PETRA

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ORANGE ▪ SAN DIEGO ▪ RIVERSIDE ▪ LOS ANGELES ▪ SAN BERNARDINO

September 30, 2005
J.N. 173-05

Mr. Richard Schlesinger
CITY OF MISSION VIEJO
200 Civic Center
Mission Viejo, CA 92691

Subject: Preliminary Geotechnical Investigation of the Ferrocarril Landslide, City of Mission Viejo, California.

Dear Mr. Schlesinger:

We are pleased to submit herewith our preliminary geotechnical investigation of the Ferrocarril Landslide that occurred on January 20, 2005 in the City of Mission Viejo. This work was performed in general accordance with the scope of services outlined in our Proposal No. 1708-05, dated February 8, 2005. This report presents the results of our field investigation, laboratory testing, and our engineering and geologic judgment, opinions, conclusions and recommendations pertaining to subject landslide. This report also incorporates observations made during temporary stabilization of the landslide and review of subsequent survey monitoring data. An executive summary that provides a brief description of landslide-related activities and our conclusions regarding its stability is included. Recommendations for final repair and related costs will be provided in a separate document prepared by others.

We appreciate this opportunity to be of service to you on this project. Should you have any questions regarding the contents of this report, or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

David C. Seymour
Associate Geologist

DCS/nls

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EXECUTIVE SUMMARY

The Ferrocarril landslide began moving on January 20, 2005 on an approximately 70 feet high graded slope that was constructed in 1967. The slope where the landslide occurred is located behind several residential homes along the eastern side of Ferrocarril and ascends to residences on Encorvado Lane in the City of Mission Viejo, California. The landslide covered an area of about ½-acre and had maximum dimensions of about 275 feet wide by 140 feet long and up to 40 feet deep. The landslide impacted seven residences including 24432, 24442, 24452, 24472, 24482 and 24492 Ferrocarril and 24422 Encorvado Lane. Initial movement of the landslide began nine days after a series of heavy rainstorms swept through southern California and dropped almost 10 inches of rain. These storms commenced on December 28, 2004 and continued through January 11, 2005 and included heavy downpours resulting in daily totals of 1 to 2 inches. The above-average rainfall is believed to be the triggering mechanism for the landslide.

Several days after initial movement of the landslide, the impacted portion of the slope was cleared of vegetation and covered with heavy plastic sheeting. During this period, three exploratory borings were drilled within the limits of the active landslide under contract to six of the impacted property owners. Subsurface observations made within these borings in conjunction with review of pertinent technical documents indicated that the landslide failed along on a pre-existing clay seam that was not recognized during grading of the slope in 1967.

Information gathered from the initial exploration program was used to determine methods for temporarily stabilizing the landslide. The main goal of the temporary stabilization was to reduce the potential for structural damage to the residences from landslide movement. Based on the results of preliminary engineering analyses, we recommended that soils from the upper portions of the landslide be removed and placed along its lower portion. This operation commenced on February 24, 2005 and was essentially completed on February 28, 2005. During this period, four exploratory borings were drilled in the adjoining streets under contract to the City of Mission Viejo in order to assess the stability of adjoining areas.

Upon completion of the grading for the temporary stabilization a survey monitoring system was established for the slope. Survey monitoring of the temporarily repaired slope indicated that the movement of the sliding mass reduced from a few inches per day prior to temporary repair to about a few inches per month after repair. Survey monitoring data recorded from March 3, 2005 through July 7, 2005 indicated that the temporarily stabilized slope moved at an equivalent constant rate of about 1/8-inch per day. Continued movement of the slope at this rate could cause damage to the existing structures along Ferrocarril and create unstable areas in the rear yards of the residences along Encorvado Lane. Based on the rate of movement and the results of engineering stability analyses, the incorporation of additional remedial measures to stabilize the slope is recommended. Subsequent survey monitoring of the slope will be required and installation of at least two slope inclinometers should also be considered for monitoring subsurface movements.

PRELIMINARY GEOTECHNICAL INVESTIGATION OF THE FERROCARRIL LANDSLIDE, CITY OF MISSION VIEJO, CA

INTRODUCTION

Purpose and Scope of Services

Petra Geotechnical, Inc. (Petra), is pleased to present the results of our preliminary geotechnical investigation for the Ferrocarril landslide. The purposes of this investigation were to 1) obtain information regarding surface and subsurface geologic conditions within the area adjacent to the landslide, 2) evaluate the engineering properties of the underlying geologic units, 3) provide geotechnical conclusions regarding the cause of the landslide, 4) provide preliminary options for future repair of the landslide, and 5) express an opinion regarding the stability of the adjoining areas. In addition to the services provided to the City, we also provided geotechnical services to the impacted homeowners. These services included logging of three borings within the landslide mass, geologic and engineering analyses, and providing recommendations for temporary stabilization of the landslide. Findings from the homeowners' study are included with this report. Our scope of services for the City of Mission Viejo included the following:

1. Review of available published and unpublished literature and maps pertaining to regional soil and geologic conditions within and adjacent to the site (see References).

2. Review of historical stereoscopic pairs of aerial photographs for the years from 1952 through 1999.

3. Reconnaissance-level geologic mapping of the landslide and adjoining neighborhood.

4. Drilling, sampling and logging of four exploratory bucket-auger borings to evaluate subsurface soil and groundwater conditions. Bucket auger borings were downhole logged by a certified engineering geologist. Exploration logs of these borings are presented in Appendix A.

5. Laboratory testing and analyses of representative samples of earth materials (bulk and relatively undisturbed) obtained from the borings to determine their engineering properties. Laboratory test criteria and test results are presented in Appendix B.

6. Preparation of a geotechnical map of the site using a base map provided by the City of Mission Viejo (Plate 1).

7. Preparation of ten geologic cross-sections (Sections A-A' to I-I', Plates 2 through 4) depicting the underlying geologic conditions.

8. Engineering and geologic analyses of the field and laboratory data as they pertain to the proposed construction. Results of our stability analyses are presented in Appendix C.

9. Preparation of this report presenting our findings, conclusions and recommendations.

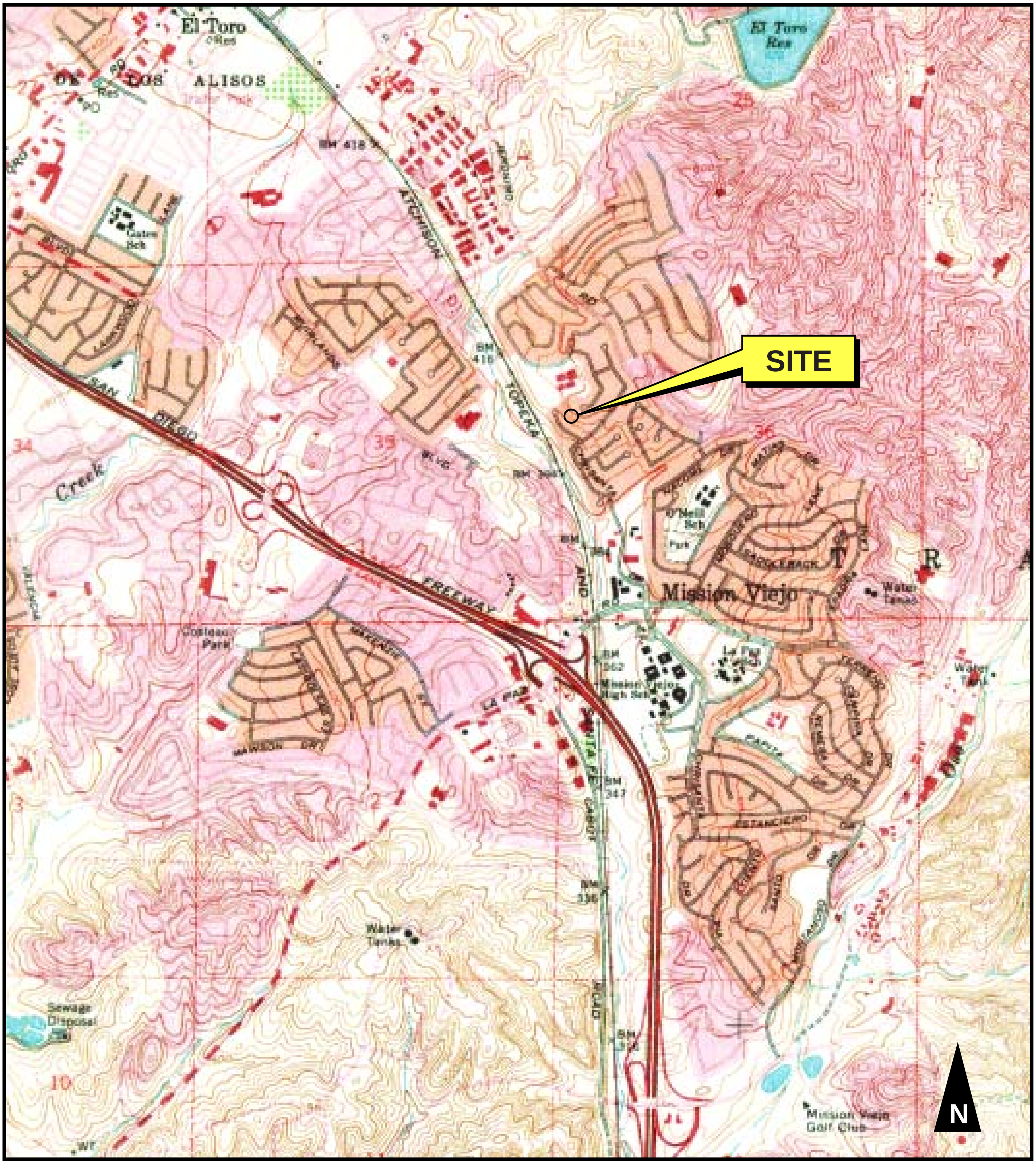
SITE LOCATION AND DESCRIPTION

The Ferrocarril landslide began moving on January 20, 2005 and occurred on a man-made (graded) slope located in the rear portions of 24432, 24442, 24452, 24472, 24482, and 24492 Ferrocarril in the City of Mission Viejo, California (Figure 1). The slope where the landslide occurred ascends approximately 70 feet in height to residences along Encorvado Lane. The top or main scarp of the landslide encroached into the rear yard of 24422 Encorvado Lane and undermined the western portion of an existing swimming pool and adjacent pool decking. The landslide encompassed an area of about ½ acres, with maximum horizontal dimensions of about 275 feet wide by 140 feet long (Figure 2).

The subject slope was graded in 1967 at a slope ratio of approximately 1¾:1 (horizontal to vertical) to a maximum height of about 70 feet. Grading of the slope also included construction of a surface drainage system consisting of two concrete-lined v-ditches (terrace drains) connected to concrete-lined v-ditches (down drains). Landscape vegetation on the slope included various types of trees, shrubs and ground cover. The landscape vegetation was maintained by irrigation systems consisting of irrigation lines and sprinklers.

SITE HISTORY AND GRADING

Development of the residential neighborhood where the landslide occurred began in 1967. Prior to residential development, the site consisted of a gently inclined west facing natural slope that was owned by the Mission Viejo Company. This slope descended westerly to the



SITE LOCATION MAP

Ref: Portion of USGS SAN JUAN CAPISTRANO QUADRANGLE,
7.5 Minute Topographic Series 1968,
(Photorevised 1981)

SCALE: 1 inch = 2000 feet

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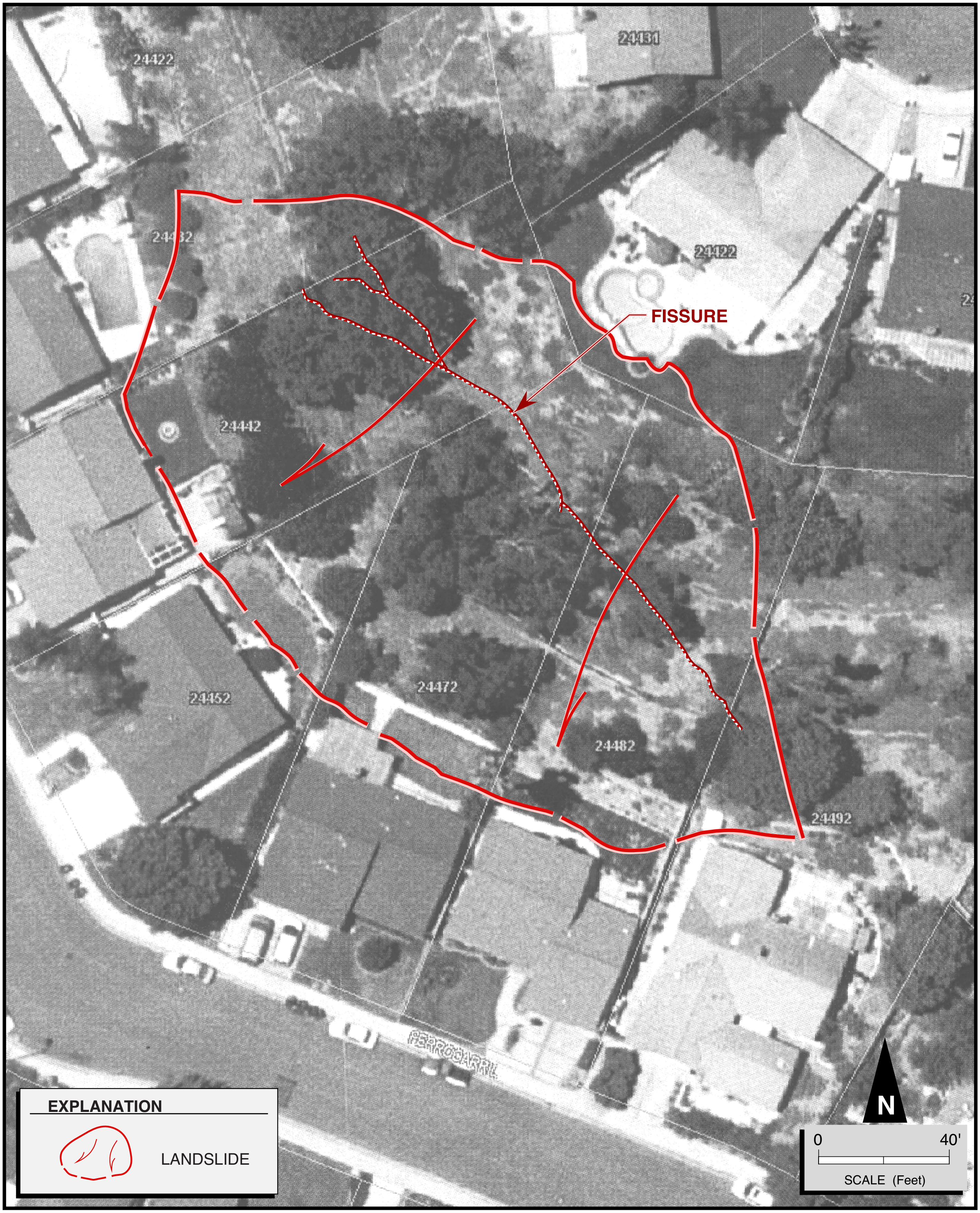
JN 173-05 **SEPT., 2005** **FIGURE 1**



LANDSLIDE LOCATION MAP

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JN 173-05 SEPT., 2005

FIGURE 2

railroad tracks and Oso Creek and had a maximum height of about 110 feet as shown on older topographic maps. Historical aerial photographs indicate that the slope was covered with light brush and grasses.

In 1967, the Mission Viejo Company began construction of the residential development that included Tract Nos. 6333 and 6340. This portion of Mission Viejo was a part of unincorporated Orange County at the time and all of the work was done under the review of the County of Orange. Geotechnical consulting services for the project were performed by Geotechnical Consultants, Inc. and included a preliminary study and observation and testing services during grading operations (see References). Geotechnical maps included with the grading reports indicate that artificial fills were placed along the top and bottom of the natural slope. Placement of the artificial fills was necessary in order to construct the graded slope and building pads for the residential lots. The majority of the artificial fill was placed along the top of the slope and beneath the residential lots on the west side of Ferrocarril that are located close to the railroad tracks.

Construction of the slope where the landslide occurred included the placement of artificial fill along the top of the slope, with the thickest area located below 24422 Encorvado Lane. Up to 35 feet of artificial fill was placed to construct the graded slope in this area. In addition, a keyway, which is an earth filled rectangular prism, was constructed along the toe of the graded slope to enhance its surficial stability. This keyway measured 25 feet wide by 5 feet deep and was shown on maps included with the reports of rough grading (Geotechnical Consultants, 1967). Artificial fills were also placed for construction of the residences on the west side of Ferrocarril. Fills up to 40 feet thick were placed in this area to construct the flat building pads and the slope that descends toward the railroad tracks.

PREVIOUS STUDIES

Regional and site specific studies covering the subject site include those by the California Division of Mines and Geology (Morton et al, 1974), the U.S. Geological Survey (Vedder, et al, 1957), Geotechnical Consultants, Inc. (1966 and 1967), and Geofirm (1992). The regional geologic studies conducted by the California Division of Mines and Geology (CDMG) and the U.S. Geological Survey (USGS) indicate that the surrounding area is underlain by marine sedimentary rocks of the Pliocene Niguel Formation. These studies did not identify any landslides in the general area; however, regional studies of this type often do not identify small scale geologic features. More recent studies by the CDMG (2001) indicate that the slope may be susceptible to movement during a moderate or large magnitude earthquake. As such, the slope is part of an earthquake-induced landslide zone.

Site-specific geotechnical studies covering the site include those by Geotechnical Consultants, Inc. (GCI) and Geofirm. The GCI studies available within the City of Mission Viejo files include a final geotechnical report of grading, dated May 24, 1967. This report includes a summary of GCI's observations made during grading of Tract 6333, including a brief description of the geologic conditions. This report does not discuss the presence of a landslide, and the accompanying maps do not indicate one as well. Unfortunately, the geotechnical investigation report, which is referenced in the GCI grading report, is not present in the City files. The original grading was completed under the jurisdiction of the County of Orange; therefore, it is unknown if the County provided this report to the City after incorporation. The investigation report would have included geologic data that were collected and evaluated prior to grading of the property.

In 1992, Geofirm drilled a single boring on the property located at 24481 Chrisanta. The log of this boring describes geologic conditions very similar to those encountered during our study. A copy of their boring log is included in Appendix A.

LANDSLIDING AND TEMPORARY STABILIZATION

The Ferrocarril landslide began moving on January 20, 2005 on an approximately 70 feet high graded slope and eventually impacted seven residences including 24432, 24442, 24452, 24472, 24482 and 24492 Ferrocarril and 24422 Encorvado Lane. Initial movement of the landslide began nine days after a series of heavy rainstorms swept through southern California and dropped almost 10 inches of rain. These storms commenced on December 28, 2004 and continued through January 11, 2005 and included heavy downpours resulting in daily totals of 1 to 2 inches.

Several days after initial movement of the landslide, the impacted portion of the slope was cleared of vegetation and covered with heavy plastic sheeting. During this period, three exploratory borings were drilled within the limits of the active landslide under contract to six of the impacted property owners. Subsurface observations made within these borings in conjunction with review of pertinent technical documents indicated that the landslide failed along on a pre-existing clay seam that was not recognized during grading of the slope in 1967.

Information gathered from the initial exploration program for the homeowners was used to determine methods for temporary stabilization of the landslide. The main goal of the temporary stabilization was an attempt to significantly reduce movement of the landslide mass in order to reduce the potential for structural damage to the residences. Based on the results of our preliminary engineering analyses, we recommended that soils from the upper portion of the landslide be removed and placed along its lower portion. This operation commenced on February 24, 2005 and was essentially completed on February 28, 2005. Temporary stabilization included construction of a 15- to 20-foot-high fill berm along the bottom of the slope. In order to create this berm as recommended, soils were removed from the central and upper portions of the slope and placed along the bottom. During this process, the main fissure across the landslide was filled in and a gently sloping surface was created in the central portion of the slope. Along the top of the slope the main scarp of the landslide was trimmed off and fill was placed to create a more uniform slope across the top. Several weeks after the slope was stabilized, the pool shell along the top of the slope was underpinned to provide additional support. The underpinning was performed by the homeowner and was not observed by Petra Geotechnnical, Inc. It should be noted that the pool shell remained intact during the failure and repair processes, and did not show visible signs of tilting or excessive cracking.

Prior to temporary stabilization, the landslide was moving from 2 to 4 inches per day. After the landslide was temporarily stabilized, a survey monitoring system was installed that included numerous survey points on and adjacent to the landslide. Results of the survey monitoring program indicated that the slope went from moving a few inches per day prior to repair to about 1/8 inch per day after repair. Figure 3 depicts the topographic conditions created by the temporary stabilization and the location of the survey monitoring points. Figures 3a and 3b depict the amount of horizontal and vertical movement that occurred during the period from March 3, 2005 to July 7, 2005.

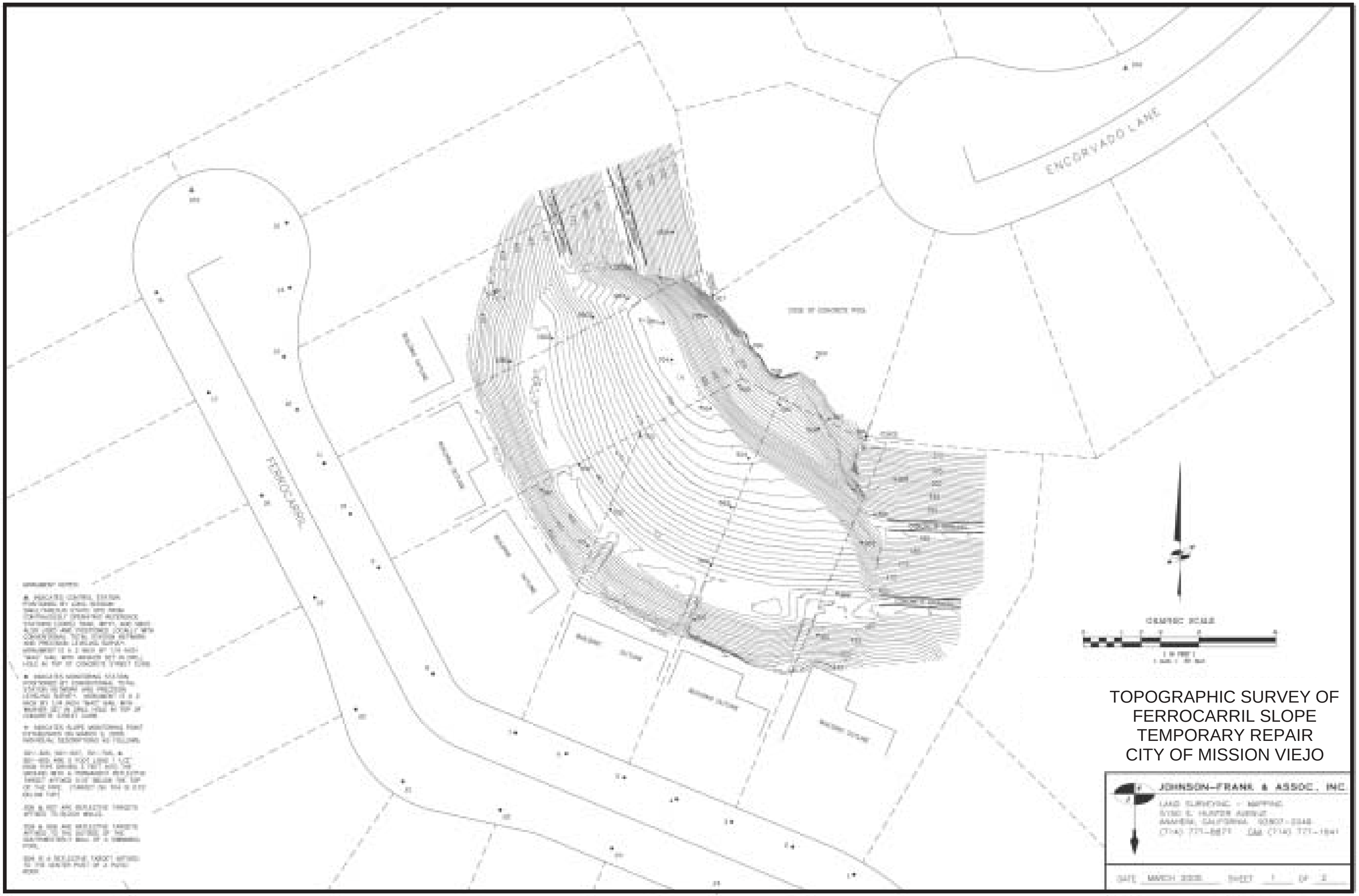
FIELD INVESTIGATION AND LABORATORY TESTING

Subsurface Exploration

Our subsurface exploration consisted of drilling four large-diameter exploratory borings (Borings B-1A through B-4A) using a bucket-auger drill rig to depths of up to 82 feet. The approximate locations of the exploratory borings are shown on the attached preliminary geologic map (Plate 1). Detailed boring logs are presented in Appendix A of this report along with logs from another investigation conducted at 24481 Chrisanta (Geofirm, 1992).

Soil and bedrock materials encountered were classified and logged in accordance with the visual-manual procedures of the Unified Soil Classification System and the Engineering Geology Field Manual by the U.S. Department of the Interior, Bureau of Reclamation, respectively.

