Grover Hollingsworth and Associates, Inc.

PRE-PURCHASE GEOLOGIC AND GEOTECHNICAL ENGINEERING EVALUATION

Lot 18, Block D, Tract 8557
7027 S. Vista Del Mar Lane
Los Angeles, California
for
MR. BILL PUREWAL

November 22, 2017 GH18197-G

Engineering Geology **Geotechnical Engineering**
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INTRODUCTION

The following report summarizes findings of our geologic and soils engineering exploration performed on the subject property. The purpose of the exploration was to evaluate the nature, distribution, engineering properties, relative stability, and geologic structure of the earth materials underlying the property with respect to evaluation of the potential for future site development.

It is the intent of this report to aid in your purchase decision. This report is prepared for the use of the client and authorized agents and should not be considered transferable. Prior to use by others, the site and this report should be reviewed by Grover-Hollingsworth and Associates, Inc. This report is not suitable for submission to the City of Los Angeles Department of Building and Safety. Additional work will be required to update this report once development plans are prepared.

EXPLORATION

The scope of our exploration was based on preliminary development information provided by the client. The exploration was limited to the areas of the proposed project, as shown on the enclosed Geologic Map and Cross Section.

The field exploration was initially conducted on April 4, 2017. with the aid of hand labor. The initial exploration included excavating three (3) test pits to depths of 4½ to 7½ feet and obtaining samples. Downhole observation of the earth materials encountered in the test pits was performed by the staff geologist. Excavations were backfilled and tamped but should not be considered compacted.

Subsequent exploration was performed on October 31, 2017, with the aid of hand labor and a hand-auger. A hand auger was used to excavate hand-auger boring HA-1 to a depth of 17½ feet. Excavation spoils and samples from the hand-auger boring were visually logged by the staff geologist. Excavations were backfilled and tamped but should not be considered compacted.

Office tasks included laboratory testing, engineering analysis, review of City records, and the preparation of this report. Test pits are logged on plates A-1 through A-4b. Laboratory test methodology and results are discussed in the Appendix and are presented on plates A, B, and D. Surface geologic conditions, existing site improvements, and the locations of the test pits are shown on the enclosed Geologic Map. Subsurface distribution of the earth materials, projected geologic structure and contacts, existing structures and the proposed project are shown on Section A, which forms the basis for the enclosed slope stability and temporary stability calculations.

PROPOSED DEVELOPMENT

Information concerning the possible future development was provided by your architect John G. Davis. A proposed development plan was not provided prior to field exploration. It is our understanding that the purpose of the report is to provide general information on the geologic and geotechnical conditions of the site to assist in the client's property purchase decision. The general feasibility of construction on the subject property is addresses herein, based on an assumption that a residence will be constructed over the descending slope from the upper portion of Vista del Mar Lane adjoining the site.

SITE DESCRIPTION

The subject property consists of an undeveloped hillside lot located in the Playa Del Rey area of Los Angeles, California. The property is situated on the eastern side of Vista Del Mar and the western side of Vista Del Mar Lane. The lot ascends from Vista Del Mar to Vista Del Mar Lane at a gradient of 1½:1 to 1:1. The total slope relief is approximately 80 feet. The site vegetation currently consists of scattered ice-plant over the majority of the slope, and native bushes near the toe of the slope.

The neighboring property to the south is developed with a multi-level residence that is situated at or near the south property line. The structure has been constructed at the same grade as the subject property. It is unknown if this neighboring structure has been constructed with a basement. The neighboring property to the north is also currently undeveloped, although, a parking space exists at its toe. A small, 2-foot-tall wall, with an additional 2 feet of railroad ties has been constructed to provide the parking space.

RESEARCH FINDINGS

As part of our work, records at City of Los Angeles Department of Building and Safety were reviewed. Geotechnical documents for the subject property were not found during our research.

EARTH MATERIALS

Fill/Slopewash

Fill/slopewash was observed in test pit TP-3. The depth of fill where observed is 5½ feet. The fill consists of sand to slightly silty sand that is gray-brown to dark brown, moist, and medium dense to dense. The fill contains scattered rootlets and trash/debris.

Soil

Natural residual soil was encountered in test pits TP-1 and TP-2, and in hand-auger hole HA-1, with an observed thickness of 1 and 2 feet. The soil consists of silty sand and sand that are brown and dark brown, moist, and dense. The upper 2 to 6 inches of the soil is soft to medium dense.

Dune Sand Deposits

Dune sand deposits underlie the site and were encountered in all of the test pits and the hand-augered hole at depths of 1 to 5½ feet, measured below existing grade. The dune sand deposits consist of interlayered silty sand and sand. The silty sand layers are dark brown and red-brown, while the sand layers are orange-brown. The dune sand deposits are moist and dense to very dense.

GROUNDWATER

Seeps, springs, or groundwater were not encountered during our exploration.

RAIN DAMAGE

Evidence of relatively recent rain damage such as significant erosion, slope failures, or landslides was not observed on the property, and research of City records does not indicate previous problems on the site.

REGIONAL GEOLOGIC SETTING

The subject site is located on an elevated terrace, on the southern edge of a portion of the coastal plain, referred as the Ballona Gap by Poland and others (1959), situated south of the Santa Monica Mountains and at the extreme northern end of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges Geomorphic Province is characterized by northwest-trending folds, faults and mountain ranges. Local faults of interest in the area of the subject property include the Newport-Inglewood, Charnock and Overland faults.

LOCAL GEOLOGIC STRUCTURE

The earth materials described is common to this area of the Ballona Gap. The dune sand deposits on the site and which comprises the slope is generally massive to crudely horizontally layered and lack any significant structural trends. The generally massive nature of the dune sand deposits is favorable for the gross stability of the site. Significant faults, folds, or other geologic hazards were not encountered during exploration.

SEISMIC CONSIDERATIONS

Earthquake Fault Zones

The State of California enacted the Alquist-Priolo Special Studies Act of 1972, which went into effect in early 1973. The Alquist-Priolo Act is intended to prohibit the location of most structures for human occupancy across a known active fault that intersects the ground surface, thereby mitigating fault-rupture hazard. The Alquist-Priolo Act requires that the State Geologist delineate "special studies zones" along active surficial faults. Development within these Special Studies Zones must include geologic investigation demonstrating the absence of a surface displacement threat. Special Studies Zones have been renamed Earthquake Fault Zones.

The maps depicting the Earthquake Fault Zones are issued by the California Department of Conservation, California Geological Survey (CGS). An earthquake fault which is well defined, active, or sufficiently active (active within the last 11,000 years) and breaks or nearly breaks the ground surface is subject to zoning. An Earthquake Fault Zone is ordinarily established from 200 feet to 500 feet from an identifiable recent break. Recent breaks are determined by surface and subsurface exploration by the CGS, and their review of previous work by others.

The site is not located within an Earthquake Fault Zone, and no zoned faults cross the site or are in close proximity. The nearest zoned fault is the northern portion of the Newport-Inglewood Fault located approximately 5 miles to the east of the subject property.

The Newport-Inglewood Fault trends northwesterly for about 40 miles from the Newport Mesa to the Cheviot Hills along the western side of the Los Angeles Basin. Folding and faulting of a thick sequence of sedimentary rocks forms the belt of domed hills and mesas known as the Newport-Inglewood structural zone. The en echelon arrangement of the uplifts combined with right-lateral strike-slip offsets leads to the belief that the Newport-Inglewood Fault is a strike-slip fault at depth (Barrows, 1974). However, surficial materials convey normal, reverse and left-lateral faulting. The Newport-Inglewood Fault is considered active by CGS and ICBO.

Faults in the Ballona Gap, including the Charnock and Overland faults, are not associated with the Newport-Inglewood uplift but have a strong influence on ground water. They bound both sides of a down-dropped graben based on well logs and water-level data. The exact attitudes of the faults are not known but absence of surficial displacement suggest that the fault has not been active in recent time. These faults are not currently considered active.

Splays of the Santa Monica Fault have been mapped 5 miles north of the site by Dolan et al. (2000), Leighton (1995), and the State of California (2017). The Santa Monica Fault is a 25-mile-long, oblique, left-lateral reverse fault that extends from Point Dume to the east to the Beverly Hills Lineament. The onshore portion of the Santa Monica Fault is delineated by a series of low (less than 40 feet high), left-stepping, overlapping, south-facing scarps which are located 2 to 2½ miles south of the Santa Monica Mountains (Dolan et al. 2000). The fault extends offshore at the mouth of Potrero Canyon as the Potrero Canyon Fault.

The Safety Element of the General Plan for the City of Santa Monica, prepared by Leighton and Associates (1995), maps the northern and southern branch of the Santa Monica Fault within the City of Santa Monica. The north branch of the Santa Monica Fault has been located based on oil field and groundwater data and from topographic scarps noticeable in old topographic maps. The southern branch has been inferred from oil well data in the Sawtelle Oil Field and by a groundwater barrier within Pleistocene sediments north of the Palisades Park (Poland, 1959). Dolan et al. (2000) report that the northern strand is the most recently active with almost all of the motion on this strand having occurred during Pleistocene and Holocene time. The southern strand in contrast is not believed to deform quaternary strata.

Leighton (1995) proposed new locations for the Santa Monica Fault, that fall between the north and south branches, based primarily on geomorphic data. The proposed new fault scarp locations are shown on the "Fault Hazard Management Zones and Liquefaction Susceptibility" map included in the Seismic Safety Element. Dolan et al. (2000) also map fault locations in the city of Santa Monica based on geomorphic data. The fault scarp locations shown by Leighton (1995) and Dolan et al. (2000) appear to closely correspond.

Dolan et al. (2000) report that recent trenches excavated across the northern strand of the Santa Monica Fault at the Veteran's Administration property in West Los Angeles revealed four zones of faulting and evidence for six events which produced surface ground rupture. The ages of the events are estimated to range from 50,000 years ago to 1,000 to 3,000 years ago. Dolan et al. (2000) estimate the reoccurrence interval for events on the Santa Monica Fault which are large enough to produce surface rupture at 7,000 to 8,000 years. Dolan et al. (2000) conclude that the results of their trench observations and age dating combined with geomorphic data indicate that the Santa Monica Fault is active.

Mapped traces of the Palos Verdes Fault zone exist approximately 2½ miles west of the subject property. This fault is considered to have both right lateral and reverse movement. The fault has a slip rate between 0.1 and 3.0 millimeters per year and has a potential for an earthquake with a probable magnitude of 6.0 to 7.0. Several geologists including Peter J. Fischer, have segmented the Palos Verdes Fault into three segments. Two of these segments are located offshore to the northwest and southeast of the Palos Verdes Peninsula. These two segments have experienced probable Holocene (recent) activity and are considered to be active. Fischer (1992) concludes that based upon the probable offshore activity, the “onshore segment is obviously active”. Past faulting has formed a complex zone of shearing and folding and has offset marine terrace platforms and deposits. Although generally considered only potentially active by most geologists, portions of the Palos Verdes Fault are considered to be active and capable of producing damaging earthquakes.

Strong Ground Shaking-2016 CBC

The majority of Southern California, including all of Los Angeles and Ventura counties, falls within a zone requiring structural design to resist earthquake loads. Section 1613 of the 2016 California Building Code (CBC) which is based on the 2015 International Building Code (IBC) requires mapped risk-targeted considered earthquake (MCE_R) ground motion response acceleration. These parameters include 5-percent critical damping at 0.2 seconds (S_s) and 1.0 seconds (S_1). In addition, a Site Class and site coefficients F_a and F_v must be assigned for use in structural design relative to strong ground shaking.

The mapped spectral acceleration parameters (S_s and S_1) are determined utilizing Figure 1613.3.1(1) and 1613.3.1(2) of the 2016 CBC or the geographic location (latitude and longitude) of the site using the USGS interactive website "U.S. Seismic Design Maps" at http://earthquake.usgs.gov/designmaps/us/application.php. Site coefficients F_a and F_v can also be obtained from the USGS program or from tables 1613.3.3(1) and 1613.3.3(2) included in the 2016 CBC.

The 2016 CBC assigns a site class based on the average soil properties within the upper 100 feet of the soil profile. Site Class D is applicable for the subject property.

Site class, spectral accelerations and seismic design coefficients have been determined for the site based on tables 1613.3.3 (1 and 2) of the 2016 CBC and the USGS interactive U.S. Seismic Design Maps website utilizing the 2010 ASCE 7 option. The required design parameters and coefficients are provided in the following table.

Site Class	Spectral Response Acceleration (0.2s) S_s (g)	Spectral Response Acceleration S_1 (g)	Site Coefficient F_a	Site Coefficient F_v
D	1.598	0.626	1.0	1.5

Design Spectral Response Acceleration (0.2s) S_{DS}	Design Spectral Response Acceleration (1.0s) S_{D1}
1.065	0.626

Peak Ground Acceleration

Analysis of the seismic stability of slopes requires an estimate of the peak ground acceleration (PGA) at the site. The PGA is a function of the distance of the site from a seismic source, the type and magnitude of fault movement, the shear wave velocity of the soil/rock, and the period of time under consideration. The current City of Los Angeles geotechnical guidelines allow the use of a PGA equal to 2/3 of PGA_M, where PGA_M is determined in accordance with Figure 22-7 and equation 11.8-1 of the 2010 ASCE 7. The PGA_M value can be obtained using the USGS interactive U.S. Seismic Design Maps website http://earthquake.usgs.gov/designmaps/us/application.php utilizing the 2010 ASCE 7 option and Site Soil Classification D. The PGA_M for the site determined utilizing this method is 0.618g. Based on the City of Los Angeles Guidelines a PGA = 2/3 PGA_M = 2/3 (0.618g) = 0.412g is applicable for seismic slope stability analysis.

Per "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California," Blake (2002), seismic slope stability analyses require an estimate of the earthquake magnitude and source distance. We have utilized the USGS 2008 Interactive Deaggregations to estimate the earthquake magnitude and source distance using the website https://geohazards.usgs.gov/deaggint/2008/. The USGS interactive website requires an estimate of the shear wave velocity for the upper 30 meters of the site (V_s^{30}) and the geographic location of the site. We have estimated the V_s^{30} = 259m/s which corresponds to Soil Site Class D. The current standard of practice accepted by the City of Los Angeles is to utilize an exceedance probability of 10 percent in 50 years or a return interval of 475 years. The website provides a mean magnitude of M = 6.58, mode magnitude of M = 6.32; mean source distance of 13.4 km and modal source distance ranging from 8.83 to 9.12 km for the site. We have elected to use a magnitude M = 6.58, and source distance 13.4 km for the site.

We determined a seismic coefficient using recommendations in the screening procedure in "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California," Blake (2002). The screening procedure requires determination of a factor (f_{eq}) relating slope displacement to earthquake magnitude and distance. This factor f_{eq} was determined utilizing a magnitude M6.58 at a distance less than 13.4 kilometers. We used the 5cm displacement threshold. The factor f_{eq} is 0.508. This factor is multiplied by probabilistic maximum horizontal acceleration (2/3 PGA_M) to obtain seismic coefficient K of 0.209g.

The proposed structure will be subjected to moderate to strong ground shaking should one of the many active Southern California faults produce an earthquake.

Seismic Hazards

The California State Legislature passed the Seismic Hazards Mapping Act of 1990. The Seismic Hazards Mapping Act was signed into law and became effective in 1991. The Seismic Hazards Mapping Act was prompted by damaging earthquakes in northern and southern California, and is intended to protect public safety from the effects of strong ground shaking, liquefaction, landslides, and other earthquake-related hazards. The Seismic Hazards Mapping Act requires that the State Geologist delineate the various "seismic hazards zones." The maps depicting the zones are released by the CGS. The fact that a site lies outside of a zone does not mean it is free of seismic or geologic hazards such as landslides, lateral spreading, liquefaction or rockfall. Not all of Southern California has been mapped, although, new maps are issued and existing maps are refined from time to time.

The Seismic Hazards Mapping Act requires a site investigation by a certified engineering geologist and/or civil engineer prior to development of a project sited within a hazard zone. The investigation is to include recommendations for a "minimum level of mitigation" that should reduce the risk of ground failure during an earthquake to a level that does not cause the collapse of buildings for human occupancy. The Seismic Hazards Mapping Act does not require mitigation to a level of no ground failure and/or no structural damage.

Seismic Hazard Zone delineations are based on correlation of a combination of factors, including: surface distribution of soil deposits and bedrock, slope steepness, depth to groundwater, bedding orientation with respect to slopes, bedrock shear strength, and occurrence of past seismic failure. Maps within the series are further designated as Reconnaissance, Preliminary, or Official. Official Seismic Hazard Zones Maps are the culmination of mapping, analysis, review and comment of CGS, other State agencies, and the public following review and revision of the Preliminary Review Map. The Official Maps are the most rigorous and have the highest confidence level.

The CGS has released an official map titled "Seismic Hazard Zones, Venice 7.5 Minute Quadrangle," which is included in Open File Report #97-13, dated March 25, 1999. The map delineates areas that have been subject to or are potentially subject to liquefaction; and areas where previous landsliding has occurred or conditions for potential permanent ground displacements exist as a result of earthquake-caused ground shaking. Dotted zones are for liquefaction hazard. Cross hatched zones are for earthquake-induced landslides.

Liquefaction is a process which occurs when saturated sediments are subjected to repeated strain reversals during a seismic event. The strain reversals cause an increase in pore water pressure such that the internal pore pressure approaches the overburden pressure and the shear strength approaches a low residual value. Liquefied soils are subject to flow, consolidation, or excessive strain. Liquefaction typically occurs in loose to medium dense sand and silty sand soils below the groundwater table. Predominately fine-grained soils, such as silts, and clay, are less susceptible to liquefaction.

The site is not included within a zone of potentially liquefiable soil. Liquefaction is not considered a hazard at the subject site because Pleistocene Age sediments underlie the site at a shallow depth.

The site is located within an area subject to potential seismic-induced slope instability. This designation has likely been made due to the presence of relatively steep slopes coupled with low inferred earth material strengths.

Earthquake-induced soil densification is not expected to occur on the site. Ground lurching may cause movement in near-surface earth materials or structures located near the top of a descending slope that are not properly founded in the dune sand deposits with the recommended setbacks. The seismic stability of the slope is addressed in the **Slope Stability** section of this report.

METHANE ZONE

The City of Los Angeles parcel map web site Navigate LA indicates that the subject site is located in a methane zone and a methane buffer zone. A methane zone or methane buffer zone is an area that is considered by the City to be at risk of methane seepage from the underlying earth materials into buildings. This property is likely included in a methane zone due to the proximity of the site to the Playa Del Rey Oil Field.

The City requires that sites in Methane Zone be tested prior to construction of any new slab on grade building, raised wood floor buildings or basement structures to determine the extent of mitigating measures required for the site. As an alternative, the City does permit new construction to conform to the full extent of the City methane mitigation requirements for the specific type of structure. The ordinance which contains these requirements, Ordinance No. 175790 was adopted by the Council of the City of Los Angeles on February 12, 2004, and became effective on March 29, 2004.

The proposed project for this site may include the construction of a residence utilizing a slab-on-grade floor and a slab-on-grade garage. The City methane mitigation requirements for construction of small slab-on-grade and raised-floor additions may be found in Information Bulletin/Public Building Code Document No. P/BC2002-102, dated August 25, 2004, on the City of Los Angeles Department of Building and Safety website www.ladbs.org.

SLOPE STABILITY

Gross Stability

Static and seismic stability calculations were performed for the existing west-facing descending slope on the subject property. The calculations were performed using the Slide Computer Program by Rocscience. We chose the Modified Bishop's Method for circular failures. A seismic coefficient K=0.209g was used in the seismic analysis. Deep and shallow circular failure surfaces extending through the toe of the slope were analyzed.

Static and seismic slope stability calculations performed along Section A with a potential development configuration along circular failures extending through the toe of the ascending slope extending to the upper street. Those analyses indicate static and seismic factor of safety of 1.17 and 0.78, respectively (Slide Files, Section A, Global Stability STATIC and SEISMIC). The calculated factors of safety are less than required by the Code indicating that engineered elements will be required to improve the static and seismic safety factors to 1.5 and 1.0, respectively, as required by the Code.

