Potential (%)
B-3	6	SM	106.8	4.0	3.2
B-3	11	SM	108.5	5.3	2.0
B-6	11	ML	96.4	2.8	5.5
B-14	6	SM	105.9	3.7	3.6
B-14	11	ML	106.6	6.3	2.3
B-14	21	SM	97.3	1.3	1.6
B-18	6	SM-ML	103.0	2.8	6.0
B-18	11	SM	107.6	2.6	2.5
B-21	26	SM-ML	102.3	11.4	2.2
B-24	6	SM	107.1	3.1	4.1
B-24	16	SM-ML	105.5	7.6	1.6

GRAIN SIZE DISTRIBUTION
ASTM D422

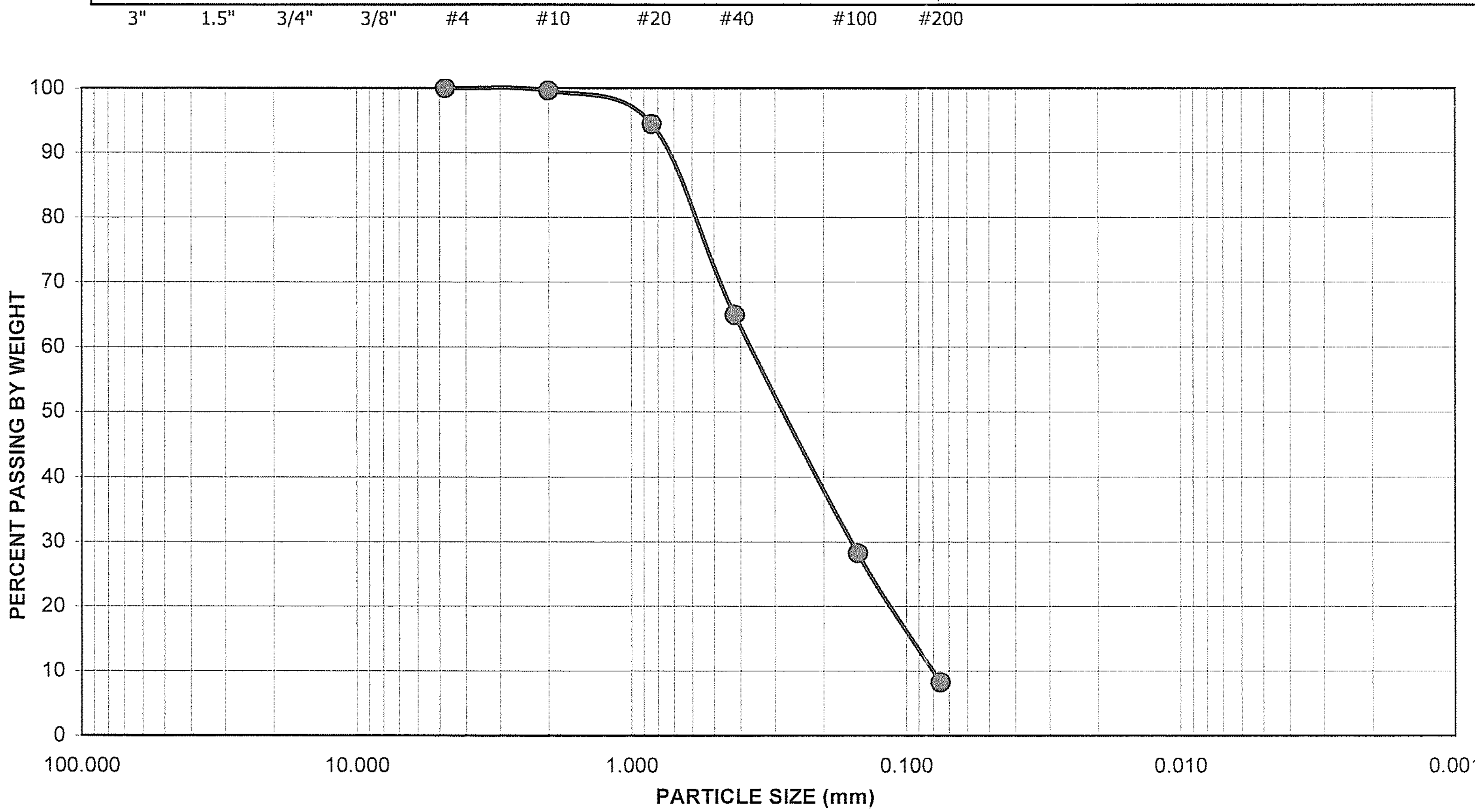


Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-11	1	0 - 5	Silty Sand	0 : 86 : 14	SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-1

GRAIN SIZE DISTRIBUTION
ASTM D422

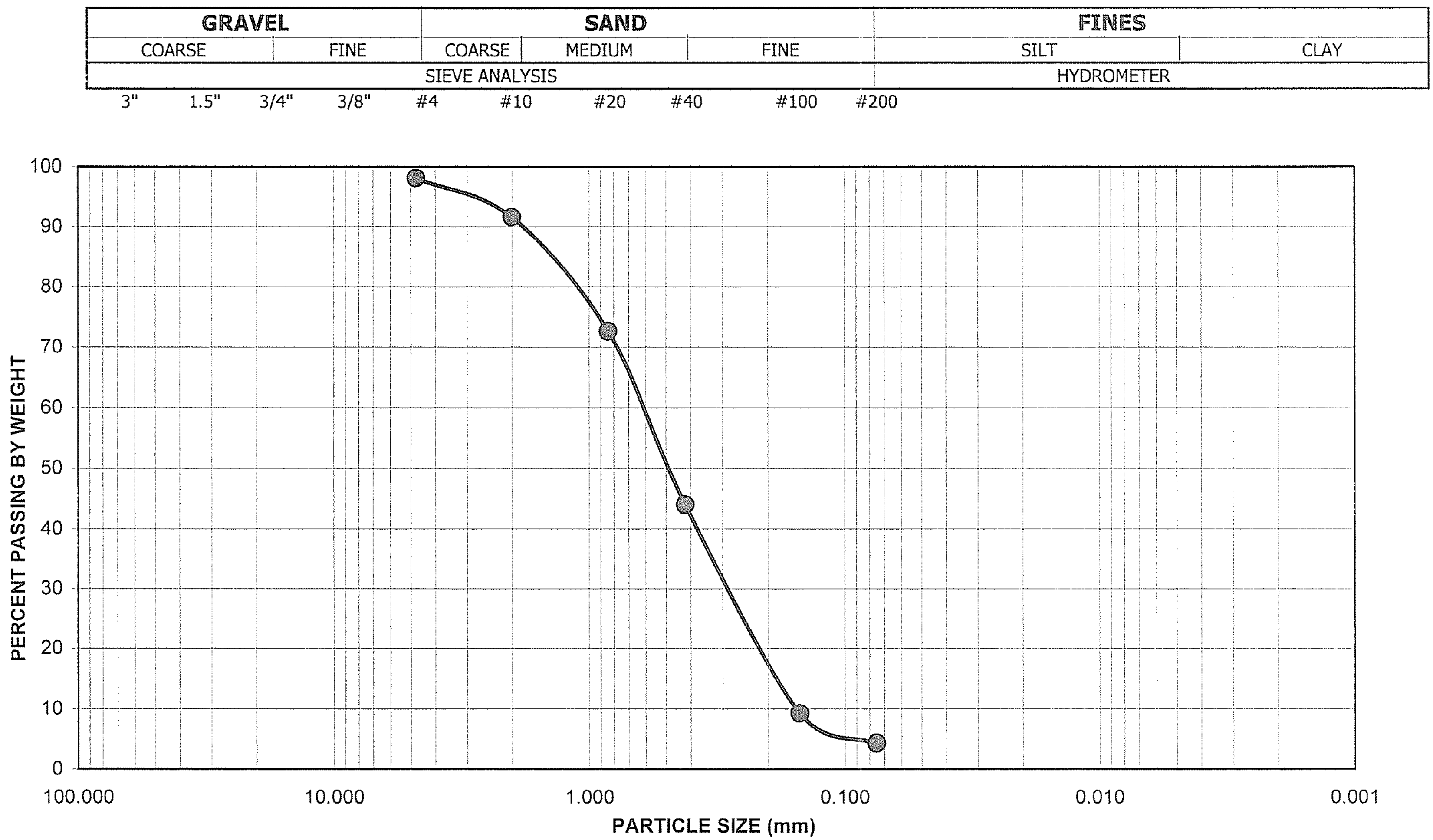
GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
SIEVE ANALYSIS					HYDROMETER	



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-13	3	5 - 6.5	Sand with Silt	0 : 92 : 8	SP-SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-2