Our subsurface exploration included the collection of bulk samples and relatively undisturbed samples of the subsurface soil materials for laboratory testing purposes. Bulk samples consisted of selected earth materials obtained at various depth intervals from the borings. Relatively undisturbed samples were collected using a 3-inch, outside-diameter, modified



SURVEY MONITORING SYSTEM

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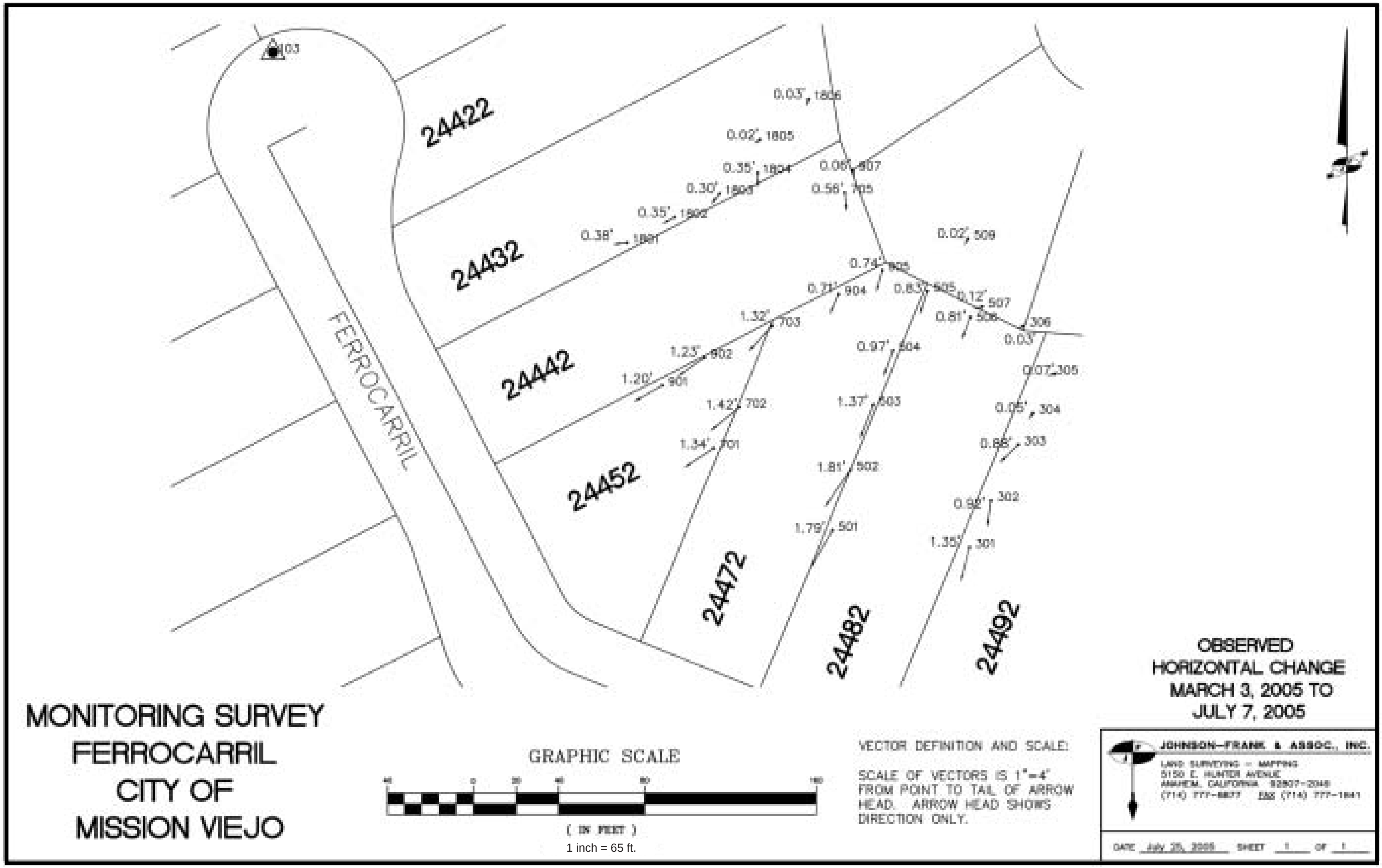
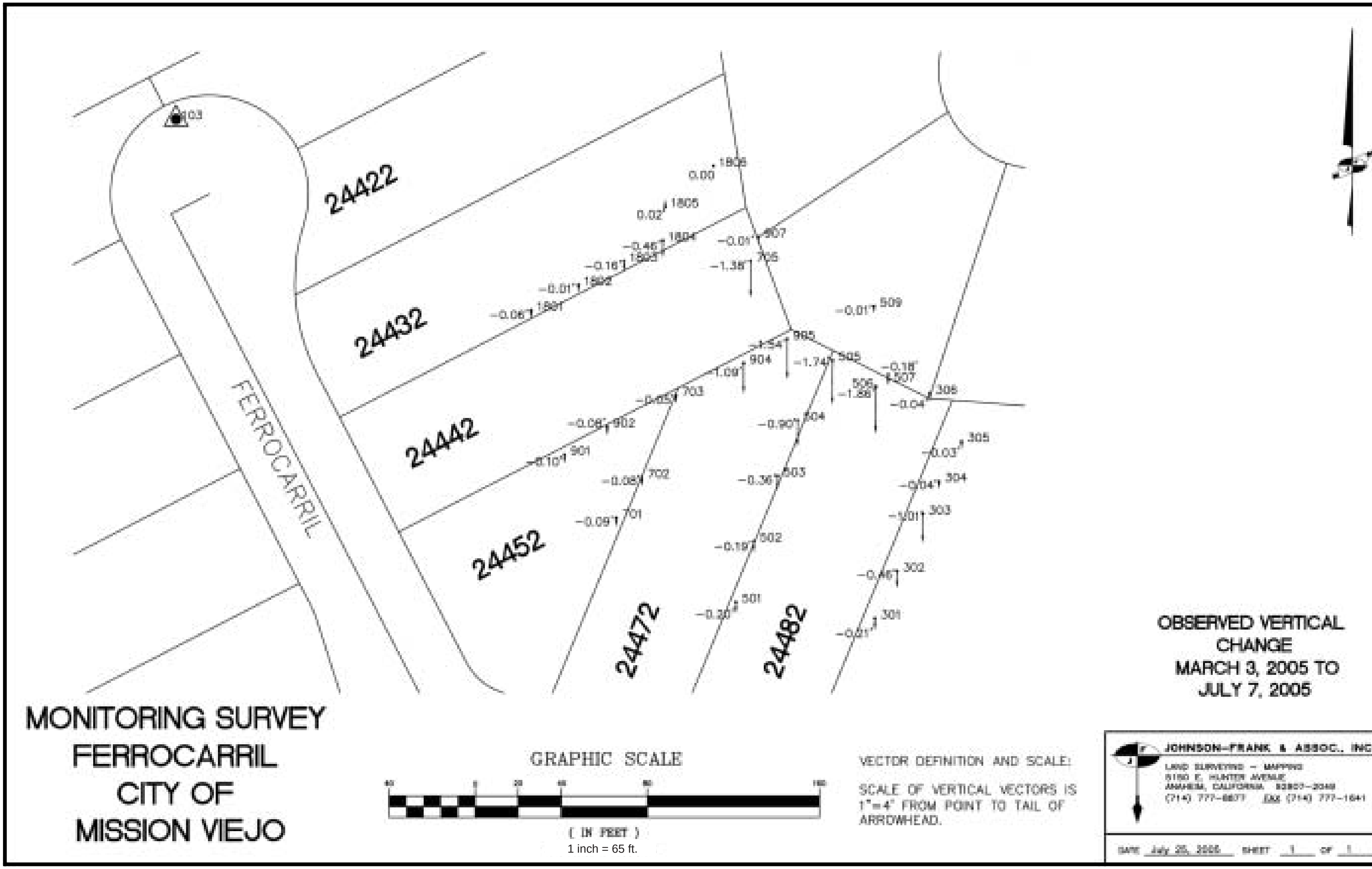
JN 173-05 **SEPT., 2005** **FIGURE 3**



HORIZONTAL MOVEMENT OF SLOPE



VERTICAL MOVEMENT OF SLOPE

California split-spoon soil sampler lined with 1-inch high brass rings. The modified California split-spoon sampler was driven with successive 12-inch drops of the Kelly bar. The total number of blows for driving the sampler 12 to 18 inches was recorded on the exploration logs. The central portions of the driven core samples were placed in sealed containers and transported to our laboratory for testing.

Laboratory Testing

Laboratory tests were performed on selected samples considered representative of those encountered in order to evaluate the engineering properties of the on-site soil and bedrock materials. Tests included the determination of in-place moisture content and unit dry density, maximum dry density and optimum moisture content, Atterberg limits, grain size analysis, and shear strength characteristics. A description of laboratory test procedures and summaries of the test data are presented in Appendix B and summaries of the test data are presented on the exploration logs (Appendix A) and in Appendix B. An evaluation of this data is reflected throughout the "Conclusions and Recommendations" section of this report.

Survey Monitoring Program

In order to determine the effectiveness of the temporarily stabilization, a survey monitoring program was implemented by Johnson – Frank & Associates, Inc. under contract to the City. Figure 3 shows the location of the survey monuments established as part of the monitoring program. Regular measurements of these monuments indicate that the temporarily stabilized slope is moving an equivalent of about 1/8-inch per day, which is much less than the 2 to 4 inches per day measured during failure. Both vertical and horizontal movements were recorded as part of the survey monitoring program. Between March 3, 2005 and July 7, 2005, vertical and horizontal movements of over one foot were measured within the slope. As anticipated, a vertical movement of about one foot occurred in the upper portions of the slope in the graben area. Vertical movements on other portions of the slope were minimal. Horizontal movements of about one foot occurred over most of the central and lower portions of the slope from about 24452 through 24492 Ferrocarril. This movement indicates that the slope is not completely stabilized and that movement is likely to continue, as the rate of movement has not decreased over time.

GEOTECHNICAL FINDINGS

Regional Geology

The subject site lies within the Capistrano Embayment, which is bounded by the San Joaquin Hills to the west and the Santa Ana Mountains to the east. These geomorphic features are part of the Peninsular Ranges Geomorphic Province of California and are underlain by Mesozoic through late Cenozoic metamorphic and sedimentary rocks. Numerous studies over the years, including those by Morton et al (1974), Ehlig (1979), and Morton and Miller (1981) describe the geology of the local area. According to Ehlig (1979), the Capistrano Embayment was a north-south trending structural trough that existed between 4 and 10 million years ago. Marine waters up to 3,000 feet deep covered the embayment, which was partially filled with layers of sand and silt. The sands and silts deposited along the bottom of the embayment eventually formed the marine sedimentary rocks that underlie the surrounding area. Over time regional uplift by tectonic forces caused the marine waters in the embayment to recede. Regional uplift in conjunction with global variations in sea level caused by various ice ages has led to the formation of the rolling hillsides and valleys that exist today.

Geologic units underlying the subject site include marine sedimentary rocks of the Pliocene Niguel Formation that are about 2 to 3 million years old (Ehlig, 1979). The Niguel Formation is composed of interbedded layers of siltstone, sandstone, and conglomerate. Thin layers of clay are sometimes found within this formation. These clay layers are typically formed by chemical weathering processes that alter thin layers of volcanic ash or other sediments into clay. Occasionally, these layers weaken overtime and act as failure planes for landslides.

Local Geology and Subsurface Conditions

The subject site is underlain by various types of earth materials including artificial fill, landslide debris and bedrock of the Niguel Formation. Detailed descriptions are presented in the exploration logs which are enclosed in Appendix A, and our interpretation of subsurface geologic conditions and the interrelationship of soil and bedrock units are shown on the enclosed preliminary geologic map and cross-sections (Plates 1 through 4). The characteristics of each of the units encountered on site are described in the following sections.

- Artificial Fill (Map Symbol: Af): Deposits of artificial fill consist of layers of silty clay, clayey silt, and silty sand, typically olive-brown to gray, moist to very moist, and soft to firm/medium dense. Fill materials appear to have been derived from the local bedrock unit and surficial soils.

- Landslide Debris (Map Symbols: Qls/Olso): Landslide debris encountered within the active slide area consists of both artificial fill and the underlying bedrock. The debris was found to be soft to firm near the surface and consist mostly of silty clay and clayey silt with variable amounts of fine sand. Ancient landslide debris found outside the limits of the active landslide consist of bedrock-derived intensely fractured materials. Along the bottom of the landslide debris lies an olive gray clay layer, about ¼- to ½-inch thick that consists of plastic, remolded clay. Striations were observed along the clay layer indicating previous movement.

- Niguel Formation (Map Symbol: Tn): This unit consists of beds of siltstone, silty sandstone and conglomerate. The siltstone and silty sandstone beds typically contain micaceous fine-grained sand and vary in color from light yellowish brown to olive gray. These beds are moderately fractured, laminated to thickly bedded, and classified as soft bedrock materials. Sandstone and conglomerate beds consist of fine-to coarse-grained sand with occasional beds of rounded gravel and are poorly cemented. Conglomerate beds contain well-rounded boulders up to 14 inches.

Geologic Structure

The geologic structure of the local area is characterized by gently inclined beds of the Niguel Formation that dip to the southwest. Geologic discontinuities within the bedrock include bedding planes and fractures. Bedding typically strikes from about N20W to N65W and dips about 3 to 7 degrees to the southwest. The orientation of the landslide rupture surface also falls within this range. Some variations from this general trend include beds dipping to the northwest, which most likely represent cross beds created during deposition. As mentioned, beds are gently inclined to the southwest, which is in the down slope direction. One of the more significant beds is a 20-foot thick sequence of permeable sandstone and conglomerate that underlies the upper portion of the slope and directly below many of the residences on Encorvado Lane. These beds are capable of transmitting groundwater and due to their southwesterly inclination direct groundwater toward the slope.

Fractures within the bedrock include joints and fractures parallel to bedding (bedding plane joints). Two joint sets are present and typically strike northwest and northeast and dip steeply to the southwest and southeast, respectively. Joint surfaces are typically stained with oxides and occasionally infilled with clay. Landslide debris is typically intensely fractured, while the underlying bedrock is typically moderately fractured. Bedding plane joints are also present and dip from about 5 to 15 degrees and are often stained with oxides. Many of the fractures and joints also act as conduits for groundwater, as observed in the borings drilled during this investigation.

Other geologic structures, including faults and well-developed folds, were not observed within the areas investigated. Active faults, as defined by the Alquist-Priolo Earthquake Fault Zoning Act (Hart and Bryant, 1997), do not transect the subject site.

Groundwater

Groundwater seepage and perched groundwater conditions were encountered in the borings drilled during this study. Groundwater seepage in the borings was observed flowing from fractures within the bedrock and along beds, particularly the sequence of sandstone and conglomerate. Significant seepage was also observed directly above and in some cases below the clay layer. The heaviest seepage was observed in boring B-4A that was drilled on Chrisanta. This boring was located at the lowest elevation of all the borings drilled.

Significant groundwater seepage, however, was not observed within the area of the active landslide, but saturated soil conditions did occur in localized areas along the toe of the slide. A test pit excavated in the rear yard of 24452 Ferrocarril to a depth of 9 feet did not encounter perched groundwater or groundwater seepage. This pit was excavated to assess the feasibility for installation of temporary sumps. Due to the lack of seepage only one temporary sump was installed in the rear yard of 24442 Ferrocarril, where the heaviest surficial seepage had been observed.

According to the Geotechnical Consultant, Inc. reports, groundwater was not encountered during grading of Tract 6333. As such, the source of the groundwater is believed to be a combination of the above-average seasonal rainfall and landscape irrigation. The permeable sandstone and conglomerate beds that underlie the residences on Encorvado Lane act as a groundwater recharge area, allowing surficial water to percolate into the ground. Fractures within the bedrock and ancient landslide debris also aid in the transmission of groundwater. Groundwater is believed to flow in a southwesterly direction toward the railroad tracks controlled by the southwesterly inclined beds and the local topographic conditions.

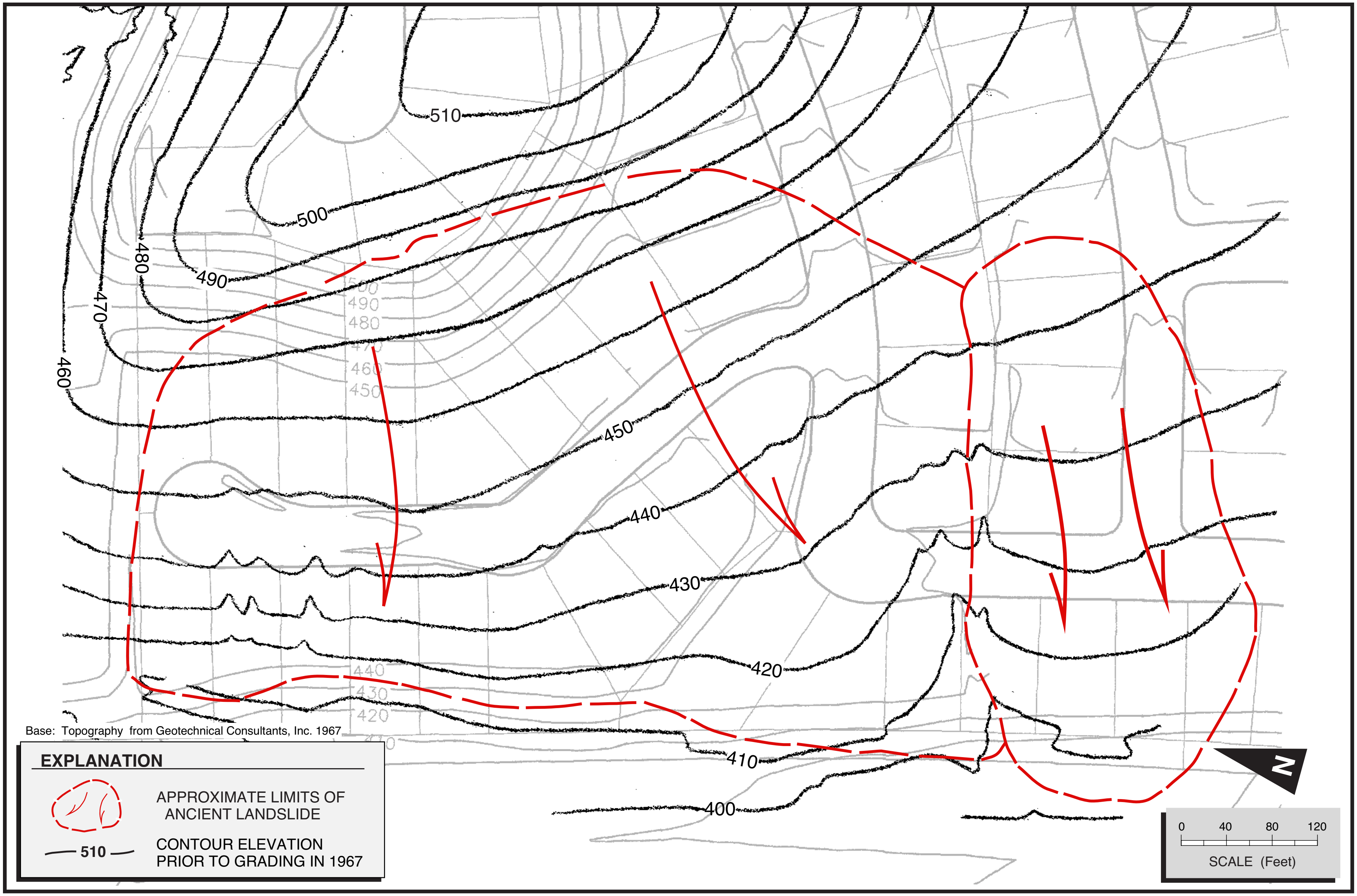
Landslides and Failure Mechanism

The Ferrocarril landslide is classified as a slow-moving block slide that failed along a pre-existing ¼- to ½-inch thick clay layer. The landslide covered an area of about ½-acre and had maximum dimensions of about 275 feet wide by 140 feet long and up to 40 feet deep. Initial movement of the slide mass resulted in the formation of tension cracks and depressions within the rear yard of 24422 Encorvado Lane and the uplifting of patios, walls and lawns in the rear yards of residences along Ferrocarril. The landslide moved slowly, typically a few inches a day resulting in vertical movements of about 3 to 5 feet along the top and the bottom of the slope. As movement progressed, open fractures formed along the flanks and within the main body of the slide, some measuring from 10 to 20 feet in depth and up to 2 feet in width. A significant open fracture, or fissure, formed across the slide mass, somewhat parallel to the upper concrete-lined terrace drain (Figure 2). This fracture formed the front of a graben, which is a depressed block that typically forms below the main scarp of block-type landslides. The graben acts as a wedge that pushes the slide mass in front of it and causes it to move down slope.

The above-average rainfall is believed to be the triggering mechanism for the landslide. Rainfall percolating into the underlying bedrock materials along fractures and within permeable sandstone beds increased pore water pressures within the bedrock and added weight to the slope. In addition, the water saturated the existing clay layer resulting in a loss of shear strength. Together these factors caused the slope to fail along the weakened layer of clay. This clay layer is believed to be the rupture surface of an ancient landslide, which is visible on historical aerial photographs that were taken prior to residential development. The presence of the clay layer in borings drilled outside the limits of the active landslide also supports this interpretation. The approximate limits of the ancient landslide, which measured about 750 wide by 500 feet long and 25 to 35 feet deep, are depicted on Figure 4 and Plate 1. The active landslide is actually thicker than the ancient slide as it includes artificial fill materials that were placed on top of the ancient landslide mass along the top of slope. The ancient landslide was also buried by artificial fill on the western side of Ferrocarril, where fills were placed to construct the slopes that descend toward the railroad tracks. This fill slope covers the toe of the ancient slide, and acts as a gravity buttress that resists reactivation of the ancient landslide.

Seismic Hazard Zones

The Seismic Hazard Zone Report for the San Juan Capistrano quadrangle (CDMG, 2001), indicates that the subject lies within an Earthquake-Induced Landslide Zone, as are several other slopes in the Mission Viejo area. This should be considered during future studies for final repair of the slope.



ANCIENT LANDSLIDE MAP

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FIGURE 4

SLOPE STABILITY ANALYSES

Slope stability calculations were performed to evaluate the gross stability of the active landslide area and adjoining portions of the slope. The results of these calculations are provided in Appendix C. This appendix also includes an explanation of shear strength parameters utilized in the calculations, a description of the various problem geometries with reference to the appropriate geotechnical cross sections, a summary of the corresponding safety factors and an overview of the computer program used to perform the calculations.

The Factor of Safety determined by slope stability analyses relies heavily upon the geologic model used in the analyses and the strength parameters of the various geologic units. The elevation of the groundwater table is also a critical factor. Variations in these factors were considered as part of our analyses and are described in the Conclusions and Recommendations portion of this report.

In order to determine the stability of the slope a series of analyses were performed that included the following:

Back Calculations – used to assess the geometry of the geologic model and strength of the geologic units prior to failure of the slope. The subsurface data obtained from the three borings drilled for the homeowners in conjunction with geologic mapping of the landslide and information obtained from the 1967 grading reports were used to model the subsurface geologic conditions. This preliminary geologic model was used in our back analysis to determine the strength of the underlying clay layer. The results of these analyses were used to develop a temporary stabilization plan.

Post Repair Analyses – used to assess the stability of the repaired portion of the slope. After the slope was temporarily stabilized a topographic survey of the slope was prepared by the City (Figure 3). The topographic survey data, in conjunction with subsurface and laboratory data obtained during our investigation for the City were used to determine the stability of the repaired portion of the slope.

Stability of Adjoining Areas – used to assess the stability of the portions of the slope adjacent to the landslide. These analyses were conducted utilizing subsurface and laboratory data obtained during our investigation for the City.

In general, the results of the stability analyses indicate that the temporarily repaired portion of the slope is marginally stable, and has a Factor of Safety of slightly less than 1.1 in the critical direction, and about 1.2 in a less critical direction. The Factor of Safety is based on the same groundwater table utilized in our back calculations. Our analyses also indicate that portions of the slope adjacent to the repaired area have a Factor of Safety ranging from about 1.0 to 1.4 depending upon the interpreted geologic conditions.

CONCLUSIONS AND RECOMMENDATIONS

Stability of Temporary Stabilization
(24432 through 24492 Ferrocarril and 24422 Encorvado Lane)

The results of our slope stability analyses and the survey monitoring program indicate that the repaired portion of the slope is marginally stable and that the slope is still moving. Any increase in pore pressure from excessive landscape irrigation or heavy winter rains will decrease the stability of the slope and most likely increase the rate of movement. Continued movement of the slope could cause damage to the impacted residences and possibly the adjoining properties. As such, we recommend that additional stabilization methods be employed that will stop the observed movement. The geologic model used to determine the stabilization method and related Factor of Safety should include the groundwater table as used in our stability analysis.

A stabilization method for temporary stabilization that may be considered includes installation of caissons along the bottom of the slope. It is our understanding that design of the caissons will be performed by others using the results of this study.

Stability of Adjoining Properties
(24412 and 24422 Ferrocarril, 24412, 24421 and 24431 Encorvado Lane, and 24461, 24471 and 24481 Christanta)

The results of our analyses indicate that the portions of the slope adjacent to the repaired area may be marginally stable. These results are highly dependent upon the geologic model used in the analyses. The geologic model used in our analyses is based on the limited subsurface data obtained during our study. Other geologic models can be derived utilizing the current information, resulting in other conclusions regarding the stability of the adjoining properties.

Based on the results of our study, we recommend that the portions of the slope from 24412 through 24492 Ferrocarril be considered for geotechnical evaluation during preparation of plans for final stabilization of the slope. In order to adequately evaluate these areas, additional subsurface information should be obtained from 24412, 24422 and 24492 Ferrocarril, as well as 24412, 24421 and 24431 Encorvado Lane and possibly 24461, 24471 and 24481 Chrisanta. As previously mentioned, the calculated stability of these areas is highly dependent upon the actual subsurface conditions, which may not coincide with our geologic model that was based on the limited subsurface information obtained during our study.

Stability of Neighborhood

Detailed analyses of other areas in the adjoining neighborhood underlain by the ancient landslide mass were not performed during this study. However, data collected during this study suggest that the residences on the west side of Ferrocarril and 24511 through 24571 Chrisanta Drive are most likely stable due to the buttressing effect of the continuous fill slope along their rear yards. The stability of other residences along Chrisanta Drive and Arcada Drive is difficult to assess at this time due to the limited amount of subsurface data. Additional studies in theses areas should be performed if formation of a special assessment district is considered in the future.