The lower portion of the slope below the potential structure location was also analyzed for its stability. The calculated static factor of stability was determined to be below the Code-required values of 1.5 and 1.0, respectively (Slide Files Section A, Lower Slope Stability STATIC and SEISMIC). Even if soldier piles are used to bring the global stability of the slope up to the required standards for the residence, the portion of slope below the structure will still be unstable. Therefore, a retaining wall and additional soldier piles may be utilized near the base of the slope to stabilize the slope below the future structure. A retaining wall is shown on Section A at its most probable location. An active load was placed horizontally at the location of the retaining wall. The load was increased until the static and seismic factor of safety of the slope below the structure was equal to 1.5 and 1.0, respectively. The static analysis governed the retaining wall design, resulting in a lateral load of 7,928 pounds per lineal foot width (Slide Files, Section B, Lower Slope w/Wall STATIC and Section B, Lower Slope w/Wall SEISMIC).

We then performed slope stability analyses to evaluate the location of the critical circle with the required static and seismic factors of safety with no applied lateral load utilizing the SLIDE program (Slide Files Section B, 1.5 Factor of Safety Surface – STATIC and Section B, 1.0 Factor of Safety Surface-SEISMIC). The surface is 18.6 feet below grade at the downslope wall of the residence and 6 feet below grade at the retaining wall.

Slope stability calculations were performed to evaluate the required residence soldier pile load to achieve the required safety factors. For purposes of this analysis, soldier piles were assumed to be placed at the western edge of a schematic depiction of the proposed residence structure. The active retaining wall load was also applied to the model. The required static and seismic residence soldier pile loads are 13,340 and 7,405 pounds per lineal foot width, respectively. The depths to the critical circles for the static and seismic conditions are approximately 23 and 19 feet, respectively at the location of the residence soldier piles and 10 and 5 feet below grade of the retaining wall. The critical static and seismic circles with the required factors of safety are depicted on the enclosed Section A. The recommended residence soldier piles will need to be designed to retain the earth material above this retention surface or to a depth of 23 feet as measured from elevation 65 feet. The retaining wall piles need to retain to a depth of 10 feet at the wall location.

Seismic Retaining Wall Calculations
The seismic loading on the proposed retaining walls has been analyzed using the MULT CALC Computer Program by Wolf Software. The program utilizes the Mononobe-Okabe Method to analyze the seismic forces on a retaining wall. This method requires a horizontal seismic coefficient A_h. The horizontal seismic coefficient can be approximated as one half the peak ground acceleration (PGA). The current City of Los Angeles Guidelines allow a PGA = (2/3)(PGA_M). Therefore, the estimated PGA at the subject site is (2/3)(0.618) = 0.412g, as discussed in the **Strong Ground Shaking** section above. The horizontal seismic coefficient A_h = (1/2)(PGA) = (1/2)(0.412g) =0.206g.

Cantilevered retaining walls supporting a 2:1 may be designed for the more critical of an active equivalent fluid pressure of 74 pounds per cubic foot or a seismic equivalent fluid pressure of 81 pounds per cubic foot. These pressures are not additive and either could govern depending on the applicable structural safety factors.

The above-described calculations are based upon shear tests of samples believed to represent the weakest material encountered during exploration. Cross sections used are thought to be the most critical for the slopes or conditions analyzed. All other slopes of flatter gradient or lesser height are considered stable.

ENGINEERING CONSIDERATIONS

Samples of the earth materials were obtained from the site and transported to the laboratory for further testing and analysis. The testing performed is described in the Appendix.

CONCLUSIONS AND RECOMMENDATIONS

General Findings

Based upon our exploration, it is our finding that future redevelopment of the subject property is feasible from a geologic and soils engineering standpoint. However, a proposed site plan should be provided before specific design recommendations can be provided.

The subject property is situated on a west-facing descending slope with gradients varying from 1½ to 1:1 and full height of approximately 80 feet. The earth materials are comprised of Middle to Upper Pleistocene Dune Sand Deposits, which were observed at depths varying from 2 to 5½ feet below the surface. Deeper fill/slopewash was also observed near the toe of the descending slope. As shown on plates B-2 and B-3, the shear strength testing of the Dune Sand Deposits resulted in a cohesion value, $c = 0$ psf and friction angle, $\varphi = 36½$ degrees. These values were utilized in our slope stability calculations.

As discussed in the **Slope Stability** section above, stability calculations performed for the existing west-facing descending slope with a residence on the upper portion of the slope indicate static and seismic factors of safety below the Code-required values of 1.5 and 1.0, respectively. This will require the use of soldier piles designed to retain the earth material above the retention surface shown on Section A. The most probable location of at least one row of soldier piles will be at the western edge of the proposed residence. The depth to the retention surface for both the static and seismic stability analyses is approximately 24 feet. Calculations indicate that soldier piles be designed for a static horizontal loads of 13.3 kips per lineal foot width. The load may be applied using a triangular distribution above the foundation retention surface. These loads may change depending on the actual design and location of the proposed structure.

The lower portion of the slope below the potential structure location was also analyzed for its stability. The calculated static factor of stability was determined to be below the Code-required value of 1.5. Even if soldier piles are used to bring the global stability of the slope up to the required standards for the residence, the portion of slope below the structure will still be unstable. Therefore, a pile-supported retaining wall will be required on the slope below the residence to improve the stability of the slope below the future structure. A potential retaining wall is diagrammatically shown below the proposed residence. The slope above and below the slope will need to be trimmed to 2:1 gradients. A 12-foot-tall retaining wall and the upper portion of the supporting piles will need to be designed for an equivalent fluid pressure of 74 pounds per cubic foot over a height of 14.7 feet. Friction piles supporting the retaining wall should derive passive support below the Retaining Wall Foundation Retention Surface shown on Section B.

Deepened Foundations - Friction Piles

Friction piles may be used to support the downslope residence wall and slope retaining wall. Piles should be a minimum of 24 inches in diameter and a minimum of 10 feet into older dune sand below the foundation retention surface. The piles may be designed for a skin friction of 300 pounds per square foot for that portion of pile in contact with the dune sand below the foundation retention surface. All residence piles should be tied in two horizontal directions with grade beams. Retaining wall piles should be tied in one direction with a grade beam or shotcrete wall facing. The downslope grade beam should extend a minimum of 24 inches below the adjacent downslope grade and should be designed for the same equivalent fluid pressure as the retaining wall. Spoils from pile excavations should not be cast over the face of the descending slope.

Lateral Design

The residence pile shafts should be designed to retain the earth materials above the foundation retention surface located upslope of and between the piles. The depth of earth above the foundation retention surface to be retained is 22 feet, as depicted on Section A. Based on the enclosed calculations, the pile shafts should be designed for an equivalent fluid pressure of 50.7 pounds per cubic foot per foot width of material retained. Piles should be spaced a maximum of 9 or 12 feet on center for 3- and 4-foot-diameter piles, respectively.

The skin friction value indicated above is for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. Piles may be assumed fixed at 3 feet into dune sand below the foundation retention surface. Resistance to lateral loading may be provided by passive earth pressure within the dune sand below the foundation retention surface. Passive earth pressure may be computed as an equivalent fluid having a density of 250 pounds per cubic foot, with a maximum earth pressure of 5,000 pounds per square foot. For design of isolated piles, the allowable passive earth pressure may be increased by 100 percent. Piles which are spaced more than 3-pile diameters on center may be considered isolated. Reductions in the capacity of one of the rows of piles for parallel pile rows are required. The reduction factors are 75 percent for pile rows spaced 3-pile diameters apart, 60 percent for pile rows spaced 4-pile diameters apart, and 30 percent for pile rows spaced 6-pile diameters apart. Pile rows spaced 8-pile diameters apart may use full passive resistance for both rows.

Temporary Excavations

Temporary vertical cuts within dune sand with a level surcharge may be excavated up to 3 feet. Vertical excavations in excess of 3 feet should have the upper portion trimmed to 1:1 (45 degrees). Vertical excavations within dune sand over 3 feet in height with a level surcharge will require the use of temporary shoring.

Temporary shoring should be designed for an equivalent fluid pressure of 35 pounds per cubic foot per the enclosed calculations.

Temporary, drilled, cast-in-place shoring piles will be required to support vertical excavations along the perimeter of the property to allow construction of the basement. The shoring design is provided for a factor of safety of 1.25.

Piles to be used to support the vertical excavations should be a minimum of 24 inches in diameter and a minimum of 6 feet into dune sand below the bottom of the basement wall footing. The recommended maximum center-to-center spacing of the shoring piles is 8 feet; however, the actual spacing should be determined by the shoring engineer. The piles may be designed for a skin friction of 250 pounds per square foot for that portion of pile in contact with dune sand below the base of the basement wall footing. Spoils from pile excavations should not be stockpiled near the top of any excavations.

The shoring piles may be designed as cantilevered or raker-braced piles.

The tops of pad footings for raker-braced piles should be a minimum of 12 inches below the ground surface and 2 feet wide by 2 feet long. A bearing value of 2,500 pounds per square foot may be used for raker pad footings inclined at up to 45 degrees from horizontal.

The skin friction value indicated above is for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. Piles may be assumed fixed at 3 feet into dune sand below the bottom of the basement wall footing. Resistance to lateral loading may be provided by passive earth pressure within the dune sand deposits below the bottom of the basement wall footing. Passive earth pressure may be computed as an equivalent fluid having a density of 350 pounds per cubic foot, with a maximum earth pressure of 5,000 pounds per square foot. Passive earth pressure for piles may be derived from the dune sand below the bottom of the basement wall footing. For design of isolated piles, the allowable passive earth pressure may be increased by 100 percent. Piles which are spaced more than 3-pile diameters on center may be considered isolated.

It is recommended that the entire vertical excavations be continuously lagged. The lagging should generally be placed against the outer flanges of the shoring pile steel beam. Voids between the lagging and the earth that is to be retained shall be tightly filled with slurry.

This evaluation is subject to the following notice.

NOTICE

The subsurface conditions, excavation characteristics, and contacts described herein and shown on the enclosed Cross Section have been projected from excavations on the site, as indicated and should in no way be construed to reflect any variations which may occur between or away from these excavations or which may result from changes in subsurface conditions. The projection of geologic contacts is based on available data and experience and should not be considered exact.

Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors not evident at the time of the measurements reported herein. Fluctuations also may occur across the site.

EXPLORATION WAS PERFORMED ONLY ON A PORTION OF THE SITE, IT CANNOT BE CONSIDERED AS INDICATIVE OF THE PORTIONS OF THE SITE NOT EXPLORED.

This report is issued and made for your sole use and benefit. This report is not transferable. The intent of this report is to advise our client on geotechnical matters involving the proposed improvements. It should be understood that the geotechnical consulting provided and the contents of this report are not perfect. Any errors or omissions noted by any party reviewing this report, and/or any other geotechnical aspect of the project, should be reported to this office in a timely fashion. Any liability in connection herewith shall not exceed our fee for the exploration.

Geotechnical engineering is characterized by uncertainty. Geotechnical engineering is often described as an inexact science or art. Conclusions presented herein are partly based upon the evaluations of technical information gathered, partly on experience, and partly on professional judgment. The conclusions presented should be considered "advice." Other consultants could arrive at different conclusions. No warranty, expressed or implied, is made or intended in connection with the above exploration or by the furnishing of this report or by any other oral or written statement.

Respectfully submitted,

STEVEN A. NORTON
Staff Geologist

ROBERT A. HOLLINGSWORTH
E.G. 1265/G.E. 2022

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REGISTERED PROFESSIONAL ENGINEER ROBERT A. HOLLINGSWORTH No. 2022 GEOTECHNICAL STATE OF CALIFORNIA

SAN:RAH:san:dl

Enc: References
Appendix
Vicinity Map
Vicinity Topographic Map (2006)
Regional Geologic Map
Seismic Hazards Maps
USGS Design Maps Reports (7 Sheets)
USGS 2008 PSHA for NEHRP D Soil for PGA (5 Sheets)
Estimation of Permanent Seismic Displacement
Geologic Map (pocket)
Section A
Plates A-1 thru A-4
Plates B-1 thru B-3
Plate D
Calculation Sheets (61)

xc: (2) Addressee
(1) Addressee via email
(1) Genna Walsh via email
(1) Robert Leighton via email

REFERENCES

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California Division of Mines and Geology*, February 1, 1998, Seismic Hazard Zones, Official Map, Venice 7.5 Minute Quadrangle, Los Angeles County, California, OFR 97-13.

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Dolan, F., Sieh, K., and Rockwell, T.K., 2000, Late Quaternary Activity and Seismic Potential of the Santa Monica Fault System, Los Angeles, California, Geological Society of American Bulletin, Volume 112, No. 10, pp. 1559-1581.

Leighton and Associates, Inc., with Topping, K.C., AICP, 1995, Safety Element of the City of Santa Monica General Plan, Project No. 2910399-01.

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**** California Department of Conservation, Division of Mines and Geology (CDMG/DMG) is now known as California Department of Conservation, California Geological Survey (CGS)(2002)***

APPENDIX

LABORATORY TESTING

Sample Retrieval - Hand Labor

Undisturbed samples of earth materials were obtained by driving a thin-walled steel sampler with successive blows of a drop hammer. The material was retained in brass rings of 2.41 inches inside diameter and 1.00-inch height. The samples were stored in close-fitting, water-tight containers for transportation to the laboratory.

Moisture Density

The field moisture content and dry density were determined for each of the undisturbed soil samples in accordance with ASTM D2216-10 and D2937-10. The dry density was determined in pounds per cubic foot. The moisture content was determined as a percentage of the dry soil weight. The results are presented on the A-plates.

Compaction Character

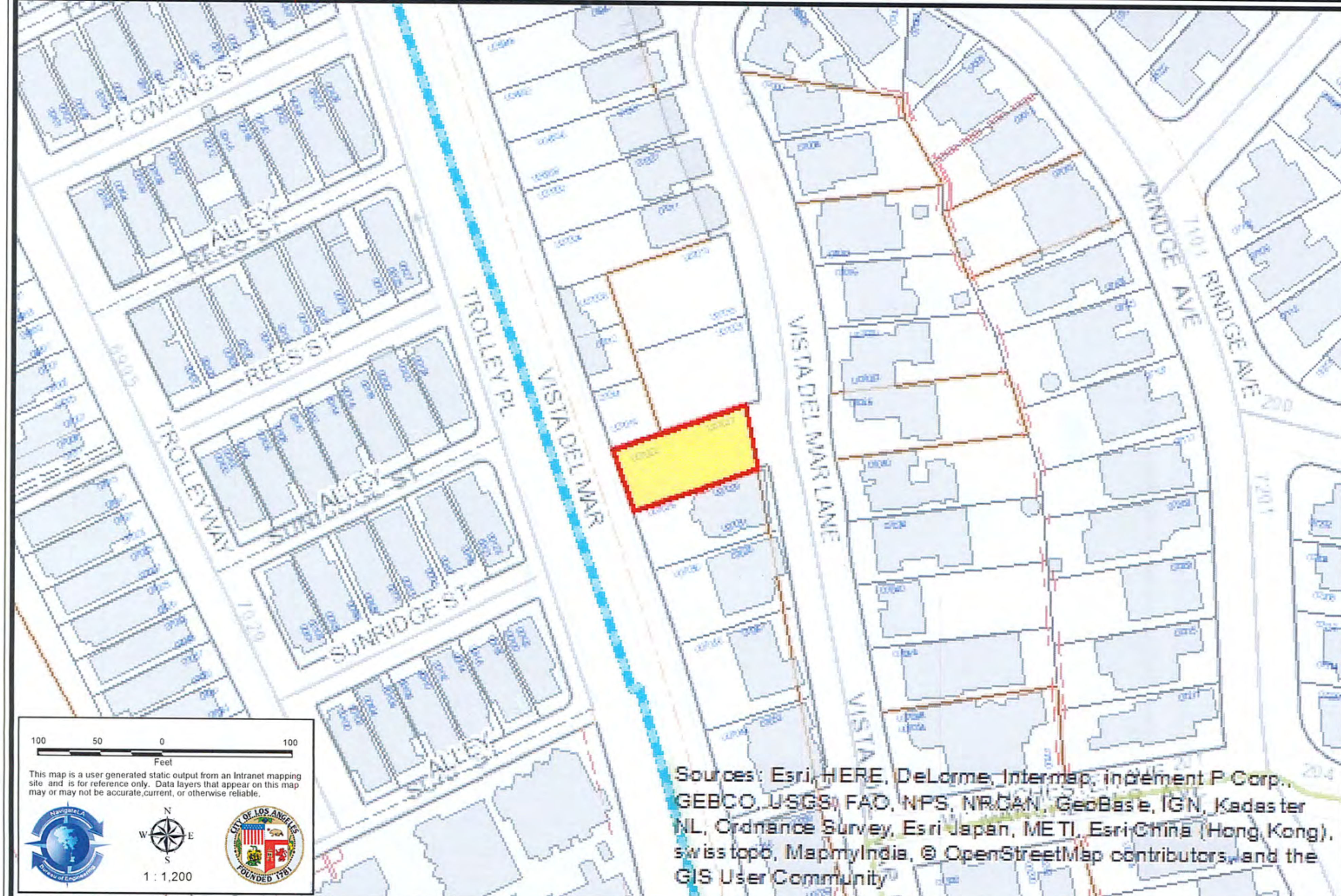
Compaction tests were performed on bulk samples of the existing fill in accordance with ASTM D1557-12. The results of the tests are provided on the table below.

Test Pit No.	Sample Depth (Feet)	Soil Type	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
1	1	Silty Sand	130.5	8.5

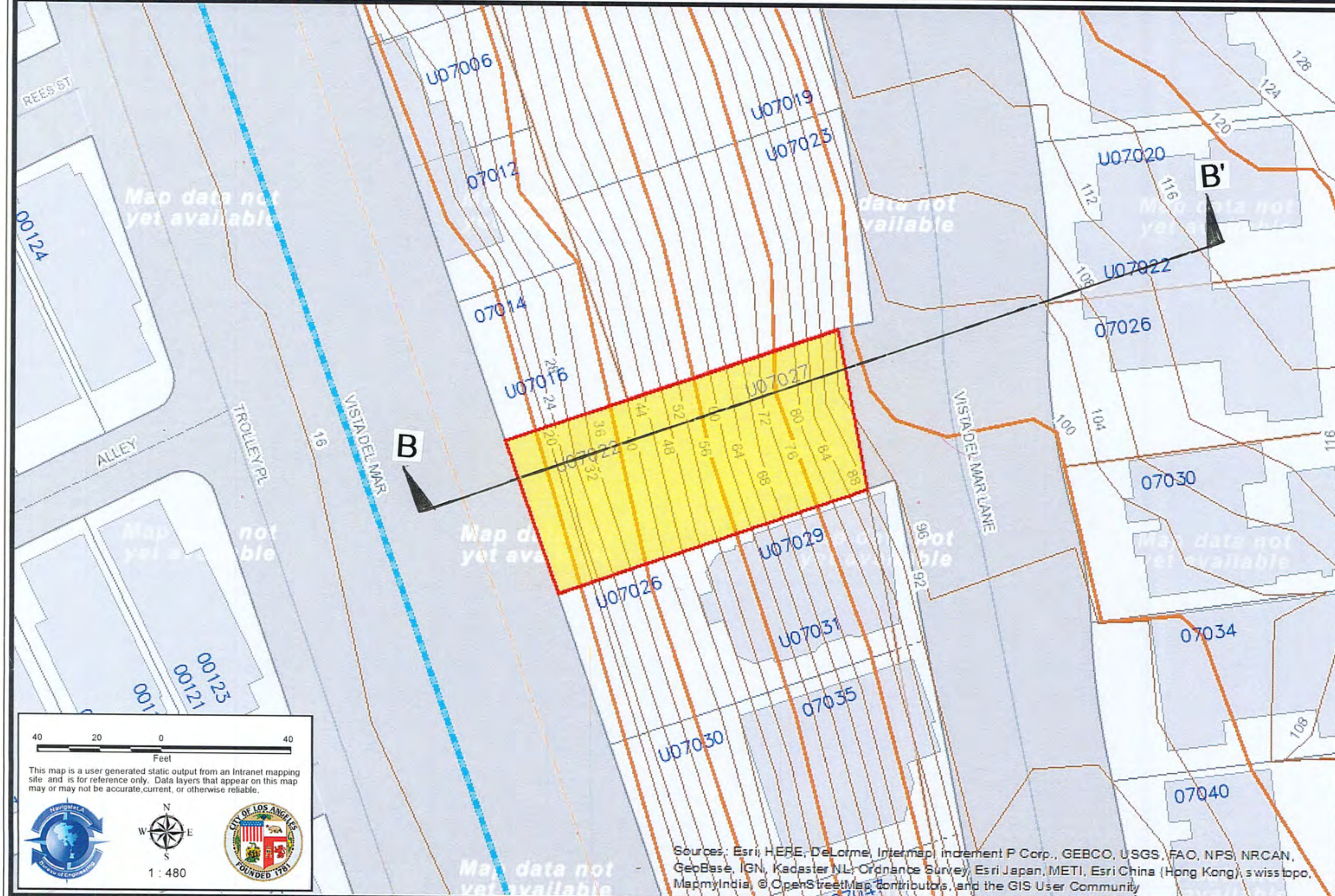
Shear Strength

The peak shear strength of the existing fill and dune sand deposits were determined by performing direct shear tests in accordance with ASTM D3080/M-11 and D5607-08. The tests were performed in a strain-controlled machine manufactured by GeoMatic. The rate of deformation was 0.01 inches per minute. Samples were sheared under varying confining pressures, as shown on the "Shear Test Diagrams," B-plates. The space between the shear rings was cleaned before the last cycle of shearing. The moisture conditions during testing are shown on the B-plates. The samples were artificially saturated in the laboratory and were sheared under submerged conditions.

