Appendix F1
Geotechnical Report (Kleinfelder 2000)

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Preliminary Geotechnical Investigation
Proposed Residential Development
353 Acres, Martin Ranch
Tentative Tract 15576, Devore Area
San Bernardino County, California
Project No. 56-2013-01

Prepared for:

Montecito Equities, Ltd
c/o Mr. Joseph C Bonadiman, P.E.
588 West Sixth Street
San Bernardino, California 92410

Prepared by:

KLEINFELDER
www.kleinfelder.com

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
353± ACRES, MARTIN RANCH
TENTATIVE TRACT 15576, DEVORE AREA
SAN BERNARDINO COUNTY, CALIFORNIA

July 28, 2000

KLEINFELDER
An employee owned company

July 28, 2000
File No: 56-2013-01

Montecito Equities, Ltd.
c/o Mr. Joseph C. Bonadiman, P.E.
588 West Sixth Street
San Bernardino, California 92410

Subject: **Report of Preliminary Geotechnical Investigation**
Tentative Tract 15576, Martin Ranch, Devore Area
San Bernardino County, California

Dear Mr. Bonadiman:

Kleinfelder, Inc. (Kleinfelder) is pleased to present this report summarizing our preliminary geotechnical investigation performed for the subject project. The project site occupies approximately 353 acres and is located northwest of the intersection of Little League Drive and Meyers Road in the unincorporated Devore area of San Bernardino County, California.

The results of our geotechnical investigation and our conclusions and recommendations for geotechnical design of the project are presented in the attached report. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 6.

Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations Sections of this report. The project owner should become familiar with these provisions in order to assess other potential impacts to the proposed project and further involvement by Kleinfelder.

From a geotechnical perspective, the proposed development is feasible utilizing conventional footings and slabs on grade as long as the recommendations presented in the attached report are properly incorporated into design and construction of the project.

We appreciate the opportunity to be of service on this project. If you have any questions or require additional information, please do not hesitate to contact our office.

Respectively submitted,

KLEINFELDER, INC.

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TABLE OF CONTENTS

APPENDICES

Appendix A - Field Density Testing

Appendix B - Laboratory Results

Appendix C – ASFE Insert

PLATES

Plate 1 – Site Location Map

Plate 2 – Boring and Test Pit Location Map

Plate 3 – Rock Disposal Detail

Plate 4 – Canyon Subdrain Detail

Plate 5 – Subdrain for Side Hill Detail

Plate 6 – Fill Slope Detail

1. INTRODUCTION

Kleinfelder, Inc. (Kleinfelder) was retained by Montecito Equities, Ltd. to conduct a preliminary geotechnical investigation for Tentative Tract 15576, Martin Ranch, located in an unincorporated area of San Bernardino County, California. The project site is located in the Devore area, northwest of the intersection of Little League Drive and Meyers Road. The location of the site is presented on Plate 1, Site Location Map. The scope of our services was presented in a proposal entitled, "Proposal to Perform Geotechnical Investigation, Proposed Residential Development, 353 Acres, Martin Ranch, Tentative Tract 15576, Devore Area, San Bernardino County, California", dated December 9, 1999. For this investigation, Kleinfelder was provided with a Tentative Tract Map of the site, prepared by Rick Engineering, dated November 23, 1999.

Kleinfelder previously performed a geotechnical feasibility and geologic fault study at the project site. Results of that investigation are presented in a report entitled "Geotechnical Feasibility and Geologic Fault Study, 353 Acres, Martin Ranch, Tentative Tract 15576, Devore Area, San Bernardino County, California," dated May 28, 1997. The findings of a supplemental fault study performed are presented in a report entitled "Response to Geologic Review Comments, Proposed Martin Ranch Subdivision, Tentative Tract Map No. 15576 and CUP No. 96-20, San Bernardino, California," dated October 13, 1998.

1.1 Purpose and Scope

The purpose of this geotechnical investigation was to evaluate the subsurface soil conditions at the site to provide preliminary geotechnical recommendations for the design and construction of the project. This report also addresses the anticipated seismic shaking at the site, geologic features and hazards and earthwork considerations. A description of the scope of work is presented below.

Task 1 – Field Exploration: For this investigation, a total of 18 test pits and 25 exploratory borings were excavated within the area of the proposed development. The test pits were advanced to a maximum depth of 8 feet below existing grade and the borings to a maximum depth of about 40 feet below existing grade.

A staff member observed and logged the test pits and a staff engineer and staff geologist logged the borings. Soils were visually classified on site using the Unified Soil Classification System. Selected bulk and drive samples were retrieved and transported to our laboratory for testing. The unit weight and moisture content of in-situ soils encountered in the test pits were measured at selected depth intervals using a nuclear gauge. The exploratory borings were drilled with a truck-mounted drill rig. Our typical sampling interval was 5 feet. The number of blows necessary to drive both a Standard Penetration Test (SPT) sampler and a California-type sampler were recorded. Upon completion, the test pits and borings were backfilled with the excavated soil. The logs of test pits, including in-place moisture content, density test results and boring logs are presented in Appendix A, Field Exploration. Approximate locations of the test pit and exploratory borings are shown on Plate 2, Boring and Test Pit Location Map.

Task 2 - Laboratory Testing: Laboratory testing was performed on representative bulk and drive samples to substantiate field classifications and to provide engineering parameters for preliminary geotechnical design. Testing consisted of grain size distribution, moisture content/dry density, maximum density/optimum moisture, direct shear, collapse potential, consolidation and corrosion potential. The test results are presented in Appendix B, Laboratory Testing.

Task 3 - Report Preparation: This report was prepared presenting our findings, conclusions and preliminary recommendations for earthwork and foundation engineering. Our recommendations address soil guidelines for earthwork construction, foundation design, asphaltic concrete pavement design, and utilization of oversized materials (greater than 12 inches in size) in on-site fills.

1.2 Proposed Project

The referenced tentative tract map indicates that 331 residential lots, including associated roadways and infrastructure and three water tanks, are proposed. Maximum cut and fill depths across the site are anticipated to be on the order of 50 and 35 feet, respectively. Cut and fill slopes at inclinations of 2:1 (horizontal:vertical) or flatter at maximum heights of 80 and 75 feet, respectively, are planned.

The proposed structural loads and/or construction plans were not provided to us at the time of this investigation. For the proposed single-family residential lots, we have assumed concrete slabs, wood framed walls, and shallow continuous and isolated footings will be utilized. We have assumed that maximum anticipated foundation loads are 2 kips per foot for wall footings and 10 kips for isolated spread footings.

2. SITE AND SUBSURFACE CONDITIONS

2.1 Site Description

The project site consists of 353 acres located near the unincorporated Devore community in southwestern San Bernardino County, California. The site is bounded on the north and east by undeveloped land of the San Bernardino National Forest, on the southwest by Meyers Road and single-family residential properties, and on the northwest by open undeveloped land.

Topographically, most of the site consists of a southwest sloping alluvial terrace which is dissected on the west and east by Cable Canyon and Meyers Canyon, respectively. In the south-central portion of the site, a northwest trending topographic break exists which corresponds to the San Andreas Fault zone. The southeast and northern portions of the site consists of relatively steep hillside terrain.

The site relief is variable. In the central and southwest portions of the site, the site slopes relatively uniformly in a southwest direction at 10 to 15 percent. The remaining portions of the site consist of relatively steeply sloping terrain (15 to 70 percent) with steeply incised drainage areas. Elevations of the site vary from 2,010 feet above mean sea level (MSL) in the southeast portion of the project to 3,540 feet MSL in the northeast portion of the site.

Major drainages on the project include the southwest flowing Cable Canyon Creek which transverses the western portion of the site, and a steeply incised canyon drainage on the southeast portion of the project. Overall drainage of the site is toward the southwest.

The site is currently undeveloped. Vegetation on the site includes several eucalyptus trees on the west-central portion of the site, phreatophyte shrubs and trees within the creek areas and along the San Andreas Fault zone, and native oaks, shrubs, and grasses on the remaining portions of the project. The site is covered predominantly by chaparral-type vegetation, consisting of thick brush, weeds, annual grasses and scattered trees.

Access to the project is from Martin Ranch Road on the southwest portion of the site. Temporary access to the site is available off of Meyers Road in the southeast corner of the site. A 100-foot wide Edison easement transects the western portion of the site.

2.2 Subsurface Soil Conditions

The site is underlain predominantly by recent (Holocene age) and older (Pleistocene age) alluvial fan deposits with dissecting active stream channel deposits within the Cable Canyon Creek and Meyers Canyon Creek areas. The upper materials consist primarily of a surface layer of silty sands and sand with gravel with an average thickness of 5 to 10 feet. Below this surficial layer, the site is underlain by gravelly sands, sand with silt and cobbles with occasional boulders at depth. The material encountered in our test pits and exploratory borings was generally medium dense to very dense condition with depth. Moisture conditions ranged from dry to moist. Boulders in excess of 2 feet in diameter were encountered in our test pits and possibly in the borings where refusal was encountered. Roots and rootlets due to existing vegetation were observed in our test pits to depths as deep as 8 feet below the ground surface.

2.3 Groundwater Conditions

Evidence of groundwater was not encountered in any of the test pits excavated to a maximum depth of 8 feet during this investigation. Generally, groundwater levels beneath the site are greater than 50 feet below ground surface (bgs). However, recent alluvial deposits within Cable Canyon and Meyers Canyon contain lush riparian vegetation and very moist soils, indicating shallow groundwater levels within these drainage areas.

Groundwater was encountered in Borings B-22 and B-23 at 20 feet bgs. These borings are located in an isolated area in the eastern portion of the site along the northeast side of the San Andreas fault, which acts as a local groundwater barrier within the site.

Fluctuations of the groundwater level, localized zones of perched water and very moist to wet soil conditions may be of concern during development of the project. Areas where near-surface groundwater is anticipated within drainage areas and adjacent to the San Andreas fault are shown on Plate 2.

3. GEOLOGIC CONDITIONS

3.1 Regional and Site Geology

The project site is located within the southwest margin of the San Bernardino Mountains within the Transverse Ranges Geomorphic Province of California. The San Bernardino Mountains are bounded by the San Andreas fault and the Cajon Pass to the west, the San Andreas fault and the San Gorgonio Pass to the south and southwest, the Pinto Mountain fault and the Little San Bernardino Mountains to the east, and the Mojave Desert to the north. The San Bernardino Mountains are the youngest of the eastern Transverse Ranges and are being actively elevated.

The regional geology is dominated by right lateral faulting of the San Andreas fault. The modern trace of the San Andreas fault in the vicinity of the site is denoted as the Cajon Pass-Mill Creek segment of the San Bernardino branch. According to Morton and others, 1985, the Cajon Pass-Mill Creek segment is characterized by its conspicuous geologic and geomorphic expression, by its overall simplicity, and by abundant evidence for youthful activity. Youthful activity along this segment is indicated by well developed primary fault features (scarps, sag ponds, pressure and shutter ridges) and by youthful geologic and physiographic features (alluvial fans, drainage lines) that have been offset by the fault during Holocene and Recent time. As identified on the site, these active fault features include linear vegetation, off-set drainages, and shallow groundwater backed up behind the fault. Locally, the site is underlain by late Pleistocene and Holocene age colluvial and alluvial fan deposits and Mesozoic age foliated metamorphic schist and gneiss rocks.

3.2 Faulting and Seismicity

We consider the most significant geologic hazard to the project to be the potential for strong seismic shaking that is likely to occur during the design life of the proposed project. The project site is located in the highly seismic Southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as a "sufficiently active and well defined fault" that has exhibited surface displacement within the Holocene time (about the last 11,000 years). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago). These active and potentially active faults are capable of

producing potentially damaging seismic shaking at the site. It is anticipated that the project site will periodically experience ground acceleration as the result of small to large magnitude earthquakes.

Areas of the site are presently located within a State of California-designated Earthquake Fault-Zone Boundary (Hart and Bryant, 1997) where a site-specific fault investigation would be required. Faults identified by the State as being either active or potentially active are known to be present on-site and have been previously evaluated (Kleinfelder, 1997, 1998). The referenced reports include recommendations for set-back zones for two active fault zones identified within the central portion of the site and one potentially active fault zone in the northern portion of the site.

We have performed a computer-aided search of the known active and potentially active faults within a 62-mile (100 kilometer) radius of the site, researched available literature to assess the maximum magnitude earthquakes expected to be generated on each fault. We have listed within Table 1, Significant Faults, the known faults in the region that in our opinion, could impact the site.

Table 1 summarizes these parameters for five of the thirty-one known active and potentially active faults within the searched radius of the site that in our opinion will have the greatest impact upon the site. Selection of the faults was based on their proximity to the site and their potential to generate moderate ground motion on the site. Table 1 was generated using, in part, the EQFAULT computer program (version 2.01) developed by Blake (rev. 1999) as modified using the fault parameters from DMG Open File Report 96-08 and the 1997 UBC fault maps (ICBO, 1998). This table does not identify the probability of reactivation or the onsite effects from earthquakes occurring on these listed faults or any of the other faults in the region. The site is located on the USGS San Bernardino North, California 7½' Quadrangle Map, at Latitude 34.225°N and Longitude 117.368°W.

TABLE 1
SIGNIFICANT FAULTS

Fault Name	Approximate Distance from Site km (mi.)	Maximum Event* (Moment Mag.)	Fault Seismic Source Type
San Andreas – San Bernardino Branch	On site	7.4	A
North Frontal - Western Branch	7 (4)	7.0	B
Cucamonga	8 (5)	7.0	A
San Andreas – Mojave Branch	12 (8)	7.8	A
San Jacinto – San Bernardino Branch	6 (4)	6.7	B

* As defined by the ICBO (1998) and CDMG (OFR 96-08).

A number of moderate earthquakes have occurred in the vicinity of the project site in the past years. The parameters used to define the limits of the historical earthquake search include geographical limits (within 62 mi. of the site), dates (1800 through 1999), and magnitude (magnitudes above M 4). A summary of the results of the historical search is presented below.

Time period (1800 to 1999)	199 years
Maximum Magnitude within 62 mi. (100 km) radius (06-28-1992 Landers Event)	M 7.6
Approximate distance to nearest historical earthquake, > M4.0	3 miles
Number of events exceeding magnitude 4.0 within the search area	656

Under the current understanding of regional seismo-tectonics, the largest magnitude event to impact the site may be generated by the San Andreas fault – San Bernardino branch having a moment magnitude of 7.4.

The USGS Seismic Hazard Mapping Program and Peterson (1999) indicates a 10 percent probability of exceedance in 50 years for an acceleration of 1.0 g for alluvial and soft rock sites within this area. The site is located in Seismic Zone 4 of the latest edition of the Uniform Building Code (UBC). Structures should be designed in accordance with the values and parameters given within the UBC.

In addition to the determination of fault activity, faults are also type classified as an A, B, or C for Near-Source Zone ground motion (C_a, C_v, and N_a, N_v) by the State of California and ICBO (in the UBC, Table 16-U) according to parameters of known slip rate and maximum earthquake magnitude. A "Type A" seismic source fault has a magnitude $M \geq 7.0$ and slip rate(SR) ≥ 5mm/yr. A "Type B" seismic source fault has a magnitude $M \geq 7.0$ and SR <5mm/yr, or $M < 7.0$ and SR>2mm/yr., or $M \geq 6.5$ and SR <2mm/yr. A "Type C" seismic source fault has a magnitude $M < 6.5$ and a slip rate of <2mm/yr, or is unrated under the current knowledge.

The site is located within the 2-km Active Fault Near-Source (Seismic) Zone for the San Andreas fault – San Bernardino Branch (a Type A seismic source) as designated by the 1999 UBC (ICBO, 1998).

The fault distances presented in Table 1 indicate the distance from the site to the nearest location where the fault trace is mapped at the surface. The Near Source Zone Map distances are based on the shortest distance from the site to the fault plane projection to the surface. In some cases, the Near Source Zone Map distance is less than the distance shown in Table 1 because the site may be closer to the fault plane than the surface trace of the fault.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Geotechnical Feasibility

Based on the results of our field exploration and geotechnical analyses, it is our opinion that it is geotechnically feasible to develop this site as planned, provided that the recommendations presented in this report are incorporated into the project design and construction. Our conclusions and recommendations are presented in the following paragraphs.

4.2 Seismic Design Considerations

4.2.1 General

The site is located in a seismically active region and the proposed facility can be expected to be subjected to strong seismic shaking during its design life. Potential seismic hazards include ground shaking, localized liquefaction, ground rupture due to faulting, and seismic settlement. The following sections discuss these potential seismic hazards with respect to this site.

4.2.2 Ground Shaking

Because this site is located in the seismically active Southern California region, we recommend that, as a minimum, the proposed development be designed in accordance with the requirements of the latest edition of the Uniform Building Code (UBC) for Seismic Zone 4. We recommend that a soil profile type S_D (UBC 1997 edition) be used with the UBC design procedure.

Using data from Table 1 and the attenuation relationship of Joyner and Boore (1994), the largest estimated peak horizontal ground acceleration that might occur at the site may come from a moment magnitude 7.4 event on the San Andreas fault, located on the site.

We recommend using the following seismic parameters for the UBC design procedure as shown in Table 2.

TABLE 2
SEISMIC DESIGN PARAMETERS

Seismic zone Factor (Table 16-I)	0.40
Soil Profile Type (Table 16-J)	S_D
Seismic Source Type (Table 16-U)	A
Near Source Factor-N_a (Table 16-S)	1.5
Near Source Factor-N_v (Table 16-T)	2.0
Seismic Coefficient C_a (Table 16-Q)	0.66
Seismic Coefficient C_v (Table 16-Q)	1.28

4.2.3 Liquefaction

The project site is generally underlain by medium dense to very dense coarse-grained soils to the maximum depth explored. The reported absence of groundwater for most of the proposed improvements across the site within the upper 50 feet, combined with the relative densities of the soil, indicate that the potential for liquefaction occurrence is low.

The canyon drainage areas, where near-surface groundwater is present, are susceptible to liquefaction and associated settlement, as shown on Plate 2. Improvements within these areas should be constructed on deep foundations or recompacted fill soils.

The area of near-surface groundwater northeast of the San Andreas fault has a low potential for liquefaction given the depth to groundwater (20 feet) and the medium dense to dense soil conditions present. Special measures to mitigate the effects of liquefaction in this area are not required.

4.2.4 Other Seismic Considerations

Areas of the site are currently located within an Earthquake Fault Zone. Therefore, the likelihood of ground surface rupture due to primary faulting from known faults is considered probable, and "no building structures" setback zones have been recommended (Kleinfelder, 1997, 1998). Based on the materials encountered at this site, the existing topographic conditions, analyses performed and the proposed improvements, we do not expect seismic slope instability to be a concern. Due to the site's inland location and remoteness from large, land locked bodies of water, we do not believe that seismic seiches or tsunamis are a concern. Due to the

probability of on-site faulting, the likelihood of ground lurching of surficial soils is considered moderate to high.

4.3 Earthwork

4.3.1 General

All site preparation and earthwork operations should be performed in accordance with applicable codes. All references to maximum dry density are established in accordance with ASTM Standard Test Method D-1557.

4.3.2 Subgrade Preparation

Overexcavation and recompaction of the surficial soils is recommended to improve the existing soil and to reduce the potential for excessive settlement. Care should be taken during overexcavation operations to maintain side wall stability and personal safety. Please refer to Section 4.3.6 for temporary excavation recommendations.

Overexcavation recommendations are as follows:

- Undocumented Fills: Areas of loosely replaced trench backfill or other encountered uncontrolled fills should be overexcavated and replaced with compacted fill.
- Fill: Prior to placing any fills, all areas to receive fill should be overexcavated a minimum of 24 inches below existing grades.
- Building Pads: The proposed building pad areas should be overexcavated and recompacted to a depth of at least 2 feet below footing bottoms. The engineered fill should extend horizontally beyond the edges of all foundation elements a minimum of 5 feet.
- Pavement Subgrade: We recommend that the proposed concrete or asphaltic concrete pavements be placed over a minimum of 18 inches of engineered fill. The upper six inches of this fill should be compacted to at least 95 percent of the maximum dry density. This engineered fill thickness is in addition to the concrete or asphalt concrete pavement sections presented in Section 4.10.

- Miscellaneous Areas to Receive Fill: Areas to receive fill, which do not fall into one of the categories above (for example, sidewalks and other flatwork), should be placed on a minimum of 12 inches of engineered fill compacted to at least 90 percent of the maximum dry density. The areas designated for landscaping do not require overexcavation.

The depth of overexcavation may vary depending on the actual conditions exposed during earthwork and may be greater than recommended above.

Deposits of potentially compressible materials may be present within localized drainage areas across the site that will necessitate removal and recompaction during grading. The specific depth and extent of removals should be evaluated during the actual earthwork operations based on the subsurface conditions observed and tested. For preliminary planning purposes, estimated depths of removals within the canyon drainage areas is estimated to be on the order of about 5 feet.

