DOCKETED	
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TN #:	261775
Document Title:	Volume 2 Virococha Hill BESS Appendix 5 4A Part C Geotechnical Investigation Report
Description:	Volume 2 Virococha Hill BESS Appendix 5 4A Part C Geotechnical Investigation Report
Filer:	Sarah Madams
Organization:	Jacobs
Submitter Role:	Applicant Consultant
Submission Date:	2/14/2025 2:01:13 PM
Docketed Date:	2/14/2025

APPENDIX F

Geophysical Survey

GEOPHYSICAL REPORT

BSA – Altamont Pass Wind Turbine Project
Alameda County, California

May 10, 2023
NORCAL Project No. NS225157

Prepared for:

Berlogar Stevens & Associates Inc.
1220 Quarry Lane, Suite C
Pleasanton, CA 94566

Prepared by:

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

May 10, 2023

Berlogar Stevens & Associates Inc.
1220 Quarry Lane, Suite C
Pleasanton, CA 94566

Attn: Dr. Abbas Abdollahi
Telephone: (925) 249.5580
E-mail: aabdollahi@berlogar.com

Re: Geophysical Report
BSA – Altamont Pass Wind Turbine Project
Altamont Pass Wind Farm
Alameda County, California
NS225157

Dear Dr. Abdollahi,

NORCAL Geophysical Consultants, Inc. (NORCAL), a Terracon Company is pleased to submit the Geophysical Report for the above-referenced site.

This report presents the findings of a geophysical survey performed by NORCAL Geophysical Consultants, Inc. for Berlogar Stevens & Associates Inc. (BSA) at the Altamont Pass Wind Farm in Alameda County, California. The survey was authorized under Agreement for Services, Reference No. NS225157, dated December 27, 2022. The field work was conducted on January 17 through 18, and April 17 through 19, 2023. The work was completed in two phases based on weather delay. The work was completed by NORCAL Project Geophysicist J. Sage Wagner III, Senior Geophysicist Chuck Carter (PGp No. 1051), Staff Geophysicist Matt N. LaRiviere, and Senior Geophysical Technician Travis W. Black, under direction of California Professional Geophysicist Donald J. Kirker (PGp No. 997). BSA Staff Andres Garibay provided site orientation and logistical support.

We appreciate the opportunity to perform professional consulting services for BSA. Please contact either of the undersigned at (707) 796-7170 if you have questions about the information provided in the report.

Respectfully,

NORCAL Geophysical Consultants, Inc

Prepared by:

J. Sage Wagner III
Project Geophysicist

Approved by:

Donald J. Kirker
Authorized Project Reviewer / SME
CA Professional Geophysicist, PGp 997

PROFESSIONAL GEOPHYSICIST
DONALD KIRKER
No. 997
STATE OF CALIFORNIA
5-10-2023

cc: Dr. Abbas Abdollahi, aabdollahi@berlogar.com
Mr. Frank Berlogar, fberlogar@berlogar.com

1. INTRODUCTION

This report presents the results of twenty multichannel analysis of surface waves (MASW) soundings. The MASW survey was performed to provide information to aid in design for the proposed wind power project located along Altamont Pass Road in Alameda County, California. Thirteen MASW soundings were collected to the north of Altamont Pass Road and seven MASW soundings to the south.

An MASW survey measures the shear wave velocities (Vs) of the subsurface as a function of depth. The survey method is a sounding, producing one-dimensional (1-D) data that is presented herein in tabular and graphical form. Descriptions of the MASW methodology, our data acquisition and analysis procedures and the instrumentation we used for the MASW survey are provided in **Appendix A: Geophysical Methods – 1-D Multi-Channel Analysis of Surface Waves (MASW)**.

The site location is depicted in the Vicinity Map found on **Plate 1 – Site Overview Map**. This map includes satellite imagery and displays each MASW sounding location and proposed turbine location as a green modified boring symbol. A textual description of the site conditions, encompassing relevant site-specific information, current ground cover, topography, and local geology, is summarized in Section 2.0 below.

2. SITE DESCRIPTION

The following description of site conditions is derived from our site visit and a review of publicly available geologic and topographic maps.

Item	Description
Site information	The project site is located 8.5 miles northeast of Livermore in the Coast Range Geomorphic Province. The approximate coordinate of the site is 37.7534°, -121.6291°.
Current ground cover	The geophysical data was gathered in close proximity to pre-existing roads and the proposed turbine sites. Taking into account effects from past atmospheric river weather conditions and the associated erosion, the data collection points were strategically positioned as near to the turbine locations as safety permitted. The terrain is comprised of open, cattle-grazing land, featuring a diverse combination of grasses, shrubs, and forbs.
Existing topography	According to Trimble GPS elevation data, the terrain within the study area exhibits varying degrees of incline, from flat to steep, and spans elevations of approximately 390 to 1,150 feet above mean sea level (NAVD88).

Item	Description
Site geology	Available geologic maps (i.e., Jennings, C.W., with modifications by Gutierrez, C., Bryant, W., Saucedo, G., and Wills, C., 2010, Geologic map of California: California Geological Survey, Geologic Data Map No. 2, scale 1: 750,000.) indicate that the site is underlain by marine sedimentary and metasedimentary rocks consisting of Upper Cretaceous sandstone, shale, and conglomerate.

3. SCOPE OF WORK

Our scope of work involved conducting an MASW survey, which includes 20 MASW soundings to measure the shear wave velocity (Vs) in the upper 100 feet of the subsurface. This information will assist others in determining the Seismic Site Class. Our work scope consisted of data acquisition, processing, and presenting our findings in a comprehensive Geophysical Report.

Mr. Andres Garibay, BSA, assisted in determining the position of the soundings to make the most of the available work area.

4. MASW RESULTS

The results of the MASW survey are depicted as Vs-versus-depth plots in **Plate 2 through 11 - MASW Sounding**. In these step plots, the horizontal axis corresponds to seismic s-wave velocity (increasing to the right), while the vertical axis represents depth (increasing downward). The solid blue line demonstrates the fluctuations in S-wave velocity versus depth for each sounding.

The locations of these MASW results are summarized in Table 1 below, which provides information on the MASW identification, latitude, and longitude.

Table 1 : *MASW sounding locations*

MASW Sounding Locations		
MASW-ID	**Latitude**	**Longitude**
MASW-3	37.74351169	-121.6551186
MASW-4	37.74112016	-121.6556776
MASW-5	37.73977456	-121.6529086
MASW-6	37.73680825	-121.6521724
MASW-7	37.73355337	-121.6515864
MASW-8	37.73773283	-121.6443397
MASW-9	37.73262278	-121.6429986
MASW-17	37.77414831	-121.6169893
MASW-18	37.77144786	-121.6156759
MASW-19	37.76970654	-121.6131051

MASW-20	37.76636268	-121.6112027
MASW-21	37.76525795	-121.610532
MASW-22	37.76162519	-121.607278
MASW-23	37.75985264	-121.6039041
MASW-24	37.75762703	-121.6014797
MASW-25	37.75481485	-121.608354
MASW-26	37.75411318	-121.5989816
MASW-27	37.75460792	-121.5942516
MASW-28	37.74820288	-121.6107506
MASW-29	37.74322824	-121.6118194

The measured Vs values, as shown on **Plate 2 through 11 - MASW Sounding**, range from a low of 410 ft./sec to a maximum of 5,010 ft./sec. Generally, Vs tends to increase with increasing depth. It is our interpretation that these features may be due to variations of stiffness (or rigidity) of subsurface materials. The standard method of reporting MASW data is to consider the location of the 1D velocity vs. depth model as the center point of the MASW spread. However, this does not mean that the measured velocity values represent materials solely beneath that location. In fact, the subsurface conditions underlying the entire length of the array, and for several tens of feet to either side, contribute to the measured velocity values.

APPENDIX A – Geophysical Methods

1-D Multi-Channel Analysis of Surface Waves (MASW)

METHODOLOGY

When seismic energy is generated at or near the ground surface, both body and surface waves are produced. Body waves expand omni-directionally throughout the subsurface. They consist of both compressional (P) and shear (S) waves. Surface waves (e.g., Rayleigh, Love, etc.) radiate along the ground surface at velocities that are proportional to shear wave velocity (Vs). Rayleigh waves are characterized by retrograde elliptical particle motion, and travel at approximately 0.9 times the velocity of S-waves.

If a vertical impact source is used, approximately two-thirds of the seismic energy that is produced is in the form of ground roll. As a result, surface waves are typically the most prominent signal on multi-channel seismic records. In addition, surface waves have dispersion properties that body waves lack. That is, different wavelengths have different penetration depths and, therefore, propagate at different velocities. By analyzing the dispersion of surface waves, it is possible to obtain an Vs versus depth plot. Since Vs is directly proportional to shear modulus, this provides a direct indication in the variation of stiffness (or rigidity) of subsurface materials with depth.

Surface waves can be recorded and analyzed using a method referred to as Seismic Multichannel Analysis of Surface Waves (MASW). This method is used to collect surface wave data using a fixed array of geophones and shot points. This is referred to as a sounding and results in a 1D model depicting variation in Vs versus depth beneath the center of the array. However, the subsurface conditions underlying the entire length of the array, and for several tens of feet to either side, contribute to the measured velocity values. The method requires an energy source that is capable of producing ground roll and geophones that are capable of detecting low frequencies (<5 Hz) signals.

DATA ACQUISITION

Each MASW sounding was configured using a seismic array consisting of four shot points and 24-geophones distributed at 6-ft intervals in a collinear array, yielding a total length of 210-ft. The array configuration is depicted in Figure 1 of this appendix, shown below. The shot points were positioned at 2, 4, and 6 stations away from both Geophone 1 and Geophone 24, resulting in offsets of 12-, 24-, and 36-feet. A sample array layout featuring 6-foot geophone spacing with 4 shot points can be seen in Figure 1 of this appendix, as illustrated below.

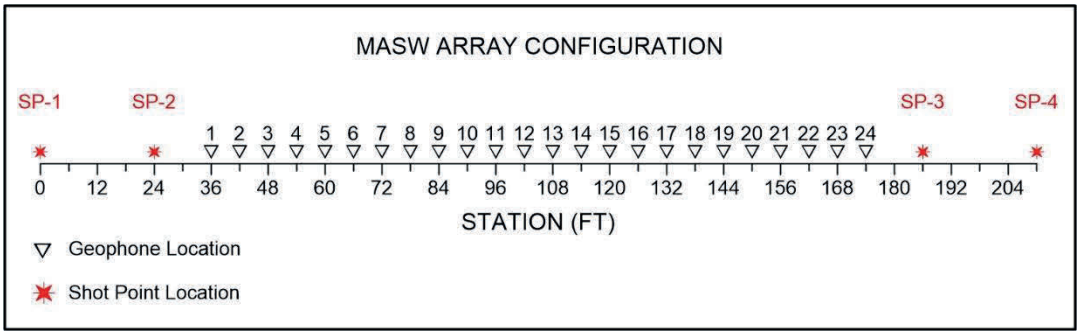


Figure 1: *MASW Array Configuration*

Seismic energy was produced at each shot point using a 16-pound sledgehammer striking an aluminum/polyurethane plate on the ground surface. The resulting seismic waveforms were detected by an array of 24 ***RT Clark*** geophones with a natural frequency of 4.5-Hz and recorded using a Geometrics ***Geode*** 24-channel distributed array engineering seismograph. The seismic waveforms were digitized, processed, and amplified by the Geode and transmitted via a ruggedized Ethernet cable to a field computer. The recorded data were archived for subsequent processing and displayed on the computer screen in the form of seismograms for quality assurance purposes.

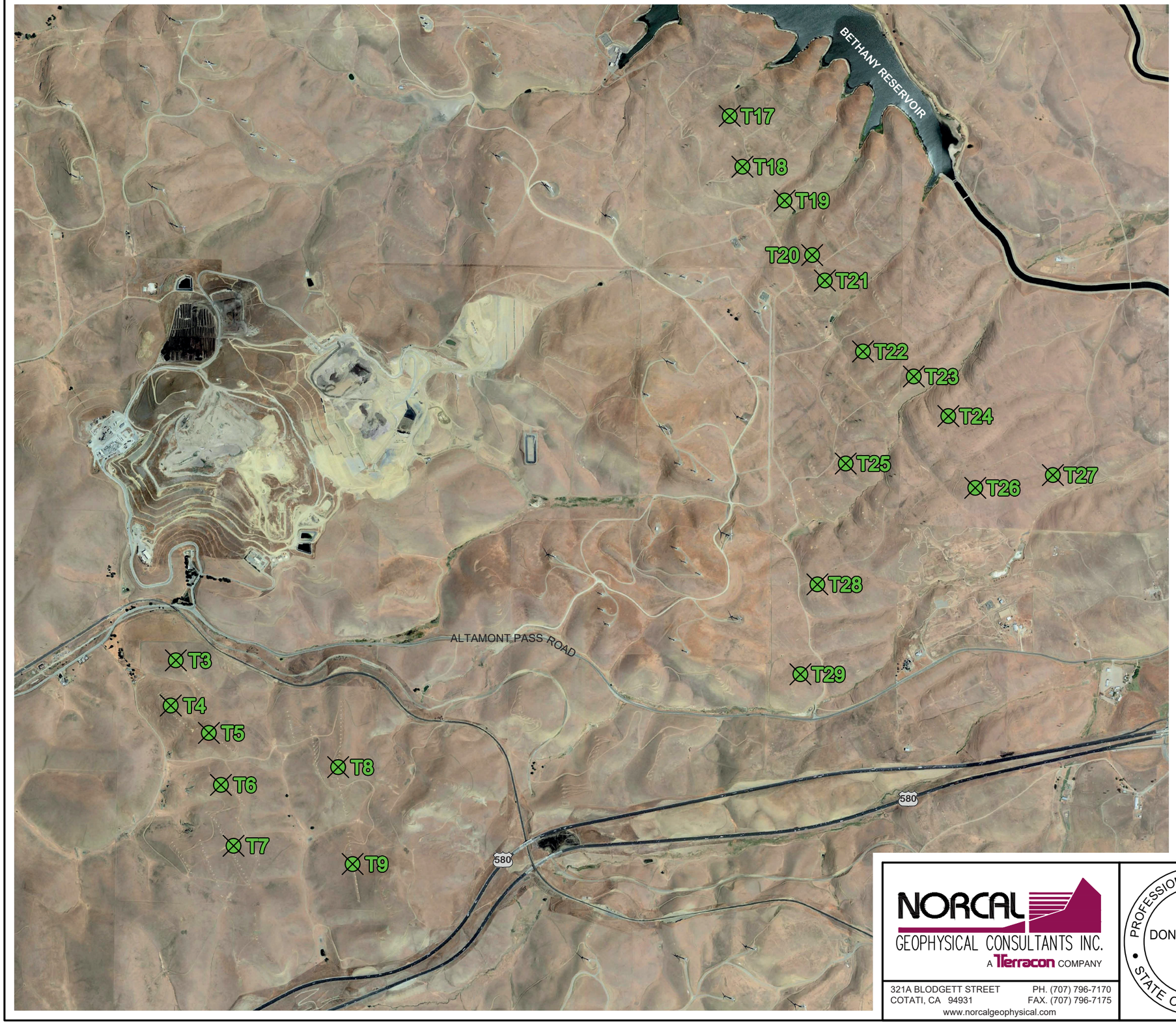
DATA ANALYSIS

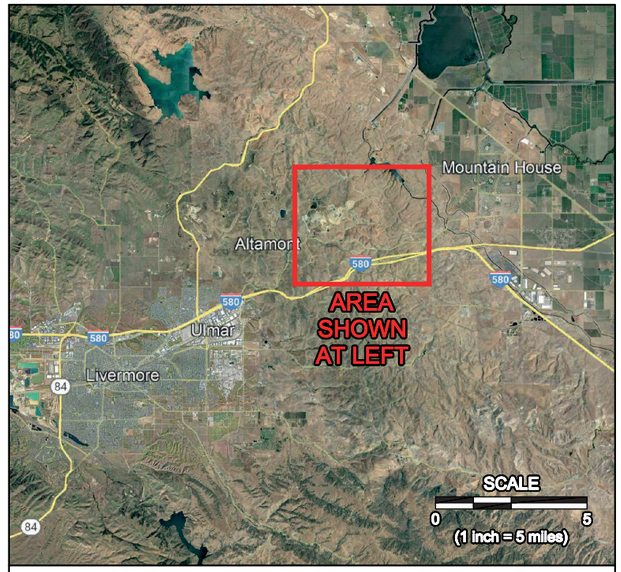
The seismic wave-traces (shot gathers) recorded at each shot point were analyzed using the computer program ***SURFSEIS*** developed by the Kansas Geological Survey (Version 6.3, 2017). This interactive program converts the data acquired from all four shot points in a given sounding into a dispersion curve representing phase velocity versus frequency. This curve is then inverted to produce a 1D model indicating Vs versus depth. The steps involved in this procedure are as follows:

1) The shot gathers are converted to KGS format.
2) Stations are assigned to the geophone and shot point locations.
3) The resulting records are viewed to determine their overall quality. If necessary, portions of the records are muted to remove interference from refractions, reflections and higher mode events.
4) For each formatted (and/or muted) record, the program produces what is referred to as an “overtone plot”. This is a colored cross-section indicating phase velocity versus frequency and amplitude. The vertical axis represents phase velocity (increasing upward); the horizontal axis represents frequency (increasing to the right); and signal amplitude is indicated by various colors, with the hottest colors (orange to red to dark brown) representing the greatest signal to noise ratio. Typically, the strongest signals align in a curved pattern with a symmetry similar to a “hockey stick” where the blade is pointing upward at the lower end of the frequency spectrum (higher velocity at greater depth) and the handle projects to the right in the direction of increasing frequencies indicating lower velocities.

5) The overtone plots compiled from the six shot points are reviewed to determine their overall quality and the best among them (possibly all) are merged to form a single overtone. This enhances the overall signal to noise ratio of the survey and incorporates data from both ends of the spread (if feasible).
6) The resulting overtone plot is used as a guide in deriving a dispersion curve representing phase velocity versus frequency. This is done by fitting the curve along the center of the hockey stick where the signal to noise ratio is highest.
7) The resulting dispersion curve is inverted through an iterative process to compute a 1D model representing Vs versus depth.

Following this procedure, we use the computer program **Grapher** 13.0 by Golden Software to plot the 1D seismic velocity versus depth graphs shown on Plates 2. On these step plots, the horizontal axis represents seismic velocity (increasing to the right), and the vertical axis represents depth (increasing downward). The solid blue line depicts the variations in S-wave velocity versus depth for each sounding.





VICINITY MAP

SCALE
0 1000 2000 4000
(1 inch = 2000 feet)

LEGEND	
⊗	MASW SOUNDING & PROPOSED TURBINE LOCATION

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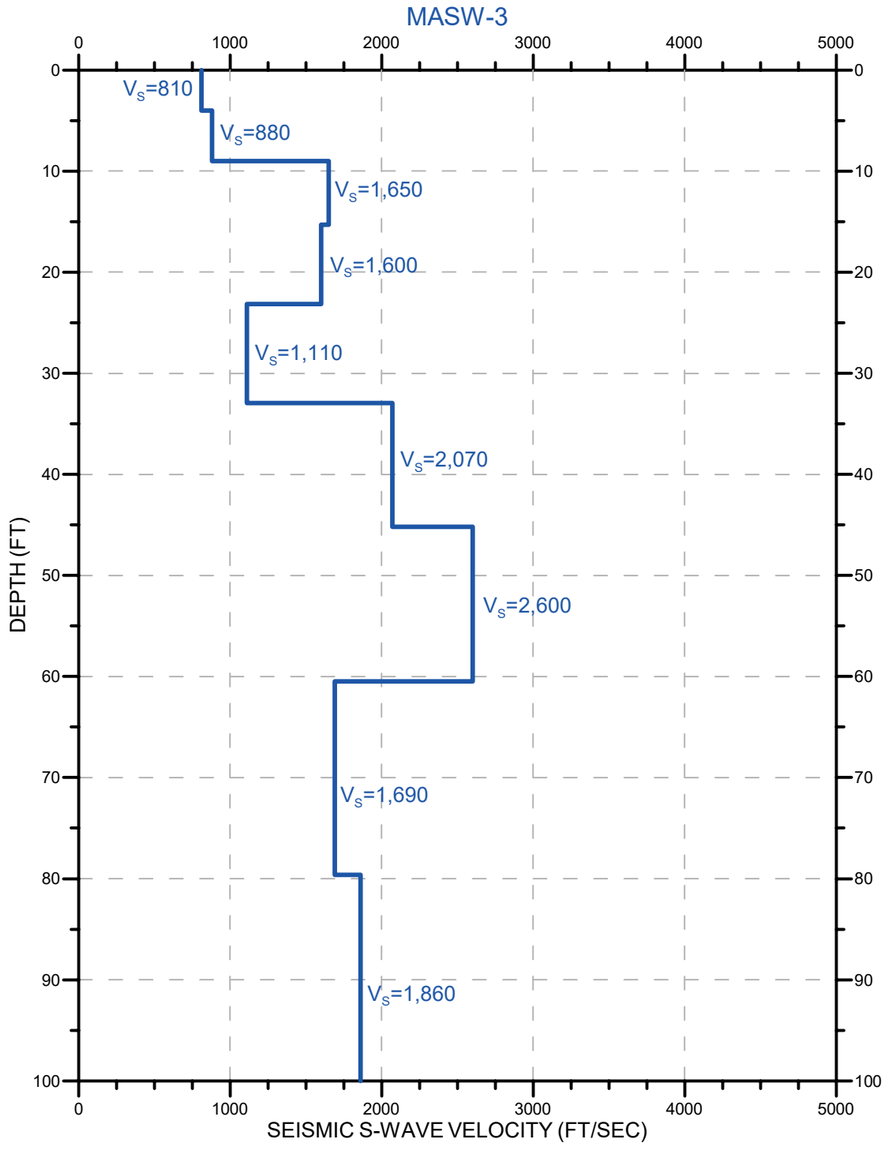
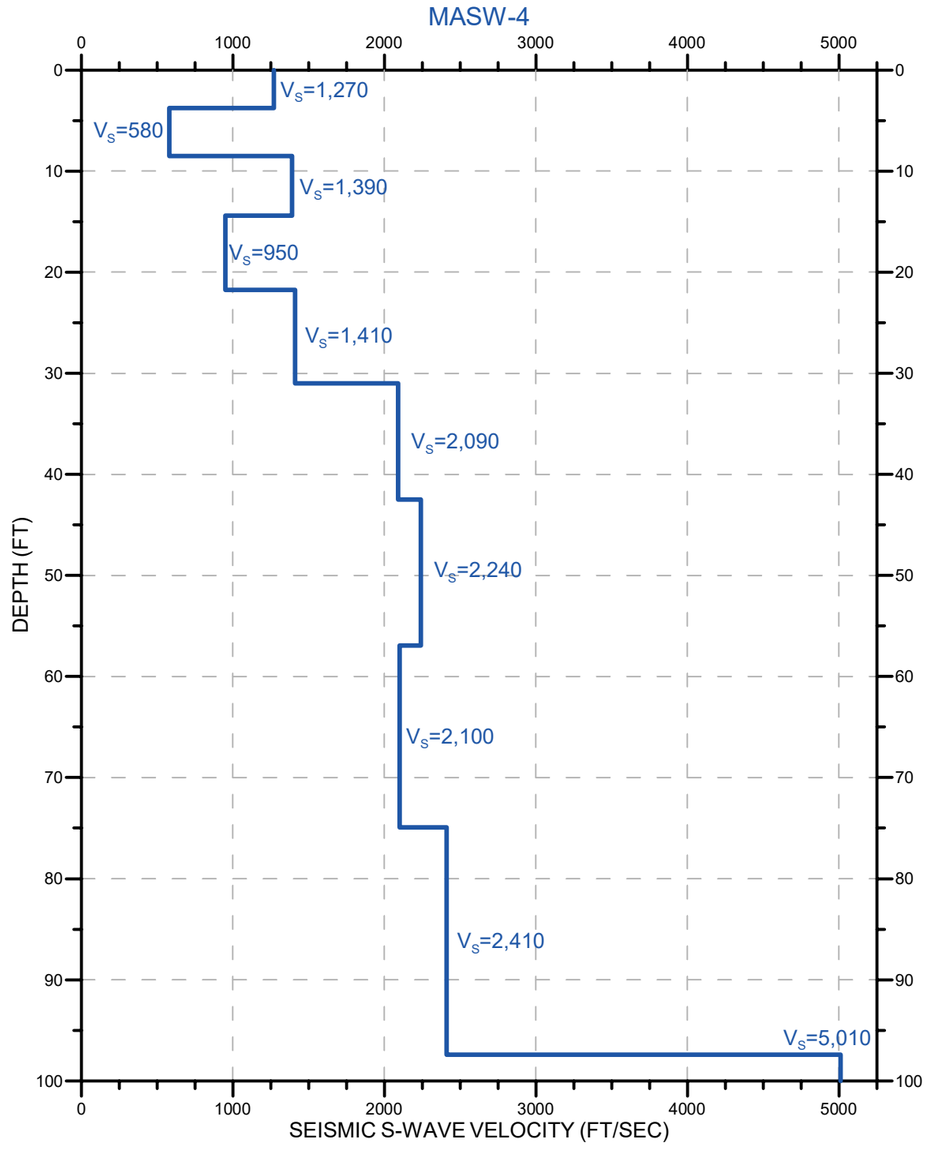
DONALD KIRKER
No. 997
STATE OF CALIFORNIA

SITE OVERVIEW MAP
MASW SURVEY
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES
JOB #. NS225157
DATE: MAY 2023
DRAWN BY: H.PHILSON
APPROVED BY: DJK
Donald J. Kirker 5/1/2023

PLATE
1





LEGEND	
———	SEISMIC S-WAVE VELOCITY

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MASW SOUNDINGS — MASW-3 & MASW-4
TURBINES 3 & 4
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES

JOB #: NS225157	DATE: MAY 2023	PLATE
DRAWN BY: H.PHILSON	APPROVED BY: DJK	2

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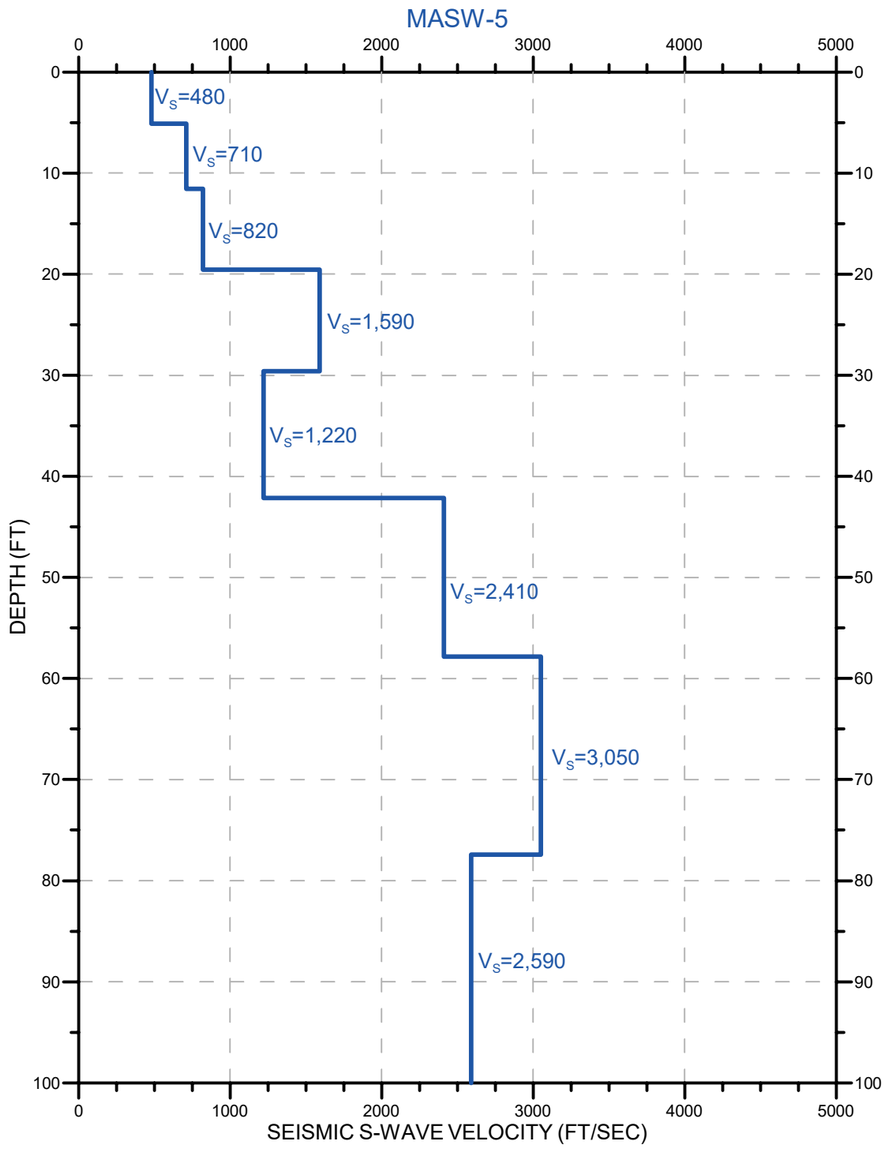

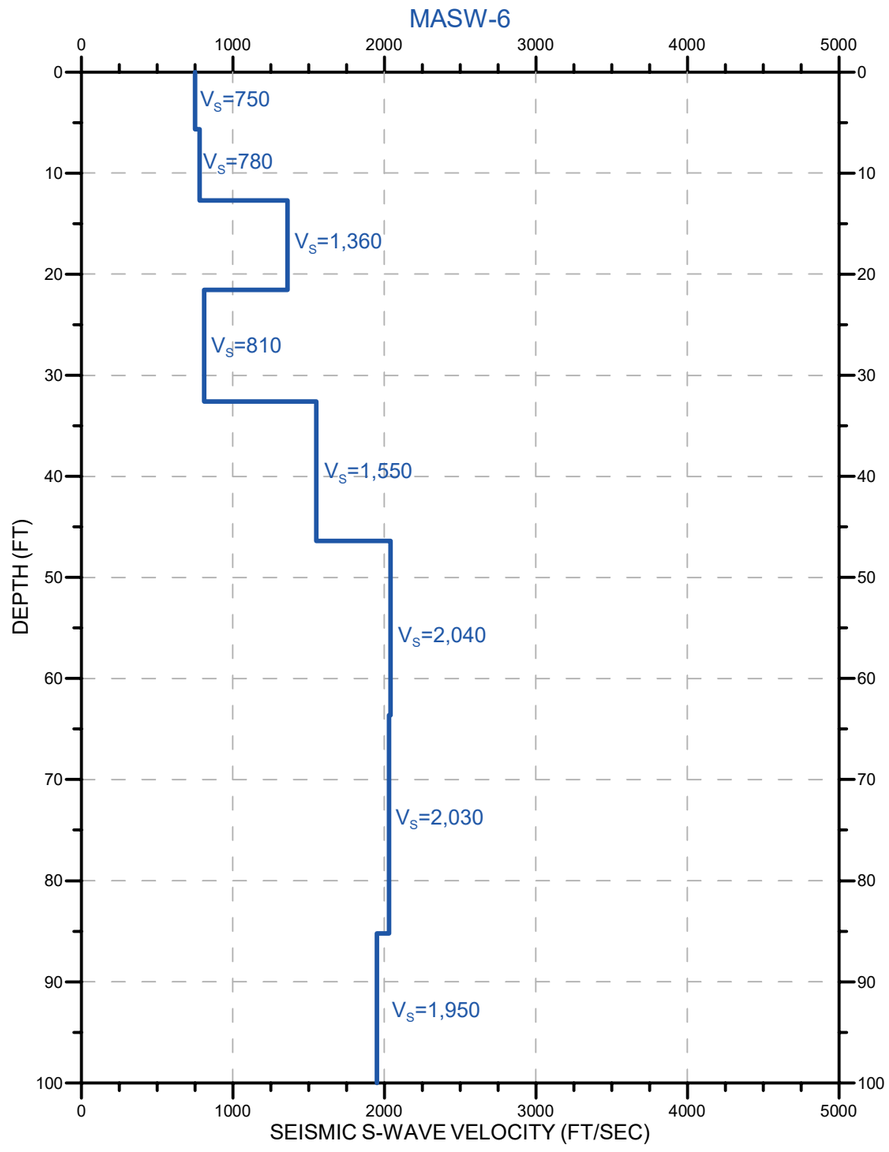

LEGEND	
———	SEISMIC S-WAVE VELOCITY

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MASW SOUNDINGS — MASW-5 & MASW-6
TURBINES 5 & 6
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES

JOB #: NS225157	DATE: MAY 2023	PLATE
DRAWN BY: H.PHILSON	APPROVED BY: DJK	3

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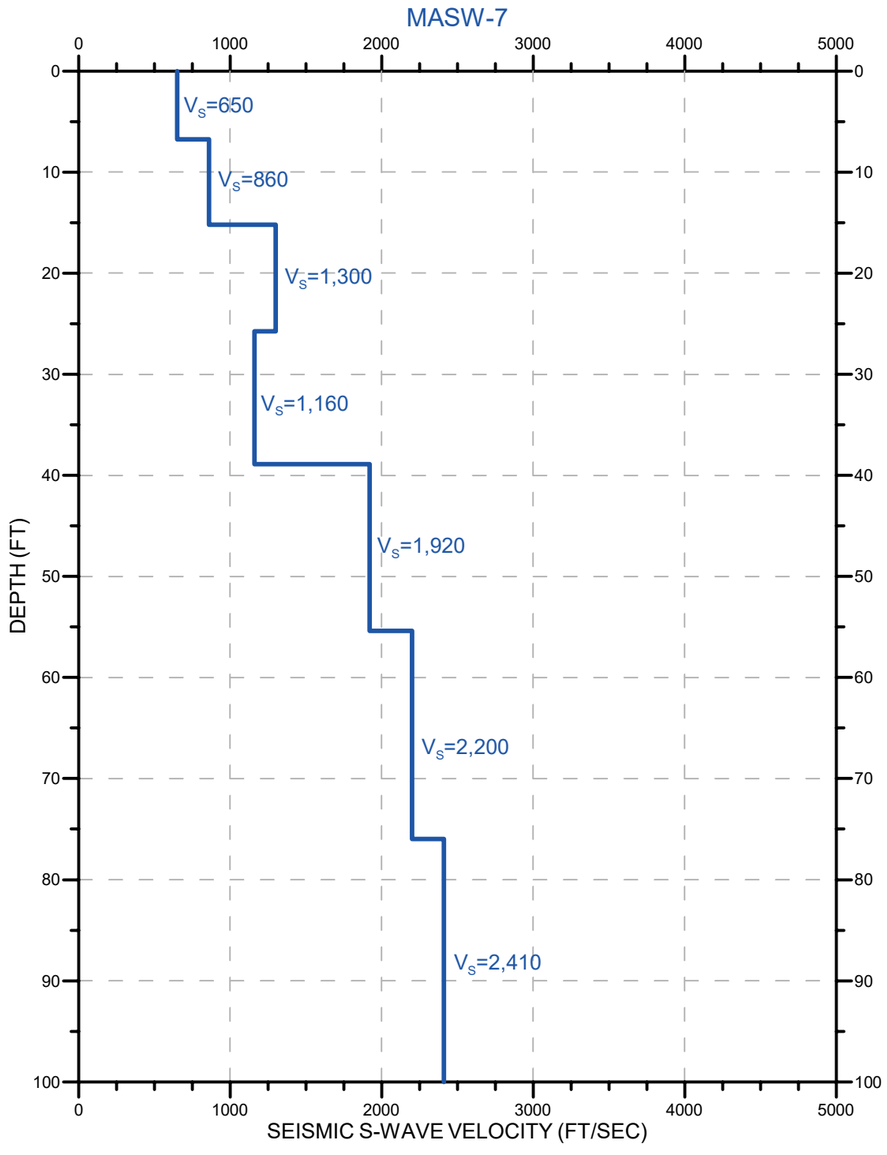

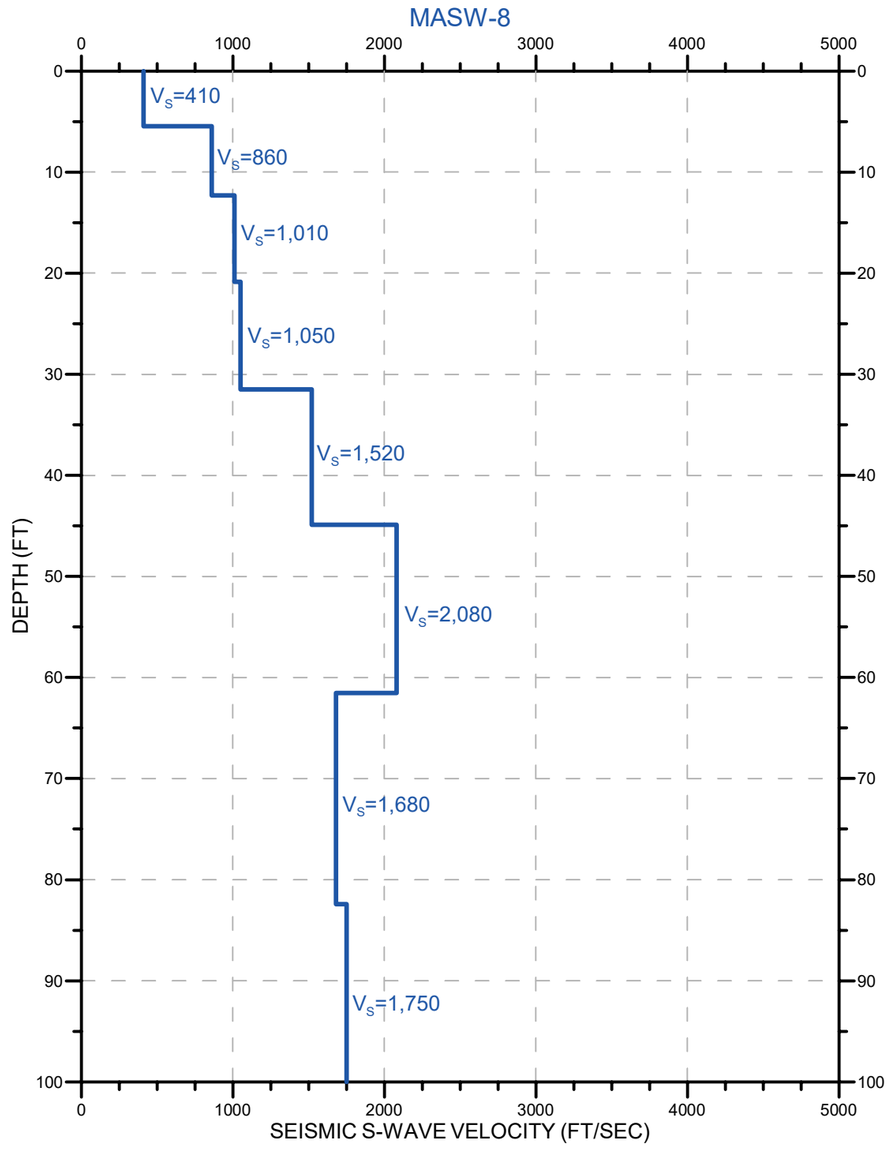

LEGEND	
———	SEISMIC S-WAVE VELOCITY

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MASW SOUNDINGS — MASW-7 & MASW-8
TURBINES 7 & 8
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA		
CLIENT: BERLOGAR STEVENS & ASSOCIATES		
JOB #: NS225157	DATE: MAY 2023	PLATE 4
DRAWN BY: H.PHILSON	APPROVED BY: DJK	

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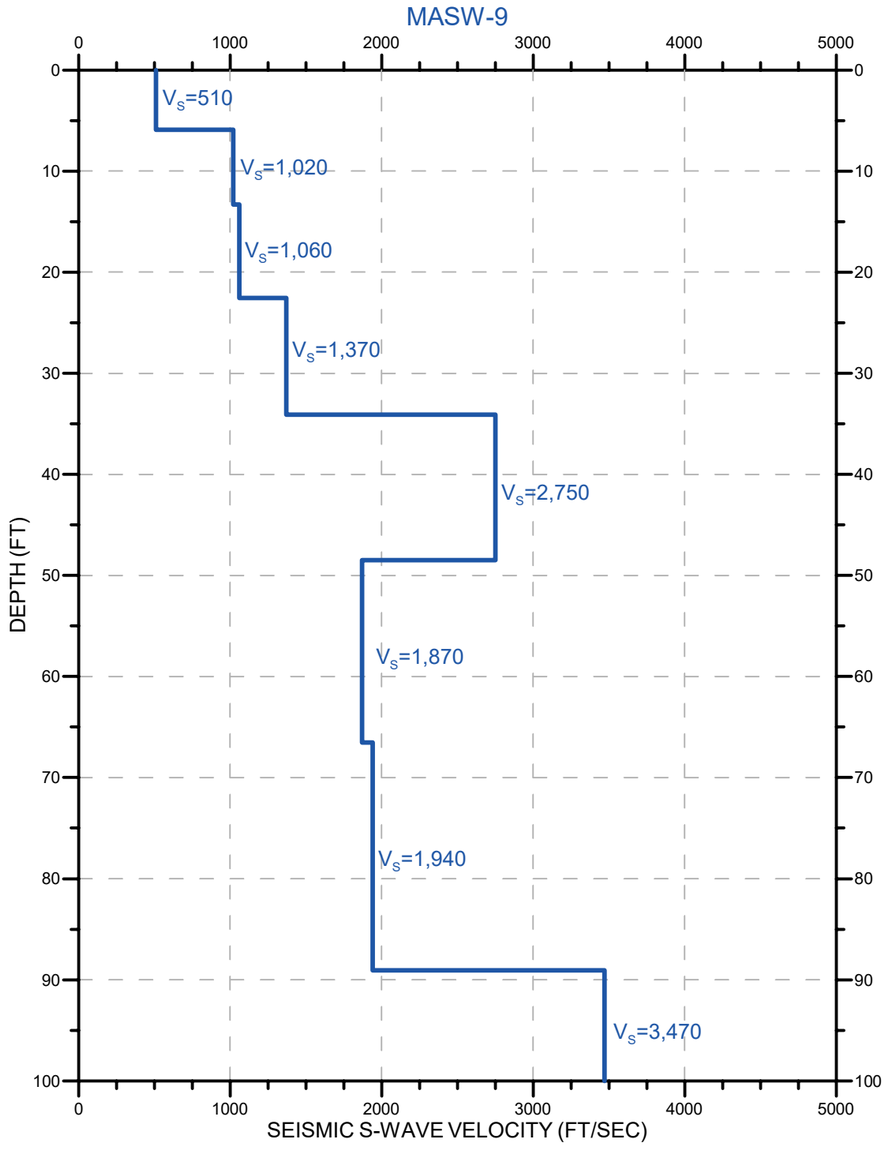

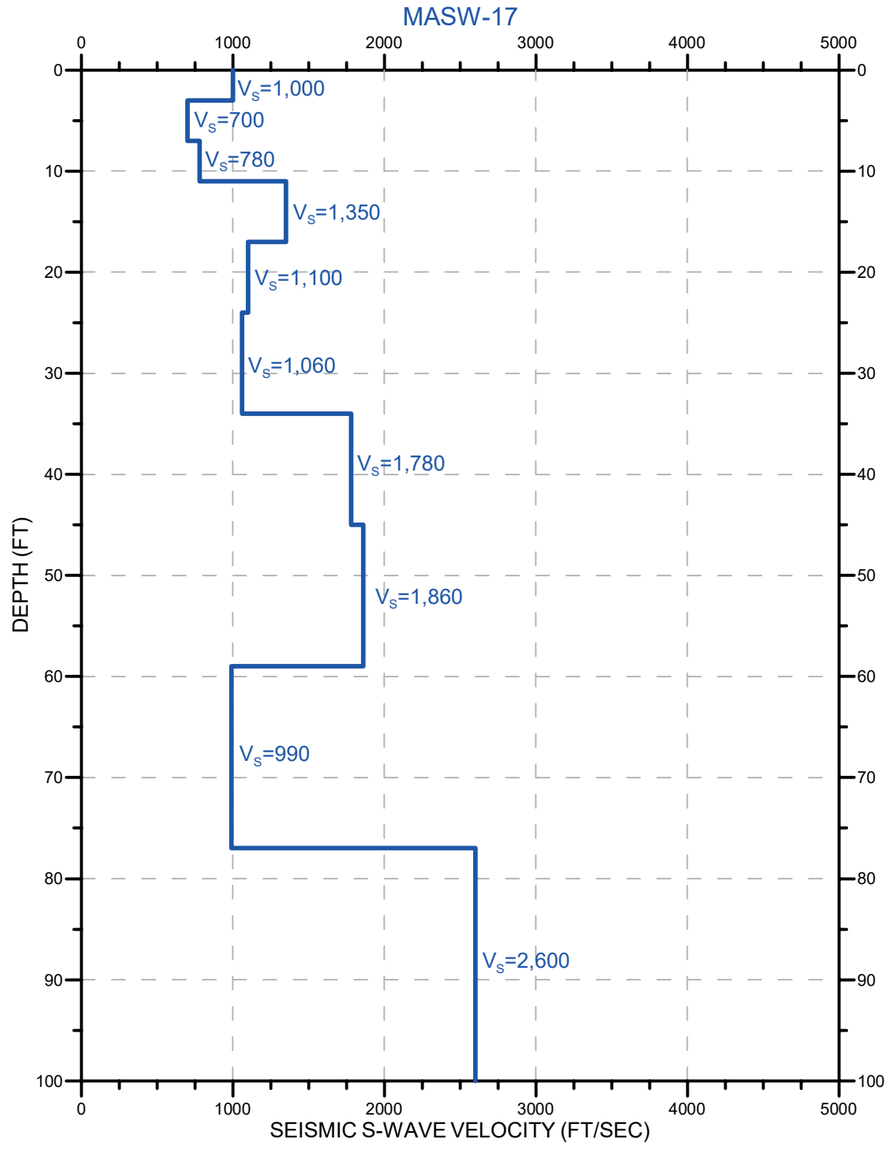

LEGEND	
———	SEISMIC S-WAVE VELOCITY

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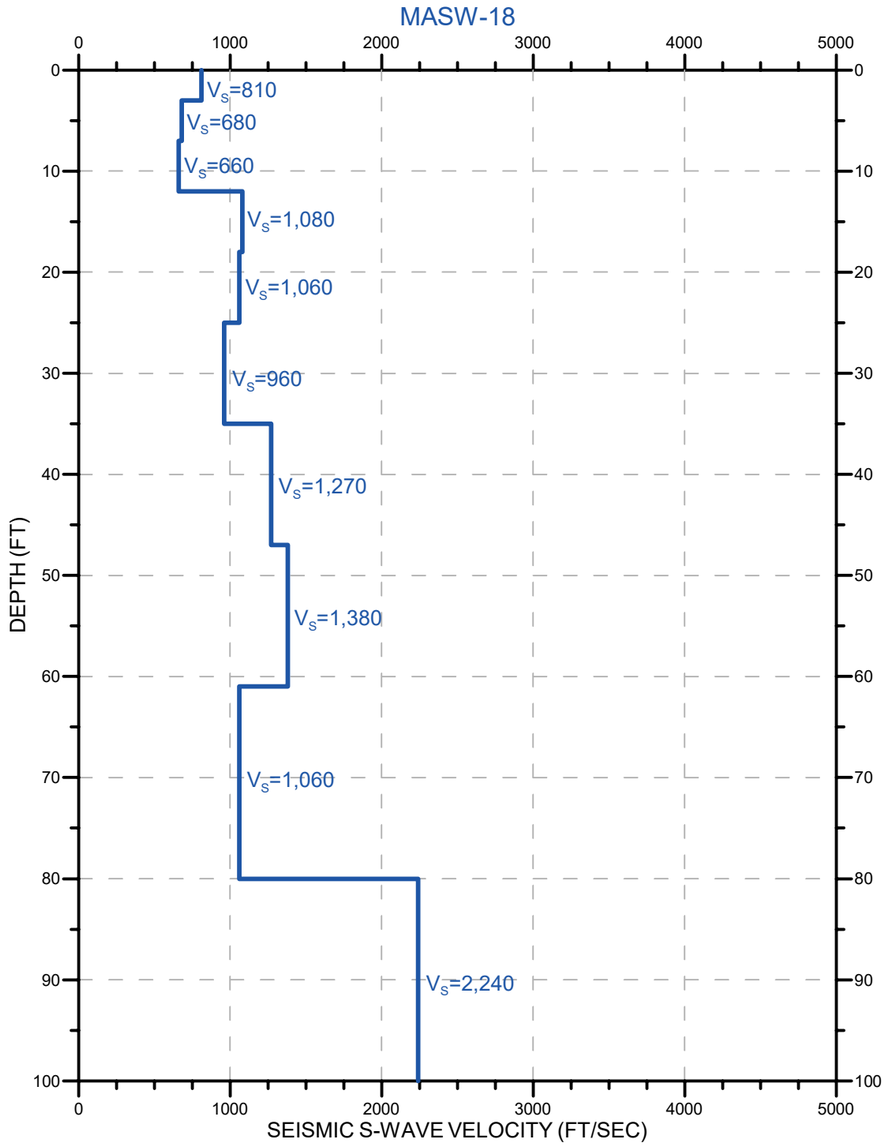
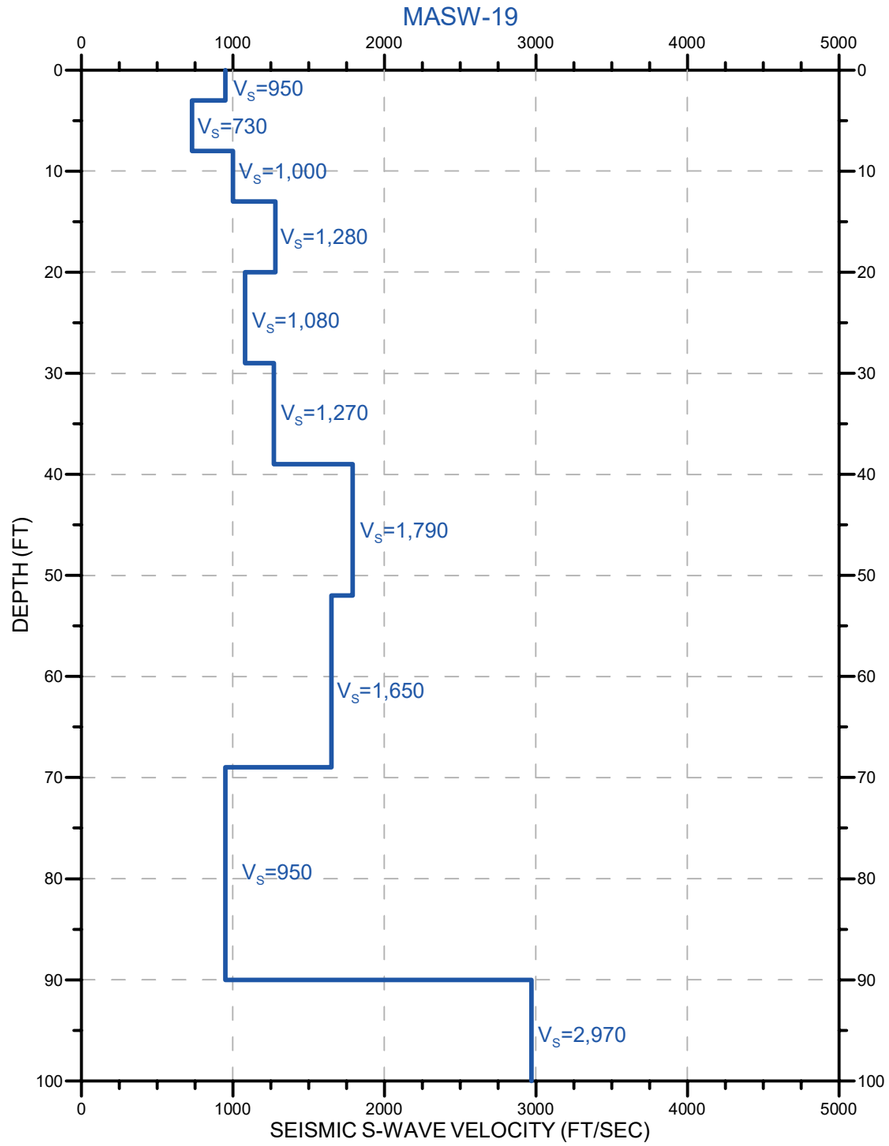
MASW SOUNDINGS — MASW-9 & MASW-17
TURBINES 9 & 17
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA		
CLIENT: BERLOGAR STEVENS & ASSOCIATES		
JOB #: NS225157	DATE: MAY 2023	PLATE 5
DRAWN BY: H.PHILSON	APPROVED BY: DJK	