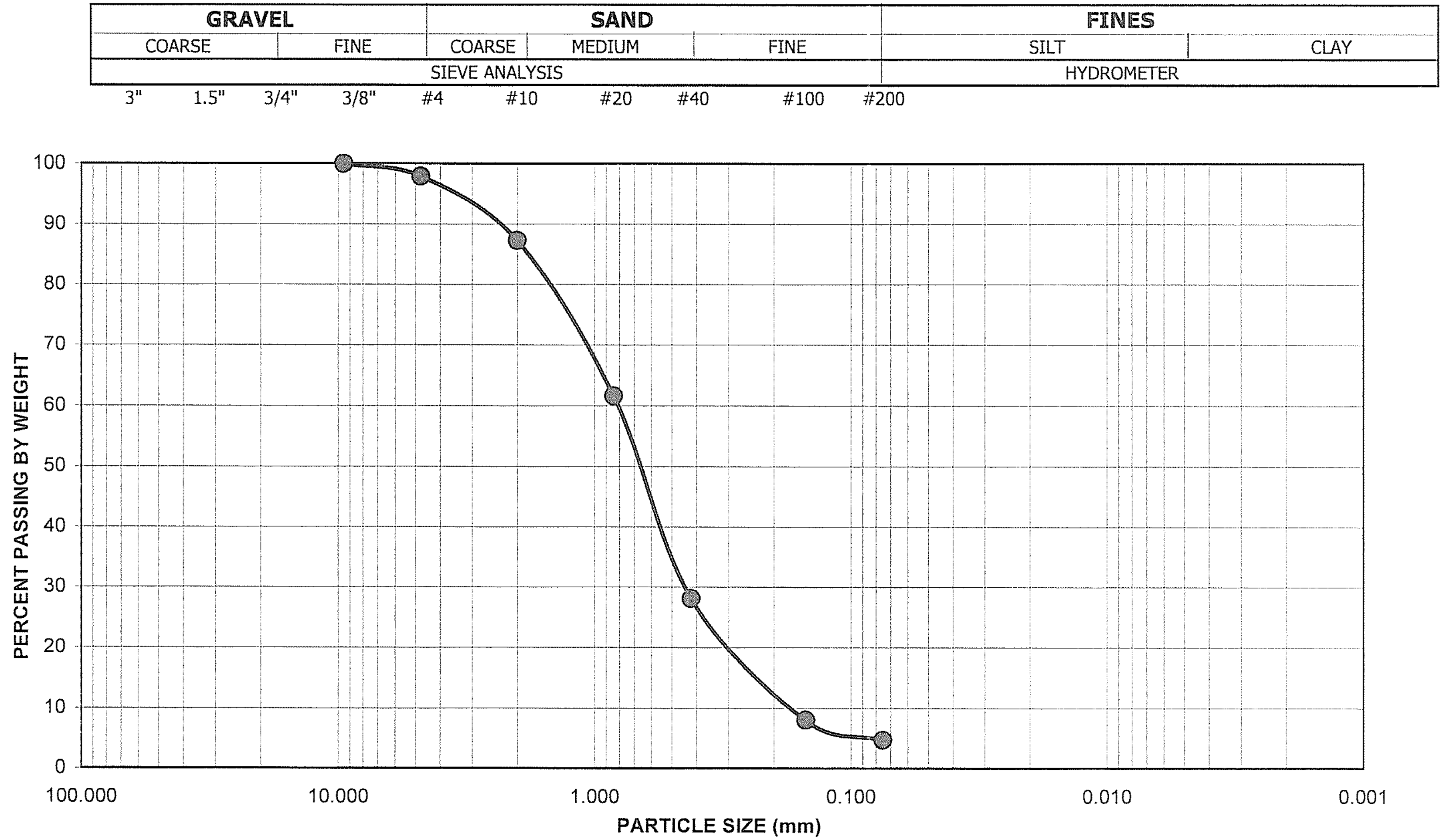
GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-13	7	20 - 21.5	Sand	2 : 94 : 4	SP

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-3

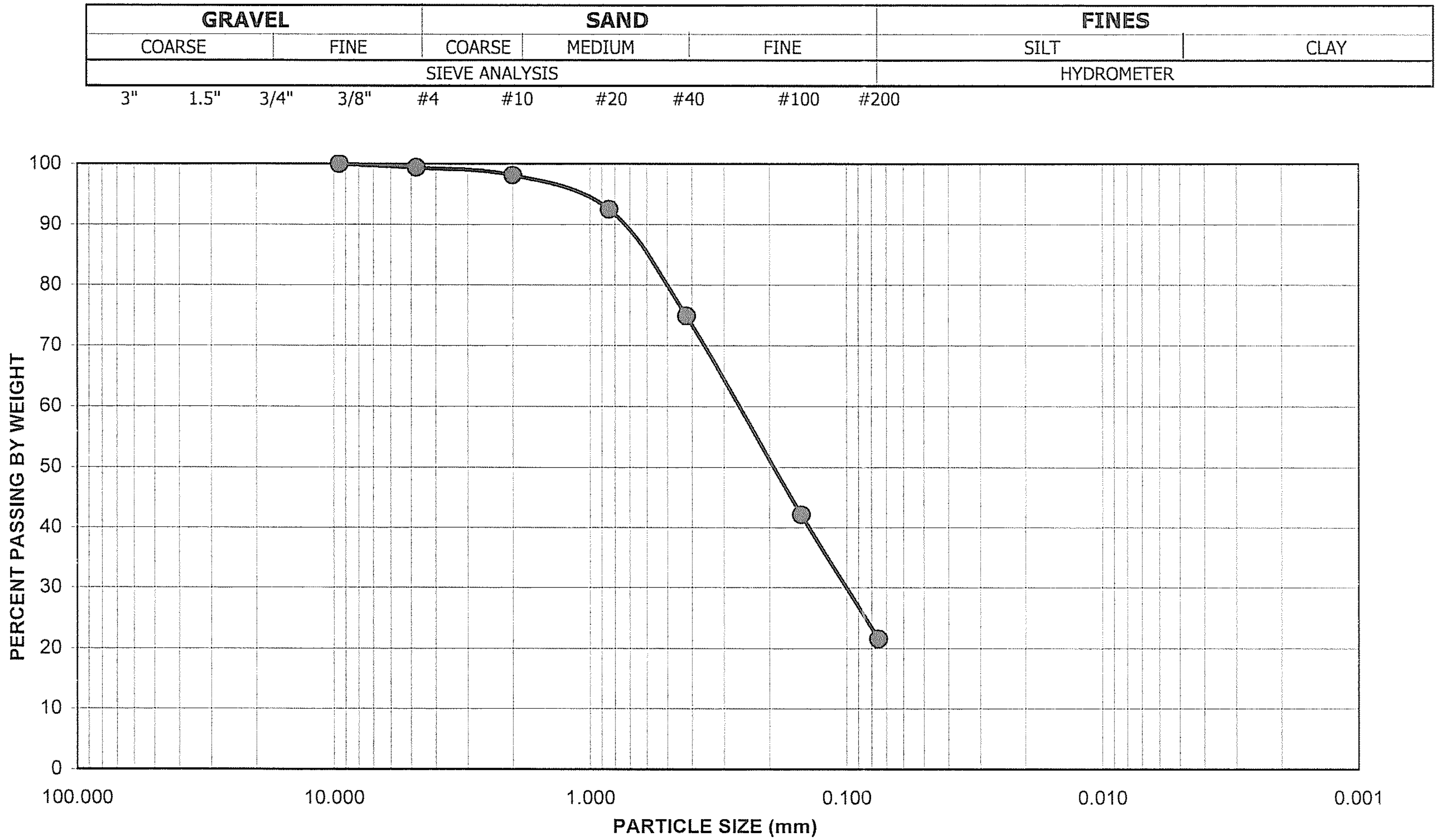
GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-13	11	40 - 41.5	Sand with Silt	2 : 93 : 5	SP-SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-4

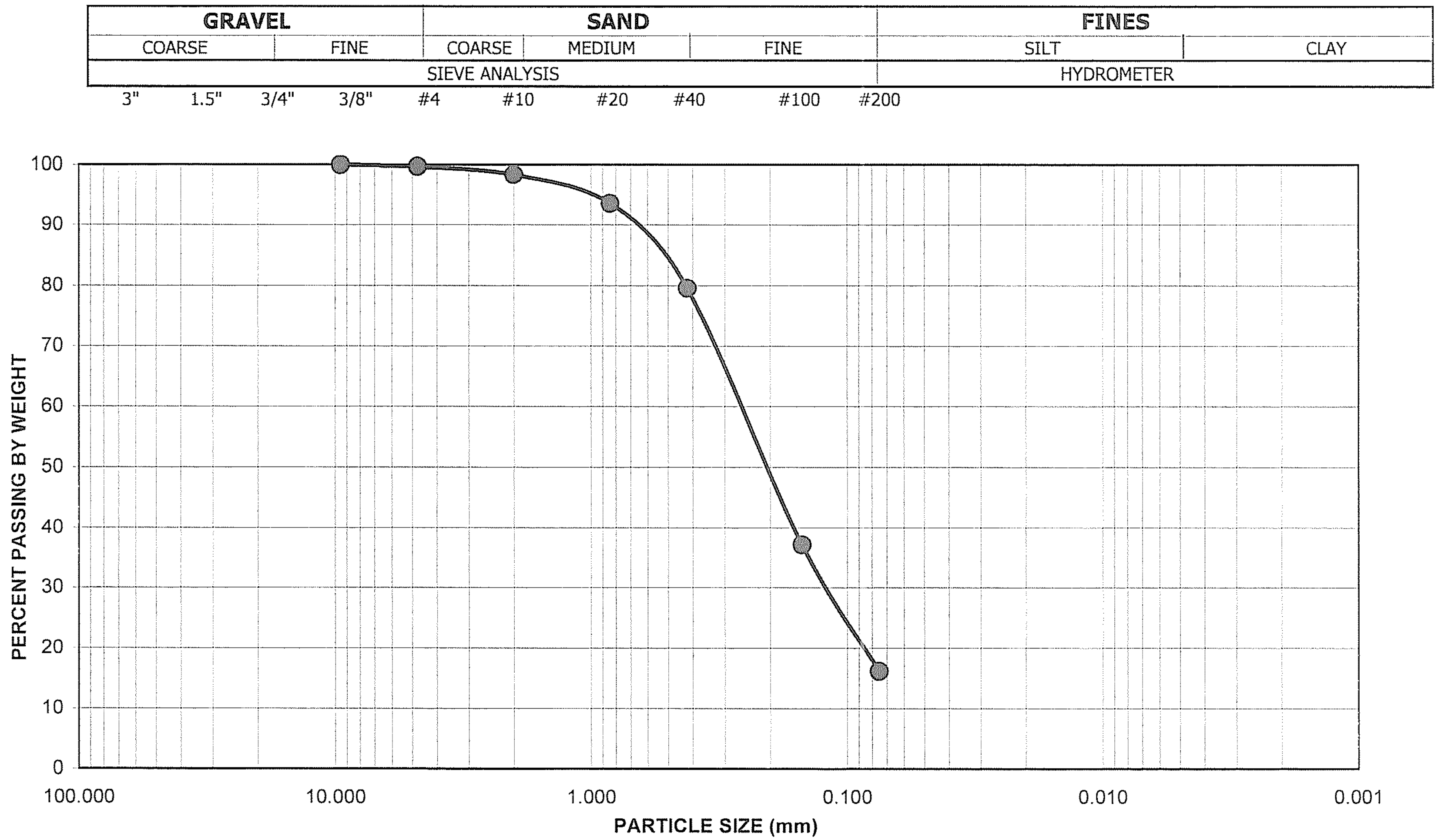
GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-14	1	0 - 5	Silty Sand	0 : 78 : 22	SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-5