Prior to the placement of engineered fill, after site preparation and overexcavation, processing of the approved excavation bottom should be performed by scarifying to a minimum depth of 8 inches, moisture conditioning to near optimum moisture content and compacting to a minimum of 90 percent of the maximum dry density.

The removal and stripping operations must expose a firm, non-yielding subgrade that is free of significant voids and organics. The subgrade soils exposed at the bottom of each excavation should be observed by a geotechnical engineer or geologist from our office prior to scarification and the placement of any fill. Additional removals may be required as a result of observation and testing of the exposed subgrade soils.

Oversized rock greater than 12 inches in size may be generated during overexcavation within the recent alluvium, terrace deposits and crystalline bedrock. Oversized rock greater than 12 inches in size but less than 3 feet may be placed in the deeper fill areas. See Plate 3 for generalized rock disposal details. Materials larger than 6 inches should not be placed within 12 inches of footing bottoms, concrete slabs or pavement subgrades.

4.3.3 Subdrains

Subdrains should be constructed in accordance with the typical subdrain details shown on Plates 4 and 5, and as described below.

Canyon Bottom Subdrains

- Nine cubic feet (per lineal foot) of open-graded rock containing 6-inch diameter Schedule 40 PVC perforated pipe surrounded by a filter fabric should be placed in the canyon bottom. Graded filter material or Class II permeable base material should not be used.

Side Hill Fill

- Four cubic feet (per lineal foot) of open-graded rock containing 4-inch diameter Schedule 40 PVC perforated pipe surrounded by a filter fabric should be placed at the back-cut or heel of side hill fill keys. These subdrains may be outletted at the face of the fill slope utilizing solid pipe.

4.3.4 Excavation Characteristics

The test pits and borings excavated at the site were advanced using a conventional rubber-tired backhoe and truck-mounted, hollow-stem auger drill rig, respectively. Excavating was completed with moderate effort through the existing native soils. However, due to the presence of cobbles and boulders across the site, difficult excavation may periodically be encountered during rough grading operations.

Based on the material encountered within our exploratory test pits and borings and on our knowledge of the local geology, we do not anticipate the need for blasting.

4.3.5 Engineered Fill

The on-site soils encountered during our investigation, excluding debris, oversized material and/or other deleterious material are considered suitable for use as engineered fill. When adequately compacted at an appropriate moisture content, these materials can be expected to possess suitable bearing and settlement characteristics for the proposed construction. Fill should be uniformly moisture conditioned to near optimum moisture content, placed in lifts no greater

than 8 inches thick, loose measurement, and should be compacted to at least 90 percent of the maximum dry density. Import materials, if required, should be evaluated by the project geotechnical engineer prior to being transported to the site. Based on the sandy nature of the potential fill material, we expect that most of the settlement will occur during construction. We estimate that about ½ inch of settlement may occur as post-construction settlement resulting from placement of the maximum anticipated engineered fill depth, 35 feet. All earthwork operations should be observed and tested by a representative of this office.

4.3.6 Temporary Trench Excavations

Shallow, temporary utility trench excavations are anticipated for installation of the required utility lines. All vertical or steeply-sided trench excavations greater than 5 feet in depth should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes.

Due to the potential for local trench wall instability, we recommend that temporary cut slopes needed to achieve the proposed subgrade elevations be constructed at inclinations no steeper than 1.5 H:1V in the existing and newly placed fill soils. Heavy construction loads, such as those resulting from stockpiles and heavy machinery, should be kept back from the top of the excavation a distance equal to the depth of the excavation. All surface water should be diverted away from the excavations.

If steep or vertical-sided excavations in excess of 5 feet deep are necessary, we recommend that the sidewalls be shored in accordance with OSHA standards to provide temporary trench stability during construction. The contractor should be responsible for the structural design and safety of the temporary shoring system and we recommend that this design be submitted to Kleinfelder for review and approval.

4.3.7 Pipe Bedding and Trench Backfill

Pipe bedding should consist of sand or similar granular material having a minimum sand equivalent value of 30. The sand should be placed in a zone that extends a minimum of 6 inches below and 12 inches above the pipe for the full trench width. Trench backfill above pipe bedding may consist of approved, on-site or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry unit weight.

4.3.8 Shrinkage and Subsidence

We have provided estimates for earthwork shrinkage and subsidence based on the limited information available at this time. We have estimated that shrinkage may range between 10 and 15 percent, with a subsidence value of 0.15 feet for soils within the upper 5 feet below existing grade. Shrinkage values of 5 to 10 percent and a subsidence value of 0.10 feet should be used for materials below 5 feet. These estimates do not include losses due to stripping, or to oversize materials. These values are subject to change upon the development of more information during grading operations, and should be considered to be very general. These values are based on a limited number of density tests. A better approximation can be developed during the early stages of site work. It should be emphasized that variations in natural soil density, as well as in compacted fill densities, render these types of values very approximate. In addition, other factors should be considered, such as the contractor's methodology and compaction methods used during grading.

4.4 Proposed Cut and Fill Slopes

The proposed cut and fill slopes designed at inclinations of 2:1 (horizontal:vertical) or flatter at maximum heights of 80 and 75 feet, respectively, have been analyzed and have been found to be grossly stable.

Some raveling and surficial slope instability should be anticipated due to the generally granular nature of the on-site materials. Cut slopes which expose bedrock materials will tend to weather over time and should be planted with deep-rooted vegetation. Slopes which are not vegetated and maintained should be expected to experience various forms of surficial slope instability. Periodic maintenance and removal of debris will be necessary.

Fill slopes should be constructed in accordance with the typical fill slope detail shown on Plate 6 and as described below. Fill slopes should be constructed in accordance with applicable provisions of the UBC following typical key excavation, benching, and sub-drainage procedures. To ensure proper compaction at the slope face, it is recommended that the fill slopes be overfilled and then cut back to compacted material. After cutting back, slope faces may need to be rolled with compaction equipment. Due to the erosion potential of soil materials found on-site, we recommend that all fill slopes be protected against erosion. The use of a jute-type mat should adequately protect the slopes from erosion until a healthy plant growth is established.

4.5 Drainage and Landscaping

It is important that positive surface drainage be provided to prevent ponding and/or saturation of the soils in the vicinity of foundations, concrete slabs-on-grade, or pavements. We recommend that the site be graded to carry surface water away from the improvements and that positive measures be implemented to carry away roof runoff. Poor perimeter or surface drainage could allow migration of water beneath the building or pavement areas which may result in distress to project improvements. If planted areas adjacent to the structure are desired, we suggest that care be taken not to overirrigate and to maintain a leak-free sprinkler piping system. In addition, it is recommended that planter areas next to buildings have a minimum of 5 percent positive fall away from building perimeters to a distance of at least 5 feet. Drain spouts should be extended to discharge a minimum of 5 feet from the building, or some other method should be utilized to prevent water from accumulating in planters. Landscaping after construction should not promote ponding of water adjacent to structures.

4.6 Erosion Control

Moderate potential for erosion exists when sandy terrace and crystalline bedrock materials are used to construct fill slopes. The proposed 2:1 slopes should perform satisfactorily without excessive erosion, provided that proper surface drainage and vegetation are established soon after completion.

The steep slopes and deep, narrow drainages or canyons on-site indicate that the area is at least moderately susceptible to erosion. The potential for erosion of the natural slopes above the graded pad and parking areas is expected to be moderate to high. Fill materials generated from the sandy terrace materials and "granitic" bedrock areas will have relatively low cohesion and, therefore, will also have a moderate to high potential for erosion.

4.7 Foundation and Slab Recommendations

4.7.1 General

The proposed structures may be designed using shallow continuous strip and isolated rectangular spread column foundation systems, supported on engineered fill. Preliminary recommendations for the design of the shallow foundation system are presented below and are based on the anticipated structural loads. We have provided preliminary geotechnical recommendations for

shallow foundations only. Evaluation of more elaborate foundation systems was beyond the scope of this investigation.

4.7.2 Shallow Foundations

The proposed structures may be founded on a series of shallow continuous strip and square footings. We recommend that the foundations be placed at a minimum depth of 18 inches below the lowest adjacent grade and bear on a minimum of 24 inches of engineered fill prepared as described in Section 4.3.5. The engineered fill should also extend beyond the edges of all foundations at least five feet horizontally.

For a foundation system designed and constructed in accordance with the recommendations presented above, we recommend that an allowable bearing pressure of 1,500 pounds per square foot (psf) be used for the design of the foundation system. This recommended bearing value is for total dead plus live loads and may be increased by one-third for wind, seismic or other transient loading conditions.

Lateral load resistance may be derived from passive resistance along the vertical sides of the footings, friction acting at the base of the footing or a combination of the two. An allowable passive earth pressure of 350 psf per foot of depth may be used for design. Allowable passive earth pressure values should not exceed 3,500 psf. A coefficient of friction value of 0.35 between the base of the footings and the recompacted existing on-site soils can be used for sliding resistance using the dead load forces. Friction and passive resistance may be combined without reduction. We recommend that the first foot of soil cover be neglected in the passive resistance calculations if the ground surface above is not protected from erosion or disturbance by a slab, pavement or in some similar manner.

Based on the loading conditions presented above, we estimate that the total settlement for foundations designed in accordance with the recommendations presented should be less than 1 inch. Because of the dry to partially saturated nature of the near-surface soils affected by the foundation loads, we expect that most of the settlement will occur elastically during construction. Differential, post-construction, settlement between similarly loaded adjacent columns is estimated to be less than 1/2 inch.

4.7.3 Slab-on-Grade Floors

We recommend that a vapor barrier be placed below the floor slab in areas where moisture sensitive flooring materials are planned. In addition, the barrier should be covered with two-inches of clean sand and should be underlain by a layer of one inch of clean sand to protect the barrier during construction, act as a capillary break and aid in the proper curing of the concrete slab. All areas adjacent to buildings, including planters, should be designed to drain away from the structure to avoid accumulation of water beneath the slab or footings.

4.8 Lateral Earth Pressures

Active lateral earth pressures from horizontal backfills using the on-site native soils on walls that are free to rotate at least 0.1 percent of the wall height can be taken as equivalent to a fluid weighing 35 pounds per cubic foot (pcf). Walls, which are restrained against movement or rotation at the top, should be designed for the at-rest equivalent fluid pressure. An at-rest equivalent fluid pressure of 50 pcf can be used for level, on-site backfill.

The above values are applicable if the on-site soils are used for backfill behind the walls. The recommended value does not include compaction- or truck-induced wall pressures. Care must be taken during the compaction operations not to overstress the wall. 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. The geotechnical engineer should be contacted when development plans are finalized to review wall and backfill conditions on a case-by-case basis.

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 buildup of hydrostatic pressure. Backdrains could consist of a 2-foot-wide zone of Caltrans Class 2 permeable material located immediately behind the wall extending to within 1 foot of the ground surface. A perforated pipe should be installed at the base of the backdrain and sloped to discharge to a suitable collection facility or through weep holes. Alternatively, a commercially available drainage product may be used, once accepted by the geotechnical engineer. The product manufacturer's recommendations should be followed in the installation of a drainage fabric backdrain.

4.9 Soil Expansiveness

Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from rainfall, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may cause unacceptable settlement or heave of structures, concrete slabs supported-on-grade, or pavements supported over these materials. Depending on the extent and location below finished subgrade, expansive soils can have a detrimental effect on structures. Based on our experience with the project site and the nature of soil deposits underlying the site, we believe that the expansion potential of the on site soils is low to very low. No specific recommendations for expansion potential are required.

The expansion potential of the final subgrade soils should be evaluated during grading and the recommendations, presented herein, should be modified as necessary.

4.10 Pavement Design

Preliminary pavement sections are presented below in Table 3, Preliminary Recommended Pavement Sections. The pavement sections are based on a minimum R-value of 35 and current Caltrans design procedures. Traffic indexes of 4, 5, 6 and 7 were assumed for design purposes. The traffic indexes assumed should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project. Changes in the traffic indexes will affect the corresponding pavement section.

TABLE 3
RECOMMENDED PAVEMENT SECTIONS*

	Standard Caltrans		Full Depth
Traffic Index	**Asphalt Concrete (inches)**	**Aggregate Base (inches)**	**Asphalt Concrete (inches)**
5.0	3.0	4.0	5.5
6.0	3.5	6.0	6.5
7.0	4.0	8.0	8.0
8.0	5.5	8.5	9.5

*Note: Since significant grading of the site is to be conducted and the actual pavement subgrade materials exposed during grading may be significantly different than those tested for this study, R-value testing of the actual finished subgrade soils should be performed and modifications to the preliminary pavement sections should be made, if necessary.

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

- The pavement sections recommended above should be placed on a minimum of 18 inches of engineered fill. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to between 2 and 4 percent above the optimum moisture content, and compacted to at least 90 percent relative compaction, with the upper 6 inches compacted to 95 percent relative compaction.
- Subgrade soils should be in a stable, relatively non-yielding condition at the time aggregate base materials are placed and compacted.
- Aggregate base materials should be compacted to at least 95 percent relative compaction.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate baserock.
- Asphaltic concrete paving materials and placement methods should meet current Caltrans specifications for asphaltic concrete.
- All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.

Concrete pavements may be desirable in trash collection or higher traffic areas. For the existing on-site near-surface soils, we have assumed a design modulus of subgrade reaction of 150 pounds per cubic inch. For an unlimited number of applications of 18 kips single axle load, the concrete pavement should have a minimum thickness of 6 inches and a minimum 28-day compressive strength of 4,000 psi. A minimum of 6 inches of aggregate base should be placed beneath the rigid pavement for purposes of providing additional structural strength and a more uniform bearing surface for the pavement. The aggregate base should be compacted to a minimum of 95 percent of the maximum dry density performed in accordance with ASTM Test Method D-1557. Control joints should be spaced at every 15 feet. The subgrade soils should be scarified to a minimum depth of 8 inches below finished subgrade elevation, uniformly moisture

conditioned to near the optimum moisture content, and compacted to at least 95 percent relative compaction.

4.11 Corrosivity

One (1) sample of the near surface soils from Boring B-17 was tested for potential corrosion to concrete and reinforcing steel. A sample of the material was sent to AP Engineering and Testing, Inc. Samples were tested in general accordance with California Test Methods 643, 422, and 417 for pH and resistivity, soluble chlorides, and soluble sulfates, respectively. The test results are as follows:

Boring	Depth (ft.)	Resistivity (Ohm-cm)	pH	Water Soluble Sulfates (ppm)	Water Soluble Chlorides (ppm)
B-17	7.5 - 12	7,600	7	27	127

We have provided the above corrosion tests as requested by the client. These tests are only an indicator of soil corrosivity for the tested sample. Other soils found on the site may be more, less, or of 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 proposed improvements, to recommend further testing as required, and to provide specific corrosion mitigation methods appropriate for the project. In general, the corrosion potential for the soil samples tested are normally considered to be low to moderate to concrete and moderate to buried metals. Since significant earthwork is anticipated to be performed on site, 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.

5. ADDITIONAL SERVICES

5.1 Grading and Foundation Plan Review

We recommend that a general review of the project plans and specifications be conducted before they are finalized to verify that our geotechnical recommendations have been properly interpreted and implemented during the design process. A more detailed geotechnical investigation will be required for the proposed school site and commercial portion of the project to address design-specific elements of the project. Due to the potential for shallow groundwater conditions, additional geotechnical evaluation of the proposed reservoir tanks in the north and east portion of the site is recommended. If we are not accorded the privilege of performing this additional investigation and review, Kleinfelder can assume no responsibility for misinterpretation of our recommendations.

5.2 Construction Monitoring

The construction process is an integral design component with respect to the geotechnical aspects of a project. Because of the fact that geotechnical engineering is an inexact science due to the variability of the natural process and because it is possible to sample only a small portion of the soils affecting the performance of the site improvements and structures, unanticipated or altered conditions can be disclosed during grading. Proper geotechnical observation and testing during construction is imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process. Therefore, we recommend that Kleinfelder be retained during the site grading and construction of this tract to observe compliance with design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study.

6. LIMITATIONS

This report has been prepared for the exclusive use of Montecito Equities. Ltd., and their agents for specific application to the subject project site. The findings, conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, expressed or implied, is made. Our field exploration program was based on the site location map provided to us at the time of this investigation. Kleinfelder should review the final Tract map to verify that our trenches were properly located, and to provide additional information regarding the site.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information, which may be useful in the preparation of contract specifications. However, the report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. 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. Based on the intended use of this report and the nature of the new project, 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.

7. REFERENCES

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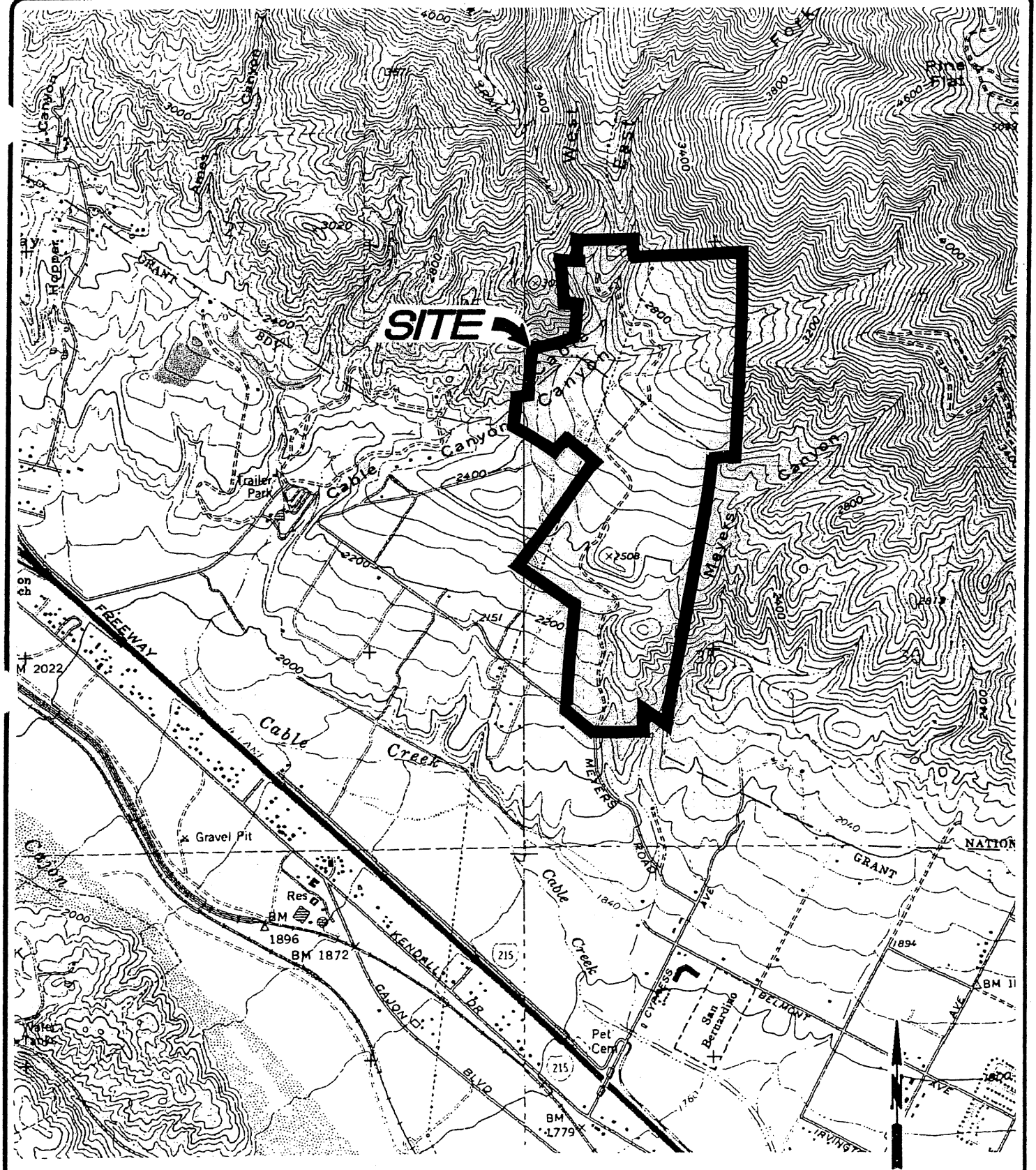
Petersen, Mark D., et al, 1996, "Probabilistic Seismic Hazard Assessment For The State of California," Division of Mines and Geology Open File Report 96-08.



SOURCE: U.S.G.S. 7.5' topographic series, San Bernardino North, California quadrangle dated 1967, photorevised 1988.

SOURCE: U.S.G.S. 7.5' topographic series, Devore, California quadrangle dated 1966, photorevised 1988.

KLEINFELDER

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

Project: 56-2013-01

SITE LOCATION MAP

PLATE
1

REV.	DATE	DESCRIPTION	DWN.

