Appendix F - Preliminary Geotechnical Investigation

SIERRA GEOTECHNICAL SERVICES INC.

December 9, 2003

Project No. 3.30481

Mammoth Mountain Ski Area
P.O. Box 24
Mammoth Lakes, California 93546

Attention: Ms. Alex Fabbro

Subject: **LIMITED GEOTECHNICAL INVESTIGATION**
MMSA Ski-Back Trail
Mammoth Lakes, California

Reference: **PRELIMINARY SOILS ENGINEERING REPORT**
PROPOSED SKI BACK TRAIL
MMSA, Mono County, California

Dear Ms. Fabbro:

In accordance with your authorization of our proposal dated October 3, 2003, we herein submit the results of our limited geotechnical investigation for the proposed MMSA Ski-Back Trail project located east of the Mammoth Mountain Ski Area (MMSA) and south of Highway 203 in Mammoth Lakes, California. The purpose of this study was to assess the geotechnical constraints to development (if any) and provide geotechnical recommendations relative to the future development of the proposed project. Our work consisted of a limited subsurface exploration, laboratory testing, engineering analyses and the preparation of this report.

This study is considered limited, as a more comprehensive subsurface investigation could not be conducted due to inaccessible terrain and inclement weather conditions. As a result, Sierra Geotechnical Services, Inc. should observe all site grading including the backcuts for the proposed retaining walls to identify field conditions that differ from those anticipated by the investigation, and to identify field conditions not observed in proximity of the retaining wall areas.

P.O. BOX 5024 • MAMMOTH LAKES, CA 93546 • (760) 934-3992 • FAX (760) 934-8832
214 W. LINE STREET, SUITE E • BISHOP, CA 93514 • (760) 873-4273 • FAX (760) 873-8024

As part of this study we have reviewed both preliminary and revised preliminary topographic plans, prepared by Triad/Holmes Associates, dated 8/26/2003 and 11/7/03, respectively. In addition, we have reviewed the above referenced report including the results of our previous investigation. Based on the results of this investigation, it is our opinion that the proposed improvements are feasible from a geotechnical standpoint provided the recommendations contained in this report are followed.

Sierra Geotechnical Services Inc. should review final grading plans prior to construction in order to assure that they are in conformance with this report; some of the recommendations contained herein may need to be revised after reviewing.

We appreciate this opportunity to be of service to you. Should you have any questions regarding this report, please do not hesitate to contact us.

Respectfully,

SIERRA GEOTECHNICAL SERVICES INC.

Thomas A. Platz,
President
PE C41039

REGISTERED PROFESSIONAL ENGINEER
THOMAS A. PLATZ
No. C 41039
Exp. 3/31/07
CIVIL
STATE OF CALIFORNIA

Joseph A. Adler
Senior Geologist
CEG 2198

REGISTERED GEOLOGIST
JOSEPH AARON ADLER
NO 2198
CERTIFIED ENGINEERING GEOLOGIST
03-31-05
STATE OF CALIFORNIA

jaa:tap

(2) addressee

GEOTECHNICAL INVESTIGATION

FOR

MMSA SKI-BACK TRAIL
MAMMOTH LAKES, CALIFORNIA

DECEMEBER 9, 2003
PROJECT NO. 3.30481

Prepared By:

SIERRA GEOTECHNICAL SERVICES, INC.
P.O. Box 5024
Mammoth Lakes, California 93546
(760) 934-3992

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LIST OF ATTACHMENTS

1. PURPOSE AND SCOPE

This report presents the results of a limited geotechnical investigation for the proposed Ski-Back Trail project located east of the Mammoth Mountain Ski Area and south of Highway 203 in Mammoth Lakes, California (Figure 1). The purpose of this study was to assess the geotechnical constraints to development (if any) and provide geotechnical recommendations relative to the future development of the proposed project. A report entitled *Preliminary Soils Engineering Report Proposed Skiback Trail* was prepared by Sierra Geotechnical Services Inc., August 29, 2000. Since that report was issued, the proposed alignment of the Ski-Back Trail and location and design of the associated retaining walls have changed.

The scope of this investigation included a review of stereoscopic aerial photographs, readily available published and unpublished geologic literature, a limited subsurface field investigation that included the excavation of two exploratory test pits along the proposed trail alignment, laboratory testing of representative soil samples obtained during our field investigation, geotechnical evaluation and analysis of the collected field and laboratory data, and preparation of this report presenting the results of our findings, conclusions, geotechnical recommendations for site grading, and construction considerations for the proposed development.

A limited field investigation was performed on October 19 and 21, 2003. A more comprehensive subsurface investigation could not be conducted due to inaccessible terrain and inclement weather conditions. Logs of the exploratory test pits are presented in Appendix A, Figures A-1 to A-2. The approximate locations of the exploratory test pits are shown on the Site Plan (Figure 2).

In-place nuclear density tests and bulk samples of the soils encountered were obtained during the field investigation. Results of the in-place nuclear density tests are presented on the logs of the exploratory test pits, Appendix A. Details of the laboratory testing are presented in Appendix B.

2. SITE DESCRIPTION

The proposed Ski Back Trail is situated on National Forest Service Land in Mono County, California. The proposed trail alignment primarily parallels State Route 203, the main access road leading to the Mammoth Mountain Ski Area (Figure 1). The majority of the trail is situated approximately 50 to 300-feet south of State Route 203, and generally slopes at gradients ranging from 6 to 12-percent. Drainage onsite is via sheet flow runoff of incident rainfall and snowmelt. Indigenous pine trees and brush presently cover the site.

3. PROPOSED IMPROVEMENTS

It is our understanding that the proposed approximate 20-foot wide trail will trend in an east-west direction from the MMSA Maintenance Garage to Forest Trail Road, just west of Highway 203 (see Figure 1). Where possible, the trail will be constructed utilizing 2:1 (horizontal to vertical) cut and fill slopes. In areas where conventional grading methods are not feasible, "rock-stack" retaining walls from 4 to 15-feet in height will be constructed.