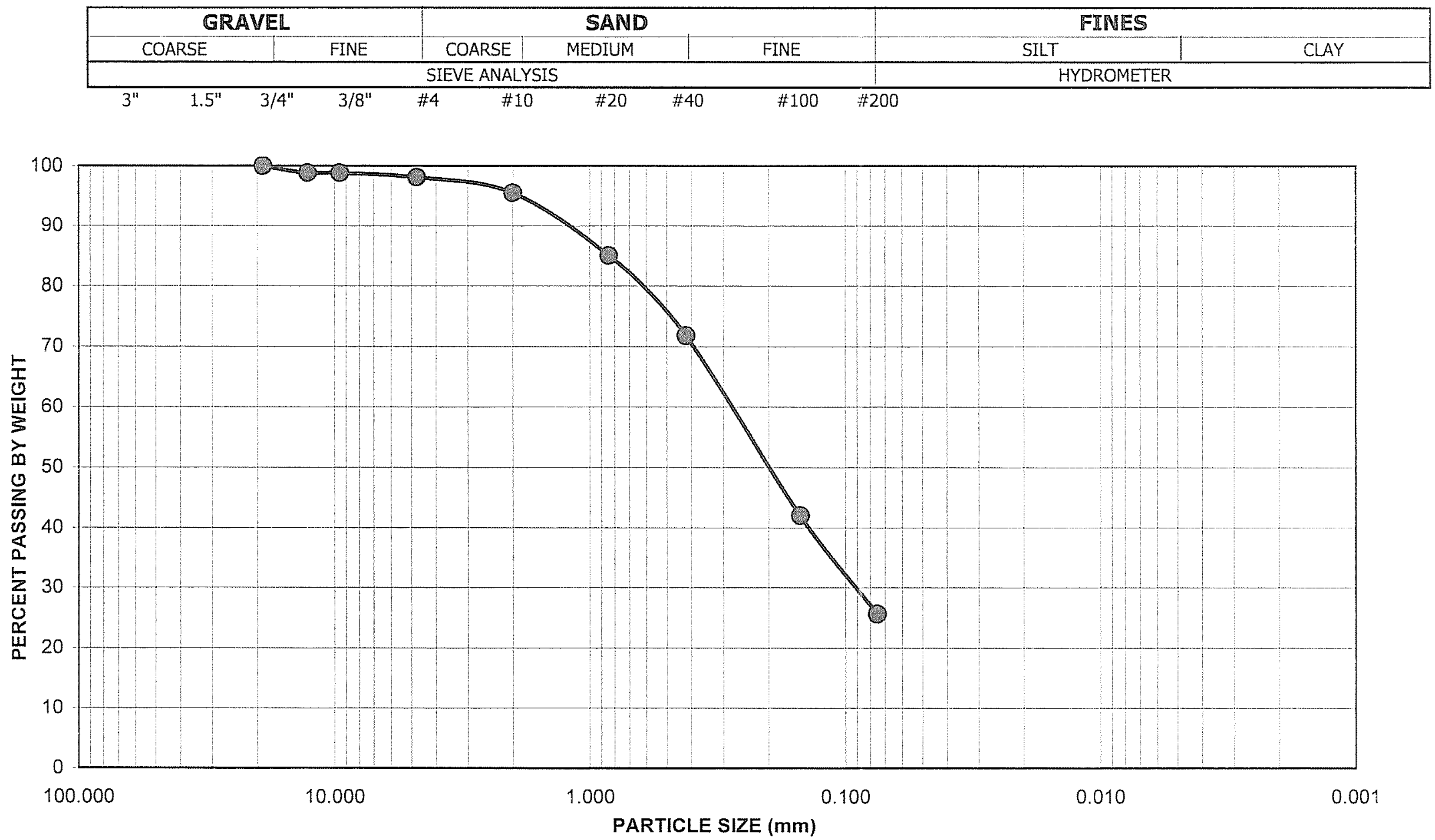
GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-21	1	0 - 5	Silty Sand	0 : 84 : 16	SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-6

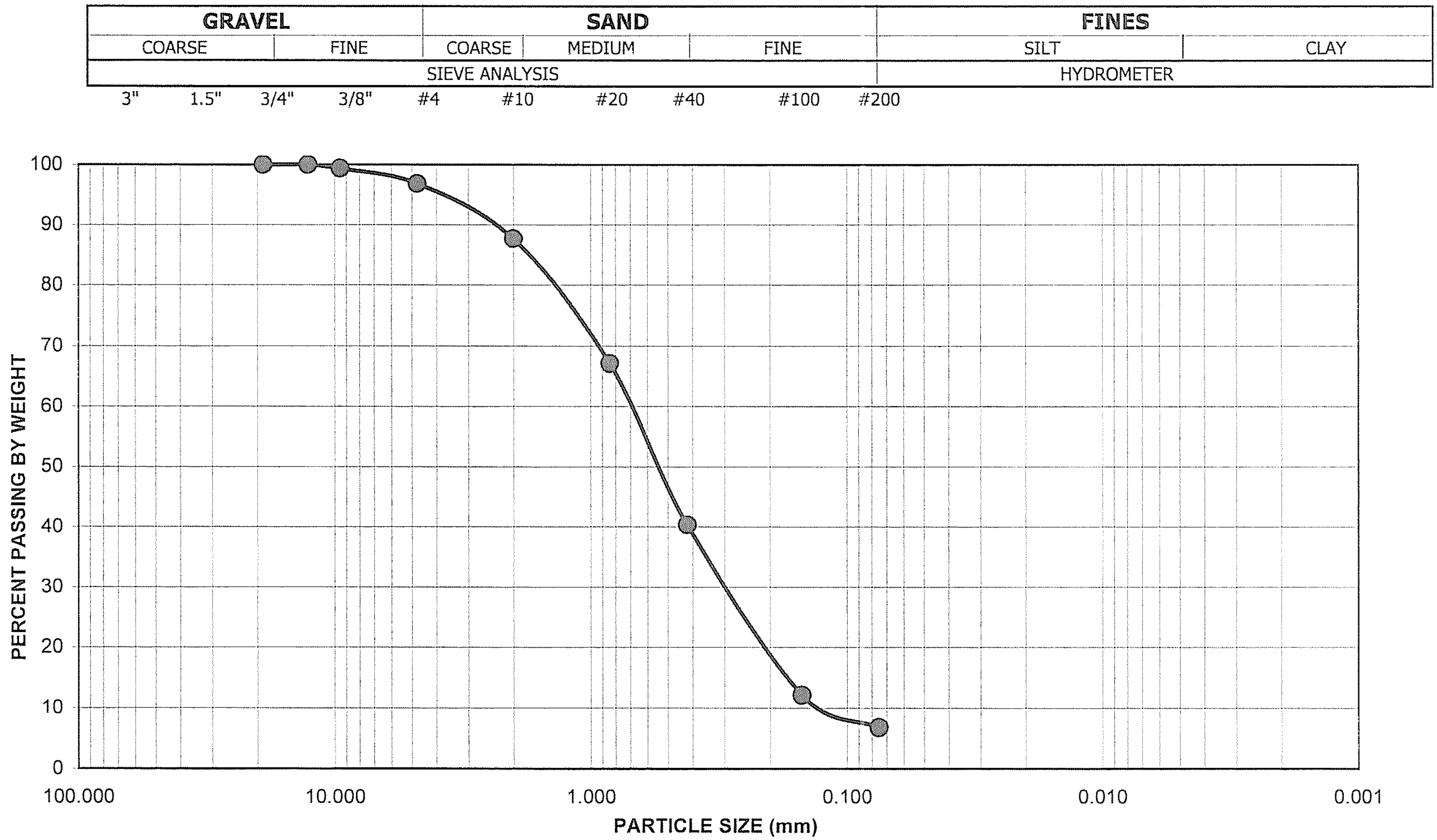
GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-21	6	20 - 21.5	Silty Sand	1 : 73 : 26	SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-7

