APPENDIX 5.4

Geotechnical Documentation

ENGEO
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GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS

PRELIMINARY
GEOTECHNICAL RECONNAISSANCE

MONTREUX
SUBDIVISION 8279
PITTSBURG, CALIFORNIA

Submitted to:
Mr. Louis Parsons
Discovery Builders, Inc.
4021 Port Chicago Highway
P. O. Box 4113
Concord, CA 94524-4113

Prepared by:
ENGEO Incorporated

February 16, 2011
Project No. 5469.200.200

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GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
5469.200.200

February 16, 2011

Mr. Louis Parsons
Discovery Builders, Inc.
4061 Port Chicago Highway,
Concord, CA 94520

Subject: Montreux Vesting Tentative Map
Subdivision 8279
Pittsburg, California

PRELIMINARY GEOTECHNICAL REPORT

Dear Mr. Parsons:

As requested, this preliminary geotechnical report summarizes our geologic findings, conclusions and planning-level geotechnical considerations for planned Montreux - Subdivision 8279 in Pittsburg, California. The purpose of this report was to provide the project design team with geotechnical guidance for project planning.

PURPOSE AND SCOPE

This report presents a summary of geologic constraints and preliminary geotechnical recommendations/mitigation measures for the proposed Montreux project. This study included a review of previous geotechnical reports, geologic literature and maps, geologic reconnaissance of the site, examination of aerial photographs, and preparation of this report.

The conclusions and recommendations presented in this report are preliminary in nature. This report was prepared for the exclusive use of Seecon Financial & Construction Co., Inc. and their design team consultants. In the event that any changes are made in the character, design or layout of the development, ENGEO should review the conclusions and recommendations contained in this report to determine whether modifications to the report and related recommendations are necessary. This document may be reproduced in its entirety in the context of preparation of the CEQA document for the project. However, it may not be quoted or excerpted without the express written consent of ENGEO Incorporated.

LOCATION AND DESCRIPTION

The site is located about ½ mile south of Buchanan Road on the west side of Kirker Pass Road, as shown on Figure 1. Topography at the site consists of northwest and northeast trending ridgelines and adjacent valleys. The subject property varies in elevation from approximately 275 feet at the eastern boundary of the property to 770 feet at the southern property boundary. The area of development depicted on the VTM generally occupies an east-northeast trending valley bounded on the north and south by east northeast trending ridgelines. A portion of the ridge area adjacent to Kirker Pass Road was formerly used as a quarry for sandstone of the Neroly Formation.

PROPOSED PROJECT

Based on the Vesting Tentative Map (VTM) prepared by Isakson & Associates, dated January 2011, the proposed subdivision will include grading for approximately 368 lots, a water tank, detention and water quality basins, interior roads and utilities. According to the VTM, proposed grading at this site is shown to include cuts up to approximately 100 feet deep at the north side of the project and fills up to around 85 feet thick in the low-lying central portion of the site. A proposed water tank is planned at the top of the ridgeline adjacent to the northern portion of the site. Sanitary sewer and storm drain lines and a stormwater detention basin are proposed in the northwest portion of the site.

PREVIOUS STUDIES

The site was previously investigated by Kleinfelder, Inc. (2000). The previous investigation included eight auger borings, two cored borings 21 test pits, and three seismic refraction survey lines. The locations of previous subsurface investigation points are shown on the geologic map Figure 5. The findings and conclusions of the Kleinfelder report were reviewed as part of this study.

REGIONAL GEOLOGY AND SEISMICITY

The site is located in the Los Medanos Hills, an uplifted range north of Concord and south of Antioch and Pittsburg, California. As depicted in Figure 2, the site bedrock consists of a series of northwest-striking and northeast-dipping sedimentary deposits of Eocene to Miocene age. The bedrock formations include marine shales and sandstones of the Markley, Kirker, Briones and Neroly Formations, volcanic tuff and sandstone of the Lawlor Tuff, and nonmarine sediments of the Tulare Formation (Graymer, 1994). The dip of bedding in the bedrock formations varies from approximately 20 to 40 degrees to the northeast.

Figure 4 shows the approximate location of active and potentially active faults and significant historic earthquakes mapped within the San Francisco Bay Region. The nearest active fault is the Concord fault located approximately 6 miles west of the property.

The Working Group on California Earthquake Probabilities (WGEP) (2007) evaluated the 30-year probability of a M6.7 or greater earthquake occurring on the known active fault systems in the Bay Area, including the Calaveras fault. The WGEP calculated an overall probability of 63 percent for the Bay Area as whole.

GEOLOGIC MATERIALS

Artificial Fill (Qaf)

There is a large area of existing fill on the eastern portion of the site as depicted on Figure 5. Based on review of previous Kleinfelder subsurface exploration logs, it appears that the fill consists of a mixture of on-site soils and bedrock, and construction debris such as concrete, wood and asphalt.

Surficial Soils and Colluvium

The ground surface is typically mantled with 1 to 5 feet of residual soil formed from weathering and decomposition of the underlying bedrock. The composition of the residual soils typically varies based on the underlying parent material. On the site, the weathering of the underlying soils and bedrock typically produces a silty/sandy clay soil with moderate to moderately high shrink swell potential.

Deposits of colluvium (Qc), typically thicker than 5 feet, occur in swales and ravines at the property. Colluvium is a soil deposit formed from downslope movement and deposition of residual soil by such processes as slope wash, sloughing/shallow sliding, and creep. Colluvium typically consists of silty/sandy clay with some scattered rock fragments.

Debris-Flow Deposits

There are deposits of silty to sandy clay along the base of the steep slopes south of the extensive outcrop area of the Neroly Sandstone and Lawlor Tuff, and in swale areas on the slope. These deposits are interpreted to be accumulations of debris flow-derived soil from the adjacent steep slopes. There are remnant debris-flow scars at the heads of many of the swales along this slope.

Alluvium (Qal)

Soils deposited by stream flow and sheet wash have accumulated on the floors of larger valleys on site as shown on Figure 5. Based on borings by Kleinfelder, the alluvium appears to consist of interbedded stiff sandy and silty clay.

Tulare Formation (Tt)

The northern portion of the site is underlain by bedrock of the Miocen-Pliocene-age Tulare Formation, consisting of interbedded friable non-marine claystone, siltstone and sandstone. The Tulare Formation typically contains a high proportion of fine-grained expansive clays.

Lawlor Tuff (Tlt)

The Lawlor Tuff outcrops at the crest of the northern site ridgeline. The Lawlor Tuff consists of moderately-to well indurated volcanoclastic sandstone and volcanic tuff. Soils developed on fine grained units in the Lawlor tuff can be highly expansive.

Neroly Formation (Tn)

The Miocene-age Neroly Formation underlies much of the steep south-facing slop of the northern ridgeline and central portions of the site. The Neroly Formation typically consists of interbedded blue-gray very well-indurated marine sandstone and siltstone. Soils developed on the Neroly Formation are typically thin. A preliminary rippability evaluation of the Neroly Formation by Kleinfelder included measurement of rock quality in cored borings and seismic velocity surveys. Their study suggests that excavation of the Neroly formation will require moderate to heavy ripping at depths of greater than 5 to 10 feet. Experience with the same deposit in nearby grading projects has shown that the well-indurated sandstone of the Neroly Formation can typically be excavated using heavy tractors (Catterpillar D-10 or larger), and that deep excavation will produce rock fragments greater than 6-to12 inches in diameter.

Cierbo Sandstone (Tc)

The Miocen-age Cierbo Sandstone underlies low ridges in the central portion of the site. The Ceirbo sandstone typically consists of moderately to well-indurated gray-brown marine sandstone and siltstone.

Kirker Formation (Tk)

The Kirker Formation underlies a narrow band through the south-central portion of the site. The Kirker Formation consists of friable to moderately indurated marine tuffaceous sandstone and tuff of Oligocene age. Soils developed on fine grained units in the Kirker Formation can be highly expansive.

Markley Formation (Tkm)

The Markley Formation outcrops along and extensive north-facing dip slop at the south side of the property. The marine, Eocene-age Markley Formation typically consists of interbedded weak siltstone, fine-grained claystone and weakly indurated sandstone. The slope angle in this area appears to be approximately parallel to the bedding in the Markley.

Landslides

Figure 5 depicts landslides identified by our geologic mapping at the Montreux property. We have categorized landslides as relatively shallow surficial earthflows and possible deeper-seated earthflows and rotational slumps. Earthflows on the site typically occur within deposits of colluvium that have accumulated in swale areas. Deep-seated rotational slumps commonly incorporate portions of the site bedrock. The possible bedrock landslide mapped near the northwest site corner occurs in an orientation that is consistent with a wedge failure geometry. Experience with this formation in the site vicinity has shown that such wedge-type landslides commonly form along bedding and joint planes in weak unit of the Tulare Formation. We have identified another potential bedrock landslide on the north-facing dip slope in the Markley formation as depicted on Figure 5.

PRELIMINARY CONCLUSION AND RECOMMENDATIONS

Based on the results of geologic reconnaissance at the site, we conclude that residential development of the property is feasible provided that the project is appropriately designed for the geologic and geotechnical conditions identified in this report. These project considerations are common to residential and commercial construction projects throughout California. Once the construction documents are developed, a supplemental geotechnical report should be prepared to provide site-specific geotechnical recommendations. We anticipate that site-specific geotechnical considerations for the planned development will include:

- Excavatability of bedrock, and appropriate treatment of oversized-rock fragments.
- Preparation of recommendations for moisture conditioning and compaction of fills to reduce potential fill settlements.
- Preparation of recommendations for the construction of stable cut and fill slopes.
- Preparation of recommendations for slope stabilization where appropriate.

GROUND RUPTURE

The site is not located in a State of California Earthquake Fault Zone, and there are no known active faults passing though the property. The project is therefore not considered subject to seismic surface rupture hazards.

SEISMIC GROUND SHAKING

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the 2007 California Building Code (CBC) requirements, as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

LIQUEFACTION, LATERAL SPREADING, AND GROUND LURCHING

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength because of pore pressure buildup under the cyclic shear stresses associated with earthquakes. Lateral spreading is a failure within a nearly horizontal soil zone, commonly associated with liquefaction, which causes the overlying soil mass to move towards a free face or down a gentle slope. Ground lurching can occur in soft, saturated clays and silts that are subjected to strong ground shaking during earthquakes. Based on the existing subsurface data, it appears that the alluvium consists of stiff silty to sand clays that will not be subject to liquefaction, lateral spreading or ground lurching hazards.

LANDSLIDES

As depicted on Figure 5, we have identified a number of landslides on the Montreux property. Landslides are a significant planning consideration for development of the property, as they are for most construction projects in hillside terrain in the California Coast Ranges. Landslide movement can be triggered by changes in groundwater elevation due to rainfall, saturation by leaking utilities or impounded water, stream incision, man-made excavations and fill placement, as well as by seismic ground shaking. Landslide movement can cause large vertical and horizontal ground movements, ground warping and bulging, displacement of large masses of debris from slopes onto roads and structures, and blocking of stream courses. Landslides at the site can be mitigated by a combination of the following measures:

- Construction of catchment areas between landslides and proposed improvements.
- Partial landslide debris removal and buttressing with engineered fill.
- Complete landslide debris removal and replacement as engineered fill.

We recommend that the project final plans include a debris bench at the interface between any residential lots and natural or cut slopes. Typically, debris benches should consist of a minimum 15-foot-wide near-level bench located between the rear or side yard and the adjacent slopes. The bench is typically elevated between 10 and 15 feet above the building pad elevation. Detailed site-specific corrective grading plans and landslide mitigation measures will be prepared during review of the final 40-scale grading plans. It is important to note that to preserve the natural topography of the site, stabilization of is planned only for landslides that potentially threaten the proposed improvements. Landslides that do not threaten proposed improvements will not be repaired. Based on the results of this study and on experience with similar projects in the Pittsburg area, it is our opinion that the landslides depicted on Figure 5 can be successfully mitigated.

SLOPE STABILITY

Graded slopes proposed for the project could be subject to slope stability issues related to natural soil and groundwater conditions in cut slopes and in foundation soils below fills. The stability of graded slopes is also affected by construction methods such as slope inclination, fill compaction and the adequacy of subsurface drainage systems. Seismic ground shaking can result in lateral and vertical deformation of graded slopes.

Based on the performance of existing slopes and on our experience in the Pittsburg area, we recommend that that graded slopes be inclined no steeper than 2:1.

The design-level geotechnical report will provide detailed, site-specific analyses for proposed graded slopes, geotechnical recommendations and corrective grading plans that will depict specific geotechnical design measures based on the final project grading plans.

Graded slopes constructed for this project will be required to meet standards of slope stability that are appropriate for residential construction. Standards for Contra Costa County and for Northern California typically require that all graded slopes have a minimum factor of safety of 1.5 for static conditions and 1.1 for seismic loading conditions.

EXPANSIVE SOILS

An important geotechnical consideration is the potential expansive nature of the native soil and bedrock across the proposed development area. The clayey soils and claystone units within the bedrock in this region have moderate to high plasticity and moderate to high expansion potential. Expansive soils shrink and swell as a result of seasonal fluctuation in moisture content. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Potentially detrimental volume changes associated with expansive soils will be reduced through proper foundation design. Potential expansive soil impacts can also be reduced, if desired, by constructing the upper portions of building pads with relatively non-expansive granular fill.

Successful construction on expansive soils requires special attention during construction. It is imperative that exposed soils be kept moist by watering for several days before placement of concrete. It is extremely difficult to remoisturize clayey soils without excavation, moisture conditioning, and recompaction.

EXISTING FILLS

As shown on Figure 5, existing fills are present on site associated with the abandoned quarry. Common mitigation techniques for non-engineered fills, if within or at the margin of the grading limits, include removal and replacement as engineered fill, provided the material is deemed suitable for reuse by the Geotechnical Engineer at the time of grading. Based on preliminary subsurface data from Kleinfelder, it appears that portions of the existing fill contain deleterious material (wood debris) that will need to be segregated from structural fills. Construction debris such as concrete or asphalt fragments can be re-used in fills provided that they are placed no shallower than 10 feet below finished grades.

LIMITATIONS

This report presents preliminary geotechnical recommendations for planning purposes. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our services.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

Philip Stuecheli
No. 1640
Exp. 3/31/2012

Philip L. Stuecheli, CEG
Associate

Theodore P. Bayham
No. 2480
Exp. 9/30/2012

Theodore P. Bayham, GE, CEG
Principal

Attachments: References
Figures 1 – 5

REFERENCES

Crane, R., 1995, Geology of the Mount Diablo Region, *in* Geology of the Mount Diablo Region Guidebook, Northern California Geological Society.

Dibblee, T. W., Jr., 2005, Geologic Map of the Clayton Quadrangle, Alameda and Contra Costa Counties, California, DF 192, 2005.

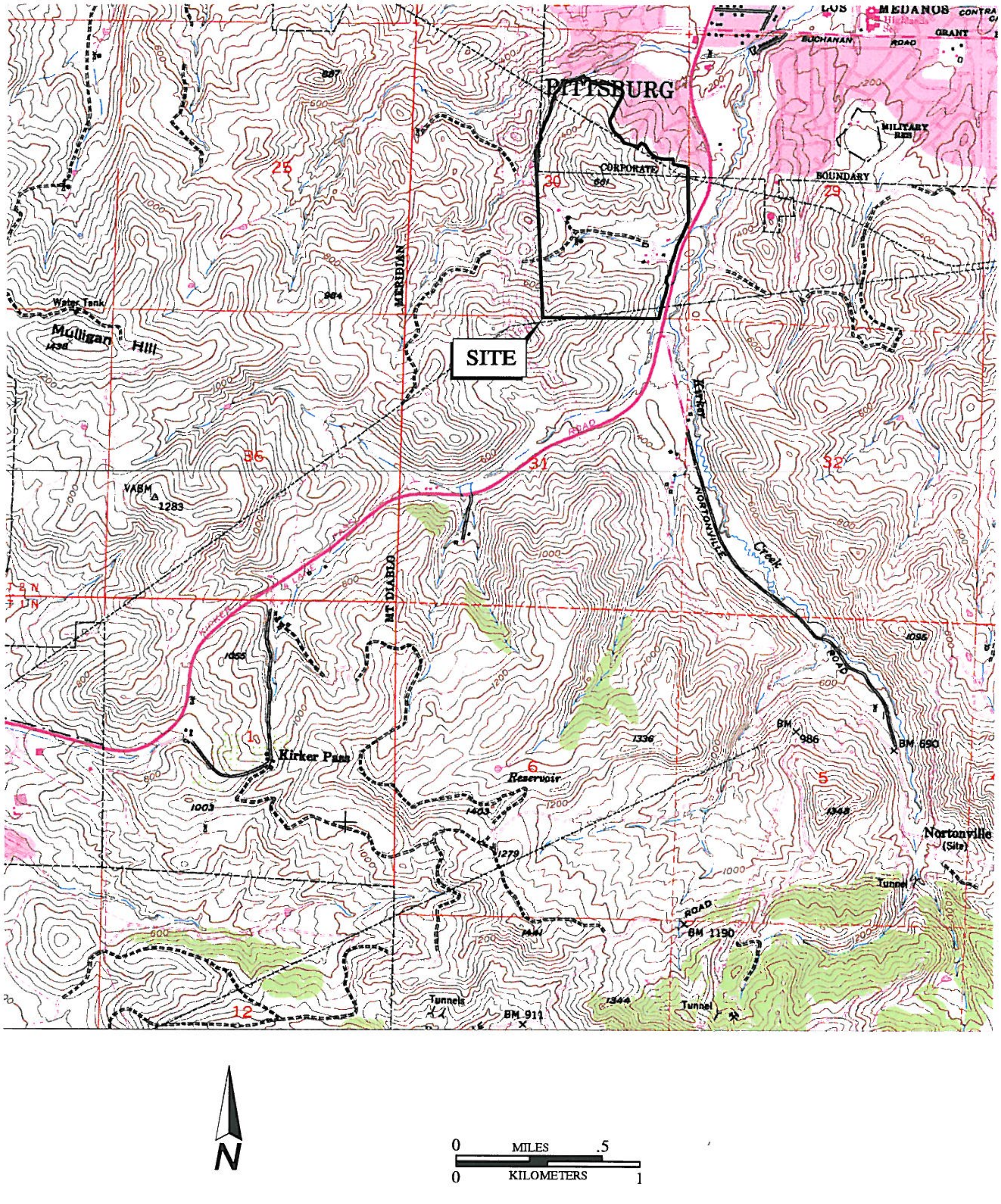
ENGEO, 2010, Geotechnical Feasibility Report, Montreux Tentative Map, Subdivision 8279, Pittsburg, California, ENGEO project No. 5469.200.200, Dated May 6, 2009.

Nilsen, T. H., 1975, Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Clayton' Quadrangle, Contra Costa County, California, USGS 75-277-24.

Kleinfelder, 2000, Geotechnical Investigation Report, Montreux Subdivision, Kirker Pass Road, Pittsburg, California, Project No. 43-1131-01/4319R007, Dated January 6, 2000.

2007 Working Group on California Earthquake Probabilities, 2008, The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2): U.S. Geological Survey Open-File Report 2007-1437 and California Geological Survey Special Report 203 [http://pubs.usgs.gov/of/2007/1437/].

FIGURES



BASE MAP SOURCE: U.S.G.S.