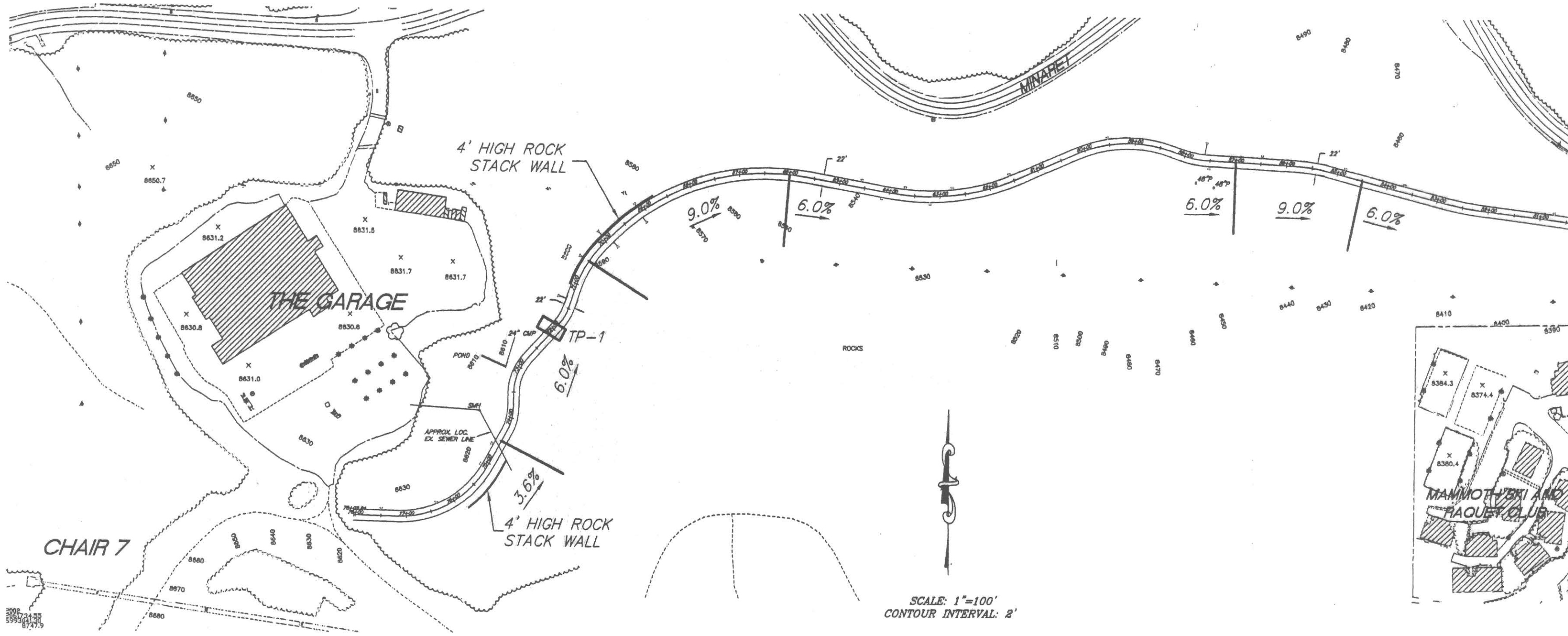
4. GEOLOGY AND SUBSURFACE CONDITIONS

The project site is located at the southwestern edge of the Long Valley caldera near the eastern flank of the Sierra Nevada. The caldera (collapsed volcano) is an east-west elongate, oval depression formed approximately 760,000 years ago with continued volcanic activity to the present (Bailey, 1989). The pre-volcanic basement rock in the Mammoth Lakes area is predominantly Mesozoic granitic rocks of the Sierra Nevada batholith. The batholith is a series of intrusions that displaced overlying ancient sedimentary sea floor rocks (roof pendants) during the Jurassic and Cretaceous Periods. Piedmont glaciation occurred throughout the Pleistocene leaving a mantle of glacial till covering the basement and volcanics rocks throughout the area now occupied by the Town of Mammoth Lakes.

As observed during this investigation, Topsoil/Colluvium, Pleistocene Avalanche Deposits, and Quartz Latite Volcanic Rock underlie the site. Logs of the subsurface conditions encountered in the test pits are provided in Appendix A. A generalized description of the material encountered during this investigation follows.

Sierra Geotechnical Services

PROJECT:	VICINITY MAP MMSA SKI-BACK TRAIL		
SCALE:	N.T.S	DATE:	12/2003
DRAWING:	3.30481.DWG	DRAWN BY:	JAA
JOB NO.:	3.30481	FIGURE:	FIGURE 1

