Appendix H-2

Access Road Geotechnical Report

Prepared for

Southern California Gas Company
555 West 5th Street
Los Angeles, California 90051

GEOTECHNICAL ENGINEERING REPORT

STORAGE FIELD ACCESS ROAD EXPANSION

HONOR RANCHO FACILITY

SANTA CLARITA, CALIFORNIA

Prepared by

Geosyntec consultants

engineers | scientists | innovators

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Project Number: SC1339

November 22, 2023

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Geosyntec consultants

November 22, 2023

Jessica Yuan, P.E.
Project Engineer
Southern California Gas Company | Gas Engineering
555 W 5th St.
Los Angeles, California 90013

Subject: Geotechnical Engineering Report
Storage Field Access Road Expansion
Santa Clarita, California

Dear Ms. Yuan:

Geosyntec Consultants (Geosyntec) is pleased to provide Southern California Gas Company (SCG) with the accompanying report presenting recommendations for the proposed Storage Field Access Road Expansion at SCG's Honor Rancho Facility in Santa Clarita, California.

Geosyntec's services were performed in general agreement with the Standard Services Agreement with SCG (Agreement No. CW10080), dated January 18, 2023, as per the scope of services outlined in Geosyntec's 'Proposal for Geotechnical Study for Proposed Road Expansion', dated November 9, 2022. This report applies to the revised road expansion extent provided by SCG on August 14, 2023.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Rehan Khan

Rehan Khan, P.E.(TX)
Project Engineer

Bora Baturay, Ph.D., P.E.(CA), G.E. (CA)
Principal Engineer

Geosyntec consultants

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1. INTRODUCTION AND BACKGROUND INFORMATION

Southern California Gas Company's (SCG) Honor Rancho facility (Facility) is located in Santa Clarita, California, and situated to the north of Newhall Ranch Road (Figure 1). The Facility currently includes an existing gas compressor facility and other related gas storage facilities.

An undeveloped sloped area (referred to herein as 'the hill') is present south of the intersection of Brady Parkway and Company Road, both of which are private roads within the facility. The proposed road expansion scope involves these private access roads around the north half of the hill. About 550 linear feet of Brady Parkway starting from its intersection with Company Road and going southeast is planned to be widened to include 36 feet wide paved road and an additional 10 feet of space for shoulder and stormwater ditch. This expansion will be achieved by making a cut into the northeast side of the hill. Additionally, about 400 linear feet of Company Road starting from its intersection with Brady Parkway and going south is planned to be minimally graded to add a v-ditch and repaved. It is our understanding this minimal grading will not change the configuration of slopes on the north and northwest side of the hill. Expansion along Brady Parkway will involve grading by cutting into the sideslopes of the hill. The proposed road expansion extents are shown on Figure 2 based on the information provided to Geosyntec by SCG.

In 2021, Geosyntec had prepared a geotechnical engineering report (Geosyntec, 2021a) for the Compressor Modernization project at the Facility. Geosyntec utilized the explorations performed as part of Geosyntec (2021a) which are nearby the proposed expansion. The logs for these explorations are presented in Appendix A of this report. No additional explorations were performed for this study. As part of Geosyntec (2021a), Geosyntec had drilled three hollow stem auger borings (designated TPB-1 through TPB-3), two rock core borings (B-3 and B-4), and performed one Cone Penetration Test (CPT-6) near the alignment of the proposed road expansion. Additionally, two hollow stem auger borings, HSA-1 and HSA-2 were drilled about 800 feet to the east from the road expansion site which were utilized for infiltration testing and P-wave seismic refraction survey was performed about 800 feet southeast from the road expansion site to measure P-wave velocity within the Saugus rock formation. The previous explorations are shown on Figure 2.

1.1 Findings from Geosyntec (2021a)

An executive summary of the findings from explorations performed for Geosyntec (2021a) that are relevant to Geosyntec's current study can be summarized as follows:

- Geologic hazards that may impact projects within the Facility include strong seismic shaking which can impact stability of hill slopes and may cause landslides.
- Groundwater was not observed during the field investigations that extended to 31 ft bgs. Therefore, shallow groundwater is not anticipated.
- The subsurface soils at the storage field to the east of Brady Parkway are anticipated to consist of up to 3 feet of fill (silty sand and clayey sand) underlain by Saugus formation.

The existing Brady Parkway and the proposed expansion are anticipated to be cut into Saugus formation. Saugus formation encountered generally consisted of interbedded, silty and clayey sandstones, as well as sandy claystones. Saugus formation at this site is moderately to highly weathered.

- P-wave seismic refraction survey performed on the Saugus rock formation at a location about 800 feet southeast from the road expansion site indicated that P-wave velocities in the Saugus formation within the upper 40 ft were in the range of 2,500 to 4,500 ft/sec. Based on this range, the Saugus formation may be expected to be rippable within the upper 40 ft bgs.
- The samples of Saugus formation tested were not found to be corrosive.
- Based on infiltration tests conducted at HSA-1 and HSA-2 within the undocumented fill and alluvium, the infiltration rates are below what is typically acceptable for incorporation in a stormwater infiltration system. As such, it is recommended that infiltration best management practices not be employed as part of the development of this project.
- Flexible pavement section for the proposed road expansion should consist of 4 to 5 inches of asphaltic concrete (as defined in Section 39 of the latest edition of the Caltrans Standard Specifications) over 8 to 16 inches of Class 2 aggregate base (as defined in Section 26 of the latest edition of the Caltrans Standard Specifications), depending on the traffic load over properly prepared subgrade assuming subgrade consists of clayey sand fill soils.

2. SITE AND GEOLOGIC CONDITIONS

Geosyntec's understanding of the site conditions has been developed based on a geologic site reconnaissance, review of published geologic literature for the site, and findings from field exploration and laboratory testing program performed previously as part of Geosyntec (2021a) investigation.

2.1 Regional Geology

The Facility lies along the northeastern margin of the Ventura Basin within the Transverse Ranges geomorphic province, which extends approximately 320-miles (west to east) from Point Arguello and San Miguel Island to the Eagle and Pinto Mountains of the Mojave Desert. The Transverse Ranges is characterized by a series of east-west trending convergent deformational structural features in contrast to the predominant northwest-southeast structural trend of southern California. The trend of the Transverse Ranges is controlled by the effects of north-south compressive deformation attributed to the San Andreas fault system that has rotated and compressed the region to its current configuration. The compression has resulted in folding and reverse/thrust faulting with similar east to west trends, and regional uplift.

The Ventura Basin consists of an elongated sedimentary trough which extends from the Santa Barbara Channel on the west to the San Gabriel fault zone on the east. The axis of the Ventura Basin trends east-west reflecting the regional orientation of the Transverse Ranges, and generally coincides with the Santa Clara River Valley. This sedimentary basin contains a thick sequence of marine and non-marine sediments that have been uplifted and deformed by past tectonic forces.

The northeastern margin of the Ventura Basin is characterized by rugged, steep, hilly terrain and is dissected by numerous drainages that generally empty towards the Santa Clara River Valley to the south and the Castaic Valley to the west. Based on published surficial geologic maps (Dibblee and Ehrenspeck, 1996), the Facility is underlain by artificial fill, Quaternary-age alluvial and colluvial deposits, and the Pleistocene-age Saugus Formation. The local geology map in the area of the proposed road expansion is shown on Figure 3 and local geology is discussed in Section 2.4.

2.2 Seismic Setting

Faults in southern California are generally classified as "active," "potentially active," and "inactive" faults. Division of these major groups are based on criteria by the California Geologic Survey (CGS, formerly known as California Division of Mines and Geology, CDMG) for the Alquist-Priolo Earthquake Fault Zoning Program [Bryant and Hart, 2007]. By definition, an "active" fault is one that has had displacement within Holocene time (last 11,000 years). A "potentially active" fault has demonstrated displacement of Quaternary-age deposits (last 1.6 million years). "Inactive" faults have not exhibited displacement in the last 1.6 million years.

The San Gabriel Fault – Palomar Section, which is a part of the San Gabriel fault system, is the closest major active fault to the Facility. A strand of the San Gabriel Fault is mapped approximately

0.3 miles northeast of the Facility. Other major nearby active faults include the Holser, Northridge Blind Thrust, Del Valle, Santa Felicia, Santa Susana, and San Andreas Faults.

The locations of regional faults and historic earthquake epicenters are shown on Figure 4.

2.3 Surface Conditions

Generally, the Honor Rancho Facility lies within an alluvial drainage valley trending north-south ending at the Santa Clara River south of the site. Based on a review of historical aerial imagery and topographic maps (Geosyntec, 2021a), the site was graded in the early 1950's to support the oil and gas facility improvements. Roads were created around the site and various pads were constructed in the early 1970's to achieve the general layout that exists today.

The existing Brady Parkway and Company Road are asphaltic concrete roads. These roads are about 20 to 25 feet wide for the most part. The surface elevation ranges from 1,124 ft at the southern end of Company Road within the limits of the proposed expansion ascending up to 1,167 feet at the northern end (close to the intersection of Brady Parkway and Company Road) after which it descends down to 1,146 feet at the eastern end of the Brady Parkway. The hill is mostly vegetated with crest elevation of about 1,205 feet, per existing topographic contour map provided by SCG. A relief header knockout vessel and several transmission towers were observed on top of the hill. The current average sideslope inclinations of the hill on the east side, which will be cut into to accommodate the proposed Brady Parkway expansion, ranges from about 1.25H:1V to 1.75H:1V, per the contour map.

2.4 Subsurface Conditions

Based on the regional geology map, geologic reconnaissance performed, and previous explorations performed by Geosyntec in the vicinity of the road expansion, the hill around which the road expansion is planned consists of Saugus formation with primarily Quaternary alluvium/colluvium deposits present to the west, south and east of the hill. The Company Road on the west side of the hill and the western end of the Brady Parkway may be underlain partially by Quaternary Alluvium/Colluvium. The eastern portion of the Brady Parkway is likely underlain by Saugus Formation and may consist of limited thickness of fill beneath the asphalt section and above Saugus formation. The geologic units anticipated at the expansion area are discussed below.

2.4.1 Saugus Formation (Sandstone Unit) (Qss)

Based on the boring B-3 as well as geologic mapping, the hill consists primarily of Plio-Pleistocene age Saugus Formation. The Saugus Formation encountered during the explorations at the Facility generally consists of interbedded, silty and clayey sandstones as well as low to medium plasticity claystone. The Saugus Formation was observed to be moderately to highly weathered and occasionally friable in the absence of fines. Based on geologic mapping over the hill the Saugus Formation indicated a general dip of about 45 to 55 degrees to the southwest, correlating with the southern leg of an anticline with the axis located approximately parallel to the San Gabriel Fault, 1.5 miles north of the proposed location.

2.4.2 Quaternary Young Alluvium and Quaternary Colluvium (Q_{ya}/Qc)

As shown on the geologic map, surficial quaternary young alluvium and/or quaternary colluvium exists at the western portion of the site and also at one location on top of the hill at the northwest side of the hill. Where observed in the borings at other locations within the Facility, alluvium generally consisted of loose to medium dense, fine-grained sands and medium plasticity sandy clays.

2.4.3 Fill

Fill was encountered underneath the pavement at borings TPB-1, TPB-2, TPB-3, and B-4, all of which are located to the east of Brady Parkway, and extended to depths that ranged from about 1½ to 3 feet below ground surface (bgs). Fill soils observed in Geosyntec's borings consisted of clayey sand and silty sand with trace amount of gravel and cobbles.

The fill that was encountered in the vicinity of the proposed expansion is considered undocumented in that the history of their placement is not known and compaction reports documenting that they were placed as engineered fill are not available.

Fill is anticipated only to the east of and in a limited area over the hill in the project area and is not anticipated to impact the expansion project. However, presence of limited thickness of fill similar to what was encountered to the east of Brady Parkway cannot be ruled out beneath the existing pavement throughout Brady Parkway and Company Road and should be considered in pavement design.

2.4.4 Groundwater

Groundwater was not encountered during the previous explorations (Geosyntec, 2021a). Site specific data regarding recent groundwater levels at the site was not available.

Historically highest depth to groundwater contour map obtained from the CGS (1997) Seismic Hazard Zone Report for the Newhall 7.5 Minute Quadrangle indicates that shallow groundwater levels were observed within Quaternary alluvium near the Santa Clara River approximately 1,000 feet south of the Site at approximate elevation of 1,050 ft MSL. However, an interpretation specific to the vicinity of the site is not available.

Since the proposed expansion will cut into Saugus formation rock over the hill above street level, groundwater is not anticipated to impact the site or pose associated geohazards if proper site drainage is designed, installed, and maintained per the recommendations of the project civil engineer.

3. GEOLOGIC HAZARDS

3.1 Surface Fault Rupture

Seismically induced surface fault rupture occurs as the result of differential movement across a fault. The potential for surface fault rupture is generally considered to be significant along "Holocene-active" faults and to a lesser degree along "pre-Holocene" faults (CGS, 1998). A review of published geologic maps did not identify the presence of faults crossing or projecting towards the proposed Site. Therefore, the potential for surface fault rupture at the project site is considered to be low. Furthermore, according to California Geological Survey's (CGS) Earthquake Zones of Required Investigation for Newhall Quadrangle (CGS, 1998a), the site is not located within a delineated earthquake fault rupture hazard zone.

3.2 Strong Ground Shaking

The Facility is situated within a seismically active region and will likely experience moderate to severe ground shaking in response to a large magnitude earthquake occurring on a local or more distant active fault during the expected lifespan of the proposed substation. As a result, seismically induced ground shaking in response to an earthquake occurring on a nearby active fault, such as the San Gabriel Fault, or a regional fault, such as the San Andreas fault zone, is considered to be a major geologic hazard affecting the project.

The average shear wave velocity in the upper 30 meter (V_{s30}) were obtained from Geosyntec (2021a) and the earthquake moment magnitude and design response spectrum were obtained from a supplemental slope stability evaluation report (Geosyntec, 2021b).

3.3 Seismically Induced Settlement

Saugus formation bedrock is not anticipated to be subject to seismically induced settlements during ground shaking. However, the medium dense fill and alluvium underlying the roads may be subject to seismic settlement if exists with significant thickness below the pavement section and not compacted properly.

3.4 Expansive Soils/Rocks

Based on the plasticity characteristics of the soils and rocks encountered, the site soils/rocks are generally considered to have negligible to low potential for expansion. The exception to this general observation is the presence of medium plasticity Saugus claystone, which exhibited liquid limits of 36 and 39 and plasticity index of 24 (refer to Appendix A). If during grading (cuts), the medium plasticity claystone is exposed, there may be moderate potential for expansion when the rock comes in contact with water followed by shrinkage and cracking upon drying.

3.5 Collapsible Soils/Rocks

Collapse potential tests performed on fill and alluvium in other parts of this Facility, as part of Geosyntec (2021a) indicated significant collapse mechanism (collapse strain of up to 2 to 3 percent for loading conditions consistent with expected bearing pressures) of soils upon inundation. However, the Saugus formation is not anticipated to be susceptible to collapse. The proposed expansion is anticipated to be underlain primarily by Saugus formation and limited thickness of fill or alluvium, if any, therefore collapse phenomena impacting the proposed expansion is low.

3.6 Soil Liquefaction

According to CGS (1998a), the western portion of the proposed road expansion site falls within a liquefaction potential zone. The Saugus formation bedrock is not anticipated to be susceptible to liquefaction, however the fill and alluvium could liquefy if groundwater is shallow.

3.7 Flooding

The Federal Emergency Management Agency (FEMA) presents the flood hazard potential in the vicinity of the site as part of their Flood Insurance Rate Maps. FEMA Map No. 06037C0805F indicates that the Site is located in Zone D, which is defined as “area of undetermined flood hazard.” (FEMA, 2008).

Seiches typically occur when enclosed bodies of water are seismically shaken to generate oscillations and waves resulting in overtopping. Damage resulting from oscillatory waves (seiches) at the nearby Castaic Lake and Castaic Lagoon is considered unlikely due to the high relief topography between the lake and the Site.

Based on Geosyntec’s review of the FEMA mapping, the geologic and physiographic setting, distance to the ocean and other large water bodies, and the project elevations, the potential for flooding or inundation is considered low at the Site.

3.8 Landslide

According to CGS (1998), the road expansion site does not fall within an earthquake-induced landslide potential zone. The static and seismic stability of the planned cut slopes on the northeast side of the hill as part of the proposed expansion were performed and discussed in Section 4.3.

4. DESIGN RECOMMENDATIONS

The recommendations presented herein for the proposed road expansion are based on desktop review of publicly available geotechnical information, results of Geosyntec's previous field investigations and laboratory testing, engineering and geologic evaluations, and professional judgment. The following sections provide recommendations for earthwork, surface drainage, hill slope-cuts, and pavement design.

4.1 <u>Grading</u>

A grading plan for the potential cut slopes along the roads as part of the expansion was not provided to Geosyntec at the time of this report. As discussed in Section 1, only significant grading will be performed along the Brady Parkway. Geosyntec assumed the toe of the potential cut slope will be at approximately 46 feet away from the existing outside edge of Brady Parkway as discussed in Section 1. Based on the location of the existing vent stack and a dirt road providing access to the vent stack on top of the hill, the steepest cut slope that can be implemented without taking these features out appears to be 1.5 horizontal to 1 vertical (1.5H:1V). Based on our past experience at the Facility, cut slopes as steep as 1H:1V maybe implemented, although the steeper the slope the greater the need for surface erosion protection may become in the long term.

Figure 5 shows the existing elevation contours along the roads and on the hill. Figure 5 also shows the approximate daylight line for potential cut slopes along which the proposed cut on the hill will daylight for 1H:1V and 1.5H:1V cuts. Based on the elevation contours, mass excavations to as much as 20 feet into the Saugus formation may be required for the final grades. These excavations will require the construction of 40- to 50-foot high permanent cut slopes. .

Excavation should be performed in accordance with SCG requirements, the recommendations of this geotechnical report, applicable sections of the 2022 CBC, applicable Los Angeles County and City of Santa Clarita grading regulations, the current version of the Standard Specifications for Public Works Construction "Greenbook," as well as California Occupational Safety and Health Administration (Cal OSHA) safety requirements.

Only minor backfilling is anticipated to be required as part of grading. Engineered fill recommendations are provided in Sections 4.1.2 and 4.1.3.

4.1.1 Site Preparation

Loose or soft soils or soils disturbed by construction activities within the proposed grading areas, as identified by the geotechnical consultant during grading, should be excavated, the base of excavations scarified, moisture conditioned, and compacted as recommended herein before placing additional fill. Soil containing organic or other deleterious matter, if encountered, should be removed from the site, and properly disposed of. Topsoil where encountered should be segregated and reused as appropriate for landscaping purposes. Subgrades should be proof rolled and moisture conditioned prior to placement and compaction of engineered fill.

4.1.2 Fill Materials

The surficial fill, alluvial materials, and Saugus Formation materials are considered suitable for use as fill if properly prepared as recommended herein. Soil containing organic or other deleterious matter or other compressible material should not be used for engineered fill. Geosyntec does not anticipate the need to import soils to achieve the design site grades, however, if needed, the import soil should be non-expansive in accordance with CBC 2022 Section 1803.5.3.

4.1.3 Fill Placement and Compaction

Fill soils should be moisture conditioned to a minimum of the optimum moisture content and compacted in layers that do not exceed 8-inch loose lifts for heavy equipment compaction and 4-inch loose lifts for hand-held equipment compaction. Each lift of fill should be compacted to a minimum of 90 percent relative compaction unless otherwise specified. Relative compaction is defined as the ratio (in percent) of the in-place dry density to the maximum dry density determined using the latest version of ASTM D1557 as the compaction standard. Modified Proctor Compaction Tests should be performed on the fill soils to determine the maximum dry density and optimum moisture content.