Donald J. Kirker 5/1/2023





LEGEND	
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MASW SOUNDINGS — MASW-18 & MASW-19
TURBINES 18 & 19
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
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JOB #: NS225157 | DATE: MAY 2023
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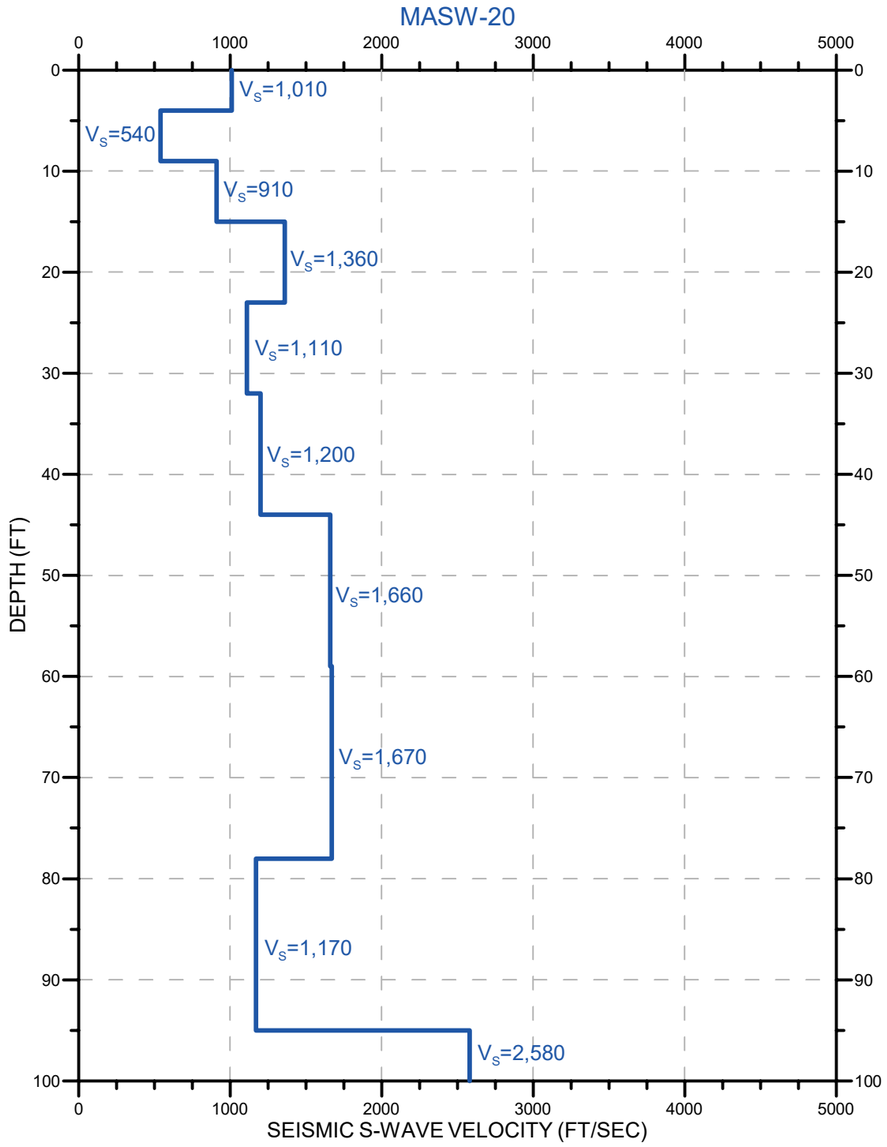
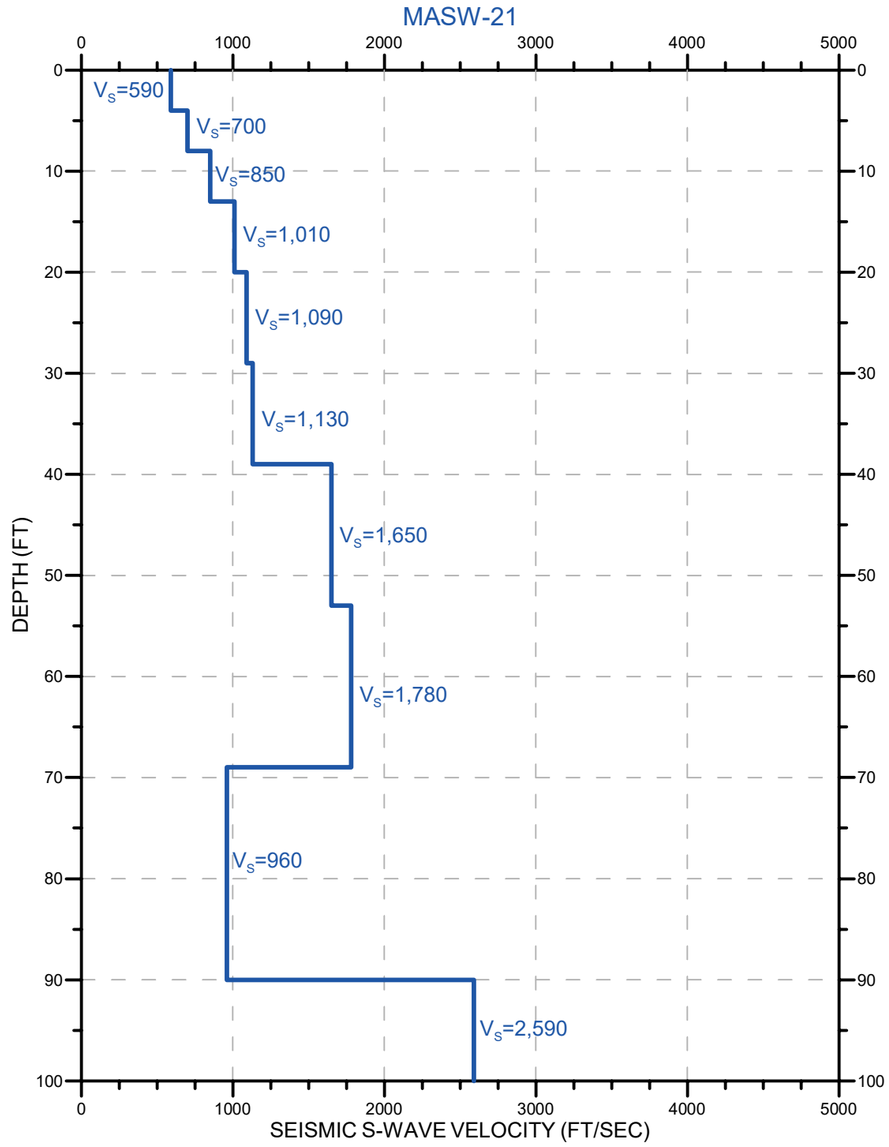
Donald J. Kirker 5/1/2023

PLATE 6





LEGEND	
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MASW SOUNDINGS — MASW-20 & MASW-21
TURBINES 20 & 21
ALTAMONT PASS WIND TURBINE PROJECT

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JOB #: NS225157 | DATE: MAY 2023
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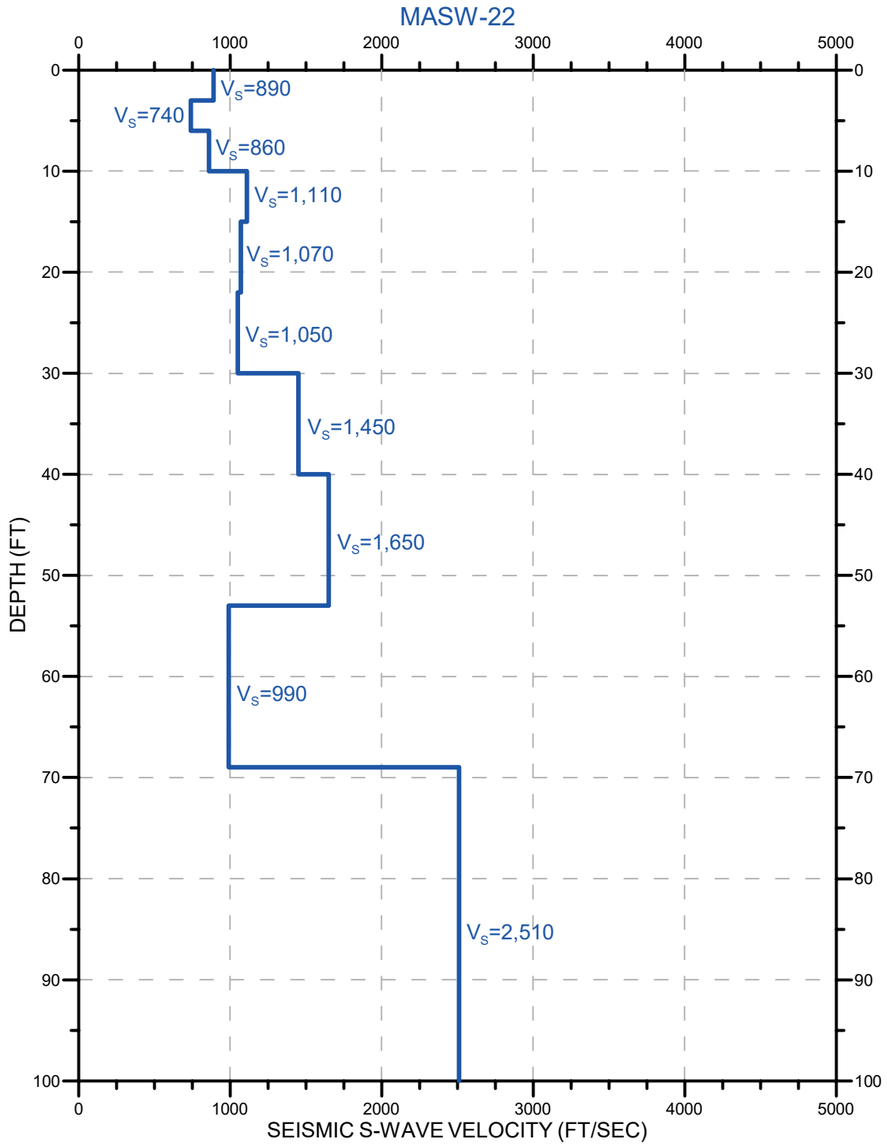
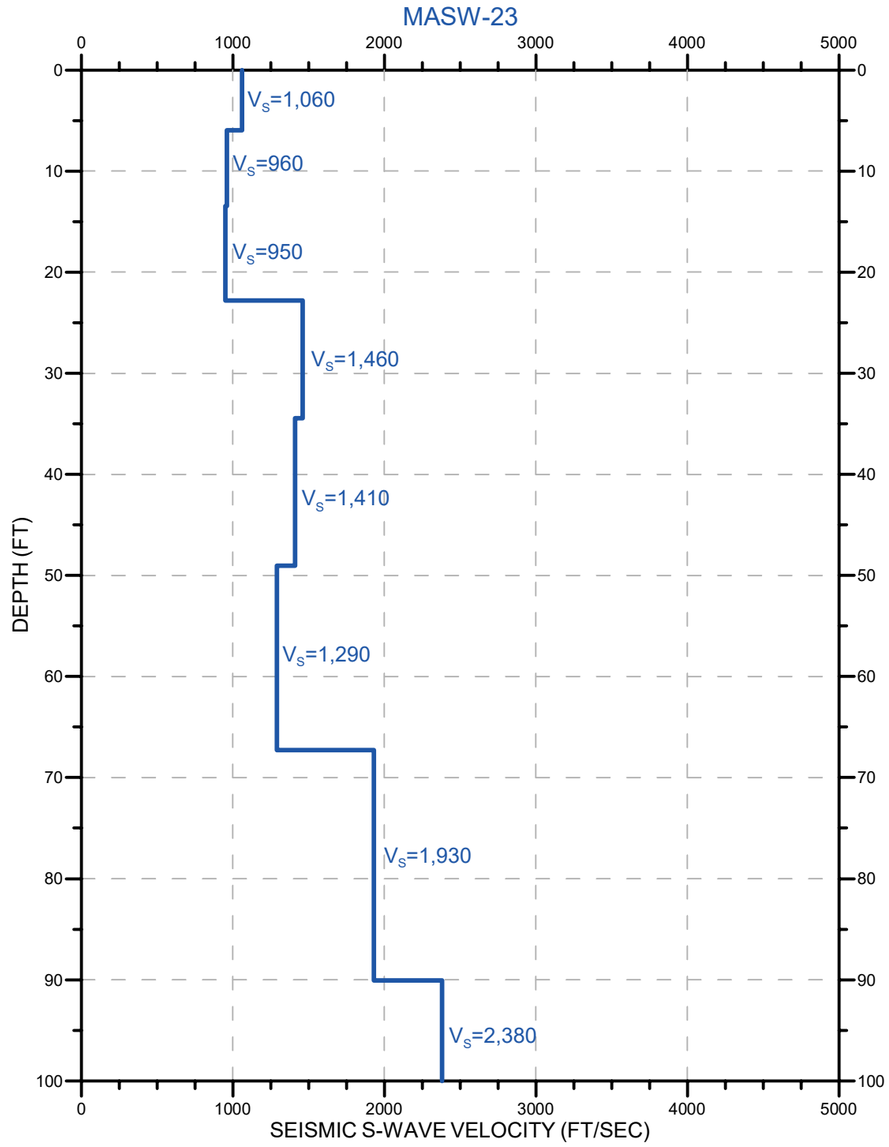
PLATE 7





LEGEND	
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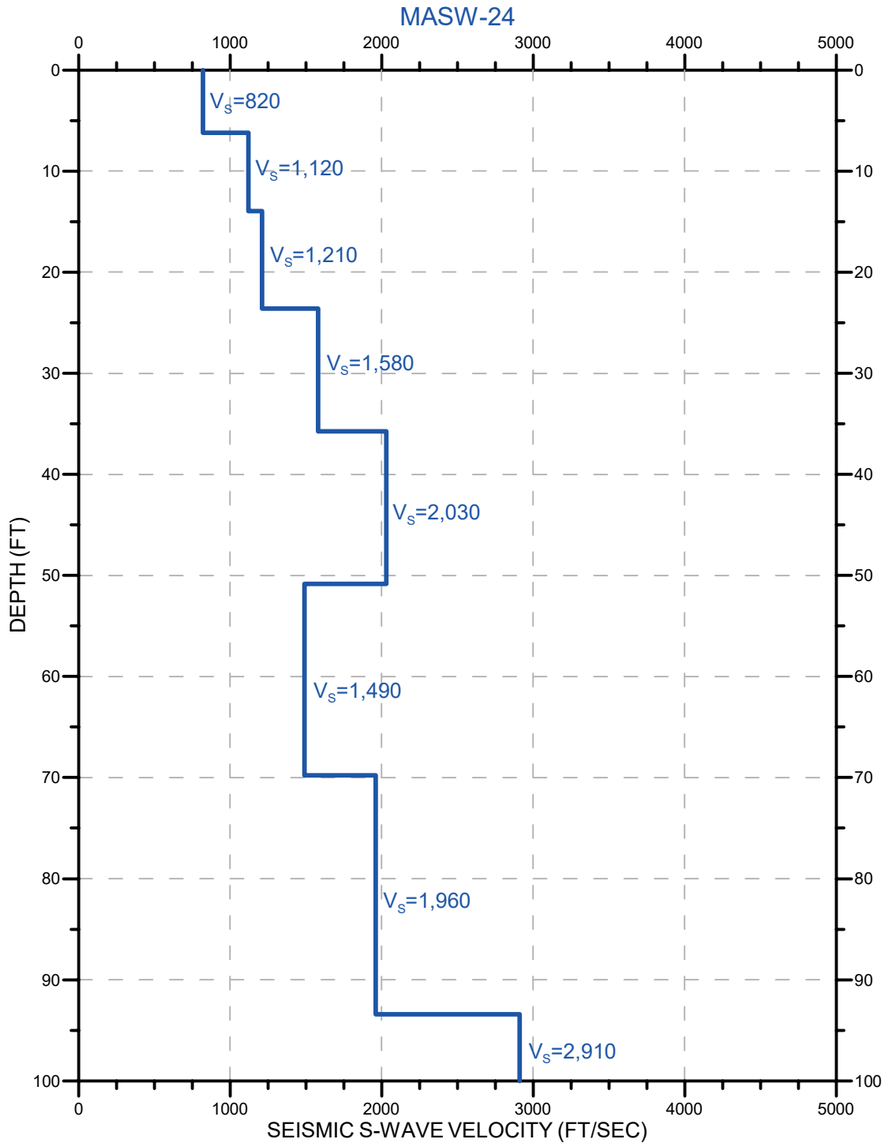
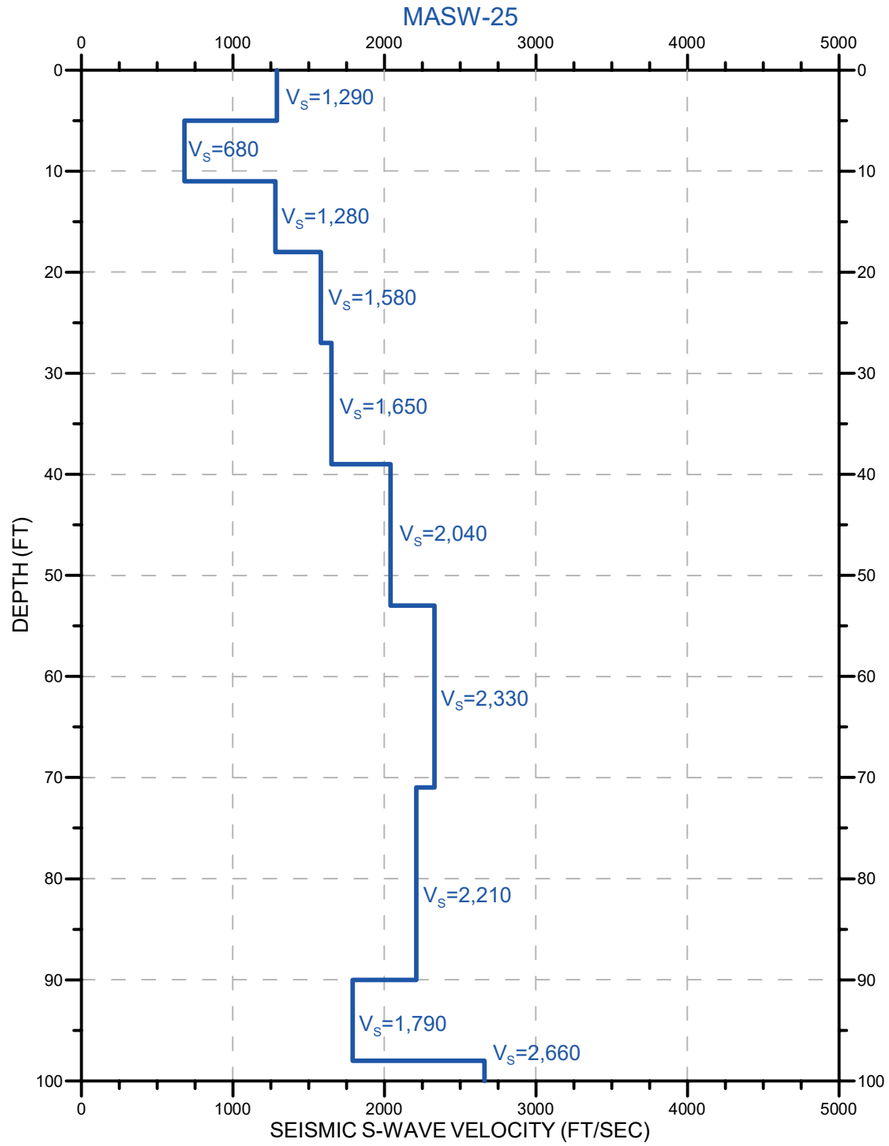
MASW SOUNDINGS — MASW-22 & MASW-23
TURBINES 22 & 23
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES
JOB #: NS225157 | DATE: MAY 2023
DRAWN BY: H.PHILSON | APPROVED BY: DJK
Donald J. Kirker 5/1/2023

PLATE 8





LEGEND	
———	SEISMIC S-WAVE VELOCITY

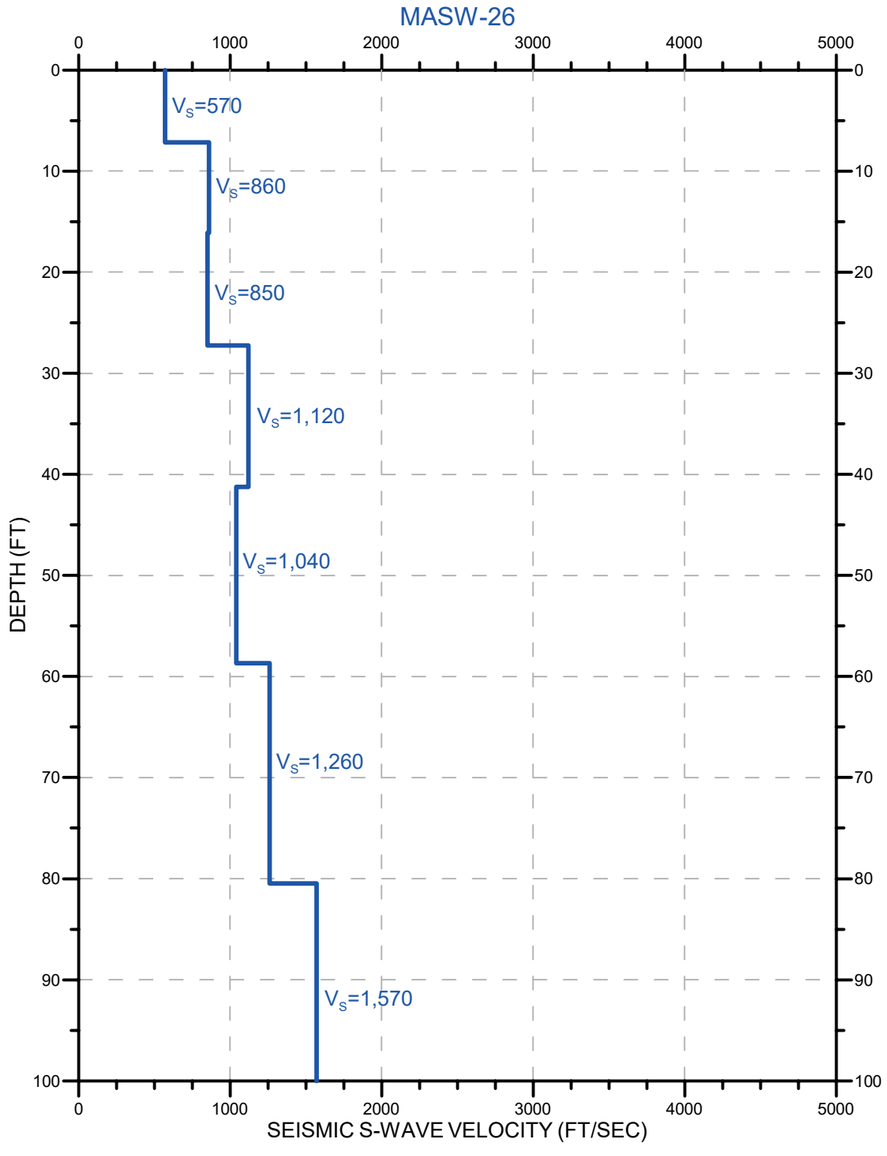
NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY
321A BLODGETT STREET
COTATI, CA 94931
PH. (707) 796-7170
FAX. (707) 796-7175
www.norcalgeophysical.com

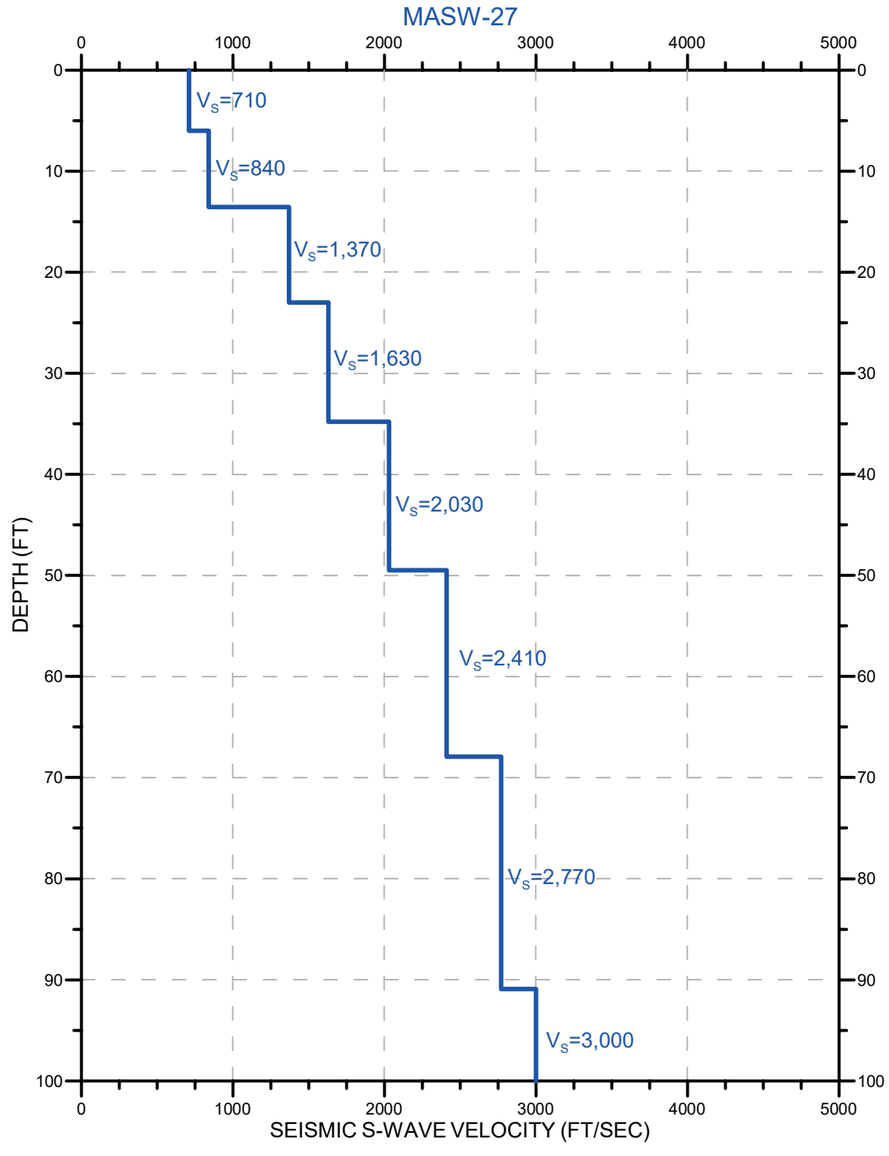
PROFESSIONAL GEOPHYSICIST
DONALD KIRKER
No. 997
STATE OF CALIFORNIA

MASW SOUNDINGS — MASW-24 & MASW-25
TURBINES 24 & 25
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES
JOB #: NS225157 | DATE: MAY 2023
DRAWN BY: H.PHILSON | APPROVED BY: DJK
Donald J. Kirker 5/1/2023

PLATE 9





LEGEND	
———	SEISMIC S-WAVE VELOCITY

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY
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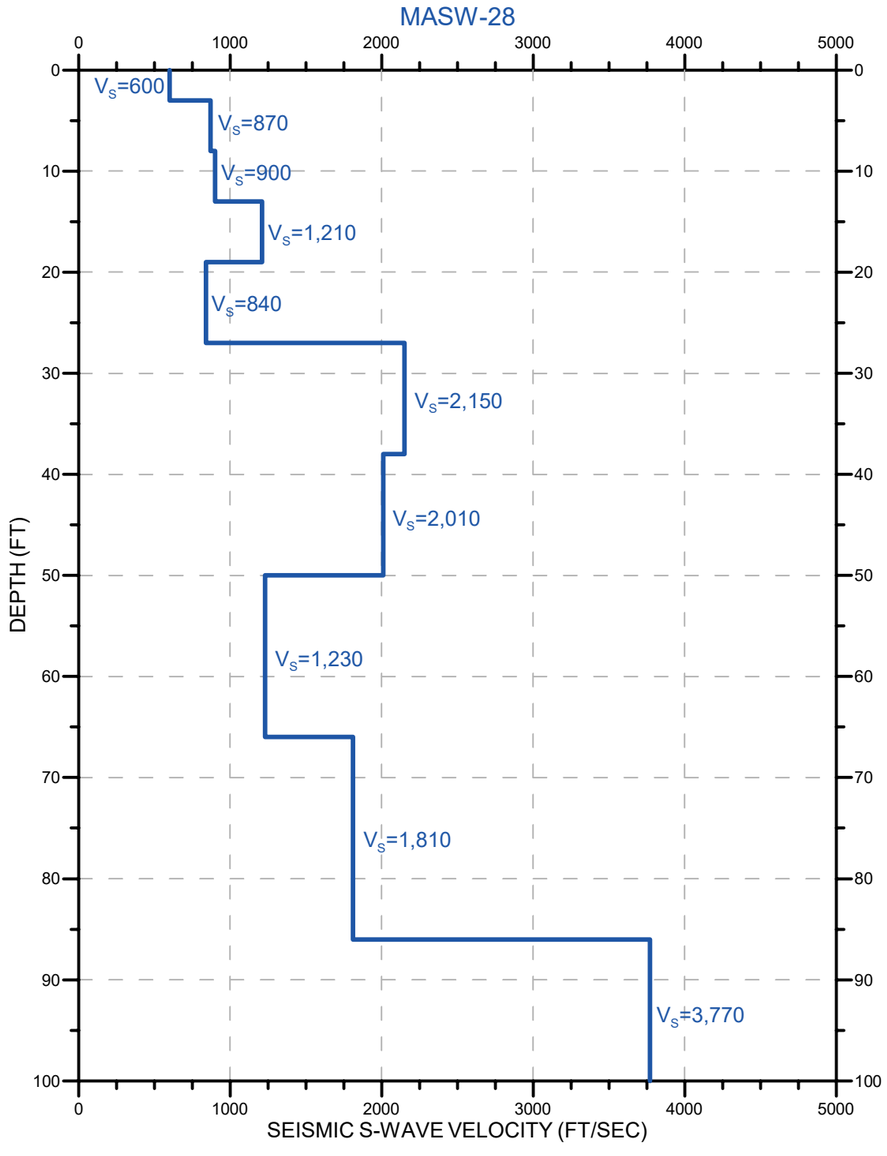
PROFESSIONAL GEOPHYSICIST
DONALD KIRKER
No. 997
STATE OF CALIFORNIA

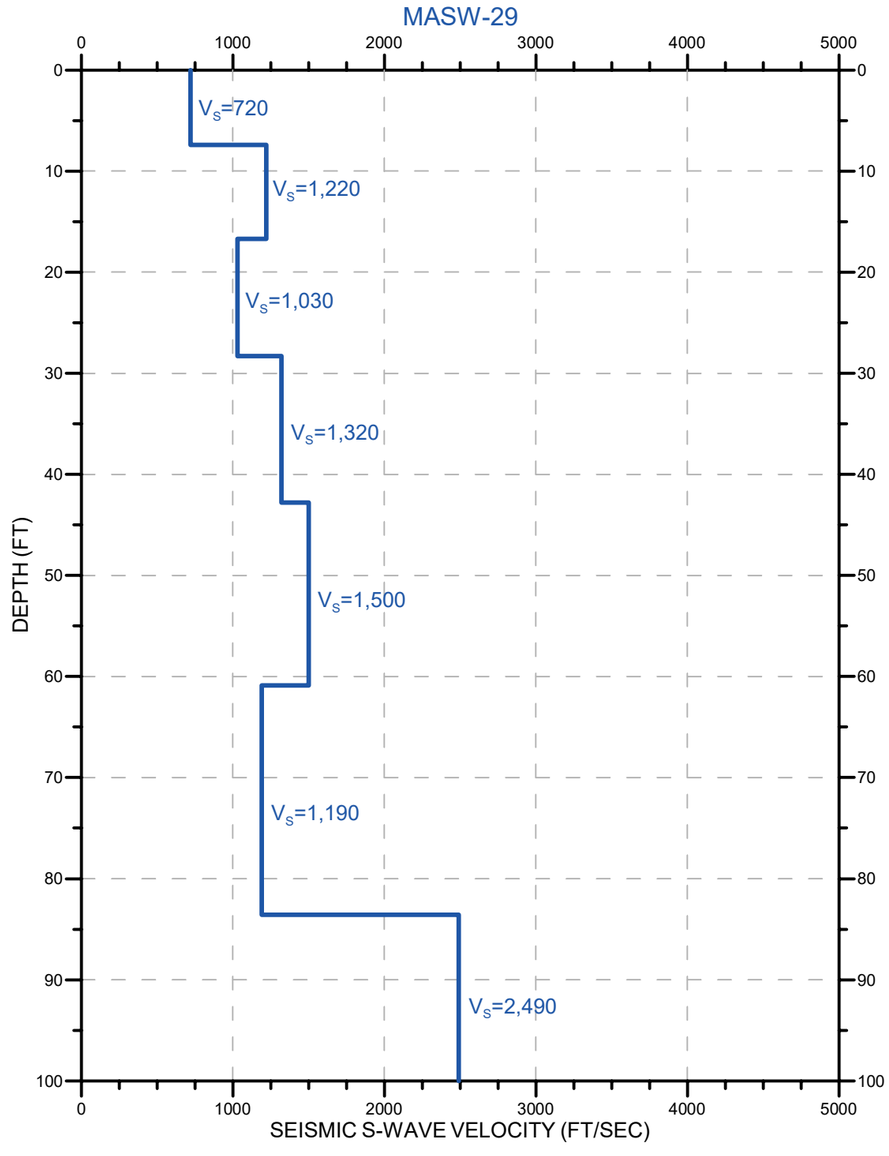
MASW SOUNDINGS — MASW-26 & MASW-27
TURBINES 26 & 27
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES

JOB #: NS225157	DATE: MAY 2023	PLATE
DRAWN BY: H.PHILSON	APPROVED BY: DJK	10

Donald J. Kirker 5/1/2023





LEGEND	
———	SEISMIC S-WAVE VELOCITY

NORCAL GEOPHYSICAL CONSULTANTS INC.
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DONALD KIRKER
No. 997
STATE OF CALIFORNIA

MASW SOUNDINGS — MASW-28 & MASW-29
TURBINES 28 & 29
ALTAMONT PASS WIND TURBINE PROJECT

LOCATION: ALAMEDA COUNTY, CALIFORNIA
CLIENT: BERLOGAR STEVENS & ASSOCIATES

JOB #: NS225157	DATE: MAY 2023	PLATE
DRAWN BY: H.PHILSON	APPROVED BY: DJK	11

Donald J. Kirker 5/1/2023

APPENDIX G

Electrical Resistivity Survey

GEOPHYSICAL REPORT

BSA – Altamont Pass Wind Turbine Project
Vertical Electrical Resistivity Sounding (VES) Survey
Alameda County, California

June 15, 2023
NORCAL Project No. NS225157

Prepared for:

Berlogar Stevens & Associates Inc.
1220 Quarry Lane, Suite C
Pleasanton, CA 94566

Prepared by:

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

NORCAL Geophysical Consultants, Inc. 321 Blodgett St. #A Cotati, CA 94931
P (707) 796-7170 F (707) 796-7175 norcalgeophysical.com

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

June 15, 2023

Berlogar Stevens & Associates Inc.
1220 Quarry Lane, Suite C
Pleasanton, CA 94566

Attn: Dr. Abbas Abdollahi
Telephone: (925) 249.5580
E-mail: aabdollahi@berlogar.com

Re: Geophysical Report
BSA – Altamont Pass Wind Turbine Project
Altamont Pass Wind Farm
Alameda County, California
NS225157

Dear Dr. Abdollahi,

NORCAL Geophysical Consultants, Inc. (NORCAL), a Terracon Company is pleased to submit the Geophysical Report for the above-referenced site.

This report presents the findings of a geophysical survey performed by NORCAL Geophysical Consultants, Inc. for Berlogar Stevens & Associates Inc. (BSA) at the Altamont Pass Wind Farm in Alameda County, California. The survey was authorized under Supplement to Agreement for Services, Reference No. NS22157, dated May 19, 2023. The field work was conducted on May 30, 2023. The work was completed by NORCAL Project Geophysicist J. Sage Wagner III and Senior Geophysical Technician Travis W. Black, under direction of California Professional Geophysicist Donald J. Kirker (PGp No. 997). BSA Staff Matt Valentine provided site orientation and logistical support.

We appreciate the opportunity to perform professional consulting services for BSA. Please contact either of the undersigned at (707) 796-7170 if you have questions about the information provided in the report.

Respectfully,

Respectfully,

NORCAL Geophysical Consultants, Inc

Prepared by:

J. Sage Wagner III
Project Geophysicist

Approved by:

Donald J. Kirker
Authorized Project Reviewer / SME
CA Professional Geophysicist, PGp 997

PROFESSIONAL GEOPHYSICIST
DONALD KIRKER
No. 997
STATE OF CALIFORNIA

6-9-2023

cc: Dr. Abbas Abdollahi, aabdollahi@berlogar.com
Mr. Frank Berlogar, fberlogar@berlogar.com
Mr. Matt Valentine, mvalentine@berlogar.com

1. INTRODUCTION

This report presents the findings of four Vertical Electrical Sounding (VES) surveys. The VES surveys were conducted to gather essential information to assist in the design of a proposed wind power project located along Altamont Pass Road in Alameda County, California. Two VES soundings were executed to the north of Altamont Pass Road and two to the south.

A VES survey measures the electrical resistivity (ER) of the subsurface as a function of depth. The survey method yields one-dimensional (1-D) data, which is presented herein both tabularly and graphically. Descriptions of the VES methodology, our data acquisition and analysis procedures, and the instruments used for the VES survey are detailed in **Appendix A: Electrical Resistivity Sounding**.

The site location is depicted in the Vicinity Map found in **Plate 1 – Site Overview Map**. Further details of these locations, featuring satellite imagery, illustrate each VES sounding location and proposed turbine location, indicated with green modified boring symbols. A written description of the site conditions, covering relevant site-specific information, current ground cover, topography, and local geology, is summarized in Section 2.0 below.

2. SITE DESCRIPTION

The following description of site conditions is derived from our site visit and a review of publicly available geologic and topographic maps.

Item	Description
Site information	The project site, the proposed wind power addition, is located 8.5 miles northeast of Livermore in the Coast Range Geomorphic Province. The approximate coordinate of the site is 37.7534°, -121.6291°.
Current ground cover	The geophysical data was gathered in close proximity to pre-existing roads and the proposed turbine site. Taking into account past atmospheric river weather conditions, the data collection points were strategically positioned as near to the turbine locations as safety permitted. The terrain is comprised of open, cattle-grazing land, featuring a diverse combination of grasses, shrubs, and forbs.
Existing topography	According to Trimble GPS elevation data, the terrain within the study area exhibits varying degrees of incline, from flat to steep, and spans elevations of approximately 390 to 1,150 feet above mean sea level (NAVD88).
Site geology	Available geologic maps (i.e., Jennings, C.W., with modifications by Gutierrez, C., Bryant, W., Saucedo, G., and Wills, C., 2010, Geologic map of California: California Geological Survey, Geologic Data Map No. 2, scale 1: 750,000.) indicate that the site is underlain by marine sedimentary and metasedimentary rocks consisting of Upper Cretaceous sandstone, shale, and conglomerate.

3. SCOPE OF WORK

Our scope of work consisted of conducting an VES survey which encompasses four VES soundings to measure apparent resistivity. Our scope of work included data acquisition, processing, and presentation of our findings in a written Geophysical Report.

Mr. Mr. Matt Valentine, BSA, aided in determining the position of the soundings to best optimize the available work area.

4. VES SURVEY

4.1 METHODOLOGY

The VES survey, using the Wenner 4-Pin method, measures the Electrical Resistivity (ER) of the shallow sub-surface. The four “pins” (electrodes) are arranged in a collinear array. Current is transmitted between the outer two electrodes and the resulting voltage is measured across the inner two electrodes. Readings were taken with electrode separations (a-spacings) of 2.5-, 5-, 10-, 20-, 40-ft. More detailed descriptions of the VES methodology, our data acquisition and analysis procedures, and the instrumentation we used are provided in Appendix A – VES Survey.

4.2 RESULTS

The data for each ER sounding were acquired along two perpendicular arrays with a common center point, oriented N-S and E-W as specified on the data sheets. The VES survey results are presented by the Field Electrical Resistivity Data Sheets in Appendix A. The apparent resistivity values are presented in units of ohm-centimeters.

The locations of these VES results are summarized in Table 1 below, which provides information on the VES identification, latitude, and longitude.

Table 1 : *VES sounding locations*

VES Sounding Locations		
VES-ID	**Latitude**	**Longitude**
T-5	37.7397750	-121.6529090
T-23	37.7598530	-121.6039040
AML-Midway Substation	37.7476621	-121.5986460
Zond Substation	37.7432563	-121.6590904

APPENDIX A:
Electrical Resistivity Sounding

1.0 METHODOLOGY

1.1 ELECTRICAL RESISTIVITY: DEFINITION AND APPLICATIONS

Electrical Resistivity (ER) denotes the degree to which a specific volume of earth material resists the passage of an electric current. ER in sedimentary earth materials is influenced directly by a variety of factors, such as grain size, porosity, mineral content, moisture levels, and salinity of the groundwater. Our extensive experience conducting ER surveys throughout the Bay Area has led us to conclude that, particularly in unconsolidated materials, the grain size exerts the most significant effect on ER. For instance, fine-grained materials like clays and silts usually demonstrate low ER, while coarse-grained materials like sands and gravels exhibit high ER.

The ER of rock materials is primarily determined by their mineral composition and the extent of weathering and fracturing. Deeply buried rock formations that remain unexposed to chemical weathering are typically impermeable, have minimal water content, and exhibit high electrical resistivity. On the other hand, highly weathered and fractured rocks that retain moisture generally exhibit lower resistivity values. Moreover, certain rocks consist of conductive minerals which can contribute to the rock demonstrating relatively low ER.

The aforementioned relationships elucidate how geophysical methods that measure subsurface ER can be effectively utilized to ascertain the depth, thickness, and lateral spread of groundwater aquifers, depth to groundwater, depth to rock, and the depth, thickness, and lateral spread of clay layers and sand/gravel deposits. Furthermore, ER measurements serve to evaluate soil corrosion potential and offer parameters required for designing electrical grounding systems.

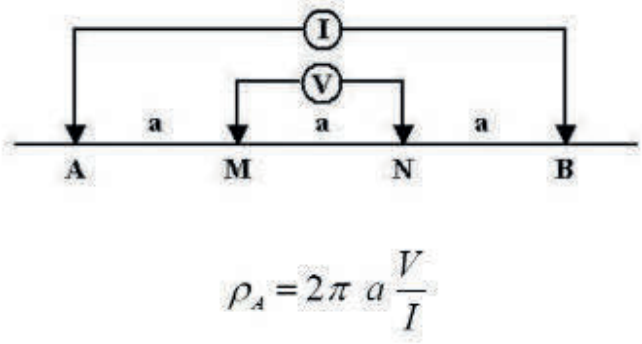
1.2 ELECTRICAL RESISTIVITY SOUNDING

A procedure known as Vertical Electric Sounding (VES) is used to measure variations in ER as a function of depth beneath a specific point. This involves injecting an electric current (I) into the ground via two electrodes, and then recording the consequential electrical potential or voltage drop (V) using two additional electrodes. A multitude of electrode configurations exist, but the most common ones are the Wenner and Schlumberger arrays. Both techniques require the four electrodes to be arranged in a collinear array, with the outer pair (designated A and B) transmitting the current, and the inner pair (M and N) measuring the resulting voltage. The measurements are typically taken with various electrode separations, ranging from under one

foot to several hundred feet. A larger separation forces the current to penetrate deeper into the ground to complete the circuit. The actual current flows within a hemispherical volume of earth located between the current electrodes. The readings from each electrode separation are employed to compute an entity known as the apparent resistivity (ρa). The label "apparent" is used because this value represents the resistivity of an earth volume with varying resistivity values, not a discrete layer with uniform resistivity. The location of the sounding is defined as the center of the electrode array.

For ER surveys related to the design of grounding systems, including this survey, the Four Pin Wenner Array is typically employed. In this configuration, the electrode separation, "a", is constant for all four electrodes, but changes from one reading to another. The array configuration diagram and the corresponding equation used to compute apparent resistivity are illustrated in Figure 1.

Figure 1: *Schematic Representation of the Wenner Array and the Associated Apparent Resistivity (ρa) Equation.*



$$\rho_A = 2\pi\, a \frac{V}{I}$$

2.0 INSTRUMENTATION

We collected VES data using a ***SuperSting R1*** Resistivity Meter, manufactured by Advanced Geosciences Incorporated (AGI). The SuperSting is a self-contained unit that transmits current at outputs ranging from 1 to 2,000 milliAmps (mA). The instrument measures the potential drop (voltage) caused by the current influx and converts the data to values of apparent resistivity. The data are stored in internal memory and can be downloaded to a computer for subsequent archiving.

3.0 DATA ACQUISITION

The VES survey was composed of four approximately orthogonal arrays, labeled T-5, T-23, the AML-Midway Substation, and the Zond Substation. The SuperSting R1 was linked to the four electrodes in the array using 14-gauge insulated single conductor wires. Once the instrument was programmed with the a-spacing for a specific measurement, it injected the electrical current through the outer electrodes (A and B) and measured the voltage drop across the inner pair (M

and N). Each measurement was repeated twice, and the results were compared to ensure a maximum deviation of 2% between the measurements. The averaged readings were then automatically used to compute the apparent resistivity values (ρa) based on the equation depicted in Figure 1. This procedure was iteratively applied for each predefined a-spacing, commencing with the smallest values (a=2.5-ft) and progressively expanding with each subsequent measurement up to the largest spacing (a=40-ft).