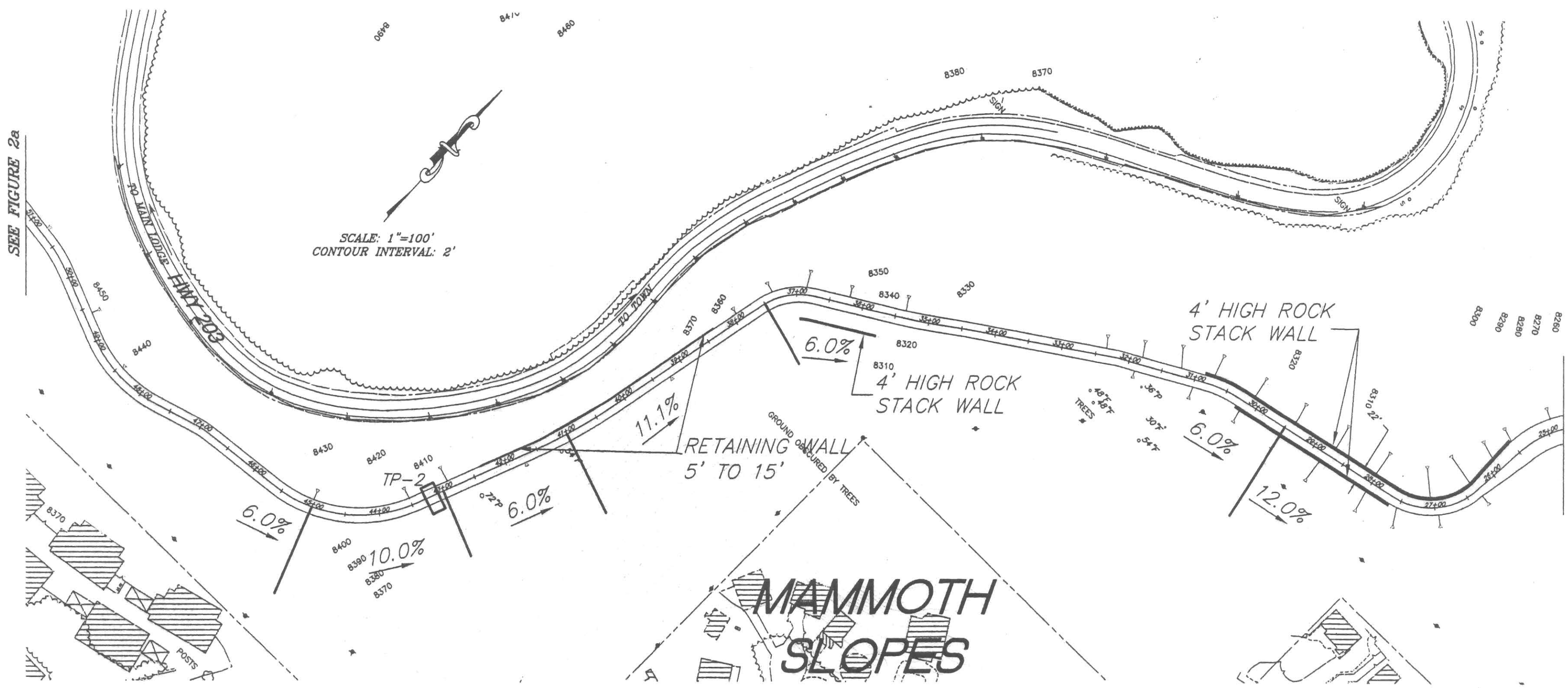


LEGEND

TP-2 ▭ APPROXIMATE LOCATION OF EXPLORATORY TEST PIT

Sierra Geotechnical Services

PROJECT:	SITE PLAN/TEST PIT LOCATION MAP MMSA SKI-BACK TRAIL		
SCALE:	1"=100'	DATE:	12/2003
DRAWING:	3.30481.dwg	DRAWN BY:	JAA
JOB NO.:	3.30481	FIGURE:	FIGURE 2a

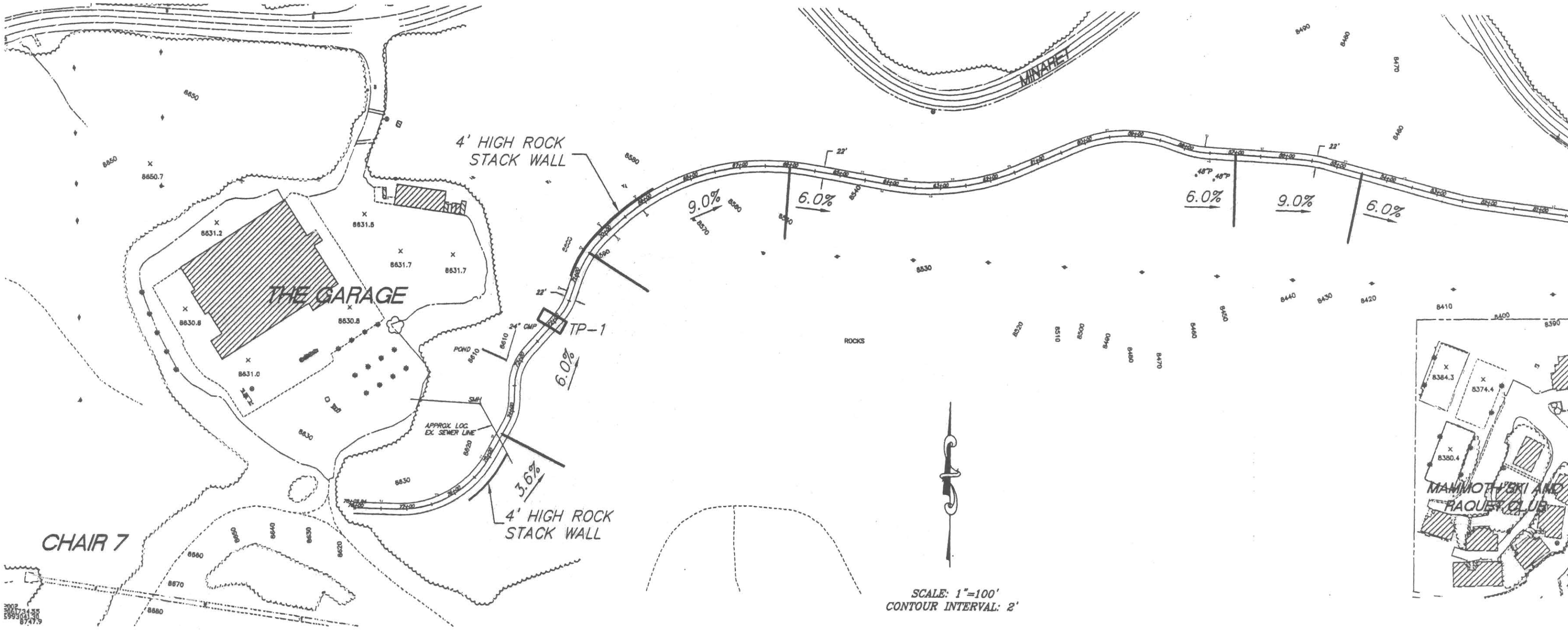


LEGEND

TP-2 ▭ APPROXIMATE LOCATION OF EXPLORATORY TEST PIT

Sierra Geotechnical Services

PROJECT:	SITE PLAN/TEST PIT LOCATION MAP MMSA SKI-BACK TRAIL		
SCALE:	1"=100'	DATE:	11/2003
DRAWING:	3.30481DWG	DRAWN BY:	JAA
JOB NO.:	3.30481	FIGURE:	FIGURE 2b