4.2 Storm Water Conveyance

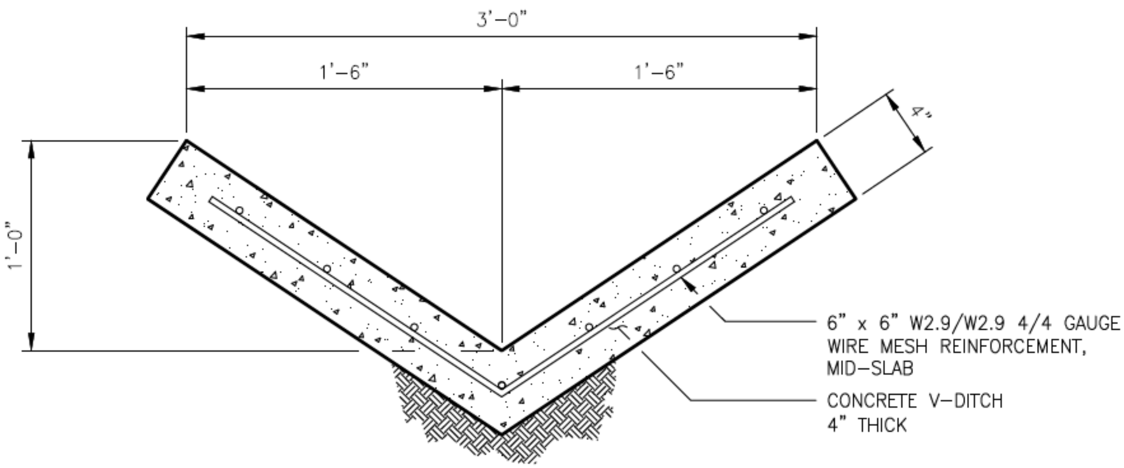
4.2.1 Subsurface Infiltration

As part of Geosyntec (2021a), Geosyntec had carried out field testing to develop input regarding infiltration rates following the guidance contained in the County of Los Angeles Administrative Manual GS200.2 (GMED, 2017). The tests were conducted within alluvium (in HSA-1) and within undocumented fill (in HSA-2). The soils classified predominantly as silty and clayey sands (SM and SC). Based on the results of field infiltration testing, the calculated hydraulic conductivities for these soils ranged between 3.2×10^{-5} cm/s [0.05 in./hr] and 4.5×10^{-5} cm/s [0.06 in./hr]. These infiltration rates are below those typically acceptable for incorporation in a stormwater infiltration system. Moreover, Saugus formation material is expected to have even lower hydraulic conductivity than SC and SM material. Therefore, it is recommended that infiltration best management practices not be employed as part of the development of this project.

4.2.2 Surface Drainage

Surface drainage should be planned to prevent ponding and promote the drainage of surface water away from edges of pavements and towards suitable collection and discharge facilities. Paved areas should be sloped to drain water away from flatwork at a minimum gradient of 1 percent, and unpaved areas should be finish graded with a minimum slope of 2 percent away from pavements.

Based on Geosyntec's previous experience at this Facility and considering the size of the stormwater catchment area, the recommended roadside v-ditch geometry is shown in the diagram below.



4.3 Stability of Permanent Cut Slopes

As discussed in Section 4.1, based on the existing ground elevation contours presented in Figure 5, it appears that the hill slopes from the inner edge (edge close to the hill) of Brady Parkway post-grading to the crest of the hill will vary in height from 40 to 50 feet at the highest location.

LADPW (2013) requires slope stability analysis for all cut, fill, and natural slopes when the slope height exceeds 30 ft. Therefore, Geosyntec evaluated the stability of conceptual 40-foot and 50-foot tall cut slopes ascending to the west from the inner edge of Brady Parkway. The details and the results of Geosyntec's evaluation are presented in this section. Once the final grading plan is available, Geosyntec should be provided a copy to evaluate if revisions to Geosyntec's limited slope stability evaluation presented herein is needed and issue a revised slope stability report as an additional service, if applicable.

4.3.1 Cross Sections Analyzed

Geosyntec performed stability evaluation of two conceptual slope height (one 40-ft tall and one 50-foot tall) for two slope inclination configurations (1H:1V and 1.5H:1V), incorporating Los Angeles County Department of Public Works Grading Guidelines (LADPW, 2017). LADPW (2017) requires that drainage terraces at least 8 ft in width shall be established at no more than 30-foot vertical intervals on all slopes to control surface drainage and debris. Thus, Geosyntec's cut slopes were assumed to have one 8-ft wide horizontal drainage terrace at mid-height of the slopes.

4.3.2 Rock Strength Characterization

Geosyntec previously prepared a supplemental report (Geosyntec 2021b) to the Geosyntec (2021a) report presenting slope stability analyses for the proposed cut slopes for the Compressor Modernization project. Based on Geosyntec (2021b), unfavorable along bedding shear strength characteristics do not exist in the Saugus formation at the site, therefore isotropic shear strength parameters can be used regardless of bedding plane orientation, in engineering analyses. The isotropic rock strength parameters were developed as part of the Geosyntec (2021b) using the Generalized Hoek-Brown empirical failure criterion (Hoek, Carranza-Torres, Corkum, 2002) and a copy of the description of development of the parameters from that report is included in Appendix B herein. The table below summarizes the rock strength parameters utilized for Geosyntec (2021b). In the absence of field investigation for the current study, Geosyntec utilized these parameters for our evaluation.

Generalized Hoek-Brown Parameter	Design Value
Intact Rock Strength	21 ksf
Geological Strength Index, GSI	65
Material constant (for intact rock), m_i	10
Disturbance Factor, D	0.7

4.3.3 Slope Stability Analysis and Seismic Deformation Evaluation Methods

For evaluating the slope stability of the configurations described above, Geosyntec used conventional two-dimensional limit equilibrium analysis method and calculated a factor of safety (FS) against sliding for static and seismic conditions. In particular, Geosyntec employed the Morgenstern and Price (1965) method, as implemented in SLIDE2 (Rocscience).

The results of the static analyses are presented in the form of critical (static) failure surfaces and the corresponding lowest calculated FS. For the seismic stability evaluation, a pseudostatic stability analysis was performed by applying a horizontal seismic coefficient, k_h, as an additional driving force and calculating the FS. Two separate pseudostatic analyses were performed for each cross section. The first analysis was performed by applying a k_h of 0.15 and calculating the FS as a screening analysis for deformations up to 3 ft per the LADPW (2013). The second analysis was performed following the method presented in Bray and Travasarou (2007) and provides an estimate of the anticipated permanent seismic displacements following the design seismic event. The input parameters to Bray and Travasarou (2007) method for each cross section are the k_h value providing an FS of 1.0 (i.e., yield acceleration), the natural period of the potential slip surface, the design response spectral acceleration corresponding to 1.5 times the natural period of the potential slip surface, and moment magnitude (assumed 7.0 based on Geosyntec, 2021a). The design response spectrum presented in Geosyntec (2021b) was utilized in Geosyntec's evaluation of seismic deformation.

4.3.4 Acceptance Criteria

The slope stability acceptance criteria were developed primarily based on LADPW (2013) and are presented below.

Analysis Case	Criteria	Notes
Long-term static	FS ≥ 1.5	Per LADPW (2013)
Seismic	FS ≥ 1.1 with a k_h = 0.15	Per LADPW (2013)

FS = 1.1 for a horizontal seismic coefficient of 0.15 corresponds to seismic deformation of 36 inches or less. Therefore, if the above FS criteria are met, it implies that the proposed cut slope is anticipated to have deformations less than 36 inches.

4.3.5 Analysis Results

The calculated FS for the static and seismic conditions and the calculated permanent seismic deformations are summarized in Table 1. The graphical outputs of the Slope/W computer program are included in Appendix C. The FS criteria for static and seismic cases were met for both the 1H:1V and 1.5H:1V cut slope configurations analyzed. The calculated seismic deformations ranged from 3¾ to 6 inches for the 40-foot tall slope and 5 to 8½ inches for the 50-foot tall slope with steeper slope inclination producing greater permanent seismic deformations.

4.4 Pavements

Geosyntec recommends that the pavement sections along Brady Parkway and Company Road be designed for a traffic index selected by the project civil engineer, however Geosyntec has provided preliminary recommendations based on potential subsurface conditions at the expansion area.

The flexible pavement section should consist of asphalt concrete (as defined in Section 39 of the latest edition of the Caltrans Standard Specifications) over Class 2 aggregate base (as defined in Section 26 of the latest edition of the Caltrans Standard Specifications) over properly prepared subgrade. Properly prepared pavement subgrade consists of the uppermost 12 inches of subgrade that is moisture conditioned and compacted to a minimum relative compaction of 95 percent. Asphalt and aggregate base should be compacted to a minimum relative compaction of 95 percent.

The actual pavement section should be selected based on the anticipated traffic conditions. The pavement sections for different traffic indices are provided in Table 2 for flexible pavement. Structural section thicknesses were based on an R-value of 18 based on Geosyntec (2021a). The R-value test was performed on a soil sample collected from boring HSA-2 from a depth of 0 to 5 feet below ground surface. This soil sample was classified as clayey sand fill (see Appendix A). The subgrade along the existing Brady Parkway and Company Road and under the proposed expansion is anticipated to include mostly Saugus formation which is a stiffer material than the clayey sand fill soils and expected to have a higher R-value than 18. However, some parts of the existing pavement maybe underlain by alluvium on Company Road and limited thickness of fill throughout the extents of the expansion area. Therefore, the pavement structural section calculated using R-value of 18 is considered appropriate for areas underlain by alluvium and fill and conservative for areas underlain by Saugus formation. The geotechnical consultant shall observe the prepared subgrade for the pavements to confirm the subgrade conditions are consistent with the design assumptions. Additional R-value testing may be required if varying soil conditions are encountered during construction.

Geosyntec recommends including subgrade enhancement geotextile or geogrid within the soil and aggregate base layer to reinforce the subgrade, distribute traffic loading and reduce the potential for cracking for flexible pavements. Non-woven geotextiles or geogrid used for subgrade enhancement shall conform to the requirement in Section 96 of the latest edition of the Caltrans Standard Specifications and Caltrans' Subgrade Enhancement Geosynthetic Design and Construction Guide (2013).

The selection of the appropriate type of geotextile or geogrid shall be based on subgrade R-value and gradation of the subgrade and aggregate base materials, evaluated by the geotechnical consultant during construction. The subgrade preparation requirements would remain unchanged if a subgrade enhancement geotextile or geogrid is used.

5. CONSTRUCTION CONSIDERATIONS

5.1 Permanent Slope Cuts

Based on conditions encountered in exploratory borings and geophysical explorations performed as part of Geosyntec (2021a) investigation, the Saugus Formation materials are expected to be rippable with conventional excavation equipment. Along a seismic geophysical survey line, the Saugus bedrock portion of the subsurface exhibited p-wave velocities in the 2,500 to 4,500 ft/sec range to a depth of about 40 ft bgs. P-wave velocity profile below a depth of 40 ft bgs is not available. Based on Caterpillar Performance Handbook, 2018, 48^{th} edition (Caterpillar, 2018), sandstone rock may broadly be characterized as rippable using a Caterpillar D8R ripper when p-wave velocities are less than 6,500 ft/sec, marginally rippable to 8,300 ft/sec, and non-rippable at p-wave velocities greater than 8,300 ft/sec. Thus, the Saugus formation within the upper 40 ft bgs generally appear to be rippable. The anticipated depth of cut as part of the proposed expansion is not expected to exceed approximately 20 feet.

Geosyntec understands SCG has extensive experience performing slope cuts in Saugus bedrock within the Facility. However, if SCG requires input on the rippability of the rock specific to the hill adjacent to Brady Parkway and Company Road, Geosyntec recommends performing a seismic refraction survey at this location, similar to what was done for Geosyntec (2021a). Geosyntec can provide this service, if needed.

Geosyntec recommends spraying the slopes with bonded fiber matrix (BFM) hydraulic mulch as part of regular maintenance of the cut slopes to reduce the potential of rain-based slope surface erosion. Additionally, drainage ditches should be incorporated along the 8-foot wide benches approximately at the slope mid-height.

5.2 Temporary Slopes

The design and excavation of temporary slopes and their maintenance during construction are the responsibility of the contractor. Based on the materials observed in the Geosyntec (2021a) borings, the design of temporary slopes not exceeding 20 feet in height within Saugus formation for planning purposes may assume Type A conditions with an allowable temporary slope inclination of ¾H:1V. The contractor shall have a geotechnical or geological professional evaluate the soil conditions encountered during excavation, for any variation in soil conditions, to determine the appropriate permissible temporary slope inclinations and other measures required by Cal OSHA. Existing infrastructure within a 2:1 (H:V) line projected up from the toe of temporary slopes should be monitored during construction.

5.3 Construction Observation and Testing

Soil/rock deposits may vary in type, strength, and many other important properties due to non-uniformity of the geologic formations or due to man-made cut and fill operations during construction at the site. To permit correlation between the investigation data, design, and the conditions encountered during construction, Geosyntec recommends that the geotechnical engineer be retained to provide continuous observations of grading operations.

6. LIMITATIONS

The geotechnical investigation for this project was based on subsurface explorations performed for Geosyntec (2021a) which are up to 800 feet away from the current site location. The recommendations made herein are based on the assumption that soil/rock conditions do not deviate appreciably from those found during Geosyntec (2021a) field investigation. This report has been prepared in accordance with current practices and the standard of care exercised by scientists and engineers performing similar tasks in this area. The conclusions contained in this report are based solely on the analysis of the conditions observed by Geosyntec personnel. Geosyntec cannot make any assurances concerning the completeness of the data presented to us.

No warranty, expressed or implied, is made regarding the professional opinions expressed in this report. Site grading and earthwork should be observed by a qualified engineer or geologist to verify that the site conditions are as anticipated. If actual conditions are found to differ from those described in the report, or if new information regarding the site conditions is obtained, Geosyntec should be notified and additional recommendations, if required, will be provided. Geosyntec is not liable for any use of the information contained in this report by persons other than SCG and Southern California Edison, or their subconsultants, or the use of information in this report for any purposes other than referenced in this report without the expressed, written consent of Geosyntec.

California, including Los Angeles County, is an area of high seismic risk. It is generally considered economically unfeasible for the design to resist earthquake loadings without damage. The pavements designed in accordance with the recommendations presented in this report could experience limited distress/damage if subjected to strong earthquake shaking.

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TABLES

Table 1
Summary of Slope Stability Analysis Results and Seismic Deformations
Storage Field Access Road Expansion
Honor Rancho Facility
Santa Clarita, California

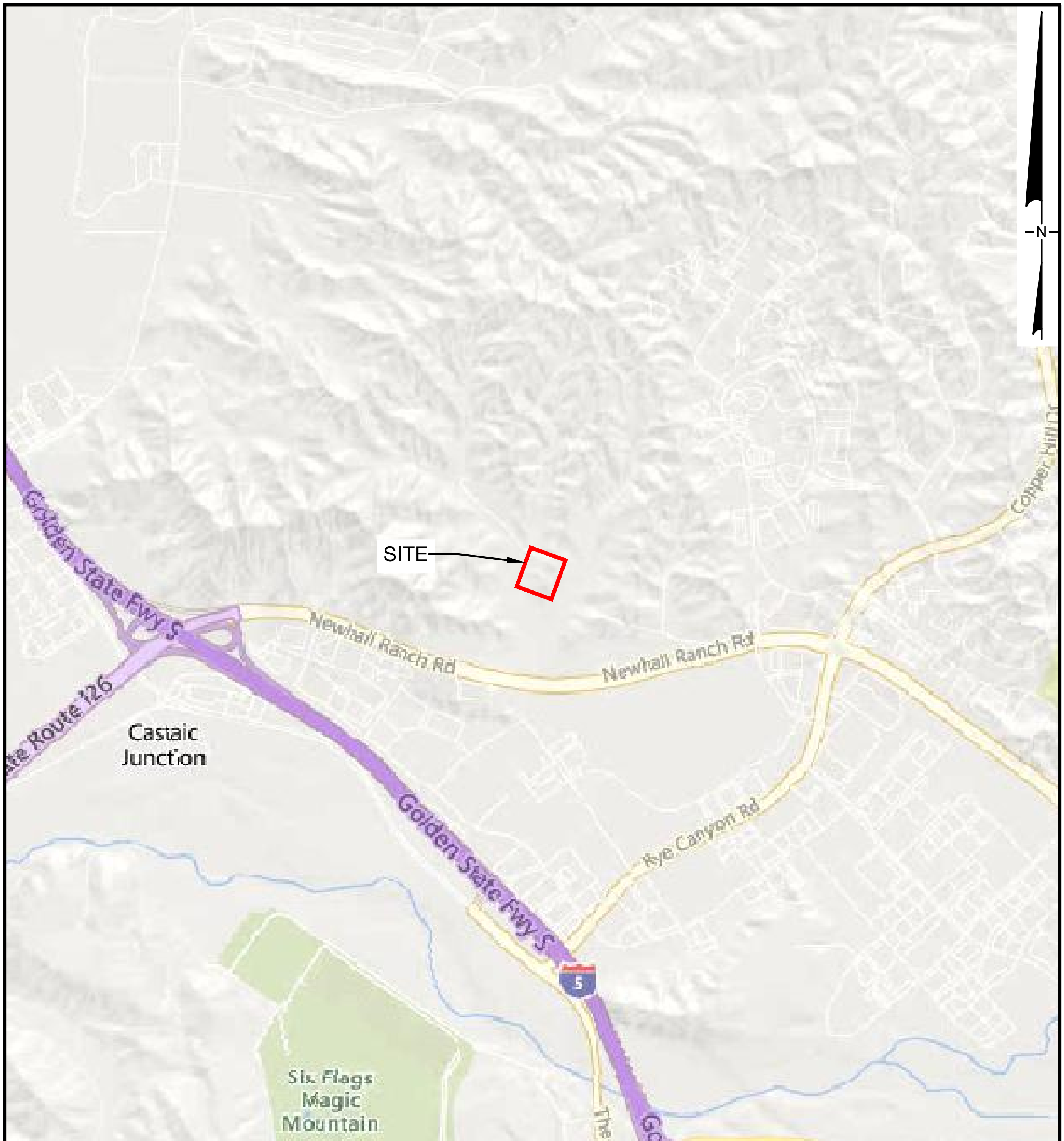
Slope Height (feet)	Slope Configuration	Analysis Case	FS (Calculated)	Seismic Deformation (inches)
40	1H:1V	Long-term Static	2.21	6
		Seismic (with k_h=0.15)	1.72	
	1.5H:1V	Long-term Static	2.73	3¾
		Seismic (with k_h=0.15)	2.04	
50	1H:1V	Long-term Static	1.98	8½
		Seismic (with k_h=0.15)	1.55	
	1.5H:1V	Long-term Static	2.47	5
		Seismic (with k_h=0.15)	1.85	

Table 2
Flexible Pavement Structural Sections
Storage Field Access Road Expansion
Honor Rancho Facility
Santa Clarita, California

Traffic Index [a]	Pavement Structural Section [b,c,d]		
	Asphaltic Concrete (in)	Class II Aggregate Base (in)	Class II Aggregate Base with Geogrid [e] (in)
TI = 5.0	4	8	7
TI = 6.0	4	11	10
TI = 7.0	4	15	13
TI = 8.0	5	16	14

Notes:
a. These traffic index values should be confirmed by the project Traffic Engineer or SCG prior to final design.
b. The pavement sections summarized are minimum thicknesses.
c. Structural section thicknesses were based on an R-value of 18 based on limited geotechnical sampling. The geotechnical consultant shall observe the prepared subgrade for the pavements to confirm the subgrade conditions are consistent with the design assumptions. Additional R-value testing may be required if varying soil conditions are encountered during construction.
d. These structural sections assume 12 inches of properly prepared subgrade compacted to a minimum 95 percent relative compaction.
e. Structural section for Class II Aggregate Base was based on an R-value of 25 per recommendations provided by Caltrans (2018) for a pavement section with a subgrade enhancement geogrid layer.

