GEOTECHNICAL EVALUATION REPORT
PIT SLOPE STABILITY ANALYSES
FOR PROPOSED CARLI EXPANSION
FLORIN ROAD AND EAGLES NEST ROAD
SACRAMENTO COUNTY, CALIFORNIA
KLEINFELDER PROJECT #20171856.001A

JUNE 19, 2017

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Subject: **Geotechnical Evaluation Report**
Pit Slope Stability Analyses
Proposed Carli Expansion
Florin Road and Eagles Nest Road
Sacramento County, California 95830

Dear Mr. Torell:

Kleinfelder is pleased to present this geotechnical data report that provides the slope stability analyses results for final pit configuration of the proposed Carli Expansion located northeast of the intersection of Florin Road and Eagles Nest Road, in Sacramento County, California. The purpose of our investigation was to explore and evaluate the subsurface conditions at various locations on the site in order to develop geotechnical engineering recommendations for slope configuration for the Carli Expansion and to assist Vulcan Material Company (Vulcan) with their permitting process in accordance with requirements of the State of California Office of Mine Reclamation.

Based on the results of our field investigation, laboratory testing, and engineering analyses, it is our professional opinion the site is suitable for the proposed mining pit slopes. Recommendations regarding the geotechnical aspects of project design and construction are presented in the following report.

Recommendations provided herein are contingent on the provisions outlined in the ADDITIONAL SERVICES and LIMITATIONS sections of this report. The project Owner should become familiar with these provisions in order to assess further involvement by Kleinfelder and other potential impacts to the proposed project.

We appreciate the opportunity of providing our services for this project. If you have any questions regarding the information or recommendations presented in our report, please do not hesitate to contact us at (916) 366-1701.

Sincerely,

KLEINFELDER, INC.

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1 INTRODUCTION

1.1 GENERAL

This report presents the results of our slope stability analyses for the proposed final pit configuration project for the Carli Expansion, located northeast of the intersection of Florin Road and Eagles Nest Road, in Sacramento County, California. The approximate location of the pit site is shown on the Site Location Map, Figure 1. The locations of the borings drilled for this investigation are shown on the Boring Location Map, Figure 2.

This report includes recommendations related to the design and construction of the proposed pit slopes. This work was performed to provide recommended slope configurations for the Carli Expansion and to assist Vulcan Materials Company (Vulcan) with their permitting process in accordance with requirements of the State of California Office of Mine Reclamation and Sacramento County. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our explorations and the provisions and requirements outlined in the ADDITIONAL SERVICES and LIMITATIONS sections of this report. Recommendations presented herein should not be extrapolated to other areas or used for other projects without prior review by Kleinfelder.

1.2 PROJECT DESCRIPTION

We understand the proposed project will involve the planned Carli Expansion final pit and reclamation plan, as discussed below based on a drawing and communication provided by Vulcan:

Final Mining Pit: Approximately 14,900,000 cubic yard of overburden and rock will be removed to elevations ranging between approximately 70 and 50 feet (approximate depths of 50 to 70 feet below current average site elevation of 120 feet), with side slope of 1H:1V. This is a temporary slope that will be partially filled during mine reclamation. Setback of the mining slope to the County road right-of-way should be a minimum of 30 feet.

Reclamation Plan: Approximately 6,700,000 cubic yards of fill will be backfilled into the pit to raise the bottom approximately 30 feet to Elevation 84. The site plan indicates final side slopes of 1.75H:1V are planned.

If the actual project is different from that discussed above, Kleinfelder should review our recommendations for applicability and/or provide supplemental recommendations as warranted.

1.3 PREVIOUS INVESTIGATIONS

Previous geotechnical reports and field exploration programs have been prepared for the site by others. The reports provided by Vulcan that were reviewed by Kleinfelder included:

- Reference 1: A site map entitled Sacramento Reserve and Reclamation, prepared by Vulcan Materials Company, dated January 9, 2015.
- Reference 2: A previous letter submitted by Vulcan Materials Company to Mr. John C. Buada, dated November 27, 2007.
- Reference 3: A previous study titled Clarification of Excavation Recommendations, Sacramento Aggregates, East Vineyard Community Plan Amendment, Rezone and Use Permit, (Sacramento County Control No. 94-CZB-UPB-0715), Vicinity of Jackson Highway and Sunrise Boulevard, Sacramento County, California, prepared by Wallace Kuhl & Associates Inc., dated April 4, 1996.
- Reference 4: A previous study titled Supplemental Slope Stability Analysis, Sacramento Aggregates Mining Use Permit, Vicinity of Jackson Highway and Sunrise Boulevard, Sacramento County, California, prepared by Wallace Kuhl & Associates Inc., dated February 26, 1996.
- Reference 5: A previous study titled Slope Stability Study, Sacramento Aggregates Mining Use Permit, Vicinity of Jackson Highway and Sunrise Boulevard, Sacramento County, California, prepared by Wallace Kuhl & Associates Inc., dated September 29, 1995.
- Reference 6: A previous study performed for Sacramento Aggregates by Vulcan including a site location map and boring logs (SA-1 through SA-15) performed in March 1997.

- Reference 7: A previous study performed for Triangle Rock – Rancho Cordova by Vulcan including boring logs (TR-1 through TR-9) performed in October 1998.
- Reference 8: A previous study entitled Proposed Aggregate Pit, APN 067-0120-073, 9875 Eagles Nest Road, Sacramento County, California, performed by KC Geotechnical Engineering Consultants, dated 23 June 2008. This report included boring logs KC-1 through KC-8) and limited laboratory testing in the underlying gravel.
- Reference 9: A boring location map entitled Carli Property, Drill Hole Locations.

1.4 PURPOSE AND SCOPE OF SERVICES

The purpose of our investigation was to explore and evaluate the subsurface conditions at various locations on the site in order to develop recommendations related to the geotechnical aspects of project design and construction.

The scope of services was outlined in our proposal dated October 27, 2015, and included the following:

- A review of available subsurface and laboratory information contained in our files and from previous studies pertinent to the proposed construction and project site.
- Exploration of the subsurface conditions at two locations within the area of the proposed mining activities utilizing the sonic drilling method.
- Limited laboratory testing of representative samples obtained during the field investigation to evaluate relevant engineering parameters of the subsurface soils.
- Engineering slope stability analyses on which to base our recommendations for the design and construction of the geotechnical aspects of the project.
- Preparation of this report which includes:
- A description of the proposed project
- A discussion of the surface and subsurface site conditions encountered during our field investigation including groundwater

- Slope stability analysis results for static and pseudostatic conditions and graphical pots
- Recommendations related to the geotechnical aspects of:
    - Remedial grading
    - Cut and fill slope design
    - Construction considerations
- An appendix that includes a summary of our field investigation and laboratory testing programs.
- Site location map
- Site plan showing proposed mining configuration
- Geologic map

Three hard copies will be provided

2 GEOLOGY AND SEISMICITY

2.1 GEOLOGY

The project is located in the southern portion of the Sacramento Valley. The Sacramento Valley represents the north extension of California's Great Valley Geomorphic Province characterized by a thick accumulation of alluvial and floodplain deposits within an asymmetric trough, approximately 400 miles long and 40 miles wide. The province is bordered to the north by the Cascade and Klamath ranges, to the west by strongly deformed sedimentary and volcanic rock units of the Coast Ranges, to the east by the granitic, gently sloping western foothills of the Sierra Nevada range, and to the south by east-west trending Transverse ranges. Erosion of these mountains has resulted in the accumulation of thousands of feet of granular and fine-grained alluvium in the valley. These deposits thin and terminate on the older bedrock units representative of the mountain provinces along the boundaries of the basin.

Geologic mapping has been performed at the closest detail (1:62,000) by Helley and Harwood (1985) in the site vicinity. Figure 3 shows a portion of this map along with the site location and description of the site geologic units as mapped by Helley and Harwood. The area is characterized from west to east and oldest to youngest by:

- Laguna Formation (map symbol Tl): Pliocene, interbedded alluvial gravel, sand, and silt.
- Turlock Lake Formation (map symbol Qtl): Pleistocene, deeply weathered and dissected arkosic gravels with minor resistant metamorphic rock fragments and quartz pebbles.
- Riverbank Formation:
  - Upper Member (map symbol Qru): Late Pleistocene, unconsolidated but compact dark-brown to red alluvium composed of gravel, sand, silt and with minor clay.
  - Lower Member (map symbol Qrl): Late Pleistocene, red semi-consolidated gravel, sand, and silt.

The project site is mapped underlain by the Turlock Lake Formation. The older Laguna Formation is mapped approximately one third mile west of the site and stratigraphically beneath the Turlock Lake Formation. The Laguna Formation formed topographically higher and was eroded over time before the subsequent Turlock Lake and Riverbank Formations were deposited, respectively, along the eroded relief areas. This erosion and deposition sequence created the terraced topography with older geologic units topographically higher than younger geologic units.

2.2 FAULTING AND SEISMICITY

The project site is located within an area influenced by several major Quaternary faults to the west and east. These include the Dunnigan Hills Fault, the Great Valley fault zone, and the Vaca Fault Zone to the west and the Foothills Fault System (FFS) to east of the project. The nearest Quaternary fault located west of the project site is the Dunnigan Hills fault located 47 miles west. The FFS is represented by multiple faults including the Prairie Creek, Spenceville, Deadman, Maidu, Ione, and Cleveland Hill faults. The closest portion of this fault system is located approximately 28 miles east of the project site. During the life of the project it is probable at least one moderate to severe earthquake generated on one of these faults will cause ground shaking at the site. There is no evidence of recent (Holocene) faulting within the site area and no faults are mapped trending toward or near the site. Active Earthquake Fault Zones are not indicated in the site area by Special Publication 42, as defined by the Alquist-Priolo Earthquake Zoning Act of 1972.

The nearest fault to the project site is the Willows Fault, mapped by Helley & Harwood (1985) about 8 miles west of the site. This is a buried fault (no surface evidence of faulting) and is defined as potentially capable of generating infrequent and moderate magnitude earthquakes along its northern extent north of the Sutter Buttes. The fault is mapped on the basis of offset, deep (i.e. 1,500 feet) bedrock strata and associated groundwater elevation anomalies in that region.

2.2.1 Historic Seismicity

A search of the USGS Earthquake Catalog (http://earthquake.usgs.gov/earthquakes/search/) of earthquakes between 1800 and present day within an approximately 60-mile radius of the site was performed. The data confirms the general absence of large earthquake epicenters (magnitude 4.5 or greater) in the Sacramento region with the most significant events represented by:

- Magnitude 6.0 on August 24, 2014 (South Napa) located approximately 60 miles southwest
- Magnitude 4.5 on January 25, 1980 (Concord) located approximately 52 miles southwest
- Magnitude 5.3 on January 27, 1980 (Concord) located approximately 52 miles southwest
- Magnitude 4.5 on July 4, 1990 (San Francisco) located approximately 56 miles southwest
- Magnitude 4.7 on October 11, 1986 (San Francisco) located approximately 56 miles southwest
- Magnitude 5.8 on January 24, 1980 (San Francisco) located approximately 52 miles southwest
- Magnitude 5.8 on August 1, 1975 (Oroville) located approximately 63 miles north

3 SITE INVESTIGATION

3.1 SITE DESCRIPTION

The proposed pit is located on the southwest corner of the Carli Expansion located northeast of the intersection of Florin Road and Eagles Nest Road, in Sacramento County California. The site is mostly level with low vegetation. A shallow pond is present in the center of the property, approximately 200 feet by 200 feet in size. A water canal extends north-south along the eastern-center of the property. The northeast portion of the site is currently used for organic material processing with a house and multiple out buildings associated with the business. A barb-wire fence extends around the perimeter of the site. Various unpaved, aggregate base access roads are present across the site.

3.2 FIELD INVESTIGATION

3.2.1 Exploratory Borings

The field exploration program, conducted from September 6 through September 8, 2016, included drilling two exploratory borings. A track-mounted, Geoprobe 8140LS drill rig using sonic drilling methods was used to drill the borings. The depths of exploration extended to approximately 90 feet below the ground surface. The approximate locations of the borings are shown on Figure 2. Prior to subsurface exploration, Underground Service Alert (USA) was contacted to provide utility clearance.

A Kleinfelder professional maintained logs of the borings, visually classified the soils encountered according to the Unified Soil Classification System, presented on Figures A-3 and A-4 in Appendix A, and obtained disturbed bulk samples of the subsurface materials. Soil classifications made in the field from samples were in general accordance with ASTM Method D2488. These classifications were re-evaluated in the laboratory after further examination and testing in general accordance with ASTM D2487. The undrained shear strengths of cohesive samples were estimated in the field using a hand-held pocket penetrometer and values are presented on the boring logs. Sample classifications, running times recorded during sampling, and other related information were recorded on the boring logs. A key to the symbols used on the Logs of Borings is presented on Figure A-1. A Soil Description Key is presented on Figure

A-2. Logs of Borings are presented on Figures A-3 and A-4. Borings were located in the field by measuring from existing landmarks. Horizontal coordinates and elevations of the borings were not surveyed. Therefore, the locations of the borings shown on Figure 2 should be considered approximate.

3.2.2 Sampling

Continuous core samples were taken during drilling, the maximum depth explored of 90 feet below the ground surface. Borings B-1 and B-2 were drilled using a track-mounted sonic drill rig equipped with a 10-foot long, 4.75-inch diameter core barrel and button bit. Core extrusions obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance. The core extrusions were contained in plastic sleeves and wooden core boxes and were returned to our Sacramento laboratory for further examination and testing. After the borings were completed, they were backfilled with neat cement grout and upper 5 feet was backfilled with soil. The soil cuttings generated during drilling operations were spread around the area adjacent to the borings.