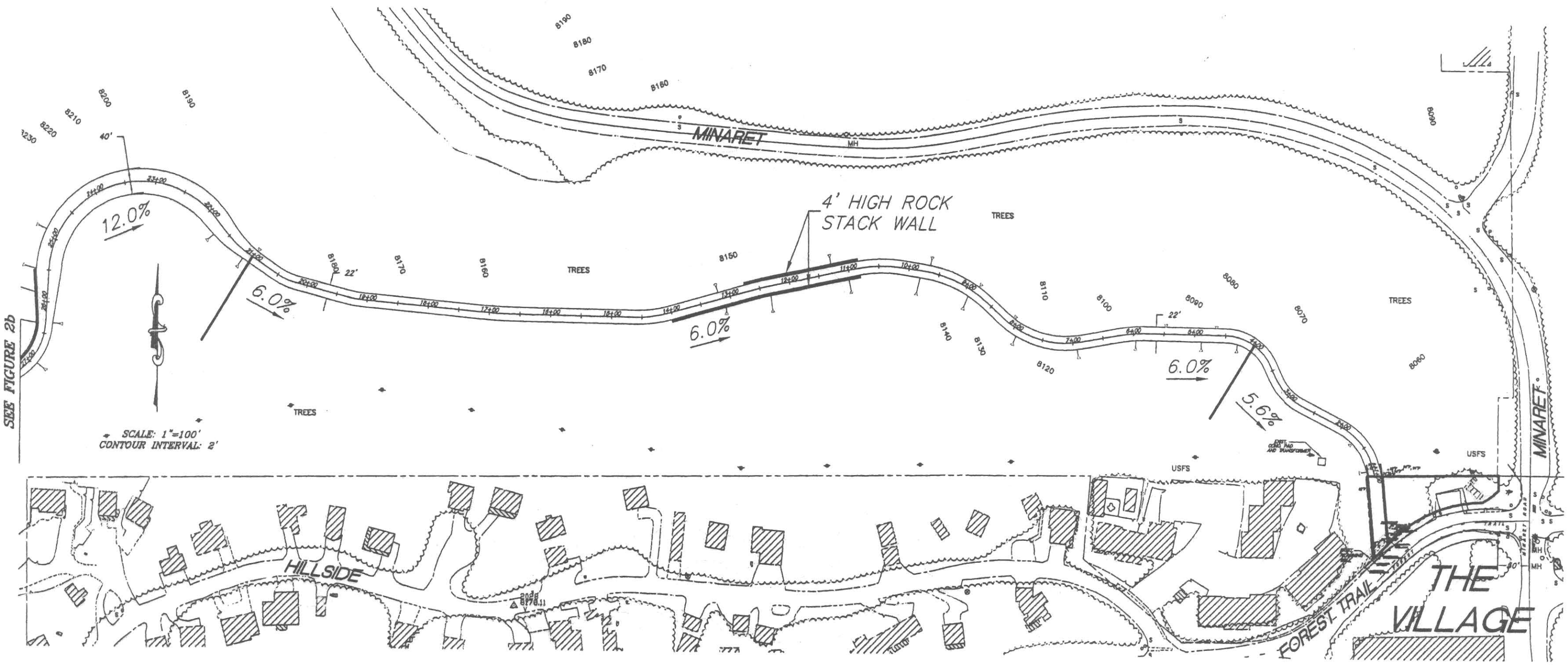


LEGEND

TP-2 — APPROXIMATE LOCATION OF EXPLORATORY TEST PIT

Sierra Geotechnical Services

PROJECT: **SITE PLAN/TEST PIT LOCATION MAP** MMSA SKI-BACK TRAIL	
SCALE: 1"=100'	DATE: 12/2003
DRAWING: 3.30481.dwg	DRAWN BY: JAA
JOB NO.: 3.30481	FIGURE: FIGURE 2a



LEGEND

TP-2 ▭ APPROXIMATE LOCATION OF EXPLORATORY TEST PIT

Sierra
Geotechnical
Services

PROJECT:	**SITE PLAN/TEST PIT LOCATION MAP** MMSA SKI-BACK TRAIL		
SCALE:	1"=100'	DATE:	12/2003
DRAWING:	3.3048.DWG	DRAWN BY:	JAA
JOB NO.:	3.30481	FIGURE:	FIGURE 2c

4.1 Topsoil/Colluvium

Topsoil/Colluvium was encountered in the upper portions of both test pits and generally consisted of light brown, loose, moist, silty, very fine to coarse-grained SAND (Unified Soil Classification Symbol: SP/SM). Numerous roots and subrounded gravels, cobble clasts, and boulders to approximately 12-inches diameter were encountered. The thickness of the Topsoil/Colluvium extended to a depth of approximately 3-feet below existing grades.

4.2 Pleistocene Avalanche Deposits

Pleistocene Avalanche deposits were encountered in the both test pits below the Topsoil/Colluvium. The Avalanche deposits generally consisted of light-brown to light gray, medium-dense, moist, silty, very fine to coarse-grained SAND (SP/SM). Abundant cobble clasts and boulders to approximately 36-inches diameter were encountered. Based upon in-place density tests, the Avalanche deposits become dense at approximately 4 to 5-feet. The total thickness of the Avalanche deposits was not determined in Test Pit No. 1; however this deposit extended to approximately 7-feet in depth in Test Pit No. 2.

4.3 Quartz Latite Volcanic Rock

Weathered Quartz Latite Volcanic Rock was encountered within Test Pit No. 2 below the Pleistocene Avalanche deposits. In general, the volcanic rock was reddish-brown, highly weathered, and highly to moderately fractured, with a silty sand matrix. The excavations could not be advanced below approximately 9½-feet due to rock refusal.

4.4 Groundwater

Groundwater was not encountered during our field investigation. Groundwater is not anticipated to be encountered during site development due to the location of the site with respect to overall drainage. Minor amounts of seepage may be encountered if the site is graded during the peak snow melt runoff period between April and May.

Since the location of such conditions is difficult to predict, they are typically mitigated if and when they occur.

5. SITE SEISMICITY

The contents of this investigation are specific to the grading and construction of the proposed trail and "rock-stack" retaining walls. Geotechnical recommendations for habitable structures are not included within this investigation. As such, a site specific seismic design response spectra study is not included.

A review of the available literature indicates that there are no known active, potentially active, or inactive faults (Hart and Bryant, 1999) that transect the subject site. Evidence of active faulting on the site was not encountered. Seismic hazards at the site may be caused by ground shaking during seismic events on regional active faults, or seismic events produced by volcanic unrest within the local area.