APPENDIX H

General Laboratory Testing

Dry Density-Moisture Content Worksheet

Project Name: **Rooney Sand Hill** Sample Diameter, in,: 2.420 **Project Number:** **4245.200**

Sample ID	Moisture Content, %	Dry Density, pcf:	Sample Description	Wet Sample Weight, g:	Sample Height, in:	Tare ID:	Tare Weight, g:	Wet Sample + Tare Weight, g:	Dry Sample + Tare Weight, g:
B4 at									
9.5-	17.2	112.5	CL Sandy Clay Brown	604.2	3.79	410	197.0	601.0	541.7
14-	23.6	101.1	CL Sandy Clay Orange Brown	814.2	5.40	58	231.2	1,107.3	939.8
B5 at									
8.5	17.7	107.7	CL Sandy Clay Brown	688.5	4.50	837	110.4	338.9	304.5
B6 at									
9-10	20.4	103.9	SC Clayey Sand Orange Brown	475.9	3.15	400	194.6	932.3	807.4

Invoice Number: 23040 initials:

ASTM D-2166 Unconfined
Compressive Strength of Cohesive Soils

Project Name: Rooney Sand Hill	Project Number: 4245.200
Sample ID: B1 at 9-1/2ft	Invoice Number: 23040
Sample Description: CL Sandy Clay Brown	Date Tested: 06/22/22
Comments:	

Summary of Results

Max. Stress, psf:	Strain at Failure, %:	Dry Density, pcf:	Moist. Content, %:
4,235	3.8	103.6	20.9

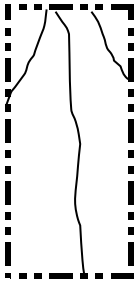
Test Data

Strain Gauge Reading, inches:	Load, lbs:	Percent Strain, %:	Stress, psf:	Strain Gauge Reading, inches:	Load, lbs:	Percent Strain, %:	Stress, psf:
0.000		-	0	0.300			
0.010				0.340			
0.020				0.380			
0.030				0.420			
0.040				0.460			
0.050				0.500			
0.060				0.540			
0.070				0.580			
0.080				0.620			
0.090				0.660			
0.100				0.700			
0.120				0.740			
0.140				0.780			
0.160				0.820			
0.180				0.860			
0.200				0.900			
0.220							
0.240							
0.260							
0.280							

Sample Data

Sample Diameter, inch:	2.420
Wet Sample Mass, (g):	903.1
Sample Height, inch:	5.970
Wet Density, pcf:	125.3
Tare ID:	35
Tare Mass, (g):	115.0
Tare + Wet Sample Mass,(g):	961.4
Tare + Dry Sample Mass, (g):	814.8

Sketch of Failure



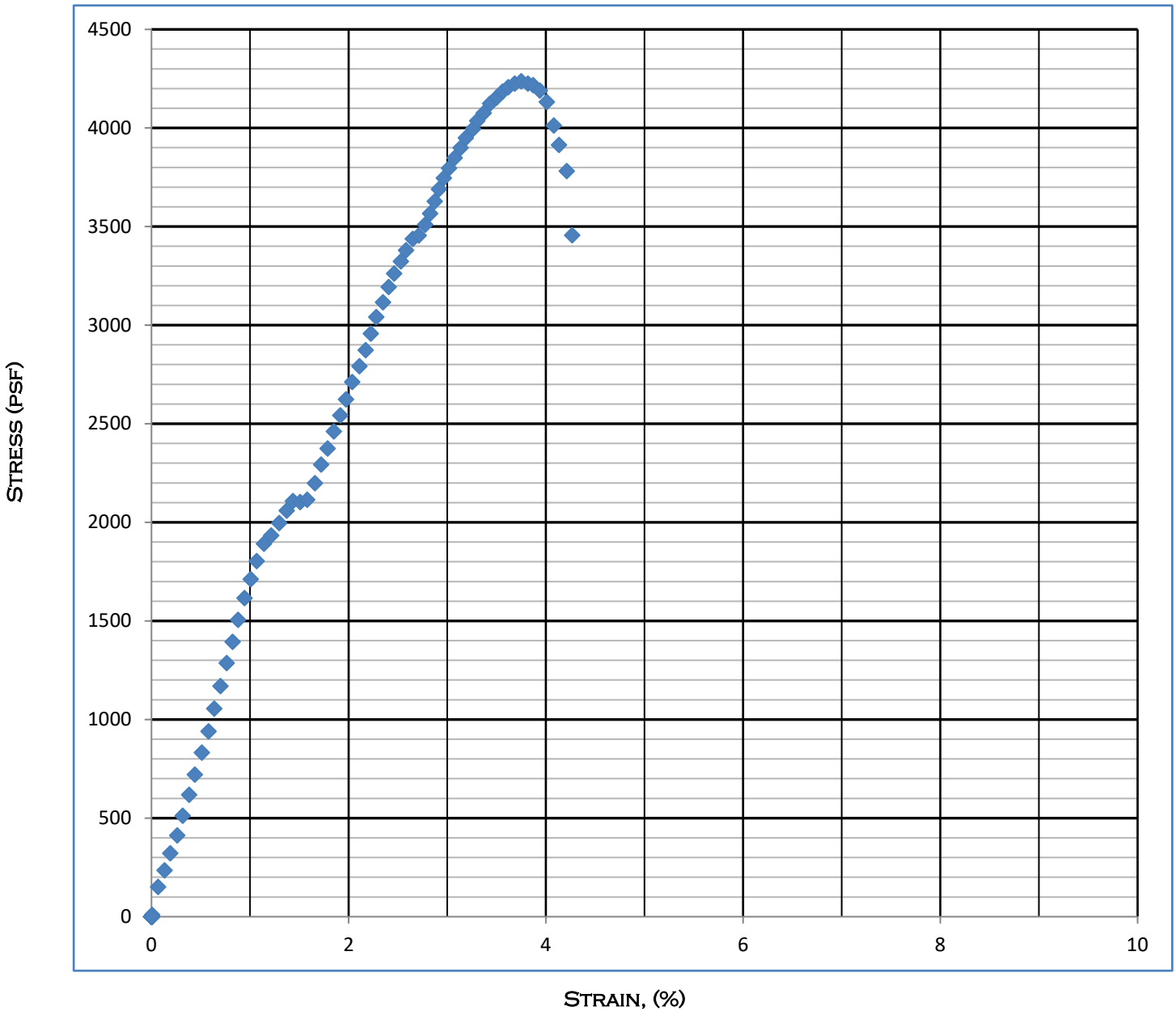
Reported By: G Suckow

Tested By: gs

ASTM D-2166 Unconfined
Compressive Strength of Cohesive Soils

Project Name: Rooney Sand Hill			Project Number: 4245.200
Sample ID: B1 at 9-1/2ft			Invoice Number: 23040
Sample Description: CL Sandy Clay Brown			Date Tested: 06/22/22
Dry Density, pcf: 103.6	Moisture Content,%: 20.9	Maxi Stress, psf: 4,230	Strain at Failure, %: 3.9
Comments:			

Stress, (psf) vs Strain (%) Curve



Reported By: G Suckow

Tested By: GS

Berlogar Stevens & Associates
Lab Summary Sheet

Project Name: Rooney Sand Hill	**Project Number:** 4245.200
Client:	Date Completed: 3/30/2023
Attention:	Date Delivered: 3/23/2023
Sample ID: B4 at 9-1/2ft	Invoice Number: 23040
Sample Descrption: CL Lean Clay Brown	Reported By: G Suckow

Hydrometer ASTM D422

US	Metric, mm	% Passing	Spec
3"	75.0		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.17		
#30	0.600		
#40	0.500		
#50	0.300		
#100	0.150		
#200	0.075		
	0.055		
	0.037		
	0.019		
	0.009		
	0.005		
	0.002		
	0.001		

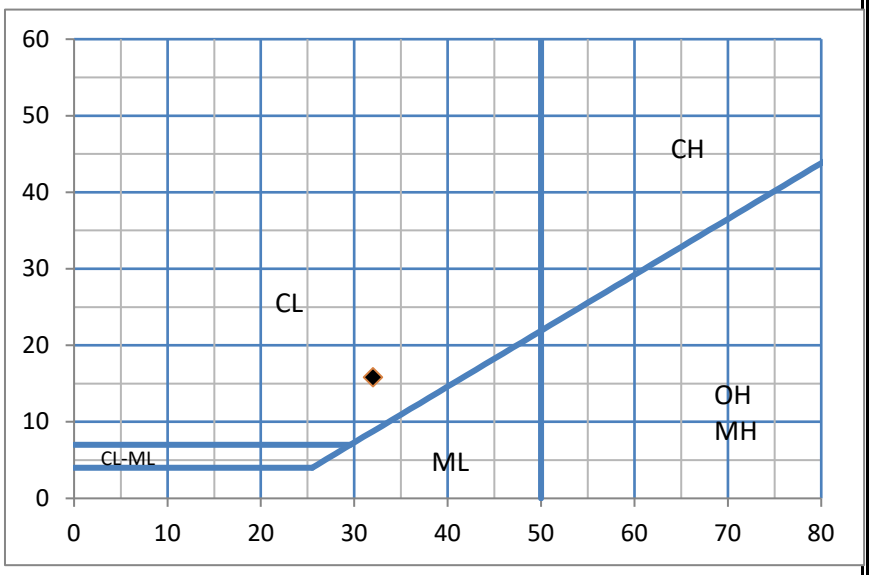
ASTM C117 200 Wash

	Spec
Percent Passing #200:	

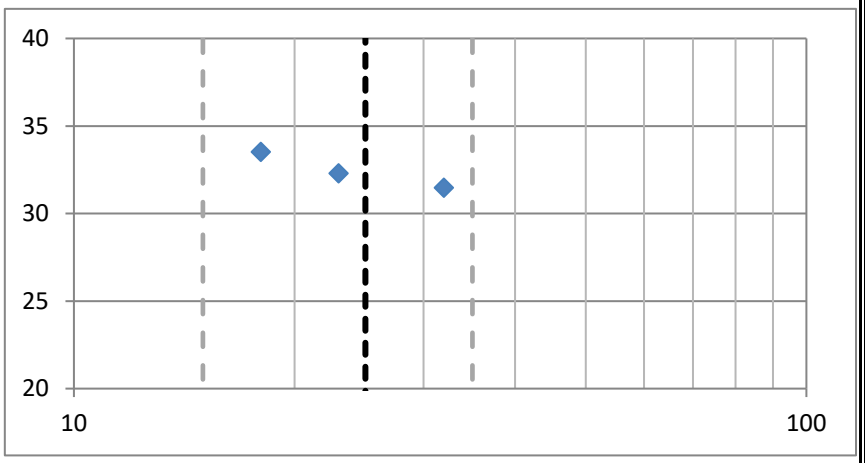
Atterberg Limit ASTM D4318

	Spec.
Plasticity Index	**16**
Liquid Limit	32
Plastic Limit	16
Minus 40 Classification	CL Lean Clay

Liquid Limit (LL) vs Plasticity Chart



Flow Curve



Berlogar Stevens & Associates
Lab Summary Sheet

Project Name: Rooney Sand Hill	**Project Number:** 4245.200
Client:	Date Completed: 3/30/2023
Attention:	Date Delivered: 3/23/2023
Sample ID: B5 at 8-1/2ft	Invoice Number: 23040
Sample Descrption: CL Sandy Clay Brown	Reported By: G Suckow

Hydrometer ASTM D422

US	Metric, mm	% Passing	Spec
3"	75.0		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.17		
#30	0.600		
#40	0.500		
#50	0.300		
#100	0.150		
#200	0.075		
	0.055		
	0.037		
	0.019		
	0.009		
	0.005		
	0.002		
	0.001		

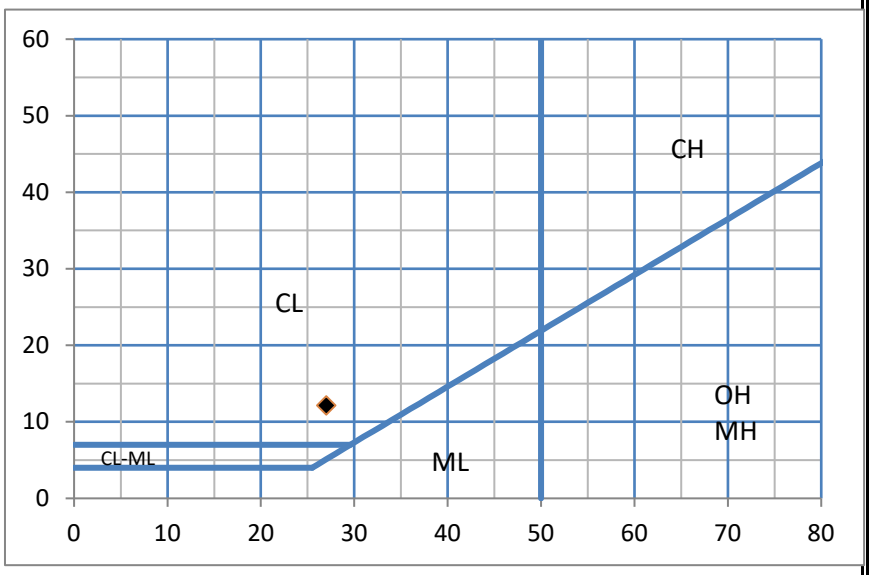
ASTM C117 200 Wash

	Spec
Percent Passing #200:	

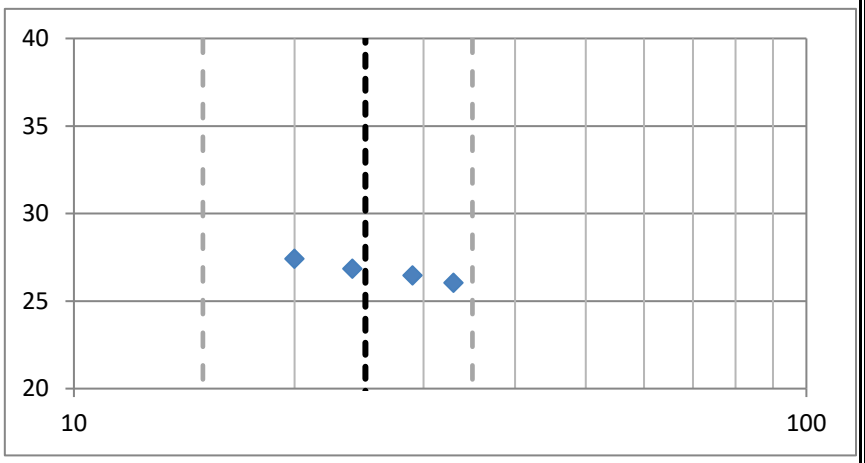
Atterberg Limit ASTM D4318

	Spec.
Plasticity Index	12
Liquid Limit	27
Plastic Limit	15
Minus 40 Classification	0

Liquid Limit (LL) vs Plasticity Chart



Flow Curve



Berlogar Stevens & Associates

ASTM Laboratory Tests Summary Sheets

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Client:		Date Reported:	03/29/23
Attention:		Date Received:	03/24/23
Sample ID:	**B4 at 14ft**	Invoice Number:	**23040**
Material Description:	CL Sandy Lean Clay Orange Brown	Reported By:	G Suckow

Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5	100	
1/4"	6.3		
#4	4.75	100	
#8	2.36	99	
#10	2.00		
#16	1.18	98	
#30	0.600	96	
#40	0.425		
#50	0.300	89	
#100	0.150	76	
#200	0.075	64.5	

Dry Density Moisture Content Relationship

Test Method	Optimum Moisture Content, %:	Maximum Dry Density, Pcf:
D1557B		

Relative Compaction of Untreated Soils CTM 216

Moisture Content, %	Maximum Wet Density, g/cc:

Resistance Value (R-Value) ASTM D2844 CTM 301

	A	B	C	D
Exudation Pressure, psi:				
Corrected R-Value:				
Moisture Content at Test, %:				
Dry Density, pcf:				
Expansion Pressure, psf:				
R-Value at 300 psi:		**Specification:**		
Expansion Pressure at 300 psi:		psf		

Plasticity Index ASTM D4318

Liquid Limit:		Specification	
Plastic Limit:		Specification	
Plasticity Index:		Specification	

-40 Soil Classification:	

Coarse and Fine Aggregate Quality Tests

		Specifications
Cleanliness Value, CTM 227:		
Sand Equivalency, ASTM D2419:		
Coarse Durability Index, ASTM3744:		
Fine Durability Index, ASTM3744:		
Sodium Soundness ASTM C88, % Loss:		
LA Abrasion ASTM C131 500 Revs. % Loss:		
LA Abrasion ASTM C131 100 Revs. % Loss:		
LA Abrasion ASTM C131 Grading Used:		
ASTM D-4829 Expansion Index($EI)_{50\%}$:		
Expansion Potential:		

Comments:

Berlogar Stevens & Associates

ASTM Laboratory Tests Summary Sheets

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Client:		Date Reported:	03/29/23
Attention:		Date Received:	03/24/23
Sample ID:	**B6 at 9ft**	Invoice Number:	**23040**
Material Description:	SC Clayey Sand Orange Brown	Reported By:	G Suckow

Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5	100	
1/4"	6.3		
#4	4.75	99	
#8	2.36	96	
#10	2.00		
#16	1.18	93	
#30	0.600	90	
#40	0.425		
#50	0.300	79	
#100	0.150	59	
#200	0.075	44.1	

Dry Density Moisture Content Relationship

Test Method	Optimum Moisture Content, %:	Maximum Dry Density, Pcf:
D1557B		

Relative Compaction of Untreated Soils CTM 216

Moisture Content, %	Maximum Wet Density, g/cc:

Resistance Value (R-Value) ASTM D2844 CTM 301

	A	B	C	D
Exudation Pressure, psi:				
Corrected R-Value:				
Moisture Content at Test, %:				
Dry Density, pcf:				
Expansion Pressure, psf:				
R-Value at 300 psi:		**Specification:**		
Expansion Pressure at 300 psi:		psf		

Plasticity Index ASTM D4318

Liquid Limit:		Specification	
Plastic Limit:		Specification	
Plasticity Index:		Specification	
-40 Soil Classification:			

Coarse and Fine Aggregate Quality Tests

		Specifications
Cleanliness Value, CTM 227:		
Sand Equivalency, ASTM D2419:		
Coarse Durability Index, ASTM3744:		
Fine Durability Index, ASTM3744:		
Sodium Soundness ASTM C88, % Loss:		
LA Abrasion ASTM C131 500 Revs. % Loss:		
LA Abrasion ASTM C131 100 Revs. % Loss:		
LA Abrasion ASTM C131 Grading Used:		
ASTM D-4829 Expansion Index$(EI)_{50\%}$:		
Expansion Potential:		

Comments:

Consolidation ASTM D 2435

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Sample ID:	B4 at 9-1/2ft	Date Started:	03/27/23
Sample Description:	CL Sandy Lean Clay Brown	Invoice Number:	23040
Consolidometer No.:	826	Tare ID: 37	Ring Diameter, inches: 2.395
Ring Area, cm^2:	29.065		
Remarks:		Initial Sample Height, in:	1.001

Summary of Results

Initial Moisture Content, %:	**16.4**	**Consolidate Moisture Content, %:**		**Final Moisture Content, %:**	**16.9**
Initial Dry Density, pcf:	**112.1**	**Consolidated Dry Density, pcf:**	**127.9**	**Final Dry Density, pcf:**	**124.3**

Test Data

Sample Stage	Saturated	**Load, psf**	Dial Reading, inches	Correction Factor, inches	Height, inches	**Volume Change, percent**	Moisture Content, percent	Dry Density, pcf
Init.		**50**	0.0534	-	1.0007	**-**	16.4	112.1
	yes	**500**	0.0604	0.0015	0.9952	**-0.55**		
		1,000	0.0626	0.0024	0.9939	**-0.68**		
		2,000	0.0681	0.0036	0.9896	**-1.11**		
		4,000	0.0788	0.0041	0.9794	**-2.13**		
		8,000	0.0984	0.0046	0.9603	**-4.04**		
		16,000	0.1488	0.0053	0.9106	**-9.00**		
con		**32,000**	0.1834	0.0063	0.8770	**-12.36**		127.9
		8,000	0.1761	0.0049	0.8829	**-11.77**		
		2,000	0.1655	0.0038	0.8924	**-10.82**		
final		**500**	0.1540	0.0023	0.9024	**-9.82**	16.9	124.3

Sample Data

Initial Wet Sample + Tare Mass, (g):	328.0	Corrected Sample Height, inches:	1.0007
Final Wet Sample + Tare Mass, (g):	328.6	Blank Height, inches:	1.0000
Dry Sample + Tare Mass, (g):	306.2	Blank Dial Reading, inches:	0.0200
Tare Mass, (g):	173.5	Sample Dial Reading inches:	0.0193

Tested By: gs

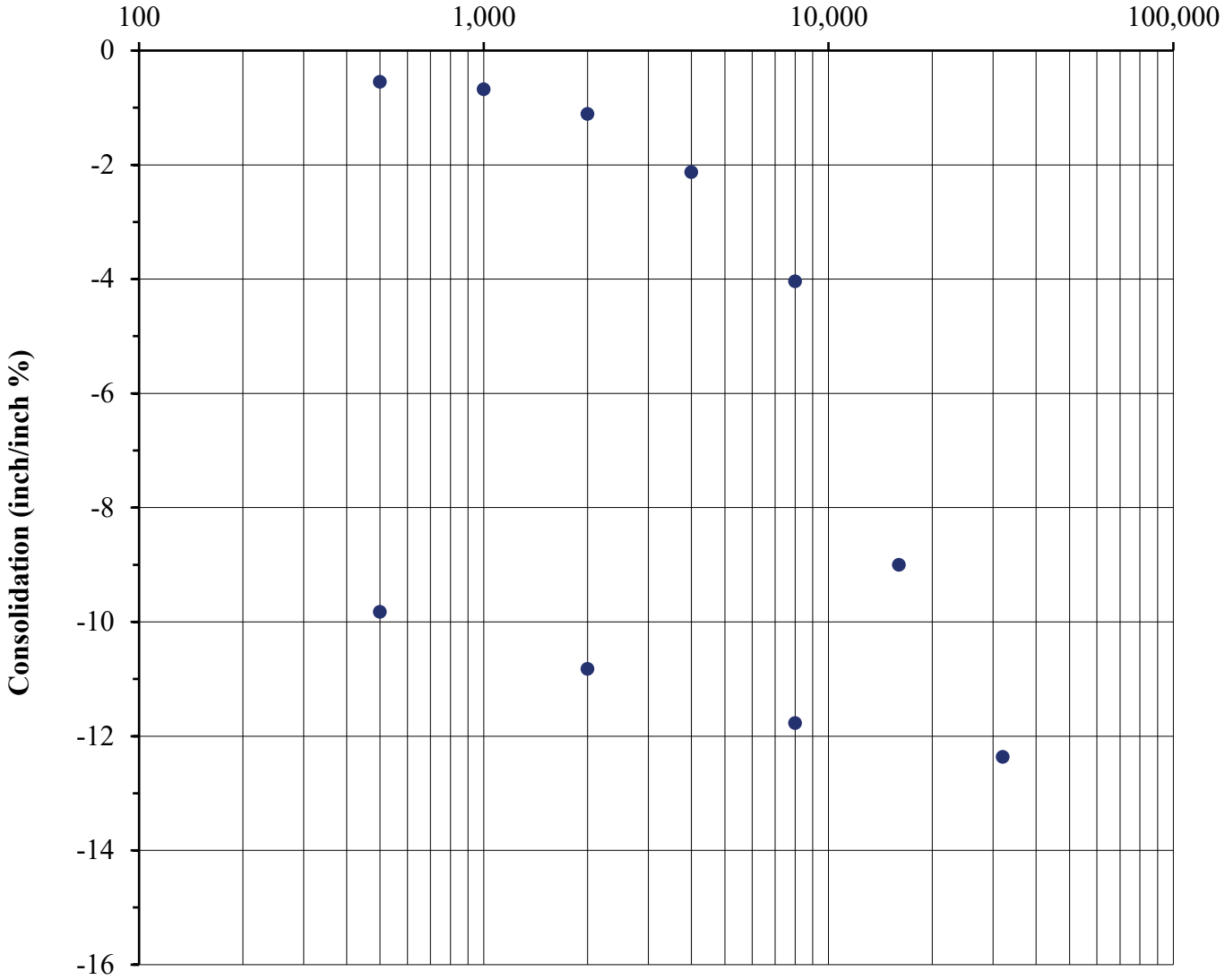
Checked By: Greg Suckow

Consolidation Test Data ASTM D 2435

Project Name: Rooney Sand Hill	**Project No: 4245.200**
Remarks:	**Date:** 03/27/23

Consolidation Graph

Pressure (psf)



Symbol	Sample ID	Description	Initial Moisture Content (%)	Initial Dry Density (pcf)
	B4 at 9-1/2ft	CL Sandy Lean Clay Brown	16.4	112.1

Consolidation ASTM D 2435

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Sample ID:	B6 at 8-1/2ft	Date Started:	03/27/23
Sample Description:	SC Clayey Sand Orange Brown	Invoice Number:	23040
Consolidometer No.:	827	Tare ID: 79	Ring Diameter, inches: 2.395
Ring Area, cm^2:	29.065		
Remarks:		Initial Sample Height, in:	1.001

Summary of Results

Initial Moisture Content, %:	**20.3**	**Consolidate Moisture Content, %:**		**Final Moisture Content, %:**	**16.8**
Initial Dry Density, pcf:	**106.4**	**Consolidated Dry Density, pcf:**	**121.6**	**Final Dry Density, pcf:**	**119.9**

Test Data

Sample Stage	Saturated	**Load, psf**	Dial Reading, inches	Correction Factor, inches	Height, inches	**Volume Change, percent**	Moisture Content, percent	Dry Density, pcf
Init.		**50**	0.0330	-	1.0007	**-**	20.3	106.4
	yes	**500**	0.0508	0.0012	0.9841	**-1.66**		
		1,000	0.0600	0.0023	0.9760	**-2.47**		
		2,000	0.0749	0.0034	0.9622	**-3.85**		
		4,000	0.0944	0.0042	0.9435	**-5.72**		
		8,000	0.1172	0.0047	0.9212	**-7.94**		
		16,000	0.1393	0.0051	0.8995	**-10.11**		
con		**32,000**	0.1640	0.0059	0.8756	**-12.50**		121.6
		8,000	0.1596	0.0045	0.8786	**-12.20**		
		2,000	0.1547	0.0038	0.8828	**-11.78**		
final		**500**	0.1478	0.0020	0.8879	**-11.27**	16.8	119.9

Sample Data

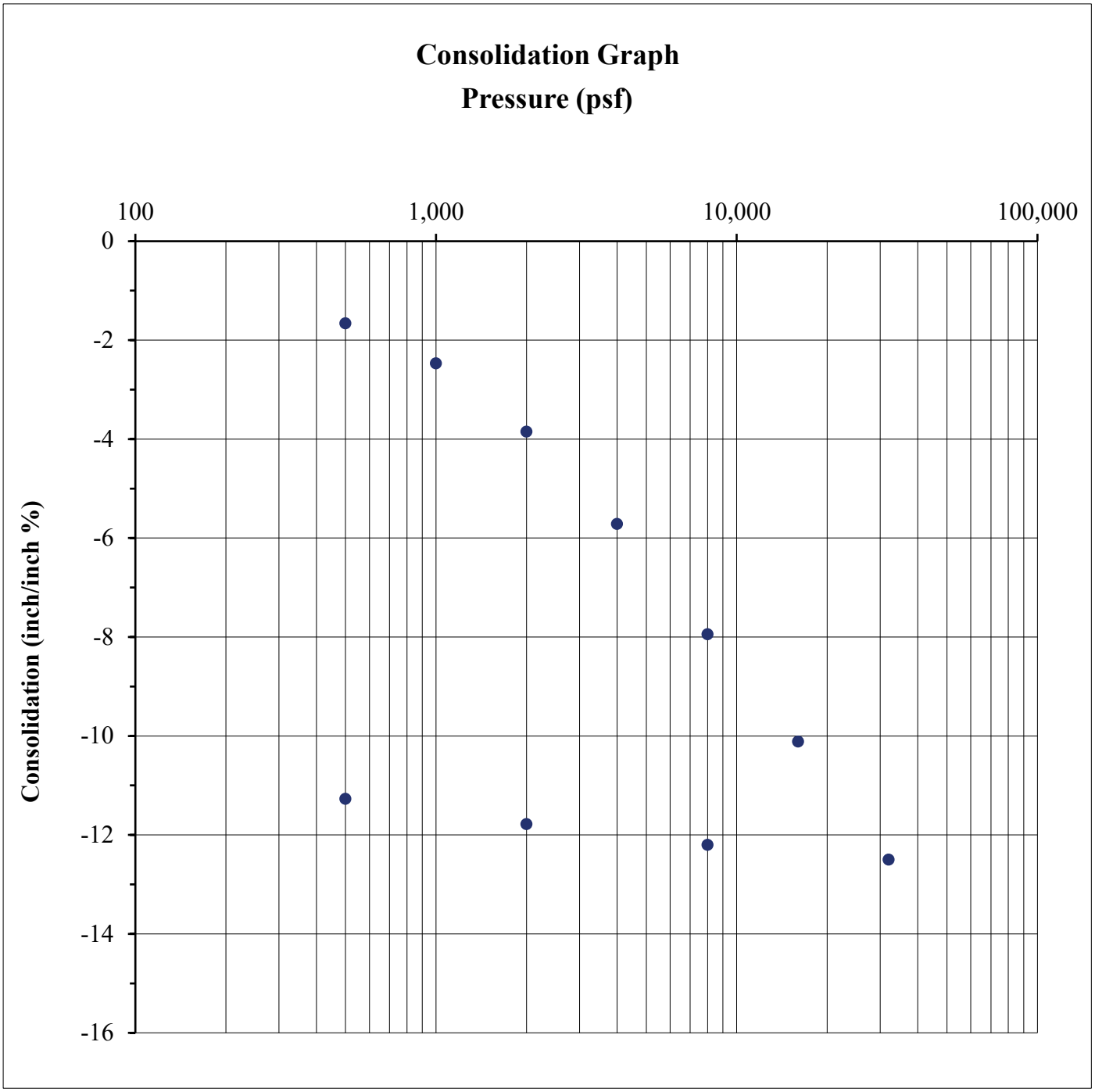
Initial Wet Sample + Tare Mass, (g):	331.5	Corrected Sample Height, inches:	1.0007
Final Wet Sample + Tare Mass, (g):	327.1	Blank Height, inches:	1.0000
Dry Sample + Tare Mass, (g):	305.9	Blank Dial Reading, inches:	0.0200
Tare Mass, (g):	179.9	Sample Dial Reading inches:	0.0193

Tested By: gs

Checked By: Greg Suckow

Consolidation Test Data ASTM D 2435

Project Name: Rooney Sand Hill	**Project No: 4245.200**
Remarks:	**Date:** 03/27/23



Symbol	Sample ID	Description	Initial Moisture Content (%)	Initial Dry Density (pcf)
	B6 at 8-1/2ft	SC Clayey Sand Orange Brown	20.3	106.4

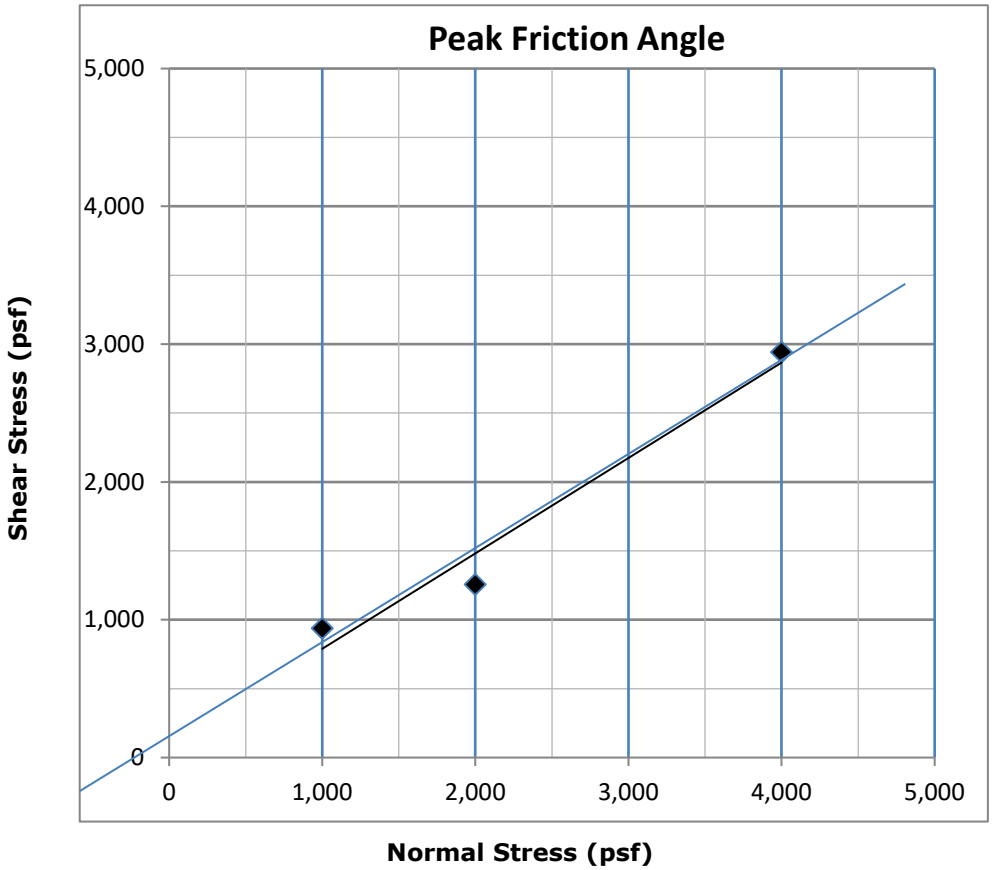
Direct Shear Worksheet ASTM D-3080

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Sample ID:	B2 at 9ft	Date Tested:	04/12/23
Material Description:	CS Sandy Claystone Orange Brown Bedded	Invoice Number:	23040
Sample Type:	Unidsturbed	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**1,000**	**2,000**	**4,000**	
Peak Shear Stress, psf:	**939**	**1,257**	**2,941**	
Initial Dry Density, pcf:	**105.0**	**104.2**	**102.1**	
Initial Moisture Content, %:	**15.4**	**15.4**	**15.4**	
Final Moisture Content, %:	**27.6**	**25.9**	**27.2**	
Peak Cohesion, **(C')**, psf:	**100.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**35.4**

Graph of Shear Stress vs Normal Stress



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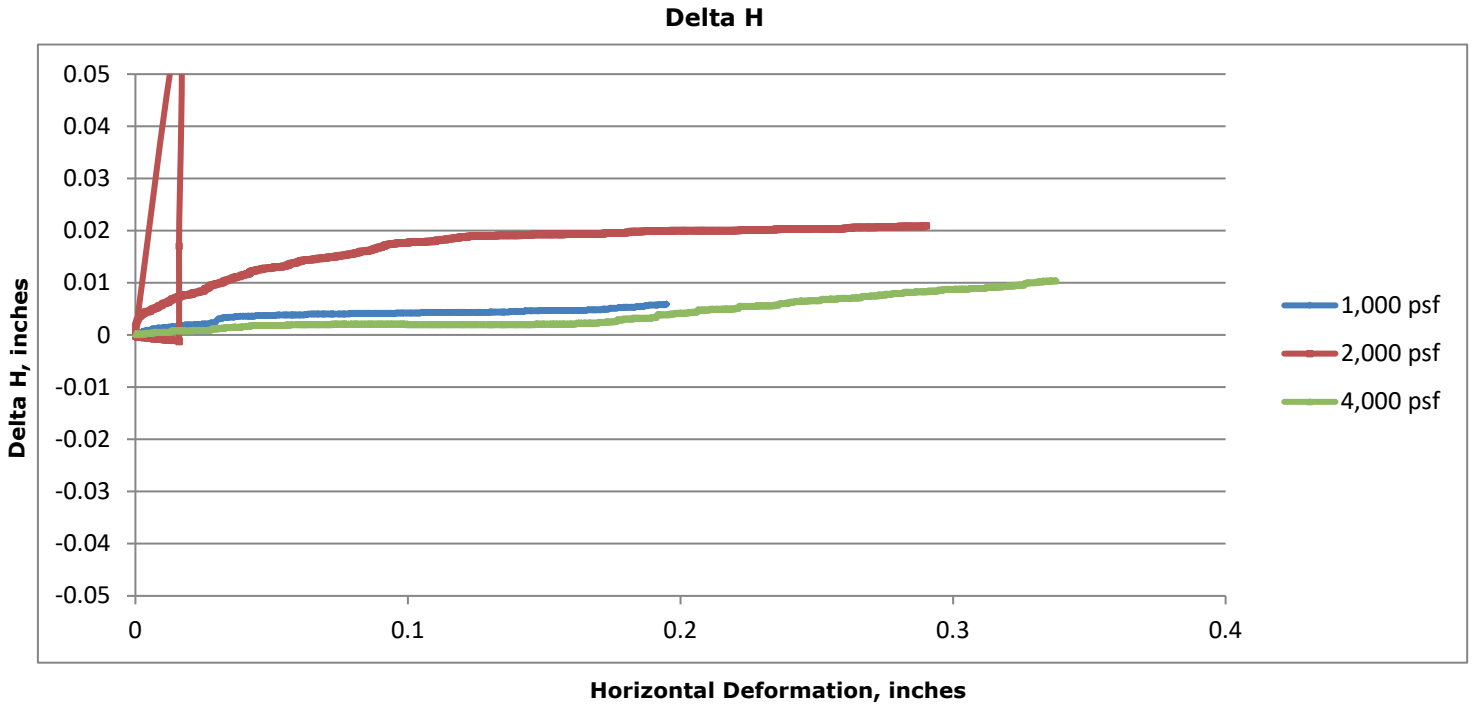
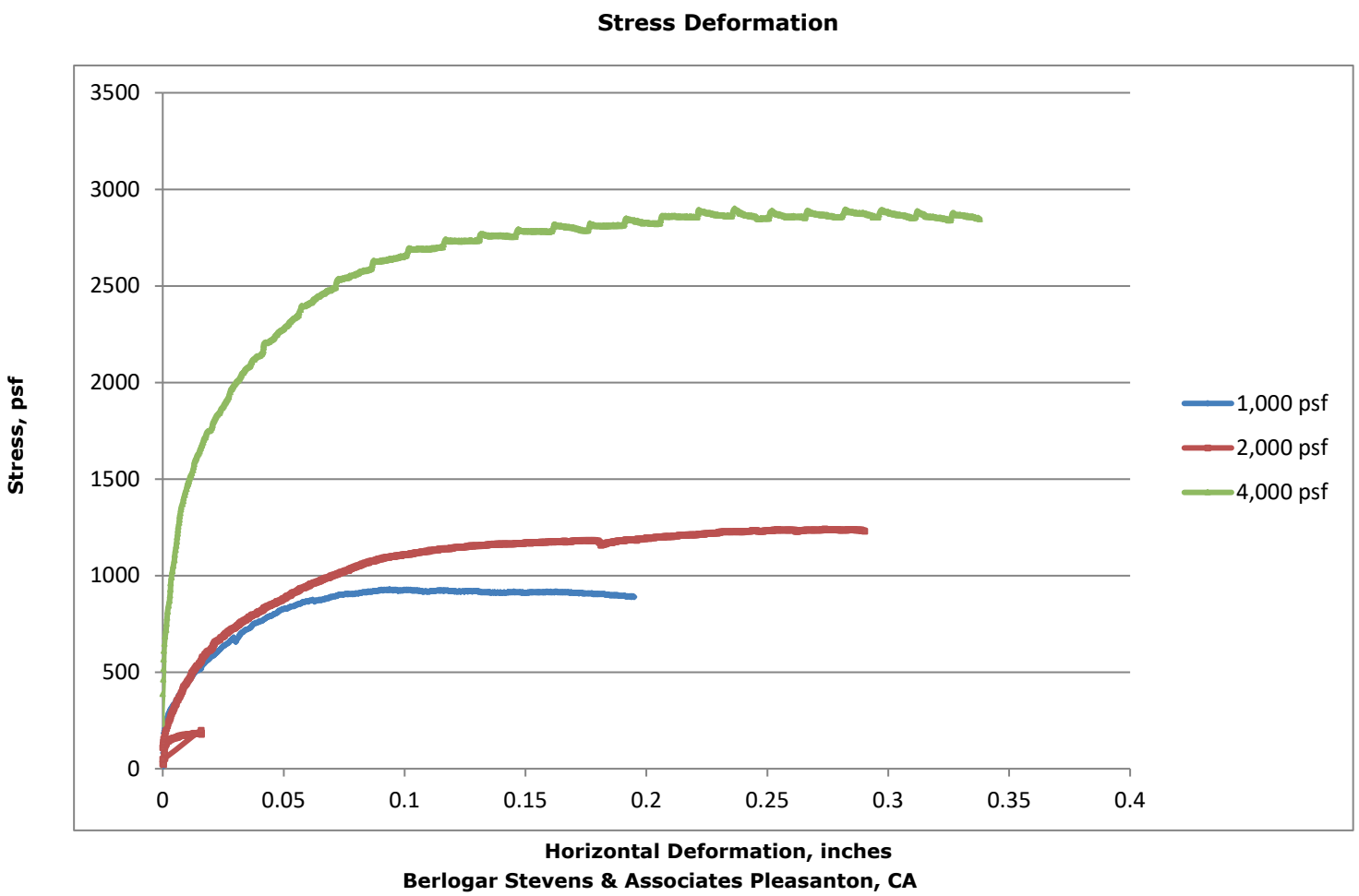
Direct Shear Graphs ASTM D-3080

Project Name: Rooney Sand Hill	**Project Number: 4245.200**
Sample ID: B2 at 9ft	Date Tested: 04/12/23
Material Description: CS Sandy Claystone Orange Brown Bedded	Invoice Number: 23040





Direct Shear Worksheet ASTM D-3080

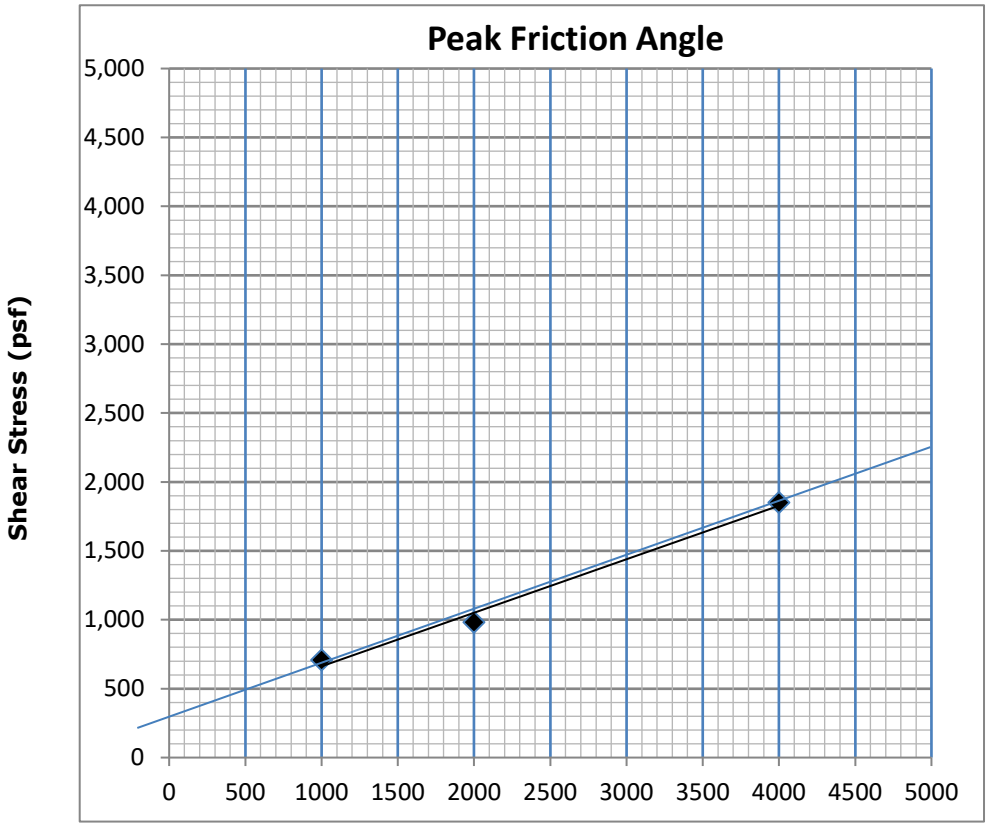
Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Sample ID:	B4 at 14ft	Date Tested:	04/12/23
Material Description:	Sandy Clay Orange Brown	Invoice Number:	23040
Sample Type:	undisturbed	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**1000**	**2,000**	**4,000**		
Peak Shear Stress, psf:	**708**	**983**	**1,850**		
Initial Dry Density, pcf:	**103.5**	**102.5**	**104.4**		
Initial Moisture Content, %:	**21.6**	**21.6**	**21.6**		
Final Moisture Content, %:	**23.0**	**24.0**	**21.9**		

Peak Cohesion, **(C')**, psf: **240.0** Peak Friction Angle, **(Φ'_{peak})**, Degrees: **21.9**

Graph of Shear Stress vs Normal Stress



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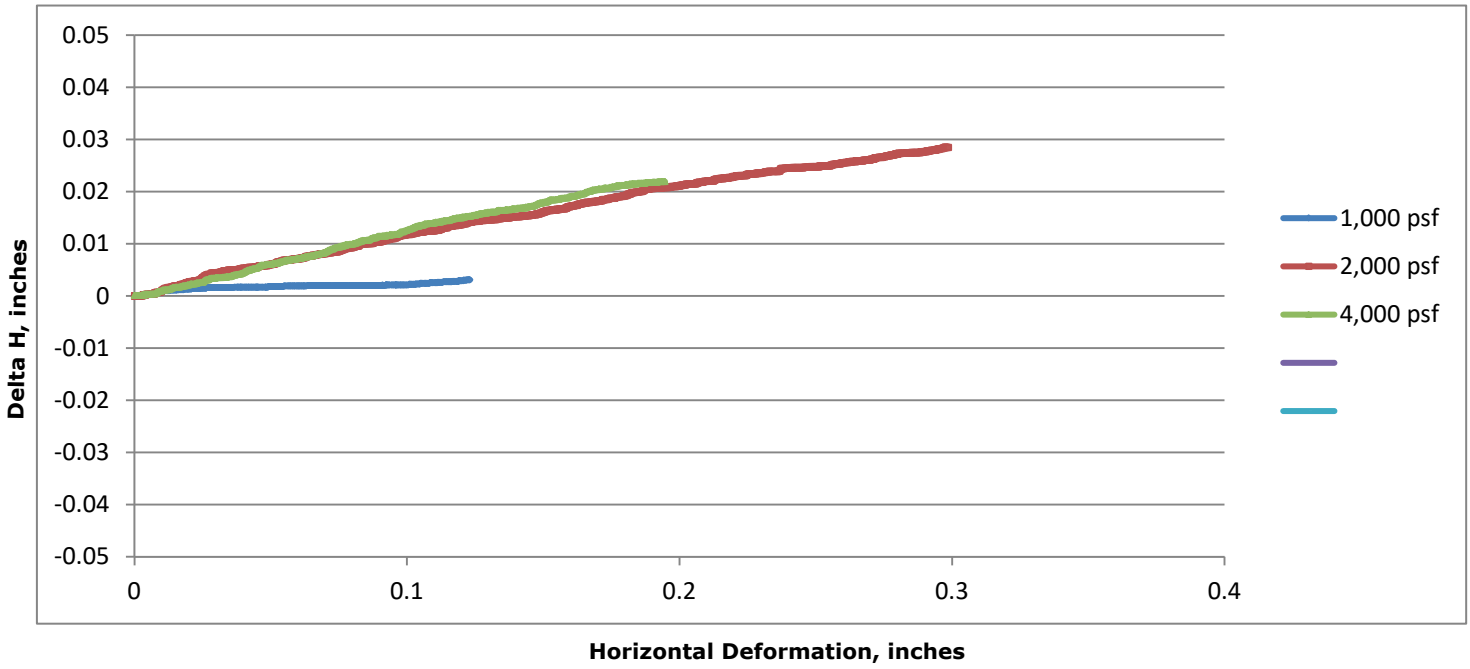
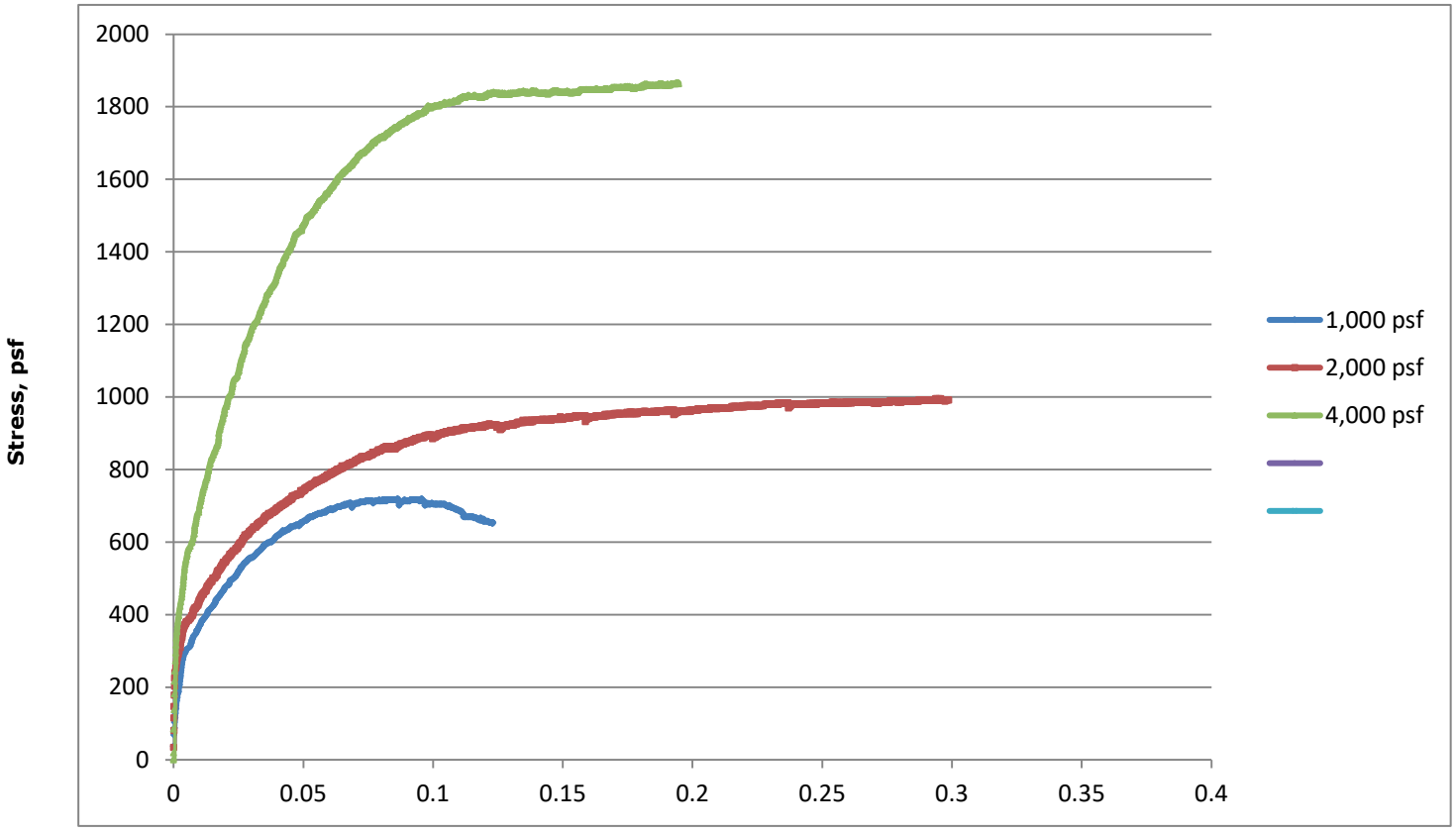
Direct Shear Graphs ASTM D-3080

Project Name: Rooney Sand Hill	**Project Number: 4245.200**
Sample ID: B4 at 14ft	Date Tested: 04/12/23
Material Description: Sandy Clay Orange Brown	Invoice Number: 23040

