Appendix C

Preliminary Geotechnical Evaluation

GeoSoils 2011

PRELIMINARY GEOTECHNICAL EVALUATION
11 ACRES AT 2115 AMANDA LANE, UNINCORPORATED ESCONDIDO
SAN DIEGO COUNTY, CALIFORNIA

FOR

ARETE HOMES
3660 MERCED DRIVE
OCEANSIDE, CALIFORNIA 92056

W.O. 6269-A-SC JULY 1, 2011

GeoSoils, Inc.
Geotechnical • Geologic • Coastal • Environmental

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July 1, 2011

W.O. 6269-A-SC

Arete Homes
3660 Merced Drive
Oceanside, California 92056

Attention: Mr. Gil Miltenberger

Subject: Preliminary Geotechnical Evaluation, 11 Acres at 2115 Amanda Lane, Unincorporated Escondido, San Diego County, California

Dear Mr. Miltenberger:

In accordance with your request, GeoSoils, Inc. (GSI) has performed a preliminary geotechnical investigation of the subject site with respect to proposed residential development. The purpose of our study was to evaluate the onsite soils and geologic conditions and their effects on the proposed site development from a geotechnical viewpoint.

EXECUTIVE SUMMARY

Based on our review of the available data (see Appendix A), field exploration, laboratory testing, and geologic and engineering analysis, the proposed development of the property appears to be feasible from a geotechnical viewpoint, provided the recommendations presented in the text of this report are properly incorporated into the design and construction of the project. The most significant elements of this study are summarized below:

- It is our understanding that proposed development will consist of preparing the site for residential development, including street and underground utilities. We further understand that the proposed residential construction will utilize a concrete slab-on-grade floor with continuous footings.

- Subsurface exploration indicates that the site is underlain by granitic bedrock mantled with surficial deposits of colluvium (topsoil) and local areas of undocumented artificial fill. Soil type generated during exploratory excavation operations consisted primarily of silty sand and sand, with trace clayey sand and clay.

- Our evaluation indicates there are no known active faults crossing the site. In addition, other than strong seismic shaking produced from an earthquake on a nearby active fault, other geologic hazards such as liquefaction, surface fault rupture, etc., have a low potential to affect the proposed site development.

- Adverse geologic features that would preclude project feasibility were not encountered.

- The seismic acceleration values and design parameters provided herein should be considered during the design of the proposed development. The adverse effects of seismic shaking on the structure(s) will likely be wall cracks, some foundation/slab distress, and some seismic settlement. However, it is anticipated that the structure will be repairable in the event of the design seismic event. This potential should be disclosed to all interested/affected parties.

- Our review indicates that regional groundwater should generally not significantly affect site development, based on the available data. However, due to the nature of the site materials, seepage and/or perched groundwater conditions may develop throughout the site in the future, both during and subsequent to development, especially along boundaries of contrasting permeabilities (i.e., fill/bedrock contacts, discontinuities, etc.), and should be anticipated. This potential should be disclosed to all interested/affected parties. Thus, more onerous slab design is necessary for any new slab-on-grade floor (State of California, 2011). Recommendations for reducing the amount of water and/or water vapor through slab-on-grade floors are provided in the "Soil Moisture Considerations" sections of this report.

- GSI has reviewed USDA (2011) in order to evaluate the infiltration rate of water into the subsoil as it pertains to the design of an onsite storm water infiltration system, and/or septic systems. Based on our review, USDA (2011) indicates that the capacity of the soil to transmit water (K_{sat}) ranges from approximately 2 to 6 inches per hour (i.e., 10 to 30 minutes per inch), for sandy soil layers within approximately 48 inches from the surface. However, the capacity of the most limiting layer of soil to transmit water (K_{sat}) below this depth is on the order of 0.57 inches per hour (105 minutes per inch).

- Soils considered unsuitable for the support of settlement-sensitive improvements and/or engineered fill include, existing, undocumented artificial fill, Quaternary-age colluvium/topsoil, and near-surface, highly weathered bedrock. Cretaceous-age granitic bedrock is considered appropriate for the support of settlement-sensitive improvements and/or engineered fill in their existing state. Based on the available data, the thickness of unsuitable soils across the site is anticipated to range between approximately 3 to 6 feet. However, localized deeper removals cannot be precluded. In order to provide suitable foundation support, unsuitable soils may be removed to expose suitable, bedrock, and recompacted to desirable design finish grades. Removals should be performed to at least 5 feet outside any proposed settlement-sensitive improvements, where possible. The removed soils may be reused as engineered fill provided that major concentrations of vegetation and/or debris have been removed prior to placement. A minimum 3-foot thick layer of compacted fill, or 2 feet below the footing, whichever is deeper, is recommended for the support of all foundation systems.

- It should be noted that the 2010 California Building Code ([2010 CBC], California Building Standards Commission [CBSC], 2010) indicates that removals of unsuitable soils be performed across all areas under the purview of the grading permit, not just within the influence of the residential structure. Relatively deep removals may also necessitate a special zone of consideration on perimeter/confining areas. This zone would be approximately equal to the depth of removals, if removals cannot be performed offsite. Thus, any settlement-sensitive improvements (walls, flatwork, etc.), constructed within this zone may require deepened foundations, reinforcement, etc., or will retain some potential for settlement and associated distress. The presence of existing, offsite improvements may limit remedial earthwork along property boundaries. Should unmitigated soils remain within the property boundaries at the conclusion of grading, the potential for settlement-sensitive improvements, constructed within the influence of these soils, to experience settlement-associated distress should be anticipated and be properly disclosed to all interested/affected parties.

- Practical refusal on dense bedrock was encountered at depths ranging from 6 to 11 feet with a Caterpillar 420 D backhoe. Depths to refusal on hard rock using heavy grading equipment will likely be greater, and may be approximated as 15 to perhaps 20 feet, based on the available information, and our experience in the region. Additional rock hardness evaluations, including, but not limited to a seismic refraction survey, and air track drilling, are recommended once preliminary grading plans are made available.

- Excavations into bedrock generally produced silty sand and sand, with some brittle, gravel to cobble size rock fragments produced within 1 to 2 feet of practical refusal depths. Scattered, boulder size corestones should also be anticipated to occur throughout the site. Excavations completed below the depths explored in this study should be anticipated to encounter a greater frequency of corestones and rock fragments. Additional evaluations are recommended once preliminary grading plans are made available.

- Temporary excavations greater than 4 feet but less than 20 feet in overall height should conform to CAL-OSHA and/or OSHA requirements for Type "B" soils. Temporary construction slopes, up to a maximum height of ±20 feet, may be excavated at a 1:1 (horizontal to vertical [h:v]) gradient, or flatter, provided groundwater is not present, and stockpiled soil or heavy equipment are not stored at the top of the slope. All temporary excavations should be observed by a licensed engineering geologist or geotechnical engineer prior to worker entry.

- Graded slopes should perform adequately, assuming proper construction and maintenance. The need for stabilization fill, and/or buttresses is not considered likely at this time. The need for subdrainage will be evaluated once preliminary grading plans have been developed.

- The expansion potential of tested onsite soils is generally in the range of very low (Expansion Index [E.I.] 0 to 20), with a minor component exhibiting medium (E.I. 51 to 90), and a plasticity index of 24. On a preliminary basis, it appears that the majority of soils onsite are very low expansive, and an appropriate blend of all soil types onsite will likely result in very low to possibly low expansive soil conditions. As such, conventional-type foundations and/or post tensioned foundations may be used for the onsite soil conditions. Final recommendations for foundation design and construction will be provided at the conclusion of site earthwork, which may result in amendments to the preliminary design.

- Soil pH, saturated resistivity, and soluble sulfate, and chloride testing, performed by Prime Testing, Inc., indicates that the site soils are mildly alkaline with respect to soil acidity/alkalinity, are mildly corrosive to ferrous metals when saturated, possess negligible ("not applicable") sulfate exposure to concrete (per Table 4.2.1 of ACI 318-08), and are not considered an external source of chlorides. Reinforced concrete mix design should conform to "Exposure Class CO" in Table 4.3.1 of ACI 318-08. These findings indicate that corrosive effects of on-site soils on concrete are expected to be low, and low corrosion potential on buried metal; however, GSI does not consult in corrosion engineering. Additional comments and recommendations should be obtained from the structural engineer and/or architect for the project, should corrosion mitigation be desired or required. Test results are presented in Appendix D.

- The recommendations presented in this report should be incorporated into the design and construction considerations of the project. Due to the very preliminary nature of this project, additional studies will be recommended, once grading plans are developed.

The opportunity to be of service is greatly appreciated. If you have any questions concerning this report, or if we may be of further assistance, please do not hesitate to contact any of the undersigned.

Respectfully submitted,

GeoSoils, Inc.

Robert G. Crisman
Engineering Geologist, CEG 1934

David W. Skelly
Civil Engineer, RCE 47857

RGC/JPF/DWS/jh

Distribution: (4) Addressee

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ATTACHMENTS:

PRELIMINARY GEOTECHNICAL EVALUATION
11 ACRES AT 2115 AMANDA LANE, UNINCORPORATED ESCONDIDO
SAN DIEGO COUNTY CALIFORNIA

SCOPE OF SERVICES

The scope of our services has included the following:

1. Review of the available geologic literature for the site (see Appendix A).

2. Geologic site reconnaissance, subsurface exploration with 12 test pit excavations (see Appendix B), sampling, and mapping.

3. General areal seismicity evaluation (see Appendix C).

4. Appropriate laboratory testing of representative soil samples (text and Appendix D).

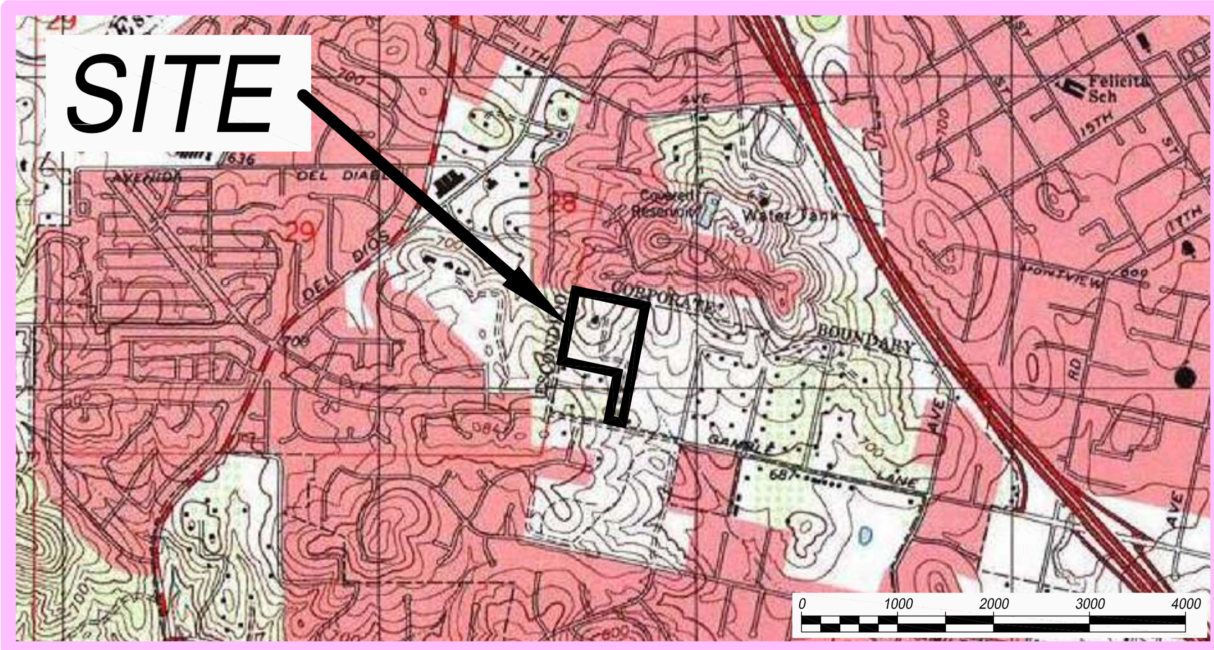
5. Engineering and geologic analysis of data collected.

6. Preparation of this report.

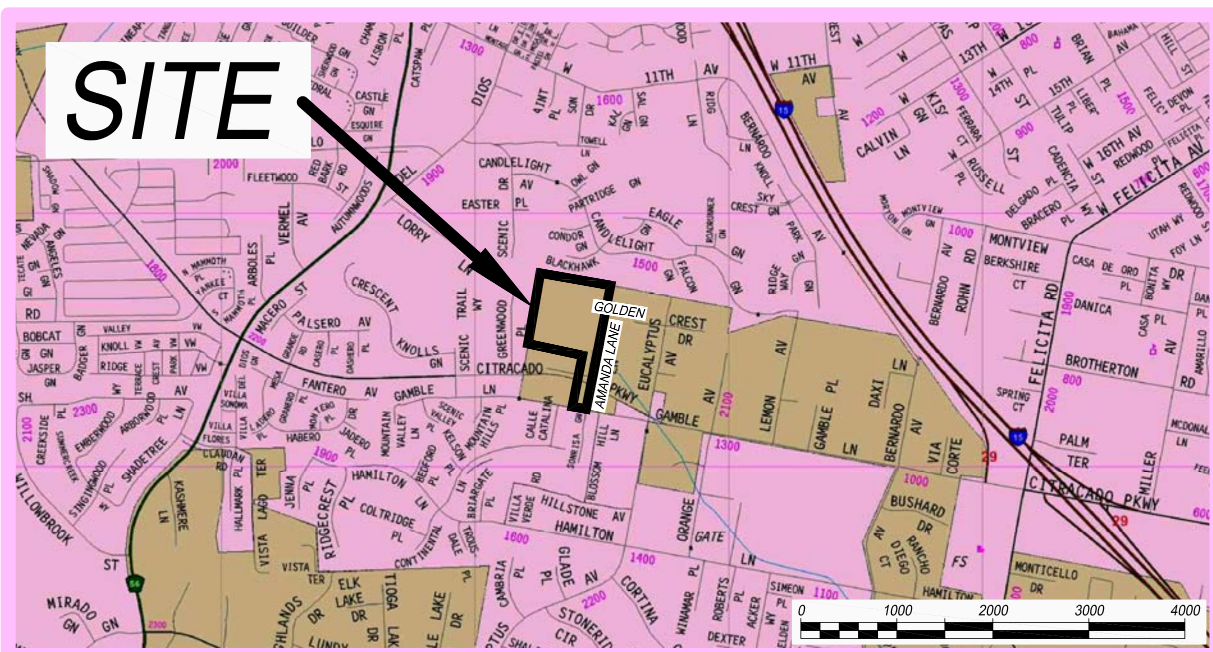
SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The site consists of approximately 11 acres located at 2115 Amanda Lane in the unincorporated area of Escondido, California (see Figure 1, Site Location Map). The property is bounded by Amanda Lane to the south, and existing residential development on the remaining sides. Topographically, the site is situated across a low, south trending ridge line. The eastern flank of the ridge line slopes eastward, at gradients on the order of 5:1 (horizontal:vertical [h:v]), while the western flank slopes westward, at gradients on the order of 4:1 (h:v). Maximum elevations across the site range from approximately 820 to 840 feet Mean Sea Level (MSL) along the crest of the ridge line, to minimum elevations ranging from approximately 750 to 780 feet MSL near the base of the lower, flanking slopes, for an overall topographic relief across the site of approximately 90 feet. Site drainage appears to be directed offsite to the west and southeast, via tributary drainages. Existing site improvements consist of a single family residential structure, detached garage, and small outbuilding, located along the ridge line, with the remaining property relatively undeveloped. It is our understanding that the site was formerly used for agricultural purposes. Site vegetation consists of several trees in close proximity to the existing residence, with grasses, weeds, and scattered shrubs throughout the remaining property. Existing site conditions are shown on Figure 2 (Geotechnical Map).

While a preliminary site plan was not available, it is our understanding that the 11 acre property will be subdivided into smaller residential parcels, with lots conceptually ranging from approximately ⅓ to 1 acre in size, dependant on various factors, including site grading, sewage disposal, etc. Residential structures will likely be one, or two story, with foundation systems utilizing concrete slab-on-grade floors with continuous footings.

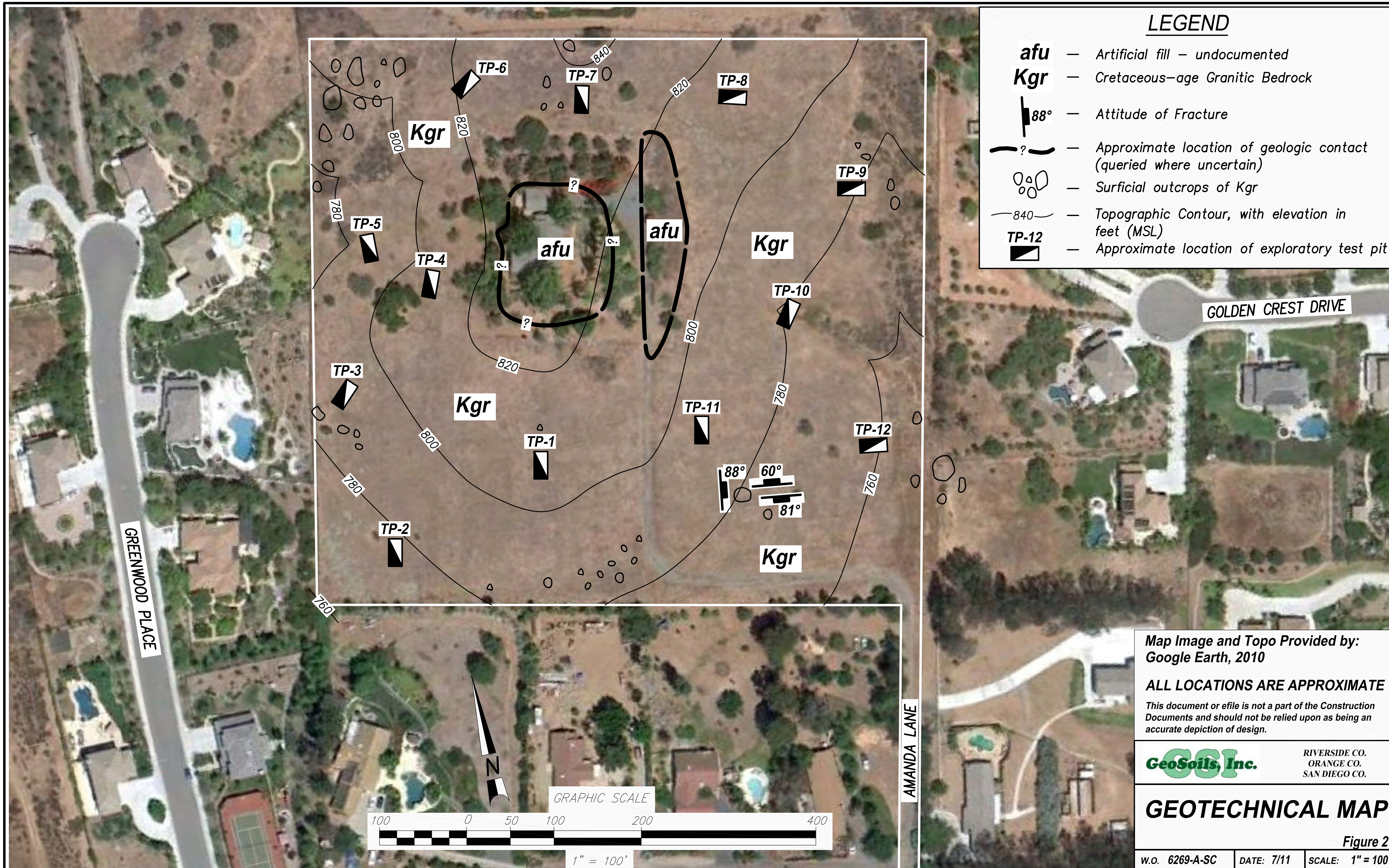


Base Map: TOPO!® ©2003 National Geographic, U.S.G.S Escondido Quadrangle, California -- San Diego Co., 7.5 Minute, dated 1996, current, 1999.



Base Map: The Thomas Guide, San Diego Co., Street Guide and Directory, 2005 Edition, by Thomas Bros. Maps, page 1129.

GeoSoils, Inc.	W.O. 6269-A-SC
SITE LOCATION MAP	Figure 1


LEGEND
afu — Artificial fill – undocumented
Kgr — Cretaceous–age Granitic Bedrock
88° — Attitude of Fracture
? — Approximate location of geologic contact (queried where uncertain)
— Surficial outcrops of Kgr
840 — Topographic Contour, with elevation in feet (MSL)
TP-12 — Approximate location of exploratory test pit
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-7
TP-8
TP-9
TP-10
TP-11
TP-12
afu
afu
Kgr
Kgr
Kgr
Kgr
Kgr
88°
60°
81°
760
780
800
820
840
GOLDEN CREST DRIVE
GREENWOOD PLACE
AMANDA LANE
N
GRAPHIC SCALE
100 0 50 100 200 400
1" = 100'
Map Image and Topo Provided by: Google Earth, 2010
ALL LOCATIONS ARE APPROXIMATE
This document or efile is not a part of the Construction Documents and should not be relied upon as being an accurate depiction of design.
GeoSoils, Inc.
RIVERSIDE CO.
ORANGE CO.
SAN DIEGO CO.
GEOTECHNICAL MAP
Figure 2
W.O. 6269-A-SC
DATE: 7/11
SCALE: 1" = 100'

Building loads are unknown at this time, but are assumed typical for this type of relatively light residential construction.

Cut and fill grading techniques are anticipated to bring the site to the desired configuration. While a preliminary grading plan has not been developed, cut, and/or fill slopes up to approximately 20 feet in height, and at gradients ranging from 1.5:1 (h:v) for cut slopes, to 2:1 (h:v) for fill slopes, are anticipated at this time.

Sewage disposal is anticipated to be either tied to into the municipal system, or use onsite disposal techniques (septic). The need for import soils is unknown at this time.

SITE EXPLORATION

Surface observations and subsurface explorations were performed during June, 2011, by a representative of this office. A survey of line and grade for the subject site was not conducted by this firm at the time of our site reconnaissance. Near-surface soil and geologic conditions were explored with 12 exploratory test pits excavated with a rubber tire backhoe (Caterpillar 420 D). The approximate locations of each exploratory test pit are shown on the Geotechnical Map (see Figure 2). Logs of the test pits are presented in Appendix B.

REGIONAL GEOLOGY

The subject property is located within a prominent natural geomorphic province in southwestern California known as the Peninsular Ranges. It is characterized by steep, elongated mountain ranges and valleys that trend northwesterly. The mountain ranges are underlain by basement rocks consisting of pre-Cretaceous metasedimentary rocks, Jurassic metavolcanic rocks, and Cretaceous plutonic rocks of the southern California batholith.

In the San Diego County region, deposition occurred during the Cretaceous Period and Cenozoic Era in the continental margin of a forearc basin. Sediments, derived from Cretaceous-age plutonic rocks and Jurassic-age volcanic rocks, were deposited into the narrow, steep, coastal plain and continental margin of the basin. These rocks have been uplifted, eroded, and deeply incised. During early Pleistocene time, a broad coastal plain was developed. During mid- to late-Pleistocene time, this plain was uplifted, eroded, and incised. Alluvial deposits have since filled the lower valleys, and young marine sediments are currently being deposited/eroded within coastal and beach areas. Our evaluation indicates that the site is underlain with granitic bedrock belonging to the Peninsular Ranges batholith.

SITE GEOLOGIC UNITS

The site geologic units encountered during our subsurface investigation and site reconnaissance included existing, undocumented artificial fill, colluvium (topsoil), and Cretaceous-age granitic bedrock belonging to the Peninsular Ranges batholith. The earth materials are generally described below from the youngest to the oldest. The distribution of these materials across the site is shown on Figure 2.

Undocumented Artificial Fill (Map Symbol - Afu)

Existing, undocumented fill was observed in the general vicinity of the existing residential structure, and, to a lessor extent, along Amanda Lane. Where observed, existing fills consist of brown silty sand, and are typically dry, loose, and heavily burrowed. In general, the thickness of fill appears to vary up to approximately 6 feet. Existing fills are considered potentially compressible in their existing state and therefore should be removed and recompacted, if settlement-sensitive improvements and/or planned fills are proposed within their influence.

Colluvium (Not Mapped)

Where encountered, colluvium is on the order of 2 to 6 feet thick, and consists predominantly of silty sand, with minor amounts of clayey sand. These soils are typically dry to moist, loose, porous, and heavily burrowed. Colluvium is not considered suitable for support of settlement-sensitive improvements, unless these soils are removed, moisture conditioned, and placed as compacted fill.

Granitic Bedrock (Map Symbol - Kgr)

Granitic bedrock underlies the entire site and may be observed in scattered, surficial outcrops throughout the property (see Figure 2). Where encountered in our exploratory test pits and observed in outcrop, bedrock consists of medium dense to very dense rock (disintegrated granitic, or "DG"), breaking to brown and medium gray, slightly moist to moist, silty sand and sand upon excavation. Practical refusal on dense rock with a Cat 420 D backhoe was typically encountered at depths on the order of 6 to 9 feet below existing surface grades. Bedrock is considered suitable for the support of settlement-sensitive improvements and/or planned fill in their existing state.

Locally, a discontinuous mantle of highly weathered bedrock, breaking to clayey sand and sandy clay upon excavation, was encountered within the eastern portion of the property. This highly weathered bedrock is typically brown, slightly moist to moist, and medium dense (clayey sand) to firm (clay). Highly weathered bedrock is considered potentially compressible in its' existing state and therefore should be removed and recompacted if settlement-sensitive improvements and/or planned fills are proposed within its' influence.

Bedrock encountered with the test excavations was typically massive (i.e., no visible structure), however, jointing was observed locally in surficial outcrops. Joint patterns observed were typically high angle (i.e., 45 degrees or steeper), and generally trending north-south, and east west (see Figure 2). The causes of the jointing may be several: (1) tectonic stresses causing fracturing essentially contemporaneously with the tectonic activity; (2) residual stresses, due to events that happened long before the fracturing; (3) contraction due to shrinkage because of cooling or dessication; and (4) surficial movements, such as mechanical/chemical weathering.

LANDSLIDE SUSCEPTIBILITY

According to regional landslide susceptibility mapping by Tan and Giffen (1995), the site is located within Landslide Susceptibility Area 3-1, which is characterized as being "generally susceptible" to landsliding. However, given the site's relatively gentle relief (i.e., slope gradients on the order of 4:1 [h:v], or less), the absence of adverse geologic structure, and dense nature of the underlying bedrock, the potential for landslides to affect the proposed site development is considered low.

GROUNDWATER

Our review indicates that regional groundwater should generally not significantly affect site development, and is anticipated to generally be deeper than at least 50 feet. Due to the nature of the site materials, seepage and/or perched groundwater conditions may develop throughout the site in the future, both during and subsequent to development, especially along boundaries of contrasting permeabilities (i.e., sandy/clayey fill lifts, fill/bedrock contacts, bedding, discontinuities, etc.), and should be anticipated. This potential should be disclosed to all interested/affected parties. As such, more onerous slab design is necessary for any new slab-on-grade floor (State of California, 2011). Recommendations for reducing the amount of water and/or water vapor through slab-on-grade floors are provided in the "Soil Moisture Considerations" sections of this report.

FAULTING AND REGIONAL SEISMICITY

Regional Faults

Our review indicates that there are no known active faults crossing this site, and the site is not within an Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). However, the site is situated in an area of active faulting. These include, but are not limited to: the San Andreas fault; the San Jacinto fault; the Elsinore fault; the Coronado Bank fault zone; and the Newport-Inglewood - Rose Canyon fault zone (NIRCFZ). Portions of the nearby NIRCFZ are located in an Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). The location of these, and other major faults relative to the site, are indicated in Appendix C

(California Fault Map). The possibility of ground acceleration, or shaking at the site, may be considered as approximately similar to the southern California region as a whole. Major active fault zones that may have a significant affect on the site, should they experience activity, are listed in Appendix C (modified from Blake, 2000a).

Local Faulting

No local faulting was observed to transect the site during the field investigation. Additionally, a review of available regional geologic maps does not indicate the presence of local faults crossing the site.

Seismicity

The acceleration-attenuation relation of Bozorgnia, Campbell, and Niazi (1999)has been incorporated into EQFAULT (Blake, 2000a). EQFAULT is a computer program developed by Thomas F. Blake (2000a), which performs deterministic seismic hazard analyses using digitized California faults as earthquake sources.

The program estimates the closest distance between each fault and a given site. If a fault is found to be within a user-selected radius, the program estimates peak horizontal ground acceleration that may occur at the site from an upper bound ("maximum credible") earthquake on that fault. Site acceleration (g) was computed by one user-selected acceleration-attenuation relation that is contained in EQFAULT. Based on the EQFAULT program, a peak horizontal ground acceleration from an upper bound event at the site may be on the order of 0.17 g. The computer printouts of pertinent portions of the EQFAULT program are included within Appendix C.

Historical site seismicity was evaluated with the acceleration-attenuation relation of Bozorgnia, Campbell, and Niazi (1999), and the computer program EQSEARCH (Blake, 2000b, updated to June 2010). This program performs a search of the historical earthquake records for magnitude 5.0 to 9.0 seismic events within a 100-kilometer radius, between the years 1800 through June 2010. Based on the selected acceleration-attenuation relationship, a peak horizontal ground acceleration is estimated, which may have effected the site during the specific event listed. Based on the available data and the attenuation relationship used, the estimated maximum (peak) site acceleration during the period 1800 through June 2010 was 0.13 g. A historic earthquake epicenter map and a seismic recurrence curve are also estimated/generated from the historical data. Computer printouts of the EQSEARCH program are presented in Appendix C.

A probabilistic seismic hazards analysis was performed using the 2008 Interactive Deaggregations (Beta) Seismic Hazard Analysis tool available at the USGS website (https://geohazards.usgs.gov/deaggint/2008/) which evaluates the site specific probabilities of exceedance for selected spectral periods. Based on a review of these data, and considering the relative seismic activity of the southern California region, a probabilistic horizontal ground acceleration (PHGA) of 0.20g and 0.37 g were calculated.

These values were chosen as they correspond to a 10 percent and 2 percent probability of exceedance in 50 years, respectively. Printouts from this analysis are also included in Appendix C.

Seismic Shaking Parameters

Based on the site conditions, the following table summarizes the site-specific design criteria obtained from the 2010 CBC (CBSC, 2010), Chapter 16 Structural Design, Section 1613, Earthquake Loads. The computer program Seismic Hazard Curves and Uniform Hazard Response Spectra, provided by the United States Geologic Survey (U.S.G.S.) was utilized for design. The short spectral response utilizes a period of 0.2 seconds.

CBC SEISMIC DESIGN PARAMETERS		
PARAMETER	**VALUE**	**2010 CBC REFERENCE**
Site Class	C	Table 1613.5.2
Spectral Response - (0.2 sec), S_s	1.054g	Figure 1613.5(1)
Spectral Response - (1 sec), S_1	0.390g	Figure 1613.5(2)
Site Coefficient, F_a	1.0	Table 1613.5.3(1)
Site Coefficient, F_v	1.41	Table 1613.5.3(2)
Maximum Considered Earthquake Spectral Response Acceleration (0.2 sec), S_{MS}	1.054g	Section 1613.5.3 (Eqn 16-36)
Maximum Considered Earthquake Spectral Response Acceleration (1 sec), S_{M1}	0.550g	Section 1613.5.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (0.2 sec), S_{DS}	0.702g	Section 1613.5.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.367g	Section 1613.5.4 (Eqn 16-39)
GENERAL SEISMIC DESIGN PARAMETERS		
Distance to Seismic Source (Rose Canyon fault zone)	14.2 mi. (22.9 km)	
Upper Bound Earthquake (Rose Canyon fault zone)	M_W 6.9**	
Probabilistic Horizontal Ground Acceleration ([PHGA] 10% and 2% probability of exceedance in 50 years)	0.20g/0.37g	
** International Conference of Building Officials (ICBO, 1998)		

Conformance to the criteria above for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur in the event of a large earthquake. The primary goal of seismic design is to protect life, not to eliminate all damage, since such design may be economically prohibitive. Cumulative effects of seismic events are not addressed in the 2010 CBC (CBSC; 2010) and regular maintenance and repair following locally significant seismic events (i.e., M_w5.0) will likely be necessary.

Seismic Hazards

The following list includes other seismic related hazards that have been considered during our evaluation of the site. The hazards listed are considered negligible and/or mitigated as a result of site location, soil characteristics, and typical site development procedures:

- Dynamic Settlement
- Liquefaction
- Surface Fault Rupture
- Ground Lurching or Shallow Ground Rupture
- Tsunami
- Seiche

It is important to keep in perspective that in the event of an upper bound or maximum credible earthquake occurring on any of the nearby major faults, strong ground shaking would occur in the subject site's general area. Potential damage to any structure(s) would likely be greatest from the vibrations and impelling force caused by the inertia of a structure's mass than from those induced by the hazards considered above. Following implementation of remedial earthwork and design of foundations described herein, this potential would be no greater than that for other existing structures and improvements in the immediate vicinity that comply with current and adopted building standards.

USDA SOIL ASSOCIATIONS

A review of USDA (2011) and Bowman, et al. (1973) indicates that site soils are generally referred to as the Fallbrook Sandy Loam. As described, these soils consist of "somewhat excessively drained to moderately well drained loamy coarse sands and fine sandy loams that have a subsoil of sandy clay over hardpan." According to USDA (2011), the depth to restrictive feature (i.e. bedrock) is on the order of 40 to 60 inches below grade. This depth is generally consistent with the findings of this study.

PERCOLATION FEASIBILITY

GSI has reviewed USDA (2011) in order to evaluate the infiltration rate of water into the subsoil as it pertains to the design of an onsite storm water infiltration system, and/or septic systems. Based on our review, USDA (2010) indicates that the capacity of the soil to transmit water (K_{sat}) ranges from approximately 2 to 6 inches per hour, for sandy soil layers within approximately 48 inches from the surface. However, the capacity of the most limiting layer of soil to transmit water (K_{sat}) below this depth is on the order of 0.57 inches per hour.

LABORATORY TESTING

General

Laboratory tests were performed on representative samples of the onsite earth materials in order to evaluate their physical characteristics. The test procedures used and results obtained are presented below.

Classification

Soils were classified visually according to the Unified Soils Classification System (Sowers and Sowers, 1979). The soil classifications are shown on the Test Pit Logs in Appendix B.

Maximum Density Testing

The laboratory maximum dry density and optimum moisture content for the major soil type within this construction phase were determined according to test method ASTM D 1557. The following table presents the results:

LOCATION - SOIL TYPE	MAXIMUM DENSITY (PCF)	MOISTURE CONTENT (PERCENT)
TP-7 @ 0-2' - SILTY SAND	127.5	9.0

Expansion Potential

Representative samples of soil near surface grade were tested for expansivity. The Expansion Index (E.I.) tests were performed in general accordance with ASTM Standard D 4829, and were classified according to Table 18-I-B, as outlined in Section 1803 of the 2001 California Building Code ([2001 CBC], International Conference of Building Officials [ICBO], 2001). Please note the current 2010 CBC (CBSC, 2010) does not classify an expansion potential index and as such, we have utilized these previous standards only to classify this material. The laboratory test results are presented in the following table.

LOCATION AND DEPTH (FT)	EXPANSION INDEX	EXPANSION POTENTIAL*
TP-8 @ 4'	<20	Very Low
TP-9 @ 2-4'	64	Medium
* - per Table 18-I-B of the 2001 California Building Code (International Conference of Building Officials, 2001)		

Atterberg Limits

Tests were performed to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D-4318. The test results are presented in Appendix D, and the table below:

LOCATION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
TP-9 @ 2'-4'	44	20	24

Direct Shear Test

Shear testing was performed on a relatively undisturbed sample of site soil in general accordance with ASTM Test Method D3080. Results of shear testing are provided in the following table and in Appendix D.

SAMPLE LOCATION AND DEPTH (FT)	PRIMARY		RESIDUAL	
	COHESION (PSF)	FRICTION ANGLE (DEGREES)	COHESION (PSF)	FRICTION ANGLE (DEGREES)
TP-4 @ 4	454	30	313	32

Grain-Size Distribution

A grain-size distribution test was performed on a representative sample in general accordance with ASTM Test Method D422. Test results are presented in Appendix D.

Resistance Value

Resistance value (R-value) testing was performed on a representative sample of the onsite soils in general accordance with California Test Method 301. Testing indicates a R-value of 75. The results of this testing is presented in Appendix D.