Vicinity Map- 7027 S Vista Del Mar Lane



Vicinity Topographic Map- 7027 S Vista Del Mar Lane



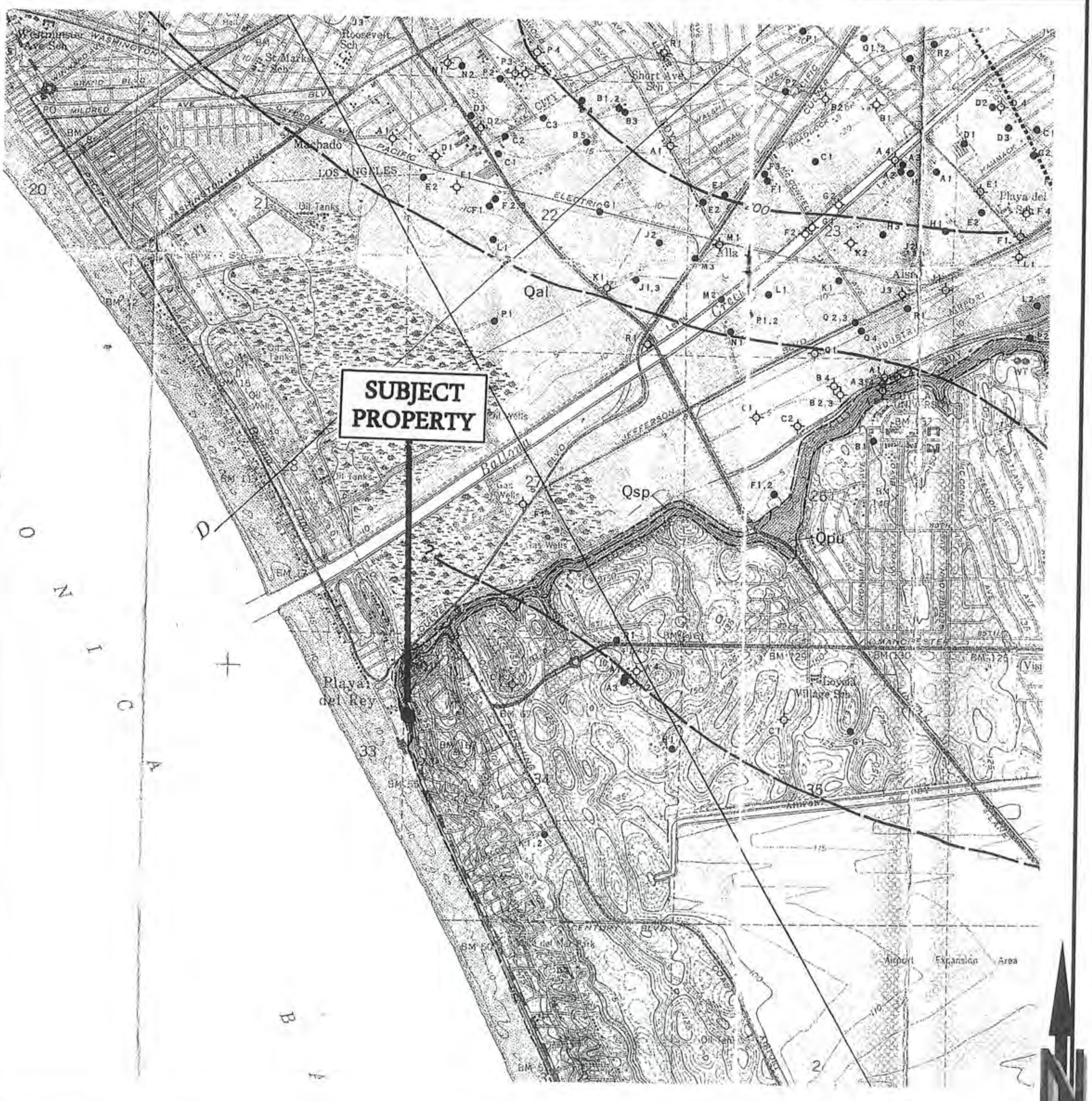
Grover-Hollingsworth and Associates, Inc.
Geotechnical Consultants

BY **SAN** DATE **11/17** CLIENT **PUREWAL**

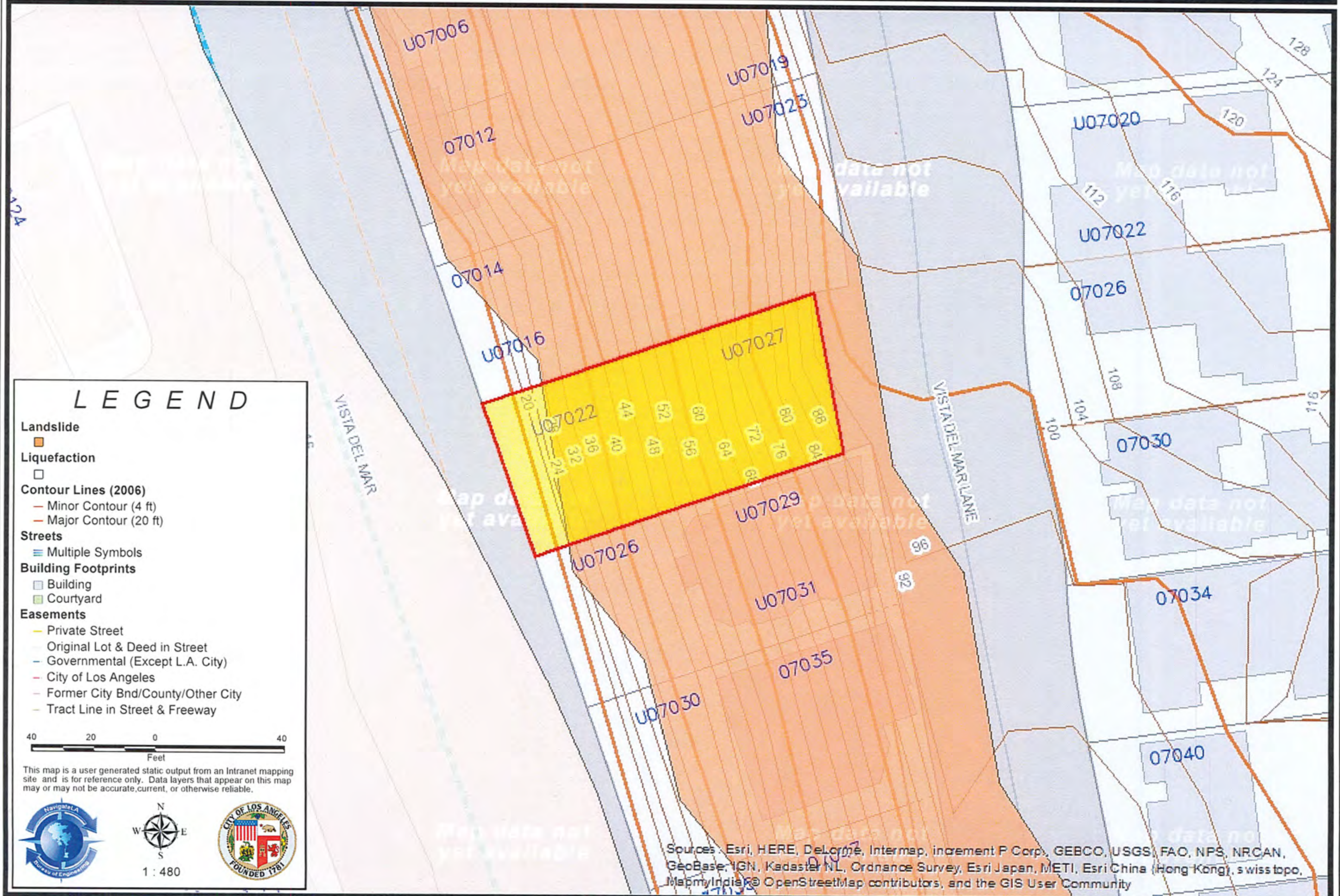
REFERENCE **GH18197–G**

WATER-SUPPLY PAPER 1461
PLATE 2 (NORTHERN HALF)
POLAND 1951

SUBJECT **REGIONAL GEOLOGIC MAP**



Seismic Hazard Zones- 7027 S Vista Del Mar Lane



USGS Design Maps Summary Report

User–Specified Input

Building Code Reference Document ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates 33.95586°N, 118.4477°W

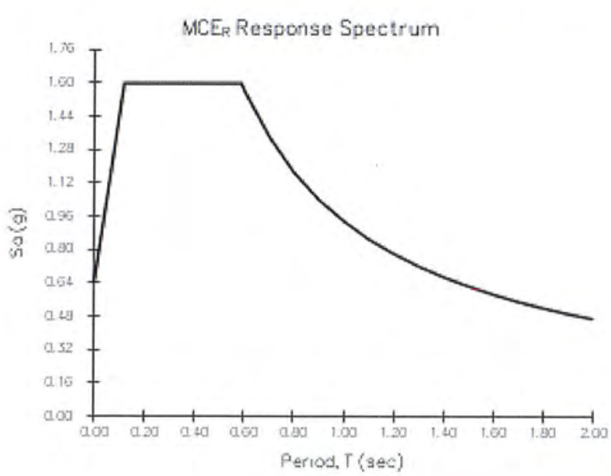
Site Soil Classification Site Class D – "Stiff Soil"

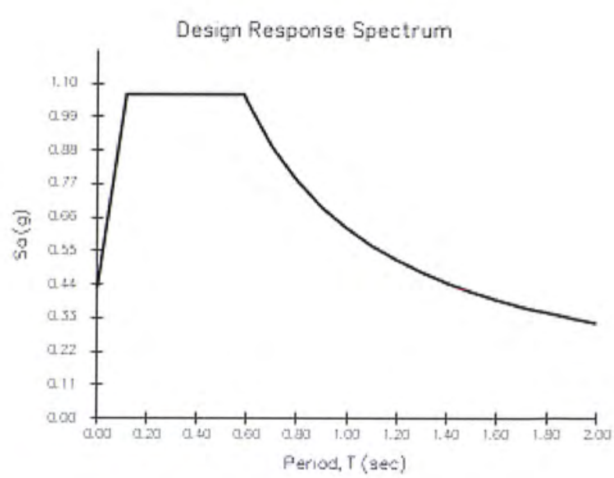
Risk Category I/II/III

USGS–Provided Output

S_S =	1.598 g	S_{MS} =	1.598 g	S_{DS} =	1.065 g
S_1 =	0.625 g	S_{M1} =	0.937 g	S_{D1} =	0.625 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.95586°N, 118.4477°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 1.598$ g

From Figure 22-2 [2] $S_1 = 0.625$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index $PI > 20$, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.598 g, F_a = 1.000

Table 11.4-2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.625 g, F_v = 1.500

Equation (11.4-1): $S_{MS} = F_aS_S = 1.000 \times 1.598 = 1.598$ g

Equation (11.4-2): $S_{M1} = F_vS_1 = 1.500 \times 0.625 = 0.937$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

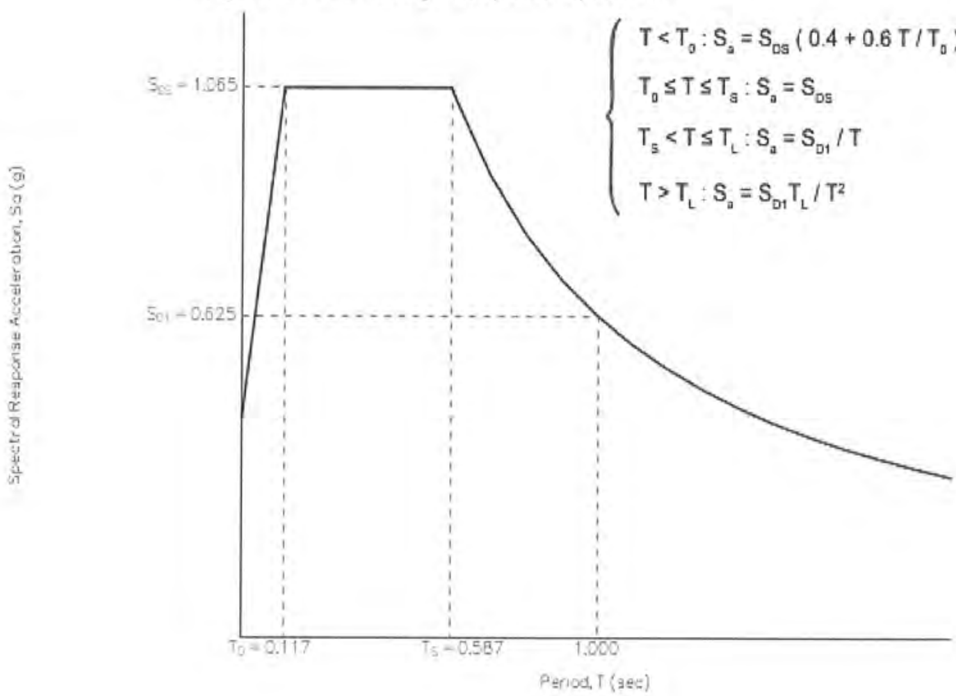
Equation (11.4-3): $S_{DS} = ⅔ S_{MS} = ⅔ \times 1.598 = 1.065$ g

Equation (11.4-4): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.937 = 0.625$ g

Section 11.4.5 — Design Response Spectrum

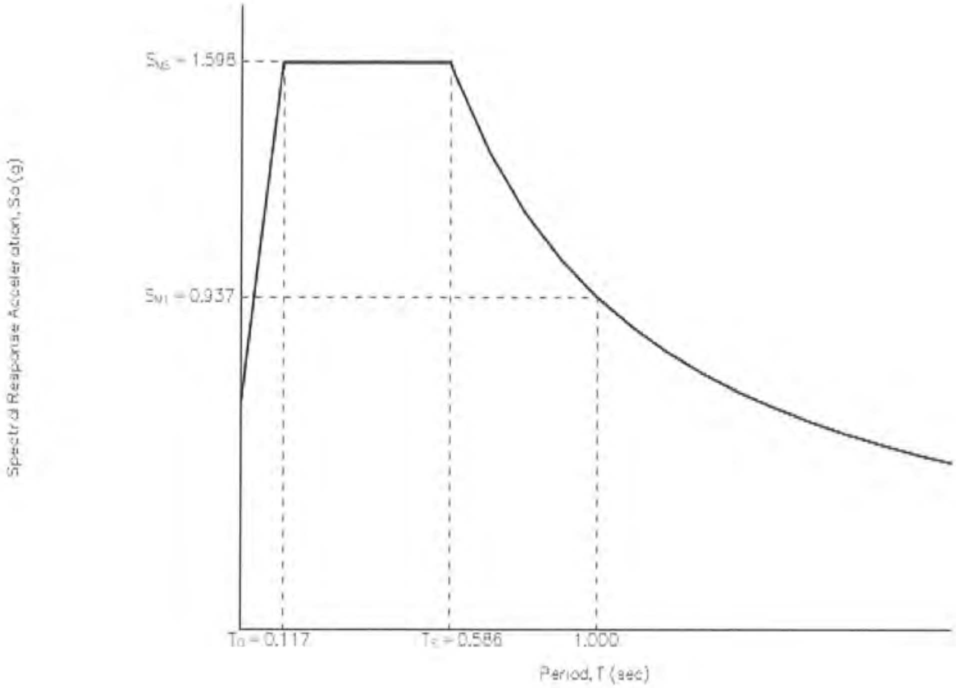
From Figure 22-12 [3] T_L = 8 seconds

Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.618

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.618 = 0.618$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.618 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 0.994

From Figure 22-18 [6] C_{R1} = 0.998

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.065 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.625 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition

Dynamic: Conterminous U.S. 2014

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

33.955861

Time Horizon

Return period in years

475

Longitude

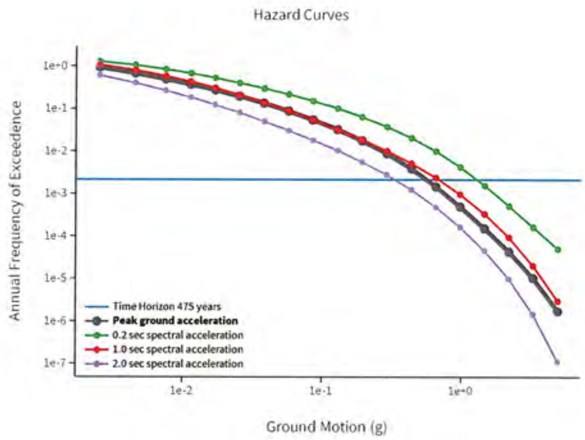
Decimal degrees, negative values for western long...