Homeowner Occupancy

Based on the current rate of movement of the slope, it is our opinion that the residences at 24442, 24452, 24472, 24482 and 24492 Ferrocarril should remain unoccupied until such time that the slope is stabilized. This can most likely be accomplished by installation of additional stabilization measures, such as soldier beams, along the bottom of the slope. However, the permanent final repair of the slope should be completed prior to granting permanent occupancy. The residences at 24412, 24422 and 24432 Ferrocarril can remain occupied; however, owners should notify the City if any signs of movement are observed on their property.

Based on our review of the survey data and observations, it is our opinion that the residence at 24422 Encorvado Lane can be re-occupied provided that a vertical barricade is placed at least 5 feet behind the main scarp of the landslide located in the rear portion of the property. This barricade must have a minimum height of 5 feet. The existing swimming pool is to remain empty at all times until the descending slope is repaired. In addition, we recommend that the property be periodically monitored for signs of movement. A geotechnical consultant under contract to the property owner should perform the monitoring. We suggest that the monitoring be performed at intervals not exceeding four weeks and that a written summary of the consultant's observations be submitted to the City. The property owner should observe the property on a continual basis and notify the City and request an interim visit by the consultant should any signs of new distress or worsening of any existing distress is observed between two successive visits. We also recommend that the property owner's geotechnical consultant obtain copies from the City of the results of the ongoing survey monitoring program of the slope to assist them in their monitoring of the property.

Slope Maintenance and Landscape Irrigation

The repaired portion of the slope should be covered with heavy plastic sheeting (or equivalent materials) during the months of October through May. The plastic sheeting can be removed at the City's discretion during the summer months to help promote drying of the slope. The plastic sheeting should be secured by staking or other methods and maintained on a regular basis.

Landscape irrigation for the repaired portion of the slope has been shut off and should remain so until such time that the slope is permanently repaired. Landscape irrigation for the adjoining portions of the slope should also be drastically reduced or shut off if not already done so until the slope is permanently repaired. Homeowners along Encorvado Lane should also be asked to minimize their landscape irrigation due to the fact that water from these areas percolates into the ground and flows toward the slope.

Final plans for repair of the slope should incorporate proper drainage devices and recommendations for slope maintenance and planting.

INVESTIGATION LIMITATIONS

This report is based on the proposed project and geotechnical data as described herein. The materials encountered on the project site, described in other literature and utilized in our laboratory investigation are believed representative of the project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soils and bedrock can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. Residents concerned about the conclusions and recommendations provided in this report should consider having this report independently reviewed by another geotechnical consultant.

This report has been prepared consistent with the level of care being provided by other professionals providing similar services at the same locale and in the same time period. This report provides our professional opinions and as such, they are not to be considered a guaranty or warranty.

This opportunity to be of service is sincerely appreciated. Please call if you have any questions pertaining to this report.

Respectfully submitted,

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AERIAL PHOTOGRAPHS REVIEWED

Source – Continental Air Services

Date	Flight No.	Frame No.
12-12-1952	AKK-3K	70, 71
3-28-1959	261 7-26	134, 135
3-30-1967	2	135, 136
1-31-1970	61-8	206, 207
10-30-1973	132 11	11, 12
1-13-1975	157 12	19, 20
2-26-1980	80033	205, 206
1-13-1981	211 12	19, 20
4-8-1983	218 12	20, 21
1-9-1987	F	273, 274
1-20-1992	C85-13	9, 10
5-14-1993	C90-7	235, 236
1-28-1995	C102-41	158, 159
9-23-1997	C117-41	9, 10
3-2-1999	C135-41	233, 234

APPENDIX A

EXPLORATION LOGS

PREVIOUS BORING (OTHER CONSULTANT)

PETRA

Key to Soil and Bedrock Symbols and Terms

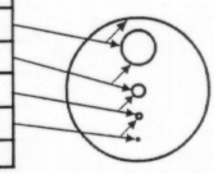
PETRA

Unified Soil Classification System

Major Divisions				Symbol	Description
Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye	GRAVELS more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
			Gravels with fines	GM	Silty Gravels, poorly-graded gravel-sand-silt mixtures
				GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
		SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
			Sands with fines	SM	Silty Sands, poorly-graded sand-gravel-silt mixtures
				SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve		SILTS & CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts & clays of low plasticity
		SILTS & CLAYS Liquid Limit Greater Than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silt
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic silts and clays of medium-to-high plasticity
Highly Organic Soils				PT	Peat, humus swamp soils with high organic content

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller



Laboratory Test Abbreviations

MAX	Maximum Dry Density
EXP	Expansion Potential
SO4	Soluble Sulfate Content
RES	Resistivity
pH	Acidity
CON	Consolidation
SW	Swell
CL	Chloride Content
RV	R-Value
MA	Mechanical (Particle Size) Analysis
AT	Atterberg Limits
#200	#200 Screen Wash
DSU	Direct Shear (Undisturbed Sample)
DSR	Direct Shear (Remolded Sample)
HYD	Hydrometer Analysis
SE	Sand Equivalent
OC	Organic Content
COMP	Mortar Cylinder Compression

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

Sampler and Symbol Descriptions

- ▽ Approximate Depth of Seepage
- ▼ Approximate Depth of Standing Groundwater
- Modified California Split Spoon Sample
- Standard Penetration Test
- Bulk Sample
- Shelby Tube
- No Recovery in Sampler

Bedrock Hardness

Soft	Can be crushed and granulated by hand; "soil like" and structureless
Moderately Hard	Can be grooved with fingernails; gouged easily with butter knife; crumbles under light hammer blows
Hard	Cannot break by hand; can be grooved with a sharp knife; breaks with a moderate hammer blow
Very Hard	Sharp knife leaves scratch; chips with repeated hammer blows

Notes:

Blows Per Foot: Number of blows required to advance sampler 1 foot (unless a lesser distance is specified). Samplers in general were driven into the soil or bedrock at the bottom of the hole with a standard (140 lb.) hammer dropping a standard 30 inches unless noted otherwise in Log Notes. Drive samples collected in bucket auger borings may be obtained by dropping non-standard weight from variable heights. When a SPT sampler is used the blow count conforms to ASTM D-1586

E X P L O R A T I O N   L O G

Project: **Ferrocarril Landslide**		Boring No.:	**B-1**
Location: **Mission Viejo, California**		Elevation:	**+\- 506'**
Job No.: **151-05**	Client: **Homeowners**	Date:	**1/28/05**
Drill Method: **Limited Access B.A.**	Driving Weight: **See Notes**	Logged By:	**DS**

Depth (Feet)	Material Description	Water	Samples: Blows	Laboratory Tests: Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	LANDSLIDE DEBRIS (Qls) Silty Clay to Clayey Silt (CL/ML): Mottled light olive brown to olive yellow; moist to very moist; soft; some fine-grained sand; micaceous; low plasticity (FILL).					
5						
10	@10 Feet: Becomes very moist.		4			
	@11 Feet: Minor seepage.					
	@12 Feet: Becomes mottled light olive brown with very dark gray to black (FILL).		16	11.3	113.1	DSU MAX
	Sandy Clay (CL): Mottled very dark gray and black; moist; soft; medium-grained sand.					
	Silty Clay with Sand (CL): Mottled olive brown and very dark gray; moist; soft; trace of cobbles up to 7" in diameter.					
15	@14.5 Feet: Driller encountered possible void.					
	Silty Clay to Clayey Silt (CL/ML): Mottled light olive brown and olive yellow; moist to very moist.		19	25.6	96.5	DSU
20	@20.75 Feet: Trace of coarse-grained gravel.					
	Silty Clay (CL): Mottled very dark gray to black and olive brown; moist to very moist; soft; trace of sand.					
	Silty Sand (SM): Light brown; moist; soft; fine- to medium-grained sand; trace gravel up to 3", micaceous.		40	24.6	96.7	DSU
25	@23.3 Feet: FRACTURE - N72E / 62SE; fracture cuts through fill; open 1/8" (rupture surface).					

PLATE A-1

Petra Geotechnical

EXPLORATION LOG

Project:	**Ferrocarril Landslide**	Boring No.:	**B-1**
Location:	**Mission Viejo, California**	Elevation:	**+\- 506'**
Job No.: **151-05**	Client: **Homeowners**	Date:	**1/28/05**
Drill Method: **Limited Access B.A.**	Driving Weight: **See Notes**	Logged By:	**DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af) Silty Clay to Clayey Silt (CL/ML): Mottled light olive brown to olive gray and brownish-yellow; moist to very moist; soft; trace of fine- to medium-grained sand; highly plastic.							
		Sandy Clay (CL): Mottled gray to very dark gray and black; very moist; soft; fine- to coarse-grained sand; slight organic odor; 12-14" boulder observed; some seepage.							
30		Silty Clay to Clayey Silt (CL/ML): Olive brown (2.5Y 4/4); moist; soft; some fine-grained sand; some carbonate nodules. @30 Feet: Becomes dark grayish brown (2.5Y 4/2); moist; carbonate stringers.		50/ 14"			17.6	108.6	MAX
35		**BEDROCK - Niguel Formation (Tn)** Silty Sandstone: Pale yellow (2.5Y 7/4); moist; soft; fine-grained sand; micaceous; occasional thin beds of clayey silt; grayish brown (2.5Y 5/2).							

Notes:
Total Depth = 39 Feet
Minor Seepage within Fill
Hole Left Open Over Weekend
Borehole Offset ~8" Horizontally at 23.3 Feet
Caving at 29 Feet
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-5 Feet - 90 lbs
5-10 Feet - 90 lbs
10-15 Feet - 80 lbs
15-20 Feet - 60 lbs
20-25 Feet - 55 lbs
Stems - 100 & 125 lbs.

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.:	**B-2**
Location: **Mission Viejo, California**		Elevation:	**+\- 445'**
Job No.: **151-05**	Client: **Homeowners**	Date:	**2/1/05**
Drill Method: **Limited Access B.A.**	Driving Weight: **See Notes**	Logged By:	**AP/DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af) Silty Clay (CL): Pale olive to olive gray; very moist; soft to firm; some orange mottling; some roots.							
		LANDSLIDE DEBRIS (Qls) Clayey Siltstone: Mottled olive gray to olive; soft; moderately to intensely fractured; poorly bedded; carbonates noted in cuttings. @3.8 Feet: JOINT - N37W / 76SW; clay lined; closed.							
5		@5 Feet: Becomes stiff; micaceous. @6 Feet: Minor seepage on north and south sides of borehole. @6.5 Feet: Sidewall of borehole ravels off readily. @7 Feet: Some carbonate nodules. @7.5 Feet: Increased seepage; JOINT - N50W / 45SW.		8			27.5	94.3	DSU
10		@9.75 Feet: Clay; olive gray; remolded; 1/2" thick; some striations; some carbonate nodules; some roots on upper surface; flat lying; CLAY SEAM - N65W / 3-4SW (Rupture Surface). @9.8 Feet: Polished surface; some striations; N65W / 3-4SW.		33			26.5	97.5	AT DSR HYD
		BEDROCK - Niguel Formation (Tn) Sandy Siltstone: Olive brown; moist; soft; fine-grained sand; moderately fractured; poorly bedded; micaceous; some iron oxide staining. @12 Feet: Digs very stiff.							
15		Sandy Siltstone: Orange Mottled with olive gray; moist; soft; flat lying. @13.6 Feet: Grades to siltstone.		50/ 15"			25.4	98.1	
20		Clayey Siltstone: Dark gray; moist; soft.		15/ 17"			25.1	99.3	

Notes:
Total Depth = 21 Feet
Minor to Moderate Seepage from 6 to 7.5 Feet
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-5 Feet - 90 lbs
5-10 Feet - 90 lbs
10-15 Feet - 80 lbs
15-20 Feet - 60 lbs.

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.: **B-3**	
Location: **Mission Viejo, California**		Elevation: **+\- 463'**	
Job No.: **151-05**	Client: **Homeowners**	Date: **2/1/05**	
Drill Method: **Limited Access B.A.**	Driving Weight: **See Notes**	Logged By: **AP/DS**	

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		LANDSLIDE DEBRIS (Qls)							
		Sandy Silt to Silty Sand (ML/SM): Pale olive; moist; medium dense/firm; (FILL).							
5				18			14.9	103.1	
		@7 Feet: Gradual increase in moisture; stiff.							
10		Clayey Silt with Sand (ML): Olive to yellowish-brown; moist; firm to stiff; fine-grained sand; micaceous.		19			20.8	101.8	
		@12.5 Feet: Sand; white; 1/2" thick.							
		Silt (ML): Pale olive; very moist; firm.							
15		Clayey Silt to Silty Clay (CL/ML): Mottled olive gray to yellowish-gray; very moist; firm to stiff.		20			21.0	102.1	DSU
		@19 Feet: Moderate to heavy seepage; moderate caving; hole belled ~12" to 18" on all sides.							
20		Silty Sand (SM): Olive gray; medium dense; fine-grained sand.		11			18.9	100.5	
		Siltstone: Olive with orange mottling; moist; soft.							

EXPLORATION LOG

Project:	Ferrocarril Landslide		Boring No.:	B-3
Location:	Mission Viejo, California		Elevation:	+\- 463'
Job No.:	151-05	Client: Homeowners	Date:	2/1/05
Drill Method:	Limited Access B.A.	Driving Weight: See Notes	Logged By:	AP/DS

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		@26 Feet: Becomes mottled olive gray and olive yellow (oxide staining); stiff; fine-grained sand; micaceous; bioturbated.		48	■		29.7	93.3	
30		Sandy Siltstone: Light yellowish-brown (2.5Y 3/1 & 3/2); moist; soft; fine-grained sand; micaceous.		100	■		25.6	96.6	
35		**BEDROCK - Niguel Formation (Tn)** Siltstone: Mottled very dark gray and dark olive gray (2.5Y 3/1 &3/2); moist; soft; thin sand lenses; unoxidized zone; thinly bedded; beds disturbed (bioturbated; nearly flat lying).		100	■		20.4	104.7	

Notes:
Total Depth = 36.3 Feet
Moderate to Heavy Seepage at 19 Feet
Caving at 19 to 21 Feet
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-5 Feet - 90 lbs
5-10 Feet - 90 lbs
10-15 Feet - 80 lbs
15-20 Feet - 60 lbs
20-25 Feet - 55 lbs
Stems - 100 & 125 lbs.

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.: **B-1A**	
Location: **Mission Viejo, California**		Elevation: **442'**	
Job No.: **173-05**	Client: **City of Mission Viejo**	Date: **2/22/05**	
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By: **DS**	

Depth (Feet)	Lith- ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ASPHALT 2.5"-thick.							
		BASE 6.5"-thick.							
		ANCIENT LANDSLIDE DEBRIS Sandy Siltstone: Mottled light brownish-gray and dark grayish-brown (2.5Y 6/2 - 4/2); moist; soft; very fine-grained sand; intensely fractured; moderately weathered; clayey; micaceous.							
5		@4.5 Feet: JOINT - N57W / 83SW; lined with carbonates; intensely fractured.		4			28.6	93.7	
		@6.3 Feet: Bedding is relatively flat lying; some carbonate fractures along bedding.							
		@9.3 Feet: Becomes very moist; very soft.							
10		@10 Feet: Clay seam; olive gray; 1/4" thick; some roots; highly plastic; failure surface is very planar; lined with carbonates; minor seepage from uphill(east) side of hole; downhill(west) side of hole is weakly cemented with carbonates; CLAY SEAM - N30W / 1-4SW (Rupture Surface).		5			28.0	94.0	
		BEDROCK - Niguel Formation (Tn) Siltstone to Clayey Siltstone: Mottled light brownish-gray, olive gray (5Y 5/2), and light olive brown; moist; soft; intensely fractured; moderately weathered; occasional rounded gravel; micaceous.							
		@10.3 Feet: Discontinuous shear.							
		@12.6 Feet: 3-5" layer of siliceous cobbles; well rounded; cobble layer dips 3-5W; discontinuous shear below cobble layer; seepage along fractures at noted depth.							
15		Sandy Siltstone: moderately fractured; iron oxide stained; micaceous.		10			19.6	101.1	DSU
		Silty Sandstone: White (5Y 8/1) to light yellowish-brown and gray; moist to very moist; soft; very fine-grained sand; very thinly bedded; moderately fractured; oxidation banding along bedding; poorly cemented; micaceous.							
		@15 Feet: 2"-thick zone of iron oxide banding; BEDDING - N30-40W / 2SW; signs of infilled burrows.							
		@15.3 Feet: 1"-thick zone of sand; gray with iron oxide staining.							

PLATE A-6

Petra Geotechnical

EXPLORATION LOG

Project:	**Ferrocarril Landslide**	Boring No.:	**B-1A**
Location:	**Mission Viejo, California**	Elevation:	**442'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/22/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DS**

Depth (Feet)	Lith- ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		@15.4 Feet: 6"-thick sand bed; white with iron oxide banding. @15.9 Feet: 1"-thick sand bed; gray with oxide banding. @17 Feet: Significant increase in seepage. @17.3 Feet: Base of sandstone; contact is wavy and iron oxide coated; CONTACT - N35W / 6SW (sandstone overyling siltstone).							
20		<u>Sandy to Clayey Siltstone</u>: soft; fine-grained sand.		6	■		27.5	97.0	
		@19.3 Feet: Clay seam; paper thin; parallel to bedding above. @19.5 Feet: Discontinuous clay lined fracture; FRACTURE - N72E / 8NW. @19.7 Feet: Clay layer; paper thin. @22 Feet: Clay layer; paper thin; parallels bedding; discontinuous; dip 4NW. @23.3 Feet: Sandy Siltstone; 4-5"-thick; mottled gray and yellowish-brown. @23.9 Feet: Discontinuous fracture; iron oxide coated; dip 8NW.							
25									
		<u>Silty Sandstone</u>: Gray; soft. @27.9 Feet: Discontinuous fracture; iron oxide coated; nearly flat lying.							
30		<u>Sandy to Clayey Siltstone</u>: Mottled gray (5Y 5/1) and olive brown (2.5 Y 4/4); moist; soft; very thinly bedded; slightly to moderately fractured; moderately weathered; some iron oxide staining; micaceous. @31 Feet: Transition to unoxidized zone. @32 Feet: Contact of oxidized overlying unoxidized; yellowish-brown iron oxide staining along contact; CONTACT - N20-25W / 3-4SW.		12	■		27.6	95.3	
35		<u>Sandy Siltstone to Siltstone</u>: Dark gray to very dark gray (5Y 4/1 - 3/1); moist; soft; very fine-grained sand; very thinly bedded; slightly to moderately fractured; fresh to slightly weathered; micaceous.							

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.: **B-1A**	
Location: **Mission Viejo, California**		Elevation: **442'**	
Job No.: **173-05**	Client: **City of Mission Viejo**	Date: **2/22/05**	
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By: **DS**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Sandy Siltstone to Siltstone: Dark gray to very dark gray (5Y 4/1 - 3/1); moist; soft; very fine-grained sand; very thinly bedded; slightly to moderately fractured; fresh to slightly weathered; micaceous.							
40				30/ 11"			25.5	97.5	
45									
50				50/ 8"			25.1	97.0	

PLATE A-8

EXPLORATION LOG

Project:	**Ferrocarril Landslide**	Boring No.:	**B-1A**
Location:	**Mission Viejo, California**	Elevation:	**442'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/22/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
55		Sandy Siltstone to Siltstone: Dark gray to very dark gray (5Y 4/1 - 3/1); moist; soft; very fine-grained sand; very thinly bedded; slightly to moderately fractured; fresh to slightly weathered; micaceous.							
60				50	■		25.1	98.4	

Notes:
Total Depth = 61 Feet
Minor Seepage at 10 Feet with Increased Seepage at 17 Feet
No Caving
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-24 Feet - 2,150 lbs
25-44 Feet - 1,350 lbs
45-65 Feet - 650 lbs.

EXPLORATION LOG

Project:	**Ferrocarril Landslide**	Boring No.:	**B-2A**
Location:	**Mission Viejo, California**	Elevation:	**443.6'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/23/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DPO/DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ASPHALT 2.5"-thick.							
		BASE 6.5"-thick.							
		ANCIENT LANDSLIDE DEBRIS Sandy to Clayey Siltstone: Mottled dark grayish-brown (2.5Y 4/2); very moist; soft; fine-grained sand; intensely fractured; moderately weathered; some clay; micaceous; moderately plastic. @1.7 Feet: Becomes mottled light olive brown (2.5Y 5/4) to light brownish-gray (2.5Y 6/2); moist to very moist. @3.8 Feet: Clay Seam; paper thin- to 1/8"-thick; few roots within zone; CLAY SEAM - N50W / 6SW (Rupture Surface).							
5		**BEDROCK - Niguel Formation (Tn)** Sandy Siltstone: Mottled gray and olive brown; moist; soft; very fine- to fine-grained sand; very thinly to thinly bedded; moderately fractured; moderately weathered; micaceous; some clay. @5.8 Feet: Intensely fractured zone; 6"-thick; fractures discontinuous and clay lined; fractures within zone N5E / 26NW and N45W / 14SW. @7.8 Feet: Increased sand content.		6			26.6	96.7	
10		@9.8 Feet: JOINT - N10W / 62SW. @10.2 Feet: BEDDING - dips 3SW. @12.3 Feet: Sandy siltstone; very thinly bedded; bedding planes wavy; micaceous; abundant infilled burrows; BEDDING - N22W / 5-12W. @14.2 Feet: Iron oxide coated surface; wavy.		6			25.5	97.2	
15		Sandy to Clayey Siltstone: Olive gray (5Y 4/2) to very dark gray; moist; soft; very thinly bedded; slightly to moderately weathered; some fine-grained sand; transition into unoxidized zone. @16.7 Feet: Fracture, near horizontal; iron oxide stained. @17 Feet: Becomes siltstone; dark gray to very dark gray; becomes more unoxidized. @18.4 Feet: Iron oxide stained surface along bedding; wavy; N10-20W / 5-10SW. @19.5 Feet: Fracture along bedding; discontinuous; minor seepage along surface.		7			24.0	99.6	
20		Siltstone to Sandy Siltstone: Olive gray (5Y 4/2); moist; soft; fine-grained sand; slightly weathered; micaceous; partially unoxidized; slight organic odor. @21 Feet: Becomes unoxidized; dry; no mudcake. @22.4 Feet: Shell hash.		6			24.6	98.1	
		Siltstone: Very dark gray; dry to slightly moist; very thinly bedded; unoxidized; BEDDING - dip 5SW.							

PLATE A-10

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.:	**B-2A**
Location: **Mission Viejo, California**		Elevation:	**443.6'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/23/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DPO/DS**

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Siltstone: Very dark gray; dry to slightly moist; very thinly bedded; unoxidized.							
		@26 Feet: BEDDING - N30-40W / 6SW.							
30				25	■		25.6	97.3	
		@32.9 Feet: BEDDING - N45W / 4SW.							
35									
40				30	■		24.8	99.4	DSU

Notes:
Total Depth = 41 Feet
Minor Seepage at 19.5 Feet
No Caving
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-24 Feet - 2,150 lbs
25-44 Feet - 1,350 lbs.

EXPLORATION LOG

Project: Ferrocarril Landslide		Boring No.: B-3A
Location: Mission Viejo, California		Elevation: 509'
Job No.: 173-05	Client: City of Mission Viejo	Date: 2/24/05
Drill Method: Bucket Auger	Driving Weight: See Notes	Logged By: DPO/DS

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ASPHALT 2.5"-thick.							
		BASE 6.0"-thick.							
		BEDROCK - Niguel Formation (Tn) Sandy Siltstone: Light yellowish-brown (2.5Y 6/4); moist to very moist; soft; fine-grained sand.							
		Sandy Siltstone to Silty Sandstone: Light yellowish-brown (2.5Y 6/4); moist; soft; fine-grained sand; moderately weathered. @3.6 Feet: Becomes light gray mottled with iron oxide staining; thinly bedded; moderately fractured; micaceous; BEDDING N10W / 4SW. @4 Feet: JOINT - N30E / 78SE (iron oxide lined).							
5		@5 Feet: Becomes light yellowish-brown (2.5Y 6/3).		7	■		23.7	99.8	
		Siltstone to Clayey Siltstone: Olive gray (5Y 5/2); moist; soft; slightly to moderately weathered; iron oxide stained; some fine-grained sand interbeds; JOINT - N20E / 86SE; closed; slight seepage along fracture. @8.3 Feet: Iron oxide stained sand lens; BEDDING - N5-10W / 4SW.				■			MAX
		@9.3 Feet: Discontinuous polished surfaces along bedding; wavy-irregular; thin layer of clay.							
10		@9.4 Feet: Fracture along bedding; iron oxide stained; irregular/wavy; FRACTURE - dips 15-20NW. @10.2 Feet: Iron stained bed; 1/2"-thick; BEDDING - N55E / 10NW.		6	■		25.3	96.6	
		@11 Feet: Becomes Clayey Siltstone; moist to very moist; thin to very thinly bedded; moderately to intensely fractured; moderately weathered; some infilled burrows; micaceous; JOINT - N35E / 87SE. @12.4 Feet: Fracture along bedding; discontinuous; iron oxide stained; FRACTURE - N35W / 7SW.							
		@14 Feet: Increase in sand content; some laminations of very fine-grained sand.							
		Sandstone: White to light yellowish-brown (10YR 6/4); slightly moist to							

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.: **B-3A**
Location: **Mission Viejo, California**		Elevation: **509'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date: **2/24/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By: **DPO/DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		moist; soft; fine-grained sand; moderately weathered; micaceous. @15.3-16.2 Feet: Pebbly Conglomerate; varies from fine-grained gravel to small cobble sized clasts; fine- to coarse-grained sand. @16.2 Feet: Sandstone; white; fine- to medium grained sand; trace gravel; contact with overlying pebble conglomerate is wavy. @17 Feet: Becomes fine- to coarse-grained sand. @17.4-17.6 Feet: Becomes very fine-grained sand; bedding is nearly flat lying. @17.6-18.6 Feet: Pebbly Conglomerate; distinct increase in moisture.		10/ 8"			5.1	120.6	
		<u>Siltstone</u>: Medium gray to olive gray; moist; soft; upper contact is very wavy; erosional; minor to slight seepage.							
20				10/ 6"			14.9	115.1	
		<u>Sandstone</u>: White; slightly moist; fine- to medium-grained sand; slightly fractured; uncemented; micaceous. @22 Feet: BEDDING - N25E / 4NW. @22.3 Feet: Sidewalls of the boring begin to bell out.							
		<u>Conglomeratic Sandstone</u>: Dark yellowish-brown (10YR 4/4); moist to wet; fine- to coarse-grained sand; numerous boulders up to 13"; well rounded.							
25									
		<u>Sandstone</u>: Light gray; moist to very moist; soft; fine- to coarse-grained sand; trace coarse-grained gravel; and small cobbles; rounded to well rounded; uncemented.							
		<u>Sandy Siltstone</u>: Olive gray to light olive brown (2.5Y 5/6); moist; soft; fine-grained sand; very thinly to thinly bedded; iron oxide staining; micaceous; contact with overlying sandstone is iron oxide stained.							
		<u>Sandstone</u>: White; very fine- to fine-grained sand; laminated; infilled burrows 3" to 4" long; BEDDING - N35W / 6NE.							