Delta H



Stress Deformation



Direct Shear Worksheet ASTM D-3080

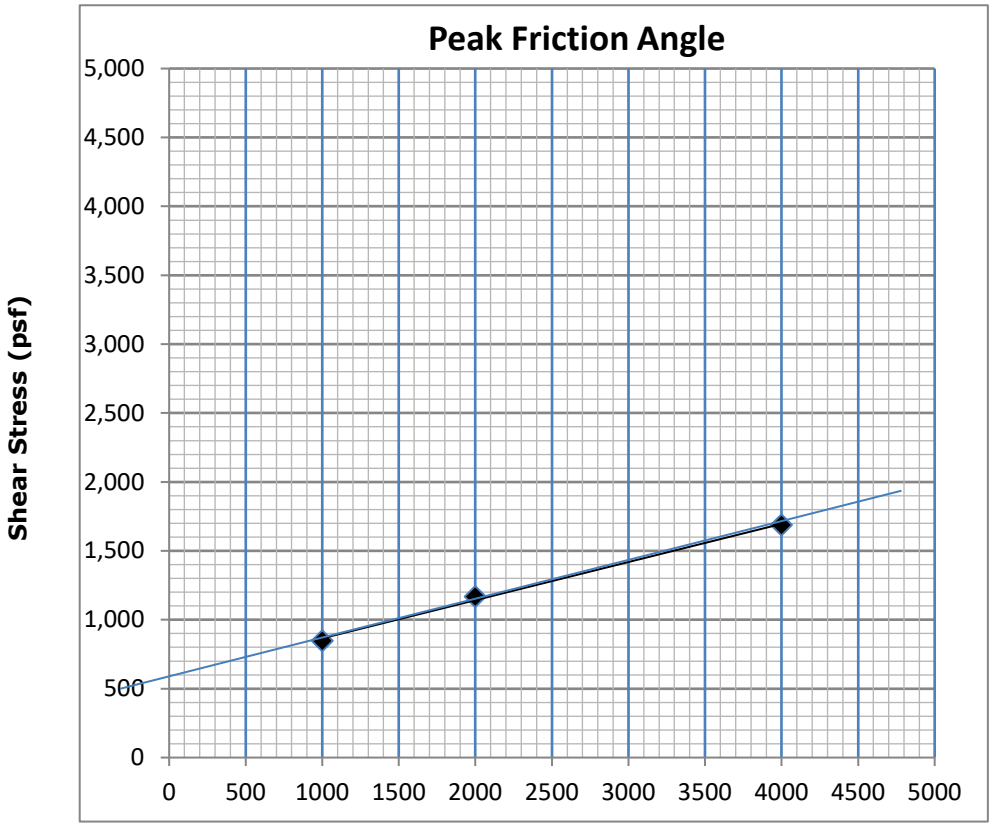
Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Sample ID:	B5 at 8ft	Date Tested:	04/15/23
Material Description:	Sandy Clay Brown	Invoice Number:	23040
Sample Type:	undisturbed	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**1000**	**2,000**	**4,000**		
Peak Shear Stress, psf:	**848**	**1,168**	**1,687**		
Initial Dry Density, pcf:	**114.0**	**114.1**	**116.0**		
Initial Moisture Content, %:	**15.6**	**15.6**	**15.6**		
Final Moisture Content, %:	**17.0**	**17.2**	**14.9**		

Peak Cohesion, **(C')**, psf: **550.0** Peak Friction Angle, **(Φ'_{peak})**, Degrees: **16.6**

Graph of Shear Stress vs Normal Stress



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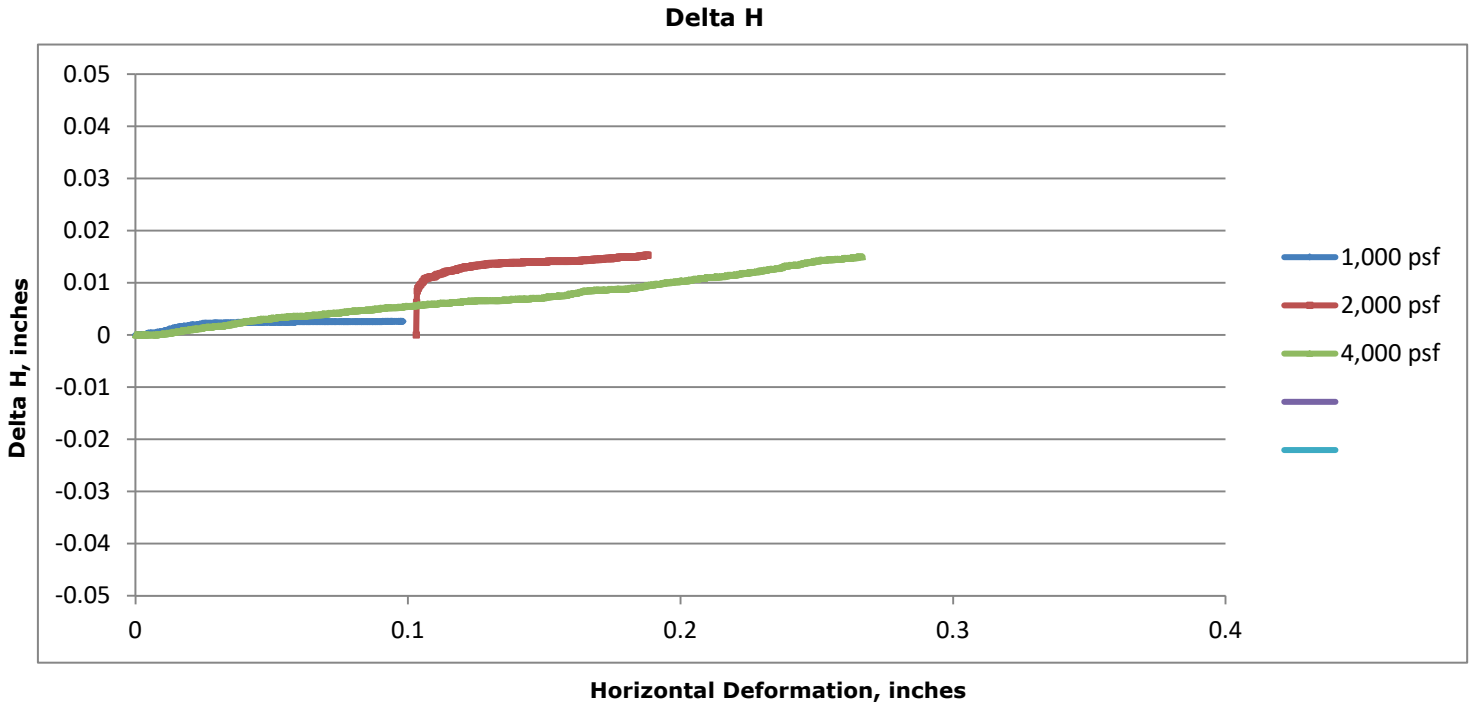
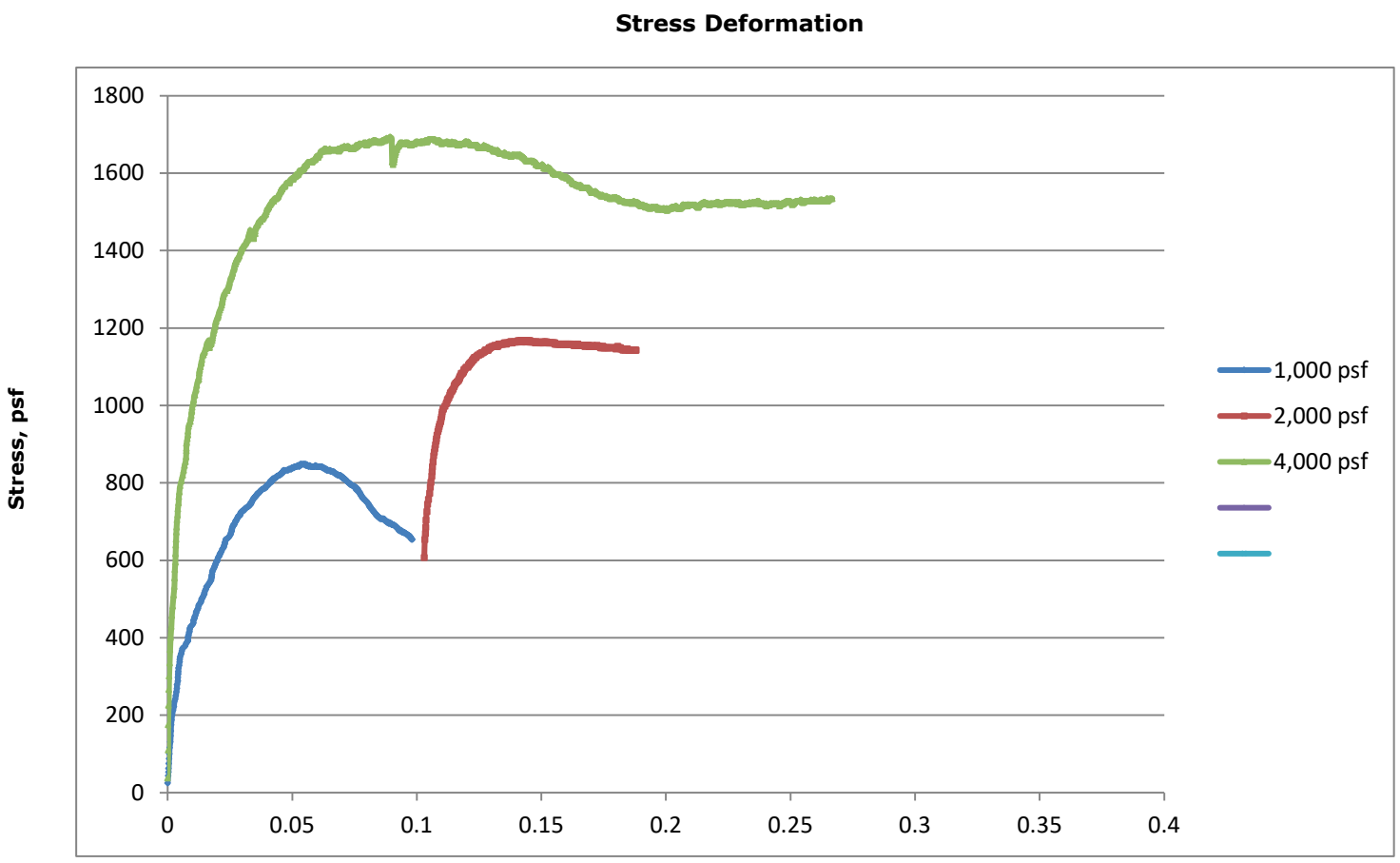
Direct Shear Graphs ASTM D-3080

Project Name: Rooney Sand Hill	**Project Number: 4245.200**
Sample ID: B5 at 8ft	Date Tested: 04/15/23
Material Description: Sandy Clay Brown	Invoice Number: 23040





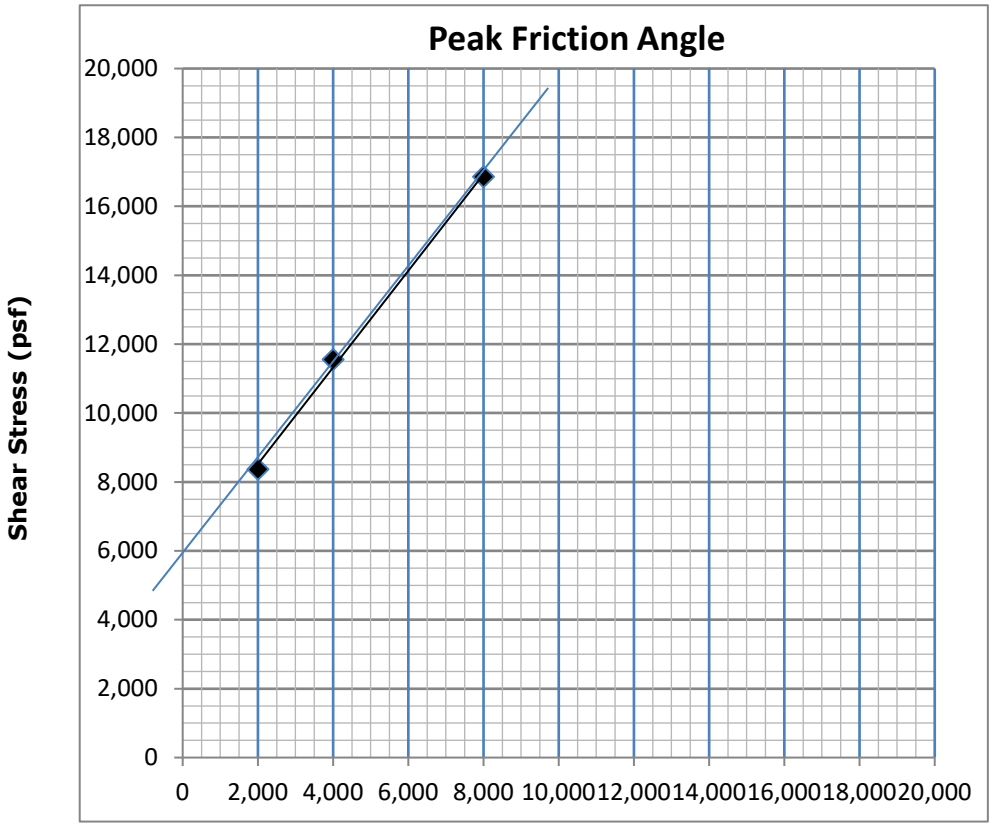
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 28**	**Project Number:**	**4245.200**
Sample ID:	T28 at 16ft	Date Tested:	01/20/23
Material Description:	CS Sandy Claystone Light Brown Weathered	Invoice Number:	23004
Sample Type:	as received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**2,000**	**4,000**	**8,000**	
Peak Shear Stress, psf:	**8,368**	**11,551**	**16,858**	
Initial Dry Density, pcf:	**127.7**	**127.4**	**127.9**	
Initial Moisture Content, %:	**12.0**	**12.0**	**12.0**	
Final Moisture Content, %:	**14.9**	**14.5**	**13.6**	
Peak Cohesion, **(C')**, psf:	**5,600.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**54.5**

Graph of Shear Stress vs Normal Stress



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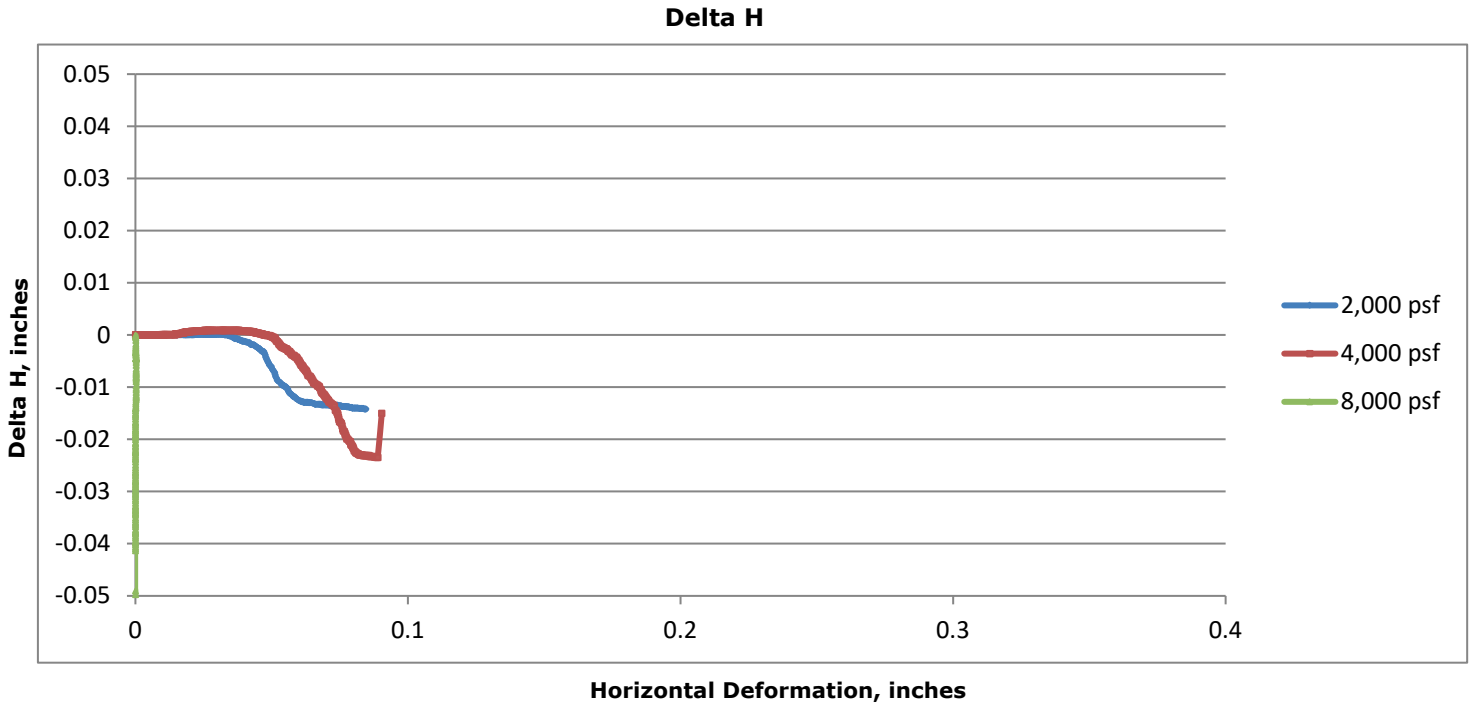
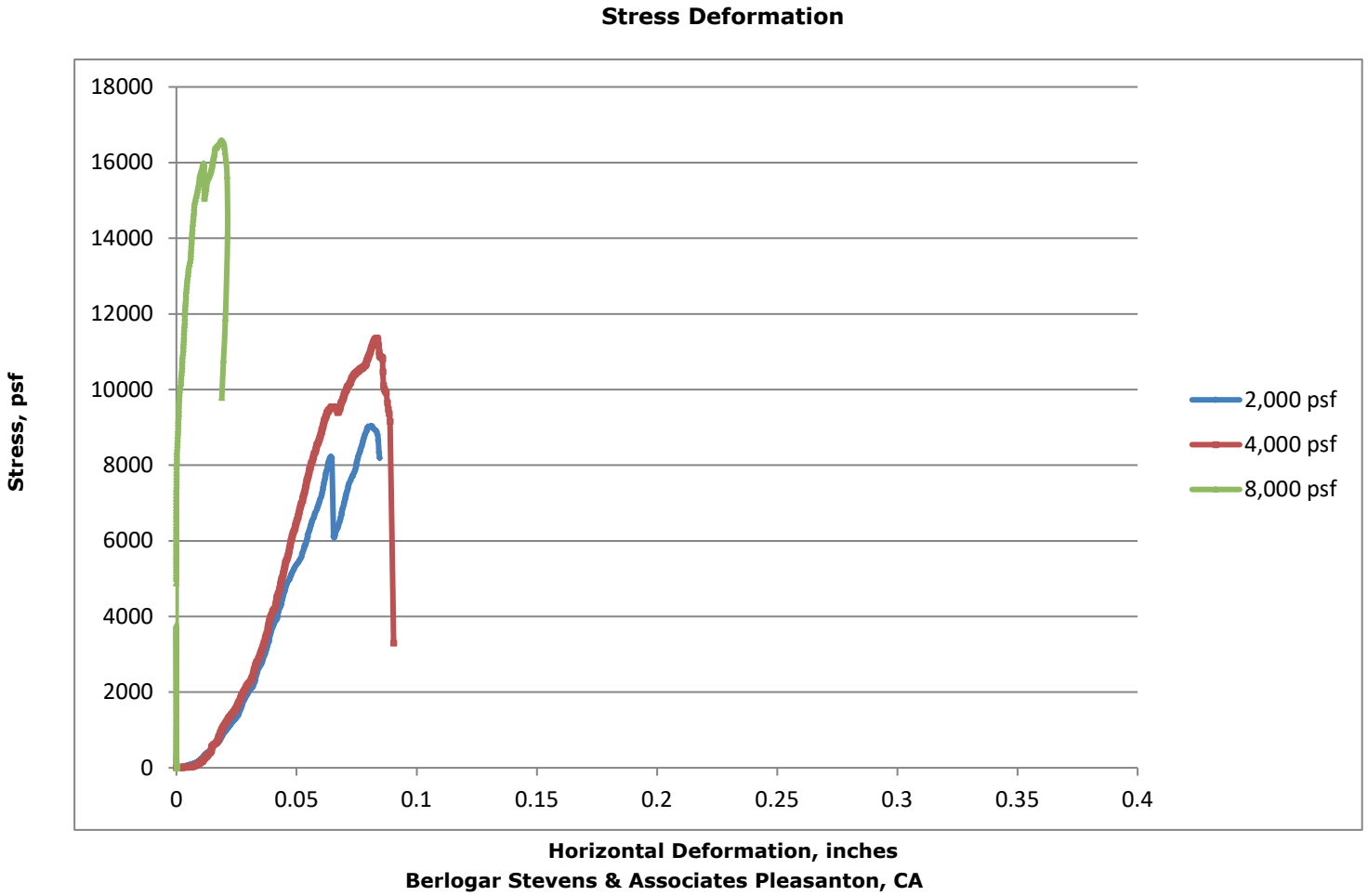
Direct Shear Graphs ASTM D-3080

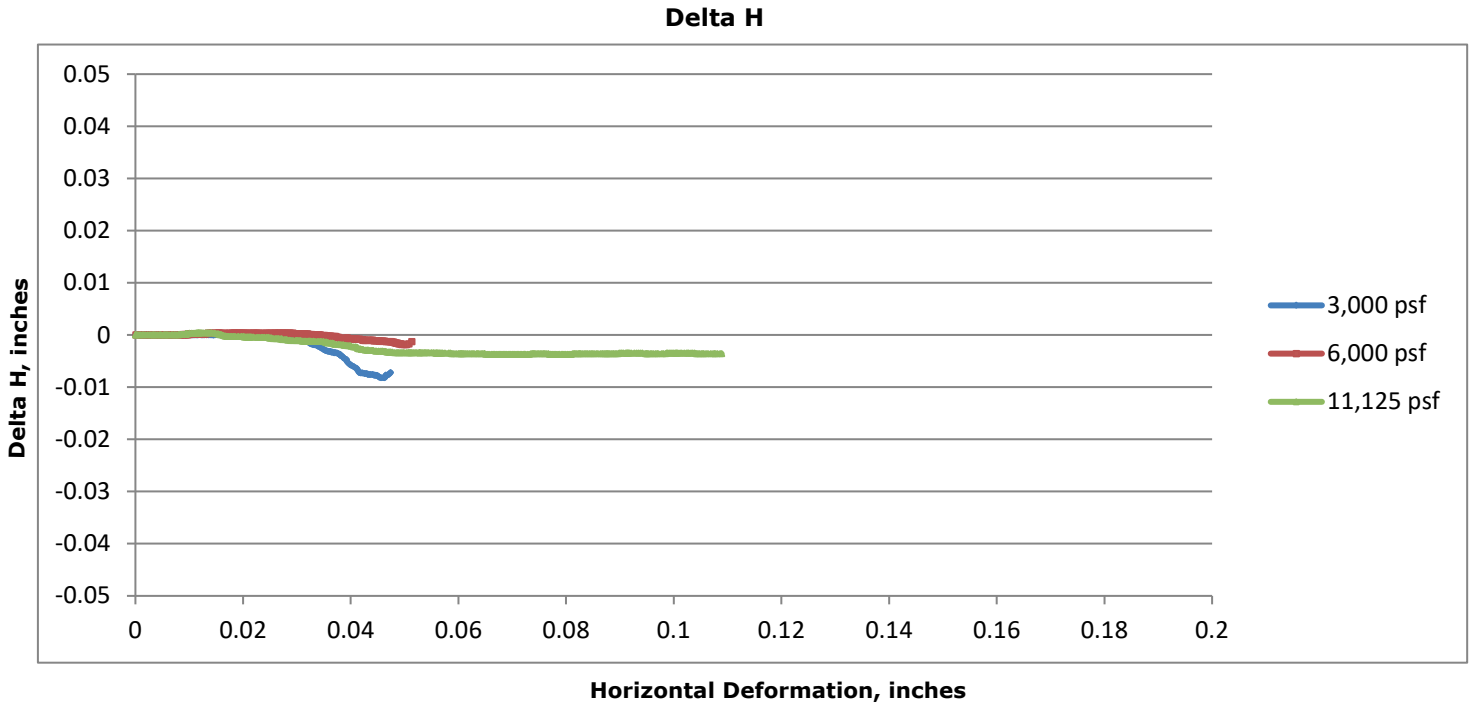
Project Name: Sandhill Turbine 28	**Project Number: 4245.200**
Sample ID: T28 at 16ft	Date Tested: 01/20/23
Material Description: CS Sandy Claystone Light Brown Weathered	Invoice Number: 23004

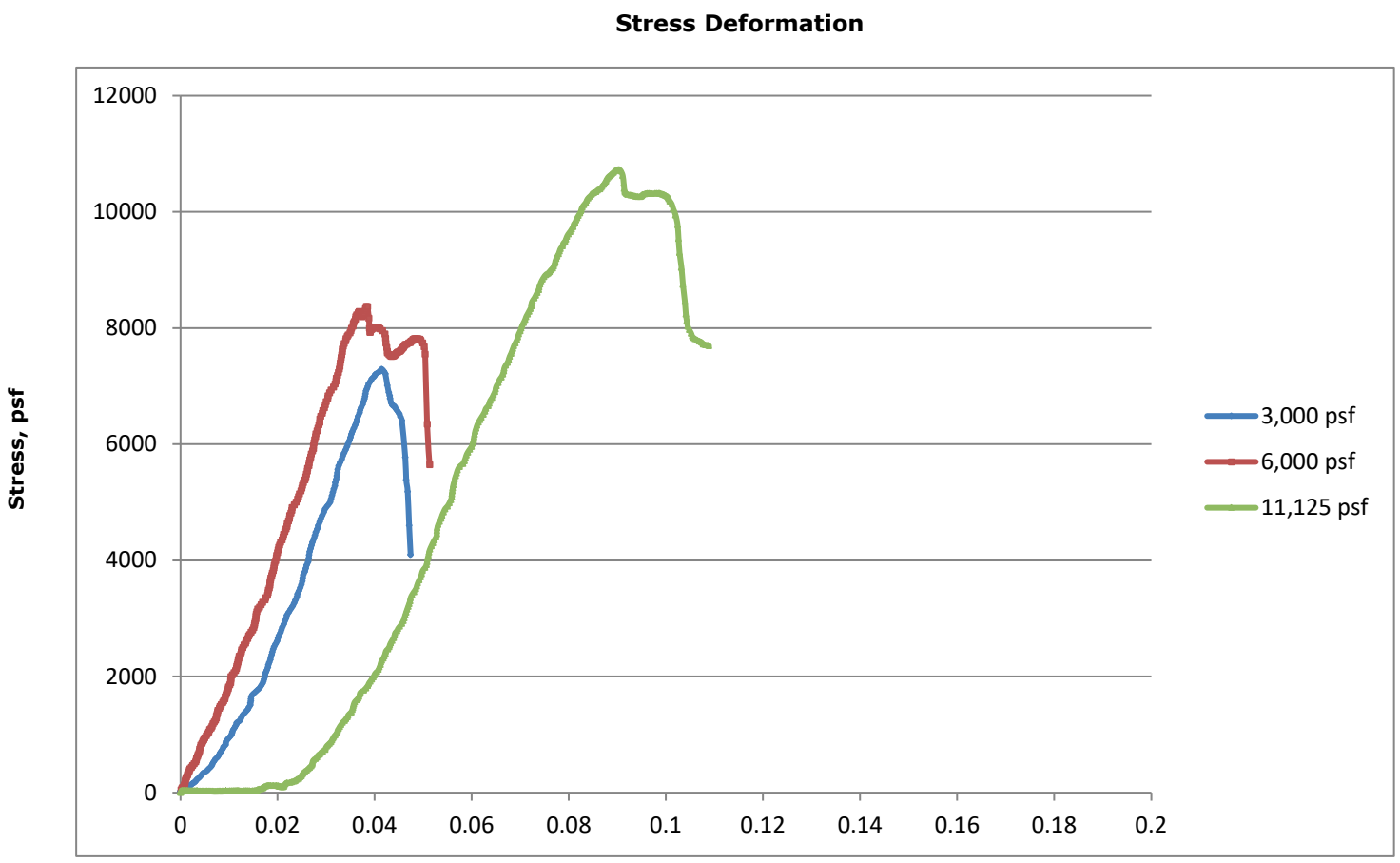




Direct Shear Graphs ASTM D-3080

Project Name: Sandhill Turbine 28	**Project Number: 4245.200**
Sample ID: T28 at 28-1/2ft	Date Tested: 01/23/23
Material Description: CS Sandy Claystone Light Olive Gray	Invoice Number: 23004





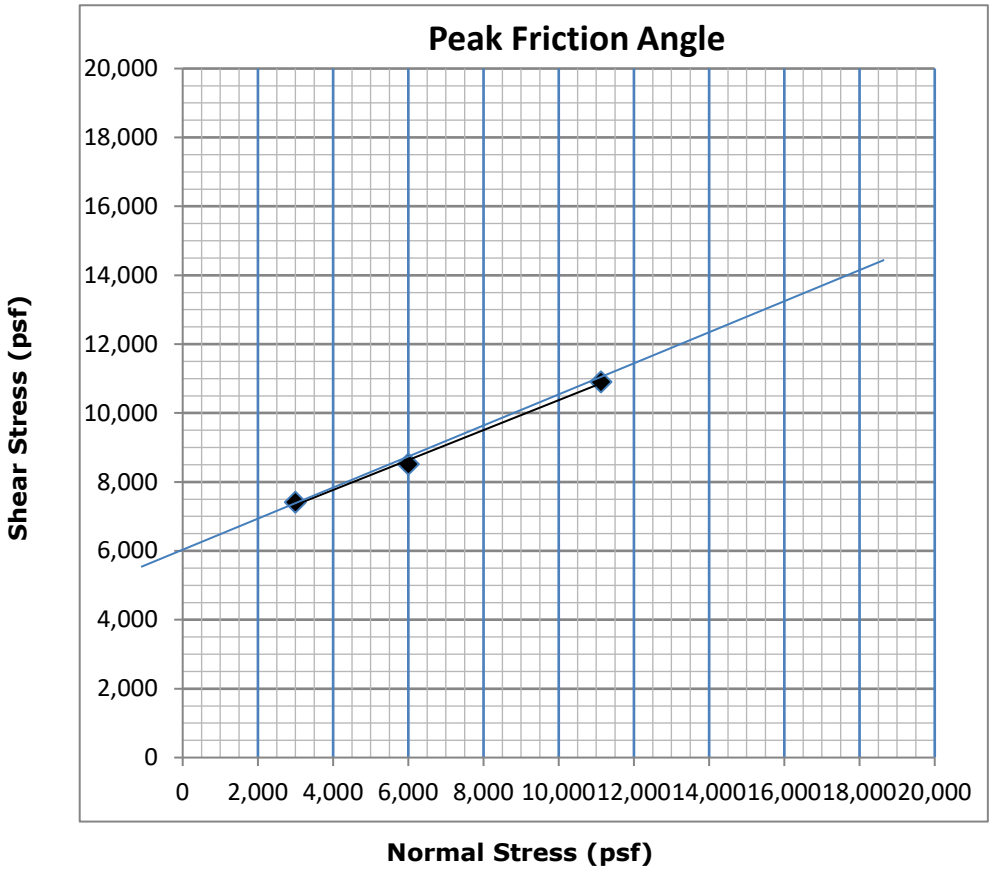
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 28**	**Project Number:**	**4245.200**
Sample ID:	T28 at 28-1/2ft	Date Tested:	01/23/23
Material Description:	CS Sandy Claystone Light Olive Gray	Invoice Number:	23004
Sample Type:	as received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**3,000**	**6,000**	**11,125**	
Peak Shear Stress, psf:	**7,410**	**8,515**	**10,908**	
Initial Dry Density, pcf:	**132.2**	**130.1**	**129.3**	
Initial Moisture Content, %:	**8.8**	**8.8**	**8.8**	
Final Moisture Content, %:	**10.2**	**10.1**	**9.5**	
Peak Cohesion, **(C')**, psf:	**5,800.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**24.5**

Graph of Shear Stress vs Normal Stress



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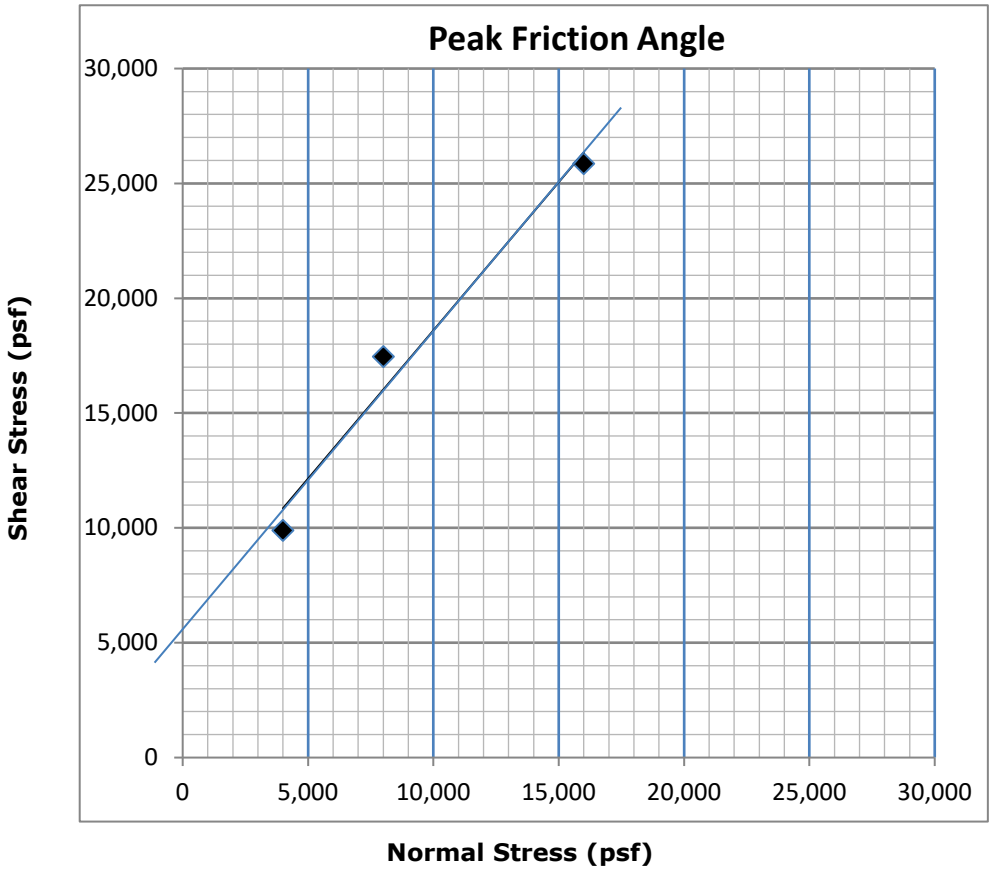
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 28**	**Project Number:**	**4245.200**
Sample ID:	T28 at 42ft	Date Tested:	01/00/00
Material Description:	CS Claystone Brown	Invoice Number:	23004
Sample Type:	as received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**4,000**	**8,000**	**16,000**	
Peak Shear Stress, psf:	**9,887**	**17,459**	**25,863**	
Initial Dry Density, pcf:	**135.6**	**137.8**	**135.9**	
Initial Moisture Content, %:	**12.4**	**12.4**	**12.4**	
Final Moisture Content, %:	**15.1**	**15.8**	**15.1**	
Peak Cohesion, **(C')**, psf:	**5,000.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**52.4**

Graph of Shear Stress vs Normal Stress



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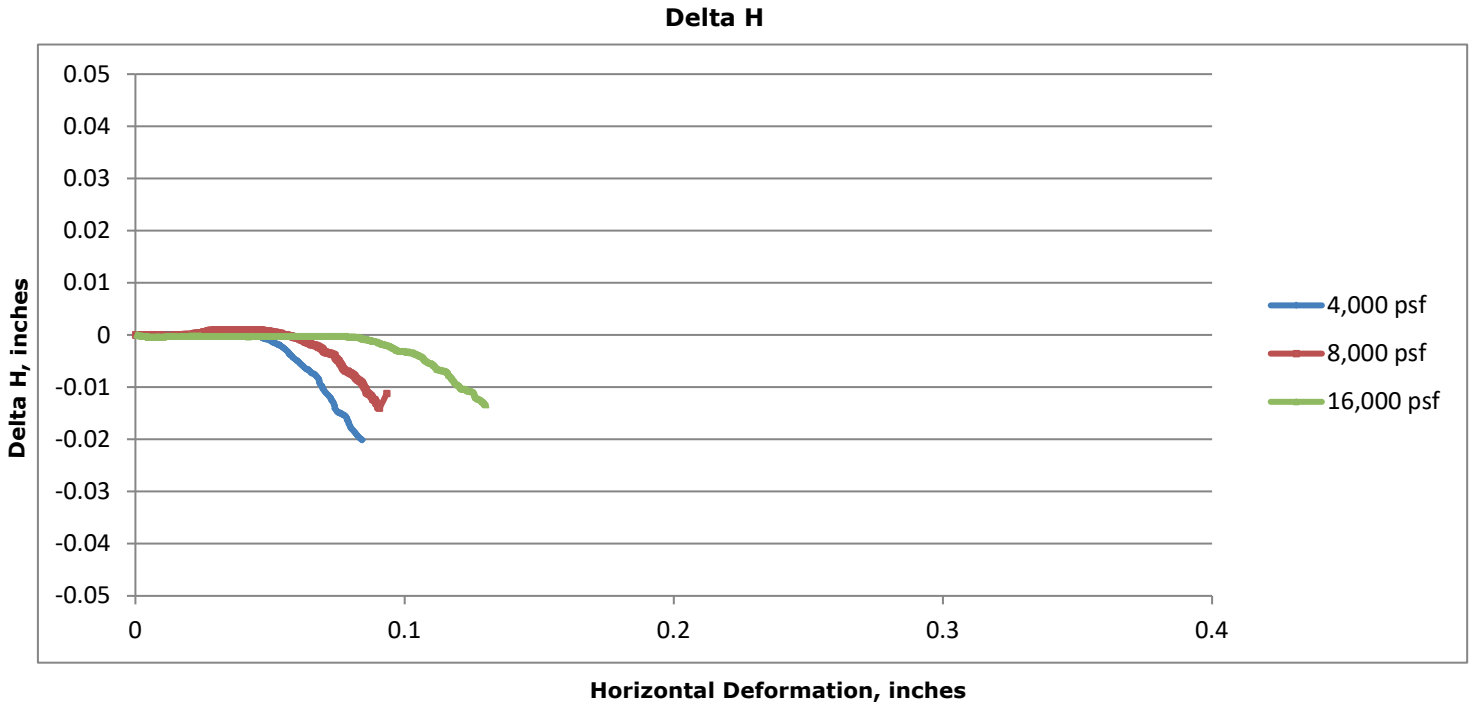
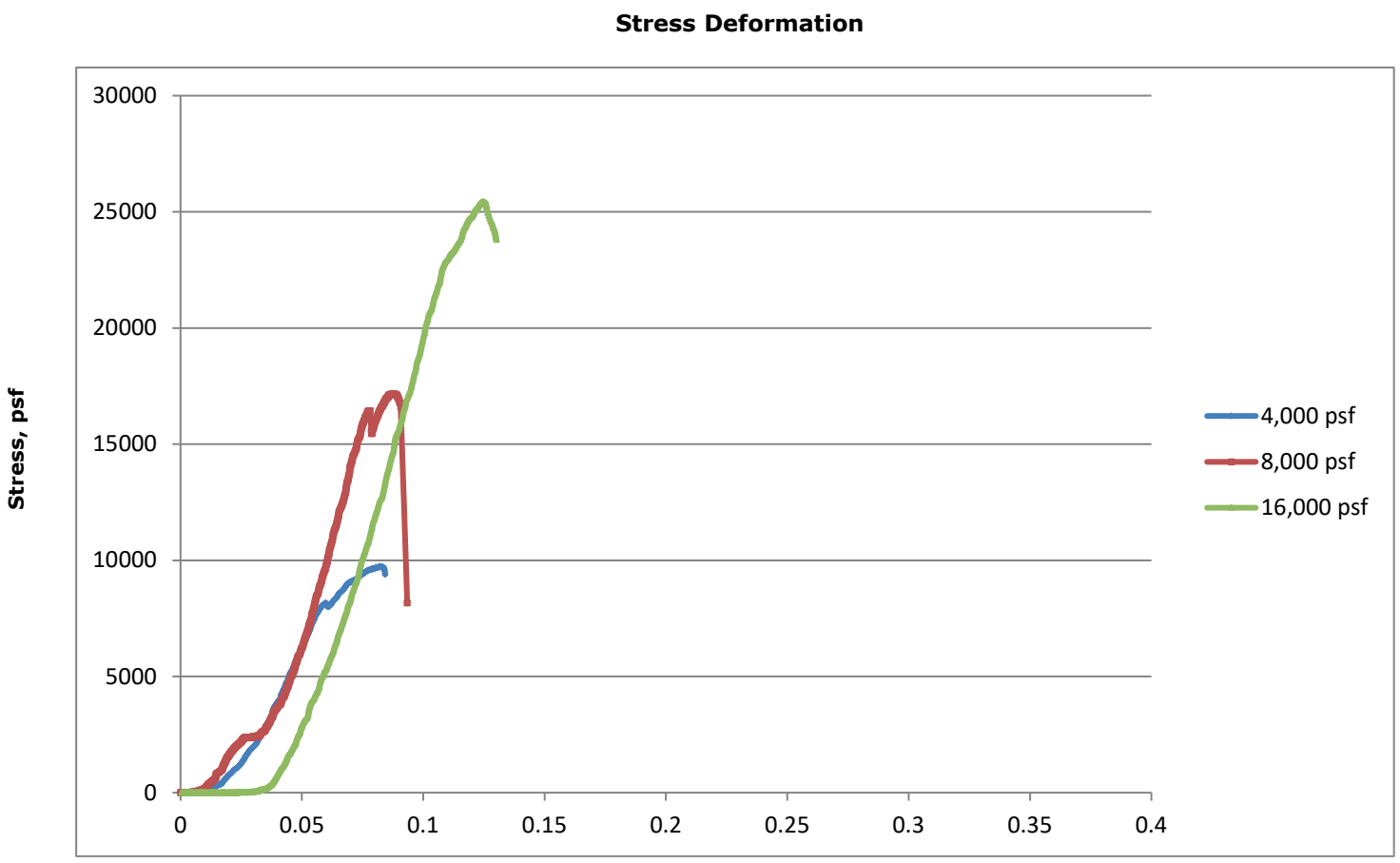
Direct Shear Graphs ASTM D-3080

Project Name: Sandhill Turbine 28	**Project Number: 4245.200**
Sample ID: T28 at 42ft	Date Tested: 01/00/00
Material Description: CS Claystone Brown	Invoice Number: 23004





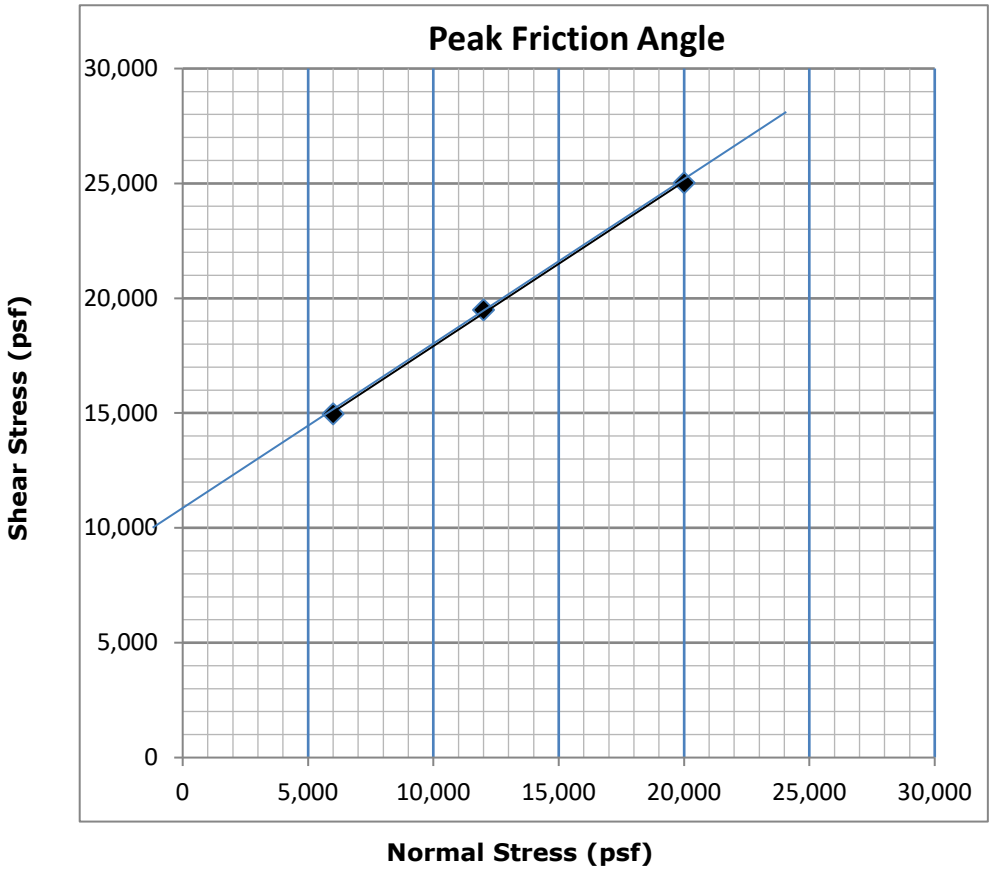
Direct Shear Worksheet ASTM D-3080

Project Name: Sandhill Turbine 28			**Project Number: 4245.200**
Sample ID: T28 at 59ft			Date Tested: 01/25/23
Material Description: CS Claystone Gray			Invoice Number: 23004
Sample Type: as received	Test Type: CD		Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf: 0.0		Minimum Required Compaction, %: 0.0	
Optimum Moisture Content, %: 0.0		Minimum Compacted Moisture Content, %: 0.0	

Summary of Results

Normal Stress, psf:	**6,000**	**12,000**	**20,000**	
Peak Shear Stress, psf:	**14,967**	**19,487**	**25,022**	
Initial Dry Density, pcf:	**145.7**	**144.2**	**146.0**	
Initial Moisture Content, %:	**3.6**	**3.6**	**3.6**	
Final Moisture Content, %:	**5.5**	**5.4**	**5.4**	
Peak Cohesion, **(C')**, psf:	**10,500.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**35.9**

Graph of Shear Stress vs Normal Stress



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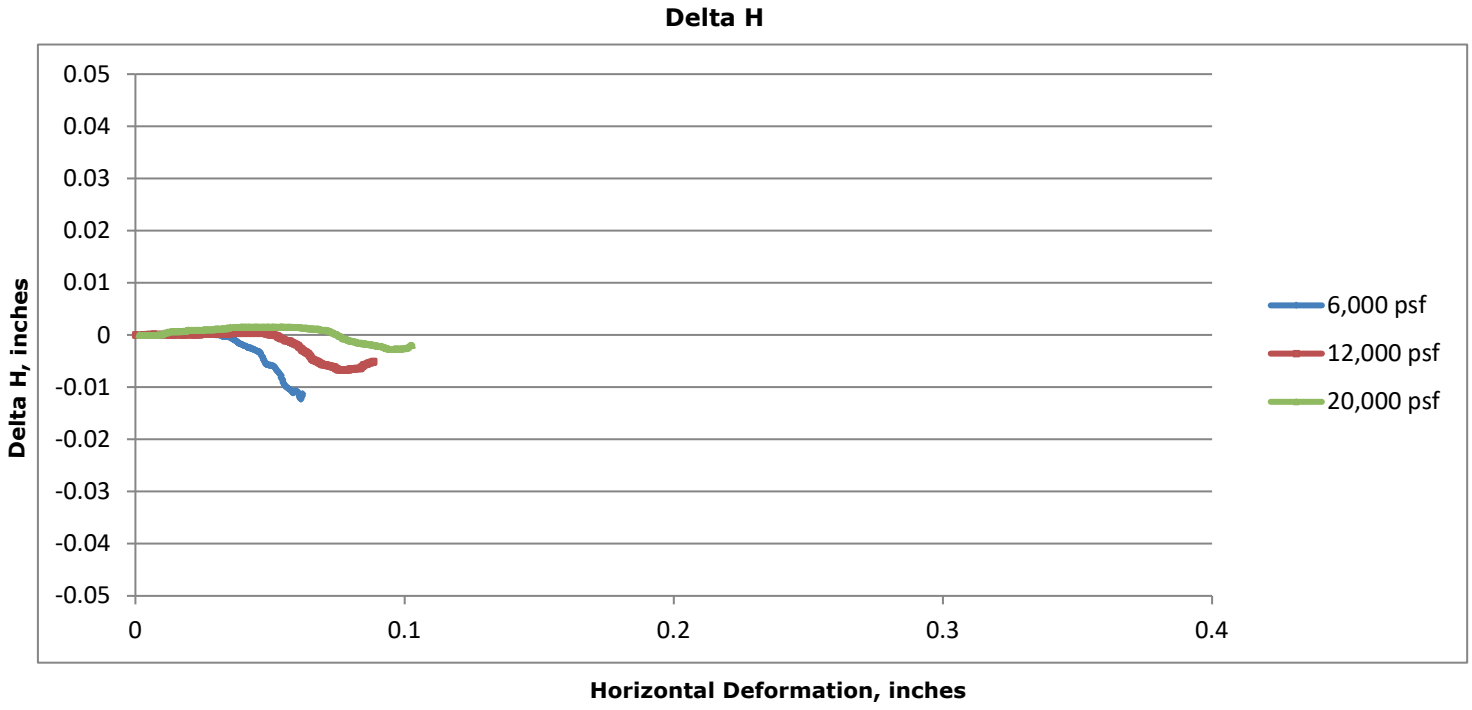
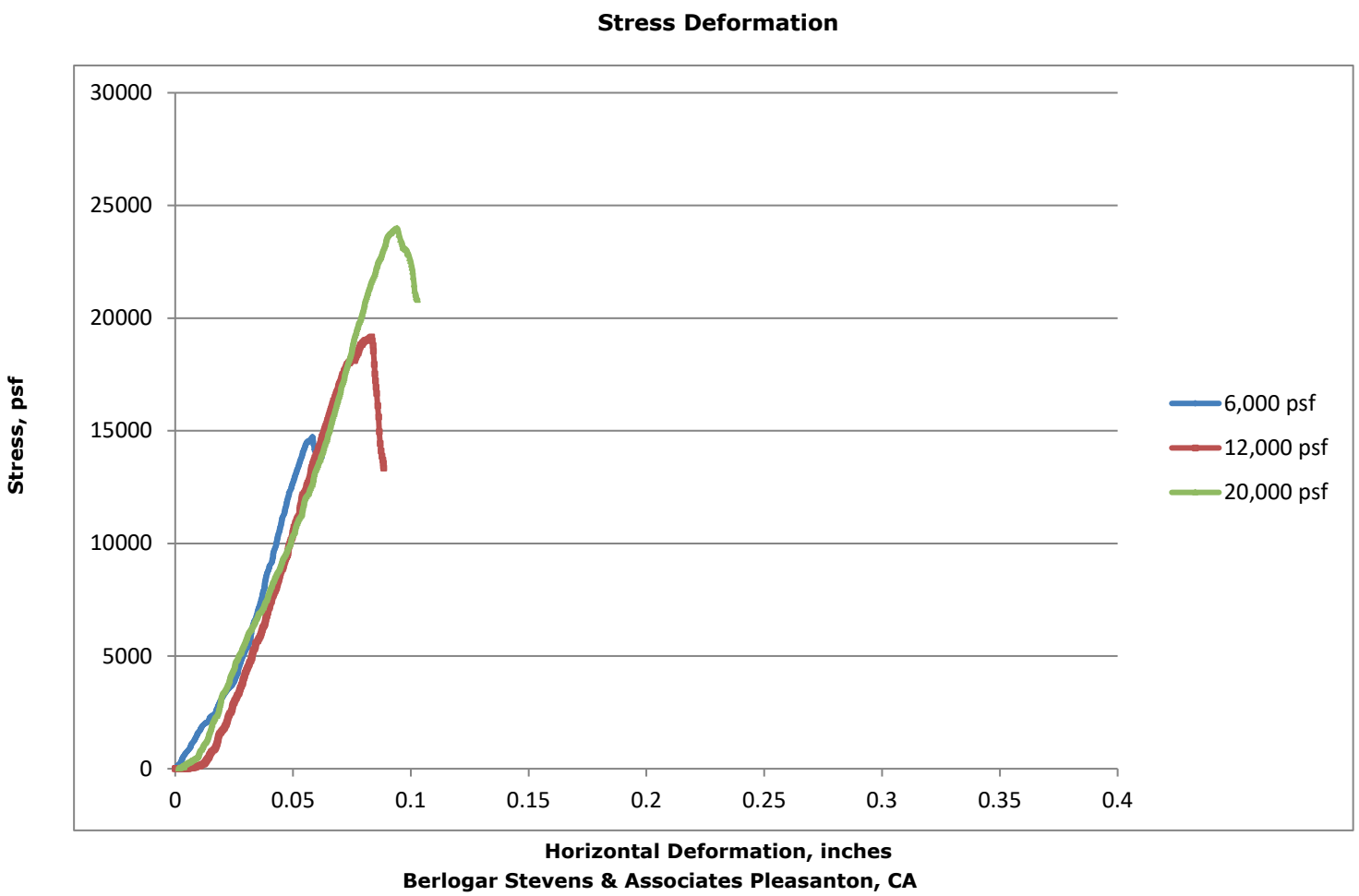
Direct Shear Graphs ASTM D-3080