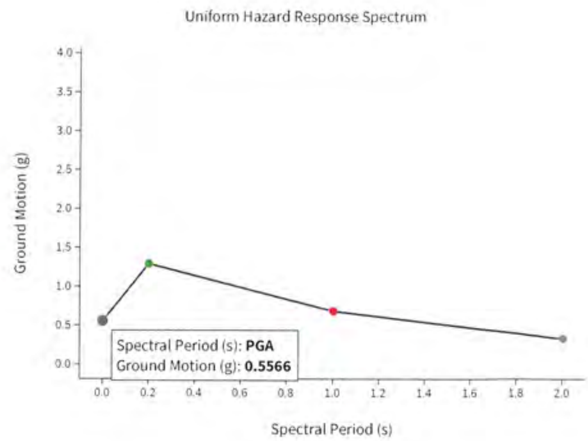
-118.447701

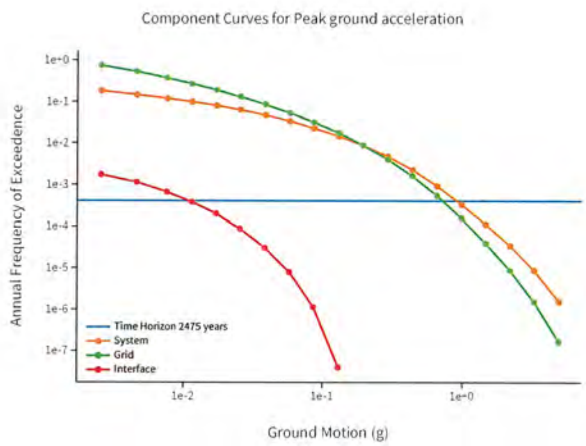
Site Class

259 m/s (Site class D)

^ Hazard Curve





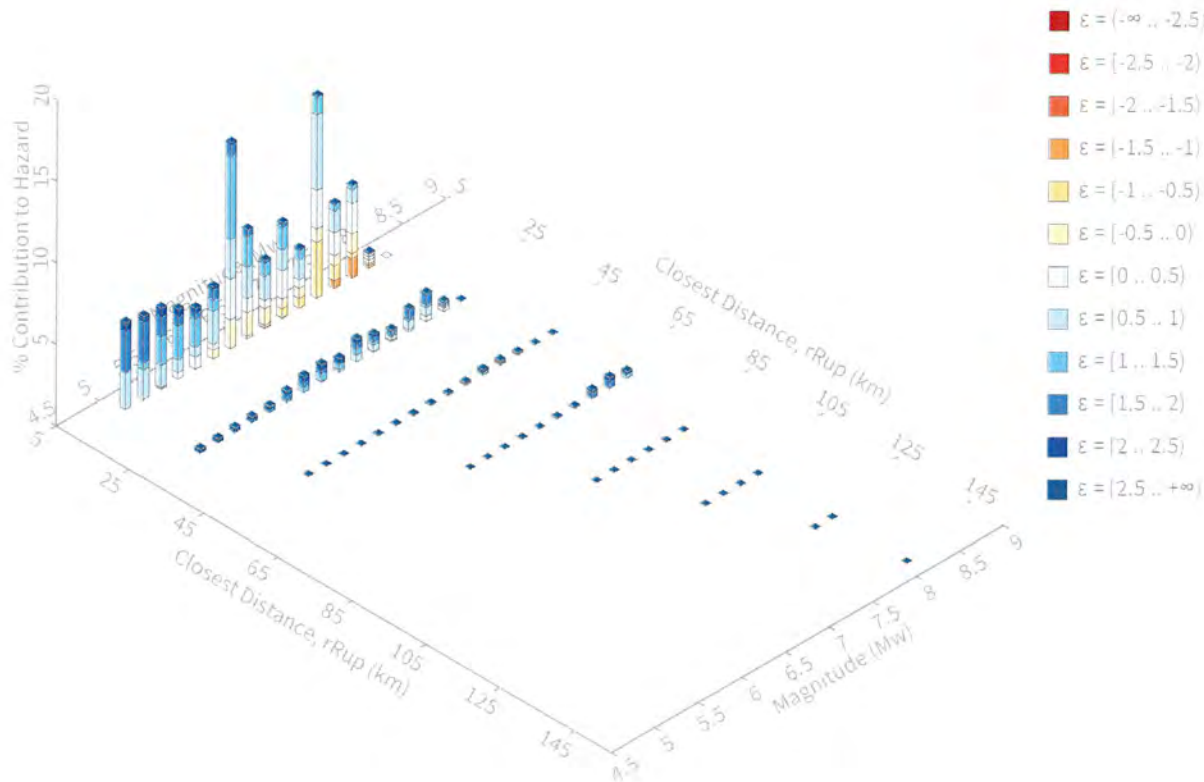


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 475 yrs
Exceedance rate: 0.0021052632 yr^{-1}
PGA ground motion: 0.55656994 g

Recovered targets

Return period: 508.86142 yrs
Exceedance rate: 0.0019651716 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.17 %

Mean (for all sources)

r: 13.43 km
m: 6.58
ε_0: 0.81 σ

Mode (largest r-m bin)

r: 9.12 km
m: 6.32
ε_0: 0.78 σ
Contribution: 12.65 %

Mode (largest ε_0 bin)

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							31.94
Palos Verdes [14]		7.28	6.92	0.35	118.508°W	33.915°N	230.51	9.81
Newport-Inglewood alt 1 [7]		8.84	6.66	0.60	118.356°W	33.976°N	75.38	4.90
Compton [3]		8.47	7.39	-0.12	118.499°W	33.903°N	218.84	3.68
Santa Monica alt 1 [1]		9.76	7.19	0.34	118.488°W	34.036°N	337.51	3.00
UC33brAvg_FM32	System							30.02
Palos Verdes [14]		7.28	6.91	0.36	118.508°W	33.915°N	230.51	8.86
Compton [3]		8.47	7.47	-0.16	118.499°W	33.903°N	218.84	3.37
Newport-Inglewood alt 2 [8]		9.54	6.66	0.66	118.361°W	34.000°N	58.38	3.14
Santa Monica alt 2 [2]		9.78	7.21	0.34	118.460°W	34.043°N	353.41	2.29
Hollywood [2]		14.55	6.97	0.75	118.422°W	34.084°N	9.27	2.05
UC33brAvg_FM31 (opt)	Grid							19.57
PointSourceFinite: -118.448, 34.014		7.98	5.69	0.95	118.448°W	34.014°N	0.00	3.73
PointSourceFinite: -118.448, 34.014		7.98	5.69	0.95	118.448°W	34.014°N	0.00	3.73
PointSourceFinite: -118.448, 34.023		8.71	5.70	1.03	118.448°W	34.023°N	0.00	2.88
PointSourceFinite: -118.448, 34.023		8.71	5.70	1.03	118.448°W	34.023°N	0.00	2.88
PointSourceFinite: -118.448, 34.086		14.01	5.86	1.40	118.448°W	34.086°N	0.00	1.09
PointSourceFinite: -118.448, 34.086		14.01	5.86	1.40	118.448°W	34.086°N	0.00	1.09
UC33brAvg_FM32 (opt)	Grid							18.47
PointSourceFinite: -118.448, 34.014		7.96	5.70	0.94	118.448°W	34.014°N	0.00	3.26
PointSourceFinite: -118.448, 34.014		7.96	5.70	0.94	118.448°W	34.014°N	0.00	3.26
PointSourceFinite: -118.448, 34.023		8.69	5.70	1.02	118.448°W	34.023°N	0.00	2.70
PointSourceFinite: -118.448, 34.023		8.69	5.70	1.02	118.448°W	34.023°N	0.00	2.70
PointSourceFinite: -118.448, 34.086		14.01	5.86	1.40	118.448°W	34.086°N	0.00	1.13
PointSourceFinite: -118.448, 34.086		14.01	5.86	1.40	118.448°W	34.086°N	0.00	1.13

ESTIMATION OF PERMANENT SEISMIC DISPLACEMENT USING THE BRAY AND RATHJE (1998) PROCEDURE.

INPUT PARAMETERS:

Yield Acceleration, ky (g):	0		Normalized MHEA Sigma:	0	
Vertical Thickness, h (m):	0		Mean Period Sigma:	0	
Shear Wave Vel., Vs (m/s):	259		Significant Duration Sigma:	0	
Earthquake Magnitude, M:	6.58	*	Normalized Displacement Sigma:	0	
Earthquake Accel., Rock (g):	0.412	*			
Earthquake Distance, r (km):	13.43	*	Allowable screen displacement (cm):	5	*
Landslide factor, 0.8 for large slide, 1.0 for small slide	1	*???			

CALCULATIONS:

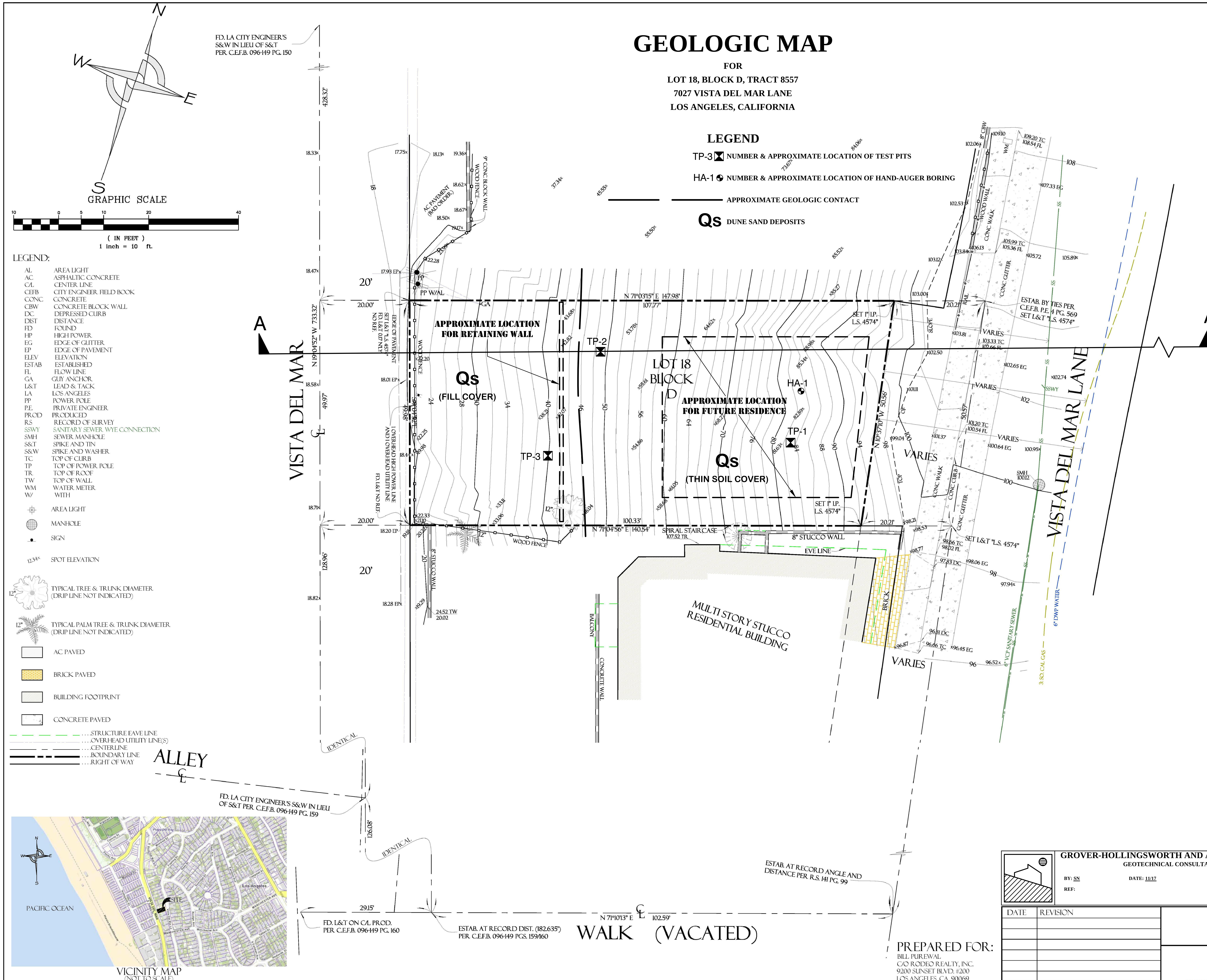
Site Period (s):	0.000
NRF Factor:	0.987
Mean Period (s):	0.487
Duration, D05-95 (s):	10.200
Ts/Tm:	0.0000
MHEA/MHA*NRF:	#NUM!
MHEA, kmax:	#NUM!
ky/kmax:	#NUM!
Normalized Disp. (cm/sec):	#NUM!

(Input values marked with asterisks are used for calculation of seismic coefficient for screen)

Estimated Displacement (cm):	#NUM!	**Median f_{eq} for Screen Procedure:**	0.508	*
Estimated Displacement (in):	#NUM!	**Seismic Coefficient for Screen Procedure:**	0.209	*

GEOLOGIC MAP

FOR
LOT 18, BLOCK D, TRACT 8557
7027 VISTA DEL MAR LANE
LOS ANGELES, CALIFORNIA



SURVEYOR'S NOTES:

1. DATE OF SURVEY: MAY 4, 2017AND NOVEMBER 8, 2017.

2. SITE AREA:

NET AREA: 5,202.53 SQ. FT. OR 0.1194 ACRES
GROSS AREA TO CENTERLINE: 7,213.23 SQ. FT. OR 0.1656 ACRES

3. BASIS OF BEARINGS:

THE BEARING N 19°04' 52" W OF THE SIDELINE OF VISTA DEL MAR SHOWN AS OCEAN VIEW LANE, AS SHOWN ON MAP OF MAP OF TRACT NO. 8557, AS PER MAP RECORDED IN BOOK 103 PAGES 1-3 OF MAPS, WAS TAKEN AS THE BASIS OF BEARINGS FOR THIS MAP.

4. VERTICAL DATUM:
CITY OF LOS ANGELES BENCHMARK NO. 17-15078
DATUM: NAVD 1988 ELEV = 56.932 (2000 ADJ.)
DESC.: USC&GS BM DISC *STMPD S 767 1945* IN TOP OF CONC RETAINING WALL; ABOUT 2FT ABOVE SIDEWALK; NEAR MC OF SELY PROPERTY LINE RETURN VISTA DEL MAR AND WATERVIEW ST; 9FT E OF E CURB LINE VISTA DEL MAR; 906FT S OF S CURB LINE WATERVIEW ST **NOTE MILEAGE**

5. UNDERGROUND UTILITIES SHOWN HEREON ARE PER CITY OF LOS ANGELES RECORDS AND PER FIELD LOCATION AS EVIDENCED BY PAINT MARKS ON THE PAVEMENT, AND CANNOT BE GUARANTEED FOR COMPLETENESS OR ACCURACY. THEIR LOCATION SHOULD BE VERIFIED IN THE FIELD BEFORE ANY EXCAVATING.

6. ZONING: R1-1

USE: ONE-FAMILY DWELLING

SETBACK REQUIREMENTS

HEIGHT: 3 FT. MAX
FRONT YARD: 20% LOT DEPTH; 25 FT. MAX, BUT NOT LESS THAN PREVAILING
SIDE YARD: 10% LOT WIDTH < 50 FT.; 5 FT.; 3 FT. MIN. + 1 FT. EACH STORY OVER 2ND
REAR YARD: 15 FT. MINIMUM

THIS SUMMARY IS ONLY A GUIDE. DEFINITIVE INFORMATION SHOULD BE OBTAINED FROM THE ZONING CODE ITSELF AND FROM CONSULTATION WITH THE DEPARTMENT OF BUILDING AND SAFETY.

7. DISTRICT MAP NO.: 096B149

8. SEWER WYE MAP NO.: 7194-9

9. STREET DEDICATION:

" DEDICATIONS SHOWN HEREON ARE BASED ON NAVIGATE L.A. STREET & HIGHWAY STANDARDS AND ARE SUBJECT TO REVIEW BY BUREAU OF ENGINEERING AND DEPARTMENT OF TRANSPORTATION. "

10. FLOOD ZONE DATA:

FLOOD ZONE X (UNSHADED)
NUMBER: 06037C
PANEL: 1754F
EFFECTIVE DATE: 09-26-08

THE AREAS OF MINIMAL FLOOD HAZARD, WHICH ARE THE AREAS OUTSIDE THE SFHA AND HIGHER THAN THE ELEVATION OF THE 0.2-PERCENT-ANNUAL-CHANCE FLOOD, ARE LABELED ZONE C OR ZONE X (UNSHADED).

11. NOTE:
ONLY A SIGNED AND SEALED COPY OF THIS SURVEY REPRESENTS A TRUE COPY OF OUR WORK PRODUCT; ANY COPIES CREATED FROM ELECTRONIC FILES OR OTHER METHODS MUST BE COMPARED TO A SIGNED AND SEALED COPY TO ASSURE IT'S ACCURACY AND COMPLETENESS.

LEGAL DESCRIPTION:

LOT 18 IN BLOCK "D" OF TRACT 8557, IN THE CITY OF LOS ANGELES, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 103, PAGES 1 TO 3 OF MAPS IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

APN: 4116-029-001

PROFESSIONAL LAND SURVEYOR MARK FOX PLS 6892 EXP. 6-30-17 STATE OF CALIFORNIA

GROVER-HOLLINGSWORTH AND ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

BY: SN DATE: 11/17 CLIENT: PUREWAL
REF: GH: 18197-G
SUBJECT: GEOLOGIC MAP

PREPARED FOR:
BILL PUREWAL
C/O RODEO REALTY, INC.
9200 SUNSET BLVD. #200
LOS ANGELES, CA. 90069

DATE	REVISION

ARCHITECTURAL SURVEY
7025 VISTA DEL MAR LANE
PLAYA DEL REY, CALIFORNIA

IACOBELLIS & ASSOCIATES, INC.
PROFESSIONAL LAND SURVEYORS
SURVEYS • SUBDIVISIONS • PHOTOGRAMMETRY
11145 TAMPA AVENUE STE 15B, NORTHRIDGE, CA. 91326 PH 818-366-9222 FAX 818-366-4813

DATE: 11-17-17
PROJECT NO.: 17-115
DRAFTED BY: JJM
CHECKED BY: MF
SHEET NO. 1 OF 1

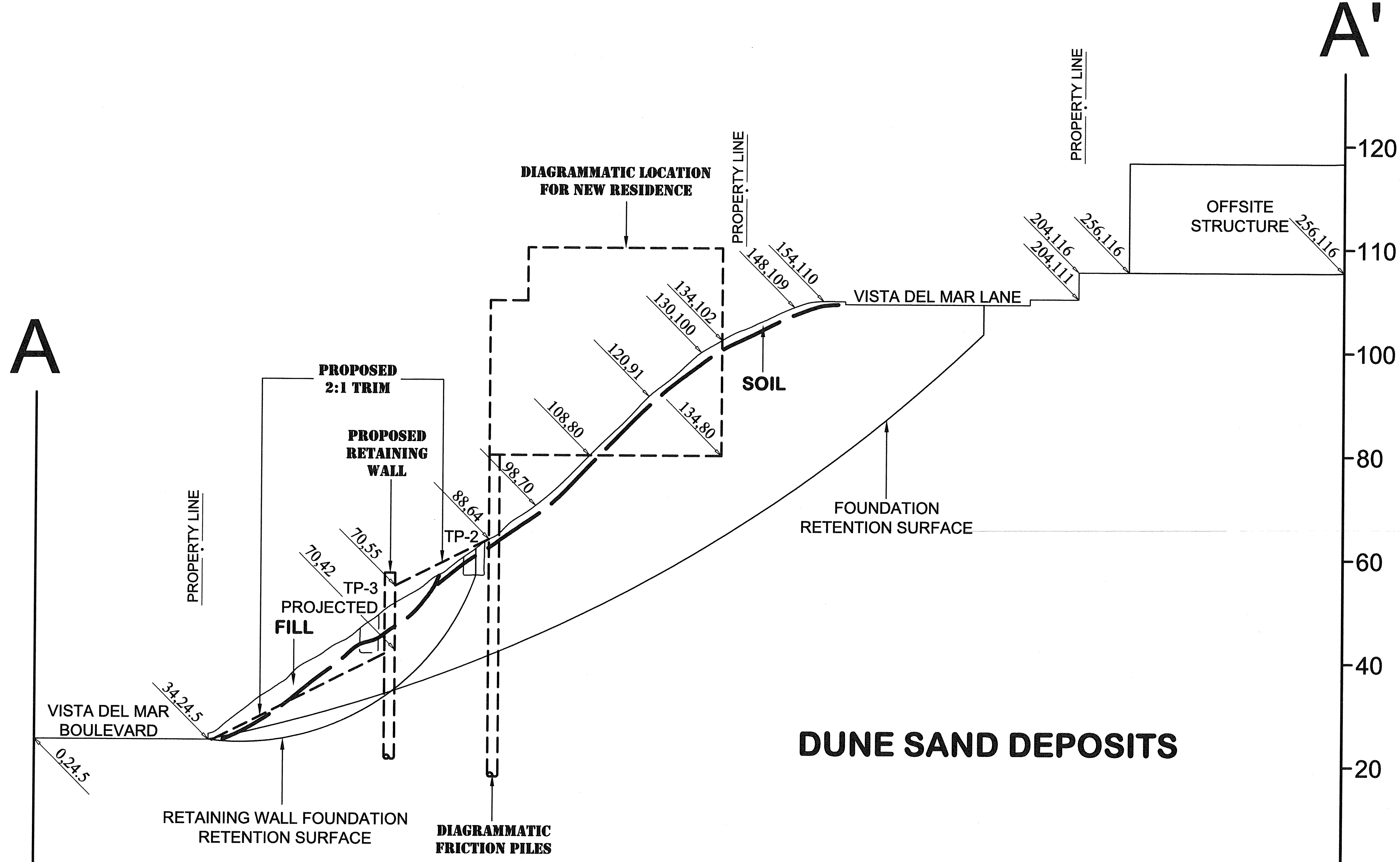
J:\DRAWING FILES\2017 JOBS\17148 VISTA DEL MAR\DWG\17148-111617.DWG 11/17/2017 2:04 PM

GROVER-HOLLINGSWORTH AND ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

BY: SN | DATE: 11/17 | CLIENT: PUREWAL
REF: GEOLOGIC MAP | GH: 18197-G
SUBJECT: GEOLOGIC SECTION A

GEOLOGIC SECTION A

SCALE 1"=20'



LOG OF TEST PIT TP-1

Date Drilled: 4/4/17 Logged by: S. Norton Project Manager: S. Norton

Equipment: Hand Labor Driving Weight and Drop: Hand Sampler

Surface Elevation(ft): Depth to Water(ft):

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT (Equiv. SPT)	MOISTURE (%)	DRY UNIT WT. (pcf)	SAMPLE TYPE
		SOIL: Silty Sand to Sand, dark brown and brown, moist, medium dense in upper 6", dense in lower 1-1/2', contains scattered rootlets						
				X				B
		Contact gradational						
		DUNE SAND DEPOSITS: Sand, orange-brown and brown, dense; lower 6" are very dense	X			6.7	117.4	R
			X			2.6	109.8	R
			X			2.5	106.0	R
		End at 4-1/2' No Water; No Caving; No Fill						
5								

GEO5 18076LOG.GPJ 11/22/17

Grover Hollingsworth and Associates, Inc.