Saturated Resistivity, pH, and Soluble Sulfates

GSI conducted sampling of onsite earth materials for general soil corrosivity and soluble sulfates, and chlorides testing. Laboratory testing was completed by Prime Testing, Inc. The testing included evaluation of soil pH, soluble sulfates, chlorides, and saturated resistivity. Test results indicate that site soils are mildly basic (pH = 6.1) with respect to soil acidity/alkalinity, are corrosive to ferrous metals when saturated (saturated resistivity = 1,300 ohm-cm), present a negligible sulfate exposure to concrete (960 mg/kg), and not exhibit an external source of chlorides to reinforced concrete (chloride content = 50 ppm), and are not considered an external source of chlorides. Reinforced concrete mix design should conform to "Exposure Class CO" in Table 4.3.1 of ACI 318-08. These findings indicate that corrosive effects of on-site soils on concrete are expected to be low, and corrosive toward buried metal; however, GSI does not consult in corrosion engineering. Additional comments and recommendations should be obtained from the structural engineer and/or architect for the project, should corrosion mitigation be desired or required. Test results are presented in Appendix D.

SLOPE STABILITY

Gross Stability

Graded slopes up to approximately 20 feet in height, are anticipated to be generally stable assuming proper construction and maintenance. On a preliminary basis, fill slopes may be constructed at gradients of 2:1 (h:v), or flatter, while cut slopes, exposing suitable dense granitic bedrock, may be constructed at gradients of 1.5:1 (h:v), or flatter, on a preliminary basis.

Additional site specific analysis is recommended once 40-scale grading plans have been developed. All cut slope construction will require observation during grading in order to evaluate the findings and conclusions presented herein and in subsequent reports. Our analysis assumes that graded slopes are designed and constructed in accordance with guidelines provided by the County, the CBC (CBSC, 2010), and recommendations provided by this office.

Surficial Stability

Graded slopes should perform adequately with respect to surficial stability, provided that the slopes are properly constructed and maintained, under normal rainfall. Earth materials derived from the underlying granitic bedrock will generally consist of granular, sandy soil. Planting and management of surficial drainage is imperative to the surficial performance of slopes. Foot traffic and other activities that exacerbate surficial erosion should not be allowed to occur on slopes. Failure to adhere to these conditions may drastically increase and localize surficial erosion.

ROCK HARDNESS

The majority of the site is underlain with dense granitic bedrock. Site work to date indicates practical refusal on hard rock at depths ranging from approximately 6 to 11 feet below existing grades, using a Caterpillar 420D backhoe. Observation of existing cut slopes in the vicinity indicate excavation depths completed to at least 15 feet into similar granitic bedrock, consisting of scattered "corestones" in a matrix of weathered, disintegrated granite, or "DG."

Due to the variable nature of bedrock (i.e., corestones, concretions, fractured zones, etc.), localized rock breaking should be anticipated to achieve proposed trench depths. Locally very difficult ripping and trenching should also be anticipated. On a preliminary basis, bedrock should be generally rippable to depths on the order of 15 to perhaps 20 feet using heavy grading equipment. The depth of "trenchable" bedrock will be less, and may be assumed for preliminary planning purposes to be on the order of 10 to 12 feet using a heavy hydraulic excavator. Consideration should be given to undercutting street sections during grading in order to facilitate utility construction.

Additional rock hardness evaluations, including, but not necessarily limited to, seismic refraction surveys, and air track drilling, may be recommended once grading plans are available in order to adequately evaluate depths to non-rippable rock, as necessary.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

General

Based on our field exploration, laboratory testing and geotechnical engineering analysis, it is our opinion that the subject site appears suitable for the proposed development from a geotechnical engineering and geologic viewpoint, provided that recommendations presented in the following sections are incorporated into the design and construction phases of site development. The primary geotechnical concerns with respect to the proposed development are:

- Earth materials characteristics and depth to competent bearing material.
- Slope stability.
- Corrosion and expansion potential.
- Subsurface water and potential for perched water.
- Settlement potential.
- Rock hardness.
- Regional seismicity and faulting.

The recommendations presented herein consider these as well as other aspects of the site. The engineering analyses, performed, concerning site preparation and the recommendations presented herein have been completed using the information provided and obtained during our field work. In the event that any significant changes are made to proposed site development, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report are evaluated or modified in writing by this office. Foundation design parameters are considered preliminary until the foundation design, layout, and structural loads are provided to this office for review.

EARTHWORK CONSTRUCTION RECOMMENDATIONS

General

Grading should conform to the guidelines presented in Appendix J of the 2010 CBC (CBSC, 2010), the requirements of the County of San Diego, and the Grading Guidelines presented in Appendix E (this report), except where specifically superceded in the text of this report. In case of conflict, the more onerous code or recommendations should govern. Prior to grading, a GSI representative should be present at the pre-construction meeting to provide additional grading guidelines, if needed, and review the earthwork schedule.

During earthwork construction, all site preparation and the general grading procedures of the contractor should be observed and the fill selectively tested by a representative(s) of GSI. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and, if warranted, modified and/or additional recommendations will be offered. All applicable requirements of local and national construction and general industry safety orders, the Occupational Safety and Health Act (OSHA), and the Construction Safety Act should be met. It is the onsite general contractor and individual subcontractors responsibility to provide a safe working environment for our field staff who are onsite. GSI does not consult in the area of safety engineering.

Demolition/Grubbing

1. Vegetation, and any miscellaneous deleterious debris generated from the demolition of existing site improvements should be removed from the areas of proposed grading/earthwork.

2. Cavities or loose soils remaining after demolition and site clearance should be cleaned out and observed by the geotechnical consultant. The cavities should be replaced with fill materials that have been moisture conditioned to at least optimum moisture content and compacted to at least 90 percent of the laboratory standard.

Remedial Removals (Removal of Potentially Compressible Surficial Materials)

Where planned fills or settlement-sensitive improvements are proposed, potentially compressible fill, colluvium, and highly weathered bedrock should be removed to expose suitable bedrock. Removed soils may be reused as properly engineered fill provided that major concentrations of organic material have been removed prior to placement. In general, the remedial removal excavations are anticipated to be on the order of 3 to 6 feet across a majority of the site. However, local deeper removal excavations cannot be precluded and should be anticipated. The removal of potentially compressible soils should be performed below a 1:1 (h:v) projection down from the bottom, outermost edge of proposed settlement-sensitive improvements. Once the unsuitable soils have been removed, the exposed bedrock should be scarified approximately 6 to 8 inches, moisture conditioned as necessary to achieve the soil's optimum moisture content and then be re-compacted to at least 90 percent of the laboratory standard prior to fill placement. Remedial removal excavations should be observed by the geotechnical consultant prior to scarification

Earthwork Balance (Shrinkage/Bulking)

The volume change of excavated materials upon compaction as engineered fill is anticipated to vary with material type and location. The overall earthwork shrinkage and bulking may be approximated by using the following parameters:

Existing Artificial Fill	5% to 10% shrinkage
Colluvium from 0 - 1 foot	25% to 30% shrinkage
Colluvium from 1 - 2 feet	15% to 20% shrinkage
Colluvium below 2 feet	3% to 8% shrinkage
Highly weathered Granitics	2% to 3% shrinkage or bulk
Granitic Bedrock	5% to 10% bulk

It should be noted that the above factors are estimates only, based on preliminary data. Alluvium may achieve higher shrinkage if organics or clay content is higher than anticipated. Final earthwork balance factors could vary. In this regard, it is recommended that balance areas be reserved where grades could be adjusted up or down near the completion of grading in order to accommodate any yardage imbalance for the project.

Subdrains

Subdrains will be recommended at the base of any canyon fill. A subsequent review of 40-scale plans (when available) should be performed to evaluate the need for subdrainage. If encountered, local seepage along the contact between the bedrock and overburden materials, or along jointing patterns of the bedrock may require a subdrain system. Typical subdrain design and construction details are presented in Appendix E.

Overexcavation/Transitions

In order to provide for the uniform support of structures, a minimum 3-foot thick fill blanket is recommended for lots containing plan transitions. Any cut portion of the pad for a residential structure should be over excavated a minimum 3 feet below finish pad grade, or 2 feet below the bottom of footing, whichever is deeper. Areas with planned fills less than 3 feet should be over excavated in order to provide the minimum fill thickness. Maximum to minimum fill thickness within a given lot should not exceed a ratio of 3:1, if conventional foundations are desired. Overexcavation is also recommended for cut lots. Overexcavation depths should be evaluated in the field based on site conditions. In order to mitigate the development of perched groundwater conditions along fill/bedrock contacts, overexcavation in pad areas should be sloped to drain toward streets. The intent of this recommendations is to provide a minimum fill blanket thickness of 2 feet below the foundations.

Fill Placement and Suitability

Subsequent to ground preparation, onsite soils may be placed in thin (6- to ±8-inch) lifts, cleaned of vegetation and debris, brought to a least optimum moisture content, and compacted to achieve a minimum relative compaction of 90 percent of the laboratory standard (ASTM Test Method D 1557). Fill with ultimate thicknesses (including remedial grading) exceeding 50 feet, should have that portion of the fill below 50 feet minimally compacted to 95 percent of the laboratory standard (ASTM D 1557). Medium expansive soils present onsite should either be blended sufficiently to reduce to the overall expansive potential of the resultant soil blend (i.e., expansion index <20, or a plasticity index of less than 15), or placed no closer than 10 feet from a given pad grade.

Site exploration completed in preparation of this report indicates that excavation into the underlying earth materials will generally produce silty sand, sand, with trace clays and scattered "corestones," or boulders, within the uppermost 10 to 11 feet from existing surface grades. With additional excavation below these depths, there is an increased potential to encounter a greater frequency of corestones, and intact rock fragments as the overall density and induration of the bedrock increases. Preliminary recommendations for the treatment of oversize rock is presented in Appendix E.

If soil importation is planned, samples of the soil import should be evaluated by this office prior to importing in order to assure compatibility with the onsite site soils and the recommendations presented in this report. Import soils should be relatively sandy and very low expansive (i.e., E.I. less than 20).

Slope Considerations and Slope Design

Graded Slopes

All slopes should be designed and constructed in accordance with the minimum requirements of City/County, the CBC (CBSC, 2010), and the recommendations in Appendix E. Slopes constructed with the onsite sandy soils are anticipated to have erosion and surficial instability issues if left unplanted, and without engineered surface drainage control, and as such, will require periodic and regular maintenance.

Stabilization/Buttress Fill Slopes

The construction of stabilization and/or buttress slopes does not appear necessary at this time. Such remedial slope construction will be re-evaluated based upon a review of the 40-scale grading plans and/or conditions exposed in the field during grading.

Temporary Construction Slopes

In general, temporary construction slopes may be constructed at a maximum slope ratio of 1:1 (h:v) or flatter, for temporary slopes exposing dense granitic bedrock without adverse (daylighted) fracture surfaces or groundwater. Excavations for removals, drainage devices, debris basins, and other localized conditions should be evaluated on an individual basis by the soils engineer and engineering geologist for variance from this recommendation. Due to the nature of the materials anticipated, the engineering geologist should observe all excavations and fill conditions. The geotechnical engineer should be notified of all proposed temporary construction cuts, and upon review, appropriate recommendations should be presented.

Erosion Control

Onsite soils are considered highly erosive. Use of hay bales, silt fences, and/or sand/gravel bags should be considered, as appropriate. Temporary grades should be constructed to drain at 1 to 2 percent to a suitable temporary or permanent outlet. Evaluation of cuts during grading will be necessary in order to identify any areas of loose or non-cohesive materials. Should any significant zones be encountered during earthwork construction remedial grading may be recommended; however, no remedial measures are anticipated at this time. Foot traffic should not be allowed on natural or sandy slopes. Natural slopes should not be irrigated.

PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

General

This report presents minimum design criteria for the design of slabs, foundations and other elements possibly applicable to the project. These criteria should not be considered as substitutes for actual designs by the structural engineer. The proposed foundation systems should be designed and constructed in accordance with the guidelines contained in the 2010 CBC (CBSC, 2010). In the event that the information concerning the proposed development plan is not correct, or any changes in the design, location or loading conditions of the proposed structure are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report are modified or approved in writing by this office.

The foundation design and construction recommendations are based on laboratory testing and engineering evaluations of onsite earth materials by GSI. The following preliminary foundation construction recommendations are presented as a minimum criteria from a soils engineering viewpoint. As currently evaluated, the onsite soils expansion potentials are generally in the very low (E.I. < 20) range, to perhaps low (E.I. >20, <50). For low expansive soil conditions (E.I. >20 and ≤ 50), and where the P.I. is greater than 15, code-compliant foundations will be needed, and designed in accordance with Chapter 18 of the 2010 CBC (CBSC, 2010). Thus, Code may require the use of more onerous foundations (i.e., post-tension, mat, etc.), at the conclusion of grading. Final foundation design will be provided at the conclusion of grading. The information and recommendations presented in this section are not meant to supersede design by the project structural engineer or civil engineer specializing in structural design. Upon request, GSI could provide additional input/consultation regarding soil parameters, as related to foundation design.

Foundation Design

1. Foundation systems should be designed and constructed in accordance with guidelines presented in the latest adopted edition of the 2010 CBC (CBSC, 2010). All new foundations should be embedded into suitable bedrock or engineered fill.

2. An allowable bearing value of 2,000 psf may be used for design of footings that maintain a minimum width of 12 inches and a minimum depth of 12 inches, and founded into suitable bedrock or engineered fill. This value may be increased by 20 percent for each additional 12 inches in depth to a maximum value of 3,000 psf. In addition, this value may be increased by one-third when considering short duration seismic or wind loads. Isolated pad footings should have a minimum dimension of at least 24 inches square and a minimum embedment of 18 inches into suitable bedrock or engineered fill, excluding any landscaped zone or topsoil. The depth of embedment excludes slab thickness, underlayment, landscape zone, etc.

3. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pcf, with a maximum earth pressure of 3,000 psf.

4. An allowable coefficient of friction between soil and concrete of 0.35 may be used with the dead load forces.

5. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

6. The ultimate blend of site soils supporting foundations appears to be very low, to possibly low expansive. However, should higher expansive soils be encountered, foundations shall also be designed in accordance with Chapter 18 (Section 1805.8) of the 2010 CBC (CBSC, 2010). This implies that the Code may require the use of more onerous foundations (i.e., post-tension, mat, etc.). Code-compliant foundations may be conventional-type if the grading and blending of soils onsite produces a fill with an E.I. $\leq$ 20, or and E.I. $\leq$ 50, and a P.I. $<$ 15.

7. Foundation systems should be designed to accommodate a differential settlement of at least 1 inch in a 40-foot span.

8. Footings for structures adjacent to retaining walls should be deepened so as to extend below a 1:1 projection from the heel of the wall. Alternatively, walls may be designed to accommodate structural loads from buildings or appurtenances as described in the "Retaining Wall" section of this report.

Construction

The following foundation construction recommendations are presented as a minimum criteria from a soils engineering viewpoint. The site soils generally possess a very low expansion potential. Accordingly, the following foundation construction recommendations are for this type of soil condition. Recommendations by the project's design-structural engineer or architect, which may exceed the soils engineer's recommendations, should take precedence over the following minimum requirements:

1. Exterior and interior footings for the proposed residence should be minimally embedded 12 or 18 inches into suitable bedrock or engineered fill for one- or two-story floor loads, respectively. For one- and two-story floor loads, exterior and interior footing widths should be 12 and 15 inches respectively. Isolated column and panel pads, or wall footings, should be founded at a minimum depth of 24 inches into properly compacted fill or suitable bedrock. All footings should be minimally reinforced with two No. 4 reinforcing bars, one placed near the top and one placed near the bottom of the footing.

2. All exterior column footings should be tied to the main foundation in at least two directions with a grade beam. The grade beam should be at least 12 inches square

in cross section, and should be provided with a minimum of one No.4 reinforcing bar at the top, and one No.4 reinforcing bar at the bottom of the grade beam. The base of the reinforced grade beam should be at the same elevation as the adjoining footings.

3. A grade beam, reinforced as previously recommended and at least 12 inches square, should be provided across the garage entrance. The base of the reinforced grade beam should be at the same elevation as the adjoining footings.

4. Concrete slabs should be reinforced with a minimum of No. 3 reinforcement bars placed at 18-inch on centers, in two horizontally perpendicular directions (i.e., long axis and short axis).

5. All slab reinforcement should be supported to ensure proper mid-slab height positioning during placement of the concrete. "Hooking" of reinforcement is not an acceptable method of positioning.

6. Slab subgrade pre-soaking is not necessary for these soil conditions. However, the client should consider moisture conditioning the slab subgrade to at least the soil's optimum moisture content to a depth of 12 inches prior to slab underlayment construction.

7. Soils generated from footing excavations to be used onsite should be compacted to a minimum relative compaction of 90 percent of the laboratory standard (ASTM D 1557), whether the soils are to be placed inside the foundation perimeter or in the yard/right-of-way areas. This material must not alter positive drainage patterns that direct drainage away from the structural areas and toward the street.

8. Reinforced concrete mix design should conform to "Exposure Class C0" in Table 4.3.1 of ACI-318-08.

Post-Tensioned Foundations

The following foundation construction recommendations assume that soils in the upper 7 feet are very low to highly expansive in accordance with 2010 CBC, and are applicable in areas having more than 30 feet of compacted fill over bedrock. The post-tension foundation designer may exceed these minimal recommendation to increase slab stiffness performance.

The information and recommendations presented in this section are not meant to supercede design by a registered structural engineer or civil engineer qualified to perform post-tensioned design. Post-tensioned foundations should be designed using sound engineering practice and be in accordance with local and 2010 CBC requirements. Upon request, GSI can provide additional data/consultation regarding soil parameters as related to post-tensioned foundation design.

From a soil expansion/shrinkage standpoint, a common contributing factor to distress of structures using post-tensioned slabs is a "dishing" or "arching" of the slabs. This is caused by the fluctuation of moisture content in the soils below the perimeter of the slab primarily due to homeowner irrigation, climatic and seasonal changes, and the presence of expansive soils. When the outside soil environment surrounding the slab has a higher moisture content than the area beneath the slab, moisture tends to migrate underneath the slab edges to a distance beyond the slab edges known as a moisture variation distance, and cause the slab edges to lift. Conversely, when the outside soil environment is drier, the moisture regime is reversed and the soils underneath the slab edges lose their moisture and shrink. This process leads to dropping of the slab at the edges, which leads to what is commonly referred to as the center lift condition. Therefore, post-tensioned slabs should have sufficient stiffness and rigidity to resist excessive bending due to non-uniform swell and shrinkage of subgrade soils, particularly within the moisture variation distance, near the slab edges.

To mitigate this possible phenomenon, a combination of soil presaturation and construction of a perimeter "cut-off" wall grade beam should be employed. Perimeter cut-off walls should be a minimum of 12 inches deep for very low to low expansive soils and 18 inches for medium expansive soils. The cut-off walls may be integrated into the slab design or independent of the slab. The cut-off walls should be a minimum of 6 inches in width. Post-tensioned concrete slabs should be a minimum of 5 inches thick. A vapor retarder should be utilized and be of sufficient thickness to provide a durable separation of foundation from soils. For additional recommendations see the "Soil Moisture Transmission Considerations" section of this report. The vapor retarder should be sealed to provide a continuous retarder under the entire slab, per the 2010 CBC.

The following recommendations for design of post-tensioned slabs have been prepared in general compliance with the requirements of the recent Post Tensioning Institute's (PTI's) publication titled "Design of Post-Tensioned Slabs on Ground, Third Edition" (PTI, 2004), together with it's subsequent addendums (PTI, 2008).

Soil Moisture

Slab subgrade pre-soaking is not necessary for very low expansive soil conditions. However, the client should consider moisture conditioning the slab subgrade to at least the soil's optimum moisture content to a depth of 12 inches prior to slab underlayment construction. Pre-moistening of the slab subgrade soil is recommended for low, and higher expansive soil conditions. The moisture content of the subgrade soils should be equal to or greater than optimum moisture to a depth equivalent to the exterior footing depth in the slab areas (typically 12 or 18 inches for very low to low, and medium expansive soils, respectively). Pre-moistening and/or pre-soaking should be evaluated by the soils engineer 72 hours prior to vapor retarder placement. This time should be checked again 24 hours prior to placement of concrete for expansive soil subgrade.

Soil Support Parameters

The recommendations for soil support parameters have been provided based on the typical soil index properties for soils that are very low to medium in expansion potential. The soil index properties are typically the upper bound values based on our experience and practice in the southern California area. The following table presents suggested minimum coefficients to be used in the Post-Tensioning Institute design method.

Thornthwaite Moisture Index	-20 inches/year
Correction Factor for Irrigation	20 inches/year
Depth to Constant Soil Suction	7 feet or overexcavation depth to bedrock
Constant soil Suction (pf)	3.6
Moisture Velocity	0.7 inches/month
Plasticity Index (P.I.)	15-30

Based on the above, the recommended soil support parameters are tabulated below:

DESIGN PARAMETERS	VERY LOW TO LOW EXPANSION (3) (E.I. = 0-50)	MEDIUM EXPANSION (E.I. = 51-90)
e_m center lift	9.0 feet	8.7 feet
e_m edge lift	5.2 feet	4.5 feet
y_m center lift	0.3 inches	0.49 inches
y_m edge lift	0.7 inch	1.3 inch
Bearing Value (1)	1,000 psf	1,000 psf
Lateral Pressure	250 psf	175 psf
Subgrade Modulus (k)	100 pci/inch	85 pci/inch
Minimum Perimeter Footing Embedment (2)	12 inches	18 inches

(1) Internal bearing values within the perimeter of the post-tension slab may be increased to 2,000 psf for a minimum embedment of 12 inches, then by 20 percent for each additional foot of embedment to a maximum of 3,000 psf.
(2) As measured below the lowest adjacent compacted subgrade surface without landscape layer or sand underlayment.
(3) the California, or spanability method, may be used for the design of foundations underlain with very low expansive soils (E.I.<20).
Note: The use of open bottomed raised planters adjacent to foundations will require more onerous design parameters.

Deepened footings/edges around the slab perimeter must be used to minimize non-uniform surface moisture migration (from an outside source) beneath the slab. An edge depth of 12 inches should be considered a minimum. The bottom of the deepened footing/edge should be designed to resist tension, using cable or reinforcement per the structural engineer.

The parameters are considered minimums and may not be adequate to represent all expansive soils/drainage conditions such as adverse drainage and/or improper landscaping and maintenance. The above parameters are applicable provided the structure has positive drainage that is maintained away from the structure. In addition, no trees with significant root systems are to be planted within 15 feet of the perimeter of foundations. Therefore, it is important that information regarding drainage, site maintenance, trees, settlements, and effects of expansive soils be passed on to future homeowners. The values tabulated above may not be appropriate to account for possible differential settlement of the slab due to other factors, such as excessive settlements. If a stiffer slab is desired, alternative Post-Tensioning Institute ([PTI] third edition) parameters may be recommended.

SOIL MOISTURE CONSIDERATIONS

GSI has evaluated the potential for vapor or water transmission through the slabs, in light of typical residential floor coverings and improvements. Please note that slab moisture emission rates, range from about 2 to 27 lbs/24 hours/1,000 square feet from a typical slab (Kanare, 2005), while floor covering manufacturers generally recommend about 3 lbs/24 hours as an upper limit. Thus, the client will need to evaluate the following in light of a cost v. benefit analysis, along with disclosure to all interested/affected parties.

Considering the anticipated typical water vapor transmission rates, floor coverings and improvements (to be chosen by the client) that can tolerate those rates without distress, the following alternatives are provided:

1. Concrete slabs should be a minimum of 5 inches thick.

2. Concrete slab underlayment should consist of a 10-mil to 15-mil vapor retarder, or equivalent, with all laps sealed per the 2010 CBC (CBSC, 2010) and the manufacturer's recommendation. The vapor retarder should comply with the ASTM E 1745 - Class A or B criteria, and be installed in accordance with ACI 302.1R-04 and ASTM E 1643. The 10- to 15-mil vapor retarder (ASTM E-1745 - Class A) shall be installed per the recommendations of the manufacturer, including <u>all</u> penetrations (i.e., pipe, ducting, rebar, etc.).

3. Slab underlayment should consist of 2 inches of washed sand (SE >30) placed above a vapor retarder consisting of 10- to 15- mil polyvinyl chloride, or equivalent, with all laps sealed per the 2010 CBC (CBSC, 2010). The vapor retarder shall be underlain by 2 inches of washed sand (SE>30) placed directly on properly compacted subgrade soils, and should be sealed to provide a continuous

water-resistant barrier under the entire slab, as discussed above. All slabs should be additionally sealed with suitable slab sealant.

4. Concrete should have a maximum water/cement ratio of 0.50. This does not supercede the 2010 CBC (CBSC, 2010) for corrosion or other corrosive requirements. Additional concrete mix design recommendations should be provided by the structural consultant and/or waterproofing specialist. Concrete finishing and workablity should be addressed by the structural consultant and a waterproofing specialist.

5. Where slab water/cement ratios are as indicated above, and/or admixtures used, the structural consultant should also make changes to the concrete in the grade beams and footings in kind, so that the concrete used in the foundation and slabs are designed and/or treated for more uniform moisture protection.

6. Owners(s) and all interested/affected parties should be specifically advised which areas are suitable for tile flooring, wood flooring, or other types of water/vapor-sensitive flooring and which are not suitable. In all planned floor areas, flooring shall be installed per the manufactures recommendations.

7. Additional recommendations regarding water or vapor transmission should be provided by the architect/structural engineer/slab or foundation designer and should be consistent with the specified floor coverings indicated by the architect.

Regardless of the mitigation, some limited moisture/moisture vapor transmission through the slab should be anticipated. Construction crews may require special training for installation of certain product(s), as well as concrete finishing techniques. The use of specialized product(s) should be approved by the slab designer and water-proofing consultant. A technical representative of the flooring contractor should review the slab and moisture retarder plans and provide comment prior to the construction of the residential foundations or improvements. The vapor retarder contractor should have representatives onsite during the initial installation.

CORROSION

Upon completion of any grading, additional testing of soils (including import materials) for corrosion to concrete and metals should be performed prior to the construction of utilities and foundations to confirm or modify the preliminary results contained herein.

WALL DESIGN PARAMETERS

Conventional Retaining Walls

The design parameters provided below assume that either non expansive soils (typically Class 2 permeable filter material or Class 3 aggregate base) or native onsite materials (up to and including an E.I. of 50) are used to backfill any retaining walls. The type of backfill (i.e., select or native), should be specified by the wall designer, and clearly shown on the plans. Below grade walls should be waterproofed. The foundation system for the proposed retaining walls should be designed in accordance with the recommendations presented in this and preceding sections of this report, as appropriate. Footings should be embedded a minimum of 18 inches below adjacent grade into engineered fill or unweathered bedrock (excluding landscape layer, 6 inches) and should be 24 inches in width. There should be no increase in bearing for footing width. Recommendations for specialty walls (i.e., crib, earthstone, geogrid, etc.) can be provided upon request, and would be based on site specific conditions.

Restrained Walls

Any retaining walls that will be restrained prior to placing and compacting backfill material or that have re-entrant or male corners, should be designed for an at-rest equivalent fluid pressure (EFP) of 65 pcf, plus any applicable surcharge loading. For areas of male or re-entrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall (2H) laterally from the corner.

Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 10 feet high. Design parameters for walls less than 3 feet in height may be superceded by the County standard design. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material.

SURFACE SLOPE OF RETAINED MATERIAL (HORIZONTAL:VERTICAL)	EQUIVALENT FLUID WEIGHT P.C.F. (SELECT BACKFILL**)	EQUIVALENT FLUID WEIGHT P.C.F. (NATIVE BACKFILL***)
Level*	35	42
2 to 1	50	60

* Level backfill behind a retaining wall is defined as compacted earth materials, properly drained, without a slope for a distance of 2H behind the wall.
** As evaluated by testing, P.I. <15, E.I. <21, S.E. ≥30, and ≤10% passing No. 200 sieve.
*** As evaluated by testing, E.I. ≤50, S.E. ≥25 and ≤15% passing No. 200 sieve.

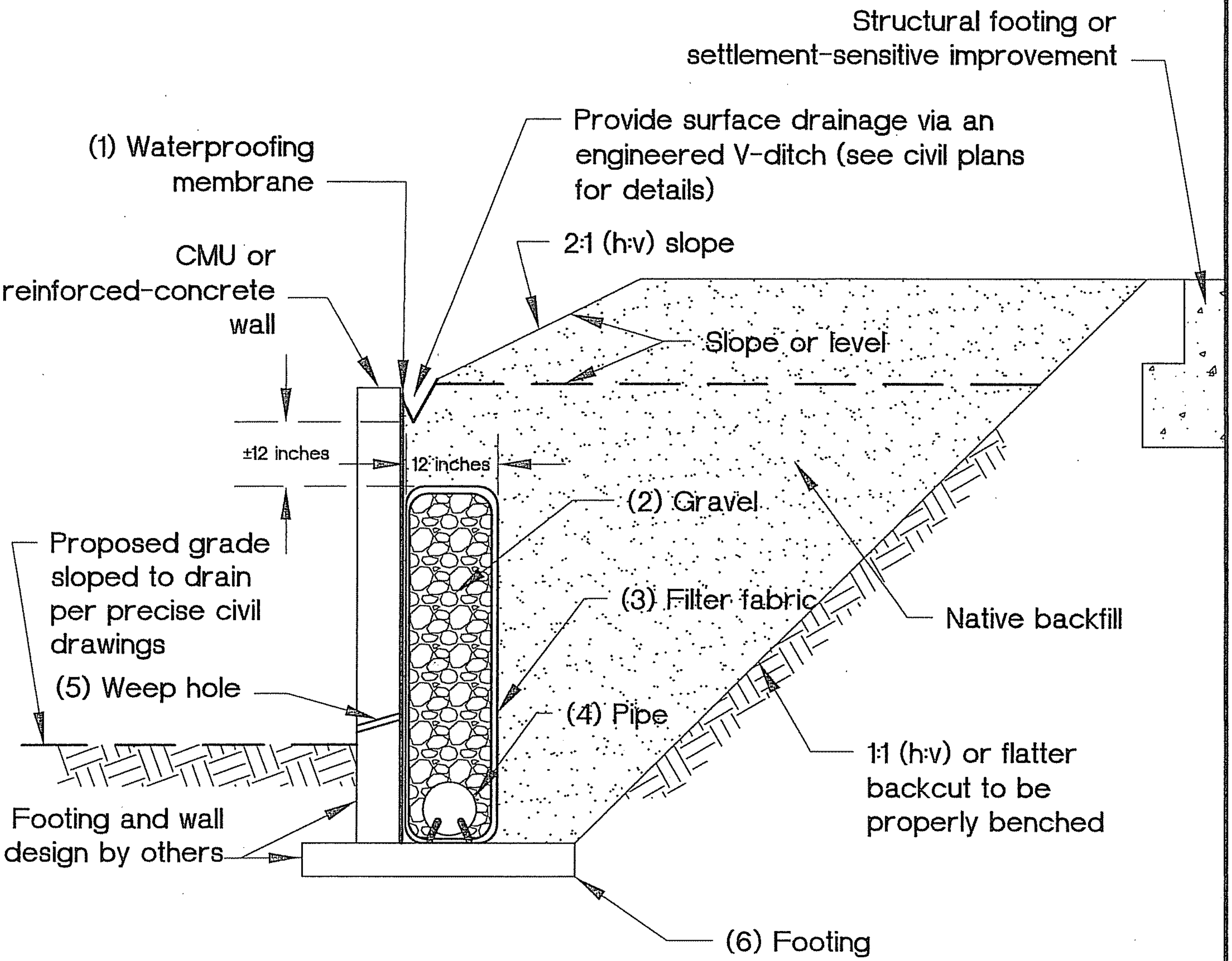
Earthquake Loads (Seismic Surcharge)

Given the granular nature of the site soils and the anticipated level of potential earthquake shaking given herein, GSI recommends that for walls retaining more than, or equal to, 6 feet of soil and that are 6 feet or less from structures, or may inhibit ingress/egress for the site driveways , are incorporated into the building (stepped foundations), or critical access pathways (i.e., collector streets, fire access roads, etc.), a seismic surcharge (increment) of 10H should be used where H is the height of the wall and the surcharge is applied as a uniform pressure for restrained walls. For cantilever walls, this distribution may be taken as an inverted triangular distribution. The resulting wall design should be safe from seismic induced overturning with a minimum factor-of-safety (F.O.S.) of 1.3. Basement walls, or utility or wine cellar vaults, if proposed, will need to be evaluated as retaining walls, as well as part of the wall design from a seismic standpoint per the 2010 CBC (CBSC; 2010) and Section 15.6.1 of ASCE (2006).

Retaining Wall Backfill and Drainage

Positive drainage must be provided behind all retaining walls in the form of gravel wrapped in geofabric and outlets. A backdrain system is considered necessary for retaining walls that are 2 feet or greater in height. Details 1, 2, and 3, present the back drainage options discussed below. Backdrains should consist of a 4-inch diameter perforated PVC or ABS pipe encased in either Class 2 permeable filter material or ¾-inch to 1½-inch gravel wrapped in approved filter fabric (Mirafi 140 or equivalent). For low expansive backfill, the filter material should extend a minimum of 1 horizontal foot behind the base of the walls and upward at least 1 foot. For native backfill that has an E.I. up to 50, continuous Class 2 permeable drain materials should be used behind the wall. This material should be continuous (i.e., full height) behind the wall, and it should be constructed in accordance with the enclosed Detail 1 (Typical Retaining Wall Backfill and Drainage Detail). For limited access and confined areas, (panel) drainage behind the wall may be constructed in accordance with Detail 2 (Retaining Wall Backfill and Subdrain Detail Geotextile Drain). Materials with an E.I. potential of greater than 50 should not be used as backfill for retaining walls. For more onerous expansive situations, backfill and drainage behind the retaining wall should conform with Detail 3 (Retaining Wall And Subdrain Detail Clean Sand Backfill).

Outlets should consist of a 4-inch diameter solid PVC or ABS pipe spaced no greater than ±100 feet apart, with a minimum of two outlets, one on each end. The use of weep holes, only, in walls higher than 2 feet, is not recommended. The surface of the backfill should be sealed by pavement or the top 18 inches compacted with native soil (E.I. $\leq$50). Proper surface drainage should also be provided. For additional mitigation, consideration should be given to applying a water-proof membrane to the back of all retaining structures. The use of a waterstop should be considered for all concrete and masonry joints.



(1) Waterproofing membrane.

(2) Gravel: Clean, crushed, ¾ to 1½ inch.

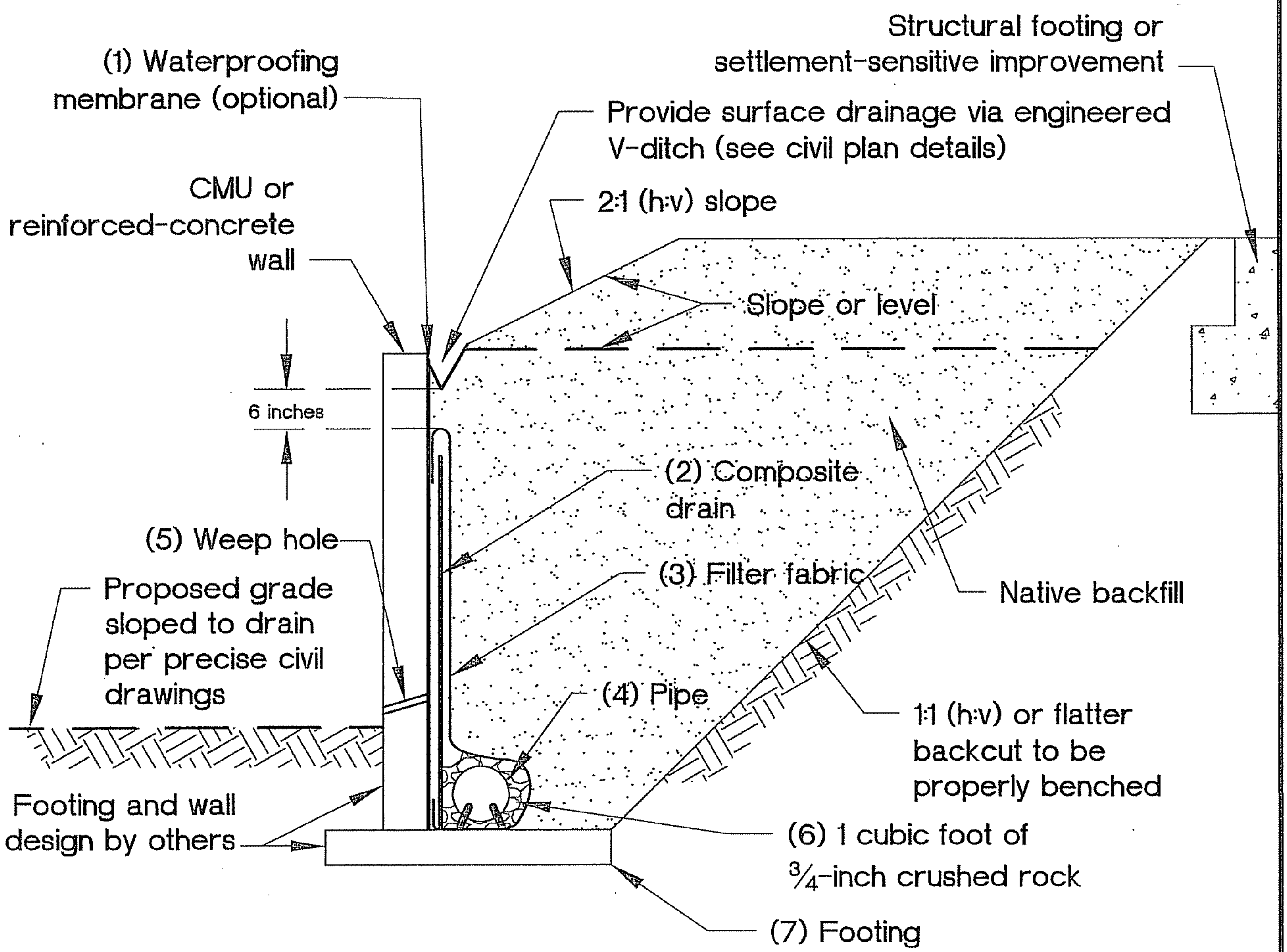
(3) Filter fabric: Mirafi 140N or approved equivalent.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient sloped to suitable, approved outlet point (perforations down).