APPROVED BY:

DATE

DESIGNED BY

DRAWN D. FAHRNEY

CHECKED M. SIERADZKI

APPROVED M. SIERADZKI

ENG. MGR. M. SIERADZKI

DATE JULY 2000

CLIENT

LOCATION DEVORE, CA

KLEINFELDER
1940 Orange Tree Lane
Redlands, CA 92374
(909) 793-2691

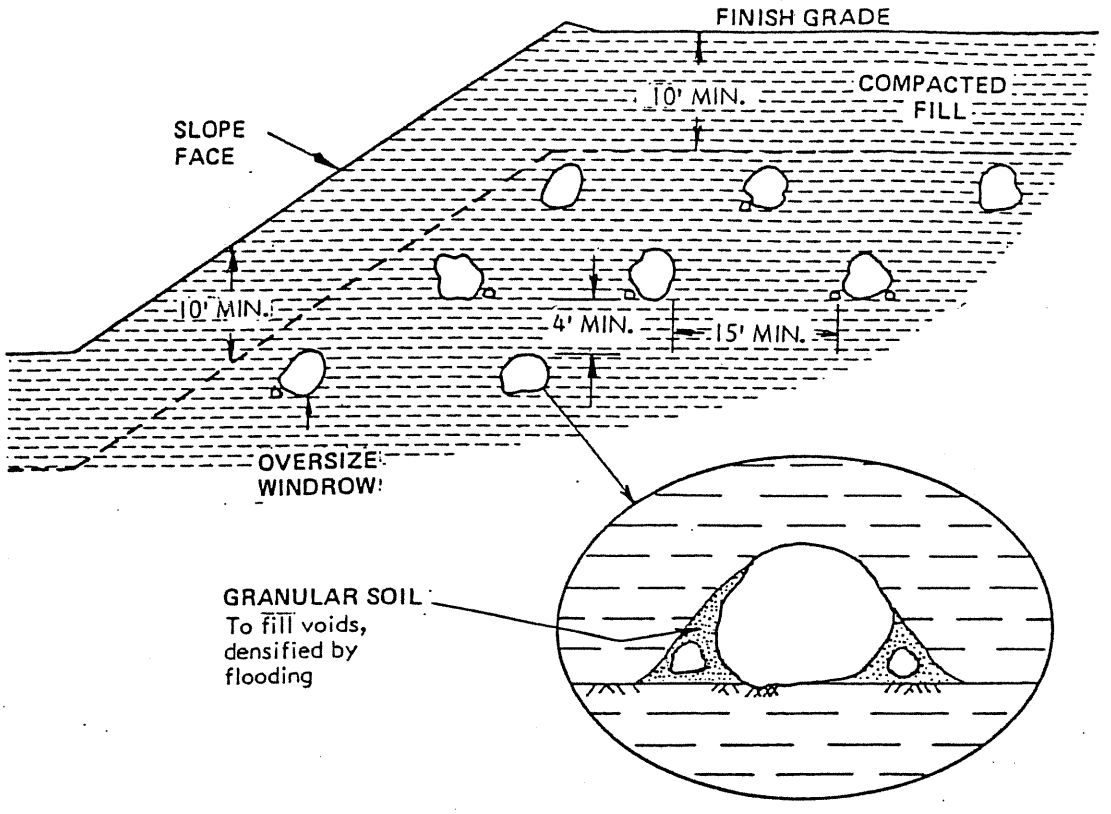
DESCRIPTION

BORING AND TEST PIT LOCATION MAP

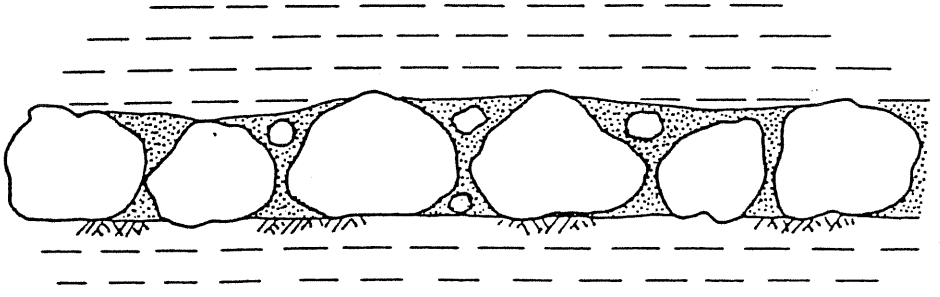
PROJ. NO.	FILED AS	DRAWING NO.
58-9377-01	A9377	A9377P02

PLATE 2

SHEET 1 OF 1



PROFILE ALONG WINDROW



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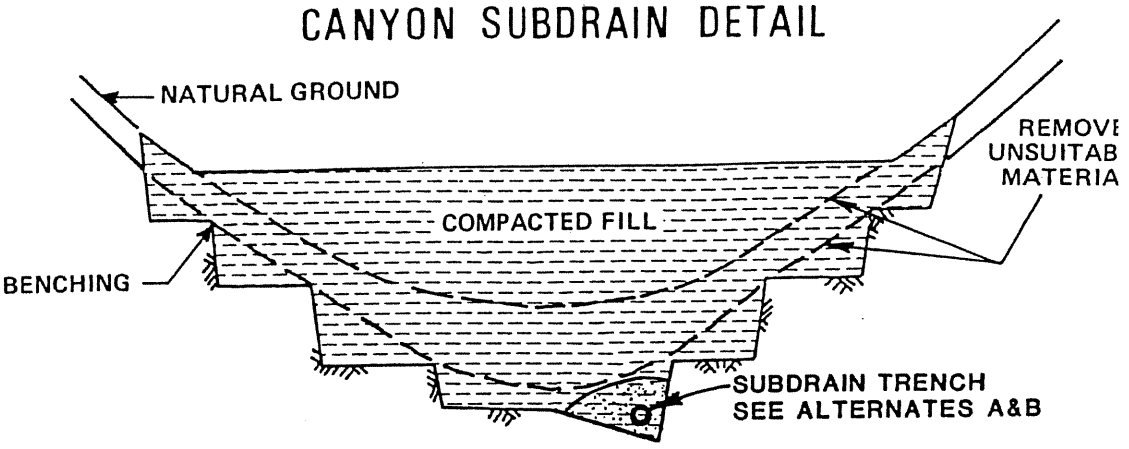
PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

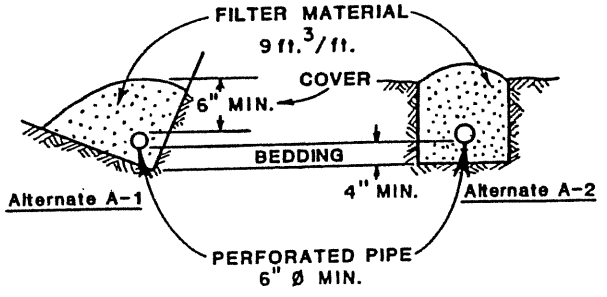
Project : 56 - 2013 - 01

ROCK DISPOSAL DETAIL

CANYON SUBDRAIN DETAIL



SUBDRAIN ALTERNATE A: Perforated Pipe Surrounded With Filter Material

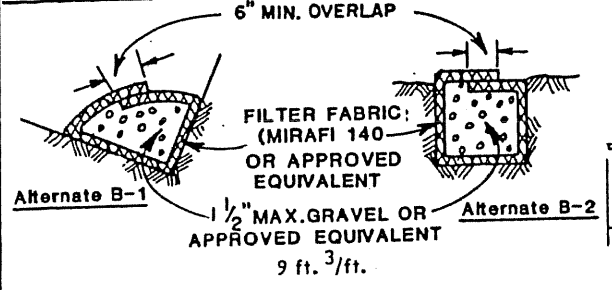


FILTER MATERIAL

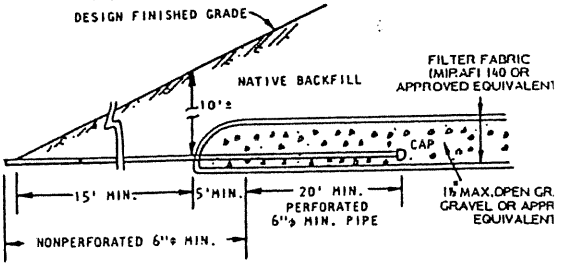
Filter material shall be Class 2 permeable material per State of California Standard Specifications, or approved alternate. Class 2 grading as follows:

SIEVE SIZE	PERCENT PASSING
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

SUBDRAIN ALTERNATE B: 1 1/2" Gravel Wrapped in Filter Fabric



DETAIL OF CANYON SUBDRAIN TERMINAL



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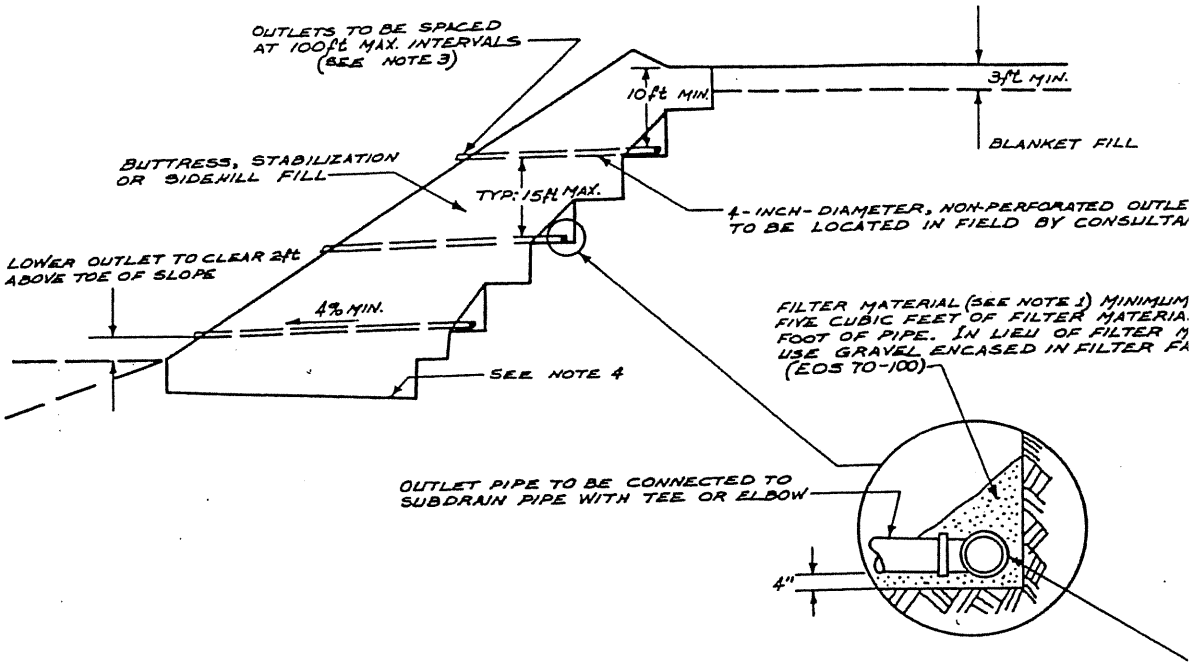
PROPOSED RESIDENTIAL DEVELOPMENT

353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

Project : 56 - 2013 - 01

CANYON SUBDRAIN DETAIL

TYPICAL SUBDRAIN FOR BUTTRESS, STABILIZATION OR SIDEHILL FILL MASSES



MINIMUM 4-INCH-DIAMETER, PVC OR ABS SCH
PLASTIC WITH MINIMUM OF 8 UNIFORMLY SPAC
3/8" DIAMETER PERFORATIONS AT 120° ANGLE
FOOT OF PIPE INSTALLED WITH PERFORATION
ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTR
END OF PIPE. SLOPE AT 2% TO OUTLET PIPE

NOTES:

1. FILTER MATERIAL SHOULD BE STATE OF CALIFORNIA CLASS 2 PERMEABLE FILTER, (CALTRANS SECTION 68-1.025).
2. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH COMPACTED ON-SITE SOIL.
3. FOR TERRACED SLOPES BACKDRAINS AND OUTLETS SHOULD BE PLANNED TO OUTLET ABOVE THE TERRACE.
4. THE NECESSITY OF SUBDRAIN AT HEEL OF BACKCUT AND CORRESPONDING OUTLET SHOULD BE DETERMINED IN THE FIELD BY GEOTECHNICAL CONSULTANT.
5. EACH SUBDRAIN SHOULD EXTEND THE ENTIRE LENGTH OF THAT PORTION OF BACKCUT EXPOSING BEDROCK.

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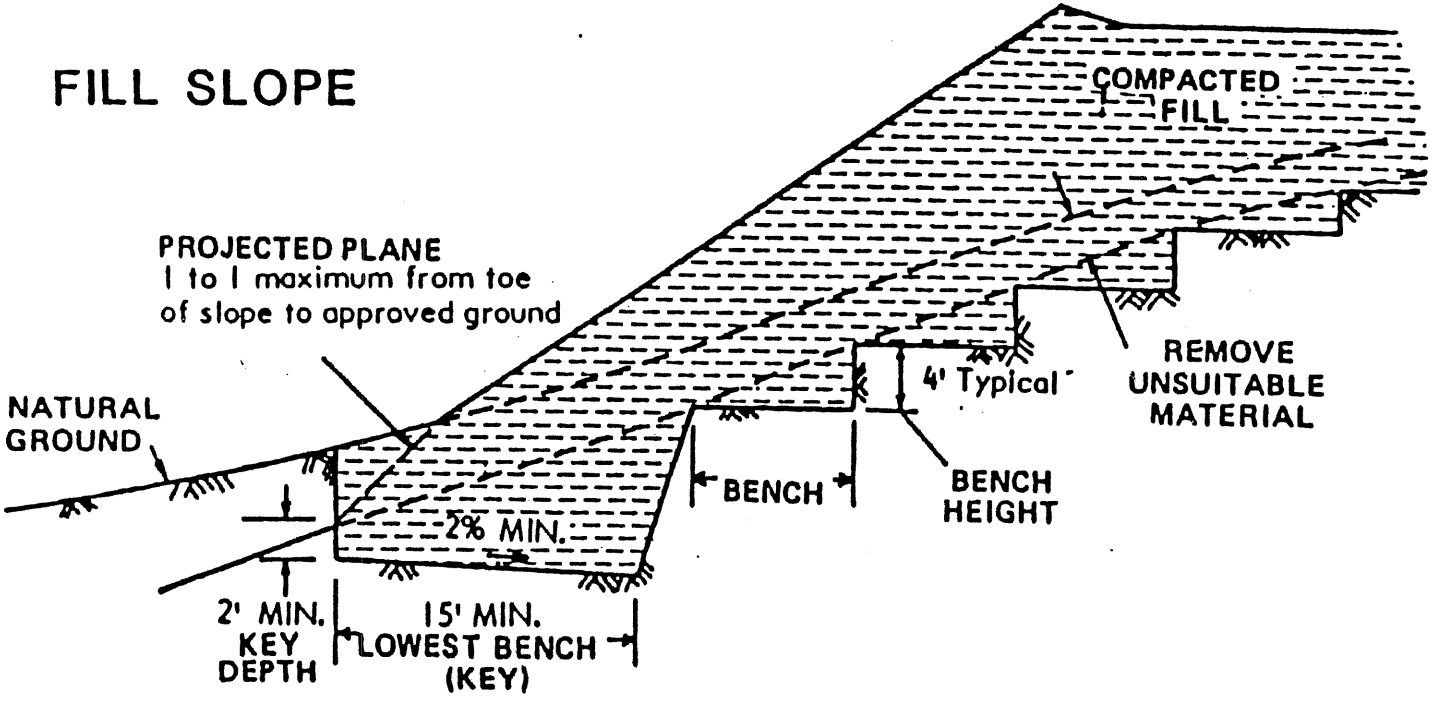
PROPOSED RESIDENTIAL DEVELOPMENT

353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

Project : 56 - 2013 - 01

SUBDRAIN FOR SIDE HILL DETAIL

FILL SLOPE



PROPOSED RESIDENTIAL DEVELOPMENT

APPENI

FIELD EXPLORAT

APPENDIX A
FIELD EXPLORATION

General

The subsurface exploration program consisted of the excavation and logging 25 hollow-stem auger borings and 18 exploratory test pits. The borings ranged in depth from approximately 4 to 40 feet below existing grades. Test pits were excavated to a depths between 5 and 8 feet. Plate 2 shows the locations of the hollow-stem auger borings and exploratory test pits. Additionally, in-situ density tests were performed at random locations during test pit excavation.

Hollow Stem Auger Borings

The Logs of Borings are presented as Plates A-2 through A-26. A legend to the logs is presented as Plate A-1. The Logs of Borings describe the earth materials encountered, samples obtained and show laboratory tests performed. The logs also show the location, boring number, drilling date and the name of the logger and drilling subcontractor. The borings were logged by an engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and intact samples of representative earth materials were obtained from the borings at maximum intervals of about 5 feet.

The exploratory borings were advanced using a Mobile B-57, truck-mounted drill rig equipped with 8-inch-diameter hollow-stem augers provided by Spectrum Exploration of Huntington Beach, California. All borings were backfilled using the soil from cuttings.

A California sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4-inch I.D. split barrel shaft that is driven a total of 12-inches into the soil at the bottom of the boring. The soil was retained in two 6-inch brass liners for laboratory testing. An additional 2-inches of soil from each drive remained in the cutting shoe and was usually discarded after visually classifying the soil. The sampler was driven using a 140 pound hammer falling 30-inches. The total number of hammer blows required to drive the sampler the 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.

Exploratory Test Pits and In-Situ Density Testing

Bulk samples of representative soils were collected from the test pits for further evaluation. A total of 18 field density tests were performed at random locations during test pit excavation. Tests were performed in general accordance with American Society for Testing and Materials (ASTM) Test Methods D-2922 and D-3017 (nuclear probe test method) A summary of field density test results including in-place dry density and moisture content are shown in logs of test pits and in Table A-1

The test pits were excavated using a John Deere 310 tractor-mounted backhoe equipped with a 24-inch wide bucket provided by Spectrum Exploration of Huntington Beach, California.

Table A-1 In- Situ Moisture Content and Dry Density Test Results			
Test Pit	Depth (ft)	Moisture Content (%)	Dry Density (pcf)
TP- 1	3.5	2.3	108
TP- 2	2.5	6.3	96
TP- 3	3.5	6.3	102
TP- 4	3.5	14.9	100
TP- 5	2.5	11.4	104
TP- 6	3.0	11.2	110
TP- 7	4.0	4.0	109
TP- 8	1.5	7.8	112
TP- 9	2.5	8.1	99
TP-10	3.5	12.1	103
TP-11	3.0	6.5	114
TP-12	3.0	6.9	118
TP-13	2.5	6.0	103
TP-14	2.5	5.9	99
TP-15	3.5	6.2	119
TP-16	3.5	10.7	96
TP-17	3.0	9.0	110
TP-18	3.5	9.4	99

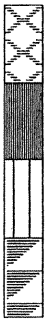
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures
		GP		Poorly-graded gravels, gravel-sand mixtures
		GM		Silty gravels, gravel-sand-silt mixtures
		GC		Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands
		SP		Poorly-graded sands and gravelly sands
		SM		Silty sands, sand-silt mixture
		SC		Clayey sands, sand-clay mixture

MAJOR DIVISION		LTR	ID	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		OL		Organic silts and organic silt-clays of low plasticity
	SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH		Inorganic clays of medium to high plasticity
		OH		Organic clays of medium to high plasticity
	HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE



Bulk Sample

Drive Sample - California Sample

Shelby Tube Sample

Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

MAX - Maximum Dry Density

SIEVE - Grain Size Distribution

WASH - Wash Sieve

PI - Plasticity Index

EI - Expansion Index

CP - Collapse Potential Testi

SHEAR - Direct Shear

CN - Consolidation Test

CHEM - Corrosion Test

CBR - California Bearing Ratio

RV - R-Value

NOTES

Blow counts represents the number of blows of a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18-inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represents the soil section observed at the boring location on the date of drilling only.