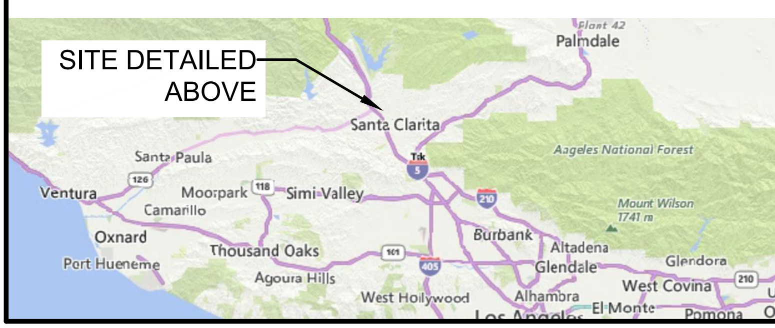
FIGURES



SOURCE: © 2023 MICROSOFT CORPORATION, © 2023 TOMTOM

0 2,000

SCALE IN FEET



SITE LOCATION MAP
STORAGE FIELD ACCESS ROAD EXPANSION
HONOR RANCHO FACILITY
SANTA CLARITA, CALIFORNIA

Geosyntec consultants

FIGURE 1

PROJECT NO: SC1339 | OCTOBER 2023

N:\CACADD\S\SO CAL GAS COMPANY\SO CAL GAS COMPANY - SC1339\FIGURES\SC1339F011 - Last Saved By: KViswanathan on 10/23/23

LEGEND

- 1150 EXISTING GROUND MAJOR CONTOUR (10')
- EXISTING GROUND MINOR CONTOUR (2')
- HOLLOW STEM AUGER BORING (HSA) [GEOSYNTEC, 2021]
- CONE PENETRATION TEST (CPT) [GEOSYNTEC, 2021]
- MUD ROTARY/ROCK CORE (B) [GEOSYNTEC, 2021]
- HOLLOW STEM AUGER BORING (TPB) [GEOSYNTEC, 2021]
- SEISMIC REFRACTION LINE (SREF) [GEOSYNTEC, 2021]
- EXISTING TRANSMISSION TOWERS
- EXISTING POWER POLES

N

0 100

SCALE IN FEET

SITE PLAN AND PREVIOUS EXPLORATIONS
STORAGE FIELD ACCESS ROAD EXPANSION
HONOR RANCHO FACILITY
SANTA CLARITA, CALIFORNIA

Geosyntec consultants

PROJECT NO: SC1339 | NOVEMBER 2023

FIGURE 2

N:\CADD\DWG\CACADD\S\SO CAL GAS COMPANY\SO CAL GAS COMPANY - SC1339\FIGURES\SC1339F012 - Last Saved by: Alan.Santos on 10/25/23

LEGEND

Symbol	Description
— — ?	Approximate location of Geologic Contact, queried where uncertain
55	Strike and Dip of Bedding Plane
(solid line)	Limits of mapped area
Fill/Qc	Artificial Fill and/or Quaternary colluvium
Qya/Qc	Quaternary younger alluvium and/or Quaternary colluvium, undivided.
Qss	Quaternary Saugus Formation

GEOLOGIC MAP

STORAGE FIELD ACCESS ROAD EXPANSION

HONOR RANCHO FACILITY

SANTA CLARITA, CALIFORNIA

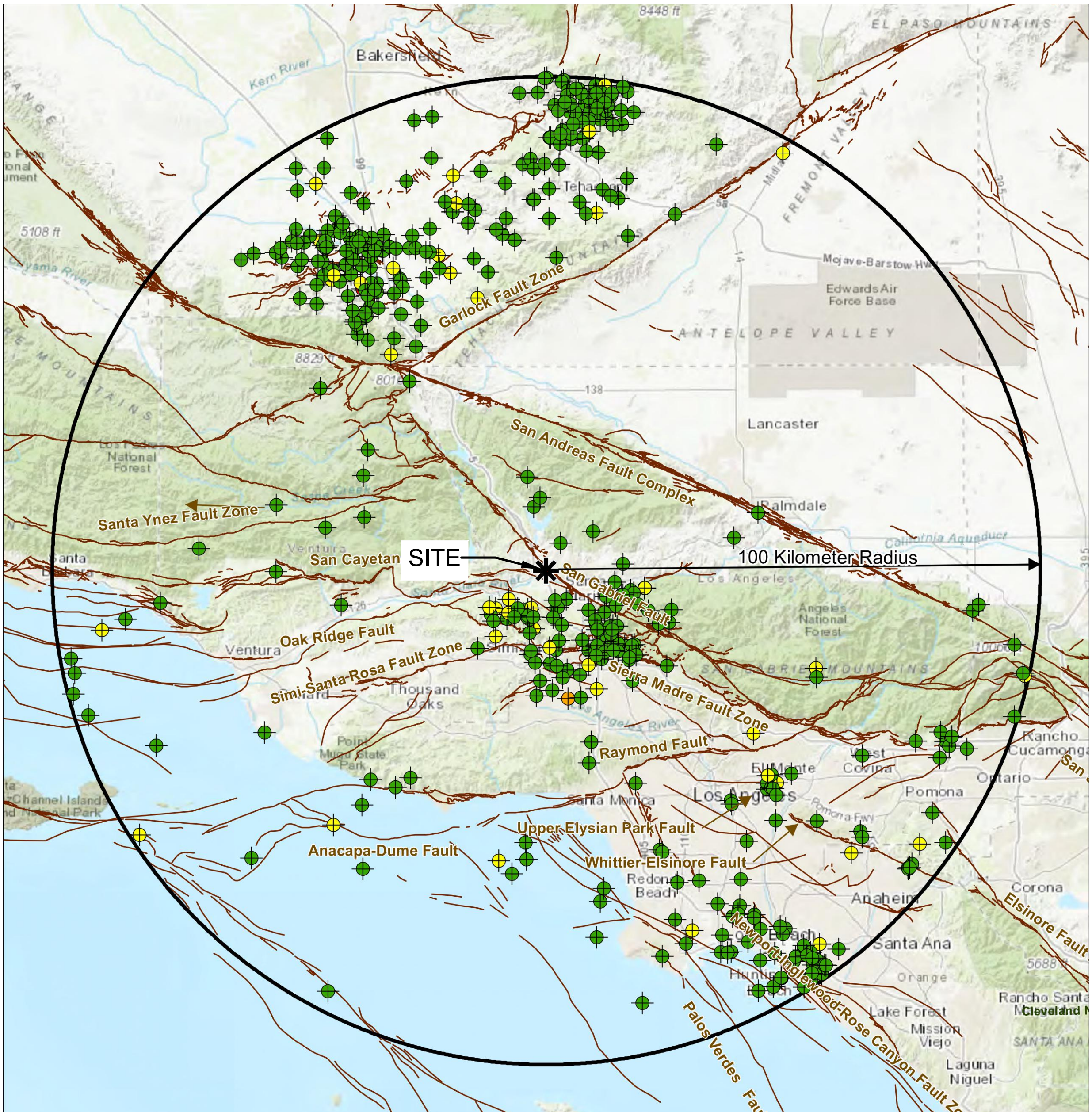
Geosyntec consultants

PROJECT NO.: SC1339

OCTOBER2023

FIGURE

3



N:\CACADD\SISO CAL GAS COMPANY\SO CAL GAS COMPANY - SC1339\FIGURES\SC1339F014 - Last Saved By: KViswanathan on 10/23/23

SOURCE: SEISMIC HAZARD ZONE REPORT FOR THE NEWHALL 7.5-MINUTE QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA. DEPARTMENT OF CONSERVATION, DIVISION OF MINES AND GEOLOGY, 1997.

0 20
SCALE IN MILES

LEGEND

Reported Earthquake Magnitudes 1932 - 2021

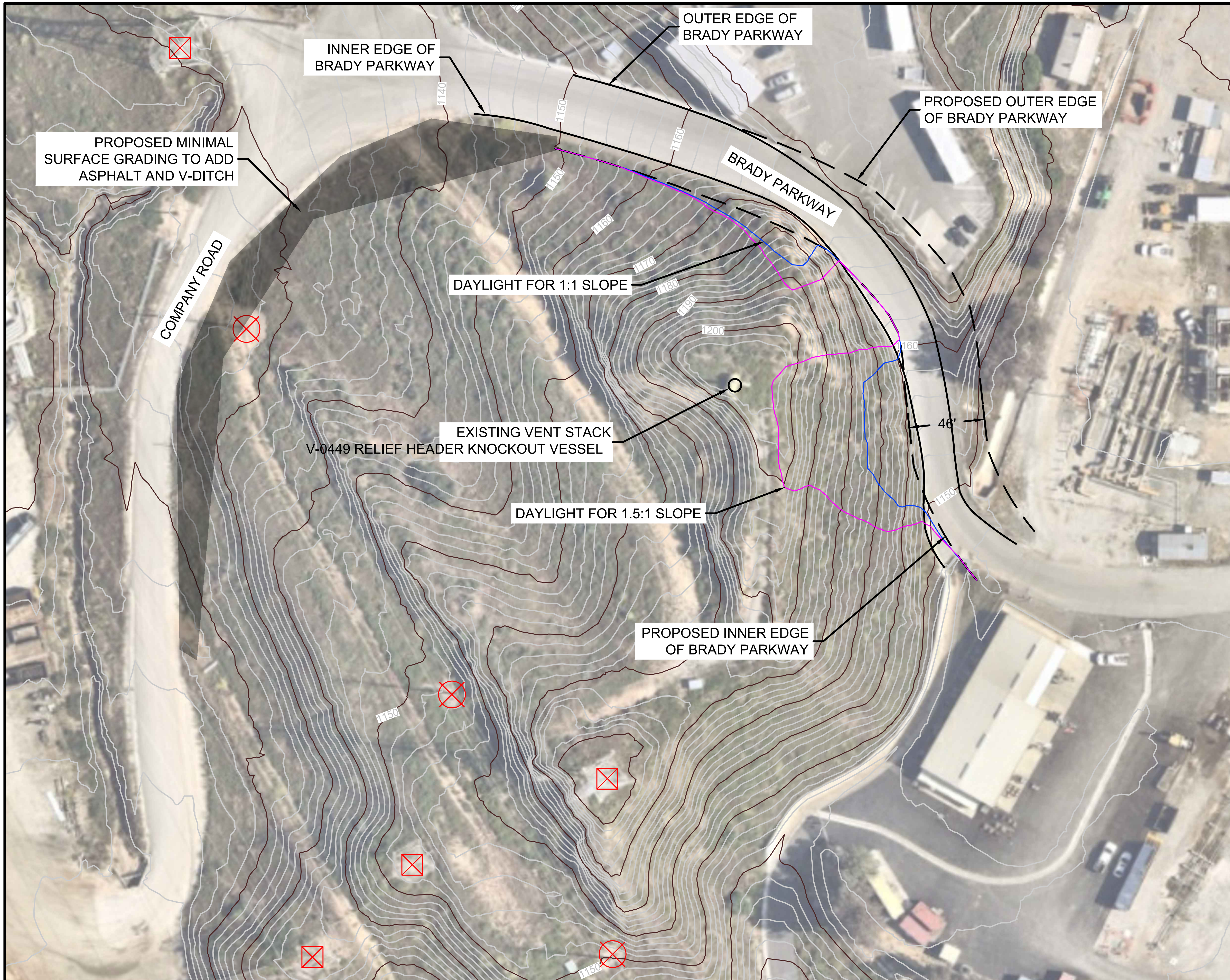
- 7.5
- 6.0 - 6.99
- 5.0 - 5.99
- 4.0 - 4.99
- Quarternary Fault

REGIONAL FAULT AND HISTORICAL EARTHQUAKE EPICENTER MAP
STORAGE FIELD ACCESS ROAD EXPANSION
HONOR RANCHO FACILITY
SANTA CLARITA, CALIFORNIA

Geosyntec consultants

FIGURE 4

PROJECT NO: SC1339 | OCTOBER 2023



LEGEND

- 1150 EXISTING GROUND MAJOR CONTOUR (10')
- EXISTING GROUND MINOR CONTOUR (2')
- EXISTING TRANSMISSION TOWERS
- EXISTING POWER POLES

N

0 60
SCALE IN FEET

EXISTING ELEVATION CONTOURS
STORAGE FIELD ACCESS ROAD EXPANSION
HONOR RANCHO FACILITY
SANTA CLARITA, CALIFORNIA

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FIGURE 5

PROJECT NO: SC1339 | NOVEMBER 2023

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APPENDIX A

Nearby Geosyntec 2021(a) Boring Logs

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PROJECT HRCM
PROJECT LOCATION Santa Clarita, CA
PROJECT NUMBER SC0766U

KEY SHEET - CLASSIFICATIONS AND SYMBOLS

GS FORM: KEY/SYMBOLS 01/04

EMPIRICAL CORRELATIONS WITH STANDARD PENETRATION RESISTANCE N60 VALUES *

FINE GRAINED SOILS

N60 VALUE * (BLOWS/FT)	CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TONS/SQ FT)
0 - 2	VERY SOFT	<0.25
3 - 4	SOFT	0.25 - 0.50
5 - 8	FIRM	0.50 - 1.00
9 - 15	STIFF	1.00 - 2.00
16 - 30	VERY STIFF	2.00 - 4.00
31 - 50	HARD	>4.00
>50	VERY HARD	

COARSE GRAINED SOILS

N60 VALUE * (BLOWS/FT)	RELATIVE DENSITY
0 - 4	VERY LOOSE
5 - 10	LOOSE
11 - 30	MEDIUM DENSE
31 - 50	DENSE
>50	VERY DENSE

* ASTM D 1586; NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 IN. O.D., 1.4 IN. I.D. SAMPLER ONE FOOT, CORRECTED FOR HAMMER EFFICIENCY.

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

MAJOR DIVISIONS			SYMBOLS	DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL COARSER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO.4 SIEVE	CLEAN GRAVELS — LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES — APPRECIABLE AMOUNT OF FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL -SAND-CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING NO.4 SIEVE	CLEAN SANDS — LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES — APPRECIABLE AMOUNT OF FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL FINER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS

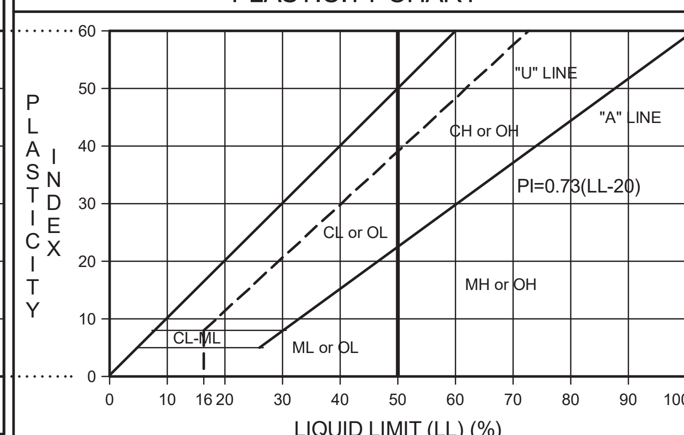
PARTICLE SIZE IDENTIFICATION

USCS (SOILS ONLY) *		SEDIMENTARY (ROCK ONLY)	
BOULDER	>300 mm	BOULDER	>256 mm
COBBLE	75 - 300 mm	COBBLE	64 - 256 mm
GRAVEL: COARSE	20 - 75 mm	PEBBLE	4 - 64 mm
GRAVEL: FINE	4.75 - 20 mm	GRANULE	2 - 4 mm
		SAND: V. COARSE	1 - 2 mm
SAND: COARSE	2 - 4.75 mm	SAND: COARSE	0.5 - 1 mm
SAND: MEDIUM	0.42 - 2 mm	SAND: MEDIUM	0.25 - 0.5 mm
SAND: FINE	0.074 - 0.42 mm	SAND: FINE	0.125 - 0.25 mm
		SAND: V. FINE	0.063 - 0.125 mm
SILT/CLAY	<0.074 mm	SILT	0.004 - 0.063 mm
		CLAY	<0.004 mm

* WELL GRADED - HAVING WIDE RANGE OF GRAIN SIZES AND APPRECIABLE AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES
* POORLY GRADED - PREDOMINANTLY ONE GRAIN SIZE, OR HAVING A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING

PERCENTAGE OF PARTICLE TYPE IN DECREASING ORDER OF PARTICLE SIZE (GRAVEL,SAND,FINES), BASED ON VISUAL OBSERVATION

PLASTICITY CHART



OTHER MATERIAL SYMBOLS

- Conglomerate
- Sandstone
- Silty Sandstone
- Clayey Sandstone
- Sandy Siltstone
- Siltstone
- Claystone
- Clayey Siltstone/ Silty Claystone
- Sandy Claystone
- Granitic/Intrusive
- Volcanic/Extrusive
- Metamorphic
- Limestone
- Dolomite
- Glacial Till
- Landslide Debris
- Marker Bed
- Artificial Fill
- Refuse
- Concrete/Asphalt

WELL SYMBOLS

- CONCRETE
- GROUT
- BENTONITE SEAL
- TRANSITION SAND
- SAND PACK
- GRAVEL PACK
- NATIVE/SLUFF
- CENTRALIZER

SAMPLE TYPE AND OTHER SYMBOLS

- BULK SAMPLE
- STANDARD PENETRATION TEST
- MODIFIED CALIFORNIA SAMPLE
- CORE SAMPLE
- SHELBY TUBE
- DRIVE SAMPLE

- ▽ Water Level at Time Drilling, or as Shown
- ▼ Static Water Level
- Pump Inlet
- ◀ Loss of Drilling Fluid
- MSL: Mean Sea Level
- AGS: Above Ground Surface
- BGS: Below Ground Surface
- BTOC: Below Top of Casing
- HSA: Hollow Stem Auger

WEATHERING

FRESH (W1): Body of rock is not oxidized or discolored; fracture surfaces are not oxidized or discolored*; no separation of grain boundaries; no change of texture and no solutioning. Hammer rings when crystalline rocks are struck.

SLIGHTLY WEATHERED TO FRESH (W2):**

SLIGHTLY WEATHERED (W3): Discoloration or oxidation is limited to surface of, or short distance from fractures; some feldspar crystals are dull; fracture surfaces have minor to complete discoloration or oxidation; no visible separation of grain boundaries; texture preserved and minor leaching of soluble minerals may be present. Hammer rings when crystalline rocks are struck, body of rock is not weakened by weathering.

MODERATELY TO SLIGHTLY WEATHERED (W4):**

MODERATELY WEATHERED (W5): Discoloration or oxidation extends from fractures, usually throughout body of rock; ferromagnesian minerals are "rusty," feldspar crystals are "cloudy;" all fracture surfaces are discolored or oxidized; partial opening of grain boundaries visible; texture generally preserved but soluble minerals may be mostly leached. Hammer does not ring when rock is struck, body of rock is slightly weakened.

INTENSLEY TO MODERATELY WEATHERED (W6):**

INTENSELY WEATHERED (W7): Body of rock is discolored or oxidized throughout; all feldspars and ferromagnesian minerals are altered to clay to some extent. All fracture surfaces are discolored or oxidized, surfaces friable; partial separation of grain boundaries, rock is friable; in situ disaggregation of granitics common in semi-arid regions; texture altered and leaching of soluble minerals may be complete. Rock has dull sound when struck with hammer; rock is weakened, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness.

VERY INTENSELY WEATHERED (W8):**

DECOMPOSED (W9): Body of rock is discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and ferromagnesian minerals are completely altered to clay; complete separation of grain boundaries (disaggregated), partial or complete remnant rock structure may be preserved, but resembles a soil.

NOTE: Weathering categories are established primarily for crystalline rocks and those with ferromagnesian minerals, weathering in various sedimentary rocks will not always fit the categories established - weathering categories may be modified for particular site conditions or alteration such as hydrothermal alteration. Where modified criteria are established, they are identified and described.

* Characteristics of fracture surfaces do not include directional weathering along shears or faults and their associated fracture zones; for example a shear that carries weathering to great depths in a fresh rock mass would not require the whole rock mass to be classified as weathered.

** Combination descriptors are used where equal distribution of both weathering characteristics are present over significant intervals or where characteristics noted are "in between" the diagnostic characteristics.

DURABILITY INDEX

DURABILITY DESCRIPTOR	DESCRIPTIVE CRITERIA
DI0	Rock specimen or exposure remains intact with no deleterious cracking after exposure longer than 1 year.
DI1	Rock specimen or exposure develops hairline cracking on surfaces within 1 month, but no disaggregation within 1 year of exposure.
DI2	Rock specimen or exposure develops hairline cracking on surfaces within 1 week, and/or disaggregation within 1 month of exposure.
DI3	Specimen or exposure may develop hairline cracks in 1 day and displays pronounced separation of bedding and/or disaggregation within 1 week of exposure.
DI4	Specimen or exposure displays pronounced cracking and disaggregation within 1 day (24 hours) of exposure. Generally ravels and degrades to small fragments.

COLOR

The Munsell color system (Geologic Society of America Rock Color Chart) was used. This system defines wet color by its hue, value, and chroma. Color symbols (i.e., 5 YR 5/6 may be included).

SEDIMENTARY AND PYROCLASTIC ROCK PARTICLE SIZES

Size in mm	Sedimentary (Rounded, subrounded, subangular): Particle or fragment	Sedimentary: Lithified product	Pyroclastic: Fragment	Pyroclastic: Lithified product
	Boulder	Boulder conglomerate	Block* or Bomb**	Volcanic breccia* or Volcanic agglomerate**
256	Cobble	Cobble conglomerate	(cont.)	(cont.)
64	Pebble	Pebble conglomerate	Lapilli	Lapillistone and Lapilli tuff
4	Granule	Granule conglomerate	(cont.)	(cont.)
2	Very coarse sand	Sandstone	Coarse ash	Coarse tuff
1	Coarse sand	(cont.)	(cont.)	(cont.)
0.5	Medium sand	(Very coarse, coarse, medium, fine, or very fine)	(cont.)	(cont.)
0.25	Fine sand	(cont.)	(cont.)	(cont.)
0.125	Very fine sand	(cont.)	(cont.)	(cont.)
0.0625	Silt	Siltstone/ Shale	Fine ash	Fine tuff
0.00391	Clay	Claystone/ Shale	(cont.)	(cont.)