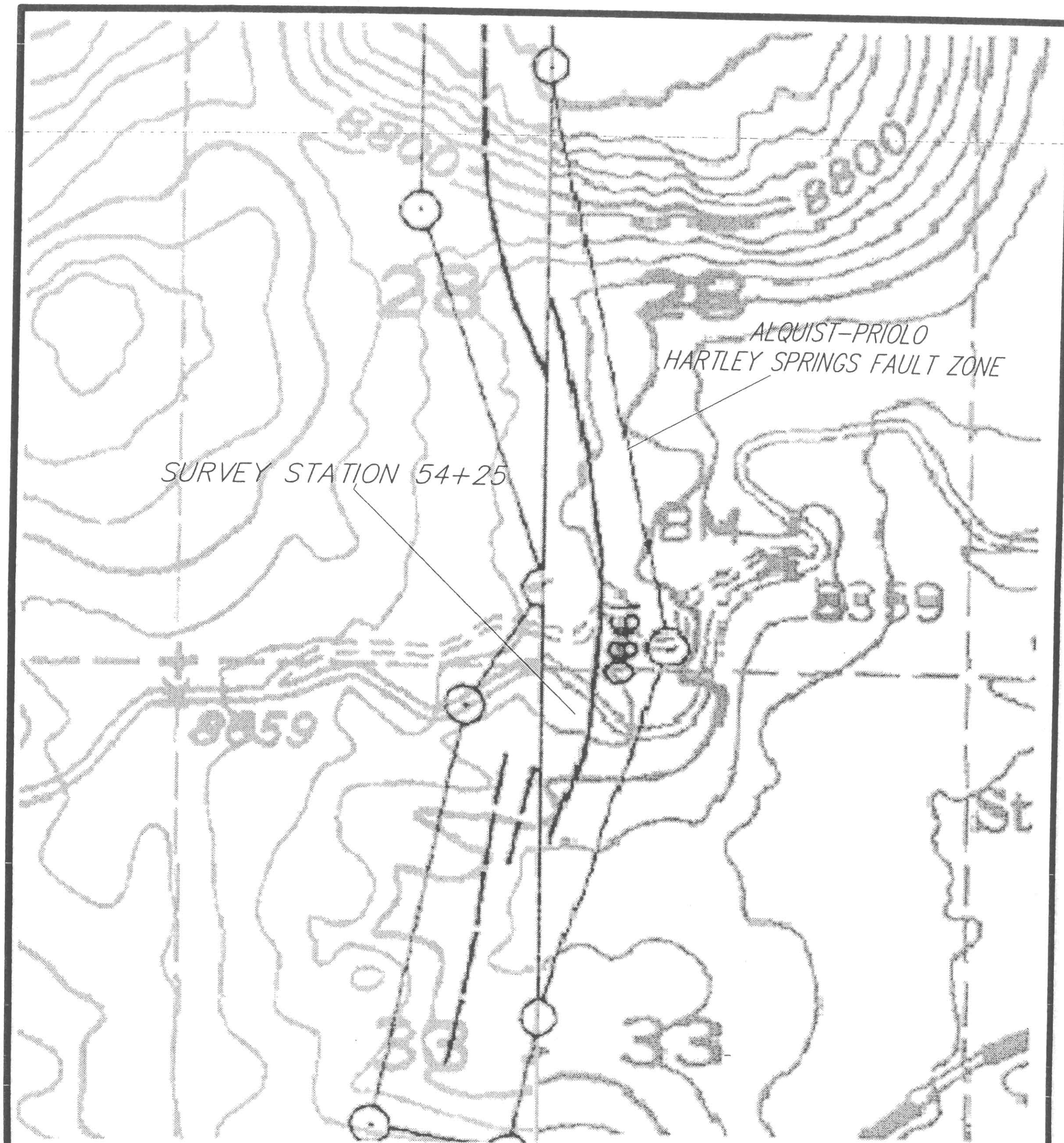
The nearest known active regional fault is the Hartley Springs fault which transects the subject site at approximate survey station 54+25. The Hartley Springs fault is classified as a Type "B" seismic source capable of producing a magnitude 6.6 (Mw) earthquake (Uniform Building Code, 1997). Where the Hartley Springs fault transects the site, it is known as the "Earthquake Fault".

6. SECONDARY EARTHQUAKE EFFECTS

Secondary effects that can be associated with severe ground shaking following a relatively large earthquake include ground lurching, shallow ground rupture, liquefaction, tsunamis and seiches. These secondary effects of seismic shaking are discussed in the following sections.

6.1 Lurching and Shallow Ground Rupture

Soil lurching refers to the rolling motion on the ground surface by the passage of seismic surface waves. Effects of this nature are likely to be most severe where the thickness of soft sediments varies appreciably under structures.



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PROJECT: ALQUIST-PRIOLO FAULT ZONE **HARTLEY SPRINGS "EARTHQUAKE" FAULT LOCATION MAP**	
SCALE: N.T.S	DATE: 12/2003
DRAWING: 3.30481.DWG	DRAWN BY: JAA
JOB NO.: 3.30481	FIGURE: FIGURE 3

In its present condition, the potential for lurching at the subject site is considered low due to the presence of the shallow, potentially compressible soils within the upper few feet of material below existing grades. The potential for lurching can be mitigated if the potentially compressible soils, present on site, are removed and properly compacted during grading, as per the earthwork recommendations provided herein.

Ground rupture is generally considered most likely to occur along pre-existing active faults. The southern extension of the Hartley Springs fault which is considered active transects the subject site. Therefore, the potential for ground rupture at the subject site, in the event of an earthquake along this section of the Hartley Springs fault, is considered high.

6.2 Liquefaction

Liquefiable soils typically consist of cohesionless sands and silts that are loose to medium-dense and saturated. To liquefy, these soils must be subjected to a ground shaking of sufficient magnitude and duration. The potential for liquefaction to occur is considered remote, given the lack of a water table and the medium-dense nature of bearing soils present on site.

6.3 Seiches and Tsunamis

The potential for tsunamis and seiches as the result of the design level earthquake from a nearby fault are considered non-existent, due to the distance of the ocean or large open bodies of water from the project site.

7. VOLCANIC HAZARDS

The area of eastern California that includes the Long Valley Caldera and the Mono-Inyo Craters volcanic chain has a long history of geologic activity that includes earthquakes and volcanic eruptions. Studies within this area indicate that massive eruptions of the size that accompanied formation of Long Valley Caldera approximately 760,000 years ago are extremely rare (none have occurred during the period of written human history). Currently, there is no evidence that an eruption of such catastrophic proportions might be forming beneath the Long Valley caldera (Miller, 1985; 1989).

A small to moderate volcanic eruption could occur however; somewhere along Mono-Inyo Craters volcanic chain producing pryoclastic flows and surges, as well as volcanic ash and pumice fallout, which could significantly impact the subject site. The odds however, of such an eruption are roughly one in a thousand in a given year (Miller, 1985; 1989).

8. LANDSLIDES, AVALANCHES AND ROCKFALLS

Landslides, avalanches, or rockfalls can occur as a result of moderate to large earthquakes in Alpine terrain, which can cause rock and snow to move vertically and laterally downslope. These hazards typically affect structures which are located at the base of slopes or within close proximity to the area of flow. Although the site is underlain by Pleistocene Avalanche Deposits, these were derived volcanically by phreatic explosions and the mechanism for their deposition is no longer active.

The subject site is however located along a moderately steep slope area which may be subject to both future rockfalls and snow avalanches as a result of environmental conditions and/or the design level earthquake.

9. CONCLUSIONS

Based on the results of this investigation, it is our opinion that the construction of the proposed project is feasible from a geotechnical standpoint provided the following recommendations are incorporated into the design and construction. The following sections discuss the principal geotechnical concerns affecting site development and grading, and provide preliminary grading and retaining wall design recommendations which should be implemented during site development to mitigate site geologic constraints. Implementation of these recommendations and adherence to the 1997 UBC, and the 2001 CBC, does not however preclude property damage during or following a significant seismic event.

- This study is considered limited, as a more comprehensive subsurface investigation could not be conducted due to inaccessible terrain and inclement weather conditions. As a result, Sierra Geotechnical Services, Inc. should

9. CONCLUSIONS (Continued)

observe all site grading including the backcuts for the proposed retaining walls to identify field conditions that differ from those anticipated by the investigation, and to identify field conditions not observed in proximity of the retaining wall areas.