4 LABORATORY TESTING

Kleinfelder performed laboratory tests on selected soil samples to evaluate certain physical and engineering characteristics. The following laboratory tests were performed:

- Atterberg Limits (ASTM D4318)
- Grain Size Analysis (ASTM D1140 and D422)
- Proctor Compaction (ASTM D1557 Method A)
- Direct Shear (ASTM D3080)

The laboratory test results are presented on the boring logs in Appendix A. Graphic presentation of the results of the Atterberg Limits, Grain Size Analysis, Compaction, and Direct Shear are presented in Appendix B.

5 SUBSURFACE CONDITIONS

5.1 GENERAL

The two borings were advanced on the western and southern boundaries of the property, within the fence line. The surface soils immediately inside the fence line had been recently disced at the time of the investigation. Organic materials were present at the ground surface at each location.

Soils from a depth of 0 to approximately 33 feet below ground surface consist of alternating layers of predominantly sandy silt, silt, and clay with lesser amounts of silty sand and clayey sand. These soils exhibited slight to moderate cementation. Sands are mostly fine grained. Poorly to well graded gravels and cobbles and silty and clayey gravel with sand are present from depths of approximately 33 to 57 feet. The maximum observed particle size was 5 inches. Silt and fine to coarse grained sand are present with the gravels and cobbles. Groundwater was encountered at the bottom of the gravel and cobble layer, at an approximate depth of 57 feet. Sandy silt and sandy clay with gravel were encountered above and below these gravel soils with some cementation. Alternating layers of silt and hard clay were present from depths of approximately 55 to 90 feet with clayey sand with gravel up to ¾ inch encountered at a depth of approximately 73 to 84 feet. Both borings were terminated 90 feet below the ground surface.

As described in Section 2.1, the site is underlain by the Turlock Lake Formation which is describe by Helley and Harwood as deeply weathered and dissected arkosic gravels. However, the subsurface soils encountered are more consistent with the Upper Member of the Riverbank Formation; which is described as dark-brown to red alluvium composed of gravel, sand, and silt with minor clay. The age of the Turlock Lake Formation (between 600,000 and 700,000 years old) is very close to the Riverbank Upper Member (between 130,000 and 450,000 years old) which could account for the inconsistency between the mapped geologic units and the encountered subsurface soils. Detailed descriptions of the subsurface conditions encountered are provided on the boring logs presented in Appendix A. Laboratory test results on soil samples collected from the borings are included in Appendix B

5.2 GROUNDWATER

Free water was encountered in Borings B-1 and B-2 at depths ranging of about 57 to 58 feet while drilling. The regional groundwater elevation is shown on Sacramento County Department of Water Resources Groundwater Elevations Map (Spring 2007) to be between elevation 0 and +10 feet (mean sea level) which correlate to depths of approximately 110 to 120 feet below the current site grade. The water encountered in the borings is considered perched water and not the regional groundwater. Seasonal fluctuations in the groundwater level may occur due to variations in rainfall, temperature, irrigation, pumping from wells, and as a result of other factors that were not evident at the time of our investigation.

Soil and groundwater conditions can deviate from those conditions encountered at the boring locations. Should such deviations be encountered during construction, Kleinfelder should be notified immediately for possible revisions to the recommendations that follow.

6 SLOPE STABILITY ANALYSES RESULTS

Kleinfelder has evaluated slope stability for the proposed Carli Expansion pit slope configurations for static and pseudostatic conditions. This section contains a discussion of the analysis criteria, material properties, cross section selection, and analysis results.

6.1 GEOTECHNICAL CRITERIA FOR MINING PIT STABILITY EVALUATION

Based upon current Sacramento County and surface mining regulations there is not a selected slope stability factor of safety criteria. However, based upon our experience with these types of projects and applications a factor of safety for static conditions of 1.4 and factor of safety for pseudostatic conditions of 1.1 was used for this study.

6.2 MODELING PROGRAM

Slope stability analyses were performed using SLOPE/W Version 8.15.5.11777, developed by GEO-SLOPE International, Ltd. (2012). SLOPE/W was used to perform automatic searches of different potential failure surfaces and to compute the lowest factor of safety (FOS) corresponding to a critical failure surface for a steady-state stability analysis condition. Input parameters for the slope stability model include the pit slope geometry and the approximate unit weight and shear strength properties of the native soils.

Failure surfaces defined by circular arcs or block specified were analyzed using Spencer's method. Spencer's method is a two-dimensional limit-equilibrium method that satisfies force equilibrium of slices and overall moment equilibrium of the potential sliding mass. The inclination of side forces between vertical slices is assumed to be the same for all slices and is calculated along with the FOS. This method uses the pit slope configuration, unit weight and shear strength properties of pit slope and foundation materials, and boundary and internal distribution of forces due to water pressures. After a potential failure surface has been assumed, the soil mass located above the failure surface is divided into a series of vertical slices. Forces acting on each slice include the slice weight, the pore pressure, the effective normal force on the base, the mobilized shear force (including both cohesion and friction), and the horizontal side forces due to earth pressures. Searches for critical failure surfaces were performed by specifying entry and exit ranges for the circular arc analysis or specifying ranges of hinge points and entry and exit angles for the block analysis. For the circular arc analysis, the entry range defines where the failure surface initiates and the exit range defines where the failure surface ends. For the block analysis, the entry and exit angles define where the failure surface begins and ends.

For the purpose of pit slope safety, shallow failure surfaces within the landside slope that do not impact the pit slope crest are judged to be maintenance concerns and do not affect safety. For the purposes of this analysis, a depth of 3 feet was selected as the limiting depth for maintenance concerns. Shallow failures less than 3 feet in height are not addressed in this geotechnical evaluation.

The FOS is calculated by determining the ratio of the resisting force (cohesion and friction along the failure surface) to the driving forces about the center of the assumed failure surface. The computer program was used to perform automatic searches of different potential failure surfaces and to compute the lowest FOS corresponding to a critical failure surface for a particular analysis condition.

6.3 MINING PIT GEOMETRY

Based upon review of the project drawings and communication with Vulcan the proposed mine pit excavation geometry is shown below:

- Final Mining Slope Inclination 1H:1V. This is a temporary slope that will be partially filled during mine reclamation.
- Reclamation Pit Slope Inclination of 1.75H:1V. Fill will be placed against the final mining slope of 1H:1V to achieve the final slope.
- Setback of a minimum of 30 feet from the County roadways to excavation face

6.4 CROSS SECTION DEVELOPMENT

Two cross sections were evaluated using the CADD drawing provided by Vulcan. A cross section drawn east-west across the site near boring location B-1 and a cross section drawn north-south across the site near boring location B-2 were reviewed. The east-west cross section was selected for analysis based upon the location of the exploration and slightly higher ground surface elevation.

The stratigraphy of Boring B-1 was added to the cross section to visually display the subsurface soils encountered. A table summarizing the stratigraphy is provided in Table 1. It should be noted that Pleistocene Alluvium of both the Upper Member of the Riverbank Formation and the Turlock Lake Formation (map symbols Qru and Qtl, respectively) are present at the site. These soils are described as unconsolidated compact dark brown to red gravel, sand and silt with minor clay and deeply weathered arkosic gravels with sand and silt, respectively.

Material properties were selected for these soil layers using laboratory test results, references summarized above, Kleinfelder's experience working in the area and in these soil formations, and published literature correlations including the reference "Shear Strength Correlations for Geotechnical Engineering," published by the Virginia Tech Department of Civil Engineering and Geotechnical Engineering by Duncan, Horz, and Yang 1989. The selected material properties are summarized in Table 2.

Table 1 – Summary of Stratigraphy in Boring B-1

Soil Description	Depth to Top of Layer (feet)	Depth to Bottom of Layer (feet)	Layer Thickness (feet)
Sandy Silt (ML)	0	30.5	30.5
Silty Sand (SM)	30.5	34	3.5
Well-Graded Gravel with Silt and Sand (GW-GM)	34	40	6
Poorly Graded Gravel with Silt and Sand (GP-GM)	40	57.5	17.5
Clayey Sand with Gravel (SC)	57.5	61	3.5
Sandy Silt (ML)	61	73	12
Clayey Sand with Gravel (SC)	73	84	11
Lean Clay with Sand (CL)	84	90	6

Table 2 – Summary of Material Properties for Stability Analysis

Soil Description	Total Unit Weight (pcf)	Effective Strength		Undrained Strength	
		c' (psf)	ϕ' (deg)	c (psf)	ϕ (deg)
Sandy Silt (ML)	110	--	--	1,500	30
Silty Sand (SM)	115	--	--	600	32
Well-Graded Gravel with Silt and Sand (GW-GM)	145	--	--	0	40
Poorly Graded Gravel with Silt and Sand (GP-GM)	145	--	--	0	40
Clayey Sand with Gravel (SC)	120	1,000	30	--	--
Sandy Silt (ML)	110	1,000	28	--	--
Clayey Sand with Gravel (SC)	120	1,000	30	--	--
Lean Clay with Sand (CL)	120	2,500	28	--	--
Engineered Fill	110	100	28	200	20

6.5 SLOPE STABILITY

Two types of loading conditions were evaluated for slope stability. The design factors of safety shown below are based on criteria normally used by this industry as established by the Army Corps of Engineers, the Federal Emergency Management Agency, Caltrans, and the State of California Department of Water Resources Division of Safety of Dams.

- Static, to evaluate long-term open cut excavation slope configuration. Minimum Factor of Safety of 1.4.
- Psuedostatic, applying a horizontal seismic coefficient to evaluate the effect of a seismic event on the open excavation slope configuration. Minimum Factor of Safety of 1.1. The horizontal seismic coefficient (k_h) was taken to be ½ (2/3 PGA_m). The PGA_m was calculated using the USGS Earthquake Hazards program using the project latitude and longitude coordinates and ASCE 7-10 method for Site Class D – "Stiff Soil"

(http://earthquake.usgs.gov/designmaps/us/application.php). The PGA_m was calculated to be 0.257g and the k_h was calculated to be 0.086g.

6.5.1 Mining Pit Slope Stability

The slope stability of the mining pit slopes is primarily a function of the geometry, soil types, soil shear strength, and groundwater elevation, including perched water. It is Kleinfelder's understanding that current upper slopes within adjacent mining pits have been stable at slopes generally flatter than 1H:1V, and more typically closer to 2H:1V. No reported slope distress/failures were provided by Vulcan.

Shallow sloughing that does not extend to the pit slope crest was not evaluated. Circular-type failures that intersect the ground surface were the mode of failure analyzed. For most conditions, circular-type failures most closely resemble expected failure types.

6.5.2 Stability Analyses

Stability analyses results meet the minimum FOS requirements for static and pseudostatic conditions. This is attributed mainly to the cementation and consolidated properties of the underlying soils. Results of stability analyses are shown in Table 3.

Table 3 - Summary of Slope Stability Analyses Results

Case	Condition	Factor of Safety	Analysis Results Figure Number
Static	Final Pit, 1H:1V slopes (depth 70 feet)	1.72	C-1
	Reclaimed, 1.75H:1V slopes (depth 35 feet)	1.41	C-3
Pseudostatic	Final Pit, 1H:1V slopes (depth 70 feet)	1.44	C-2
	Reclaimed, 1.75H:1V slopes (depth 35 feet)	1.19	C-4

The final slope configuration has a lower factor of safety, since the fill placed against the slope has a lower shear strength than the native soils.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 GENERAL

Our evaluation has not identified geologic, seismic, or soils conditions that would preclude excavation of the proposed mining pit. However, based on the results of the field investigation and laboratory testing programs, there are several geotechnical issues that should be considered in the project design and construction. The primary consideration identified from a geotechnical standpoint is the presence of relatively clean well and poorly graded gravel and cobbles soils which may not stand at steep cut slope inclinations without having surficial sloughing. Recommendations regarding the geotechnical aspects of project design and construction are presented in the following sections of this report.

7.2 GROUNDWATER

Perched groundwater was encountered at a depth of approximately 58 feet below existing site grade within the clay, silt, and clayey sand layers directly below the gravel. This perched groundwater is likely to be encountered during the proposed mining operations final depth of excavation of approximately 70 feet.

It is recommended accumulated water be removed from the active excavation site during mining and prior to backfill of the pit.

7.3 EXCAVATIONS

Based upon results of the slope stability analysis, it is Kleinfelder's opinion the proposed mining excavation slopes meet criteria at 1H:1V for the final pit depth and 1.75H:1V backfilled with engineered fill for the reclaimed pit depth under both static and pseudostatic loading conditions. These results are dependent upon the depth of perched groundwater and the removal of water from the active mining face.

7.4 EARTHWORK – PIT SLOPE RECLAMATION

7.4.1 General

Site preparation and earthwork operations for pit slope reclamation should be performed in accordance with applicable codes, safety regulations and other local, state or federal specifications, and the recommendations included in this report. References to maximum dry unit weights are established in accordance with the latest version of ASTM Test Method D1557 (modified Proctor). The earthwork operations should be observed and tested by a representative of Kleinfelder.

Prior to replacing soils, the exposed subgrade should be compacted with at least a 10-ton roller. Following compaction, subgrade should be proof-rolled with a fully-loaded tandem-axle dump truck or water truck. Areas identified as being soft or yielding may require additional compaction or over-excavation.