Project Name: Purewal, 7027 S Vista Del Mar Lane, Los Angeles

Project No. 18197-G

Plate A-1

LOG OF TEST PIT TP-2

Date Drilled: 4/4/17 | Logged by: S. Norton | Project Manager: S. Norton

Equipment: Hand Labor | Driving Weight and Drop: Hand Sampler

Surface Elevation(ft): | Depth to Water(ft):

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT (Equiv. SPT)	MOISTURE (%)	DRY UNIT WT. (pcf)	SAMPLE TYPE
		SOIL: Silty Sand to Sand, dark brown, moist, medium dense to dense, upper 2" are very soft, contains scattered rootlets						
		Contact gradational and parallel to slope						
		DUNE SAND DEPOSITS: Interlayed Silty Sand and Sand; Silty Sand is dark brown and red-brown, sand layer is orange-brown, moist, dense to very dense; layers are approximately 1" in thickness and horizontally oriented						
			■			5.4	114.2	R
			■	▩		6.2	120.7	R B
5			■			6.8	107.3	R
		End at 5-1/2' No Water; No Caving; No Fill						

GEO5 18076LOG.GPJ 11/22/17

Grover Hollingsworth and Associates, Inc.

Project Name: Purewal, 7027 S Vista Del Mar Lane, Los Angeles

Project No. 18197-G

Plate A-2

LOG OF TEST PIT TP-3

Date Drilled: 4/4/17 Logged by: S. Norton Project Manager: S. Norton

Equipment: Hand Labor Driving Weight and Drop: Hand Sampler

Surface Elevation(ft): ______ Depth to Water(ft): ______

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT (Equiv. SPT)	MOISTURE (%)	DRY UNIT WT. (pcf)	SAMPLE TYPE
		FILL/SLOPE WASH: Sand to slightly Silty Sand, gray-brown to dark brown, moist, medium dense, contains scattered rootlets						
			■			2.9	98.1	R
		Contact parallel to slope						
		Sand to slightly Silty Sand, dark brown and orange-brown, moist, medium dense to dense, contains scattered rootlets and scattered trash/debris	■			3.8	109.6	R
			■			3.1	107.3	R
			■			4.9	112.8	R
5			■			5.7	108.0	R
		Contact slightly horizontal						
		DUNE SAND DEPOSITS: Sand to slightly Silty Sand, orange-brown to brown, moist, dense						
			■			3.7	114.9	R
			■			3.2	104.5	R
		End at 7-1/2' No Water; No Caving Fill to 5-1/2'						

GEO5 18076LOG.GPJ 11/22/17

Grover Hollingsworth and Associates, Inc.

Project Name: Purewal, 7027 S Vista Del Mar Lane, Los Angeles

Project No. 18197-G

Plate A-3

LOG OF TEST PIT HA-1

Date Drilled: 10/31/17 Logged by: S. Norton Project Manager: R. Hollingsworth

Equipment: Hand Labor Driving Weight and Drop: Hand Sampler

Surface Elevation(ft): Depth to Water(ft):

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT (Equiv. SPT)	MOISTURE (%)	DRY UNIT WT. (pcf)	SAMPLE TYPE
		SOIL: Silty Sand to Sand, medium brown to dark brown, moist, medium dense.						
		Contact parallel to slope.						
		DUNE SAND DEPOSITS: Silty Sand and Sand, red-brown to orange-brown, moist, dense to very dense.						
5			■			3.2	98.7	R
		Sample at 7' slightly disturbed.	■			2.5	90.8	R

GEO5 18197LOG.GPJ 11/22/17

LOG OF TEST PIT HA-1

Date Drilled: 10/31/17 Logged by: S. Norton Project Manager: R. Hollingsworth

Equipment: Hand Labor Driving Weight and Drop: Hand Sampler

Surface Elevation(ft): Depth to Water(ft):

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT (Equiv. SPT)	MOISTURE (%)	DRY UNIT WT. (pcf)	SAMPLE TYPE
			■			2.8	107.4	R
10								
		Sample fell out.	■			2.2	105.2	R
		Sample fell out.	■					R
		Sand, orange-brown, moist, dense.						
15								
			■			1.7	102.8	R
		END at 17-1/2' No Water; No Caving; No Fill						

GEO5 18197LOG.GPJ 11/22/17

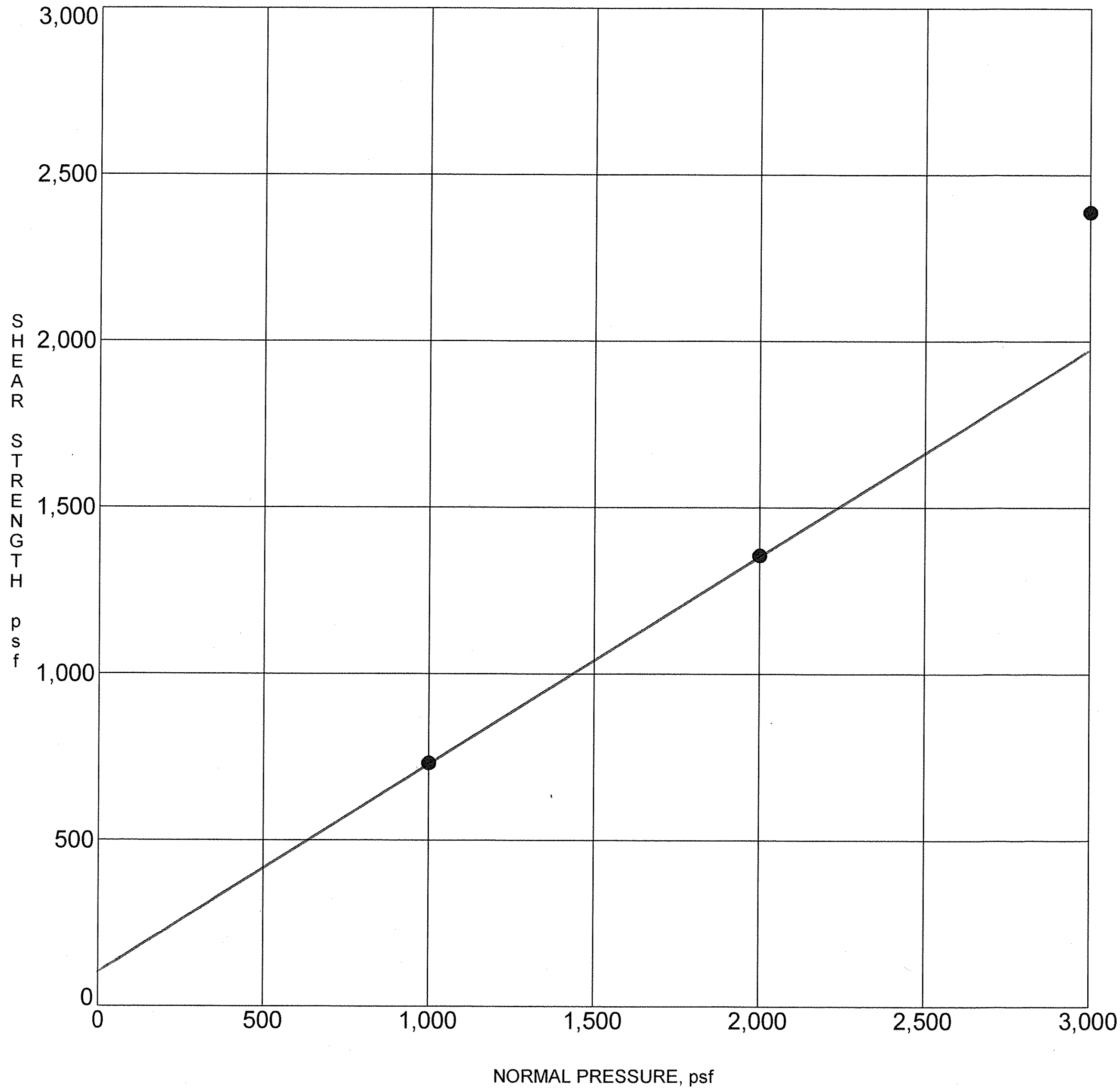
Grover Hollingsworth and Associates, Inc.

Project Name: Purewal 7027 W Vista Del Mar Lane

Project No. 18197-G

Plate A-4b

SHEAR TEST DIAGRAM



***NOTE: PEAK STRENGTH VALUES**

	Specimen Identification		Soil Type/Classification	Cohesion	Friction Angle	DD	MC%
●	**TP-3**	**4.0**	**FILL**	**90**	**32**	**112.8**	**19.0**

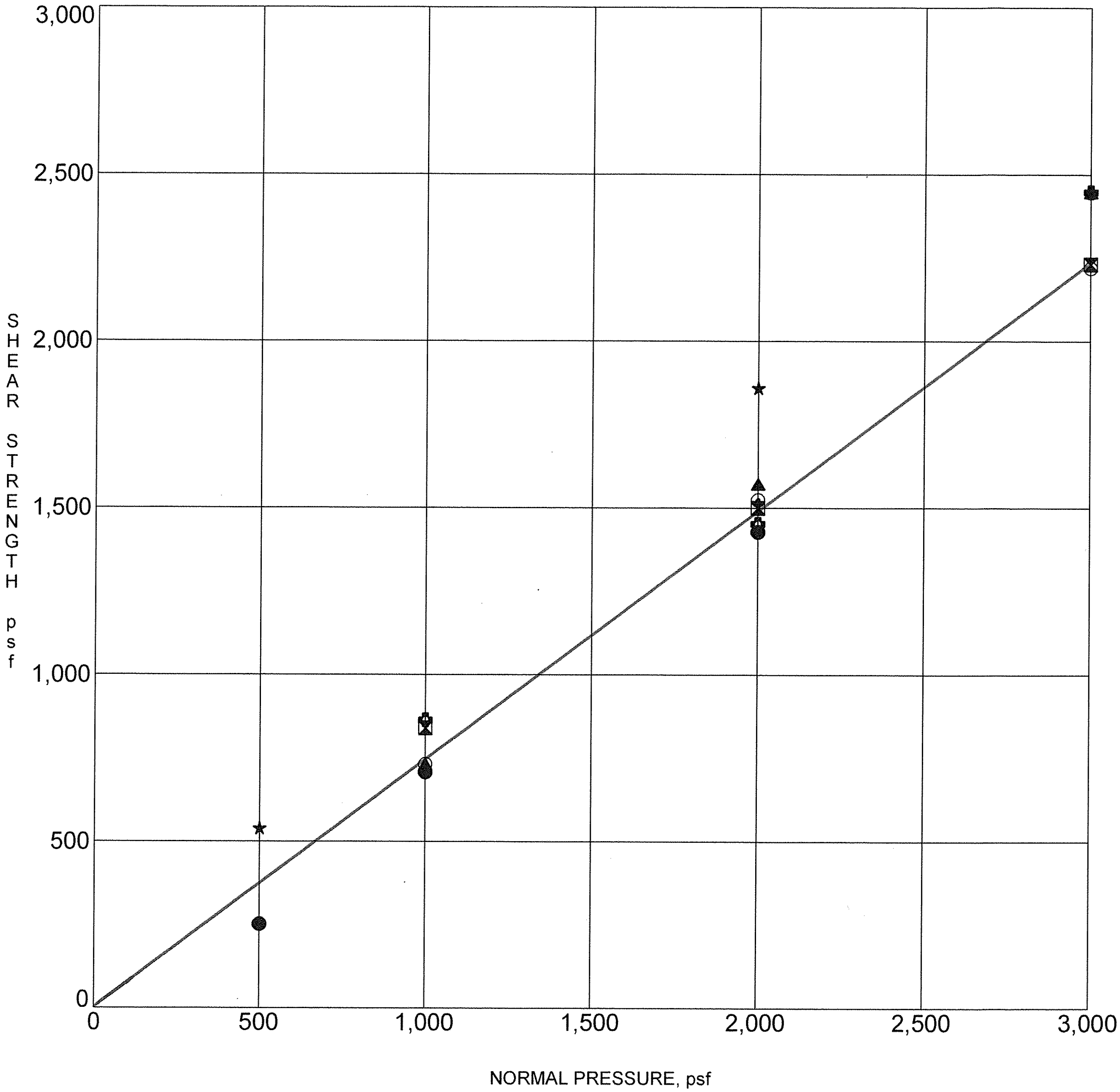
PROJECT **PUREWAL - 7027 S Vista Del Mar Lane, Los Angeles**

JOB NO. **18197-G**
DATE **5/17**

Grover-Hollingsworth

PLATE B-1

SHEAR TEST DIAGRAM



***NOTE: PEAK STRENGTH VALUES**

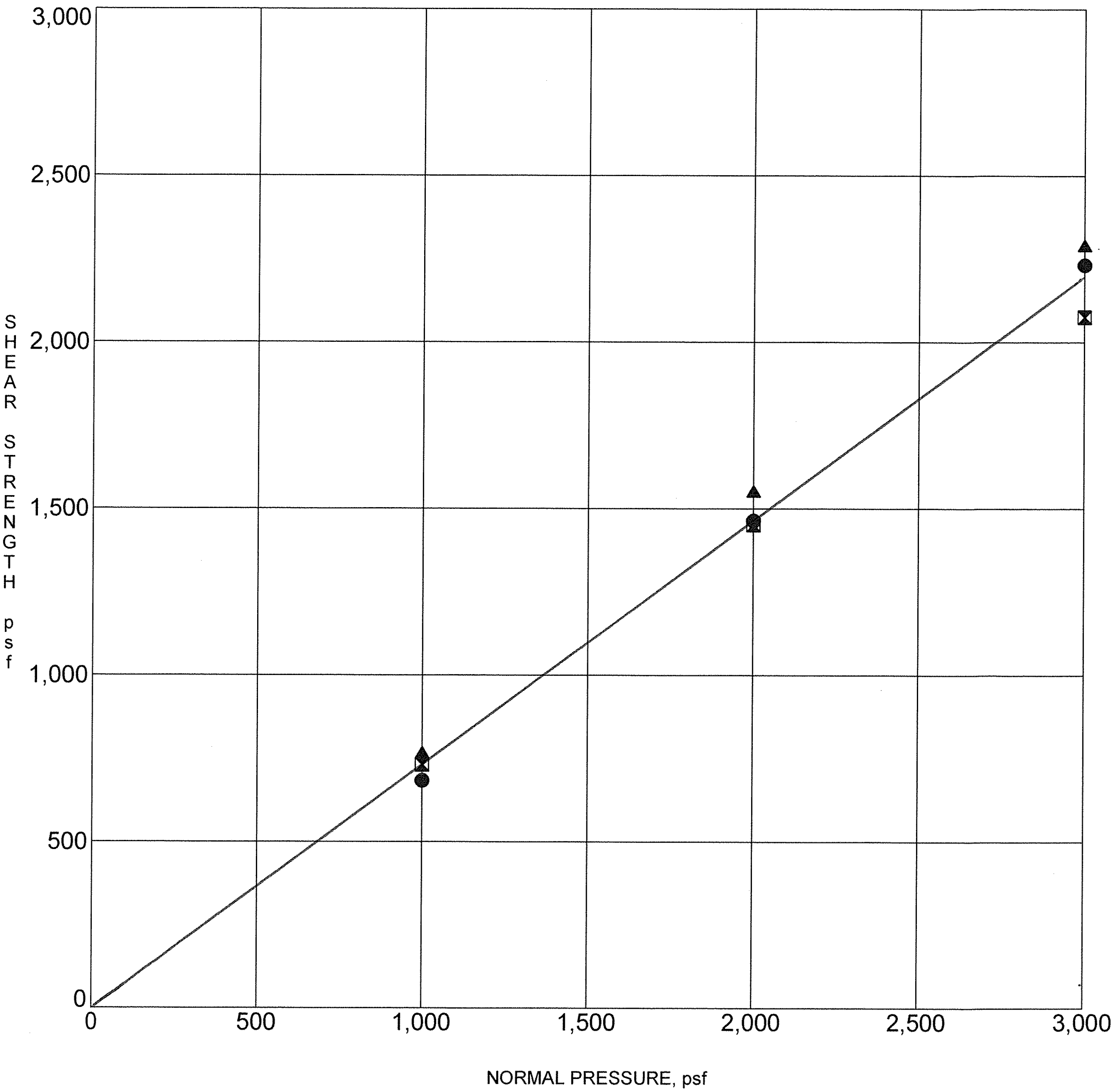
	Specimen Identification		Soil Type/Classification	Cohesion	Friction Angle	DD	MC%
●	**TP-1**	**4.0**	**DUNE SAND DEPOSITS**			**106.0**	**17.8**
⊠	**TP-2**	**2.0**	**DUNE SAND DEPOSITS**	**0**	**37**	**114.7**	**19.1**
▲	**TP-2**	**4.0**	**DUNE SAND DEPOSITS**			**120.7**	**22.9**
★	**TP-2**	**5.0**	**DUNE SAND DEPOSITS**			**107.3**	**22.5**
⊙	**TP-3**	**6.0**	**DUNE SAND DEPOSITS**			**114.9**	**17.1**
✪	**TP-3**	**7.0**	**DUNE SAND DEPOSITS**			**104.5**	**22.6**

PROJECT **PUREWAL - 7027 S Vista Del Mar Lane, Los Angeles** JOB NO. **18197-G**
DATE **5/17**

Grover-Hollingsworth

PLATE B-2

SHEAR TEST DIAGRAM



***NOTE: PEAK STRENGTH VALUES**

	Specimen Identification		Soil Type/Classification	Cohesion	Friction Angle	DD	MC%
●	**HA-1**	**9.0**	**DUNE SAND DEPOSITS**	**0**	**36.5**	**107.4**	**18.6**
⊠	**HA-1**	**11.0**	**DUNE SAND DEPOSITS**			**105.2**	**20.2**
▲	**HA-1**	**17.0**	**DUNE SAND DEPOSITS**			**102.8**	**21.5**

PROJECT **Purewal - 7027 S Vista Del Mar Lane, Los Angeles**

JOB NO. **18197-G**

DATE **11/17**

Grover-Hollingsworth

PLATE B-3

Job No. 18197-G Date 11/22/17

Project PUREWAL - 7027 S Vista Del Mar Lane, Los Angeles

Source of Material: **TP-1 1.0**

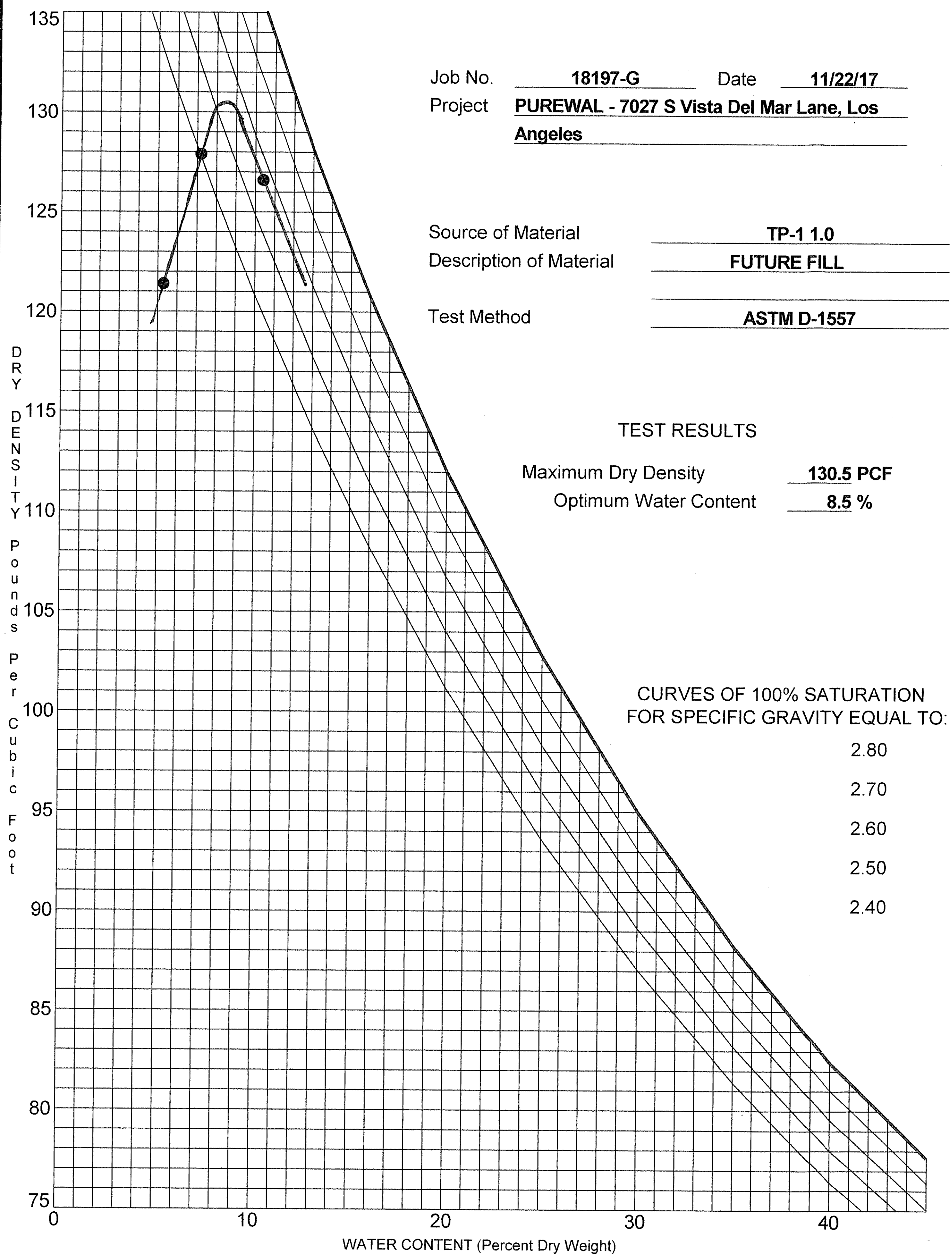
Description of Material: **FUTURE FILL**