- The southern extension of the Hartley Spring fault known locally as the "Earthquake fault" transects the subject at approximate survey station 54+25 (Hart and Bryant, 1999). Evidence of past soil failures, or landslides, were not encountered. Seismic hazards at the site may be caused by ground shaking during seismic events on the Hartley Spring fault or regional active faults.

- Groundwater was not encountered during our field investigation. Groundwater is not anticipated to be encountered during site development due to the location of the site with respect to overall drainage. Minor amounts of seepage may be encountered if the site is graded during the peak snowmelt runoff period between April and May.

- A volcanic eruption could occur somewhere along Mono-Inyo Craters volcanic chain producing pryoclastic flows and surges, as well as volcanic ash and pumice fallout, which could significantly impact the subject site. The odds however, of such an eruption are roughly one in a thousand in a given year (Miller, 1985; 1989).

- Site soils encountered during our field investigation generally consist of loose to dense, silty to gravelly sands, with abundant cobble clasts and boulders to 36-inches diameter. In addition, weathered volcanic rock was encountered at depth and may require additional excavation effort in the form of rock braking or blasting, where encountered.

- The proposed improvements may be underlain by up to 4 to 5-feet of loose soils considered unsuitable for the support of new fill or structural loads. Where these soils will be subjected to increased loads from new fills, remedial grading consisting of overexcavation and compaction is recommended to improve the bearing capacity of those materials. Remedial grading recommendations are provided in this report.

- The depth of the unsuitable soils is based upon the areas observed. It should be anticipated that the overall depth of the unsuitable materials exposed during construction may vary from that encountered in the test pits. Reasonably continuous construction observation and review during site grading allows for evaluation of the actual soil conditions and the ability to provide appropriate revisions where required during construction

- In general, excavations at the site should be achievable using standard earthmoving equipment. However, where encountered volcanic rock may require additional excavation effort in the form of rock braking or blasting.

10. RECOMMENDATIONS

The following recommendations should be adhered to during site development. These recommendations are based on empirical and analytical methods typical of the standard of practice in California. If these recommendations appear to not cover any specific feature of the project, please contact our office for additions or revisions to the recommendations.

10.1 Geotechnical Review

Geotechnical review is of paramount importance in engineering practice. The poor performance of many earthwork projects has been attributed to inadequate construction review. Sierra Geotechnical Services, Inc. should be provided the opportunity to review the following items or we waive all liability for any and all geotechnical issues associated with grading or construction relative to the subject site.

10.1.1 Plan and Specification Review

Only preliminary plans for construction and grading were available at the time of this report. SGSI should review final grading and construction plans prior to construction in order to assure that they are in conformance with this report; some of the recommendations contained herein may need to be revised after reviewing.

10.2 Earthwork

Earthwork should be performed in accordance with the General Earthwork and Grading Specifications in Appendix C and the following recommendations. The recommendations contained in Appendix C are general grading specifications provided for typical grading projects. Some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report supersede the general recommendations in Appendix C. The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place the fill properly in accordance with the recommendations of this report and the specifications in Appendix C, notwithstanding the testing and observation of the geotechnical consultant.

10.3 Excavation and Grading Observation

Site grading including the backcuts for the proposed retaining walls should be observed by SGSI. Such observations are considered essential to identify field conditions that differ from those anticipated by the investigation, to adjust design to actual field conditions, and to determine that the grading is accomplished in general accordance with the recommendations of this report. Earthwork and grading recommendations which include guidelines for site preparation fill compaction, slopework, temporary excavations, and trench backfill are provided in Appendix C.

10.4 Free Standing Cantilever Retaining Walls

Embedded structural walls or cantilever retaining walls should be designed for the lateral earth pressures exerted on them. The magnitude of these pressures depends on the amount of deformation that the wall can yield under load. If a wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If a wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance.

10.4.1 Preliminary Lateral Earth Pressures

The following earth pressures may be utilized for the project provided that the soils utilized for backfill of the retaining wall are "select" or selectively graded soils. The select backfill should have an expansion index (EI) of no greater than 50 and a sand equivalent (SE) greater than 15. The backfill soils should be tested by the soils engineer prior to backfill operations starting for the retaining wall structures.

Slope of Backfill Behind Retaining Wall	Lateral Earth Pressure in Equivalent Fluid Weight (pcf)	
	Active Case	Passive Case
Horizontal	30	400
2:1 (H:V)	43	200

The earth pressures are given in terms of equivalent fluid pressures for walls having backfills of horizontal and 2 to 1 slopes. For sliding resistance, the friction coefficient of 0.35 may be used at the concrete and soil interface.In combining the total lateral resistance, the passive pressure or the frictional resistance should be reduced by 50 percent. Wall footings should be designed in accordance with structural considerations. The passive resistance value may be increased by one-third when considering loads of short duration, including wind or seismic loads. The horizontal distance between foundation elements providing passive resistance should be a minimum of three times the depth of the elements to allow full development of these passive pressures. The total depth of retained earth for design of cantilever walls should be the vertical distance below the ground surface measured at the wall face for stem design or measured at the heel of the footing for overturning and sliding.

Wall backcut excavations less than 5-feet in height can be made near vertical. For backcuts greater than 5-feet in height, but less than 35-feet in height, the backcut should be flattened to a gradient of not steeper than 2:1 (horizontal to vertical) slope inclination for the full width of the loose, Topsoil/Colluvium and approximate upper 1-foot of the loose, Pleistocene Avalanche Deposits.

Below these deposits, the backcut can be flattened to a gradient of not steeper than 1:1 (horizontal to vertical).

For backcuts in excess of 35-feet in height, specific recommendations should be requested from the geotechnical consultant. The granular and native backfill soils should be compacted to at least 90-percent relative compaction (based on ASTM Test Method D-1557). The granular fill should extend horizontally to a minimum distance equal to one-half the wall height behind the walls. The walls should be constructed and backfilled as soon as possible after backcut excavation. Prolonged exposure of backcut slopes may result in some localized slope instability. Compaction equipment for the backfill of the site retaining walls should be relatively light to avoid potentially damaging the retaining walls.

All retaining wall structures should be provided with appropriate drainage and waterproofing. Drainage should consist of continuous drains installed along the base of the wall outletting to a storm drain system or the surface if grade allows.

10.4.2 Preliminary Wall Foundations

Retaining wall footings should be placed at a minimum embedment depth of 24-inches into competent native soil or compacted fills. When placed at this depth a soil bearing value of 2000-psf can be used for design. Subgrade soils should be scarified to a minimum depth of 12-inches; moisture conditioned as necessary, and compacted to at least 90-percent maximum dry density obtained using ASTM D-1557.