7.5 ENGINEERED FILL

We understand overburden soils will be used as engineered fill to backfill the mining pit and provide a 1.75H:1V backfilled buttress to the mined slopes and to backfill the mine pit bottom to Elevation +85. This material was modeled using the strength obtained from a sampled compacted to 85 percent relative compaction in the stability analysis. Therefore, it is recommended the buttress fill be placed in such a manner as to meet this criteria.

7.5.1 Compaction Criteria

Soils used for engineered fill to raise the bottom of the pit to the reclaimed elevation should be uniformly moisture-conditioned to between 2 and 5 percent above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. The upper twelve inches of subgrades should be compacted to at least 95 percent relative compaction. Fills exceeding 5 feet in thickness should be compacted to at least 95 percent relative compaction for their full depth.

Engineered fill to be placed as a buttress at the base of the excavated pit slopes should be placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 85 percent relative compaction. Note: Disking and/or blending will likely be required to uniformly moisture-condition soils used for engineered fill.

8 ADDITIONAL SERVICES

8.1 PLANS AND SPECIFICAITONS

We recommend Kleinfelder conduct a general review of final plans and specifications to evaluate that our recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

8.2 CONSTRUCTION OBSERVATIONS AND TESTING

We recommend that all earthwork during construction be monitored by a representative from Kleinfelder, including site preparation, placement of all engineered fill and trench backfill, construction of roadway subgrades, and all structure foundation excavations. The purpose of these services would be to provide Kleinfelder the opportunity to observe the soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

9 LIMITATIONS

Recommendations contained in this report are based on field observations and subsurface explorations, limited laboratory tests, and the present knowledge of the proposed construction. It is possible that soil conditions could vary between or beyond the points explored. If the scope of the proposed construction changes from that described in this report, recommendations contained in this report should also be reviewed. This report has been prepared in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of this study. No warranty, express or implied, is made.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinion, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction. Furthermore, the contractor should be prepared to handle contamination conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers.

10 REFERENCES

County of Sacramento. Sacramento County, California, Groundwater Elevations, Spring 2007. Department of Water Resources, drawn March 2009. www.waterresources.saccounty.net/pages/countourmaps.aspx

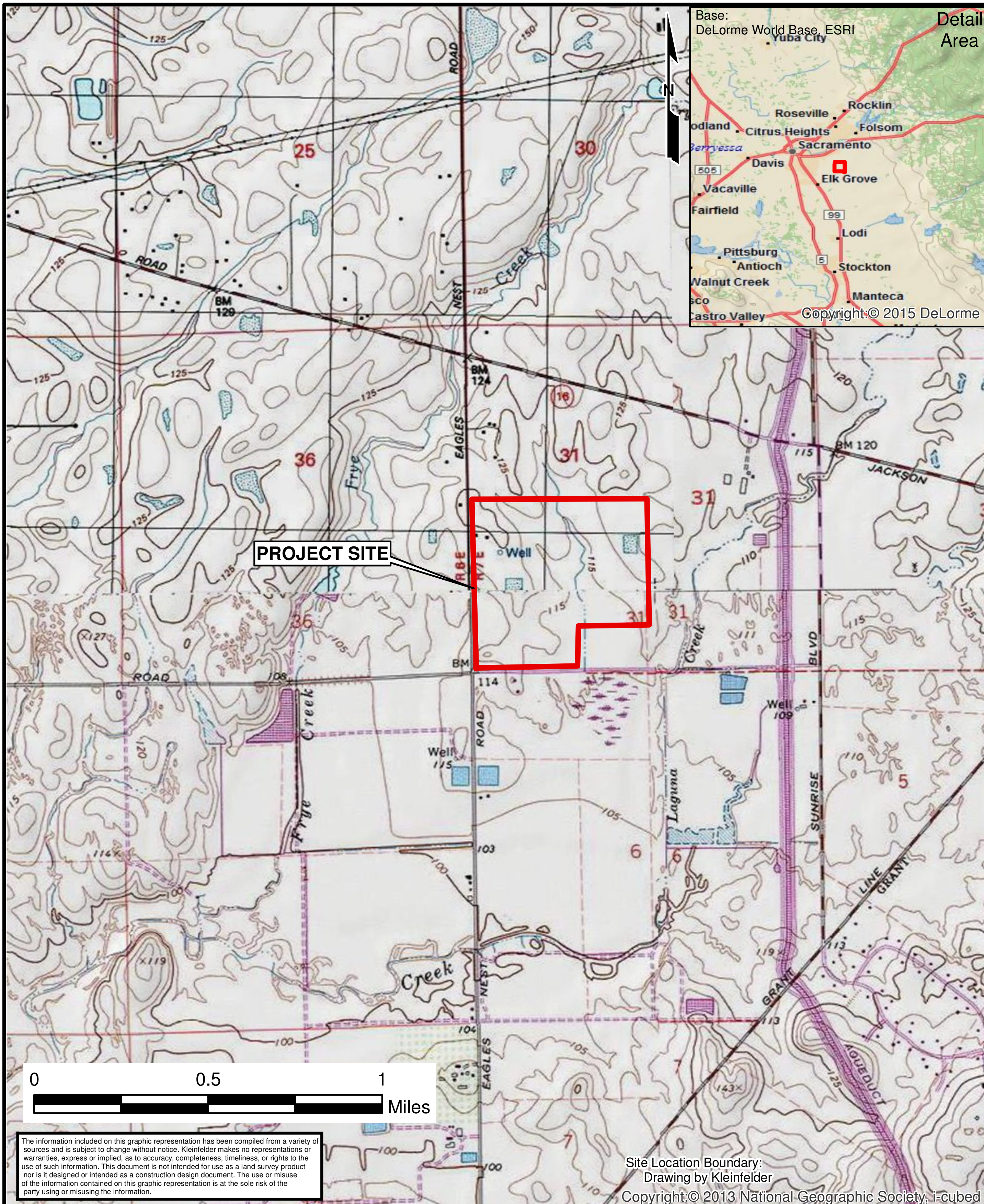
Helley, E.J., and D.S. Harwood (1985) "Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California," U.S. Geological Survey Miscellaneous Field Studies Map MF-1790.

U.S. Geological Survey (USGS) Search Earthquake Catalog, accessed 10-21-16 at: http://earthquake.usgs.gov/earthquakes/search

U.S. Geological Survey (USGS) Geologic Hazards Science Center website (http://geohazards.usgs.gov/designmaps/us/application.php

FIGURES

Date Saved: never never



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PROJECT NO. 20171856	
DRAWN:	11/10/2016
DRAWN BY:	D. Ross
CHECKED BY:	M. Beswick
FILE NAME: .mxd	

SITE LOCATION MAP

Vulcan - Carli Expansion
Florin Road
Sacramento, California

FIGURE
1

Document Path:

PLOTTED: 11 Nov 2016, 12:07pm, dross

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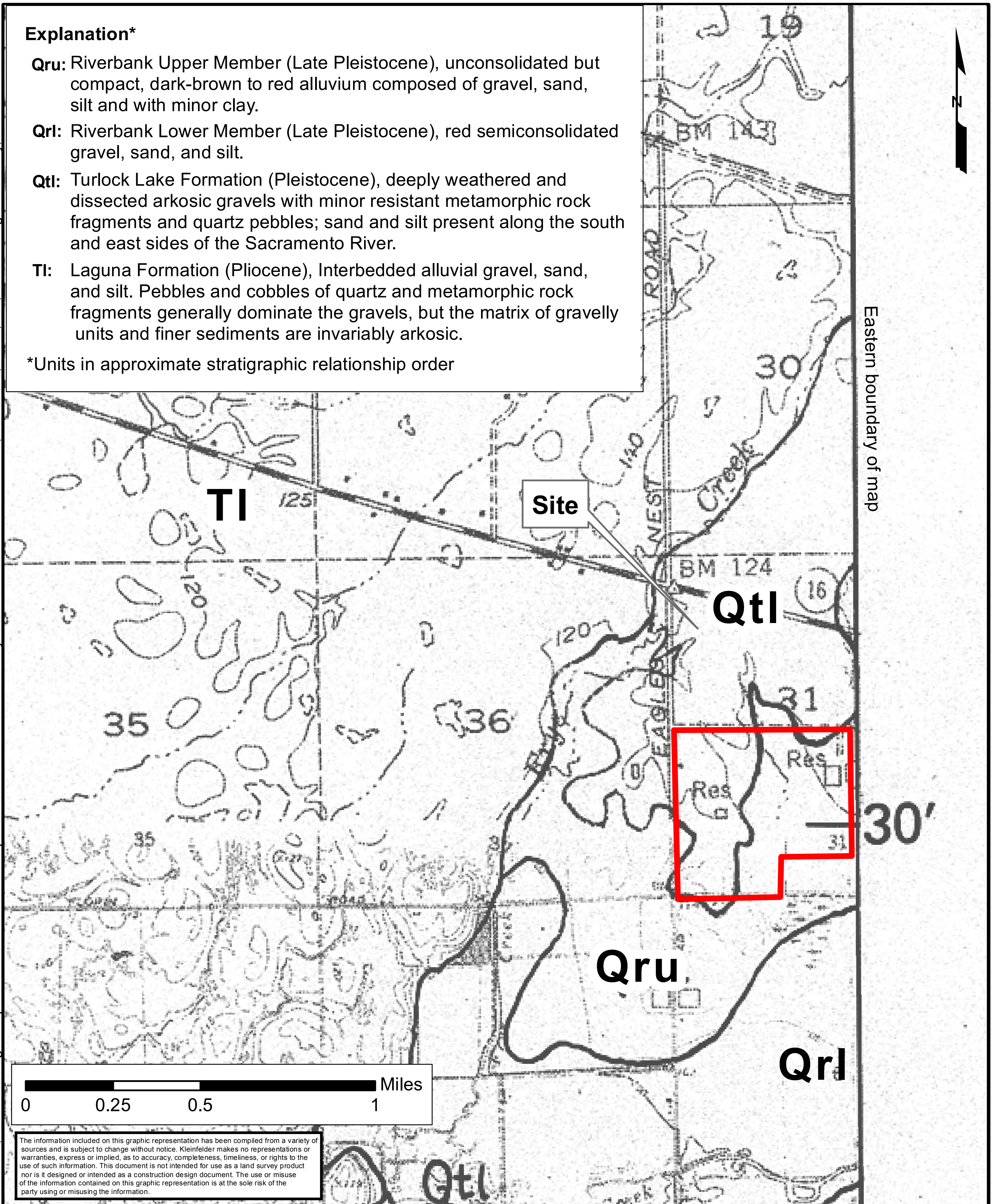
PROJECT NO.	20171856
DRAWN:	11/11/2016
DRAWN BY:	D. Ross
CHECKED BY:	C. Riddle
FILE NAME:	20171856_2.dwg

BORING LOCATION MAP

Vulcan - Carli Expansion
Florin Road
Sacramento, California

FIGURE
2

CAD FILE: K:\2016_PROJECTS\20171856.001A-Vulcan-Carli Expansion\CAD\ LAYOUT: Layout1



Source: Helley, E.J., and Harwood, D.S. "Geologic Map of the Late Cenozoic deposits of the Sacramento Valley and northern Sierran Foothills, California," 1:62,500, U.S. Geological Survey, 1985

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PROJECT NO. 20171856	
DRAWN:	11/1/2016
DRAWN BY:	M. Beswick
CHECKED BY:	B. Anderson
FILE NAME:	VulcanRegGeoMap.mxd

REGIONAL GEOLOGY MAP

Vulcan - Carli Expansion
Florin Road
Sacramento, California

FIGURE
3

APPENDIX A
LOGS OF EXPLORATORY BORINGS

SAMPLE/SAMPLER TYPE GRAPHICS

- BULK / GRAB / BAG SAMPLE
- MODIFIED CALIFORNIA SAMPLER (2 or 2-1/2 in. (50.8 or 63.5 mm.) outer diameter)
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)
- SHELBY TUBE SAMPLER
- HOLLOW STEM AUGER
- SOLID STEM AUGER
- WASH BORING
- NQ CORE SAMPLE (1.874 in. (47.6 mm.) core diameter)
- TEXAS CONE PENETRATION

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Division	Subdivision	Fines	Criteria	Symbol	Description
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu≥4 and 1≤Cc≤3	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu<4 and/ or 1>Cc>3	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu≥4 and 1≤Cc≤3	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu<4 and/ or 1>Cc>3	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu≥6 and 1≤Cc≤3	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu<6 and/ or 1>Cc>3	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu≥6 and 1≤Cc≤3	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu<6 and/ or 1>Cc>3	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

Major Division	Subdivision	Symbol	Description
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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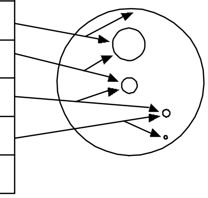
PROJECT NO.:	20171856	GRAPHICS KEY	FIGURE
DRAWN BY:	DR		
CHECKED BY:	BM	Vulcan-Carli Expansion Florin Road Sacramento, California	A-1
DATE:	9/12/2016		
REVISED:	11/4/2016		

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

Term of Use	AMOUNT: Secondary Constituent is Fine Grained	AMOUNT: Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MUNSELL COLOR

NAME	ABBR	NAME	ABBR
Red	R	Blue	B
Yellow Red	YR	Purple Blue	PB
Yellow	Y	Purple	P
Green Yellow	GY	Red Purple	RP
Green	G	Black	N
Blue Green	BG		

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure.
Moderately	Crumbles or breaks with considerable finger pressure.
Strongly	Will not crumble or break with finger pressure.