Test Method: **ASTM D-1557**

TEST RESULTS

Maximum Dry Density: **130.5 PCF**

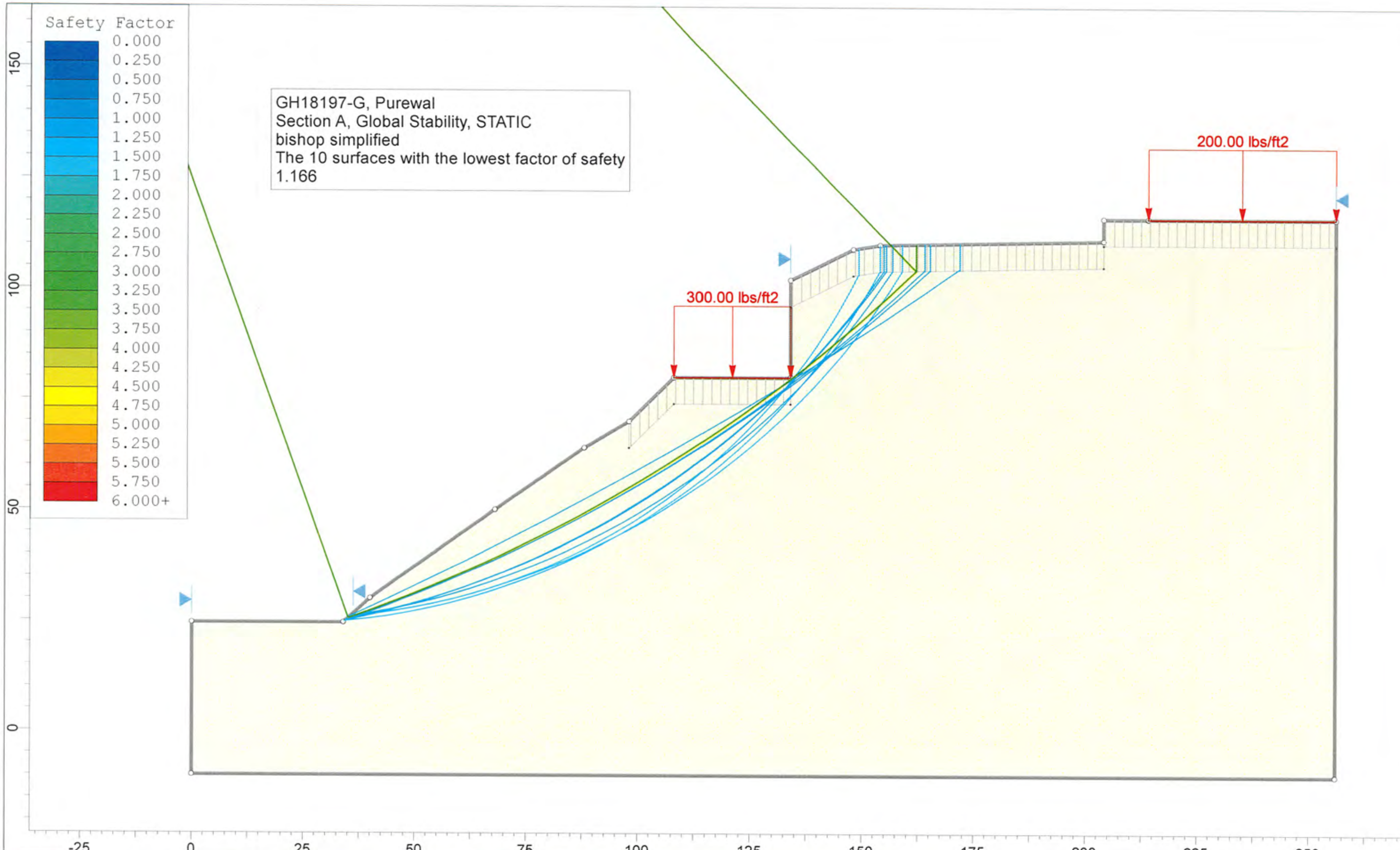
Optimum Water Content: **8.5 %**



MOISTURE-DENSITY RELATIONSHIP

Grover-Hollingsworth

PLATE D



Project	GH18197-G, Purewal		
Analysis Description	Section A, Global Stability, STATIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Global stability, STATIC.slim

rocscience

SLIDEINTERPRET 7.023

Slide Analysis Information
GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Global stability, STATIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Global Stability, STATIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.165900
Center:	-82.799, 357.702
Radius:	352.505
Left Slip Surface Endpoint:	35.083, 25.492
Right Slip Surface Endpoint:	162.103, 104.162
Left Slope Intercept:	35.083 25.492
Right Slope Intercept:	162.103 110.162
Resisting Moment:	4.6219e+007 lb-ft
Driving Moment:	3.96423e+007 lb-ft
Total Slice Area:	1487.06 ft2
Surface Horizontal Width:	127.02 ft
Surface Average Height:	11.7073 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	2278
Number of Invalid Surfaces:	2722

Error Codes:

Error Code -103 reported for 440 surfaces
Error Code -105 reported for 4 surfaces
Error Code -113 reported for 313 surfaces
Error Code -114 reported for 1965 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This

usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-105 = More than two surface / slope intersections with no valid slip surface.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

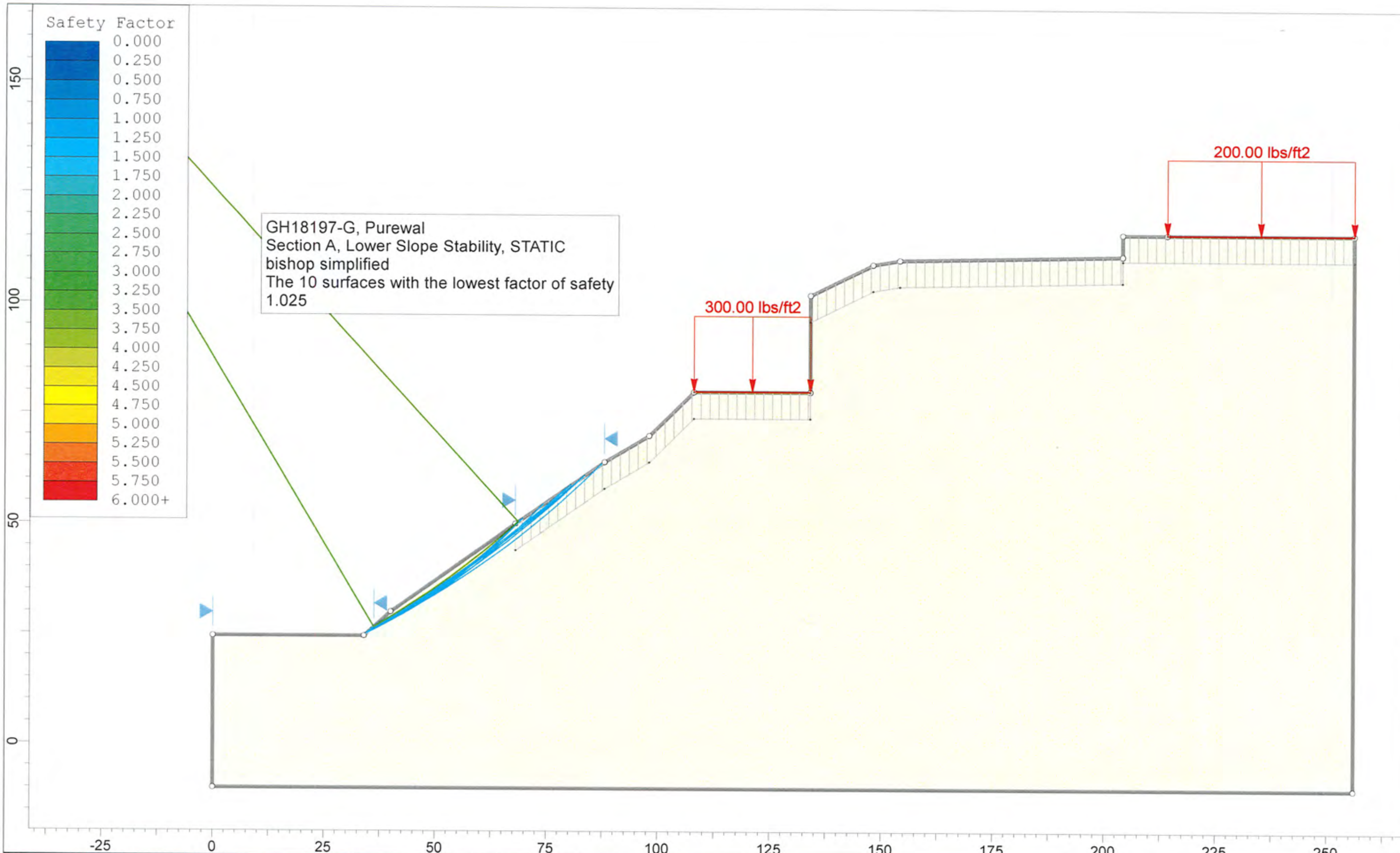
X	Y
134	80
108	80

Tension Crack

X	Y
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
68	50
40	30
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Lower Slope Stability, STATIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Lower Slope Stability.slim

SLIDEINTERPRET 7.023

Slide Analysis Information
GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Lower Slope Stability.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Lower Slope Stability, STATIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.025210
Center:	-65.902, 198.594
Radius:	200.111
Left Slip Surface Endpoint:	36.118, 26.441
Right Slip Surface Endpoint:	68.572, 50.401
Resisting Moment:	629082 lb-ft
Driving Moment:	613610 lb-ft
Total Slice Area:	38.7676 ft2
Surface Horizontal Width:	32.455 ft
Surface Average Height:	1.1945 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 2290
Number of Invalid Surfaces: 2710

Error Codes:

Error Code -113 reported for 53 surfaces
Error Code -114 reported for 2657 surfaces

Error Codes

The following errors were encountered during the computation:

-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

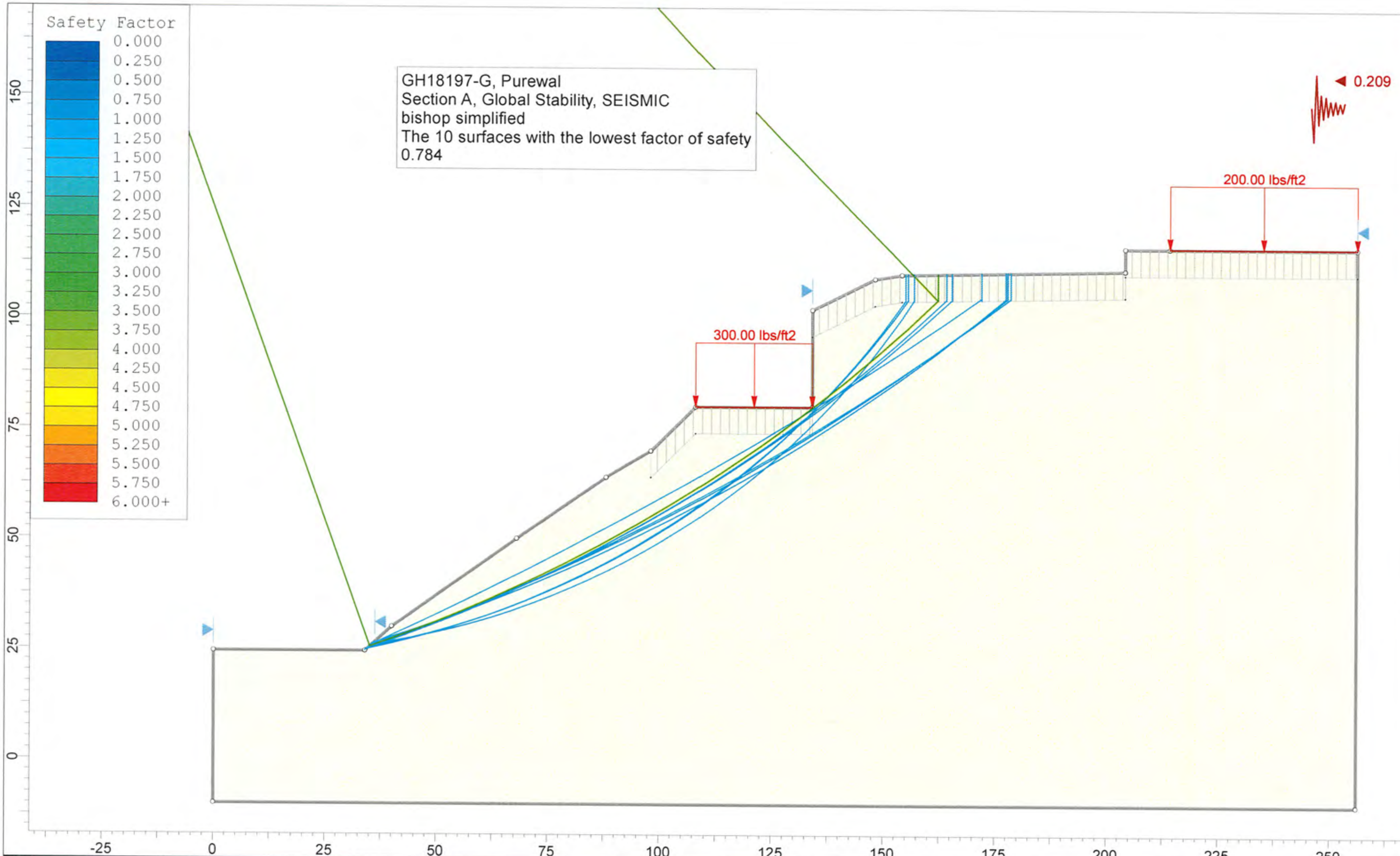
X	Y
134	80
108	80

Tension Crack

X	Y
68	44
88	58
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
68	50
40	30
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Global Stability, SEISMIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Global stability, SEISMIC.slim

SLIDEINTERPRET 7.023

Slide Analysis Information
GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Global stability, SEISMIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Global Stability, SEISMIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.209

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	0.784240
Center:	-82.799, 357.702
Radius:	352.505
Left Slip Surface Endpoint:	35.083, 25.492
Right Slip Surface Endpoint:	162.103, 104.162
Left Slope Intercept:	35.083 25.492
Right Slope Intercept:	162.103 110.162
Resisting Moment:	4.05533e+007 lb-ft
Driving Moment:	5.17103e+007 lb-ft
Total Slice Area:	1487.06 ft2
Surface Horizontal Width:	127.02 ft
Surface Average Height:	11.7073 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	2278
Number of Invalid Surfaces:	2722

Error Codes:

Error Code -103 reported for 440 surfaces
Error Code -105 reported for 4 surfaces
Error Code -113 reported for 313 surfaces
Error Code -114 reported for 1965 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-105 = More than two surface / slope intersections with no valid slip surface.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

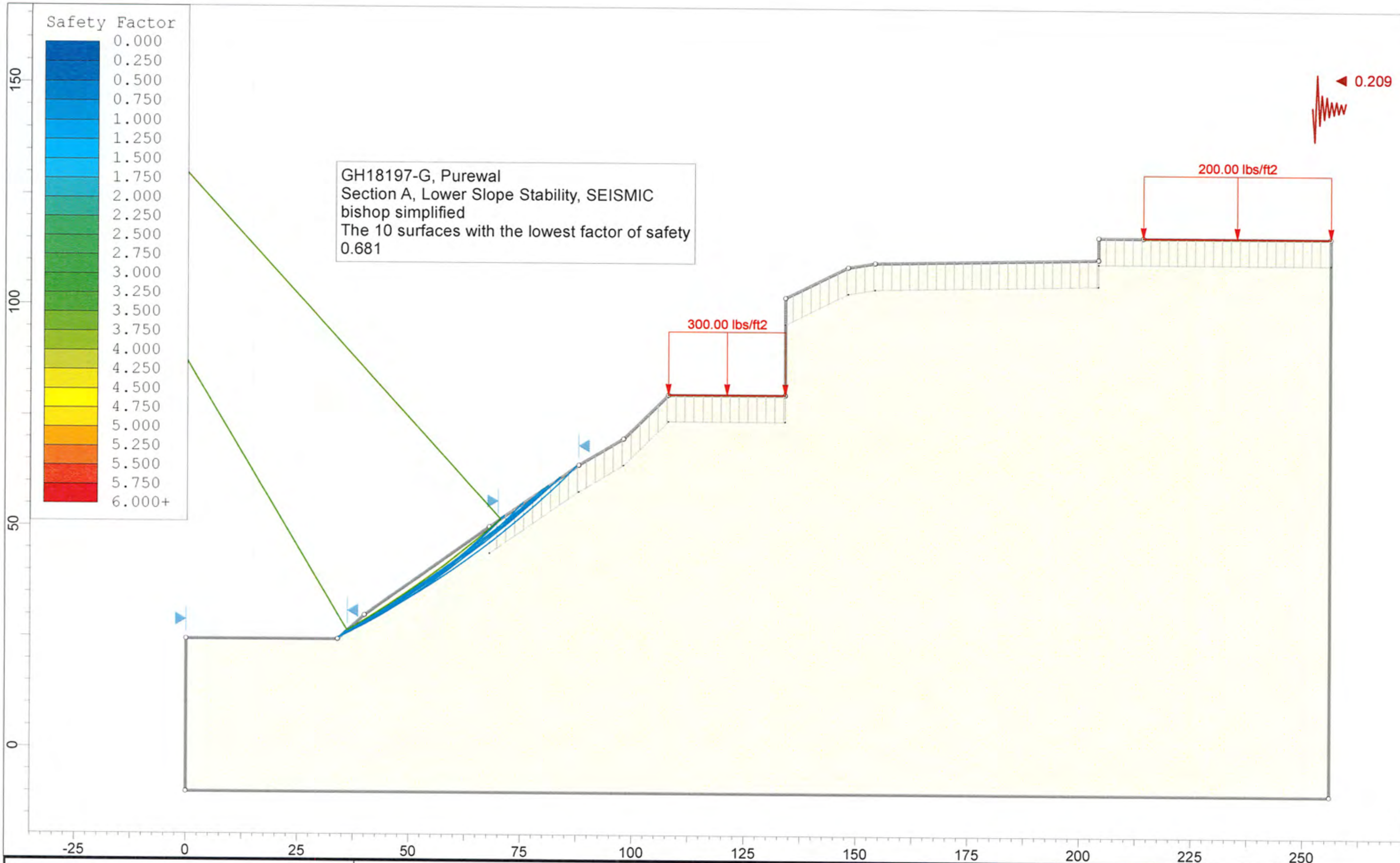
X	Y
134	80
108	80

Tension Crack

X	Y
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
68	50
40	30
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Lower Slope Stability, SEISMIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Lower Slope Stability, SEISMIC.slim

SLIDEINTERPRET 7.023

Slide Analysis Information
GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Lower Slope Stability, SEISMIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Lower Slope Stability, SEISMIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.209