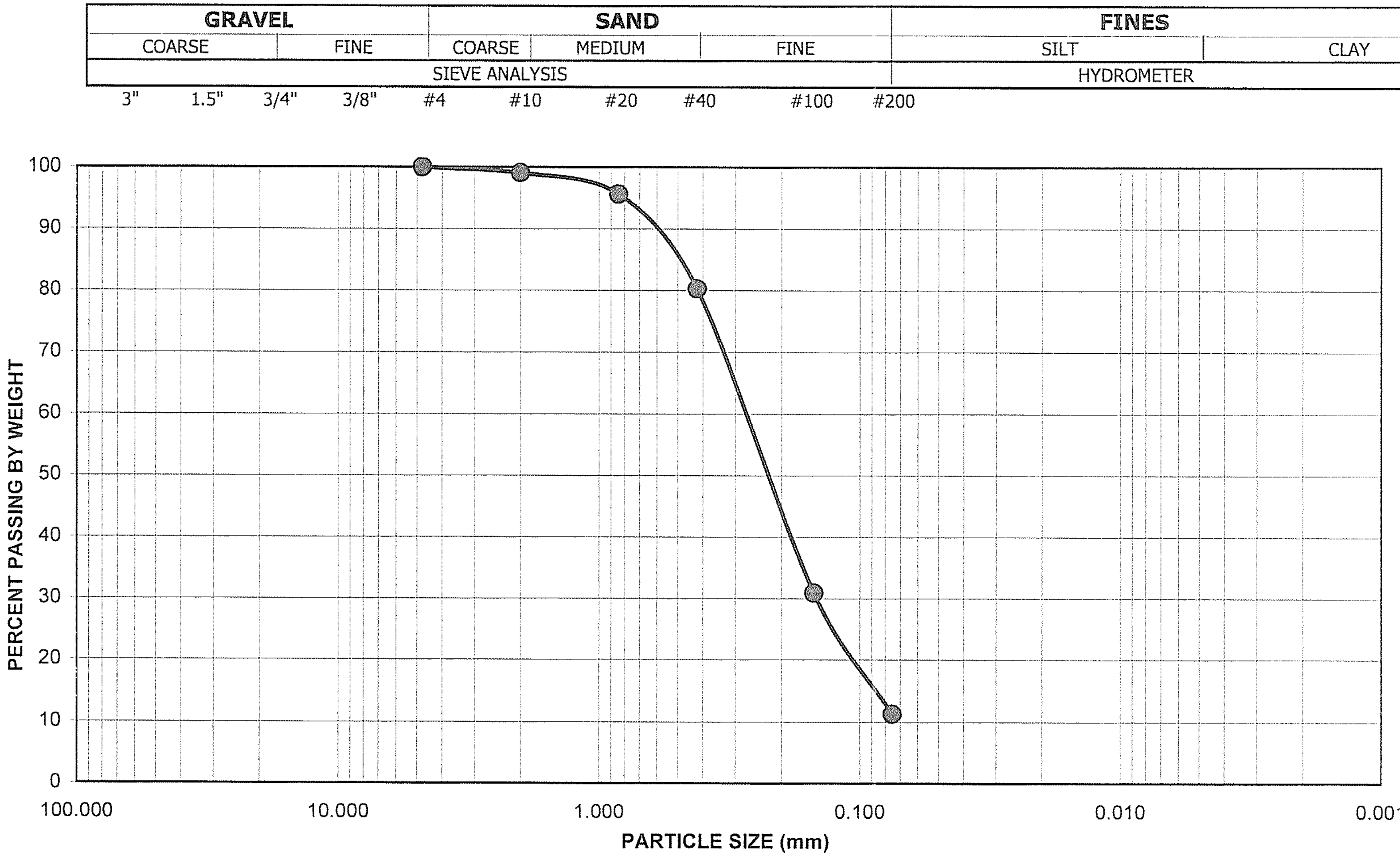
GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-21	8	30 - 31.5	Sand with Silt	3 : 90 : 7	SP-SM

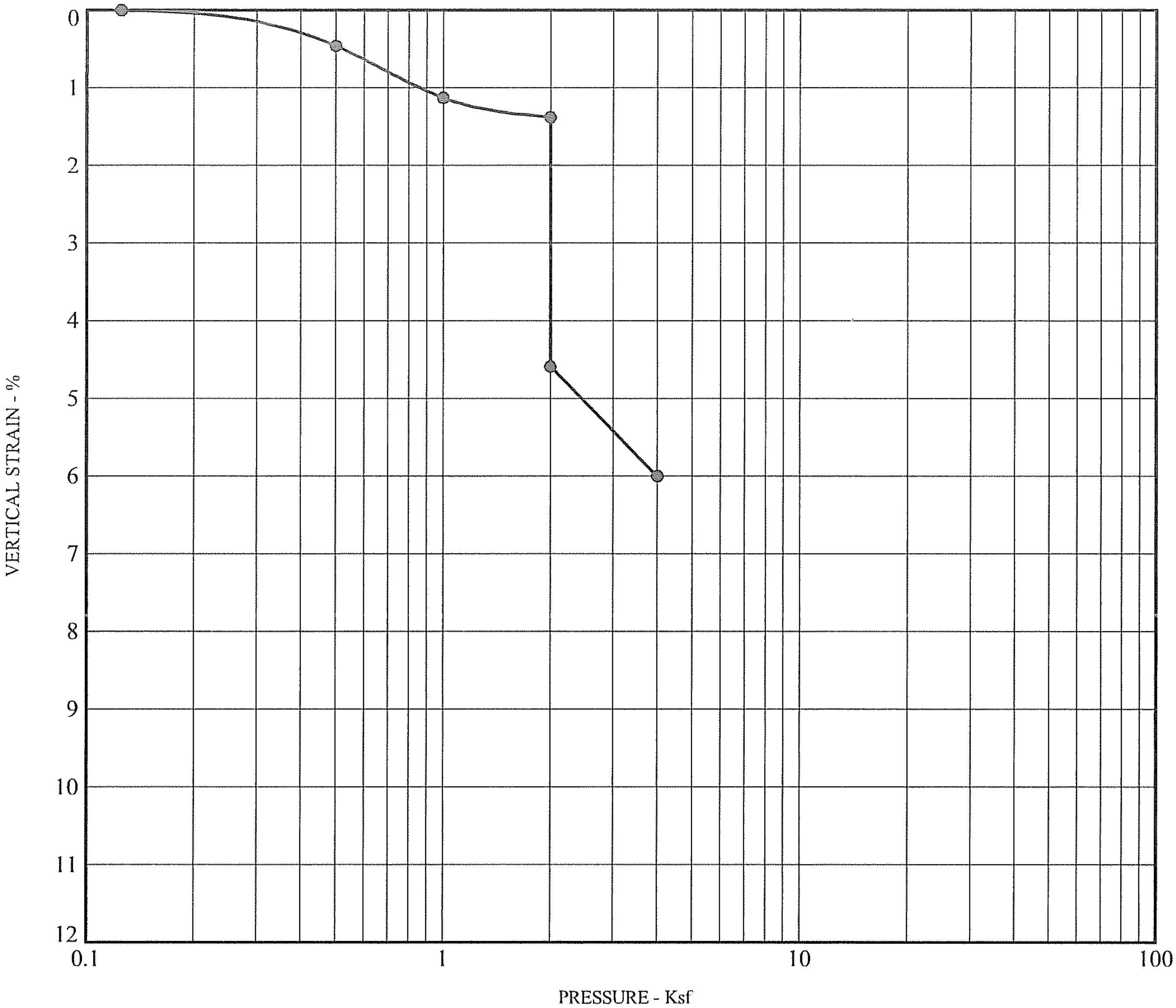
KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-8

GRAIN SIZE DISTRIBUTION
ASTM D422



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	B-26	1	0 - 5	Sand with Silt	0 : 89 : 11	SP-SM

KLEINFELDER	Palmdale Power Project	PLATE NO.
PROJECT NO. 82300	Palmdale, California	B-9



Boring	B-3	
Depth (feet)	6	
Moisture Content (%)	4.0 Before	15.4 After
Dry Unit Weight (pcf)	107	
Description	Silty Sand	
Classification	SM	