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium	4 - 8	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

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PROJECT NO.: 20171856	SOIL DESCRIPTION KEY	FIGURE
DRAWN BY: DR		
CHECKED BY: BM	Vulcan-Carli Expansion Florin Road Sacramento, California	A-2
DATE: 9/12/2016		
REVISED: 11/4/2016		

Date Begin - End:	9/07/2016 - 9/08/2016	**Drilling Company:**	Cascade	**BORING LOG B-1**
Logged By:	C. Riddle	**Drill Crew:**	Brandon	
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Geoprobe 8140LS	
Plunge:	-90 degrees	**Drilling Method:**	Sonic Drill Rig	
Weather:	Sunny	**Bore Diameter:**	4.75 in. O.D.	

Depth (feet)	Graphical Log	FIELD EXPLORATION Surface Condition: Soil Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy SILT (ML): low plasticity, olive brown, moist, soft to firm, weakly to moderately cemented, fine sand, crumbly texture												Hand auger to 4 feet
5			Run 1 (4-6')											
			Run 1 (6-8')											
			Run 1 (8-9')											
10		**Sandy SILT (ML)**: low to medium plasticity, olive brown, moist, weakly cemented, fine sand	Run 2 (9-11')								56			
		soft, non-plastic fines	Run 3 (11-14')											
15		**SILT with Sand (ML)**: low to medium plasticity, olive brown, moist, hard, weakly cemented, fine sand	Run 4 (14-16')		PP=>4.5									
			Run 4 (16-18')		PP=4.0							43	16	
			Run 4 (18-19')											
			Run 5											

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PROJECT NO.: 20171856	BORING LOG B-1	FIGURE
DRAWN BY: DR		
CHECKED BY: BM	Vulcan-Carli Expansion Florin Road Sacramento, California	A-3
DATE: 9/12/2016		
REVISED: 11/4/2016		PAGE: 1 of 5

Date Begin - End:	9/07/2016 - 9/08/2016	Drilling Company:	Cascade
Logged By:	C. Riddle	Drill Crew:	Brandon
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Geoprobe 8140LS
Plunge:	-90 degrees	Drilling Method:	Sonic Drill Rig
Weather:	Sunny	Bore Diameter:	4.75 in. O.D.

BORING LOG B-1

Depth (feet)	Graphical Log	Lithologic Description (Surface Condition: Soil)	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		SILT with Sand (ML): low to medium plasticity, olive brown, moist, hard, weakly cemented, fine sand	(19-20')											
			Run 6 (20-22')											
			Run 6 (22-24')											
25			Run 6 (24-26')											
			Run 6 (26-28')											
			Run 7 (28-30')											
30			Run 7 (30-32')		PP=>4.5									
		Silty SAND (SM): brown, moist, medium dense, fine to medium sand, non-plastic fines												
			Run 7 (32-34')								30			
		Well-graded GRAVEL with Silt and Sand (GW-GM): brownish gray, moist, dense, fine to coarse subrounded gravel up to 3 inches, fine to coarse sand, non-plastic fines	Run 7 (34-36')											
35														
			Run 8 (36-38')											
			Run 8 (38-40')				GW-GM			45	12			

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PROJECT NO.:	20171856
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CHECKED BY:	BM
DATE:	9/12/2016
REVISED:	11/4/2016

BORING LOG B-1

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE
A-3

Date Begin - End:	9/07/2016 - 9/08/2016	**Drilling Company:**	Cascade
Logged By:	C. Riddle	**Drill Crew:**	Brandon
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Geoprobe 8140LS
Plunge:	-90 degrees	**Drilling Method:**	Sonic Drill Rig
Weather:	Sunny	**Bore Diameter:**	4.75 in. O.D.

BORING LOG B-1

Surface Condition: Soil

Depth (feet)	Lithologic Description	Sample Number	Recovery (NR=No Recovery)	USCS Symbol	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
	Poorly graded GRAVEL with Silt and Sand (GP-GM): brownish gray, moist, dense, fine to coarse subrounded gravel up to 3 inches, fine to coarse sand, non-plastic fines	Run 9 (40-42')					NP	NP
		Run 9 (42-44')						
45		Run 9 (44-46')						
		Run 9 (46-48')						
		Run 10 (48-49')		GP-GM	42	10		
50	gravel up to 4 inches	Run 10 (49-51')						
		Run 10 (51-53')						
		Run 10 (53-55')						
55		Run 11 (55-57')	NR					
	Clayey SAND with Gravel (SC): low plasticity, reddish brown to dark brown, wet, dense, fine to coarse sand, fine to coarse subrounded gravel up to 2 inches	Run 12 (57-59')						
		Run 12 (59-61')						

Additional columns (no entries on this page): Sample Type, Pocket Pen(PP)= tsf, Water Content (%), Dry Unit Wt. (pcf), Additional Tests/Remarks

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PROJECT NO.:	20171856
DRAWN BY:	DR
CHECKED BY:	BM
DATE:	9/12/2016
REVISED:	11/4/2016

BORING LOG B-1

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE
A-3

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PLOTTED: 11/04/2016 07:02 AM BY: dross
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gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2016.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End:	9/07/2016 - 9/08/2016	Drilling Company:	Cascade
Logged By:	C. Riddle	Drill Crew:	Brandon
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Geoprobe 8140LS
Plunge:	-90 degrees	Drilling Method:	Sonic Drill Rig
Weather:	Sunny	Bore Diameter:	4.75 in. O.D.

BORING LOG B-1

Depth (feet)	Graphical Log	FIELD EXPLORATION: Lithologic Description (Surface Condition: Soil)	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		SILT (ML): low plasticity, olive brown to yellowish brown, moist, very hard, fine sand	Run 12 (61-63')		PP=>4.5									
			Run 12 (63-65')											
65			Run 12 (65-67')		PP=>4.5									
		Sandy SILT (ML): low plasticity, brown, moist, firm, fine sand			PP=2.25									
			Run 13 (67-69')				ML				87	45	18	
			Run 13 (69-71')											
70		**Sandy SILT (ML)**: low plasticity, brown, moist, firm, fine sand			PP=4.0									
			Run 13 (71-73')		PP=3.5									
		Clayey SAND with Gravel (SC): dark brown to dark reddish brown, moist, very dense, fine to coarse sand, fine subrounded gravel up to 3/4 inch, low plasticity fines	Run 14 (73-74')											
75			Run 14 (74-76')											
		reddish brown	Run 14 (76-78')		PP=4.5									
			Run 14 (78-80')											

Date Begin - End:	9/07/2016 - 9/08/2016	Drilling Company:	Cascade
Logged By:	C. Riddle	Drill Crew:	Brandon
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Geoprobe 8140LS
Plunge:	-90 degrees	Drilling Method:	Sonic Drill Rig
Weather:	Sunny	Bore Diameter:	4.75 in. O.D.

BORING LOG B-1

Depth (feet)	Graphical Log	FIELD EXPLORATION Surface Condition: Soil Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Clayey SAND with Gravel (SC): dark brown to dark reddish brown, moist, very dense, fine to coarse sand, fine subrounded gravel up to 3/4 inch, low plasticity fines	Run 15 (80-82')											
			Run 15 (82-84')											
85		**Lean CLAY with Sand (CL)**: medium plasticity, olive to olive brown, moist, firm, fine sand	Run 15 (84-86')		PP=2.5									
			Run 15 (86-88')		PP=2.0 PP=2.25									
90														

The boring was terminated at approximately 90 ft. below ground surface. The boring was backfilled with neat cement grout to 5 feet below ground surface and capped with cuttings

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 57 ft. below ground surface during drilling.
GENERAL NOTES:
6 inch diameter casing installed to 40 feet

95

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DATE:	9/12/2016
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BORING LOG B-1

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE
A-3

BORING LOG B-2

Date Begin - End:	9/06/2016 - 9/07/2016	**Drilling Company:**	Cascade
Logged By:	M. Galouei/C. Riddle	**Drill Crew:**	Brandon
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Geoprobe 8140LS
Plunge:	-90 degrees	**Drilling Method:**	Sonic Drill Rig
Weather:	Sunny	**Bore Diameter:**	4.75 in. O.D.

FIELD EXPLORATION / LABORATORY RESULTS

Surface Condition: Gravel and cobbles

Depth (feet)	Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	Silty SAND (SM): yellowish brown, moist, soft, fine to medium sand, non-plastic fines												
5	brown, firm, weakly to moderately cemented	Run 1 (5-7')											
	yellowish brown	Run 1 (7-10')											
10	**Clayey SAND (SC)**: red, moist, firm, weakly to moderately cemented, fine to medium sand, low plasticity fines	Run 2 (10-12')											
		Run 3 (12-14')											
	Lean CLAY with Sand (CL): high plasticity, reddish brown, moist, moderately to strongly cemented												
		Run 4 (14-16')								64			
15	**Sandy SILT (ML)**: low plasticity, brown, moist, firm, weakly cemented, fine to medium sand												
	Lean CLAY (CL): medium plasticity, brown, moist, firm, weakly to moderately cemented, trace fine to medium sand	Run 4 (16-18')											
	Sandy SILT (ML): medium plasticity, yellowish brown, moist, soft, weakly to moderately cemented, fine to medium sand	Run 5 (18-21')											

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Date Begin - End:	9/06/2016 - 9/07/2016	Drilling Company:	Cascade
Logged By:	M. Galouei/C. Riddle	Drill Crew:	Brandon
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Geoprobe 8140LS
Plunge:	-90 degrees	Drilling Method:	Sonic Drill Rig
Weather:	Sunny	Bore Diameter:	4.75 in. O.D.

BORING LOG B-2

FIELD EXPLORATION / LABORATORY RESULTS

Surface Condition: Gravel and cobbles

Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy SILT (ML): medium plasticity, yellowish brown, moist, soft, weakly to moderately cemented, fine to medium sand dark yellowish brown	Run 5 (21-22.5											
		non-plastic, weakly to moderately cemented	Run 5 (22.5-25									NP	NP	
25		hard	Run 6 (25-26')											
			Run 6 (26-28')											
		Lean CLAY with Sand (CL): medium plasticity, yellowish brown, moist, hard, fine to medium sand	Run 6 (28-30')											
30		**Silty SAND (SM)**: brown, moist, dense, non-plastic fines	Run 7 (30-33')				SM				15			
		Poorly graded GRAVEL with Silt and Sand (GP-GM): brown, moist, fine to coarse gravel, with subrounded cobbles	Run 7 (33-35')											
35		**Silty GRAVEL with Sand (GM)**: brown, moist, fine to coarse gravel, with subrounded cobbles subangular cobbles	Run 7 (35-37')				GM			53	13			
		subrounded cobbles	Run 8 (37-40')									NP	NP	

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BORING LOG B-2

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE

A-4

Date Begin - End:	9/06/2016 - 9/07/2016	**Drilling Company:**	Cascade
Logged By:	M. Galouei/C. Riddle	**Drill Crew:**	Brandon
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Geoprobe 8140LS
Plunge:	-90 degrees	**Drilling Method:**	Sonic Drill Rig
Weather:	Sunny	**Bore Diameter:**	4.75 in. O.D.

BORING LOG B-2

Depth (feet)	Graphical Log	FIELD EXPLORATION — Surface Condition: Gravel and cobbles / Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS — USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Silty GRAVEL with Sand (GM): brown, moist, fine to coarse gravel, with subrounded cobbles increasing subrounded cobbles	Run 8 (40-42')											
		subangular cobbles	Run 8 (42-44')											
45			Run 8 (44-46')											
		Clayey GRAVEL with Sand (GC): brown, moist, dense, fine to coarse subrounded gravel up to 2 inches, fine to coarse sand, low plasticity fines	Run 9 (46-47.5											
			Run 9 (47.5-50							52	15			
50		**Silty GRAVEL with Sand (GM)**: light brown, moist, dense, fine to coarse subrounded gravel up to 3 inches, fine to coarse sand, non-plastic fines	Run 10 (50-52')											
			Run 10 (52-54')											
55		**Lean CLAY (CL)**: medium to high plasticity, olive brown, moist, very hard	Run 10 (54-56')											
			Run 10 56-58		PP=>4.5									
∇		**SILT (ML)**: low plasticity, olive, moist, firm, trace fine sand	Run 11 (58-60')		PP=3.25									

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20171856	BORING LOG B-2	FIGURE
	DRAWN BY: DR		
	CHECKED BY: BM	Vulcan-Carli Expansion Florin Road Sacramento, California	A-4
	DATE: 9/12/2016		
	REVISED: 11/4/2016		PAGE: 3 of 5

Date Begin - End:	9/06/2016 - 9/07/2016	**Drilling Company:**	Cascade
Logged By:	M. Galouei/C. Riddle	**Drill Crew:**	Brandon
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Geoprobe 8140LS
Plunge:	-90 degrees	**Drilling Method:**	Sonic Drill Rig
Weather:	Sunny	**Bore Diameter:**	4.75 in. O.D.