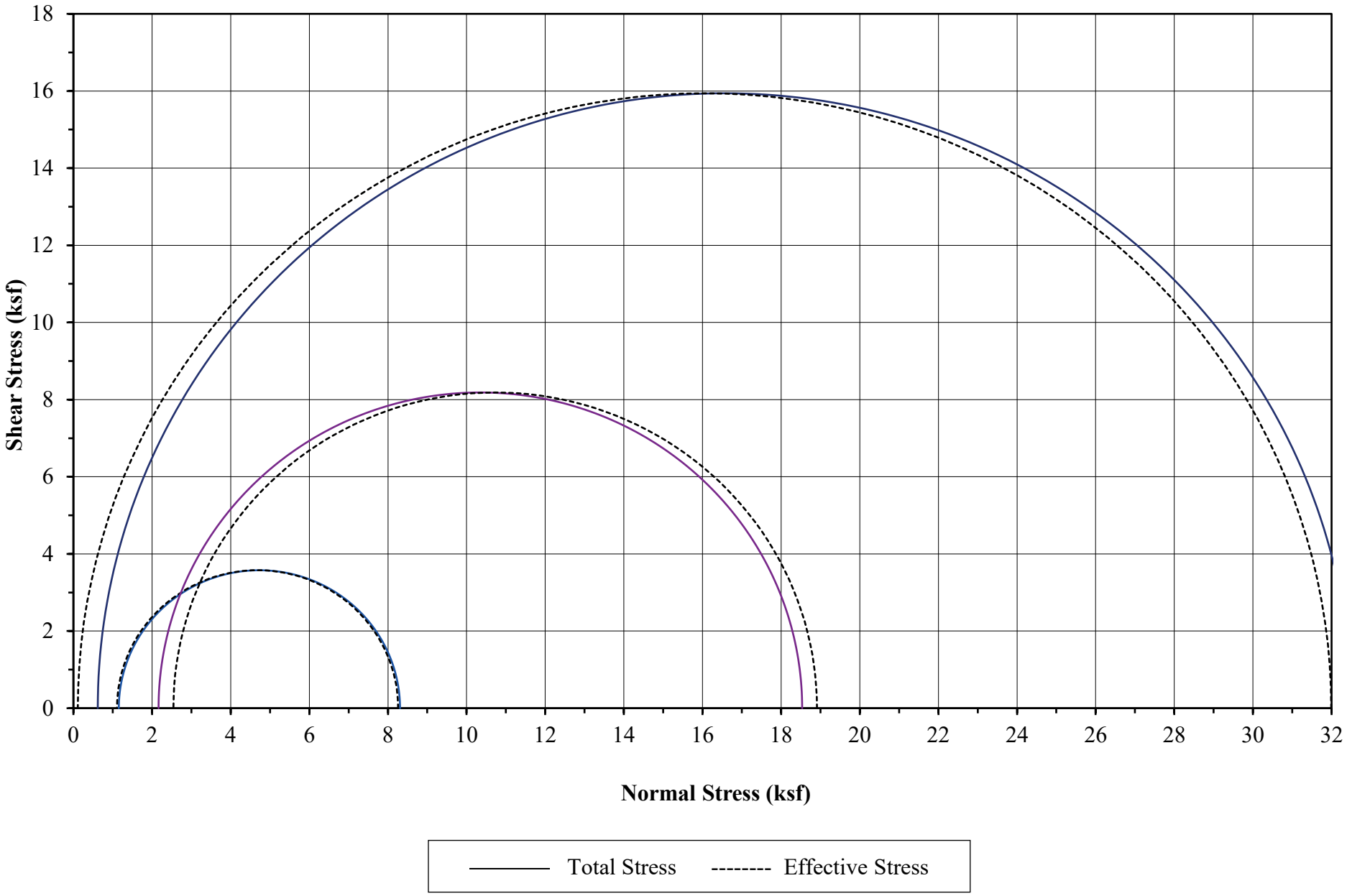
Project Name: Sandhill Turbine 28	**Project Number: 4245.200**
Sample ID: T28 at 59ft	Date Tested: 01/25/23
Material Description: CS Claystone Gray	Invoice Number: 23004





TXCU TEST DATA ASTM D4767

Job No. 3062.200 Sample ID: B3 at 46'



Consolidated-Undrained Triaxial Compression Strength ASTM D-4767

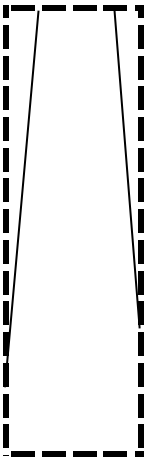
Project Name: Sandhill Turbine 28	**Project Number: 4245-200**
Sample ID: T28 at 19ft	Date:
Sample Description: CS Sandy Claystone Light Brown Weathered	Invoice Number: 23004
Test Type: As received	Deflection Rate, in/min: 0.0060
Cell Pressure, psi: 64.1 Back Pressure, psi: 59.8	**Effective Consolidation Pressure, ksf: 0.619**
Initial Dry Density, pcf:	**Consolidated Dry Density, pcf:**
Initial Moisture Content, %:	**Consolidated Moisture Content, %:**

Test Data

Load, lbs	Pore Pressure, psi	Axial Strain, inches	**Deviator Stress, ksf**	**Axial Strain, %**	**Δ** Pore Pressure, ksf	**σ** $_1$, ksf	**σ**$_3$' ksf	**σ**$_1$'/ **σ**$_3$'
0	59.9	0.000	**0.000**	**0.0**	0.000	0.619	0.619	1.0
7	60.0	0.003	**0.217**	**0.0**	0.013	0.836	0.606	1.4
7	60.0	0.005	**0.216**	**0.1**	0.013	0.836	0.606	1.4
7	59.9	0.008	**0.216**	**0.2**	0.012	0.835	0.608	1.4
7	59.9	0.013	**0.216**	**0.2**	0.010	0.835	0.609	1.4
56	61.0	0.024	**1.725**	**0.5**	0.168	2.344	0.451	4.8
123	61.8	0.033	**3.783**	**0.6**	0.278	4.402	0.341	12.1
220	62.4	0.043	**6.753**	**0.8**	0.370	7.373	0.249	28.1
326	62.9	0.053	**9.988**	**1.0**	0.439	10.607	0.180	56.5
665	63.4	0.073	**20.297**	**1.4**	0.516	20.916	0.104	196.8
1,049	63.4	0.093	**31.895**	**1.7**	0.508	32.515	0.111	288.7
1,427	62.9	0.113	**43.222**	**2.1**	0.431	43.841	0.189	230.1
1,844	60.0	0.132	**55.638**	**2.5**	0.023	56.258	0.596	94.3
2,291	52.9	0.153	**68.857**	**2.9**	-1.005	69.476	1.624	43.4
2,531	48.5	0.163	**75.923**	**3.1**	-1.633	76.542	2.252	34.7
2,784	43.4	0.173	**83.350**	**3.3**	-2.367	83.969	2.987	28.9
3,030	38.1	0.183	**90.538**	**3.4**	-3.136	91.157	3.756	25.1
3,199	34.2	0.189	**95.468**	**3.6**	-3.694	96.087	4.313	23.1
3,337	30.9	0.195	**99.466**	**3.7**	-4.176	100.085	4.795	21.7
3,437	28.2	0.200	**102.348**	**3.8**	-4.559	102.968	5.178	20.8

Initial Data		Consolidated Data		Final Data	
Sample Mass, (g)	831.7	ΔH_C, in:	0.17	Tare ID:	
Diameter, inches:	2.40	ΔH_{Sat}, in:	0.01	Wet Sample + Tare Mass,(g)	
Height, inches:	5.13	ΔV_C, cm^3:	0.4	Dry Sample + Tare Mass, (g)	
Initial Area. ft^2:	0.031	$Area_c$, ft^2:	0.032	Tare Mass, (g)	
Initial Vol. ft^3:	0.013	Vol_C, ft^3:	0.014	init γ_{wet}, pcf:	136.7

Sketch of Failure



Tested By: gs

Reported By: G Suckow

Consolidated-Undrained Triaxial Compression Strength ASTM D-4767

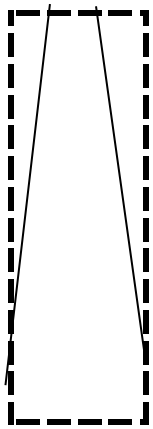
Project Name: Sandhill Turbine 28	**Project Number: 4245-200**
Sample ID: T28 at 19ft	Date: 01/00/00
Sample Description: CS Sandy Claystone Light Brown Weathered	Invoice Number: 23004
Test Type: As received	Deflection Rate, in/min: 0.0060
Cell Pressure, psi: 68.0 Back Pressure, psi: 60.0	**Effective Consolidation Pressure, ksf: 1.155**
Initial Dry Density, pcf:	**Consolidated Dry Density, pcf:**
Initial Moisture Content, %:	**Consolidated Moisture Content, %:**

Test Data

Load, lbs	Pore Pressure, psi	Axial Strain, inches	**Deviator Stress, ksf**	**Axial Strain, %**	**Δ** Pore Pressure, psf	**σ** $_1$, ksf	**σ**$_3$' ksf	**σ**$_1$'/ **σ**$_3$'
0	60.0	0.000	**0.000**	**0.0**	0.000	1.155	1.155	1.0
23	60.3	0.003	**0.711**	**0.0**	0.042	1.866	1.113	1.6
39	61.0	0.005	**1.206**	**0.1**	0.150	2.361	1.005	2.2
54	61.3	0.008	**1.668**	**0.2**	0.192	2.823	0.963	2.7
130	61.5	0.015	**4.012**	**0.3**	0.223	5.166	0.932	5.3
178	61.1	0.024	**5.483**	**0.5**	0.161	6.638	0.994	6.5
245	60.3	0.033	**7.535**	**0.6**	0.048	8.690	1.107	7.8
306	57.9	0.052	**9.375**	**1.0**	-0.301	10.530	1.456	7.4
357	56.1	0.073	**10.896**	**1.4**	-0.557	12.051	1.712	7.4
407	54.5	0.093	**12.374**	**1.7**	-0.796	13.529	1.951	7.3
452	53.0	0.114	**13.687**	**2.1**	-1.011	14.841	2.166	7.3
502	51.1	0.133	**15.146**	**2.5**	-1.280	16.301	2.435	7.2
519	50.3	0.142	**15.630**	**2.7**	-1.398	16.785	2.553	7.1
513	49.8	0.152	**15.418**	**2.9**	-1.472	16.573	2.627	6.9
499	49.8	0.163	**14.967**	**3.1**	-1.472	16.122	2.627	6.7
420	49.8	0.173	**12.574**	**3.3**	-1.473	13.729	2.628	5.8
543	48.7	0.183	**16.224**	**3.4**	-1.621	17.379	2.776	6.8
555	48.3	0.190	**16.560**	**3.6**	-1.683	17.715	2.838	6.8
564	48.1	0.195	**16.811**	**3.7**	-1.715	17.965	2.870	6.9
573	47.8	0.200	**17.061**	**3.8**	-1.760	18.216	2.915	6.9

Initial Data		Consolidated Data		Final Data	
Sample Mass, (g)	831.7	ΔH_C, in:	0.17	Tare ID:	
Diameter, inches:	2.40	ΔH_{Sat}, in:	0.01	Wet Sample + Tare Mass,(g)	
Height, inches:	5.13	ΔV_C, cm^3:	0.4	Dry Sample + Tare Mass, (g)	
Initial Area. ft^2:	0.031	Area$_c$, ft^2:	0.032	Tare Mass, (g)	
Initial Vol. ft^3:	0.013	Vol$_C$, ft^3:	0.014	init γ_{wet}, pcf:	136.8

Sketch of Failure



Tested By: Reported By:

Berlogar Stevens & Associates

Consolidated-Undrained Triaxial Compression Strength ASTM D-4767

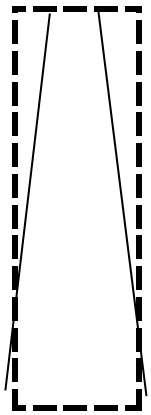
Project Name: Sandhill Turbine 28	**Project Number: 4245-200**
Sample ID: T28 at 19ft	Date: 01/00/00
Sample Description: CS Sandy Claystone Light Brown Weathered	Invoice Number: 23004
Test Type: As received	Deflection Rate, in/min: 0.0060
Cell Pressure, psi: 75.0 Back Pressure, psi: 60.0	**ffective Consolidation Pressure, ksf: 2.166**
Initial Dry Density, pcf:	**Consolidated Dry Density, pcf:**
nitial Moisture Content, %:	**Consolidated Moisture Content, %:**

Test Data

Load, lbs	Pore Pressure, psi	Axial Strain, inches	**Deviator Stress, ksf**	**Axial Strain, %**	**Δ** Pore Pressure, psf	**σ** $_1$, ksf	**σ**$_3$' ksf	**σ**$_1$'/ **σ**$_3$'
0	60.0	0.000	**0.000**	**0.0**	0.000	2.166	2.166	1.0
26	60.8	0.002	**0.826**	**0.0**	0.118	2.992	2.048	1.4
67	61.9	0.007	**2.127**	**0.1**	0.281	4.292	1.885	2.1
95	62.3	0.011	**3.013**	**0.2**	0.336	5.179	1.830	2.6
136	62.4	0.015	**4.310**	**0.3**	0.350	6.476	1.816	3.4
297	61.0	0.031	**9.385**	**0.6**	0.147	11.551	2.019	5.6
520	57.3	0.051	**16.369**	**1.0**	-0.377	18.535	2.543	7.4
597	52.5	0.071	**18.720**	**1.3**	-1.080	20.886	3.246	6.8
653	50.0	0.091	**20.400**	**1.7**	-1.436	22.566	3.601	6.7
714	47.9	0.111	**22.218**	**2.1**	-1.735	24.384	3.901	6.7
782	46.2	0.130	**24.245**	**2.5**	-1.986	26.410	4.152	6.8
836	43.5	0.151	**25.818**	**2.8**	-2.363	27.983	4.529	6.7
886	41.7	0.171	**27.253**	**3.2**	-2.631	29.419	4.797	6.7
928	39.9	0.190	**28.439**	**3.6**	-2.889	30.605	5.054	6.6
957	38.4	0.210	**29.212**	**4.0**	-3.108	31.377	5.273	6.5
1,004	36.9	0.231	**30.521**	**4.4**	-3.315	32.687	5.481	6.6
1,044	35.5	0.251	**31.613**	**4.7**	-3.518	33.778	5.684	6.6
1,077	34.4	0.271	**32.484**	**5.1**	-3.684	34.650	5.849	6.6
1,066	33.9	0.291	**32.026**	**5.5**	-3.757	34.192	5.923	6.4
1,080	33.1	0.300	**32.384**	**5.7**	-3.865	34.549	6.031	6.4

Initial Data		Consolidated Data		Final Data	
Sample Mass, (g)	831.7	ΔH_C, in:	0.17	Tare ID:	
Diameter, inches:	2.40	ΔH_{Sat}, in:	0.05	Wet Sample + Tare Mass,(g)	
Height, inches:	5.13	ΔV_C, cm^3:	0.4	Dry Sample + Tare Mass, (g)	
Initial Area. ft^2:	0.031	Area$_c$, ft^2:	0.031	Tare Mass, (g)	
Initial Vol. ft^3:	0.013	Vol$_C$, ft^3:	0.014	init γ_{wet}, pcf:	136.7

Sketch of Failure



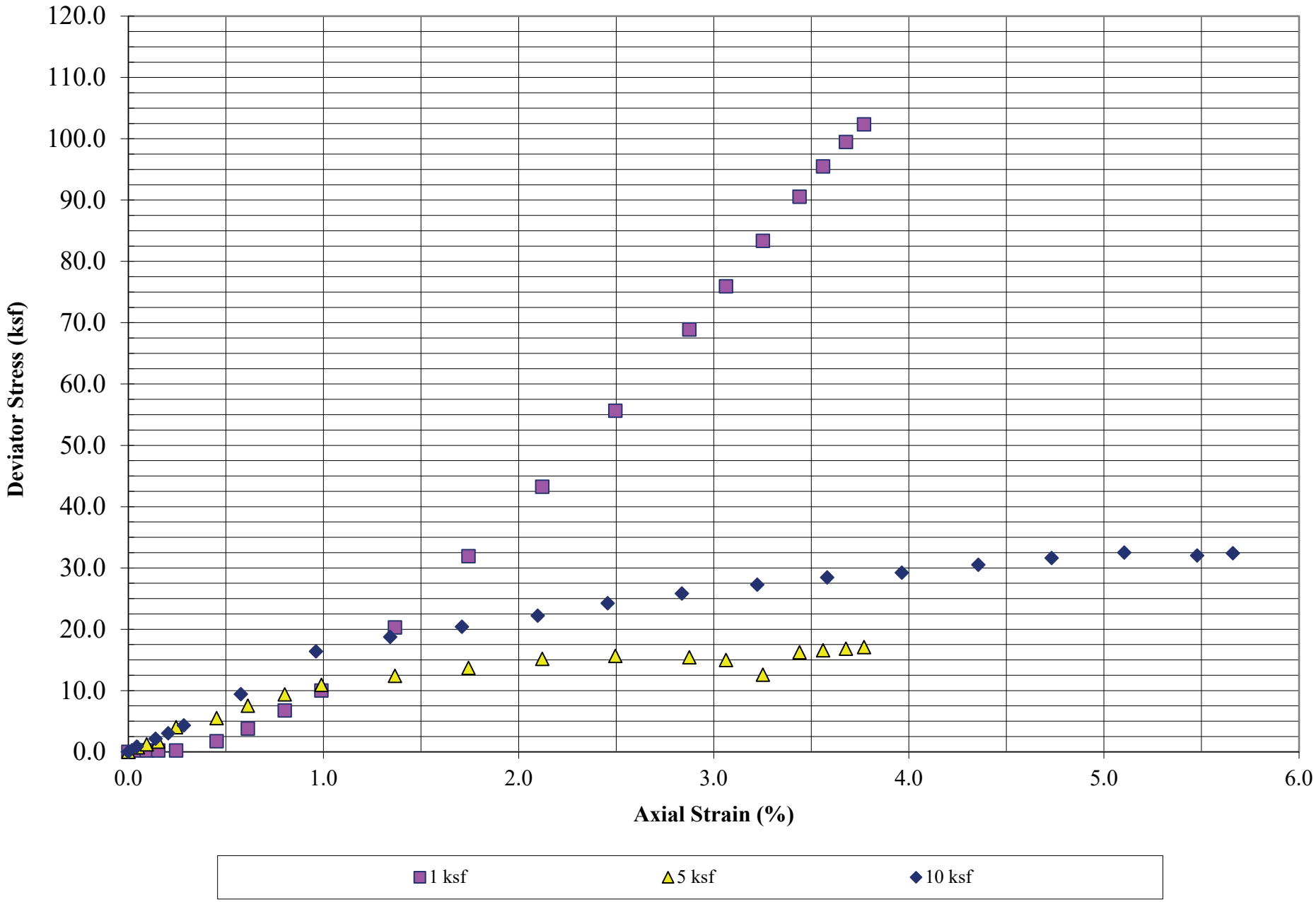
Failure on well defined shear plane

Tested By: Reported By:

Berlogar Stevens & Associates

TXCU D-4767 TEST

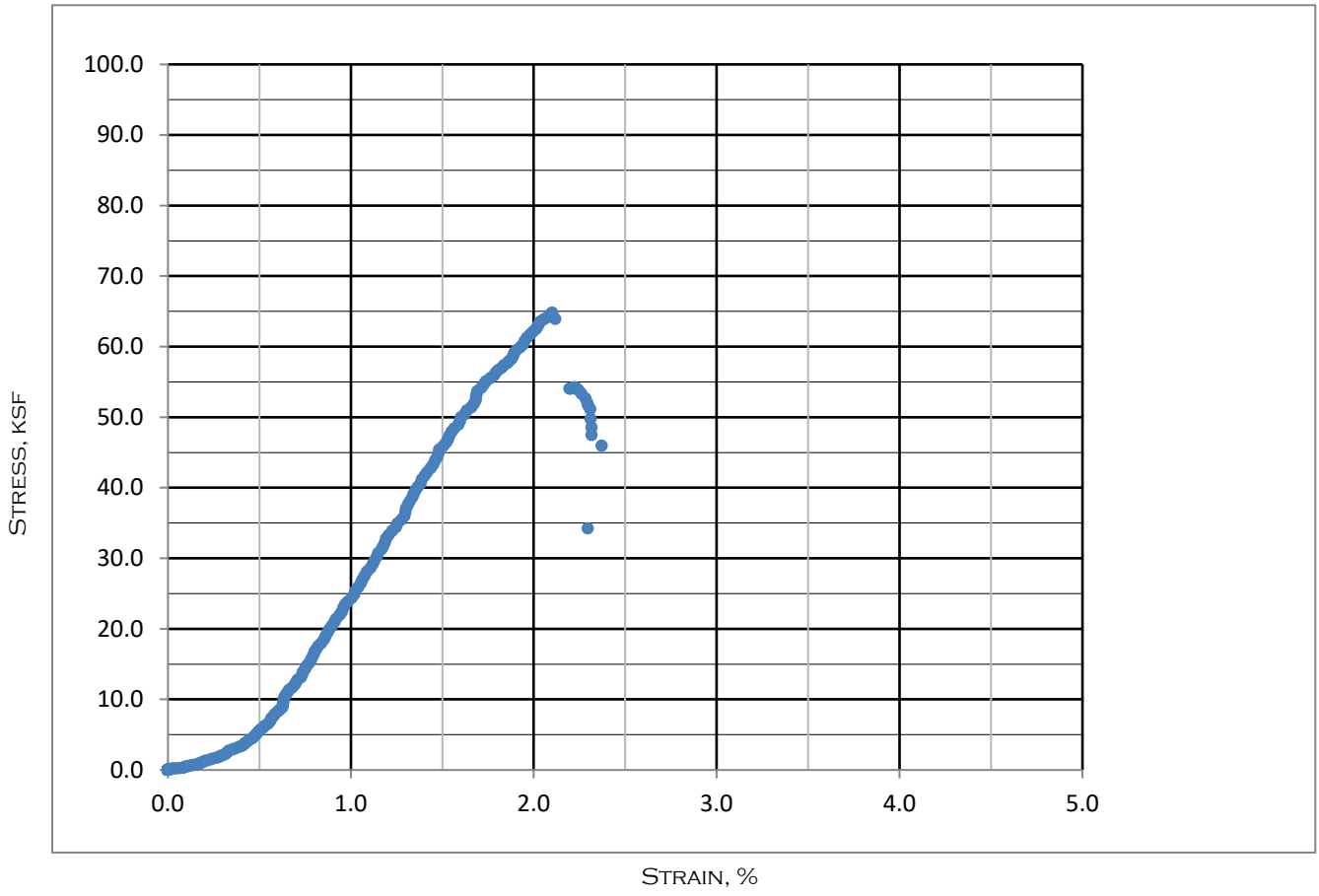
Job No. 4245-200
Sample ID: T28 at 19ft



Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

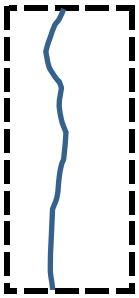
Project Name: Sand Hill Turbine 28			**Project Number:** 4245.200
Sample ID: Turbine-28 at 14ft			Date: 01/12/23
Sample Description: Bedded Claystone-Sandstone Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 124.9	**Maximum Compressive strength, ksf:**	64.8	**Strain at Failure, %:** 2.10
Initial Moisture Content, %: 9.2	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	708.0	Tare ID:	800
Dia., inches:	2.389	Wet Samp. Tare wt,g:	817.7
Height, inches:	4.413	Dry Samp tare wt,g:	758.2
Init. Area. ft^2:	0.0311	Tare wt, g:	110.5
Init Vol. ft^3:	0.0114	init γ_{wet}, pcf:	136.4

Sketch of Failure



Tested By: gs

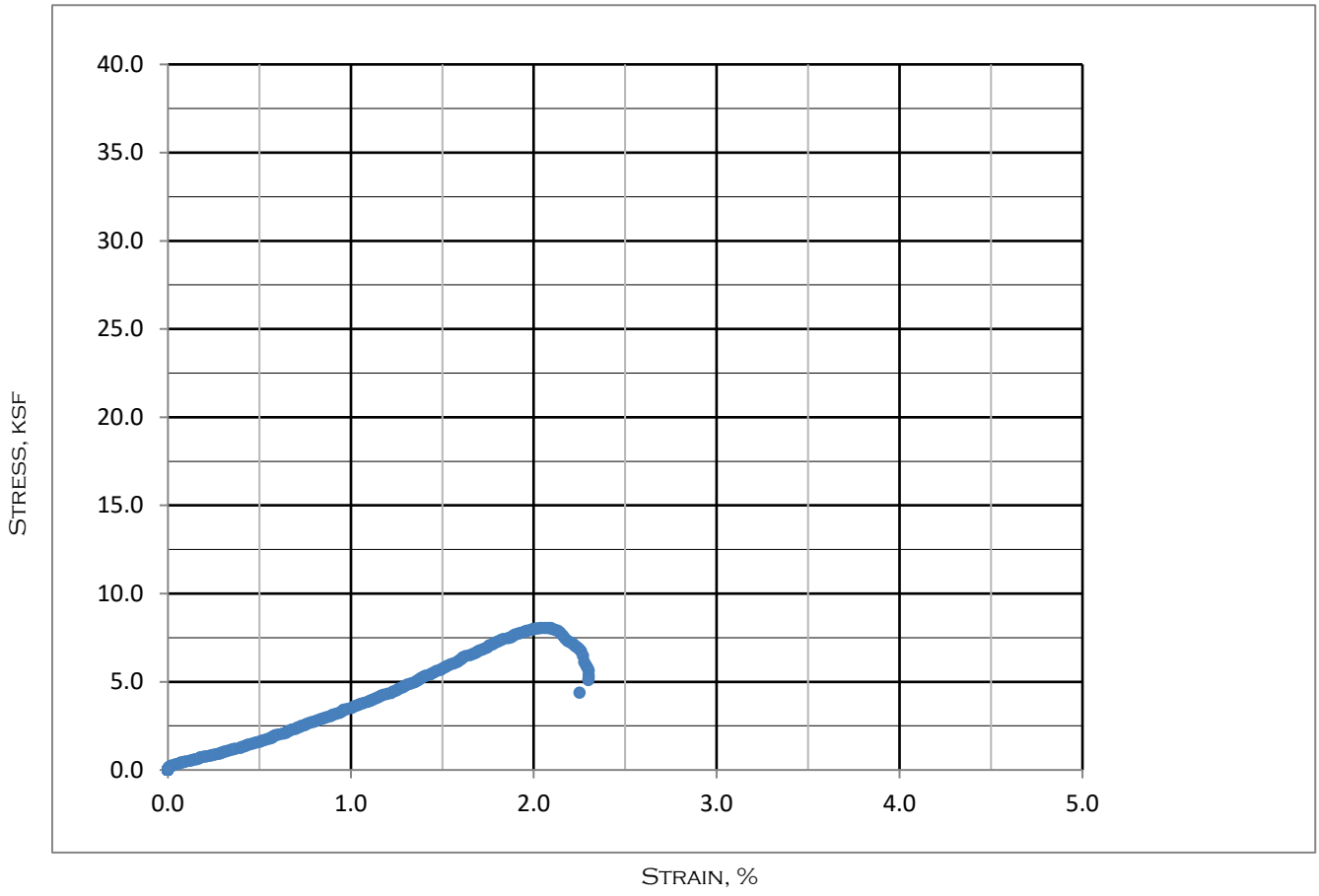
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

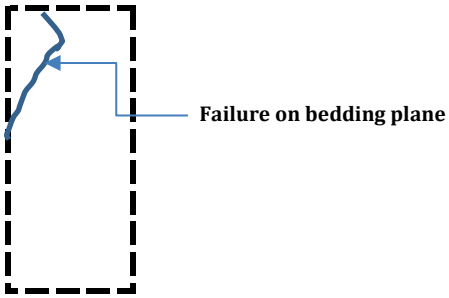
Project Name: Sand Hill Turbine 28			**Project Number:** 4245.200
Sample ID: Turbine-28 at 22ft			Date: 01/12/23
Sample Description: CS Claystone Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 118.7	**Maximum Compressive strength, ksf:**	8.0	**Strain at Failure, %:** 2.10
Initial Moisture Content, %: 14.2	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	783.3	Tare ID:	833
Dia., inches:	2.383	Wet Samp. Tare wt,g:	889.5
Height, inches:	4.94	Dry Samp tare wt,g:	793.0
Init. Area. ft^2:	0.0310	Tare wt, g:	111.4
Init Vol. ft^3:	0.0128	init γ_{wet}, pcf:	135.5

Sketch of Failure



Tested By: gs

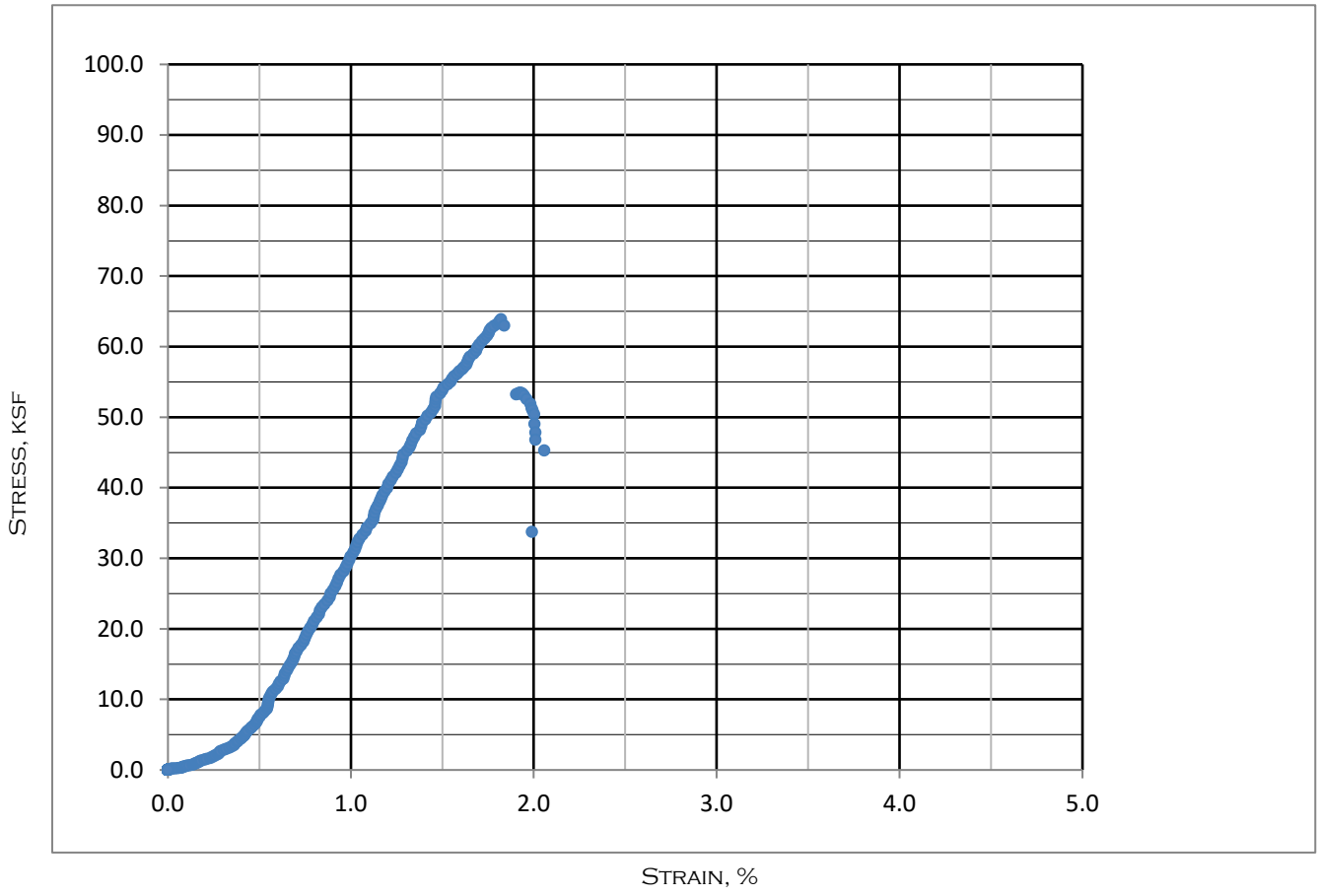
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

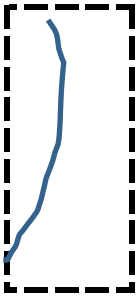
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 27ft			Date: 01/12/23
Sample Description: SS Sandstone Light Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 125.6	**Maximum Compressive strength, ksf:**	**64.8**	**Strain at Failure, %: 2.10**
Initial Moisture Content, %: 9.5	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	837.4	Tare ID:	840
Dia., inches:	2.410	Wet Samp. Tare wt,g:	933.6
Height, inches:	5.087	Dry Samp tare wt,g:	862.2
Init. Area. ft^2:	0.0317	Tare wt, g:	111.0
Init Vol. ft^3:	0.0134	init γ_{wet}, pcf:	137.5

Sketch of Failure



Tested By: gs

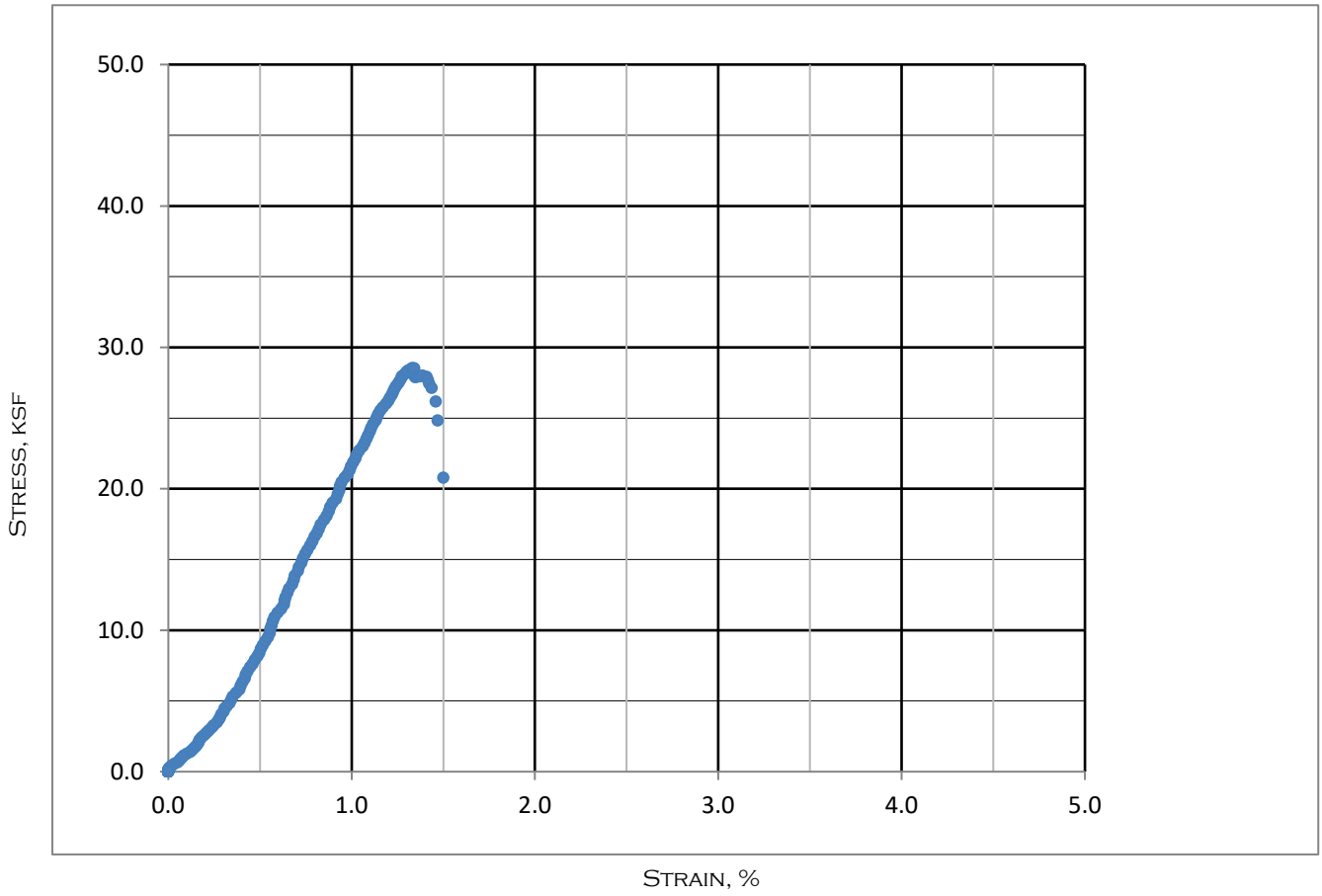
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

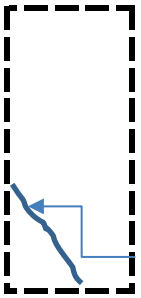
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 34ft			Date: 01/12/23
Sample Description: CS Clayestone Gray Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf:	**Maximum Compressive strength, ksf:**	**28.5**	**Strain at Failure, %: 1.33**
Initial Moisture Content, %:	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	812.7	Tare ID:	837
Dia., inches:	2.386	Wet Samp. Tare wt,g:	921.4
Height, inches:	5.037	Dry Samp tare wt,g:	
Init. Area. ft^2:	0.0311	Tare wt, g:	110.6
Init Vol. ft^3:	0.0130	init γ_{WET}, pcf:	137.5

Sketch of Failure



Faliure on bedding plane

Tested By: gs

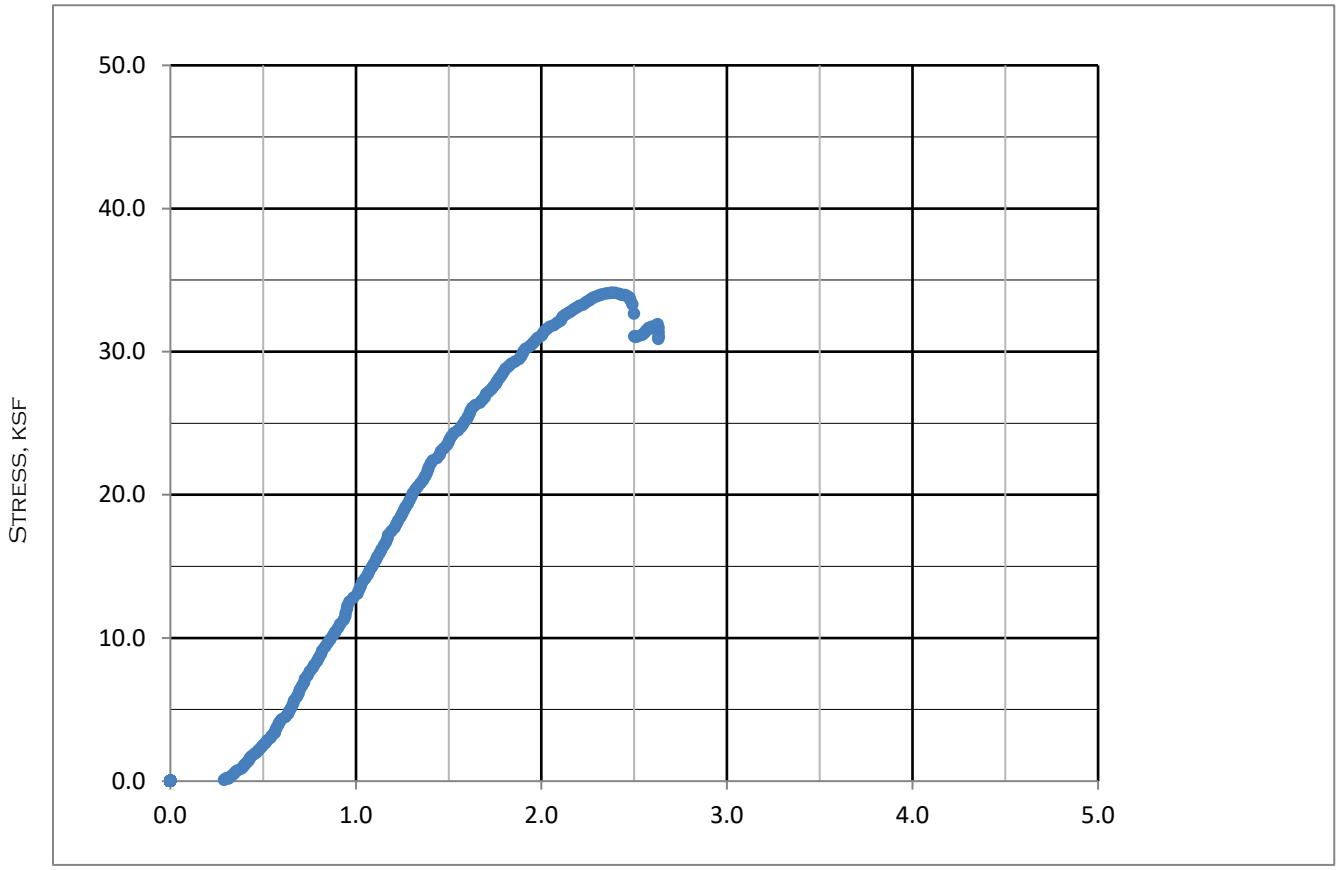
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

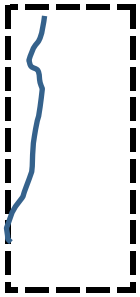
Project Name: Sand Hill Turbine 28			**Project Number:** 4245.200
Sample ID: Turbine-28 at 43ft			Date: 01/12/23
Sample Description: CS Clayestone Gray Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 123.9	**Maximum Compressive strength, ksf:**	34.1	**Strain at Failure, %:** 2.40
Initial Moisture Content, %: 11.2	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	789.9	Tare ID:	823
Dia., inches:	2.388	Wet Samp. Tare wt,g:	897.8
Height, inches:	4.877	Dry Samp tare wt,g:	818.7
Init. Area. ft^2:	0.0311	Tare wt, g:	111.9
Init Vol. ft^3:	0.0126	init γ_{wet}, pcf:	137.8

Sketch of Failure



Tested By: gs

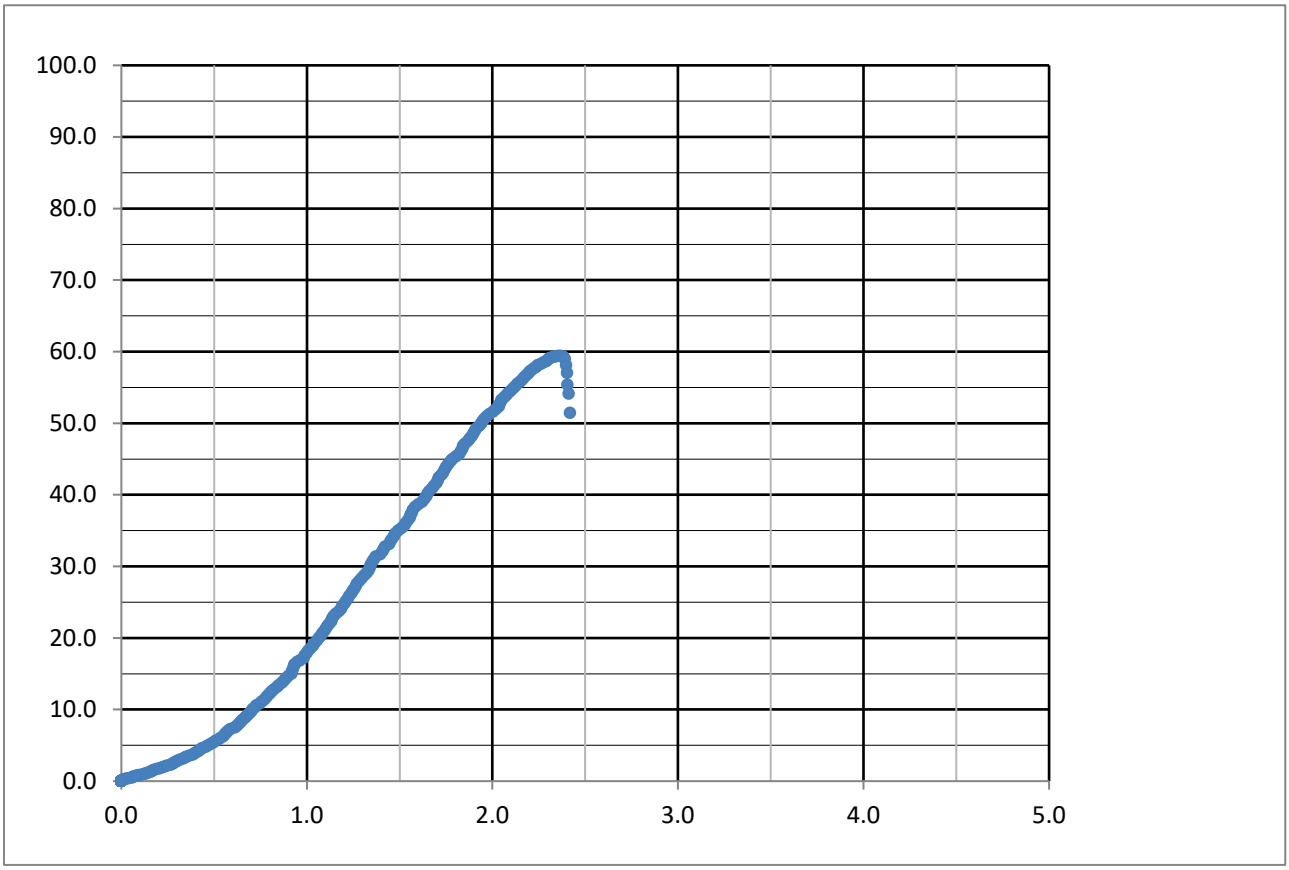
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

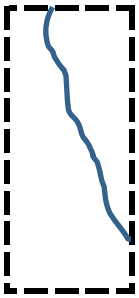
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 47ft			Date: 01/12/23
Sample Description: CS Clayestone Gray Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 124.8	**Maximum Compressive strength, ksf:**	**59.4**	**Strain at Failure, %: 2.37**
Initial Moisture Content, %: 11.1	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	839.8	Tare ID:	819
Dia., inches:	2.408	Wet Samp. Tare wt,g:	931.5
Height, inches:	5.065	Dry Samp tare wt,g:	849.4
Init. Area. ft^2:	0.0316	Tare wt, g:	110.9
Init Vol. ft^3:	0.0133	init γ_{wet}, pcf:	138.7