KLEINFELDER

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
Project No.: 56 - 2013 - 01

LEGEND TO LOGS

PLATE
A-1

Date Drilled:	3/13/00	Water Depth:	>15 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2586 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
2585 1					**SILTY SAND (SM):** olive brown, slightly moist, fine to coarse grained sand, fine to coarse grained gravel, 4" diameter cobble			
2								
3					medium dense			
4		1	24					WASH
5								
2580 6								
7								
8								
9		2	42		**SAND with SILT (SW-SM):** olive brown, moist, medium dense, fine to coarse grained sand, fine to coarse grained gravel, 4" diameter cobble	126	4.4	SHEAR
10								
2575 11								
12								
13								
14		3	32					
15					Boring terminated at 15 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 1

PLATE
A-2

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>11.5 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2552 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
1					**SILTY SAND (SM):** olive brown, moist, fine to coarse grained sand, fine to coarse grained gravel			
2550 2								
3								
4								
5		1	18		medium dense, some coarse gravel			
6								
2545 7								
8								
9								
10		2	50-3"		**SAND with SILT (SW-SM):** olive brown, slightly moist, very dense, fine to coarse grained sand, fine to coarse grained gravel, 4" diameter cobble			
11					Boring terminated at 11.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 2

PLATE A-3

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>16.5 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2554 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
1					**SILTY SAND (SM):** olive brown, moist, fine to coarse grained sand, fine to coarse grained gravel, 5-6" diameter cobble			
2								
3								
2550 4								
5		1	25		medium dense	108	2.9	
6								
7								
8								
2545 9								
10		2	14		**SAND with SILT and GRAVEL (SP-SM):** olive brown, moist, medium dense, fine to coarse grained sand, fine to coarse grained gravel			SIEVE, WASH
11								
12								
13								
2540 14								
15		3	64		dense, 4-5" diameter cobble			
16								
					Boring terminated at 16.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 3

PLATE
A-4

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>11.5 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2632 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
1					**SILTY SAND (SM):** olive brown, slightly moist, fine to coarse grained sand, fine to coarse grained gravel, 4-5" diameter cobble.			
2630 2								
3								
4								
5		1	31		**SAND with SILT (SP-SM):** olive brown, slightly moist, medium dense, fine to coarse grained sand, fine to coarse grained gravel, 3" diameter cobble	117	2.7	
6								
2625 7								
8								
9								
10		2	25					
11					Boring terminated at 11.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 4

PLATE
A-5

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>40.5 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2702 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
1					**SILTY SAND (SM):** olive brown, slightly moist, fine to coarse grained sand, fine to coarse grained gravel, 5" diameter cobble.			
2700 2								
3					boulder size cobble			
4								
5		1	17		medium dense, micaceous			
6								
2695 7								
8								
9								
10		2	43		**SAND with SILT (SP-SM):** olive brown, slightly moist, medium dense, fine to coarse grained sand, fine to coarse grained gravel, with 4" diameter cobble	124	4.4	SHEAR
11								
269012								
13								
14								
15		3	18		micaceous			
16								
268517								
18					moist, fine to medium grained sand, some coarse grained gravel			
19								
20		4	50-6"		very dense, fine to coarse grained sand, boulder			
21								
268022								
23								
24								
25		5	50-6"		fine to medium grained sand, more fines			SIEVE, WASH
26		6						
267527								
28								
29								
30								

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 5

PLATE
A-6a

Legend To Logs On Plate A-1

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Density (pcf)	Moisture Content (%)	Additional Tests
30		7	50-3"		3" diameter cobble			
31								
2670 32								
33								
34								
35		8	37		dense			
36								
2665 37								
38								
39								
40		9	50-6"		no recovery, boulder/cobble			
					Boring terminated at 40.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 5

PLATE
A-6b

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>10.5 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2716 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
2715 1					**SILTY SAND (SM):** olive brown, moist, fine to coarse grained sand, fine to coarse grained gravel, 8" diameter cobble			
2								
3								
4								
5		1	50-4"		very dense			
2710 6								
7								
8								
9								
10		2	50-4"		**SANDY GRAVEL (GP):** olive brown, moist, very dense, 1/2" diameter fine gravel			
					Boring terminated at 10.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 6

PLATE A-7

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>13 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2752 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SANDY GRAVEL with SILT (GM):** coarse gravel and cobble up to 4" in diameter			
1								
2750 2								
3								
4								
5		2	37		dense	126	4.3	
6					**SANDY GRAVEL (GP):** light brown, moist, medium dense			
2745 7								
8								
9								
10		3	32		**SAND with SILT (SW-SM):** olive brown, dense			
11								
2740 12					**SANDY GRAVEL (GP):**			
13					refusal on boulder at 13 feet			
					Boring terminated at 13 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 7

PLATE A-8

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>6 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2776 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
2775 1		1						
2		2	20		**SILTY SAND (SM):** olive brown, moist, medium dense, fine to medium grained sand, some fine grained gravel, micaceous	118	7.5	RV
3								
4								
5		3	50-6"		**SANDY GRAVEL with SILT (GM):** brown, moist, very dense, fine to coarse grained sand, fine to coarse grained gravel refusal on large cobble			
2770 6					Boring terminated at 6 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 8

PLATE
A-9

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>12.5 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2622 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1								
2620 2		1	17		**SAND with SILT and GRAVEL (SW-SM):** olive brown, moist, medium dense, fine to coarse grained sand, trace of fine grained gravel, micaceous	116	10.3	CP
3								
4								
5		2	19					SIEVE, WASH
6								
2615 7								
8								
9								
10		3	50-6"		very dense, fine to coarse grained sand, fine to coarse grained gravel			
11					**GRAVEL (GP):** 11 feet to 12 feet			
261012					refusal on cobble or boulder			
					Boring terminated at 12.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B- 9

PLATE
A-10

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>4.7 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2554 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1		1			**SANDY GRAVEL with SILT (GM):** olive brown, moist			
2								
3								
2550 4					refusal on gravel or boulder			
					Boring terminated at 4.7 feet.			
					Groundwater was not encountered.			
					Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-10

PLATE
A-11

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>15 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2506 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
2505 1								
2								
3		1	11		**SILTY SAND with GRAVEL (SM):** olive brown to dark olive brown, moist, medium dense, fine to medium grained sand, fine grained gravel, micaceous, trace of roots			
4								
5		2	14					WASH
2500 6								
7								
8								
9								
10		3	23		**SAND (SP):** light brown, moist, medium dense, fine to coarse grained sand, some fine grained gravel			
2495 11								
12								
13								
14					**SANDY GRAVEL (GP):** olive brown, moist, very dense, fine to coarse grained sand, fine to coarse grained gravel with cobbles and boulders, some silt refusal on cobble or boulder			
15					Boring terminated at 15 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-11

PLATE
A-12

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>21.5 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2472 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1					**SANDY GRAVEL with SILT (GM):** olive brown, moist, fine to coarse grained sand, coarse gravel up to 2" in diameter			
2470 2								
3		1						
4								
5								
6								
2465 7		2	14		**SILTY SAND (SM):** olive brown, moist, medium dense, fine to coarse grained sand, trace of fine grained gravel, micaceous			SIEVE, WASH
8								
9								
10		3	36		**SAND with SILT (SW-SM):** olive brown, moist, dense, fine to coarse grained sand, some fine to coarse grained gravel, some silt	118	12.1	
11								
246012								
13								
14								
15		4	62		**SILTY SAND (SM):** olive brown, moist, very dense, fine to coarse grained sand, micaceous, thin gravel interbedded			
16								
245517								
18								
19								
20		5	50-6"		**SAND with GRAVEL (SP):** light brown, moist, very dense, fine to coarse grained sand, weathered fine to coarse grained gravel			
21								
					Boring terminated at 21.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-12

PLATE A-13

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>14 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2448 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1								
2								
2445 3		1	18		**SILTY SAND (SM):** dark olive brown, moist, medium dense, fine to coarse grained sand, micaceous, trace of fine to coarse grained gravel	111	10.1	CP
4								
5								
6								
7								
2440 8		2	14		fine to medium grained sand			
9								
10								
11								
12								
2435 13		3	40		olive brown, moist, dense, fine to medium grained sand	118	5.4	
14								
					Boring terminated at 14 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-13

PLATE
A-14

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>14 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2462 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1					**SILTY GRAVEL with SAND (GM):** fine to coarse gravel, some cobbles and trace of boulders in upper 1 to 4 feet below surface			
2460 2								
3								
4		1	9		**SILTY SAND (SM):** brown, moist, loose, fine to coarse grained sand, some fine to coarse grained gravel, trace of clay, slightly micaceous	100	4.9	
5								
6								
2455 7		2	50-6"		**SAND (SP):** light olive brown, moist, very dense, fine to coarse grained sand trace of gravel			
8		3						
9								
10					**SILTY SAND (SM):** brown, moist, medium dense			MAX, CHEM
11								
2450 12								
13		4	21			114	13.4	
14								
					Boring terminated at 14 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-14

PLATE
A-15

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>15 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2468 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND with GRAVEL (SM):**			
1								
2								
2465 3								
4								
5					cobbles to approximately 5 feet			
5		1	19		**SILTY SAND (SM):** brown, moist, medium dense, fine to coarse grained sand, slightly micaceous	100	19.3	CN
6								
7								
2460 8								
9								
10		2	21		brown to dark brown, medium dense, micaceous			
11								
12								
245513								
14								
15					refusal on gravel or cobbles			
					Boring terminated at 15 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-15

PLATE A-16

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	>16.5 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2510 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
2510 0					**SILTY SAND (SM):** fine to medium grained sand, roots common, trace of fine gravel			
1		1			**SILTY GRAVEL with SAND (GM):** dark olive brown, slightly moist			
2					gravels to 10 feet-no sampling possible			
3								
4								
2505 5								
6								
7								
8								
9								
250010		2	61		olive brown, moist, dense, fine to coarse grained sand, fine to coarse grained gravel, some cobbles			
11								
12								
13								
14								
249515		3	70		**SILTY SAND (SM):** olive brown, moist, very dense, fine to coarse grained sand, some fine grained gravel, micaceous	118	1.7	
16					**SAND (SP):** light gray brown, dry, very dense, fine to coarse grained sand, fine to coarse grained gravel			
					Boring terminated at 16.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-16

PLATE A-17

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>11 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2094 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					Road Fill approximately 6"			
1		1			**SILTY GRAVEL with SAND (GM):** olive brown, dry to slightly moist, fine to coarse grained sand, slightly micaceous, fine to coarse grained gravel, trace of cobbles			
2								
3								
2090 4		2	50-2"		**SILTY SAND SM):** olive brown, moist, very dense, fine to coarse grained sand, some fine gravel	114	5.1	
5								
6					coarse gravel			
7		3	37		dense, micaceous			SIEVE, WASH
8								
2085 9								
10		4	50-3"		very dense			
11					Boring terminated at 11 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-17

PLATE
A-18

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>21 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2126 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
2125 1					**SILTY GRAVEL with SAND (GM):** olive brown, dry to slightly moist, fine to medium grained sand, fine to coarse grained gravel			
2								
3					cobbles up to 6" in diameter common			
4								
5								
2120 6								
7		1	30		**SAND with SILT and GRAVEL (SP-SM):** olive brown, moist, medium dense, fine to coarse grained sand, trace of fine to coarse grained gravel, trace of roots	115	8.8	SHEAR
8								
9								
10		2	32		dense, slightly micaceous, trace of fine grained gravel			SIEVE, WASH
2115 11								
12								
13								
14								
15		3	80		very dense, fine to medium grained sand			
2110 16								
17								
18								
19								
20		4	50-6"		fine to coarse grained sand, some fine grained gravel, trace of micaceous layering - 1/2" thick			
2105 21					Boring terminated at 21 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-18

PLATE A-19

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>26.5 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2170 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
2170 0					Road fill gravel approximately 6"			
1								
2		1	29		**SAND with SILT and GRAVEL (SW-SM):** olive brown, slightly moist, medium dense, fine to coarse grained sand, fine to coarse grained gravel			
3								
4		3						
2165 5		2	12		moist, fine grained gravel			MAX SIEVE, WASH
6								
7								
8								
9								
216010		4	36		dense, fine to coarse grained gravel, slightly micaceous, much weathered gravel clasts of granitics	126	6.9	
11								
12								
13								
14								
215515		5	27		medium dense, fine grained gravel, trace of coarse gravel up to 1.5" in diameter			
16								
17								
18								
19								
215020		6	50-5"		very dense, slightly moist			
21								
22								
23								
24								
214525		7	78		light gray brown, dry to slightly moist, fine to medium grained sand, trace of coarse sand			
26								
					Boring terminated at 26.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-19

PLATE A-20

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>15 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2214 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1					**SILTY GRAVEL with SAND (GM):** olive brown			
2								
3								
2210 4								
5								
6								
7		1	55		**SILTY SAND (SM):** brown, very dense, fine to coarse grained sand, some fine grained gravel	122	4.8	
8								
2205 9								
10					**SAND (SP):** brown			
11								
12								
13		2	50-6"		trace of silt			WASH
2200 14								
15					refusal on boulder at 15 feet			

Boring terminated at 15 feet.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-20

PLATE
A-21

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	>19.3 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2256 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
2255 1					**SILTY GRAVEL with SAND (GM):** olive brown, moist, fine to medium grained sand, fine to coarse grained gravel, some cobbles			
2								
3								
4								
5								
2250 6								
7		1	44		brown, slightly moist, dense, fine to coarse grained sand in matrix, occasional cobble up to 3.5" in diameter, trace of clay	104	3.2	
8								
9								
10								
2245 11								
12					gravel layer approximately 6" thick, coarse gravel to cobbles			SIEVE, WASH
13		2	24		**SILTY SAND (SM):** olive brown, slightly moist, medium dense, fine to coarse grained sand, some fine grained gravel			
14								
15								
2240 16								
17								
18					brown, dry to slightly moist, very dense, fine to medium grained sand			
19		3	50-4"					
					Boring terminated at 19.3 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-21

PLATE
A-22

Legend To Logs On Plate A-1

Date Drilled:	3/16/00	Water Depth:	20 feet
Drilled By:	Spectrum	Date Measured:	3/16/00
Drilling Method:	HSA 6"	Reference Elevation:	2428 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
1								
2								
2425 3		1	21		**SILTY SAND (SM):** dark olive brown, moist, medium demse, fine to coarse grained sand, trace of fine grained gravel up to 1/2" in diameter, much organic pieces (roots), some pinhole porosity, micaceous	114	11.2	CP
4								
5		2	15		trace of fine grained gravel up to 3/4" in diameter			
6								
7								
2420 8					changes to olive brown at approximately 9 feet, slightly less moisture			
9								
10		3	27		moist, medium dense, much less micaceous, less moisture than at 5 foot sample	110	9.4	
11								
12								
241513								
14								
15		4	25		medium dense			
16								
17								
241018								
19								
20		5	50-4"		**GRAVEL with SAND (GP):** very dense			
21					wet at 21 feet and below, slow drilling on gravels			
22								
240523					gravels with fine to coarse grained sand, trace of silt			
24					no samples due to poor recovery from hole and high gravel content of soil			
25								
26								
27					refusal at 27.5 feet			
					Boring terminated at 27.5 feet. Groundwater was encountered at 21 feet during drilling and measured			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-22

PLATE A-23a

Legend To Logs On Plate A-1

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Density (pcf)	Moisture Content (%)	Additional Tests
					at 20 feet next day. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-22

PLATE
A-23b

Legend To Logs On Plate A-1

Date Drilled:	3/17/00	Water Depth:	20 feet
Drilled By:	Spectrum	Date Measured:	3/17/00
Drilling Method:	HSA 6"	Reference Elevation:	2416 feet (approx.)
Logged By:	Janis Hernandez	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0								
2415 1					**SILTY SAND (SM):** dark olive brown, wet, medium dense, fine to coarse grained sand, some fine to coarse grained gravel			
2								
3								
4		1	19			116	8.3	CP
5					**SANDY GRAVEL with SILT (GM):** olive brown, moist, medium dense, fine to coarse grained sand, fine to coarse grained gravel up to 3" in diameter, slightly micaceous			
2410 6								
7								
8								
9		2	24		**SILTY SAND with GRAVEL (SM):** olive brown, moist, medium dense, fine to medium grained sand, trace of coarse sand, fine grained gravel			SIEVE, WASH
10								
2405 11								
12								
13								
14		3	52			129	3.0	
15					**SAND (SP):** olive brown, moist, dense, fine to medium grained sand, some silt			
2400 16								
17								
18								
19								
20 ▼		4	50-6"		**SILTY GRAVEL with SAND (GM):** light olive brown, very moist, very dense, fine to coarse grained sand, fine grained gravel, trace of iron oxide staining			
2395 21								
22								
23					grinding on cobble layer 6" thick			
24								
25		5	50-5"		**SANDY GRAVEL (GP):** gray brown, wet, very dense, fine to coarse grained sand, fine to coarse grained gravel up to 2.5" in diameter, some iron oxide staining, micaceous			
2390 26								
27								
28								
29								
30								

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-23

PLATE
A-24a

Legend To Logs On Plate A-1

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Density (pcf)	Moisture Content (%)	Additional Tests
30		6	66		**WEATHERED BEDROCK:**			SIEVE, WASH
2385 31					**GRANODIORITE:** recovered as:			
32					**SILTY SAND (SM)**, slightly moist, very dense, micaceous			
33					hard drilling			
34								
35		7	50-3"		less weathered bedrock, very dense			
					refusal at 35.3 feet			

Boring terminated at 35.3 feet.
Groundwater was encountered at 20 feet during drilling.
Hole backfilled and tamped using soil from cuttings.

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-23

PLATE
A-24b

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>15 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2538 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
1					**SILTY SAND (SM):** olive brown, slightly moist, fine to coarse grained sand, fine to coarse grained gravel, some 4" diameter cobble			
2								
2535 3					cobble up to 8" in diameter			
4								
5		1	30		dense, cobble 3" in diameter			
6								
7								
2530 8								
9		2	13		micaceous			WASH
10								
11								
12								
252513								
14		3	50-6"		slightly moist, cobble 4-5" in diameter			
15								
					Boring terminated at 15 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-24

PLATE A-25

Legend To Logs On Plate A-1

Date Drilled:	3/13/00	Water Depth:	>21.5 feet
Drilled By:	Spectrum	Date Measured:	3/13/00
Drilling Method:	HSA 6"	Reference Elevation:	2568 feet (approx.)
Logged By:	Eric Philips	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**ALLUVIUM:**			
1					**SILTY SAND (SM):** olive brown, slightly moist, loose, fine to coarse grained sand, fine to coarse grained gravel, some cobble			
2								
2565 3								
4		1	16		moist, medium dense	106	10.2	
5								
6								
7								
2560 8								
9		2	11		less cobble, coarse gravel 3/4" in diameter			
10								
11								
12								
255513								
14		3	81					
15					**SAND (SP):** olive brown, slightly moist, very dense, fine to coarse grained sand, fine to coarse grained gravel, cobble 4" in diameter			
16								
17								
255018								
19								
20		4	35		dense, coarse gravel up to 3/4" in diameter			
21								
					Boring terminated at 21.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF BORING B-25

PLATE
A-26

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2578 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** brown, fine to medium grained, gravel, cobbles up to 10 inches in diameter, roots in upper 18 inches			
1								
2					Cobbles with fine to coarse sand and gravel			
2575 3					**GRAVEL with SAND (GP):** yellow, medium to coarse sand, cobbles up to 8 inches in diameter	108	2.3	
4								
5								
6					boulders 12 inches in diameter and greater			
7					Total depth of test pit was 7 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 1

PLATE
A-27

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2594 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND with GRAVEL (SM):** slightly moist, fine to medium grained sand			
1					cobbles and boulders up to 18 inches in diameter			
2						96	6.3	
3								
2590 4					sandy cobbles up to 8 inches in diameter			
5					**SAND (SP):** yellow, coarse grained, gravel, cobbles, boulders up to 2.5 feet in diameter			
6					Total depth of test pit was 6.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 2

PLATE
A-28

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2770 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
2770 0					**SILTY SAND with GRAVEL (SM):** brown, moist, fine to medium grained sand, fine to coarse grained gravel			
1					fine to coarse grained sand, gravel, cobbles up to 8 inches in diameter			
2								
3					slightly moist, some silt, cobbles up to 10 inches in diameter	102	6.3	
4					sandy cobbles			
2765 5								
6					sandy cobbles up to 12 inches in diameter			
					Total depth of test pit was 6.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 3

PLATE
A-29

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2874 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, coarse gravel			
1								
2								
3								
2870 4					fine to coarse grained sand, cobbles and boulders up to 12 inches in diameter	100	14.9	
5								
6								
7								
					Total depth of test pit was 7.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 4

PLATE
A-30

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2806 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SAND (SP):** brown, moist, fine to medium grained, trace of gravel			
2805 1								
2						104	11.4	
3					**SILTY SAND (SM):** brown, fine to medium grained, gravel and cobbles up to 6 inches in diameter			
4					**SAND (SP):** brown, moist, fine to coarse grained, some silt, cobbles up to 10 inches in diameter			
5								
2800 6					light brown, slightly moist, medium to coarse grained sand, gravel			
					Total depth of test pit was 6 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 5

PLATE
A-31

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2472 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** dark brown, moist, fine to medium grained sand, trace of gravel and cobbles up to 4 inches in diameter, roots in upper 18 inches			
1								
2470 2								
3						110	11.2	
4								
5								
6								
2465 7								
8					yellow, coarse gravel			
9					Total depth of test pit was 9 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 6

PLATE
A-32

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2426 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** dark brown to black, very moist, fine grained sand, organics			
2425 1								
2					trace of cobbles 4 inches in diameter			
3								
4					light brown, mostly fine to medium grained sand, trace of coarse grained sand	109	4.0	
5								
2420 6					gravel and cobbles			
7					**SAND (SP):** orange yellow, medium to coarse grained sand, gravel and cobbles			
8					Total depth of test pit was 8 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 7