* Broken from previous igneous rock, block shaped (angular to subangular).
** Solidified from plastic material while in flight, rounded clasts.

IGNEOUS AND METAMORPHIC ROCK TEXTURE

TEXTURE DESCRIPTOR	AVERAGE GRAIN DIAMETER
VERY COARSE GRAINED OR PEGMATITIC	>10 mm [>3/8 in]
COARSE GRAINED	5-10 mm [3/16 - 3/8 in]
MEDIUM GRAINED	1-5 mm [1/32 - 3/16 in]
FINE GRAINED	0.1-1 mm [0.004 - 1/32 in]
APHANITIC (Cannot be seen with the unaided eye)	<0.1 mm [<0.004 in]

ADDITIONAL TEXTURAL ADJECTIVES

PIT (pitted) - Pinhole to 0.03 ft [3/8 in] (<1 to 10 mm) openings.

VUG (vuggy) - Small openings (usually lined with crystals) ranging in diameter from 0.03 ft [3/8 in] to 0.33 ft [4 in] (10 to 100 mm).

CAVITY - An opening larger than 0.33 ft [4 in] (100 mm), size descriptions are required, and adjectives such as small, large, etc., may be used.

HONEYCOMBED - If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.

VESICLE (vesicular) - Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

BEDDING FOLIATION OR FLOW TEXTURE

DESCRIPTORS	THICKNESS/SPACING
MASSIVE	Greater than 10 ft (>3 m)
VERY THICKLY (bedded, foliated, or banded)	3 to 10 ft (1 to 3 m)
THICKLY	1 to 3 ft (300 mm to 1 m)
MODERATELY	0.3 to 1 ft (100 to 300 mm)
THINLY	0.1 to 0.3 ft (30 to 100 mm)
VERY THINLY	0.03 [3/8 in] to 0.1 ft (10 to 30 mm)
LAMINATED (Intensely foliated or banded)	Less than 0.03 ft [3/8 in] (<10 mm)

BEDROCK HARDNESS / STRENGTH

EXTREMELY HARD (H1): Core, fragment or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.

VERY HARD (H2): Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.

HARD (H3): Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.

MODERATELY HARD (H4): Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.

MODERATELY SOFT (H5): Can be grooved 1/16 inch (2 mm) deep by knife or sharp pick with (moderate or heavy) pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.

SOFT (H6): Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.

VERY SOFT (H7): Can be readily indented, groved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Note: Bedrock units softer than H7, Very Soft, are described using USCS (soils) consistency descriptors.

Source: U.S. Department of the Interior Bureau of Reclamation, Engineering Geology Field Manual, 2nd Edition, 1988

Geosyntec consultants

Standard Descriptors and Descriptive Criteria for Rock

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Tel: (714) 969-0800
Fax: (714) 333-4275

PROJECT: HRCM
PROJECT LOCATION: Santa Clarita, CA
PROJECT NUMBER: SC0766U

KEY TO ROCK DESCRIPTIVE TERMS USED ON CORE LOGS

DISCONTINUITY DESCRIPTORS

a TYPE:
F – Fault
JT – Joint
Sh – Shear
Fo – Foliation
V – Vein
Bd – Bedding

b FRACTURE DENSITY (feet):
EW – Extremely Wide (>6)
W – Wide (2-6)
M – Moderate (0.7-2)
C – Close (0.2-0.7)
VC – Very Close (<0.2)

c APERTURE (inches):
W – Wide (0.5-2.0)
MW – Moderately Wide (0.1-0.5)
N – Narrow (0.05-0.1)
VN – Very Narrow (<0.05)
T – Tight (0)

d FRACTURE INFILLING:
Su – Surface Stain
Sp – Spotty
Pa – Partially Filled
Fi – Filled
No – None

e MINERAL TYPE:
Cl – Clay
Ca – Calcite
Ch – Chlorite
Fe – Iron Oxide
Gy – Gypsum/Talc
H – Healed
No – None
Py – Pyrite
Qz – Quartz
Sd – Sand

f PLANARITY:
Wa – Wavy
Pl – Planar
St – Stepped
Ir – Irregular

g DIP: – Dip of planar feature measured relative to horizontal

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GS FORM: WELL BORE 01/04

BOREHOLE LOG

BORING HSA-1 | **SHEET** 1 **OF** 1
START DRILL DATE Jan 4, 21
FINISH DRILL DATE Jan 4, 21
LOCATION Santa Clarita, CA
PROJECT HRCM
NUMBER SC0766U

ELEVATION DATA:
GROUND SURF. 1152
TOP OF CASING
DATUM ft +MSL

DESCRIPTION: 1) Unit/Formation, Mem. 2) USCS Name 3) Color 4) Moisture 5) Percent Grain Size 6) Plasticity 7) Density/Consistency 8) Structure 9) Other (Mineralization, Discoloration, Odor, etc.)

COMMENTS: 1) Rig Behavior 2) Air Monitoring

DEPTH (ft-bgs)	DESCRIPTION	GRAPHIC LOG	WELL LOG	GROUNDWATER OR STRUCTURE	ELEVATION (ft)	SAMPLE NO.	TYPE	BLOWS PER 6"	RECOVERY (%)	PID READING (ppm)	TIME (00:00)	COMMENTS
0	GRAVEL/SUB-BASE			Bentonite Plug (0'-2')							08:30	
	FILL: Clayey SAND (SC): brown; slightly moist; fine sand with clay; medium dense; trace gravels and mica.				1151	HSA-1 @1-5						Hand-augered to 5-ft. bgs.
				Native Backfill (2'-12')	1150							
					1149							
					1148							
5					1147	HSA-1 @5		4 6 8	100		08:39	
					1146							
					1145							
	Quaternary Young Alluvium (Qya): Silty SAND (SM): brown to reddish brown; slightly moist; predominantly fine-grained with trace medium to coarse sand; medium dense.				1144							
					1143							
10					1142	HSA-1 @10		4 7 5	100			
					1141							
					1140							
				Bentonite Plug (12'14')	1139							
					1138							
				Sand Pack (14'-25')	1137							
15						HSA-1 @15		4 5 5	100			
	Interbedded Poorly-graded SAND (SP).				1136							
	Silty SAND (SM): brown to reddish brown; slightly moist; predominantly fine-grained with trace medium to coarse sand.				1135							
					1134							
					1133							
20					1132	HSA-1 @20		2 11 38	100			
	Saugus Formation (Qss): SANDSTONE (SM): light brown; slightly moist; silty fine sand; very dense; trace clay.				1131							Saugus Formation observed: appeares relatively impermeable due to cementation and fines content.
					1130							
					1129							
					1128							
25					1127	HSA-1 @25		50	100			
	Terminated Boring at 25.5 ft. below ground surface. After completion of drilling, borehole was converted to infiltration test well.				1126							
					1125							
					1124							
					1123							
30					1122							

CONTRACTOR Martini Drilling Corp
EQUIPMENT CME-75
DRILL MTHD Hollow Stem Auger
DIAMETER 8-inch
LOGGER D. Kilian, PG, CEG
REVIEWER C. Conkle, PE, GE
NORTHING 34.446158
EASTING -118.585700
COORDINATE SYSTEM:

NOTES: No groundwater encountered. Hammer energy transfer ratio was 78.7%. Logging of soils completed in general accordance with ASTM D2488 and ASTM D1586. Location is approximate and obtained from Google Earth.

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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3088 waSi 1t
1uSe 098
HuntSgton veami; Ek O36T,
MeF IP0TcO6O-8, 88
zax: IP0Tc222-T3P9

) 1 zI Nw: @GRRvI NG 80A8T

BOREHOLE LOG

BORING	**HSA-2**	**SHEET**	**1 OF 1**
START DRILL DATE	Jan T; 30	**ELEVATION DATA:**	
FINISH DRILL DATE	Jan T; 30	**GROUND SURF.**	00T6
LOCATION	1anta EfarSa; Ek	**TOP OF CASING**	
PROJECT	HNEw	**DATUM**	5t +w1R
NUMBER	1E8P66V		

sGpMH I5-. gbc	sG1ENWMW(	) NkpHWWRI)	@GRRI)	) NI V(s@kMGN I N 1MNVEMNG	GRG4kMW(I5c	SAMPLE: 1kwpRG(I f	MhpG	vRI @1 pGN 6"	NGEI 4GNh I%c	pWNGks W) IDDCc	MWG I88:88c	EI wwG(M1 0cNSg vei a' Sr 3ckS wonSorSg
	) Nk4GRAVv-vk1G			ventonSe pFug I8y3yc	00T9							
	FILL: EfaLeL 1k(s I1Ec . ro/ n to reddSi . ro/ nU bFSgi tFL CoStU DredoC SantFL 5e-graSed / Si CedSiC to moarbe bandU CedSiC denbeU trame bSf and gra' eFbf				00TT	H1k-3 7 8-9						Hand-augered to 9-5f . gbf
				1and pamBl3y09yc	00T2							
					00T3	H1k-3 7 2		T 03 0T	088		08:88	
9					00T0							
					00T8	H1k-3 7 9		00 O T	088			
					002O							
					002,							
					002P							
					0026							
08					0029	H1k-3 7 08		00 02 03	088			
					002T							
					0022							
					0023							s rSfer SndSated tSgi ter drSfSgf
	Quaternary Young Alluvium (Qya): 1SfL 1k(s I1wc FSgi t. ro/ n to . ro/ nU bFSgi tFL CoStU DredoC SantFL 5e-graSed / Si trame CedSiC to moarbe bandU CedSiC denbeU trame gra' eFf				0020							
09				ventonSe pFug I09y0Pyc	0028	H1k-3 7 09		P 08 ,	088			
				(atSe vamBSf I0Py20yc	003O							
					003,							
					003P							
					0036							
38	. emoCeb Fobe to CedSiC debnef				0039	H1k-3 7 38		T 6 6	088			
					003T							
					0032							
					0033							s rSfer SndSated i arder drSfSgf
39	EfaLeL 1k(s I1Ec CottFed . ro/ n; reddSi . ro/ n and graL Si . ro/ nUbFSgi tFL CoStU DredoC SantFL 5e-graSed / Si CedSiC to moarbe bandU CedSiC denbef				0030							
					0038	H1k-3 7 39		O P P	088		08:39	
					000O							
					000,							
	Saugus Formation (Qss): ERkh1M (GIERc reddSi . ro/ nUbFSgi tFL CoStU ardUtrame bandf				000P							
28					0006	H1k-3 7		0O 98	088			
	MeF CSated vorSg at 20 5f . eFo/ ground burfamef k5er moCDFetSn o5drSfSg; . orei oFe / ab mon' erted to SfSfratSn tebt / eFf				0009							
					000T							
					0002							
					0003							

CONTRACTOR wartSSs rSfSg EorD	**NORTHING** 2TfTT920P
EQUIPMENT EwG-P9	**EASTING** -00, f9, 62, 8
DRILL MTHD HoFo/ 1teC kuger	**COORDINATE SYSTEM:**
DIAMETER , -Smi	
LOGGER s f KSan; p) ; EG)	**REVIEWER** Ef EonBe; pG;) G

NOTES: (o ground/ ater enmounteredf HaCCer energL tranbfer ratSo / ab P, fP%f RoggSg o5boSo moCDFeted Sn generaFammordanme / Si k1Mw s 3T, , and k1Mw s 09, 6f RomatSn Si aDDroxSCate and o. taSed 5roC) oogFe Garti f

1GG KGh 1HGGMzI N 1hwvI R1 k(s kvvNG4WMW(1

8P-@GRRvI NG 1E8P66V-1I WW) pJ) GI 1(MGEf) s M 3A0A80

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GS FORM: GEOTECH2 01/04

BOREHOLE LOG

BORING TPB-1 **SHEET** 1 **OF** 1
START DRILL DATE Jan 4, 21
FINISH DRILL DATE Jan 4, 21
LOCATION Santa Clarita, CA
PROJECT HRCM
NUMBER SC0766U

ELEVATION DATA:
GROUND SURF. 1172
TOP OF CASING
DATUM ft +MSL

DESCRIPTION: 1) Soil Name (USCS) 2) Color 3) Moisture 4) Grain Size 5) Percentage 6) Plasticity 7) Density/Consistency 8) Other (Mineral Content, Discoloration, Odor, etc.)

COMMENTS: 1) Rig Behavior 2) Air Monitoring 3) Pocket Pen 4) Tor Vane

DEPTH (ft-bgs)	ELEVATION (ft)	DESCRIPTION	SAMPLE NO.	BLOWS PER 6"	N VALUE	RECOVERY (%)	PID READING (ppm)	TIME (00:00)	COMMENTS	DRY DENSITY (pcf)	MAX. DRY DENSITY (pcf)	PERCENT FINES (%)	PERCENT GRAVEL (%)	MOIST. CONTENT (%)	OPT. MOIST. CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0	1172	ASPHALT						12:00										
	1171	AGGREGATE BASE							Hand-augered to 5-ft. bgs.									
	1170	**FILL:** Clayey SAND (SC): mottled brown and reddish brown; moist; fine sand; medium dense; trace gravels and cobbles.																
	1168	**Saugus Formation (Qss):** Sandy CLAYSTONE (CL): reddish brown with gray mottling; slightly moist; clayey fine sand to hard sandy claystone; dense to very dense.																
5	1167		TPB-1 @5	10 20 30	50	100						72				39	15	24
10	1162	Silty SANDSTONE (SM): pale brown; slightly moist; predominantly fine-grained with trace medium to coarse sand; very dense.	TPB-1 @10	17 50/3		100				112.8		42		7.5				
15	1157		TBP-1 @15	26 50/5	50/5	100												
	1156	Terminated Boring at 15.9 ft. below ground surface. After completion of drilling, borehole was backfilled with high-solids cement-bentonite grout.						13:00										

CONTRACTOR Martini Drilling Corp
EQUIPMENT CME-75
DRILL MTHD Hollow Stem Auger
DIAMETER 8-inch
LOGGER D. Kilian, PG, CEG **REVIEWER** C. Conkle, PE, GE
NORTHING 34.446133
EASTING -118.588290
COORDINATE SYSTEM:

NOTES: No groundwater encountered. Hammer energy transfer ratio was 78.7%. Logging of soils completed in general accordance with ASTM D2488 and ASTM D1586. Location is approximate and obtained from Google Earth.

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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GS FORM: GEOTECH2 01/04

BOREHOLE LOG

BORING TPB-2 **SHEET** 1 **OF** 1
START DRILL DATE Jan 4, 21
FINISH DRILL DATE Jan 4, 21
LOCATION Santa Clarita, CA
PROJECT HRCM
NUMBER SC0766U

ELEVATION DATA:
GROUND SURF. 1171
TOP OF CASING
DATUM ft +MSL

DESCRIPTION: 1) Soil Name (USCS) 2) Color 3) Moisture 4) Grain Size 5) Percentage 6) Plasticity 7) Density/Consistency 8) Other (Mineral Content, Discoloration, Odor, etc.)

COMMENTS: 1) Rig Behavior 2) Air Monitoring 3) Pocket Pen 4) Tor Vane

DEPTH (ft-bgs)	ELEVATION (ft)	DESCRIPTION	SAMPLE NO.	BLOWS PER 6"	N VALUE	RECOVERY (%)	PID READING (ppm)	TIME (00:00)	COMMENTS	DRY DENSITY (pcf)	MAX. DRY DENSITY (pcf)	PERCENT FINES (%)	PERCENT GRAVEL (%)	MOIST. CONTENT (%)	OPT. MOIST. CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0	1171	ASPHALT						13:00										
	1170	AGGREGATE BASE	TPB-2 @0-5						Hand-augered to 5-ft. bgs.		130.8				8.8			
	1169	**FILL:** Silty to Clayey SAND (SM/SC): reddish brown; slightly moist; fine sand; medium dense.																
	1168	**Saugus Formation (Qss):** Sandy CLAYSTONE (CL): reddish brown; slightly moist; fine sandy clay to dense clayey sand with trace coarse sand; hard.																
5	1166		TPB-2 @5	12 14 20	34	100						67				36	12	24
	1164	SANDSTONE (SM): pale to olive brown; slightly moist; fine sand; very dense.																
10	1161		TPB-2 @10	40 50/2	50/2	100						28	0	5.1				
15	1156		TBP-2 @15	50/5	REF	100												
	1155	Terminated Boring at 15.5 ft. below ground surface. After completion of drilling, borehole was backfilled with high-solids cement-bentonite grout.						14:00										
30	1141																	

CONTRACTOR Martini Drilling Corp
EQUIPMENT CME-75
DRILL MTHD Hollow Stem Auger
DIAMETER 8-inch
LOGGER D. Kilian, PG, CEG **REVIEWER** C. Conkle, PE, GE
NORTHING 34.446281
EASTING -118.588460
COORDINATE SYSTEM:

NOTES: No groundwater encountered. Hammer energy transfer ratio was 78.7%. Logging of soils completed in general accordance with ASTM D2488 and ASTM D1586. Location is approximate and obtained from Google Earth.

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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GS FORM: GEOTECH2 01/04

BOREHOLE LOG

BORING TPB-3 **SHEET** 1 **OF** 1
START DRILL DATE Jan 4, 21
FINISH DRILL DATE Jan 4, 21
LOCATION Santa Clarita, CA
PROJECT HRCM
NUMBER SC0766U

ELEVATION DATA:
GROUND SURF. 1172
TOP OF CASING
DATUM ft +MSL

DESCRIPTION: 1) Soil Name (USCS) 2) Color 3) Moisture 4) Grain Size 5) Percentage 6) Plasticity 7) Density/Consistency 8) Other (Mineral Content, Discoloration, Odor, etc.)

COMMENTS: 1) Rig Behavior 2) Air Monitoring 3) Pocket Pen 4) Tor Vane

DEPTH (ft-bgs)	ELEVATION (ft)	DESCRIPTION	SAMPLE NO.	TYPE	BLOWS PER 6"	N VALUE	RECOVERY (%)	PID READING (ppm)	TIME (00:00)	COMMENTS	DRY DENSITY (pcf)	MAX. DRY DENSITY (pcf)	PERCENT FINES (%)	PERCENT GRAVEL (%)	MOIST. CONTENT (%)	OPT. MOIST. CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0	1172	ASPHALT							14:00										
	1171	AGGREGATE BASE								Hand-augered to 5-ft. bgs.									
	1170	**FILL:** Silty to Clayey SAND (SM/SC): mottled brown and reddish brown; slightly moist; fine sand; medium dense.																	
	1168	**Saugus Formation (Residual) (Qss):** Silty SANDSTONE (SM): light brown; slightly moist; predominantly fine-grained with trace medium to coarse sand; very dense.																	
5	1167		TPB-3 @5		19 50/6	50/6	100												
6	1166	Terminated Boring at 6.0 ft. below ground surface. After completion of drilling, borehole was backfilled with high-solids cement-bentonite grout.							14:45										

Elevation scale: 1171 to 1142; depth scale: 5, 10, 15, 20, 25, 30.

CONTRACTOR Martini Drilling Corp
EQUIPMENT CME-75
DRILL MTHD Hollow Stem Auger
DIAMETER 8-inch
LOGGER D. Kilian, PG, CEG **REVIEWER** C. Conkle, PE, GE

NORTHING 34.446300
EASTING -118.588300
COORDINATE SYSTEM:

NOTES: No groundwater encountered. Hammer energy transfer ratio was 78.7%. Logging of soils completed in general accordance with ASTM D2488 and ASTM D1586. Location is approximate and obtained from Google Earth.

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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GS FORM: CONT. CORE 01/04

COREHOLE LOG

BORING	B-3	**SHEET**	1 OF 1
START DRILL DATE	Jan 14, 21	**ELEVATION DATA:**	
FINISH DRILL DATE	Jan 14, 21	**GROUND SURF.**	1145
LOCATION	Santa Clarita, CA	**TOP OF CASING**	
PROJECT	HRCM	**DATUM**	ft +MSL
NUMBER	SC0766U		

DESCRIPTION: 1) Formation, Member 2) Rock Name 3) Color 4) Grain Size/Percentage 5) Bedding 6) Weathering 7) Hardness 8) Cementation 9) Moisture 10) Other (Mineralization, Discoloration, Odor, etc.)