Foundation excavations should be observed by SGSI and the actual extent of the removal determined based on the field evaluation of exposed conditions during grading.

10.5 Drainage

Positive site drainage should direct runoff away from foundations and should not be allowed to pond. Site drainage should be directed to approved drainage facilities. Drainage should not flow uncontrolled down any descending slopes.

11. LIMITATIONS

This report has been prepared for the sole use and benefit of our client. The intent of the report is to advise our client on the geotechnical recommendations relative to the future development of the proposed project. It should be understood that the consulting provided and the contents of this report are not perfect. Any errors or omissions noted by any party reviewing this report, and/or any other geotechnical aspects of the project, should be reported to this office in a timely fashion. The client is the only party intended by this office to directly receive this advice. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Sierra Geotechnical Services Incorporated from and against any liability, which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Sierra Geotechnical Services Incorporated.

Conclusions and recommendations presented herein are based upon the evaluation of technical information gathered, experience, and professional judgment. Other consultants could arrive at different conclusions and recommendations. Final decisions on matters presented are the responsibility of the client and/or the governing agencies. No warranties in any respect are made as to the performance of the project.

12. REFERENCES

Bailey, R.A., (1989). Geologic Map of the Long Valley Caldera, Mono-Inyo Craters Volcanic Chain, and Vicinity, Eastern California: U.S. Geological Survey, Map I-1933, 1:1,000,000

California Building Code (2001). California Code of Regulations, Title 24, Part 2, Volume 2.

CDMG and Structural Engineers Association of California Seismology Committee (SEAOC), 1998, Maps of known active fault near-source zones in California and adjacent portions of Nevada, to be used with the 1997 UBC: International Conference of Building Officials (ICBO).

Hart, Earl W., and Bryant, William A (1999). Fault-rupture Hazard Zones in California, California Geological Survey Special Publication 42, 38p.

Miller, C.D., 1985, Holocene eruptions at the Inyo volcanic chain, California: Implications for possible eruptions in Long Valley caldera: Geology, v. 13, pp. 14-17.

Miller, C.D., 1989, Potential hazards from future volcanic eruptions in California: U.S. Geological Survey Bulletin 1847, 17 p.

Jennings, C.W., 1994, Fault activity map of California and adjacent areas: California Division of Mines and Geology Geologic Data Map No. 6, 1:750,000 scale.

Sierra Geotechnical Services Inc., 2000, Preliminary Soils Engineering Report for the Proposed Skiback Trail, Mammoth Mountain Ski Area, Mono County California, W.O. 3.01707.

Uniform Building Code (1997). Structural Engineering Design Provisions, International Conference of Building Officials, Whittier, California, v. 2.

United States Department of Agriculture, Stereoscopic Aerial Photographs: 615040: 501-86 to 501-87; Dated 7/14/01, 1:12,500

United States Department of Agriculture, Stereoscopic Aerial Photographs: EMG-7-147 to EMG-7-148; Dated 9/10/63, 1:12,500

United States Department of Agriculture, Stereoscopic Aerial Photographs: EAD-19-131 to EAD-19-132; Dated 8/23/56, 1:24,000.

APPENDIX A

EXPLORATORY TEST PIT LOGS

A subsurface field investigation was performed on October 19 and 21, 2003 that included the excavation of two exploratory test pits in the proposed construction area. Logs of the exploratory test pits are presented herein. Representative soil samples were obtained during the field investigation for laboratory testing. The approximate locations of the exploratory test pits are shown on the Site Plan (Figure 2a through 2c).

SIERRA GEOTECHNICAL SERVICES INC.
P.O. BOX 5024
MAMMOTH LAKES, CA 93546
(760) 934-3992

APPENDIX A-1

TEST PIT LOGS

JOB NO: 3.30481
DATE: 10/19/03
LOCATION: STA. 72+00
ELEV: 8598' MSL

PROJECT: MMSA SKIBACK TRAIL
LOGGED BY: P.S.
EQUIP: CAT 304.5

TEST PIT	DEPTH (FT)	U.S.C.S. GROUP SYMBOL	SAMPLE DEPTH	DRY PERCENT MOISTURE	DENSITY (pcf)	DESCRIPTION
1	0 - 1	SP/SM				**Topsoil/Colluvium** Light brown, loose, moist, silty, very fine- to coarse-grained SAND, few gravels and cobble clasts, few boulders to approximately 12-inches, abundant roots.
	1 - 5	SP/SM				**Pleistocene Avalanche Deposits** Light brown, medium-dense, moist, silty, very fine to coarse-grained SAND, abundant gravels cobble clasts, and boulders to approximately 36-inches diameter, few rootlets to 3-feet in depth.

SIERRA GEOTECHNICAL SERVICES INC.
P.O. BOX 5024
MAMMOTH LAKES, CA 93546
(760) 934-3992

APPENDIX A-2

TEST PIT LOGS

JOB NO: 3.30481
DATE: 10/21/03
LOCATION: STA. 43+10
ELEV: 8394' MSL

PROJECT: MMSA SKIBACK TRAIL
LOGGED BY: P.S.
EQUIP: CAT 304.5

TEST PIT	DEPTH (FT)	U.S.C.S. GROUP SYMBOL	SAMPLE DEPTH	DRY PERCENT MOISTURE	DENSITY (pcf)	DESCRIPTION
2	0 - 3	SP/SM	3	5.3	94.0	**Topsoil/Colluvium** Light brown, loose, moist, silty, very fine- to medium-grained SAND, few gravels and cobble clasts, few boulders to approximately 12-inches, abundant roots.
	3 - 5½	SP/SM	4½	4.4	96.8	**Pleistocene Avalanche Deposits** Light brown, medium-dense, moist, silty, fine to coarse-grained SAND, few gravels and cobble clasts, few boulders to approximately 12-inches, abundant roots.
	5½ - 7	SP/SM	6½	4.5	94.3	Light gray, medium-dense, moist, silty, fine to coarse-grained SAND, abundant gravels and cobble clasts, few boulders to approximately 36-inches diameter.
	7 - 9½		8½	3.8	105	**Weathered Quartz Latite** Highly weathered, highly to moderately fractured, reddish-brown, VOLCANIC ROCK, with fine to coarse sand matrix.