(5) Weep hole: Minimum 2-inch diameter placed at 20-foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Footing: If bench is created behind the footing greater than the footing width, use level fill or cut natural earth materials. An additional "heel" drain will likely be required by geotechnical consultant.

GeoSoils, Inc.	RETAINING WALL DETAIL — ALTERNATIVE A	Detail 1



(1) Waterproofing membrane (optional): Liquid boot or approved mastic equivalent.

(2) Drain: Miradrain 6000 or J-drain 200 or equivalent for non-waterproofed walls; Miradrain 6200 or J-drain 200 or equivalent for waterproofed walls (all perforations down).

(3) Filter fabric: Mirafi 140N or approved equivalent; place fabric flap behind core.

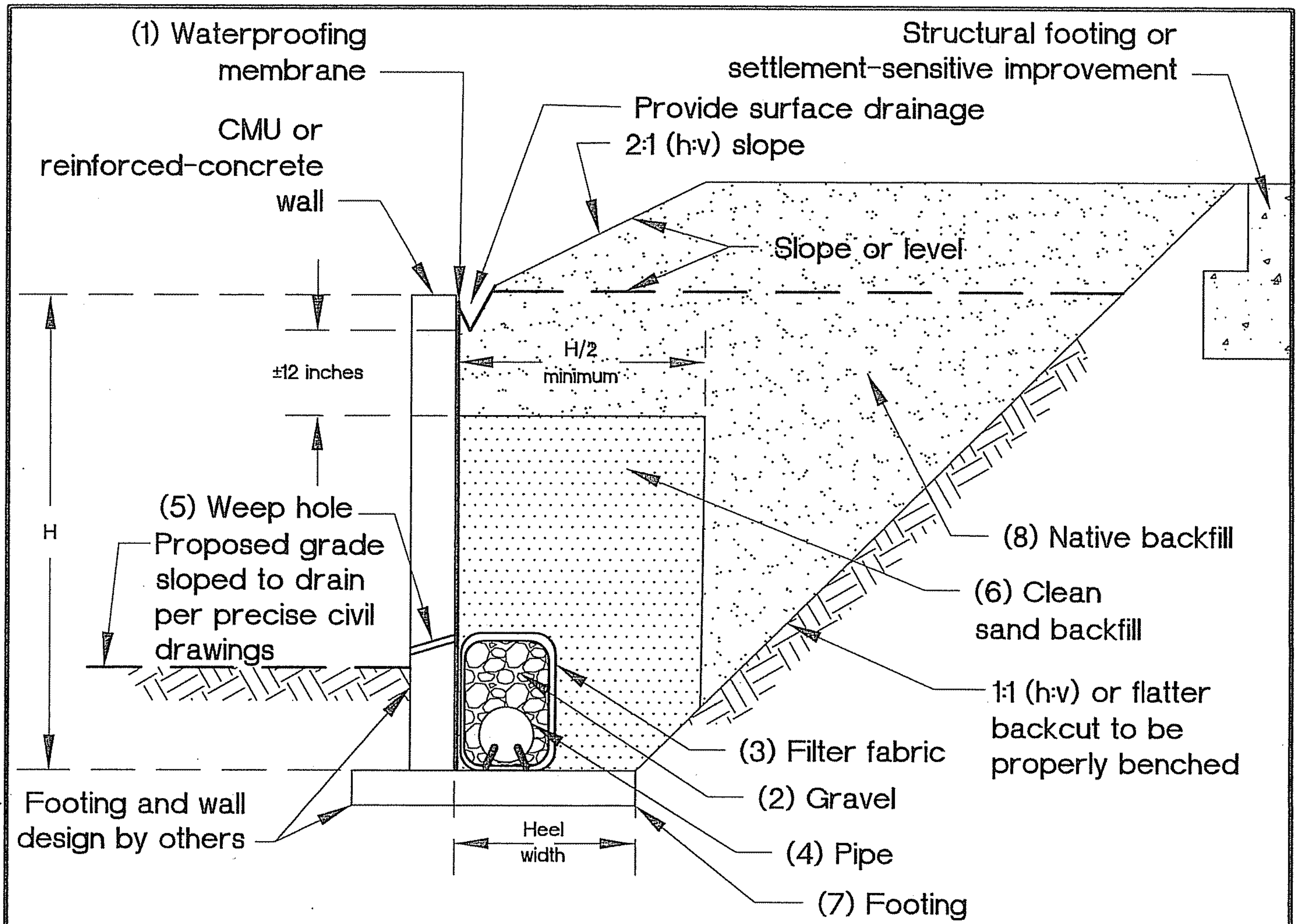
(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient to proper outlet point (perforations down).

(5) Weep hole: Minimum 2-inch diameter placed at 20-foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Gravel: Clean, crushed, ¾ to 1½ inch.

(7) Footing: If bench is created behind the footing greater than the footing width, use level fill or cut natural earth materials. An additional "heel" drain will likely be required by geotechnical consultant.

GeoSoils, Inc.	RETAINING WALL DETAIL — ALTERNATIVE B	Detail 2



(1) Waterproofing membrane: Liquid boot or approved masticequivalent.

(2) Gravel: Clean, crushed, $\frac{3}{4}$ to $1\frac{1}{2}$ inch.

(3) Filter fabric: Mirafi 140N or approved equivalent.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient to proper outlet point (perforations down).

(5) Weep hole: Minimum 2-inch diameter placed at 20-foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Clean sand backfill: Must have sand equivalent value (S.E.) of 35 or greater; can be densified by water jetting upon approval by geotechnical engineer.

(7) Footing: If bench is created behind the footing greater than the footing width, use level fill or cut natural earth materials. An additional "heel" drain will likely be required by geotechnical consultant.

(8) Native backfill: If E.I. <21 and S.E. ≥ 35 then all sand requirements also may not be required and will be reviewed by the geotechnical consultant.

GeoSoils, Inc. | RETAINING WALL DETAIL — ALTERNATIVE C | Detail 3

Wall/Retaining Wall Footing Transitions

Site walls are anticipated to be founded on footings designed in accordance with the recommendations in this report. Should wall footings transition from cut to fill, the civil designer may specify either:

a) A minimum of a 2-foot overexcavation and recompaction of cut materials for a distance of 2H, from the point of transition.

b) Increase of the amount of reinforcing steel and wall detailing (i.e., expansion joints or crack control joints) such that a angular distortion of 1/360 for a distance of 2H on either side of the transition may be accommodated. Expansion joints should be placed no greater than 20 feet on-center, in accordance with the structural engineer's/wall designer's recommendations, regardless of whether or not transition conditions exist. Expansion joints should be sealed with a flexible, non-shrink grout.

c) Embed the footings entirely into native formational material (i.e., deepened footings).

If transitions from cut to fill transect the wall footing alignment at an angle of less than 45 degrees (plan view), then the designer should follow recommendation "a" (above) and until such transition is between 45 and 90 degrees to the wall alignment.

DRIVEWAY, FLATWORK, AND OTHER IMPROVEMENTS

Some of the soil materials on site may be expansive. The effects of expansive soils are cumulative, like corrosion, and typically occur over the lifetime of any improvements. On relatively level areas, when the soils are allowed to dry, the dessication and swelling process tends to cause heaving and distress to flatwork and other improvements. The resulting potential for distress to improvements may be reduced, but not totally eliminated. To that end, it is recommended that disclosure be provided to all interested/affected parties of this long-term potential for distress. To reduce the likelihood of distress, the following recommendations are presented for all exterior flatwork:

1. The subgrade area for concrete slabs should be compacted to achieve a minimum 90 percent relative compaction, and then be presoaked to 2 to 3 percentage points above (or 125 percent of) the soils' optimum moisture content, to a depth of 18 inches below subgrade elevation. If very low expansive soils are present, only optimum moisture content, or greater, is required and specific presoaking is not warranted. The moisture content of the subgrade should be proof tested within 72 hours prior to pouring concrete.

2. Concrete slabs should be cast over a non-yielding surface, consisting of a 4-inch layer of crushed rock, gravel, or clean sand, that should be compacted and level prior to pouring concrete. If very low expansive soils are present, the rock or gravel

or sand may be deleted. The layer or subgrade should be wet-down completely prior to pouring concrete, to minimize loss of concrete moisture to the surrounding earth materials.

3. Exterior slabs should be a minimum of 4 inches thick. Driveway slabs and approaches should additionally have a thickened edge (12 inches) adjacent to all landscape areas, to help impede infiltration of landscape water under the slab.

4. The use of transverse and longitudinal control joints are recommended to help control slab cracking due to concrete shrinkage or expansion. Two ways to mitigate such cracking are: a) add a sufficient amount of reinforcing steel, increasing tensile strength of the slab; and, b) provide an adequate amount of control and/or expansion joints to accommodate anticipated concrete shrinkage and expansion.

   In order to reduce the potential for unsightly cracks, slabs should be reinforced at mid-height with a minimum of No. 3 bars placed at 18 inches on center, in each direction. If subgrade soils within the top 7 feet from finish grade are very low expansive soils (i.e., E.I. $\leq$20), then 6x6-W1.4xW1.4 welded-wire mesh may be substituted for the rebar, provided the reinforcement is placed on chairs, at slab mid-height. The exterior slabs should be scored or saw cut, ½ to ⅜ inches deep, often enough so that no section is greater than 10 feet by 10 feet. For sidewalks or narrow slabs, control joints should be provided at intervals of every 6 feet. The slabs should be separated from the foundations and sidewalks with expansion joint filler material.

5. No traffic should be allowed upon the newly poured concrete slabs until they have been properly cured to within 75 percent of design strength. Concrete compression strength for exterior flatwork should be a minimum of 2,500 psi, and as determined by the designer.

6. Driveways, sidewalks, and patio slabs adjacent to the house should be separated from the house with thick expansion joint filler material. In areas directly adjacent to a continuous source of moisture (i.e., irrigation, planters, etc.), all joints should be additionally sealed with flexible mastic.

7. Planters and walls should not be tied to the house.

8. Overhang structures should be supported on the slabs, or structurally designed with continuous footings tied in at least two directions. If very low expansion soils are present, footings need only be tied in one direction.

9. Any masonry landscape walls that are to be constructed throughout the property should be grouted and articulated in segments no more than 20 feet long. These segments should be keyed or doweled together.

10. Positive site drainage should be maintained at all times. Finish grade on the lots should provide a minimum of 1 to 2 percent fall to the street, as indicated herein. It should be kept in mind that drainage reversals could occur, including post-construction settlement, if relatively flat yard drainage gradients are not periodically maintained by the homeowner.

11. Shrinkage cracks could become excessive if proper finishing and curing practices are not followed. Finishing and curing practices should be performed per the Portland Cement Association Guidelines. Mix design should incorporate rate of curing for climate and time of year, sulfate content of soils, corrosion potential of soils, and fertilizers used on site.

UTILITIES

Utilities should be enclosed within a closed utilidor (vault) or designed with flexible connections to accommodate differential settlement and expansive soil conditions. Due to the potential for differential settlement, air conditioning (A/C) units should be supported by slabs that are incorporated into the building foundation or constructed on a rigid slab with flexible couplings for plumbing and electrical lines. A/C waste waterlines should be drained to a suitable outlet.

PRELIMINARY PAVEMENT DESIGN

Pavement sections presented are based on estimated R-value data (to be evaluated by specific R-value testing at completion of grading), a range of typical design classifications, and the minimum requirements of the County. For planning purposes, the following preliminary pavement sections, consisting of asphaltic concrete over base are provided in the following table.

ASPHALTIC CONCRETE PAVEMENT				
TRAFFIC AREA	TRAFFIC INDEX[2] (TI, Assumed)	SUBGRADE R-VALUE	A.C. THICKNESS (inches)	CLASS 2 AGGREGATE BASE THICKNESS[1] (inches)
Local Street	5.0	75	3.0	6.0
Collector	6.0	75	3.0	6.0

[1]Denotes standard Caltrans Class 2 aggregate base R ≥78, SE ≥22).
[2]TI values have been assumed for planning purposes herein and should be confirmed by the design team during future plan development.

The recommended pavement sections provided above are meant as minimums. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. If the ADT (average daily traffic) beyond that intended, as reflected by the traffic index used for design, increased maintenance and repair could be required for the pavement section.

Subgrade preparation and aggregate base preparation should be performed in accordance with the recommendations presented below, and the minimum subgrade (upper 12 inches) and Class 2 aggregate base compaction should be 95 percent of the maximum dry density (ASTM D 1557). If adverse conditions (i.e., saturated ground, etc.) are encountered during preparation of subgrade, special construction methods may need to be employed.

These recommendations should be considered preliminary. Further R-value testing and pavement design analysis should be performed upon completion of grading for the site.

Pavement Grading Recommendations

General

All section changes should be properly transitioned. If adverse conditions are encountered during the preparation of subgrade materials, special construction methods may need to be employed.

Subgrade

Within street areas, all surficial deposits of loose soil material should be removed and recompacted as recommended. After the loose soils are removed, the bottom is to be scarified to a depth of 12 inches, moisture conditioned as necessary and compacted to 95 percent of maximum laboratory density, as determined by ASTM Test Method D 1557.

Deleterious material, excessively wet or dry pockets, concentrated zones of oversized rock fragments, and any other unsuitable materials encountered during grading should be removed.

The compacted fill material should then be brought to the elevation of the proposed subgrade for the pavement. The subgrade should be proof-rolled in order to ensure a uniformly firm and unyielding surface.

All grading and fill placement should be observed by the project soil engineer and/or his representative.

Base

Compaction tests are required for the recommended base section. Minimum relative compaction required will be 95 percent of the maximum laboratory density as determined by ASTM Test Method D 1557. Base aggregate should be in accordance to the "Standard Specifications for Public Works Construction" (green book) current edition.

Paving

Prime coat may be omitted if all of the following conditions are met:

1. The asphalt pavement layer is placed within two weeks of completion of base and/or subbase course.

2. Traffic is not routed over completed base before paving.

3. Construction is completed during the dry season of May through October.

4. The base is free of dirt and debris.

If construction is performed during the wet season of November through April, prime coat may be omitted if no rain occurs between completion of base course and paving <u>and</u> the time between completion of base and paving is reduced to three days, provided the base is free of dirt and debris. Where prime coat has been omitted and rain occurs, traffic is routed over base course, or paving is delayed, measures shall be taken to restore base course, subbase course, and subgrade to conditions that will meet specifications as directed by the soil engineer.

Drainage

Positive drainage should be provided for all surface water to drain towards the area swale, curb and gutter, or to an approved drainage channel. Positive site drainage should be maintained at all times. Water should not be allowed to pond or seep into the ground. If planters or landscaping are adjacent to paved areas, measures should be taken to minimize the potential for water to enter the pavement section.

DEVELOPMENT CRITERIA

Slope Deformation

General

Compacted fill slopes, designed using customary factors of safety for gross or surficial stability, and constructed in general accordance with the design specifications, should be expected to undergo some differential vertical heave, or settlement, in combination with differential lateral movement in the out-of-slope direction, after grading. This post-construction movement occurs in two forms: slope creep; and, lateral fill extension (LFE).

Slope Creep

Slope creep is caused by alternate wetting and drying of the fill soils which results in slow downslope movement. This type of movement is expected to occur throughout the life of the slope, and is anticipated to potentially affect improvements or structures (i.e., separations and/or cracking), placed near the top-of-slope, generally within a horizontal distance of approximately 15 feet, measured from the outer, deepest (bottom outside) edge of the improvement, to the face of slope. The actual width of the zone affected is generally dependant upon: 1) the height of the slope; 2) the amount of irrigation/rainfall the slope receives; and, 3) the type of materials comprising the slope. This movement generally results in rotation and differential settlement of improvements located within the creep zone.

Suitable mitigative measures to reduce the potential for distress due to lateral deformation typically include: setback of improvements from the slope faces (per the CBC); positive structural separations (i.e., joints) between improvements; and, stiffening and deepening of foundations. Per Section 1805.3 of the CBC (CBSC, 2007) guidelines, unless specifically superceded herein, a horizontal setback (measured from the slope face to the outside bottom edge of the building footing) of H/3 is provided for structures, where H is the height of the fill slope in feet and H/3 need not be greater than 40 feet. Alternatively, in consideration of the discussion presented above, site conditions and Section 1805.3 of the CBC (CBSC, 2007), H/3 generally need not be greater than 20 feet for the development. As an alternative to a deepened footing, where the adjacent slope is greater than 45 feet in height and the building/footing is within 20 feet from the slope face, a differential settlement of 0.5 inch (additional) may be applied to the design of that portion of the structure(s). Any settlement-sensitive improvements (i.e., walls ,spas, flatwork, etc.) should consider the above.

Lateral Fill Extension (LFE)

LFE occurs due to deep wetting from irrigation and rainfall on slopes comprised of expansive materials. Based on the generally very low expansive character of onsite soils, the potential component of slope deformation due to LFE is considered minor, but may not be totally precluded. Although some movement should be expected, long-term movement from this source may be minimized, but not eliminated, by placing the fill throughout the slope region, wet of the fill's optimum moisture content.

Summary

It is generally not practical to attempt to eliminate the effects of either slope creep or LFE. Suitable mitigative measures to reduce the potential of lateral deformation typically include: setback of improvements from the slope faces (per the CBC); positive structural separations (i.e., joints) between improvements; stiffening; and, deepening of foundations. All of these measures are recommended for design of structures and improvements and minimizing the placement of "dry" fills.

Slope Maintenance and Planting

Water has been shown to weaken the inherent strength of all earth materials. Slope stability is significantly reduced by overly wet conditions. Positive surface drainage, away from slopes, should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Over-watering should be avoided as it can adversely affect site improvements and cause perched groundwater conditions. Graded slopes constructed utilizing onsite materials would be erosive. Eroded debris may be minimized and surficial slope stability enhanced by establishing and maintaining a suitable vegetation cover soon after construction. Compaction to the face of fill slopes would tend to minimize short-term erosion until vegetation is established. Plants selected for landscaping should be light weight, deep rooted types that require little water and are capable of surviving the prevailing climate. Jute-type matting, or other fibrous covers, may aid in allowing the establishment of a sparse plant cover. Utilizing plants other than those recommended above will increase the potential for perched water, staining, mold, etc. to develop. A rodent control program to mitigate burrowing should be implemented. Irrigation of natural (ungraded) slope areas is not recommended. Over-steepening of slopes should be avoided during building construction activities and landscaping.

Drainage

Adequate lot surface drainage is a very important factor in reducing the likelihood of adverse performance of foundations, hardscape, and slopes. Surface drainage should be sufficient to mitigate ponding of water anywhere on a lot, and especially near structures and tops of slopes. Lot surface drainage should be carefully taken into consideration during fine grading, landscaping, and building construction. Therefore, care should be taken that future landscaping or construction activities do not create adverse drainage conditions. Positive site drainage within lots and common areas should be provided and maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. In general, the area within 5 feet around a structure should slope away from the structure. We recommend that unpaved lawn and landscape areas have a minimum gradient of 1 percent sloping away from structures, and whenever possible, should be above adjacent paved areas. Consideration should be given to avoiding construction of planters adjacent to structures (buildings, pools, spas, etc.). Pad drainage should be directed toward the street or other approved area(s). Although not a geotechnical requirement, roof gutters, down spouts, or other appropriate means may be utilized to control roof drainage. Down spouts, or drainage devices should outlet a minimum of 5 feet from structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall, and should be anticipated. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.

Toe of Slope Drains/Toe Drains

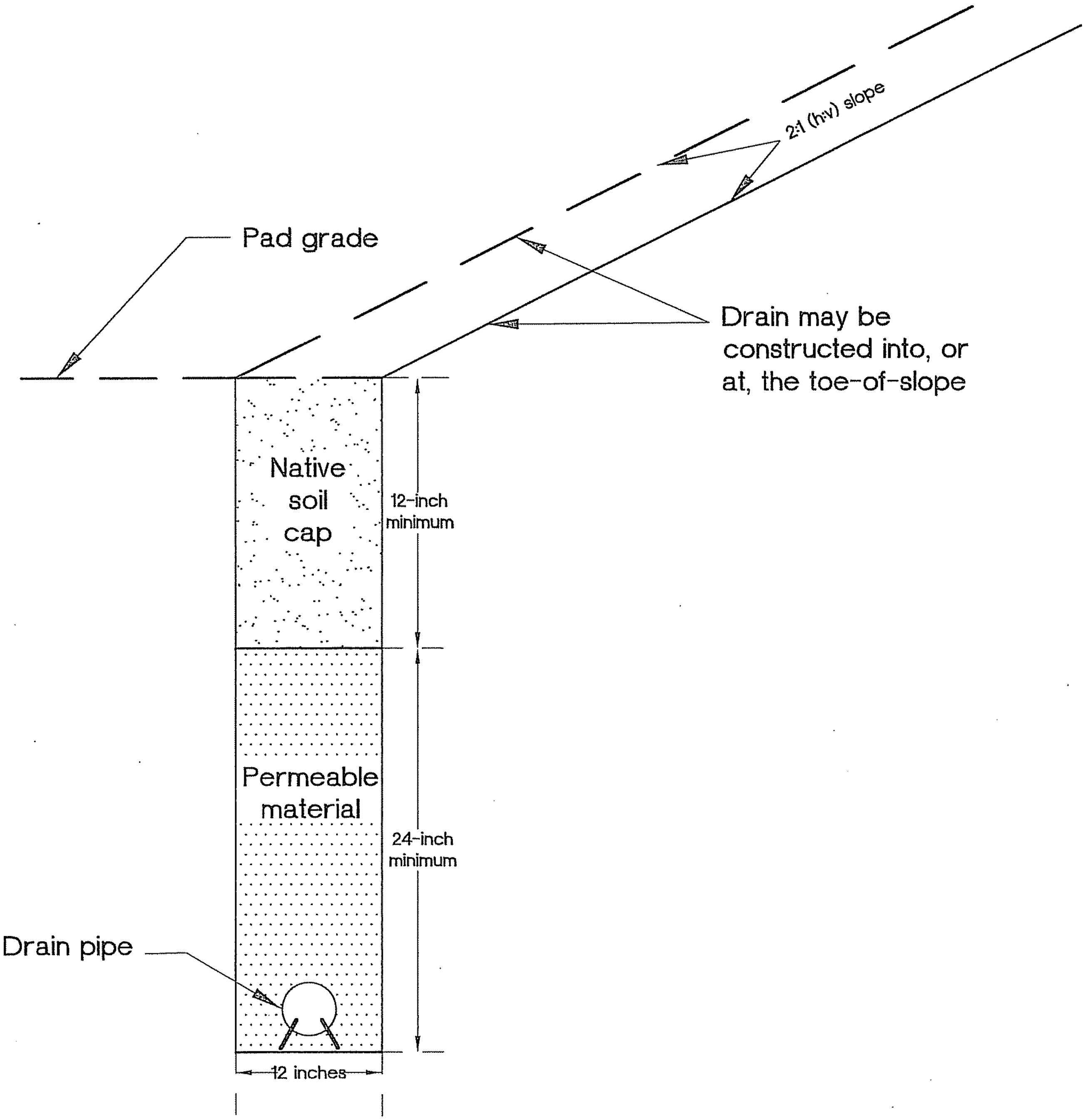
Where significant slopes intersect pad areas, surface drainage down the slope allows for some seepage into the subsurface materials, sometimes creating conditions causing or contributing to perched and/or ponded water. Toe of slope/toe drains may be beneficial in the mitigation of this condition due to surface drainage. The general criteria to be utilized by the design engineer for evaluating the need for this type of drain is as follows:

- Is there a source of irrigation above or on the slope that could contribute to saturation of soil at the base of the slope?
- Are the slopes hard rock and/or impermeable, or relatively permeable, or; do the slopes already have or are they proposed to have subdrains (i.e., stabilization fills, etc.)?
- Was the lot at the base of the slope overexcavated or is it proposed to be overexcavated? Overexcavated lots located at the base of a slope could accumulate subsurface water along the base of the fill cap.
- Are the slopes north facing? North facing slopes tend to receive less sunlight (less evaporation) relative to south facing slopes and are more exposed to the currently prevailing seasonal storm tracks.
- What is the slope height? It has been our experience that slopes with heights in excess of approximately 10 feet tend to have more problems due to storm runoff and irrigation than slopes of a lesser height.
- Do the slopes "toe out" into a residential lot or a lot where perched or ponded water may adversely impact its proposed use?

Based on these general criteria, the construction of toe drains may be considered by the design engineer along the toe of slopes, or at retaining walls in slopes, descending to the rear of such lots. Following are Detail 4 (Schematic Toe Drain Detail) and Detail 5 (Subdrain Along Retaining Wall Detail). Other drains may be warranted due to unforeseen conditions, homeowner irrigation, or other circumstances. Where drains are constructed during grading, including subdrains, the locations/elevations of such drains should be surveyed, and recorded on the final as-built grading plans by the design engineer. It is recommended that the above be disclosed to all interested parties, including homeowners and any homeowners association.

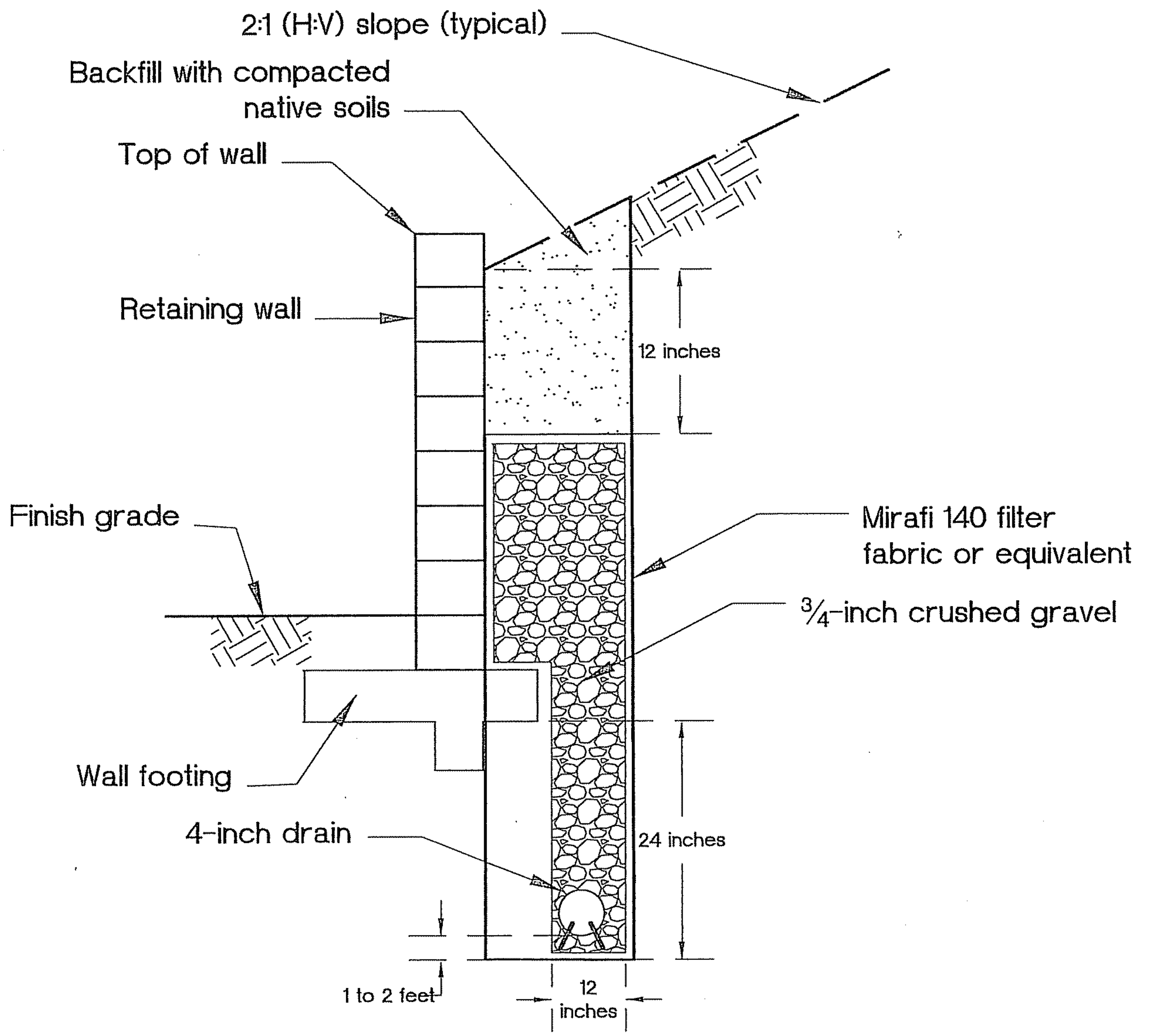
Erosion Control

Cut and fill slopes will be subject to surficial erosion during and after grading. Onsite earth materials have a moderate to high erosion potential. Consideration should be given to providing hay bales and silt fences for the temporary control of surface water, from a geotechnical viewpoint.



1. Soil cap compacted to 90 percent relative compaction.
2. Permeable material may be gravel wrapped in filter fabric (Mirafi 140N or equivalent).
3. 4-inch-diameter, perforated pipe (SDR-35 or equivalent) with perforations down.
4. Pipe to maintain a minimum 1 percent fall.
5. Concrete cut-off wall to be provided at transition to solid outlet pipe.
6. Solid outlet pipe to drain to approved area.
7. Cleanouts are recommended at each property line.

GeoSoils, Inc. | SCHEMATIC TOE DRAIN DETAIL | Detail 4



NOTES:

1. Soil cap compacted to 90 percent relative compaction.
2. Permeable material may be gravel wrapped in filter fabric (Mirafi 140N or equivalent).
3. 4-inch-diameter, perforated pipe (SDR-35 or equivalent) with perforations down.
4. Pipe to maintain a minimum 1 percent fall.
5. Concrete cut-off wall to be provided at transition to solid outlet pipe.
6. Solid outlet pipe to drain to approved area.
7. Cleanouts are recommended at each property line.
8. Effort to compact should be applied to drain rock.

GeoSoils, Inc.	SUBDRAIN ALONG RETAINING WALL DETAIL	Detail 5

Landscape Maintenance

Only the amount of irrigation necessary to sustain plant life should be provided. Over-watering the landscape areas will adversely affect proposed site improvements. We would recommend that any proposed open-bottom planters adjacent to proposed structures be eliminated for a minimum distance of 10 feet. As an alternative, closed-bottom type planters could be utilized. An outlet placed in the bottom of the planter, could be installed to direct drainage away from structures or any exterior concrete flatwork. If planters are constructed adjacent to structures, the sides and bottom of the planter should be provided with a moisture retarder to mitigate penetration of irrigation water into the subgrade. Provisions should be made to drain the excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Graded slope areas should be planted with drought resistant vegetation. Consideration should be given to the type of vegetation chosen and their potential effect upon surface improvements (i.e., some trees will have an effect on concrete flatwork with their extensive root systems). From a geotechnical standpoint leaching is not recommended for establishing landscaping. If the surface soils are processed for the purpose of adding amendments, they should be recompacted to 90 percent minimum relative compaction.

Gutters and Downspouts

As previously discussed in the drainage section, the installation of gutters and downspouts should be considered to collect roof water that may otherwise infiltrate the soils adjacent to the structures. If utilized, the downspouts should be drained into PVC collector pipes or other non-erosive devices (e.g., paved swales or ditches; below grade, solid tight-lined PVC pipes; etc.), that will carry the water away from the structure, to an appropriate outlet, in accordance with the recommendations of the design civil engineer. Downspouts and gutters are not a requirement; however, from a geotechnical viewpoint, provided that positive drainage is incorporated into project design (as discussed previously).

Subsurface and Surface Water

Subsurface and surface water are not anticipated to affect site development, provided that the recommendations contained in this report are incorporated into final design and construction and that prudent surface and subsurface drainage practices are incorporated into the construction plans. Perched groundwater conditions along zones of contrasting permeabilities may not be precluded from occurring in the future due to site irrigation, poor drainage conditions, or damaged utilities, and should be anticipated. Should perched groundwater conditions develop, this office could assess the affected area(s) and provide the appropriate recommendations to mitigate the observed groundwater conditions. Groundwater conditions may change with the introduction of irrigation, rainfall, or other factors.

Site Improvements

If in the future, any additional improvements (e.g., pools, spas, etc.) are planned for the site, recommendations concerning the geological or geotechnical aspects of design and construction of said improvements could be provided upon request. Preliminary design and construction recommendations for pools/spas are presented in this report. This office should be notified in advance of any fill placement, grading of the site, or trench backfilling after rough grading has been completed. This includes any grading, utility trench and retaining wall backfills, flatwork, etc.

Tile Flooring

Tile flooring can crack, reflecting cracks in the concrete slab below the tile, although small cracks in a conventional slab may not be significant. Therefore, the designer should consider additional steel reinforcement for concrete slabs-on-grade where tile will be placed. The tile installer should consider installation methods that reduce possible cracking of the tile such as slipsheets. Slipsheets or a vinyl crack isolation membrane (approved by the Tile Council of America/Ceramic Tile Institute) are recommended between tile and concrete slabs on grade.

Additional Grading

This office should be notified in advance of any fill placement, supplemental regrading of the site, or trench backfilling after rough grading has been completed. This includes completion of grading in the street, driveway approaches, driveways, parking areas, and utility trench and retaining wall backfills.

Footing Trench Excavation

All footing excavations should be observed by a representative of this firm subsequent to trenching and prior to concrete form and reinforcement placement. The purpose of the observations is to evaluate that the excavations have been made into the recommended bearing material and to the minimum widths and depths recommended for construction. If loose or compressible materials are exposed within the footing excavation, a deeper footing or removal and recompaction of the subgrade materials would be recommended at that time. Footing trench spoil and any excess soils generated from utility trench excavations should be compacted to a minimum relative compaction of 90 percent, if not removed from the site.

Trenching/Temporary Construction Backcuts

Considering the nature of the onsite earth materials, it should be anticipated that caving or sloughing could be a factor in subsurface excavations and trenching. Shoring or excavating the trench walls/backcuts at the angle of repose (typically 25 to 45 degrees [except as specifically superceded within the text of this report]), should be anticipated. All excavations should be observed by an engineering geologist or soil engineer from GSI, prior to workers entering the excavation or trench, and minimally conform to Cal-OSHA, state, and local safety codes. Should adverse conditions exist, appropriate recommendations would be offered at that time. The above recommendations should be provided to any contractors and/or subcontractors, or property owners, etc., that may perform such work.

Utility Trench Backfill

1. All interior utility trench backfill should be brought to at least 2 percent above optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard. As an alternative for shallow (12-inch to 18-inch) under-slab trenches, sand having a sand equivalent value of 30 or greater may be utilized and jetted or flooded into place. Observation, probing and testing should be provided to evaluate the desired results.

2. Exterior trenches adjacent to, and within areas extending below a 1:1 plane projected from the outside bottom edge of the footing, and all trenches beneath hardscape features and in slopes, should be compacted to at least 90 percent of the laboratory standard. Sand backfill, unless excavated from the trench, should not be used in these backfill areas. Compaction testing and observations, along with probing, should be accomplished to evaluate the desired results.