PLATE
A-33

Legend To Logs On Plate A-1

Date Excavated:	3/16/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2464 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**GRAVEL with SAND (GP):** brown, fine to coarse grained, some silt, cobbles up to 6 inches in diameter			
1								
						112	7.8	
2					**SAND (SP):** dark brown, moist, fine to coarse grained sand, some silt, gravel, cobbles up to 8 inches in diameter			
3					yellow-brown, boulders up to 2 feet in diameter			
2460 4								
5					**SILTY SAND (SM):** light brown, fine to coarse grained sand, cobbles up to 6 inches in diameter, some decomposed granite			
6					Total depth of test pit was 6 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 8

PLATE
A-34

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2466 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SAND (SP):** brown, slightly moist, fine to coarse grained, some silt, cobbles up to 12 inches in diameter, boulders up to 3 feet in diameter			
2465 1								
2						99	8.1	
3								
4								
5					yellow, coarse grained sand, gravel, cobbles and boulders up to 18 inches in diameter			
2460 6					Total depth of test pit was 6 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP- 9

PLATE
A-35

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2490 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
2490 0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, gravel			
1								
2					coarse gravel up to 2 inches in diameter			
3					**SAND (SP):** brown, fine to coarse grained, some silt, gravel up to 4 inches in diameter			
					medium to coarse grained sand, cobbles up to 6 inches in diameter	103	12.1	
4					yellow, medium to coarse grained sand			
2485 5					cobbles up to 12 inches in diameter			
6								
7					Total depth of test pit was 7 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-10

PLATE A-36

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2120 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
2120 0					**SAND (SP):** brown, moist, fine to coarse grained, some silt, fine to coarse grained gravel			
1					cobbles up to 10 inches in diameter			
2								
3						114	6.5	
4					**GRAVEL with SAND (GP):** yellow, medium to coarse grained, cobbles up to 10 inches in diameter			
2115 5								
6					cobbles up to 6 inches in diameter			
					Total depth of test pit was 6.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-11

PLATE A-37

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2188 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, fine to coarse grained gravel			
1								
2								
2185 3					**SAND (SP):** brown, slightly moist, fine to medium grained sand, some silt, coarse grained gravel up to 2 inches in diameter	118	6.9	
4					cobbles up to 10 inches in diameter			
5								
6					**GRAVEL with SAND (GP):** light brown, medium to coarse grained, cobbles			
7					Total depth of test pit was 7 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-12

PLATE
A-38

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2644 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, some cobbles, trace of gravel			
1								
2						103	6.0	
3								
2640 4					**SAND (SP):** brown, fine to coarse grained sand, some silt, gravel and cobbles up to 6 inches in diameter, some boulders up to 1.5 feet in diameter			
5					yellow, coarse grained sand			
6								
					Total depth of test pit was 6.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-13

PLATE
A-39

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2758 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, trace of gravel and cobbles up to 6 inches in diameter			
1					fine to coarse grained sand, cobbles up to 12 inches in diameter			
2					boulders 18 inches in diameter and greater	99	5.9	
2755 3					yellow, medium to coarse grained sand, boulders up to 2 feet in diameter			
4								
5					coarse grained sand, cobbles up to 12 inches in diameter			
6								
7					Total depth of test pit was 7 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-14

PLATE
A-40

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2640 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
2640 0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, gravel, cobbles			
1								
2					medium to coarse grained sand, cobbles up to 8 inches in diameter			
3					fine to coarse grained sand			
						119	6.2	
4								
2635 5					coarse grained sand, cobbles up to 6 inches in diameter			
6								
7					Total depth of test pit was 7 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-15

PLATE
A-41

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2518 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) / Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SAND (SP):** brown, slightly moist, fine to medium grained sand, fine to coarse grained gravel			
1								
2					medium to coarse grained sand, boulders up to 1.5 feet in diameter			
2515 3						96	10.7	
					boulders up to 2 feet in diameter			
4								
5					**GRAVEL with SAND (GP):** yellow, medium to coarse grained, cobbles			
					Total depth of test pit was 5.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-16

PLATE
A-42

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2584 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SAND (SP):** dark brown, moist, fine to medium grained sand, trace of gravel, trace of cobbles up to 4 inches in diameter			
1								
2								
3						110	9.0	
2580 4								
5					**SILTY SAND (SM):** brown, moist, fine to coarse grained, gravel, trace of cobbles up to 6 inches in diameter			
6								
7					**SAND (SP):** brown, moist, fine to coarse grained, cobbles, boulders 12 to 18 inches in diameter			
8					Total depth of test pit was 8 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-17

PLATE
A-43

Legend To Logs On Plate A-1

Date Excavated:	3/17/00	Equipment:	Tractor-Mounted Backhoe
Excavated By:	Spectrum Exploration		
Bucket Size	24"	Reference Elevation:	2628 feet (approx.)
Logged By:	Harley Brogdon	Datum:	MSL

Elevation (feet) Depth	Sample	Sample No.	Blow Count (Blows/ft.)	Graphic Log	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Density (pcf)	Moisture Content (%)	Additional Tests
0					**SILTY SAND (SM):** brown, slightly moist, fine to medium grained sand, gravel			
1					cobbles up to 8 inches in diameter			
2					medium to coarse grained sand, cobbles up to 4 inches in diameter			
2625 3					fine to medium grained sand, some silt	99	9.4	
4					boulders up to 2 feet in diameter			
5					light brown, slightly moist			
					Total depth of test pit was 5.5 feet. Test pit was backfilled using excavated soil.			

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

LOG OF TEST PIT TP-18

PLATE
A-44

Legend To Logs On Plate A-1

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on representative intact and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in accordance with one of the following references:

1. Lambe, T. William, Soil Testing for Engineers, Wiley, New York, 1951
2. Laboratory Soils Testing, U.S. Army, Office of the Chief of Engineers, Engineering Manual No. 1110-2-1906, November 30, 1970
3. ASTM Standards for Soil Testing, latest revisions
4. State of California Department of Transportation, Standard Test Methods, latest revisions.

LABORATORY MOISTURE AND DENSITY DETERMINATIONS

Natural moisture content and dry density tests were performed on selected drive samples collected. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The results are presented on the Logs of Borings and are summarized in Table B-1.

GRAIN SIZE DISTRIBUTION

Grain size distribution of selected soil samples were performed by mechanical and wash sieving in general accordance with ASTM Standard Test Method D422-63. The test results are presented on Plate B-1 through B-10 and in Table B-2.

DIRECT SHEAR

Direct shear testing was performed on three drive sample to evaluate the drained shear strength of the on-site soils. Samples were tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). Results of this test are presented on Plates B-11 through B-13.

COLLAPSE POTENTIAL

Collapse potential testing was performed on four drive samples to evaluate the settlement potential of the soil when subjected to anticipated overburden loads and wetting. The tests were performed in accordance with ASTM Standard Test Method D5333. The test results are presented on Plates B-14 through B-17.

CONSOLIDATION TESTS

A consolidation test was performed on one soil sample from the site to evaluate the settlement characteristics of the in-situ soils. The test was conducted in accordance with ASTM Standard Test Method D2435, Standard Test Method for One-dimensional Consolidation Properties of Soils. The test results are shown on Plate B-18.

MAXIMUM DENSITY/OPTIMUM MOISTURE TEST

Two maximum density/optimum moisture tests were performed on a selected bulk sample of the on-site soils to determine compaction characteristics. The test was performed in accordance with ASTM Standard Test Method D-1557-91. The test results are presented in Table B-3.

CORROSIVITY TESTS

A series of chemical tests were performed on a selected sample of the soils to estimated pH, resistivity, sulfate and chloride contents. Test Results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The results are presented on Table B-4.

R-VALUE TESTS

R-value testing was performed on one sample of the near-surface soils encountered at the site. The test was performed in general accordance with Caltrans Standard Test Method 301. The test results are presented in Table B-5.

APPENDIX B

LABORATORY TESTING

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LABORATORY TESTING

Laboratory tests were performed on representative intact and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in accordance with one of the following references:

1. Lambe, T. William, Soil Testing for Engineers, Wiley, New York, 1951
2. Laboratory Soils Testing, U.S. Army, Office of the Chief of Engineers, Engineering Manual No. 1110-2-1906, November 30, 1970
3. ASTM Standards for Soil Testing, latest revisions
4. State of California Department of Transportation, Standard Test Methods, latest revisions.

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Natural moisture content and dry density tests were performed on selected drive samples collected. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The results are presented on the Logs of Borings and are summarized in Table B-1.

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Grain size distribution of selected soil samples were performed by mechanical and wash sieving in general accordance with ASTM Standard Test Method D422-63. The test results are presented on Plate B-1 through B-10 and in Table B-2.

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Direct shear testing was performed on three drive sample to evaluate the drained shear strength of the on-site soils. Samples were tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). Results of this test are presented on Plates B-11 through B-13.

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Collapse potential testing was performed on four drive samples to evaluate the settlement potential of the soil when subjected to anticipated overburden loads and wetting. The tests were performed in accordance with ASTM Standard Test Method D5333. The test results are presented on Plates B-14 through B-17.

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A consolidation test was performed on one soil sample from the site to evaluate the settlement characteristics of the in-situ soils. The test was conducted in accordance with ASTM Standard Test Method D2435, Standard Test Method for One-dimensional Consolidation Properties of Soils. The test results are shown on Plate B-18.

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Two maximum density/optimum moisture tests were performed on a selected bulk sample of the on-site soils to determine compaction characteristics. The test was performed in accordance with ASTM Standard Test Method D-1557-91. The test results are presented in Table B-3.

CORROSIVITY TESTS

A series of chemical tests were performed on a selected sample of the soils to estimated pH, resistivity, sulfate and chloride contents. Test Results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The results are presented on Table B-4.

R-VALUE TESTS

R-value testing was performed on one sample of the near-surface soils encountered at the site. The test was performed in general accordance with Caltrans Standard Test Method 301. The test results are presented in Table B-5.

Table B-1 Laboratory Moisture Content and Dry Density Test Results			
Boring	Depth (ft)	Moisture Content (%)	Dry Density (pcf)
B- 1	8.5	4.4	126
B- 3	5.0	2.9	108
B- 4	5.0	2.7	117
B- 5	10.0	4.4	124
B- 7	5.0	4.3	126
B- 8	2.0	7.5	118
B- 9	2.0	10.3	116
B-12	10.0	12.1	118
B-13	2.5	10.1	111
	12.5	5.4	118
B-14	4.0	4.9	100
	12.5	13.4	114
B-15	5.0	19.3	100
B-16	15.0	1.7	118
B-17	4.0	5.1	114
B-18	7.0	8.8	115
B-19	10.0	6.9	126
B-20	7.0	4.8	122
B-21	7.0	3.2	104
B-22	2.5	11.2	114
	10.0	9.4	110
B-23	4.0	8.3	116
	14.0	3.0	129

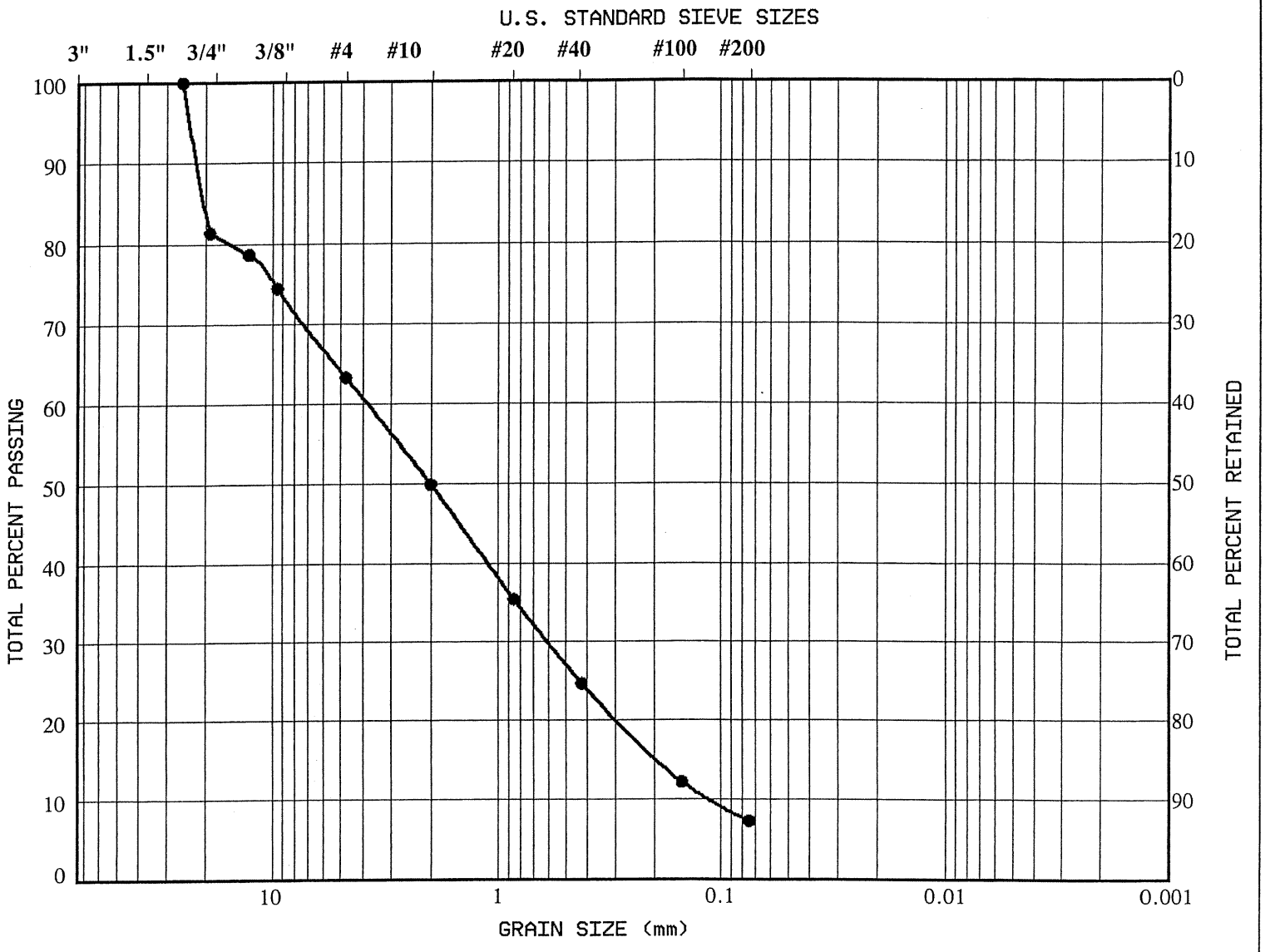
Table B-2 Wash Sieve Test Results		
Boring	Depth (ft)	Percent Passing # 200 (0.075 mm)
B- 1	3.5	18.5
B- 3	10.0	7.0
B- 5	25.0	10.5
B- 9	5.0	10.0
B-11	5.0	19.0
B-12	7.0	16.5
B-17	7.0	16.5
B-18	10.5	10.5
B-19	5.0	8.0
B-20	12.5	3.5
B-21	12.0	16.0
B-23	9.0	38.0

Table B-3 Maximum Density/Optimum Moisture Content Test Results			
Boring	Depth (ft)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)
B-14	8 – 12	8.0	136
B-19	4 - 8	6.0	137

Table B-4 Corrosion Test Results					
Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Minimum Resistivity (ohm-cm)
B-14	8 – 12	7.0	27	127	7,600

Table B-5 R-Value Test Results		
Boring	Depth (ft)	R – Value
B-14	1 – 5	35

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B3-2	10.0	SAND with SILT and GRAVEL	SP-SM

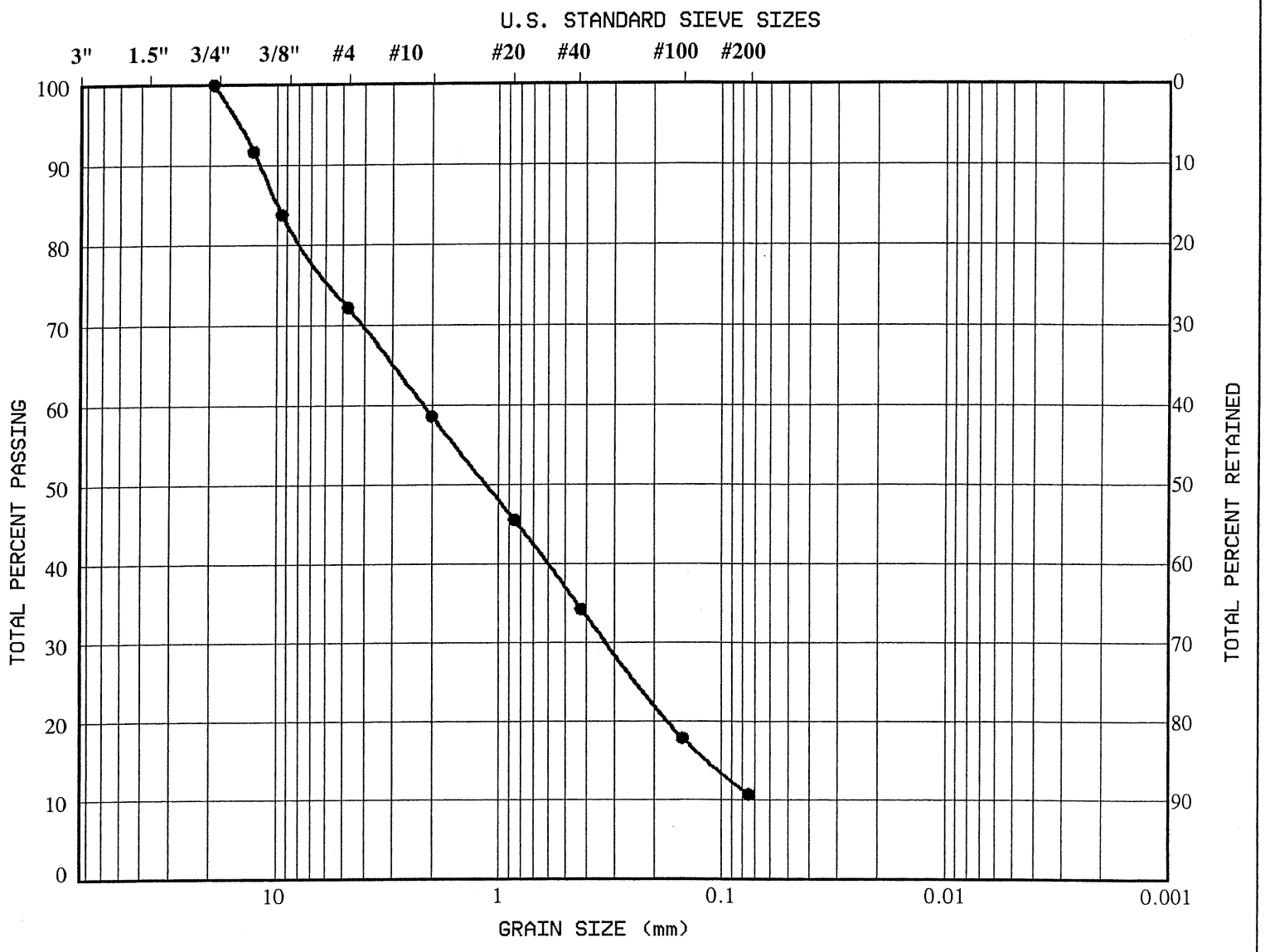
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-1

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B5-5	25.0	SAND with SILT and GRAVEL	SP-SM