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VICINITY MAP

MONTREUX SUBDIVISION

PITTSBURG, CALIFORNIA

PROJECT NO.: 5469.200.200

SCALE: AS SHOWN

DRAWN BY: DLB

CHECKED BY: TB

FIGURE NO
1

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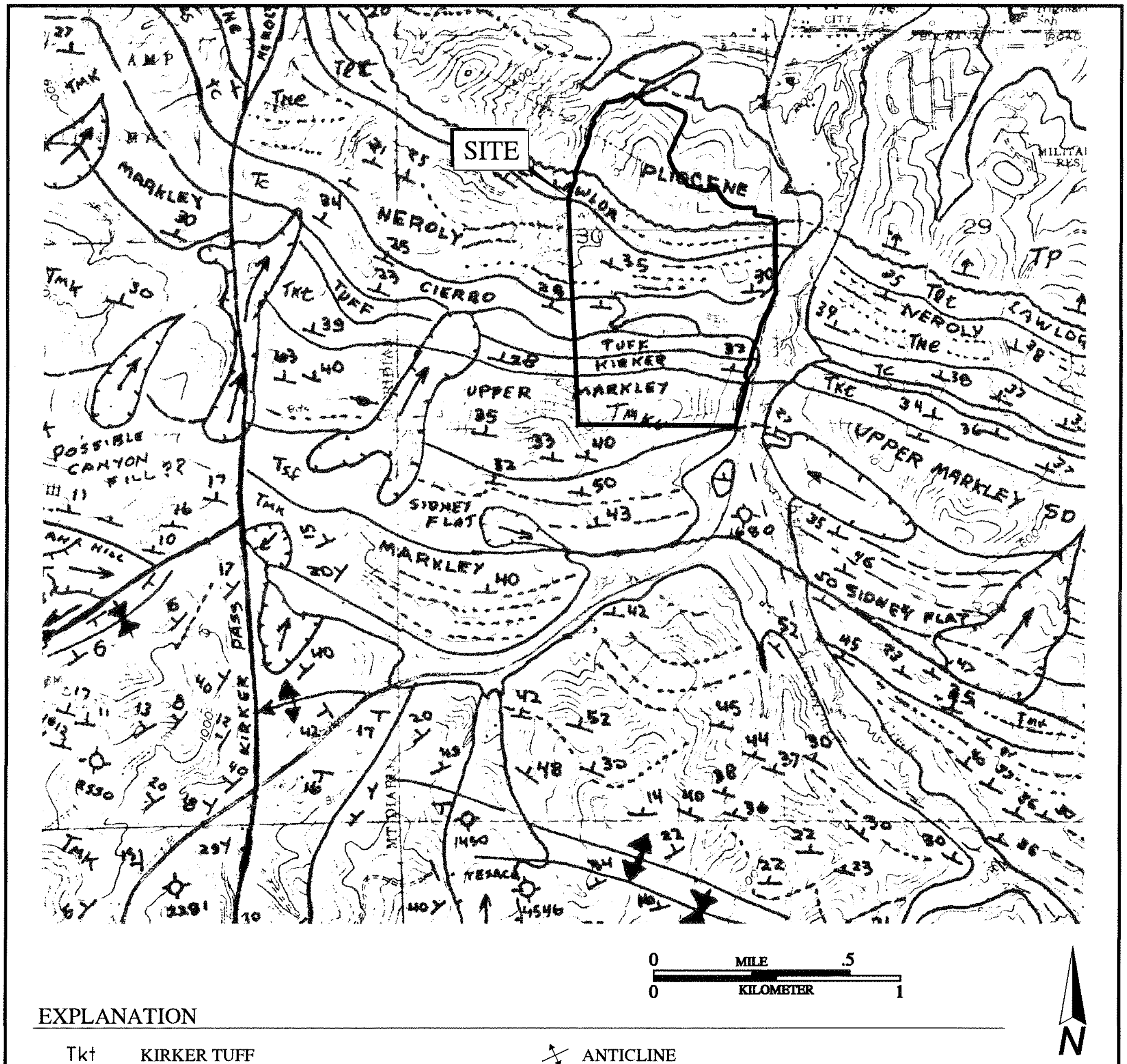

EXPLANATION

Tkt	KIRKER TUFF
Tsf	SIDNEY FLAT SHALE
TNe	NEROLY FORMATION
TC	CIERBO FORMATION
TMku	UPPER MARKLEY
TMk	MARKLEY

GEOLOGIC CONTACT (APPROXIMATE)

RESISTANT BEDDING

FAULT

THRUST FAULT, SAWTEETH ON UPPER PLATE

ANTICLINE

SYNCLINE

OVERTURNED ANTICLINE

OVERTURNED SYNCLINE

50 STRIKE AND DIP OF BEDDING

STRIKE AND DIRECTION OF DIP

50 STRIKE AND DIP OF OVERTURNED BEDDING

HORIZONTAL BEDDING SHOWNING TREND OF LINEATION

BASE MAP SOURCE: CRANE, 1988

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REGIONAL GEOLOGIC MAP
MONTREUX SUBDIVISION
PITTSBURG, CALIFORNIA

PROJECT NO.: 5469.200.200
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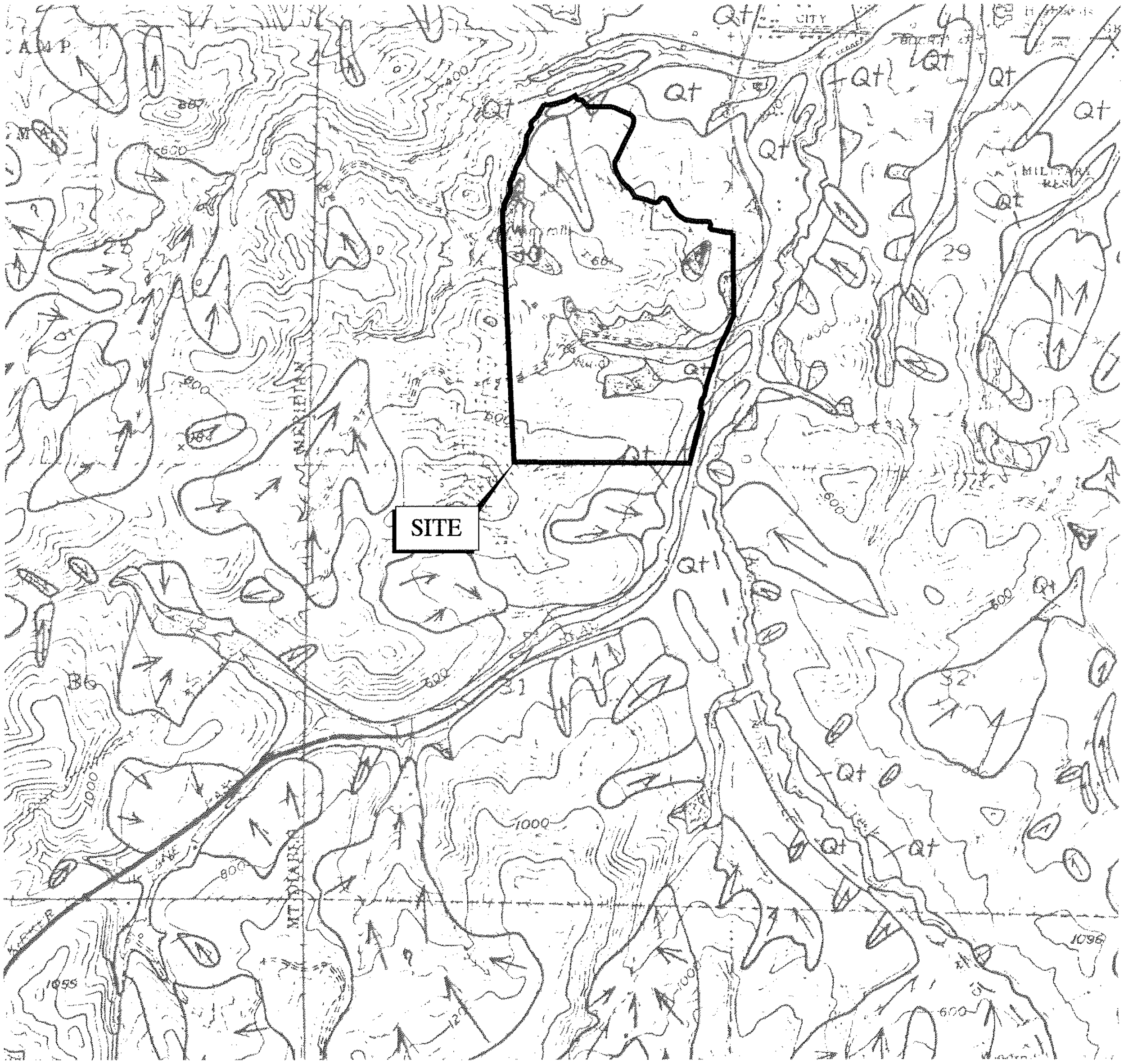
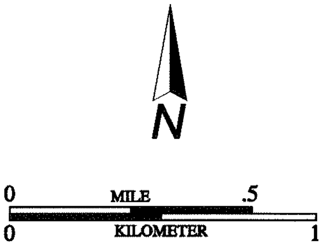
FIGURE NO 2



EXPLANATION

⬭	LANDSLIDE DEPOSIT. ARROWS INDICATE GENERAL DIRECTION OF DOWNSLOPE MOVEMENT. QUERIED WHERE UNCERTAIN
Qal	ALLUVIAL DEPOSIT
Qt	ALLUVIAL TERRACE DEPOSIT. QUERIED WHERE UNCERTAIN
■	COLLUVIAL DEPOSIT AND/OR SMALL ALLUVIAL FAN DEPOSIT
Qaf	ARTIFICIAL FILL
☐	BEDROCK. QUERIED WHERE IDENTIFICATION UNCERTAIN
⚒	QUARRY OR GRAVEL PIT



BASE MAP SOURCE: NILSEN, 1975

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REGIONAL LANDSLIDE MAP
MONTREUX SUBDIVISION
PITTSBURG, CALIFORNIA

PROJECT NO.: 5469.200.200	
SCALE: AS SHOWN	
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FIGURE NO	3

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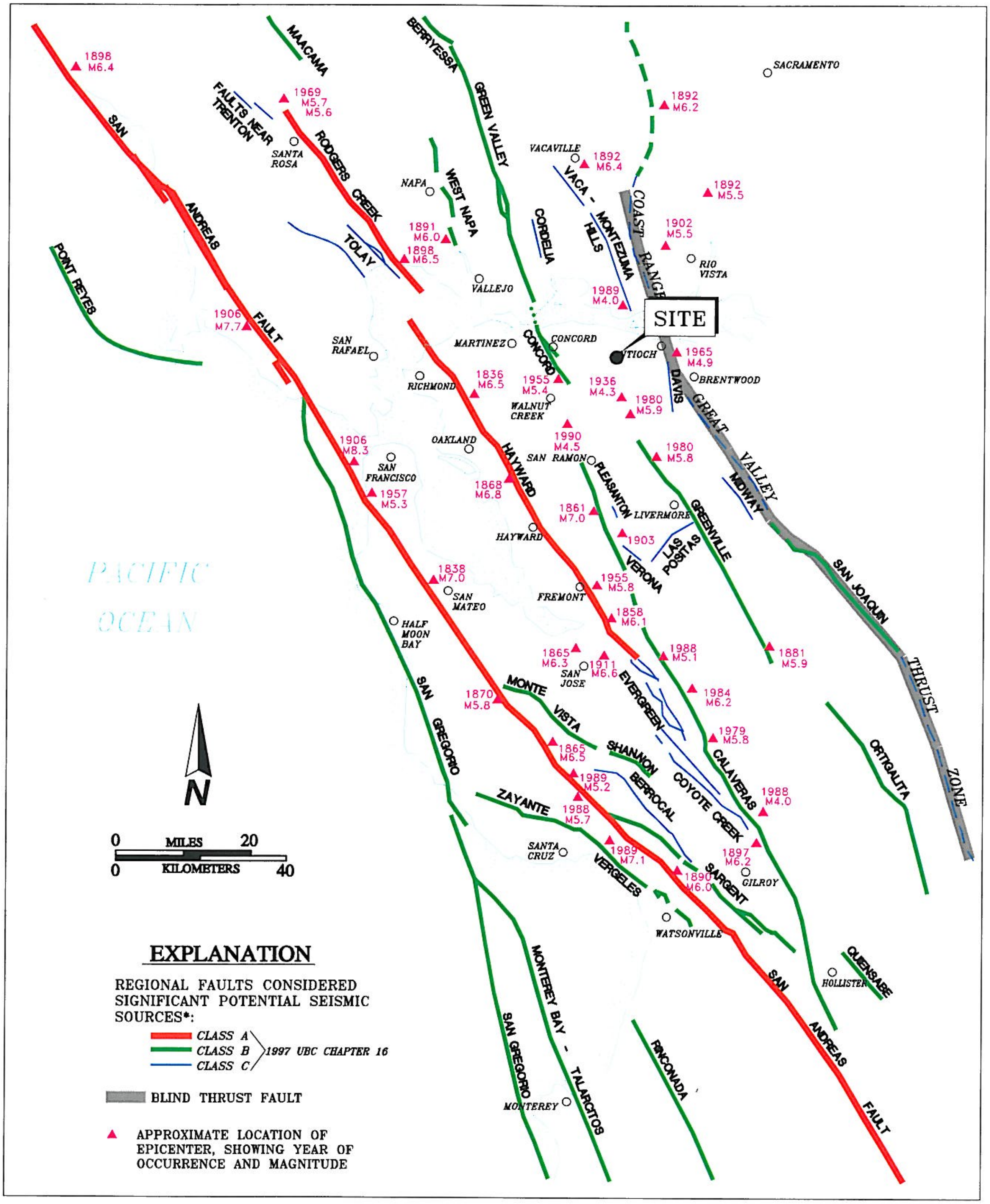

BASED ON U.S.G.S. OPEN REPORT 96-706

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REGIONAL FAULTING AND SEISMICITY
MONTREUX SUBDIVISION
PITTSBURG, CALIFORNIA

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FIGURE NO
4

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BASE MAP SOURCE: ISAKSON & ASSOCIATES

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GEOLOGIC MAP
MONTREUX SUBDIVISION
PITTSBURG, CALIFORNIA

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FIGURE NO. 5

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GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
5469.200.200

April 27, 2012
Revised May 21, 2012

Mr. Albert Seeno III
Seecon Financial & Construction Co., Inc.
4021 Port Chicago Highway
P. O. Box 4113
Concord, CA 94524-4113

RECEIVED
MAY 23 2012
PLANNING DIVISION

Subject: Montreux - Subdivision (8279)
Offsite Detention Basin
Pittsburg, California

PRELIMINARY GEOTECHNICAL EVALUATION OF OFF-SITE DETENTION BASIN

References:

1. Isakson And Associates, Vesting Tentative Map Off-Site Exhibit, Montreux, Subdivision 8279, Contra Costa County California, March 27, 2012.
2. ENGEO, Geotechnical Feasibility Report, Montreux Vesting Tentative Map Subdivision 8279, Pittsburg, California, February 11, 2010.

Dear Mr. Seeno:

ENGEO is pleased to present this geotechnical exploration for the proposed off-site detention basin area located north of the proposed Montreux Subdivision (8279) in Pittsburg, California. The ENGEO report of February 2010 (Reference 2) provides a summary of the geologic setting and general geotechnical conditions at the Montreux project. The purpose of this report is to provide our discussion of geology and soil conditions at the basin location, and provide preliminary geotechnical recommendations for construction.

PROJECT DESCRIPTION

Several locations have been contemplated for the subject basin. The current location concept is depicted in Reference 1, and it shows the basin on a northwest slope, just south of a mapped landslide location as shown on Figure 2. The planned 40,368-square foot basin is shown at Elevation 365 feet (msl). The basin will be created mainly in cuts. Proposed cut and fill slopes are shown to have inclinations ranging from of 3:1 to 2.5:1 (horizontal to vertical).

PREVIOUS EXPLORATION

ENGEO performed a subsurface exploration on the northern ridge flank for a previous proposed basin location. The locations of test pits performed for that study are shown on Figure 2. The test pit logs and laboratory test results are attached.

GEOLOGIC CONDITIONS

The site bedrock in the basin area consists of volcanic tuff and sandstone of the Lawlor Tuff, and nonmarine sediments of the Tulare Formation (Graymer, 1994). The dip of bedding in the bedrock formations varies from approximately 20 to 40 degrees to the northeast. The proposed basin is located on the contact between the two formations. As currently designed, the basin lies outside and south of a mapped deep-seated landslide area; a small portion of the basins northern limits is underlain by a smaller, surficial landslide, as shown on Figure 2. Based on the proposed plan grades, it appears that most of the basin will be cut into Tulare Formation bedrock.

The general bedding encountered in test pits varied from approximately N 50°E to N 55°W inclined at 16°N to 32°N, with an approximate average dip of about 20°N. The bedding attitudes and subsurface conditions recorded in the test pits are presented in the attached logs. The locations of the test pits and the measured bedding attitudes are depicted on the Site Plan, Figure 2.

The test pits depicted on Figure 2 were excavated into Tulare Formation bedrock similar that which will underlie most of the basin. The test pits encountered surficial soils consisting of moderately to highly expansive silty and sandy clays of thicknesses varying from 3 feet to 9½ feet overlying Tulare Formation bedrock. The bedrock encountered in the test pits consisted of weakly cemented to un-cemented dense silty sand interlayered with highly over-consolidated clayey silt, silty clay beds. The interlayered, weak bedrock conditions are typical for the Tulare Formation. The Plasticity Index (PI) of a sample of sandy claystone collected from Test Pit TP-4 was measured at 48, which indicates that the fine-grained bedrock layers are highly plastic. We reviewed previous laboratory testing in our files from adjacent projects in the Tulare Formation in Pittsburg and Antioch, including PI, grain size, and shear strength testing. The measured PI is consistent with the previous test data. The soil and bedrock conditions we observed in the test pits are generally consistent with the characteristics of the Tulare Formation that ENGEO has observed on a number of grading projects in the area.

CONCLUSIONS AND RECOMMENDATIONS

Based on the mapped geologic conditions it is our opinion that the proposed basin is geotechnically feasible provided that our recommendations are incorporated in design and implemented during construction. The proposed basin construction will require corrective grading, which should include removal, and replacement landside debris at the northern extent with suitable material. We anticipate that the corrective grading will include excavation of unsuitable soils, construction of toe keys and subsurface drainage.

The remedial grading design should consider the presence of soils and bedrock layers containing moderately to highly expansive clay. This basin location and orientation of cut slope is preferable to the other locations proposed.

Supplemental geotechnical analysis and recommendations should be prepared to provide site-specific geotechnical recommendations once detailed 40-scale design-level plans are available. We anticipate that design-level recommendations for the planned basin construction will include:

- Specific design recommendations for remedial grading including, slope rebuild configurations, keyways and subdrains.
- Site-specific geotechnical recommendations for site preparation grading and compaction of engineered fills.
- Corrective grading plans depicting the location and dimensions of required slope buttresses keyways and subdrains.

LIMITATIONS

The conclusions and recommendations contained in this report are solely professional opinions. The professional staff of ENGEO Incorporated strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. There are risks of earth movement and property damages inherent in land development. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our work.

If you have any questions or comments regarding this letter, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

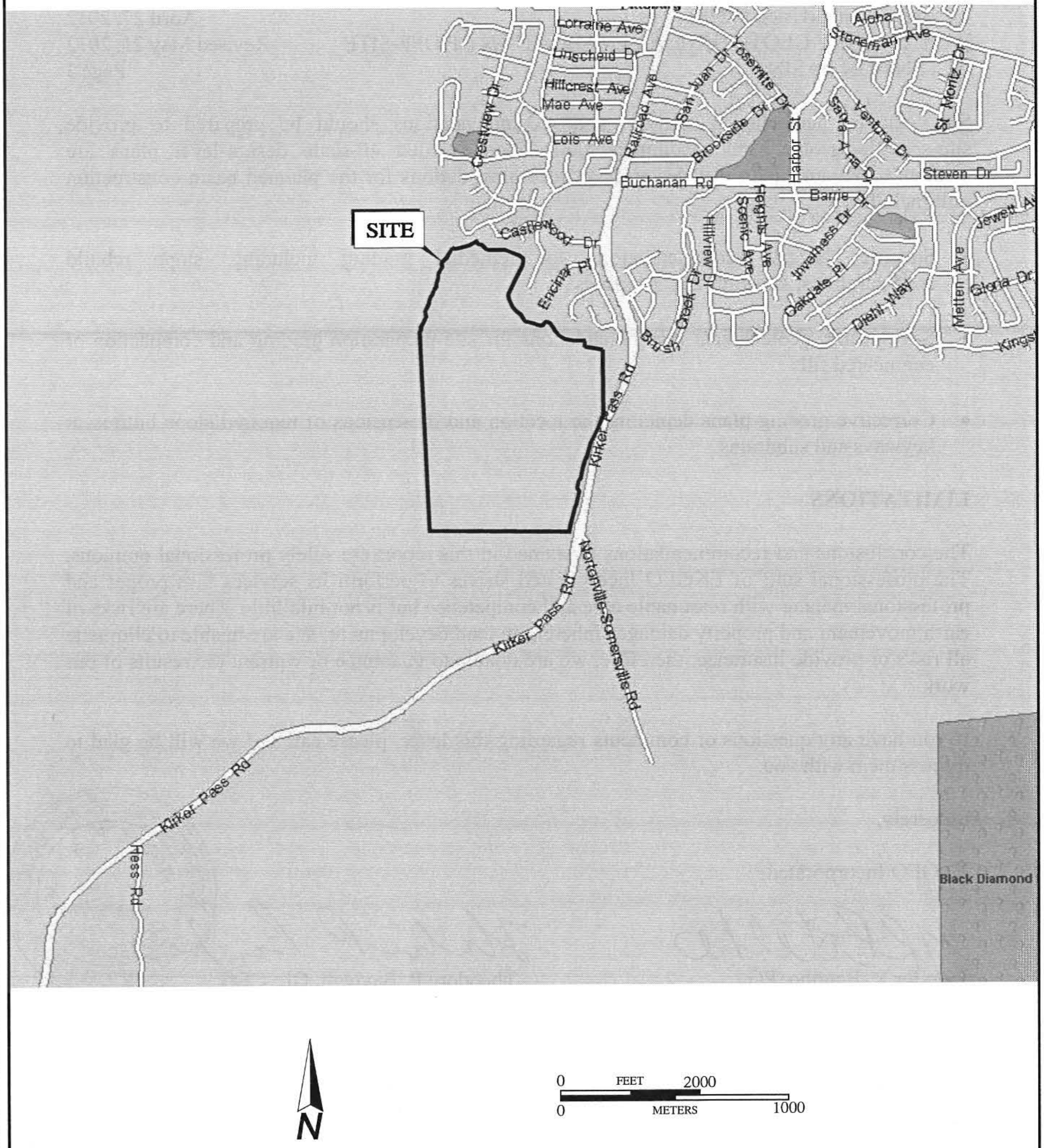
JRBotelho
Jennifer R. Botelho, PG

Theodore P. Bayham, GE, CEG

REGISTERED PROFESSIONAL ENGINEER
THEODORE P. BAYHAM
No. 2480
Exp. 9/30/2012
GEOTECHNICAL
STATE OF CALIFORNIA

Philip Stuecheli, CEG

Attachments: Figure 1 – Vicinity Map
Figure 2 – Site Plan and Preliminary Geologic Map
Test Pit Logs – TP-1 through TP-8
Liquid and Plastic Limits Test Report