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	0.680547
Center:	-73.437, 211.301
Radius:	214.884
Left Slip Surface Endpoint:	36.118, 26.441
Right Slip Surface Endpoint:	70.515, 51.761
Resisting Moment:	637706 lb-ft
Driving Moment:	937049 lb-ft
Total Slice Area:	42.8563 ft2
Surface Horizontal Width:	34.3977 ft
Surface Average Height:	1.24591 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 2032
Number of Invalid Surfaces: 2968

Error Codes:

Error Code -113 reported for 274 surfaces
Error Code -114 reported for 2694 surfaces

Error Codes

The following errors were encountered during the computation:

-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

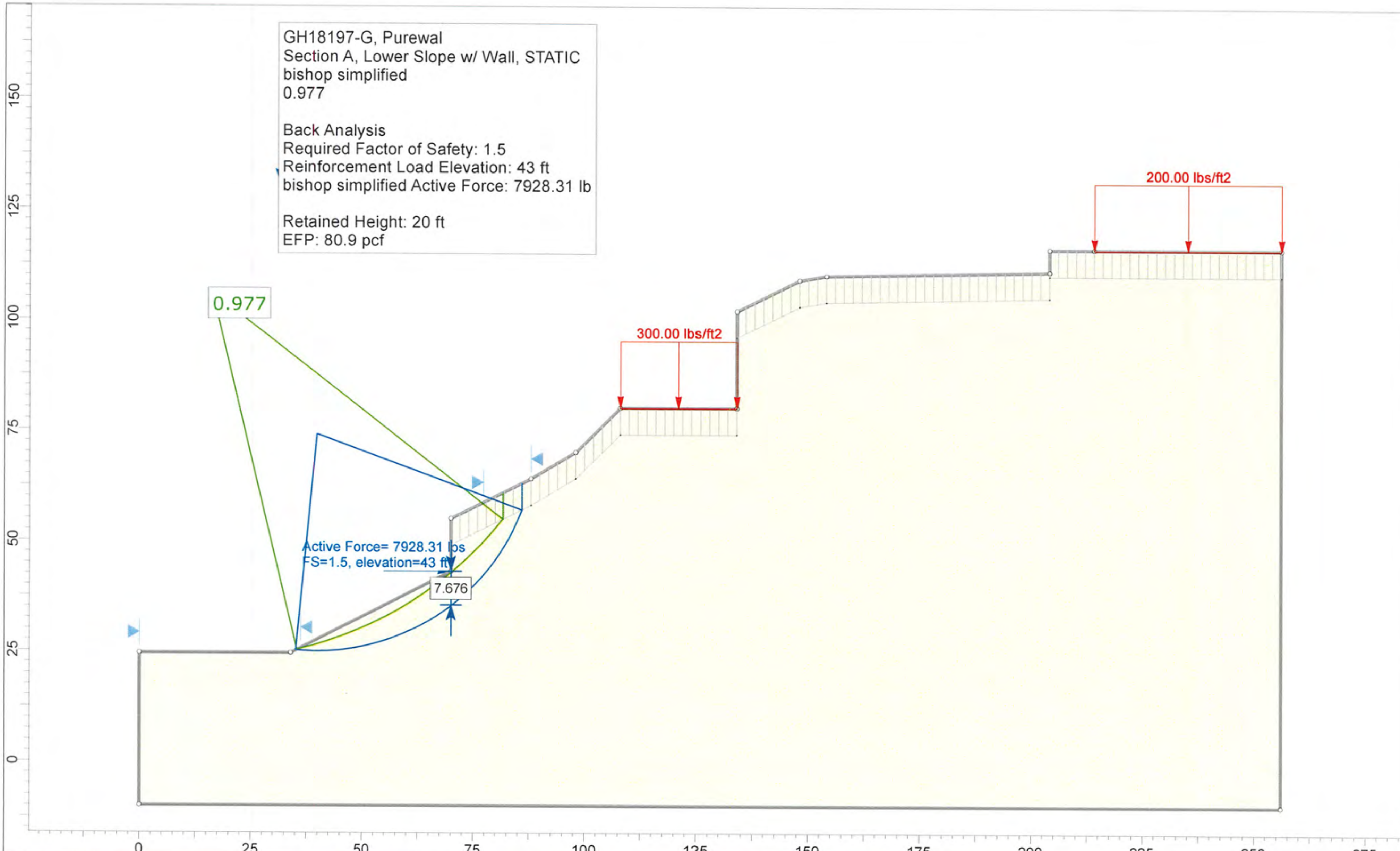
X	Y
134	80
108	80

Tension Crack

X	Y
68	44
88	58
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
68	50
40	30
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Lower Slope w/ Wall, STATIC		
Drawn By: SAN	Scale: 1:360	Company	Grover-Hollingsworth and Assoc.
Date: 5/22/2017, 10:56:57 AM		File Name	GH18197-g, Sect A, Lower Slope with Wall, 1.5 FS Surf.slim

SLIDEINTERPRET 7.023

Slide Analysis Information

GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Lower Slope with Wall, 1.5 FS Surf.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Lower Slope w/ Wall, STATIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used

Bishop simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Back Analysis

Required Factor of Safety:	1.5
Reinforcement Load Elevation:	43 ft
bishop simplified Active Force:	7928.31 lb
Center (39.790, 74.013) Radius 49.163	
bishop simplified Passive Force:	11892.5 lb
Center (39.790, 74.013) Radius 49.163	

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	0.976516
Center:	16.260, 106.013
Radius:	83.043
Left Slip Surface Endpoint:	35.352, 25.195
Right Slip Surface Endpoint:	81.650, 54.825
Left Slope Intercept:	35.352 25.195
Right Slope Intercept:	81.650 60.825
Resisting Moment:	1.18301e+006 lb-ft
Driving Moment:	1.21146e+006 lb-ft
Total Slice Area:	176.122 ft2
Surface Horizontal Width:	46.2982 ft
Surface Average Height:	3.80408 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	1488
Number of Invalid Surfaces:	3512

Error Codes:

Error Code -101 reported for 1 surface
Error Code -105 reported for 2 surfaces
Error Code -113 reported for 503 surfaces
Error Code -114 reported for 3006 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.
-105 = More than two surface / slope intersections with no valid slip surface.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

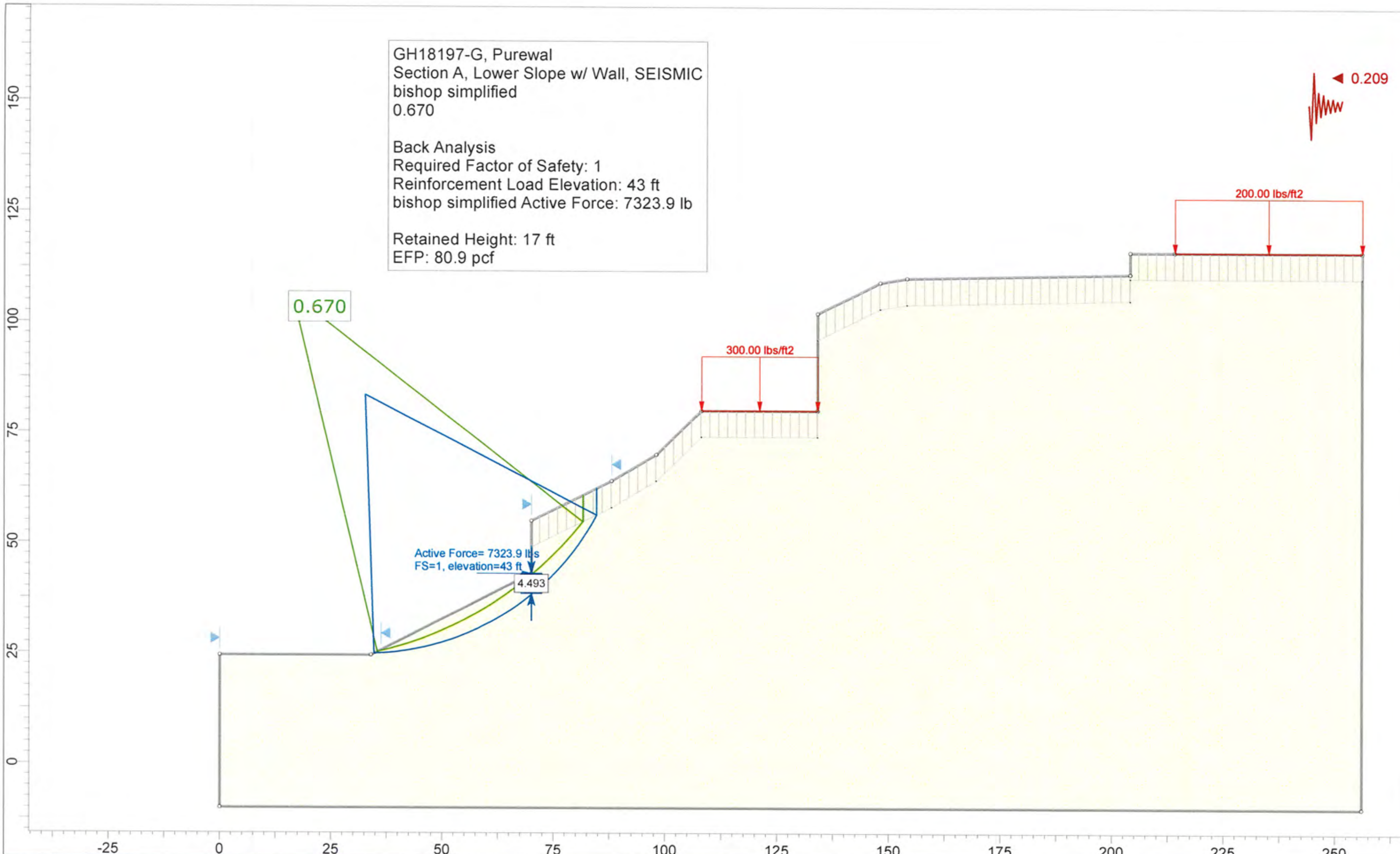
X	Y
134	80
108	80

Tension Crack

X	Y
70	49
88	58
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
70	55
70	43
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Lower Slope w/ Wall, SEISMIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Lower Slope with Wall, SEISMIC.slim

SLIDEINTERPRET 7.023

Slide Analysis Information

GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Lower Slope with Wall, SEISMIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Lower Slope w/ Wall, SEISMIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.209

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Back Analysis

Required Factor of Safety: 1
Reinforcement Load Elevation: 43 ft
bishop simplified Active Force: 7323.9 lb
Center (32.615, 83.414) Radius 58.614
bishop simplified Passive Force: 7323.9 lb
Center (32.615, 83.414) Radius 58.614

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	0.670227
Center:	16.241, 105.919
Radius:	82.948
Left Slip Surface Endpoint:	35.383, 25.211
Right Slip Surface Endpoint:	81.541, 54.771
Left Slope Intercept:	35.383 25.211
Right Slope Intercept:	81.541 60.771
Resisting Moment:	999887 lb-ft
Driving Moment:	1.49186e+006 lb-ft
Total Slice Area:	173.925 ft2
Surface Horizontal Width:	46.1583 ft
Surface Average Height:	3.76801 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 1181
Number of Invalid Surfaces: 3819

Error Codes:

Error Code -105 reported for 258 surfaces
Error Code -113 reported for 506 surfaces
Error Code -114 reported for 3055 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

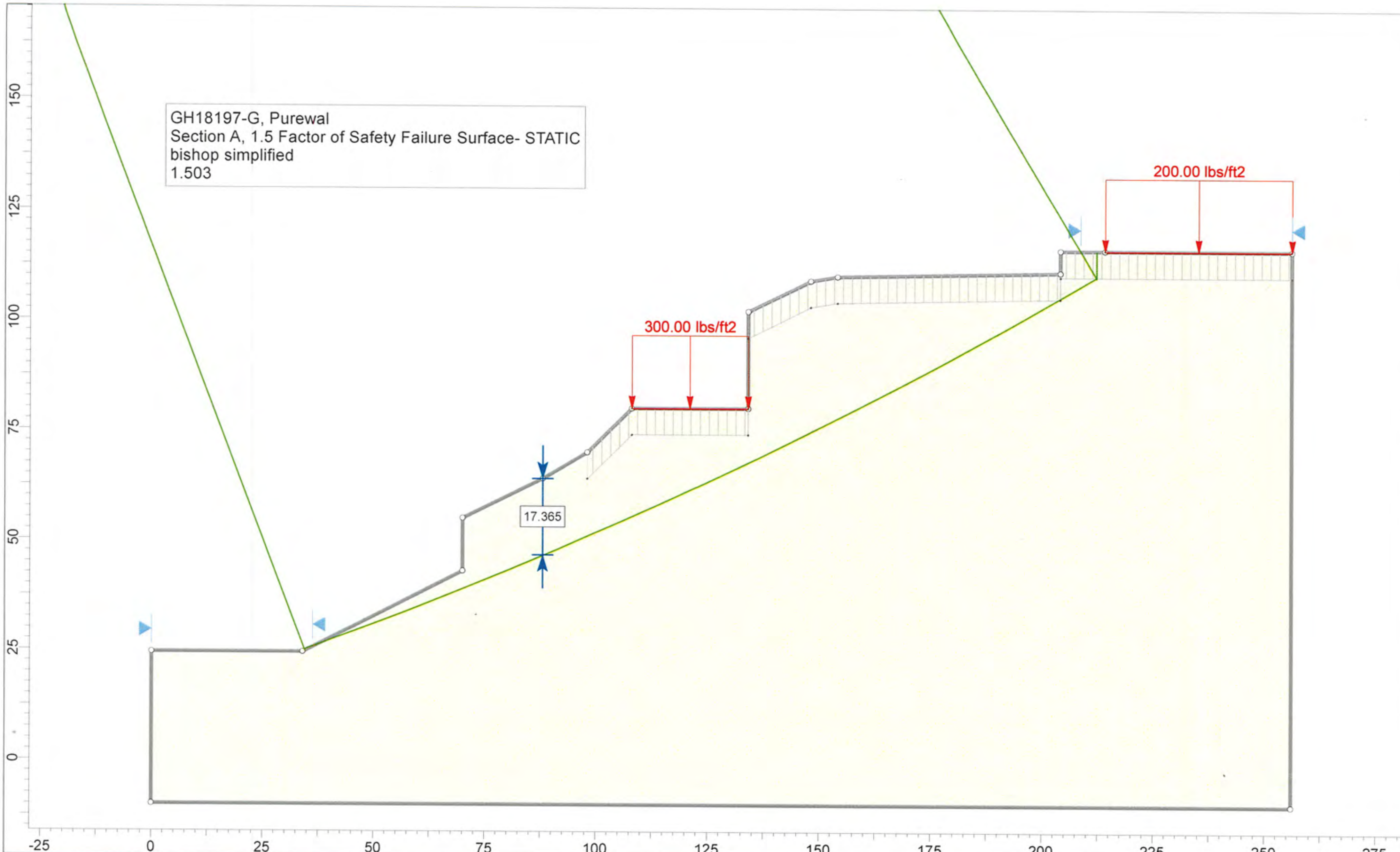
X	Y
134	80
108	80

Tension Crack

X	Y
70	49
88	58
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
70	55
70	43
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, 1.5 Factor of Safety Failure Surface- STATIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, 1.5 FS Surf.slim

rocscience

SLIDEINTERPRET 7.023

Slide Analysis Information

GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, 1.5 FS Surf.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, 1.5 Factor of Safety Failure Surface- STATIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.503160
Center:	-362.065, 1078.352
Radius:	1125.760
Left Slip Surface Endpoint:	34.470, 24.741
Right Slip Surface Endpoint:	212.069, 110.000
Left Slope Intercept:	34.470 24.741
Right Slope Intercept:	212.069 116.000
Resisting Moment:	3.05933e+008 lb-ft
Driving Moment:	2.03526e+008 lb-ft
Total Slice Area:	2971.48 ft2
Surface Horizontal Width:	177.599 ft
Surface Average Height:	16.7314 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	3217
Number of Invalid Surfaces:	1783

Error Codes:

Error Code -101 reported for 1 surface
Error Code -103 reported for 1168 surfaces
Error Code -113 reported for 124 surfaces
Error Code -114 reported for 490 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

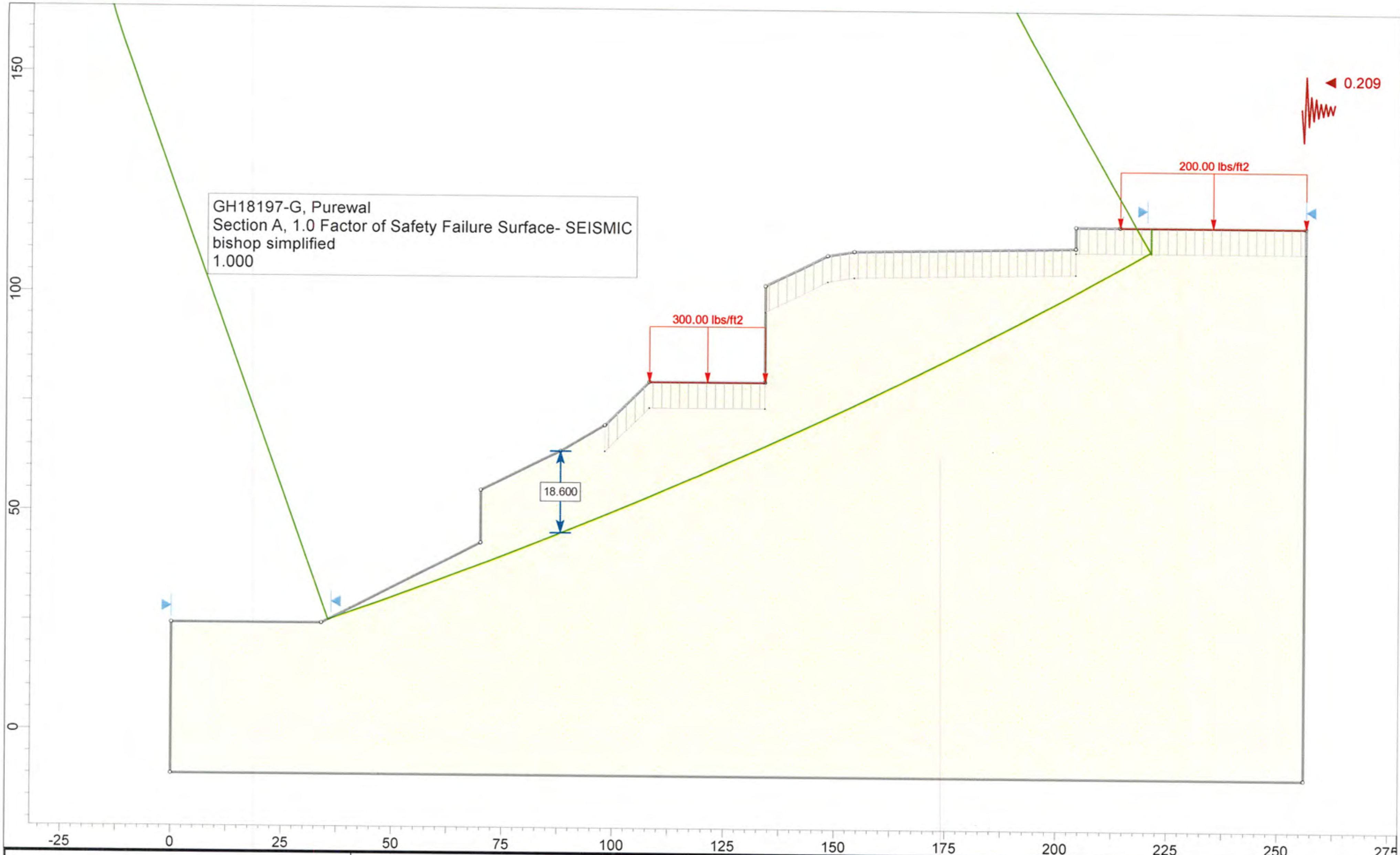
X	Y
134	80
108	80

Tension Crack

X	Y
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
70	55
70	43
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal
Analysis Description	Section A, 1.0 Factor of Safety Failure Surface- SEISMIC
Drawn By	SAN
Scale	1:360
Company	Grover-Hollingsworth and Assoc.
Date	5/22/2017, 10:56:57 AM
File Name	GH18197-g, Sect A, 1.0 FS Surf, SEISMIC.slim

SLIDEINTERPRET 7.023

Slide Analysis Information
GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, 1.0 FS Surf, SEISMIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, 1.0 Factor of Safety Failure Surface- SEISMIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.209