COMMENTS: 1) Rig Behavior 2) Air Monitoring

DEPTH (ft-bgs)	ELEVATION (ft)	DESCRIPTION	GRAPHIC LOG	WELL LOG	RUN NUMBER	LENGTH (ft)	RECOVERY (ft)	RECOVERY (%)	RQD	RUN TIME (min.)	COMMENTS	TYPE	FRACTURE DENSITY	APERTURE	FRACTURE FILLING	MINERAL TYPE	PLANARITY	DIP (degrees)
0–2.25	1145–1142	**Saugus Formation (Qss):** Clayey SANDSTONE (SC): reddish brown; slightly moist; clayey fractured sandstone with trace medium to coarse sand; dense; highly weathered; moderately hard; mechanical fractures below 0.5'. Residual Soil @ upper 1'.			1	3	3	100	67	13:09			1					
2.25–6	1142–1139	@2.25' - becomes gray; with gravel. becomes moderately to highly weathered. @4.0' - gray with 2" band of red clay.			2	3	3	100	100	13:15 13:20			0					
6–10	1139–1135	Sandy CLAYSTONE (CL): Reddish brown; moderately to highly weathered.			3	5	4.75	95	95	13:25 13:30			0.20					
~8	1137											J						80
10–11	1135–1134	@10' - becomes Saugus Sandstone; gray.																
11–16	1134–1129	Clayey SANDSTONE (SC): grayish brown; slightly moist; clayey sandstone with fine to coarse sand and gravels; dense to very dense; moderately to highly weathered; soft to moderately hard. Poor Recovery.			4	5	0.75	15	15	13:43 13:48								
16–18.5	1129–1126	No recovery.			5	2.5	0	0		14:00 14:07	Switched rods to drive SPT sampler. Driller stated Soft and Sandy, leading to no recovery. Drove SPT sampler to try to sample.							
18.5–19	1126	SANDSTONE (SM): brown; dry to slightly moist; fine to coarse sand with silt; very dense; friable.			B-3 @18.5	0.5	0.5	100			SPT driven with blow counts 32,50/1.							
19–21	1125–1124	No recovery - sands in coring fluid. Material is friable with low fines content.			6	2	0	0		15:06								
21–23	1124–1122	No recovery - sands in coring fluid. Material is friable with low fines content.			7	2	0	0		15:14 15:17								
23–25	1122–1120	SANDSTONE (SM): brown; fine sand with gravel; very dense; recovery ~3".			8	2	0.25	13	0	15:22 15:26								
25–30	1120–1115	No recovery - friable sands.			9	5	0	0		15:35 15:42	Low pump, high pressure - still no recovery.							
30	1115	Terminated Coring at 30.0 ft. below ground surface. After completion of coring, corehole was backfilled with high-solids cement-bentonite grout.								15:54								

CONTRACTOR	Gregg Drilling, LLC	**NORTHING**	34.446033
EQUIPMENT	Fraste XL 140T	**EASTING**	-118.589140
DRILL MTHD	HQ3 Rock Coring	**COORDINATE SYSTEM:**	
DIAMETER	4-inch		
LOGGER	D. Kilian, PG, CEG	**REVIEWER**	C. Conkle, PE, GE

NOTES: No groundwater encountered. Corehole drilled using potable water and polymer for circulation. Location and elevation are approximate and obtained from Google Earth.

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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GS FORM: CONT. CORE 01/04

COREHOLE LOG

BORING B-4 **SHEET** 1 **OF** 1
START DRILL DATE Jan 15, 21
FINISH DRILL DATE Jan 15, 21
LOCATION Santa Clarita, CA
PROJECT HRCM
NUMBER SC0766U

ELEVATION DATA:
GROUND SURF. 1172
TOP OF CASING
DATUM ft +MSL

DESCRIPTION: 1) Formation, Member 2) Rock Name 3) Color 4) Grain Size/Percentage 5) Bedding 6) Weathering 7) Hardness 8) Cementation 9) Moisture 10) Other (Mineralization, Discoloration, Odor, etc.)

COMMENTS: 1) Rig Behavior 2) Air Monitoring

DEPTH (ft-bgs)	ELEVATION (ft)	DESCRIPTION	RUN NUMBER	LENGTH (ft)	RECOVERY (ft)	RECOVERY (%)	RQD	RUN TIME (min.)	COMMENTS	TYPE	FRACTURE DENSITY	APERTURE	FRACTURE FILLING	MINERAL TYPE	PLANARITY	DIP (degrees)
	1171	ASPHALT														
		AGGREGATE BASE														
	1170	**FILL:** Silty SAND (SM): brown; slightly moist; fine sand; medium dense.	1	4.5	4.5	100	100	14:43								
	1169	**Saugus Formation (Qss):** Silty SANDSTONE (SM): olive to grayish brown; slightly moist; fine sand; moderately to highly weathered; dense to very dense.														
	1168															
5	1167															
	1166	becomes moderately weathered; soft; poor recovery.	2	5	1.25	25	25	14:52 14:56	Poor Recovery.							
	1165															
	1164	mottled gray and reddish brown; fine-grained with coarse sand and gravel.														
	1163															
10	1162															
	1161	becomes moderately weathered; soft to medium hard; poor recovery.	3	2.5	1	40		15:06 15:10	Poor Recovery.		0.67					
	1160	fine-grained with coarse sand and gravel.														
	1159	CLAYSTONE (CL): mottled brown and reddish brown; slightly moist; moderately weathered; soft to medium hard.														
	1158		4	2.5	2	80	75	15:19 15:22			0.67					55
15	1157															
	1156	Terminated Coring at 16.0 ft. below ground surface. After completion of coring, corehole was backfilled with high-solids cement-bentonite grout.						15:36								
	1155															
	1154															
	1153															
20	1152															
	1151															
	1150															
	1149															
	1148															
25	1147															
	1146															
	1145															
	1144															
	1143															
30	1142															

CONTRACTOR Gregg Drilling, LLC
EQUIPMENT Fraste XL 140T
DRILL MTHD HQ3 Rock Coring
DIAMETER 4-inch
LOGGER D. Kilian, PG, CEG **REVIEWER** C. Conkle, PE, GE

NORTHING 34.446208
EASTING -118.588320
COORDINATE SYSTEM:

NOTES: No groundwater encountered. Corehole drilled using potable water and polymer for circulation. Location and elevation are approximate and obtained from Google Earth.

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

05-CONT_CORE SC0766U-ROCK.GPJ GEOSNTEC.GDT 2/11/21

APPENDIX B

Rock Strength Characterization

Written by:	O. Doygun	Date:	06/16/2021	Reviewed by:	Dennis Kilian	Date:	06/16/2021
Client:	SoCal Gas	Project:	Honor Rancho Compressor	Project No.	SC0766U	Task No.:	6

EVALUATION OF MOHR COULOMB PARAMETERS FOR SAUGUS FORMATION

1. PURPOSE AND SCOPE

The purpose of this calculation package is to develop equivalent Mohr-Coulomb shear strength parameters (i.e., friction angle and cohesion) for the Saugus Formation at the Site. Hoek-Brown failure criterion (1980, 2002) was used along with the unconfined compression strength test results obtained from intact rock samples at the Site, observation of the continuous rock cores, and the site visit observations of exposed cut slopes.

2. BACKGROUND

The original Hoek-Brown failure criterion was developed in 1980 in the form of a dimensionless equation that could be scaled in relation to geological information and geological observations. In 2002, the entire Hoek-Brown criterion was re-examined and the relationships between the Mohr-Coulomb and the Hoek-Brown criteria were examined for slopes and a set of equations linking the two were presented (Hoek et al. 2002). The final relationships were derived by comparing hundreds of tunnel and slope stability analyses in which both the Hoek-Brown and the Mohr Coulomb criteria were used, and the best match was found by iteration. In the following, first the implemented equations and assumptions are introduced, which is followed by the presentation of the resulting equivalent Mohr Coulomb parameters (friction angle and cohesion)..

3. INPUT PARAMETERS

3.1 Rock Type

Based on the explorations, including continuous rock coring in multiple locations, as well as geologic mapping, Plio-Pleistocene age Saugus Formation underlies the slope area. The Saugus Formation encountered during the explorations generally consists predominantly of silty and clayey sandstones with gravels and cobbles with interbedded red and light brown sandy claystone. The approximate range observed in the unit was estimated at 60% sandstone to 40% claystone. The Saugus Formation was observed to be moderately to highly weathered and occasionally friable in the absence of fines. Topsoils, residual soils, and slopewash encountered overlying the Saugus formation are generally unconsolidated and remediated through grading and therefore, not considered for use in this analysis. Based on geologic mapping the Saugus Formation indicated a general dip of 50 to 70 degrees to the southwest, correlating with the southern leg of an anticline with the axis located approximately parallel to the San Gabriel Fault, 1.5 miles north of the site.

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The unit observed was generally intact and massive with thick to very thick bedding. Well-developed jointing and fracturing of in-situ rock was minimal. Based on the results of the seismic refraction survey (Geosyntec, 2021), the Saugus Formation within the footprint of the proposed Compressor Facility is interpreted to be rippable with Primary compression wave (P-wave) velocities in the range of 2,500 to 4,500 ft/s within the depth of the investigation of about 40 ft. The maximum P-wave velocities in the Saugus Formation underlying the alluvium in the valley area were approximately 5,500 to 6,000 ft/s.

3.2 Intact uniaxial compressive strength

The unconfined compression test results for the rock samples from the Saugus formation are summarized in Table 1. Based on the evaluation of the results in Table 1 and averaging the results between the estimated sandstone and claystone ratio (60:40), an intact uniaxial strength of 21 ksf (1 MPa) was deemed representative for the Saugus formation. The chosen uniaxial compressive strength indicates that the Saugus formation on Site corresponds to a very weak formation based on Table 2, which is also in good agreement with our geological surveys on Site. Based on our review, the results from samples 3 and 6 were omitted because the samples may have been compromised and are not believed to be representative of the intact rock within the overall rock mass.

Table 1. Uniaxial Compressive Strength Test Results (Geosyntec, 2021)

Sample Information				Description	Uniaxial Compressive Strength Test Results (ASTM D7012)
Sample Number	**Sample ID**	**Sample Type [a]**	**Depth (ft bgs)**		
1	B-1@40-43	Rock Core	40.5-41	Clayey Sandstone	UCS = 14.08 ksf
2	B-1@43-46	Rock Core	44.1-44.5	Clayey Sandstone	UCS = 31.83 ksf
3	B-2@7.5-10	Rock Core	9-9.5	Silty Sandstone	UCS = 2.32 ksf
4	B-2@15-17.5	Rock Core	15.5-16	Silty Claystone	UCS = 7.04 ksf

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5	B-2@22.5-25	Rock Core	24-24.5	Claystone	UCS = 6.14 ksf
6	B-2@27-30	Rock Core	27.5-28	Silty Sandstone	UCS = 0.89 ksf
7	B-3@6-11	Rock Core	7.5-8	Sandy Claystone	UCS = 5.33 ksf
8	B-4@1.5-6	Rock Core	5-5.5	Silty Sandstone	UCS = 47.60 ksf

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Table 2. Field estimates of unconfined compressive strength (Hoek, 2001)

Grade*	Term	Uniaxial Comp. Strength (MPa)	Point Load Index (MPa)	Field estimate of strength	Examples
R6	Extremely Strong	> 250	>10	Specimen can only be chipped with a geological hammer	Fresh basalt, chert, diabase, gneiss, granite, quartzite
R5	Very strong	100 - 250	4 - 10	Specimen requires many blows of a geological hammer to fracture it	Amphibolite, sandstone, basalt, gabbro, gneiss, granodiorite, peridotite , rhyolite, tuff
R4	Strong	50 - 100	2 - 4	Specimen requires more than one blow of a geological hammer to fracture it	Limestone, marble, sandstone, schist
R3	Medium strong	25 - 50	1 - 2	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow from a geological hammer	Concete, phyllite, schist, siltstone
R2	Weak	5 - 25	**	Can be peeled with a pocket knife with difficulty, shallow indentation made by firm blow with point of a geological hammer	Chalk, claystone, potash, marl, siltstone, shale, rocksalt,
R1	Very weak	1 - 5	**	Crumbles under firm blows with point of a geological hammer, can be peeled by a pocket knife	Highly weathered or altered rock, shale
R0	Extremely weak	0.25 - 1	**	Indented by thumbnail	Stiff fault gouge

* Grade according to Brown (1981).
** Point load tests on rocks with a uniaxial compressive strength below 25 MPa are likely to yield highly ambiguous results.

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3.3 Geological strength index (GSI)

The strength of a jointed rock mass depends on the properties of the intact rock pieces and also upon the freedom of these pieces to slide and rotate under different stress conditions. This freedom is controlled by the geometrical shape of the intact rock pieces as well as the condition of the surfaces separating the pieces. Angular rock pieces with clean, rough discontinuity surfaces will result in a much stronger rock mass than one which contains rounded particles surrounded by weathered and altered material. The Geological Strength Index (GSI), introduced by Hoek (1994) and Hoek, Kaiser and Bawden (1995) provides a system for estimating the reduction in rock mass strength for different geological conditions. This system is presented in Table 3, for blocky rock masses, and Table 4 for schistose metamorphic rocks.

Table 3. Characterization of a blocky rock masses based on particle interlocking and discontinuity condition (Hoek, 2001)

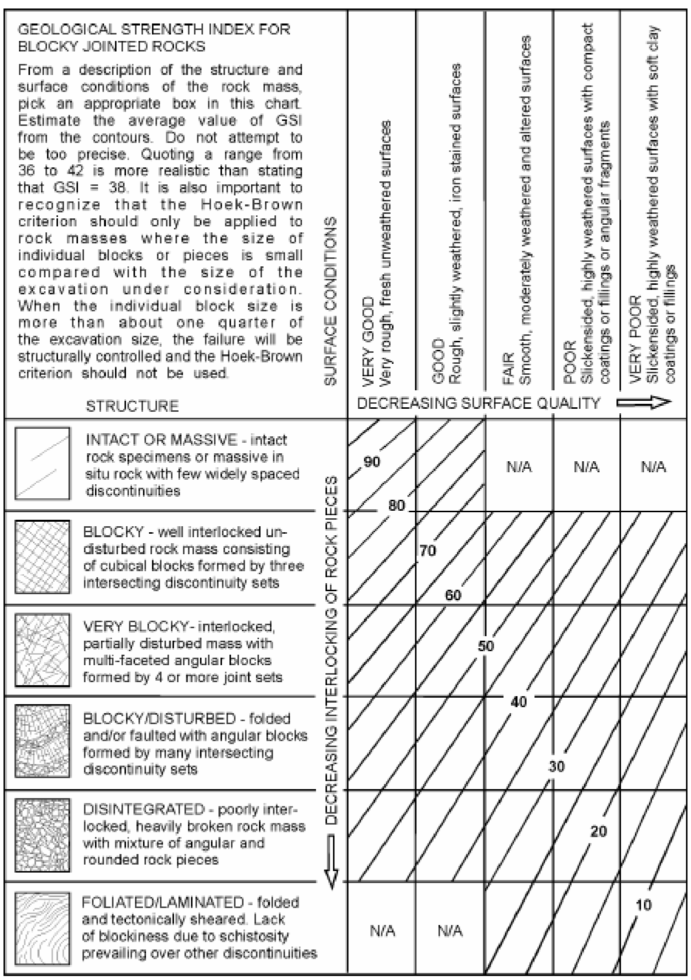

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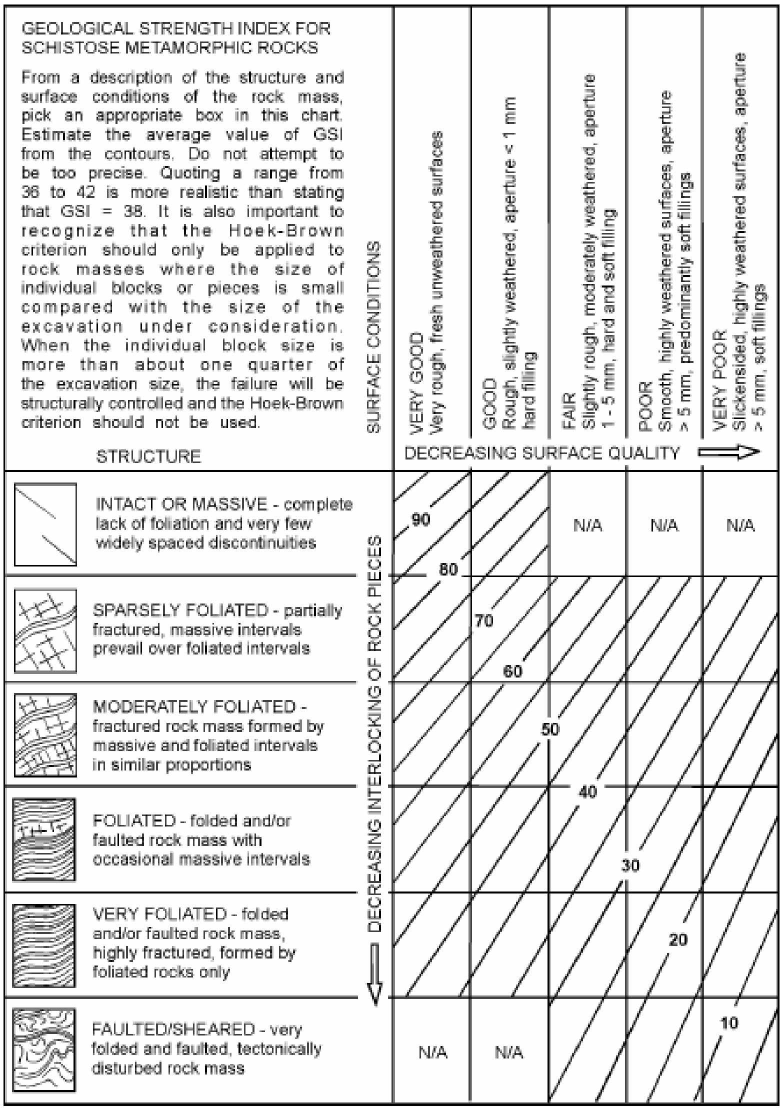
Table 4. Characterization of schistose metamorphic rock masses based on foliation and discontinuity condition (Hoek, 2001)



Based on the observed surface and structure conditions of the thick to very thick beds (generally greater than ten inches and as much as five feet thick) observed during Geosyntec field soil investigation visit on Site, a good to fair surface condition with a GSI value of 65 was deemed to

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be representative for the observed surface conditions and rock structure (Rough, slightly to moderately weathered surfaces, altered surfaces, and blocky).

3.4 Material Constants

The generalized Hoek-Brown failure criterion for rock masses is defined by the equation below:

$$\sigma_1' = \sigma_3' + \sigma_{ci} * (m_b * \frac{\sigma_3'}{\sigma_{ci}} + s)^a \quad (1)$$

where σ_1' and σ_3' are the major and minor effective principal stresses at failure;

m_b is a reduced value of the material constant m_i and is given by $m_b = m_i * \exp\left(\frac{GSI-100}{28-14D}\right)$

D is disturbance factor (defined in Section 3.4)

σ_{ci} is the uniaxial compressive strength of the intact rock material;

m_i is the material constant for intact rock;

s and a are constants for the rock mass given by the following relationships:

$$s = \exp\left(\frac{GSI-100}{9-3D}\right) \quad (2)$$

$$a = \frac{1}{2} + \frac{1}{6} * (e^{-\frac{GSI}{15}} - e^{-\frac{20}{3}}) \quad (3)$$

The material constant, m_i can be estimated for the Saugus formation considering the 60 to 40 sandstone to claystone ratio as 10 based on Table 5.

3.5 Disturbance Factor (*D*)

Disturbance factor (*D*) depends on the degree of disturbance to which the rock mass has been subjected by blast damage, mechanical excavation and/or stress relaxation. It varies from 0 for undisturbed in-situ rock masses to 1 for very disturbed rock masses. Guidelines for the selection of *D* are presented in Table 6. Considering the fact that rock masses at Site are observed to be weathered yet primarily intact on the surface, the Saugus formation can be assumed to possess a *D* factor of 0.7 based on Geosyntec's observations on site and observed intact rock samples from the site.

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3.6 Rock mass deformation modulus (E_{rm}), Modulus Ratio (MR), Intact modulus (E_i)

Hoek and Diederichs (2006) re-examined existing empirical methods for estimating rock mass deformation modulus. In their analysis, they incorporated modulus ratio (MR), which is the ratio of rock mass deformation modulus to intact modulus (E_{rm}/E_i). Using the modulus ratio (MR), the intact modulus (E_i) can be estimated as:

$$E_i = MR * \sigma_{ci} \quad (4)$$

The modulus ratio (MR) in equation (4) can be assumed as MR=250 based on Table 7 for the encountered Saugus formation at Site, which results in an intact modulus value of E_i = 250 MPa based on the uniaxial compressive strength of the rock material (σ_{ci} = 1 MPa).