BASE MAP SOURCE: MS STREETS AND TRIPS

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VICINITY MAP
MONTREUX
PITTSBURG, CALIFORNIA

PROJECT NO.: 5469.200.200
SCALE: AS SHOWN
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FIGURE NO. 1

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G:\Drafting\DRAFTING2_Dwg\5469\200\GEX\5469200200-fig2-SitePlan-0412.dwg Plot Date:5-03-12 spotters

EXPLANATION

TP-8 ■	APPROXIMATE LOCATION OF TEST PIT
16	STRIKE AND DIP OF BEDDING
	APPROXIMATE LOCATION OF LANDSLIDE
	APPROXIMATE LOCATION OF DEEP - SEATED LANDSLIDE
— — —	APPROXIMATE LOCATION OF GEOLOGIC CONTACT
Qc	COLLUVIUM
Tlt	LAWLOR TUFF
Tn	NEROLY SANDSTONE
Tt	TULARE FORMATION

N

0 FEET 160
0 METERS 80

BASE MAP SOURCE: ISAKSON & ASSOCIATES

ENGEO
Expect Excellence

SITE PLAN AND PRELININARY GEOLOGIC MAP
MONTREUX
PITTSBURG, CALIFORNIA

PROJECT NO.: 5469.200.200
SCALE: AS SHOWN
DRAWN BY: SRP CHECKED BY: TB
FIGURE NO. 2

ORIGINAL FIGURE PRINTED IN COLOR

ENGEO
INCORPORATED

TEST PIT LOG

Montreux Detention Basin
Pittsburg, California
5469.200.200

Logged By: Jennifer Botelho
Logged Date: October 26, 2011

Test Pit Number	Depth (feet)	Description
		Surface Elevation approximately 445 feet (msl).
TP-1	0 - 4	LEAN CLAY (CL), brown, dry, stiff to very stiff, abundant rootlets, contains fine-grained sand, below 2 feet abundant carbonate.
	4 – 6	CLAYEY SAND (SC), light yellowish brown, dry, dense, fine-grained sand, contains carbonate, gradational contact with SANDSTONE below.
	6 - 12	SANDSTONE, light yellowish brown, dry, extremely weak, moderately-to highly-weathered, very thinly bedded to laminated, poorly to non-cemented, pebble line ~ 6 inches thick at ~10 feet in depth, bedding at ~ N85°E, 28°N to N72°E, 16°N.
		Bottom at approximately 12 feet. Groundwater not encountered.
		Surface Elevation approximately 415 feet (msl).
TP-2	0 - 3	LEAN CLAY (CL), brown to dark brown, dry, stiff to very stiff, abundant rootlets, contains silt.
	3 – 5	SILT (ML), light yellowish brown, dry, very stiff, contains abundant carbonate, gradational contact with CLAYEY SILTSTONE below.
	5 - 11	CLAYEY SILTSTONE, light yellowish brown to brown, dry, weak, moderately to deeply weathered, faintly laminated, at ~8 feet in depth less carbonate, bedding at ~ N65°E, 17°N.
		Bottom at approximately 11 feet. Groundwater not encountered.
		Surface Elevation approximately 350 feet (msl).
TP-3	0 - 4	LEAN CLAY (CL), dark brown, dry, very stiff, abundant rootlets, contains silt, contains abundant carbonate below 2 feet.
	4 – 6	LEAN CLAY (CL), light yellowish brown, dry, very stiff, contains sand, contains abundant carbonate nodules.

ENGEO
INCORPORATED

TEST PIT LOG

Montreux Detention Basin
Pittsburg, California
5469.200.200

Logged By: Jennifer Botelho
Logged Date: October 26, 2011

Test Pit Number	Depth (feet)	Description
	6 – 9	SANDSTONE, yellowish brown, to gray brown, dry, extremely weak, deeply weathered, thin to very thin bedding, poorly to weakly cemented, gradational contact with SILTSTONE below.
	9 – 10	SILTSTONE, brown, dry, weak, moderately weathered, laminated, bedding at N73°W, 24°N.
		Bottom at approximately 10 feet. Groundwater not encountered
		Surface Elevation approximately 280 feet (msl).
TP-4	0 – 4½	FAT CLAY (CL), dark brown, dry, very stiff, abundant rootlets.
	4½ – 10	CLAYSTONE, interlayered light yellowish brown to brown and dark grayish brown with oxidation staining, weak, slightly moist, moderately to deeply weathered, contains carbonate between layers, bedding at ~ N85°E, 32°N.
		Bottom at approximately 10 feet. Groundwater not encountered.
		Surface Elevation approximately 305 feet (msl).
TP-5	0 - 5	FAT CLAY (CL), dark brown, dry, very stiff, abundant rootlets, contains silt, contains abundant carbonate below 3 feet.
	5 – 9½	LEAN CLAY (CL), reddish brown, moist, very stiff, contains carbonate and carbonate nodules, contains coarse-grained sand and small gravels, vesicular texture at base of layer.
	9½ –11½	SILTSTONE, yellowish brown, moist, weak, moderately weathered, faint laminations.
	11½ –14½	SANDSTONE, yellowish brown, very weak, slightly moist, laminated, lightly cemented, pebble lines with gravels and cobbles, bedding at ~ N55°W, 25°N.
		Bottom at approximately 14½ feet. Groundwater not encountered.

ENGEO INCORPORATED

TEST PIT LOG

Montreux Detention Basin
Pittsburg, California
5469.200.200

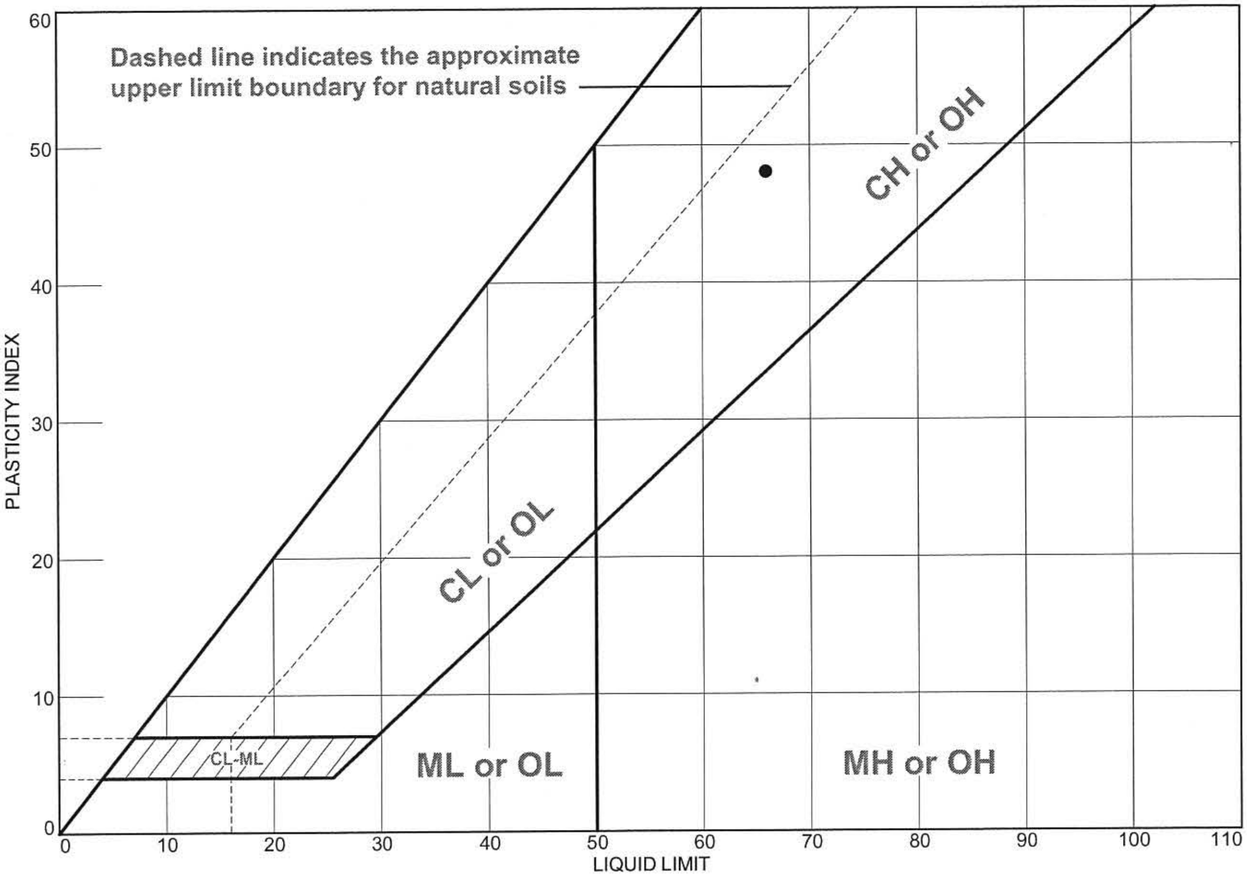
Logged By: Jennifer Botelho
Logged Date: October 26, 2011

Test Pit Number	Depth (feet)	Description
		Surface Elevation approximately 345 feet (msl).
TP-6	0 - 2	LEAN CLAY (CL), dark brown, dry, very stiff, abundant rootlets, contains silt and coarse-grained sand.
	2 – 3	LEAN CLAY/SILT (CL-ML), light yellowish brown, dry, very stiff, contains carbonate, pebble lines at the bottom contact.
	3 – 10	SILTSTONE, brown with ~ 6" reddish brown CLAYSTONE at ~8½ feet to grayish brown, weak, slightly moist, moderately weathered, laminated, contains abundant carbonate to 8 feet, less carbonate below 8 feet, gradational contact at CLAYSTONE to SILTSTONE transition, bedding at ~ N50°E, 17-21°N.
		Bottom at approximately 10 feet. Groundwater not encountered.
		Surface Elevation approximately 360 feet (msl).
TP-7	0 – 4½	LEAN CLAY (CL), dark brown, dry, very stiff, abundant rootlets, contains silt, contains fine-to coarse-grained sand and abundant carbonate below 2 feet.
	4½ – 7½	SILT (ML), yellowish brown, dry, very stiff, contains fine-to-coarse-grained sand, gravels, clay, and abundant carbonate.
	7½ - 10½	Interlayered SILTSTONE and SANDSTONE, yellowish brown and brown, slightly moist, weak, deeply weathered, faint laminations, weakly cemented, contains abundant carbonate, bedding at ~ N73°E, 21°N.
		Bottom at approximately 10½ feet. Groundwater not encountered.
		Surface Elevation approximately 270 feet (msl).
TP-8	0 - 4	LEAN CLAY (CL), dark brown, dry, very stiff, abundant rootlets, contains silt, contains fine-to coarse-grained sand and abundant carbonate below 2 feet.

TEST PIT LOG

Test Pit Number	Depth (feet)	Description
	4 – 8½	SILT (ML), yellowish brown, dry, very stiff, contains fine-to coarse-grained sand, gravels, and abundant carbonate.
	8½ – 15	SILTSTONE, brown, dry to slightly moist, weak, moderately weathered, laminated, bedding at N65°E, 17°N and N70°E, 20°N.
		Bottom at approximately 10 feet. Groundwater not encountered.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark yellowish brown weathered sandy CLAYSTONE.	66	18	48			CH

Project No. 5469.200.200 **Client:** SEECON Financial & Construction Co.

Project: Montreux

●**Sample Number:** TP-4

Remarks:

ENGEO
INCORPORATED

Tested By: GC

Checked By: DS

Geotechnical Investigation Report

GEOTECHNICAL INVESTIGATION REPORT
MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

January 6, 2000

KLEINFELDER
An employee owned company

January 6, 2000
File No. 43-1131-01.GEO

Mr. Donald E. Lapidus
Seecon Financial and Construction Co., Inc.
4021 Port Chicago Highway
Post Office Box 4113
Concord, California 94524-4113

Subject: **Geotechnical Engineering Report**
Montreux Subdivision
Kirker Pass Road
Pittsburg, California

Dear Mr. Lapidus:

Kleinfelder is pleased to present the results of our geotechnical investigation for the proposed Montreux Subdivision to be located in Pittsburg, California. The accompanying report includes background information regarding the anticipated construction, purpose of our investigation, and scope services provided. In addition, discussions regarding our investigative procedures, the known geologic conditions within the project area, and the site conditions encountered during our field exploration are presented. Finally, geotechnical conclusions and recommendations are provided for project design and construction. The appendices of the report provides logs of borings, a description of our laboratory testing, and results of laboratory tests

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 further involvement by Kleinfelder and other potential impacts to the proposed project.

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact our office.

Sincerely,

KLEINFELDER

Gary H. Gulseth, C.E., G.E.
Area Manager

No. 2233
6/01

GHG:pr4319R007

4c: Client

TABLE OF CONTENTS

GEOTECHNICAL INVESTIGATION REPORT
MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

1. INTRODUCTION

1.1 General

In this report we present the results of our geotechnical investigation for the proposed Montreux Subdivision to be located in Pittsburg, California. The site location relative to existing streets is shown on Plate 1.

This report includes our recommendations related to the geotechnical aspects of project design and construction. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our explorations and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented herein should not be extrapolated to other areas or used for other projects without our prior review.

1.2 Proposed Construction

We understand that design of the proposed development is currently underway and that final criteria are not available as of this writing. On a preliminary basis, we understand the central portion of the proposed 160-acre project site will be subdivided into 114 lots for single family residential construction. Appurtenant construction will include interior paved streets, buried utilities, and various concrete flatwork. We anticipate the future homes will be one and/or two story, wood frame structures with concrete slab-on-grade floor systems. Structural loading is anticipated to be relatively light, typical for small to moderately sized residential homes. Accordingly, we anticipate conventional spread footings or post-tensioned slabs will provide structural support. Maximum column and bearing wall loads (dead-plus-live) of 20 kips and 1.5 kips per linear foot, respectively, were assumed for the purpose of our evaluation. Subsurface structures, such as basements or cellars, are not anticipated.

The development boundaries generally lay within an elongated "bowl" shaped canyon with a maximum relief of about 185 feet. Two narrow drainage channels meander east-west through the property and drain through a culvert extending below Kirker Pass Road. Maximum fills on the order of 60 to 65 feet are anticipated in vicinity of lots 10, 123 and 124 located in the northeast and west-central portions of the site based on a preliminary grading plan prepared by Isakson and Associates, Inc. (dated July, 1, 1996). The primary fill slopes will be located along the east perimeter of the development and range from about 10 to 62 feet in height. Fill slopes within the interior of the development are anticipated to be 5 feet or less in height.

A significant number of lots proposed along the perimeter of the canyon will be cut to final pad grade. Maximum cuts on the order of 75 feet in the vicinity of lots 54, 55 and 56 and between 100 to 115 feet in the vicinity of lots 17, 18 and 19 are anticipated in the southwest and northeast portions of the site, respectively. Maximum cut slopes on the order of 70 to 80 feet are anticipated. Excavations for underground utilities are not anticipated to exceed 10 feet below final site grade.

A plot plan showing the proposed subdivision layout is presented on Plate 2. In the event these structural or grading details are inconsistent with the final design criteria, our firm should be contacted prior to final design in order that we may update our recommendations.

1.3 Purpose and Scope of Services

The purpose of our investigation was to explore and evaluate the subsurface conditions at various locations on the site in order to develop recommendations related to the geotechnical aspects of project design and construction.

The scope of our services was outlined in our proposal dated December 21, 1998 (File No. 43-YP8-070) and included the following:

- A visual site reconnaissance to investigate the surface conditions at the project site;
- A field investigation that consisted of excavating 21 test pits, performing 3 seismic refraction surveys, drilling 8 borings, and performing 2 rock cores within the area of the proposed development to explore the subsurface conditions at the project site;
- Geologic mapping within the area of the proposed development by an engineering geologist;
- Laboratory testing of representative samples obtained during the field investigation to evaluate relevant physical and engineering parameters of the subsurface soils;

- A review of selected literature regarding the known geology and seismicity of the project area;
- Evaluation of the data obtained and an engineering analyses to develop our geotechnical conclusions and recommendations;
- Preparation of this report which includes:
    - ➢ A description of the proposed project;
    - ➢ A description of the field and laboratory investigations;
    - ➢ A summary of the geologic conditions within the project area;
    - ➢ A description of the surface and subsurface site conditions encountered during our field investigation;
    - ➢ Conclusions and recommendations related to the geotechnical aspects of:
        - Potential geologic hazards;
        - Long-term fill settlement;
        - Cut and fill slopes;
        - Debris flows and landslides;
        - Artificial fill and debris;
        - Foundation design and construction;
        - Concrete floor slabs and exterior flatwork;
        - Earth retaining walls;
        - Asphalt concrete pavements;
        - Site surface and subsurface drainage;
        - General earthwork, including site preparation, fill materials, engineered fill, temporary excavations, trench backfill, and wet weather construction.
    - ➢ Appendices which include logs of borings, a summary of our laboratory testing, and results of laboratory tests.

2. FIELD AND LABORATORY INVESTIGATIONS

2.1 Field Investigation

Initially, the subsurface conditions at the site were explored on January 22, 1999 by excavating 21 test pits (T-1 through T-21) to depths ranging from about 3 to 11 feet below existing grade. Test pits were excavated using a John Deer 301 tire-mounted backhoe equipped with a 1.5-foot-wide bucket. In addition, three seismic refraction surveys (S-1 through S-3) were performed using a Dynamic multi-channel seismograph to evaluate the rippability of the near-surface rock. On March 17, 18 and 19, 1999 the subsurface conditions at the site were further explored by drilling eight borings (B-1 through B-8) and performing two rock cores (C-1 and C-2) to depths ranging from about 15 to 50 feet below existing grade. The borings were drilled using a CME-85 truck-mounted drill rig equipped with 8-inch O.D. hollow-stem auger. The rock cores were performed using a NQ^2 core barrel. The approximate test pits, seismic refraction survey, boring and core locations are presented on Plate 2

During the drilling operations, penetration tests were performed at regular intervals using a Modified California Sampler and/or Standard Penetration Sampler to evaluate soil relative density (cohesionless soils) or consistency (cohesive soils), obtain information regarding the engineering properties of the subsoils, and to retain soil samples for laboratory testing. The penetration tests were performed by initially driving the sampler 6 inches into the bottom of the bore hole using a 140 pound trip-hammer falling 30 inches to penetrate loose soil/weathered rock cuttings and "seat" the sampler. Thereafter, the sampler was progressively driven an additional 12 inches, with the results recorded as the corresponding number of blows required to advance the sampler 12 inches, or any part thereof. An engineer with our firm maintained a log of the borings and visually classified soil and rock encountered according to the Unified Soil Classification System (see Plate A-1 of Appendix A) and Rock Classification System (see Plate A-2). Soil and rock samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance, and returned to Kleinfelder's Pittsburg and Stockton laboratories for further testing.

After borings and cores were completed, they were backfilled with a lean cement grout under the observation of a representative from the Contra Costa County Environmental Health Department. Test pit excavations were backfilled with the excavated soil. Backfill was loosely placed and <u>not</u>

compacted to the requirements typically specified for engineered fill. Accordingly, structures, slabs-on-grade, or pavements located over the test pit areas may experience excessive settlement. Removal and compaction of test pit fill is recommended prior to construction of improvements over these areas.

A key to the Logs of Borings is presented on Plate A-3 of Appendix A. Logs of test pits, borings and cores are presented on Plates A-4 through A-34 of the appendix.

Please note the test pits, seismic refraction surveys, borings and cores were located in the field by visual sighting and/or pacing from existing site features. Therefore, the locations shown on Plate 2 should be considered highly approximate and may vary from that indicated on the plate.

2.2 Laboratory Investigation

Laboratory tests were performed in accordance with current ASTM standards on selected soil samples to evaluate their physical and engineering characteristics and engineering properties. The laboratory testing program was formulated with emphasis on the evaluation of natural moisture content, in-place density, grain-size distribution, plasticity, consolidation potential, and shear strength of the materials encountered. Two R-value tests were performed on composite samples of the native clays and weathered sandstone to evaluate pavement sections.

Details of the laboratory test program and the results of laboratory tests are summarized in Appendix B. This information, along with the field observations, was used to prepare the final test pits, boring and core logs in Appendix A.

3. GEOLOGIC CONDITIONS

3.1 Regional Geology

Northern Contra Costa County is bordered on the west by the San Francisco Bay, on the north by the Carquinez Straits and Suisun Bay, and on the north and east by the Sacramento and San Joaquin Rivers. A major part of the county lies within the Coast Ranges geomorphic province of Central California. The easternmost part of the county, including the area around the confluence of the Sacramento and San Joaquin Rivers, is within the Great Valley geomorphic province. The Coast Ranges consist of smooth rolling hills and fairly rugged mountains ranging in elevation from near sea level along San Francisco Bay and the San Joaquin Valley to 3,849 feet at Mount Diablo. Folds, thrusts, and faults form a series of nearly parallel, northwest-trending ridges made up mostly of Tertiary age (2 to 65 million years old) marine and non-marine shales, siltstones, sandstones, claystones, and conglomerates that strike roughly east-west and dip to the north. Bedrock at depth is presumed to be the Franciscan Complex of Upper Jurassic to Cretaceous age (65 to 140 million year old) that lies along the east side of the San Andreas Fault, located about 41 miles southwest of the site. Valleys between the ridges, including the San Joaquin Valley, are filled with Quaternary alluvium on fans and flood plains. Ridges bordering the San Francisco and Suisun Bays are skirted by terraces and alluvial fans that merge into the tidal flats adjacent the bays.