3. All trench excavations should conform to Cal-OSHA, state, and local safety codes.

4. Utilities crossing grade beams, perimeter beams, or footings should either pass below the footing or grade beam utilizing a hardened collar or foam spacer, or pass through the footing or grade beam in accordance with the recommendations of the structural engineer.

SUMMARY OF RECOMMENDATIONS REGARDING GEOTECHNICAL OBSERVATION AND TESTING

We recommend that observation and/or testing be performed by GSI at each of the following construction stages:

- During grading/recertification.

- During excavation.

- During placement of subdrains, toe drains, or other subdrainage devices, prior to placing fill and/or backfill.

- After excavation of building footings, retaining wall footings, and free standing walls footings, prior to the placement of reinforcing steel or concrete.

- Prior to pouring any slabs or flatwork, after presoaking/presaturation of building pads and other flatwork subgrade, before the placement of concrete, reinforcing steel, capillary break (i.e., sand, pea-gravel, etc.), or vapor retarders (i.e., visqueen, etc.).

- During retaining wall subdrain installation, prior to backfill placement.

- During placement of backfill for area drain, interior plumbing, utility line trenches, and retaining wall backfill.

- When any unusual soil conditions are encountered during any construction operations, subsequent to the issuance of this report.

- When any owner improvements, such as flatwork, spas, pools, walls, etc., are constructed, prior to construction.

- A report of geotechnical observation and testing should be provided at the conclusion of each of the above stages, in order to provide concise and clear documentation of site work, and/or to comply with code requirements.

OTHER DESIGN PROFESSIONALS/CONSULTANTS

The design civil engineer, structural engineer, post-tension designer, architect, landscape architect, wall designer, etc., should review the recommendations provided herein, incorporate those recommendations into all their respective plans, and by explicit reference, make this report part of their project plans. This report presents minimum design criteria for the design of slabs, foundations and other elements possibly applicable to the project. These criteria should not be considered as substitutes for actual designs by the structural engineer/designer. Please note that the recommendations contained herein are not intended to entirely preclude the transmission of water or vapor through the slab or foundation. The structural engineer/foundation and/or slab designer should provide recommendations to not allow water or vapor to enter into the structure so as to cause damage to another building component, or so as to limit the installation of the type of flooring materials typically used for the particular application.

The structural engineer/designer should analyze actual soil-structure interaction and consider, as needed, bearing, expansive soil influence, and strength, stiffness and deflections in the various slab, foundation, and other elements in order to develop appropriate, design-specific details. As conditions dictate, it is possible that other influences will also have to be considered. The structural engineer/designer should consider all applicable codes and authoritative sources where needed. If analyses by the structural engineer/designer result in less critical details than are provided herein as minimums, the minimums presented herein should be adopted. It is considered likely that some, more restrictive details will be required.

If the structural engineer/designer has any questions or requires further assistance, they should not hesitate to call or otherwise transmit their requests to GSI. In order to mitigate potential distress, the foundation and/or improvement's designer should confirm to GSI and the governing agency, in writing, that the proposed foundations and/or improvements can tolerate the amount of differential settlement and/or expansion characteristics and other design criteria specified herein.

PLAN REVIEW

Final project plans (grading, precise grading, foundation, retaining wall, landscaping, etc.), should be reviewed by this office prior to construction, so that construction is in accordance with the conclusions and recommendations of this report. Based on our review, supplemental recommendations and/or further geotechnical studies may be warranted.

LIMITATIONS

The materials encountered on the project site and utilized for our analysis are believed representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during mass grading. Site conditions may vary due to seasonal changes or other factors.

Inasmuch as our study is based upon our review and engineering analyses and laboratory data, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice, and no warranty, either express or implied, is given. Standards of practice are subject to change with time. GSI assumes no responsibility or liability for work or testing performed by others, or their inaction; or work performed when GSI is not requested to be onsite, to evaluate if our recommendations have been properly implemented. Use of this report constitutes an agreement and consent by the user to all the limitations outlined above, notwithstanding any other agreements that may be in place. In addition, this report may be subject to review by the controlling authorities. Thus, this report brings to completion our scope of services for this portion of the project. All samples will be disposed of after 30 days, unless specifically requested by the client, in writing.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

TEST PIT LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM				
Major Divisions			Group Symbols	Typical Names
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with	GM	Silty gravels gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands more than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, mucic, and other highly organic soils

CONSISTENCY OR RELATIVE DENSITY

CRITERIA

Standard Penetration Test

Penetration Resistance N (blows/ft)	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
> 50	Very dense

Standard Penetration Test

Penetration Resistance N (blows/ft)	Consistency	Unconfined Compressive Strength (tons/ft^2)
<2	Very Soft	<0.25
2 - 4	Soft	0.25 - .050
4 - 8	Medium	0.50 - 1.00
8 - 15	Stiff	1.00 - 2.00
15 - 30	Very Stiff	2.00 - 4.00
>30	Hard	>4.00

		3"		3/4"	#4	#10	#40	#200 U.S. Standard Sieve
Unified Soil Classification	Cobbles	Gravel		Sand			Silt or Clay	
		coarse	fine	coarse	medium	fine		

MOISTURE CONDITIONS

Dry	Absence of moisture: dusty, dry to the touch
Slightly Moist	Below optimum moisture content for compaction
Moist	Near optimum moisture content
Very Moist	Above optimum moisture content
Wet	Visible free water; below water table

MATERIAL QUANTITY

trace	0 - 5 %
few	5 - 10 %
little	10 - 25 %
some	25 - 45 %

OTHER SYMBOLS

C	Core Sample
S	SPT Sample
B	Bulk Sample
▼	Groundwater
Qp	Pocket Penetrometer

BASIC LOG FORMAT:
Group name, Group symbol, (grain size), color, moisture, consistency or relative density. Additional comments: odor, presence of roots, mica, gypsum, coarse grained particles, etc.

EXAMPLE:
Sand (SP), fine to medium grained, brown, moist, loose, trace silt, little fine gravel, few cobbles up to 4" in size, some hair roots and rootlets.

GeoSoils, Inc.

W.O. 6269-A-SC
Arete Homes
Amanda Lane, Escondido
Logged By: RGC
June 23, 2011

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	ELEV. (ft.)	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-1	807	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown, slightly moist, loose; porous, heavily burrowed, many roots.
		1-2½	SM				SILTY SAND, brown, moist, loose; porous.
		2½-6	SW				**GRANITIC BEDROCK:** WEATHERED GRANITIC ROCK (DG) breaking to SAND w/SILT, brown, moist, dense.
		6-7	SW				GRANITIC ROCK (DG) breaking to SAND w/SILT and brittle gravel- to cobble-size rock fragments.
							Total Depth = 7' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011
TP-2	778	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry to slightly moist, loose; porous, heavily burrowed.
		1-5½	SM				SILTY SAND, brown to dark brown, moist, loose; porous.
		5½-9	SW				**GRANITIC BEDROCK:** WEATHERED GRANITIC ROCK (DG) breaking to SAND w/SILT, medium gray, moist, dense.
		9-11	SW				Breaking to SAND and brittle, gravel- to cobble-size angular rock fragments upon excavation, medium gray, moist, very dense.
							Total Depth = 11' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011

GeoSoils, Inc.

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	ELEV. (ft.)	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-3	792	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown, slightly moist to dry, loose; porous, heavily burrowed, many roots.
		1-2½	SM				SILTY SAND, brown, slightly moist, loose; porous.
		2½-3	SM				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SILTY SAND, brown, moist, medium dense; weathered.
		3-5	SW				Breaks to SAND w/SILT (DG), gray brown, moist, dense; massive.
		5-6	SW				Breaks to SAND w/SILT (DG) with brittle gravel- to cobble-size angular rock fragments, medium gray, moist, dense.
							Total Depth = 6' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011
TP-4	807	0-1½	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry, loose; porous, heavily burrowed, many roots.
		1½-2	SM				SILTY SAND, brown, slightly moist, loose.
		2-3½	SM/SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SILTY SAND, brown, moist, medium dense; weathered.
		3½-7	SW				Breaking to SAND w/SILT (DG) with brittle gravel- to cobble-size fragments, medium gray, moist, dense.
							Total Depth = 7' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011

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LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	ELEV. (ft.)	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-5	782	0-1½	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry, loose; porous, heavily burrowed, many roots.
		1½-4	SM				SILTY SAND, brown, slightly moist, loose; porous.
		4-5	SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SAND w/SILT, brown, slightly moist, dense.
							Total Depth = 5' No Groundwater/Caving Encountered Backfilled 6-23-2011
TP-6	821	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry to slightly moist, loose; porous, heavily burrowed, many roots.
		1-3	SM				SILTY SAND, brown, moist, loose; porous.
		3-4½	SM/SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SILTY SAND and SAND, brown, moist, medium dense to dense; massive.
		4½-8	SW				Breaking to SAND upon excavation, gray brown to medium gray, moist, dense.
		8-10	SW				Becomes very dense, breaking to SAND and brittle gravel- to cobble-size rock fragments.
							Total Depth = 10' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	ELEV. (ft.)	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-7	836	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown to brown, dry, loose; many roots, burrowed.
		1-3	SM				SILTY SAND, brown, moist, loose; porous.
		3-4	SM/SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SILTY SAND, moist, medium dense; massive, weathered.
		4-7	SW				Breaking to SAND w/SILT, medium gray, moist, dense; massive. @ 6' Breaks to SAND and brittle gravel- to cobble-size angular fragments, very dense.
							Total Depth = 7' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011
TP-8	810	0-1½	SM				**COLLUVIUM:** SILTY SAND, brown, dry, loose; porous, heavily burrowed, many roots in upper 6".
		1½-3	SM				SILTY SAND, brown, slightly moist to moist, loose; porous.
		3-4	SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SAND w/SILT, brown, moist, medium dense to dense; weathered, massive.
		4-8	SW				Breaking to SAND and angular gravel- to cobble-size fragments (below 6'), medium gray, slightly moist, very dense.
							Total Depth = 8' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011

GeoSoils, Inc.

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	ELEV. (ft.)	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-9	780	0-2	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry, loose; porous.
		2-3	SC				CLAYEY SAND, brown, moist, loose; porous.
		3-4½	SC/CL				**HIGHLY WEATHERED GRANITIC BEDROCK:** CLAYEY SAND to SANDY CLAY, mottled olive brown and brown, moist, loose to firm.
		4½-6	SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SAND w/SILT, medium gray, moist, dense; massive, few brittle angular gravel- to cobble-size fragments below 5½'.
							Total Depth = 6' No Groundwater/Caving Encountered Backfilled 6-23-2011
TP-10	779	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry, loose; porous, heavily burrowed, many roots in upper 6".
		1-2½	SC				CLAYEY SAND, brown, slightly moist, loose to medium dense; porous.
		2½-6	SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SAND w/SILT, medium gray to gray brown, slightly moist, dense.
							Total Depth = 6' (Practical Refusal) No Groundwater/Caving Encountered Backfilled 6-23-2011

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LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	ELEV. (ft.)	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-11	796	0-1½	SM	1'	6.3	93.1	**COLLUVIUM:** SILTY SAND, dark brown, dry, loose.
		1½-3	SC	2'	8.0	116.0	CLAYEY SAND, brown, slightly moist, loose; porous.
		3-4	SM/SM				**HIGHLY WEATHERED BEDROCK:** CLAYEY SAND, brown, moist, medium dense; porous.
		4-8	SW				**GRANITIC BEDROCK:** GRANITIC ROCK (DG) breaking to SAND w/SILT, medium gray, slightly moist, dense. @ 7' Becomes very dense.
							Total Depth = 8' No Groundwater/Caving Encountered Backfilled 6-23-2011
TP-12	761	0-1	SM				**COLLUVIUM:** SILTY SAND, dark brown, dry, loose; porous, heavily burrowed, many roots in upper 6".
		1-3	SM				SILTY SAND, brown to dark brown, slightly moist, loose; porous.
		3-6	SW	1	8.0	101.5	**GRANITIC BEDROCK:** GRANITIC ROCK (DG), breaking to SILTY SAND to SAND, brown, slightly moist, dense.
		6-8	SW				Breaking to SAND w/SILT, medium gray, moist, dense; few angular gravel- to cobble-size brittle rock fragments at 7½'.
							Total Depth = 8' No Groundwater/Caving Encountered Backfilled 6-23-2011

APPENDIX C

EQFAULT, EQSEARCH, AND PHGA

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*                      *
*    E Q F A U L T     *
*                      *
*    Version 3.00      *
*                      *
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 6269

DATE: 06-28-2011

JOB NAME: Amanda Lane

CALCULATION NAME: Amanda Lane

FAULT-DATA-FILE NAME: CDMGFLTE.DAT

SITE COORDINATES:
SITE LATITUDE: 33.0983
SITE LONGITUDE: 117.0996

SEARCH RADIUS: 100 mi

ATTENUATION RELATION: 9) Bozorgnia Campbell Niazi (1999) Hor.-Hard Rock-Uncor.
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
DISTANCE MEASURE: cdist
SCOND: 1
Basement Depth: .00 km Campbell SSR: 0 Campbell SHR: 1
COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: CDMGFLTE.DAT

MINIMUM DEPTH VALUE (km): 3.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
ROSE CANYON	14.2(22.9)	6.9	0.161	VIII
ELSINORE-JULIAN	18.5(29.7)	7.1	0.137	VIII
NEWPORT-INGLEWOOD (Offshore)	19.6(31.5)	6.9	0.110	VII
ELSINORE-TEMECULA	20.0(32.2)	6.8	0.099	VII
CORONADO BANK	28.8(46.3)	7.4	0.100	VII
EARTHQUAKE VALLEY	30.6(49.2)	6.5	0.046	VI
ELSINORE-GLEN IVY	40.3(64.9)	6.8	0.041	V
SAN JACINTO-ANZA	40.9(65.9)	7.2	0.055	VI
SAN JACINTO-COYOTE CREEK	42.3(68.1)	6.8	0.038	V
ELSINORE-COYOTE MOUNTAIN	43.7(70.4)	6.8	0.037	V
SAN JACINTO-SAN JACINTO VALLEY	45.6(73.4)	6.9	0.037	V
PALOS VERDES	50.3(80.9)	7.1	0.039	V
SAN JACINTO - BORREGO	52.9(85.2)	6.6	0.024	V
CHINO-CENTRAL AVE. (Elsinore)	57.1(91.9)	6.7	0.028	V
NEWPORT-INGLEWOOD (L.A.Basin)	59.3(95.4)	6.9	0.027	V
WHITTIER	60.8(97.9)	6.8	0.024	IV
SAN ANDREAS - San Bernardino	63.8(102.7)	7.3	0.033	V
SAN ANDREAS - Southern	63.8(102.7)	7.4	0.036	V
SAN JACINTO-SAN BERNARDINO	64.0(103.0)	6.7	0.020	IV
SAN ANDREAS - Coachella	67.5(108.7)	7.1	0.026	V
SUPERSTITION MTN. (San Jacinto)	68.6(110.4)	6.6	0.017	IV
COMPTON THRUST	69.0(111.1)	6.8	0.027	V
PINTO MOUNTAIN	69.8(112.4)	7.0	0.023	IV
ELYSIAN PARK THRUST	70.4(113.3)	6.7	0.025	V
BURNT MTN.	72.0(115.8)	6.4	0.014	IV
ELMORE RANCH	72.3(116.3)	6.6	0.016	IV
SUPERSTITION HILLS (San Jacinto)	73.3(117.9)	6.6	0.016	IV
EUREKA PEAK	74.6(120.1)	6.4	0.013	III
LAGUNA SALADA	75.1(120.8)	7.0	0.021	IV
SAN JOSE	77.9(125.3)	6.5	0.016	IV
NORTH FRONTAL FAULT ZONE (West)	79.2(127.4)	7.0	0.024	IV
CUCAMONGA	79.3(127.7)	7.0	0.024	IV
NORTH FRONTAL FAULT ZONE (East)	79.9(128.6)	6.7	0.018	IV
SIERRA MADRE	81.2(130.7)	7.0	0.023	IV
CLEGHORN	81.8(131.6)	6.5	0.013	III
BRAWLEY SEISMIC ZONE	82.5(132.7)	6.4	0.012	III
LANDERS	83.5(134.4)	7.3	0.023	IV
SAN ANDREAS - 1857 Rupture	87.4(140.7)	7.8	0.033	V
SAN ANDREAS - Mojave	87.4(140.7)	7.1	0.019	IV
HELENDALE - S. LOCKHARDT	88.9(143.1)	7.1	0.018	IV

DETERMINISTIC SITE PARAMETERS

Page 2

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
IMPERIAL	89.7(144.3)	7.0	0.017	IV
EMERSON So. - COPPER MTN.	90.5(145.6)	6.9	0.015	IV
LENWOOD-LOCKHART-OLD WOMAN SPRGS	90.8(146.2)	7.3	0.021	IV
RAYMOND	91.1(146.6)	6.5	0.013	III
CLAMSHELL-SAWPIT	91.8(147.8)	6.5	0.013	III
JOHNSON VALLEY (Northern)	92.3(148.6)	6.7	0.013	III
VERDUGO	94.4(152.0)	6.7	0.015	IV
PISGAH-BULLION MTN.-MESQUITE LK	95.8(154.1)	7.1	0.017	IV
HOLLYWOOD	96.8(155.8)	6.4	0.011	III
CALICO - HIDALGO	99.6 (160.3)	7.1	0.016	IV

****

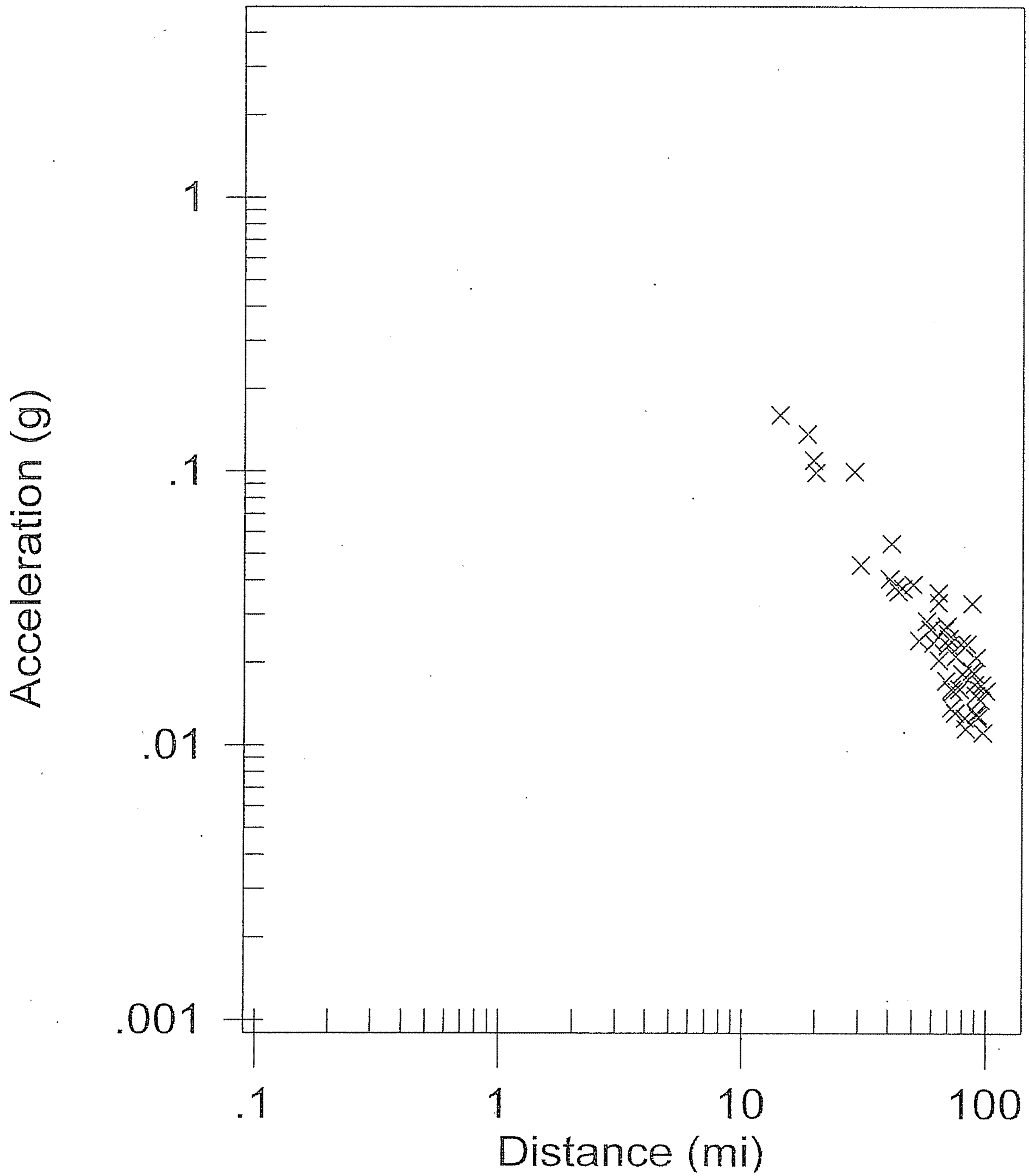
-END OF SEARCH- 50 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE ROSE CANYON FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 14.2 MILES (22.9 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.1608 g

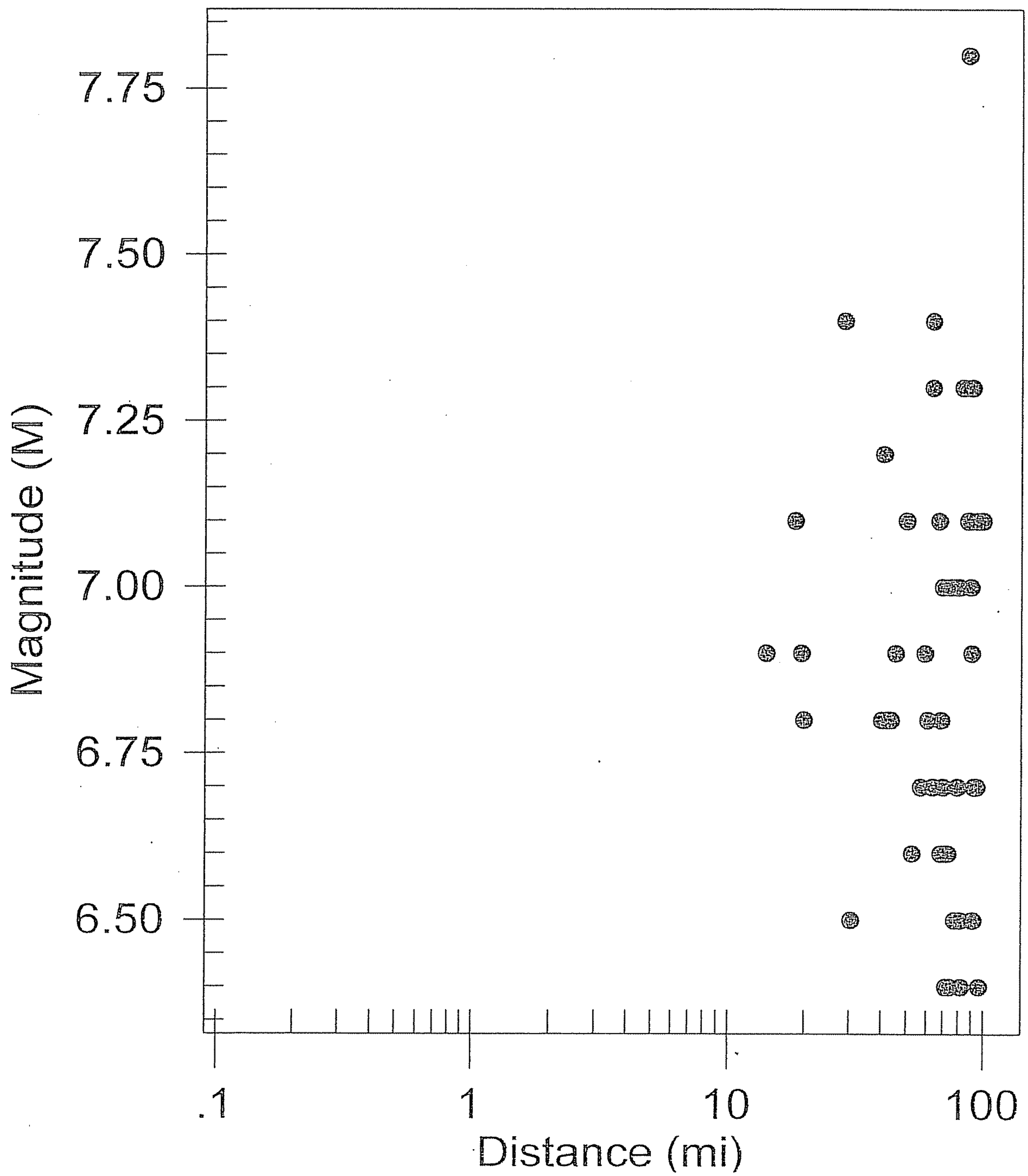
MAXIMUM EARTHQUAKES

Amanda Lane



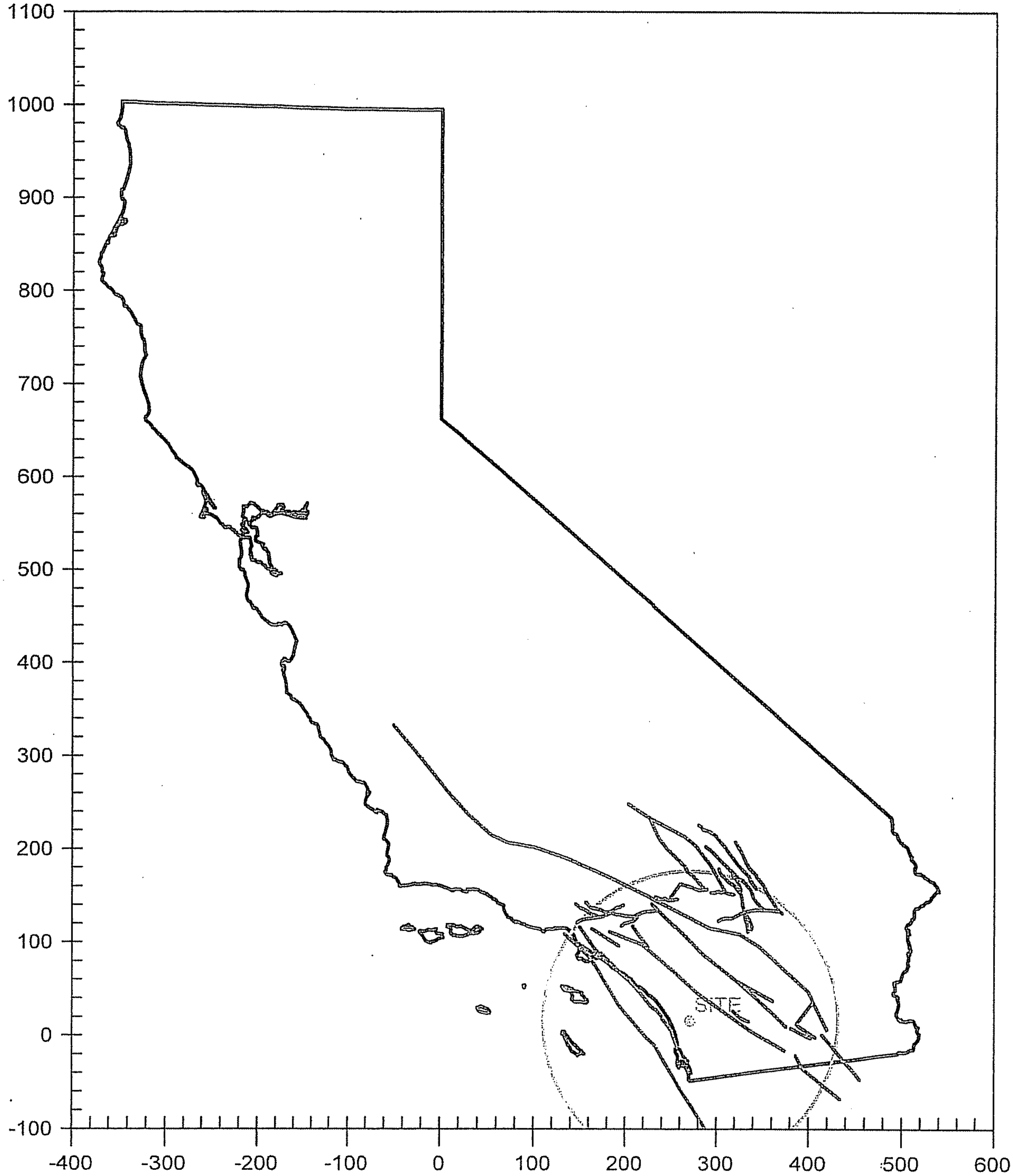
EARTHQUAKE MAGNITUDES & DISTANCES

Amanda Lane



CALIFORNIA FAULT MAP

Amanda Lane



W.O. 6269-A-SC

Plate C-6

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*                       *
*   E Q S E A R C H     *
*                       *
*     Version 3.00      *
*                       *
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ESTIMATION OF
PEAK ACCELERATION FROM
CALIFORNIA EARTHQUAKE CATALOGS

JOB NUMBER: 6269

DATE: 06-28-2011

JOB NAME: Amanda Lane

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT

MAGNITUDE RANGE:
MINIMUM MAGNITUDE: 4.00
MAXIMUM MAGNITUDE: 9.00

SITE COORDINATES:
SITE LATITUDE: 33.0983
SITE LONGITUDE: 117.0996

SEARCH DATES:
START DATE: 1800
END DATE: 2011

SEARCH RADIUS:
100.0 mi
160.9 km

ATTENUATION RELATION: 9) Bozorgnia Campbell Niazi (1999) Hor.-Hard Rock-Uncor.
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
ASSUMED SOURCE TYPE: SS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
SCOND: 1 Depth Source: A
Basement Depth: .01 km Campbell SSR: 0 Campbell SHR: 1
COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km): 3.0

THE EARTHQUAKE CLOSEST TO THE SITE IS ABOUT 8.9 MILES (14.3 km) AWAY.

LARGEST EARTHQUAKE MAGNITUDE FOUND IN THE SEARCH RADIUS: 7.6

LARGEST EARTHQUAKE SITE ACCELERATION FROM THIS SEARCH: 0.127 g

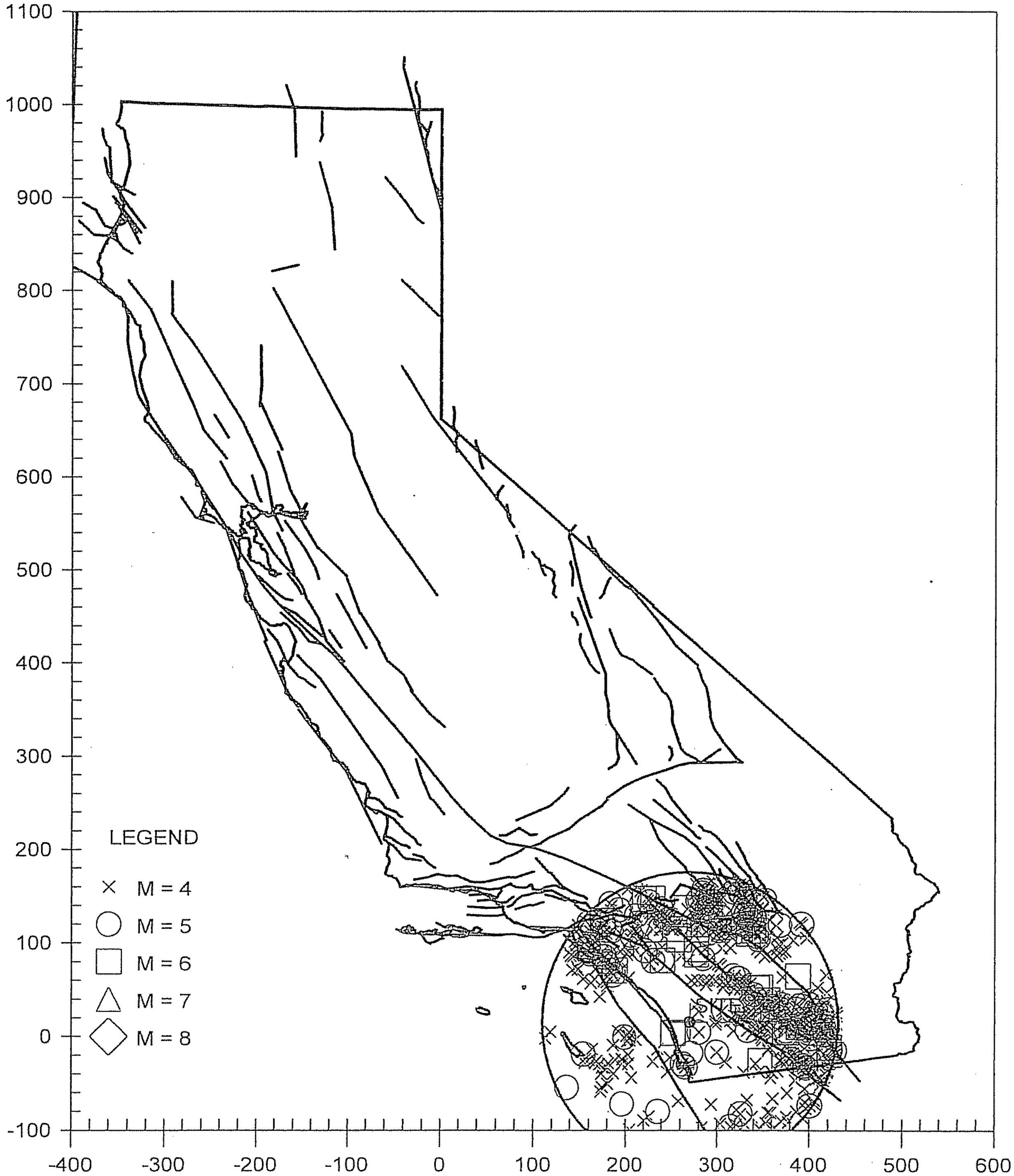
COEFFICIENTS FOR GUTENBERG & RICHTER RECURRENCE RELATION:
a-value= 4.299
b-value= 0.871
beta-value= 2.005

TABLE OF MAGNITUDES AND EXCEEDANCES:

Earthquake Magnitude	Number of Times Exceeded	Cumulative No. / Year
4.0	1476	6.96226
4.5	522	2.46226
5.0	171	0.80660
5.5	60	0.28302
6.0	29	0.13679
6.5	11	0.05189
7.0	3	0.01415
7.5	1	0.00472