Based on the detailed analysis of Hoek and Diederichs (2006), rock deformation modulus (E_{rm}) can be estimated as:

$$E_{rm} = E_i * \left(0.02 + \frac{1-\frac{D}{2}}{1+e^{\left(\frac{60+15D-GSI}{11}\right)}}\right) \quad (5)$$

By considering a GSI value of 65 and D value of 0.7, the rock deformation modulus can be calculated as E_{rm}= 66.4 MPa.

Table 5. Values of the constant m_i for intact rock, by rock group. Note that values in parenthesis are estimates. (Hoek, 2001)

Rock type	Class	Group	Texture: Coarse	Medium	Fine	Very fine
SEDIMENTARY	Clastic		Conglomerates (21 ± 3) Breccias (19 ± 5)	Sandstones 17 ± 4	Siltstones 7 ± 2 Greywackes (18 ± 3)	Claystones 4 ± 2 Shales (6 ± 2) Marls (7 ± 2)
	Non-Clastic	Carbonates	Crystalline Limestone (12 ± 3)	Sparitic Limestones (10 ± 2)	Micritic Limestones (9 ± 2)	Dolomites (9 ± 3)
		Evaporites		Gypsum 8 ± 2	Anhydrite 12 ± 2	
		Organic				Chalk 7 ± 2
METAMORPHIC	Non Foliated		Marble 9 ± 3	Hornfels (19 ± 4) Metasandstone (19 ± 3)	Quartzites 20 ± 3	
	Slightly foliated		Migmatite (29 ± 3)	Amphibolites 26 ± 6		
	Foliated*		Gneiss 28 ± 5	Schists 12 ± 3	Phyllites (7 ± 3)	Slates 7 ± 4
IGNEOUS	Plutonic	Light	Granite 32 ± 3 Granodiorite (29 ± 3)	Diorite 25 ± 5		
		Dark	Gabbro 27 ± 3 Norite 20 ± 5	Dolerite (16 ± 5)		
	Hypabyssal		Porphyries (20 ± 5)		Diabase (15 ± 5)	Peridotite (25 ± 5)
	Volcanic	Lava		Rhyolite (25 ± 5) Andesite 25 ± 5	Dacite (25 ± 3) Basalt (25 ± 5)	Obsidian (19 ± 3)
		Pyroclastic	Agglomerate (19 ± 3)	Breccia (19 ± 5)	Tuff (13 ± 5)	

* These values are for intact rock specimens tested normal to bedding or foliation. The value of m_i will be significantly different if failure occurs along a weakness plane.

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Table 6. Guidelines for estimating disturbance factor *D*. (Hoek et al, 2002)

Appearance of rock mass	Description of rock mass	Suggested value of *D*
	Excellent quality controlled blasting or excavation by Tunnel Boring Machine results in minimal disturbance to the confined rock mass surrounding a tunnel.	$D = 0$
	Mechanical or hand excavation in poor quality rock masses (no blasting) results in minimal disturbance to the surrounding rock mass. Where squeezing problems result in significant floor heave, disturbance can be severe unless a temporary invert, as shown in the photograph, is placed.	$D = 0$ $D = 0.5$ No invert
	Very poor quality blasting in a hard rock tunnel results in severe local damage, extending 2 or 3 m, in the surrounding rock mass.	$D = 0.8$
	Small scale blasting in civil engineering slopes results in modest rock mass damage, particularly if controlled blasting is used as shown on the left hand side of the photograph. However, stress relief results in some disturbance.	$D = 0.7$ Good blasting $D = 1.0$ Poor blasting
	Very large open pit mine slopes suffer significant disturbance due to heavy production blasting and also due to stress relief from overburden removal. In some softer rocks excavation can be carried out by ripping and dozing and the degree of damage to the slopes is less.	$D = 1.0$ Production blasting $D = 0.7$ Mechanical excavation

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Table 7. Guidelines for the selection of modulus ratio (MR) values in Equation (4) (Hoek, and Diederichs, 2006)

Rock type	Class	Group	Texture: Coarse	Texture: Medium	Texture: Fine	Texture: Very fine
Sedimentary	Clastic		Conglomerates 300–400 Breccias 230–350	Sandstones 200–350	Siltstones 350–400 Greywackes 350	Claystones 200–300 Shales 150–250[a] Marls 150–200
Sedimentary	Non-clastic	Carbonates	Crystalline limestones 400–600	Sparitic limestones 600–800	Micritic Limestones 800–1000	Dolomites 350–500
Sedimentary	Non-clastic	Evaporites		Gypsum (350)[b]	Anhydrite (350)[b]	
Sedimentary	Non-clastic	Organic				Chalk 1000+
Metamorphic	Non-foliated		Marble 700–1000	Hornfels 400–700 Metasandstone 200–300	Quartzites 300–450	
Metamorphic	Slightly foliated		Migmatite 350–400	Amphibolites 400–500	Gneiss 300–750[a]	
Metamorphic	Foliated[a]			Schists 250–1100[a]	Phyllites/Mica Schist 300–800[a]	Slates 400–600[a]
Igneous	Plutonic	Light	Granite[c] 300–550 Granodiorite[c] 400–450	Diorite[c] 300–350		
Igneous	Plutonic	Dark	Gabbro 400–500 Norite 350–400	Dolerite 300–400		
Igneous	Hypabyssal		Porphyries (400)[b]		Diabase 300–350	Peridotite 250–300
Igneous	Volcanic	Lava		Rhyolite 300–500 Andesite 300–500	Dacite 350–450 Basalt 250–450	
Igneous	Volcanic	Pyroclastic	Agglomerate 400–600	Volcanic breccia (500)[b]	Tuff 200–400	

[a]Highly anisotropic rocks: the value of MR will be significantly different if normal strain and/or loading occurs parallel (high MR) or perpendicular (low MR) to a weakness plane. Uniaxial test loading direction should be equivalent to field application.
[b]No data available, estimated on the basis of geological logic.
[c]Felsic Granitoids: coarse grained or altered (high MR), fined grained (low MR).

3.7 Uniaxial compressive strength, tensile strength and rock mass (global) strength

The uniaxial compressive strength of in-situ rock mass is obtained by setting $\boldsymbol{\sigma'_3}$=0 in equation (1), giving:

$$\sigma_c = \sigma_{ci} * s^a \quad (6)$$

and, the tensile strength is:

$$\sigma_t = -\frac{s*\sigma_{ci}}{m_b} \quad (7)$$

The uniaxial compressive strength of the rock mass σ_c is given by equation (6). This strength is representative for failures that initiate at the boundary of an excavation when σ_c is exceeded by the stress induced on that boundary. The failure propagates from this initiation point into a biaxial stress field and it eventually stabilizes when the local strength, defined by equation (1), is higher than the induced stresses σ'_1 and σ'_3 .

Based on Hoek et al. (2002), it is useful to consider the overall behavior of a rock mass rather than the detailed failure propagation process described above. This leads to the concept of a global rock mass strength σ'_{cm}, which can be estimated from the Mohr Coulomb relationship:

$$\sigma'_{cm} = \frac{2*c*cos\varphi}{1-sin\varphi} \quad (8)$$

with cohesion (c) and friction angle (φ) determined for the stress range $\sigma_t < \sigma_3 < \sigma_{ci}/4$, resulting in the rock mass (global) strength as:

$$\sigma'_{cm} = \sigma_{ci} * \frac{(m_b+4s-a(m_b-8s))*(\frac{m_b}{4}+s)^{(a-1)}}{2*(1+a)*(2+a)} \quad (9)$$

For the project boundary conditions, the resulting in-situ uniaxial compressive strength, tensile strength, and the rock mass (global) strength values are calculated as: σ_c = 0.08 MPa, σ_t = -0.004 MPa, σ'_{cm} = 0.17 MPa.

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3.8 Maximum confining Stress (σ_{3max}) and Mohr-Coulomb Criterion

The equivalent Mohr-Coulomb parameters (friction angle and cohesion) for a rock mass will be determined case-specifically for the relevant stress range. This is done by fitting an average linear relationship to the curve generated by solving equation (1) for a range of minor principal stress values defined by $\boldsymbol{\sigma_t < \sigma_3 < \sigma_{3max}}$, as illustrated in Figure 1.

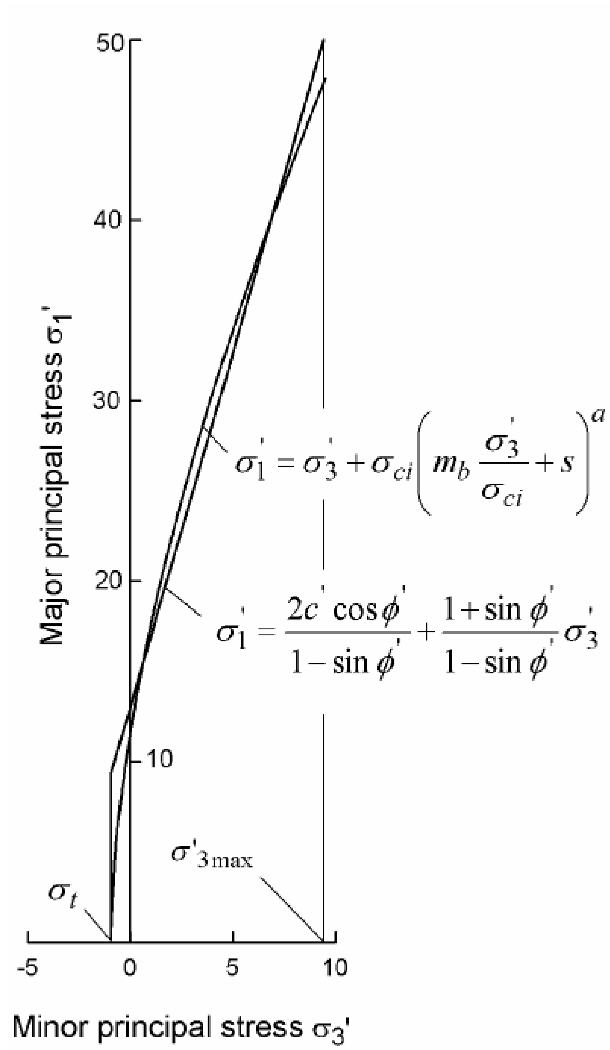

Figure 1. Relationships between major and minor principal stresses for Hoek-Brown and equivalent Mohr-Coulomb criteria (Hoek et al, 2002)

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The fitting process involves balancing the areas above and below the Mohr-Coulomb plot. This results in the following equations for the equivalent angle of friction and cohesive strength of the in-situ rock mass:

$$\varphi = sin^{-1}\left[\frac{6am_b(s+m_b\sigma_{3n})^{(a-1)}}{2(1+a)(2+a)+6am_b(s+m_b\sigma_{3n})^{(a-1)}}\right] \qquad (10)$$

$$c = \frac{\sigma_{ci}[(1+2a)s+(1-a)m_b\sigma_{3n}](s+m_b\sigma_{3n})^{(a-1)}}{(1+a)(2+a)\sqrt{1+\frac{(6am_b(s+m_b\sigma_{3n})^{(a-1)}}{(1+a)(2+a)}}} \qquad (11)$$

where $\sigma_{3n} = \frac{\sigma_{3max}}{\sigma_{ci}}$

The maximum confining stress (σ_{3max}), is the upper limit of confining stress over which the relationship between the Hoek-Brown and Mohr-Coulomb criteria is considered and this has to be determined for each individual case. Based on Hoek et al. (2002), extensive studies for slopes, using Bishop's circular failure analysis for a wide range of slope geometries and rock mass properties, gave:

$$\frac{\sigma_{3max}}{\sigma'_{cm}} = 0.72 * (\frac{\sigma'_{cm}}{\gamma H})^{-0.91} \qquad (12)$$

where H is the height of the slope.

4. RESULTS

Based on the previously described calculations (Equation 1 through 12), the equivalent Mohr-Coulomb strength parameters for the Saugus formation at Site are summarized in Table 8 for various slope heights considered in our slope stability evaluations. The graphical illustration of the equivalent Mohr-Coulomb soil strength model along with the Hoek-Brown rock model for the considered rock parameters is shown in Figure 2. Shear strength parameters used in slope stability analyses may either be based on equivalent Mohr-Coulomb parameters for corresponding equivalent slope height or the fully defined shear strength curve as a function of normal load as shown in the Hoek-Brown model solution in Figure 2 for the Saugus formation at the Site.

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Table 8. Equivalent Mohr Coulomb Parameters based on Hoek-Brown Model

Cross Section	Slope Height, H (ft)	phi (deg)	c (psf)
A, B	20	38	569
E	70	28	1107
C, D	100	26	1350

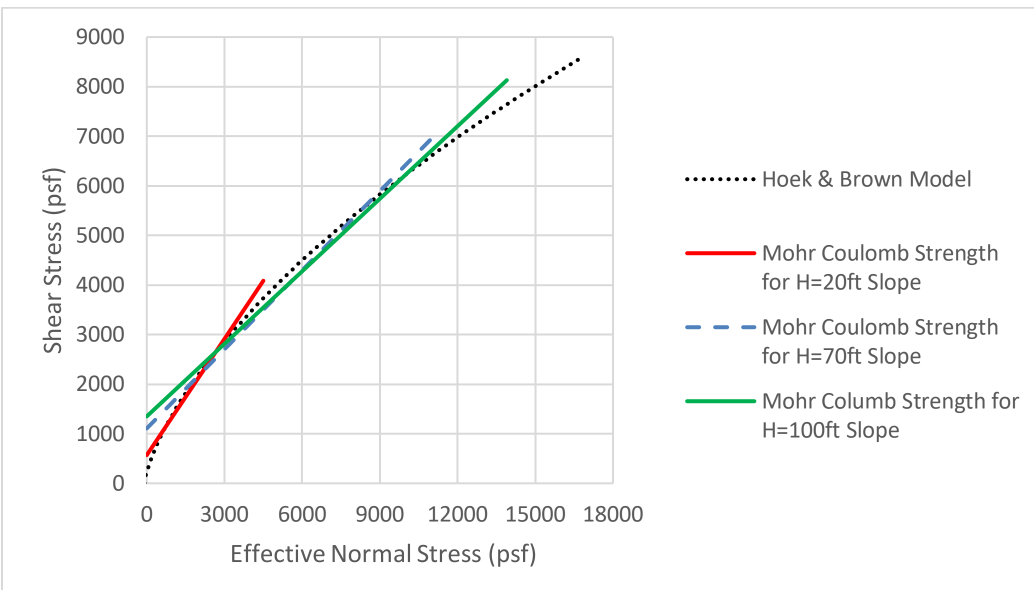
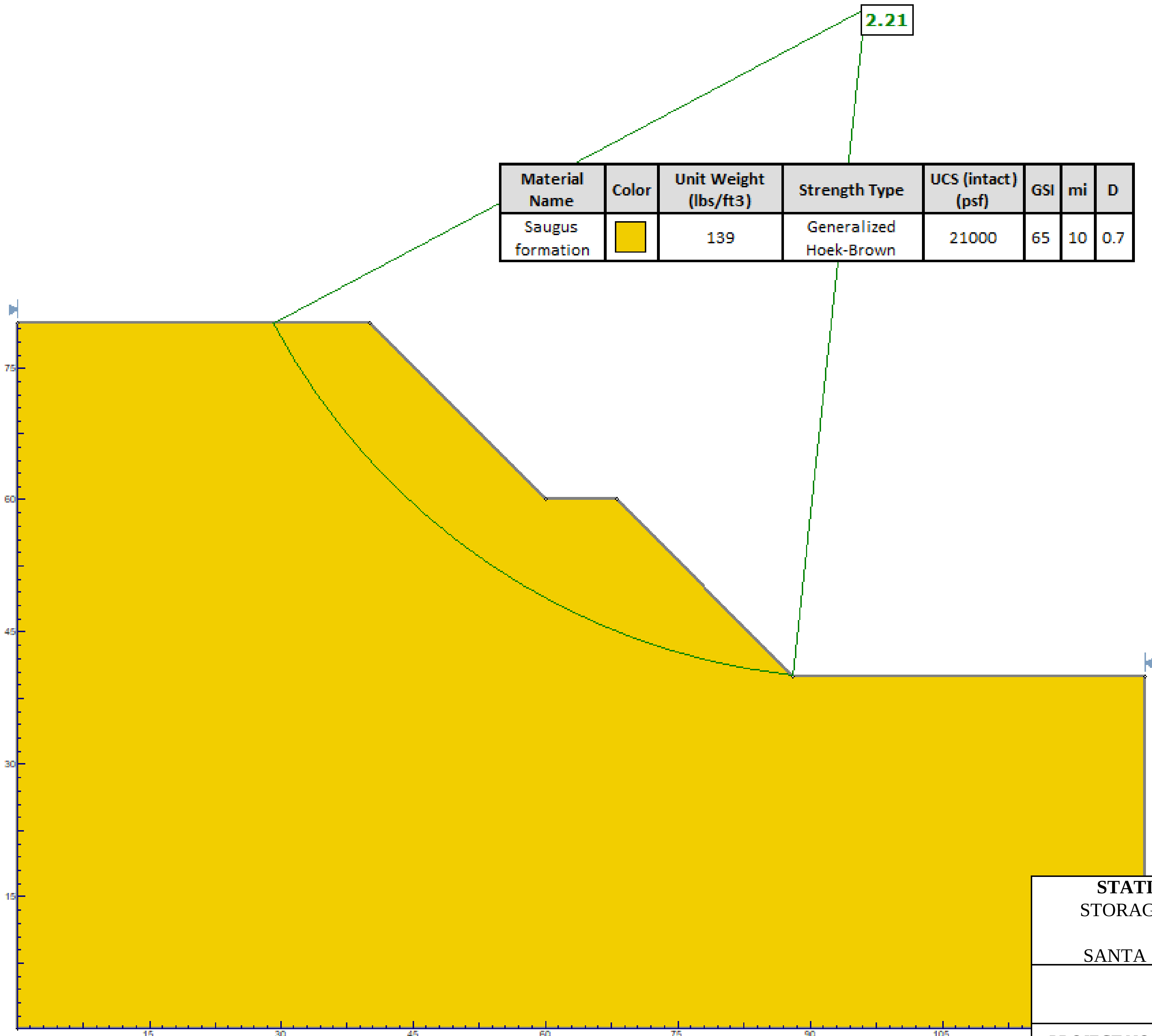