EXPLORATION LOG

Project:	**Ferrocarril Landslide**	Boring No.:	**B-3A**
Location:	**Mission Viejo, California**	Elevation:	**509'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/24/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DPO/DS**

Depth (Feet)	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	Silty Sandstone: Light gray.		30/ 11"			20.1	102.8	DSU MAX
	Sandstone: White.							
	Siltstone: Light gray.							
	Sandstone. @32 Feet: BEDDING - N25W / 4SW.							
	Silty Sandstone: Very light gray to white.							
	Sandstone: White.							
35	@35.4 Feet: Becomes olive yellow stained with iron oxides; some silt.							
	@36 Feet: Slight seepage from west sidewall of the borehole.							
	Sandy Siltstone: Mottled gray with iron oxide staining. @36.7 Feet: JOINT - N43W / 78SW; lined with oxides.							
	@38 Feet: Moderate seepage emanating from gypsum filled fractures.							
40	Siltstone: Dark grayish-brown (2.5Y 4/2); moist; soft; moderately weathered; some seepage coming from fractures within siltstone.		30			22.3	102.3	
	@42.5 Feet: Iron staining along bedding; discontinuous; dips approximately 5SW.							
	@43 Feet: Becomes very dark gray; unoxidized.							

PLATE A-14

Petra Geotechnical

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.:	**B-3A**
Location: **Mission Viejo, California**		Elevation:	**509'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/24/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DPO/DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Siltstone: Very dark gray; moist; soft; moderately weathered; some slightly polished surfaces; undulatory; shallow dips SW; some shell hash.							
		@45.9 Feet: Iron stained bed; wavy; BEDDING - N65E / 7SE.							
		@49.5 Feet: Small clam shell; 1/2"-wide.							
50		@50 Feet: JOINT - N47W / 78NE.		50/ 10"			24.1	99.8	
		@51.8 Feet: Clay seam; wavy; within an approximately 2"-thick intensely fractured zone; numerous polished surfaces; CLAY SEAM - N25-30W / 4-5SW.							
		@53-55 Feet: Joints along the west side of the borehole are steeply dipping West.							
55		@55-55.5 Feet: An approximately 6"-thick zone of concretions; discontinuous.		50/ 7"			21.8	102.6	
		@59 Feet: Joints closely spaced on the west side of the borehole; siltstone is very thinly bedded.							

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.:	**B-3A**
Location: **Mission Viejo, California**		Elevation:	**509'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/24/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DPO/DS**

Depth (Feet)	Lith- ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Siltstone: Very dark gray; moist; soft.		50/ 10"			21.2	102.3	
		@61.5 Feet: Siltstone becomes olive brown (2.5Y 4/3).							
		@63 Feet: Becomes brown to olive brown; slightly sandier than above.							
65		Siltstone to Sandy Siltstone: Olive brown (2.5Y 4/3); moist; soft; fine-grained sand; laminated to thinly bedded; moderately weathered.		40			24.4	98.3	
		@67 Feet: Becomes dark grayish-brown (2.5Y 4/2).							
		@69 Feet: Bedding remains slightly inclined to SW.							
70				40/ 2"					
		@72 Feet: Becomes dark olive gray (5Y 3/2).							

PLATE A-16

E X P L O R A T I O N   L O G

Project: Ferrocarril Landslide		Boring No.: B-3A
Location: Mission Viejo, California		Elevation: 509'
Job No.: 173-05	Client: City of Mission Viejo	Date: 2/24/05
Drill Method: Bucket Auger	Driving Weight: See Notes	Logged By: DPO/DS

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Siltstone to Sandy Siltstone: Olive brown (2.5Y 4/3); moist; soft; fine-grained sand; laminated to thinly bedded; moderately weathered.		50			24.9	100.3	
80		Siltstone: Dark gray (5Y 4/1); moist; soft; unoxidized micaceous.		50			21.7	101.5	

Notes:
Total Depth = 81.5 Feet
Slight to Moderate Seepage at 7.5, 18.6, 36, and 38 Feet
Slight Belling at 22-26 Feet
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-24 Feet - 2,150 lbs
25-44 Feet - 1,350 lbs
45-65 Feet - 650 lbs
66 and below - 500 lbs

Temporary Monitoring Well
50 Feet Total (slotted 20' - 50'; solid 0 - 20')
2-inch Diameter PVC.

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.: **B-4A**	
Location: **Mission Viejo, California**		Elevation: **421'**	
Job No.: **173-05**	Client: **City of Mission Viejo**	Date: **2/25/05**	
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By: **DPO/DS**	

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ASPHALT 2.5"-thick.							
		BASE 6.5"-thick.							
		ARTIFICIAL FILL (Af) Clayey Sand (SC): Mottled light olive brown (2.5Y 5/4) to dark grayish-brown (2.5Y 4/2); moist; medium dense; fine-grained sand.							
		Silty Sand (SM): Olive yellow (2.5Y 6/6); moist; medium dense; fine-grained sand; moderately weathered; some clay; abundant iron oxide staining.							
		ANCIENT LANDSLIDE DEBRIS Silty Sandstone: Light olive brown to light brownish-gray (2.5Y 5/4-6-2); slightly moist to moist; soft; fine-grained sand; slightly cemented; overlying contact is clean; undulatory. @3 Feet: JOINT - N26E / 84NW; fracture extends down past 5-feet.							
		Clayey Siltstone: Pale olive (5Y 6/3); moist; soft; moderately fractured; slightly weathered; fractures infilled with carbonates.							
5		Silty Sandstone: Olive yellow (2.5Y 6/6); slightly moist to moist; soft; fine-grained sand. @5 Feet: Bedding is relatively flat lying; JOINT - N40E / 80SE; fractures are wavy.		11	■		26.6	99.4	
		Clayey Siltstone: Pale olive (5Y 6/3). @6.8 Feet: Clay seam.							
		Silty Sandstone: Light olive brown; fine-grained sand. @7.4 Feet: Infilled burrows. @7.5 Feet: BEDDING - N45W / 4SW.							
		Sandstone: Light brownish-gray (2.5Y 6/2); slightly moist to moist; soft; fine-grained sand; flecks of yellow staining; micaceous.							
10		@10.4 Feet: Near vertical fractures; moderate to high seepage coming from fractures. @10.7-11.7 Feet: Silty Sandstone; light brownish-gray with abundant iron oxide staining; fine-grained sand. @11 Feet: Banding within sandstone; BEDDING - N20-25W / 7SW.		10/ 8"	■		20.2	98.4	

PLATE A-18

EXPLORATION LOG

Project:	**Ferrocarril Landslide**	Boring No.:	**B-4A**
Location:	**Mission Viejo, California**	Elevation:	**421'**
Job No.: **173-05**	Client: **City of Mission Viejo**	Date:	**2/25/05**
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By:	**DPO/DS**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Clayey Siltstone: Pale olive (5Y 6/3) to light brownish-gray; moist; soft; iron oxide stained; micaceous.							
		@12.2 Feet: Cemented zone; very flat lying and along bedding; wavy; dips 4SW.							
		@13.3-13.7 Feet: Intensely fractured zone with paper thin clay seams; clay seams are irregular; wavy; polished surfaces on clay seams; CLAY SEAM - N67W / 7SW (Possible Rupture Surface).							
		BEDROCK - Niguel Formation (Tn)							
		Clayey Siltstone: Pale olive (5Y 6/3); moist; soft.							
15		@14 Feet: Below 14 feet, numerous iron oxide stained parting surfaces; polished discontinuous surfaces; generally along bedding.		4			27.3	95.5	
		@14.4 Feet: JOINT - N40E / 80NW; continues to 16-feet.							
		@15.9 Feet: Clay lined seam; wavy; offset up to 3" by fractures; dips NW.							
		@17.4 Feet: Parting surface.							
		@18.2-19 Feet: Intensely fractured zone; numerous iron oxide stained parting surfaces; wavy; discontinuous; tops of iron oxide stained parting surfaces are polished; occasional small cobble size concretions.							
		@19 Feet: Discontinuous surface; dips 20E.							
20				5			27.9	93.2	
		@21 Feet: Becomes partially unoxidized.							
		@21.1 Feet: BEDDING - N70-90W / 10SW; surfaces are irregular; discontinuous.							

EXPLORATION LOG

Project: **Ferrocarril Landslide**		Boring No.: **B-4A**	
Location: **Mission Viejo, California**		Elevation: **421'**	
Job No.: **173-05**	Client: **City of Mission Viejo**	Date: **2/25/05**	
Drill Method: **Bucket Auger**	Driving Weight: **See Notes**	Logged By: **DPO/DS**	

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
25		@25 Feet: Becomes dark grayish-brown (2.5Y 4/2); moderately weathered.		20	■		26.7	95.0	
		@26 Feet: Becomes black (2.5Y N2/); unoxidized.							
30		Siltstone: Black (2.5Y N2/); slightly moist; soft; micaceous.		26	■		27.3	95.9	

Notes:
Total Depth = 31 Feet
Moderate to Heavy Seepage at 10.4 Feet
No Caving
Backfilled with Drill Cuttings, Tamped with Bucket

Sampling Equipment
California Modified Thick Walled Split Spoon Sampler

Driving Weights
0-24 Feet - 2,150 lbs
25-44 Feet - 1,350 lbs.

EXPLORATION LOG

Project:	Ferrocarril Landslide			Boring No.:	TP-1
Location:	Mission Viejo, California			Elevation:	443'
Job No.:	173-05	Client:	City of Mission Viejo	Date:	3/1/05
Drill Method:	Excavator	Driving Weight:	NA	Logged By:	DS

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		LANDSLIDE DEBRIS (Qls) <u>Siltstone</u>: Mottled olive gray to gray and olive yellow; moist; soft; intensely fractured; moderately weathered; sandy; micaceous.							
		@4 Feet: Becomes very moist.							
5									
		<u>Clay</u>: Olive gray; moist; soft; remolded; highly plastic; approximately 1/4"-thick; roots present; carbonate nodules; rupture surface (collected small bag sample, depth uncertain).							
		<u>Notes:</u> Total Depth = 9 Feet Minor Seepage at 6 Feet Backfilled with Native Soil.							

EXPLORATION LOG - V3 173-05.GPJ PETRA.GDT 10/10/05

Petra Geotechnical

ENGINEERING GEOLOGIC LOG 1

Sheet 1 of 1

Elevation
Diameter 24"
Geologist SF
Recorder

See map
Location of Boring

Project Slattery
Geofirm Number 209-00
Date 8/10/92

OBSERVATIONS			INFERENCES
Attitudes	Graphics	Description	
0		**SCATTERED FILL**	
J;N85W28S		0' light brown, slightly clayey to sandy silt; soft to medium stiff, slightly moist. Roots.	
		BEDROCK STRATA	
RS?N64E15S 5		0.5' brown, slightly clayey siltstone; fractured, firm.	
		1' root-lined, iron oxide stained joint. Siltstone is light brown-gray, slightly clayey to sandy.	
J;N63E79S		4.5' discontinuous, poorly developed shear.	
10		10' weathered, dark brown, clayey nodular concretion.	
		12' slightly less fractured, joints continue.	
RS?N15W06S		13' gray, 1/2" thick, slightly silty clay bed; partially remolded and sheared, some roots. Porous, soft, moist. Material is firmer, unjointed below.	Potential rupture surface at 13'
15		14' slightly more sandy.	
		14.5' scattered concretions	
20		16' grades to silty, very fine grained sandstone.	
		17.5' scattered subhorizontal stringers of sandy lenses.	
		17.5' grades to gray siltstone.	
		TOTAL DEPTH= 22'	
		No groundwater	

Geofirm

APPENDIX B

LABORATORY TEST PROCEDURES

LABORATORY TEST DATA

LABORATORY TEST PROCEDURES

Soil Classification

Soils encountered within the exploratory borings were classified and described utilizing the visual-manual procedures of the Unified Soil Classification System, and in general accordance with Test Method ASTM D 2488-00. The assigned group symbols are presented on the Exploration Logs, Appendix A.

In Situ Moisture and Density

Moisture content and dry density of the in place soils were determined in representative strata in accordance with test method ASTM D 2216-98. Test data are presented in the Exploration Logs, Appendix A.

Laboratory Maximum Dry Density/Optimum Moisture

The maximum dry density and optimum moisture content of the near-surface soil materials were determined for a selected sample in accordance with Test Method A of ASTM D 1557-00. The results of this test are presented on Plate B-1.

Atterberg Limits

Atterberg limits tests (liquid limit, plastic limit and plasticity index) were performed on a selected sample to verify visual classifications and also to aid in foundation design. These tests were performed in accordance with Test Method ASTM D 4318-00. Test results are presented on Plate B-1.

Direct Shear

The Coulomb shear strength parameters (angle of internal friction and cohesion) were determined for a selected sample of soil remolded to 90 percent of the applicable relative compaction standard. This test was performed in general accordance with Test Method ASTM D 3080-98. Three specimens were prepared for the test. The test specimens were artificially saturated, and then sheared under varying normal loads at a maximum constant rate of strain of 0.01 inches per minute. Results are graphically presented on Plate B-2 through B-11

Grain-Size Analysis

Grain-size analyses were performed on selected samples. These tests were performed in general accordance with ASTM Test Method D 422-90. Test results are presented on Plate B-12.

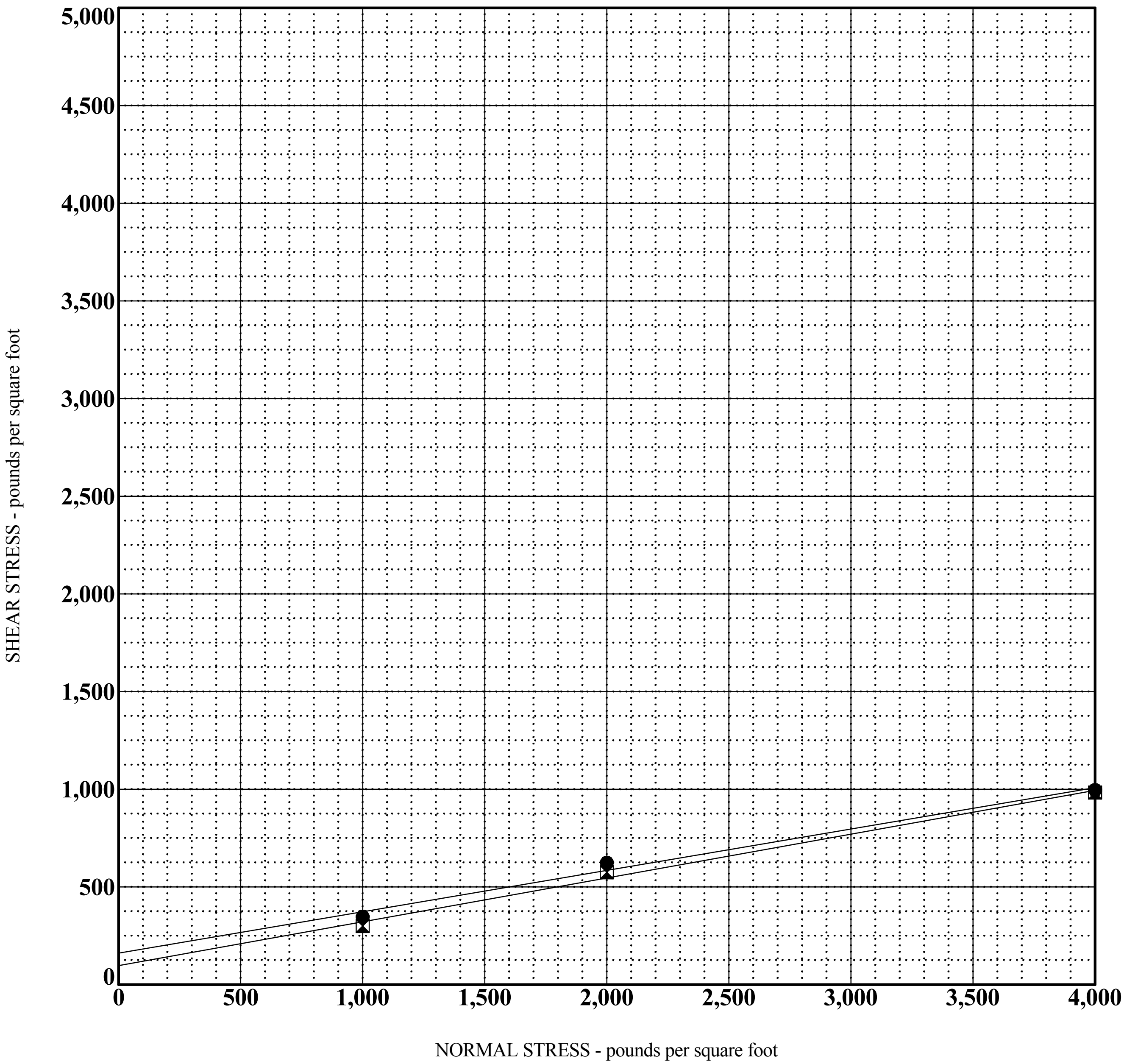
LABORATORY DATA SUMMARY							
Boring/ Test Pit Number	Sample Depth (ft)	Soil/Bedrock Description	Max. Dry Density[1] (pcf)	Optimum Moisture[1] (%)	Atterberg Limits[2]		
					LL	PL	PI
B-1	12-13	Silty Clay (Qls/Fill)	116.0	11.0	--	--	--
B-1	29-30	Silty Clay (Fill)	127.0	9.0	--	--	--
B-2	10	Rupture Surface (CH)			76	32	44
TP-1	--	Rupture Surface (CH)			75	29	46
B-3A	8-10	Siltstone	107.5	13.0	--	--	--
B-3A	30-31	Silty Sandstone	108.0	13.0	--	--	--

Test Procedures:

1) Per ASTM Test Method D 1557-02
2) Per ASTM Test Method D 4318-00

J.N. 173-05
PLATE B-1

PETRA

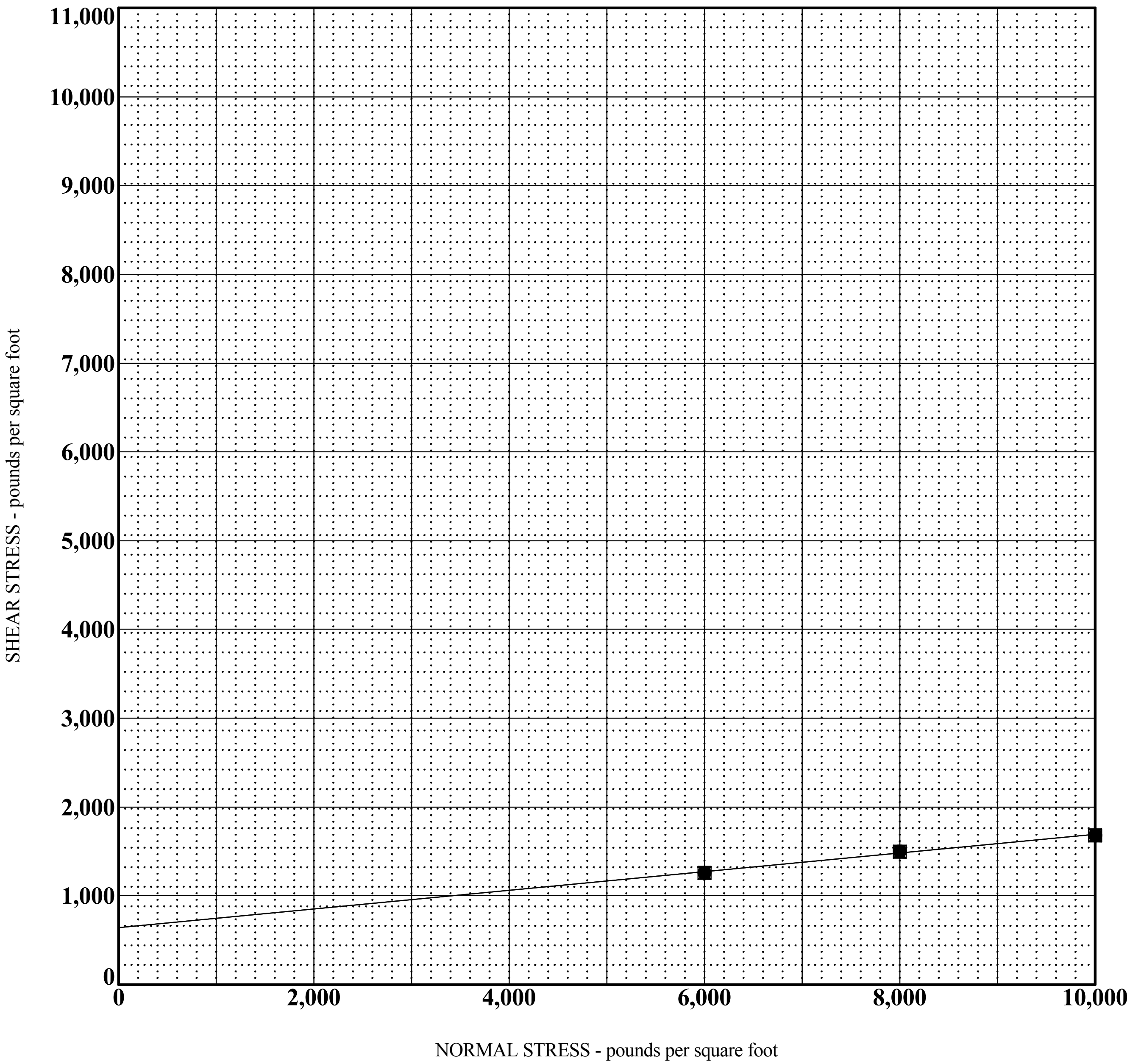


SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-2 @ 9.0	Rupture Surface - Peak	12	160
⊠ B-2 @ 9.0	Rupture Surface - Ultimate	13	100

NOTES:

Remolded Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**REMOLDED TEST SAMPLES**	**PLATE B-2**

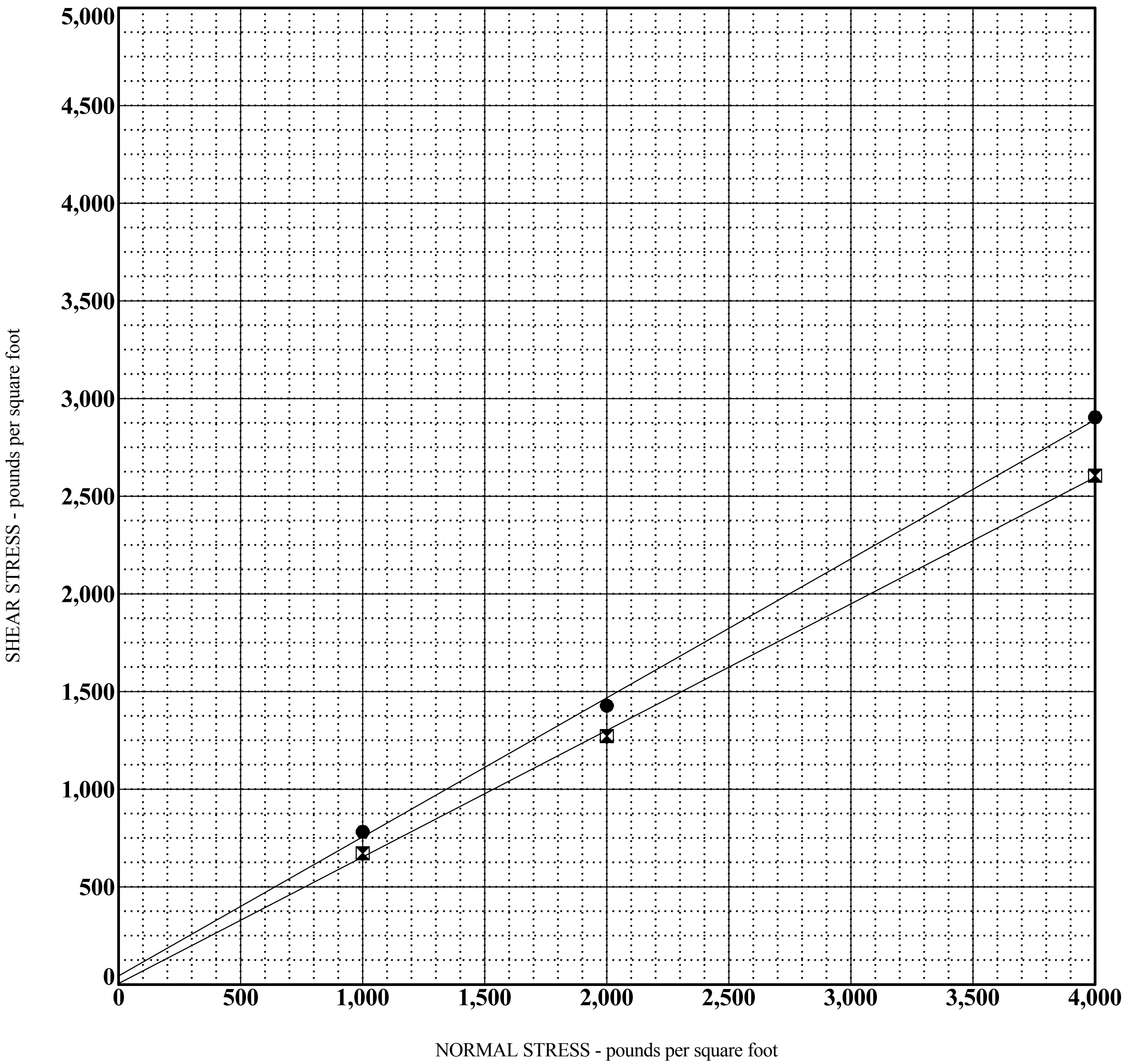


SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-2 @ 9.0	Rupture Surface - Peak	6	640
⊠ B-2 @ 9.0	Rupture Surface - Ultimate	6	640