EARTHQUAKE EPICENTER MAP

Amanda Lane

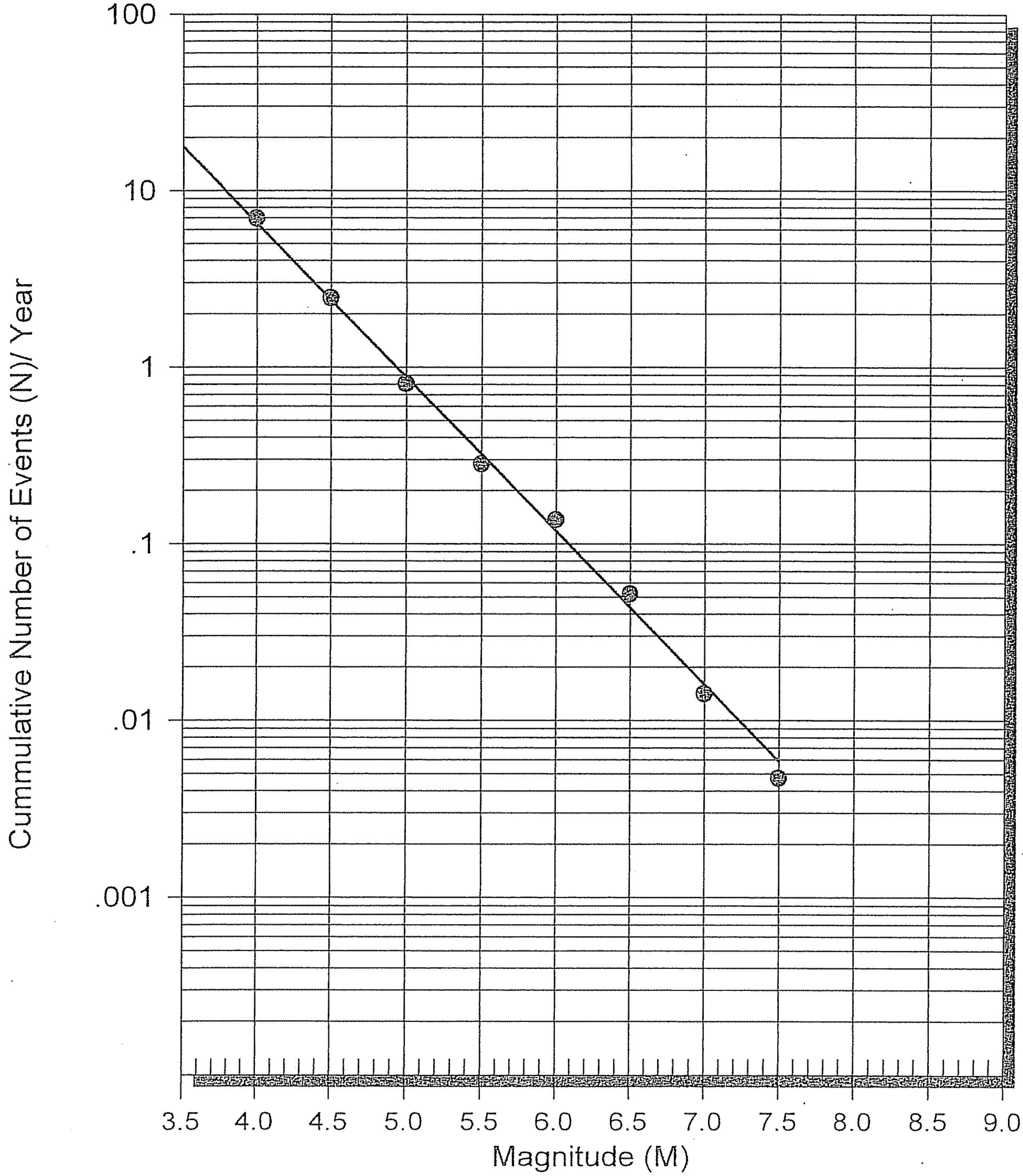


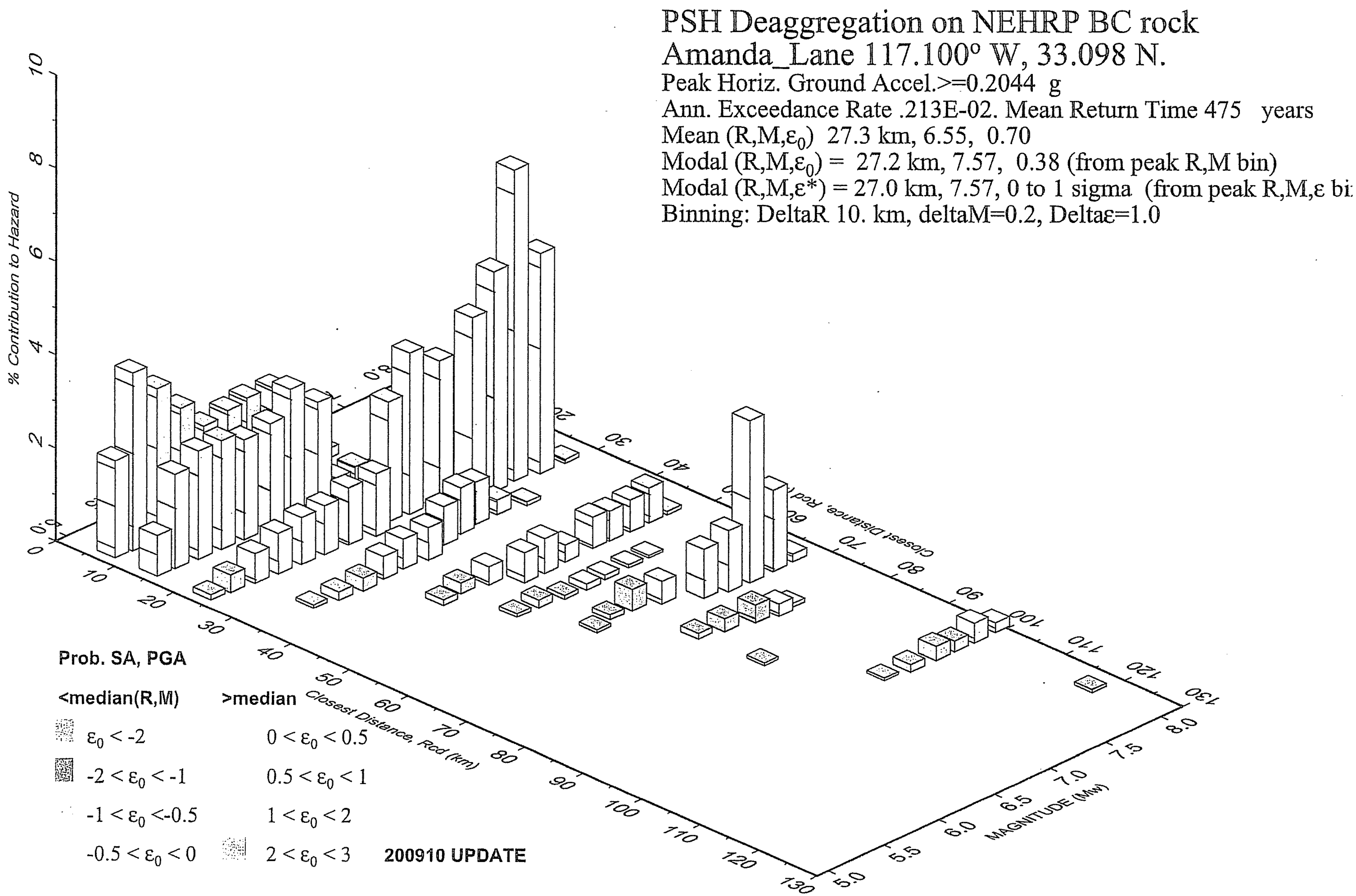
W.O. 6269-A-SC

Plate C-9

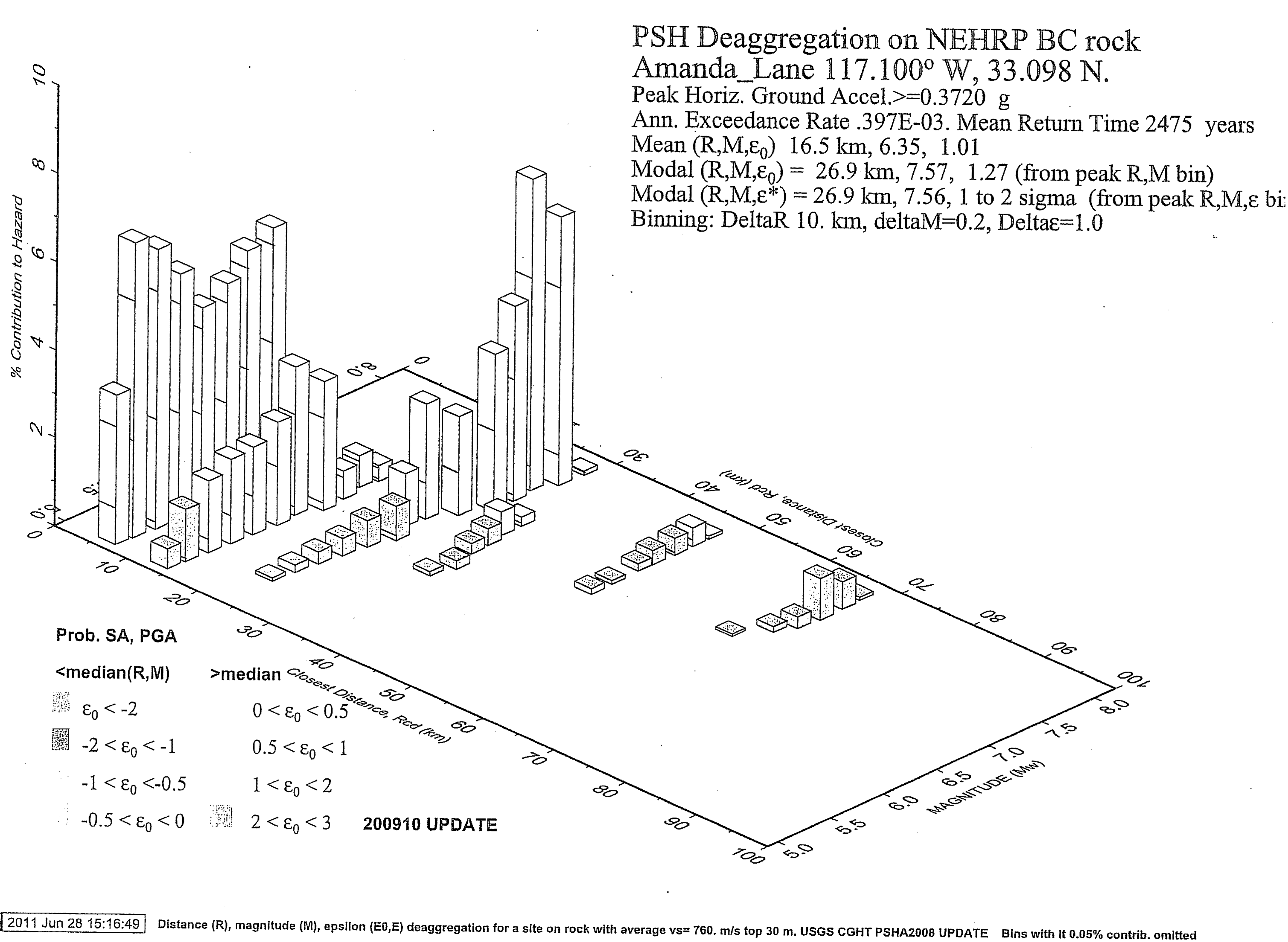
EARTHQUAKE RECURRENCE CURVE

Amanda Lane





GMT 2011 Jun 28 15:17:49 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

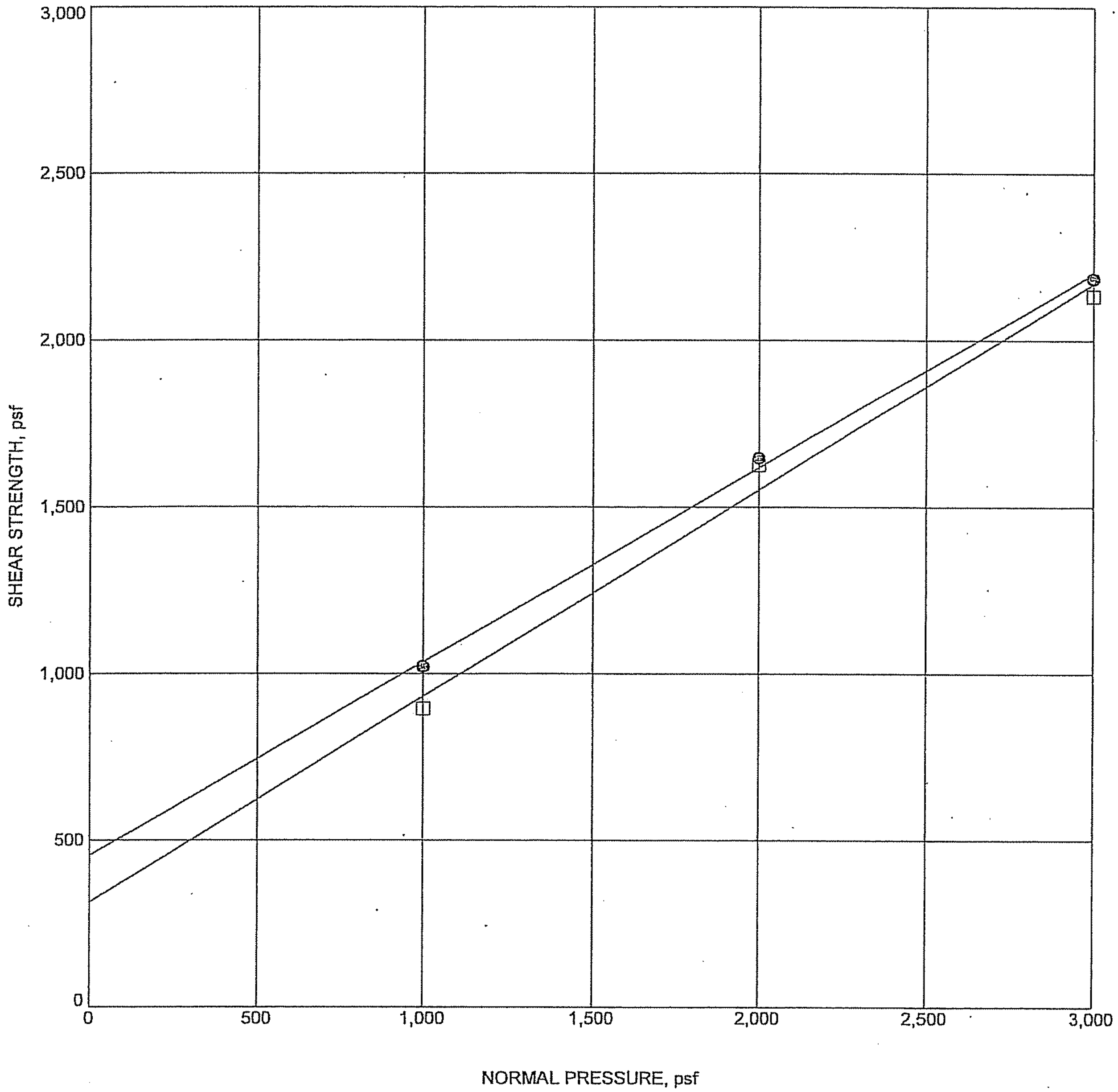


W.O. 6269-A-SC

Plate C-12

APPENDIX D

LABORATORY DATA



	Sample	Depth/El.	Range	Classification	Primary/Residual	Sample Type	γ_d	MC%	c	ϕ
⊗	TP-7	0.0	0-2	Silty Sand	Primary Shear	Remolded	114.7	9.5	454	30
□	TP-7	0.0			Residual Shear	Remolded	114.7	9.5	313	32

Note: Sample Innundated prior to testing

GeoSoils, Inc.
GeoSoils, Inc.
5741 Palmer Way
Carlsbad, CA 92008
Telephone: (760) 438-3155
Fax: (760) 931-0915

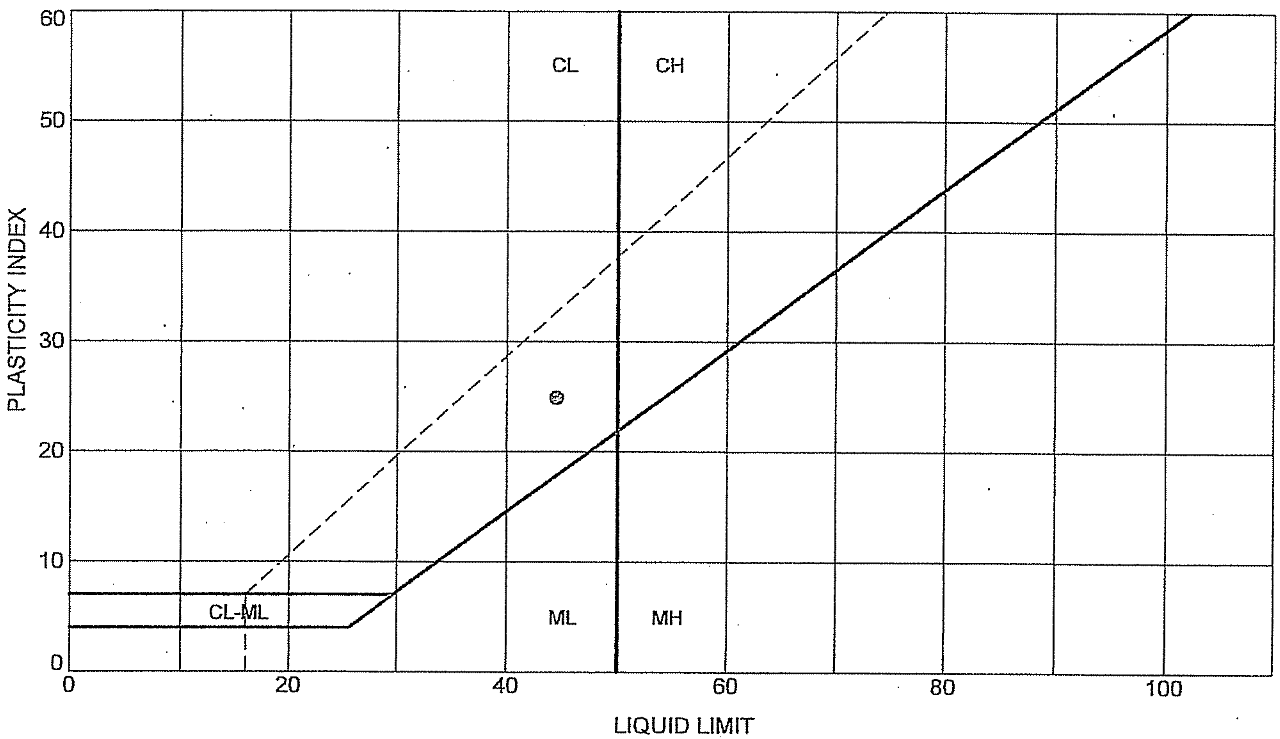
DIRECT SHEAR TEST

Project: ARETE HOMES

Number: 6269-A-SC

Date: June 2011

Plate: D - 1



	Sample	Depth/El.	LL	PL	PI	Fines	USCS CLASSIFICATION
⊕	TP- 9	2.0	44	20	24		~~Silty Sand~~ Sandy Clay

GeoSoils, Inc.
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Carlsbad, CA 92008
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Fax: (760) 931-0915

ATTERBERG LIMITS' RESULTS

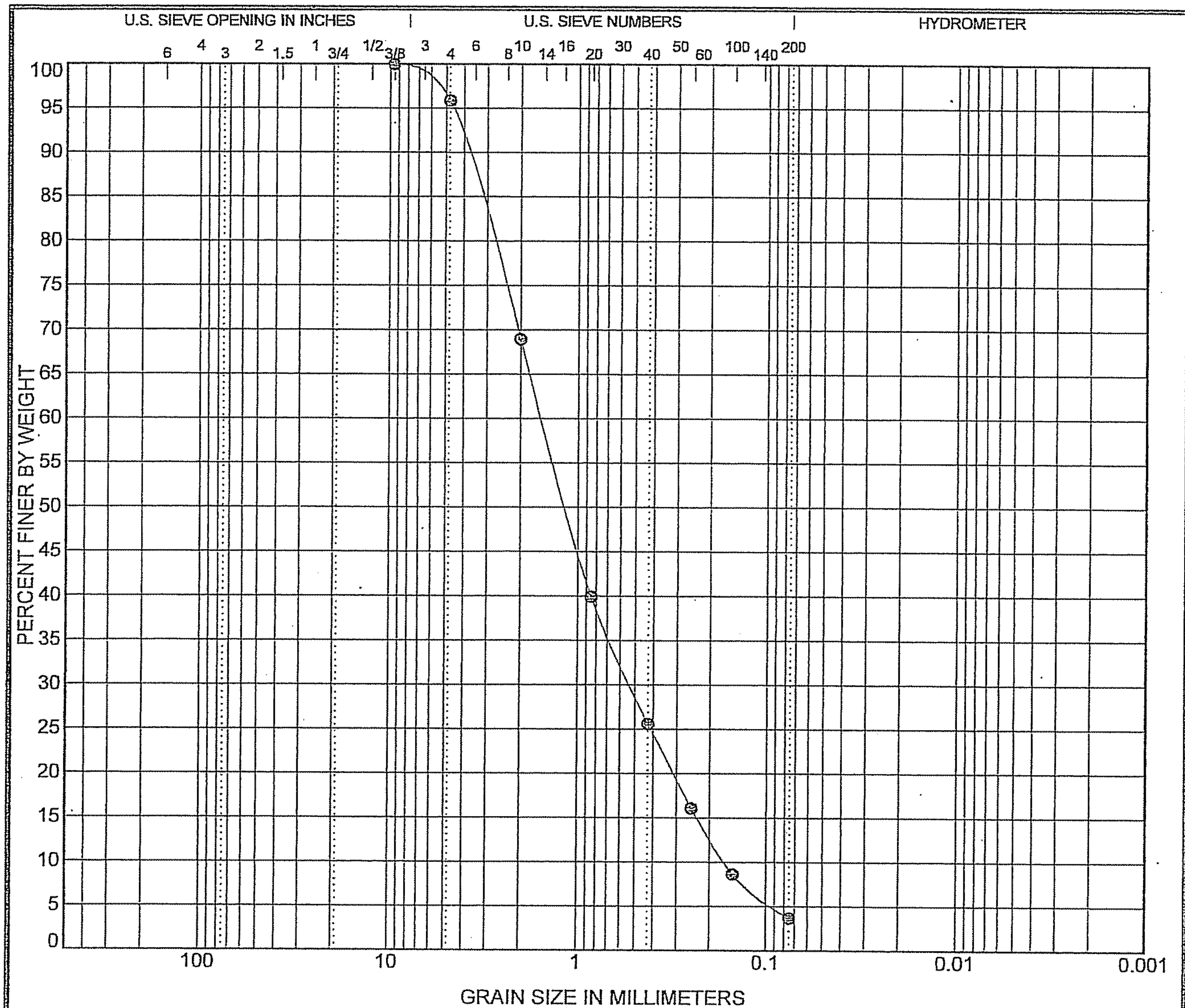
Project: ARETE HOMES

Number: 6269-A-SC

Date: June 2011

Plate: D - 1

US_ATTERBERG_LIMITS 6269.GPJ US_LAB.GDT 6/28/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth	Range	Visual Classification/USCS CLASSIFICATION	LL	PL	PI	Cc	Cu
⊜	TP- 8	4.0	4-5	WELL-GRADED SAND(SW)				1.09	9.33

	Sample	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
⊜	TP- 8	4.0	9.5	1.536	0.526	0.165	4.1	92.2	3.7	

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Carlsbad, CA 92008
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GRAIN SIZE DISTRIBUTION

Project: ARETE HOMES

Number: 6269-A-SC

Date: June 2011

Plate: D - 1

TEST SPECIMEN		A	B	C	D
Compactor air pressure	PSI	350	350	350	
Water added	%	1.8	2.1	2.3	
Moisture at compaction	%	8.5	8.8	9.0	
Height of sample	IN	2.5	2.5	2.51	
Dry density	PCF	125.9	124.8	124.7	
R-Value by exudation		79	76	74	
R-Value by exudation, corrected		79	76	74	
Exudation pressure	PSI	780	408	248	
Stability thickness	FT	0.27	0.31	0.33	
Expansion pressure thickness	FT	0.50	0.37	0.23	

DESIGN CALCULATION DATA	
Traffic index, assumed	5.0
Gravel equivalent factor, assumed	1.25
Expansion, stability equilibrium	0.32
R-Value by expansion	75
R-Value by exudation	75
R-Value at equilibrium	**75**

SAMPLE INFORMATION

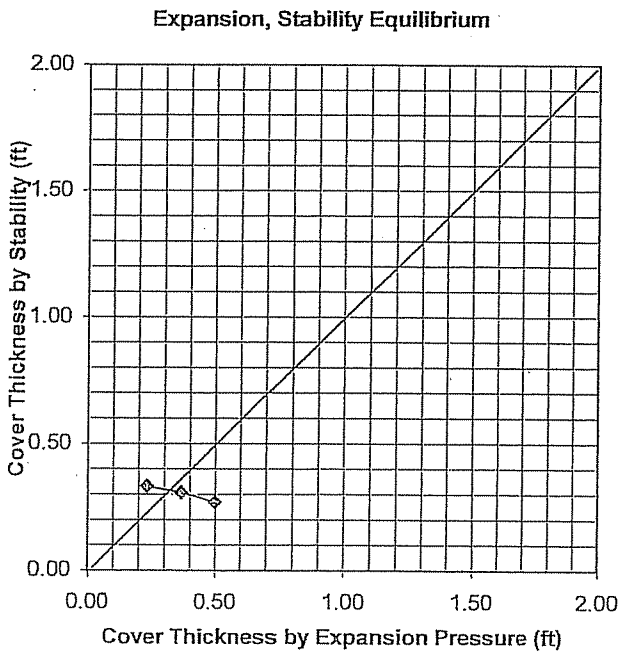
Sample Location: TP-7 @ 0-2' & TP-8 @ 4-5' Mix

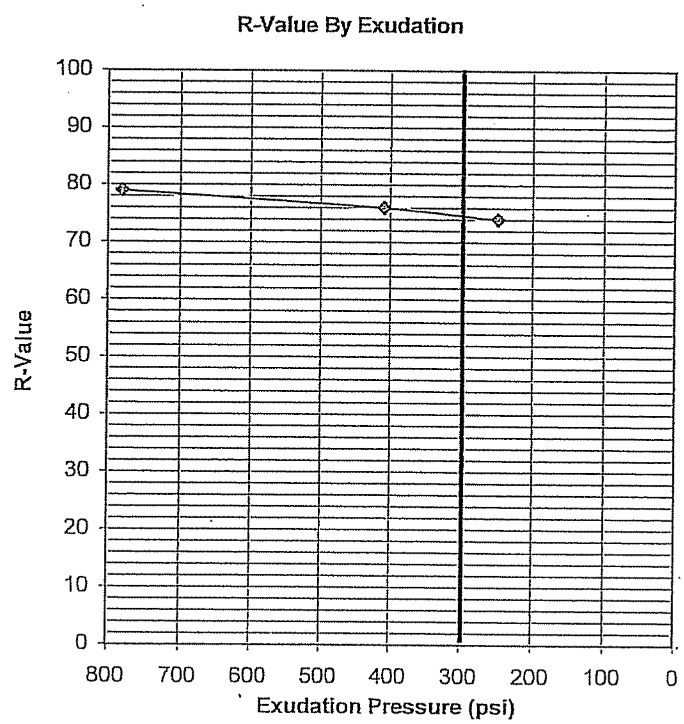
Sample Description: Brown Silty Sand

Notes:

0% Retained on 3/4 inch sieve

Test Method: Cal-Trans Test 301





GeoSoils, Inc.
5741 Palmer Way
Carlsbad, CA 92008
Telephone: (760) 438-3155
Fax: (760) 931-0915

R - VALUE TEST RESULTS

Project: ARETE HOMES

Number: 6269-A-SC

Date: Jun-11 Figure: 1

APPENDIX E

GENERAL EARTHWORK, GRADING GUIDELINES, AND PRELIMINARY CRITERIA

GENERAL EARTHWORK, GRADING GUIDELINES, AND PRELIMINARY CRITERIA

General

These guidelines present general procedures and requirements for earthwork and grading as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of subdrains, excavations, and appurtenant structures or flatwork. The recommendations contained in the geotechnical report are part of these earthwork and grading guidelines and would supercede the provisions contained hereafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new or revised recommendations which could supercede these guidelines or the recommendations contained in the geotechnical report. Generalized details follow this text.

The contractor is responsible for the satisfactory completion of all earthwork in accordance with provisions of the project plans and specifications and latest adopted code. In the case of conflict, the most onerous provisions shall prevail. The project geotechnical engineer and engineering geologist (geotechnical consultant), and/or their representatives, should provide observation and testing services, and geotechnical consultation during the duration of the project.

EARTHWORK OBSERVATIONS AND TESTING

Geotechnical Consultant

Prior to the commencement of grading, a qualified geotechnical consultant (soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for general conformance with the recommendations of the geotechnical report(s), the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that an evaluation may be made that the work is being accomplished as specified. It is the responsibility of the contractor to assist the consultants and keep them apprised of anticipated work schedules and changes, so that they may schedule their personnel accordingly.

All remedial removals, clean-outs, prepared ground to receive fill, key excavations, and subdrain installation should be observed and documented by the geotechnical consultant prior to placing any fill. It is the contractor's responsibility to notify the geotechnical consultant when such areas are ready for observation.

Laboratory and Field Tests

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D-1557. Random or representative field compaction tests should be performed in accordance with test methods ASTM designation D-1556, D-2937 or D-2922, and D-3017, at intervals of approximately ±2 feet of fill height or approximately every 1,000 cubic yards placed. These criteria would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant.

Contractor's Responsibility

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by a geotechnical consultant, and staged approval by the governing agencies, as applicable. It is the contractor's responsibility to prepare the ground surface to receive the fill, to the satisfaction of the geotechnical consultant, and to place, spread, moisture condition, mix, and compact the fill in accordance with the recommendations of the geotechnical consultant. The contractor should also remove all non-earth material considered unsatisfactory by the geotechnical consultant.

Notwithstanding the services provided by the geotechnical consultant, it is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in strict accordance with applicable grading guidelines, latest adopted codes or agency ordinances, geotechnical report(s), and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock or deleterious material, insufficient support equipment, etc., are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

During construction, the contractor shall properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor shall take remedial measures to control surface water and to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed.

SITE PREPARATION

All major vegetation, including brush, trees, thick grasses, organic debris, and other deleterious material, should be removed and disposed of off-site. These removals must be concluded prior to placing fill. In-place existing fill, soil, alluvium, colluvium, or rock materials, as evaluated by the geotechnical consultant as being unsuitable, should be removed prior to any fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the geotechnical consultant.

Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or other structures not located prior to grading, are to be removed or treated in a manner recommended by the geotechnical consultant. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground, extending to such a depth that surface processing cannot adequately improve the condition, should be overexcavated down to firm ground and approved by the geotechnical consultant before compaction and filling operations continue. Overexcavated and processed soils, which have been properly mixed and moisture conditioned, should be re-compacted to the minimum relative compaction as specified in these guidelines.

Existing ground, which is determined to be satisfactory for support of the fills, should be scarified (ripped) to a minimum depth of 6 to 8 inches, or as directed by the geotechnical consultant. After the scarified ground is brought to optimum moisture content, or greater and mixed, the materials should be compacted as specified herein. If the scarified zone is greater than 6 to 8 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to about 6 to 8 inches in compacted thickness.

Existing ground which is not satisfactory to support compacted fill should be overexcavated as required in the geotechnical report, or by the on-site geotechnical consultant. Scarification, disc harrowing, or other acceptable forms of mixing should continue until the soils are broken down and free of large lumps or clods, until the working surface is reasonably uniform and free from ruts, hollows, hummocks, mounds, or other uneven features, which would inhibit compaction as described previously.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical [h:v]), the ground should be stepped or benched. The lowest bench, which will act as a key, should be a minimum of 15 feet wide and should be at least 2 feet deep into firm material, and approved by the geotechnical consultant. In fill-over-cut slope conditions, the recommended minimum width of the lowest bench or key is also 15 feet, with the key founded on firm material, as designated by the geotechnical consultant. As a general rule, unless specifically recommended otherwise by the geotechnical consultant, the minimum width of fill keys should be equal to ½ the height of the slope.

Standard benching is generally 4 feet (minimum) vertically, exposing firm, acceptable material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed 4 feet. Pre-stripping may be considered for unsuitable materials in excess of 4 feet in thickness.

All areas to receive fill, including processed areas, removal areas, and the toes of fill benches, should be observed and approved by the geotechnical consultant prior to placement of fill. Fills may then be properly placed and compacted until design grades (elevations) are attained.

COMPACTED FILLS

Any earth materials imported or excavated on the property may be utilized in the fill provided that each material has been evaluated to be suitable by the geotechnical consultant. These materials should be free of roots, tree branches, other organic matter, or other deleterious materials. All unsuitable materials should be removed from the fill as directed by the geotechnical consultant. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated by the consultant as unsuitable and may require blending with other soils to serve as a satisfactory fill material.

Fill materials derived from benching operations should be dispersed throughout the fill area and blended with other approved material. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/bedrock contact.

Oversized materials defined as rock, or other irreducible materials, with a maximum dimension greater than 12 inches, should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the geotechnical consultant. Oversized material should be taken offsite, or placed in accordance with recommendations of the geotechnical consultant in areas designated as suitable for rock disposal. GSI anticipates that soils to be utilized as fill material for the subject project may contain some rock. Appropriately, the need for rock disposal may be necessary during grading operations on the site. From a geotechnical standpoint, the depth of any rocks, rock fills, or rock blankets, should be a sufficient distance from finish grade. This depth is generally the same as any overexcavation due to cut-fill transitions in hard rock areas, and generally facilitates the excavation of structural footings and substructures. Should deeper excavations be proposed (i.e., deepened footings, utility trenching, swimming pools, spas, etc.), the developer may consider increasing the hold-down depth of any rocky fills to be placed, as appropriate. In addition, some agencies/jurisdictions mandate a specific hold-down depth for oversize materials placed in fills. The hold-down depth, and potential to encounter oversize rock, both within fills, and occurring in cut or natural areas, would need to be disclosed to all interested/affected parties. Once approved by the governing agency, the hold-down depth for oversized rock (i.e., greater than 12 inches) in fills on this project is provided as 10 feet, unless specified differently in the text of this report. The governing agency may require that these materials need to be deeper, crushed, or reduced to less than 12 inches in maximum dimension, at their discretion.

To facilitate future trenching, rock (or oversized material), should not be placed within the hold-down depth feet from finish grade, the range of foundation excavations, future utilities, or underground construction unless specifically approved by the governing agency, the geotechnical consultant, and/or the developer's representative.

If import material is required for grading, representative samples of the materials to be utilized as compacted fill should be analyzed in the laboratory by the geotechnical consultant to evaluate it's physical properties and suitability for use onsite. Such testing should be performed three (3) days prior to importation. If any material other than that previously tested is encountered during grading, an appropriate analysis of this material should be conducted by the geotechnical consultant as soon as possible.

Approved fill material should be placed in areas prepared to receive fill in near horizontal layers, that when compacted, should not exceed about 6 to 8 inches in thickness. The geotechnical consultant may approve thick lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer should be spread evenly and blended to attain uniformity of material and moisture suitable for compaction.

Fill layers at a moisture content less than optimum should be watered and mixed, and wet fill layers should be aerated by scarification, or should be blended with drier material. Moisture conditioning, blending, and mixing of the fill layer should continue until the fill materials have a uniform moisture content at, or above, optimum moisture.

After each layer has been evenly spread, moisture conditioned, and mixed, it should be uniformly compacted to a minimum of 90 percent of the maximum density as evaluated by ASTM test designation D-1557, or as otherwise recommended by the geotechnical consultant. Compaction equipment should be adequately sized and should be specifically designed for soil compaction, or of proven reliability to efficiently achieve the specified degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture is in evidence, the particular layer or portion shall be re-worked until the required density and/or moisture content has been attained. No additional fill shall be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the geotechnical consultant.

In general, per the 1997 UBC and/or latest adopted version of the California Building Code (CBC), fill slopes should be designed and constructed at a gradient of 2:1 (h:v), or flatter. Compaction of slopes should be accomplished by over-building a minimum of 3 feet horizontally, and subsequently trimming back to the design slope configuration. Testing shall be performed as the fill is elevated to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final evaluation of fill slope compaction should be based on observation and/or testing of the finished slope face. Where compacted fill slopes are designed steeper than 2:1 (h:v), prior approval from the governing agency, specific material types, a higher minimum relative compaction, special reinforcement, and special grading procedures will be recommended.

If an alternative to over-building and cutting back the compacted fill slopes is selected, then special effort should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

1. An extra piece of equipment consisting of a heavy, short-shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the slopes, and extend out over the slope to provide adequate compaction to the face of the slope.

2. Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.

3. Field compaction tests will be made in the outer (horizontal) ±2 to ±8 feet of the slope at appropriate vertical intervals, subsequent to compaction operations.

4. After completion of the slope, the slope face should be shaped with a small tractor and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. Subsequent to testing to evaluate compaction, the slopes should be grid-rolled to achieve compaction to the slope face. Final testing should be used to evaluate compaction after grid rolling.

5. Where testing indicates less than adequate compaction, the contractor will be responsible to rip, water, mix, and recompact the slope material as necessary to achieve compaction. Additional testing should be performed to evaluate compaction.

SUBDRAIN INSTALLATION

Subdrains should be installed in approved ground in accordance with the approximate alignment and details indicated by the geotechnical consultant. Subdrain locations or materials should not be changed or modified without approval of the geotechnical consultant. The geotechnical consultant may recommend and direct changes in subdrain line, grade, and drain material in the field, pending exposed conditions. The location of constructed subdrains, especially the outlets, should be recorded/surveyed by the project civil engineer. Drainage at the subdrain outlets should be provided by the project civil engineer.

EXCAVATIONS

Excavations and cut slopes should be examined during grading by the geotechnical consultant. If directed by the geotechnical consultant, further excavations or overexcavation and refilling of cut areas should be performed, and/or remedial grading of cut slopes should be performed. When fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope should be observed by the geotechnical consultant prior to placement of materials for construction of the fill portion of the slope. The geotechnical consultant should observe all cut slopes, and should be notified by the contractor when excavation of cut slopes commence.