Figure 2. Equivalent Mohr Coulomb Strength based on Hoek-Brown Model

APPENDIX C

Slope Stability Analysis Output



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

STATIC 40-FEET 1:1 SLOPE

STORAGE FIELD ACCESS ROAD EXPANSION

SANTA CLARITA, CALIFORNIA

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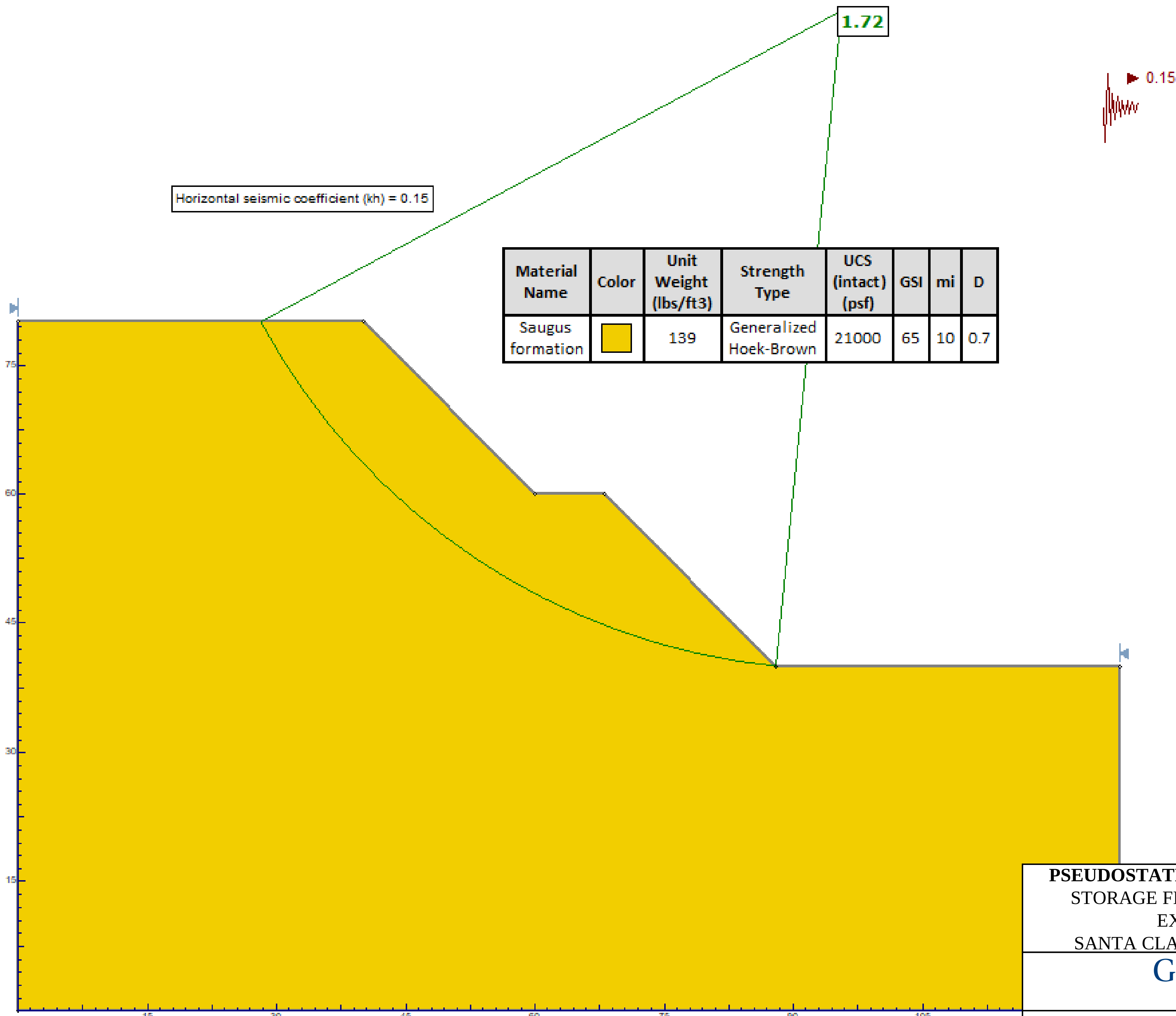

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 40-FEET 1:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
SANTA CLARITA, CALIFORNIA

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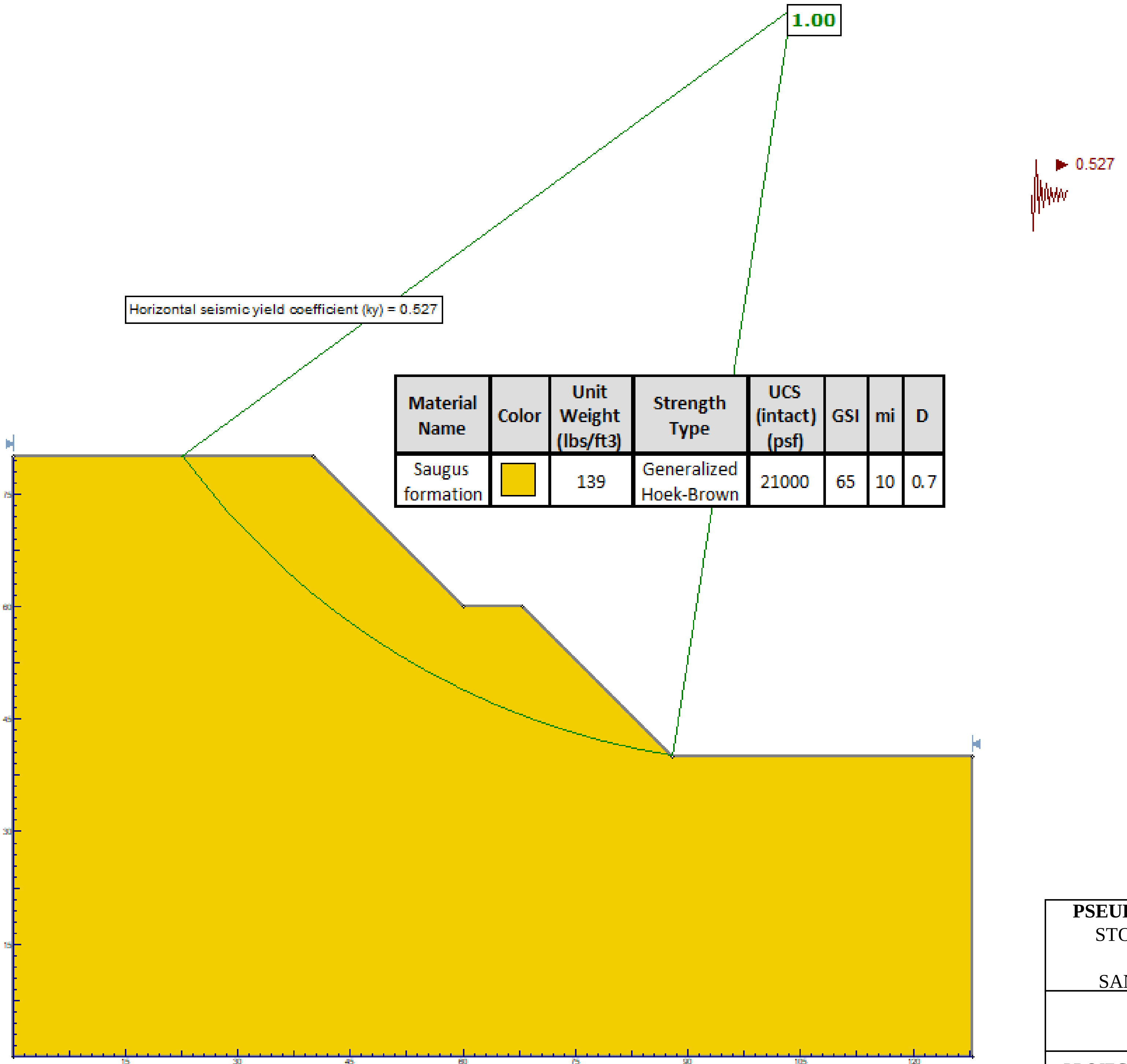

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 40-FEET 1:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
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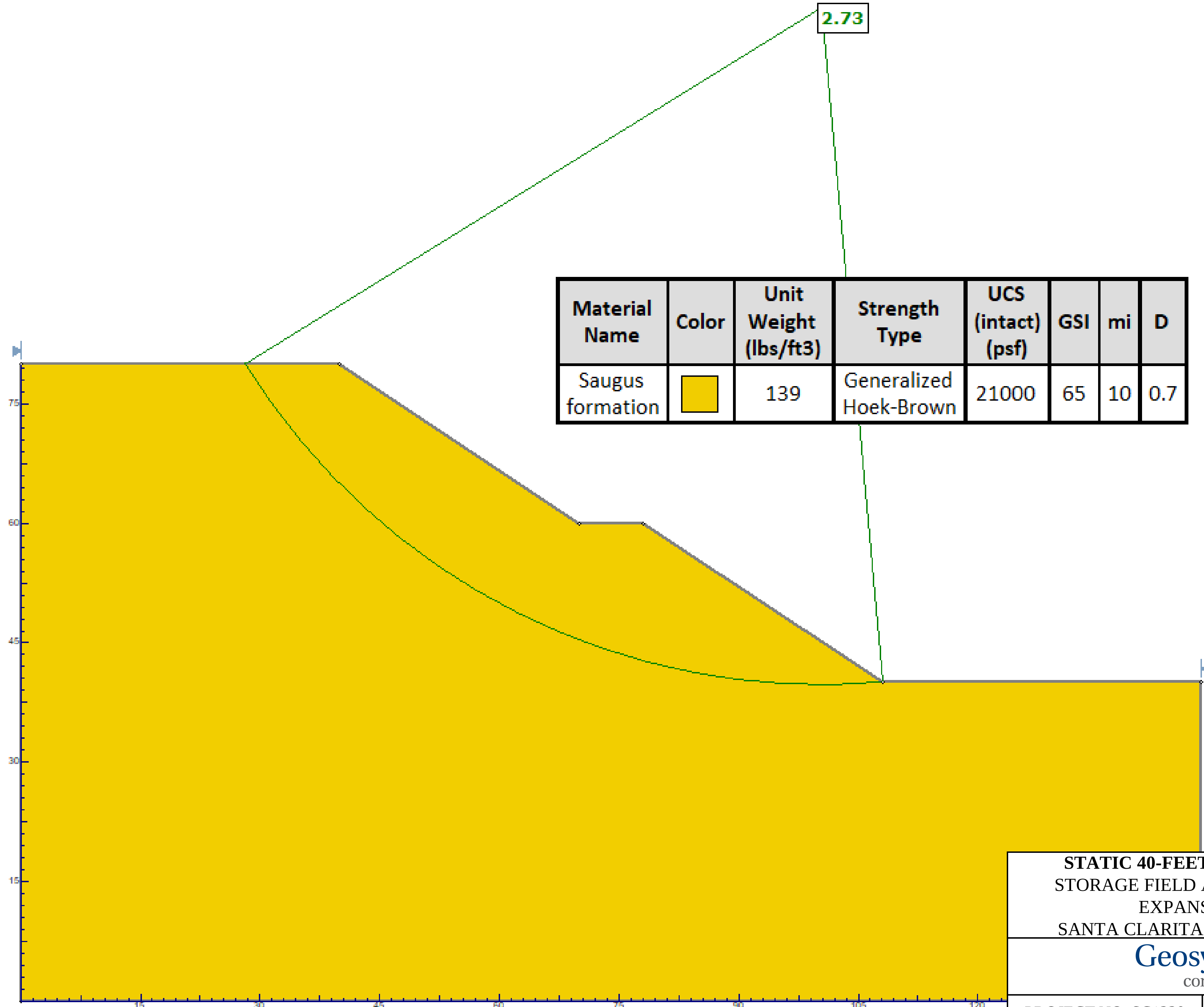

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

STATIC 40-FEET 1.5:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
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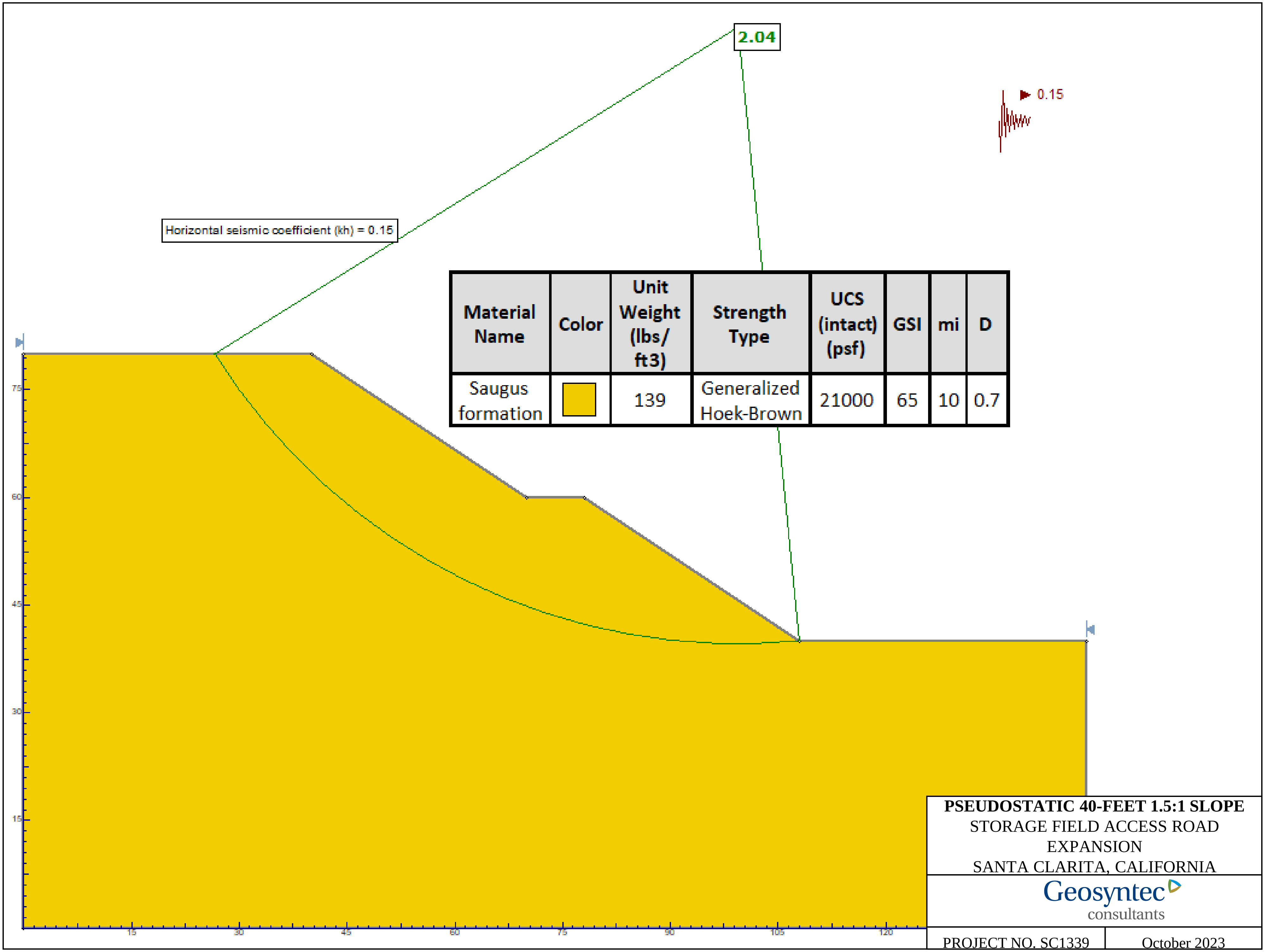

Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 40-FEET 1.5:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
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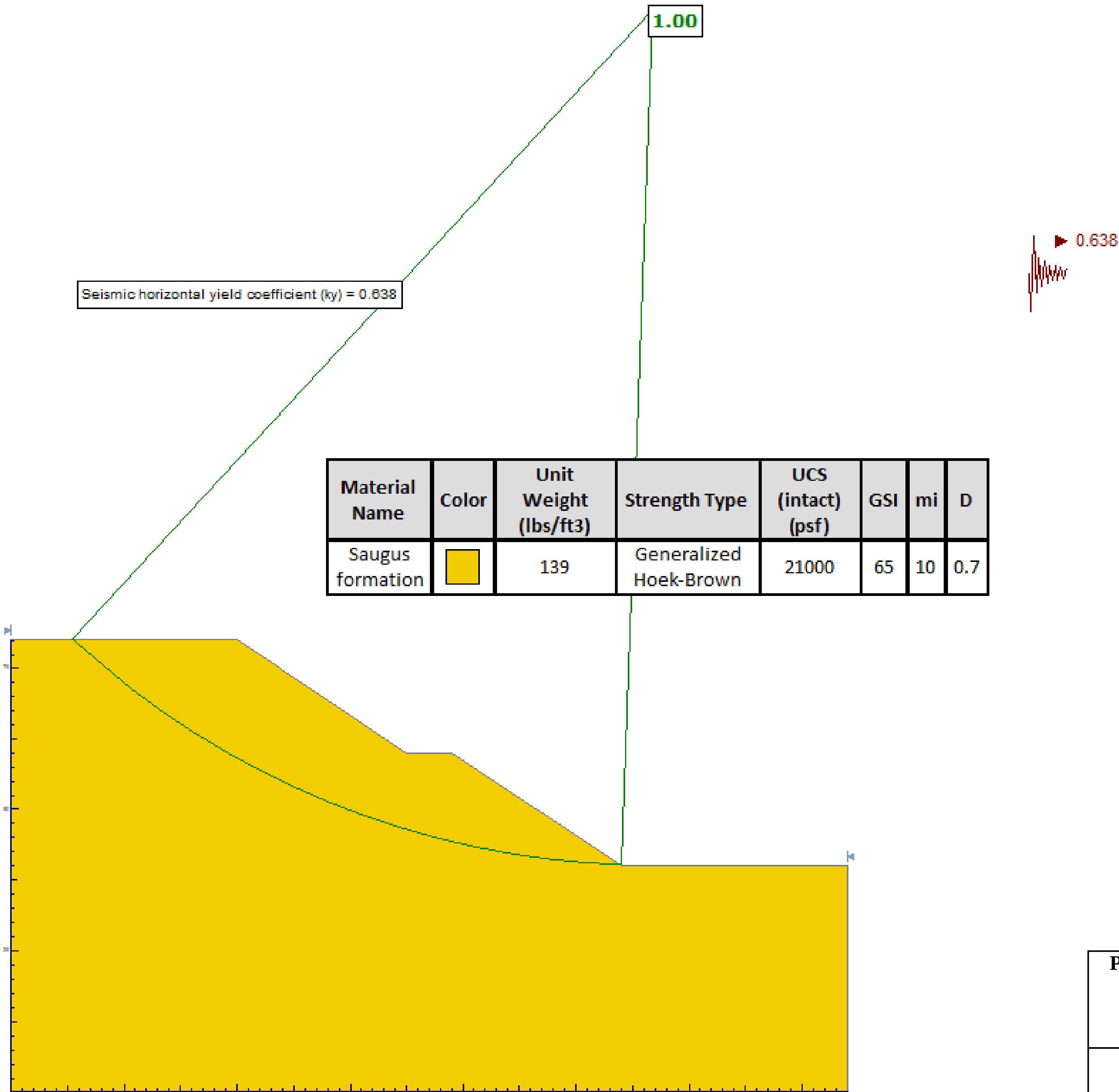

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 40-FEET 1.5:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
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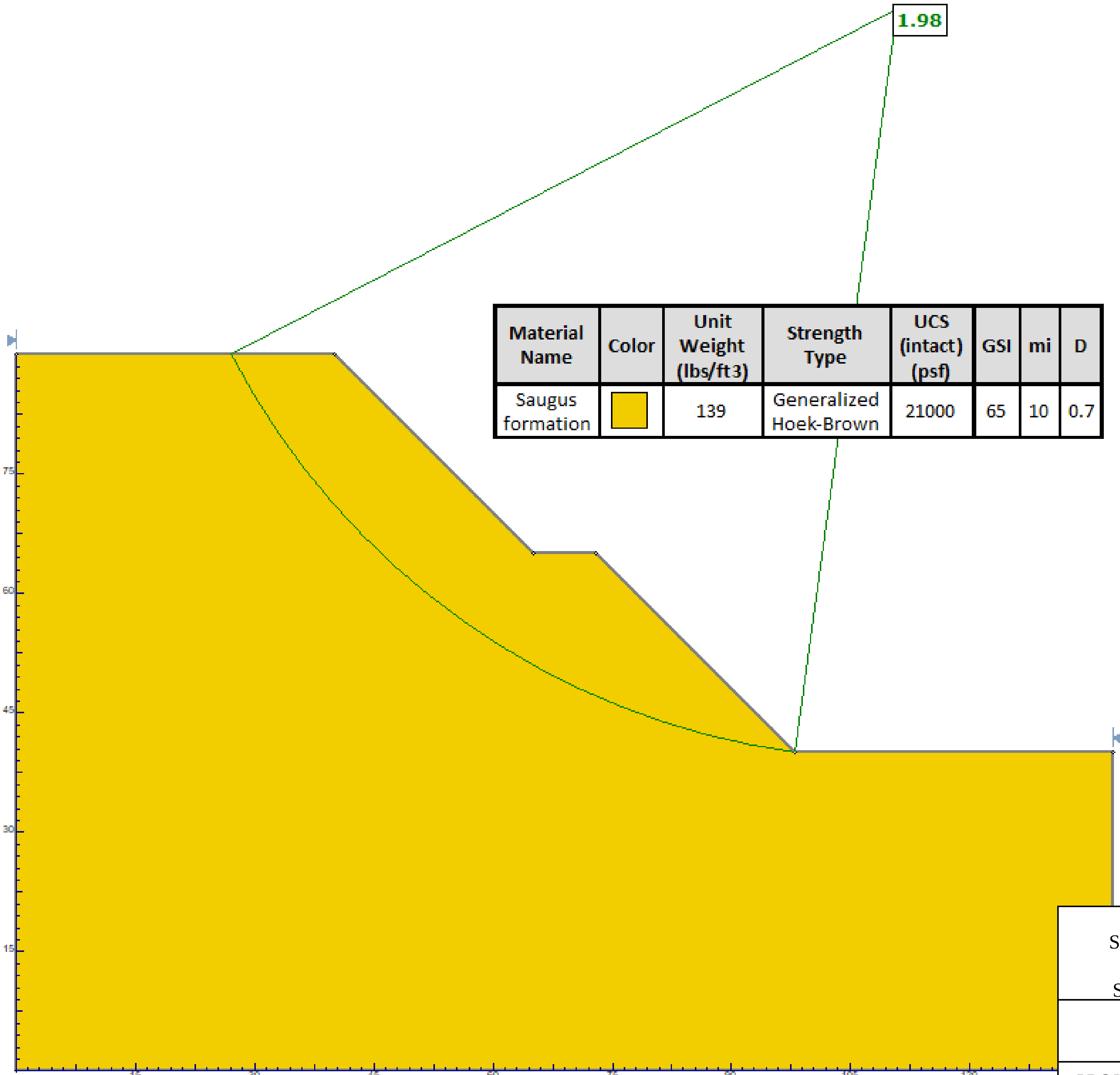