BORING LOG B-2

Surface Condition: Gravel and cobbles

Depth (feet)	Graphical Log	FIELD EXPLORATION: Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lean CLAY with Sand (CL): low plasticity, olive, moist, firm, fine sand	Run 11 (60-62.5		PP=1.75		CL				78	36	16	
		Sandy SILT (ML): low plasticity, olive brown, moist, soft to firm, fine sand increasing with depth	Run 11 (62.5-65		PP=2.25									
65			Run 11 (65-67.5											
		Fat CLAY (CH): high plasticity, olive brown to reddish brown, moist, very hard			PP=>4.5									
			Run 11 (67.5-70											
70			Run 12 (70-73')											
		Fat CLAY with Sand (CH): high plasticity, olive brown to reddish brown, moist, very hard, fine sand			PP=>4.5									
		Lean CLAY (CL): medium plasticity, reddish brown, moist, hard to very hard, fine sand	Run 12 (73-75')		PP=>4.5									
75		**Lean CLAY with Sand (CL)**: medium plasticity, reddish brown, moist, hard to very hard, fine sand	Run 12 (75-77')		PP=4.0									
		Clayey SAND with Gravel (SC): reddish brown, wet, dense, fine to coarse sand, fine gravel up to 3/4 inch, low plasticity fines	Run 13 (77-80')											

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DATE:	9/12/2016
REVISED:	11/4/2016

BORING LOG B-2

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE
A-4

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Date Begin - End:	9/06/2016 - 9/07/2016	Drilling Company:	Cascade
Logged By:	M. Galouei/C. Riddle	Drill Crew:	Brandon
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Geoprobe 8140LS
Plunge:	-90 degrees	Drilling Method:	Sonic Drill Rig
Weather:	Sunny	Bore Diameter:	4.75 in. O.D.

BORING LOG B-2

Surface Condition: Gravel and cobbles

Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Clayey SAND with Gravel (SC): reddish brown, wet, dense, fine to coarse sand, fine gravel up to 3/4 inch, low plasticity fines	Run 13 (80-82')											
		Lean CLAY (CL): medium plasticity, dark reddish brown, moist, hard, fine sand	Run 13 (82-84')		PP=3.25									
85			Run 13 (84-86')		PP=3.0									
			Run 13 (86-88')											
			Run 13 (88-90')		PP=1.75 PP=2.50									
90														
95														

The boring was terminated at approximately 90 ft. below ground surface. The boring was backfilled with neat cement grout to 5 feet below ground surface and capped with cuttings

GROUNDWATER LEVEL INFORMATION:
⊻ Groundwater was observed at approximately 58 ft. below ground surface during drilling.
GENERAL NOTES:
6 inch diameter casing installed to 60 feet

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BORING LOG B-2

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE
A-4

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APPENDIX B
LABORATORY TEST RESULTS

Exploration ID	Depth (ft.)	Sample No.	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%) Passing 3/4"	Sieve Analysis (%) Passing #4	Sieve Analysis (%) Passing #200	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plasticity Index	Additional Tests
B-1 & B-2	5.0 - 30.0	Composite	SAND SILT (ML)									**Direct Shear ASTM D3080**: c=0.2 tsf, 30.7ø **ASTM D1557 Method A=** Maximum Dry Unit Weight: 107.9 pcf Optimum Water Content: 17.5%
B-1	9.0 - 11.0	Run 2 (9-11')	SANDY SILT (ML)					56				
B-1	16.0 - 18.0	Run 4 (16-18')	SILT (ML)						43	27	16	
B-1	32.0 - 34.0	Run 7 (32-34')	SILTY SAND (SM)					30				
B-1	38.0 - 40.0	Run 8 (38-40')	WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)			81	45	12				
B-1	40.0 - 48.0	Run 9 (40-42')	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)						NP	NP	NP	
B-1	48.0 - 49.0	Run 10 (48-49')	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)			72	42	10				
B-1	67.0 - 69.0	Run 13 (67-69')	SANDY SILT (ML)					87	45	27	18	
B-2	14.0 - 16.0	Run 4 (14-16')	SANDY SILT (ML)					64				
B-2	22.5 - 25.0	Run 5 (22.5-25')	SANDY SILT (ML)						NP	NP	NP	
B-2	30.0 - 33.0	Run 7 (30-33')	SILTY SAND (SM)					15				
B-2	35.0 - 37.0	Run 7 (35-37')	SILTY GRAVEL WITH SAND (GM)			89	53	13				
B-2	37.0 - 46.0	Run 8 (37-40')	SILTY GRAVEL WITH SAND (GM)						NP	NP	NP	
B-2	47.5 - 50.0	Run 9 (47.5-50')	CLAYEY GRAVEL WITH SAND (GC)			86	52	15				
B-2	60.0 - 62.5	Run 11 (60-62.5')	LEAN CLAY WITH SAND (CL)					78	36	20	16	

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic
NA = Not Available

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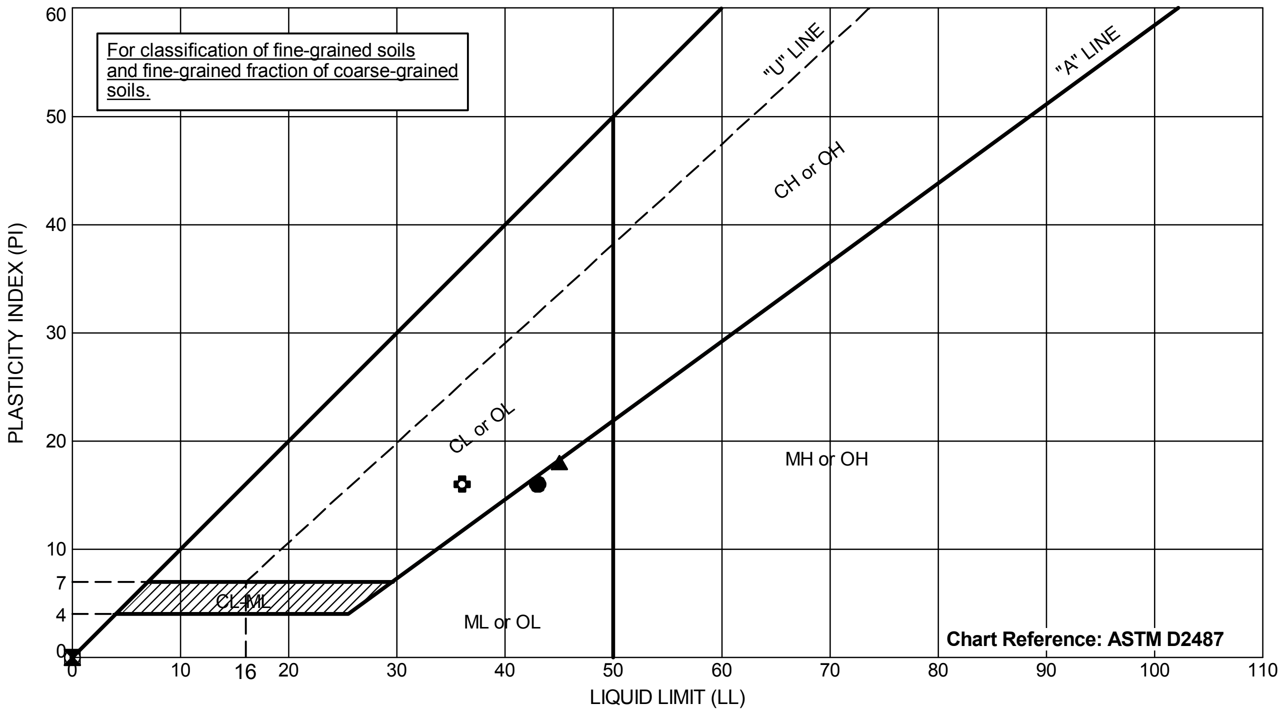
LABORATORY TEST RESULT SUMMARY

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE B-1



	Exploration ID	Depth (ft.)	Sample Number	Sample Description	Passing #200	LL	PL	PI
●	B-1	16 - 18	Run 4 (16-18')	SILT (ML)	NM	43	27	16
⧗	B-1	40 - 48	Run 9 (40-42')	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)	NM	NP	NP	NP
▲	B-1	67 - 69	Run 13 (67-69')	SANDY SILT (ML)	87	45	27	18
×	B-2	22.5 - 25	Run 5 (22.5-25')	SANDY SILT (ML)	NM	NP	NP	NP
⊙	B-2	37 - 46	Run 8 (37-40')	SILTY GRAVEL WITH SAND (GM)	NM	NP	NP	NP
✿	B-2	60 - 62.5	Run 11 (60-62.5')	LEAN CLAY WITH SAND (CL)	78	36	20	16

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NA = Not Available
NM = Not Measured

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PROJECT NO.: 20171856	ATTERBERG LIMITS		FIGURE
DRAWN BY: DR			
CHECKED BY: BM	Vulcan-Carli Expansion Florin Road Sacramento, California		B-2
DATE: 9/12/2016			
REVISED: 11/4/2016			

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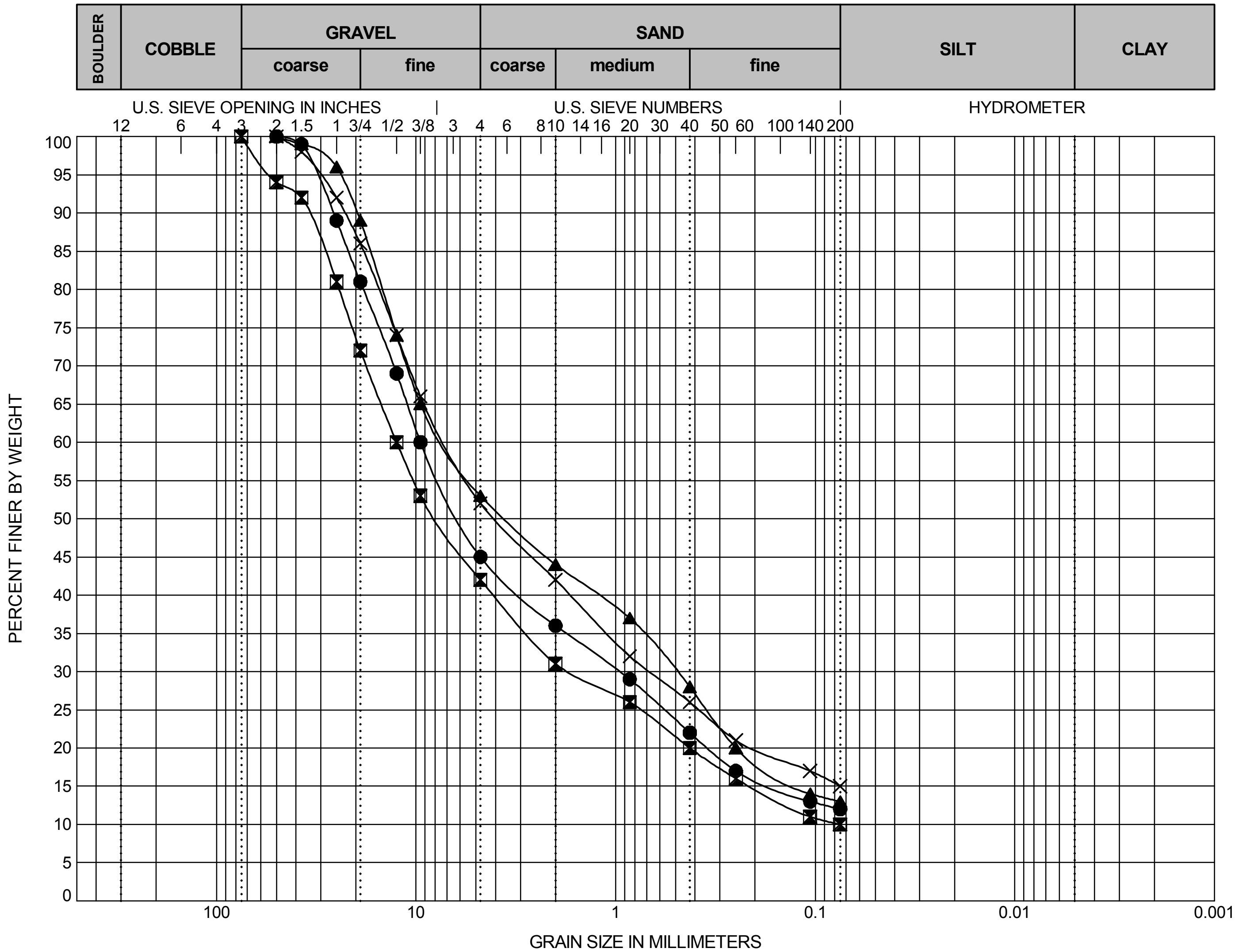

	Exploration ID	Depth (ft.)	Sample Number	Sample Description	LL	PL	PI
●	B-1	38 - 40	Run 8 (38-40')	WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)	NM	NM	NM
⧗	B-1	48 - 49	Run 10 (48-49')	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)	NM	NM	NM
▲	B-2	35 - 37	Run 7 (35-37')	SILTY GRAVEL WITH SAND (GM)	NM	NM	NM
×	B-2	47.5 - 50	Run 9 (47.5-50')	CLAYEY GRAVEL WITH SAND (GC)	NM	NM	NM

	Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	B-1	38 - 40	50	9.5	0.961	NM	2.59	253.02	81	45	12	NM	NM
⧗	B-1	48 - 49	75	12.5	1.685	0.075	3.03	166.67	72	42	10	NM	NM
▲	B-2	35 - 37	50	7.117	0.496	NM	NM	NM	89	53	13	NM	NM
×	B-2	47.5 - 50	50	7.058	0.675	NM	NM	NM	86	52	15	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.
NP = Nonplastic
NA = Not Available
NM = Not Measured

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$
Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60} D_{10}$
D_{60} = Grain diameter at 60% passing
D_{30} = Grain diameter at 30% passing
D_{10} = Grain diameter at 10% passing