KLEINFELDER

PROJECT NO. 56-2013-01

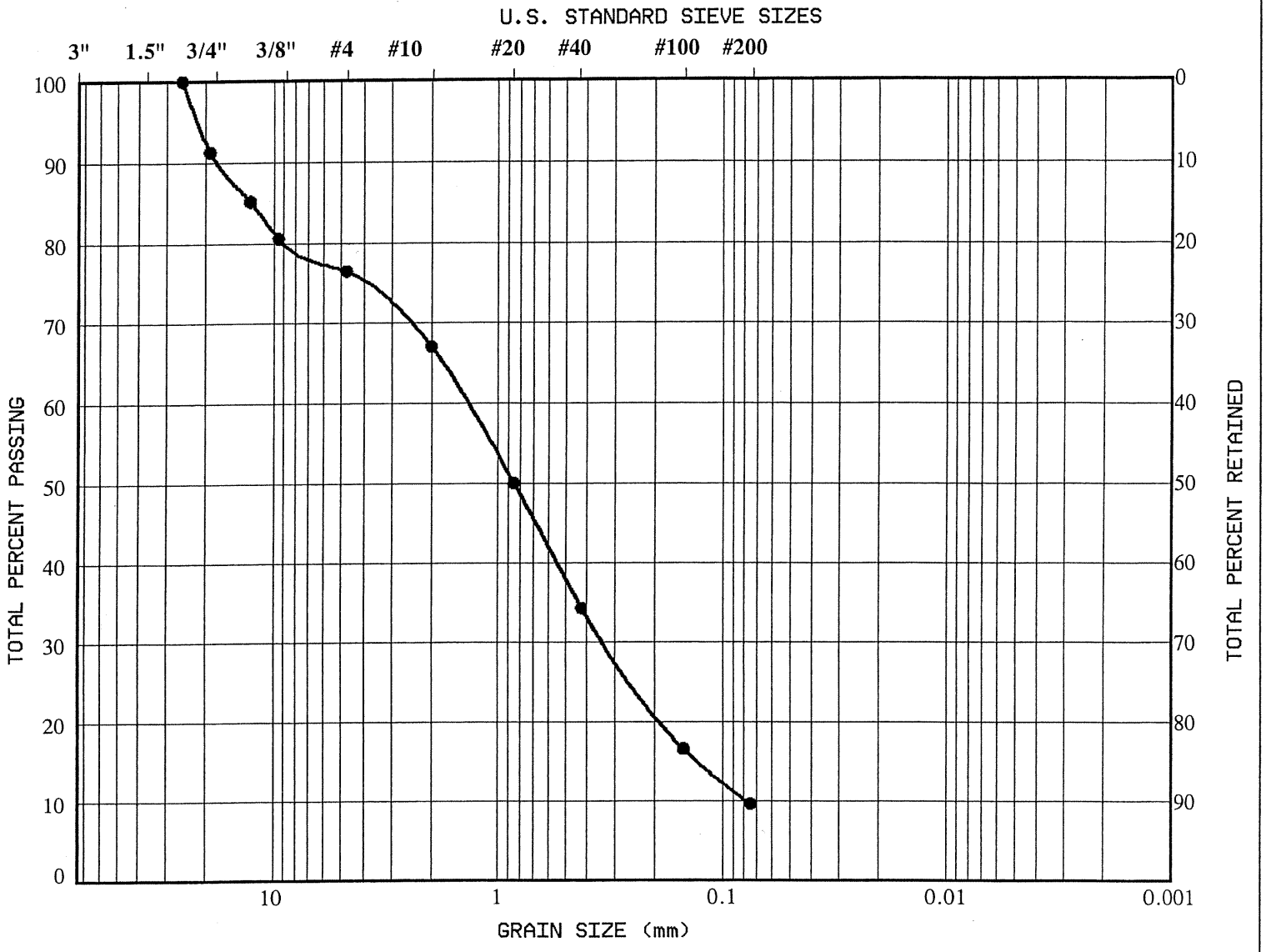
PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

GRAIN SIZE DISTRIBUTION

PLATE

B-2

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B9-2	5.0	SAND with SILT and GRAVEL	SW-SM

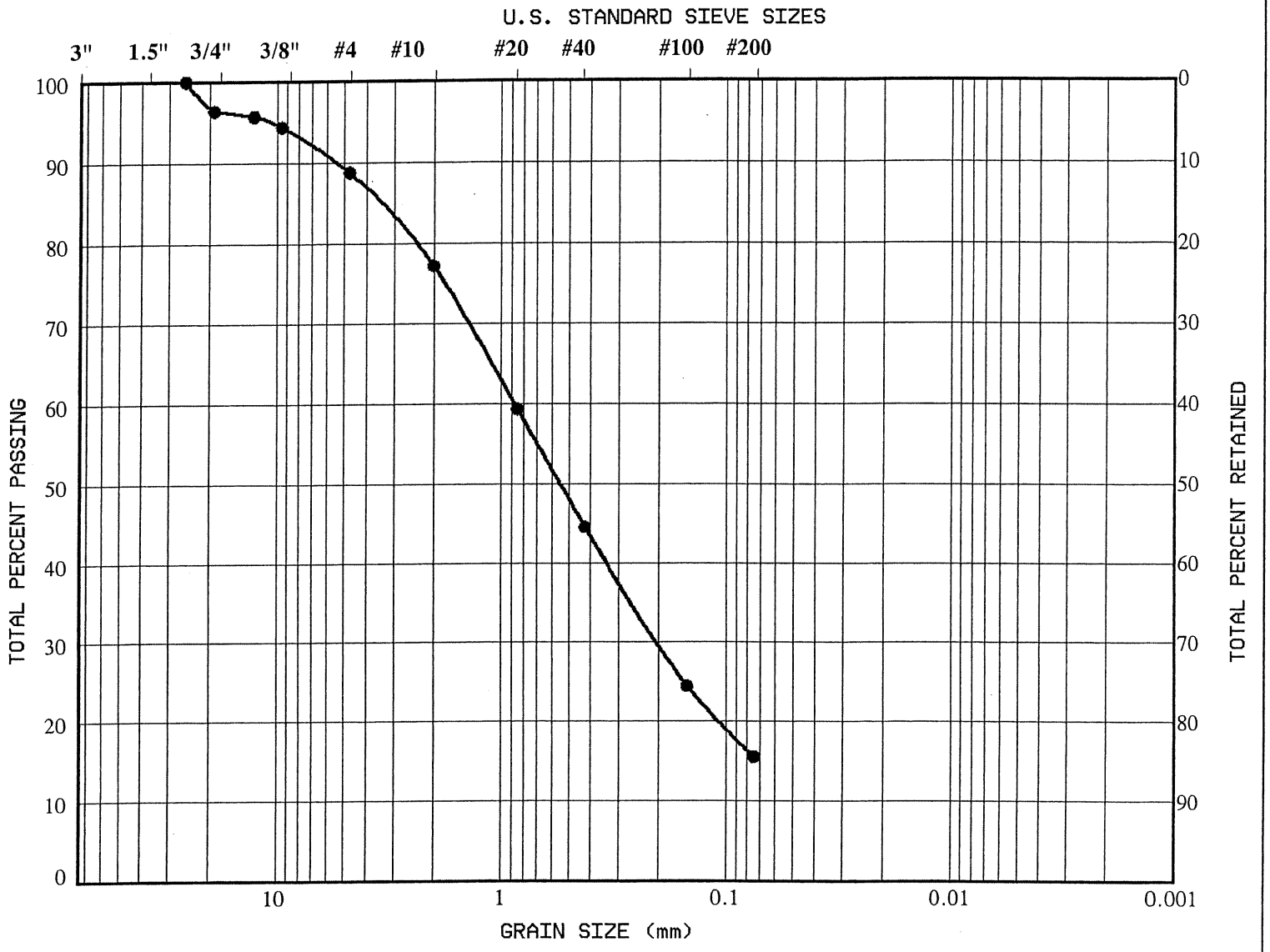
KLEINFELDER

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-3

PROJECT NO. 56-2013-01

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B12-2	7.0	SILTY SAND	SM

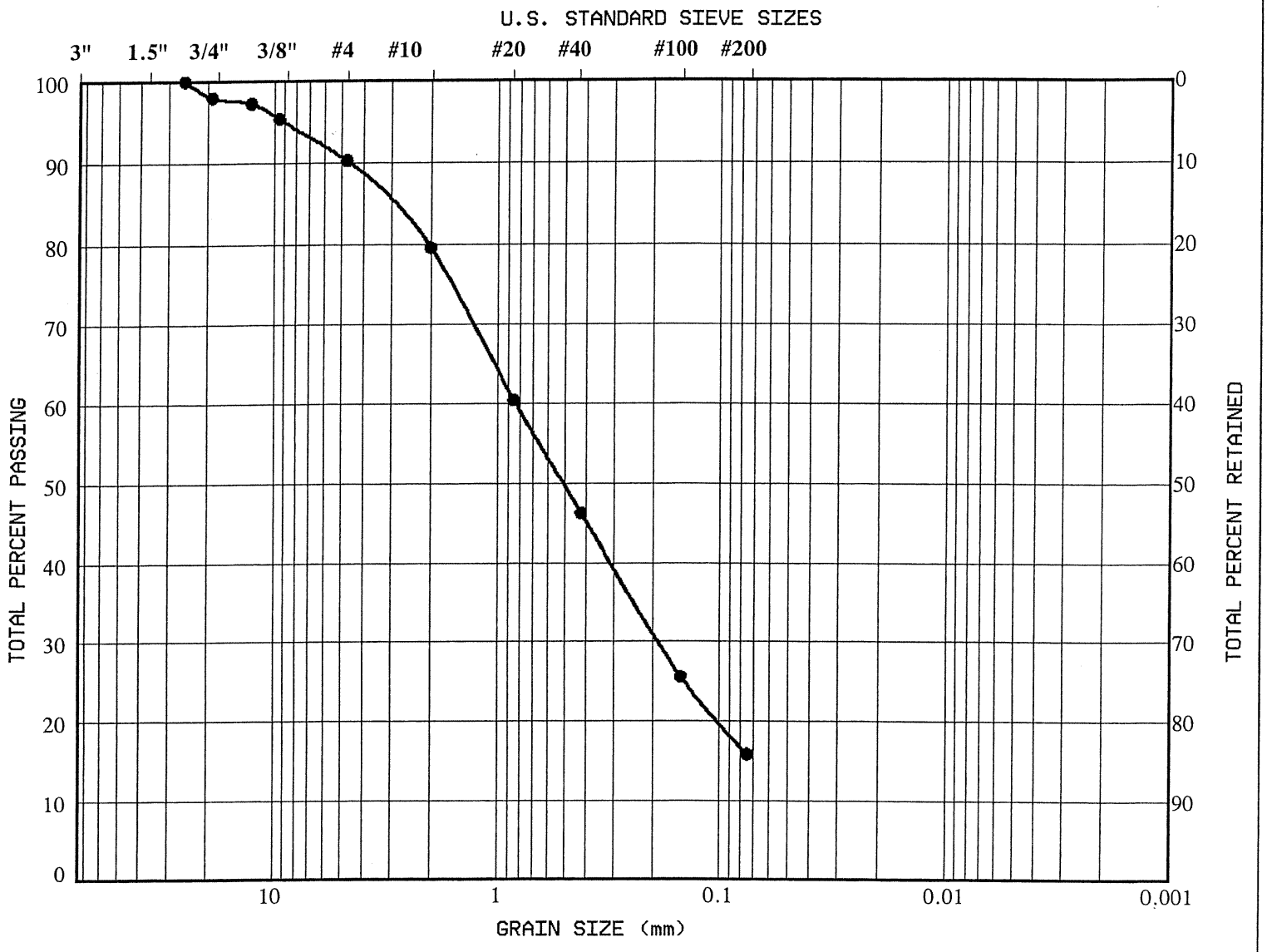
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-4

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B17-3	7.0	SILTY SAND	SM

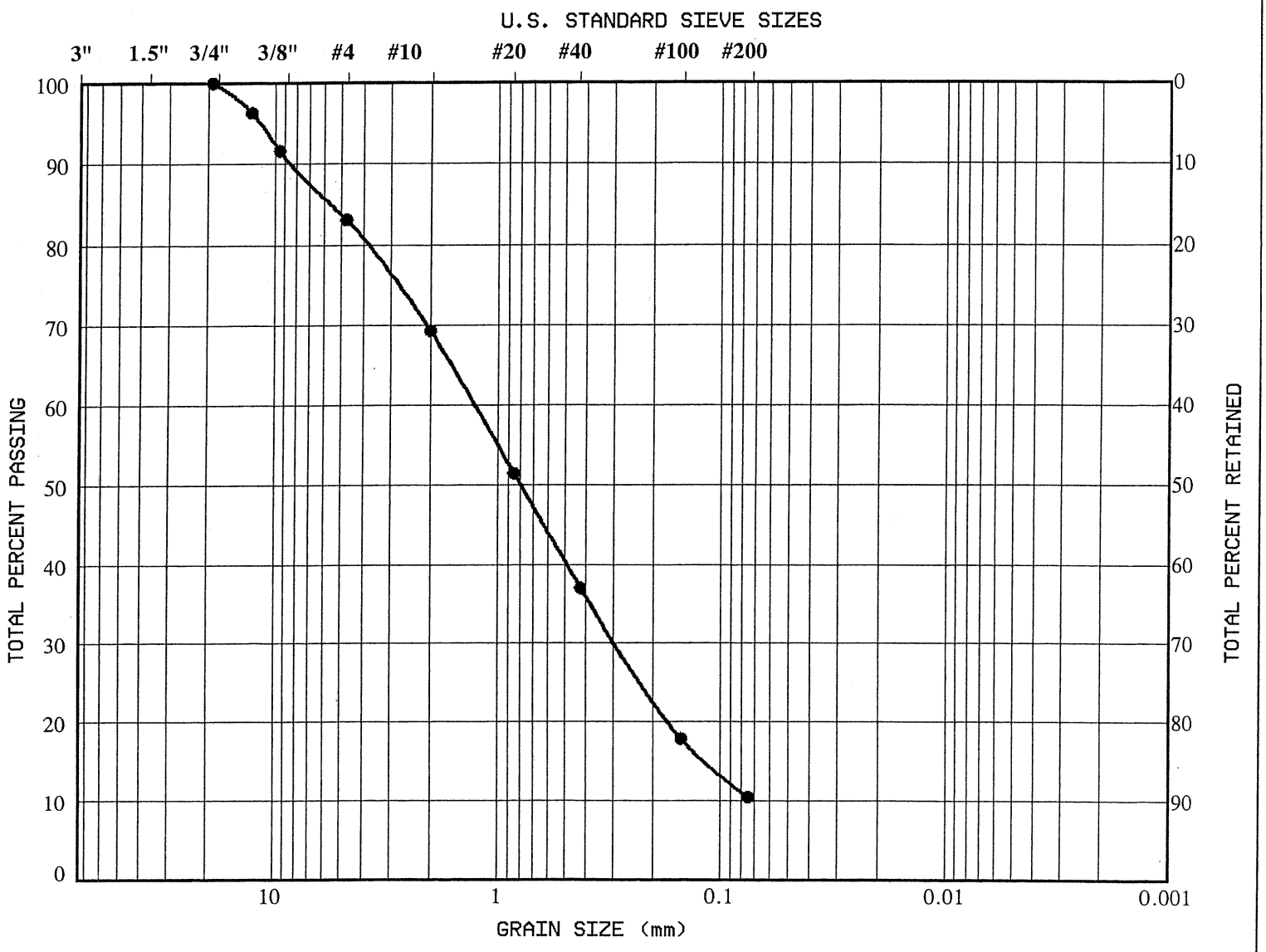
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-5

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B18-2	10.5	SAND with SILT and GRAVEL	SP-SM

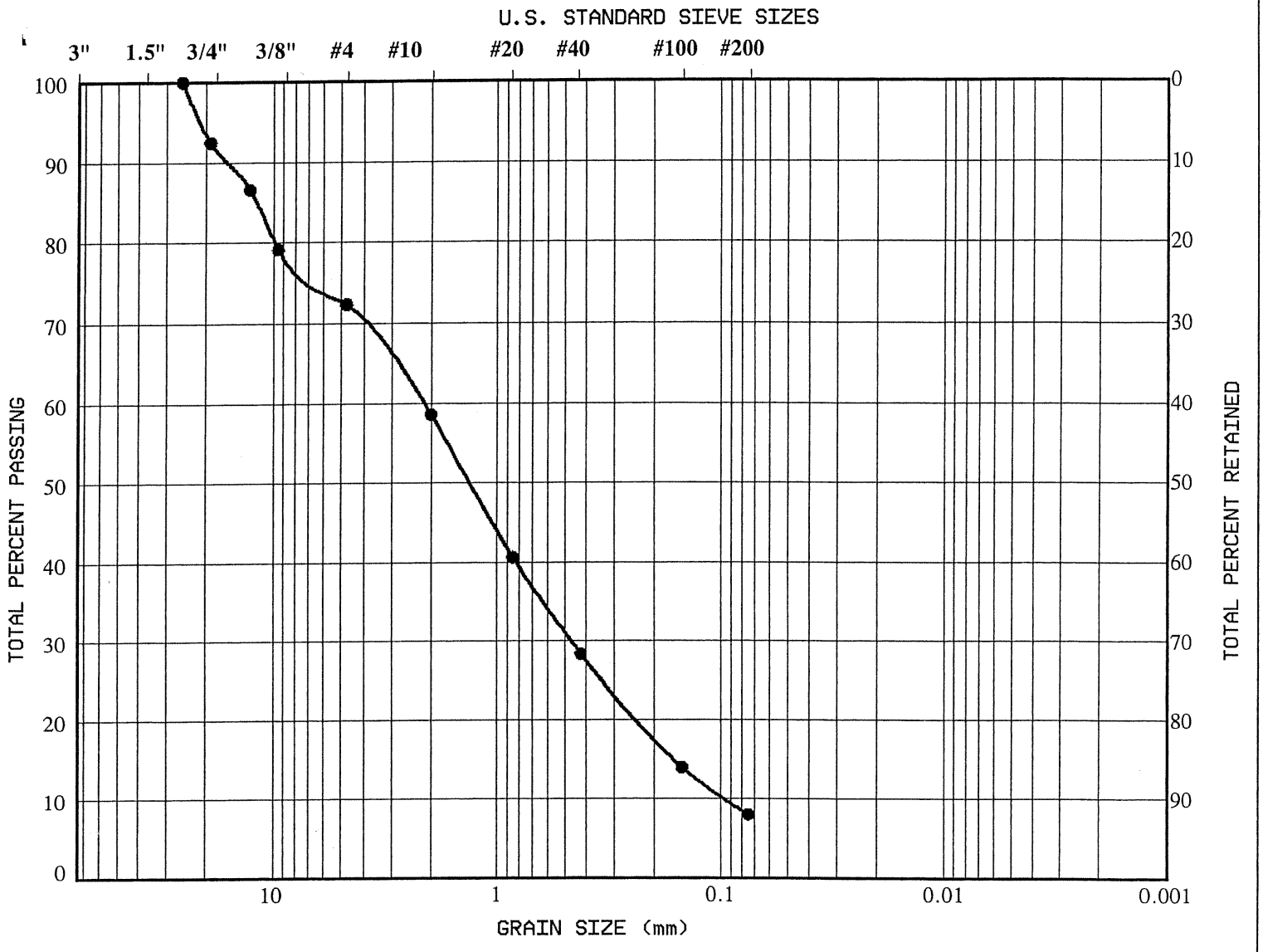
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-6

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B19-2	5.0	SAND with SILT and GRAVEL	SW-SM

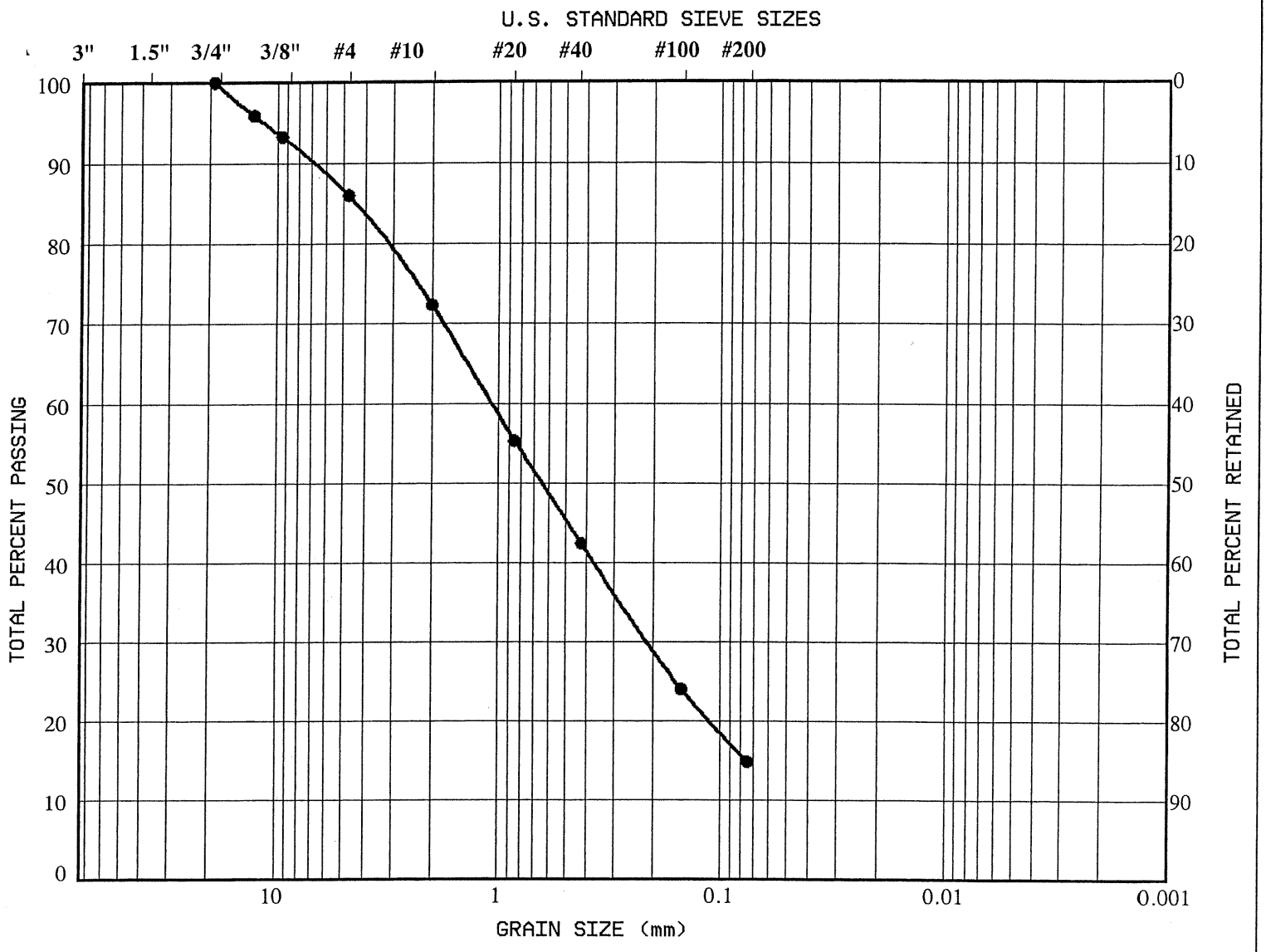
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-7