Sketch of Failure



Tested By: gs

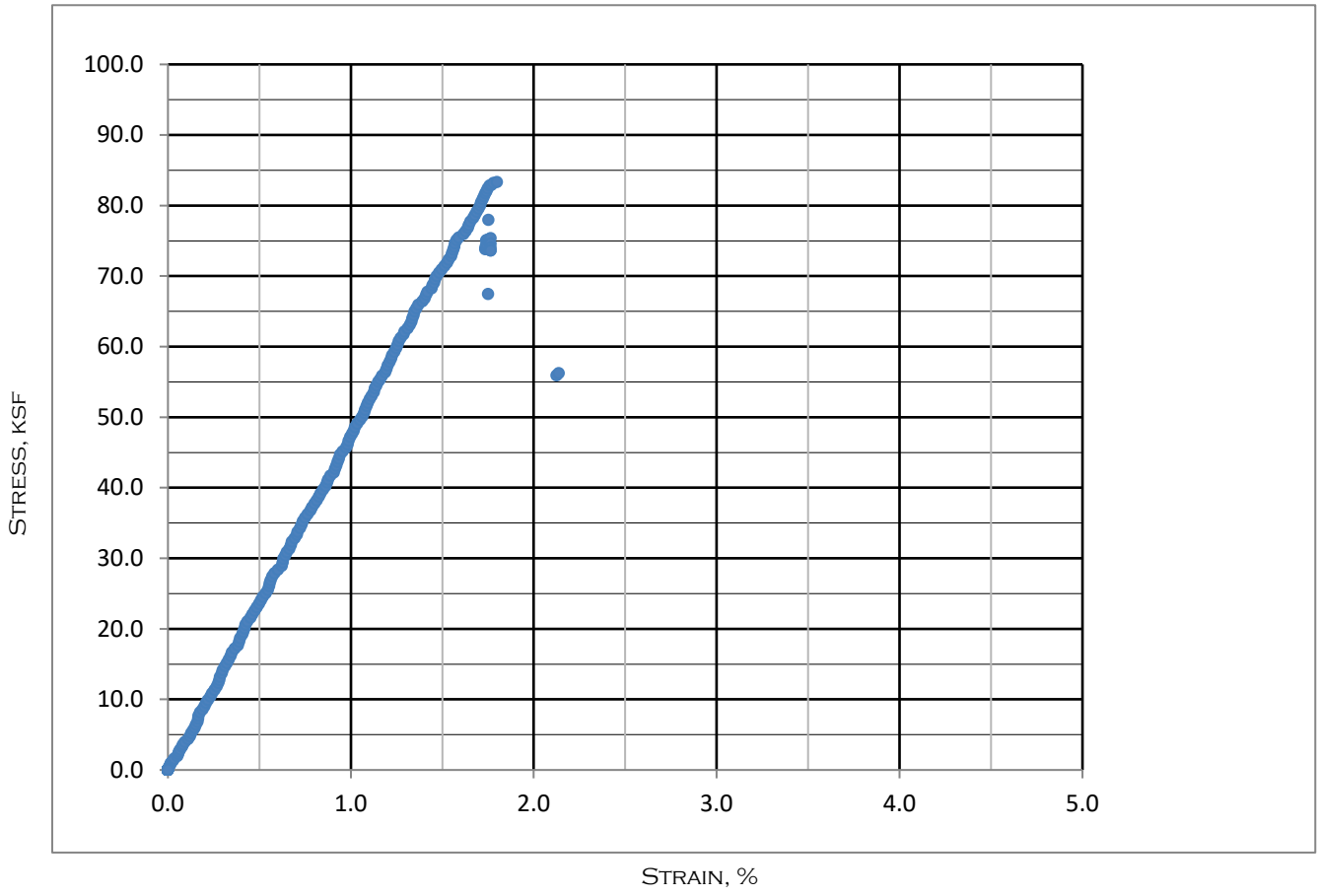
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

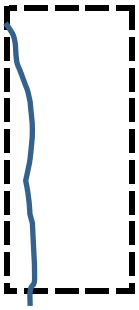
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 56-1/2ft			Date: 01/12/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 127.6	**Maximum Compressive strength, ksf:**	**83.3**	**Strain at Failure, %: 1.80**
Initial Moisture Content, %: 10.6	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	842.6	Tare ID:	838
Dia., inches:	2.392	Wet Samp. Tare wt,g:	953.4
Height, inches:	5.062	Dry Samp tare wt,g:	872.9
Init. Area. ft^2:	0.0312	Tare wt, g:	111.5
Init Vol. ft^3:	0.0132	init γ_{WET}, pcf:	141.1

Sketch of Failure



Tested By: gs

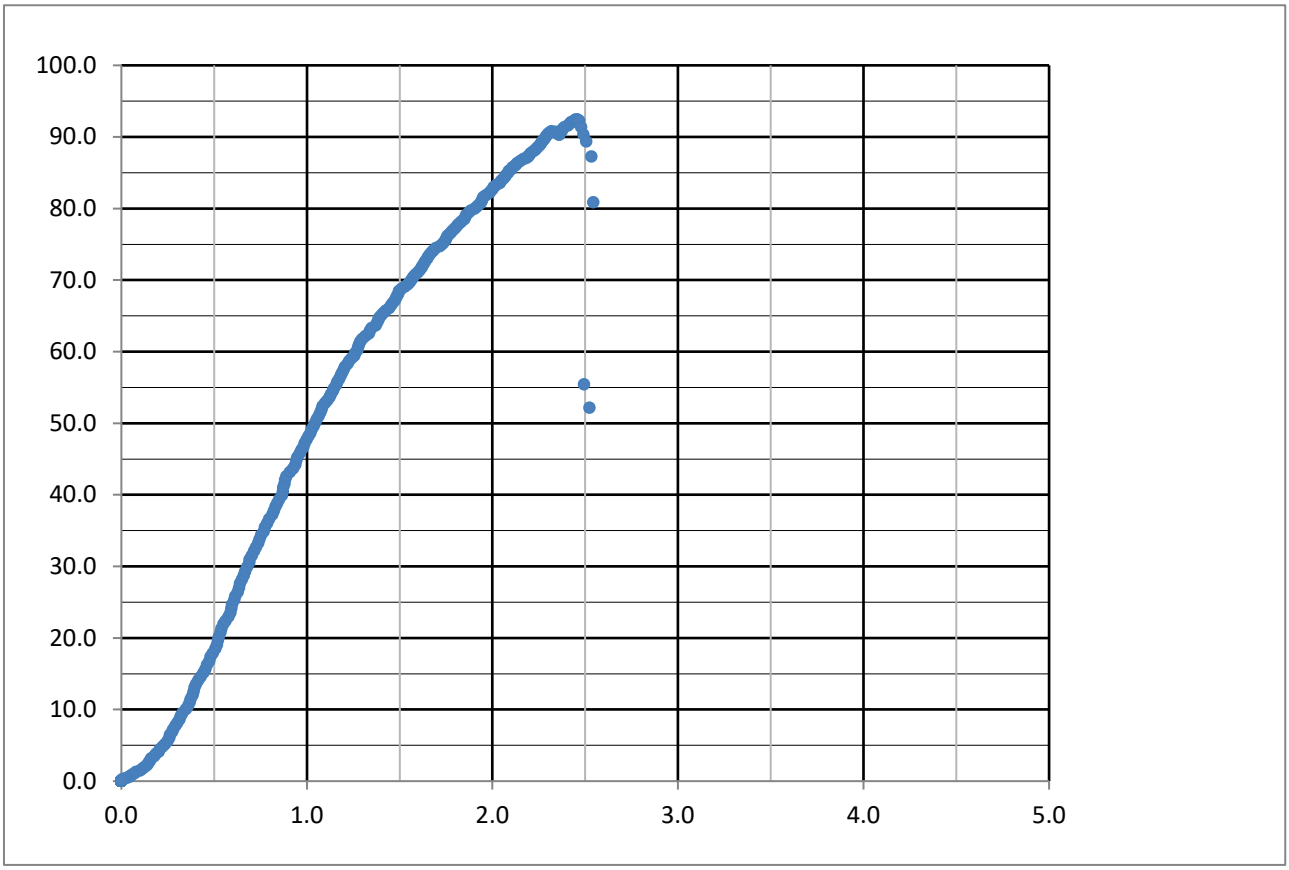
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

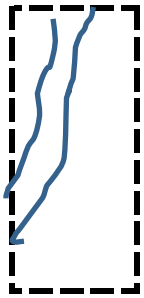
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 68ft			Date: 01/12/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 123.0	**Maximum Compressive strength, ksf:**	**92.4**	**Strain at Failure, %: 2.45**
Initial Moisture Content, %: 9.1	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	824.0	Tare ID:	813
Dia., inches:	2.373	Wet Samp. Tare wt,g:	876.1
Height, inches:	5.290	Dry Samp tare wt,g:	812.2
Init. Area. ft^2:	0.0307	Tare wt, g:	110.8
Init Vol. ft^3:	0.0135	init γ_{wet}, pcf:	134.2

Sketch of Failure



Tested By: gs

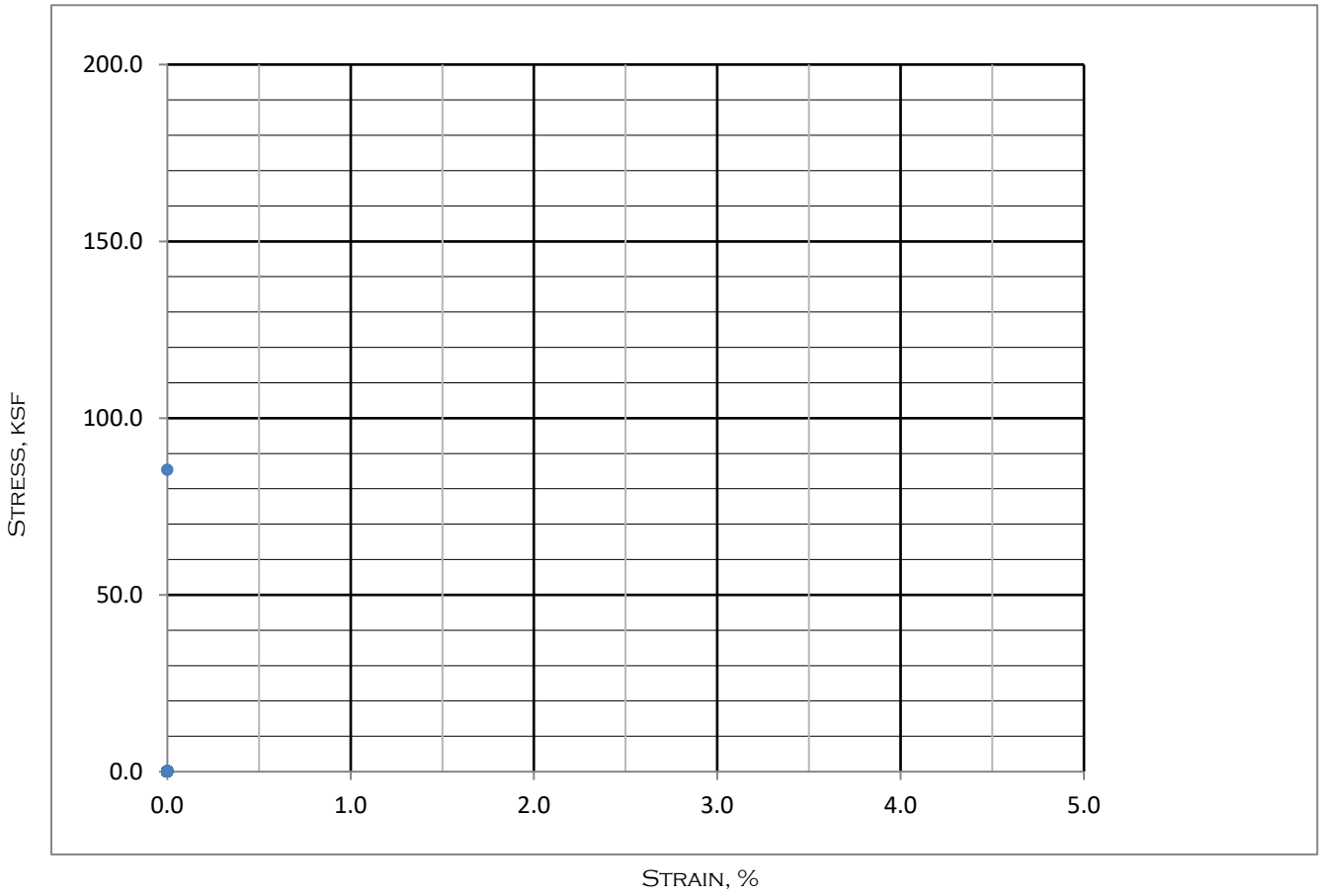
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

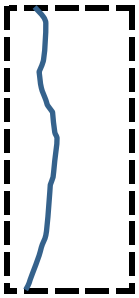
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 73ft			Date: 01/26/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 137.6	**Maximum Compressive strength, ksf:**	**84.9**	**Strain at Failure, %:**
Initial Moisture Content, %: 7.7	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	702.6	Tare ID:	102
Dia., inches:	2.365	Wet Samp. Tare wt,g:	825.4
Height, inches:	4.112	Dry Samp tare wt,g:	775.1
Init. Area. ft^2:	0.0305	Tare wt, g:	124.8
Init Vol. ft^3:	0.0105	init γ_{wet}, pcf:	148.2

Sketch of Failure



Tested By: gs

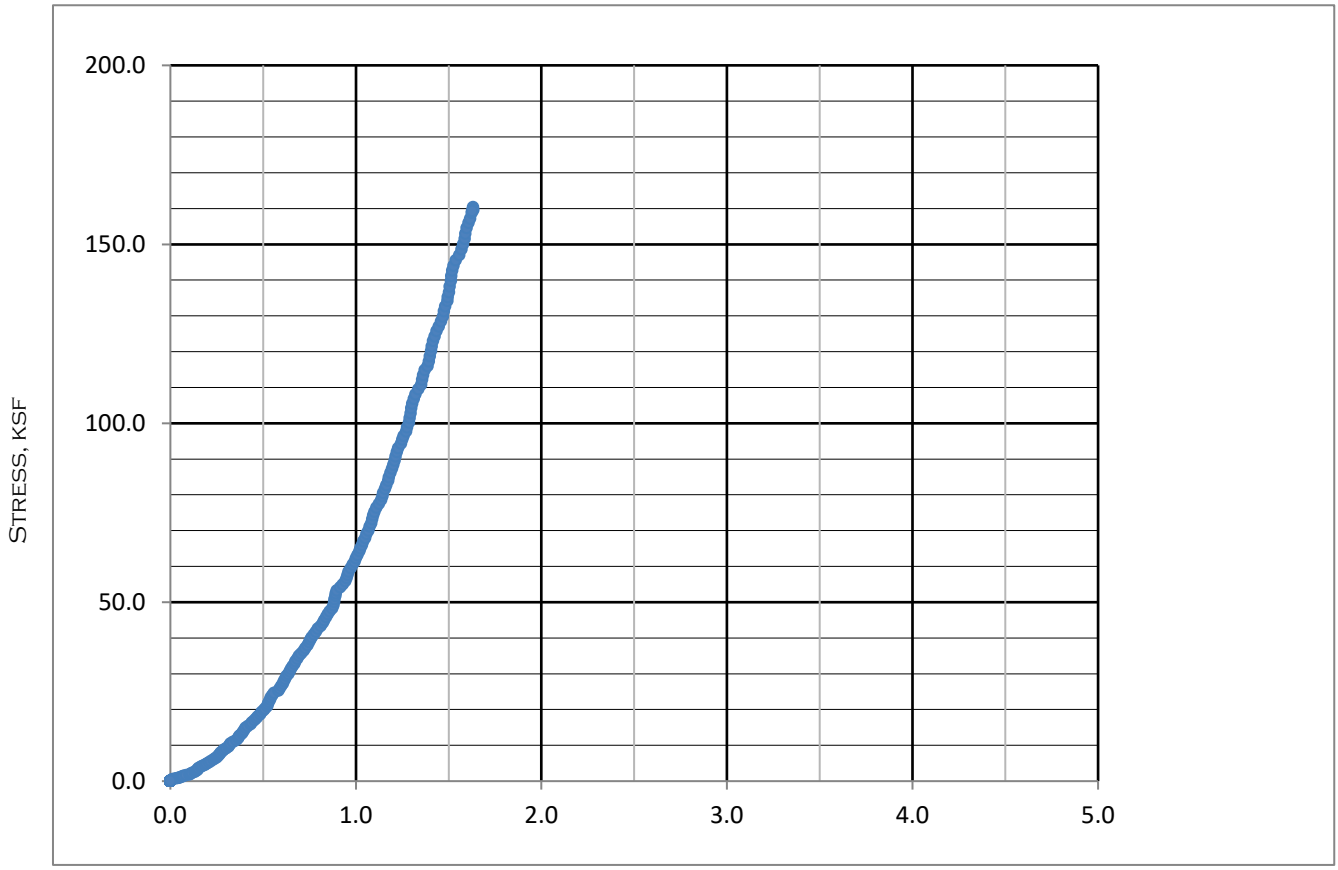
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

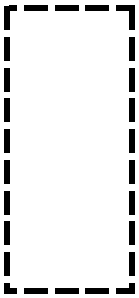
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 85ft			Date: 01/12/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 132.4	**Maximum Compressive strength, ksf:**	**160.3**	**Strain at Failure, %: 1.63**
Initial Moisture Content, %: 8.7	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	874.4	Tare ID:	824
Dia., inches:	2.381	Wet Samp. Tare wt,g:	984.3
Height, inches:	5.201	Dry Samp tare wt,g:	914.7
Init. Area. ft^2:	0.0309	Tare wt, g:	110.9
Init Vol. ft^3:	0.0134	init γ_{wet}, pcf:	143.9

Sketch of Failure



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Tested By: gs

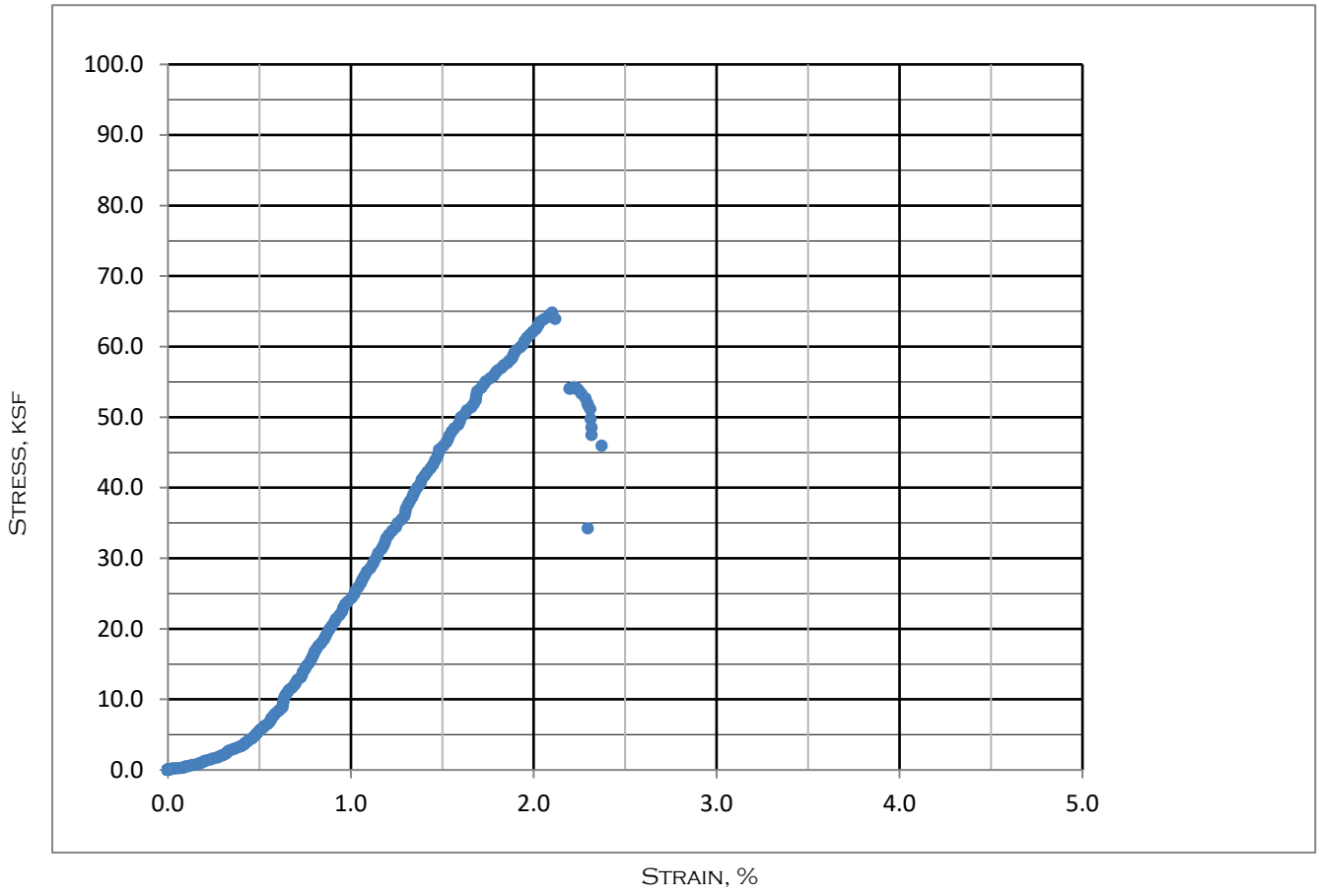
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

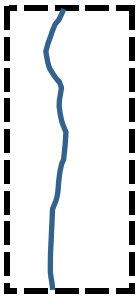
Project Name: Sand Hill Turbine 28			**Project Number:** 4245.200
Sample ID: Turbine-28 at 14ft			Date: 01/12/23
Sample Description: Bedded Claystone-Sandstone Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 124.9	**Maximum Compressive strength, ksf:**	64.8	**Strain at Failure, %:** 2.10
Initial Moisture Content, %: 9.2	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	708.0	Tare ID:	800
Dia., inches:	2.389	Wet Samp. Tare wt,g:	817.7
Height, inches:	4.413	Dry Samp tare wt,g:	758.2
Init. Area. ft^2:	0.0311	Tare wt, g:	110.5
Init Vol. ft^3:	0.0114	init γ_{wet}, pcf:	136.4

Sketch of Failure



Tested By: gs

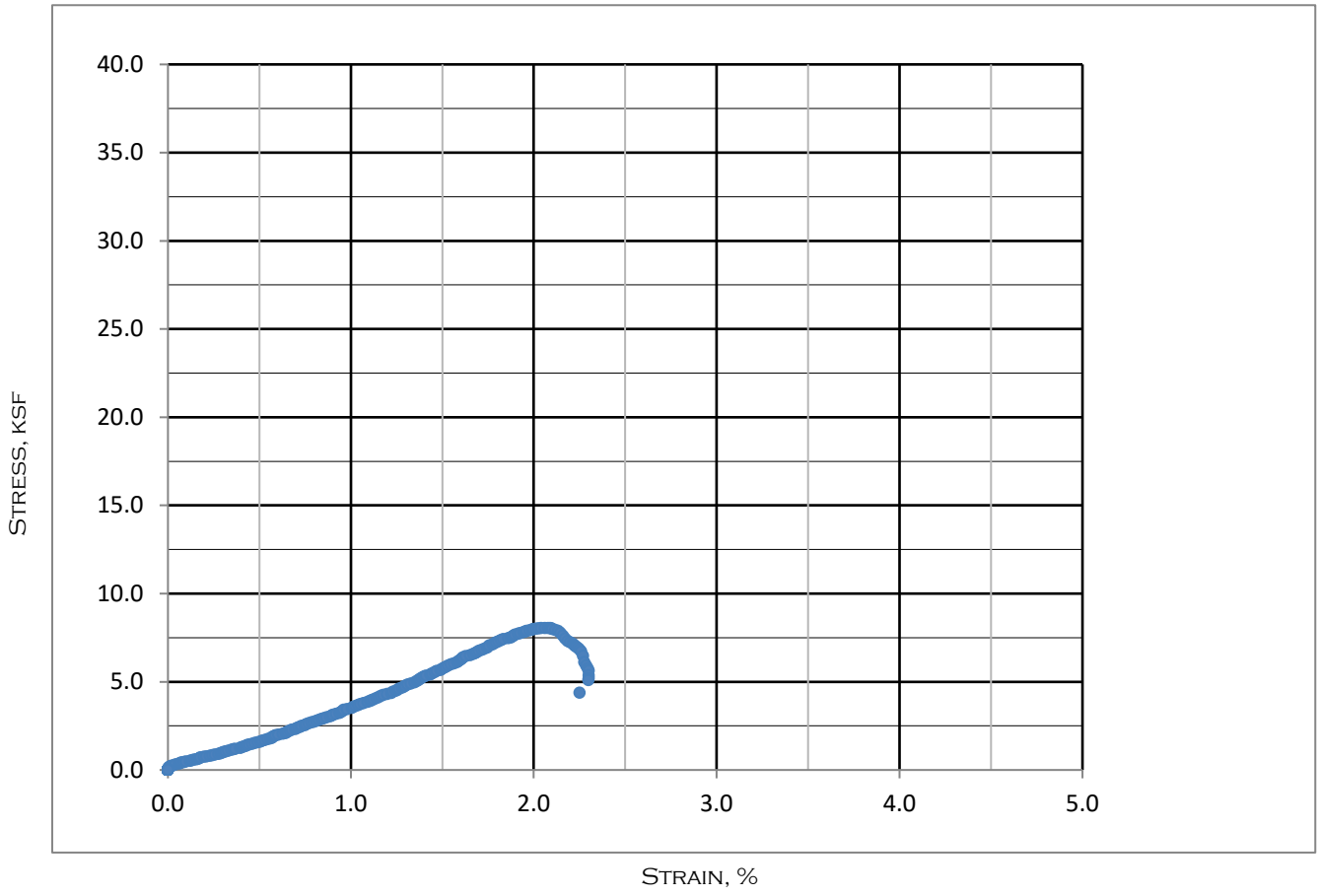
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

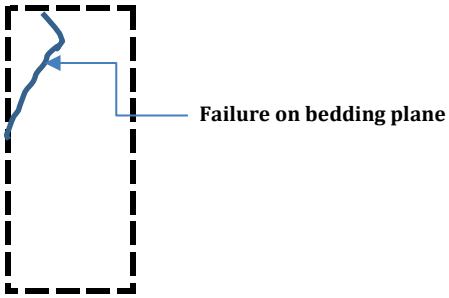
Project Name: Sand Hill Turbine 28			**Project Number:** 4245.200
Sample ID: Turbine-28 at 22ft			Date: 01/12/23
Sample Description: CS Claystone Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 118.7	**Maximum Compressive strength, ksf:**	8.0	**Strain at Failure, %:** 2.10
Initial Moisture Content, %: 14.2	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	783.3	Tare ID:	833
Dia., inches:	2.383	Wet Samp. Tare wt,g:	889.5
Height, inches:	4.94	Dry Samp tare wt,g:	793.0
Init. Area. ft^2:	0.0310	Tare wt, g:	111.4
Init Vol. ft^3:	0.0128	init γ_{wet}, pcf:	135.5

Sketch of Failure



Tested By: gs

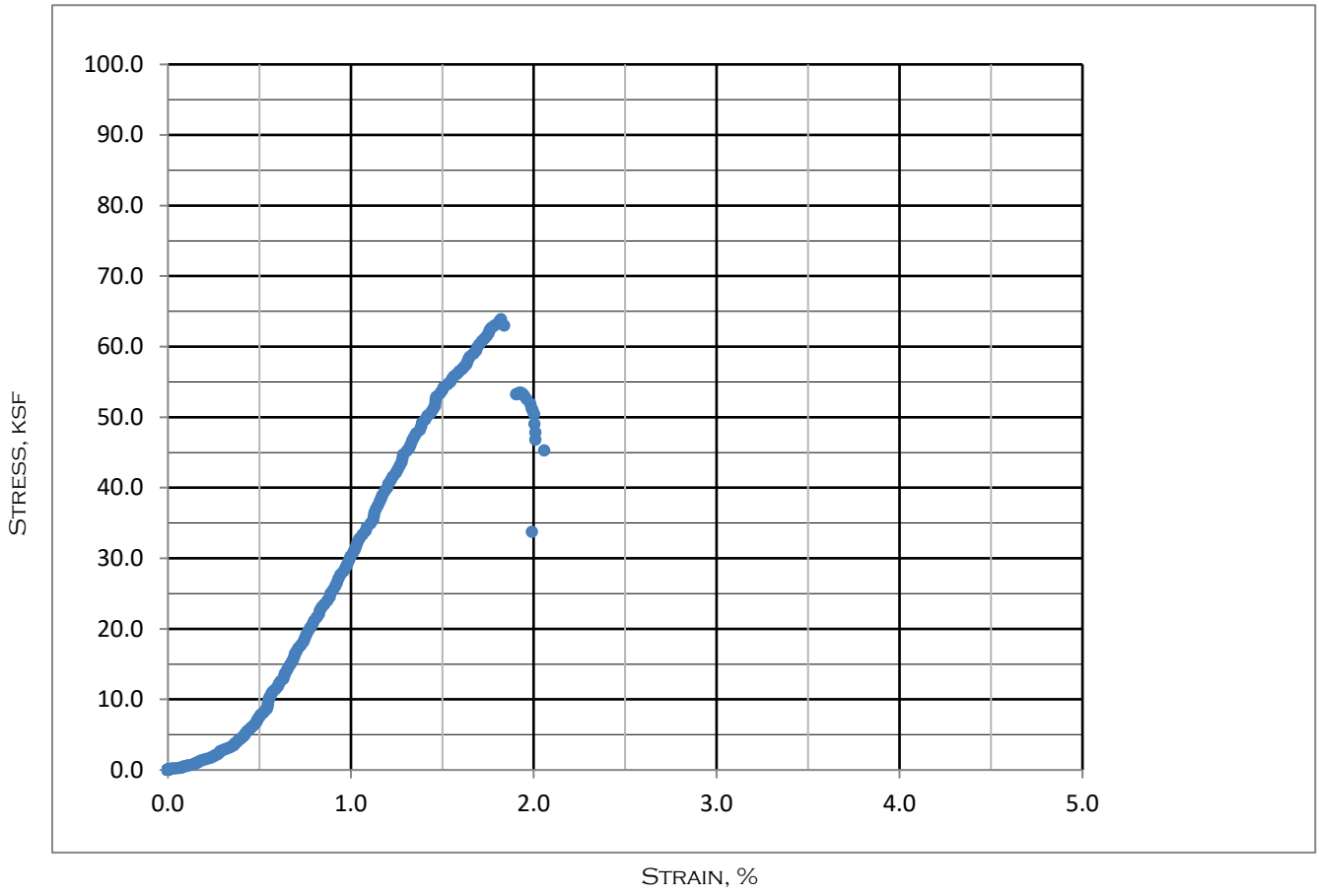
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

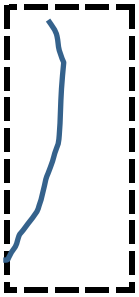
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 27ft			Date: 01/12/23
Sample Description: SS Sandstone Light Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 125.6	**Maximum Compressive strength, ksf:**	**64.8**	**Strain at Failure, %: 2.10**
Initial Moisture Content, %: 9.5	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	837.4	Tare ID:	840
Dia., inches:	2.410	Wet Samp. Tare wt,g:	933.6
Height, inches:	5.087	Dry Samp tare wt,g:	862.2
Init. Area. ft^2:	0.0317	Tare wt, g:	111.0
Init Vol. ft^3:	0.0134	init γ_{wet}, pcf:	137.5

Sketch of Failure



Tested By: gs

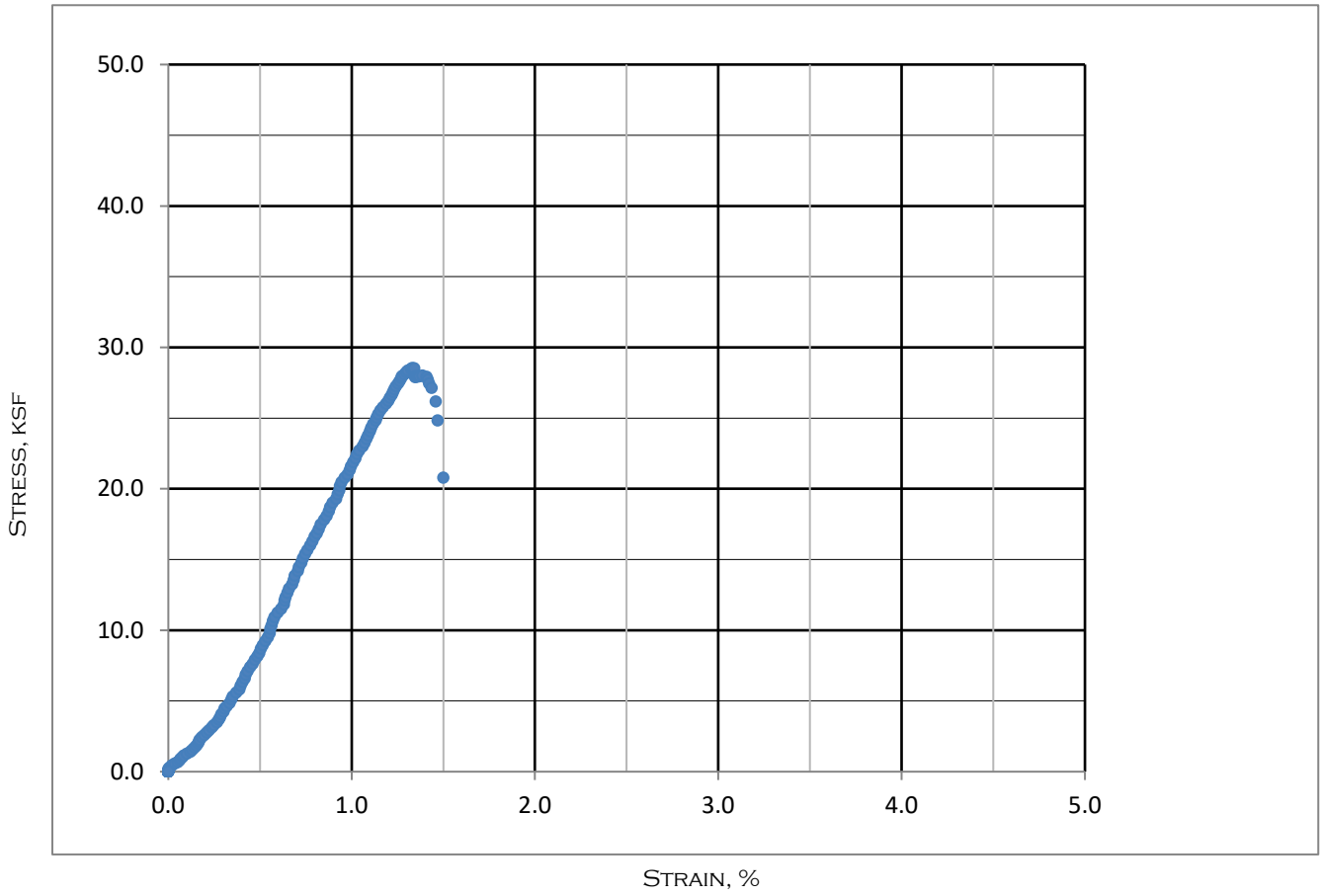
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

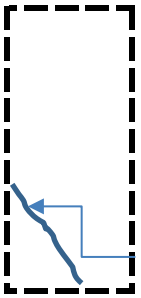
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 34ft			Date: 01/12/23
Sample Description: CS Clayestone Gray Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf:	**Maximum Compressive strength, ksf:**	**28.5**	**Strain at Failure, %: 1.33**
Initial Moisture Content, %:	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	812.7	Tare ID:	837
Dia., inches:	2.386	Wet Samp. Tare wt,g:	921.4
Height, inches:	5.037	Dry Samp tare wt,g:	
Init. Area. ft^2:	0.0311	Tare wt, g:	110.6
Init Vol. ft^3:	0.0130	init γ_{WET}, pcf:	137.5

Sketch of Failure



Faliure on bedding plane

Tested By: gs

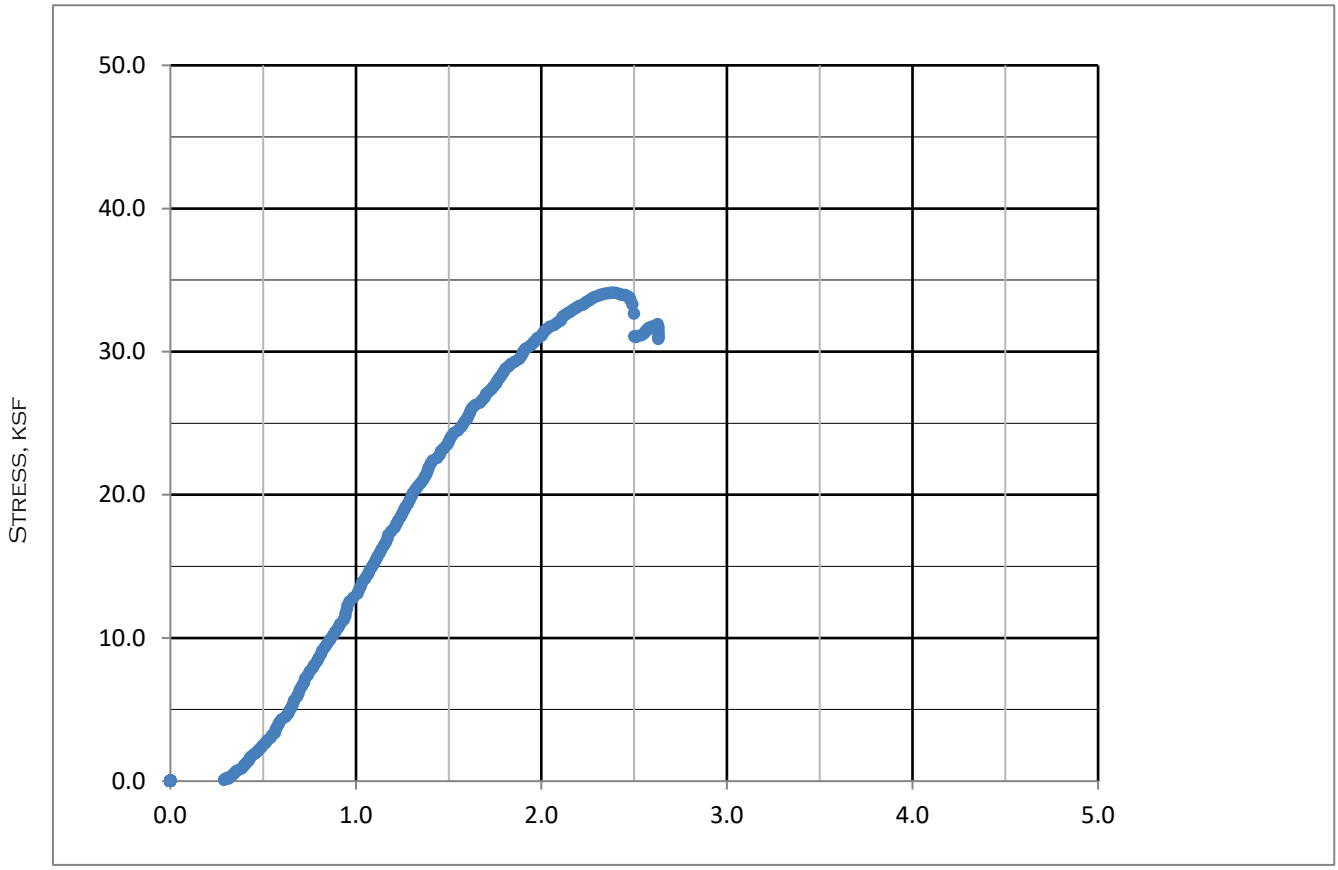
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

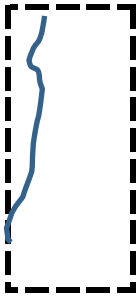
Project Name: Sand Hill Turbine 28			**Project Number:** 4245.200
Sample ID: Turbine-28 at 43ft			Date: 01/12/23
Sample Description: CS Clayestone Gray Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 123.9	**Maximum Compressive strength, ksf:**	34.1	**Strain at Failure, %:** 2.40
Initial Moisture Content, %: 11.2	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	789.9	Tare ID:	823
Dia., inches:	2.388	Wet Samp. Tare wt,g:	897.8
Height, inches:	4.877	Dry Samp tare wt,g:	818.7
Init. Area. ft^2:	0.0311	Tare wt, g:	111.9
Init Vol. ft^3:	0.0126	init γ_{wet}, pcf:	137.8

Sketch of Failure



Tested By: gs

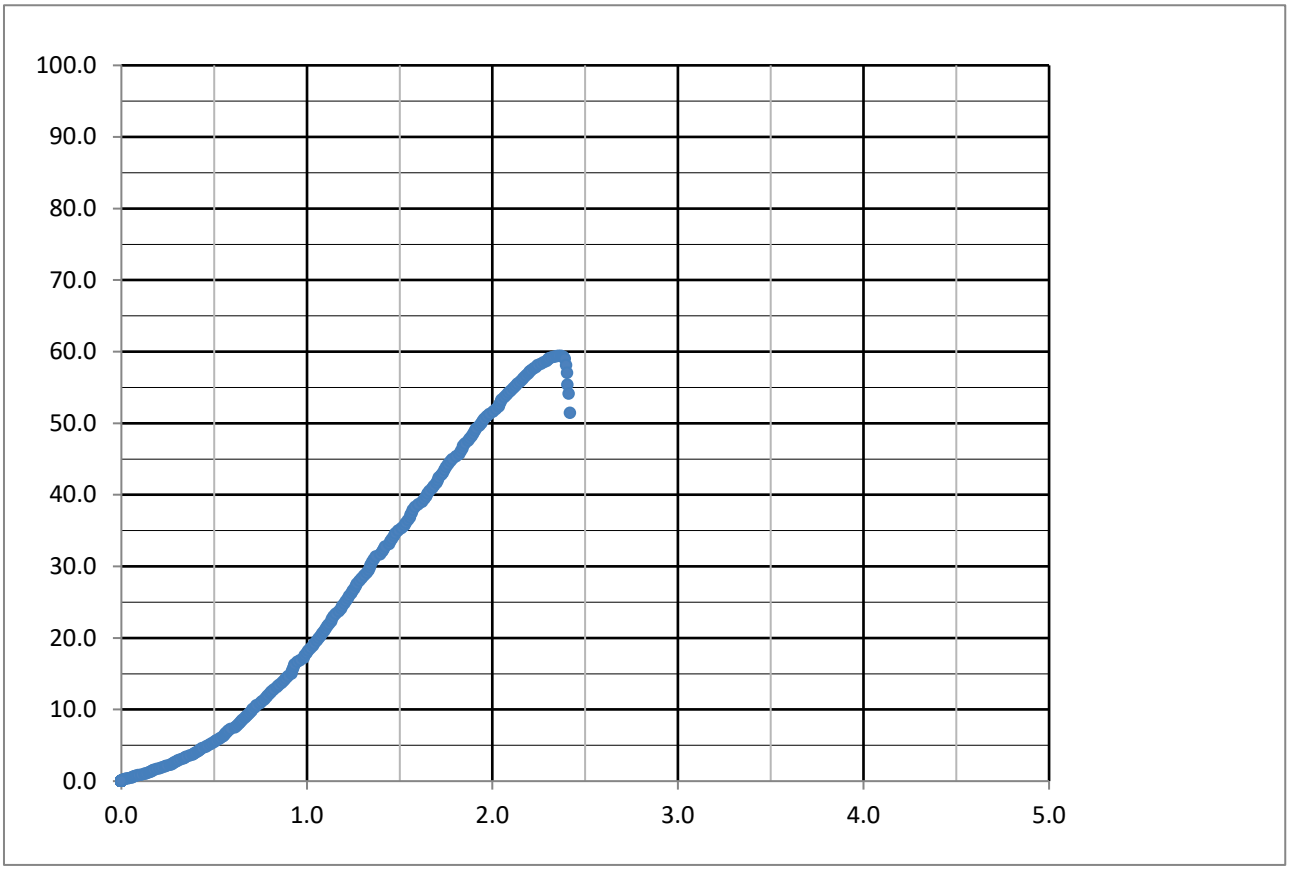
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

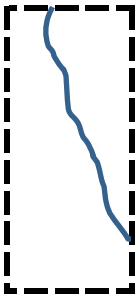
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 47ft			Date: 01/12/23
Sample Description: CS Clayestone Gray Brown			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 124.8	**Maximum Compressive strength, ksf:**	**59.4**	**Strain at Failure, %: 2.37**
Initial Moisture Content, %: 11.1	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	839.8	Tare ID:	819
Dia., inches:	2.408	Wet Samp. Tare wt,g:	931.5
Height, inches:	5.065	Dry Samp tare wt,g:	849.4
Init. Area. ft^2:	0.0316	Tare wt, g:	110.9
Init Vol. ft^3:	0.0133	init γ_{wet}, pcf:	138.7

Sketch of Failure



Tested By: gs

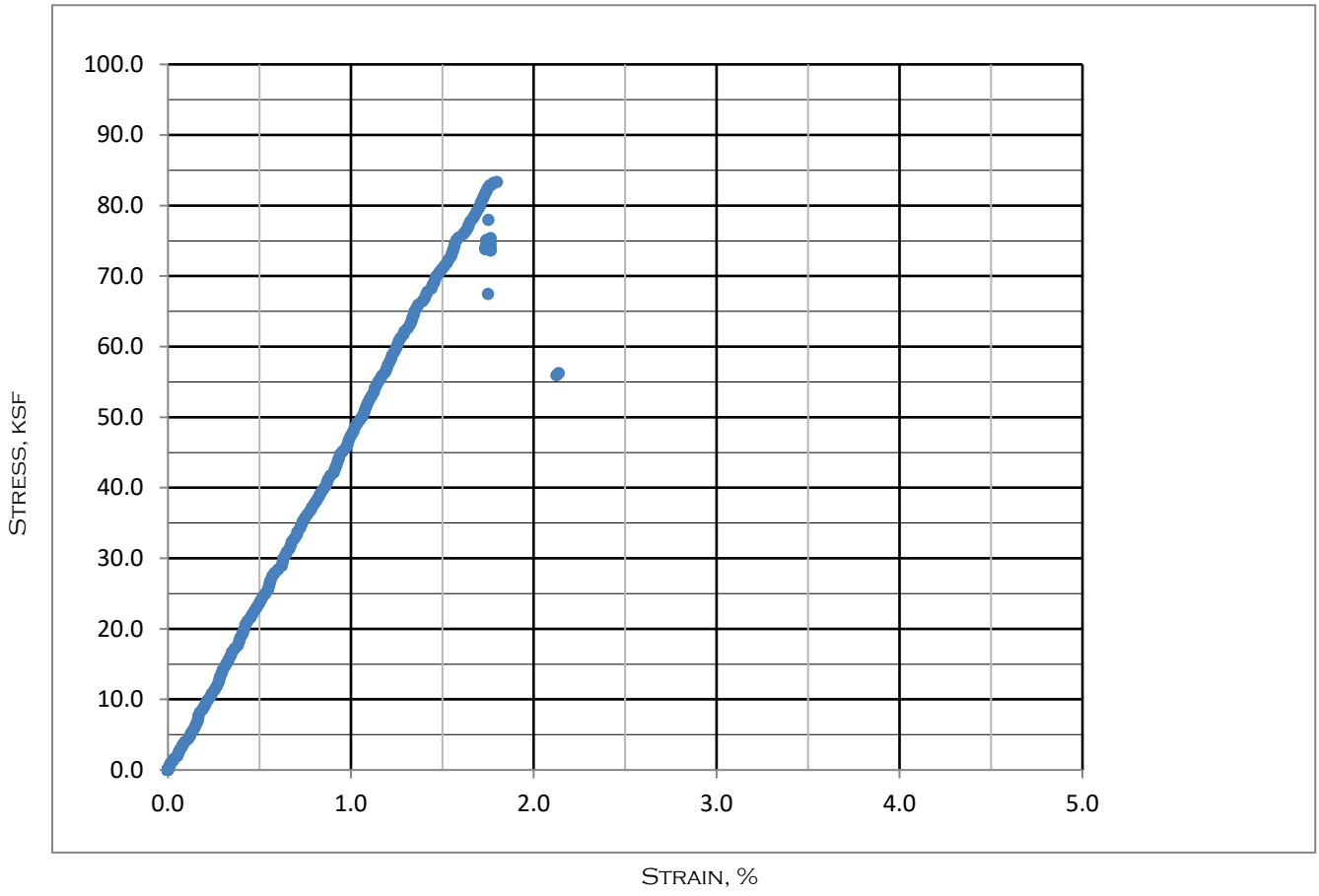
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

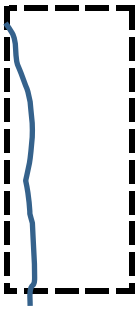
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 56-1/2ft			Date: 01/12/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 127.6	**Maximum Compressive strength, ksf:**	**83.3**	**Strain at Failure, %: 1.80**
Initial Moisture Content, %: 10.6	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	842.6	Tare ID:	838
Dia., inches:	2.392	Wet Samp. Tare wt,g:	953.4
Height, inches:	5.062	Dry Samp tare wt,g:	872.9
Init. Area. ft^2:	0.0312	Tare wt, g:	111.5
Init Vol. ft^3:	0.0132	init γ_{WET}, pcf:	141.1