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

STATIC 50-FEET 1:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
SANTA CLARITA, CALIFORNIA

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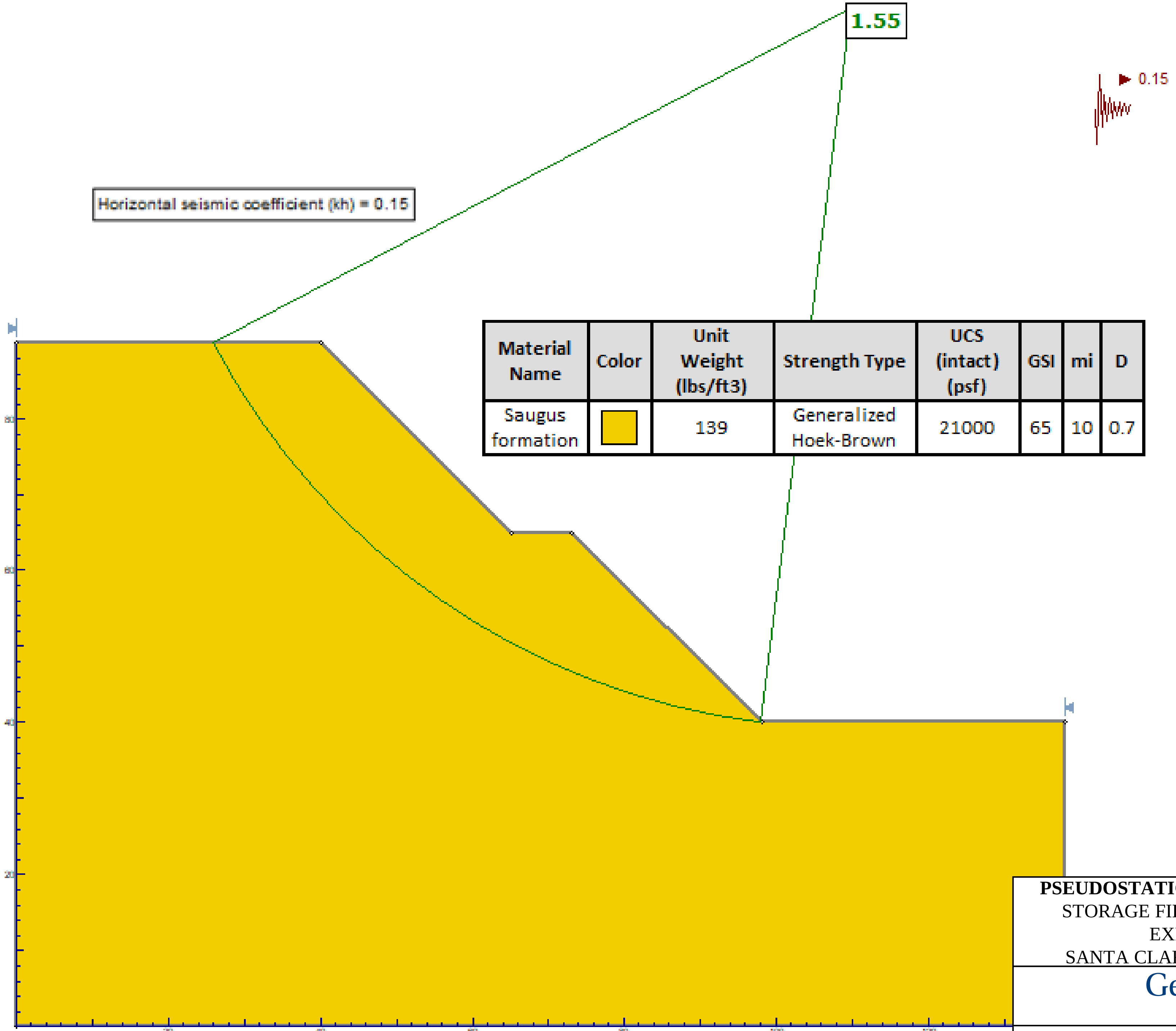
PROJECT NO. SC1339 | October 2023



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 50-FEET 1:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
SANTA CLARITA, CALIFORNIA

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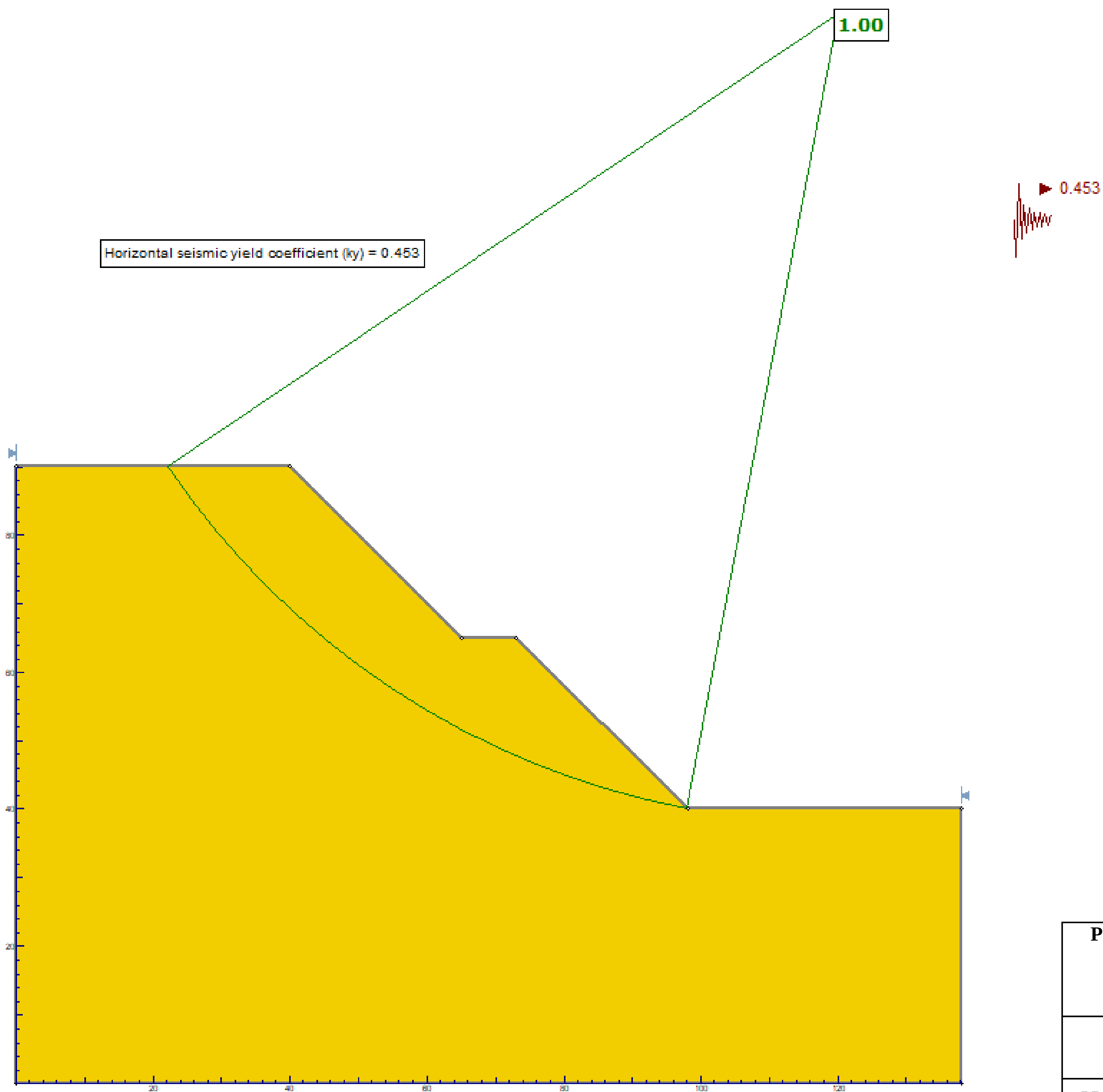

PSEUDOSTATIC 50-FEET 1:1 SLOPE
STORAGE FIELD ACCESS ROAD
EXPANSION
SANTA CLARITA, CALIFORNIA

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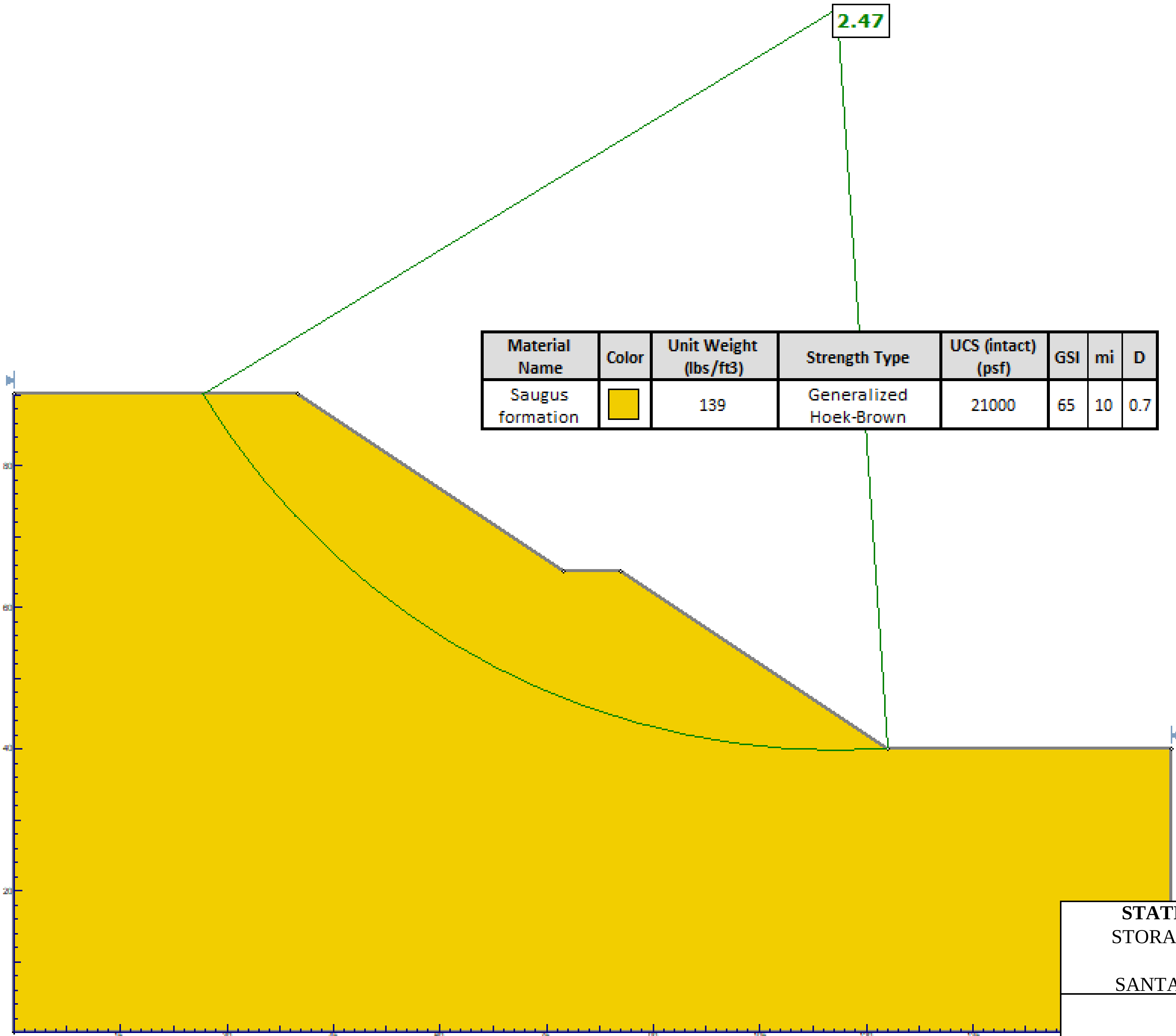
PROJECT NO. SC1339	October 2023



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

STATIC 50-FEET 1.5:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
SANTA CLARITA, CALIFORNIA

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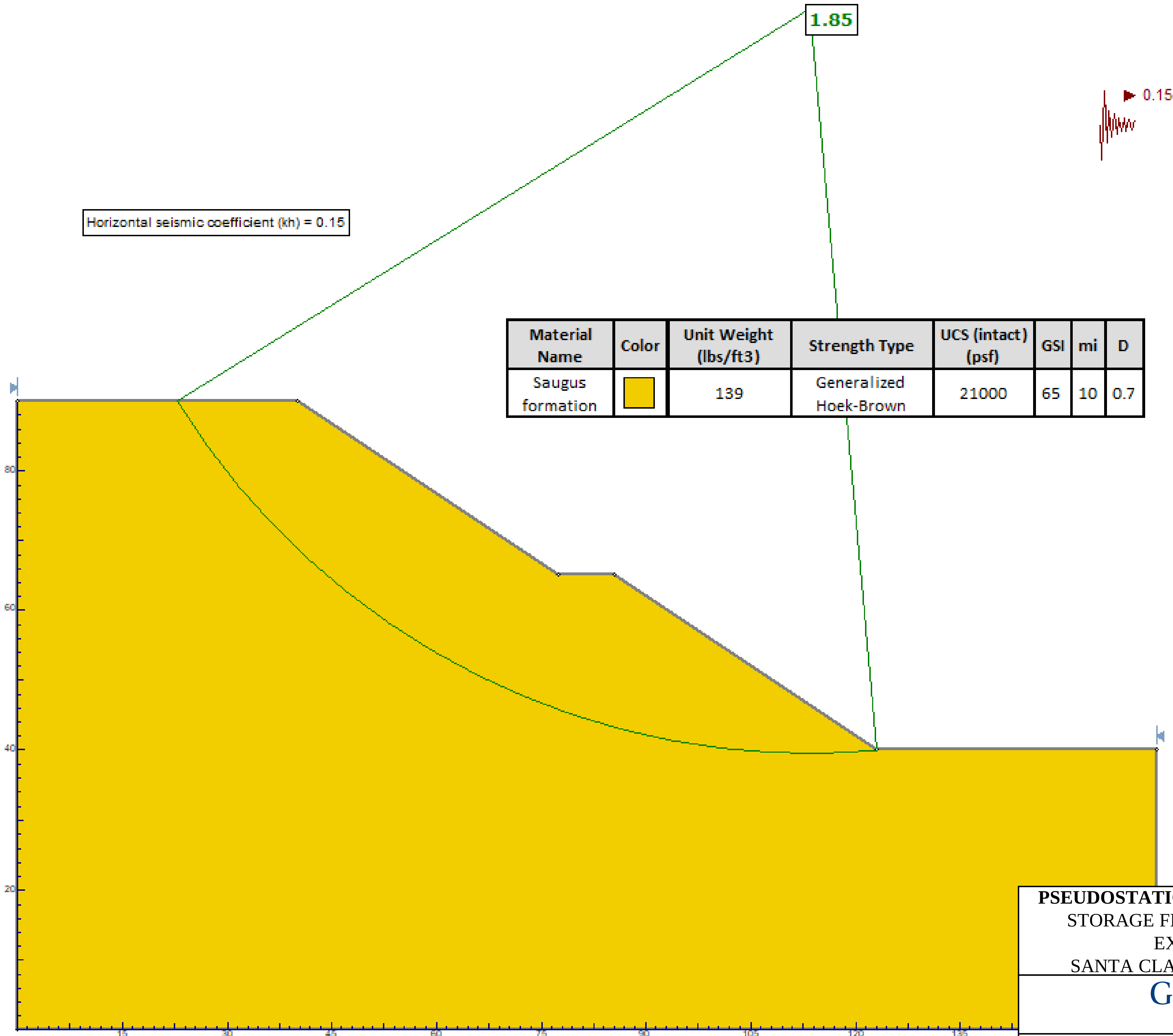

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 50-FEET 1.5:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
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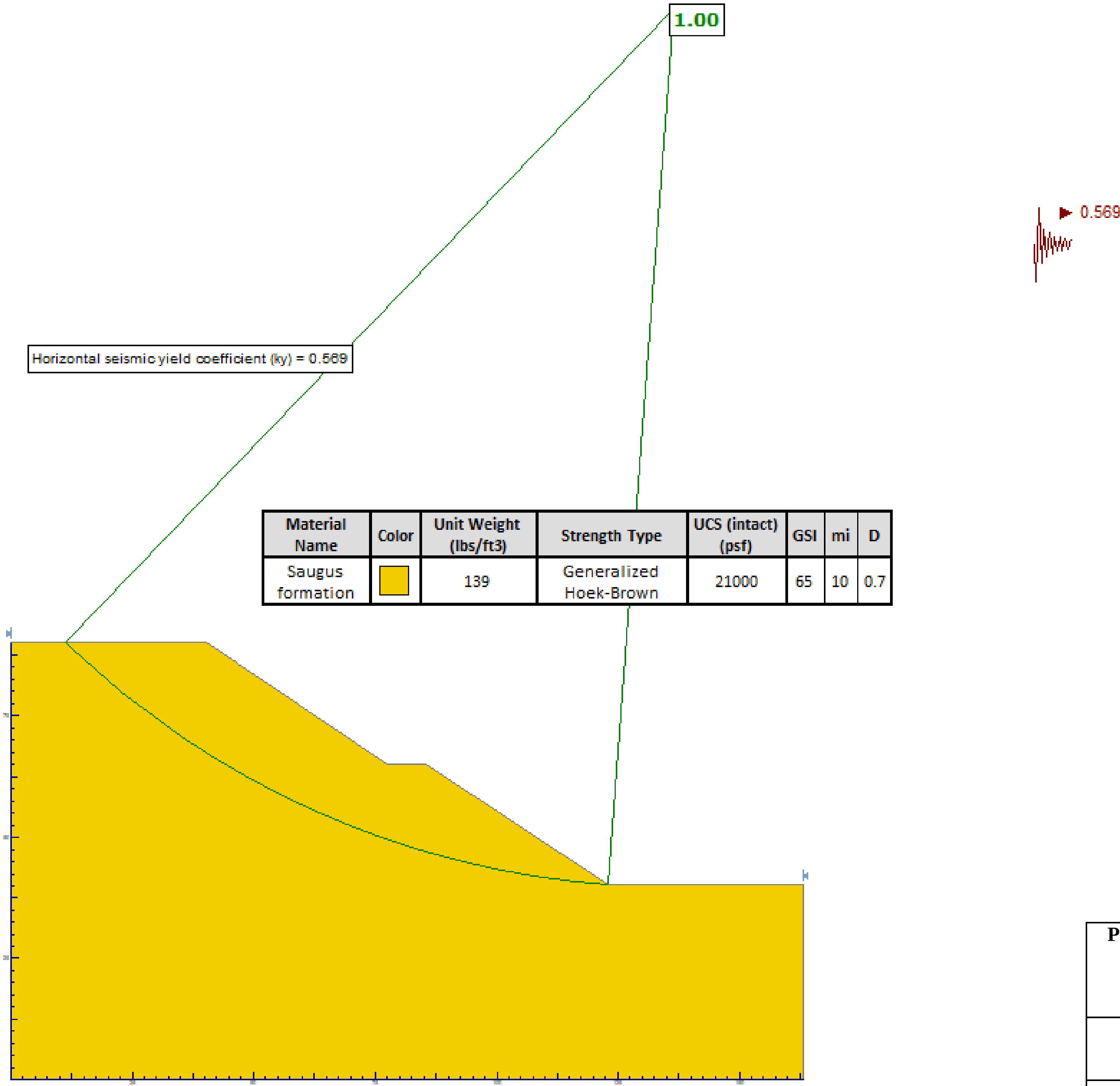

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	UCS (intact) (psf)	GSI	mi	D
Saugus formation		139	Generalized Hoek-Brown	21000	65	10	0.7

PSEUDOSTATIC 50-FEET 1.5:1 SLOPE
STORAGE FIELD ACCESS ROAD EXPANSION
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