NOTE : SPECIMEN FLOODED AT 2000 psf

CONSOL NO INDICIES 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

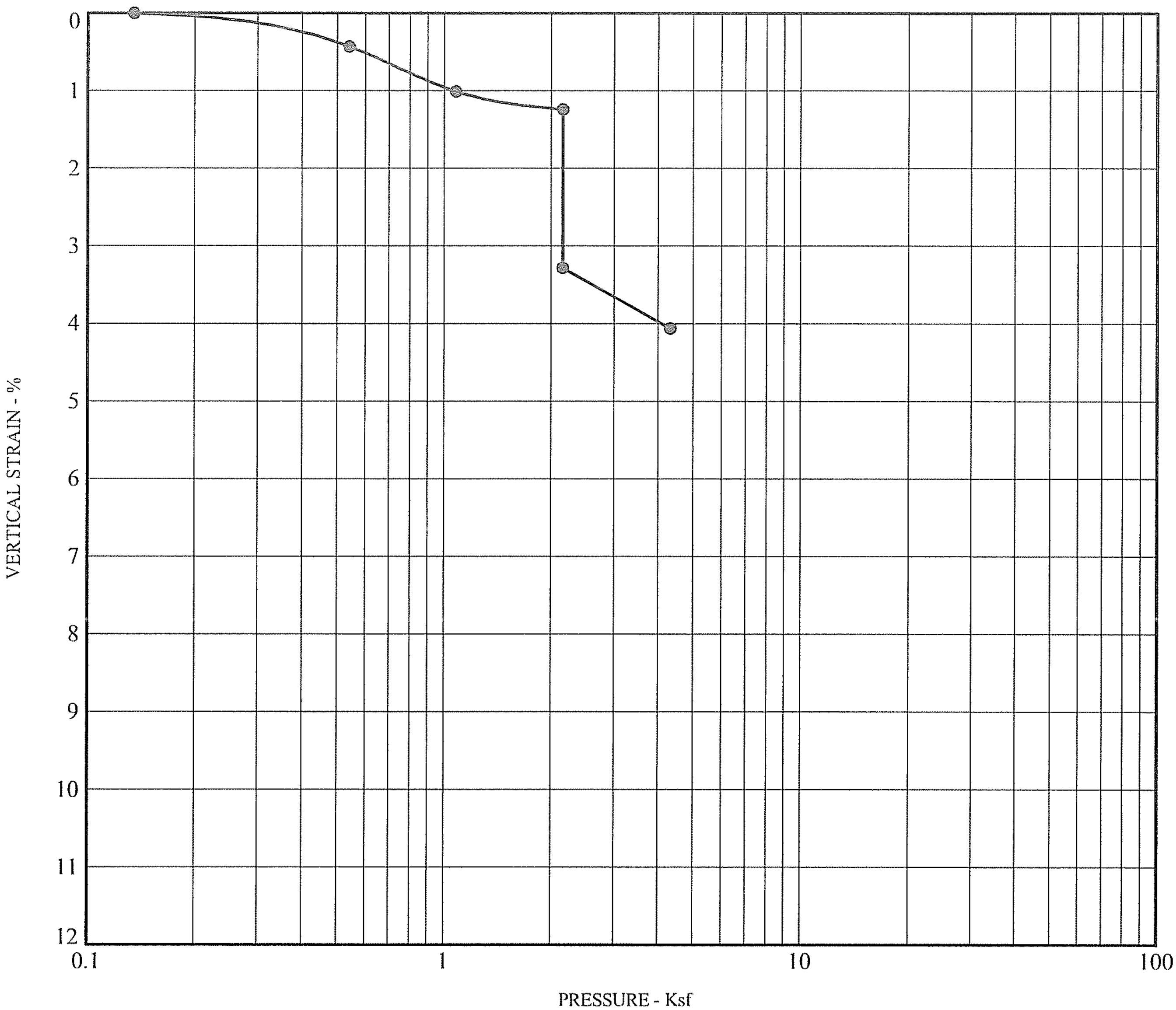
KLEINFELDER

Palmdale Power Project
Palmdale, California

PLATE B-10

PROJECT NO. 82300

CONSOLIDATION/COLLAPSE POTENTIAL TEST



Boring	B-3	
Depth (feet)	11	
Moisture Content (%)	5.3 Before	15.1 After
Dry Unit Weight (pcf)	109	
Description	Silty Sand	
Classification	SM	

NOTE : SPECIMEN FLOODED AT 2000 psf

KLEINFELDER

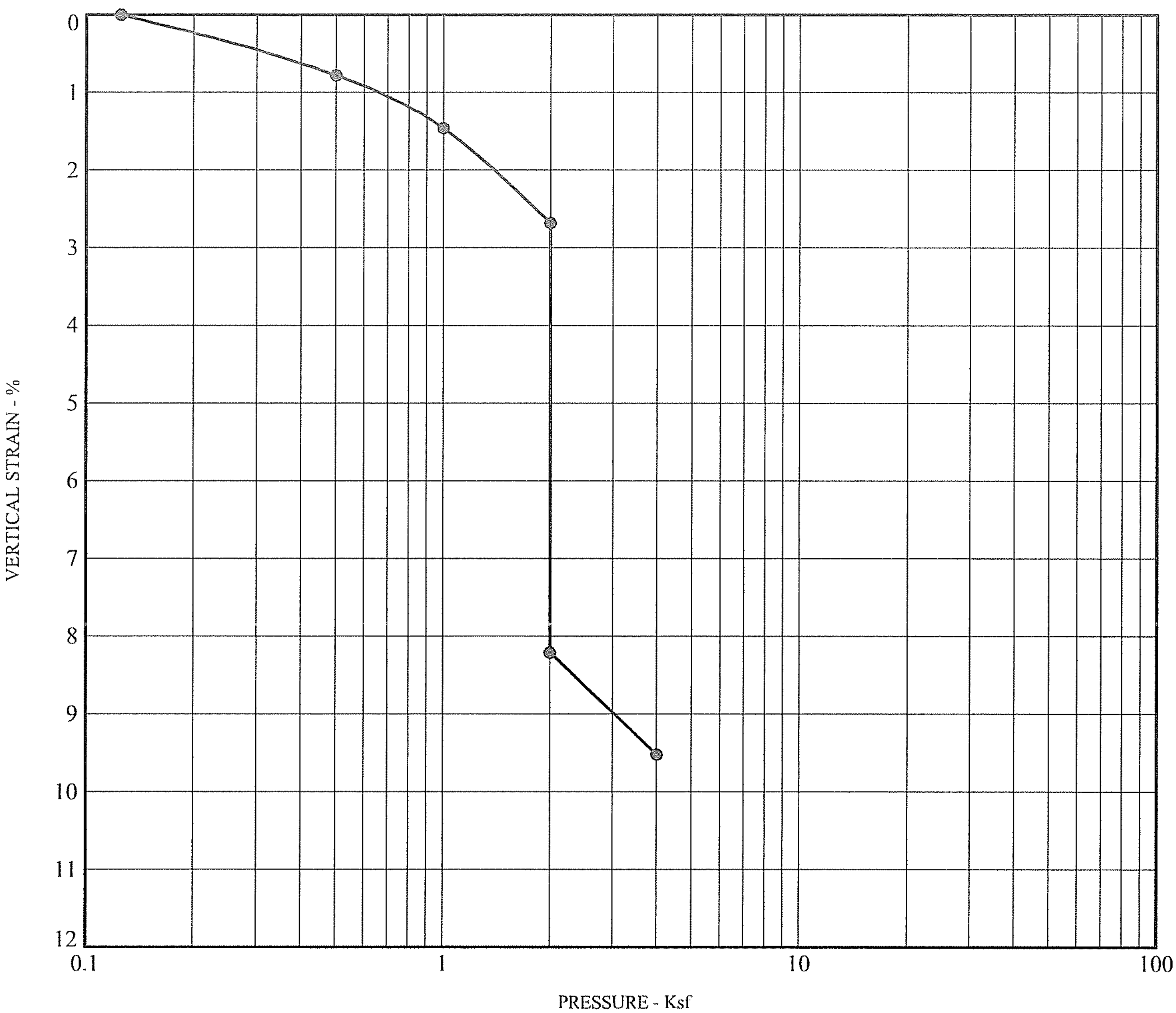
PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-11



Boring	B-6	
Depth (feet)	11	
Moisture Content (%)	2.8 Before	19.7 After
Dry Unit Weight (pcf)	96	
Description	Sandy Silt	
Classification	ML	

NOTE : SPECIMEN FLOODED AT 2000 psf

KLEINFELDER

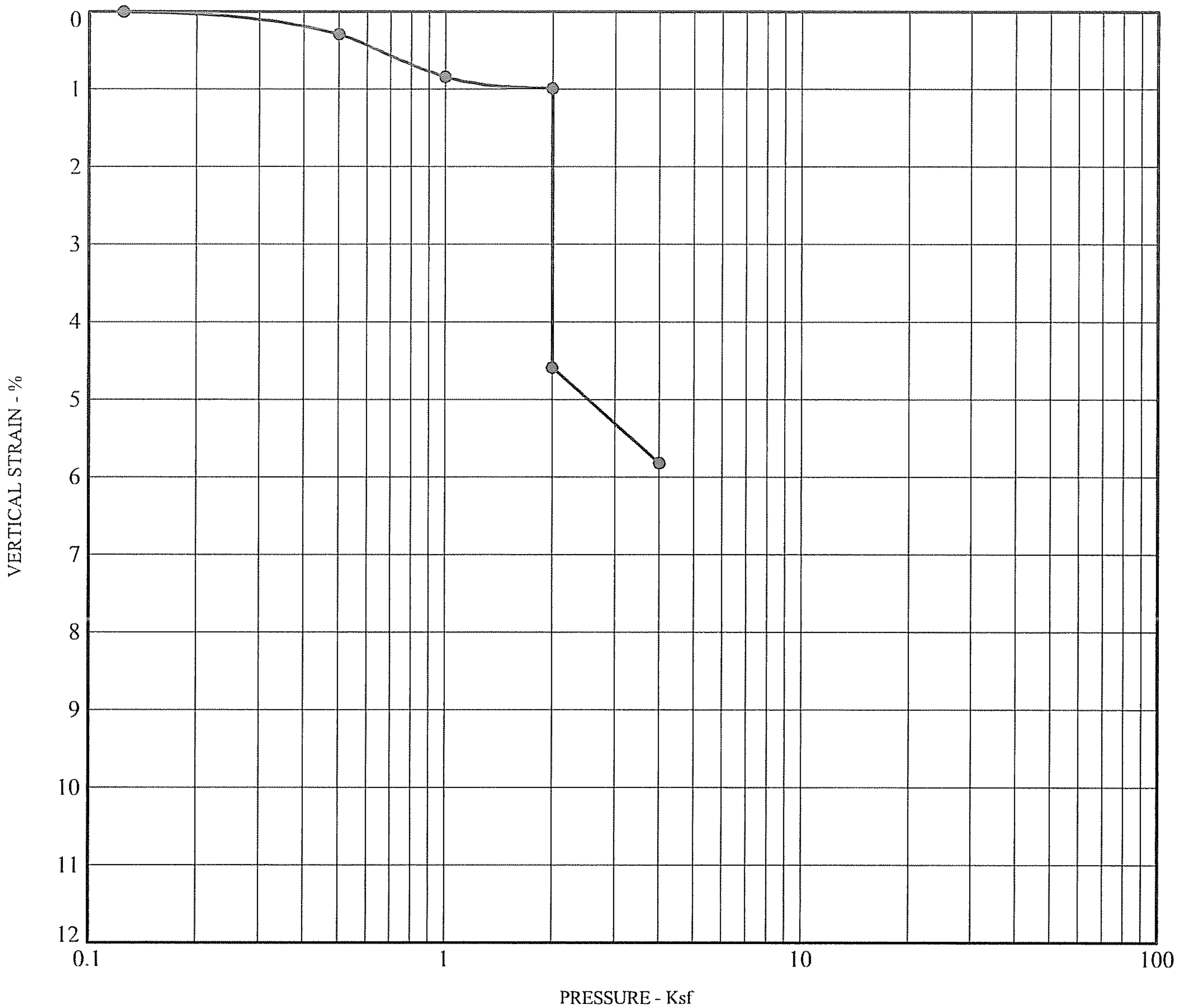
PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-12



Boring	B-14	
Depth (feet)	6	
Moisture Content (%)	3.7 Before	15.9 After
Dry Unit Weight (pcf)	106	
Description	Silty Sand	
Classification	SM	