Sketch of Failure



Tested By: gs

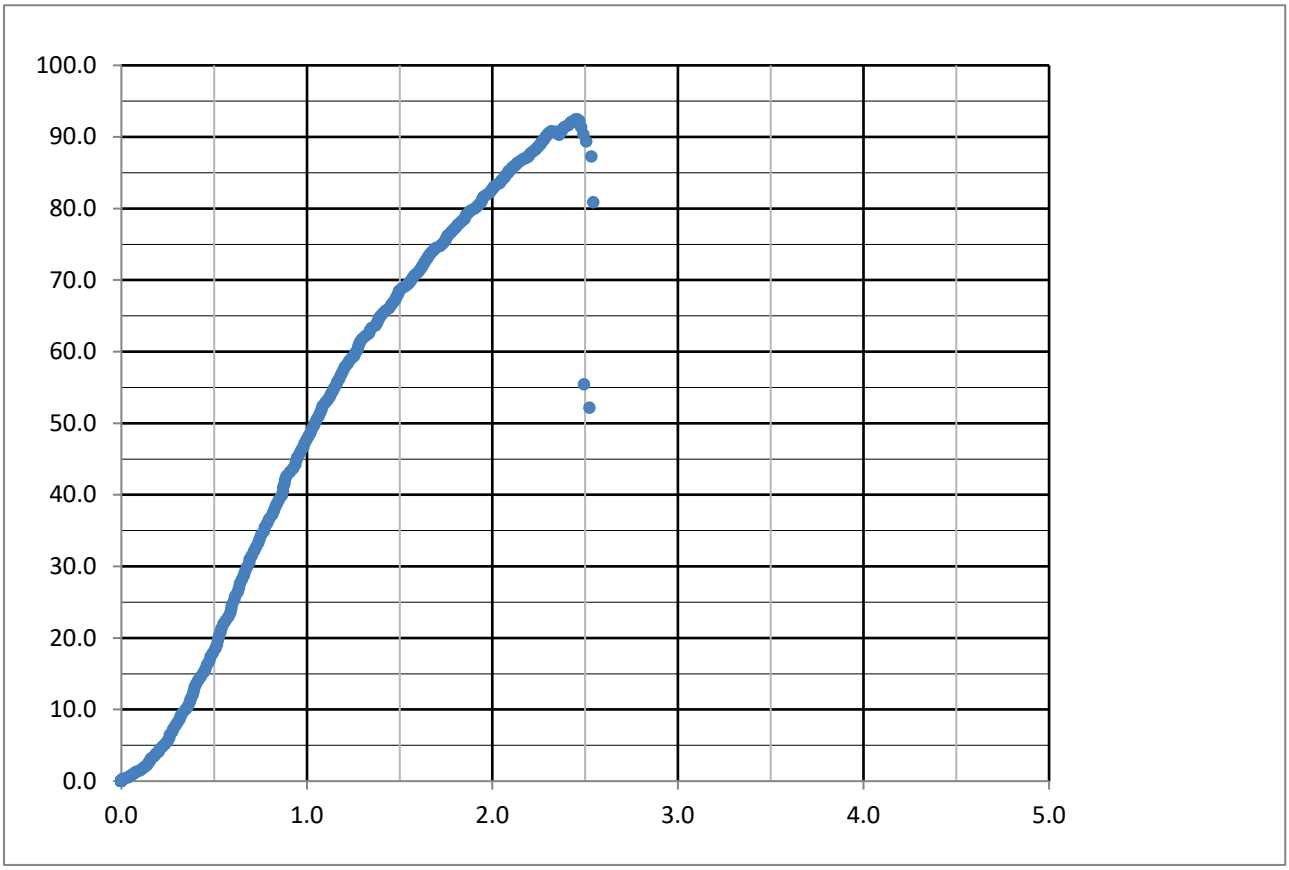
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

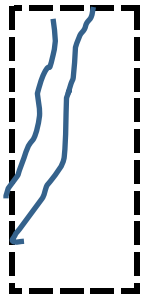
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 68ft			Date: 01/12/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 123.0	**Maximum Compressive strength, ksf:**	**92.4**	**Strain at Failure, %: 2.45**
Initial Moisture Content, %: 9.1	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	824.0	Tare ID:	813
Dia., inches:	2.373	Wet Samp. Tare wt,g:	876.1
Height, inches:	5.290	Dry Samp tare wt,g:	812.2
Init. Area. ft^2:	0.0307	Tare wt, g:	110.8
Init Vol. ft^3:	0.0135	init γ_{wet}, pcf:	134.2

Sketch of Failure



Tested By: gs

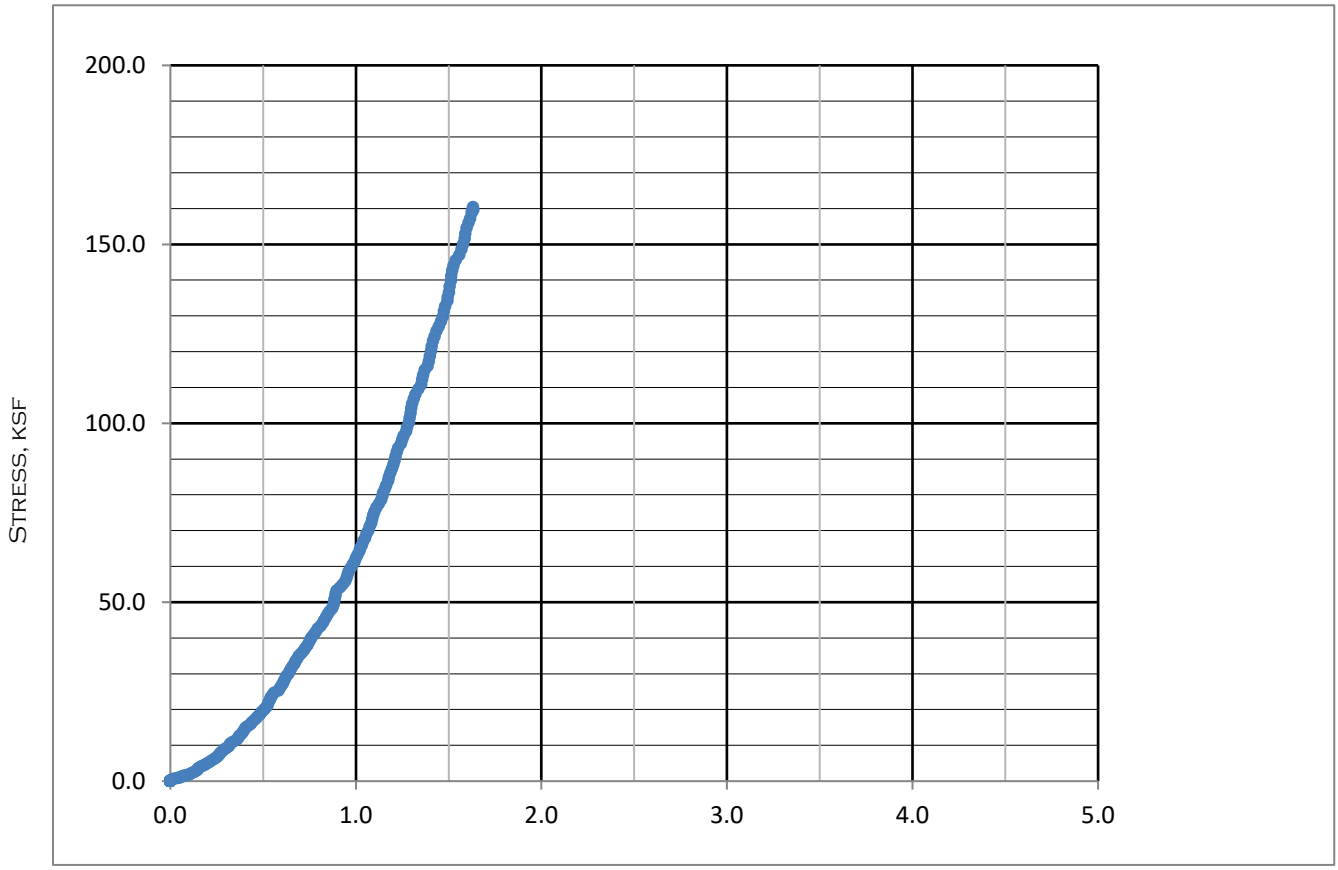
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Unconfined Compressive Strength of Cohesive Soils ASTM D-2166

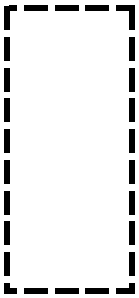
Project Name: Sand Hill Turbine 28			**Project Number: 4245.200**
Sample ID: Turbine-28 at 85ft			Date: 01/12/23
Sample Description: CS Claystone Dark Gray			Invoice Number: 23004
Test Type: as received			Deflection Rate, in/min: 0.0350
Initial Dry Density, pcf: 132.4	**Maximum Compressive strength, ksf:**	**160.3**	**Strain at Failure, %: 1.63**
Initial Moisture Content, %: 8.7	**Maximum Shear strength, ksf:**		
1557 Maximum Dry Density,pcf:			Relative Compaction, %:
1557 Optimum Moisture Content, %:			Compacted Moisture Content, %:

Stress vs Strain



Initial Data		Final Data	
Sample wt, grams:	874.4	Tare ID:	824
Dia., inches:	2.381	Wet Samp. Tare wt,g:	984.3
Height, inches:	5.201	Dry Samp tare wt,g:	914.7
Init. Area. ft^2:	0.0309	Tare wt, g:	110.9
Init Vol. ft^3:	0.0134	init γ_{wet}, pcf:	143.9

Sketch of Failure



Did not Fail exceeded load cell

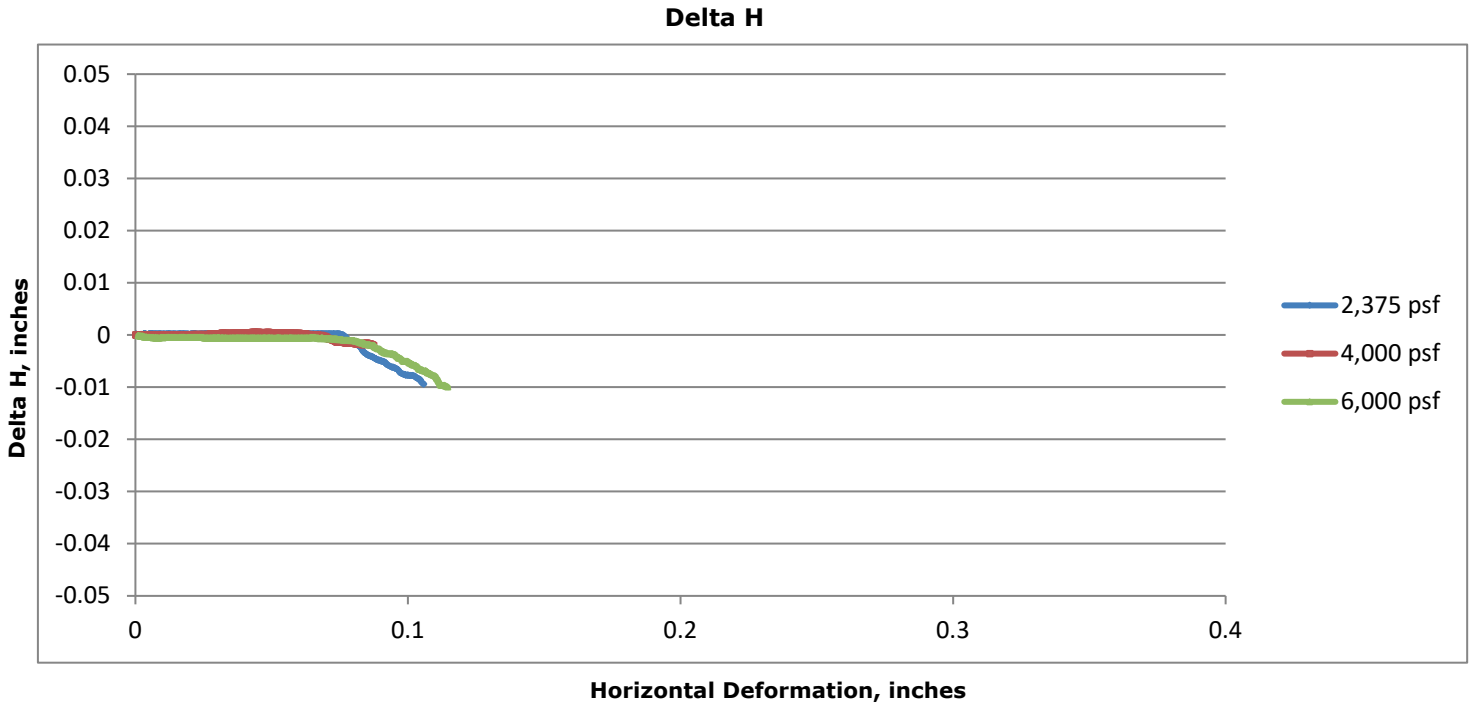
Tested By: gs

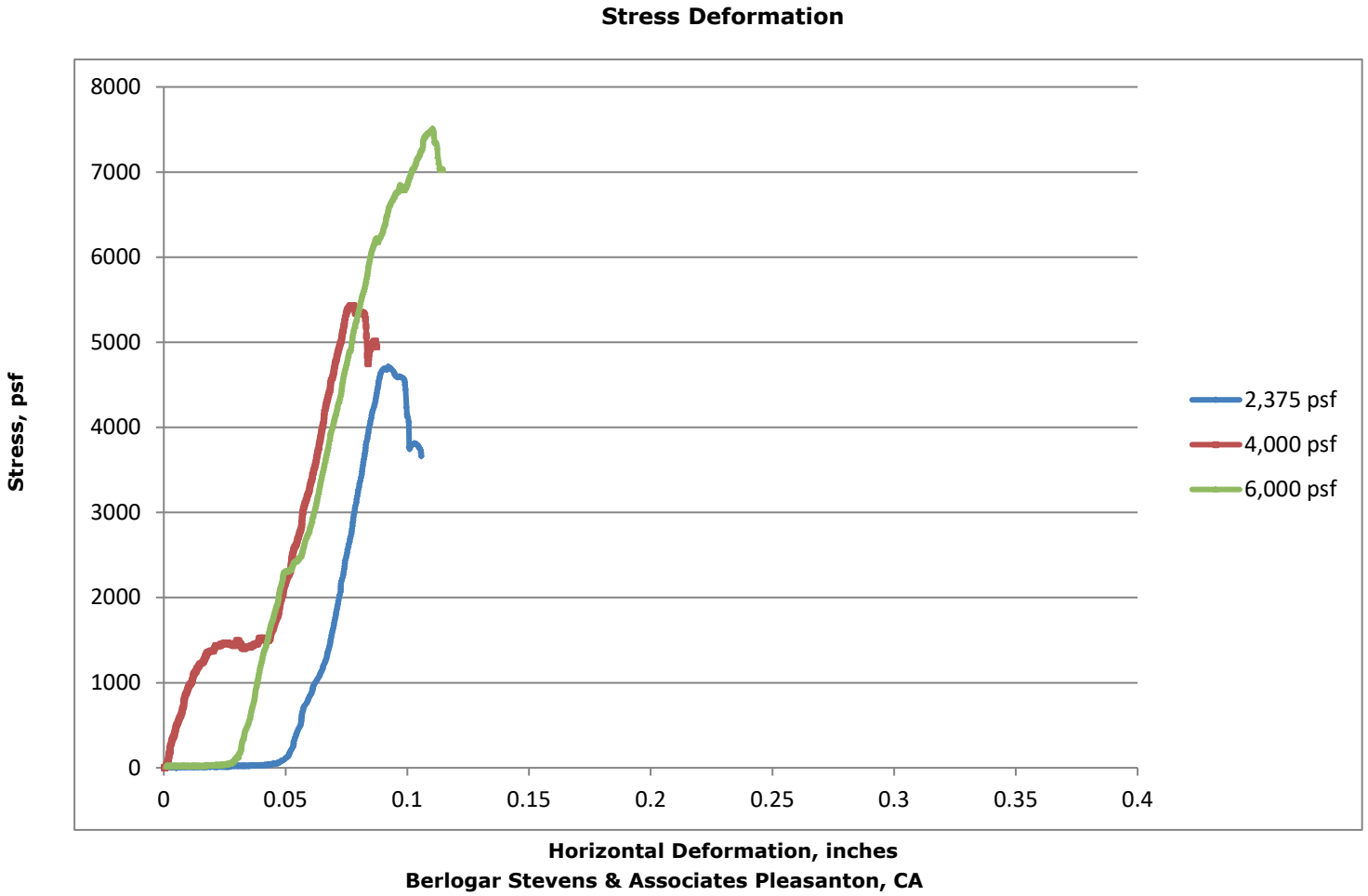
Reported By: G Suckow

Berlogar Stevens & Associates Pleasanton, CA

Direct Shear Graphs ASTM D-3080

Project Name: Sandhill Turbine 22	**Project Number: 4245.200**
Sample ID: B1 at 20-1/2ft	Date Tested: 01/10/23
Material Description: CS Clayestone Light Orange Brown	Invoice Number: 23003





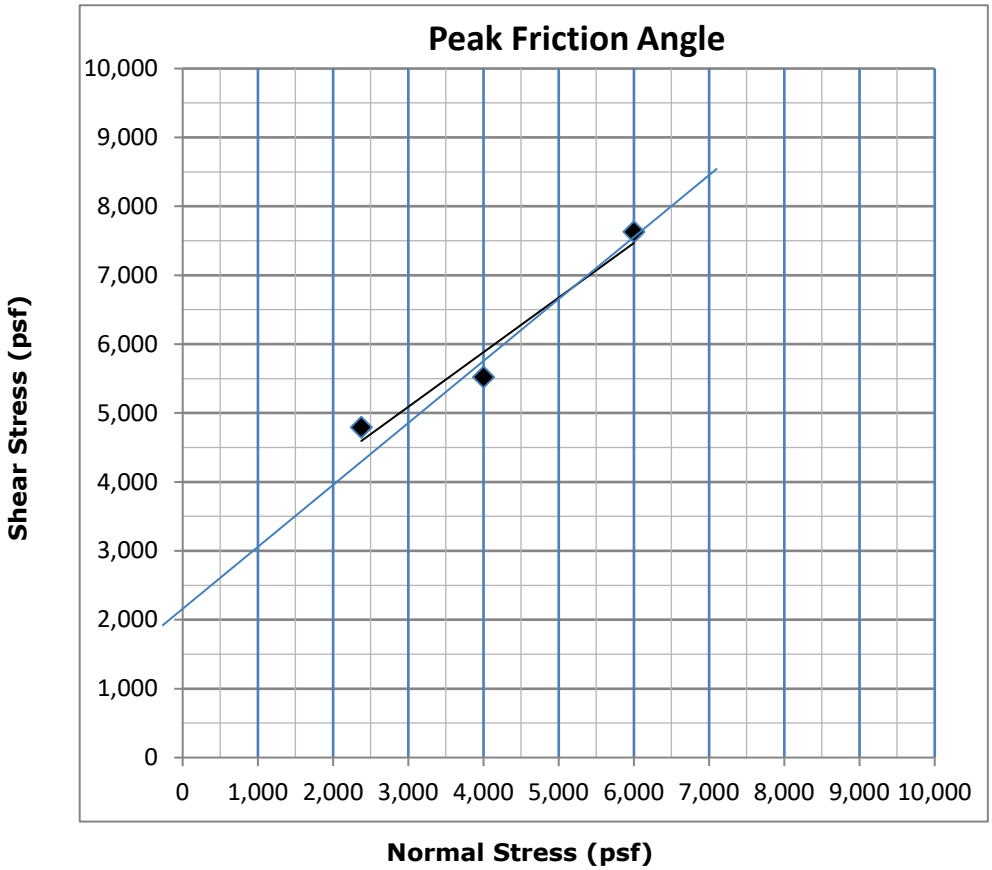
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 22**	**Project Number:**	**4245.200**
Sample ID:	B1 at 20-1/2ft	Date Tested:	01/10/23
Material Description:	CS Clayestone Light Orange Brown	Invoice Number:	23003
Sample Type:	as received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**2,375**	**4,000**	**6,000**	
Peak Shear Stress, psf:	**4,794**	**5,523**	**7,630**	
Initial Dry Density, pcf:	**116.9**	**118.1**	**118.9**	
Initial Moisture Content, %:	**13.4**	**13.4**	**13.4**	
Final Moisture Content, %:	**18.0**	**16.1**	**15.3**	
Peak Cohesion, **(C')**, psf:	**2,000.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**42.5**

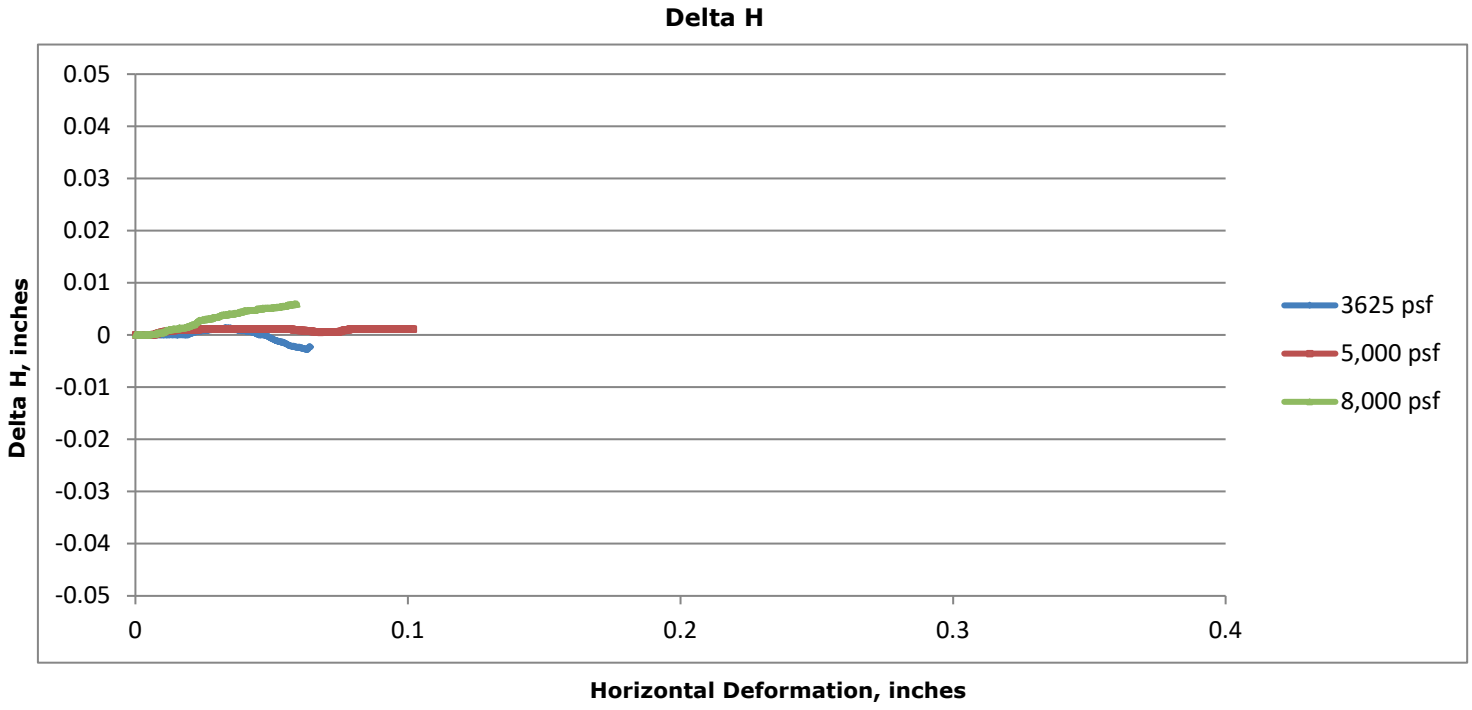
Graph of Shear Stress vs Normal Stress

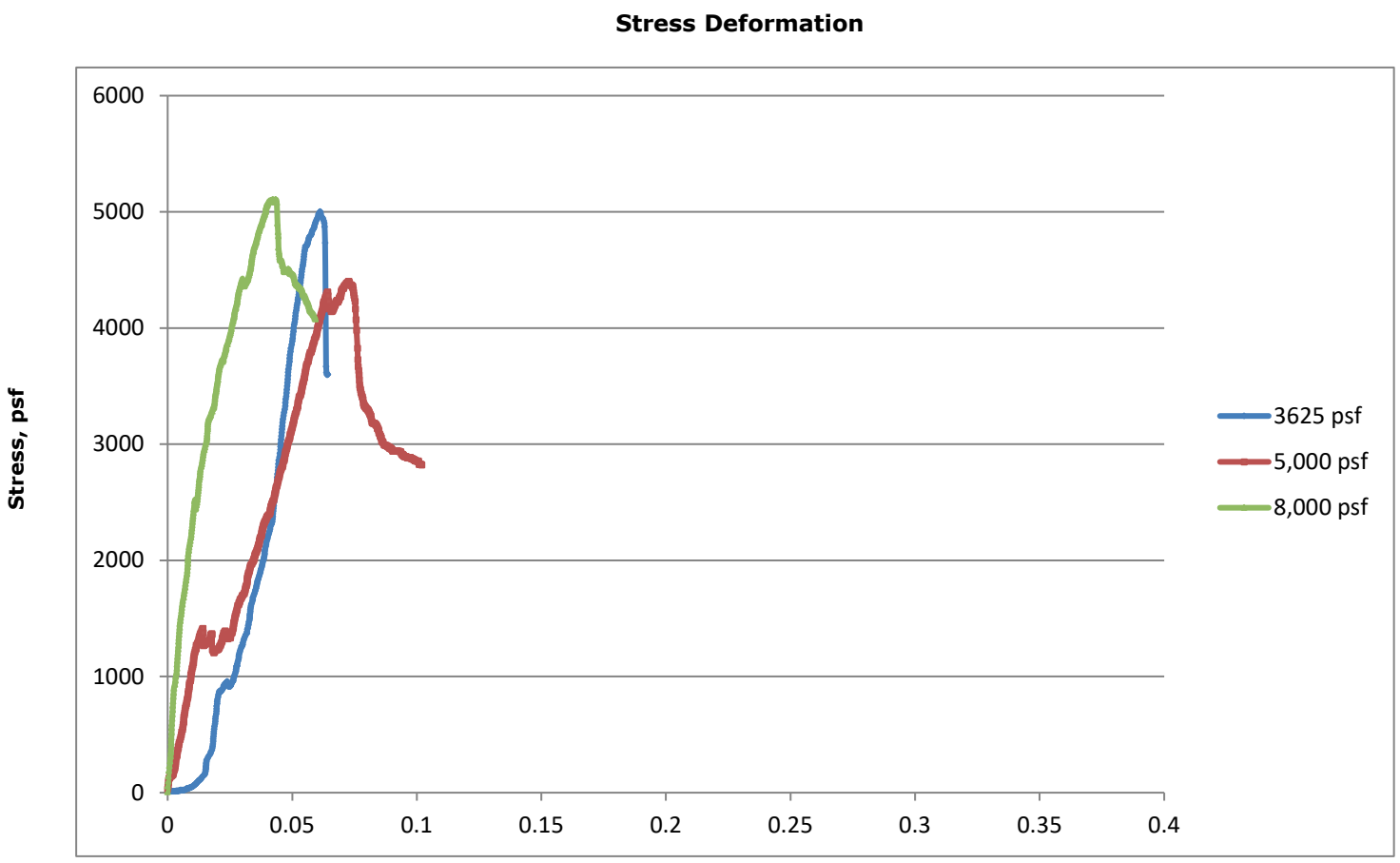


Berlogar Stevens & Associates Pleasanton, CA

Direct Shear Graphs ASTM D-3080

Project Name: Sandhill Turbine 22	**Project Number: 4245.200**
Sample ID: B1 at 29-1/2ft	Date Tested: 01/10/23
Material Description: CS Sandy Claystone Yellow Brown	Invoice Number: 23003





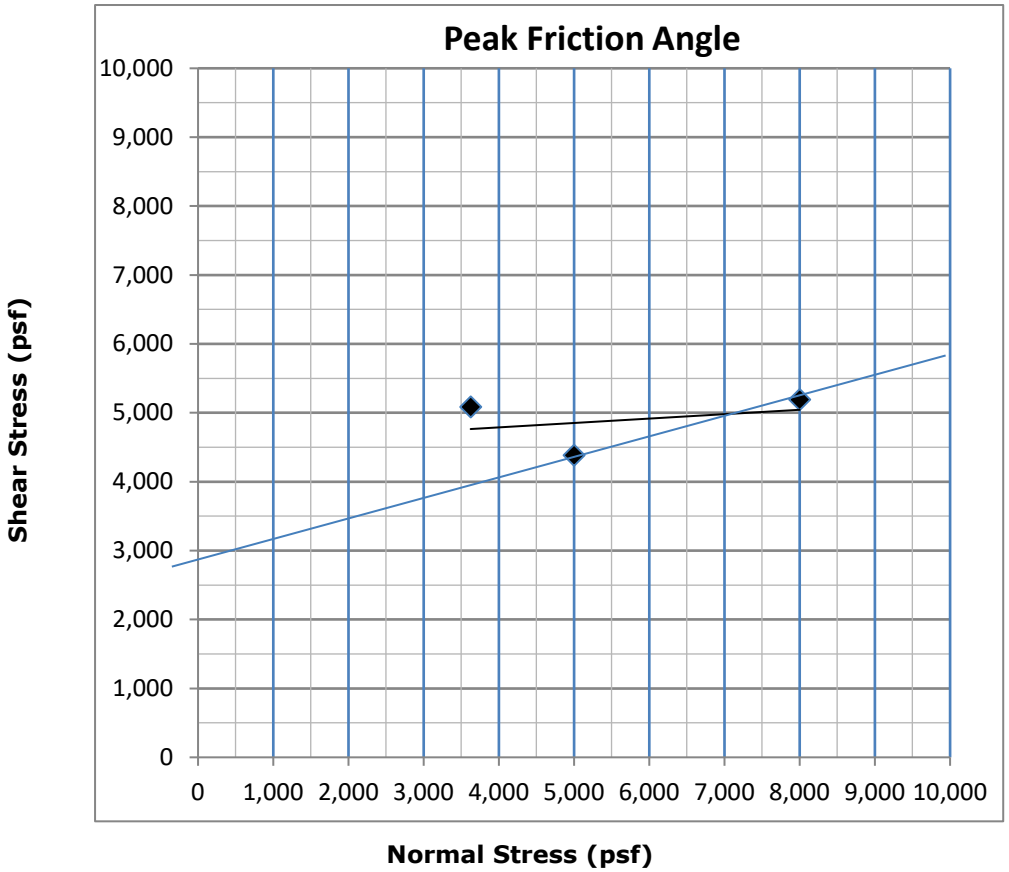
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 22**	**Project Number:**	**4245.200**
Sample ID:	B1 at 29-1/2ft	Date Tested:	01/10/23
Material Description:	CS Sandy Claystone Yellow Brown	Invoice Number:	23003
Sample Type:	As received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**3,625**	**5,000**	**8,000**	
Peak Shear Stress, psf:	**5,087**	**4,383**	**5,192**	
Initial Dry Density, pcf:	**114.8**	**113.6**	**107.6**	
Initial Moisture Content, %:	**14.5**	**14.5**	**14.5**	
Final Moisture Content, %:	**19.4**	**17.8**	**19.1**	
Peak Cohesion, **(C')**, psf:	**2,900.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**16.1**

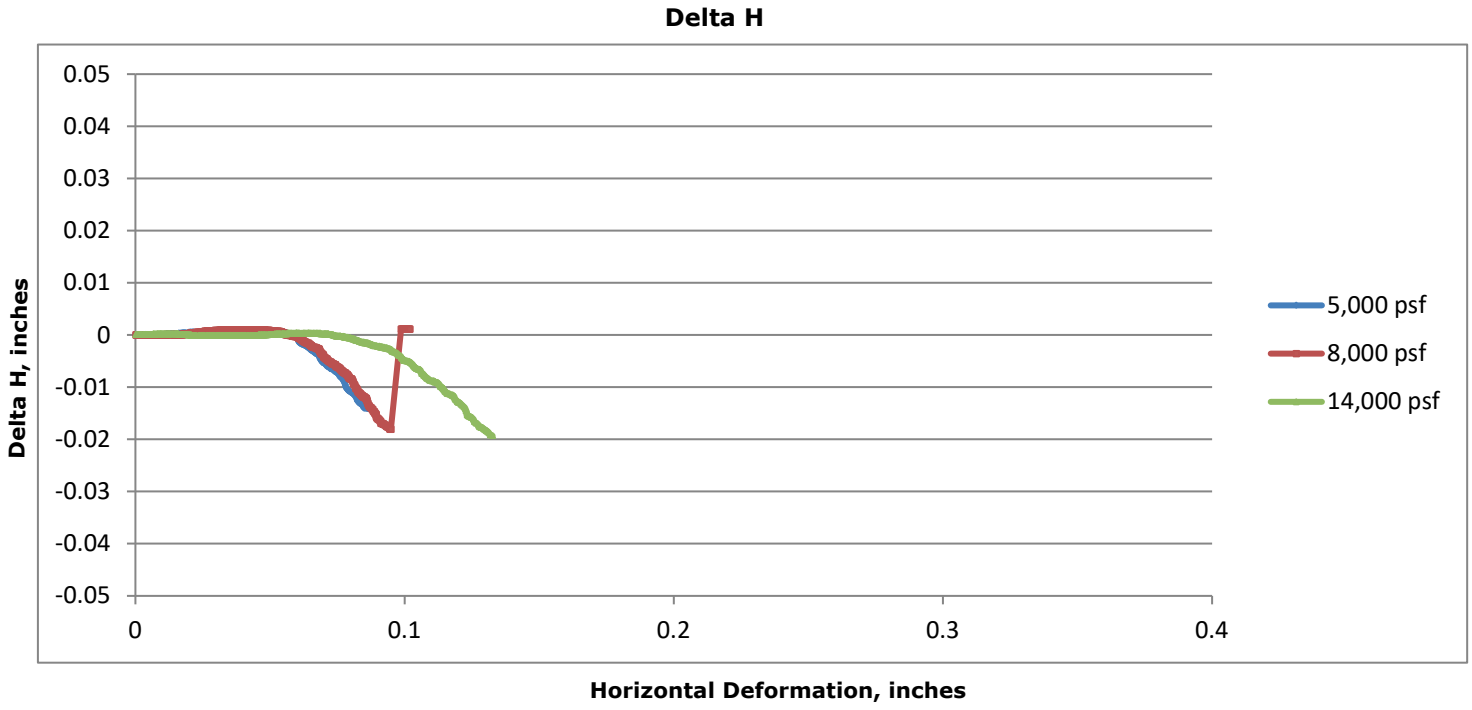
Graph of Shear Stress vs Normal Stress

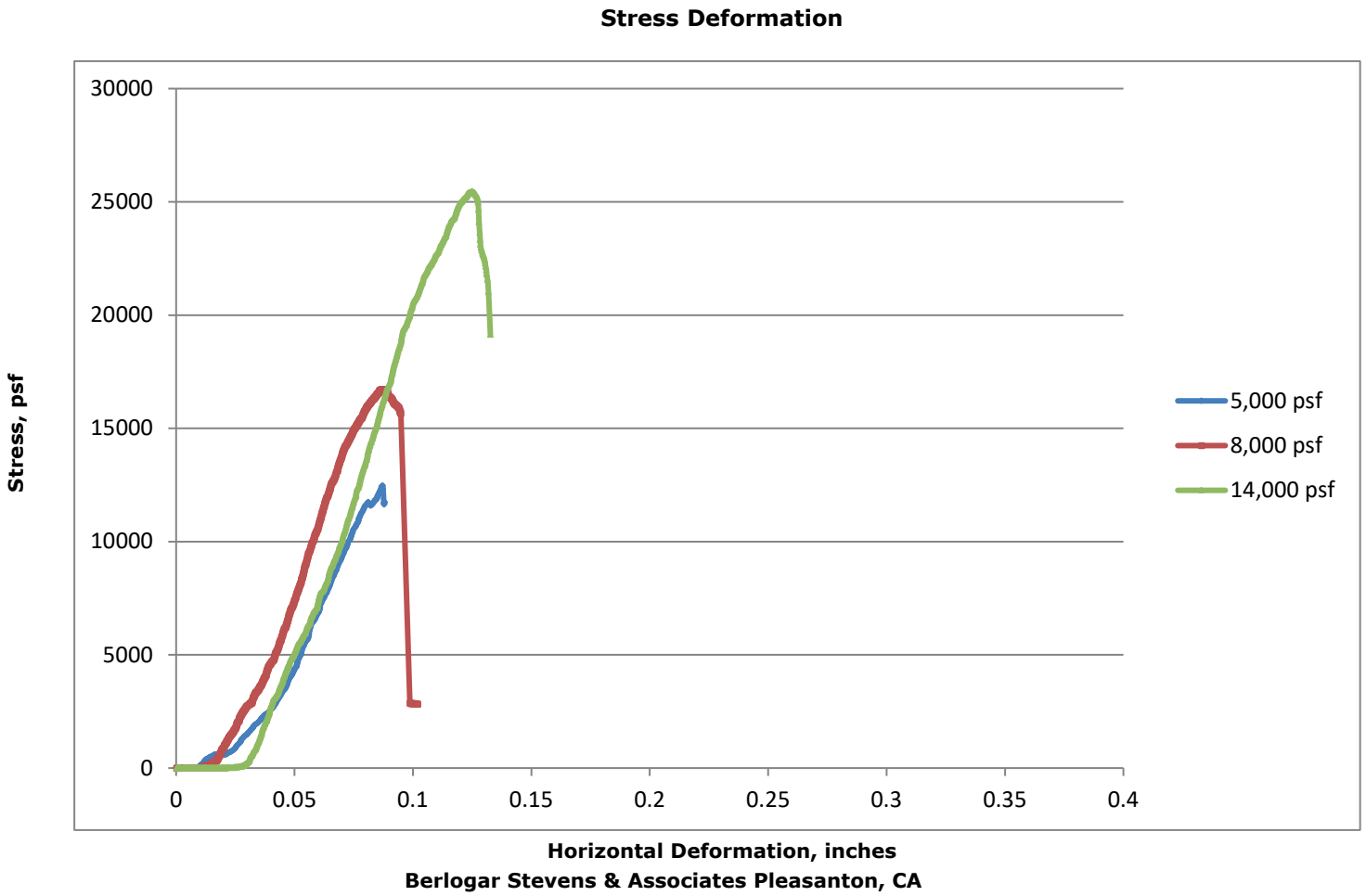


Berlogar Stevens & Associates Pleasanton, CA

Direct Shear Graphs ASTM D-3080

Project Name: Sandhill Turbine 22	**Project Number: 4245.200**
Sample ID: B1 at 53ft	Date Tested: 01/12/23
Material Description: CS Claystone Light Brown	Invoice Number: 23003





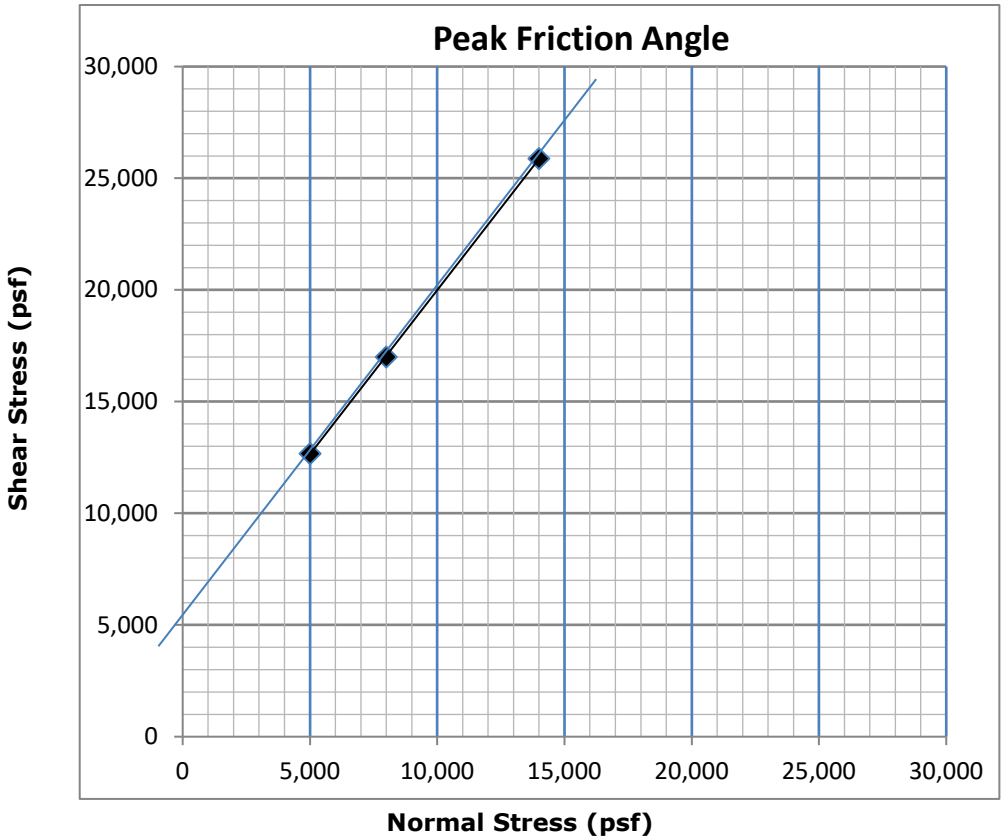
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 22**	**Project Number:**	**4245.200**
Sample ID:	B1 at 53ft	Date Tested:	01/12/23
Material Description:	CS Claystone Light Brown	Invoice Number:	23003
Sample Type:	As received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**5,000**	**8,000**	**14,000**	
Peak Shear Stress, psf:	**12,675**	**17,004**	**25,885**	
Initial Dry Density, pcf:	**127.1**	**126.2**	**128.6**	
Initial Moisture Content, %:	**8.6**	**8.6**	**8.6**	
Final Moisture Content, %:	**13.5**	**12.0**	**10.9**	
Peak Cohesion, **(C')**, psf:	**5,000.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**53.1**

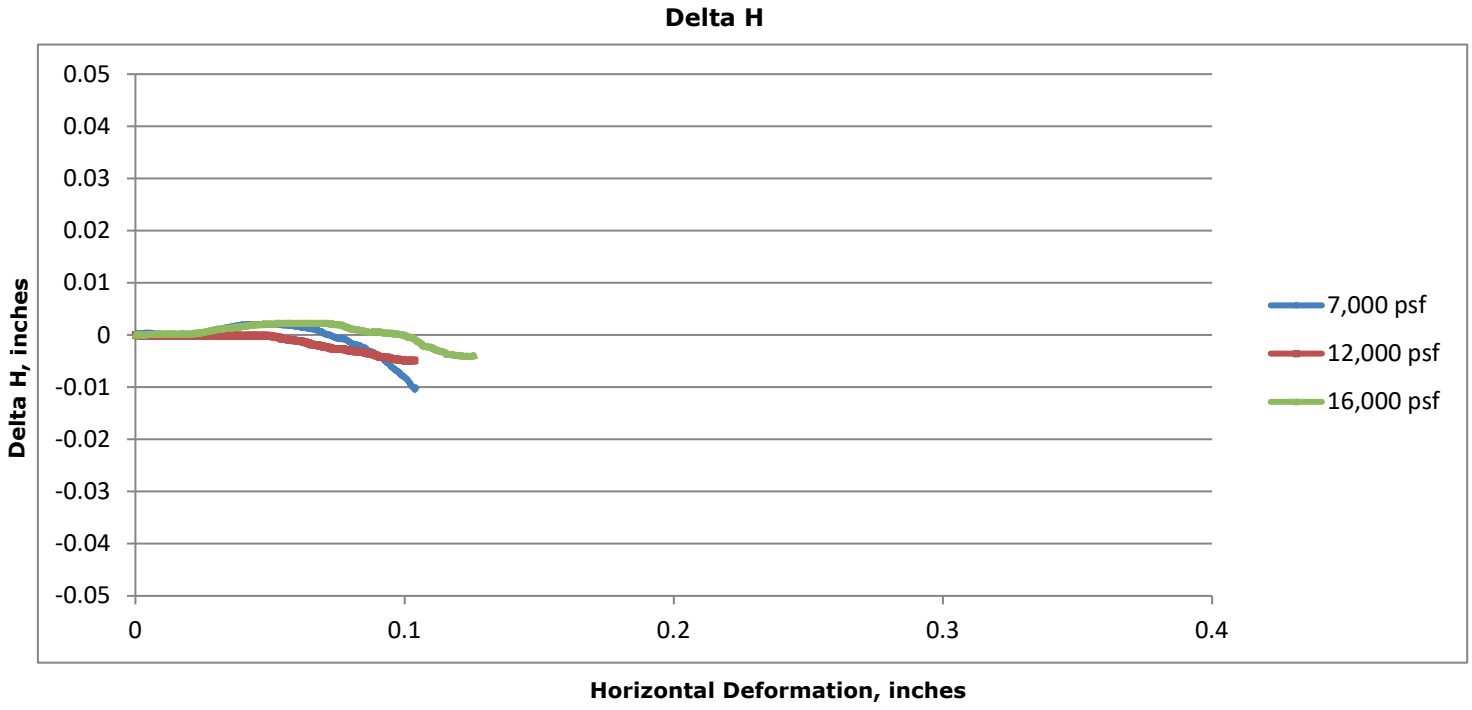
Graph of Shear Stress vs Normal Stress

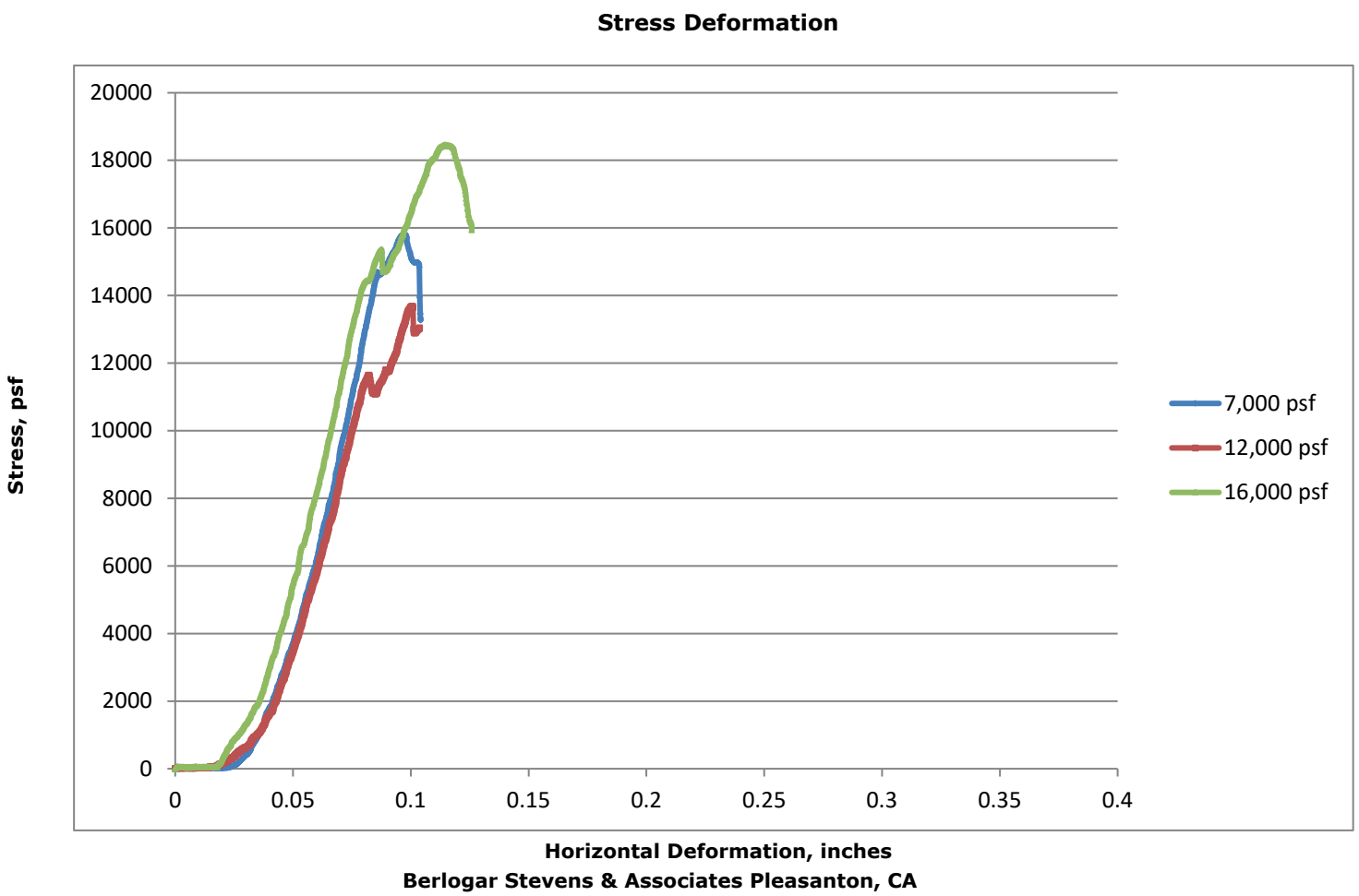


Berlogar Stevens & Associates Pleasanton, CA

Direct Shear Graphs ASTM D-3080

Project Name: Sandhill Turbine 22	**Project Number: 4245.200**
Sample ID: B1 at 64ft	Date Tested: 01/12/23
Material Description: CS Claystone Light Orange Brown	Invoice Number: 23003





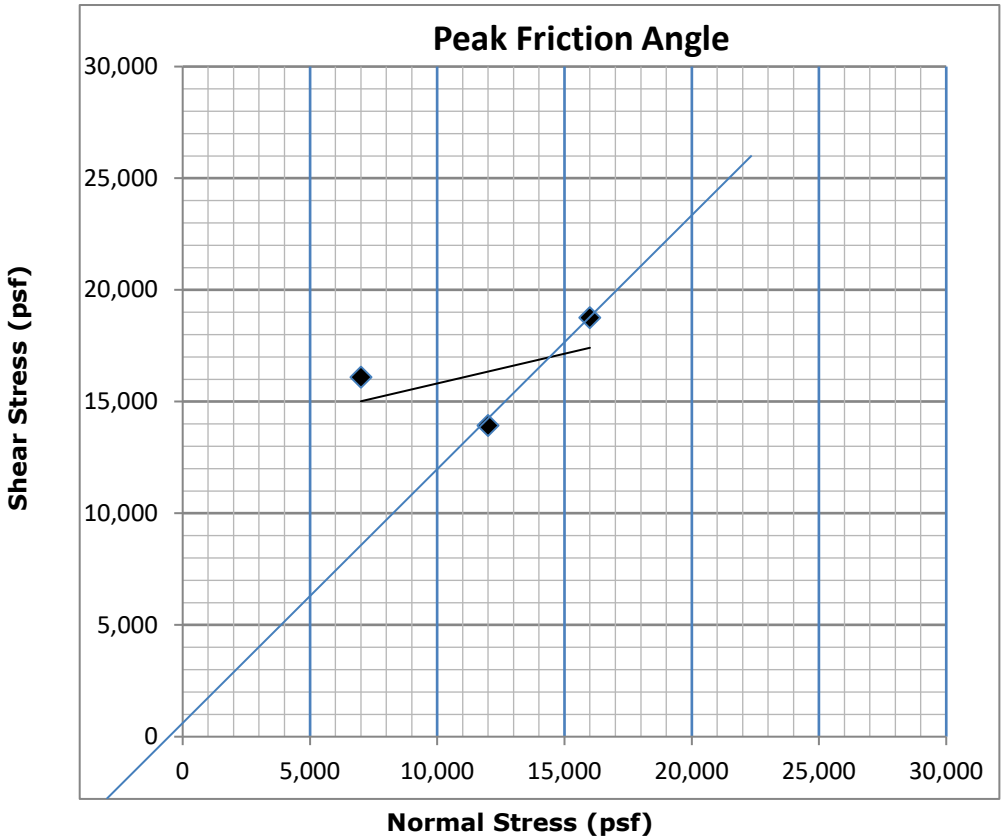
Direct Shear Worksheet ASTM D-3080

Project Name:	**Sandhill Turbine 22**	**Project Number:**	**4245.200**
Sample ID:	B1 at 64ft	Date Tested:	01/12/23
Material Description:	CS Claystone Light Orange Brown	Invoice Number:	23003
Sample Type:	As received	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	0.0	Minimum Required Compaction, %:	0.0
Optimum Moisture Content, %:	0.0	Minimum Compacted Moisture Content, %:	0.0