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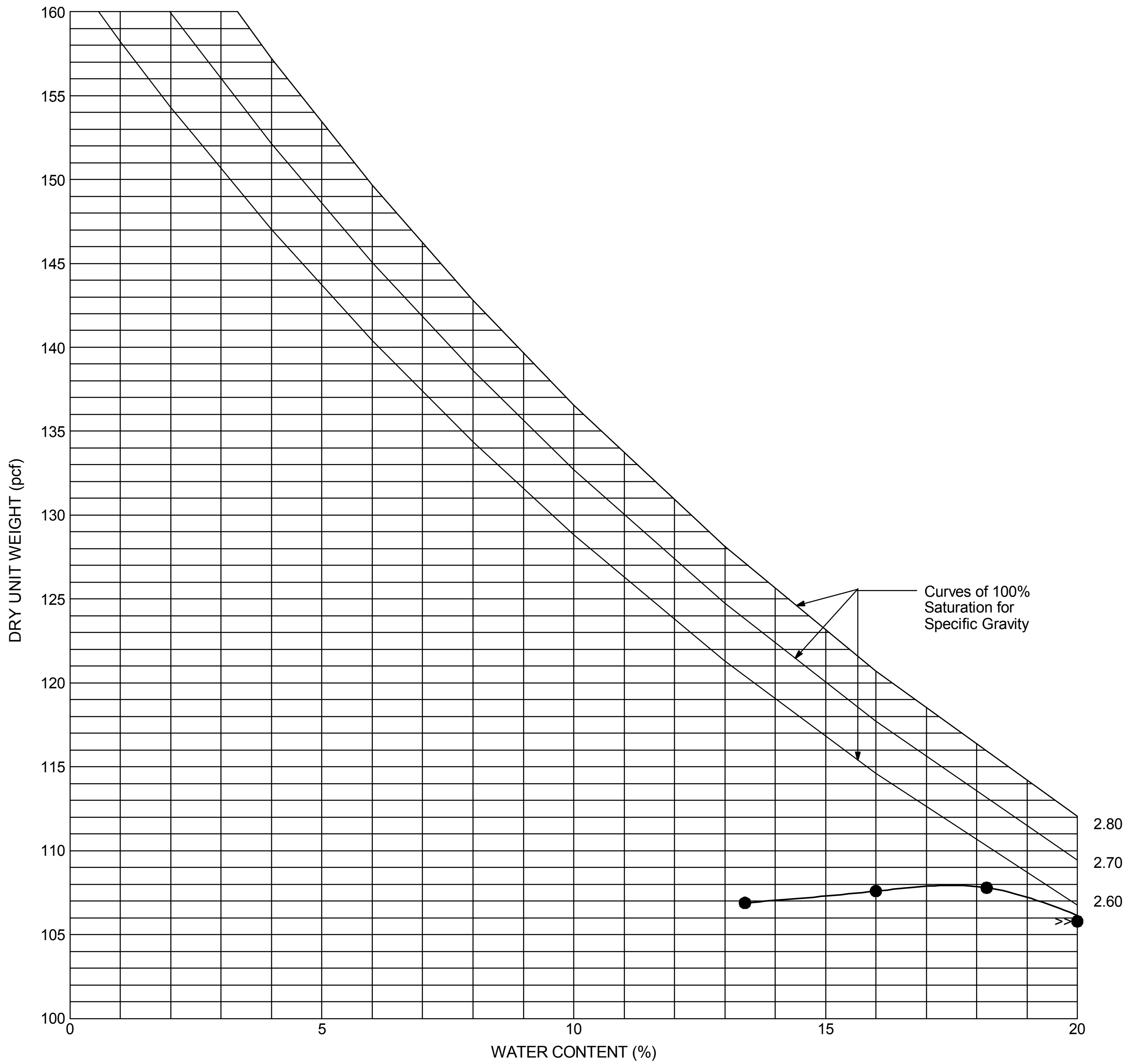
PROJECT NO.:	20171856
DRAWN BY:	DR
CHECKED BY:	BM
DATE:	9/12/2016
REVISED:	11/4/2016

SIEVE ANALYSIS

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE
B-3



Exploration ID		Depth (ft.)	Sample Number	Sample Description
●	B-1 & B-2	5 - 30	Composite	SAND SILT (ML)

Passing 3/4"	Passing #4	Passing #200	LL	PL	PI	Maximum Dry Unit Weight (pcf)	Optimum Water Content (%)
NM	NM	NM	NM	NM	NM	107.9	17.5

Testing performed in general accordance with ASTM D1557 Method A.
NP = Nonplastic
NA = Not Available
NM = Not Measured

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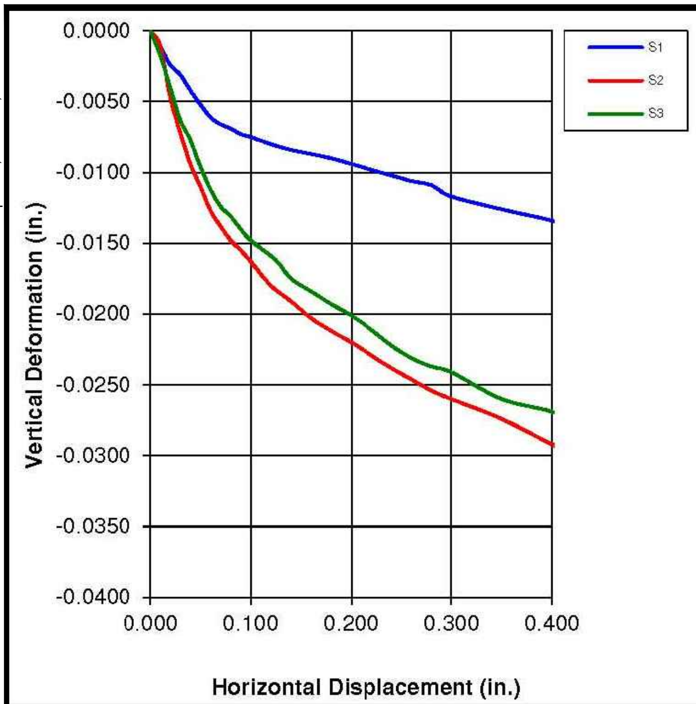
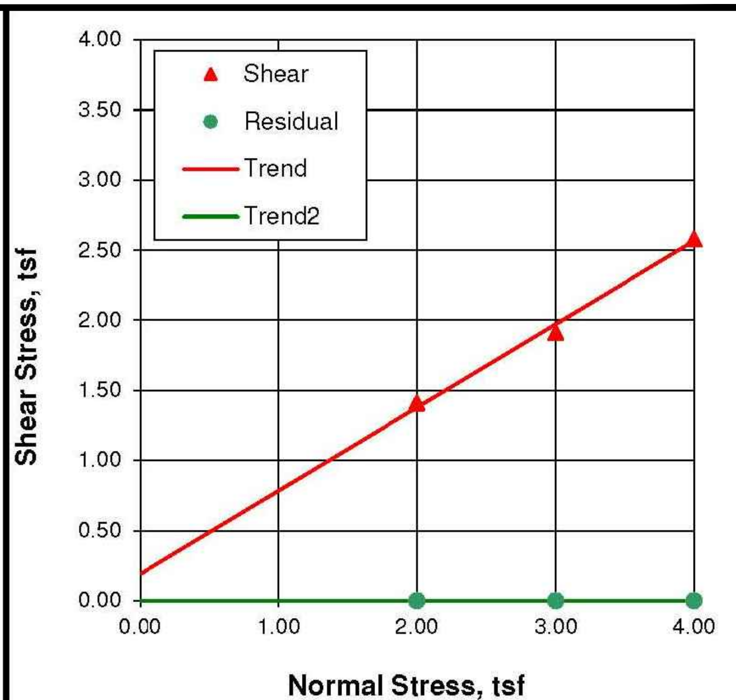
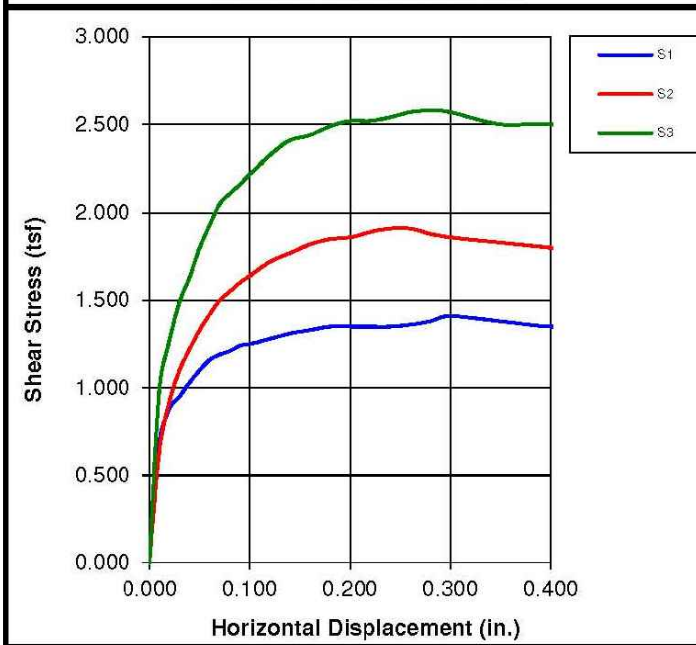
PROJECT NO.: 20171856	COMPACTION CURVE	FIGURE
DRAWN BY: DR		
CHECKED BY: BM	Vulcan-Carli Expansion Florin Road Sacramento, California	B-4
DATE: 9/12/2016		
REVISED: 11/4/2016		







Specimen Number		1	2	3	4
Initial	Water Content, %	17.0	16.9	17.2	
	Dry Density, pcf	91.1	91.7	91.0	
	Void Ratio	0.850	0.837	0.852	
	Saturation, %	54.1	54.5	54.4	
	Diameter, in	2.42	2.42	2.42	
	Height, in	0.96	0.96	0.96	
At Test	Water Content, %	30.5	30.0	28.3	
	Dry Density, pcf	99.6	103.8	106.0	
	Void Ratio	0.714	0.668	0.636	
	Saturation, %	nm	nm	nm	
	Diameter, in	2.42	2.42	2.42	
	Height, in	0.89	0.87	0.85	
Maximum Shear Stress, tsf		1.41	1.91	2.58	
Residual Shear Stress, tsf		na	na	na	
Hoizontal Displacment, in.		0.300	0.240	0.280	
Normal Stress, tsf		2.00	3.00	4.00	
Strain Rate, in./min.		0.010	0.010	0.010	

LL:	nm	PL:	nm	PI:	nm	G_S:	2.70	Assumed

Test Conditions: Remolded / Inundated

Specimen 1: Sandy Silt

Specimen 2: Sandy Silt

Specimen 3: Sandy Silt

	c, tsf	φ, deg.	Tan φ
Failure	0.2	30.7	0.59
Residual	na	na	na

Boring:	B-1 & B-2
Sample:	Composite
Depth, ft:	5-30
Test Date:	9/16/16-9/22/16

Remarks: nm = not measured, na = not applicable

The determination of strength envelopes and the development of relationships to aid in interpreting and evaluating test results are beyond the scope of this test method. The user of this report retains the sole responsibility to evaluate and approve any interpreted values from the testing.

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PROJECT NO.	20171856
ENTRY BY:	J. Slinkard
CHECKED BY:	S, Rader
DATE:	9/22/2016

DIRECT SHEAR TEST ASTM D3080

Vulcan-Carli Expansion
Florin Road
Sacramento, California

FIGURE

B-5

PLOTTED: 23 Sep 2016, 11:33am, dross

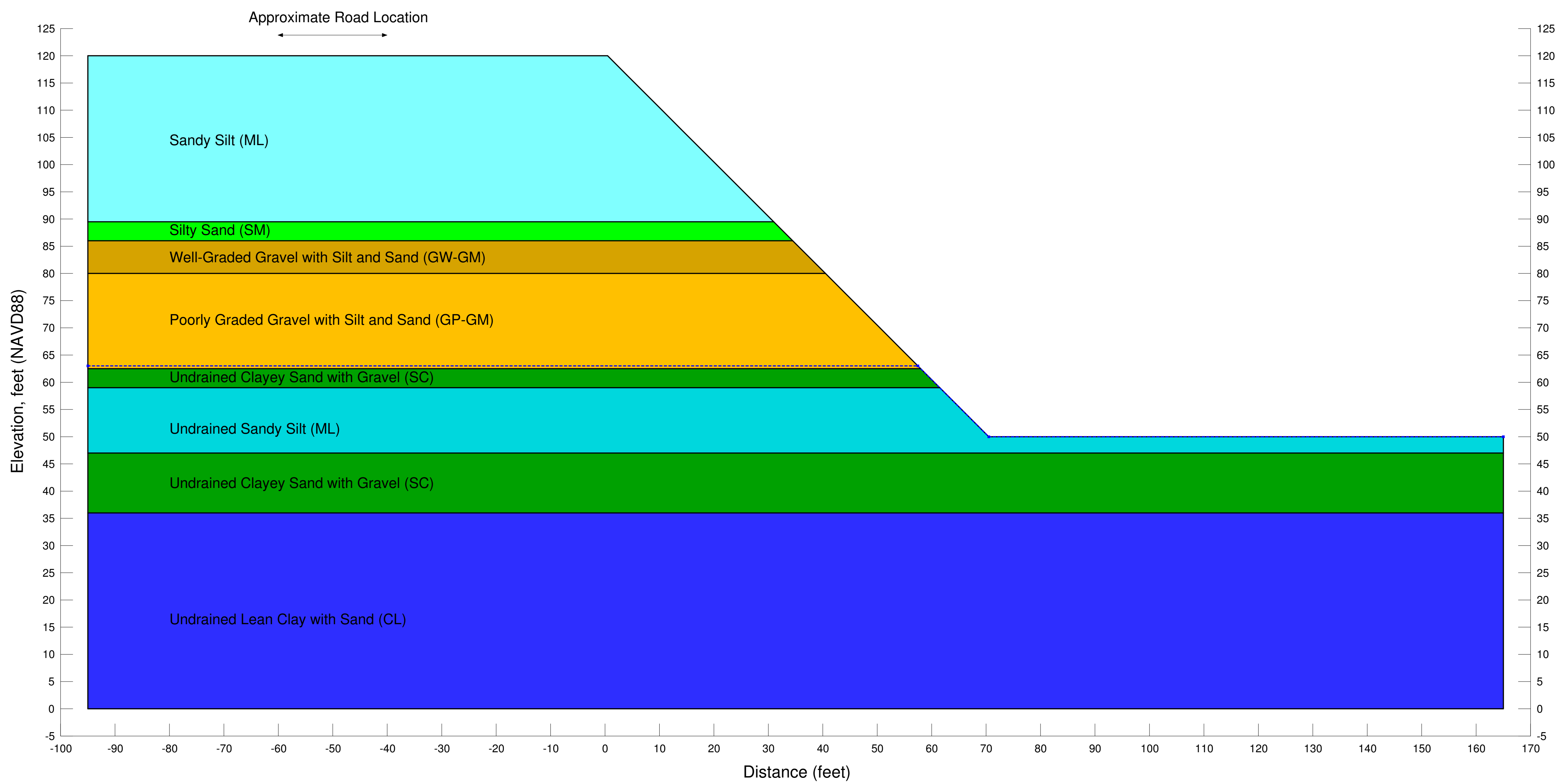
CAD FILE: K:\2016_PROJECTS\20171856.001A-Vulcan-Carli Expansion\GINT\ LAYOUT: DS