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B21-2	12.0	SILTY SAND	SM

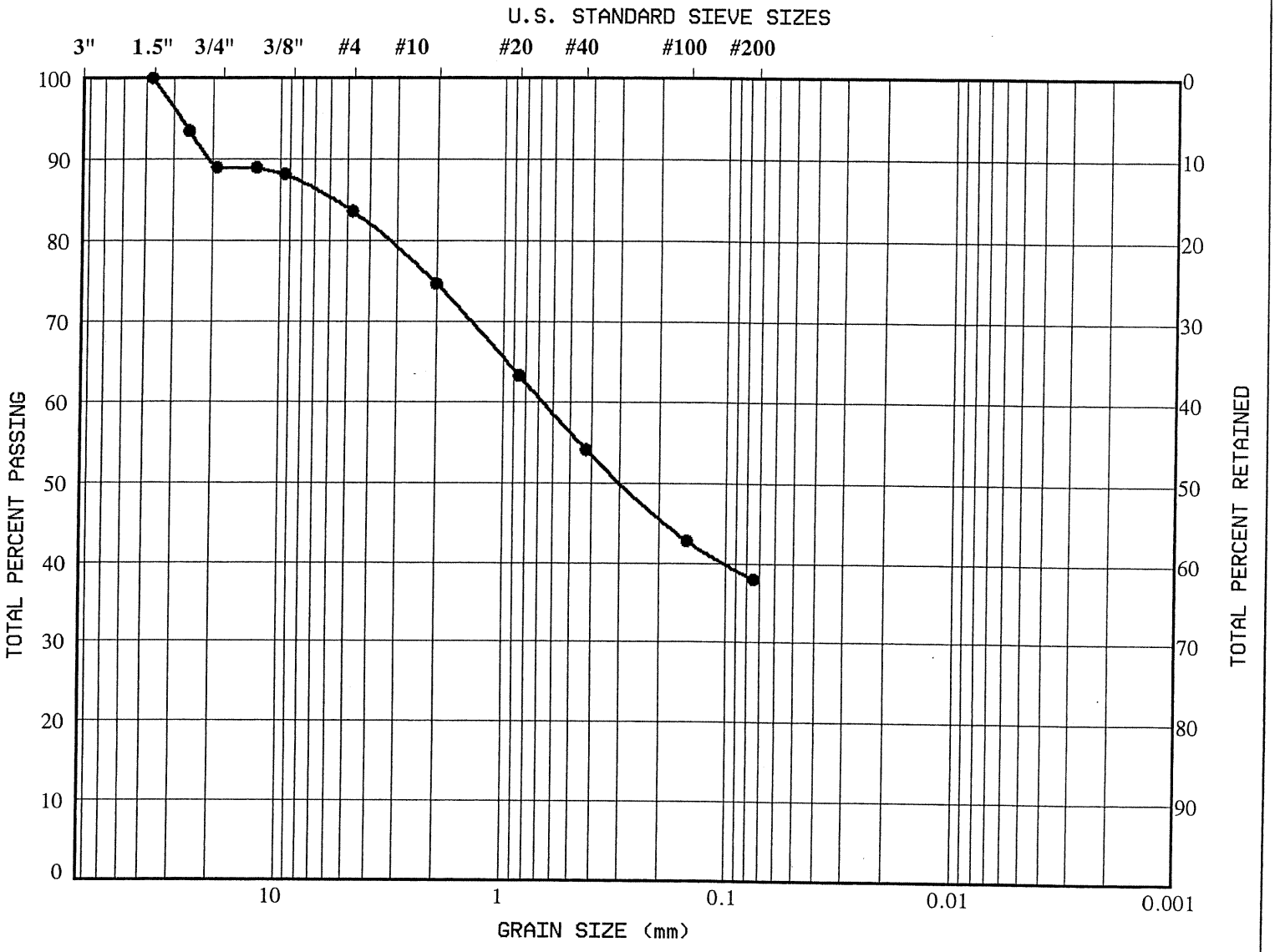
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-8

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	B23-2	9.0	SILTY SAND with GRAVEL	SM

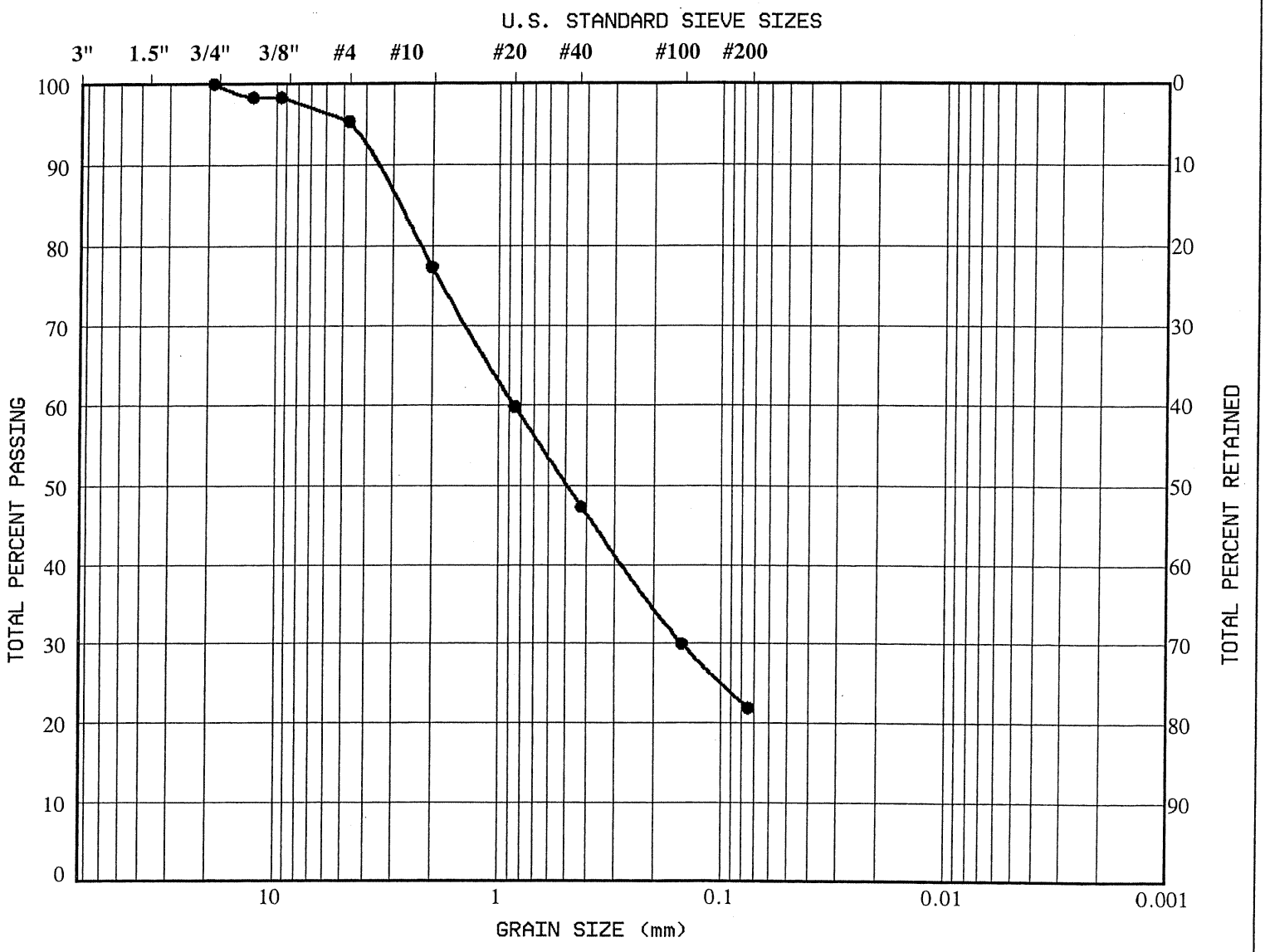
KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-9

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

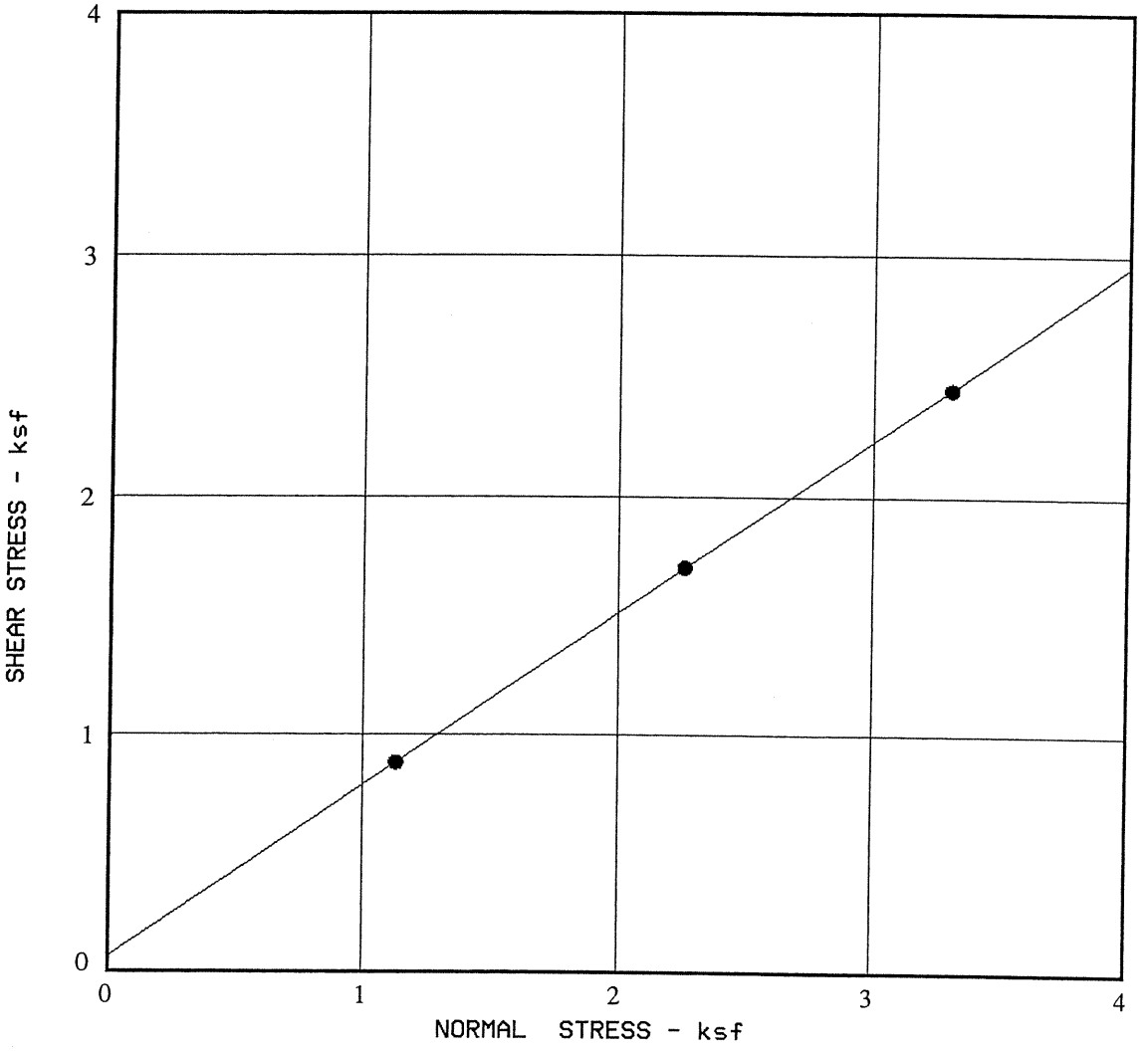
Symbol	Sample	Depth (ft)	Description	Classification
●	B23-6	30.0	SILTY SAND	SM

KLEINFELDER

PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California
GRAIN SIZE DISTRIBUTION

PLATE
B-10



Sample	B1-2
Depth (ft)	8.5
Friction Angle (deg)	36
Cohesion (ksf)	0.06
Moisture Content (%)	4.4
Dry Density (pcf)	126
Description	SAND with SILT
Classification	SW-SM

KLEINFELDER

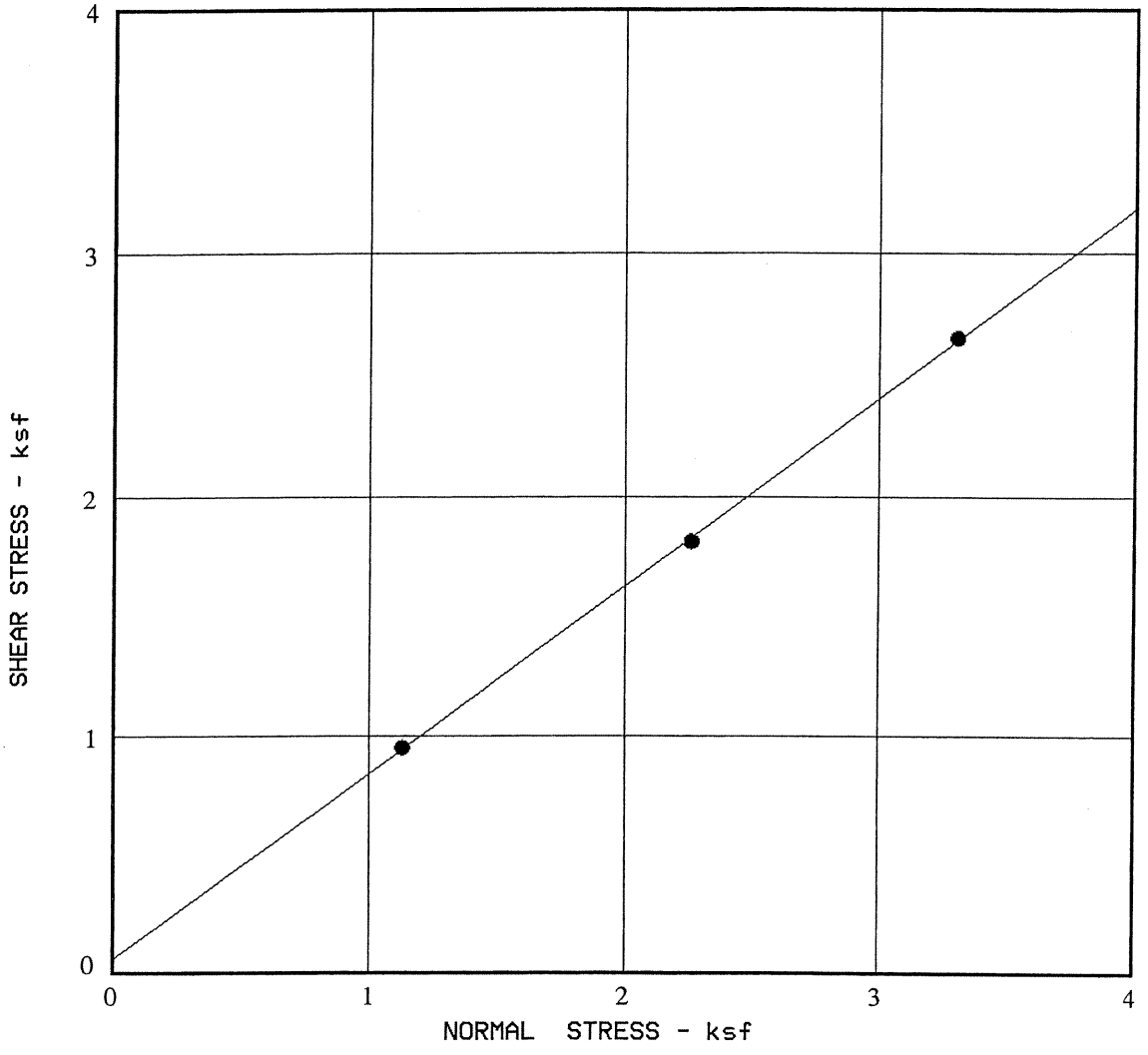
PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

DIRECT SHEAR TEST

PLATE

B-11



Sample	B18-1
Depth (ft)	7.0
Friction Angle (deg)	38
Cohesion (ksf)	0.06
Moisture Content (%)	8.8
Dry Density (pcf)	115
Description	SAND with SILT and GRAVEL
Classification	SP-SM

KLEINFELDER

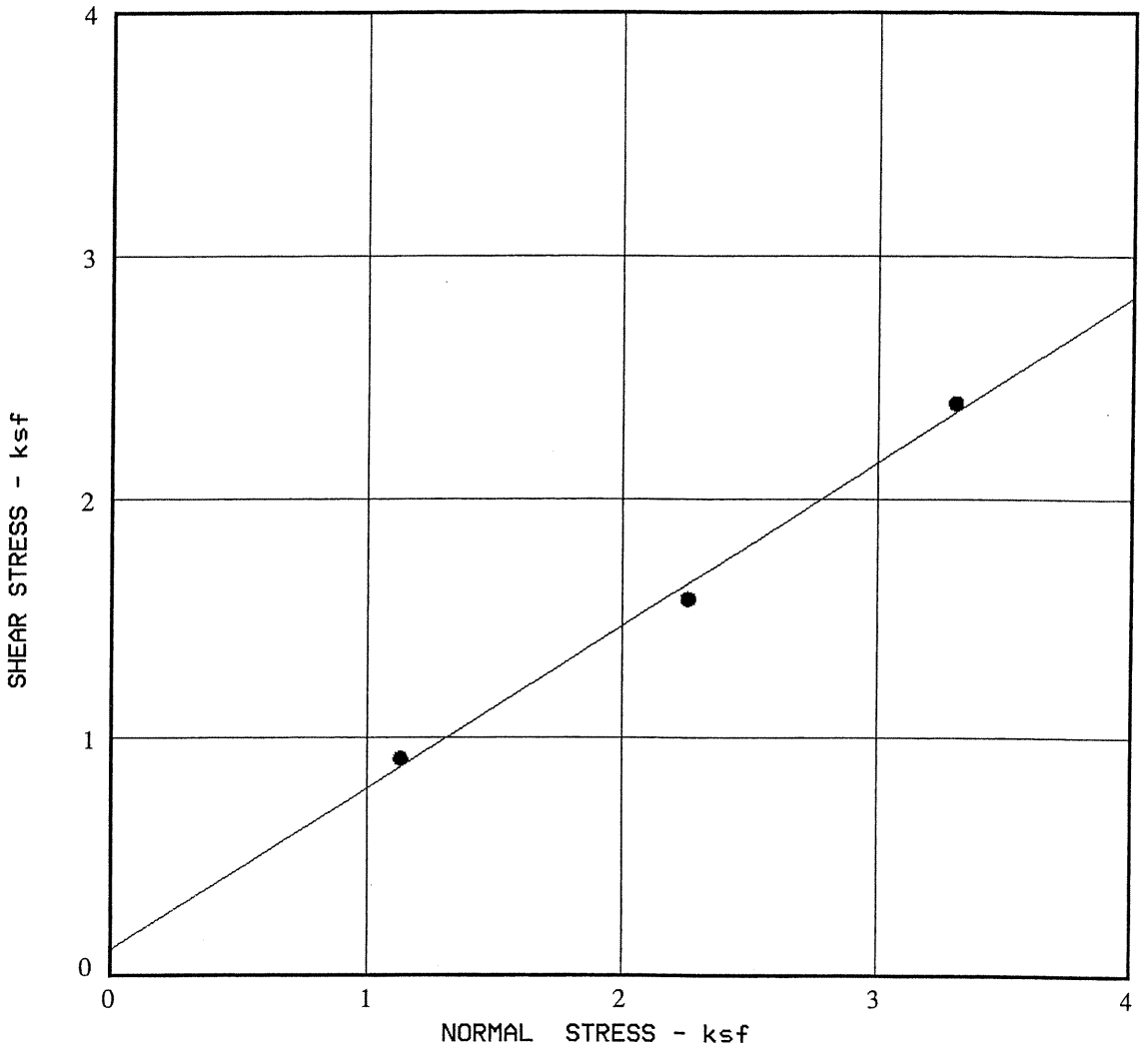
PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

DIRECT SHEAR TEST

PLATE

B-13



Sample	B5-2
Depth (ft)	10.0
Friction Angle (deg)	34
Cohesion (ksf)	0.11
Moisture Content (%)	4.4
Dry Density (pcf)	124
Description	SAND with SILT
Classification	SP-SM