3.2 Local Geology

A review of geologic maps, prepared by the United States Geological Survey (USGS), covering the site and vicinity was performed, including: Open File Report 94-622 (Preliminary Geologic map Emphasizing Bedrock Formations in Contra Costa County, California – a digital database, by R.W. Graymer, D.L. Jones, and E.E. Brabb, 1994); and Open File Report 80-547 (Preliminary Geologic map of the Clayton Quadrangle, Contra Costa County, California, by T.W. Dibblee, Jr., 1980). Based upon our review, the mountains south of Pittsburg and Antioch are comprised of marine and non-marine sedimentary and volcanic rocks ranging in age from Eocene to Pliocene (about 50 to 2 million years old). Structurally, these rocks form a homocline, whereby the bedding of the formations strikes relatively consistently to the west-northwest and dips about 25 to 45 degrees to the north. The sedimentary rocks are generally sandstone and clay shale with less common beds of volcanic ash (tuff) and diatomaceous rock.

Based upon our review of the published maps and our geologic mapping at the site, presented on Plate 2, bedrock consists of the Markley formation, the Kirker formation, the Cierbo sandstone, the Neroly sandstone, and the Lawlor tuff, from south to north. These formations are younger in age from south to north. The Markley formation consists of deep marine, clay shale with occasional diatomaceous beds and forms the ridge along the south margin of the property. This formation is typically mantled by clay rich soil deposits and outcrops are generally absent. The Kirker formation, which consists of sandstone and tuffaceous sandstone (sandstone with an abundance of volcanic ash material) forms the lower portion of the steep north facing slope in the southern portion of the property. Most of this formation is concealed beneath colluvial/slope wash soil deposits; however, as a result of quarrying in the southeast corner of the property, some outcrops of this formation are visible. These outcrops expose thinly bedded, moderately fractured, and fine grained sandstone with thin volcanic ash beds. On this site, the Cierbo Sandstone is a relatively coarse grained, thick bedded sandstone with some conglomerate beds and limited fracturing. The Cierbo sandstone forms the small ridge in the central portion of the property. The Neroly sandstone is a thin to thick bedded non-marine sandstone formation with characteristically blue colored beds; it forms the steep and moderately steep south facing slopes in the northern portion of the property. Some of the thick and little fractured Neroly sandstone beds form erosion resistant bluffs, while other portions of the formation are thin bedded and closely fractured. Quarrying in the northeast corner of the property has resulted in scattered piles of large boulders, presumably from the thick resistant beds. Forming the ridge along the northern margin of the property is the Pliocene age Lawlor tuff that consists of volcanic ash and pumice breccia.

The uplifted homocline has been dissected by several streams that have created steep canyons with thin deposits of unconsolidated alluvium in the bottom. Surficial soil cover varies in thickness and clay content depending upon the underlying bedrock and slope. The clay rich rocks typically weather more deeply and form gentler slopes than the sandstone and tuff rock. Additionally, the clay rich rocks typically support thicker soils that are more prone to downslope creep and landsliding. The steeper slopes generally cannot support thick soils but are commonly associated with debris flow and rock fall hazards.

As illustrated on Plate 2, an alluvial valley that drains from west to east traverses the site. The alluvial deposits extend up into several swales and canyons, as shown on Plate 2. The main stream channel has incised into the alluvium to depths of up to 15 feet in the central portion of the property. Based on our observation of the exposures in the creek channel, the alluvial material is composed of unconsolidated clayey sand and silt with gravel. Its thickness is less than

20 feet over most of its distribution. In an apparent effort to reduce erosion along the incised channel, an abundance of artificial debris and boulders have been dumped along much of the channel alignment. The approximate limits of two large areas of undocumented fill, related to in-filling of a portion of the creek channel and quarrying, are shown on Plate 2.

Surficial soil deposits other than the alluvium appear to be generally thin (less than 5 feet in thickness) across the site. This is likely related to the relatively steep slopes. As illustrated on Plate 2, most areas where slopes are about 4:1 (horizontal to vertical) or steeper are scarred by evidence of debris flow landslides or rock-falls. Debris flows are fast moving landslides of saturated soil and/or weathered rock material. The generally occur on slopes steeper than about 4:1 where relatively porous soils exists. Large areas of the north facing slopes, underlain by the Kirker and Markley formations, in the southern portion of the property have been impacted by shallow (2 to 3 feet in depth) debris flow failures. Most of those mapped were active in 1998. The south facing slope slopes, underlain by the Neroly sandstone, are littered with loose rock, indicating that rock-falls are common. As a result of the generally thin soil deposits, only a few small shallow landslides (failures where a relatively coherent mass moves as a unit) were observed along the narrow drainage channel descending from the southeast corner of the site were observed. These are shown on Plate 2.

3.3 Faulting and Seismicity

The site is not located within an Alquist-Priolo Earthquake Fault Zone, where surface fault rupture is considered a potential hazard. The closest active fault is the Clayton-Marsh Creek Fault, located about 5 kilometers (km) southwest of the site on the east side of Clayton Valley. This fault is the northern extension of the Greenville fault that continues for more than 35 miles to the south. This fault system has experienced significant historic earthquakes. In January of 1980, two earthquakes (M5.5 and M5.6) occurred on the southern end of the Marsh Creek segment, east of Danville and north of Livermore. The fault system is zoned the by the Alquist-Priolo Act for most of its length, based on evidence of surface ground rupture associated with the 1980 earthquakes and other Holocene (the last 10,000 years) events.

There are numerous other active faults in the region which are considered capable of generating major earthquakes resulting in strong ground shaking at the site. Other faults which are considered significant seismic sources in the region include: the Concord fault about 11 km to the west; the Green Valley fault, about 20 km to the northwest; the West Napa fault, about 35 km to the northwest; the Calaveras fault, about 40 km to the southwest; and the Hayward fault, about

43 km to the southwest. Of these faults the Concord, Calaveras and Hayward faults have generated significant historic earthquakes. The most significant seismic sources with respect to the potential severity of ground shaking at the site are the Clayton and Concord faults; however, a major earthquake on any of the major Bay area region faults could result in significant ground shaking at the site.

4. SITE CONDITIONS

4.1 Surface

The proposed development boundaries are generally situated within an elongated "bowl" shaped canyon with a small, gently sloping ridge extending from the southwest corner towards the center of the site. General site drainage is towards the east with a maximum relief of about 185 feet. Moderate to steeply sloping hillsides and ravines bound the north, south and west perimeters of the development. Kirker Pass Road bounds the eastern perimeter of the site. Two drainage channels originate southwest of the development and traverse on both sides of the small ridge in a northeast direction. Near the central portion of the site the channels appear to converge but are filled with artificial fill debris. Down-gradient, a single channel again emerges from the artificial fill and trends northeast toward a culvert passing under Kirker Pass Road.

At the time of our field explorations, a majority of the site was covered by a moderate growth of green grasses and weeds. An abandoned single story ranch house, shed, hay barn and various debris and equipment were noted in the eastern portion of the site. In addition, an abandoned well consisting of an open conduit and concrete collar was located southwest of the residence. A possible second abandoned well with a windmill was noted within the north drainage channel near the west-central portion of the site. South of the residence and north of the hay barn the original hillsides have been quarried, leaving 20 to 30 foot cut slopes along the perimeter. Various barbed wire fences and unpaved ranch roads crossed the site. During our site reconnaissance, both drainage channels were supporting light to trickling flows derived from seepage areas and springs. Marshy conditions surrounded both seepage areas.

4.2 Subsurface

In general, the subsurface conditions encountered in our test pits, borings, and cores was relatively consistent with geologic maps of the project area and our geologic mapping at the site.

The site is traversed by an valley that drains from west to east. Based on our findings, the lower elevations of the valley are generally underlain by unconsolidated alluvium consisting predominately of medium stiff to very stiff, moderately plastic clays and silts to depths in excess of 16 feet, the maximum depth explored. A strata of moderately plastic, unconsolidated clays also cover the moderate to steeply sloping hillsides to the north, south and east. The depth of these soils, however, appear be limited to about 9 feet or less in thickness and consist of colluvium/slope wash derived from up-gradient debris flow landsliding. The colluvium and small ridge near the central portion of the site are underlain by moderately to completely weathered, weak to moderately strong, very close to moderately fractured sandstone with thin interbedded siltstone layers of the Kirker, Cierbo and Neroly formations.

In an apparent effort to increase the usable area or reduce erosion, an abundance of artificial and undocumented clayey/silty fill with significant interbedded debris has been dumped along much of the drainage ravine alignment. Based on our observations, the debris appears to consist predominately of inert materials, such as brick, rebar, asphalt, pipe and concrete to about 3 feet in dimension. Isolated wood pieces were observed at several test pits. The general location of the artificial fill is shown on Plate 2.

Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Logs of Borings, Plates A-4 through A-34 of Appendix A. A summary of laboratory tests is presented on Plate B-1 of Appendix B.

4.3 Groundwater

At the time of our field investigation, free groundwater was not encountered at any of our test pit or borings locations. It should be noted that groundwater elevations and soil moisture conditions within the project area will vary depending on seasonal rainfall, irrigation practices, land use, and/or runoff conditions not apparent at the time of our field investigation. The evaluation of such factors is beyond the scope of this investigation.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on our findings, it is our professional opinion that the site should be suitable from a geotechnical standpoint to develop the proposed subdivision as planned provided the recommendations contained herein are incorporated into the project design and construction. Given the subsurface conditions encountered, the primary geotechnical considerations from a development standpoint are: 1) the moderate to highly expansive clays covering the site; 2) the stability of cut and fill slopes; 3) the long-term compression or settlement of deep fills; 4) removal and replacement of undocumented artificial fill and debris; 5) subsurface drainage and seepage control; 6) stabilization of debris flows, landslides and colluvium; 7) excavation conditions or rippability of the underlying sandstone bedrock; and 8) cut/fill transitions. Specific conclusions and recommendations addressing these geotechnical considerations, as well general recommendations regarding the geotechnical aspects of design and construction are presented in the following sections.

5.2 Seismic Hazards

The project site and its vicinity are located in an area traditionally characterized by high seismic activity. Historical records indicate the site will likely be subject to strong seismic shaking at least once during the design life of the project. The damaging effects associated with earthquakes can be classified in two categories, primary and secondary. The primary earthquake effects include ground shaking and fault-related ground rupture. A common secondary effect includes ground failure as a result of soil liquefaction.

A large earthquake on any of the active Bay Area faults will cause strong ground shaking at the site. A table summarizing regional active faults identified by the 1997 Uniform Building Code (UBC), the distance from active fault traces at the surface to the site, the estimated upper-bound earthquake magnitude for each fault, the UBC Seismic Source Type for each fault, and estimated peak accelerations (10 percent probability of exceedence in 50 years) based on an attenuation relationship developed by Joyner, Boore, and Fumal (1994, Site Class C) is presented below:

Fault	UBC Seismic Source Type	Distance, miles (km)	Maximum Magnitude	Peak acceleration, g
Greenville	B	3 (5)	6.9	0.47
Concord-Green Valley	B	7 (11)	6.9	0.32
West Napa	B	22 (35)	6.5	0.11
Calaveras	A	25 (40)	6.8	0.12
Hayward	A	27 (43)	7.1	0.19
Rodgers Creek	A	31 (50)	7.0	0.11
San Andreas	A	41 (66)	7.9	0.15

As shown, the controlling seismic event for the project would likely be a magnitude 6.9 earthquake along traces of the Greenville fault located about 3 miles southwest of the project site. The results of our evaluation can be compared with a Probabilistic Seismic Hazards Map (1996) developed by the California Department of Mines and Geology (CDMG). The map, which only includes active faults, comparably places the project site in an area with a peak horizontal ground acceleration (10 percent probability of exceedence in 50 years) of between 0.5g and 0.6g.

Earthquakes are caused by the sudden displacement of earth along faults with a consequent release of stored strain energy. The fault slippage can often extend to the ground surface where it is manifested by sudden and abrupt relative ground displacement. Damage resulting from fault rupture occurs only where structures are located astride the fault traces that move. The subject site is not located within, nor is it adjacent to any Fault-Rupture Hazard Zones (formerly Alquist-Priolo Special Studies Zones) (Hart, 1990). The closest known active fault to the site is the Greenville fault, located about 3 miles to the southwest.

Liquefaction describes a phenomenon in which saturated soil loses shear strength and deforms as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Dissipation of the excess pore pressures will produce volume changes within the liquefied soil layer, which can manifest at the ground surface as settlement of structures, floating of buried structures, and failure of retaining walls. Factors known to influence liquefaction include soil type, grain size, relative density, confining pressure, depth to groundwater, and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose sandy soils.

The potential for an earthquake with the intensity and duration characteristics capable of promoting liquefaction is a possibility during the design life of the project. However, given the subgrade soils encountered are generally high in clay content or consist of dense weathered bedrock, the potential for liquefaction is considered remote.

5.3 Seismic Design Criteria

Based on the shallow and moderately strong bedrock at the site, the site classifies as Site Class S_B, per the 1997 Uniform Building Code (UBC), in its present state. Considering that relatively deep fills (30 feet or more) are likely to be placed on this site prior to building of structures, a Site Class S_C should be considered as the design Site Class for development. Site Class S_C is defined as very dense soil and soft rock with shear wave velocities in the range of 1,200 to 5,000 feet per second (fps), SPT-N values greater than 50, and undrained shear strength greater than 2000 pounds per square foot (psf), for the upper 100 feet of the soil/rock profile.

Consideration of near fault issues in structural design will be required per the 1997 UBC and the 1998 California Building Code (CBC), which is soon to be adopted in most areas of California. Since the Greenville fault is a Type B fault, and within 5 kilometers of the site, near fault factors will need to be incorporated into structural design. Per Tables 16-S and 16-T of the 1997 UBC, the Near Source Factors N_a and N_v are 1.0 and 1.2, respectively, for a site within 5 kilometers of a Type B fault.

5.4 Expansive Clays

Based on our finding and previous experience, the clay alluvium in the lower elevations of the site and the colluvium covering the sandstone bedrock is moderately plastic and may exhibit a significant shrink-swell (expansion) potential with variations in moisture content. The underlying sandstone should be essentially non-expansive. Empirical estimates of potential expansion pressures range from about 1,000 to 1,500 psf with potential differential heave on the order of 2 to 3 inches. Accordingly floor slabs, lightly loaded foundations, exterior flatwork, and pavements could be susceptible to up-lift, cracking and increased maintenance if supported directly on the clays.

Combined with positive site drainage, the most direct and possibly cost effective approach to address this consideration would be to support structures on at least 2 feet of non-expansive fill. This can be accomplished by selectively grading the site so building pads are overlain or "capped" with crushed sandstone materials. The zone of non-expansive fill should extend laterally at least 5 feet outside the perimeter of the proposed structures. This procedure would serve to replace the near-surface clays below slabs most susceptible to seasonal or man-made shrink-swell cycles; increases the dead-load imposed on the underlying clays to resist up-lift pressures; and will produce a more uniform heave pattern with less differential movement should the lower clays expand. The depth of non-expansive fill can be reduced to 1 foot in exterior flatwork and pavement areas. Additional recommendations regarding exterior flatwork, pavements, engineered fill, and compaction criteria are presented in Sections 5.15, 5.19.4, and 5.19.5.

Structural alternatives to non-expansive fill and selective grading would be to support the homes on a rigid foundation system designed to resist and/or span the expansive soils. Candidate foundation systems include conventionally reinforced slabs, post-tensioned slabs, and/or pier and interconnecting grade beams. Based on our previous discussions, recommendations contained herein are limited to post-tensioned slabs (Section 5.13). If it is desired to pursue other foundations systems further, supplemental recommendations can be provide upon request.

5.5 Debris Flows and Landslides

Most areas of the site were slopes are about 4(h):1(v) or steeper are scarred by evidence of debris flow landslides and rock-falls. Debris flows are fast moving landslides of saturated soils and/or weathered rock material. Large areas of the north facing slopes in the southern portion of the proposed development have been impacted by shallow (2 to 3 feet in depth) debris flow failures. The south facing slope slopes are littered with loose rock indicating that rock-falls are common. As a result of the generally thin soil deposits covering the slopes, only a few small landslides (failures where a relatively coherent mass moves as a unit) were observed along the narrow drainage channel descending from the southeast corner of the site were observed.

We anticipate that large portions of the debris flow and landslide materials (colluvium) within lot areas will be removed during grading and construction of cut slopes along the perimeter of the development. Where this material remains, however, it will need to be removed entirely prior to placement of new fills and/or support of structures. In addition, colluvium on 4(h):1(v) or steeper slopes above and outside the development should be removed to prevent the material from creeping toward and onto the development. Depending on the extent of additional grading to remove this material, either the excavation should be replaced with compacted engineered fill (with keyways and benches) or the remaining slopes should be graded to an inclination of 3(h):1(v). Recommendations regarding engineered fill, benching and slope keyways is provided in Sections 5.6 and 5.19.

An alternative to removal, although presenting a greater risk for colluvium to impact down-slope lots, an interceptor ditch and/or catch wall could be constructed near the toe of the slope to intercept debris and colluvium. Th interceptor ditch should be at least 5 feet deep and 30 feet wide with side-slopes at 3(h):1(v) or flatter. If considered, a maintenance program should be implemented to clean the interceptor ditch of accumulated colluvium before the start of each rainy season, and if necessary, after each rainstorm.

During our site reconnaissance, numerous sandstone boulders to 4 feet in dimension were noted at the base of the south facing natural slope and quarried/cut slope near the southeast corner of the proposed develop. Following site grading, it is likely this rockfall will continue and possibly increase due to greater cut slope exposures combined with the frequent fracturing of the sandstone. Accordingly, protective measures should be implemented in areas were homes are located down-slope. Combined with scaling and trimming any loose rock blocks encountered during grading, the most direct method of protection is to provide frequent benches on the cut rock slope to intercept the rock-falls partway up the slope or slow falling/rolling rock. In addition, an interceptor ditch and/or catch wall should be constructed at the base of the slope. A rock fall analysis should be performed to size the interceptor ditch based on the final height and inclination of proposed cut slopes. As a minimum, the interceptor ditch should be at least 5 feet deep and 20 feet wide with side-slopes at 2(h):1(v) or flatter. Alternatives include the installation of anchored wire mesh pinned to the slope to prevent loose rock from becoming dislodged or wire-mesh catch nets and fences to intercept or slow the rockfall. If these alternatives are considered, professionals experienced in these methods and techniques should be consulted to provide final recommendations.

5.6 Cut and Fill Slopes

Cut rock slopes and fill slopes should not exceed an inclination of 2(h):1(v). Given this inclination, however, some displacement, movement, and/or rockfall should be expected in the event of significant seismic ground shaking. For the subgrade conditions at the site, this movement is expected to be shallow seated, requiring limited clean-up and dressing to restore the slopes to original condition. If this condition is unacceptable, the slopes should be flattened.

Where fills are to be constructed on original ground that slopes at an inclination of 6(h):1(v) or steeper, a 4-foot deep toe key should be excavated into firm competant soil/weathered rock. The keyway should be at least 10 feet wide at the bottom or a width equal to ½ the vertical slope height, whichever is greater; with the bottom inclined down and back into the slope at 2 percent. As filling progresses, benches should also be cut into firm competent soil/weathered rock. Each bench should consist of a level terrace at least 8-feet wide with the rise to the next bench held to 5 feet or less. Subsurface drainage should be also placed within the toe keyway and at the mid-point of the slope. A typical keyway, bench and subdrain detail is presented on Plate 3. Fill slopes should be constructed by overfilling and trimming back to provide a firm, well compacted slope face.

Paved interceptor drains should be provided along the tops of slopes where the tributary area flowing toward the slope has a drainage path greater than 40 feet, measured horizontally. Horizontal paved terraces at least 8 feet wide should be established at mid-height for slopes of between 20 and 30-feet in height, and at vertical intervals of 25-feet thereafter. The interceptor drains or terraces should be sloped to a suitable drainage device and disposed off-site well below the toe of the slope. In addition, slopes should be inspected periodically for erosion and repaired immediately if detected. Interceptor drains should be cleaned before the start of each rainy season, and if necessary, after each rainstorm. To minimize erosion and gulling, all disturbed areas should be planted with erosion-resistant vegetation suited to the area. As an alternative, jute netting or geotextile erosion control mats can be installed per the manufactures recommendations.

The stability of cut slopes (particularly in sedimentary bedrock) is due in large part on their location and orientation with respect to the structure of the underlying bedrock. If adverse bedding, joint planes, or other zones of geologic weakness are encountered during grading, corrective grading (for example: buttress fills, reconstruction of the slope or flattening of the slope) may be required to provide stability of such slopes. Particular attention needs to be provided to cuts within the north facing slope at the site. Exposed bedding on this slope appears to dip steeper than 2(h):1(v) or 26.5 degrees. If this is found to be consistent during earthwork, stability problems should not pose a significant concern. However if bedding is flatter, the beds would be exposed adversely to the cut and there would be a potential for slope failure of beds along bedding planes, especially if there are weak clay interbeds present. Accordingly, observation of the initial grading of cut slopes should be made by an engineering geologist. If an adverse dip is present, corrective recommendations may be warranted. A detail of a typical buttress fill at a reconstructed cut slope area is presented on Plate 4.