NOTE : SPECIMEN FLOODED AT 2000 psf

KLEINFELDER

PROJECT NO. 82300

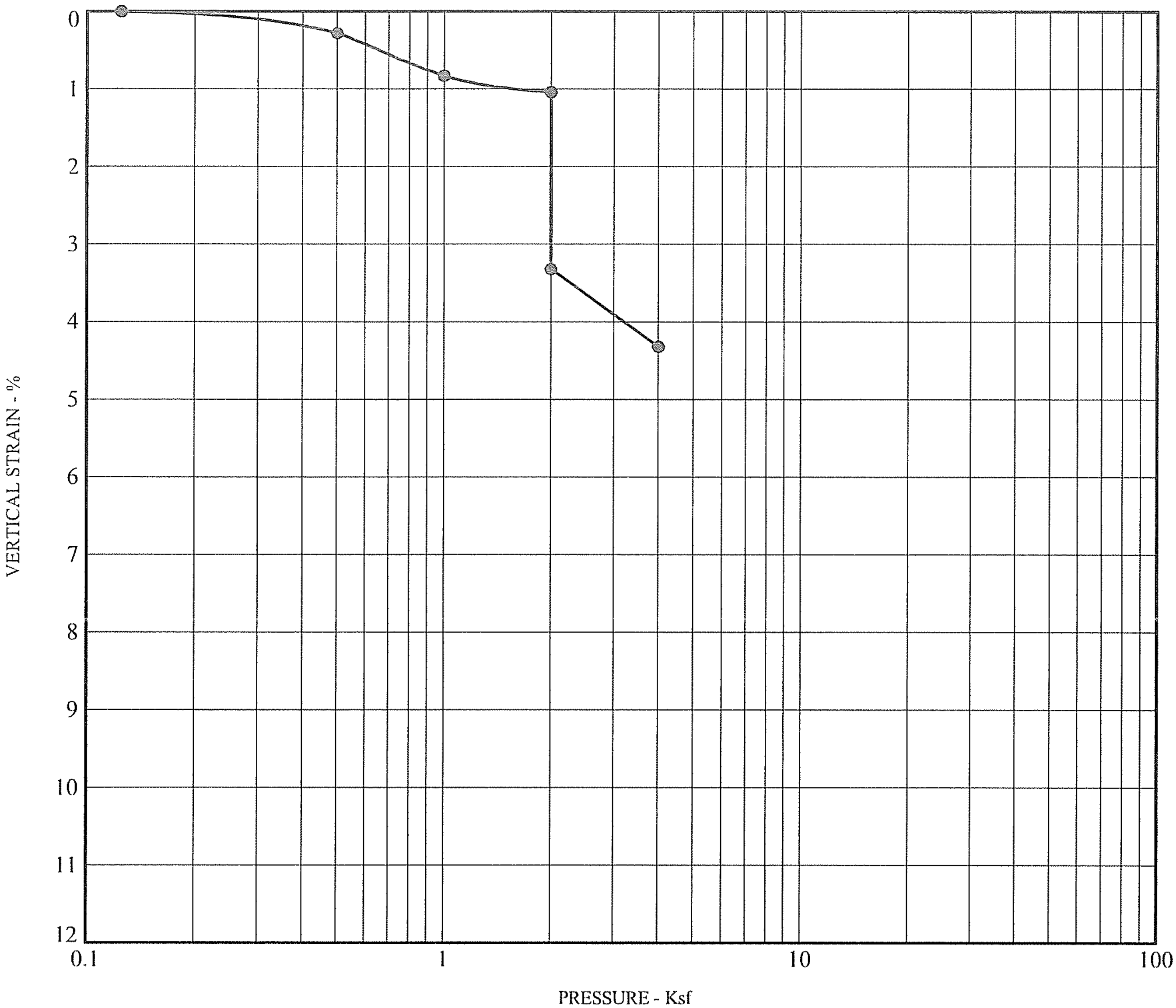
Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-13

CONSOL NO INDICIES 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08



Boring	B-14	
Depth (feet)	11	
Moisture Content (%)	6.3 Before	15.6 After
Dry Unit Weight (pcf)	107	
Description	Silty Sand	
Classification	SM	

NOTE : SPECIMEN FLOODED AT 2000 psf

CONSOL NO INDICIES 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

KLEINFELDER

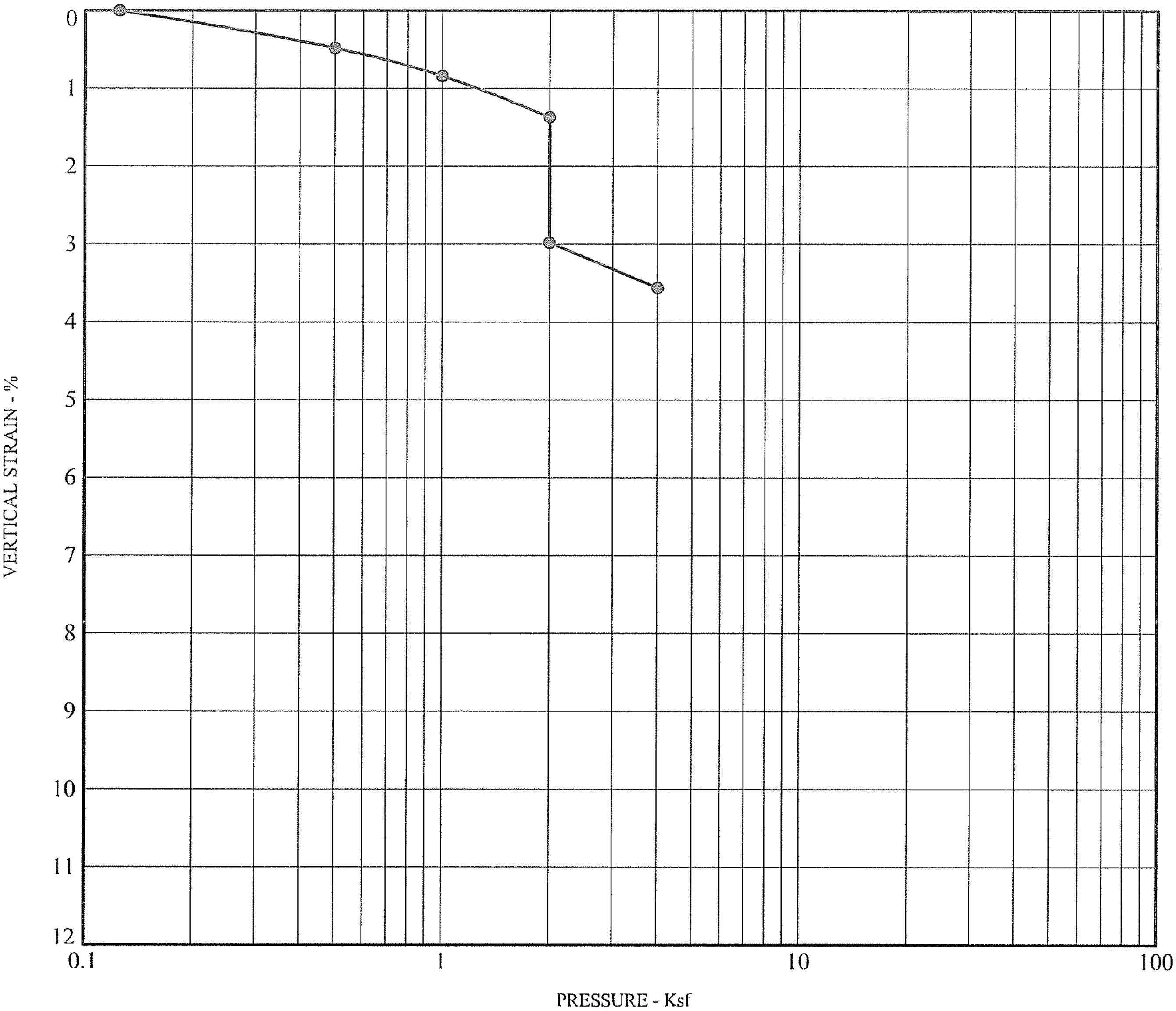
PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-14



Boring	B-14	
Depth (feet)	21	
Moisture Content (%)	1.3 Before	20.9 After
Dry Unit Weight (pcf)	97	
Description	Silty Sand	
Classification	SM	