If, during the course of grading, unforeseen adverse or potentially adverse geologic conditions are encountered, the geotechnical consultant should investigate, evaluate, and make appropriate recommendations for mitigation of these conditions. The need for cut slope buttressing or stabilizing should be based on in-grading evaluation by the geotechnical consultant, whether anticipated or not.

Unless otherwise specified in geotechnical and geological report(s), no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractor's responsibility.

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the geotechnical consultant.

COMPLETION

Observation, testing, and consultation by the geotechnical consultant should be conducted during the grading operations in order to state an opinion that all cut and fill areas are graded in accordance with the approved project specifications. After completion of grading, and after the geotechnical consultant has finished observations of the work, final reports should be submitted, and may be subject to review by the controlling governmental agencies. No further excavation or filling should be undertaken without prior notification of the geotechnical consultant or approved plans.

All finished cut and fill slopes should be protected from erosion and/or be planted in accordance with the project specifications and/or as recommended by a landscape architect. Such protection and/or planning should be undertaken as soon as practical after completion of grading.

PRELIMINARY OUTDOOR POOL/SPA DESIGN RECOMMENDATIONS

The following preliminary recommendations are provided for consideration in pool/spa design and planning. Actual recommendations should be provided by a qualified geotechnical consultant, based on site specific geotechnical conditions, including a subsurface investigation, differential settlement potential, expansive and corrosive soil potential, proximity of the proposed pool/spa to any slopes with regard to slope creep and lateral fill extension, as well as slope setbacks per code, and geometry of the proposed improvements. Recommendations for pools/spas and/or deck flatwork underlain by expansive soils, or for areas with differential settlement greater than ¼-inch over 40 feet horizontally, will be more onerous than the preliminary recommendations presented below.

The 1:1 (h:v) influence zone of any nearby retaining wall site structures should be delineated on the project civil drawings with the pool/spa. This 1:1 (h:v) zone is defined as a plane up from the lower-most heel of the retaining structure, to the daylight grade of the nearby building pad or slope. If pools/spas or associated pool/spa improvements are constructed within this zone, they should be re-positioned (horizontally or vertically) so that they are supported by earth materials that are outside or below this 1:1 plane. If this is not possible given the area of the building pad, the owner should consider eliminating these improvements or allow for increased potential for lateral/vertical deformations and associated distress that may render these improvements unusable in the future, unless they are periodically repaired and maintained. The conditions and recommendations presented herein should be disclosed to all homeowners and any interested/affected parties.

General

1. The equivalent fluid pressure to be used for the pool/spa design should be 60 pounds per cubic foot (pcf) for pool/spa walls with level backfill, and 75 pcf for a 2:1 sloped backfill condition. In addition, backdrains should be provided behind pool/spa walls subjacent to slopes.

2. Passive earth pressure may be computed as an equivalent fluid having a density of 150 pcf, to a maximum lateral earth pressure of 1,000 pounds per square foot (psf).

3. An allowable coefficient of friction between soil and concrete of 0.30 may be used with the dead load forces.

4. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

5. Where pools/spas are planned near structures, appropriate surcharge loads need to be incorporated into design and construction by the pool/spa designer. This includes, but is not limited to landscape berms, decorative walls, footings, built-in barbeques, utility poles, etc.

6. All pool/spa walls should be designed as "free standing" and be capable of supporting the water in the pool/spa without soil support. The shape of pool/spa in cross section and plan view may affect the performance of the pool, from a geotechnical standpoint. Pools and spas should also be designed in accordance with Section 1806.5 of the 1997 UBC. Minimally, the bottoms of the pools/spas, should maintain a distance H/3, where H is the height of the slope (in feet), from the slope face. This distance should not be less than 7 feet, nor need not be greater than 40 feet.

7. The soil beneath the pool/spa bottom should be uniformly moist with the same stiffness throughout. If a fill/cut transition occurs beneath the pool/spa bottom, the cut portion should be overexcavated to a minimum depth of 48 inches, and replaced with compacted fill, such that there is a uniform blanket that is a minimum of 48 inches below the pool/spa shell. If very low expansive soil is used for fill, the fill should be placed at a minimum of 95 percent relative compaction, at optimum moisture conditions. This requirement should be 90 percent relative compaction at over optimum moisture if the pool/spa is constructed within or near expansive soils. The potential for grading and/or re-grading of the pool/spa bottom, and attendant potential for shoring and/or slot excavation, needs to be considered during all aspects of pool/spa planning, design, and construction.

8. If the pool/spa is founded entirely in compacted fill placed during rough grading, the deepest portion of the pool/spa should correspond with the thickest fill on the lot.

9. Hydrostatic pressure relief valves should be incorporated into the pool and spa designs. A pool/spa under-drain system is also recommended, with an appropriate outlet for discharge.

10. All fittings and pipe joints, particularly fittings in the side of the pool or spa, should be properly sealed to prevent water from leaking into the adjacent soils materials, and be fitted with slip or expandible joints between connections transecting varying soil conditions.

11. An elastic expansion joint (flexible waterproof sealant) should be installed to prevent water from seeping into the soil at all deck joints.

12. A reinforced grade beam should be placed around skimmer inlets to provide support and mitigate cracking around the skimmer face.

13. In order to reduce unsightly cracking, deck slabs should minimally be 4 inches thick, and reinforced with No. 3 reinforcing bars at 18 inches on-center. All slab reinforcement should be supported to ensure proper mid-slab positioning during the placement of concrete. Wire mesh reinforcing is specifically not recommended. Deck slabs should not be tied to the pool/spa structure. Pre-moistening and/or pre-soaking of the slab subgrade is recommended, to a depth of 12 inches (optimum moisture content), or 18 inches (120 percent of the soil's optimum moisture content, or 3 percent over optimum moisture content, whichever is greater), for very low to low, and medium expansive soils, respectively. This moisture content should be maintained in the subgrade soils during concrete placement to promote uniform curing of the concrete and minimize the development of unsightly shrinkage cracks. Slab underlayment should consist of a 1- to 2-inch leveling course of sand (S.E.>30) and a minimum of 4 to 6 inches of Class 2 base compacted to 90 percent. Deck slabs within the H/3 zone, where H is the height of the slope (in feet), will have an increased potential for distress relative to other areas outside of the H/3 zone. If distress is undesirable,

improvements, deck slabs or flatwork should not be constructed closer than H/3 or 7 feet (whichever is greater) from the slope face, in order to reduce, but not eliminate, this potential.

14. Pool/spa bottom or deck slabs should be founded entirely on competent bedrock, or properly compacted fill. Fill should be compacted to achieve a minimum 90 percent relative compaction, as discussed above. Prior to pouring concrete, subgrade soils below the pool/spa decking should be throughly watered to achieve a moisture content that is at least 2 percent above optimum moisture content, to a depth of at least 18 inches below the bottom of slabs. This moisture content should be maintained in the subgrade soils during concrete placement to promote uniform curing of the concrete and minimize the development of unsightly shrinkage cracks.

15. In order to reduce unsightly cracking, the outer edges of pool/spa decking to be bordered by landscaping, and the edges immediately adjacent to the pool/spa, should be underlain by an 8-inch wide concrete cutoff shoulder (thickened edge) extending to a depth of at least 12 inches below the bottoms of the slabs to mitigate excessive infiltration of water under the pool/spa deck. These thickened edges should be reinforced with two No. 4 bars, one at the top and one at the bottom. Deck slabs may be minimally reinforced with No. 3 reinforcing bars placed at 18 inches on-center, in both directions. All slab reinforcement should be supported on chairs to ensure proper mid-slab positioning during the placement of concrete.

16. Surface and shrinkage cracking of the finish slab may be reduced if a low slump and water-cement ratio are maintained during concrete placement. Concrete utilized should have a minimum compressive strength of 4,000 psi. Excessive water added to concrete prior to placement is likely to cause shrinkage cracking, and should be avoided. Some concrete shrinkage cracking, however, is unavoidable.

17. Joint and sawcut locations for the pool/spa deck should be determined by the design engineer and/or contractor. However, spacings should not exceed 6 feet on center.

18. Considering the nature of the onsite earth materials, it should be anticipated that caving or sloughing could be a factor in subsurface excavations and trenching. Shoring or excavating the trench walls/backcuts at the angle of repose (typically 25 to 45 degrees), should be anticipated. All excavations should be observed by a representative of the geotechnical consultant, including the project geologist and/or geotechnical engineer, prior to workers entering the excavation or trench, and minimally conform to Cal/OSHA ("Type C" soils may be assumed), state, and local safety codes. Should adverse conditions exist, appropriate recommendations should be offered at that time by the geotechnical consultant. GSI does not consult in the area of safety engineering and the safety of the construction crew is the responsibility of the pool/spa builder.

19. It is imperative that adequate provisions for surface drainage are incorporated by the homeowners into their overall improvement scheme. Ponding water, ground saturation and flow over slope faces, are all situations which must be avoided to enhance long term performance of the pool/spa and associated improvements, and reduce the likelihood of distress.

20. Regardless of the methods employed, once the pool/spa is filled with water, should it be emptied, there exists some potential that if emptied, significant distress may occur. Accordingly, once filled, the pool/spa should not be emptied unless evaluated by the geotechnical consultant and the pool/spa builder.

21. For pools/spas built within (all or part) of the 1997 Uniform Building Code (UBC) setback and/or geotechnical setback, as indicated in the site geotechnical documents, special foundations are recommended to mitigate the affects of creep, lateral fill extension, expansive soils and settlement on the proposed pool/spa. Most municipalities or County reviewers do not consider these effects in pool/spa plan approvals. As such, where pools/spas are proposed on 20 feet or more of fill, medium or highly expansive soils, or rock fill with limited "cap soils" and built within 1997 UBC setbacks, or within the influence of the creep zone, or lateral fill extension, the following should be considered during design and construction:

    OPTION A: Shallow foundations with or without overexcavation of the pool/spa "shell," such that the pool/spa is surrounded by 5 feet of very low to low expansive soils (without irreducible particles greater that 6 inches), and the pool/spa walls closer to the slope(s) are designed to be free standing. GSI recommends a pool/spa under-drain or blanket system (see attached Typical Pool/Spa Detail). The pool/spa builders and owner in this optional construction technique should be generally satisfied with pool/spa performance under this scenario; however, some settlement, tilting, cracking, and leakage of the pool/spa is likely over the life of the project.

    OPTION B: Pier supported pool/spa foundations with or without overexcavation of the pool/spa shell such that the pool/spa is surrounded by 5 feet of very low to low expansive soils (without irreducible particles greater than 6 inches), and the pool/spa walls closer to the slope(s) are designed to be free standing. The need for a pool/spa under-drain system may be installed for leak detection purposes. Piers that support the pool/spa should be a minimum of 12 inches in diameter and at a spacing to provide vertical and lateral support of the pool/spa, in accordance with the pool/spa designers recommendations, local code, and the 1997 UBC. The pool/spa builder and owner in this second scenario construction technique should be more satisfied with pool/spa performance. This construction will reduce settlement and creep effects on the pool/spa; however, it will not eliminate these potentials, nor make the pool/spa "leak-free."

22. The temperature of the water lines for spas and pools may affect the corrosion properties of site soils, thus, a corrosion specialist should be retained to review all spa and pool plans, and provide mitigative recommendations, as warranted. Concrete mix design should be reviewed by a qualified corrosion consultant and materials engineer.

23. All pool/spa utility trenches should be compacted to 90 percent of the laboratory standard, under the full-time observation and testing of a qualified geotechnical consultant. Utility trench bottoms should be sloped away from the primary structure on the property (typically the residence).

24. Pool and spa utility lines should not cross the primary structure's utility lines (i.e., not stacked, or sharing of trenches, etc.).

25. The pool/spa or associated utilities should not intercept, interrupt, or otherwise adversely impact any area drain, roof drain, or other drainage conveyances. If it is necessary to modify, move, or disrupt existing area drains, subdrains, or tightlines, then the design civil engineer should be consulted, and mitigative measures provided. Such measures should be further reviewed and approved by the geotechnical consultant, prior to proceeding with any further construction.

26. The geotechnical consultant should review and approve all aspects of pool/spa and flatwork design prior to construction. A design civil engineer should review all aspects of such design, including drainage and setback conditions. Prior to acceptance of the pool/spa construction, the project builder, geotechnical consultant and civil designer should evaluate the performance of the area drains and other site drainage pipes, following pool/spa construction.

27. All aspects of construction should be reviewed and approved by the geotechnical consultant, including during excavation, prior to the placement of any additional fill, prior to the placement of any reinforcement or pouring of any concrete.

28. Any changes in design or location of the pool/spa should be reviewed and approved by the geotechnical and design civil engineer prior to construction. Field adjustments should not be allowed until written approval of the proposed field changes are obtained from the geotechnical and design civil engineer.

29. Disclosure should be made to homeowners and builders, contractors, and any interested/affected parties, that pools/spas built within about 15 feet of the top of a slope, and/or H/3, where H is the height of the slope (in feet), will experience some movement or tilting. While the pool/spa shell or coping may not necessarily crack, the levelness of the pool/spa will likely tilt toward the slope, and may not be esthetically pleasing. The same is true with decking, flatwork and other improvements in this zone.

30. Failure to adhere to the above recommendations will significantly increase the potential for distress to the pool/spa, flatwork, etc.

31. Local seismicity and/or the design earthquake will cause some distress to the pool/spa and decking or flatwork, possibly including total functional and economic loss.

32. The information and recommendations discussed above should be provided to any contractors and/or subcontractors, or homeowners, interested/affected parties, etc., that may perform or may be affected by such work.

JOB SAFETY

General

At GSI, getting the job done safely is of primary concern. The following is the company's safety considerations for use by all employees on multi-employer construction sites. On-ground personnel are at highest risk of injury, and possible fatality, on grading and construction projects. GSI recognizes that construction activities will vary on each site, and that site safety is the prime responsibility of the contractor; however, everyone must be safety conscious and responsible at all times. To achieve our goal of avoiding accidents, cooperation between the client, the contractor, and GSI personnel must be maintained.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of field personnel on grading and construction projects:

Safety Meetings: GSI field personnel are directed to attend contractor's regularly scheduled and documented safety meetings.

Safety Vests: Safety vests are provided for, and are to be worn by GSI personnel, at all times, when they are working in the field.

Safety Flags: Two safety flags are provided to GSI field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

Flashing Lights: All vehicles stationary in the grading area shall use rotating or flashing amber beacons, or strobe lights, on the vehicle during all field testing. While operating a vehicle in the grading area, the emergency flasher on the vehicle shall be activated.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

Test Pits Location, Orientation, and Clearance

The technician is responsible for selecting test pit locations. A primary concern should be the technician's safety. Efforts will be made to coordinate locations with the grading contractor's authorized representative, and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractor's authorized representative (supervisor, grade checker, dump man, operator, etc.) should direct excavation of the pit and safety during the test period. Of paramount concern should be the soil technician's safety, and obtaining enough tests to represent the fill.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic, whenever possible. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates the fill be maintained in a driveable condition. Alternatively, the contractor may wish to park a piece of equipment in front of the test holes, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits. No grading equipment should enter this zone during the testing procedure. The zone should extend approximately 50 feet outward from the center of the test pit. This zone is established for safety and to avoid excessive ground vibration, which typically decreases test results.

When taking slope tests, the technician should park the vehicle directly above or below the test location. If this is not possible, a prominent flag should be placed at the top of the slope. The contractor's representative should effectively keep all equipment at a safe operational distance (e.g., 50 feet) away from the slope during this testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location, well away from the equipment traffic pattern. The contractor should inform our personnel of all changes to haul roads, cut and fill areas or other factors that may affect site access and site safety.

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is required, by company policy, to immediately withdraw and notify his/her supervisor. The grading contractor's representative will be contacted in an effort to affect a solution. However, in the interim, no further testing will be performed until the situation is rectified. Any fill placed can be considered unacceptable and subject to reprocessing, recompaction, or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to the technician's attention and notify this office. Effective communication and coordination between the contractor's representative and the soil technician is strongly encouraged in order to implement the above safety plan.

Trench and Vertical Excavation

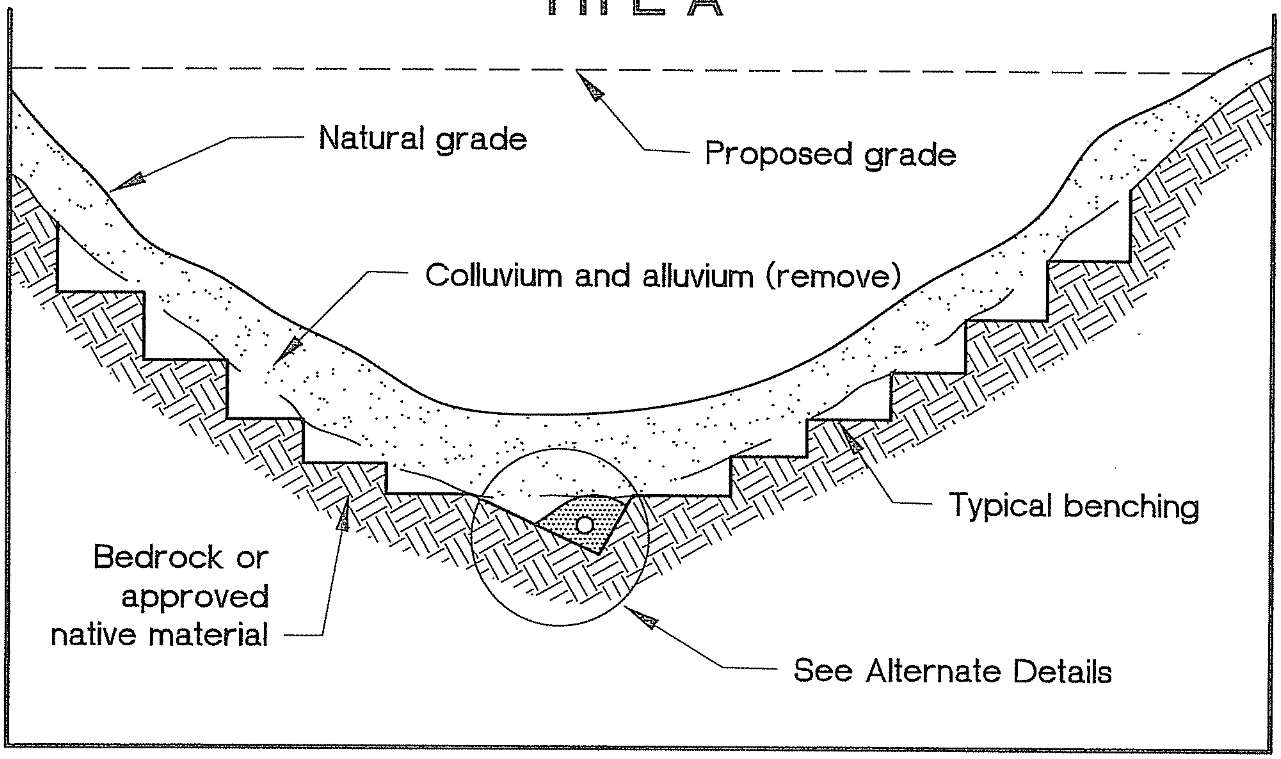
It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Our personnel are directed not to enter any excavation or vertical cut which: 1) is 5 feet or deeper unless shored or laid back; 2) displays any evidence of instability, has any loose rock or other debris which could fall into the trench; or 3) displays any other evidence of any unsafe conditions regardless of depth.

All trench excavations or vertical cuts in excess of 5 feet deep, which any person enters, should be shored or laid back. Trench access should be provided in accordance with Cal/OSHA and/or state and local standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

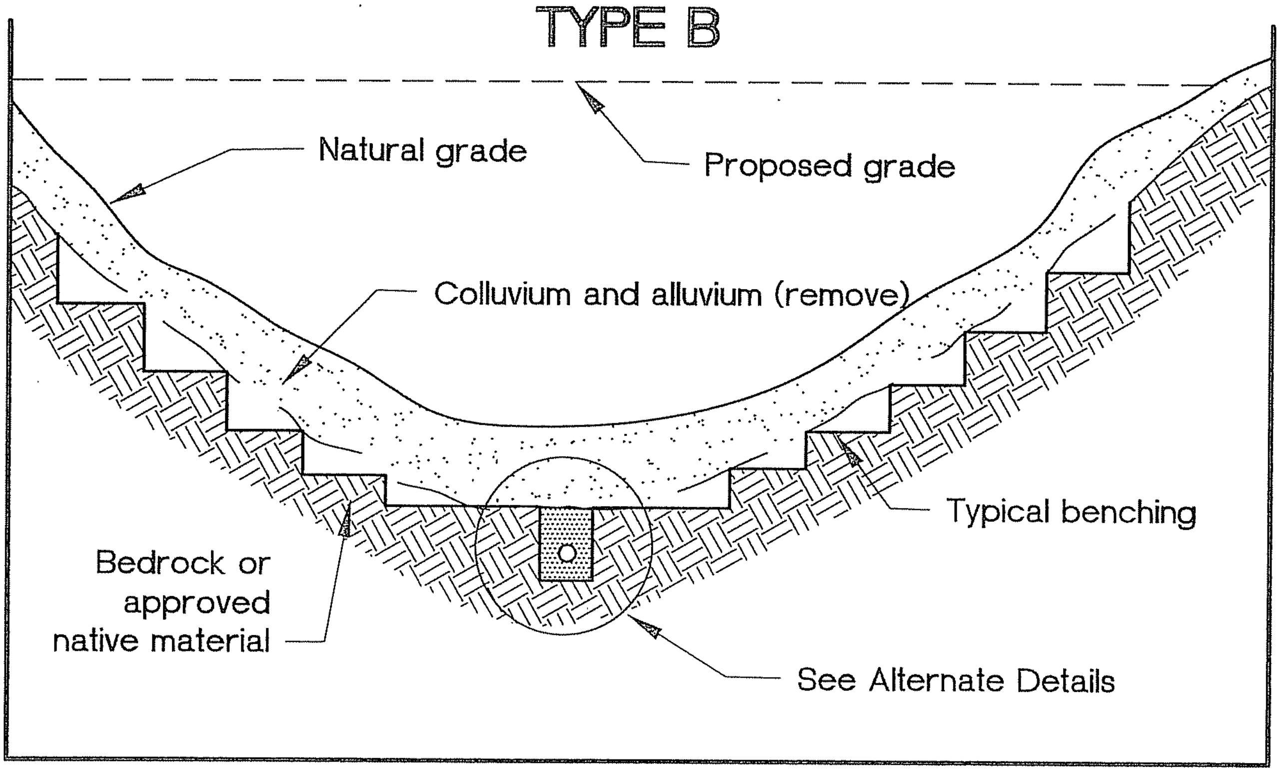
If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraw and notify his/her supervisor. The contractor's representative will be contacted in an effort to affect a solution. All backfill not tested due to safety concerns or other reasons could be subject to reprocessing and/or removal.

If GSI personnel become aware of anyone working beneath an unsafe trench wall or vertical excavation, we have a legal obligation to put the contractor and owner/developer on notice to immediately correct the situation. If corrective steps are not taken, GSI then has an obligation to notify Cal/OSHA and/or the proper controlling authorities.

TYPE A

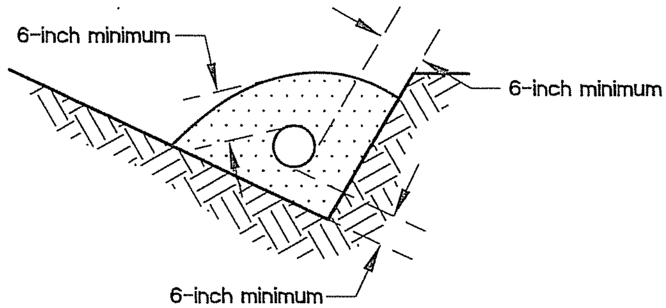


TYPE B

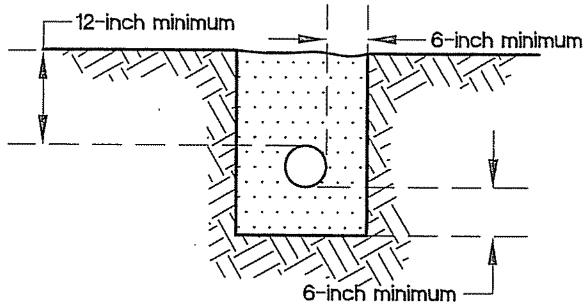


Selection of alternate subdrain details, location, and extent of subdrains should be evaluated by the geotechnical consultant during grading.

GeoSoils, Inc.	CANYON SUBDRAIN DETAIL	Plate E-1



A-1



B-1

Filter material: Minimum volume of 9 cubic feet per lineal foot of pipe.

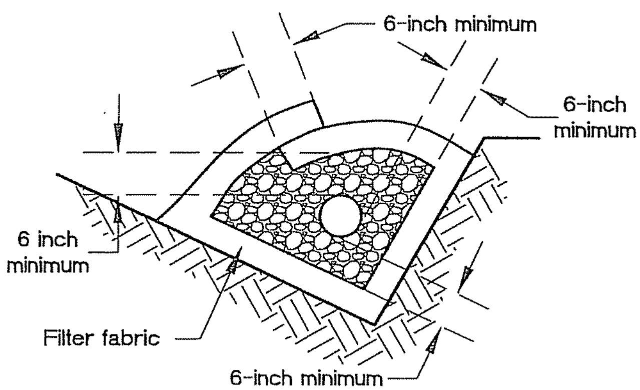
Perforated pipe: 6-inch-diameter ABS or PVC pipe or approved substitute with minimum 8 perforations (¼-inch diameter) per lineal foot in bottom half of pipe (ASTM D-2751, SDR-35, or ASTM D-1527, Schd. 40).

For continuous run in excess of 500 feet, use 8-inch-diameter pipe (ASTM D-3034, SDR-35, or ASTM D-1785, Schd. 40).

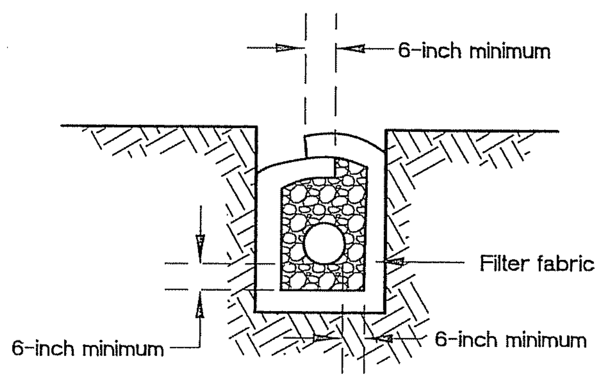
FILTER MATERIAL

Sieve Size	Percent Passing
1 inch	100
¾ inch	90-100
⅜ inch	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

ALTERNATE 1: PERFORATED PIPE AND FILTER MATERIAL



A-2

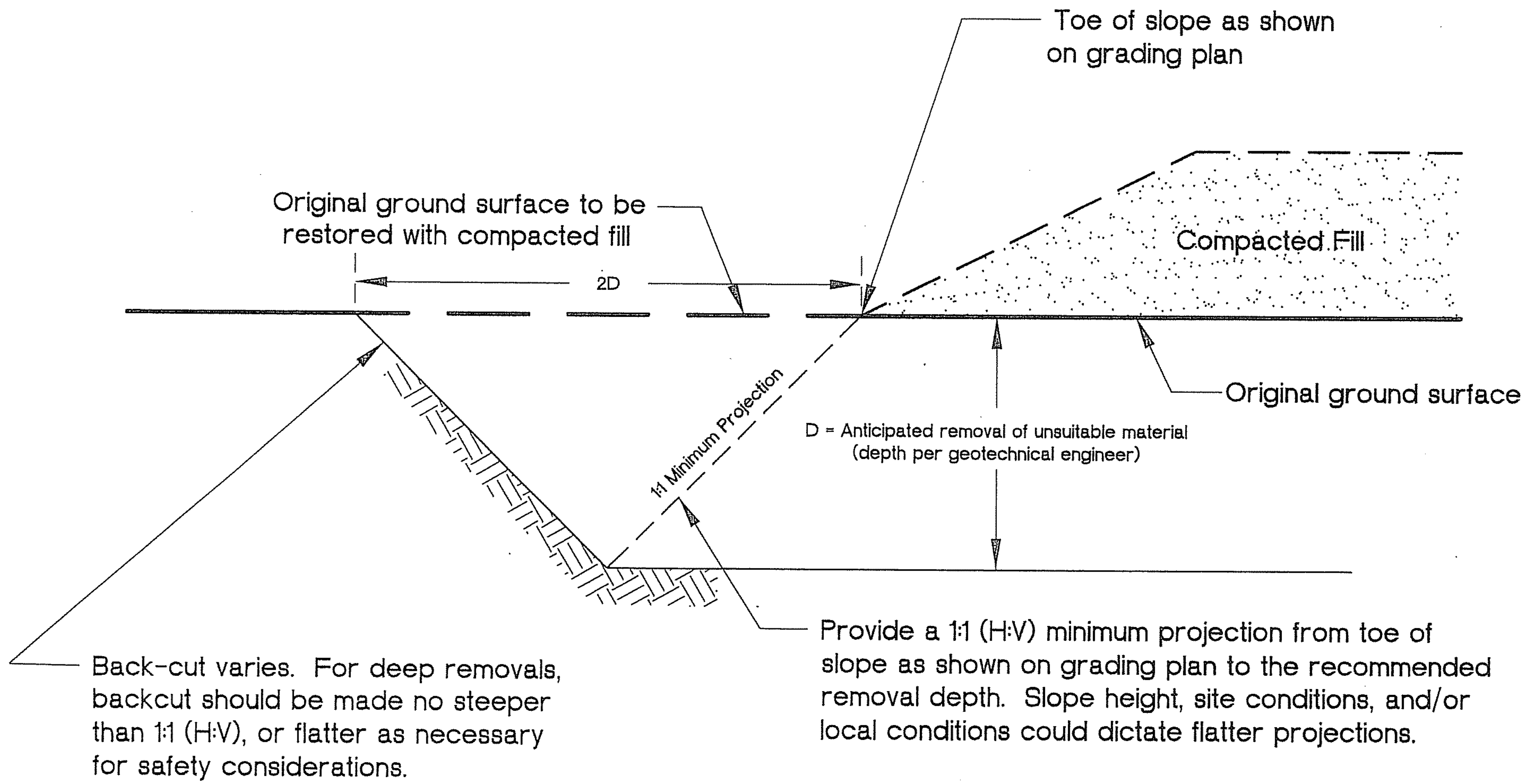


B-2

Gravel Material: 9 cubic feet per lineal foot.
Perforated Pipe: See Alternate 1
Gravel: Clean ¾-inch rock or approved substitute.
Filter Fabric: Mirafi 140 or approved substitute.

ALTERNATE 2: PERFORATED PIPE, GRAVEL, AND FILTER FABRIC

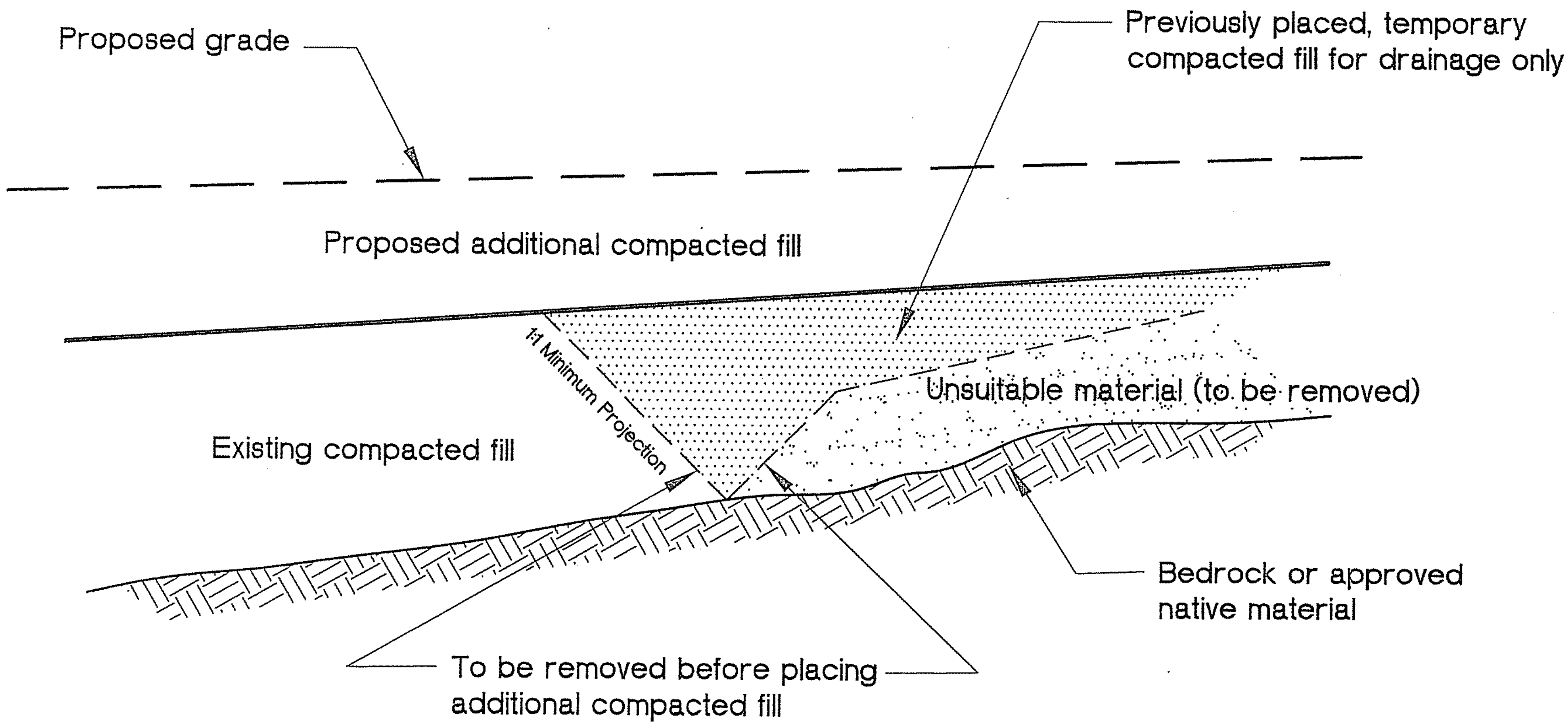
GeoSoils, Inc.	CANYON SUBDRAIN ALTERNATE DETAILS	Plate E-2



GeoSoils, Inc.

FILL SLOPE TOEING OUT ON FLAT ALLUVIATED CANYON DETAIL

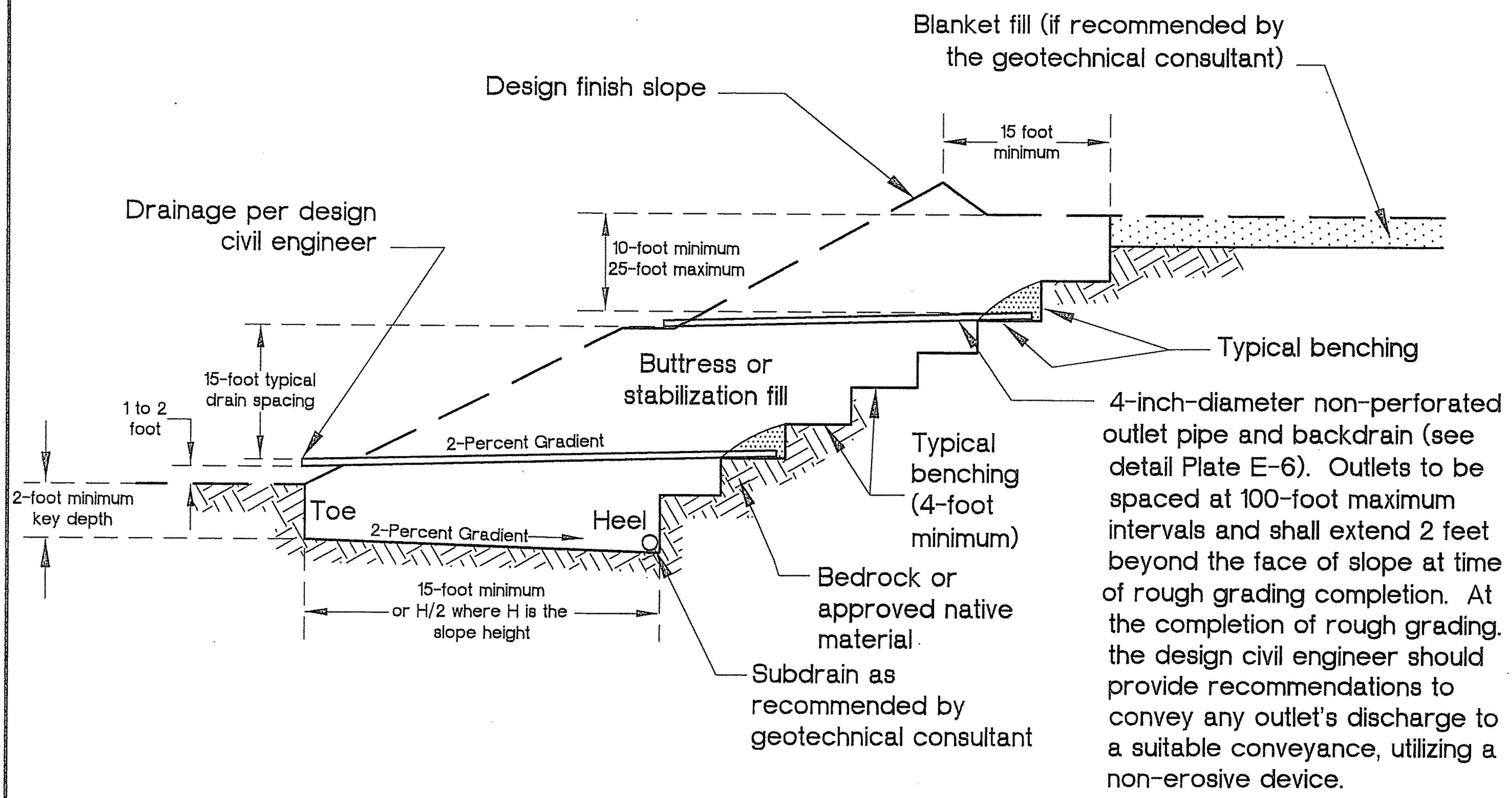
Plate E-3



GeoSoils, Inc.