5.7 Long-Term Fill Settlement

We understand that deep engineered fills on the order of 60 to 65 feet are currently planned near the central portion of the site. Even when properly controlled during earthwork, deep fill, i.e., fill exceeding 20 feet in thickness, can settlement significantly under its own weight. Additionally, deep fills may undergo further settlement if the water content of the deeper portions of the fill increases. The source of the water is typically from landscaping irrigation and/or from seeps or springs in canyon walls. Recommendations to address surface and subsurface drainage are presented in Sections 5.9 and 5.18.

Unlike landslides, the results of fill settlement are seldom catastrophic but the cost of perpetual maintenance of roadways, utilities, and possibly foundations due to continuing settlement can be substantial. For estimating purposes, long-term settlement of granular fills, i.e. crushed sandstone, on the order of 0.8 percent and 1.5 percent of the fill thickness should be anticipated for fill heights of about 20 feet and 60 feet, respectively. Accordingly, we estimate long-term settlement on the order of 1, 3 and 6.5-inches could be anticipated for fill thickness of 20, 40 and 60 feet, respectively. Likewise, long-term settlement of clay fills on the order of 1.1 percent and 2.4 percent should be anticipated for fill heights of about 20 and 60 feet, respectively. Based on this premise, we estimate long-term settlements on the order 1.5, 5 and 10-inches could be anticipated for fill heights of 20, 40 and 60 feet, respectively. Where fill thickness varies from those shown, long-term settlement can reasonably be estimated by interpolation, however, actual settlements can vary depending on factors not apparent at the time of this investigation.

Long-term settlement of granular fills is expected to be primarily elastic, with a majority occurring during or within about 1 month of earthwork operations. Clays, however, due to their low permeability typically settle much slower due to dissipation of excess pore pressures and soil creep. Settlement could continue for several months to over a year. Accordingly, consideration should be given to either thoroughly mixing clay fills with granular fill material during earthwork or placing the clays in relatively thin layers to reduce the settlement period.

The foundation materials supporting fills will likewise settle due to the surcharge loading. In areas were fills overlie sandstone and/or thin layers of clay, foundation settlement should be minimal and occur during or soon after earthwork. In areas were fills overlie deep clays, such in the lower elevations of the site, foundation settlements on the order of a few inches to 1-foot should be anticipated depending on the surcharge loading. Consistent with clay materials, this settlement will occur relatively slow and could continue for several months to over a year.

Following grading, long-term settlement should be measured using a system of settlement plates or stakes that measure deflections at the top of the fill. The purpose will be to evaluate the rate at which the fill is settling so that infrastructure could be safely installed without significant risk of movement. The settlement plates or stakes should be installed on a 100 to 150 foot grid and monitored every week for the first month and every two weeks thereafter, if necessary.

5.8 Artificial Fill and Debris

In an apparent effort to increase the usable area or reduce erosion, an abundance of artificial and undocumented clayey/silty fill with significant interbedded debris has been dumped along much of the drainage ravine alignment in the east-central portion of the site. Based on our observations, the debris appeared to consist predominately of inert materials, such as brick, rebar, asphalt, pipe and concrete to about 3 feet in dimension. Additional fills may be encountered in the area of the old hay barn and other isolated areas of the site. In our opinion, these fills will not be suitable in their current condition for support of new fills or proposed structures due to settlement considerations. The most direct method to improve the subgrade conditions would be to overexcavate the fill materials to sound native subgrade, remove any deleterious materials encountered, and compact the materials as engineered fill in accordance with Section 5.19.5.

5.9 Subsurface Drainage and Seepage Control

During our reconnaissance in January of 1999, the main drainage channel was supporting a flow of several gallons per minute in the eastern portion of the property. In March 1999, this flow had slowed to a trickle. The source of this flow was from two primary seepage areas, as illustrated on Plate 2. The generally marshy conditions surrounding the southern seepage area, and its location at the head of an alluvial fan indicate that it stays relatively fixed throughout the winter and spring. However, the seepage shown within the main drainage channel likely moves up and down the channel depending upon the discharge of water from the alluvial deposits within the channel.

To maintain the stability of fills, provide a stable base for compaction of fill, and reduce the potential for post-construction settlement of deep fills, subsurface drainage should be provided in the two natural drainage areas within the development to intercept seepage and dispose it off-site. Seepage also may be encountered in areas where it was not evident during this investigation. Accordingly, earthwork operations should be monitored by an engineering geologist and/or geotechnical engineer with Kleinfelder for the presence or suspected presence of seeps or springs. If observed, it may necessary to design and install additional subdrain systems at these locations during earthwork operations.

General subdrain details are presented on Plate 5. Prior to placement of the subdrain, the drainage channels should be cleaned of all organics, organic soils, and disturbed material to firm native subgrade and benched with sides sloped 2(h):1(v) or flatter to permit access for compaction equipment.

The planned grading will result in a significant excavations throughout the site. Installation of subsurface drainage, i.e. subdrains or hydroaugers, in the lower areas of the cut slopes are recommended for slopes greater than 30 feet in height. Additional subsurface drains may be required upslope on larger cuts. The cut slopes higher than 30 feet in particular, as well as all other cut slopes, should be monitored both during and after construction for the presence of seeps or springs and may require the installation of retrofit subdrains.

Although efforts will be undertaken during grading of the site to identify, intercept and control seepage and springs, additional seeps or springs may develop. In addition to natural groundwater, introduction of landscape water through irrigation and percolation into the hillsides will occur which could result in increased seepage at both cut and fill slopes. This may result in the need to add additional subsurface drainage systems after mass grading and site development are complete. Prior to finalization, a representative from our firm should review the project grading and drainage plan to evaluate the location and need for subdrains.

5.10 Excavation Conditions

During our field exploration, various test pits and borings were excavated and three seismic refraction tests performed to estimate the rippability of the sandstone underlying the site. The results of the seismic refraction tests are presented on the following table:

Seismic Refraction Line	Approximate Depth Interval, ft.	Apparent Shear Wave Velocity, fps
S-1	0 – 5	1,500
	5 – 60	3,500
S-2	0 - 10	725
	10 - 30	9,000
S-3	0 - 12	2,100
	12 - 60	4,100

Based on the data obtained, it should be possible to excavate the near-surface soils and the upper few feet of weathered bedrock using conventional earthmoving equipment. Below this material, the bedrock becomes less weathered and more resistant to excavation. Larger earthmoving equipment, such as a D9H or D10L Caterpillar tractor fitted with a single tooth ripper may be necessary to complete site grading. Deep cuts may require even heavier equipment, such as a Caterpillar D10N or D11N. Heavy tractors or hydraulic shovels with case-hardened steel rippers probably can excavate utility trenches that extend in to this material, although overwidening is inevitable. Pneumatic hammers (hoe-ram) may be required to break-up resistant bedrock areas.

The predicted excavation conditions reported herein are intended for informational purposes only, and should not be interpreted in imply that localized resistant bedrock layers, boulders or outcroppings will not be encountered. The ultimate proof of a materials rippability can only be determined by machine trial during grading. Accordingly, prior to grading the earthwork contractor should perform his own analysis to evaluate the rippability of the bedrock and size his equipment for the project. We suggest a unit cost be included in the bid schedule for localized overexcavation and/or blasting to remove resistant materials, if encountered.

5.11 Cut/Fill Transitions

As part of the planned grading at the site, we anticipate numerous lots will be located in transitions between cut and fill. Supporting structures on both native (cut) soils and engineered fill can lead to unpredictable and sometimes large differential settlements due to the different physical properties, and thus support characteristics, of the two materials. Cracking often develops in floor slabs and foundations spanning the transition area between two supporting soils. Accordingly, the cut portion of the building pads beneath the planned residence and extending horizontally at least 5 feet beyond, should be overexcavated to a minimum depth of 3-feet and replaced with engineered fill. Where lots are to be constructed on fills that vary more than 8 feet in thickness across the planned structure location, the grading should be modified to maintain a maximum differential fill thickness of 8 feet.

5.12 Spread Foundations

5.12.1 Allowable Bearing Pressures

The proposed residences may be supported on shallow, reinforced concrete, spread footings founded on undisturbed native soil or engineered fill. Continuous and isolated spread footings should have minimum widths of 12 and 24 inches, respectively, and be embedded at least 18 inches below the lowest final adjacent subgrade[1] Where located near existing or future utility lines, footings should extend below a 1(h):1(v) plane projected upward from the closest bottom corner of the trench. Footings so established may be designed using a net allowable bearing pressure of 2,500 pounds per square foot (psf) for dead plus sustained live loading. A one-third increase in allowable bearing pressure may be applied when considering short-term loading due to wind or seismic forces.

5.12.2 Estimated Settlements

Total settlement of an individual foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based on assumed foundation dimensions and loads, we estimate maximum total and differential foundation settlements should be on the order of ½-inch, respectively.

5.12.3 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soils, and by passive soil pressure against the sides of the foundations. A coefficient of friction of 0.40 may be used between cast-in-place concrete foundations and the underlying soil. Passive pressure available in engineered fill or undisturbed native soil may be taken as equivalent to the pressure exerted by a fluid weighing 350 pounds per cubic foot (pcf).

Lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied for design purposes. For static and seismic loading conditions, factors of safety of at least 1.5 and 1.15, respectively, should be used for design. The appropriate factor

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[1] *Within this report, subgrade refers to the top surface of undisturbed native soil, native soil compacted during site preparation, or engineered fill.*

of safety will depend on the design condition and should be determined by the project Structural Engineer.

The passive resistance of the subgrade soils will diminish if trench sidewalls slough or cave during or following excavations. If this condition is encountered, our firm should be notified to review the condition and provide remedial recommendations, if warranted.

5.12.4 Additional Considerations

Prior to placing steel or concrete, footing excavations should be cleaned of all debris, loose or soft soil, and water. If shrinkage cracks appear in the footing excavations, the excavations should be thoroughly moistened to close all cracks prior to placement of concrete All footing excavations should be observed by the project Geotechnical Engineer just prior to placing steel or concrete to verify the recommendations contained herein are implemented during construction.

The structural engineer should evaluate footing configurations and reinforcement requirements to account for loading, shrinkage and temperature stresses. As a minimum, continuous footings should be reinforced with at least two No. 4 reinforcement bars, one top and one bottom, to provide structural continuity and permit spanning of local subgrade irregularities.

Structures located near the top (or bottom) of a cut or fill slope should maintain a minimum set-back in accordance with requirements indicated in Figure No. 18-I-1 of the Uniform Building Code (UBC), 1997 edition, or 5 feet (measured horizontally from the top or bottom of slope to the closest point of approach of the structure), whichever is greater.

5.13 Post-Tensioned Slab Foundations

5.13.1 Subgrade Preparation

If post-tensioned slab-on-grade foundations are supported directly on native clays or compacted clay fill, the upper 12 inches of subgrade soils should processed so that soil clods are no larger than 3 inches in dimension, <u>uniformly</u> moisture conditioned to between 3 and 5 percentage points above the optimum moisture content, and compacted to between 88 and 92 percent relative compaction in accordance with ASTM D1557. Underlying fills and/or subgrade soils should be prepared, placed, and compacted in accordance with Section 5.19 - General Earthwork. The moisture content of the upper 12 inches of subgrade soils should be maintained until placement of slab concrete. A representative from Kleinfelder should perform a field check of the soil moisture content and consistency within 48 hours of concrete placement. If the moisture content of the subgrade soil does not meet the above requirements, additional wetting (pre-soaking) of the subgrade soils may be required. Typically wetting or pre-soaking is performed using liberal sprinkling, flooding, or other suitable method. If necessary, commercially available penetrate additives may be used to aid in moisture penetration.

If post-tensioned slabs are supported on at least 2-feet of low expansive granular fill, i.e., crushed sandstone, the soils should be compacted as engineered fill in accordance with Section 5.19 - General Earthwork. Moisture conditioning or presoaking of the subgrade soils prior to concrete placement is not warranted and not recommended

5.13.2 Design Criteria

Based on procedures presented in Section 1816 (post-tensioned slabs) of the 1997 Uniform Building Code (UBC), the following design parameters are recommended:

	Swelling Mode	
	Center Lift	**Edge Lift**
Edge Moisture Variation Distance (e_m), ft.	5.5	3.0
Differential Soil Movement (y_m), inches	3.0	1.1
Slab-Subgrade Friction Coefficient	0.75	
Net Allowable Bearing Capacity (dead-plus-live)	1,500 psf	

Post-tensioned slabs should have a minimum thickness of 10 inches with edges and beams thickened to least 12 inches. Point or line loads imposed on the center or interior of the slab should be underlain by a thickened slab bearing directly on the prepared building pad surface. Thickened slabs under point loads should be a minimum of 2 feet on a side and line loads should be a minimum of 12 inches wide.

5.13.3 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soils, and by passive soil pressure against the sides of the thickened edges and beams. A coefficient of friction of 0.40 may be used between cast-in-place concrete foundations and the underlying soil. Passive pressure available in engineered fill or undisturbed native soil may be taken as equivalent to the pressure exerted by a fluid weighing 350 pounds per cubic foot (pcf).

Lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied for design purposes. For static and seismic loading conditions, factors of safety of at least 1.5 and 1.15, respectively, should be used for design. The appropriate factor of safety will depend on the design condition and should be determined by the project Structural Engineer.

5.13.4 Additional Considerations

Post-tensioned slabs should be underlain by a rock capillary break, vapor barrier, and fine to medium grained sand as recommended in Section 5.14 - Concrete Floor Slabs. The rock capillary break can be omitted under post-tensioned slabs provided a second vapor barrier is placed over the first and precautions are taken to carefully overlap, seal, and repair the vapor barrier during construction. As an alternative, the vapor barrier can be substituted using a moisture proofing membrane, such as "Moistop" or an equivalent substitute, installed per the manufactures recommendations.

5.14 Concrete Floor Slabs

5.14.1 Rock Capillary Break

Interior concrete floor slabs supported-on-grade should be underlain by a capillary break to reduce the potential for soil moisture migrating upwards toward the slab. This capillary break should consist of compacted, free-draining crushed rock at least 4 inches thick, graded so that 100 percent passes the 1-inch sieve and less than 5 percent passes the No. 4 sieve. In general, Caltrans Class 2 aggregate base or similar materials do not meet the above recommendations.

A capillary break may not be required for some types of construction (such as garages and other nonhabitable structures) were floor coverings are not anticipated. For these types of structures, the gravel capillary break may be omitted and the slab placed directly on the prepared subgrade or other approved surface. In the event omission of the capillary break is considered, Kleinfelder should review the planned structural details in order to assess the applicability of the approach and provide (if necessary) additional recommendations regarding subgrade preparation and/or support.

5.14.2 Vapor Barrier

A vapor barrier (minimum 10 mil polyethylene sheeting) is recommended under all interior concrete floor slabs which will be covered with moisture-sensitive floor coverings. The membrane should be placed over the rock capillary break to reduce the potential for upward migration of water vapor through the slab. Care should taken to properly lap and seal the membrane, particularly around utilities, to provide a vapor tight barrier.

To promote uniform curing of the slab, protection of the membrane during construction, and provide a leveling coarse for concrete slabs; a minimum 2-inch thick layer of fine-to-medium-grained sand should be placed immediately below the floor slab prior to placing slab concrete. This sand should be moistened immediately prior to concrete placement.

5.14.3 Additional Considerations

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

Floor slabs should have a minimum nominal thickness of 4 inches and should be reinforced as a minimum with 6"x6"/10x10 welded wire mesh or preferably No. 4 reinforcement bars at 24 inches on-center each way within the middle-third of the floor slab. Where feasible, the garage slab should be designed structurally independent of foundations and allowed to "float" with changes in soil volume.

5.15 Exterior Flatwork

Like interior floor slabs, exterior concrete flatwork supported directly on native clays or clay fills may be subject to the same shrink-swell cycles and potential distress. Some of the adverse effects of swelling and shrinking can be reduced with proper moisture treatment or pre-soaking (see Section 5.13.1) prior to concrete placement. However, the flatwork will be subject to edge effects caused by seasonal wetting and drying of the subgrade soils or man-made water sources. To protect against edge effects, lateral cutoffs such as inverted curbs should be considered. To further reduce the risk of post-construction movement, consideration should be given to increasing the thickness of the flatwork and placement of at least 12 inches of non-expansive fill below the flatwork. Cutoffs should extend at least 4 inches below the depth of non-expansive fill or moisture-conditioned native soils. An evaluation of your acceptable level of risk and desired future performance of flatwork should be considered when developing project plans and specifications.

To reduce cracking and tripping hazards, consideration should be given to reinforcing exterior concrete slabs with steel bars rather than wire mesh. As a minimum, smooth dowels should be provided at all joints. The dowels should be at least 24 inches in length, greased or sleeved at one end, and spaced at a maximum lateral spacing of 18 inches. Expansion joints should be frequent within the slabs, typically 6 to 8 feet spacing horizontally.

Flatwork, such as sidewalks, patios, stairs, and planter boxes, should not be attached to buildings. These structures should be allowed to "float" with the changes in volume of the soil.

5.16 Retaining Walls

5.16.1 Lateral Earth Pressures

Retaining walls should be designed to resist the earth pressure exerted by the retained, compacted backfill plus any additional lateral force due to surcharge loading, i.e., construction equipment, foundations, roadways, etc., at or near the wall. The following equivalent fluid earth pressures are recommended assuming wall heights of 10 feet or less and a fully drained backfill condition:

Earth Pressure Condition	Backfill Slope	Lateral Earth Pressure (pcf)
Active	level	40
At-Rest	level	55

Retaining walls capable of deflecting a minimum of 0.1 percent of their height at the top may be designed using the active earth pressure. Retaining walls incapable of this deflection or are fully constrained against deflection should be designed for the at-rest earth pressure. Where uniform surcharge load(s) are located within a lateral distance from constrained and unconstrained retaining walls equal to the wall height, 30 and 45 percent of the surcharge load, respectively, should be applied uniformly over the entire height of the wall.

5.16.2 Wall Drainage

Retaining wall backfill should be free draining and provisions should be made to collect and dispose of excess water. Wall drainage may be provided by either free-draining gravel enclosed by geosynthetic filter fabric or by prefabricated drainage panels, such as Miradrain, Enkadrain, or an equivalent substitute. In either case, drainage should be collected by perforated pipes and directed to a sump, storm drain, weep hole(s), or other suitable location for disposal. Drainrock should consist of durable stone having 100 percent passing the 1-inch sieve and zero percent passing the No. 4 sieve. Synthetic filter fabric should have an equivalent opening size (EOS), U.S. Standard Sieve, of between 40 and 70, a permeability of at least 0.02 centimeters per second, a minimum flow rate of 50 gallons per minute per square foot of fabric, and a minimum puncture strength of 50 pounds. Prefabricated drainage panels should be installed in accordance with the manufacturers recommendations. The upper 12 inches of backfill above the wall drainage should consist of native soils, concrete, asphalt-concrete, or similar backfill to minimize surface drainage into the wall drain system.

If retaining walls are 4 feet or less in height, the perforated pipe may be omitted in lieu of weep hopes on 4 feet maximum spacing. The weep holes should consist of 4 inch or large diameter holes (concrete walls) or unmortered head joints (masonry walls). They should be placed as low as possible but not be higher than 18 inches above the lowest adjacent grade. Two eight-inch square overlapping patches of geosynthetic filter fabric should be affixed to the rear wall openings of each weep hole to retard soil piping.

5.16.3 Backfill Placement

All backfill should be placed and compacted in accordance with recommendations provided above for engineered fill. During grading and backfilling adjacent to any walls, heavy equipment should not be allowed to operate within a lateral distance of 5 feet from the wall, or within a lateral distance equal to the wall height, whichever is greater, to avoid overstressing of the wall. Within this zone, only hand operated equipment ("whackers", vibratory plates or pneumatic compactors) should be used to compact backfill soils.

Expansive soils, i.e., clays, plastic silts, and/or clayey sands, should not be used for backfill against retaining walls unless approved by the geotechnical engineer. The wedge of nonexpansive backfill material should extend from the bottom of each retaining wall outward and upward at a slope of 1(h):1(v) or flatter.

5.17 Asphalt Concrete Pavement

5.17.1 Subgrade Preparation

Following site stripping, all subgrade soils in pavement areas should be prepared and compacted as recommended in Section 5.19 - General Earthwork.