NOTES:

Remolded Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**REMOLDED TEST SAMPLES**	**PLATE B-3**



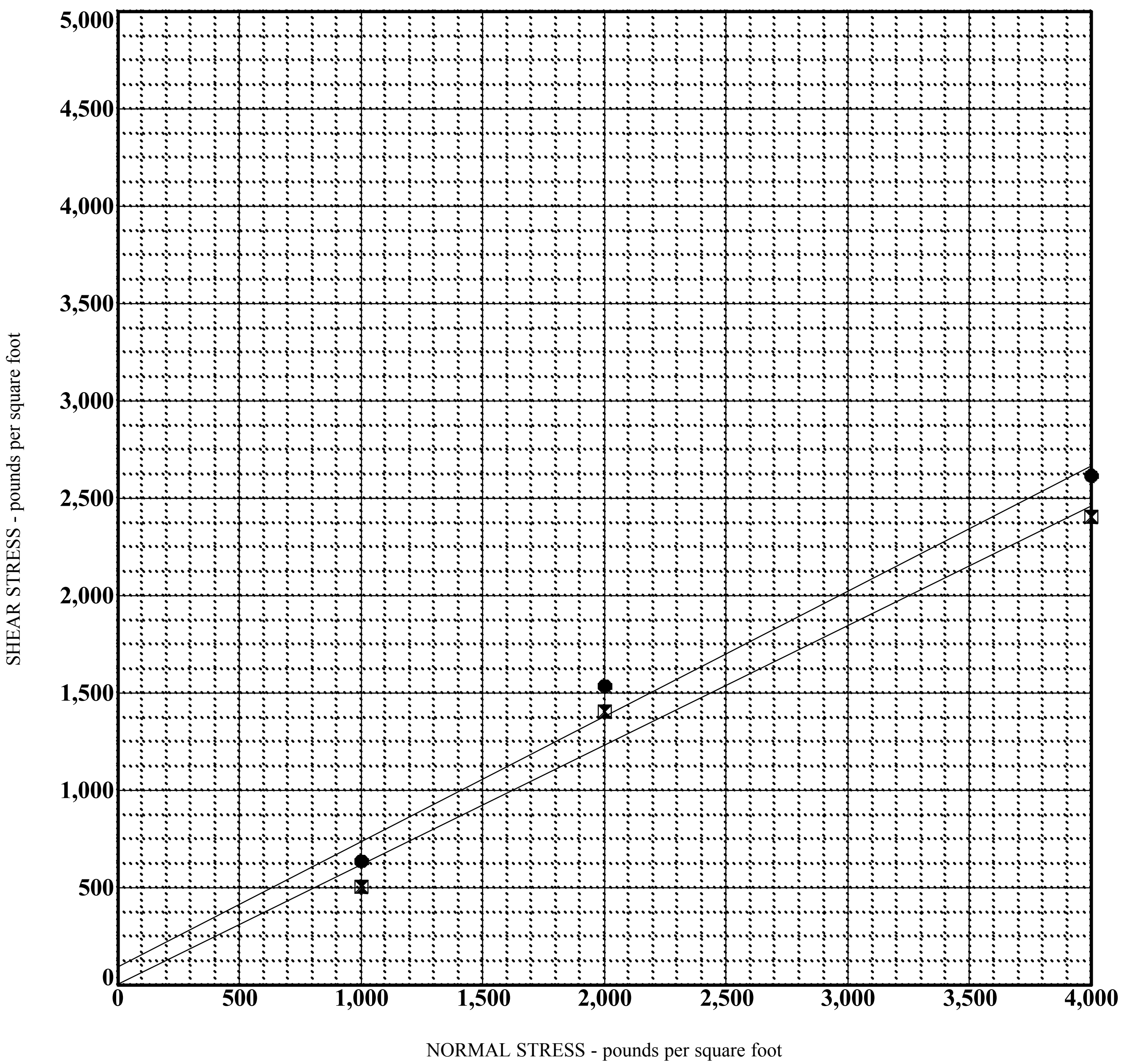
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-1 @ 12.0	Fine Sandy Silt (ML) - Peak	35	40
⊠ B-1 @ 12.0	Fine Sandy Silt (ML) - Ultimate	33	10

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-4**

DIRECT SHEAR 173-05.GPJ PETRA.GDT 10/10/05



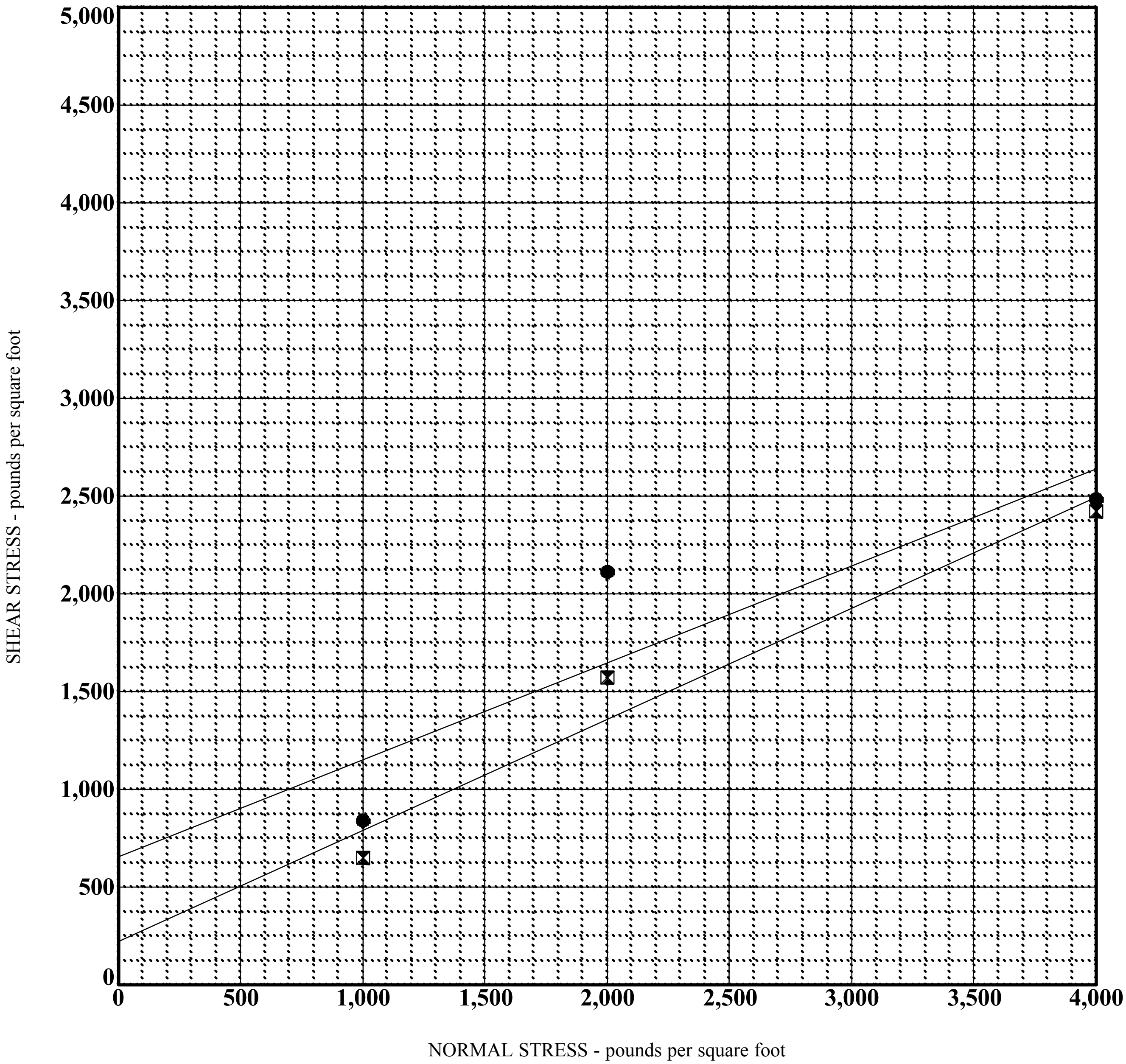
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-1 @ 17.0	Fine Sandy Silt (ML) - Peak	33	100
⧗ B-1 @ 17.0	Fine Sandy Silt (ML) - Ultimate	32	10

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	DIRECT SHEAR TEST DATA	September, 2005
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-5

DIRECT SHEAR 173-05.GPJ PETRA.GDT 10/10/05



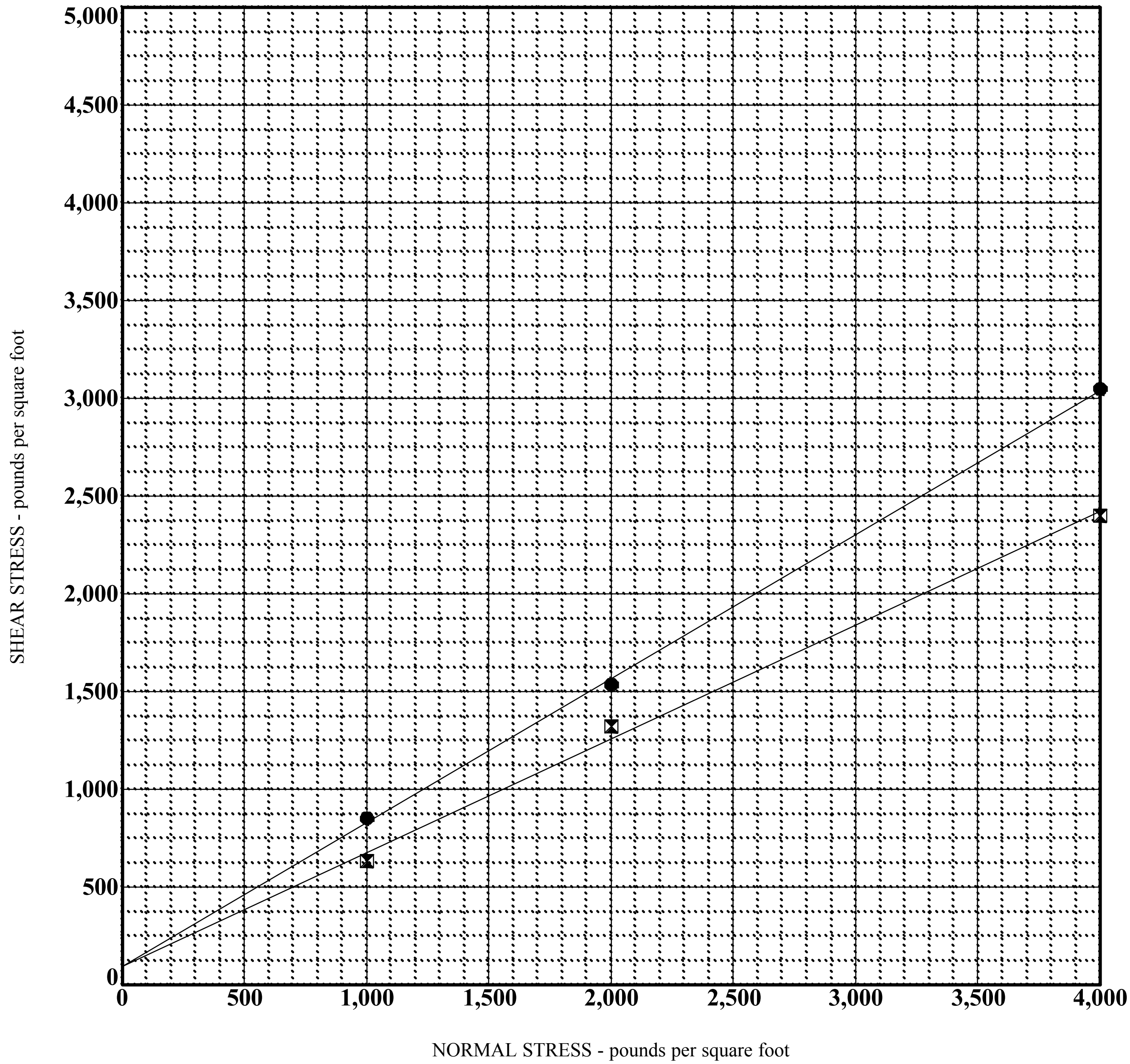
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-1 @ 23.0	Fine Sandy Silt (ML) - Peak	26	650
⊠ B-1 @ 23.0	Fine Sandy Silt (ML) - Ultimate	30	220

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-6**

DIRECT SHEAR 173-05.GPJ PETRA.GDT 10/10/05

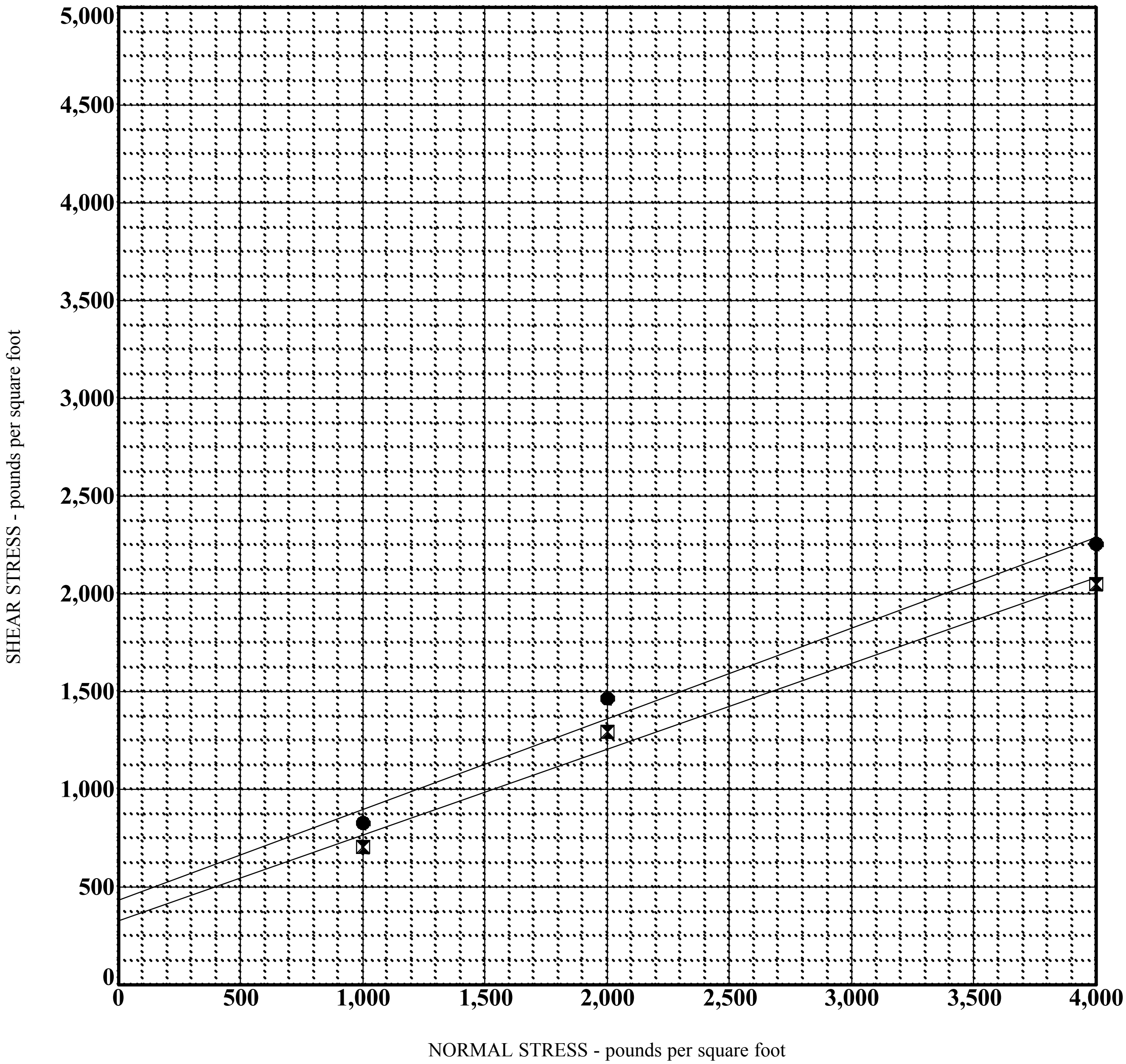


SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-2 @ 5.0	Siltstone - Peak	36	100
⧗ B-2 @ 5.0	Siltstone - Ultimate	30	100

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-7**



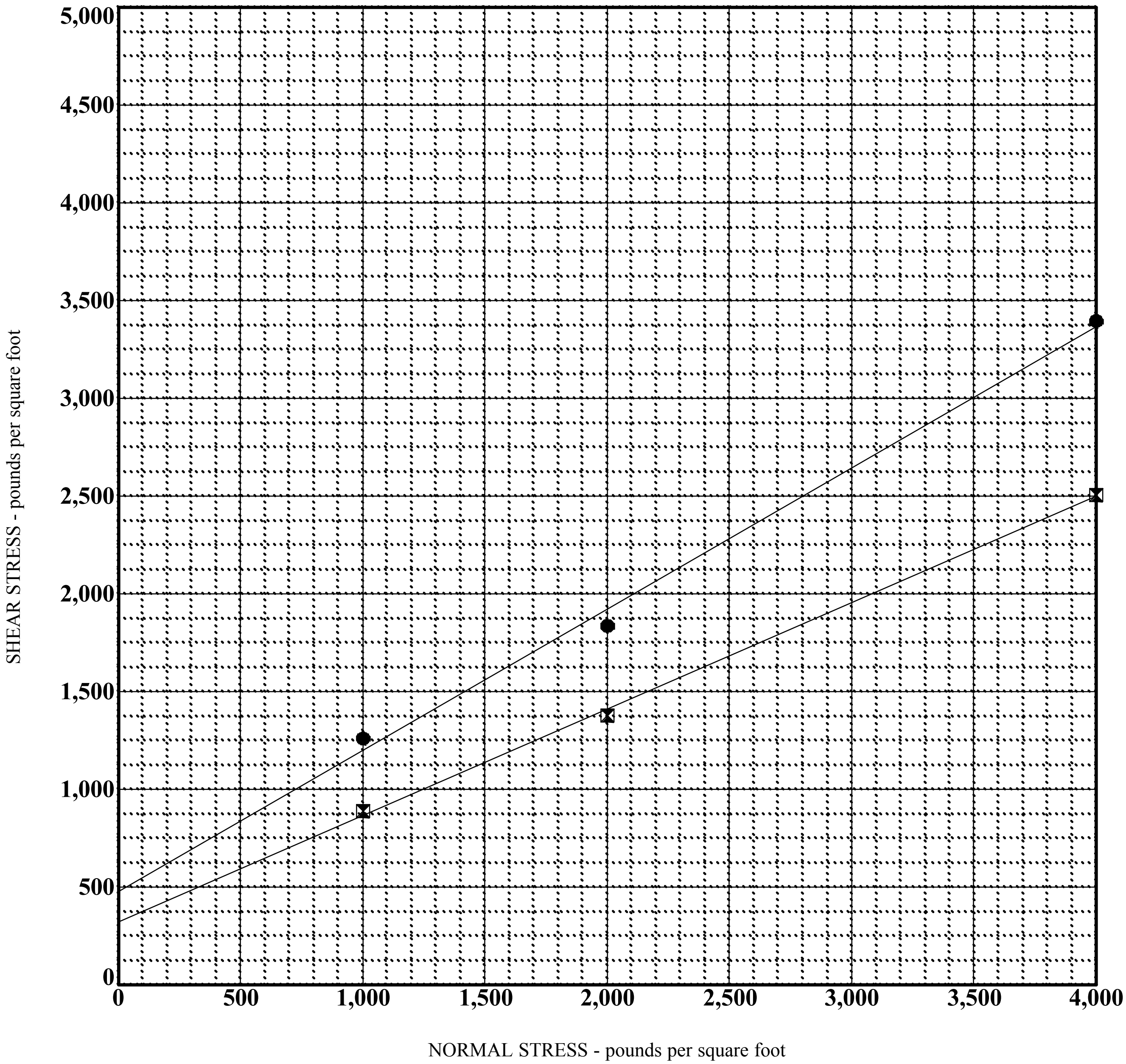
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-3 @ 15.0	Fine Sandy Silt (ML) - Peak	25	430
⧗ B-3 @ 15.0	Fine Sandy Silt (ML) - Ultimate	24	330

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

DIRECT SHEAR 173-05.GPJ PETRA.GDT 10/10/05

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-8**

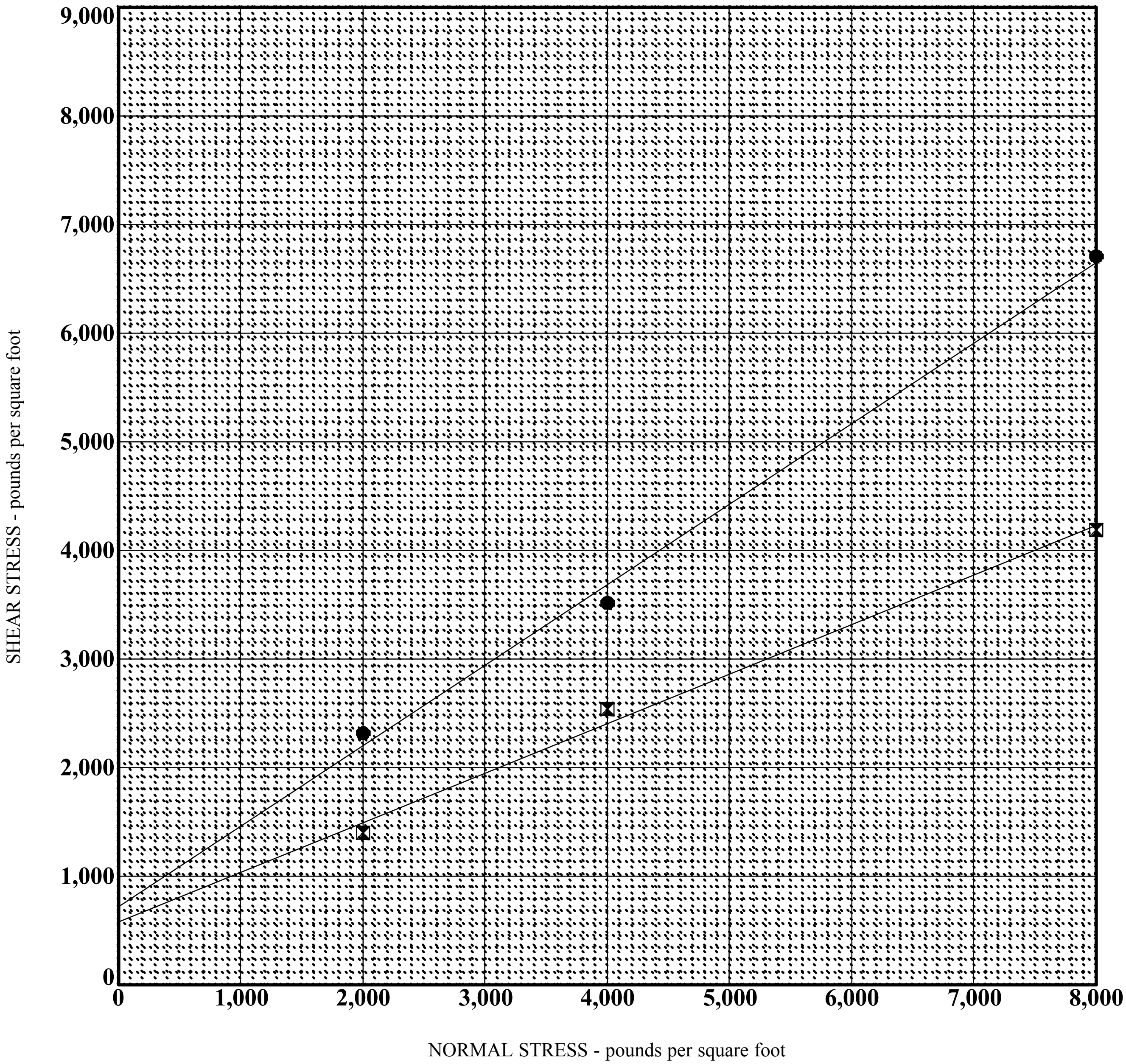


SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-1A @ 15.0	Silty Sandstone - Peak	36	480
⊠ B-1A @ 15.0	Silty Sandstone - Ultimate	29	320