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed on representative soil samples to provide a basis for development of design parameters. Soil materials were visually classified in the field according to the Unified Soil Classification System. Selected samples were tested for the following parameters: in-situ moisture content, dry density, direct shear, and maximum dry density (Proctor). Laboratory tests were performed in general accordance with the American Society of Testing and Materials (ASTM) procedures. The results of our laboratory testing along with summaries of the testing procedures are presented herein. The results of the in-situ moisture and density determinations are presented on the test pit logs (Appendix A).

LABORATORY TESTING

Maximum Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM Test Method D-1557. The results of these tests are presented in the table below:

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
TP- 1 @ 3½'	Light brown, silty, fine to medium, SAND	105	14
TP- 2 @ 8½'	Reddish-brown, fine to coarse, SAND	113	9.5

Moisture and Density Determination Tests: Moisture content and in-place density determinations were performed within the test pits using an MC-1 Portoprobe nuclear density gauge. The results of these tests are presented in the test pit logs.

Direct Shear Tests: A direct shear test was performed on a selected sample remolded to 85-percent maximum density, which was soaked for a minimum of 24-hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.001 to 0.5 inches per minute (depending upon the soil type). The test results are presented in the test data.

Sample Location	Sample Description	Friction Angle (degrees) (relaxed)	Apparent Cohesion (psf)
TP- 1 @ 3½'	Light brown, silty, fine to medium, SAND	37	12
TP- 2 @ 8½'	Reddish-brown, fine to coarse, SAND	33	330

APPENDIX C

EARTHWORK

AND

GRADING RECOMMENDATIONS

EARTHWORK AND GRADING

These earthwork and grading specifications are for the grading and earthwork shown on the approved grading or construction plan(s) and/or indicated in the geotechnical report(s). Earthwork and grading should be conducted in accordance with applicable grading ordinances, the current California Building Code, and the recommendations of this report. The following recommendations are provided regarding specific aspects of the proposed earthwork construction. These recommendations should be considered subject to revision based on field conditions observed by the geotechnical consultant during grading.

Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record. The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of grading or construction.

During grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground, after it has been cleared for receiving fill gut before it has been placed, bottoms of all "remedial removal areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the contractor on a routine and frequent basis.

The Earthwork Contractor

The Earthwork Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications. The Earthwork Contractor shall review and accept the plans, geotechnical report(s) and these Specifications prior to the commencement of grading. The Earthwork Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant unsatisfactory conditions, such as unstable soil, improper moisture condition, inadequate compaction, adverse weather, etc... are resulting in a quality of work less than required in these Specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

Site Preparation

General: Site preparation includes removal of deleterious materials, unsuitable materials, and existing improvements from areas where new improvements or new fills are planned. Deleterious materials, which include vegetation, trash, and debris, should be removed from the site and legally disposed of off-site. Unsuitable materials include loose or disturbed soils, undocumented fills, contaminated soils, or other unsuitable materials. The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1-percent of organic materials (by volume). No fill lift shall contain more than 5-percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant etc...) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fine and/or imprisonment and shall not be allowed.

Any existing subsurface utilities that are to be abandoned should be removed and the trenches backfilled and compacted. If necessary, abandoned pipelines may be filled with grout or slurry cement as recommended by, and under the observation of, the Geotechnical Consultant.

Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured, or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

Fill Compaction and Compaction

The onsite soils are suitable for placement as compacted fill provided the organics, oversized rock (greater than 6-inches in diameter) and deleterious materials are removed. Rocks greater than 6-inches and less than 2-feet in diameter can be placed in the bottom of deeper fills or approved areas provided they are selectively placed in such a manner that no large voids are created. All rocks shall be placed a minimum of 4-feet below finish grade elevation unless used for landscaping purposes. Any import soils shall be tested for suitability in advance by the project Geotechnical Engineer.

After making the recommended removals prior to fill placement, the exposed ground surface should be scarified to a depth of approximately 12-inches, moisture conditioned as necessary, and compacted to at least 90-percent of the maximum dry density obtained using ASTM D1557 as a guideline. Surfaces on which fill is to be placed which are steeper than 5:1 (Horizontal to vertical) should be benched so that the fill placement occurs on relatively level ground.

All fill and backfill to be placed in association with the proposed construction should be accomplished slightly over optimum moisture content using equipment that is capable of producing a uniformly compacted product throughout the entire fill lift. Fill materials at less than optimum moisture should have water added and the fill mixed to result in material that is uniformly above optimum moisture content. Fill materials that are too wet can be aerated by blading or other satisfactory methods until the moisture content is as required. The wet soils may be mixed with drier materials in order to achieve an acceptable moisture content.

The fill and backfill should be placed in horizontal lifts at a thickness appropriate for equipment spreading, mixing, and compacting the material, but generally should not exceed eight inches in thickness.

No fill soils shall be placed during unfavorable weather conditions. When work is interrupted by rains or snow, fill operations shall not be resumed until the field tests by the geotechnical engineer indicate that the moisture content and density of the fill are as previously specified.

Slopes

All slopes shall be compacted in a single continuous operation upon completion of grading by means of sheepsfoot or other suitable equipment, or all loose soils remaining on the slopes shall be trimmed back until a firm compacted surface is exposed. Slope compaction tests shall be made within one foot of slope surface.

Cut and fill slopes shall be a maximum of 2:1 (horizontal to vertical) unless approved by the Geotechnical Consultant.

Planting and irrigation of cut and fill slopes and/or installation of erosion control and drainage devices should be completed due to the erosion potential of the soil.

Temporary Excavations

Temporary excavation shall be made no steeper than 1.5:1 (horizontal to vertical). The recommended slope for temporary excavations does not preclude local raveling and sloughing. Where wet soils are exposed, flatter excavation of slopes and dewatering may be necessary. In areas of insufficient space for slope cuts, or where soils with little or no binder are encountered, shoring shall be used.

All large rocks exposed above temporary cuts shall be removed prior to foundation excavation. In addition any rocks exposed during development from raveling and sloughing should be removed immediately.

All excavations should comply with the requirements of the California Construction and General Industry Safety Orders and the Occupational Safety and Health Act and other public agencies having jurisdiction.

Trench Backfill

Exterior trenches, paralleling a footing and extending below a 1:1 plane projected from the outside bottom edge of the footing, shall be compacted to a minimum of 95-percent per ASTM D1557. All trenches in structural areas and under concrete flatwork shall be compacted to a minimum of 95-percent per ASTM D1557. All trenches in non-structural areas shall be compacted to a minimum of 85-percent per ASTM D1557.

All material used for trench backfill shall be approved by the Geotechnical Engineer prior to placement. All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1-foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 95-percent of maximum from 1-foot above the top of the conduit to the surface.

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

Regulations of the governing agency may supersede the above, and all trench excavations should conform to all applicable safety codes. The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.