5.17.2 Pavement Sections

Pavement sections[2] presented below are based on current Caltrans design procedures, traffic indices ranging from 4.5 to 7.0, a laboratory obtained R-values of 5 for pavements supported on native clays or clay fill and 40 for pavements supported on at least 12 inches of non-expansive fill, i.e., crushed sandstone. The traffic index (TI) is a measure of traffic wheel loading frequency and intensity of anticipated traffic. For comparison, TI's of between 4.5 and 5 are often suitable for design of average residential streets and minor or secondary collectors; TI's of between 5 and 6 are commonly used for design of major or primary collectors between minor collectors and major arterials; and TI's between 6.0 and 7.0 are common for design of light

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[2] *Caltrans design procedures for asphalt concrete pavements provide sections in units of feet, rounded to the nearest 0.05 feet. We have also provided sections in units of inches, rounded to the nearest 1/2-inch. Sections provided above include a Gravel Equivalent Safety Factor of 0.2 (as recommended by Caltrans).*

commercial roads. Traffic indices assumed above should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project

Pavements Supported on Clays
(R-value = 5)

Assumed	Asphalt Concrete		Aggregate Base	
Traffic Index	**(feet)**	**(inches)**	**(feet)**	**(inches)**
4.5	0.20	2.5	0.80	9.5
5.0	0.20	2.5	0.95	11.5
5.5	0.25	3.0	1.00	12.0
6.0	0.25	3.0	1.15	14.0
6.5	0.30	3.5	1.20	14.5
7.0	0.30	3.5	1.35	16.0

Pavements Supported on Non-Expansive Soils
(R-value = 40)

Assumed	Asphalt Concrete		Aggregate Base	
Traffic Index	**(feet)**	**(inches)**	**(feet)**	**(inches)**
4.5	0.20	2.5	0.35	4.0
5.0	0.20	2.5	0.40	5.0
5.5	0.25	3.0	0.45	5.5
6.0	0.25	3.0	0.55	6.5
6.5	0.30	3.5	0.55	6.5
7.0	0.30	3.5	0.65	8.0

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

- Subgrade soils should be in a stable, non-pumping 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.
- Asphalt paving materials and placement methods should meet current Caltrans specifications for asphalt concrete.
- All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.

5.18 Surface Drainage and Landscaping

The ground surface should slope away from building pad and pavement areas toward appropriate drop inlets or other surface drainage devices with grades maintained for the life of the project. Adjacent exterior grades in proposed building areas should be sloped a minimum of 2 percent for a minimum lateral distance of 5 feet away from the perimeter of proposed structures. Subgrade soils in pavement areas should be sloped a minimum of 1 percent and drainage gradients maintained to carry all surface water to collection facilities and off the site. Roof draining should be installed with appropriate downspout extensions outfalling on splash blocks so that water is directed a minimum of 5 feet horizontally away from the structures or be connected to the storm drain system for the development. Landscaping after construction should not promote ponding of water adjacent the structures. Care should be taken to not over irrigate and to maintain a leak free sprinkler piping system.

5.19 General Earthwork

General earthwork should be performed in accordance with the following subsections unless specifically superseded by recommendations presented in previous sections.

5.19.1 Site Stripping

Prior to general site grading, existing vegetation, organic topsoil, undocumented fills, and any debris should be removed and disposed of outside the construction limits. The depth of stripping for removal of organics is estimated to be approximately 2 to 4 inches over a majority of the site. Deeper stripping may be required where concentrations of organic soils or tree roots are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes. This material, however, should not be incorporated into any engineered fill.

Given the presence of an abandoned ranch house and barn on-site, it is possible abandoned utility lines, septic tanks, cesspools, and/or foundations exist on-site. In addition, what appears to be the remnants of two wells were observed on-site. If encountered within the area of construction, these items should be removed and disposed of off-site. Existing wells should be abandoned in accordance with applicable regulatory requirements. Existing utility pipelines which extend beyond the limits of the proposed construction and will be abandoned in-place should be plugged with cement grout to prevent migration of soil and/or water. All excavations resulting from removal activities should be cleaned of loose or disturbed material (including all previously-placed backfill) and dish-shaped (with sides sloped 3(h):1(v) or flatter) to permit access for compaction equipment.

5.19.2 Subgrade Preparation

Following site stripping, all areas to receive engineered fill or to be used for the future support of structures or concrete slabs should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to between 3 and 5 percentage points above the optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined by ASTM (American Society for Testing and Materials) Test Method D 1557[3]. Within pavement areas, the scarified subgrade should be compacted to at least 95 percent relative compaction. Scarification and compaction may not be required within earthwork cut areas consisting of undisturbed rock and if approved by the project Geotechnical Engineer during construction.

In-place scarification and compaction may not be adequate to densify all disturbed soil within areas grubbed or otherwise disturbed below a depth of about 6 inches. Therefore, overexcavation of disturbed soil, scarification and compaction of the exposed subgrade, and replacement with engineered fill may be required to sufficiently densify all disturbed soil.

5.19.3 Temporary Excavations

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face.

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[3] *This test procedure should be used wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.*

Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities. Such responsibility is not being implied and should not be inferred.

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a lateral distance equal to 1/3 the slope height from the top of any excavation. Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to maintain structural stability and to protect personnel working within the excavation. Shoring, bracing, or underpinning required for the project (if any) should be designed by a registered engineer.

During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water and/or groundwater encountered within excavations should be collected and disposed of outside the construction limits.

5.19.4 Fill Materials

The native soils and weathered bedrock encountered in our borings, minus organics, debris and/or other deleterious materials, should be suitable for use as fill. However, the native clays are also considered potentially expansive and should be avoided in all engineered fills located within 2-feet of finished building pad subgrade if residences are supported on conventional spread foundations.

All import fill soils should be nearly-free of organic or other deleterious debris, essentially non-plastic, and less than 3 inches in maximum dimension. In general, well-graded mixtures of gravel, sand, non-plastic silt, and small quantities of cobbles, rock fragments, and/or clay are acceptable for use as import fill. <u>Specific</u> requirements for import fill, as well as applicable test procedures to verify material suitability, are provided below.

Gradation		**Test Procedures**	
Sieve Size	**Percent Passing**	**ASTM**[4]	**Caltrans**[5]
3 inch	100	C 136	202
3/4 inch	70-100	C 136	202
No. 4	50-100	C 136	202
No. 40	30-100	C 136	---
No. 50	30-100	---	202
No. 200	15-70	C 136	202
Plasticity			
Liquid Limit	**Plasticity Index**		
<30	<12	D 4318	204
Organic Content			
Less than 3%		D2974	---
Expansion Potential (UBC 29-2)			
Less than 20	---	---	---

All imported fill materials to be used for engineered fill should be sampled and tested by the project Geotechnical Engineer prior to being transported to the site.

5.19.5 Engineered Fill

All fill soils, either native or imported, required to bring the site to final grade should be compacted as engineered fill. Engineered fill should be <u>uniformly</u> moisture-conditioned to between 3 and 5 percentage points above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. Fills exceeding 5 feet in thickness should be compacted to at least 95 percent relative compaction for their full depth. The upper 12 inches of subgrade soils in pavement areas should be <u>uniformly</u> moisture-conditioned to between 3 and 5 percentage points above the optimum moisture content and compacted to at least 95 percent relative compaction.

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[4] *American Society for Testing and Materials Standards (Latest Edition)*

[5] *State of California, Department of Transportation, Standard Test Methods (Latest Edition)*

All trench backfill should be placed and compacted in accordance with recommendations provided above for engineered fill. During backfill, mechanical compaction of engineered fill is recommended. Ponding or jetting should be avoided, especially in areas supporting structural loads or beneath concrete slabs supported-on-grade, pavements, or other improvements. Additional fill lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Disking and/or blending may be required to uniformly moisture-condition soils used for engineered fill.

Rock fragments, boulders or crushed inert debris, such as concrete or brick, greater than 6 inches in maximum dimension should not be included within the upper 5 feet of final subgrade level. Rock or debris fragments ranging from 6 to 18 inches in maximum dimension may be placed below a depth of 5 feet, provided that they are thoroughly mixed with soils to avoid excessive concentrations or nesting of fragments.

In pavement areas, rock or debris fragments ranging from 18 to 36 inches in maximum size may be included below a depth of 5 feet, but only at the foundation level for the fill. Fragments of this size should staggered and spaced no closer that 4 feet, edge-to-edge, the larger of any two adjacent fragments governing the spacing in any direction. This coarse should be proof-rolled with track equipment weighing at least 20 tons. Proof-rolling should be continued until three complete passes are achieved over the entire surface area of each coarse. After proof-rolling, all fills, either imported or derived on-site, should be compacted (cohesive soils) or sluiced (cohesionless soils) by flooding or jetting into the remaining voids until a compact interstitial fill has been achieved. Our representative should witness all proof-rolling and filling operations between fragments to determine the adequacy of each coarse. Fragments greater than 36 inches in maximum size should not be included in any fills.

5.19.6 Trench Backfill Materials

Trench backfill and bedding placed within existing of future City of Pittsburg right-of-ways should meet or exceed the requirements outlined in their current Standard Specifications.

Trench backfill or bedding placed outside existing or future right-of-ways could consist of native or imported soil which meets the requirements for fill material provided in Section 5.19.4 above. If import fill is used for pipe or trench zone backfill, the material should consist of fine-grained sand. Coarse-grained sand and/or gravel should be avoided, unless approved by the Geotechnical

Engineer, due to the potential for soil migration into the materials relatively large void spaces and the potential for water seepage and piping along trenches.

Recommendations provided above should be considered minimum requirements only. More stringent material specifications may be required to fulfill bedding requirements for specific types of pipes. The project Civil Engineer should develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

5.19.7 Wet Weather Construction

Based on our findings and historical records, groundwater levels are not anticipated to rise near-surface or impede grading operations at the site. However, if site grading is performed during or following extended periods of rainfall, seeps may be encountered and the moisture content of the near-surface soils may be significantly above optimum. This condition, if encountered, could seriously delay grading by causing an unstable subgrade condition. Typical remedial measures include discing and aerating the soils during dry weather; mixing the soil with dryer materials; removing and replacing the soils with an approved fill material; stabilization with a geotextile fabric or grid; or mixing the soil with an approved hydrating agent, such as a lime or cement product. Our firm should be consulted prior to implementing any remedial measure to observe the unstable subgrade condition and provide site specific recommendations.

6. ADDITIONAL SERVICES

6.1 Plan and Specification Review

Kleinfelder should conduct a general review of final plans and specifications to evaluate that our earthwork and foundation recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

6.2 Construction Observation and Testing

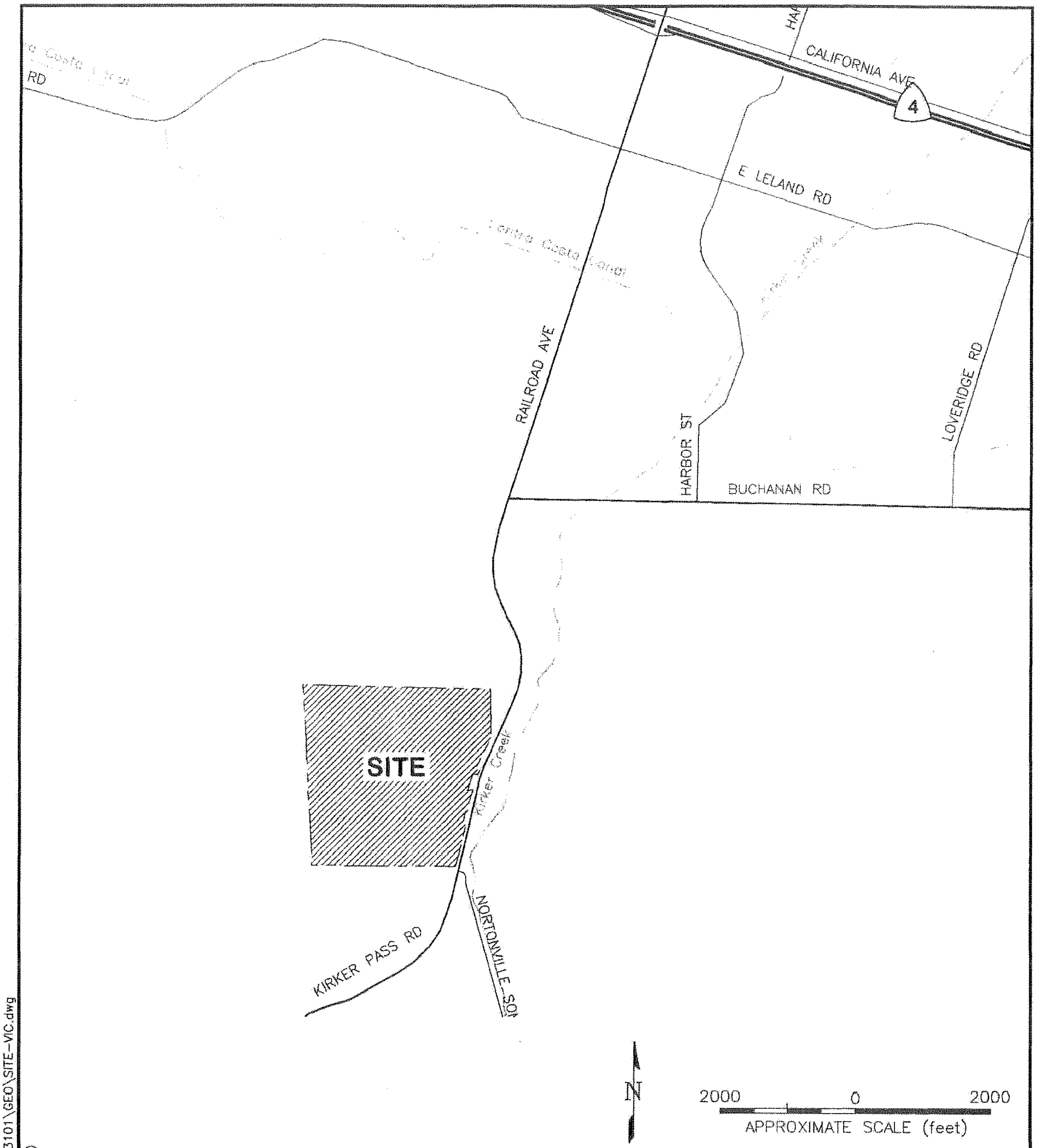
All earthwork during construction should be monitored by a representative from Kleinfelder, including site preparation, placement of all engineered fill and trench backfill, construction of slab and roadway subgrades, and all foundation excavations. The purpose of these services would be to provide Kleinfelder the opportunity to observe the soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

7. LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil conditions could vary between or beyond the points explored. If soil conditions are encountered during construction which differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, our recommendations should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by Kleinfelder during the construction phase in order to evaluate compliance with our recommendations.

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. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.



KLEINFELDER

SITE VICINITY MAP

MONTREAUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1

DRAFTED BY: L. Sue DATE: 2–5–99
CHECKED BY: J. Finnigsmier DATE: 2–5–99

PROJECT NO. 43–113101–GEO

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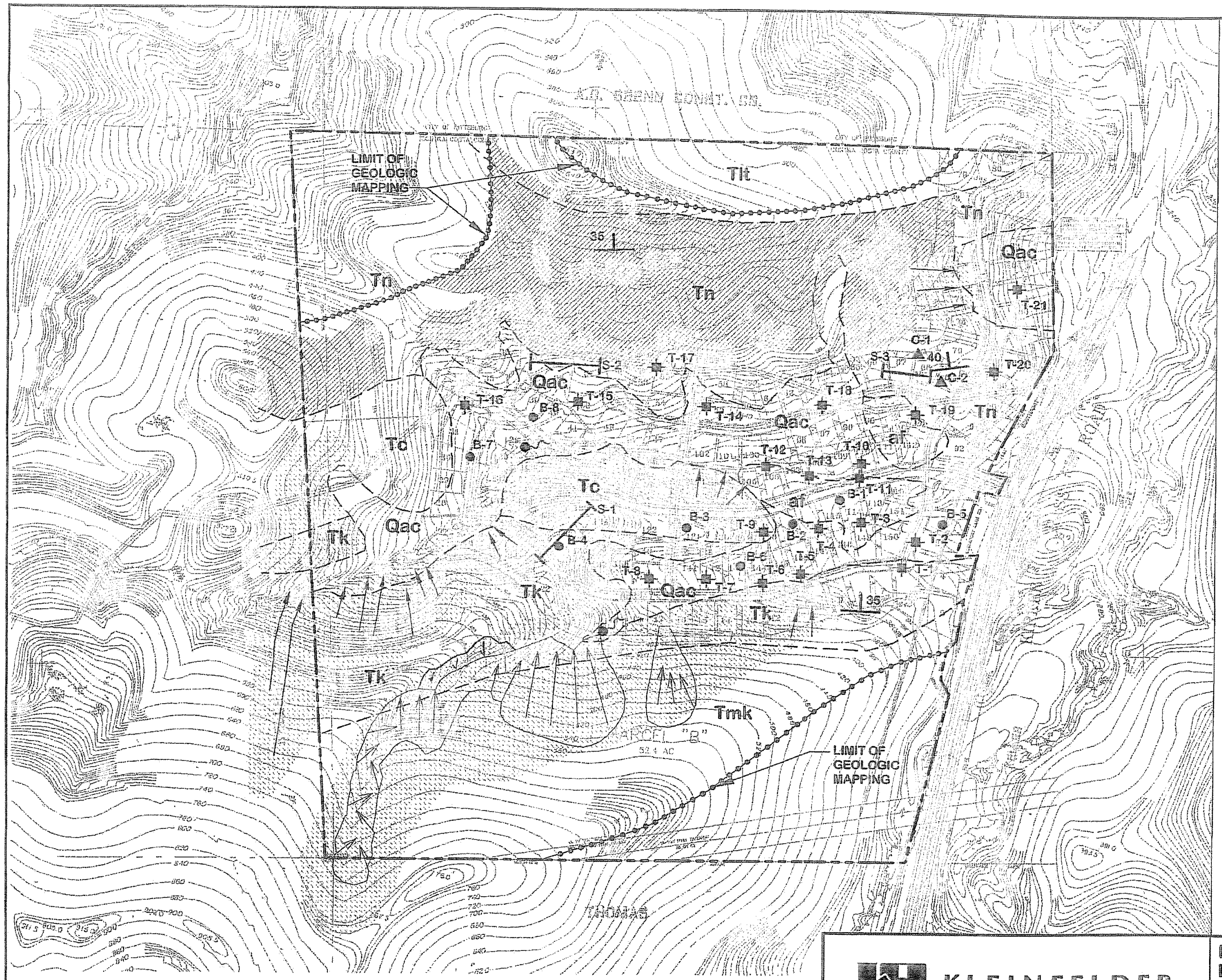

SYMBOL	EXPLANATION
af	ARTIFICIAL FILL
Qac	COLLUVIUM/ALLUVIUM – unconsolidated sand, silt and clay with gravel and occasional boulders
Tlt	LAWLOR TUFF – pumiceous tuff breccia
Tn	NEROLY SANDSTONE – blue to gray non-marine sandstone
Tc	CIERBO SANDSTONE – pebbly arkosic marine sandstone
Tk	KIRKER FORMATION – tuff and tuffaceous sandstone
Tmk	MARKLEY FORMATION – clay shale with diatomaceous beds (Kreyenhagen Formation of Dibblee, 1980)
—— – – ——	PROPERTY BOUNDARY
– – – – –	GEOLOGIC CONTACT
35	STRIKE AND DIP OF BEDROCK
●~	SPRING/SEEPAGE AREA
⇙	AREA OF INTENSE RECENT DEBRIS FLOW ACTIVITY
↙	INDIVIDUAL DEBRIS FLOW SCAR
√√	SOIL SLUMP
▨	SOURCE AREA OF HIGH ROCKFALL AND MODERATE DEBRIS FLOW HAZARD
░	SOURCE AREA OF HIGH DEBRIS FLOW HAZARD
●	SOIL BORING LOCATION
▲	CORE LOCATION
✛	TEST PIT LOCATION
├──┤	SEISMIC REFRACTION LOCATION

NOTE: Locations are approximate.

REFERENCE:
Isakson and Associates Inc., "Montreaux, Tentative and Preliminary Grading Plan, City of Pittsburg," December 1998.