REMOVAL ADJACENT TO EXISTING FILL ADJOINING CANYON FILL DETAIL

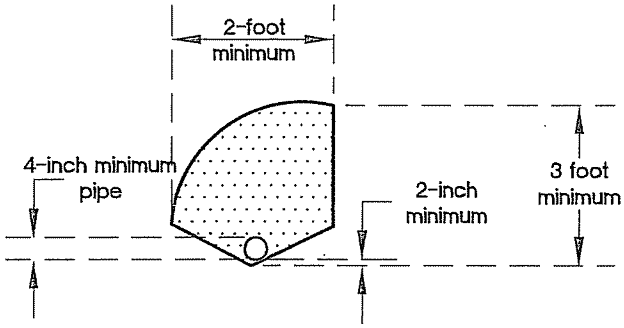
Plate E–4

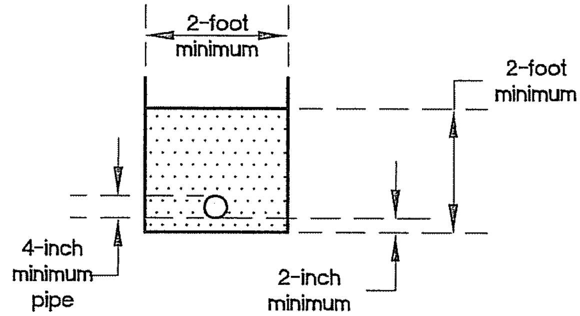


GeoSoils, Inc.

TYPICAL STABILIZATION / BUTTRESS FILL DETAIL

Plate E-5





Filter Material: Minimum of 5 cubic feet per lineal foot of pipe or 4 cubic feet per lineal feet of pipe when placed in square cut trench.

Alternative in Lieu of Filter Material: Gravel may be encased in approved filter fabric. Filter fabric shall be Mirafi 140 or equivalent. Filter fabric shall be lapped a minimum of 12 inches in all joints.

Minimum 4-Inch-Diameter Pipe: ABS-ASTM D-2751, SDR 35; or ASTM D-1527 Schedule 40, PVC-ASTM D-3034, SDR 35; or ASTM D-1785 Schedule 40 with a crushing strength of 1,000 pounds minimum, and a minimum of 8 uniformly-spaced perforations per foot of pipe. Must be installed with perforations down at bottom of pipe. Provide cap at upstream end of pipe. Slope at 2 percent to outlet pipe. Outlet pipe to be connected to subdrain pipe with tee or elbow.

Notes: 1. Trench for outlet pipes to be backfilled and compacted with onsite soil.

2. Backdrains and lateral drains shall be located at elevation of every bench drain. First drain located at elevation just above lower lot grade. Additional drains may be required at the discretion of the geotechnical consultant.

Filter Material shall be of the following specification or an approved equivalent.

Sieve Size	Percent Passing
1 inch	100
¾ inch	90-100
⅜ inch	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

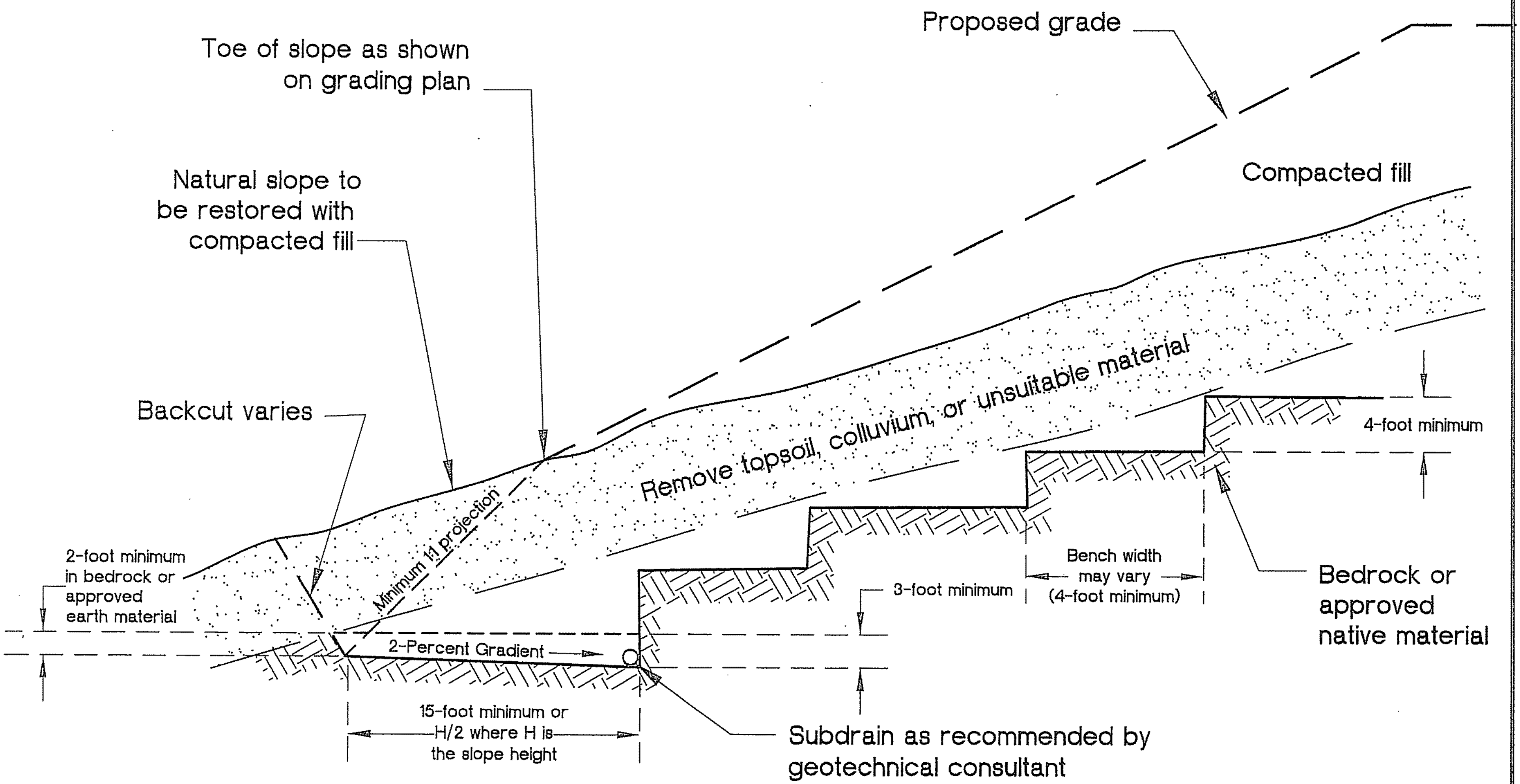
Gravel shall be of the following specification or an approved equivalent.

Sieve Size	Percent Passing
1½ inch	100
No. 4	50
No. 200	8

GeoSoils, Inc.

TYPICAL BUTTRESS SUBDRAIN DETAIL

Plate E-6

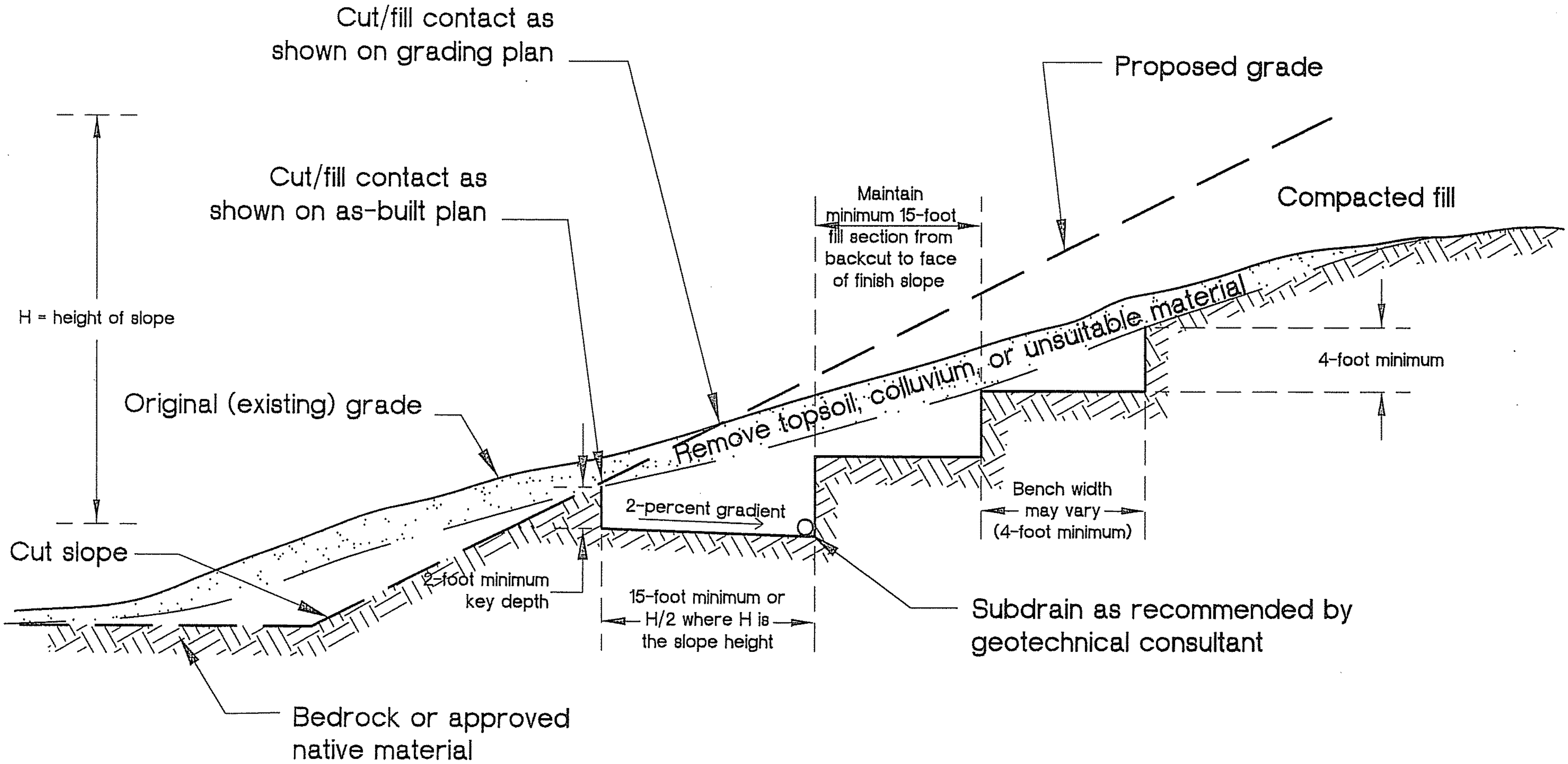


NOTES:

1. Where the natural slope approaches or exceeds the design slope ratio, special recommendations would be provided by the geotechnical consultant.

2. The need for and disposition of drains should be evaluated by the geotechnical consultant, based upon exposed conditions.

GeoSoils, Inc.	FILL OVER NATURAL (SIDEHILL FILL) DETAIL	Plate E-7

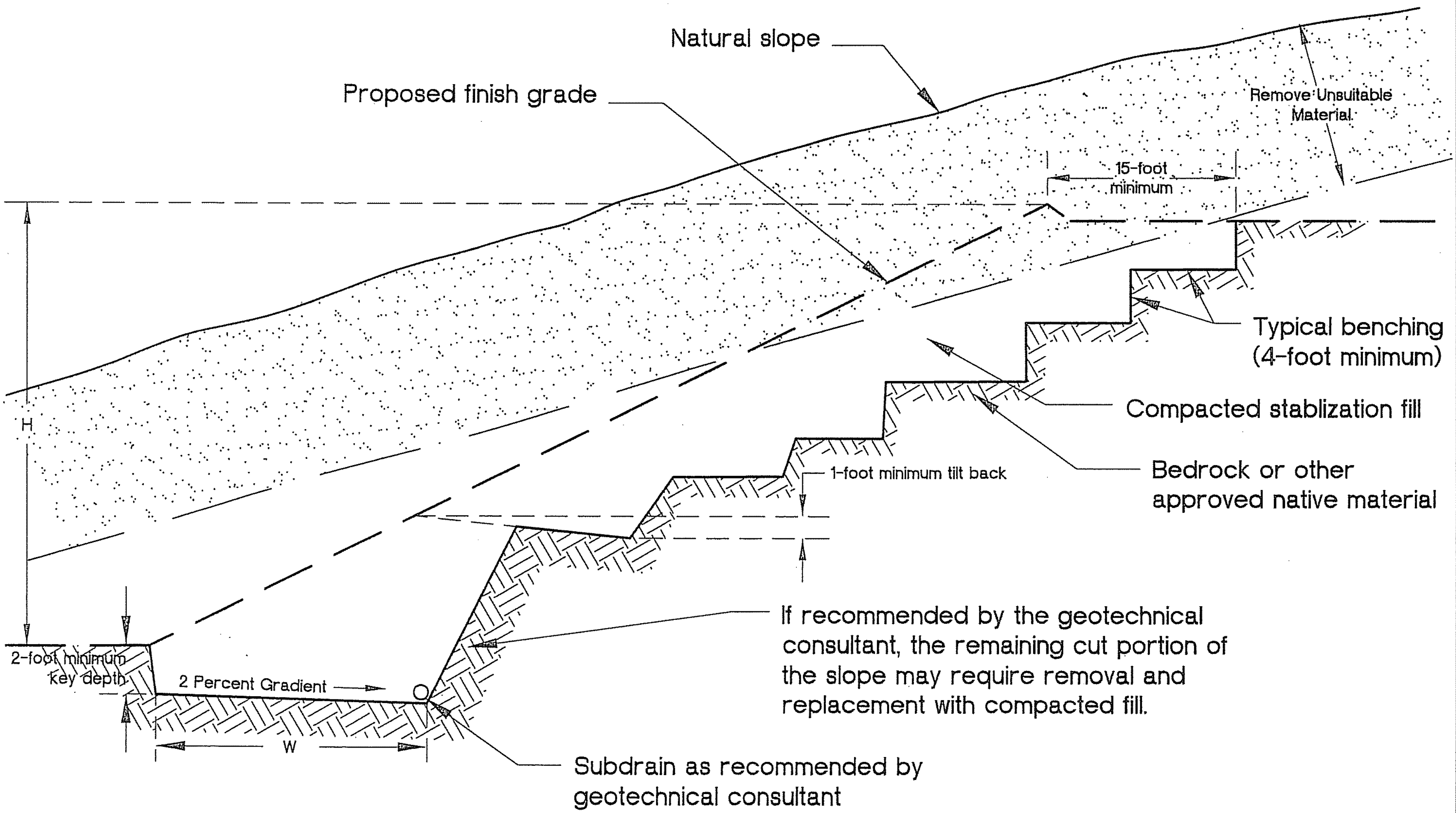


NOTE: The cut portion of the slope should be excavated and evaluated by the geotechnical consultant prior to construction of the fill portion.

GeoSoils, Inc.

FILL OVER CUT DETAIL

Plate E-8

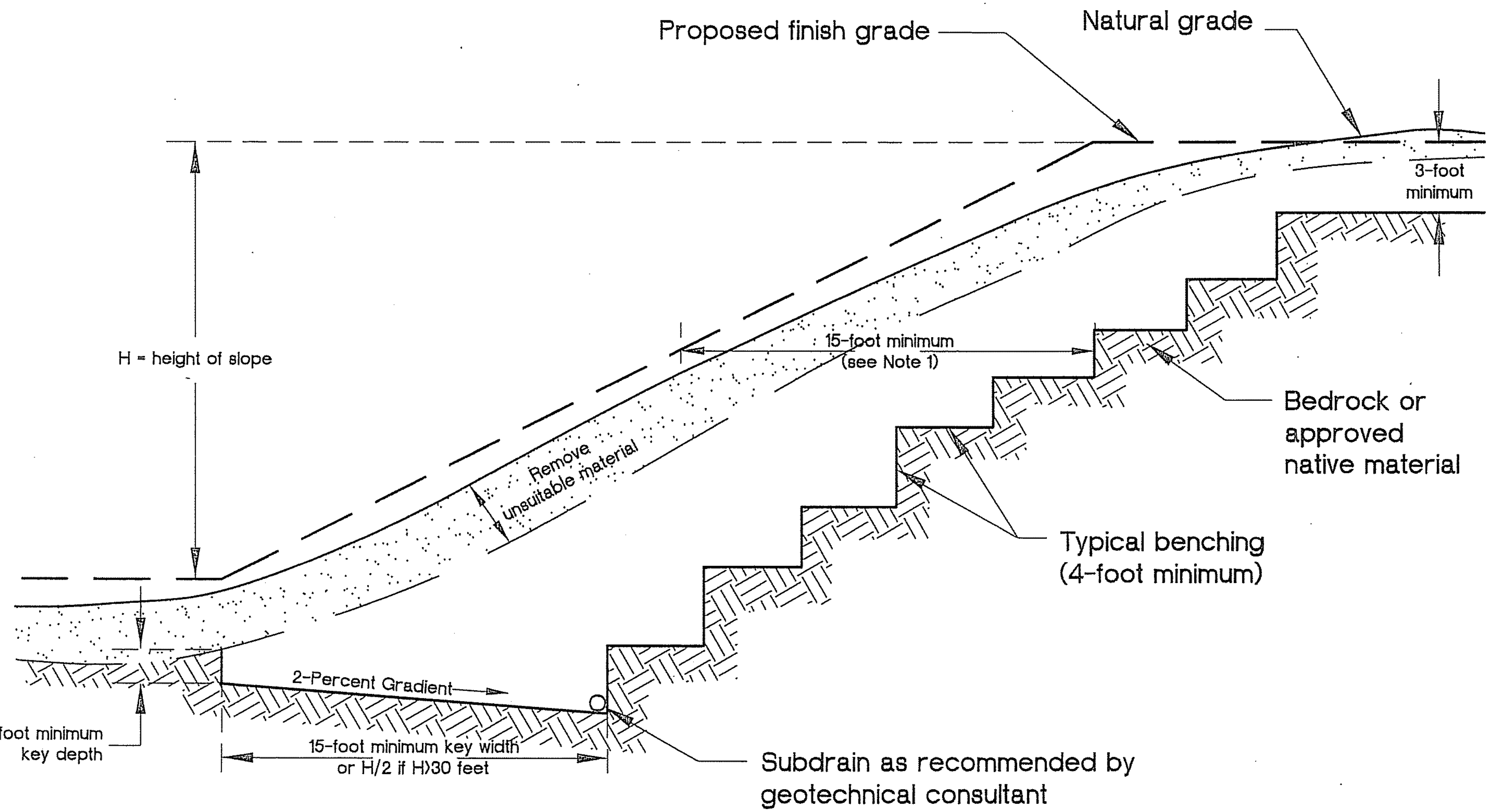


NOTES:

1. Subdrains may be required as specified by the geotechnical consultant.

2 W shall be equipment width (15 feet) for slope heights less than 25 feet. For slopes greater than 25 feet, W shall be evaluated by the geotechnical consultant. At no time, shall W be less than H/2, where H is the height of the slope.

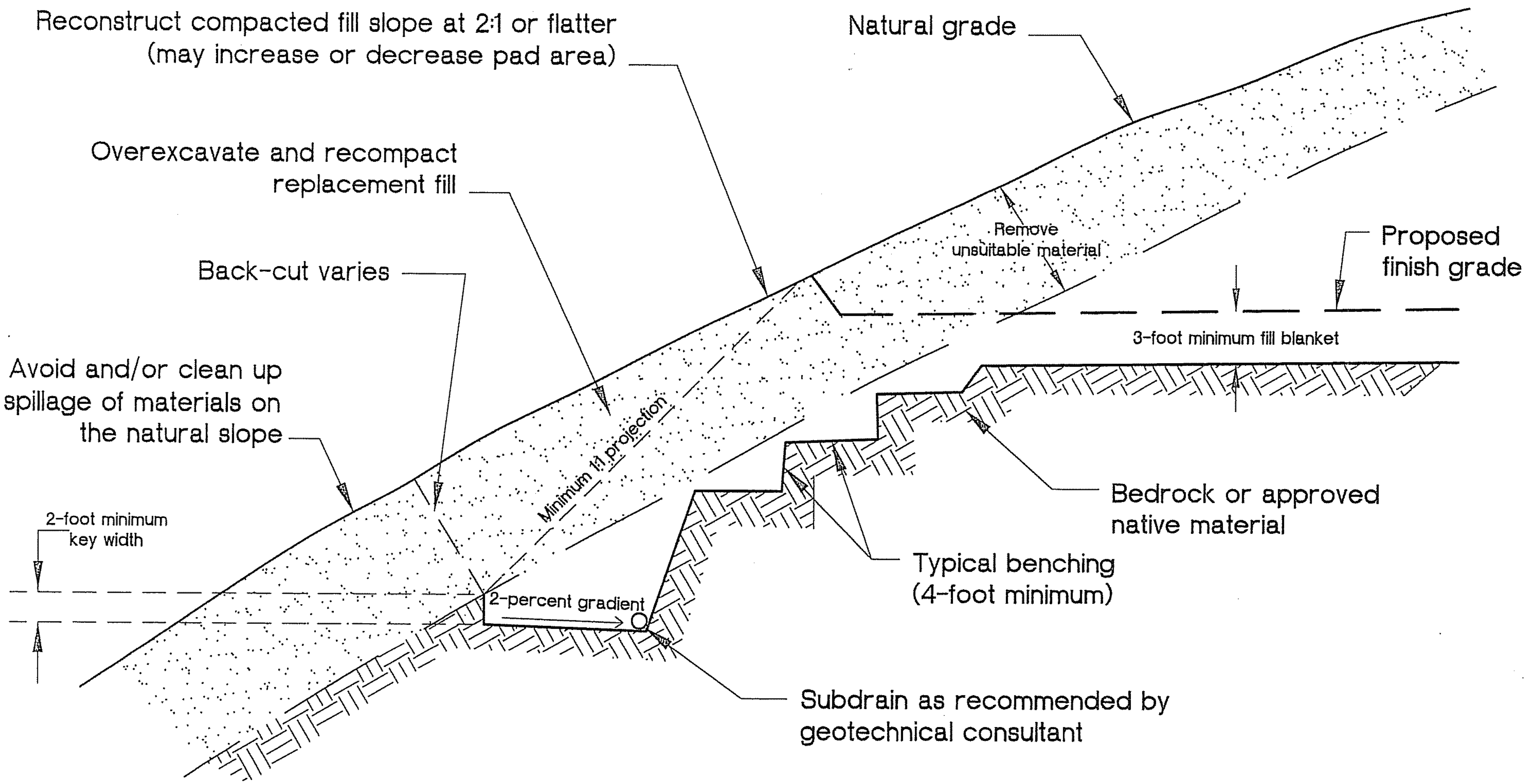
GeoSoils, Inc.	STABLIZATION FILL FOR UNSTABLE MATERIAL EXPOSED IN CUT SLOPE DETAIL	Plate E-9



NOTES:

1. 15-foot minimum to be maintained from proposed finish slope face to backcut.
2. The need and disposition of drains will be evaluated by the geotechnical consultant based on field conditions.
3. Pad overexcavation and recompaction should be performed if evaluated to be necessary by the geotechnical consultant.

GeoSoils, Inc.	SKIN FILL OF NATURAL GROUND DETAIL	Plate E-10



NOTES:

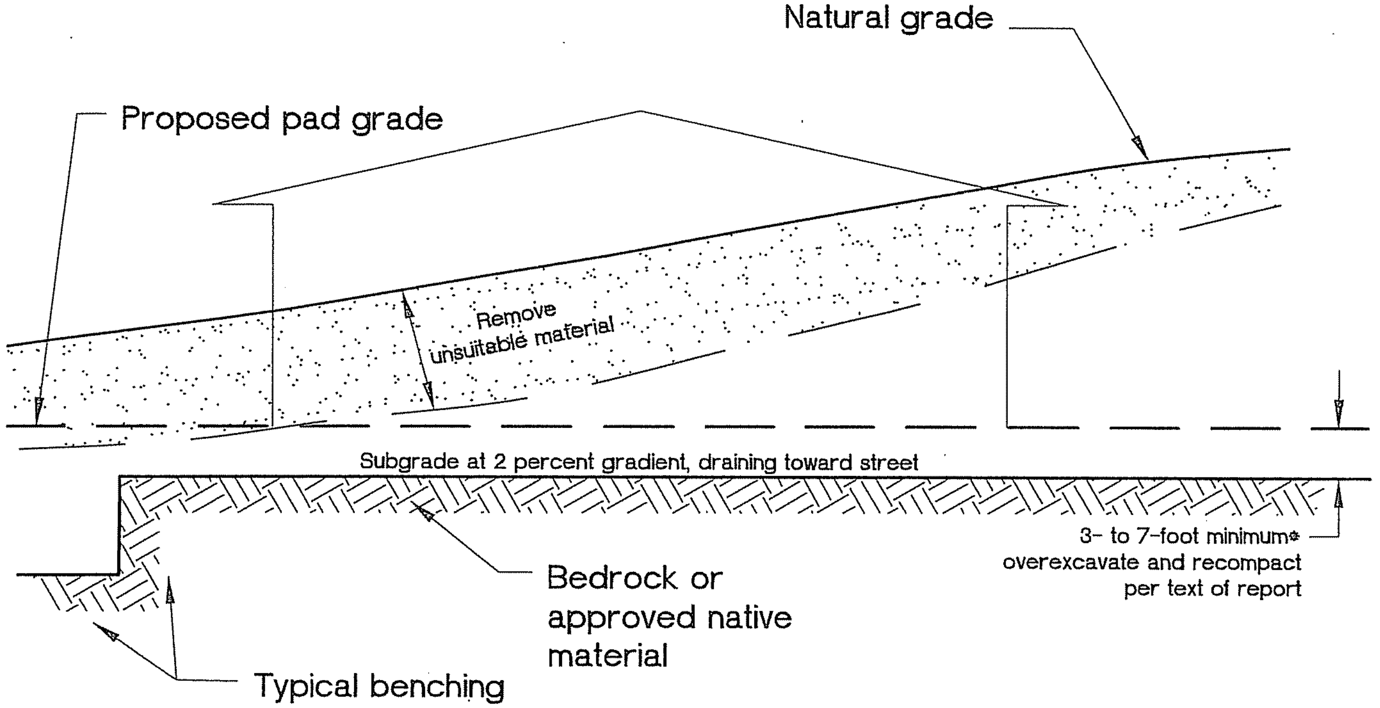
1. Subdrain and key width requirements will be evaluated based on exposed subsurface conditions and thickness of overburden.

2. Pad overexcavation and recompaction should be performed if evaluated necessary by the geotechnical consultant.

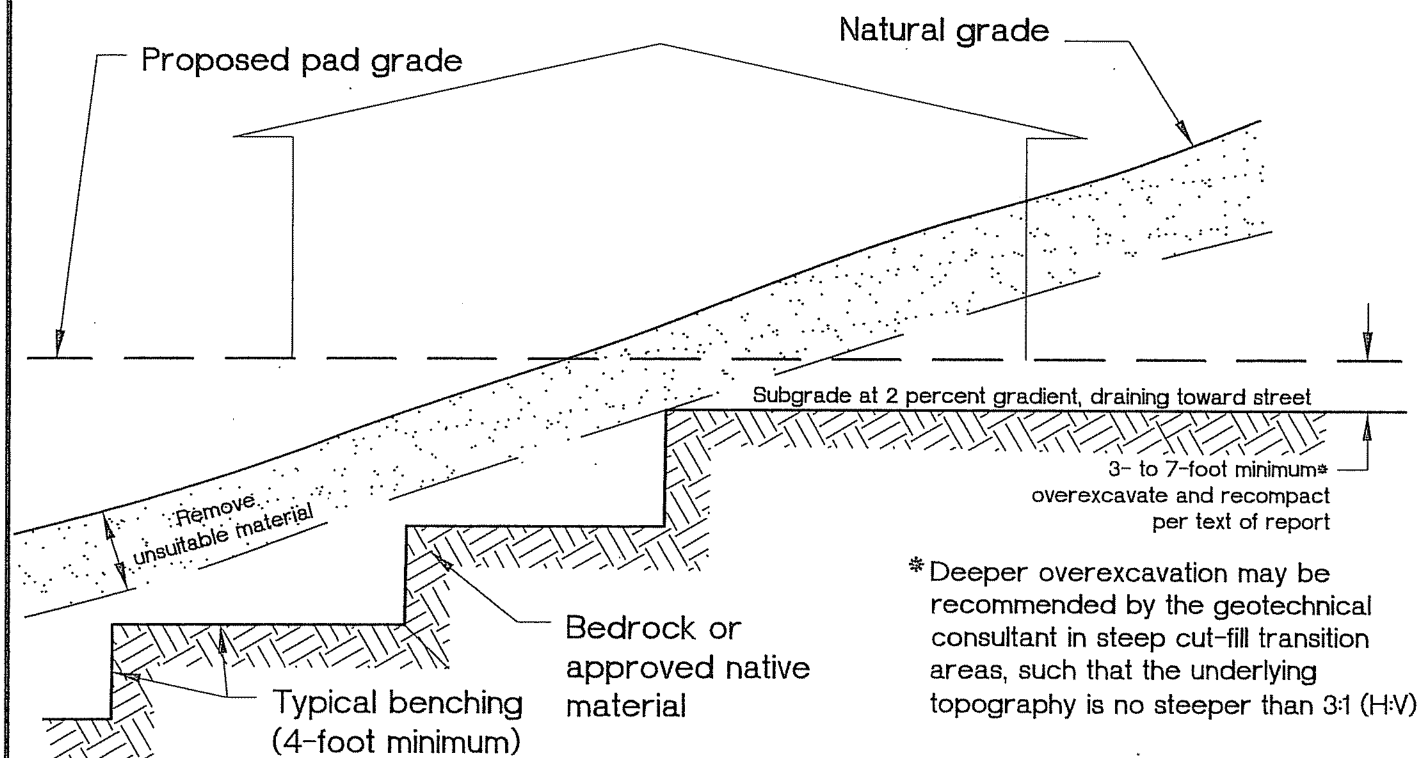
GeoSoils, Inc.

DAYLIGHT CUT LOT DETAIL

Plate E-11



CUT LOT OR MATERIAL-TYPE TRANSITION

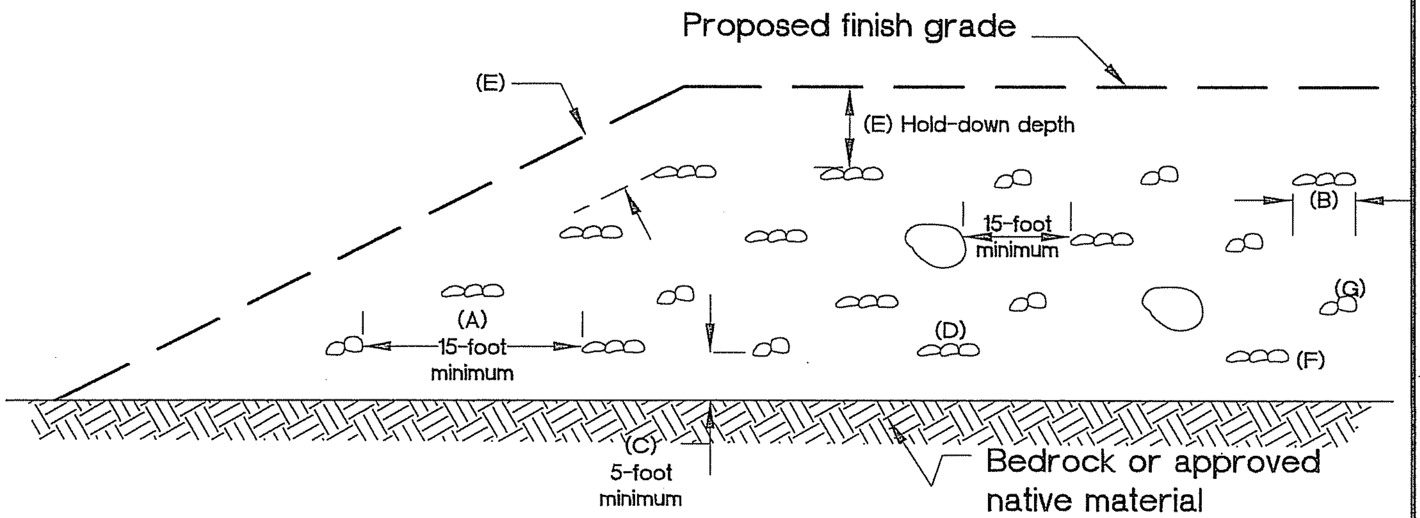


*Deeper overexcavation may be recommended by the geotechnical consultant in steep cut-fill transition areas, such that the underlying topography is no steeper than 3:1 (H:V)

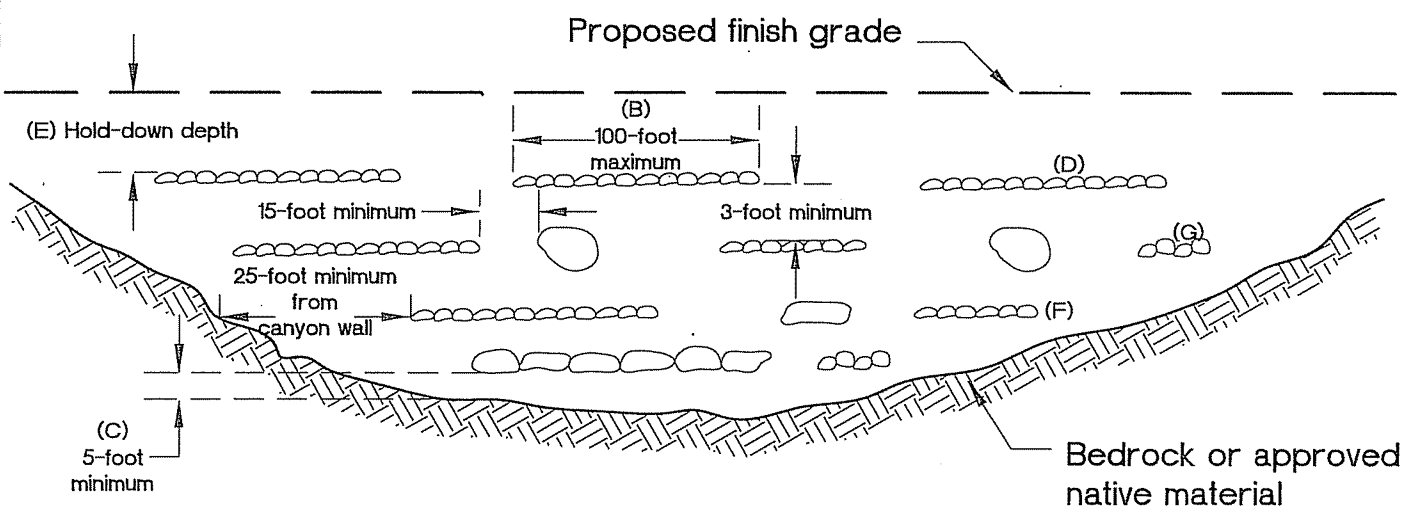
CUT-FILL LOT (DAYLIGHT TRANSITION)

GeoSoils, Inc.	TRANSITION LOT DETAILS	Plate E-12

VIEW NORMAL TO SLOPE FACE



VIEW PARALLEL TO SLOPE FACE



NOTES:

A. One equipment width or a minimum of 15 feet between rows (or windrows).

B. Height and width may vary depending on rock size and type of equipment. Length of windrow shall be no greater than 100 feet.