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-9**



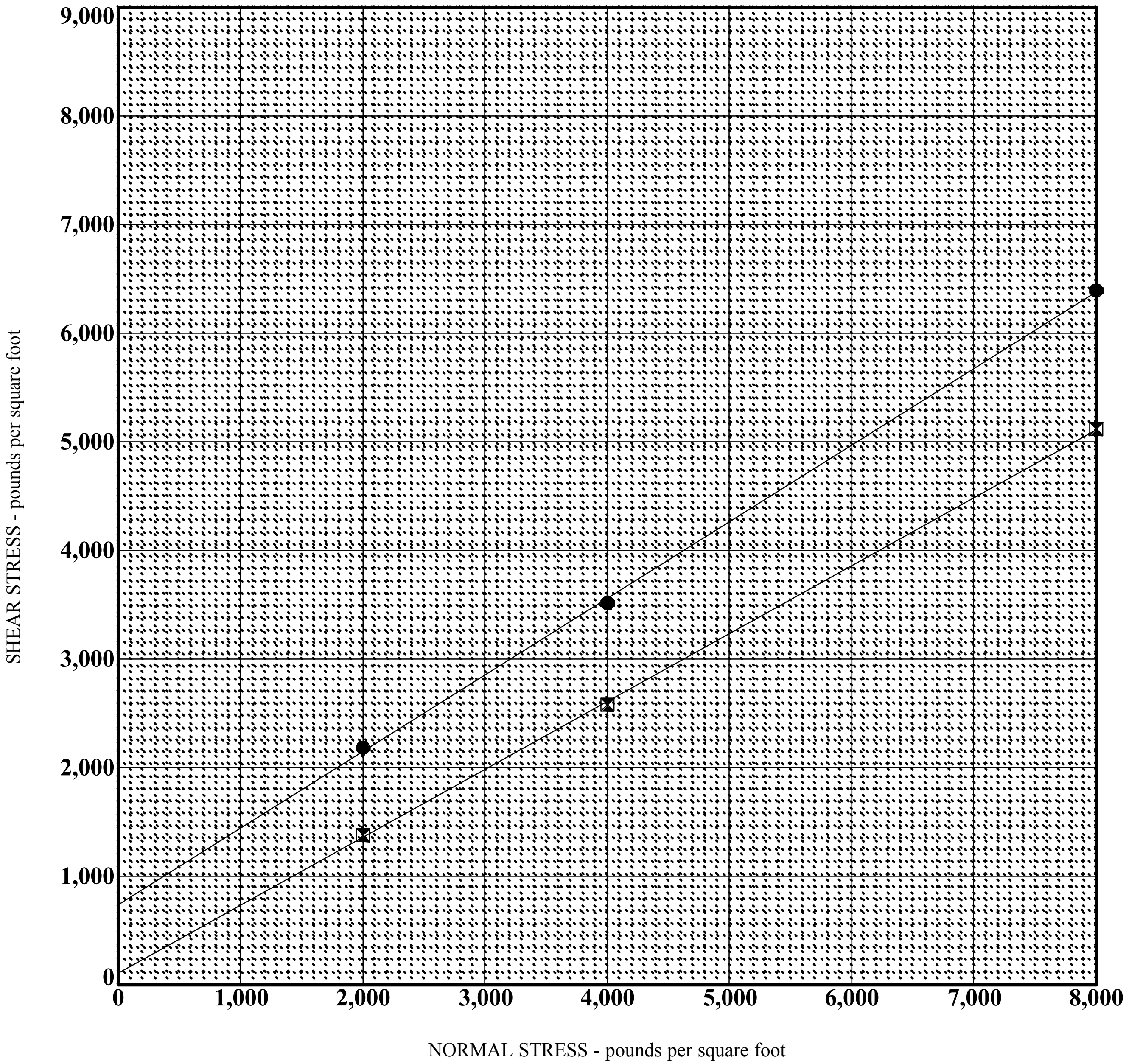
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-2A @ 40.0	Clayey Siltstone - Peak	37	720
⧗ B-2A @ 40.0	Clayey Siltstone - Ultimate	25	580

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-10**

DIRECT SHEAR 173-05.GPJ PETRA.GDT 10/10/05



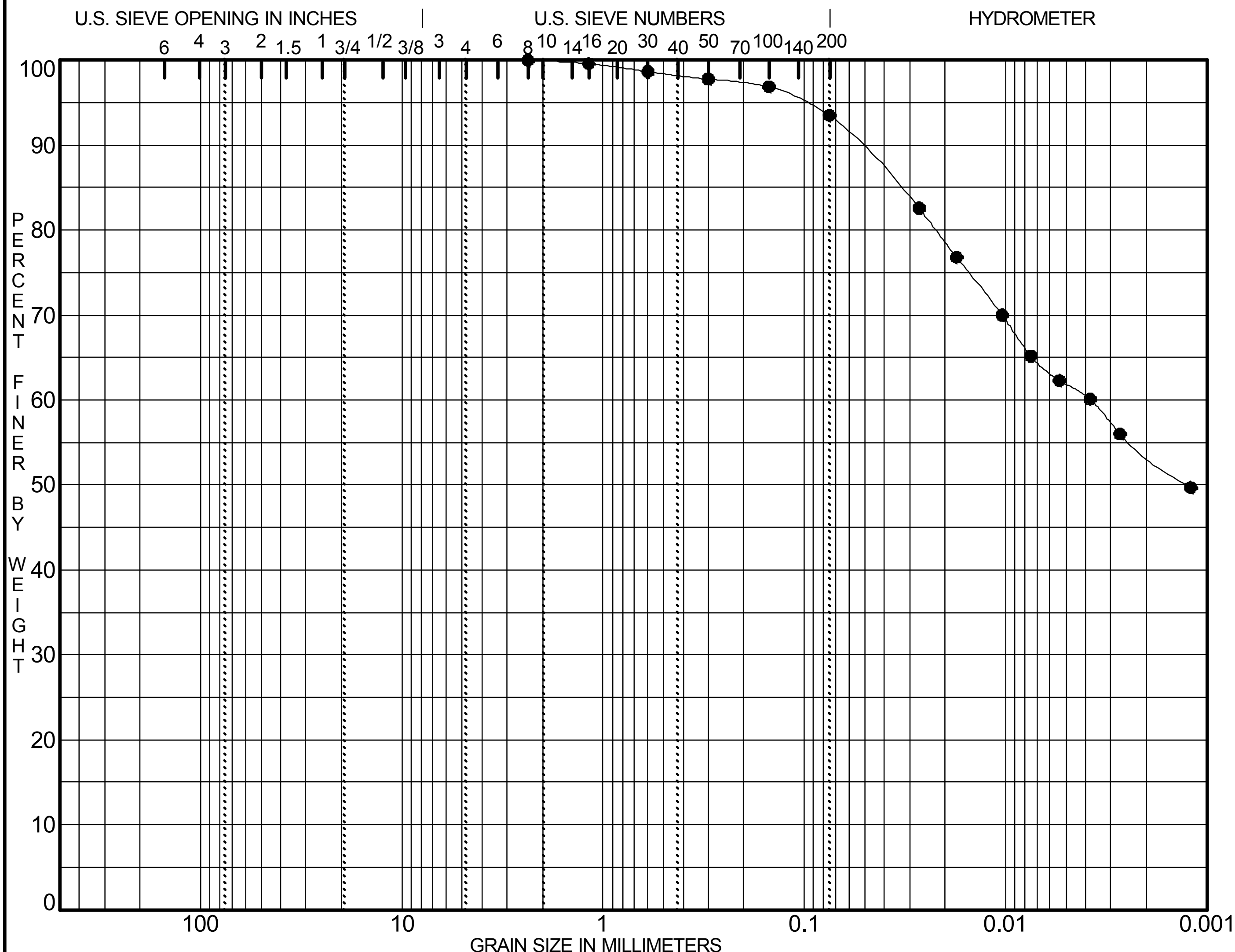
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-3A @ 30.0	Silty Sandstone - Peak	35	740
⊠ B-3A @ 30.0	Silty Sandstone - Ultimate	32	110

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

DIRECT SHEAR 173-05.GPJ PETRA.GDT 10/10/05

J.N. 173-05	**DIRECT SHEAR TEST DATA**	**September, 2005**
PETRA GEOTECHNICAL, INC.	**UNDISTURBED TEST SAMPLES**	**PLATE B-11**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	B-2	9.0	Fat Clay (CH)		76	32	44		

	Specimen Identification		D100	D60	D30	D50	%Gravel	%Sand	%Silt	%Clay
●	B-2	9.0	2.36	0.00		0.0012	0.0	6.5	31.7	61.8

GRAIN SIZE - V1 173-05.GPJ PETRA.GDT 10/10/05

J.N. 173-05	GRAIN SIZE ANALYSIS	September, 2005
PETRA GEOTECHNICAL, INC.		PLATE B-12

APPENDIX C

SLOPE STABILITY CALCULATIONS

STABILITY CALCULATIONS

Direct Shear Tests

The subject site is underlain by artificial fill, landslide debris, and bedrock materials. In order to represent the shear strengths of these materials, undisturbed samples were prepared for direct shear testing. To represent shear strength along the landslide rupture surface, remolded samples of the clay material were prepared for direct shear testing.

Direct shear tests were then performed on the samples to determine peak and ultimate shear strength values. The rupture surface samples were resheared several times until relatively constant resheared strength values were obtained. All samples were completely saturated prior to being sheared. The results of all direct shear tests are presented in Appendix B.

Direction of Anisotropy

The bedrock materials of the Niguel Formation and the landslide rupture surface dip to the west at angles ranging from about 2 to 7 degrees. In order to evaluate these conditions, our stability calculations used bedding shear strengths for dip components within this range.

Groundwater Seepage

Groundwater seepage was encountered in each of the boring locations during our investigation. Groundwater seepage was encountered both above and below the rupture surface and was one of the main causes for slope failure. As such, our stability calculations were analyzed for various groundwater levels. A groundwater level slightly higher than that observed after failure was utilized in both our back calculations and analyses of the post repaired portion of the slope. This groundwater level represents the level that might occur during future rainy seasons and should be used for design of future stabilization evaluations.

Shear Strength Parameters

The shear strength parameters used in our stability calculations are based on the results of the direct shear tests described above and on our past experience with similar materials. For our back calculations of the pre-failure conditions, peak shear strength values were utilized. For the post repaired portions of the slope and adjoining portions of the slope, ultimate shear strength values were used. For the landslide rupture surface, the average of several resheared values was used. Where multiple shear tests were performed on the same type of material, the average of the shear strength values obtained were used in our stability calculations. A summary of the shear strength parameters used in our calculations is provided below.

Back Calculations – Peak Shear Strength Values

Description	Friction (degrees)	Cohesion (psf)	Saturated Unit Weight (pcf)
Artificial Fill	30	300	125.0
Niguel Formation			
Sandstone	36	500	125.0
Siltstone	37	700	125.0
Rupture Surface	8.0	0.0	125.0

STABILITY CALCULATIONS
(Continued)

Post Repair Calculations – Ultimate Shear Strength Values

Description	Friction (degrees)	Cohesion (psf)	Saturated Unit Weight (pcf)
Artificial Fill	30	200	125.0
Niguel Formation			
Sandstone	32	100	125.0
Siltstone	25	575	125.0
Rupture Surface	8.0	0.0	125.0

Calculations

Stability calculations were performed using GTABL7, a computer program developed by Purdue University. The program is written in FORTRAN IV source language for the general solution of slope stability problems by a two-dimensional limiting equilibrium method. The calculation of the factor of safety against instability of a slope is performed by a method of slices. The particular methods employed in this version (GSTABL7) are the modified Bishop or Spencer's methods, applicable to circular-shaped failure surfaces; and the simplified Janbu method, applicable to failure surfaces of general shape.

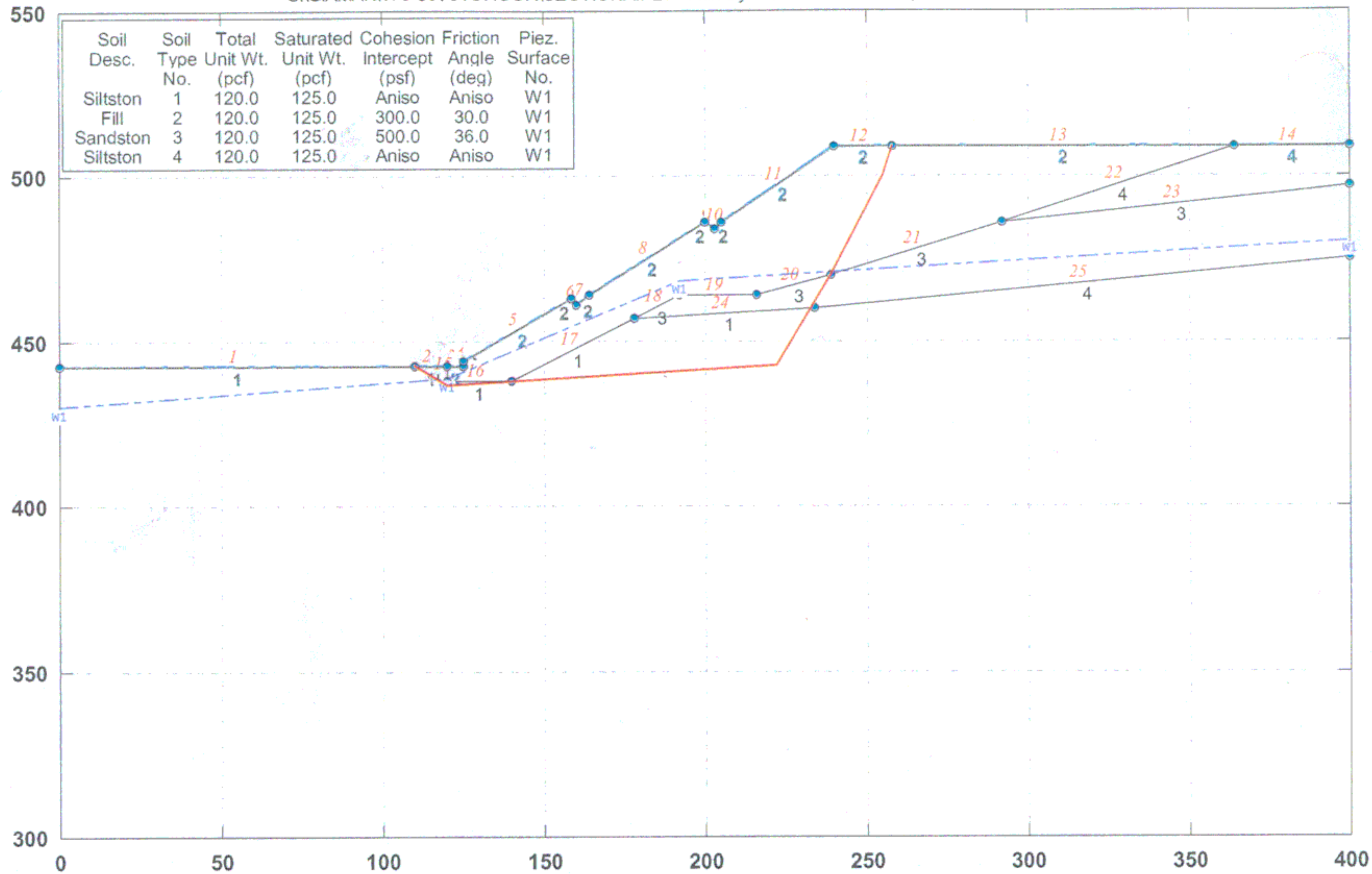
GSTABL7 features unique random techniques for generation of potential failure surfaces for subsequent determination of the more critical surfaces and their corresponding factors of safety. One technique generates circular surfaces; another, surfaces of sliding block character; and a third, more general irregular surfaces of random shape. The means for defining a specific trial failure surface and analyzing it is also provided.

Conditions that GSTABL7 are programmed to handle include the following: heterogeneous soils systems, anisotropic soil strength properties, excess pore water pressure due to shear, static groundwater and surface water, pseudo-dynamic earthquake loading, and surcharge boundary loading.

In our stability analyses of both pre-failure and post repair conditions, the simplified Janbu method was used. A pre-existing failure geometry was incorporated in our model based on the subsurface conditions encountered during our investigation. The most critical failure surfaces (lowest factor of safety) through the slope were determined utilizing a random search routine. The factor safety is calculated as the ratio between the resisting forces and the driving forces required for equilibrium. Computer printouts of the calculations are provided in this appendix. Plots of the problem geometries as well as weakest potential failure surfaces found are also provided at the end of each printout.

FERROCERRIL LANDSLIDE, SECTION A-A' (Original Ground - Back Calculation)

S:\SIAMAK\173-05\AA'ORGGR\SECTIONA.PLT Run By: Petra Geotechnical, Inc. 6/20/2005 2:30PM



GSTABL7 FSmin=1.00

Factor Of Safety Is Calculated By The Simplified Janbu Method

PETRA

***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **
** Version 1.0, January 1996; Version 1.14, Sept 1999 **
--Slope Stability Analysis--
Simplified Janbu, Modified Bishop
or Spencer`s Method of Slices
(Based on STABL6-1986, by Purdue University)

Run Date: 6/20/2005
Time of Run: 2:30PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: S:sectiona.
Output Filename: S:sectiona.OUT
Unit System: English
Plotted Output Filename: S:sectiona.PLT
PROBLEM DESCRIPTION FERROCERRIL LANDSLIDE, SECTION A-A'
(Original Ground - Back Calculation)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

14 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	142.50	110.00	142.50	1
2	110.00	142.50	120.00	142.50	1
3	120.00	142.50	125.00	142.50	2
4	125.00	142.50	125.01	144.00	2
5	125.01	144.00	158.50	163.00	2
6	158.50	163.00	160.00	161.00	2
7	160.00	161.00	164.00	164.00	2
8	164.00	164.00	200.00	186.00	2
9	200.00	186.00	203.00	184.00	2
10	203.00	184.00	205.00	186.00	2
11	205.00	186.00	240.00	209.00	2
12	240.00	209.00	258.00	209.00	2
13	258.00	209.00	364.00	209.00	2
14	364.00	209.00	400.00	209.00	4
15	120.00	142.50	120.10	138.00	1
16	120.10	138.00	140.00	138.00	1
17	140.00	138.00	178.00	157.00	1
18	178.00	157.00	192.00	164.00	3
19	192.00	164.00	216.00	164.00	3
20	216.00	164.00	239.00	170.00	3
21	239.00	170.00	292.00	186.00	3
22	292.00	186.00	364.00	209.00	4
23	292.00	186.00	400.00	197.00	3
24	178.00	157.00	234.00	160.00	1
25	234.00	160.00	400.00	175.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	700.0	37.0	0.00	0.0	1
2	120.0	125.0	300.0	30.0	0.00	0.0	1
3	120.0	125.0	500.0	36.0	0.00	0.0	1
4	120.0	125.0	700.0	37.0	0.00	0.0	1

ANISOTROPIC STRENGTH PARAMETERS
2 soil type(s)
Soil Type 1 Is Anisotropic
Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	2.0	700.0	37.0
2	4.0	0.0	8.0

3	90.0	700.0	37.0

Soil Type 4 Is Anisotropic
Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	4.0	700.0	37.0
2	7.0	0.0	8.0
3	90.0	700.0	37.0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	130.00
2	120.00	138.50
3	192.00	168.00
4	400.00	180.00

Janbu's Empirical Coef. is being used for the case of c & phi both > 0
Trial Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	142.50
2	120.00	136.50
3	222.00	142.50
4	239.00	170.00
5	255.00	200.00
6	258.00	209.00

Janbu's Empirical Coefficient (fo) = 1.085
* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *
Factor Of Safety For The Preceding Specified Surface = 0.998

Table 1 - Individual Data on the 23 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.0	1773.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3.0	1841.5	0.0	216.4	0.0	0.0	0.0	0.0	0.0
3	0.1	64.2	0.0	10.3	0.0	0.0	0.0	0.0	0.0
4	0.0	8.7	0.0	1.4	0.0	0.0	0.0	0.0	0.0
5	4.9	3505.6	0.0	822.9	0.0	0.0	0.0	0.0	0.0
6	0.0	7.9	0.0	2.2	0.0	0.0	0.0	0.0	0.0
7	15.0	20261.0	0.0	5555.3	0.0	0.0	0.0	0.0	0.0
8	18.5	44413.0	0.0	13162.5	0.0	0.0	0.0	0.0	0.0
9	1.5	4284.2	0.0	1372.6	0.0	0.0	0.0	0.0	0.0
10	4.0	11604.8	0.0	3884.2	0.0	0.0	0.0	0.0	0.0
11	14.0	49639.3	0.0	16159.7	0.0	0.0	0.0	0.0	0.0
12	14.0	62948.2	0.0	20149.8	0.0	0.0	0.0	0.0	0.0
13	8.0	41970.2	0.0	13609.2	0.0	0.0	0.0	0.0	0.0
14	3.0	16142.3	0.0	5102.3	0.0	0.0	0.0	0.0	0.0
15	2.0	10726.2	0.0	3401.2	0.0	0.0	0.0	0.0	0.0
16	11.0	64579.7	0.0	18701.4	0.0	0.0	0.0	0.0	0.0
17	6.0	38886.7	0.0	10197.2	0.0	0.0	0.0	0.0	0.0
18	10.8	65026.4	0.0	24036.6	0.0	0.0	0.0	0.0	0.0
19	6.2	31033.7	0.0	4102.3	0.0	0.0	0.0	0.0	0.0
20	0.4	1791.0	0.0	18.4	0.0	0.0	0.0	0.0	0.0
21	0.6	2737.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	15.0	41512.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	3.0	1620.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2 - Base Stress Data on the 23 Slices

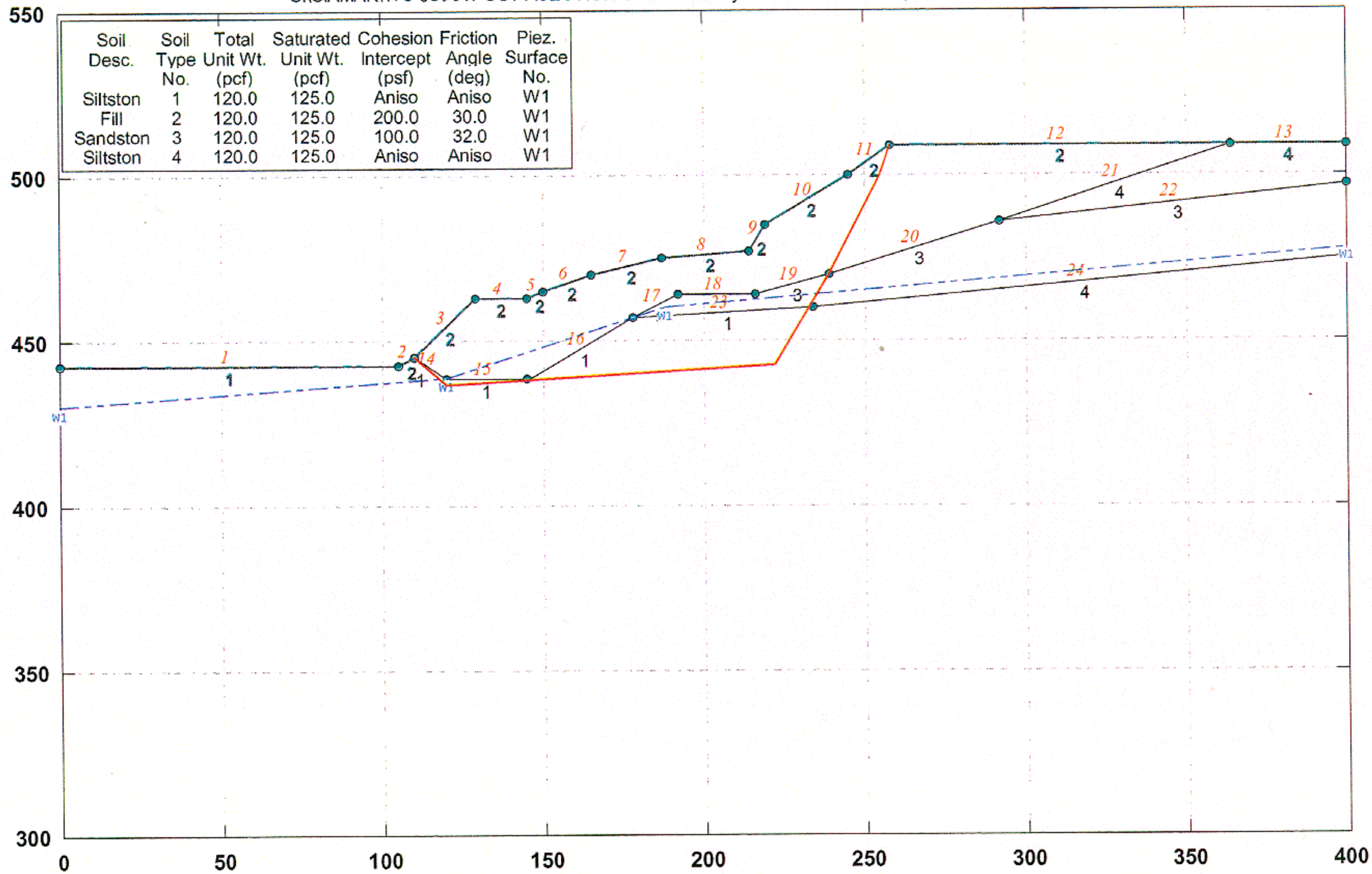
Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-30.96	113.51	8.19	1898.38	-130.00
2	-30.96	118.51	3.48	2384.77	-317.78
3	3.37	120.04	0.09	85.50	42.81
4	3.37	120.09	0.01	85.32	42.79