N

400 0 400
APPROXIMATE SCALE (feet)

KLEINFELDER

BORING, TEST PIT AND CORE LOCATIONS

MONTREAUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
2

DRAFTED BY: L. Sue DATE: 1-4-00
CHECKED BY: G. Gulseth DATE: 1-4-00
PROJECT NO. 42-113101-GEO

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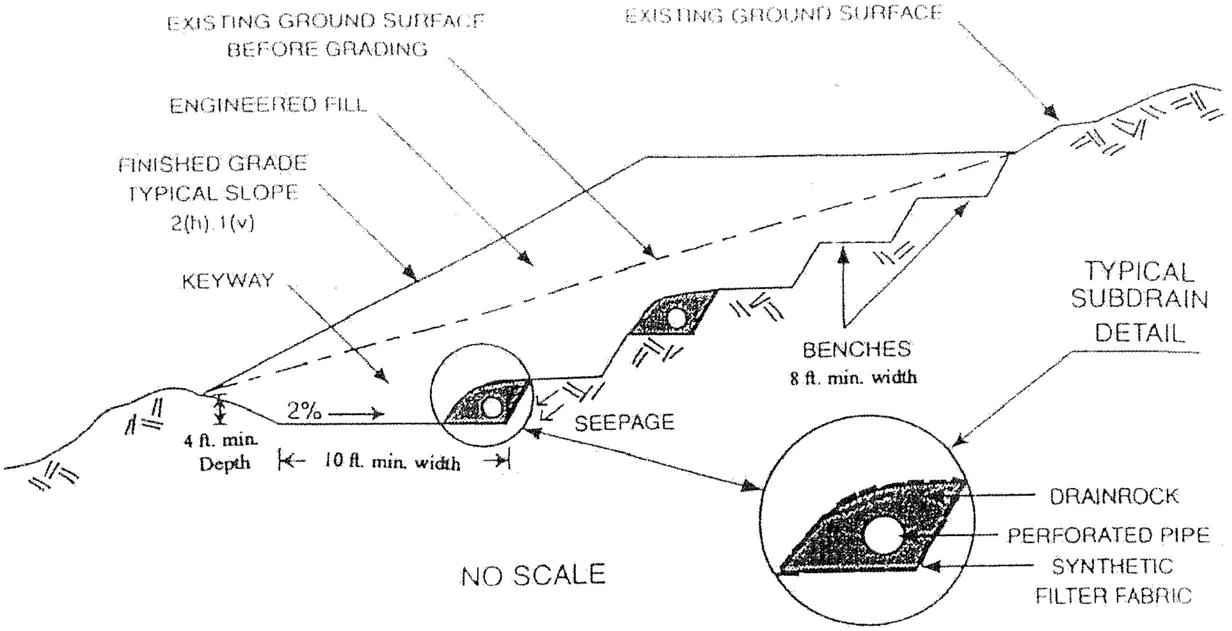


NOTES

1. Benches should be sloped about two percent (2%) away from the natural slope to facilitate drainage of the fill embankment. Benches and keyway should be excavated to competent subgrade as evaluated by the project Geotechnical Engineer during construction.
2. Cut slopes between benches should be no flatter than 1(h):1(v) and should not exceed 5 feet in height.
3. If seepage is present during construction or is suspected by the Geotechnical Engineer based on sub-surface conditions encountered subsequent to site stripping or during initial grading, subdrain should be constructed of perforated PVC pipe surrounded by drainrock, encased in a synthetic filter fabric. Specific requirements are provided below (also see detail above).
   - a) Drainrock should consist of durable stone having 100 percent passing the 1-inch sieve and zero percent passing the No. 4 sieve.
   - b) Synthetic filter fabric should have an equivalent opening size (EOS), U.S. Standard Sieve, of between 40 and 70, a permeability of at least 0.02 centimeters per second, a minimum flow rate of 50 gallons per minute per square foot of fabric, and a minimum punture strength of 50 pounds.
   - c) In general, woven fabrics are less susceptible to clogging than non-woven fabrics. Therefore, in areas subject to sustained subsurface water flows, a woven fabric should be used. In areas subject to intermittent flows, a non-woven fabric may be used.
   - d) Synthetic filter fabric should be placed in accordance with manufacturer's recommendations.
   - e) Perforated pipe should consist of schedule 40 PVC, 4 to 6 inches in diameter, with 1/4-inch-diameter (maximum) perforations, 12 to 24 inches on-center, placed down. Pipe invert should be no more than 2 inches above the bottom of bench and/or keyway.
   - f) Pipe drainage should be collected in a solid conduit and directed to a storm drain, ditch, or other suitable location for disposal.
   - g) Perforated pipe should be sloped a minimum of two percent (2%) to drain.

KLEINFELDER

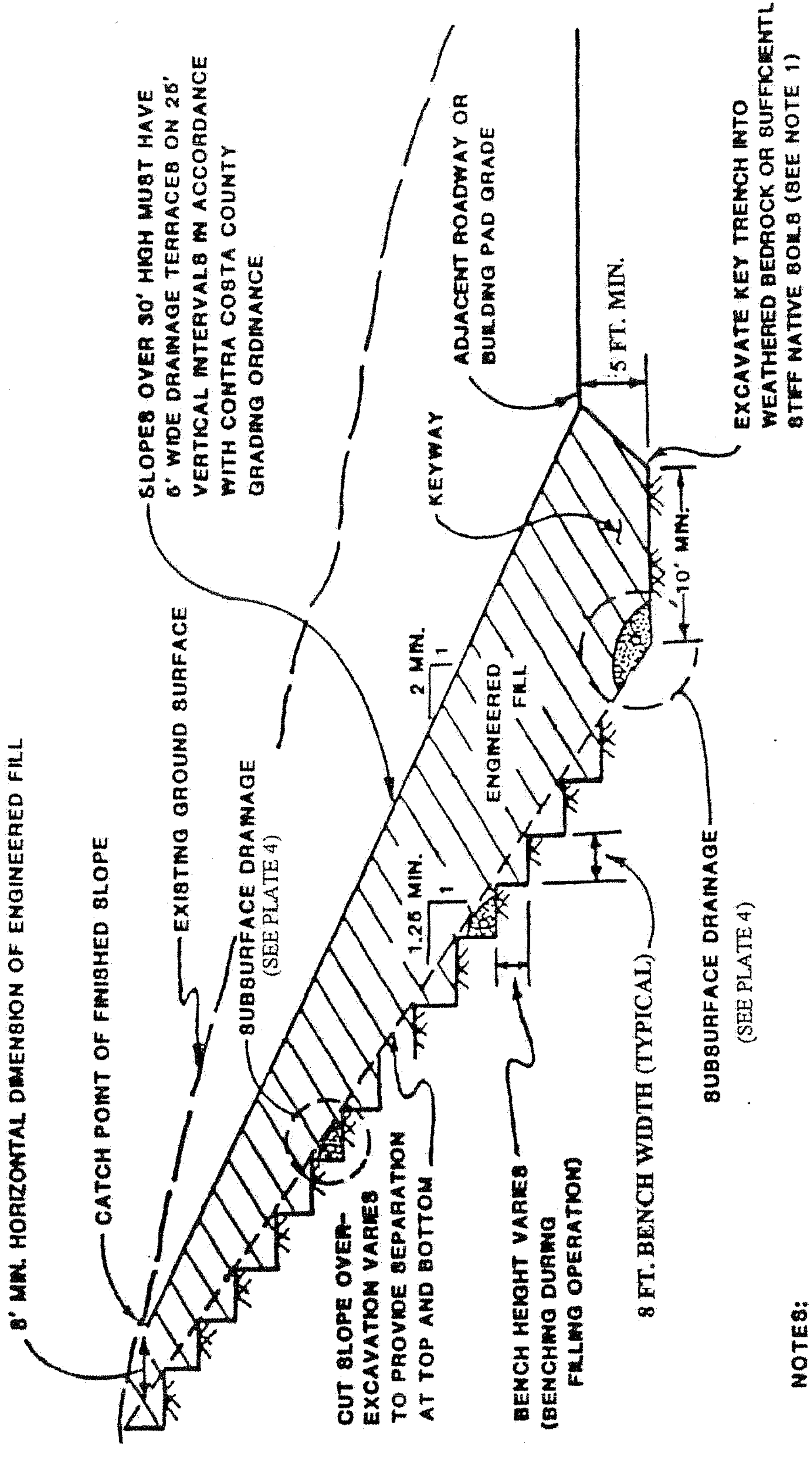
Drawn By:
Project No. 43-1131-01.GEO

Date:
Filename:

Typical Keyway, Bench and Subdrain Detail

Proposed Montruex Subdivision
Kirker Pass Road
Pittsburg, California

PLATE
3



NOTES:

1) FINAL BENCHING AND KEYWAY EXCAVATION DEPTHS AND DETAILS SUBJECT TO EVALUATION OF FIELD CONDITIONS.
2) DIMENSIONS AND LOCATIONS OF SUBDRAINAGE ARE APPROXIMATE. ACTUAL INSTALLATION TO BE BASED ON FIELD CONDITIONS.
3) GRADE PIPES TO DRAIN TO AN APPROPRIATE DISCHARGE FACILITY
4) INSTALL CLEANOUTS AT ENDS, ANGLES, AND JUNCTIONS OF PIPE

NOT TO SCALE

KLEINFELDER

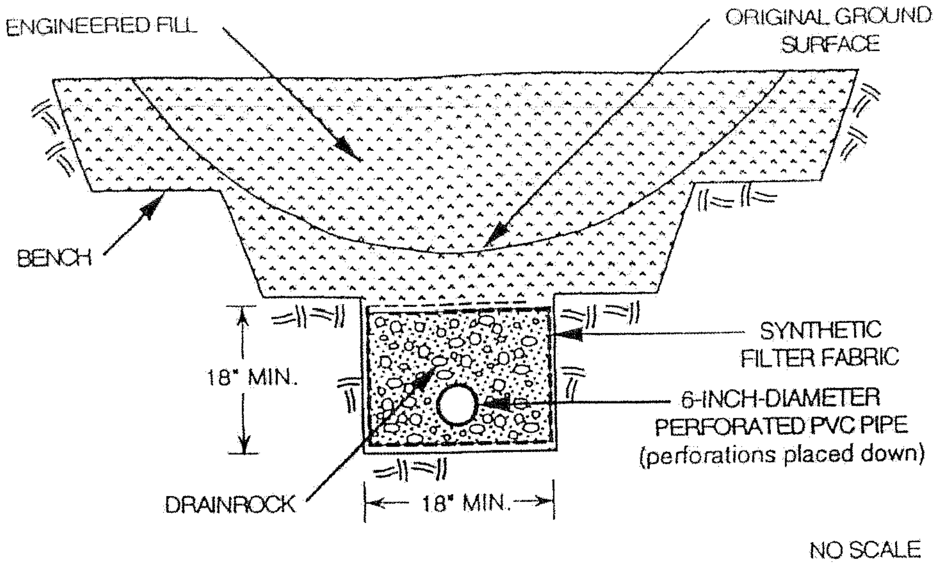
FILE NO. 43-1131-01.GEO

Buttress Fill Detail

Proposed Montruex Subdivision
Kirker Pass Road
Pittsburg, California

PLATE

4



NOTES:

1. Subdrain should be excavated into competent subgrade as evaluated by the project Geotechnical Engineer during construction.
2. Surfaces to receive filter fabric should be free of loose or extraneous material and sharp objects that might damage the filter fabric during installation.
3. Drainrock should consist of durable stone having 100 percent passing the 1-inch sieve and zero percent passing the No. 4 sieve.
4. Synthetic filter fabric should have an equivalent opening size (EOS), U.S. Standard Sieve, of between 40 and 70, a permeability of at least 0.02 centimeters per second, a minimum flow rate of 50 gallons per minute per square foot of fabric, and a minimum punture strength of 50 pounds.
5. In general, woven fabrics are less susceptible to clogging than non-woven fabrics. Therefore, in areas subject to sustained subsurface water flows, a woven fabric should be used. In areas of intermittent water flows, a non-woven fabric may be used.
6. Synthetic filter fabric should be placed in accordance with manufacturer's recommendations.
7. Perforated pipe should consist of schedule 40 PVC, 6 inches in diameter, with 1/4-inch-diameter (maximum) perforations, 12 to 24 inches on-center, placed down. Pipe invert should be no more than 2 inches above trench bottom.
8. Pipe drainage should be collected in a solid conduit and directed to a storm drain, ditch, or other suitable location for disposal.
9. Perforated pipe should be sloped a minimum of one percent (1%) to drain.

KLEINFELDER

Drawn By:
Project No. 43-1131-01.Geo

Date:
Filename:

General Subdrain Detail

Proposed Montruex Subdivision
Kirker Pass Road
Pittsburg, California

PLATE
5

APPENDIX A
FIELD INVESTIGATION AND LABORATORY TESTING

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

APPENDIX B
LABORATORY TESTING

General

Laboratory tests were performed on selected samples to aid in soil classification and to evaluate physical properties of the soils which may affect the geotechnical aspects of project design and construction. A description of the laboratory testing program is presented below; a summary of all laboratory tests performed is presented on the Summary of Laboratory Tests, Plate B-1.

Moisture Content and Dry Unit Weight

Moisture content and dry unit weight tests were performed to evaluate moisture-conditioning requirements during site preparation and earthwork grading; soil overburden, and active and passive earth pressures; and relative soil strength and compressibility. 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. Results of these tests are presented on the logs and are summarized on the Summary of Laboratory Tests.

Sieve Analysis

Sieve analyses were performed to evaluate the gradational characteristics of the material and to aid in soil classification. Tests were performed in general accordance with ASTM Test Method C 136. Results of these tests are presented on the logs and are summarized on the Summary of Laboratory Tests.

Atterberg Limits

Atterberg Limits tests were performed to aid in soil classification and to evaluate the plasticity characteristics of the material. Additionally, test results were correlated to published data to evaluate the shrink/swell potential of near-surface site soils. Tests were performed in general accordance with ASTM Test Method D 4318. Results of these tests are presented on the logs and are summarized on the Summary of Laboratory Tests.

Unconfined Compression

An unconfined compression test was performed on a selected, undisturbed sample to evaluate the undrained shear strength of the fine-grained site soils. Test procedures were in general accordance with ASTM Test Method D 2166. Results of this test are presented on the Summary of Laboratory Tests.

Consolidation

A consolidation test was performed on an undisturbed soil sample obtained near the anticipated foundation depth to evaluate potential foundation settlements under the expected loads. Test procedures were in general accordance with ASTM Test Method D 2435. Results of this test are presented on Plate B-2.

R-Value

Resistance value (R-value) tests were performed on bulk soil/crushed weathered rock samples to evaluate pavement support characteristics of the near-surface site soils. Test procedures were in general accordance with California Test 301. Results of these tests are presented on the Summary of Laboratory Tests.

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

Plate B-1	Summary of Laboratory Tests
Plate B-2	Consolidation Test

APPENDIX A
FIELD INVESTIGATION AND LABORATORY TESTING

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

Plate A-1	Unified Soil Classification System
Plate A-2	Rock Classification System
Plate A-3	Log Key
Plate A-4	Log of Test Pit TP-1
Plate A-5	Log of Test Pit TP-2
Plate A-6	Log of Test Pit TP-3
Plate A-7	Log of Test Pit TP-4
Plate A-8	Log of Test Pit TP-5
Plate A-9	Log of Test Pit TP-6
Plate A-10	Log of Test Pit TP-7
Plate A-11	Log of Test Pit TP-8
Plate A-12	Log of Test Pit TP-9
Plate A-13	Log of Test Pit TP-10
Plate A-14	Log of Test Pit TP-11
Plate A-15	Log of Test Pit TP-12
Plate A-16	Log of Test Pit TP-13
Plate A-17	Log of Test Pit TP-14
Plate A-18	Log of Test Pit TP-15
Plate A-19	Log of Test Pit TP-16
Plate A-20	Log of Test Pit TP-17
Plate A-21	Log of Test Pit TP-18
Plate A-22	Log of Test Pit TP-19
Plate A-23	Log of Test Pit TP-20
Plate A-24	Log of Test Pit TP-21
Plate A-25	Log of Boring B-1
Plate A-26	Log of Boring B-2
Plate A-27	Log of Boring B-3
Plate A-28	Log of Boring B-4
Plate A-29	Log of Boring B-5
Plate A-30	Log of Boring B-6
Plate A-31	Log of Boring B-7
Plate A-32	Log of Boring B-8
Plate A-33	Log of Core C-1
Plate A-34	Log of Core C-2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			*USCS SYMBOL*		*TYPICAL DESCRIPTIONS*
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	░	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			░	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	▦	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	░	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	▥	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		▥	ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▥	OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			▤	OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
LOAMS			▨		UNDER USDA SOIL CLASSIFICATION SYSTEM, SOIL OF APPROXIMATELY EQUAL SAND/SILT/CLAY

KEYSOIL P1131 4/21/99

KLEINFELDER

Drafted By: DWA
Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

UNIFIED SOIL CLASSIFICATION SYSTEM

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE

A-1

SYMBOL	ROCK TYPE	SYMBOL	ROCK TYPE	SYMBOL	ROCK TYPE
▨	BRECCIA	▨	GNEISS	▨	LAVA FLOW
▨	CLAYSTONE	▨	MUDSTONE	▨	SANDSTONE
▨	CONGLOMERATE	▨	SCHIST	▨	SILTSTONE
▨	GRANITIC	▨	FOLDED SCHIST	▨	TUFF

WEATHERING

Designation	Criteria
Completely Weathered	Minerals decomposed to soil-like consistency, but structure preserved. Specimen easily crumbled by hand.
Highly Weathered	Texture indistinct, most minerals partially decomposed, specimen breaks with effort by hand.
Moderately Weathered	Rock texture preserved, discoloration throughout, slight decomposition of weaker minerals, specimen cannot be broken by hand.
Slightly Weathered	Slight discoloration of open fractures, otherwise similar to fresh.
Unweathered/Fresh	No visible signs of decomposition or discoloration, rings under hammer impact.

FRACTURING

Designation	Criteria
Very Closely Fractured	Spaced 3/4 inch to 2-1/2 inches.
Closely Fractured	Spaced 2-1/2 inches to 8 inches.
Moderately Fractured	Spaced 8 inches to 2 feet.
Widely Fractured	Spaced 2 feet to 6 feet.
Very Widely Fractured	Spaced greater than 6 feet.

COMPETENCY

Designation	Criteria
Friable	Specimen crumbles by hand.
Weak	Specimen crumbles with moderate hammer blow.
Moderately Strong	Specimen shows indentation with moderate hammer blow.
Strong	Specimen breaks with single, moderate hammer blow.
Very Strong	Specimen breaks with multiple hammer blows.

KEYROCK P1131 4/21/99

KLEINFELDER

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File Number: 2063

ROCK CLASSIFICATION SYSTEM

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
A-2

LOG SYMBOLS

☒	BULK / BAG SAMPLE	-4	PERCENT FINER THAN THE NO. 4 SIEVE (ASTM Test Method C 136)
■	MODIFIED CALIFORNIA SAMPLER (2-1/2 inch outside diameter)	-200	PERCENT FINER THAN THE NO. 200 SIEVE (ASTM Test Method C 117)
◨	CALIFORNIA SAMPLER (3 inch outside diameter)	LL	LIQUID LIMIT (ASTM Test Method D 4318)
◩	STANDARD PENETRATION SPLIT SPOON SAMPLER (2 inch outside diameter)	PI	PLASTICITY INDEX (ASTM Test Method D 4318)
▯	NX SIZE CORE BARREL (2-5/8 inch outside diameter)	EI	EXPANSION INDEX (UBC Standard 29-2)
▯	SHELBY TUBE	COL	COLLAPSE POTENTIAL
▼	WATER LEVEL (level after completion)	UC	UNCONFINED COMPRESSION
▽	WATER LEVEL (level where first encountered)		
∿	SEEPAGE	MC	MOISTURE CONTENT

GENERAL NOTES

1. *Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.*
2. *No warranty is provied as to the continuity of soil conditions between individual sample locations.*
3. *Logs represent general soil conditions observed at the point of exploration on the date indicated.*
4. *In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.*

KEYLOGG P1131 4/21/99

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File Number: 2063

LOG KEY

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE

A-3

Surface Conditions: Level, unpaved, cut road.

Date Completed: 1/22/99

Logged By: G. Gulseth

Groundwater: No free groundwater encountered.

Total Depth: 5 (feet)

Depth (feet)	FIELD						LABORATORY					Lithography	DESCRIPTION 0.0 to 5.0 feet
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		Approximate Surface Elevation (feet): (msl)
													CLAY (CL): Topsoil
													SANDSTONE: Light gray to tan, highly weathered, closely to moderately fractured, weak to moderately strong, thinly bedded, oxides at fractures (kirker formation)
5													Test pit completed at a depth of approximately 5 feet below existing site grade.
10													
15													
20													
25													

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Drafted By: DWA
Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 1

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-4

GEOTC3C P1131 4/21/99

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 11 (feet)

Depth (feet)	FIELD						LABORATORY					Lithography	DESCRIPTION 0.0 to 11.0 feet Approximate Surface Elevation (feet): (msl)
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
												▨	becoming very stiff
5												▨	
												▨	**Sandy CLAY** (CL): Yellow brown to light brown, moist, stiff to very stiff, low to moderate plasticity, calcite staining
10												▨	
													Test pit completed at a depth of approximately 11 feet below existing site grade.
15													
20													
25													

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Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 2

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-5

Surface Conditions: Grass covering with debris; level.

Date Completed: 1/22/99

Logged By: G. Gulseth

Groundwater: No free groundwater encountered.