9969 Horn Rd. Sacramento, CA 95827

APPENDIX C
SLOPE STABILITY ANALYSIS RESULTS

Title: Section C-C' 1H:1V
File Name: SLOPEW_Section C-C_2016.11.11_NAR.gsz
Last Edited By: Noah Ramos
Date: 11/11/16

Name: Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,500 psf	Phi': 30 °
Name: Silty Sand (SM)	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 600 psf	Phi': 32 °
Name: Well-Graded Gravel with Silt and Sand (GW-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Poorly Graded Gravel with Silt and Sand (GP-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Undrained Clayey Sand with Gravel (SC)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 1,000 psf	Phi': 30 °
Name: Undrained Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,000 psf	Phi': 28 °
Name: Undrained Lean Clay with Sand (CL)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 2,500 psf	Phi': 28 °



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PROJECT NO.	20171856.001A
DRAWN:	11/2016
DRAWN BY:	NAR
CHECKED BY:	BM
FILE NAME:	ANALYSIS FIGURES

SECTION C-C'
1H:1V
SLOPE STABILITY

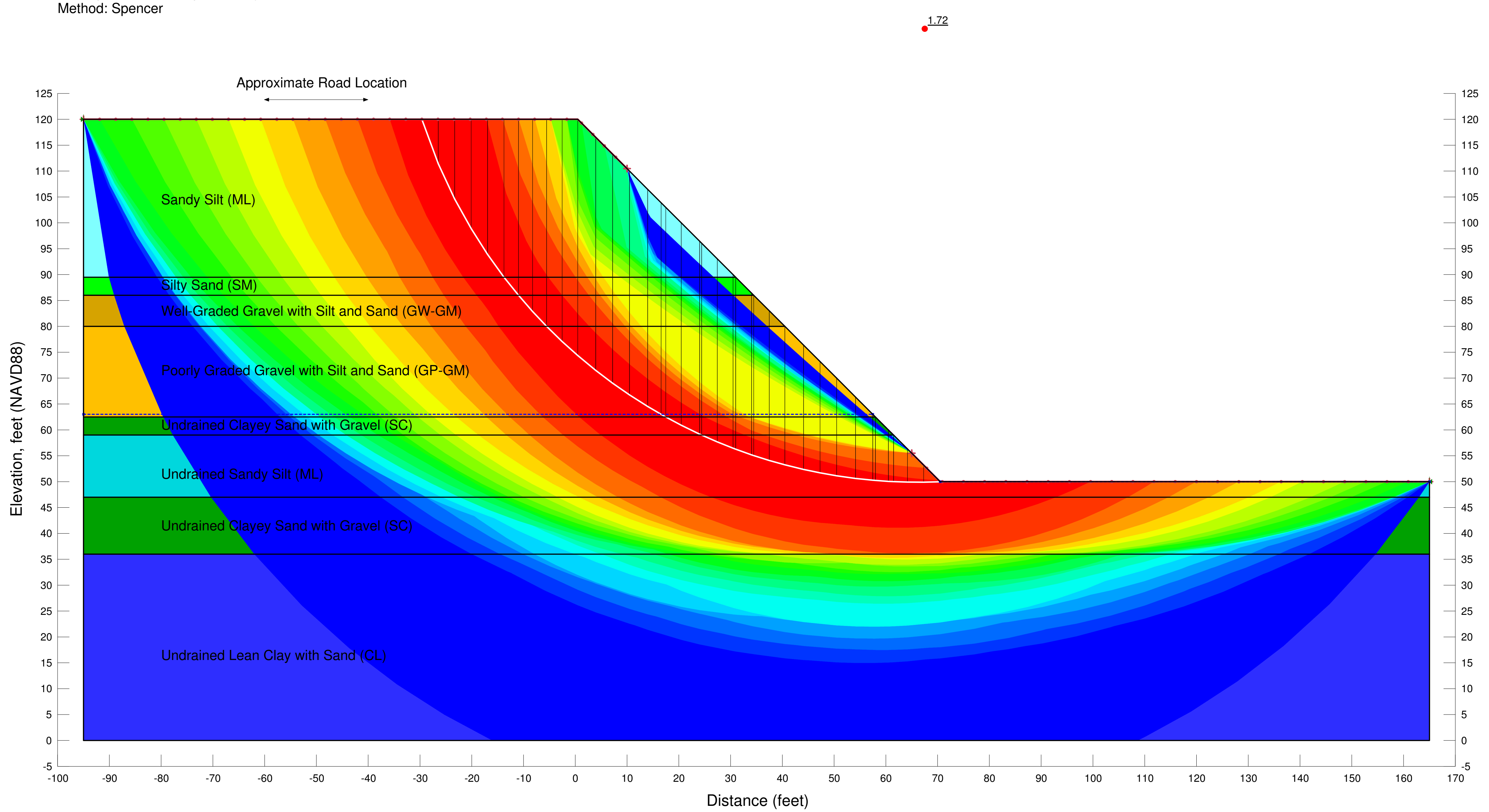
VULCAN-CARLI EXPANSION
FLORIN ROAD
SACRAMENTO, CALIFORNIA

FIGURE
C-1

Title: Section C-C' 1H:1V
File Name: SLOPEW_Section C-C_2016.11.11_NAR.gsz
Last Edited By: Noah Ramos
Date: 11/11/16

Name: Static
Description: Static Slope Stability
Method: Spencer

Name	Model	Unit Weight	Cohesion'	Phi'
Name: Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,500 psf	Phi': 30 °
Name: Silty Sand (SM)	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 600 psf	Phi': 32 °
Name: Well-Graded Gravel with Silt and Sand (GW-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Poorly Graded Gravel with Silt and Sand (GP-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Undrained Clayey Sand with Gravel (SC)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 1,000 psf	Phi': 30 °
Name: Undrained Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,000 psf	Phi': 28 °
Name: Undrained Lean Clay with Sand (CL)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 2,500 psf	Phi': 28 °



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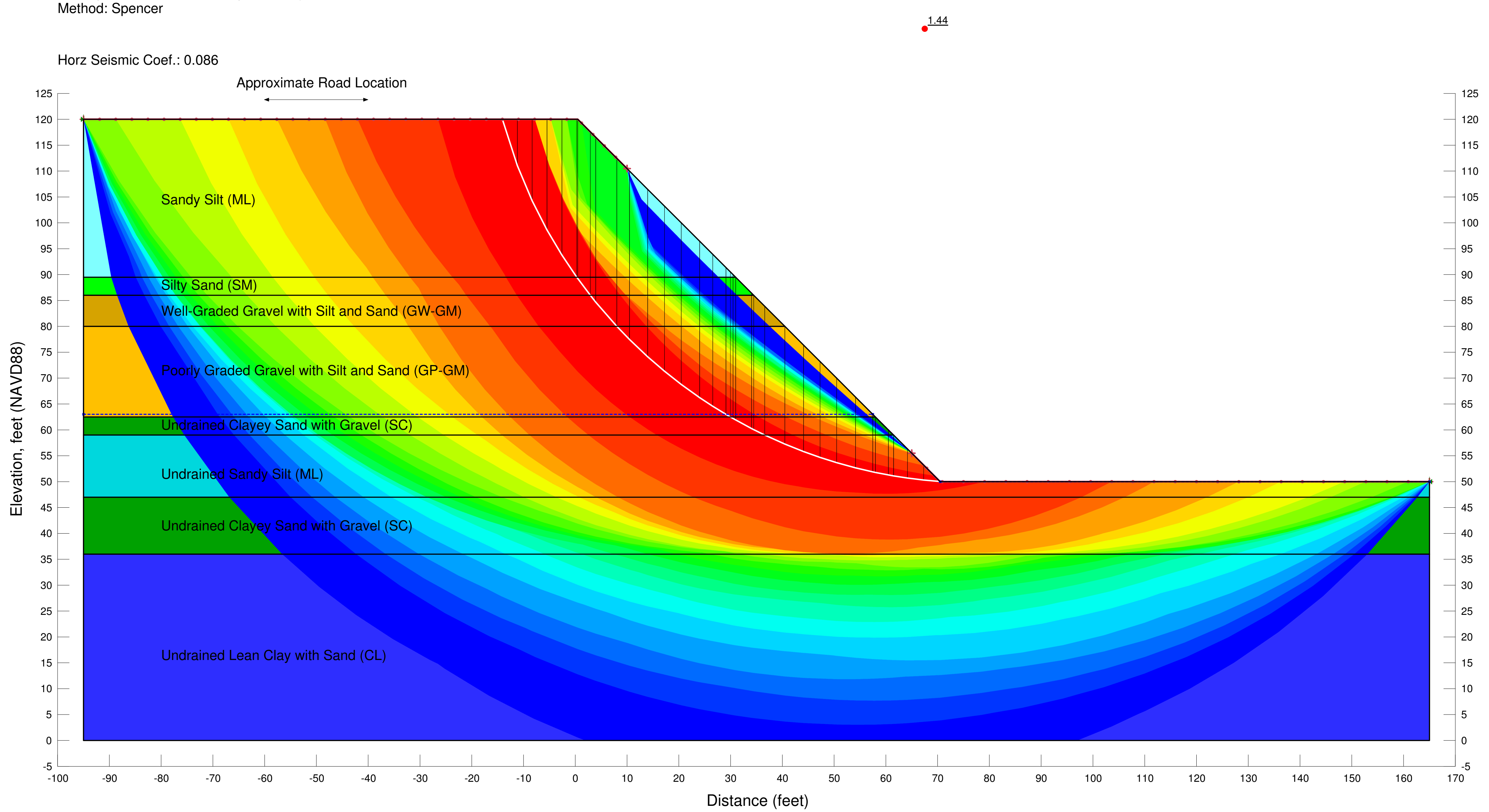
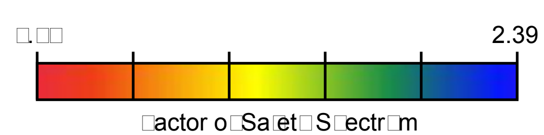
	□I□E □AME□ ANALYSIS FIGURES			

Title: Section C-C' 1H:1V
File Name: SLOPEW_Section C-C_2016.11.11_NAR.gsz
Last Edited By: Noah Ramos
Date: 11/11/16

Name: Pseudostatic (kh=0.086)
Description: Pseudostatic Slope Stability
Method: Spencer

Name	Model	Unit Weight	Cohesion'	Phi'
Name: Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,500 psf	Phi': 30 °
Name: Silty Sand (SM)	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 600 psf	Phi': 32 °
Name: Well-Graded Gravel with Silt and Sand (GW-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Poorly Graded Gravel with Silt and Sand (GP-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Undrained Clayey Sand with Gravel (SC)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 1,000 psf	Phi': 30 °
Name: Undrained Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,000 psf	Phi': 28 °
Name: Undrained Lean Clay with Sand (CL)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 2,500 psf	Phi': 28 °





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PROJECT NO.	20171856.001A
DRAWN:	11/2016
DRAWN BY:	NAR
CHECKED BY:	BM
FILE NAME:	ANALYSIS FIGURES