NOTE : SPECIMEN FLOODED AT 2000 psf

CONSOL NO INDICIES 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

KLEINFELDER

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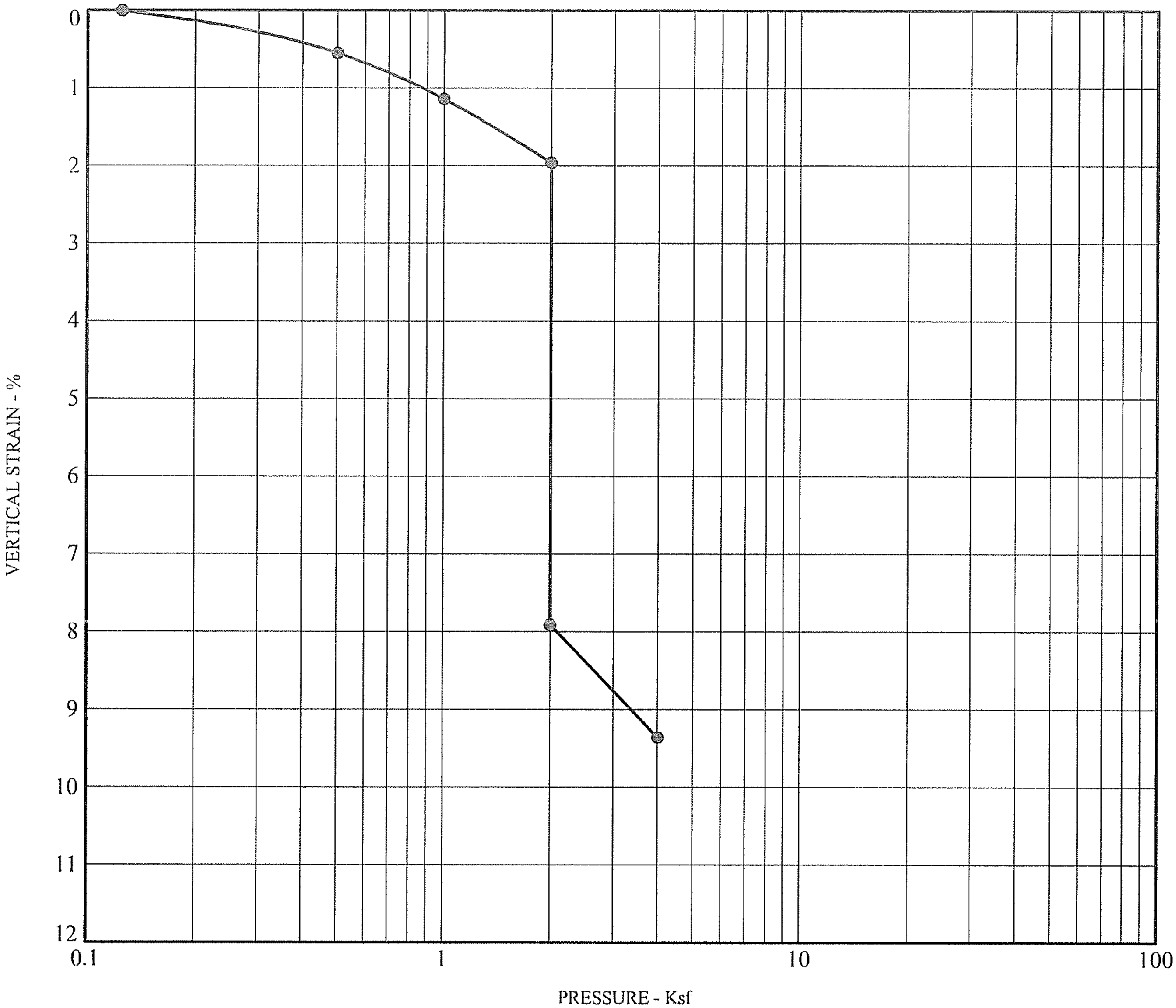
Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-15



Boring	B-18	
Depth (feet)	6	
Moisture Content (%)	2.8 Before	14.5 After
Dry Unit Weight (pcf)	103	
Description	Silty Sand to Sandy Silt	
Classification	SM-ML	

NOTE : SPECIMEN FLOODED AT 2000 psf

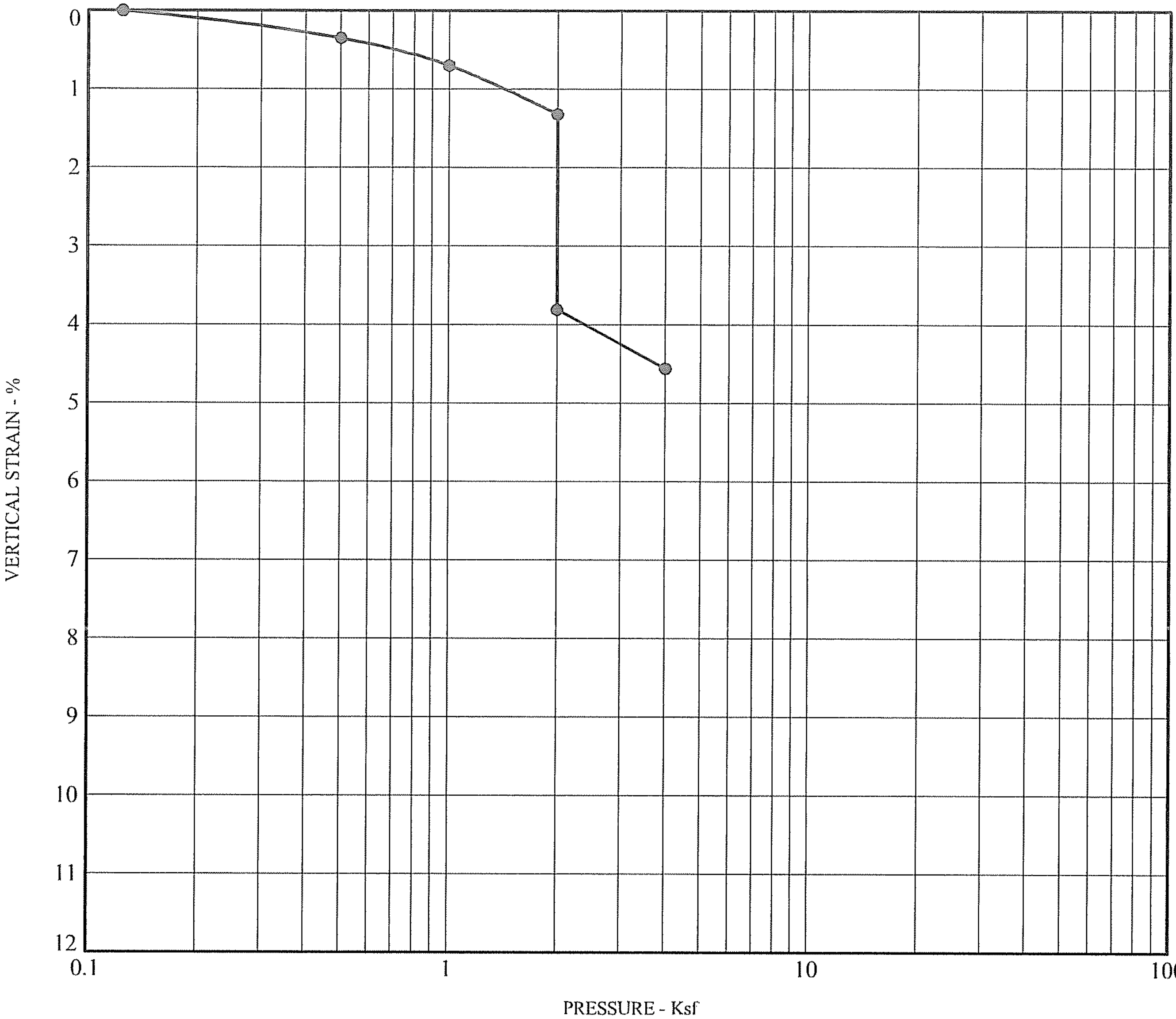
KLEINFELDER

PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE B-16



Boring	**B-18**
Depth (feet)	**11**
Moisture Content (%)	**2.6 Before** / **13.4 After**
Dry Unit Weight (pcf)	**108**
Description	**Silty Sand**
Classification	**SM**

NOTE : SPECIMEN FLOODED AT 2000 psf

KLEINFELDER

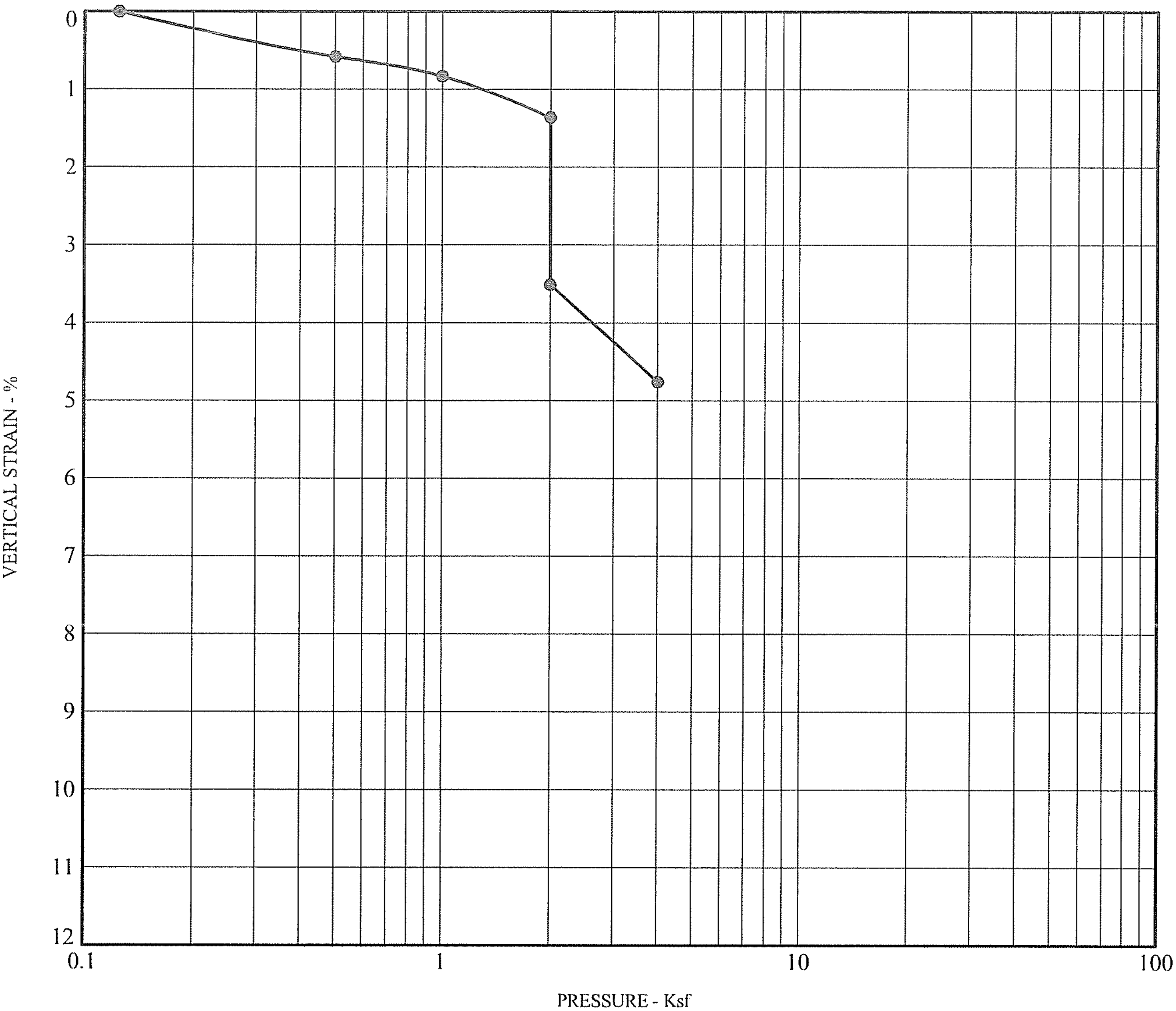
Palmdale Power Project
Palmdale, California