C. If approved by the geotechnical consultant, windrows may be placed direclty on competent material or bedrock, provided adequate space is available for compaction.

D. Orientation of windrows may vary but should be as recommended by the geotechnical engineer and/or engineering geologist. Staggering of windrows is not necessary unless recommended.

E. Clear area for utility trenches, foundations, and swimming pools; Hold-down depth as specified in text of report, subject to governing agency approval.

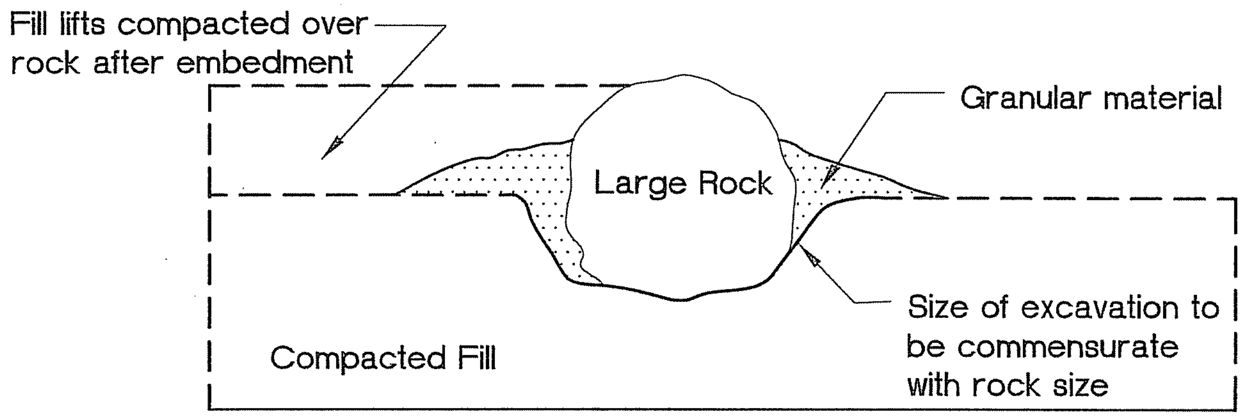
F. All fill over and around rock windrow shall be compacted to at least 90 percent relative compaction or as recommended.

G. After fill between windrows is placed and compacted, with the lift of fill covering windrow, windrow should be proof rolled with a D-9 dozer or equivalent.

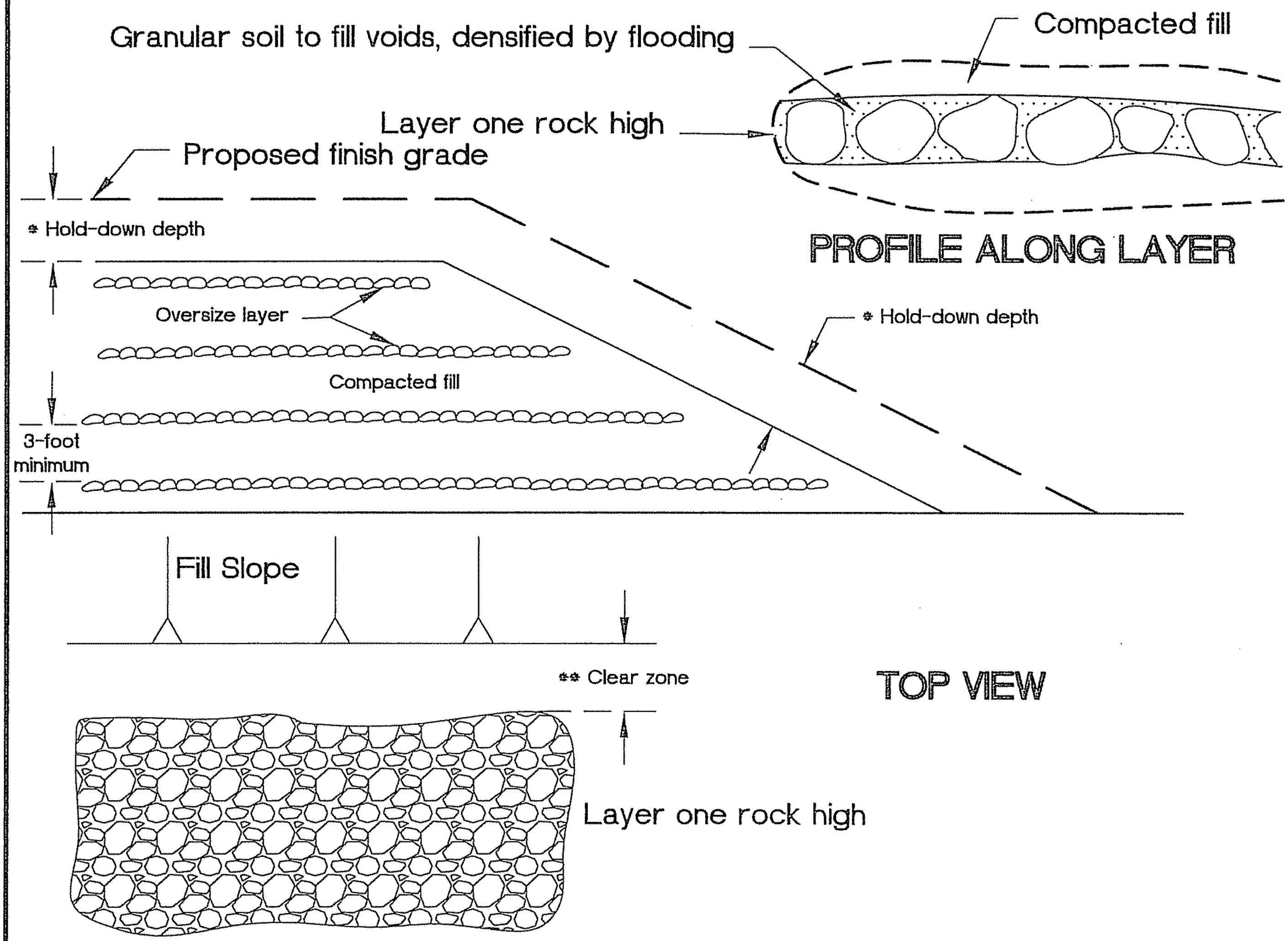
VIEWS ARE DIAGRAMMATIC ONLY AND MAY BE SUPERSEDED BY REPORT RECOMMENDATIONS OR CODE
ROCK SHOULD NOT TOUCH AND VOIDS SHOULD BE COMPLETELY FILLED

GeoSoils, Inc.	OVERSIZE ROCK DISPOSAL DETAIL	Plate E-13

ROCK DISPOSAL PITS



ROCK DISPOSAL LAYERS



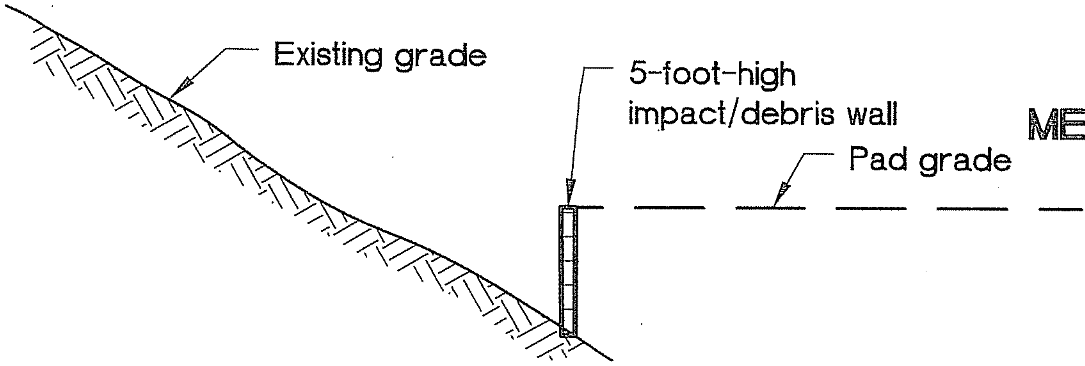
* Hold-down depth or below lowest utility as specified in text of report, subject to governing agency approval.

** Clear zone for utility trenches, foundations, and swimming pools, as specified in text of report.

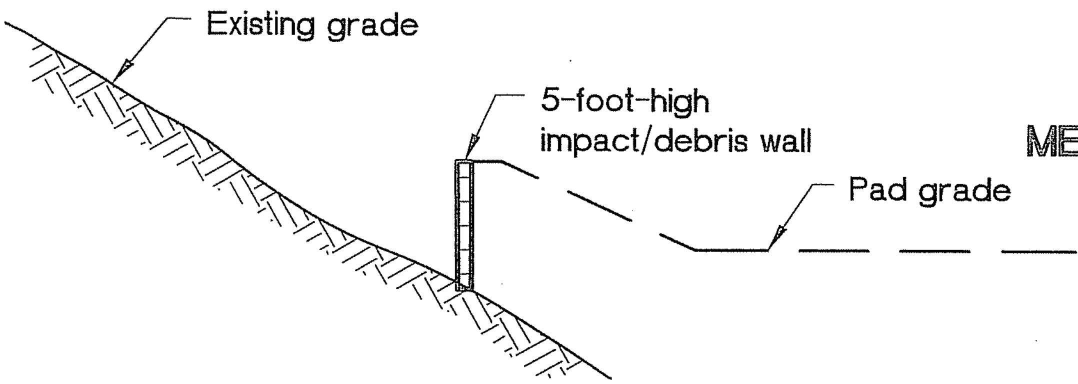
VIEWS ARE DIAGRAMMATIC ONLY AND MAY BE SUPERSEDED BY REPORT RECOMMENDATIONS OR CODE

ROCK SHOULD NOT TOUCH AND VOIDS SHOULD BE COMPLETELY FILLED IN

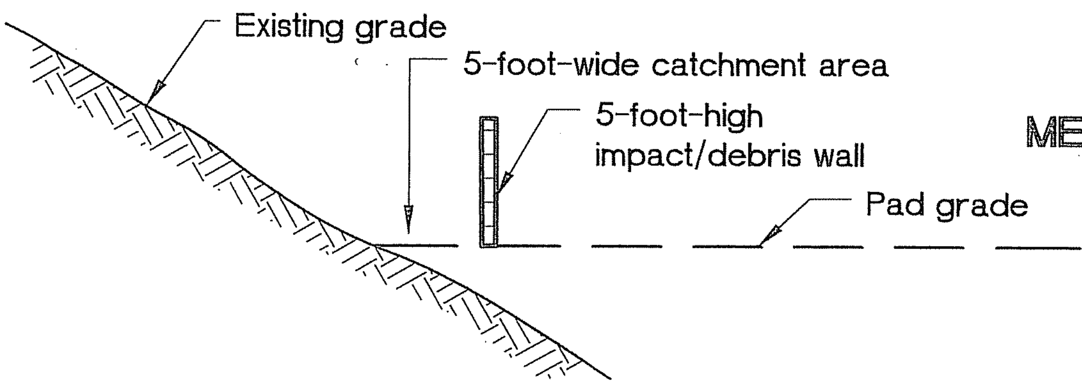
GeoSoils, Inc.	ROCK DISPOSAL DETAIL	Plate E-14



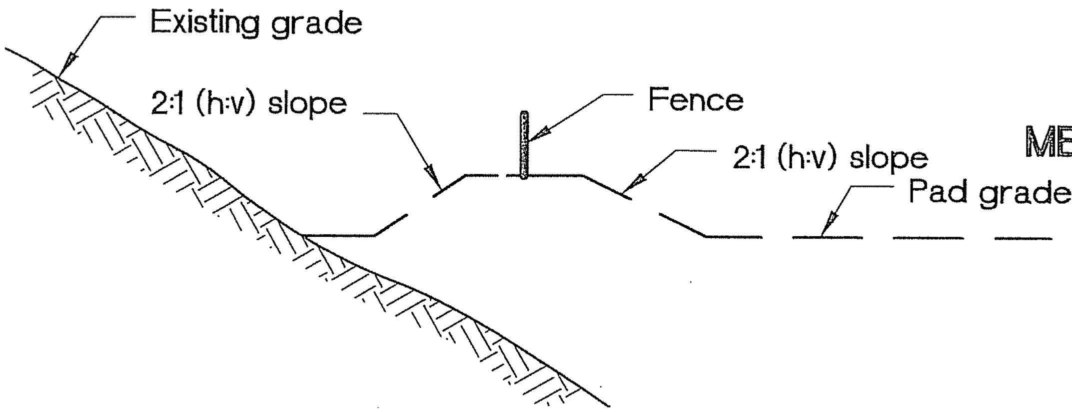
METHOD 1



METHOD 2



METHOD 3



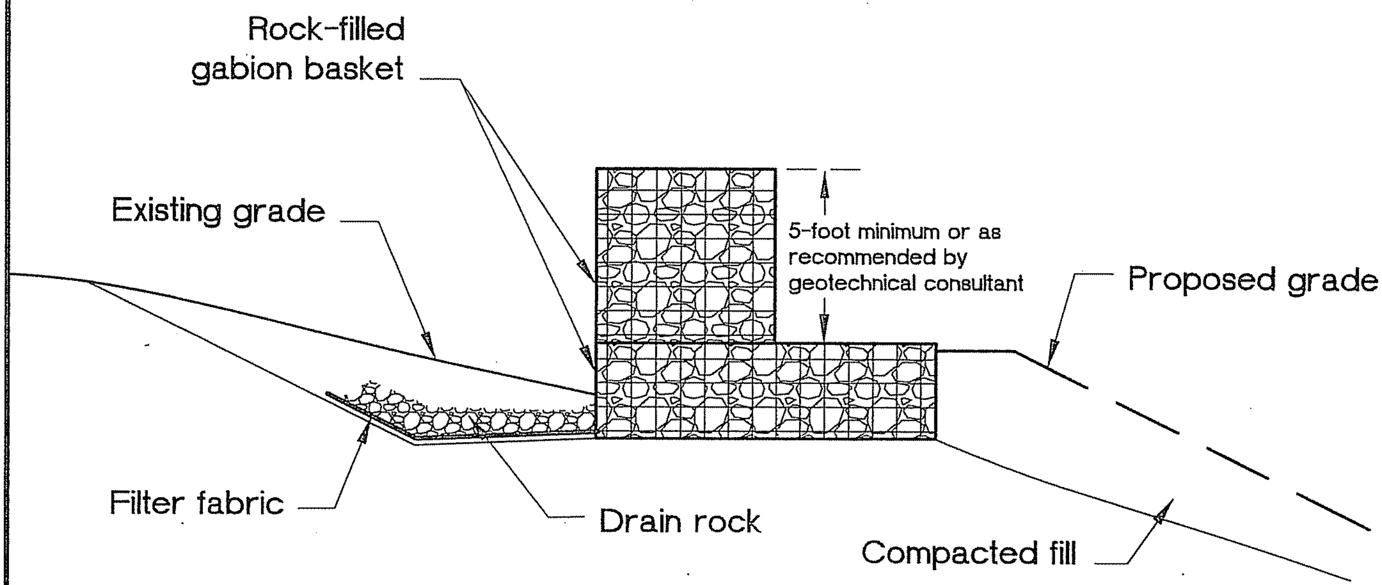
METHOD 4

NOT TO SCALE

GeoSoils, Inc.

DEBRIS DEVICE CONTROL METHODS DETAIL

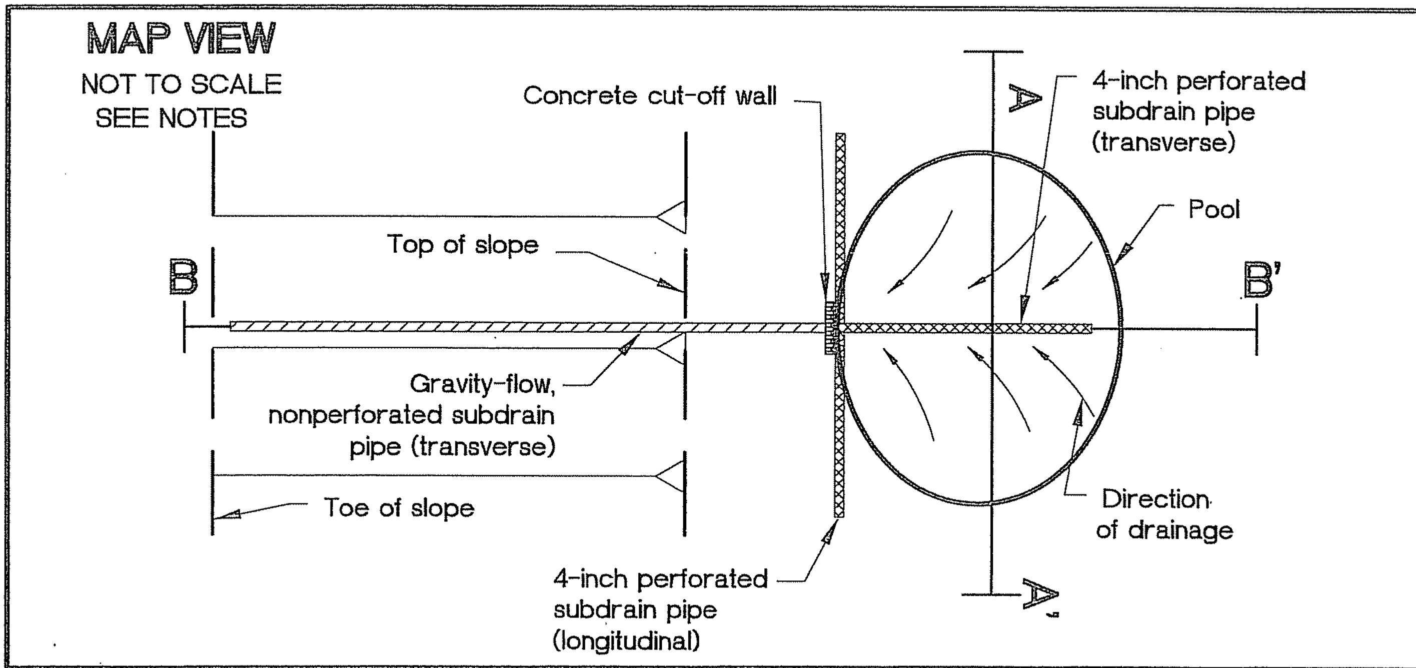
Plate E-15

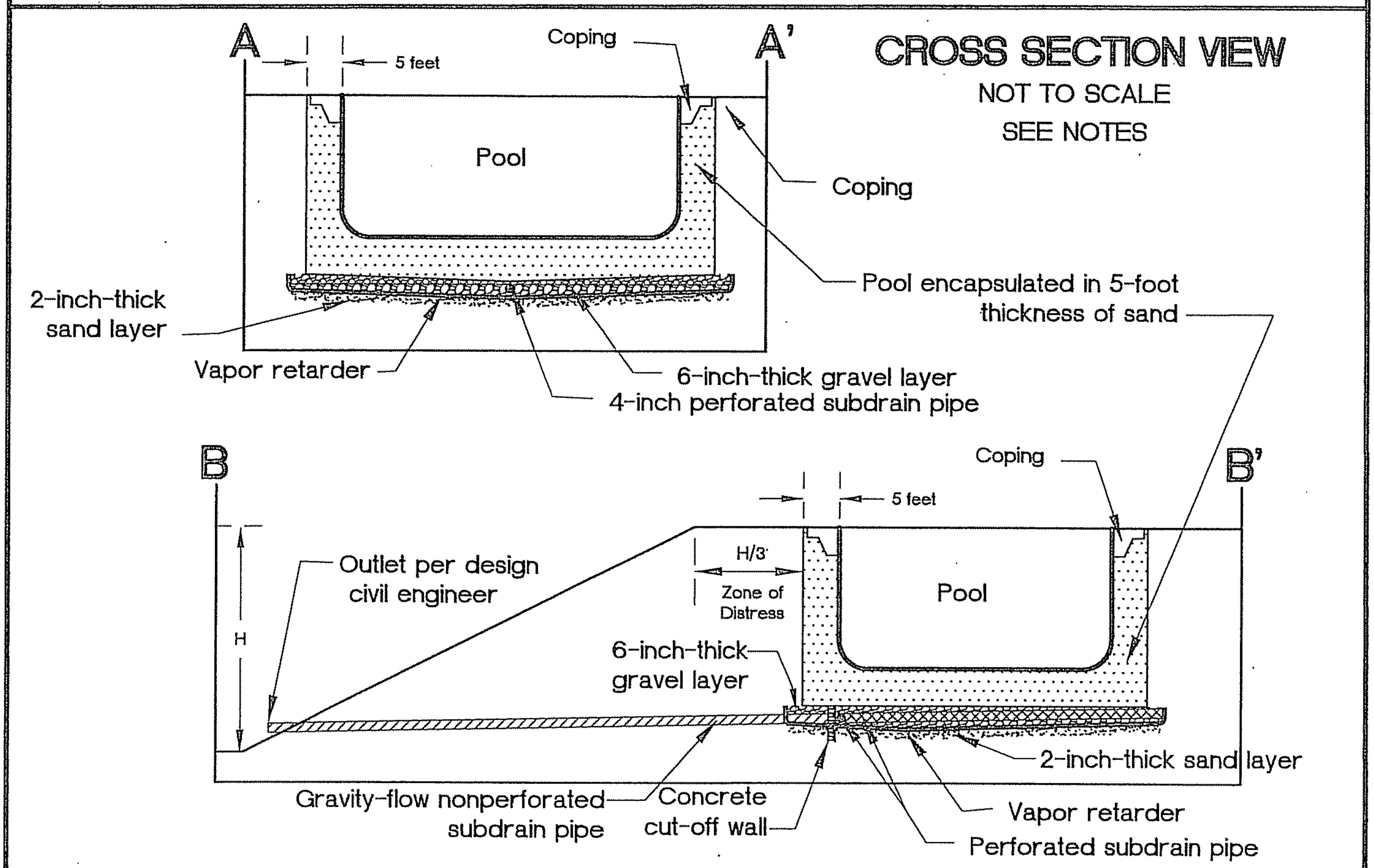


Gabion impact or diversion wall should be constructed at the base of the ascending slope subject to rock fall. Walls need to be constructed with high segments that sustain impact and mitigate potential for overtopping, and low segment that provides channelization of sediments and debris to desired depositional area for subsequent clean-out. Additional subdrain may be recommended by geotechnical consultant.

From GSA, 1987

GeoSoils, Inc.	ROCK FALL MITIGATION DETAIL	Plate E-16

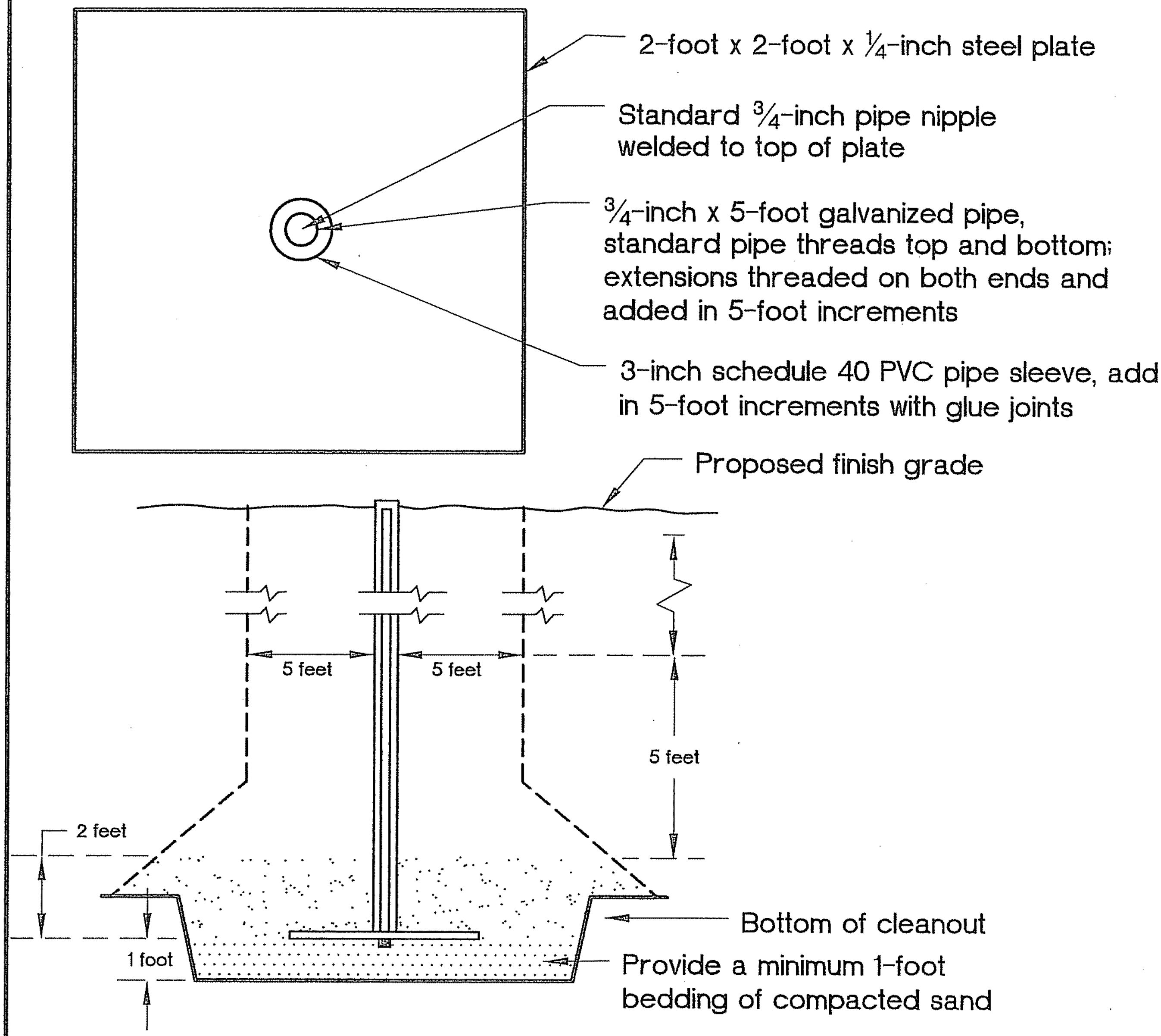




NOTES:

1. 6-inch-thick, clean gravel (¾ to 1½ inch) sub-base encapsulated in Mirafi 140N or equivalent, underlain by a 15-mil vapor retarder, with 4-inch-diameter perforated pipe longitudinal connected to 4-inch-diameter perforated pipe transverse. Connect transverse pipe to 4-inch-diameter nonperforated pipe at low point and outlet or to sump pump area.
2. Pools on fills thicker than 20 feet should be constructed on deep foundations; otherwise, distress (tilting, cracking, etc.) should be expected.
3. Design does not apply to infinity-edge pools/spas.

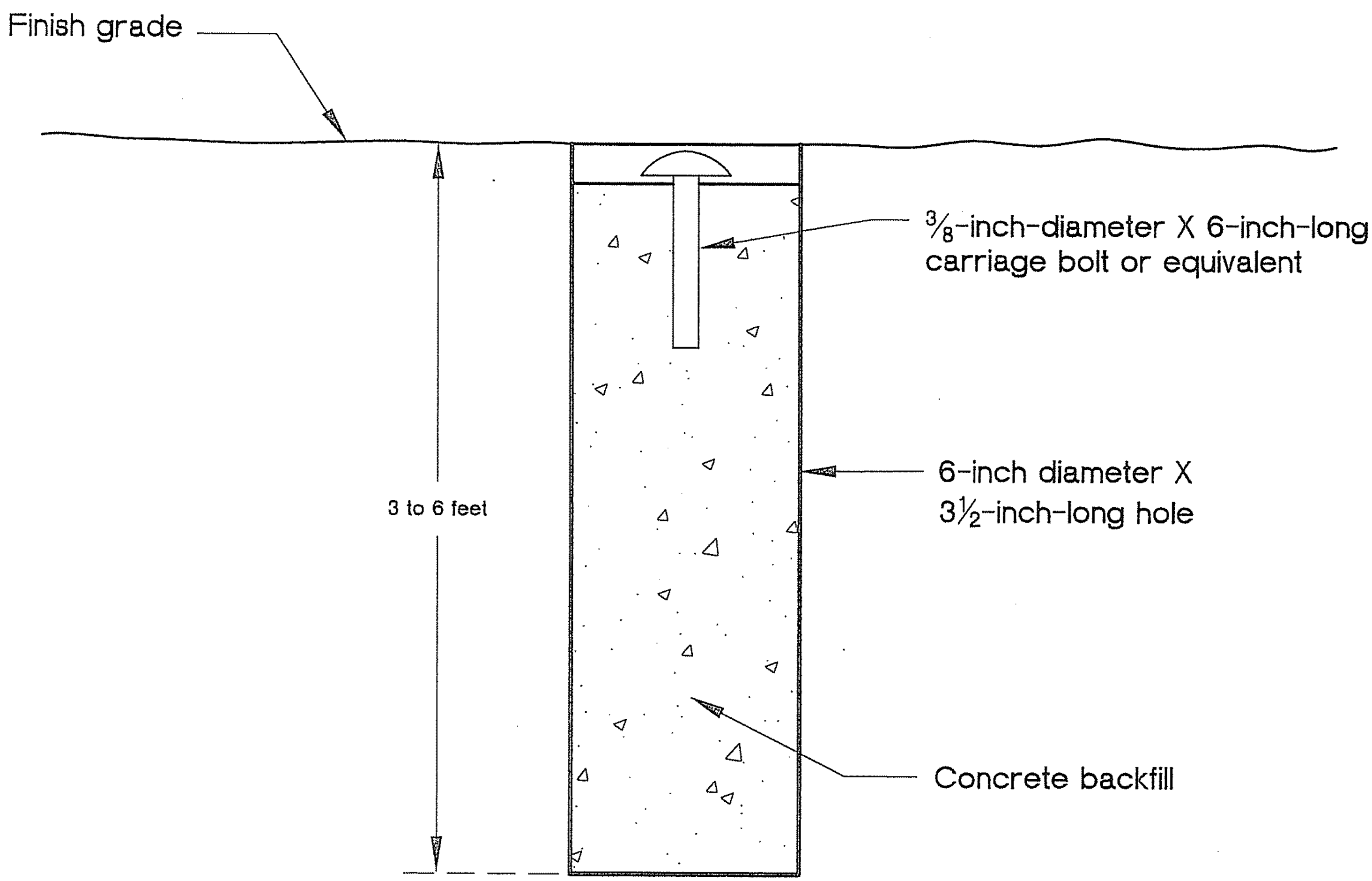
GeoSoils, Inc.	TYPICAL POOL/SPA DETAIL	Plate E-17



NOTES:

1. Locations of settlement plates should be clearly marked and readily visible (red flagged) to equipment operators.
2. Contractor should maintain clearance of a 5-foot radius of plate base and withiin 5 feet (vertical) for heavy equipment. Fill within clearance area should be hand compacted to project specifications or compacted by alternative approved method by the geotechnical consultant (in writing, prior to construction).
3. After 5 feet (vertical) of fill is in place, contractor should maintain a 5-foot radius equipment clearance from riser.
4. Place and mechanically hand compact initial 2 feet of fill prior to establishing the initial reading.
5. In the event of damage to the settlement plate or extension resulting from equipment operating within the specified clearance area, contractor should immediately notify the geotechnical consultant and should be responsible for restoring the settlement plates to working order.
6. An alternate design and method of installation may be provided at the discretion of the geotechnical consultant.

GeoSoils, Inc.	SETTLEMENT PLATE AND RISER DETAIL	Plate E-18

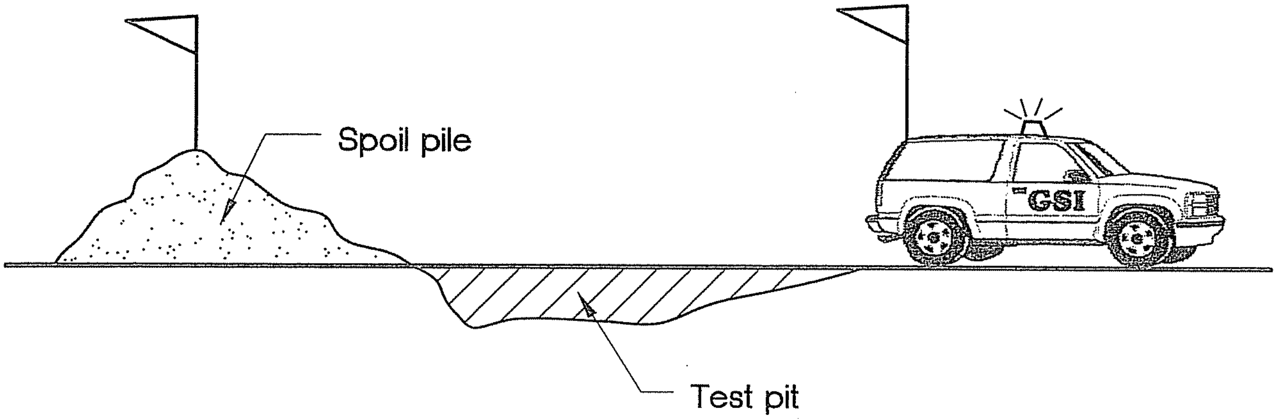


GeoSoils, Inc.

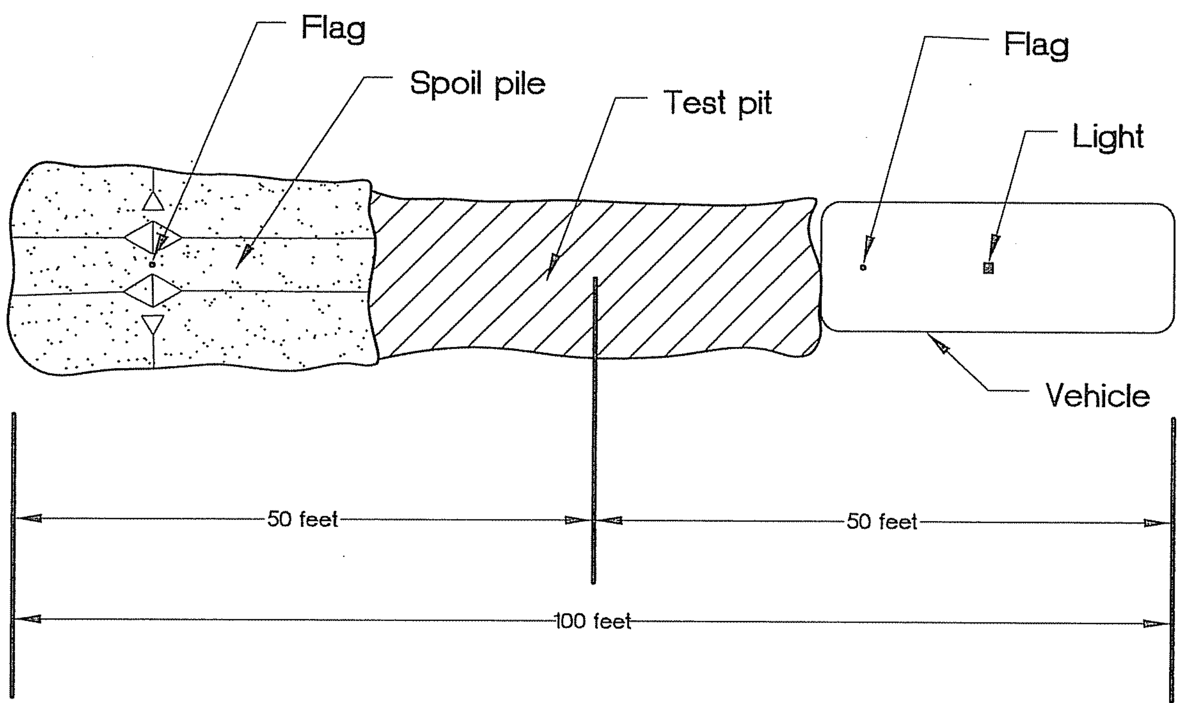
TYPICAL SURFACE SETTLEMENT MONUMENT

Plate E-19

SIDE VIEW



TOP VIEW



GeoSoils, Inc.	TEST PIT SAFETY DIAGRAM	Plate E-20