5	3.37	122.55	4.91	76.49	42.01
6	3.37	125.01	0.01	80.23	46.52
7	3.37	132.51	15.02	137.07	79.37
8	3.37	149.25	18.53	236.03	140.97
9	3.37	159.25	1.50	271.25	167.72
10	3.37	162.00	4.01	269.74	170.36
11	3.37	171.00	14.02	334.18	208.21
12	3.37	185.00	14.02	427.19	264.03
13	3.37	196.00	8.01	495.41	308.07
14	3.37	201.50	3.01	514.24	315.97
15	3.37	204.00	2.00	511.79	314.93
16	3.37	210.50	11.02	582.76	344.75
17	3.37	219.00	6.01	668.05	380.58
18	58.28	227.39	20.50	3735.14	5131.99
19	58.28	235.89	11.83	3381.38	4242.35
20	61.93	239.20	0.83	2984.85	4036.16
21	61.93	239.70	1.29	2953.85	3970.11
22	61.93	247.50	31.88	1934.55	2441.91
23	71.57	256.50	9.49	707.23	512.29

Sum of the Resisting Forces (including Pier/Pile,
Tieback, and Reinforcing Forces if applicable) = 244693.70 (lbs)
Average Available Shear Strength (including Tieback,
Pier/Pile, and Reinforcing Forces if applicable) = 1290.20(psf)
Sum of the Driving Forces = 266118.19 (lbs)
Average Mobilized Shear Stress = 1403.17(psf)
Total length of the failure surface = 189.66(ft)

FERROCERRIL LANDSLIDE, SECTION A-A' (Post Failure Temporary Repair)

S:\SIAMAK\173-05\AA'POSTT\SECTIONA.PLT Run By: Petra Geotechnical, Inc. 6/20/2005 2:44PM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Siltston	1	120.0	125.0	Aniso	Aniso	W1
Fill	2	120.0	125.0	200.0	30.0	W1
Sandston	3	120.0	125.0	100.0	32.0	W1
Siltston	4	120.0	125.0	Aniso	Aniso	W1

GSTABL7 FSmin=1.06

Factor Of Safety Is Calculated By The Simplified Janbu Method

PETRA

*** **GSTABL7** ***

** GSTABL7 by Garry H. Gregory, P.E. **
** Version 1.0, January 1996; Version 1.14, Sept 1999 **
--Slope Stability Analysis--
Simplified Janbu, Modified Bishop
or Spencer`s Method of Slices
(Based on STABL6-1986, by Purdue University)

Run Date: 6/20/2005
Time of Run: 2:44PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: S:sectiona.
Output Filename: S:sectiona.OUT
Unit System: English
Plotted Output Filename: S:sectiona.PLT
PROBLEM DESCRIPTION FERROCERRIL LANDSLIDE, SECTION A-A'
(Post Failure Temporary Repair)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
24 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	142.50	105.00	142.50	1
2	105.00	142.50	110.00	145.00	2
3	110.00	145.00	129.00	163.00	2
4	129.00	163.00	145.00	163.00	2
5	145.00	163.00	150.00	165.00	2
6	150.00	165.00	165.00	170.00	2
7	165.00	170.00	187.00	175.00	2
8	187.00	175.00	214.00	177.00	2
9	214.00	177.00	219.00	185.00	2
10	219.00	185.00	245.00	200.00	2
11	245.00	200.00	258.00	209.00	2
12	258.00	209.00	364.00	209.00	2
13	364.00	209.00	400.00	209.00	4
14	110.00	145.00	120.10	138.50	1
15	120.10	138.50	145.00	138.50	1
16	145.00	138.00	178.00	157.00	1
17	178.00	157.00	192.00	164.00	3
18	192.00	164.00	216.00	164.00	3
19	216.00	164.00	239.00	170.00	3
20	239.00	170.00	292.00	186.00	3
21	292.00	186.00	364.00	209.00	4
22	292.00	186.00	400.00	197.00	3
23	178.00	157.00	234.00	160.00	1
24	234.00	160.00	400.00	175.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	575.0	25.0	0.00	0.0	1
2	120.0	125.0	200.0	30.0	0.00	0.0	1
3	120.0	125.0	100.0	32.0	0.00	0.0	1
4	120.0	125.0	575.0	25.0	0.00	0.0	1

ANISOTROPIC STRENGTH PARAMETERS
2 soil type(s)
Soil Type 1 Is Anisotropic
Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	2.0	575.0	25.0
2	4.0	0.0	8.0
3	90.0	575.0	25.0

Soil Type 4 Is Anisotropic
Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	3.0	575.0	25.0
2	7.0	0.0	8.0
3	90.0	575.0	25.0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	130.00
2	120.00	138.50
3	188.00	160.00
4	400.00	177.50

Trial Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.00	145.00
2	120.00	136.50
3	222.00	142.50
4	239.00	170.00
5	255.00	200.00
6	258.00	209.00

* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *
Factor Of Safety For The Preceding Specified Surface = 1.060

Table 1 - Individual Data on the 24 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.8	6608.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.2	4186.6	0.0	177.4	0.0	0.0	0.0	0.0	0.0
3	0.1	145.5	0.0	8.0	0.0	0.0	0.0	0.0	0.0
4	0.0	71.7	0.0	4.0	0.0	0.0	0.0	0.0	0.0
5	8.9	23648.4	0.0	1683.9	0.0	0.0	0.0	0.0	0.0
6	16.0	49446.8	0.0	6086.1	0.0	0.0	0.0	0.0	0.0
7	5.0	15746.0	0.0	2708.1	0.0	0.0	0.0	0.0	0.0
8	15.0	52663.5	0.0	10427.5	0.0	0.0	0.0	0.0	0.0
9	12.4	48268.0	0.0	11205.5	0.0	0.0	0.0	0.0	0.0
10	0.6	2517.1	0.0	626.4	0.0	0.0	0.0	0.0	0.0
11	0.6	2496.3	0.0	625.0	0.0	0.0	0.0	0.0	0.0
12	8.4	34785.3	0.0	9086.5	0.0	0.0	0.0	0.0	0.0
13	1.0	4240.4	0.0	1155.8	0.0	0.0	0.0	0.0	0.0
14	4.0	16999.8	0.0	4870.9	0.0	0.0	0.0	0.0	0.0
15	22.0	94056.2	0.0	27212.8	0.0	0.0	0.0	0.0	0.0
16	2.0	8963.5	0.0	2509.4	0.0	0.0	0.0	0.0	0.0
17	3.0	14833.3	0.0	3775.1	0.0	0.0	0.0	0.0	0.0
18	3.0	15946.3	0.0	3788.4	0.0	0.0	0.0	0.0	0.0
19	10.8	50597.7	0.0	15339.7	0.0	0.0	0.0	0.0	0.0
20	2.5	9356.1	0.0	545.1	0.0	0.0	0.0	0.0	0.0
21	3.8	12900.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	6.0	16303.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	10.0	15403.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	3.0	1246.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2 - Base Stress Data on the 24 Slices

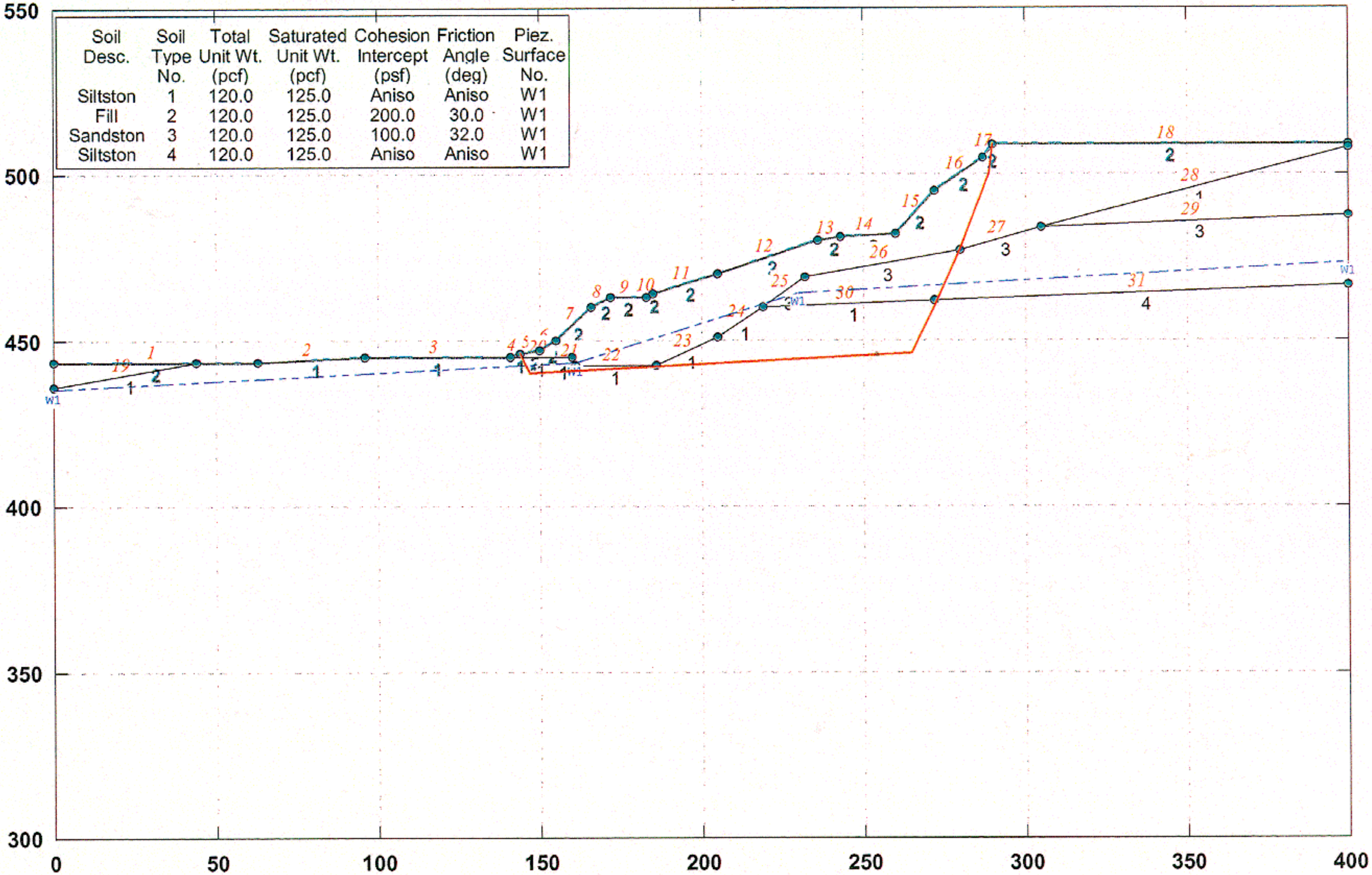
Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-40.36	113.91	10.27	2030.86	-546.74
2	-40.36	118.91	2.85	3029.20	-1248.41
3	3.37	120.03	0.07	286.42	127.43
4	3.37	120.08	0.03	287.07	127.74
5	3.37	124.55	8.92	344.80	156.03
6	3.37	137.00	16.03	378.67	181.48

7	3.37	147.50	5.01	364.40	184.93
8	3.37	157.50	15.03	393.51	206.17
9	3.37	171.19	12.40	418.53	229.01
10	3.37	177.69	0.62	424.08	237.19
11	3.37	178.31	0.62	424.61	237.97
12	3.37	182.81	8.40	428.45	243.64
13	3.37	187.50	1.00	431.18	249.01
14	3.37	190.00	4.01	423.88	249.57
15	3.37	203.00	22.04	424.74	251.05
16	3.37	215.00	2.00	451.11	263.18
17	3.37	217.50	3.01	515.22	290.35
18	3.37	220.50	3.01	566.43	312.13
19	58.28	227.39	20.50	2683.25	3993.25
20	58.28	234.00	4.66	2348.45	3247.61
21	58.28	237.11	7.17	2177.57	2909.15
22	61.93	242.00	12.75	1859.42	2397.62
23	61.93	250.00	21.25	1145.13	1359.16
24	71.57	256.50	9.49	527.96	394.07

Sum of the Resisting Forces (including Pier/Pile,
Tieback, and Reinforcing Forces if applicable) = 206128.14 (lbs)
Average Available Shear Strength (including Tieback,
Pier/Pile, and Reinforcing Forces if applicable) = 1078.54(psf)
Sum of the Driving Forces = 194503.38 (lbs)
Average Mobilized Shear Stress = 1017.71(psf)
Total length of the failure surface = 191.12(ft)

FERROCERRIL LANDSLIDE, Section B-B' (Post Failure Temporary Repair)

S:\SIAMAK\173-05\BB'POSTT\SECTIONB.PLT Run By: Petra Geotechnical, Inc. 6/20/2005 6:07PM



GSTABL7 FSmin=1.23

Factor Of Safety Is Calculated By The Simplified Janbu Method

PETRA

*** **GSTABL7** ***

** GSTABL7 by Garry H. Gregory, P.E. **
** Version 1.0, January 1996; Version 1.14, Sept 1999 **
--Slope Stability Analysis--
Simplified Janbu, Modified Bishop
or Spencer`s Method of Slices
(Based on STABL6-1986, by Purdue University)

Run Date: 6/20/2005
Time of Run: 6:07PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: S:sectionb.
Output Filename: S:sectionb.OUT
Unit System: English
Plotted Output Filename: S:sectionb.PLT
PROBLEM DESCRIPTION FERROCERRIL LANDSLIDE, Section B-B'
(Post Failure Temporary Repair)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

18 Top Boundaries
31 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	143.50	63.00	143.50	2
2	63.00	143.50	96.00	145.00	1
3	96.00	145.00	141.00	145.00	1
4	141.00	145.00	144.00	146.00	1
5	144.00	146.00	150.00	147.00	2
6	150.00	147.00	155.00	150.00	2
7	155.00	150.00	166.00	160.00	2
8	166.00	160.00	172.00	163.00	2
9	172.00	163.00	183.00	163.00	2
10	183.00	163.00	185.00	164.00	2
11	185.00	164.00	205.00	170.00	2
12	205.00	170.00	236.00	180.00	2
13	236.00	180.00	243.00	181.00	2
14	243.00	181.00	260.00	182.00	2
15	260.00	182.00	272.00	195.00	2
16	272.00	195.00	287.00	205.00	2
17	287.00	205.00	290.00	209.00	2
18	290.00	209.00	400.00	209.00	2
19	0.00	136.00	44.00	143.50	1
20	141.00	145.00	160.00	145.00	1
21	160.00	145.00	161.00	142.50	1
22	161.00	142.50	186.00	142.50	1
23	186.00	142.50	205.00	151.00	1
24	205.00	151.00	219.00	160.00	1
25	219.00	160.00	232.00	169.00	3
26	232.00	169.00	280.00	177.00	3
27	280.00	177.00	305.00	184.00	3
28	305.00	184.00	400.00	208.00	1
29	305.00	184.00	400.00	187.50	3
30	219.00	160.00	272.00	162.00	1
31	272.00	162.00	400.00	166.50	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	125.0	575.0	25.0	0.00	0.0	1
2	120.0	125.0	200.0	30.0	0.00	0.0	1
3	120.0	125.0	100.0	32.0	0.00	0.0	1
4	120.0	125.0	575.0	25.0	0.00	0.0	1

ANISOTROPIC STRENGTH PARAMETERS
2 soil type(s)
Soil Type 1 Is Anisotropic

Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	2.0	575.0	25.0
2	4.0	0.0	8.0
3	90.0	575.0	25.0

Soil Type 4 Is Anisotropic
Number Of Direction Ranges Specified = 3

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	4.0	575.0	25.0
2	7.0	0.0	8.0
3	90.0	575.0	25.0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	135.00
2	161.00	143.00
3	230.00	164.00
4	400.00	173.00

Trial Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.00	146.00
2	147.00	140.00
3	265.00	146.00
4	272.00	160.00
5	280.00	177.00
6	289.00	200.00
7	290.00	209.00

* * Factor Of Safety Is Calculated By The Simplified Janbu Method * *
Factor Of Safety For The Preceding Specified Surface = 1.231
Table 1 - Individual Data on the 29 Slices

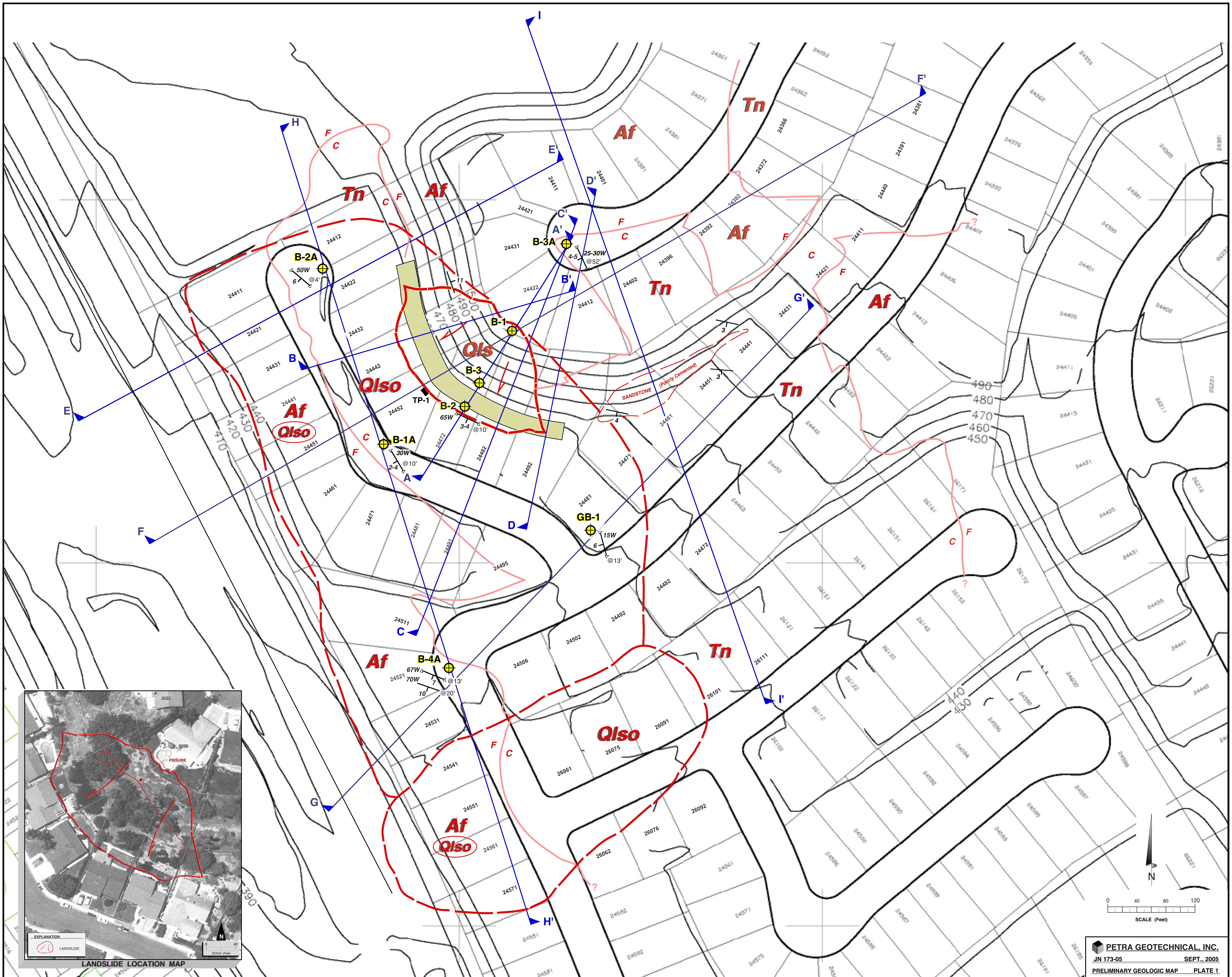
Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.5	32.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.4	424.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.1	719.1	0.0	180.5	0.0	0.0	0.0	0.0	0.0
4	3.0	2437.0	0.0	431.1	0.0	0.0	0.0	0.0	0.0
5	5.0	4989.6	0.0	717.0	0.0	0.0	0.0	0.0	0.0
6	5.0	7100.5	0.0	715.2	0.0	0.0	0.0	0.0	0.0
7	0.8	1381.9	0.0	114.8	0.0	0.0	0.0	0.0	0.0
8	0.2	347.2	0.0	28.0	0.0	0.0	0.0	0.0	0.0
9	5.0	10202.9	0.0	874.1	0.0	0.0	0.0	0.0	0.0
10	6.0	14798.6	0.0	1549.5	0.0	0.0	0.0	0.0	0.0
11	11.0	28653.7	0.0	4258.8	0.0	0.0	0.0	0.0	0.0
12	2.0	5266.2	0.0	971.5	0.0	0.0	0.0	0.0	0.0
13	1.0	2703.8	0.0	508.5	0.0	0.0	0.0	0.0	0.0
14	19.0	57283.1	0.0	12543.5	0.0	0.0	0.0	0.0	0.0
15	14.0	49661.0	0.0	12746.2	0.0	0.0	0.0	0.0	0.0
16	1.7	6408.8	0.0	1730.4	0.0	0.0	0.0	0.0	0.0
17	9.3	37261.1	0.0	10370.0	0.0	0.0	0.0	0.0	0.0
18	2.0	8385.4	0.0	2468.5	0.0	0.0	0.0	0.0	0.0
19	4.0	17162.1	0.0	4938.6	0.0	0.0	0.0	0.0	0.0
20	7.0	30761.2	0.0	8647.5	0.0	0.0	0.0	0.0	0.0
21	17.0	75503.1	0.0	21027.8	0.0	0.0	0.0	0.0	0.0
22	5.0	23796.8	0.0	6191.8	0.0	0.0	0.0	0.0	0.0
23	7.0	32550.7	0.0	12716.8	0.0	0.0	0.0	0.0	0.0
24	1.0	3964.3	0.0	732.7	0.0	0.0	0.0	0.0	0.0
25	2.0	7907.9	0.0	635.0	0.0	0.0	0.0	0.0	0.0
26	5.0	16174.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

27	7.0	14046.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	2.0	2133.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1.0	460.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2 - Base Stress Data on the 29 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-63.43	144.25	1.12	8546.51	-58.14
2	-63.43	145.19	3.08	6629.33	-276.24
3	-63.43	146.44	2.51	7742.63	-572.08
4	2.91	148.50	3.00	93.58	41.25
5	2.91	152.50	5.01	119.58	50.68
6	2.91	157.50	5.01	178.70	72.12
7	2.91	160.40	0.80	220.54	87.29
8	2.91	160.90	0.20	227.75	89.91
9	2.91	163.50	5.01	261.07	103.62
10	2.91	169.00	6.01	308.99	125.25
11	2.91	177.50	11.01	310.35	132.28
12	2.91	184.00	2.00	300.52	133.71
13	2.91	185.50	1.00	307.23	137.30
14	2.91	195.50	19.02	329.57	153.10
15	2.91	212.00	14.02	369.08	180.13
16	2.91	219.84	1.68	389.56	193.60
17	2.91	225.34	9.33	403.93	203.05
18	2.91	231.00	2.00	414.14	212.91
19	2.91	234.00	4.01	427.77	217.88
20	2.91	239.50	7.01	442.21	223.16
21	2.91	251.50	17.02	448.56	225.54
22	2.91	262.50	5.01	492.85	241.69
23	63.43	268.50	15.65	3008.43	4159.18
24	64.80	272.48	2.25	3063.95	3748.11
25	64.80	273.98	4.81	2747.94	3496.25
26	64.80	277.50	11.73	2398.63	2929.07
27	68.63	283.50	19.21	1695.89	1868.69
28	68.63	288.00	5.49	1018.42	993.33
29	83.66	289.50	9.06	807.61	457.19

Sum of the Resisting Forces (including Pier/Pile,
Tieback, and Reinforcing Forces if applicable) = 230689.39 (lbs)
Average Available Shear Strength (including Tieback,
Pier/Pile, and Reinforcing Forces if applicable) = 1194.94(psf)
Sum of the Driving Forces = 187367.22 (lbs)
Average Mobilized Shear Stress = 970.54(psf)
Total length of the failure surface = 193.06(ft)



PETRA GEOTECHNICAL, INC.
JN 173-05 SEPT., 2005
PRELIMINARY GEOLOGIC MAP PLATE 1

EXPLANATION

GEOLOGIC UNITS

Af	**ARTIFICIAL FILL** (GEOTECHNICAL CONSULTANTS, INC., 1967)
Qls	**LANDSLIDE DEPOSIT**
Qlso	**ANCIENT LANDSLIDE DEPOSIT** (Circled where buried by Artificial Fill)
Tn	**NIGUEL FORMATION** (BEDROCK)

SYMBOLS

B-3	**GEOTECHNICAL BORING** BY PETRA GEOTECHNICAL, INC. (Drilled for homeowners)
B-4A	**GEOTECHNICAL BORING** BY PETRA GEOTECHNICAL, INC. (Drilled for City of Mission Viejo)
GB-1	**GEOTECHNICAL BORING** BY GEOFIRM (Drilled for resident at 24431 Chrisanta Dr.)