PLATE

B-17

PROJECT NO. 82300

CONSOLIDATION/COLLAPSE POTENTIAL TEST



Boring	B-21	
Depth (feet)	26	
Moisture Content (%)	11.4 Before	14.0 After
Dry Unit Weight (pcf)	102	
Description	Silty Sand to Sandy Silt	
Classification	SM-ML	

NOTE : SPECIMEN FLOODED AT 2000 psf

KLEINFELDER

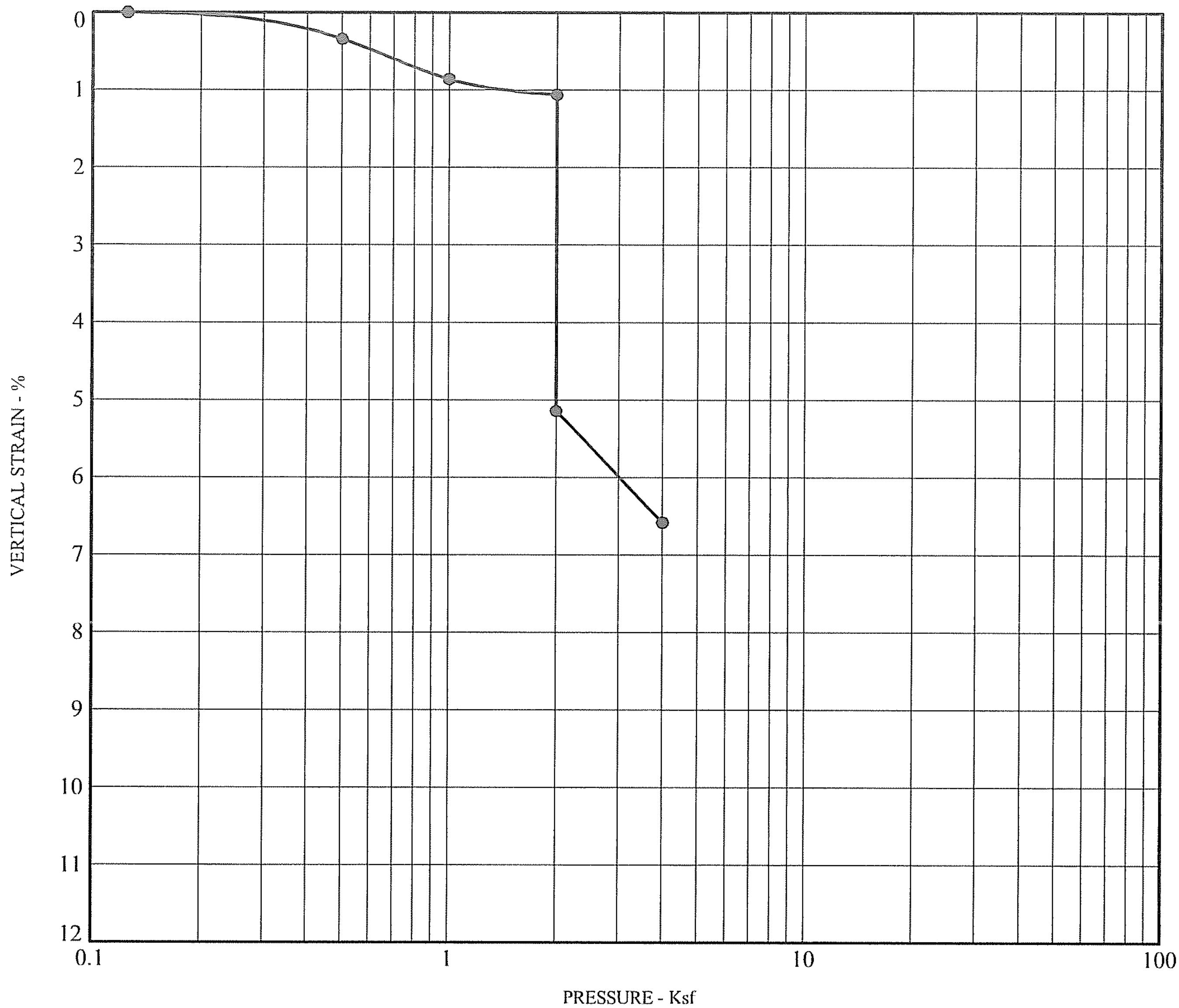
PROJECT NO. 82300

Palmdale Power Project
Palmdale, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

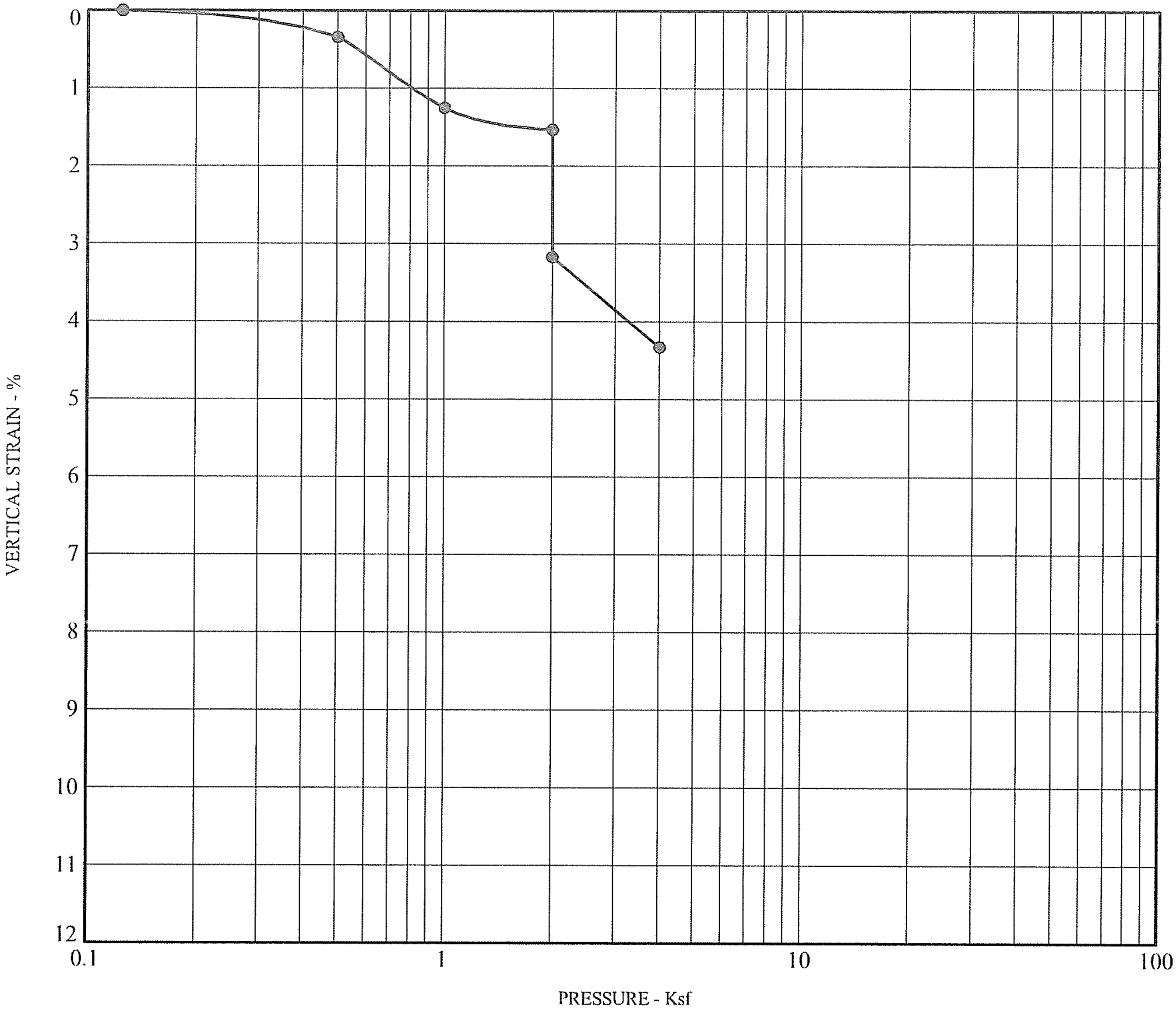
PLATE

B-18



Boring	B-24	
Depth (feet)	6	
Moisture Content (%)	3.1 Before	14.6 After
Dry Unit Weight (pcf)	107	
Description	Silty Sand	
Classification	SM	

NOTE : SPECIMEN FLOODED AT 2000 psf



Boring	B-24	
Depth (feet)	16	
Moisture Content (%)	7.6 Before	18.5 After
Dry Unit Weight (pcf)	106	
Description	Silty Sand to Sandy Silt	
Classification	SM-ML	

NOTE : SPECIMEN FLOODED AT 2000 psf

CONSOL NO INDICIES 82300 PALMDALE POWER PLANT.GPJ KA_RDLND.GDT 3/26/08

KLEINFELDER

Palmdale Power Project
Palmdale, California

PLATE B-20

PROJECT NO. 82300

CONSOLIDATION/COLLAPSE POTENTIAL TEST