Total Depth: 10 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 10.0 feet Approximate Surface Elevation (feet): (msl)
	☒										R-Value = 5	▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
5												▨	becoming very stiff
10													Test pit completed at a depth of approximately 10 feet below existing site grade.
15													
20													
25													

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Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 3

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-6

GEOTC3C P1131 4/21/99

Surface Conditions: Moderate grass and weed covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 10-1/2 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 10.5 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff to very stiff, moderate plasticity, blocky and slickensided to approximately 2-1/2 feet
												▨	sand fraction increasing
5												▨	
10												▨	
													Test pit completed at a depth of approximately 11 feet below existing site grade.
15													
20													
25													

KLEINFELDER

Drafted By: DWA
Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 4

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-7

GEOTC3C P1131 4/21/99

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 9-1/2 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 9.5 feet
													Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL): Dark brown, moist, moderate plasticity, rock pieces (FILL)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff to very stiff, moderate plasticity
5												▨	
												▨	**Sandy CLAY** (CL): Gray-brown, moist, stiff, low plasticity
10													Test pit completed at a depth of approximately 9-1/2 feet below existing site grade.
15													
20													
25													

GEOTC3C P1131 4/21/99

KLEINFELDER

Drafted By: DWA
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File Number: 2063

LOG OF TEST PIT TP- 5

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-8

Surface Conditions: Grass covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 9 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 9.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
5												▨	**Sandy CLAY** (CL): Gray-brown, moist, stiff, low to moderate plasticity
10													Test pit completed at a depth of approximately 9 feet below existing site grade.
15													
20													
25													

KLEINFELDER

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 6

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-9

GEOTC3C P1131 4/21/99

Surface Conditions: Grass covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 10 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 10.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff to very stiff, moderate plasticity
5												▨	**Sandy CLAY** (CL): Gray-brown, moist, stiff to very stiff, moderate plasticity
10													Test pit completed at a depth of approximately 10 feet below existing site grade.
15													
20													
25													

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File Number: 2063

LOG OF TEST PIT TP- 7

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-10

GEOTC3C P1131 4/21/99

Surface Conditions:

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 11 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 9.0 feet Approximate Surface Elevation (feet): (msl)
0												▨	Silty CLAY (CL) with Sand: Dark brown, moist, stiff to very stiff, moderate plasticity
4												▨	yellow-brown to gray-brown, very stiff
5												▨	
9													Test pit completed at a depth of approximately 9 feet below existing site grade.
10													
15													
20													
25													

GEOTC3C P1131 4/21/99

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 8

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-11

Surface Conditions: Grass covering; relatively level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 9 (feet)

Depth (feet)	FIELD						LABORATORY					Lithography	DESCRIPTION 0.0 to 9.0 feet
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		Approximate Surface Elevation (feet): (msl)
												▨	**Sandy CLAY** (CL) with Rock pieces (FILL)
												▨	**Silty CLAY** (CL) with Sand: Dark brown to gray-brown, moist, stiff, moderate plasticity
5												▨	gray-brown, very stiff
10													Test pit completed at a depth of approximately 9 feet below existing site grade.
15													
20													
25													

GEOTC3C P1131 4/21/99

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP- 9

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-12

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 8 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 8.0 feet
													Approximate Surface Elevation (feet): (msl)
													Silty SAND (SM): Brown, moist, loose, low plasticity (FILL)
													CLAY/SILT/SAND (SC/SM): with Concrete pieces to 3 feet (FILL)
5													**SANDSTONE**: Gray to tan, completely to highly weathered, weak, very closely fractured (Kirker Formation)
													Test pit completed at a depth of approximately 8 feet below existing site grade.
10													
15													
20													
25													

GEOTC3C P1131 4/21/99

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP-10

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-13

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 8 (feet)

	FIELD						LABORATORY						DESCRIPTION 0.0 to 8.0 feet
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL): Dark brown, moist, moderate plasticity (FILL)
												▥	**CLAY/SILT** (CL/ML) with significant concrete pieces to 2 feet and scattered metal (FILL)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
5												▨	
													Test pit completed at a depth of approximately 8 feet below existing site grade.
10													
15													
20													
25													

KLEINFELDER

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Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP-11

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-14

GEOTC3C P1131 4/21/99

Surface Conditions: Light vegetation covering with debris; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 9 (feet)

Depth (feet)	FIELD						LABORATORY					Lithography	DESCRIPTION 0.0 to 9.0 feet Approximate Surface Elevation (feet): (msl)
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		
												▨	**CLAY/SILT** (CL/ML) with concrete pieces to 2 feet, asphalt, scattered wood, metal, brick, PVC pipe, concrete pipe pieces, rock boulders (debris approx. 40% to 50% by volume) (FILL)
5												▨	
												▨	concrete pieces to 3 feet (debris approx. 50% to 60% by volume)
10													Test pit terminated at a depth of approximately 9 feet below existing site grade due to refusal on concrete.
15													
20													
25													

GEOTC3C P1131 4/21/99

KLEINFELDER

Drafted By: DWA
Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP-12

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-15

Surface Conditions: Light vegetation covering with debris; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 8 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 8.0 feet Approximate Surface Elevation (feet): (msl)
													SILT/CLAY (ML/CL) with fine gravel, significant concrete pieces to 3 feet, scattered brick, wood, asphalt, and rebar (debris approx. 50% to 60% of total) (FILL)
5													
													Test pit terminated at a depth of approximately 8 feet below existing site grade due to refusal on concrete.
10													
15													
20													
25													

GEOTC3C P1131 4/21/99

KLEINFELDER

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File Number: 2063

LOG OF TEST PIT TP-13

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-16

Surface Conditions: Moderate grass covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 9 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 9.0 feet
													Approximate Surface Elevation (feet): (msl)
													Silty CLAY (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
													Sandy CLAY (CL): Gray-brown, moist, stiff, low plasticity
5													**SANDSTONE:** Light brown to tan, completely weathered, very closely fractured, weak (Neroly Formation)
													highly weathered, closely fractured
10													Test pit completed at a depth of approximately 9 feet below existing site grade.
15													
20													
25													

KLEINFELDER

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File Number: 2063

LOG OF TEST PIT TP-14

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-17

GEOTC3C P1131 4/21/99

Surface Conditions: Moderate grass covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 10 (feet)

	FIELD						LABORATORY						DESCRIPTION 0.0 to 10.0 feet
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	Approximate Surface Elevation (feet): (msl)
													Silty CLAY (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
5													**Sandy CLAY** (CL): Light brown, stiff, low plasticity
													SANDSTONE: Light brown, completely weathered, very closely fractured, weak (Neroly Formation)
10													Test pit completed at a depth of approximately 10 feet below existing site grade.
15													
20													
25													

KLEINFELDER

Drafted By: DWA
Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP-15

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-18

GEOTC3C P1131 4/21/99

Surface Conditions:

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 9 (feet)

Depth (feet)	FIELD						LABORATORY					Lithography	DESCRIPTION 0.0 to 9.0 feet
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
	☒										R-Value = 52	░	**SANDSTONE**: Light brown to tan, completely weathered, closely fractured, weak (Neroly Formation)
5												░	
												░	highly weathered, closely fractured, moderately strong
												▥	**SILTSTONE**: Light gray, highly weathered, closely fractured, moderately strong
10													Test pit completed at a depth of approximately 9 feet below existing site grade.
15													
20													
25													

GEOTC3C P1131 4/21/99

KLEINFELDER

Drafted By: DWA

Date: 4/14/99

Project No.: 43-113101-GEO

File Number: 2063

LOG OF TEST PIT TP-16

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-19

Surface Conditions: Moderate grass covering; moderately sloping.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 5 (feet)

Depth (feet)	FIELD						LABORATORY					Lithography	DESCRIPTION 0.0 to 5.0 feet
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
												▨	**Sandy CLAY** (CL): Gray-brown, moist, stiff, low plasticity
5													**SANDSTONE**: Light brown to tan, moderately to highly weathered, closely fractured, moderately strong
													Test pit terminated at a depth of approximately 5 feet below existing site grade due to refusal in sandstone.
10													
15													
20													
25													

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LOG OF TEST PIT TP-17

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-20

GEOTC3C P1131 4/21/99

Surface Conditions:

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 3 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 3.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
												░	**SANDSTONE:** Red-brown to tan, highly to moderately weathered, closely fractured, moderately strong, coarse grained with interbedded gravel (Neroly Formation) - difficult excavation
													Test pit terminated at a depth of approximately 3 feet below existing site grade due to refusal in sandstone.
5													
10													
15													
20													
25													

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File Number: 2063

LOG OF TEST PIT TP-18

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-21

GEOTC3C P1131 4/21/99

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 4 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 3.0 feet Approximate Surface Elevation (feet): (msl)
													Silty CLAY (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
													SANDSTONE: Red-brown to gray, highly weathered, very closely to closely fractured, weak to moderately strong, fine to medium grained (Neroly Formation)
													Test pit terminated at a depth of approximately 3 feet below existing site grade due to refusal in sandstone.
5													
10													
15													
20													
25													

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File Number: 2063

LOG OF TEST PIT TP-19

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-22

Surface Conditions: Moderate weed covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 8 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 8.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
												▨	**Sandy CLAY** (CL): Gray-brown, moist, stiff, low to moderate plasticity
5												▨	
													Test pit completed at a depth of approximately 8 feet below existing site grade.
10													
15													
20													
25													

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LOG OF TEST PIT TP-20

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-23

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 1/22/99

Logged By: G. Gulseth

Total Depth: 6 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 6.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, moist, stiff, moderate plasticity
												⁘	**SANDSTONE:** Light gray to red-brown, highly weathered, closely fractured, moderately strong, fine to medium grained, oxides on fractures (Neroly Formation) 1 inch layer claystone at 3 feet
5													
													Test pit completed at a depth of approximately 6 feet below existing site grade.
10													
15													
20													
25													

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF TEST PIT TP-21

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-24

Surface Conditions: Moderate grass and weed covering; essentially level.

Groundwater: No free groundwater encountered.

Date Completed: 3/17/99

Logged By: G. Gulseth

Total Depth: 16 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 16.0 feet Approximate Surface Elevation (feet): (msl)
													Sandy CLAY (CL): Gray, moist, stiff, low plasticity (possible fill)
	◣		11										**Silty CLAY** (CL) with Sand: Brown, very moist, stiff, moderate plasticity
5	◣		20				80	109					**Clayey SILT** (ML) with Sand: Gray, moist, very stiff, low plasticity, weakly cemented
													Sandy CLAY (CL): Brown, very moist, medium stiff, moderate plasticity
10	◣		6				93	119					
													sand fraction increasing, light brown, stiff
15	◣		11										
													Boring completed at a depth of approximately 16 feet below existing site grade.
20													
25													

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Date: 4/14/99

Project No.: 43-113101-GEO

File Number: 2063

LOG OF BORING B- 1

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-25

GEOTC3C P1131 4/21/99

Surface Conditions: Moderate grass and weed covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 3/17/99

Logged By: G. Gulseth

Total Depth: 16 (feet)

Depth (feet)	FIELD Sample Type	 Sample No.	 Blows/ft	 Pen (tsf)	 RQD (%)	 Recovery (%)	LABORATORY Dry Density (pcf)	 Moisture Content (%)	 Passing #4 Sieve (%)	 Passing #200 Sieve (%)	 Other Tests	Lithography	DESCRIPTION 0.0 to 16.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL) with Sand: Dark brown, very stiff, moderate plasticity
	◣		17							74		▨	
5	◣		14									▨	stiff
10	◣		27									▨	very stiff, small gray lenses
												▨	**Sandy CLAY** (CL): Brown, moist, hard, low plasticity
15	◣		30									▨	
													Boring completed at a depth of approximately 16 feet below existing site grade.
20													
25													

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Date: 4/14/99

Project No.: 43-113101-GEO

File Number: 2063

LOG OF BORING B- 2

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-26

GEOTC3C P1131 4/21/99

Surface Conditions:

Groundwater: No free groundwater encountered.

Date Completed: 3/18/99

Logged By: G. Gulseth

Total Depth: 25 (feet)

	FIELD						LABORATORY							
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 25.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**SANDSTONE**: Tan to brown, highly weathered, weak, scattered gravel (Cierbo Formation)
												▨	difficult drilling
5	▬		50/1"									▨	
10												▨	
15	▬		50/1"									▨	
20												▨	
25													Boring completed at a depth of approximately 25 feet below existing site grade.

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF BORING B- 3

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-27

Surface Conditions:

Groundwater: No free groundwater encountered.

Date Completed: 3/17/99

Logged By: G. Gulseth

Total Depth: 50 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 27.0 feet Approximate Surface Elevation (feet): (msl)
													SANDSTONE: Gray to red-brown, highly weathered, weak (Kirker Formation)
5													
													difficult drilling
10			50/1"										
15													
20			50/1"										
25													

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF BORING B- 4

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 2

A-28

	FIELD						LABORATORY						DESCRIPTION 27.0 to 50.0 feet
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	(Continued from previous plate)
													near auger refusal
30			50/1"										
35													
40													
45													
50													Boring terminated at a depth of approximately 50 feet below existing site grade due to essential auger refusal.
55													

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File Number: 2063

LOG OF BORING B- 4

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
2 of 2
A-28

Surface Conditions: Grass covering; leveled.

Groundwater: No free groundwater encountered.

Date Completed: 3/19/99

Logged By: KC

Total Depth: 16 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 16.0 feet Approximate Surface Elevation (feet): (msl)
	☒											▨	**Silty CLAY** (CL): Dark brown, moist, stiff, moderate plasticity
	■		15									▨	
												▨	**Sandy CLAY** (CL): Light brown, moist, hard, moderate plasticity
5	■		33				108	123		63		▨	
10	■		24				98	115				▨	brown, very stiff
15	■		23									▨	red-gray
													Boring completed at a depth of approximately 16 feet below existing site grade.
20													
25													

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File Number: 2063

LOG OF BORING B- 5

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-29

Surface Conditions: Grass covering; sloped.

Groundwater: No free groundwater encountered.

Date Completed: 3/19/99

Logged By: KC

Total Depth: 16 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 16.0 feet Approximate Surface Elevation (feet): (msl)
												▨	**Silty CLAY** (CL): Dark brown, moist, stiff, moderate plasticity
	■		16				105	123			Consolidation	▨	very stiff
												▨	**Silty CLAY** (CL) with Sand: Red-gray, moist, very stiff, moderate plasticity
5	■		23				104	122				▨	
												▨	**Sandy CLAY** (CL): Dark brown, moist, hard, moderate plasticity
10	■		34				109	125				▨	
15	■		29									▨	moderate plasticity
													Boring completed at a depth of approximately 16 feet below existing site grade.
20													
25													

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KLEINFELDER

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Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF BORING B- 6

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1
A-30

Surface Conditions: Grass covering; level.

Groundwater: No free groundwater encountered.

Date Completed: 3/19/99

Logged By: KC

Total Depth: 16 (feet)

Depth (feet)	Sample Type	Sample No.	FIELD Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	LABORATORY Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 16.0 feet Approximate Surface Elevation (feet): (msl)
	■		13				92	113			UC=5650pcf		**Silty CLAY** (CL): Dark brown, moist, stiff, moderate plasticity
5	■		36				98	118					**Sandy SILT** (ML): Brown, moist, hard, low plasticity
													Silty SAND (SM): Brown, moist, medium dense, very fine grained
10	■		20				100	123		38			
15	■		11										
													Boring completed at a depth of approximately 16 feet below existing site grade.
20													
25													

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Date: 4/14/99

Project No.: 43-113101-GEO
File Number: 2063

LOG OF BORING B- 7

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-31

Surface Conditions: Grass covering; level; edge of dirt road.

Groundwater: No free groundwater encountered.

Date Completed: 3/19/99

Logged By: KC

Total Depth: 11 (feet)

DESCRIPTION
0.0 to 11.0 feet

Approximate Surface Elevation (feet): (msl)

Depth (feet)	FIELD						LABORATORY					Lithography	Description
	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests		
												▨	**Silty CLAY** (CL): Brown, moist, stiff, low to moderate plasticity
	■		78				76	101					**SILTSTONE:** Gray-brown, very moist, highly weathered, weak, friable
5	■		76										
													SANDSTONE: Brown, highly weathered, weak, fine to medium grained
10	■		87										
													Boring completed at a depth of approximately 11 feet below existing site grade.
15													
20													
25													

GEOTC3C P1131 4/21/99

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF BORING B- 8

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

A-32

Surface Conditions: Grass and boulder covering; essentially level; cut rock area.

Groundwater: No free groundwater encountered.

Date Completed: 3/17/99

Logged By: G. Gulseth

Total Depth: 30 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 27.0 feet Approximate Surface Elevation (feet): (msl)
													Sandy CLAY (CL): Brown, moist, low plasticity
													SANDSTONE: Brown to tan, moderately to highly weathered, closely fractured, moderately strong, fine to coarse grained (Neroly Formation)
		Core 1			87								
5													
		Core 2			79								
													blue-gray, fine grained
10													
													3-inch siltstone seam: light gray, highly weathered, weak
		Core 3			65								moderately weathered, fine to medium grained
15													
		Core 4			68								
20													
		Core 5			62								
													blue-gray, fine grained
													brown to tan, fine to medium grained
25													

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File Number: 2063

LOG OF BORING C- 1

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 2

A-33

GEOTC3C P1131 4/21/99

	FIELD						LABORATORY						DESCRIPTION 27.0 to 30.0 feet
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	(Continued from previous plate)
		Core 6			70								
30													Boring completed at a depth of approximately 30 feet below existing site grade.
35													
40													
45													
50													
55													

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Project No.: 43-113101-GEO
File Number: 2063

LOG OF BORING C- 1

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
2 of 2
A-33

Surface Conditions: Grass covering; gently sloping.

Groundwater: No free groundwater encountered.

Date Completed: 3/18/99

Logged By: G. Gulseth

Total Depth: 42 (feet)

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 0.0 to 27.0 feet Approximate Surface Elevation (feet): (msl)
													Silty CLAY (CL) with Sand: Brown, moist, moderate plasticity
													Clayey SAND (SC) with significant rock fragments: Brown to olive-brown, medium dense, low plasticity (completely weathered sandstone)
5													**SANDSTONE**: Olive-gray, highly weathered, closely fractured, weak to moderately strong, oxides at joints, thin olive-gray siltstone seams (Neroly Formation)
		Core 1			53								
													without siltstone seams
10		Core 2			38	77							
													dark brown to black, fine to coarse grained
15		Core 3			69	100							
													strong, highly to moderately weathered
		Core 4			85	100							
20													
		Core 5			75	94							thin completely to highly weathered claystone seams
25													

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File Number: 2063

LOG OF BORING C- 2

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 2
A-34

GEOTC3C P1131 4/21/99

	FIELD						LABORATORY						
Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	RQD (%)	Recovery (%)	Dry Density (pcf)	Moisture Content (%)	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION 27.0 to 42.0 feet (Continued from previous plate)
30		Core 6			47	75							without claystone seams
35		Core 7			70	90							
40		Core 8			76	93							
													Boring completed at a depth of approximately 42 feet below existing site grade.
45													
50													
55													

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File Number: 2063

LOG OF BORING C- 2

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
2 of 2

A-34

GEOTC3C P1131 4/21/99

APPENDIX B
LABORATORY TESTING

General

Laboratory tests were performed on selected samples to aid in soil classification and to evaluate physical properties of the soils which may affect the geotechnical aspects of project design and construction. A description of the laboratory testing program is presented below; a summary of all laboratory tests performed is presented on the Summary of Laboratory Tests, Plate B-1.

Moisture Content and Dry Unit Weight

Moisture content and dry unit weight tests were performed to evaluate moisture-conditioning requirements during site preparation and earthwork grading; soil overburden, and active and passive earth pressures; and relative soil strength and compressibility. 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. Results of these tests are presented on the logs and are summarized on the Summary of Laboratory Tests.

Sieve Analysis

Sieve analyses were performed to evaluate the gradational characteristics of the material and to aid in soil classification. Tests were performed in general accordance with ASTM Test Method C 136. Results of these tests are presented on the logs and are summarized on the Summary of Laboratory Tests.

Atterberg Limits

Atterberg Limits tests were performed to aid in soil classification and to evaluate the plasticity characteristics of the material. Additionally, test results were correlated to published data to evaluate the shrink/swell potential of near-surface site soils. Tests were performed in general accordance with ASTM Test Method D 4318. Results of these tests are presented on the logs and are summarized on the Summary of Laboratory Tests.

Unconfined Compression

An unconfined compression test was performed on a selected, undisturbed sample to evaluate the undrained shear strength of the fine-grained site soils. Test procedures were in general accordance with ASTM Test Method D 2166. Results of this test are presented on the Summary of Laboratory Tests.

Consolidation

A consolidation test was performed on an undisturbed soil sample obtained near the anticipated foundation depth to evaluate potential foundation settlements under the expected loads. Test procedures were in general accordance with ASTM Test Method D 2435. Results of this test are presented on Plate B-2.

R-Value

Resistance value (R-value) tests were performed on bulk soil/crushed weathered rock samples to evaluate pavement support characteristics of the near-surface site soils. Test procedures were in general accordance with California Test 301. Results of these tests are presented on the Summary of Laboratory Tests.

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

Plate B-1	Summary of Laboratory Tests
Plate B-2	Consolidation Test

BORING NO.	SAMPLE DEPTH (ft)	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (% of dry weight)	PARTICLE SIZE SIEVE SIZE (percent passing)						ATTERBERG LIMITS		OTHER TESTS
				3"	3/4"	#4	#10	#40	#200	L.L.	P.I.	
B- 1	1-1/2 to 3		26									
B- 1	4-1/2 to 6	80	36									
B- 1	9-1/2 to 11	93	28									
B- 2	1-1/2 to 3		12						74	39	20	
B- 2	4-1/2 to 6		16									
B- 2	9-1/2 to 11		17									
B- 5	4-1/2 to 6	108	14						63	47	26	
B- 5	9-1/2 to 11	98	17									
B- 6	1-1/2 to 3	105	17									Consolidation
B- 6	4-1/2 to 6	104	17									
B- 6	9-1/2 to 11	109	15									
B- 7	1-1/2 to 3	92	23									UC = 5650pcf
B- 7	4-1/2 to 6	98	20									
B- 7	9-1/2 to 11	100	23						38			
B- 8	1-1/2 to 3	76	33									
B- 8	4-1/2 to 6		32									
TP- 3	0 to 3											R-Value = 5
TP-16	2 to 5											R-Value = 52

LABSUM1S P1131 4/21/99

KLEINFELDER

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SUMMARY OF LABORATORY TESTS

MONTREUX SUBDIVISION
KIRKER PASS ROAD
PITTSBURG, CALIFORNIA

PLATE
1 of 1

B-1