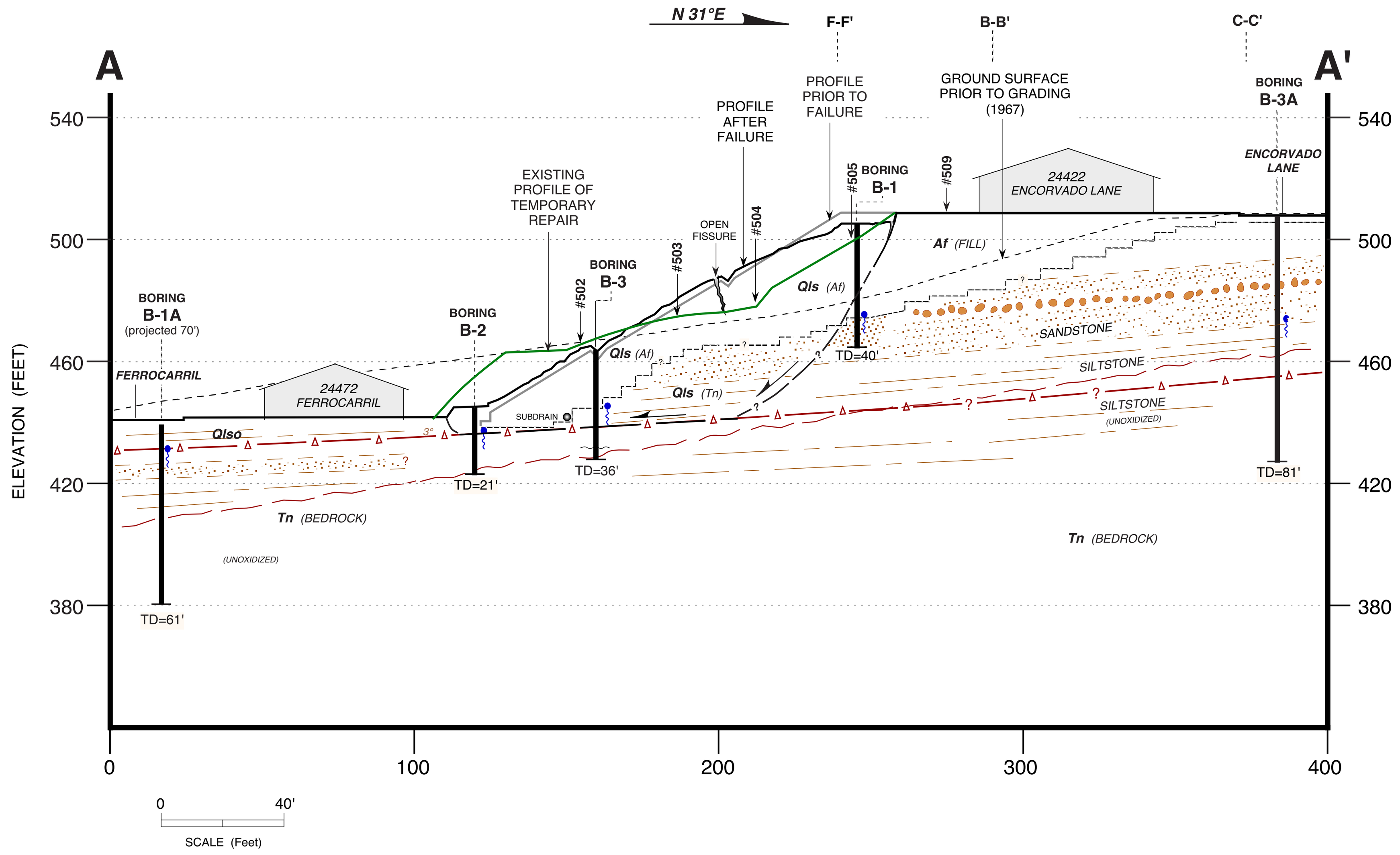
SYMBOLS (cont.)

TP-1	**TEST PIT** BY PETRA GEOTECHNICAL, INC. (Excavated for City of Mission Viejo)
50W 6 @4'	**BEDDING ATTITUDE** - CLAY SEAM (Showing depth in feet)
3	**BEDDING ATTITUDE** (GEOTECHNICAL CONSULTANTS, INC., 1967)
	HORIZONTAL BEDDING (GEOTECHNICAL CONSULTANTS, INC., 1967)
	GROUNDWATER SEEPAGE
#702	**SURVEY MONITORING STATION** (JOHNSON-FRANK & ASSOC. INC, 2005)

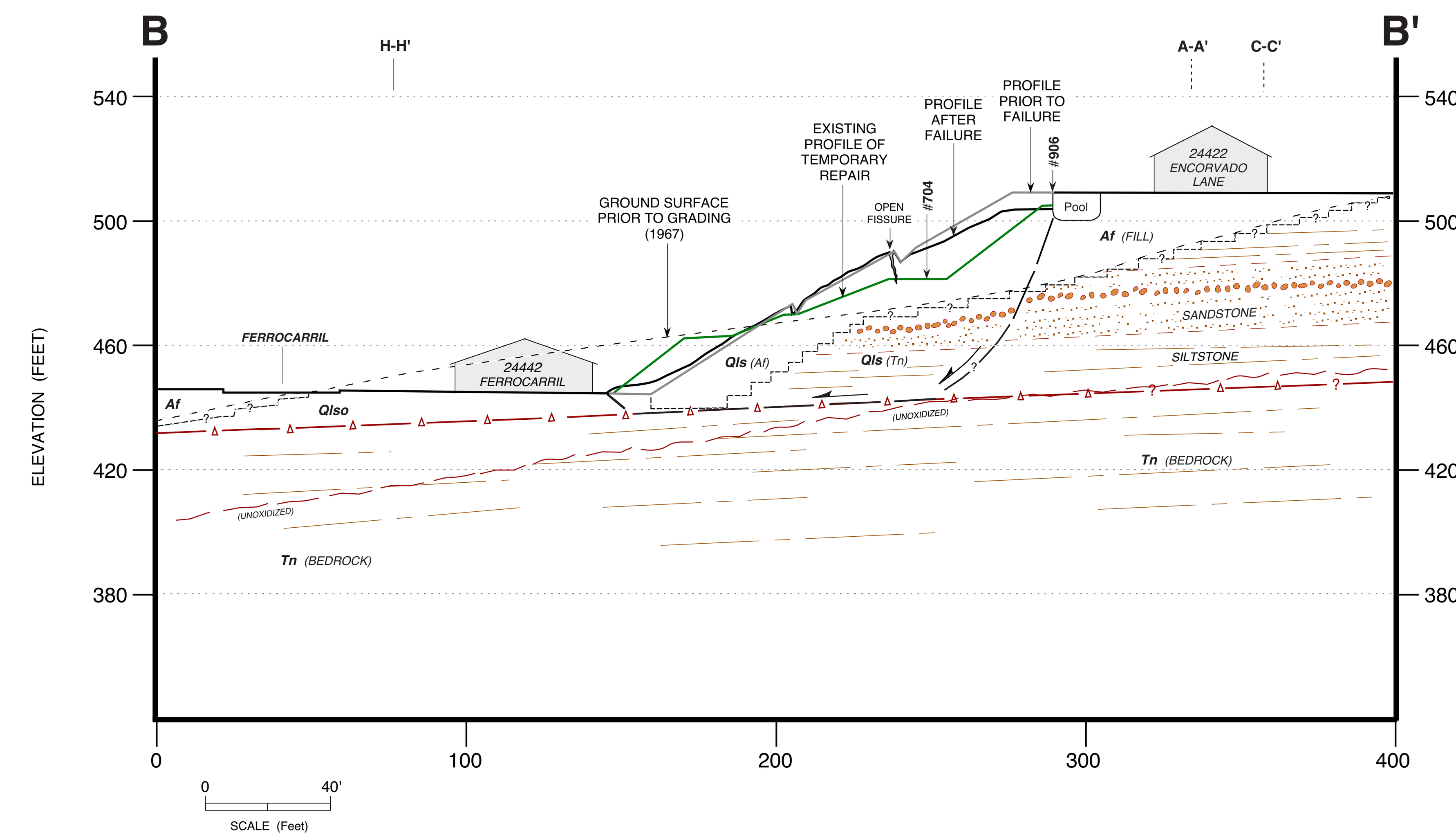
SYMBOLS (cont.)

Qls	**APPROXIMATE LIMITS OF ACTIVE LANDSLIDE**
Qlso	**APPROXIMATE LIMITS OF ANCIENT LANDSLIDE DEPOSIT**
	GEOLOGIC CONTACT (Dashed Where Approximate)
C F	**APPROXIMATE FILL/BEDROCK OR FILL/LANDSLIDE CONTACT** (Based on Cut/Fill line as shown on 1967 Grading Plans)
I I'	**GEOLOGIC CROSS-SECTION**
	APPROXIMATE LOCATION OF KEY CONSTRUCTED FOR SLOPE (1967)

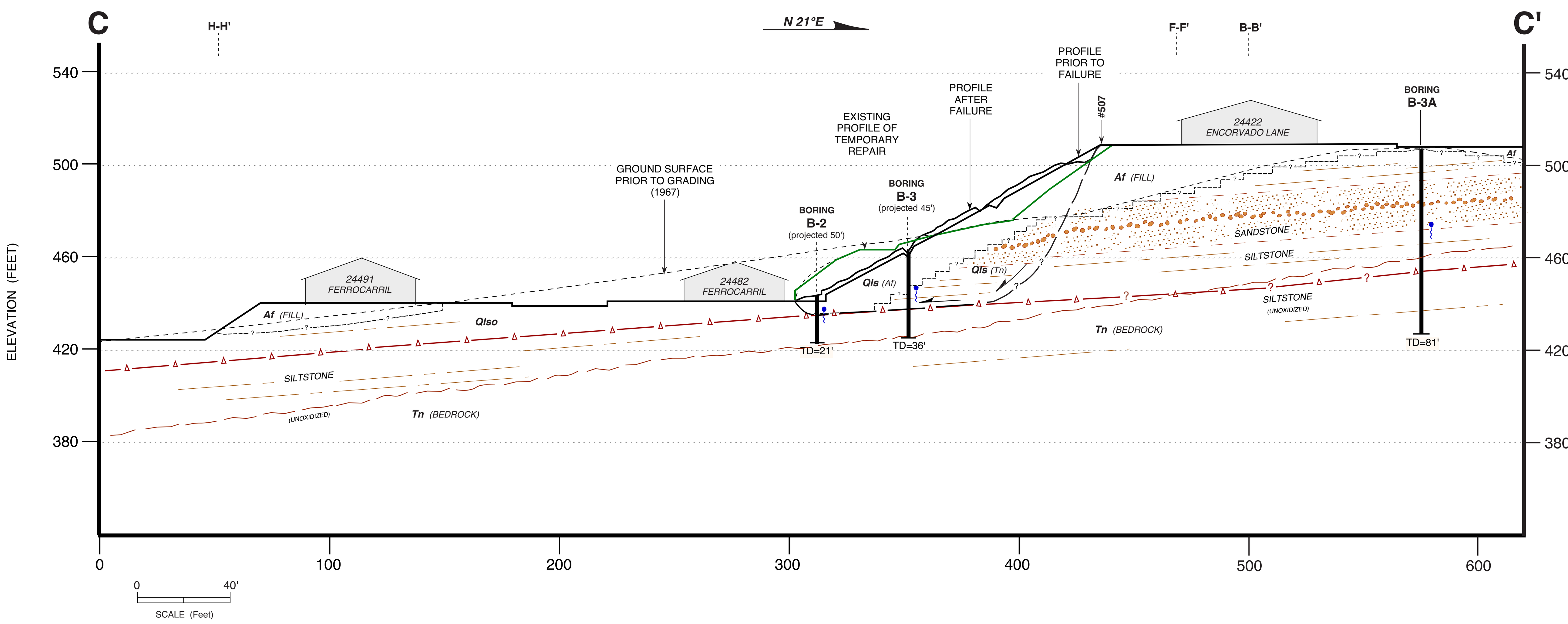
SECTION A - A'



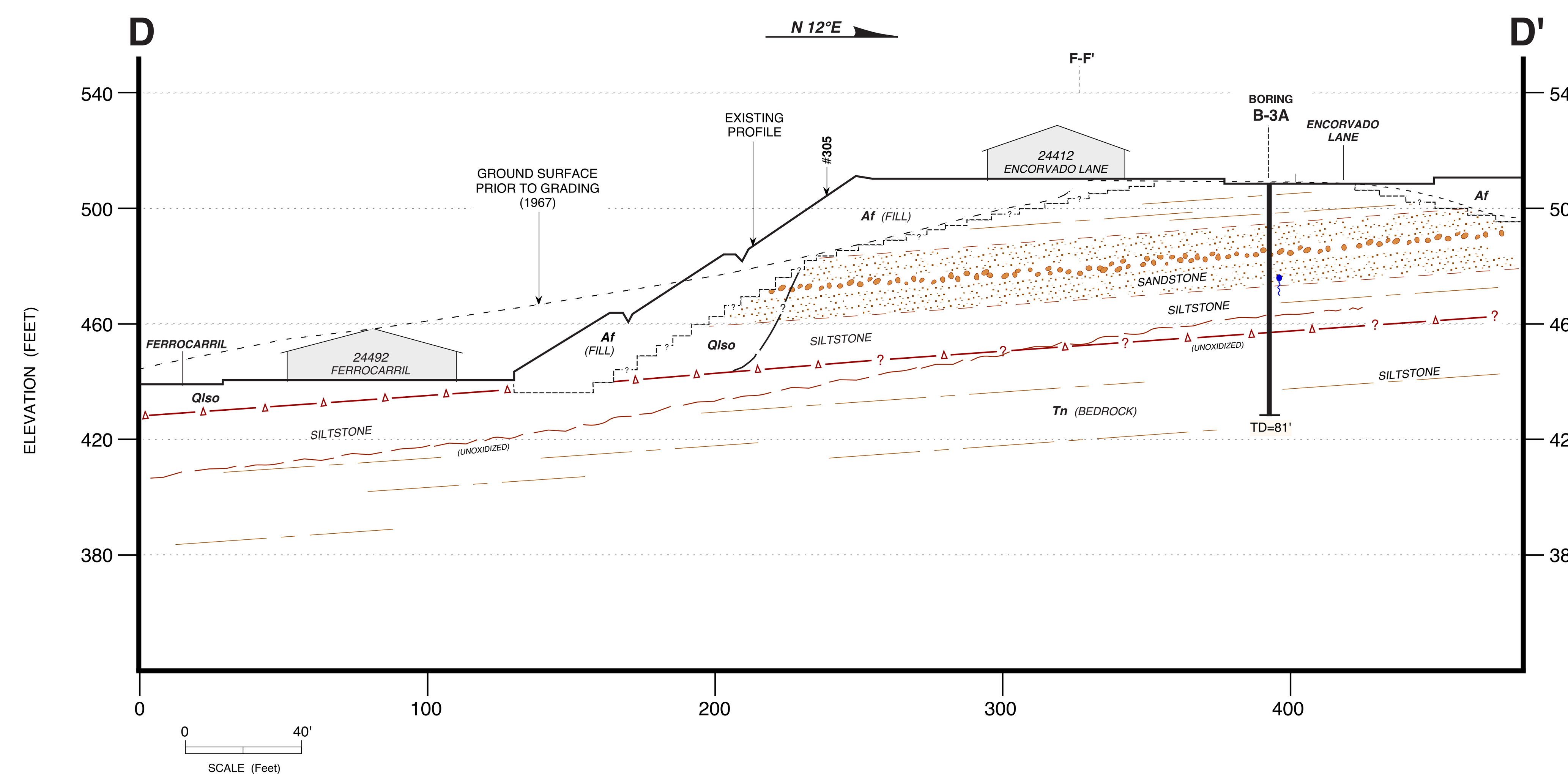
SECTION B - B'



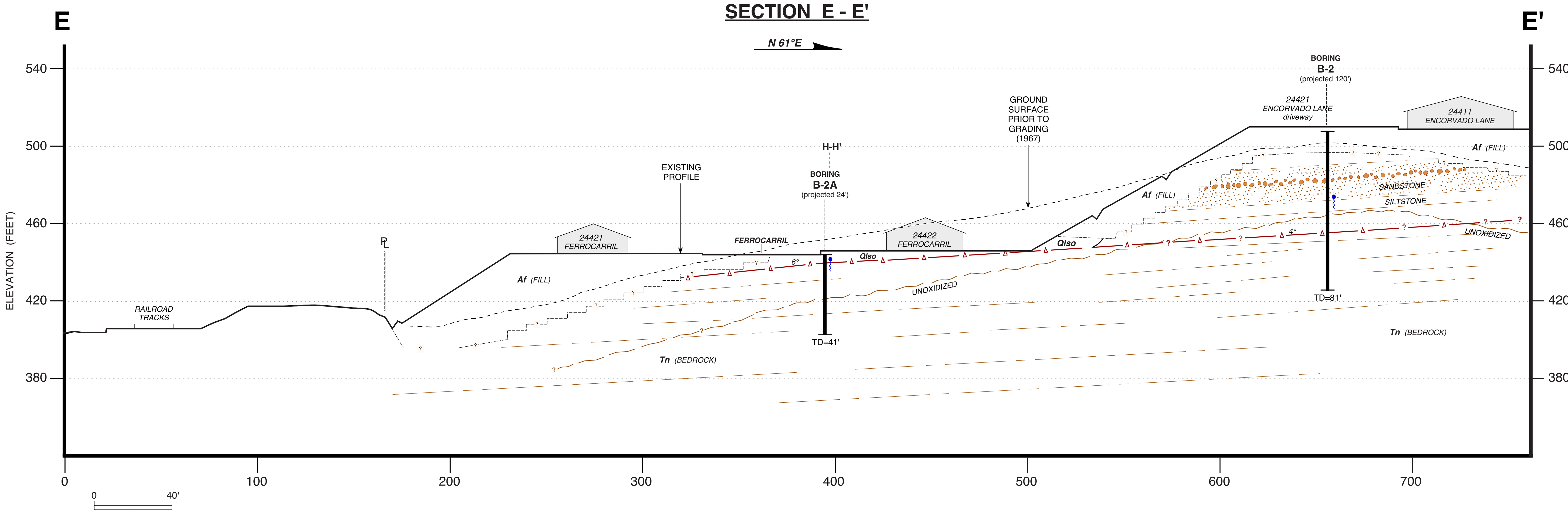
SECTION C - C'



SECTION D - D'



SECTION E - E'



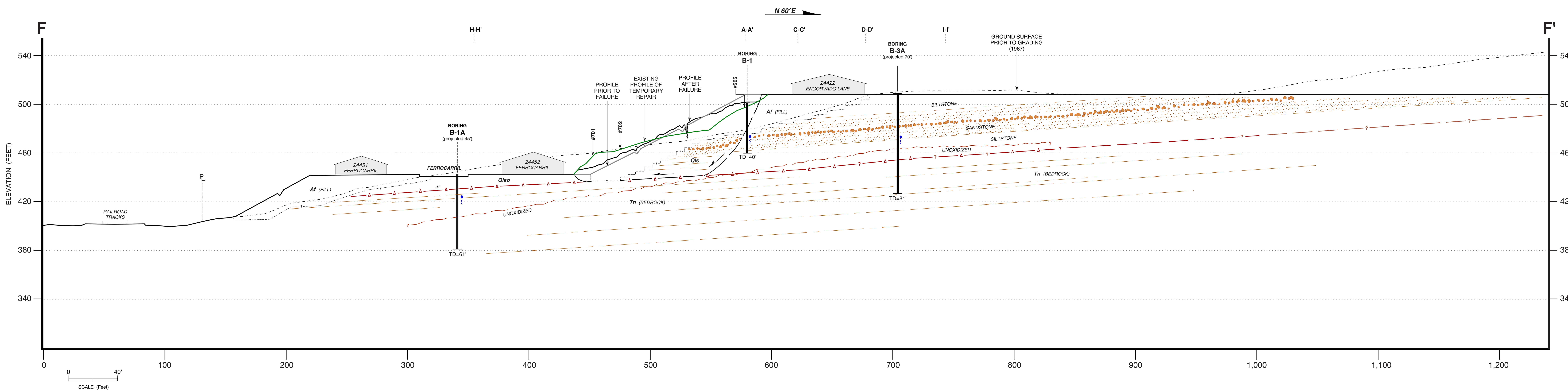
SEE PLATE 1 FOR EXPLANATION

PETRA GEOTECHNICAL, INC.

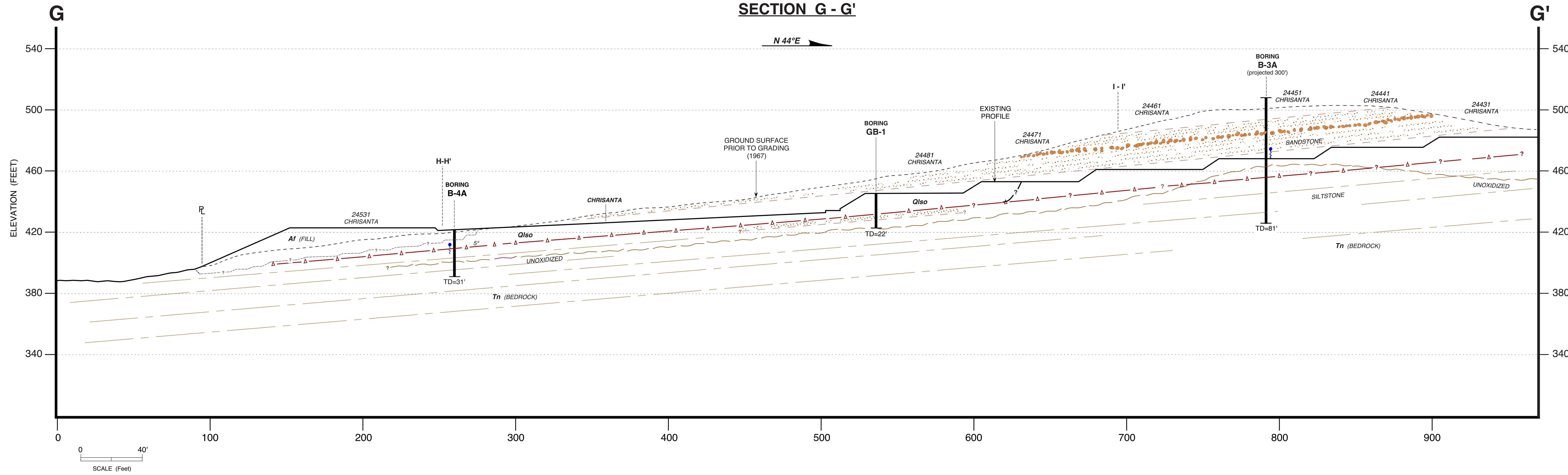
JN 173-05 SEPT., 2005

SECTIONS A-A' THROUGH E-E' PLATE 2

SECTION F - F'



SECTION G - G'



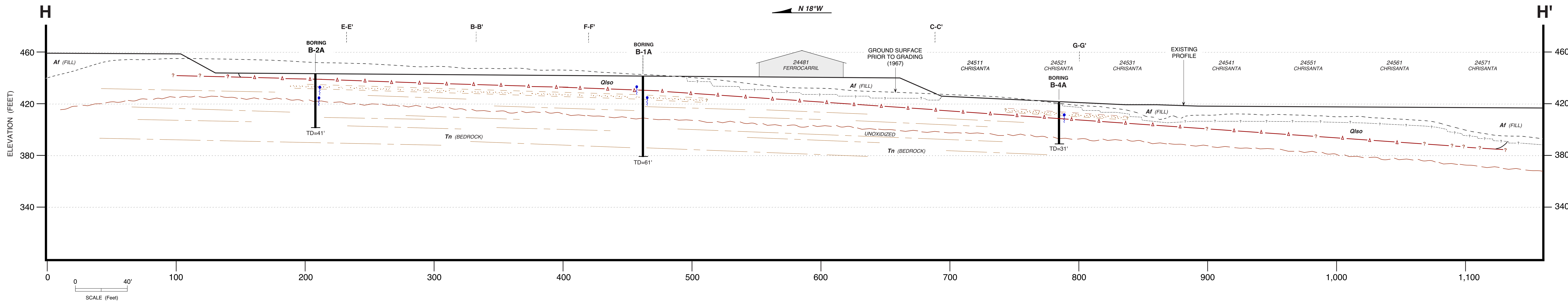
SEE PLATE 1 FOR EXPLANATION

PETRA GEOTECHNICAL, INC.

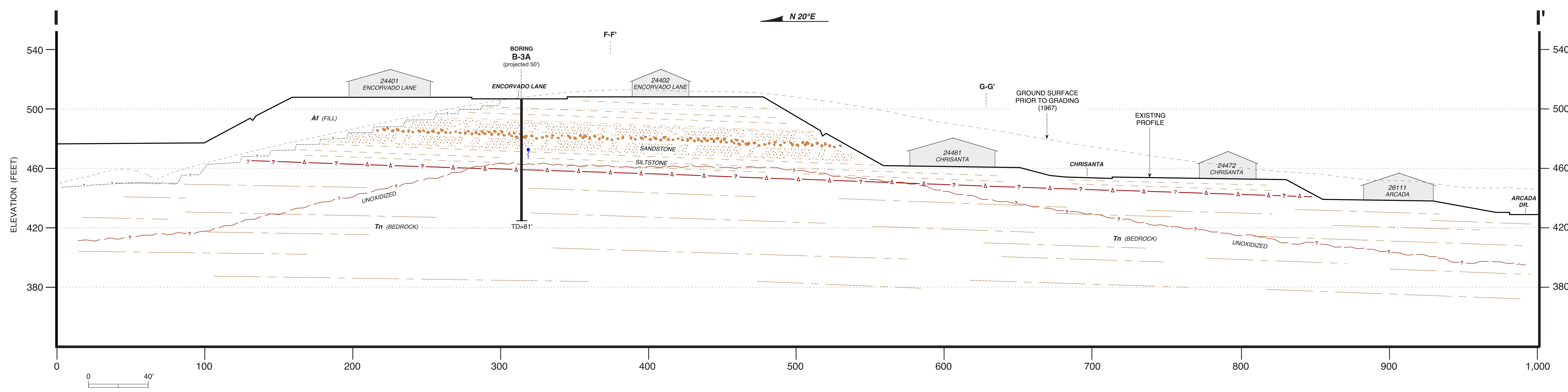
JN 173-05 SEPT., 2005

SECTIONS F-F' AND G-G' PLATE 3

SECTION H - H'



SECTION I -I'



SEE PLATE 1 FOR EXPLANATION

PETRA GEOTECHNICAL, INC.

JN 173-05 SEPT., 2005

SECTIONS H-H' AND I-I' PLATE 4