SECTION C-C'
1H:1V
PSEUDOSTATIC SLOPE STABILITY

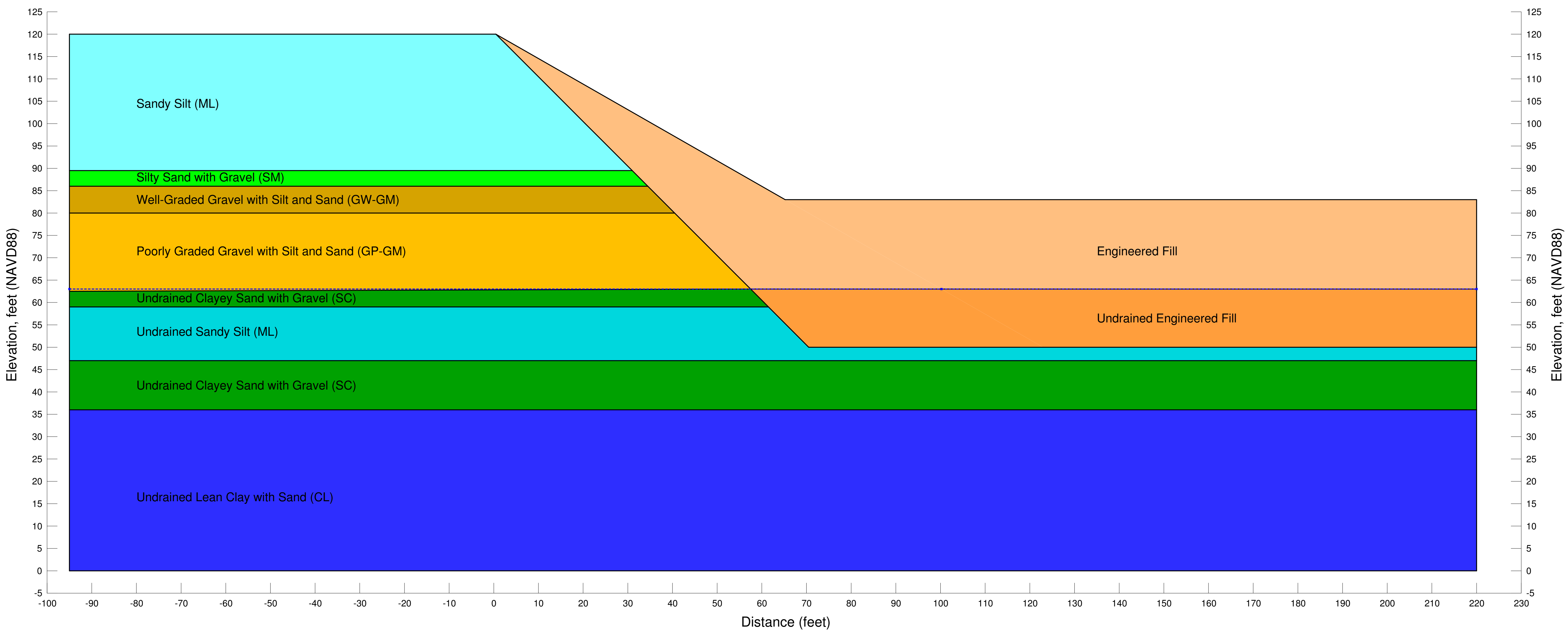
VULCAN-CARLI EXPANSION
FLORIN ROAD
SACRAMENTO, CALIFORNIA

FIGURE

C-3

Title: Section A-A' 1.75H:1V
File Name: SLOPEW_Section A-A_2016.11.11_NAR.gsz
Last Edited By: Noah Ramos
Date: 11/11/16

Name: Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,500 psf	Phi': 30 °
Name: Silty Sand with Gravel (SM)	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 600 psf	Phi': 32 °
Name: Well-Graded Gravel with Silt and Sand (GW-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Poorly Graded Gravel with Silt and Sand (GP-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Undrained Clayey Sand with Gravel (SC)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 1,000 psf	Phi': 30 °
Name: Undrained Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,000 psf	Phi': 28 °
Name: Undrained Lean Clay with Sand (CL)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 2,500 psf	Phi': 28 °
Name: Engineered Fill	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 100 psf	Phi': 28 °
Name: Undrained Engineered Fill	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 200 psf	Phi': 20 °



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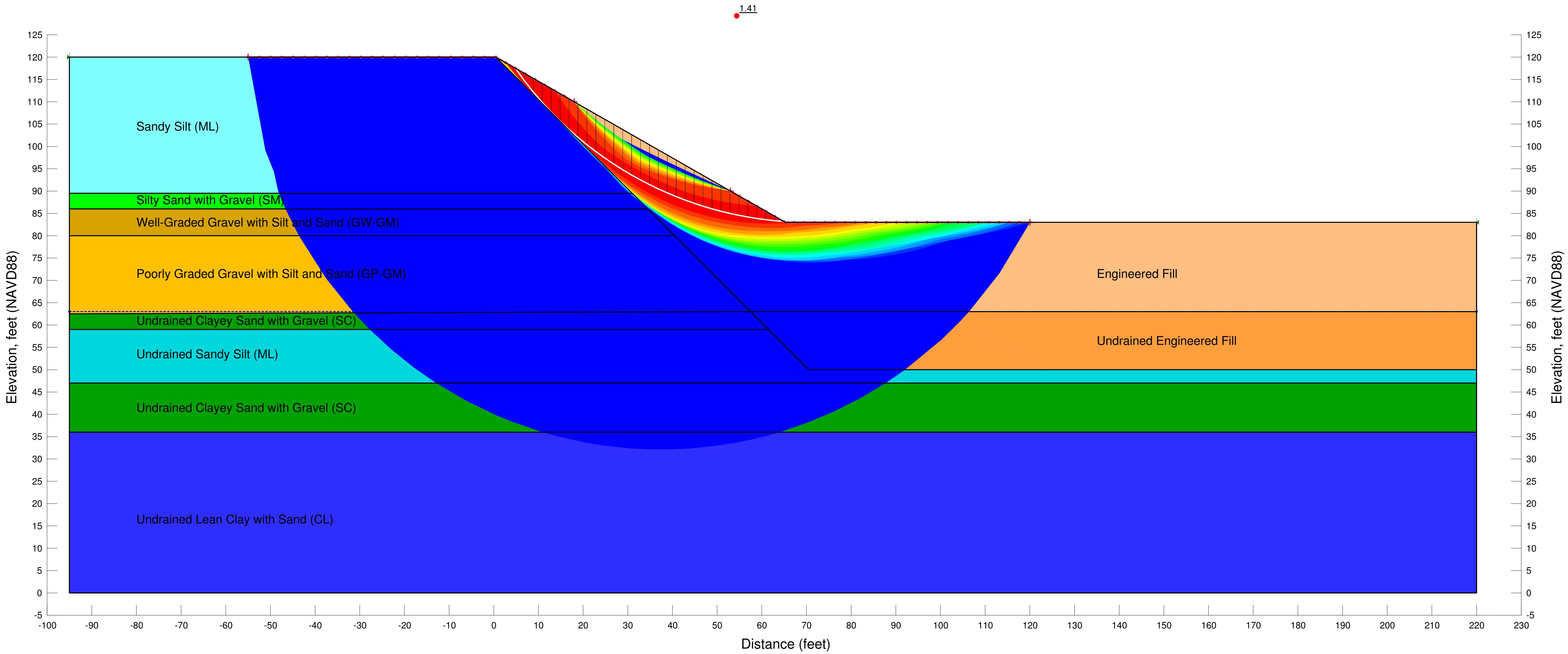
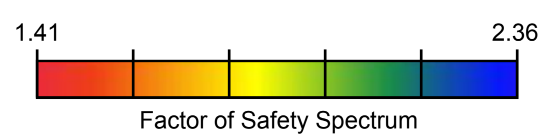
PROJECT NO. 20171856.001A	SECTION A-A' 1.75H:1V SLOPE STABILITY	FIGURE
DRAWN: 11/2016		
DRAWN BY: NAR		C-4
CHECKED BY: BM	VULCAN-CARLI EXPANSION FLORIN ROAD SACRAMENTO, CALIFORNIA	
FILE NAME: ANALYSIS FIGURES		

Title: Section A-A' 1.75H:1V
File Name: SLOPEW_Section A-A_2016.11.11_NAR.gsz
Last Edited By: Noah Ramos
Date: 11/11/16

Name: Static
Description: Static Slope Stability
Method: Spencer

Name	Model	Unit Weight	Cohesion'	Phi'
Name: Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,500 psf	Phi': 30 °
Name: Silty Sand with Gravel (SM)	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 600 psf	Phi': 32 °
Name: Well-Graded Gravel with Silt and Sand (GW-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Poorly Graded Gravel with Silt and Sand (GP-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Undrained Clayey Sand with Gravel (SC)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 1,000 psf	Phi': 30 °
Name: Undrained Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,000 psf	Phi': 28 °
Name: Undrained Lean Clay with Sand (CL)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 2,500 psf	Phi': 28 °
Name: Engineered Fill	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 100 psf	Phi': 28 °
Name: Undrained Engineered Fill	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 200 psf	Phi': 20 °





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SECTION A-A'
1.75H:1V
STATIC SLOPE STABILITY

VULCAN-CARLI EXPANSION
FLORIN ROAD
SACRAMENTO, CALIFORNIA

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C-5

Title: Section A-A' 1.75H:1V
File Name: SLOPEW_Section A-A_2016.11.11_NAR.gsz
Last Edited By: Noah Ramos
Date: 11/11/16

Name: Pseudostatic (kh=0.086)
Description: Pseudostatic Slope Stability
Method: Spencer

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Name	Model	Unit Weight	Cohesion'	Phi'
Name: Sandy Silt (ML)	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 1,500 psf	Phi': 30 °
Name: Silty Sand with Gravel (SM)	Model: Mohr-Coulomb	Unit Weight: 115 pcf	Cohesion': 600 psf	Phi': 32 °
Name: Well-Graded Gravel with Silt and Sand (GW-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
Name: Poorly Graded Gravel with Silt and Sand (GP-GM)	Model: Mohr-Coulomb	Unit Weight: 145 pcf	Cohesion': 0 psf	Phi': 40 °
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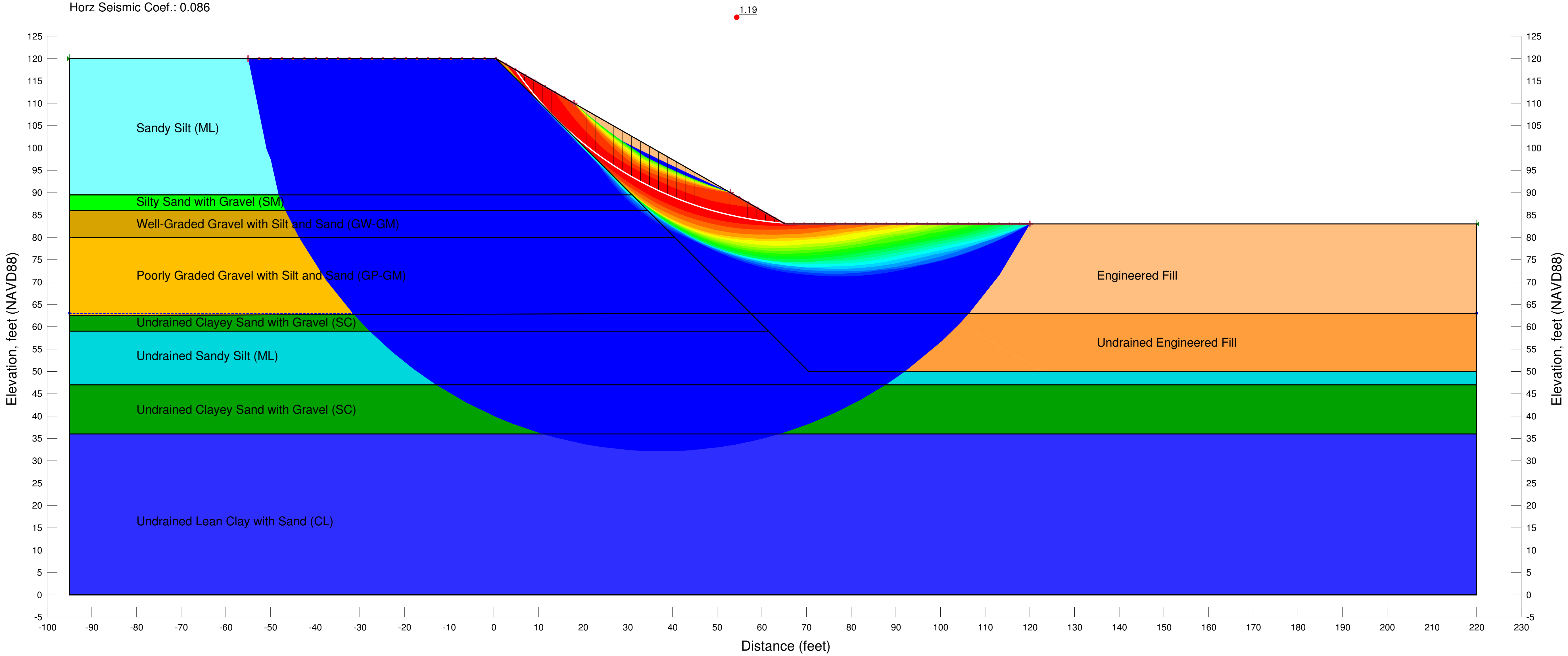
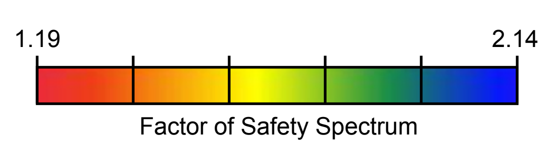
Name: Undrained Lean Clay with Sand (CL)	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Cohesion': 2,500 psf	Phi': 28 °
Name: Engineered Fill	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 100 psf	Phi': 28 °
Name: Undrained Engineered Fill	Model: Mohr-Coulomb	Unit Weight: 110 pcf	Cohesion': 200 psf	Phi': 20 °





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SECTION A-A'
1.75H:1V
PSEUDOSTATIC SLOPE STABILITY

VULCAN-CARLI EXPANSION
FLORIN ROAD
SACRAMENTO, CALIFORNIA

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C-6

APPENDIX D
GBA FLYER

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GBA GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org www.geoprofessional.org