KLEINFELDER

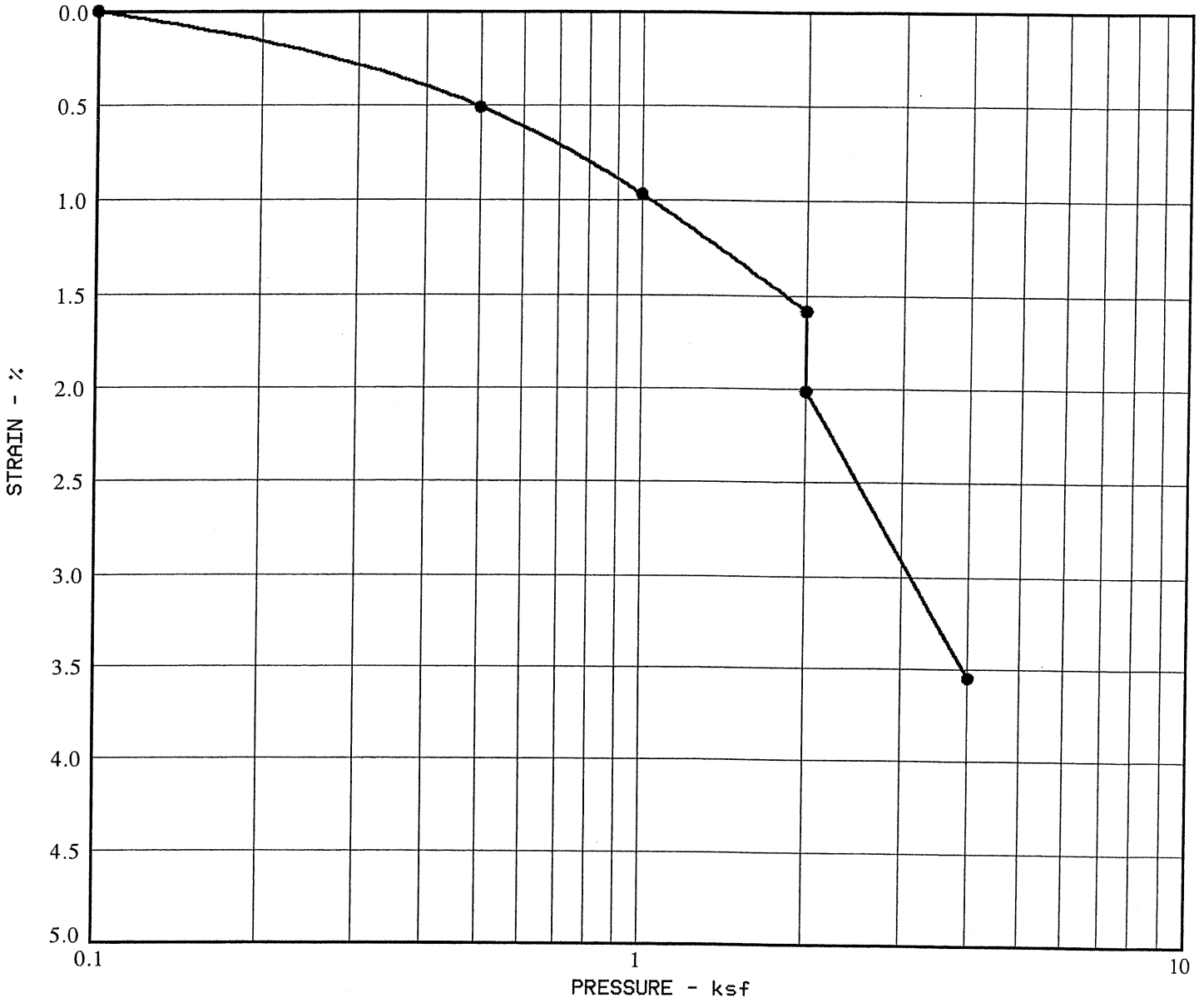
PROJECT NO. 56-2013-01

PROPOSED RESIDENTIAL DEVELOPMENT
353 Acres, Martin Ranch, Tentative Tract 15576
Devore Area, San Bernardino County, California

DIRECT SHEAR TEST

PLATE

B-12



Sample	B9-1
Depth (ft)	2.0
Description	SAND with SILT and GRAVEL
Classification	SW-SM
Moisture Content (%)	10.3
Dry Density (pcf)	116

KLEINFELDER

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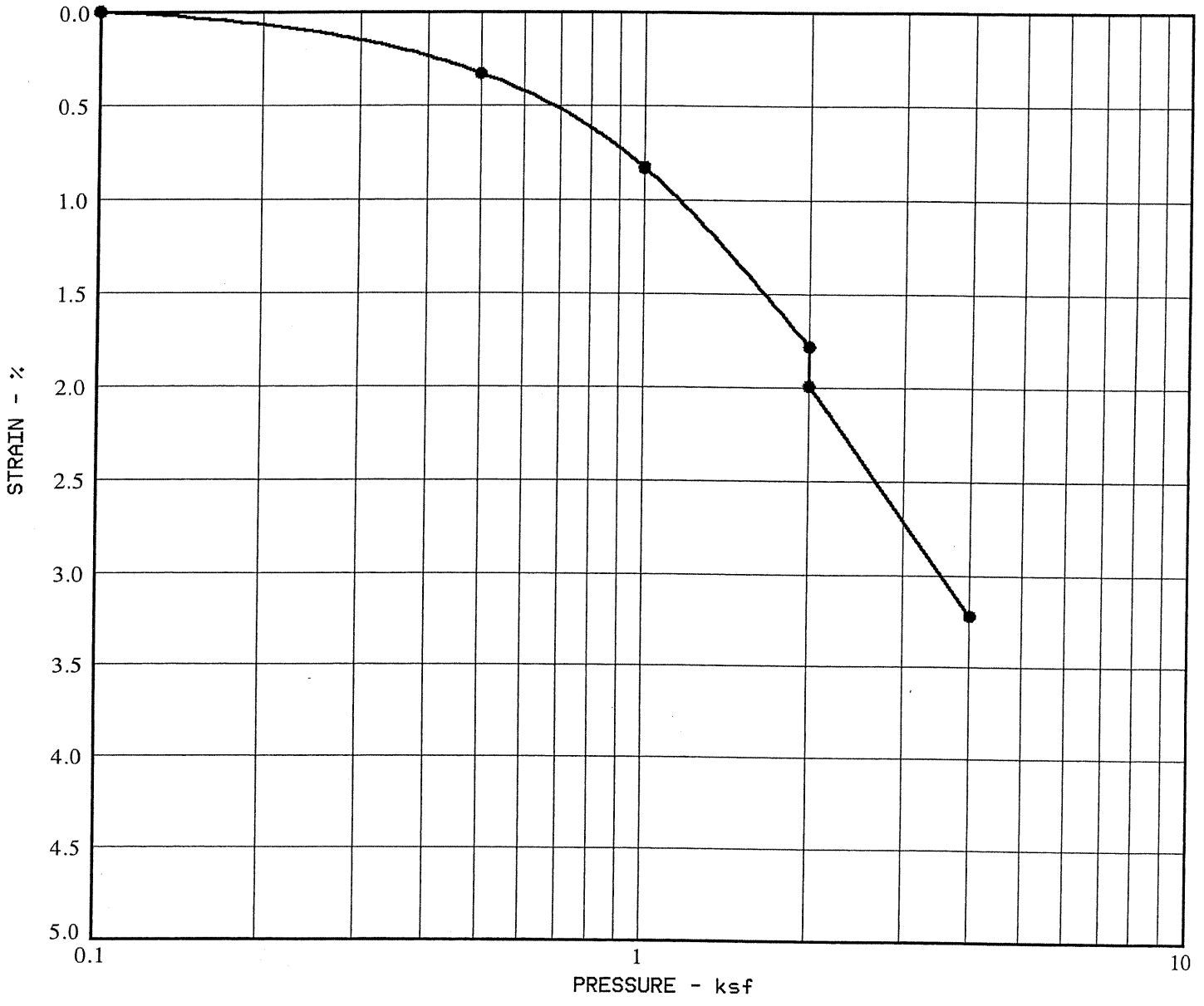
Devore Area, San Bernardino County, California
COLLAPSE POTENTIAL TEST

PLATE
B-14



Sample	**B13-1**
Depth (ft)	**2.5**
Description	**SILTY SAND**
Classification	**SM**
Moisture Content (%)	**10.1**
Dry Density (pcf)	**111**

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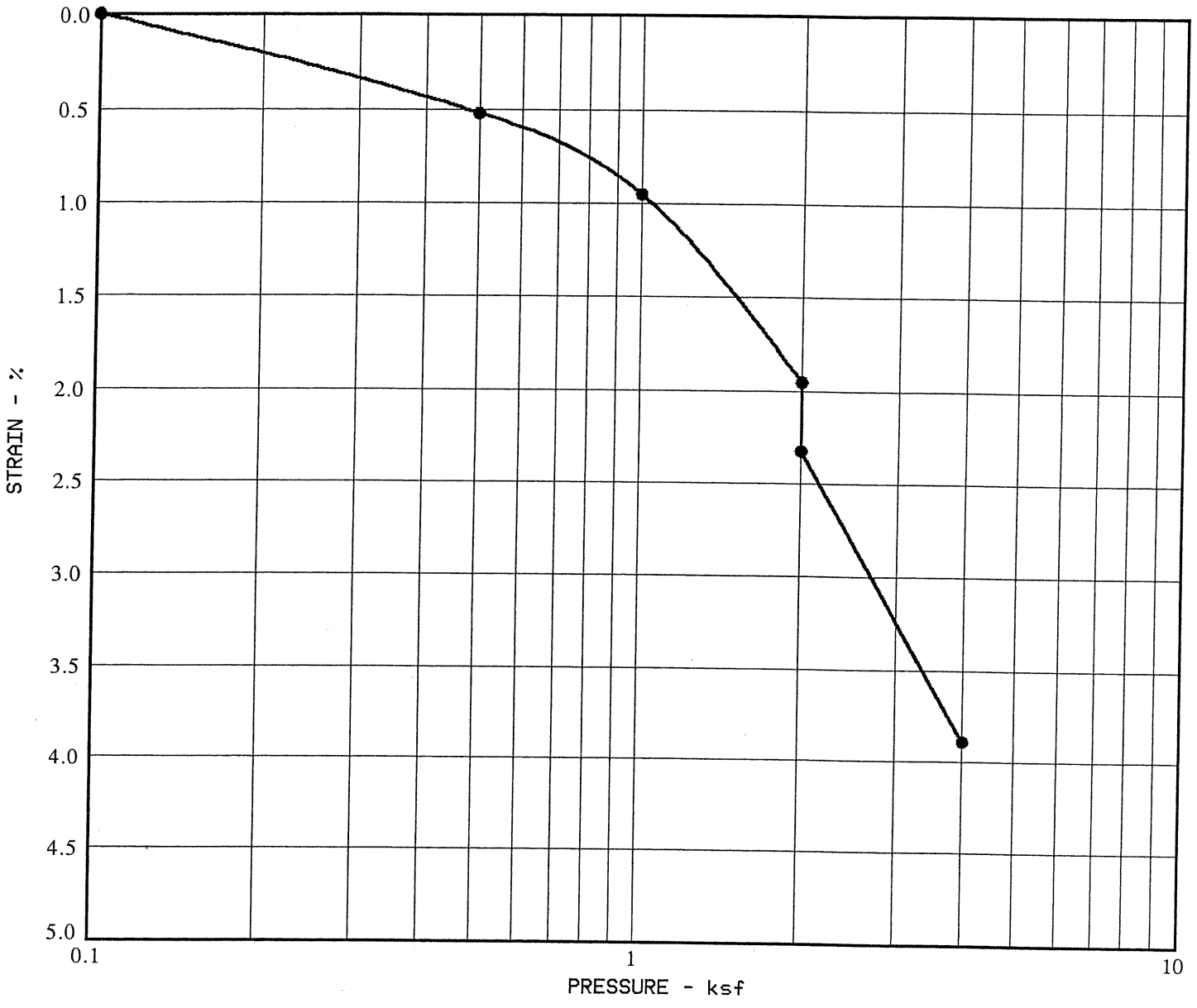
Devore Area, San Bernardino County, California

COLLAPSE POTENTIAL TEST

PLATE

B-15



Sample	B22-1
Depth (ft)	2.5
Description	SILTY SAND
Classification	SM
Moisture Content (%)	11.2
Dry Density (pcf)	114

KLEINFELDER

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PROPOSED RESIDENTIAL DEVELOPMENT
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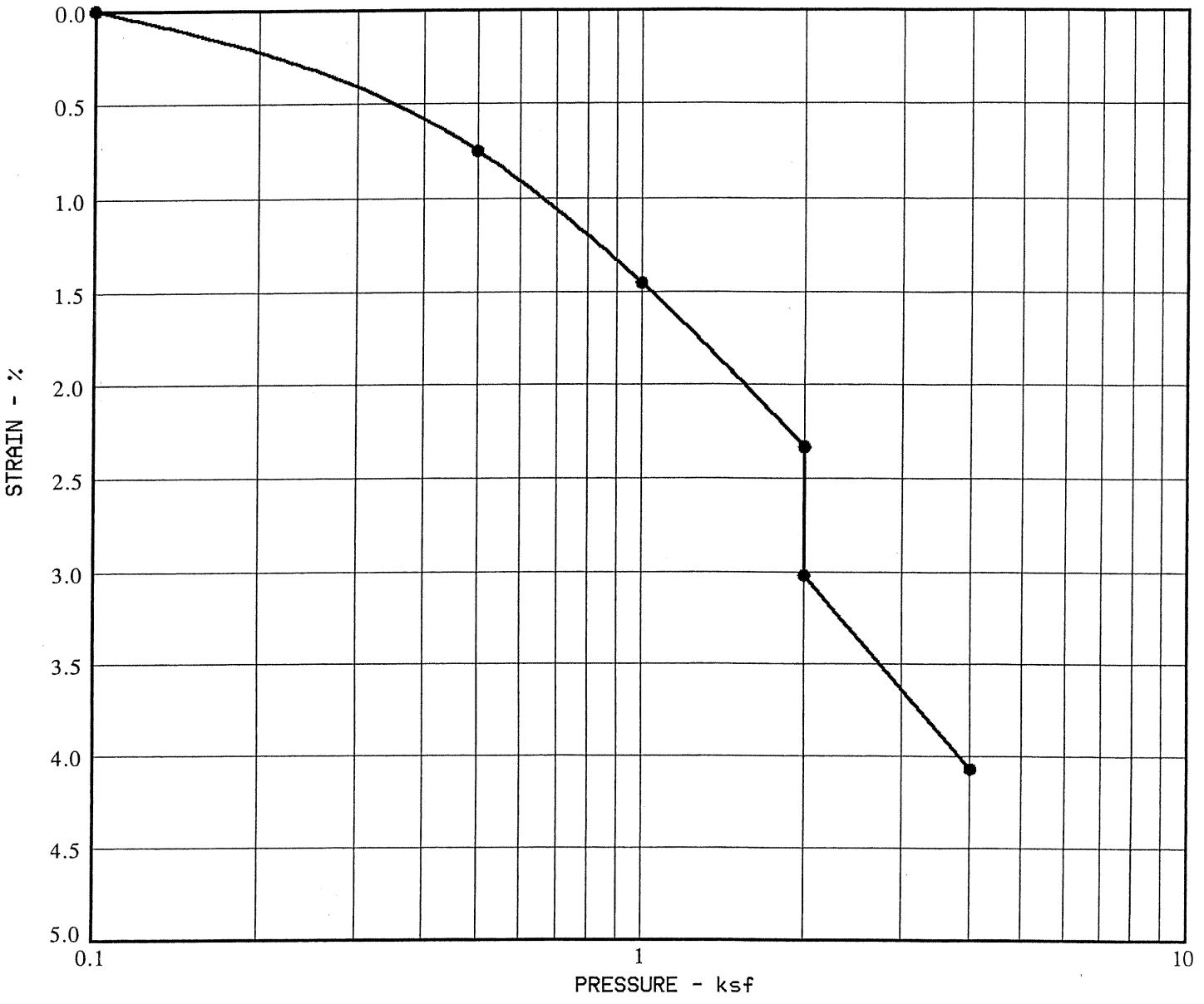
Devore Area, San Bernardino County, California
COLLAPSE POTENTIAL TEST

PLATE
B-16



Sample	**B23-1**
Depth (ft)	**4.0**
Description	**SILTY SAND**
Classification	**SM**
Moisture Content (%)	**8.3**
Dry Density (pcf)	**116**

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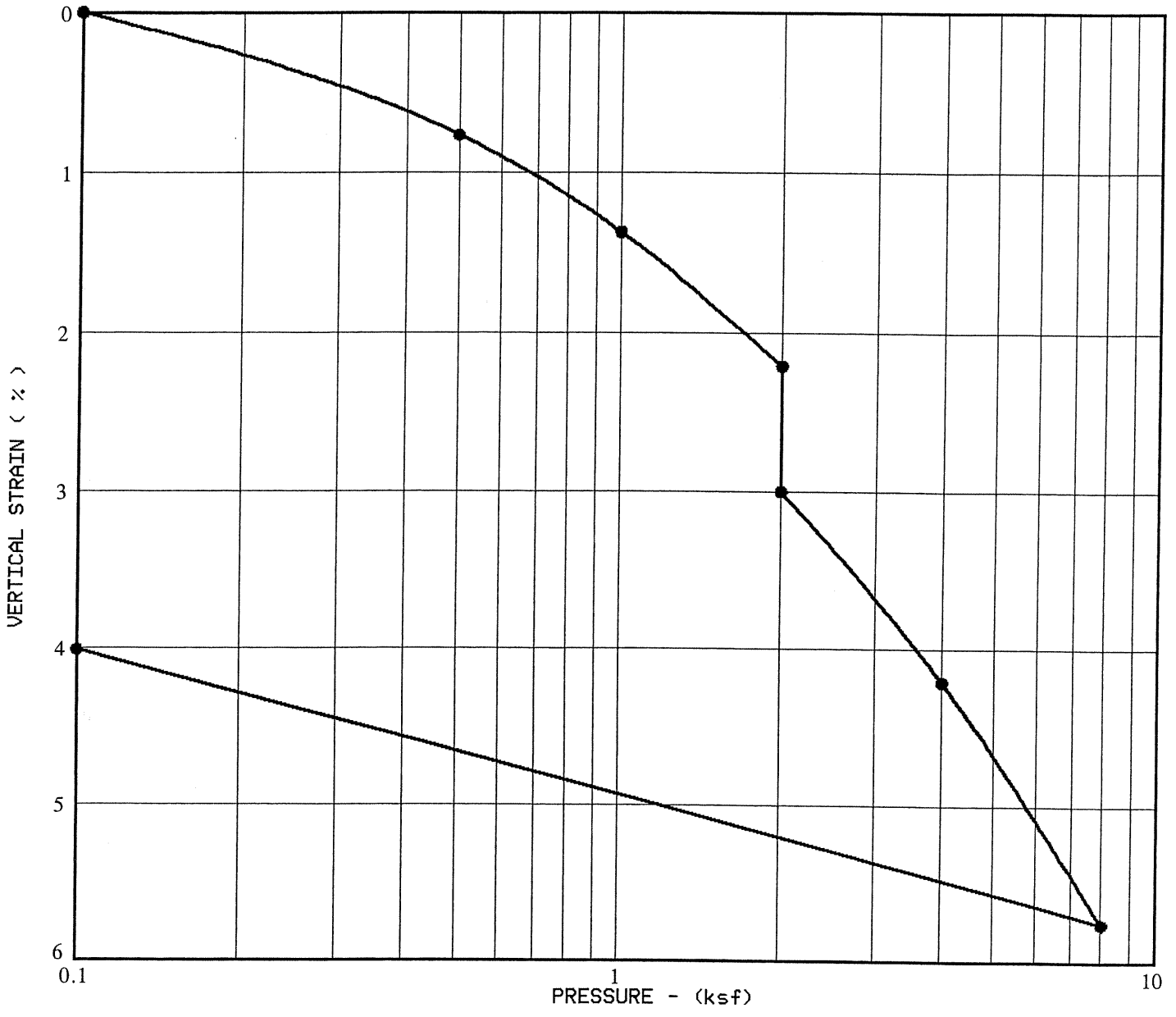
Devore Area, San Bernardino County, California

COLLAPSE POTENTIAL TEST

PLATE

B-17



Sample	B15-1
Depth (ft)	5.0
Moisture Content (%)	19.3
Dry Density (pcf)	100
Description	SILTY SAND
Classification	SM
Compression Ratio	0.046
Recompression Ratio	0.013

KLEINFELDER

PROJECT NO. 56-2013-01

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Devore Area, San Bernardino County, California
CONSOLIDATION TEST

PLATE

B-18

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES

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