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.000080
Center:	-356.951, 1130.189
Radius:	1172.546
Left Slip Surface Endpoint:	35.492, 25.267
Right Slip Surface Endpoint:	221.045, 110.000
Left Slope Intercept:	35.492 25.267
Right Slope Intercept:	221.045 116.000
Resisting Moment:	3.3721e+008 lb-ft
Driving Moment:	3.37183e+008 lb-ft
Total Slice Area:	3439.88 ft2
Surface Horizontal Width:	185.553 ft
Surface Average Height:	18.5385 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3203
Number of Invalid Surfaces: 1797

Error Codes:

Error Code -101 reported for 1 surface
Error Code -103 reported for 1363 surfaces
Error Code -113 reported for 199 surfaces
Error Code -114 reported for 234 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.
-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

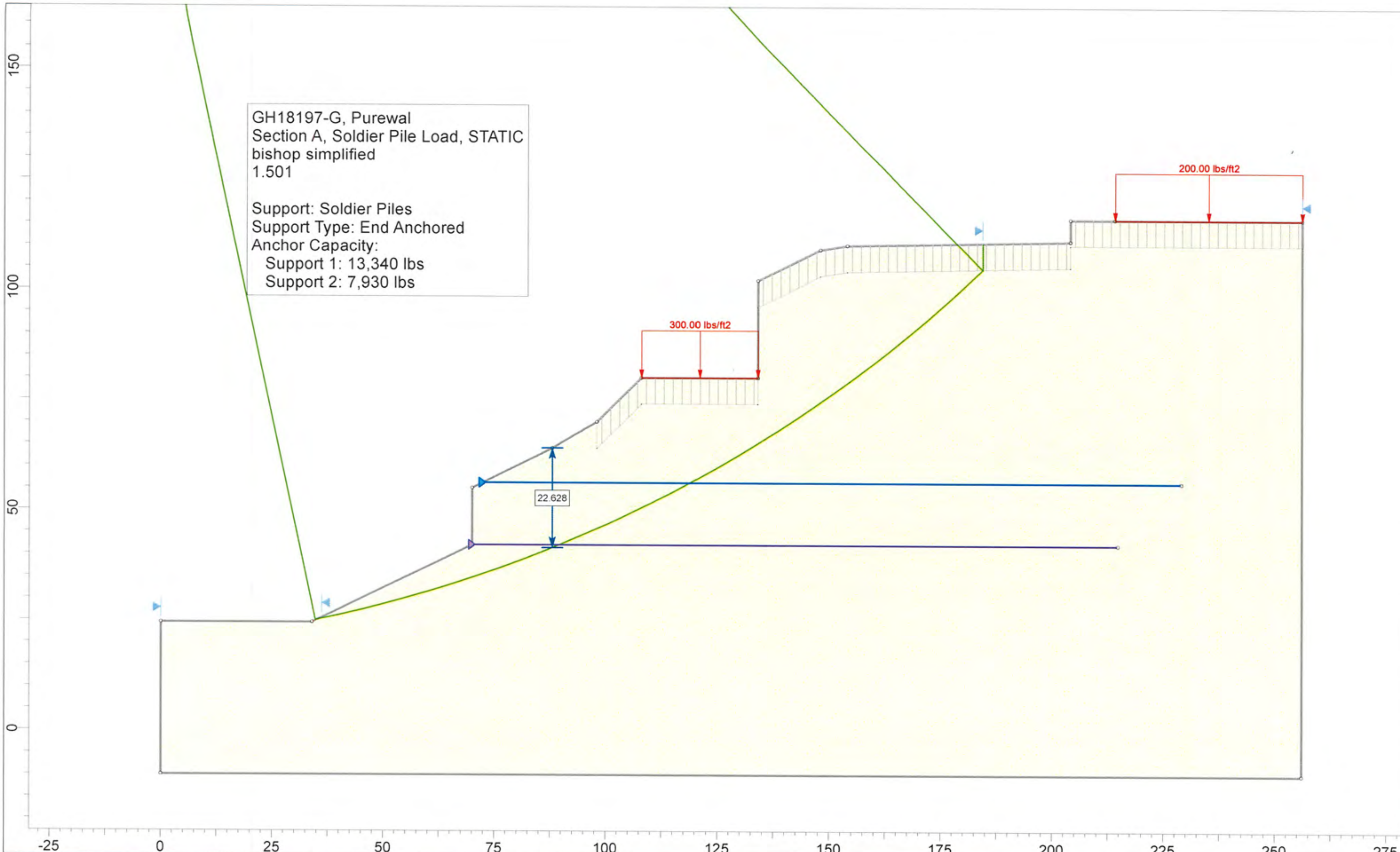
X	Y
134	80
108	80

Tension Crack

X	Y
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
70	55
70	43
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Soldier Pile Load, STATIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Soldier Pile Load, STATIC.slim

SLIDEINTERPRET 7.023

Slide Analysis Information

GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Soldier Pile Load, STATIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Soldier Pile Load, STATIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used

Bishop simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Support Properties

Support 1

Support Type: End Anchored
Force Application: Active
Out-of-Plane Spacing: 1 ft
Anchor Capacity: 13340 lb

Support 2

Support Type: End Anchored
Force Application: Active
Out-of-Plane Spacing: 1 ft
Anchor Capacity: 7930 lb

Global Minimums

Method: bishop simplified

FS	1.501110
Center:	-29.095, 324.905
Radius:	306.754
Left Slip Surface Endpoint:	34.766, 24.872
Right Slip Surface Endpoint:	184.369, 104.607
Left Slope Intercept:	34.766 24.872
Right Slope Intercept:	184.369 110.607
Resisting Moment:	8.21875e+007 lb-ft
Driving Moment:	5.4751e+007 lb-ft
Active Support Moment:	-5.82835e+006 lb-ft
Total Slice Area:	2902.18 ft2
Surface Horizontal Width:	149.602 ft
Surface Average Height:	19.3992 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 2800
Number of Invalid Surfaces: 2200

Error Codes:

Error Code -103 reported for 731 surfaces
Error Code -105 reported for 3 surfaces
Error Code -113 reported for 362 surfaces
Error Code -114 reported for 1104 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-105 = More than two surface / slope intersections with no valid slip surface.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

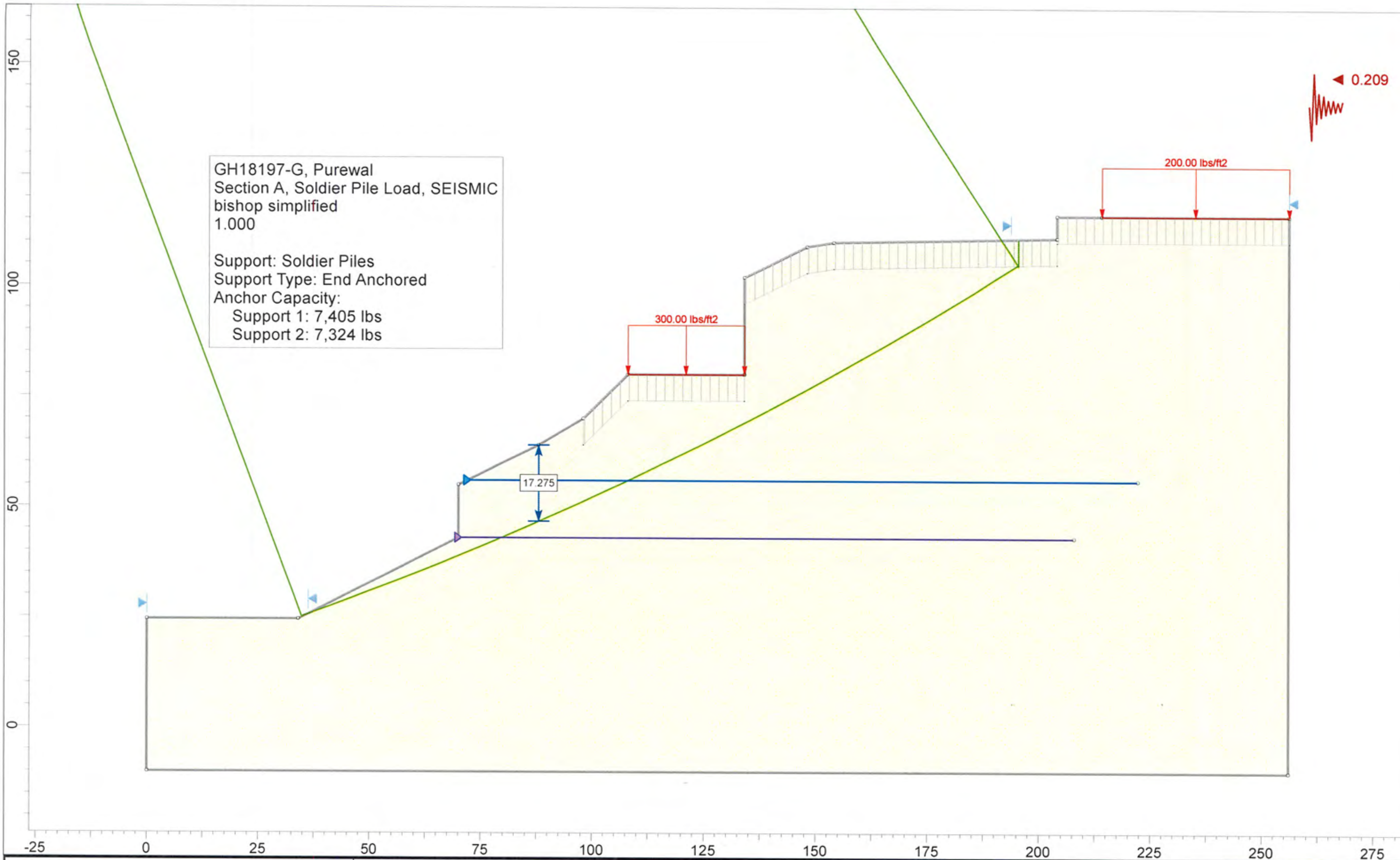
X	Y
134	80
108	80

Tension Crack

X	Y
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
70	55
70	42
34	24.5
0	24.5
0	-10



Project	GH18197-G, Purewal		
Analysis Description	Section A, Soldier Pile Load, SEISMIC		
Drawn By	SAN	Scale	1:360
Company	Grover-Hollingsworth and Assoc.		
Date	5/22/2017, 10:56:57 AM	File Name	GH18197-g, Sect A, Soldier Pile Load, SEISMIC.slim

rocscience

SLIDEINTERPRET 7.023

Slide Analysis Information

GH18197-G, Purewal

Project Summary

File Name:	GH18197-g, Sect A, Soldier Pile Load, SEISMIC.slim
Slide Modeler Version:	7.023
Project Title:	GH18197-G, Purewal
Analysis:	Section A, Soldier Pile Load, SEISMIC
Author:	SAN
Company:	Grover-Hollingsworth and Assoc.
Date Created:	5/22/2017, 10:56:57 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle:	Not Defined
Lower Angle:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.209

2 Distributed Loads present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Distributed Load 2

Distribution:	Constant
Magnitude [psf]:	300
Orientation:	Normal to boundary

Tension Crack

Water level: dry

Material Properties

Property	Dune Sand Deposits
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36.5
Water Surface	None
Ru Value	0

Support Properties

Support 1

Support Type: End Anchored
Force Application: Active
Out-of-Plane Spacing: 1 ft
Anchor Capacity: 7405 lb

Support 2

Support Type: End Anchored
Force Application: Active
Out-of-Plane Spacing: 1 ft
Anchor Capacity: 7324 lb

Global Minimums

Method: bishop simplified

FS	1.000100
Center:	-253.861, 805.725
Radius:	832.466
Left Slip Surface Endpoint:	34.782, 24.902
Right Slip Surface Endpoint:	195.294, 104.826
Left Slope Intercept:	34.782 24.902
Right Slope Intercept:	195.294 110.826
Resisting Moment:	1.81948e+008 lb-ft
Driving Moment:	1.8193e+008 lb-ft
Active Support Moment:	-1.1138e+007 lb-ft
Total Slice Area:	2627.53 ft2
Surface Horizontal Width:	160.512 ft
Surface Average Height:	16.3697 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 2812
Number of Invalid Surfaces: 2188

Error Codes:

Error Code -101 reported for 1 surface
Error Code -103 reported for 853 surfaces
Error Code -105 reported for 3 surfaces
Error Code -113 reported for 430 surfaces
Error Code -114 reported for 901 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.
-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-105 = More than two surface / slope intersections with no valid slip surface.
-113 = Surface intersects outside slope limits.
-114 = Surface with Reverse Curvature.

List Of Coordinates

Distributed Load

X	Y
256	116
214	116

Distributed Load

X	Y
134	80
108	80

Tension Crack

X	Y
98	64
108	74
134	74
134	80
134	96
148	103
154	104
204	105
204	110
256	110

External Boundary

X	Y
256	-10
256	116
214	116
204	116
204	111
154	110
148	109
134	102
134	80
108	80
98	70
88	64
70	55
70	43
34	24.5
0	24.5
0	-10

GROVER HOLLINGSWORTH and Associates, Inc.

RETAINING WALL

GH: **18197-G** CONSULT: **RAH**
CLIENT: **PUREWAL**

CALCULATION SHEET # **1**

CALCULATE THE DESIGN MINIMUM EQUIVALENT FLUID PRESSURE (EFP) FOR PROPOSED RETAINING WALLS. THE WALL HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. ASSUME THE BACKFILL IS SATURATED WITH NO EXCESS HYDROSTATIC PRESSURE. USE THE MONONOBE-OKABE METHOD FOR SEISMIC FORCES.

CALCULATION PARAMETERS

EARTH MATERIAL:	DUNE SAND	WALL HEIGHT	12 feet
SHEAR DIAGRAM:	B-2	BACKSLOPE ANGLE:	26.5 degrees
COHESION:	0 psf	SURCHARGE:	0 pounds
PHI ANGLE:	36.5 degrees	SURCHARGE TYPE:	0 Uniform
DENSITY	120 pcf	INITIAL FAILURE ANGLE:	30 degrees
SAFETY FACTOR:	1.5	FINAL FAILURE ANGLE:	80 degrees
WALL FRICTION	12 degrees	INITIAL TENSION CRACK:	1 feet
CD (C/FS):	0.0 psf	FINAL TENSION CRACK:	20 feet

PHID = ATAN(TAN(PHI)/FS) = 26.3 degrees

HORIZONTAL PSEUDO STATIC SEISMIC COEFFICIENT (k_h) 0 %g

VERTICAL PSEUDO STATIC SEISMIC COEFFICIENT (k_v) 0 %g

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	46 degrees
AREA OF TRIAL FAILURE WEDGE	132.6 square feet
TOTAL EXTERNAL SURCHARGE	0.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	15913.2 pounds
NUMBER OF TRIAL WEDGES ANALYZED	1020 trials
LENGTH OF FAILURE PLANE	28.8 feet
DEPTH OF TENSION CRACK	1.3 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	20.0 feet
CALCULATED HORIZONTAL THRUST ON WALL	**5315.9 pounds**
CALCULATED EQUIVALENT FLUID PRESSURE	**73.8 pcf**
DESIGN EQUIVALENT FLUID PRESSURE	**74.0 pcf**

CONCLUSIONS:

THE CALCULATION INDICATES THAT THE PROPOSED 12 FOOT HIGH RETAINING WALL SUPPORTING A 2:1 SLOPE MAY BE DESIGNED FOR A STATIC EQUIVALENT FLUID PRESSURE OF 74 POUNDS PER CUBIC FOOT.

GROVER HOLLINGSWORTH
and Associates, Inc.

RETAINING WALL

GH: **18197-G** CONSULT: **RAH**
CLIENT: **PUREWAL**

CALCULATION SHEET # **1**

CALCULATE THE DESIGN MINIMUM EQUIVALENT FLUID PRESSURE (EFP) FOR PROPOSED RETAINING WALLS. THE WALL HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. ASSUME THE BACKFILL IS SATURATED WITH NO EXCESS HYDROSTATIC PRESSURE. USE THE MONONOBE-OKABE METHOD FOR SEISMIC FORCES.

CALCULATION PARAMETERS

EARTH MATERIAL:	DUNE SAND	WALL HEIGHT	12 feet
SHEAR DIAGRAM:	B-2	BACKSLOPE ANGLE:	26.5 degrees
COHESION:	0 psf	SURCHARGE:	0 pounds
PHI ANGLE:	36.5 degrees	SURCHARGE TYPE:	0 Uniform
DENSITY	120 pcf	INITIAL FAILURE ANGLE:	30 degrees
SAFETY FACTOR:	1	FINAL FAILURE ANGLE:	80 degrees
WALL FRICTION	12 degrees	INITIAL TENSION CRACK:	1 feet
CD (C/FS):	0.0 psf	FINAL TENSION CRACK:	20 feet

PHID = ATAN(TAN(PHI)/FS) = 36.5 degrees

HORIZONTAL PSEUDO STATIC SEISMIC COEFFICIENT (k_h) 0.209 %g

VERTICAL PSEUDO STATIC SEISMIC COEFFICIENT (k_v) 0 %g

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	45 degrees
AREA OF TRIAL FAILURE WEDGE	139.7 square feet
TOTAL EXTERNAL SURCHARGE	0.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	16766.0 pounds
NUMBER OF TRIAL WEDGES ANALYZED	1020 trials
LENGTH OF FAILURE PLANE	28.3 feet
DEPTH OF TENSION CRACK	2.0 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	20.0 feet
CALCULATED HORIZONTAL THRUST ON WALL	**5803.0 pounds**

CONCLUSIONS:

THE CALCULATION INDICATES THAT THE PROPOSED 12 FOOT HIGH RETAINING WALL SUPPORTING DUNE SAND AND A 2:1 SLOPE MAY BE DESIGNED FOR A SEISMIC EQUIVALENT FLUID PRESSURE OF 81 POUNDS PER CUBIC FOOT.

GROVER
HOLLINGSWORTH
and Associates, Inc.

SHORING PILE

GH:	**18197-G**	CONSULT:	**RAH**
CLIENT:	**PUREWAL**		

CALCULATION SHEET #

CALCULATE THE DESIGN MINIMUM EQUIVALENT FLUID PRESSURE (EFP) FOR PROPOSED RETAINING WALLS. THE WALL HEIGHT AND BACKSLOPE AND SURCHARGE CONDITIONS ARE LISTED BELOW. ASSUME THE BACKFILL IS SATURATED WITH NO EXCESS HYDROSTATIC PRESSURE. USE THE MONONOBE-OKABE METHOD FOR SEISMIC FORCES.

CALCULATION PARAMETERS

EARTH MATERIAL:	DUNE SAND	RETAINED LENGTH	20 feet
SHEAR DIAGRAM:	B-2	BACKSLOPE ANGLE:	0 degrees
COHESION:	0 psf	SURCHARGE:	0 pounds
PHI ANGLE:	36.5 degrees	SURCHARGE TYPE:	P Point
DENSITY	120 pcf	INITIAL FAILURE ANGLE:	30 degrees
SAFETY FACTOR:	1.25	FINAL FAILURE ANGLE:	70 degrees
PILE FRICTION	12 degrees	INITIAL TENSION CRACK:	1 feet
CD (C/FS):	psf	FINAL TENSION CRACK:	20 feet

PHID = ATAN(TAN(PHI)/FS) = 30.6 degrees \

HORIZONTAL PSEUDO STATIC SEISMIC COEFFICIENT (k_h) %g

VERTICAL PSEUDO STATIC SEISMIC COEFFICIENT (k_v) %g

CALCULATED RESULTS

CRITICAL FAILURE ANGLE	59 degrees
AREA OF TRIAL FAILURE WEDGE	120.2 square feet
TOTAL EXTERNAL SURCHARGE	0.0 pounds
WEIGHT OF TRIAL FAILURE WEDGE	14420.6 pounds
NUMBER OF TRIAL WEDGES ANALYZED	820 trials
LENGTH OF FAILURE PLANE	23.3 feet
DEPTH OF TENSION CRACK	0.0 feet
HORIZONTAL DISTANCE TO UPSLOPE TENSION CRACK	12.0 feet
CALCULATED HORIZONTAL THRUST ON WALL	**6978.2 pounds**
CALCULATED EQUIVALENT FLUID PRESSURE	**34.9 pcf**
DESIGN EQUIVALENT FLUID PRESSURE	**35.0 pcf**

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CONCLUSIONS:

THE CACULATION INDICATES THAT SHORING SUPPORTING 20 FEET OF DUNE SAND DEPOSITS AND LEVEL GROUND MAY BE DEISGNED FOR AN EQUILAVENT FLUID PRESSURE OF 35 POUNDS PER CUBIC FOOT.