Summary of Results

Normal Stress, psf:	**7,000**	**12,000**	**16,000**	
Peak Shear Stress, psf:	**16,091**	**13,926**	**18,755**	
Initial Dry Density, pcf:	**128.7**	**130.1**	**126.0**	
Initial Moisture Content, %:	**10.0**	**10.0**	**10.0**	
Final Moisture Content, %:	**12.0**	**12.6**	**12.7**	
Peak Cohesion, **(C')**, psf:	**0.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**49.0**

Graph of Shear Stress vs Normal Stress



Berlogar Stevens & Associates Pleasanton, CA

Berlogar Stevens & Associates
Lab Summary Sheet

Project Name: Rooney Sand Hill	**Project Number:** 4245.200
Client:	Date Completed: 2/23/2023
Attention:	Date Delivered: 2/17/2023
Sample ID: TP5 at 0-3ft	Invoice Number: 23022
Sample Descrption: CL Lean Clay with Sand Brown	Reported By: G Suckow

Hydrometer ASTM D422

US	Metric, mm	% Passing	Spec
3"	75.0		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.17		
#30	0.600		
#40	0.500		
#50	0.300		
#100	0.150		
#200	0.075		
	0.055		
	0.037		
	0.019		
	0.009		
	0.005		
	0.002		
	0.001		

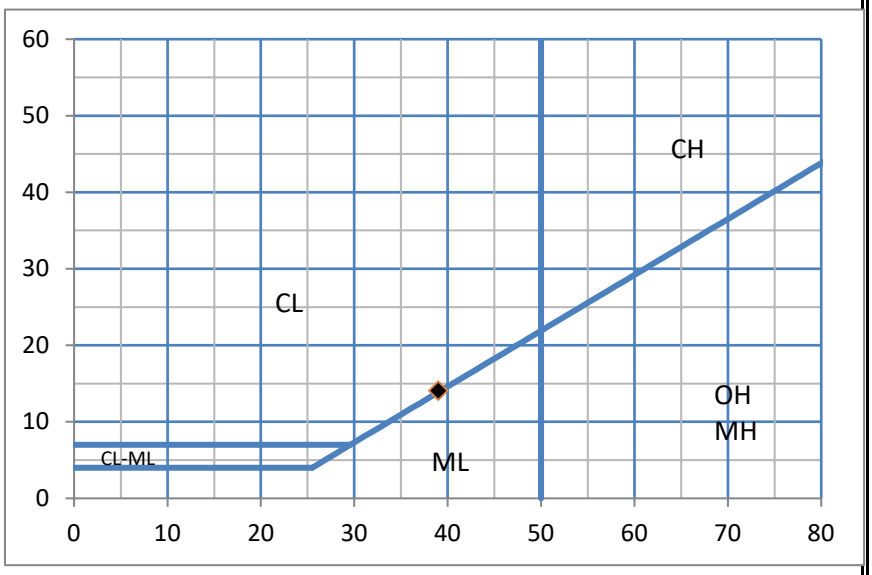
ASTM C117 200 Wash

	Spec
Percent Passing #200:	

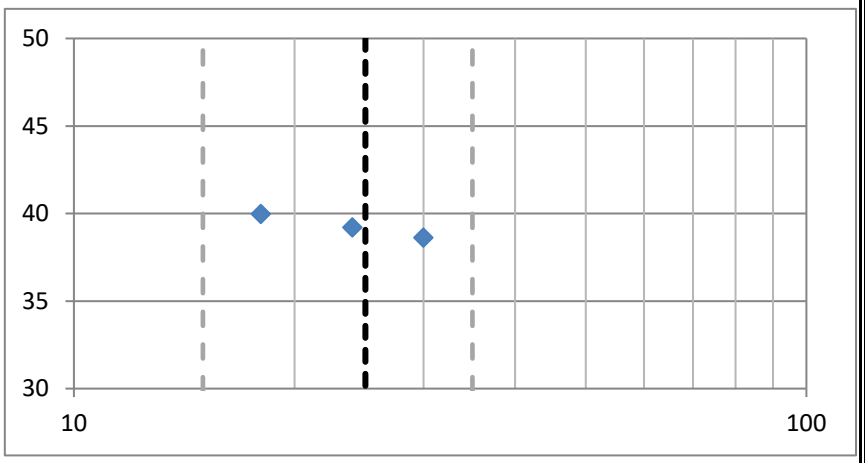
Atterberg Limit ASTM D4318

	Spec.
Plasticity Index	**14**
Liquid Limit	39
Plastic Limit	25
Minus 40 Classification	CL Lean Clay

Liquid Limit (LL) vs Plasticity Chart



Flow Curve



Berlogar Stevens & Associates
ASTM Test Summary

Project Name:	**Rooney- Sand Hill**	**Project Number:**	**4245.200**
Client:		Date Reported:	02/17/23
Attention:		Date Received:	02/16/23
Sample ID:	**TP5 at 3.5 to 6ft**	**Invoice Number:**	**23022**
Material Description:	CS Claystone Olive Brown	Reported By:	G Suckow

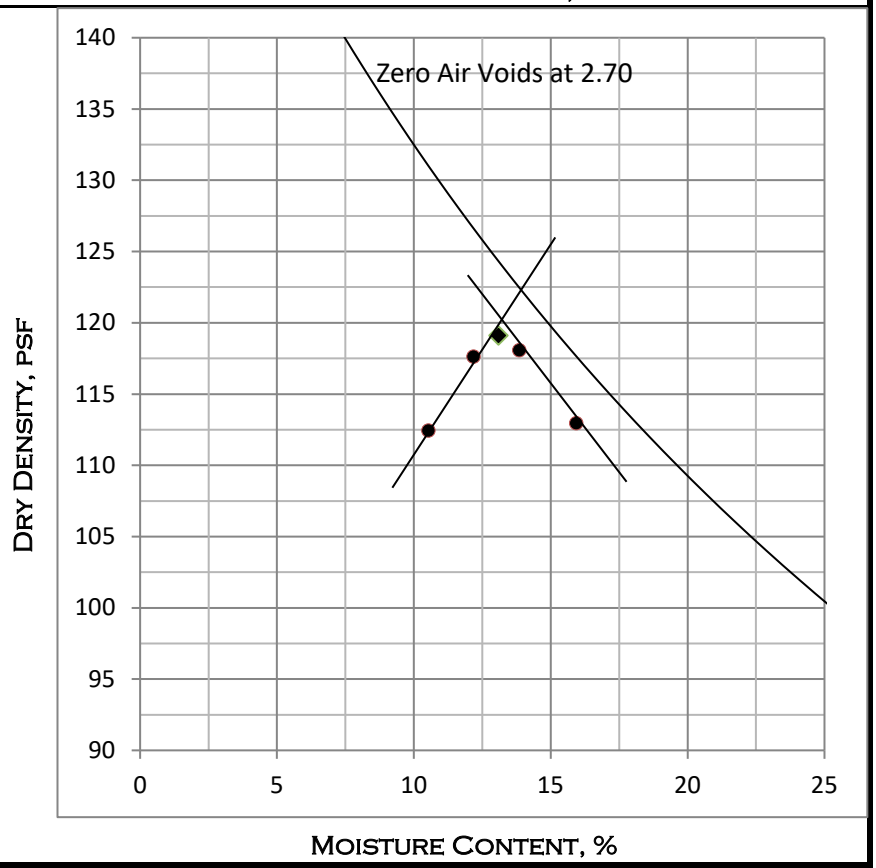
Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
1/4"	6.3		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.18		
#30	0.600		
#40	0.425		
#50	0.300		
#100	0.150		
#200	0.075		

ASTM D1557B Moisture Density Relationship

Maximum Dry Density, pcf: 119.1

Optimum Mosture Content, %: 13.1



Coarse and Fine Quality Tests

D-3744 Coarse Durability:	
D-3744 Fine Durability:	
D-2419 Sand Equivalency:	
D-2844 R Value at 300psi:	
R Value Expansion Press at 300 psi:	
CTM-227 Cleanliness Value:	

Fine Material Tests

ASTM D-4318 Liquid Limit:	Specification:
ASTM D-4318 Plastic Limit:	Specification:
ASTM D-4318 Plasticity Index:	Specification:
-40 Soil Classification:	
D-4829 Expansion Index $(EI)_{50\%}$:	Specification:
D-4829 Expansion Potential:	Specification:
Caltrans CTM216 Maximum Wet Density,g/cc:	

Comments:

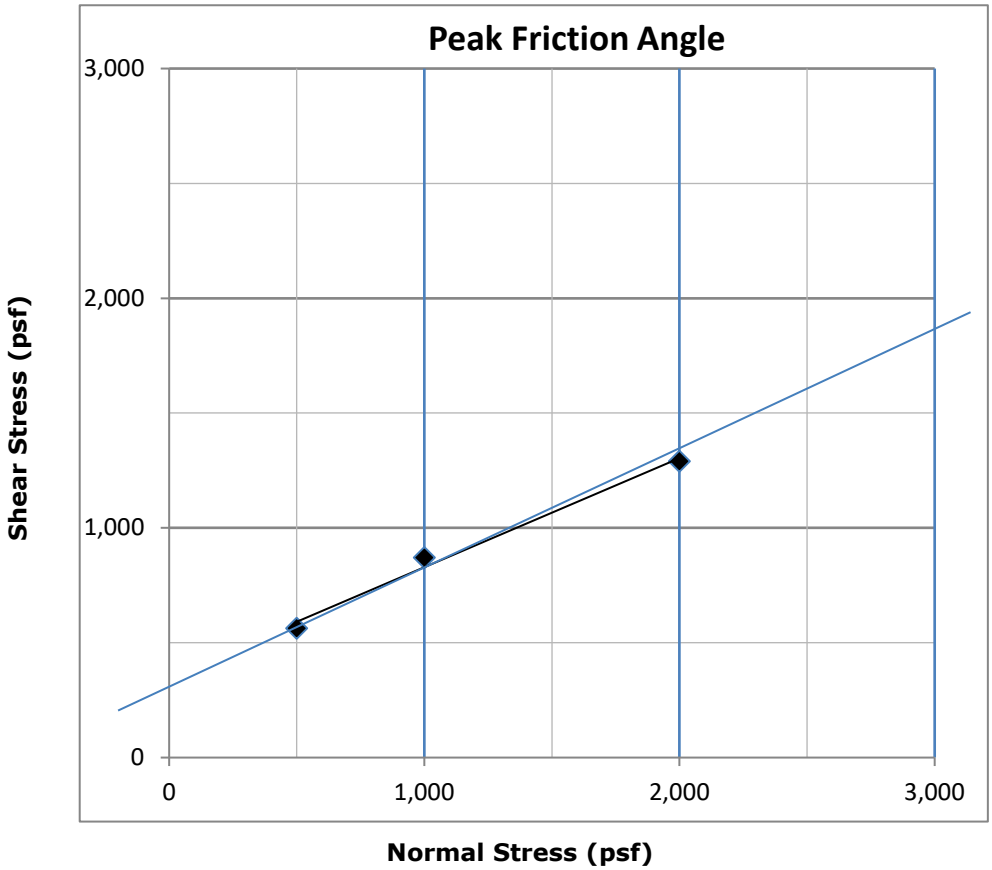
Direct Shear Worksheet ASTM D-3080

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Sample ID:	TP5 at 3.5 to 6ft	Date Tested:	02/18/23
Material Description:	CS Claystone Olive Brown	Invoice Number:	23022
Sample Type:	Remolded	Test Type: CD	Shear Rate, inches/min.: 0.00110
Maximum Dry Density, pcf:	119.1	Minimum Required Compaction, %:	90.0
Optimum Moisture Content, %:	13.1	Minimum Compacted Moisture Content, %:	15.5

Summary of Results

Normal Stress, psf:	**500**	**1,000**	**2,000**	
Peak Shear Stress, psf:	**564**	**870**	**1,290**	
Initial Dry Density, pcf:	**107.1**	**107.8**	**107.9**	
Initial Moisture Content, %:	**15.6**	**15.6**	**15.6**	
Final Moisture Content, %:	**22.9**	**22.1**	**21.7**	
Peak Cohesion, **(C')**, psf:	**300.0**	Peak Friction Angle, **(Φ'_{peak})**, Degrees:		**27.0**

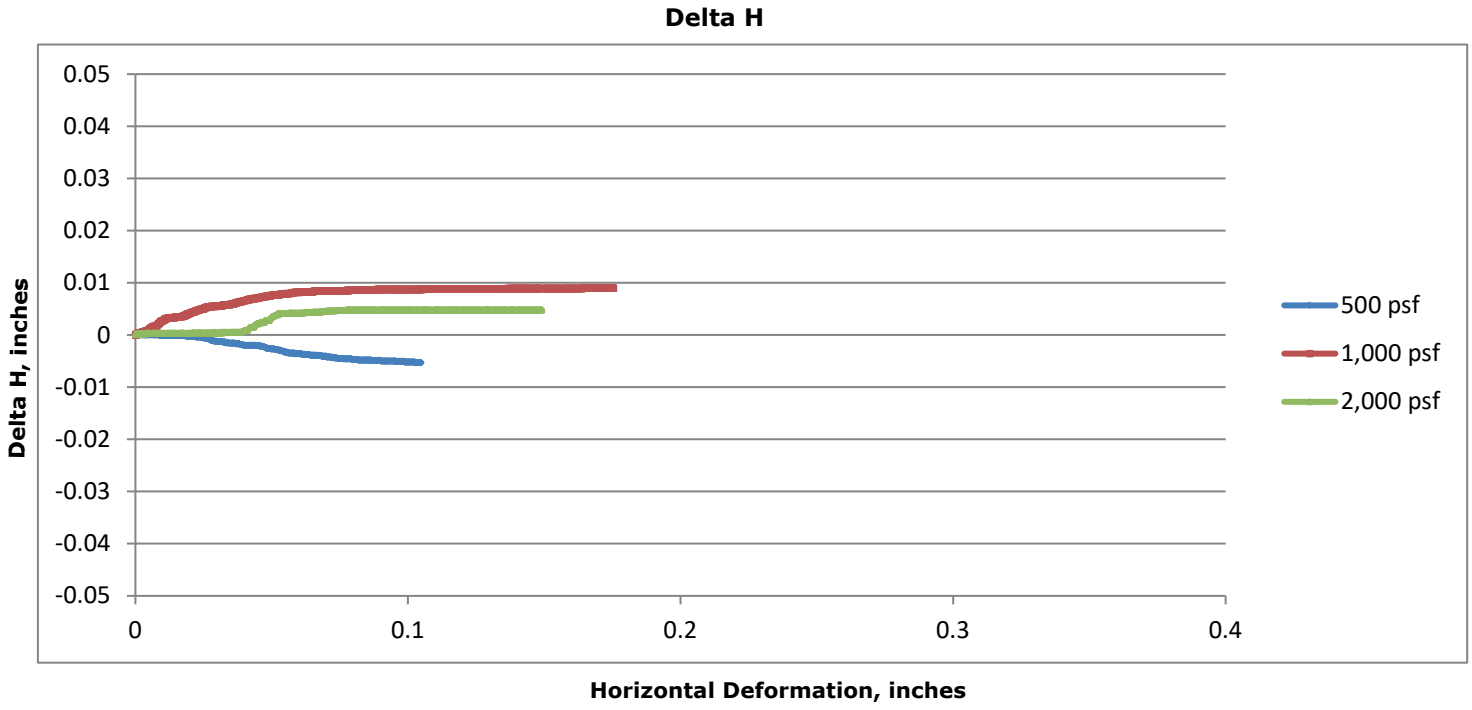
Graph of Shear Stress vs Normal Stress

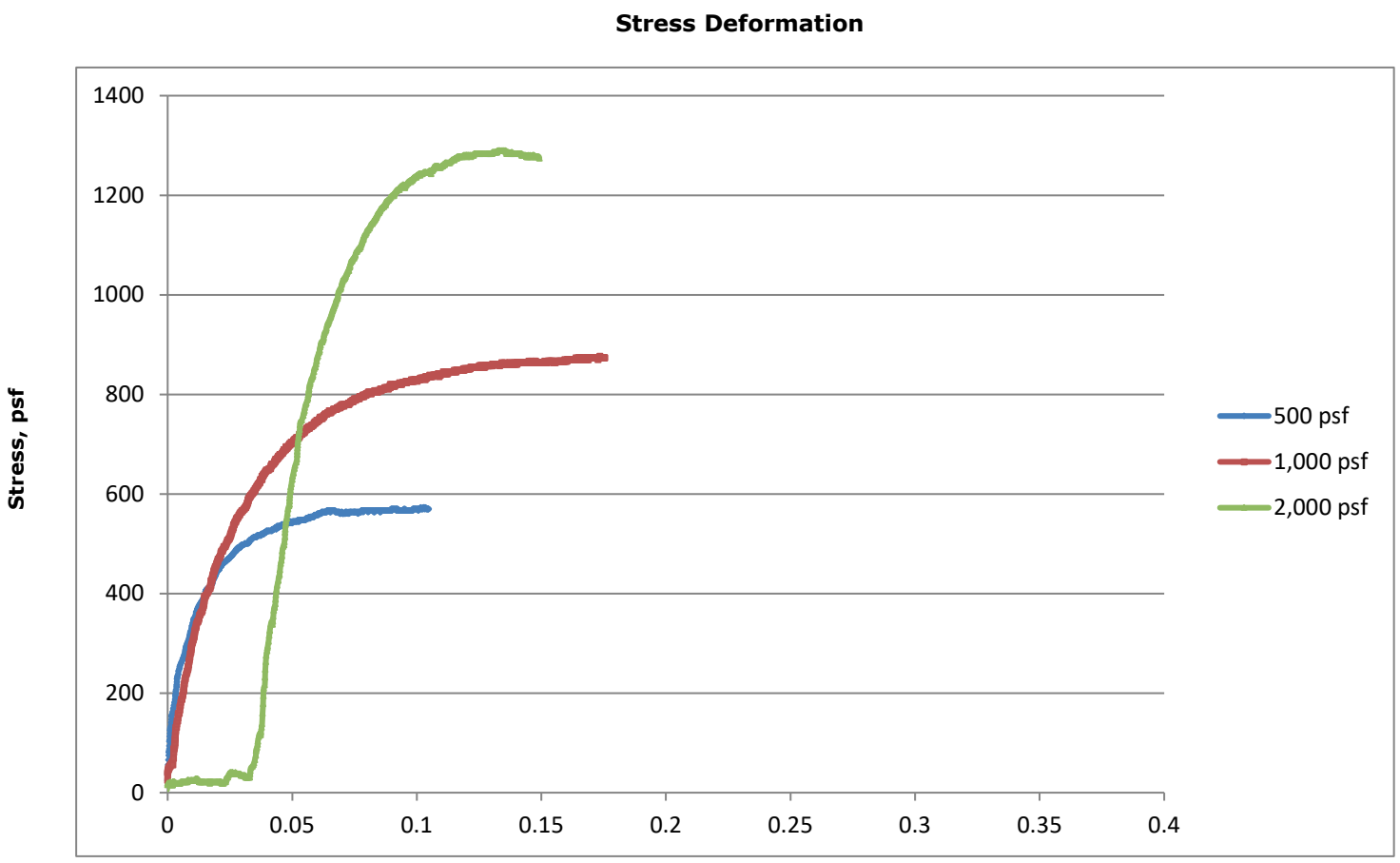


Berlogar Stevens & Associates Pleasanton, CA

Direct Shear Graphs ASTM D-3080

Project Name: Rooney Sand Hill	**Project Number: 4245.200**
Sample ID: TP5 at 3.5 to 6ft	Date Tested: 02/18/23
Material Description: CS Claystone Olive Brown	Invoice Number: 23022





Berlogar Stevens & Associates
Lab Summary Sheet

Project Name: Rooney Sand Hill	**Project Number:** 4245.200
Client:	Date Completed: 2/23/2023
Attention:	Date Delivered: 2/17/2023
Sample ID: TP6 at 0-5ft	Invoice Number: 23022
Sample Descrption: CL Lean Clay with Sand Dark Brown	Reported By: G Suckow

Hydrometer ASTM D422

US	Metric, mm	% Passing	Spec
3"	75.0		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.17		
#30	0.600		
#40	0.500		
#50	0.300		
#100	0.150		
#200	0.075		
	0.055		
	0.037		
	0.019		
	0.009		
	0.005		
	0.002		
	0.001		

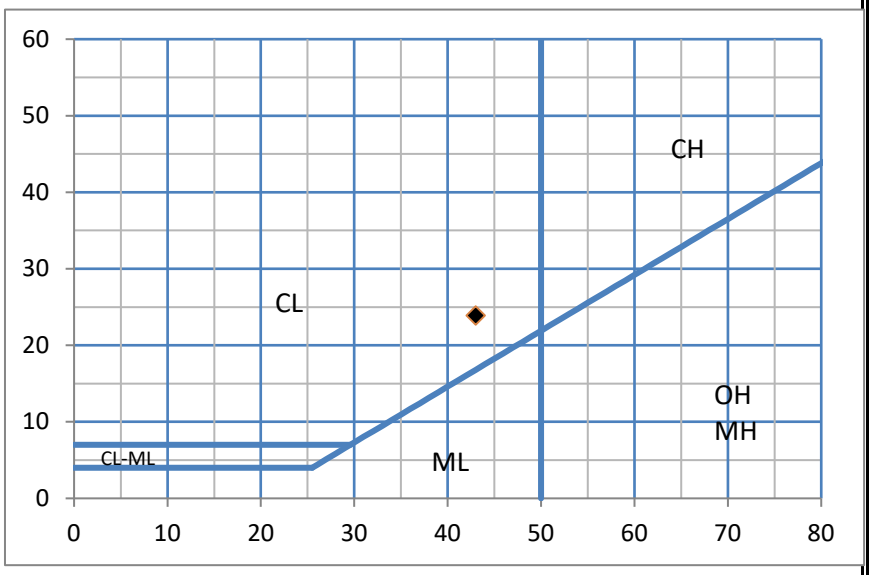
ASTM C117 200 Wash

	Spec
Percent Passing #200:	

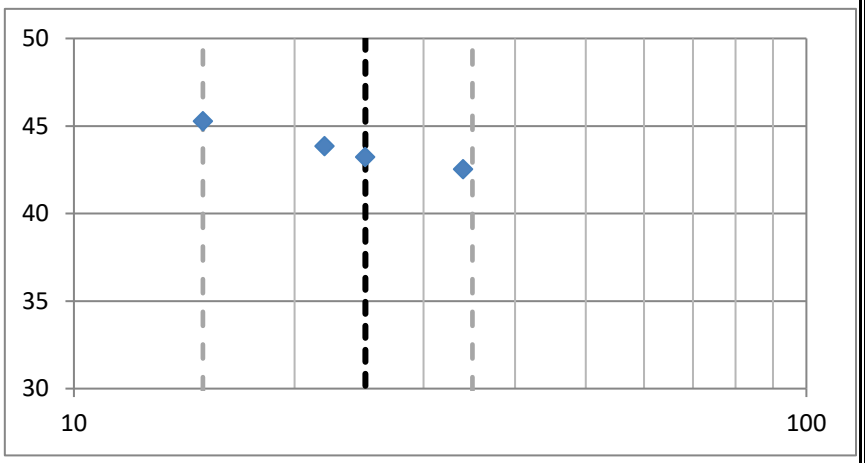
Atterberg Limit ASTM D4318

	Spec.
Plasticity Index	**24**
Liquid Limit	43
Plastic Limit	19
Minus 40 Classification	CL Lean Clay

Liquid Limit (LL) vs Plasticity Chart



Flow Curve



Berlogar Stevens & Associates
ASTM Test Summary

Project Name:	**Rooney- Sand Hill**	**Project Number:**	**4245.200**
Client:		Date Reported:	02/17/23
Attention:		Date Received:	02/16/23
Sample ID:	**TP6 0 to 5ft**	**Invoice Number:**	**23022**
Material Description:	Silty Clay Dark Brown	Reported By:	G Suckow

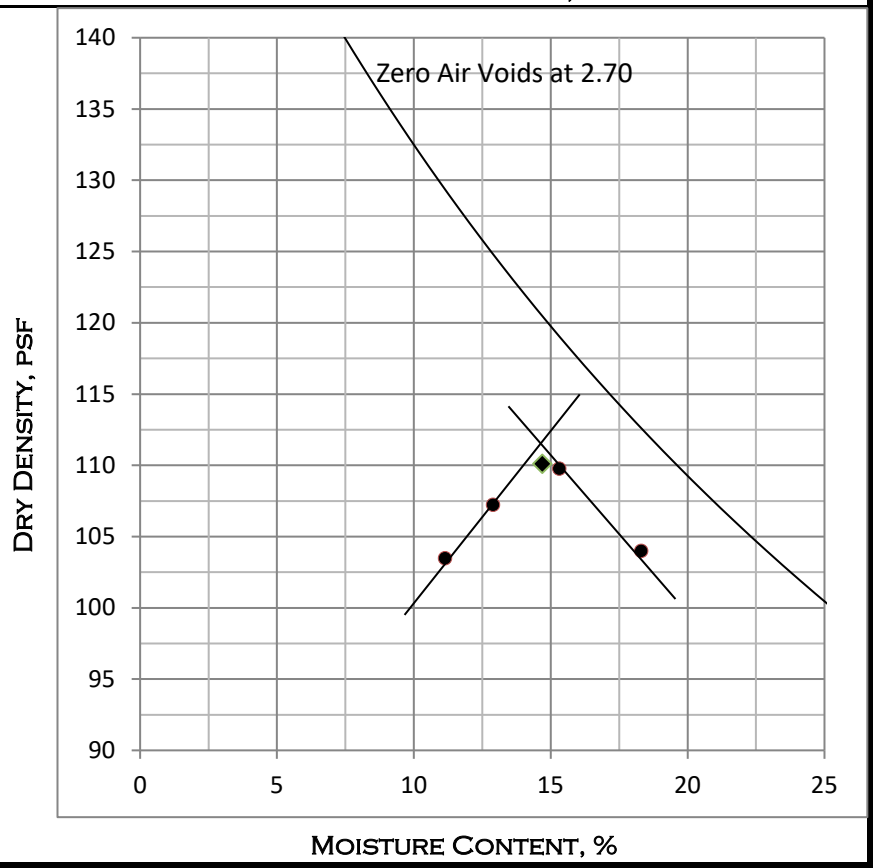
Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
1/4"	6.3		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.18		
#30	0.600		
#40	0.425		
#50	0.300		
#100	0.150		
#200	0.075		

ASTM D1557B Moisture Density Relationship

Maximum Dry Density, pcf: 110.1

Optimum Mosture Content, %: 14.7



Coarse and Fine Quality Tests	Fine Material Tests	
	ASTM D-4318 Liquid Limit:	Specification:
D-3744 Coarse Durability:	ASTM D-4318 Plastic Limit:	Specification:
D-3744 Fine Durability:	ASTM D-4318 Plasticity Index:	Specification:
D-2419 Sand Equivalency:	-40 Soil Classification:	
D-2844 R Value at 300psi:	D-4829 Expansion Index $(EI)_{50\%}$:	Specification:
R Value Expansion Press at 300 psi:	D-4829 Expansion Potential:	Specification:
CTM-227 Cleanliness Value:	Caltrans CTM216 Maximum Wet Density,g/cc:	

Comments:

APPENDIX I

Geothermal Resistivity and Related Compaction Test

21239 FM529 Rd., Bldg. F
Cypress, TX 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
http://www.geothermusa.com

April 10, 2023

Berlogar
1220 Quarry Lane Suite C
Pleasanton, CA 94566
Attn: Abbas Abdollahi

Re: Thermal Analysis of Native Soil Samples
Rooney / Sand Hill – Livermore, CA (Project No. 4245.200)

The following is the report of thermal dryout characterization tests conducted on the two (2) tube samples of native soil from the referenced project sent to our laboratory.

Thermal Resistivity Tests: The tube samples were tested 'as received'. The tests were conducted in accordance with the IEEE standard 442-2017. The results are tabulated below and the thermal dryout curves are presented in **Figures 1 and 2.**

Sample ID, Description, Thermal Resistivity, Moisture Content and Density

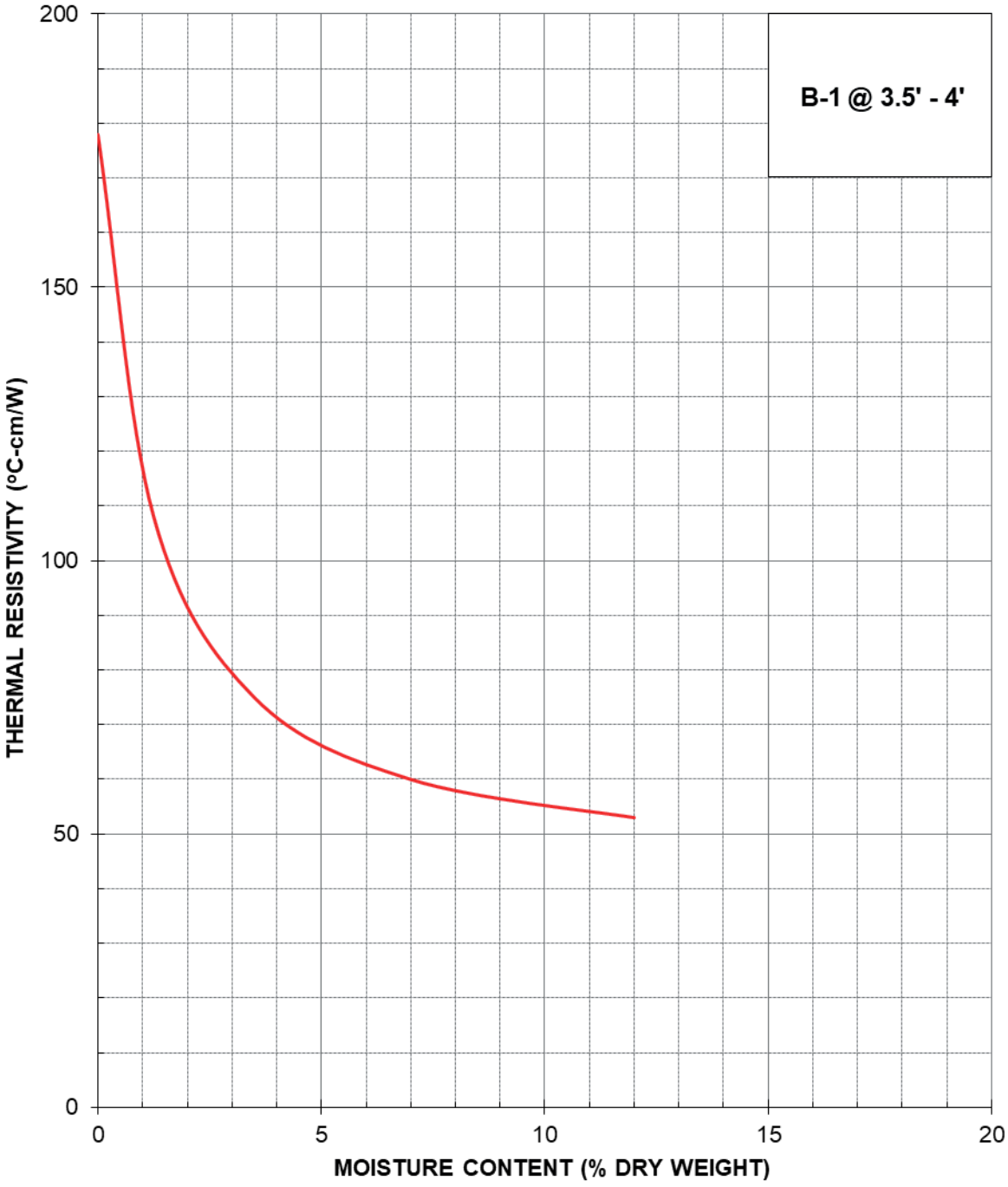
Sample ID	Depth (ft)	Description (Berlogar)	Thermal Resistivity (°C-cm/W)		Moisture Content (%)	Dry Density (lb/ft^3)
			Wet	Dry		
B-1	3.5-4	Claystone, olive brown Highly weathered	53	170	12	114
B-4	4-4.5	Silty clayey sand, brown	60	189	16	114

Comments: The thermal characteristic depicted in the dryout curves apply for the soils at their respective test dry density.

Please contact us if you have any questions or if we can be of further assistance.

Geotherm USA
Nimesh Patel

THERMAL DRYOUT CURVE



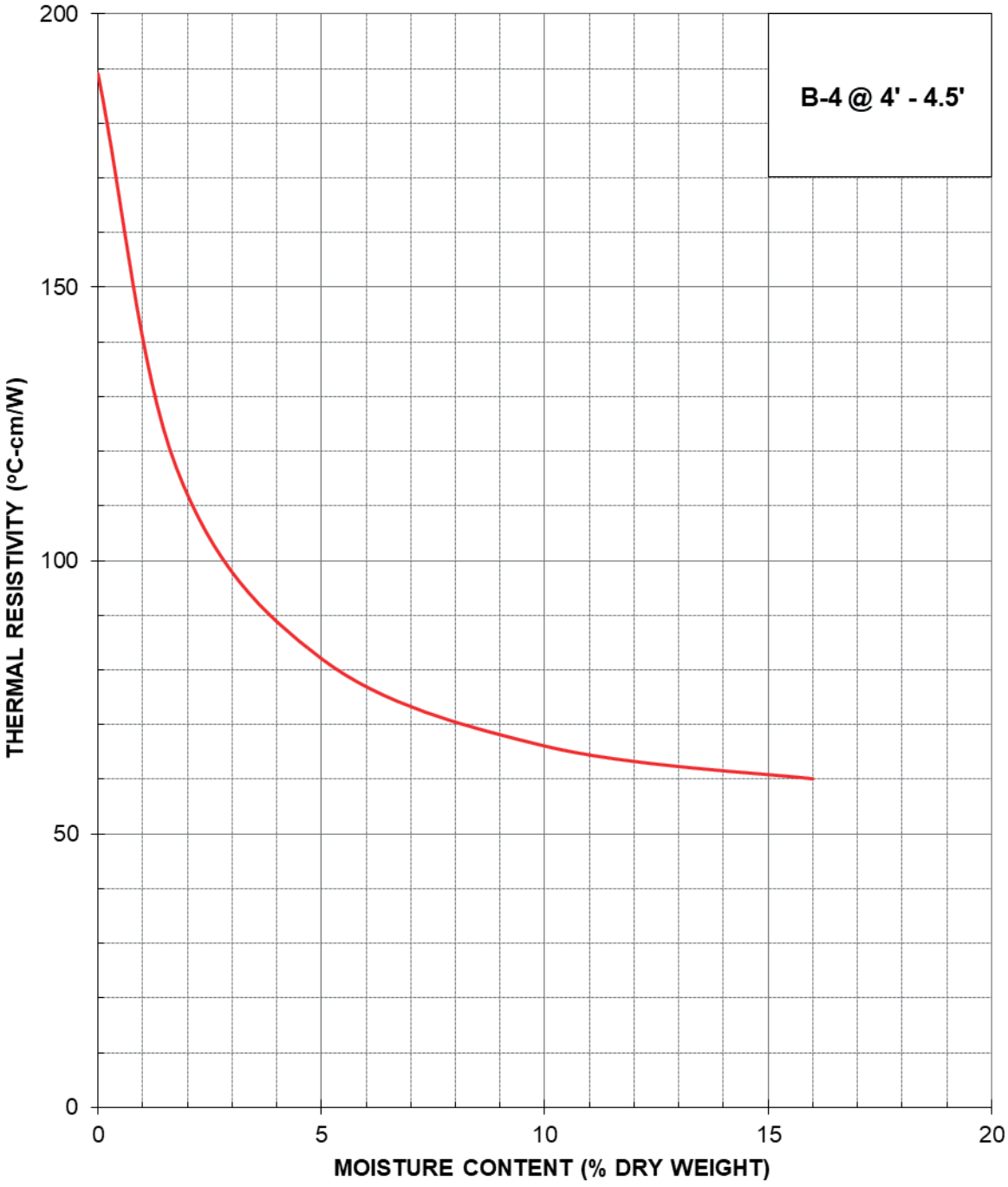
Berlogar (Project No. 4245.200)

Rooney / Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Samples

April 2023 **Figure 1**

THERMAL DRYOUT CURVE



Berlogar (Project No. 4245.200)

Rooney / Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Samples

April 2023 **Figure 2**

21239 FM529 Rd., Bldg. F
Cypress, TX 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
http://www.geothermusa.com

May 15, 2023

Berlogar Stevens & Associates
1220 Quarry Lane, Suite C
Pleasanton, CA 94566
Attn: Abbas Abdollahi

Re: Thermal Analysis of Native Soil Sample
Rooney/Sand Hill – Livermore, CA (Project No. 4245.200)

The following is the report of thermal dryout characterization tests conducted on one (1) tube sample of native soil from the referenced project sent to our laboratory.

Thermal Resistivity Tests: The tube sample was tested 'as received'. The tests were conducted in accordance with the IEEE standard 442-2017. The results are tabulated below and the thermal dryout curve is presented in **Figure 1.**

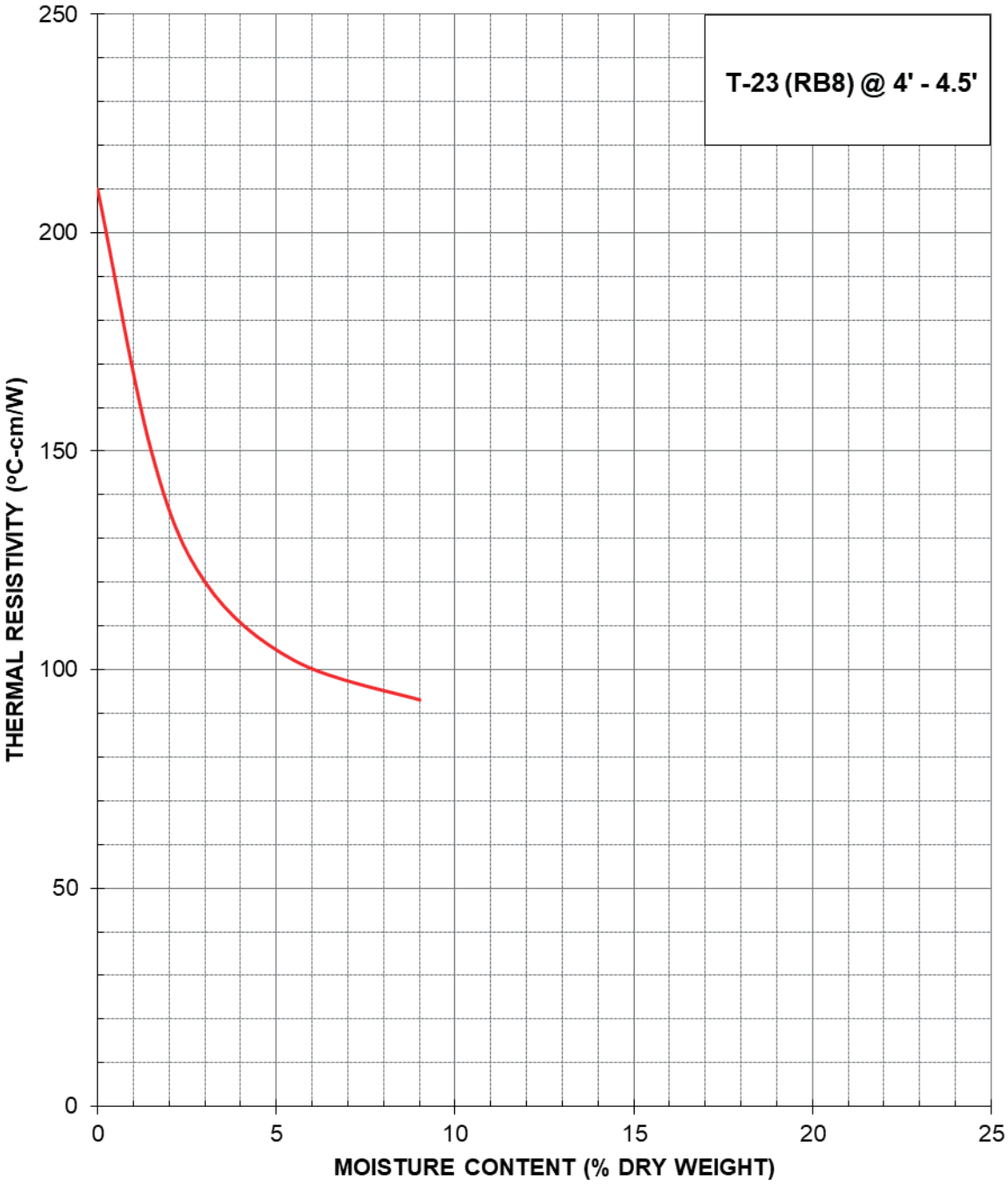
Sample ID, Description, Thermal Resistivity, Moisture Content and Density

Sample ID	Depth (ft)	Description (Berlogar Stevens & Associates)	Thermal Resistivity (°C-cm/W)		Moisture Content (%)	Dry Density (lb/ft^3)
			Wet	Dry		
T-23 (RB8)	4-4.5	Sandstone yellowish brown highly weathered friable	93	210	9	106

Please contact us if you have any questions or if we can be of further assistance.

Geotherm USA
Nimesh Patel

THERMAL DRYOUT CURVE



Berlogar Stevens & Associates (Project No. 4245.200)

Rooney/Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Sample

May 2023 **Figure 1**

Berlogar Stevens & Associates
ASTM Test Summary

Project Name:	Rooney Sand Hill	**Project Number:**	4245.200
Client:		Date Reported:	06/12/23
Attention:		Date Received:	06/08/23
Sample ID:	TP9 at 2-4ft	**Invoice Number:**	23080
Material Description:	Sandy Clay with Sandstone Brown Weak	Reported By:	G Suckow

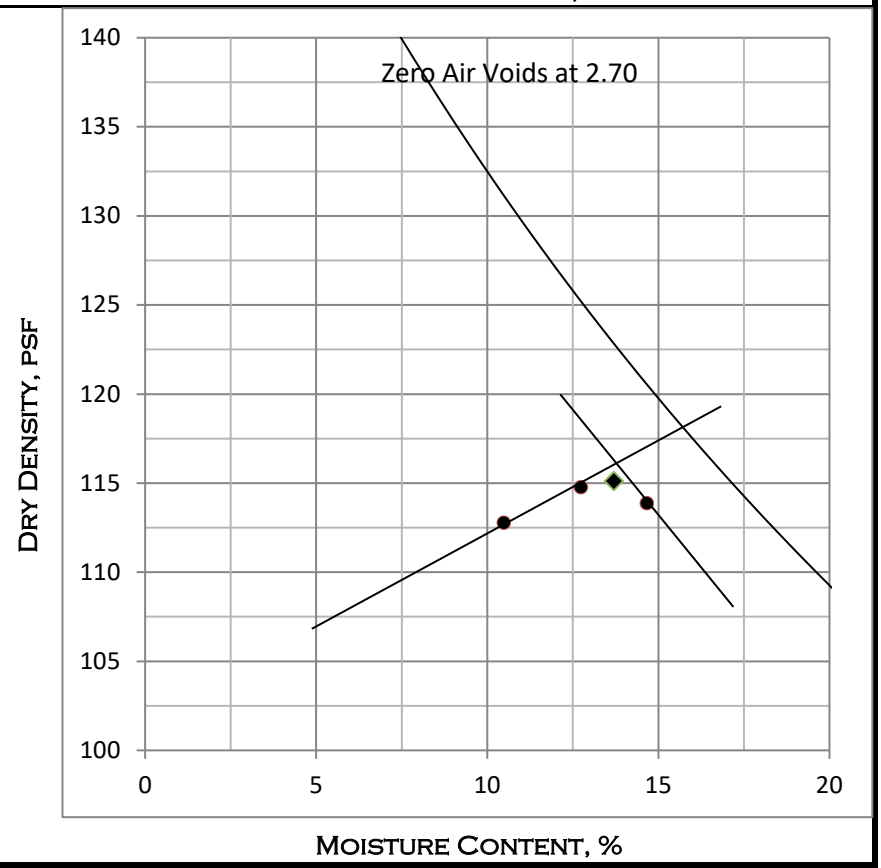
Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
1/4"	6.3		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.18		
#30	0.600		
#40	0.425		
#50	0.300		
#100	0.150		
#200	0.075		

ASTM D1557B Moisture Density Relationship

Maximum Dry Density, pcf: 115.1

Optimum Mosture Content, %: 13.7



Coarse and Fine Quality Tests

D-3744 Coarse Durability:	
D-3744 Fine Durability:	
D-2419 Sand Equivalency:	
D-2844 R Value at 300psi:	
R Value Expansion Press at 300 psi:	
CTM-227 Cleanliness Value:	

Fine Material Tests

ASTM D-4318 Liquid Limit:	Specification:
ASTM D-4318 Plastic Limit:	Specification:
ASTM D-4318 Plasticity Index:	Specification:
-40 Soil Classification:	
D-4829 Expansion Index $(EI)_{50\%}$:	Specification:
D-4829 Expansion Potential:	Specification:
Caltrans CTM216 Maximum Wet Density,g/cc:	

Comments:

Berlogar Stevens & Associates
ASTM Test Summary

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Client:		Date Reported:	06/12/23
Attention:		Date Received:	06/08/23
Sample ID:	**TP10 at 1-1/2 to 4ft**	**Invoice Number:**	**23080**
Material Description:	Sandy Clay with Sandstone Light Brown Weak	Reported By:	G Suckow

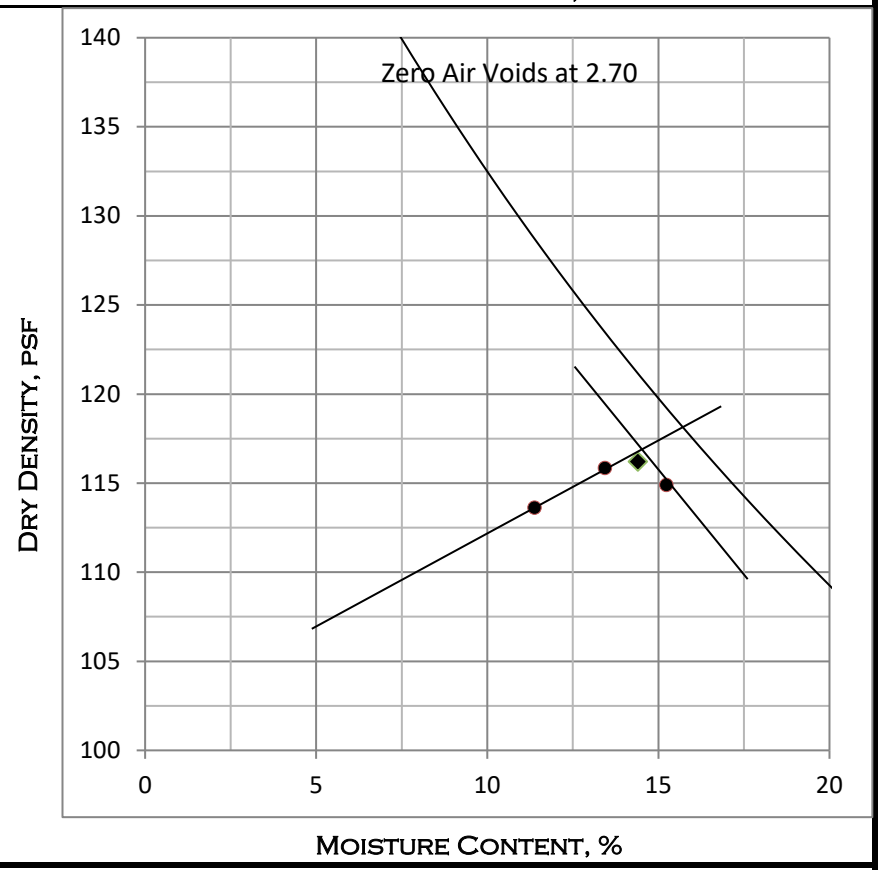
Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
1/4"	6.3		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.18		
#30	0.600		
#40	0.425		
#50	0.300		
#100	0.150		
#200	0.075		

ASTM D1557B Moisture Density Relationship

Maximum Dry Density, pcf: 116.2

Optimum Mosture Content, %: 14.4



Coarse and Fine Quality Tests		Fine Material Tests	
		ASTM D-4318 Liquid Limit:	Specification:
D-3744 Coarse Durability:		ASTM D-4318 Plastic Limit:	Specification:
D-3744 Fine Durability:		ASTM D-4318 Plasticity Index:	Specification:
D-2419 Sand Equivalency:		-40 Soil Classification:	
D-2844 R Value at 300psi:		D-4829 Expansion Index $(EI)_{50\%}$:	Specification:
R Value Expansion Press at 300 psi:		D-4829 Expansion Potential:	Specification:
CTM-227 Cleanliness Value:		Caltrans CTM216 Maximum Wet Density,g/cc:	

Comments:

Berlogar Stevens & Associates
ASTM Test Summary

Project Name:	Rooney Sand Hill	**Project Number:**	4245.200
Client:		Date Reported:	06/12/23
Attention:		Date Received:	06/08/23
Sample ID:	TP11 at 2 to 4ft	**Invoice Number:**	23080
Material Description:	Sandy Clay Red Brown	Reported By:	G Suckow

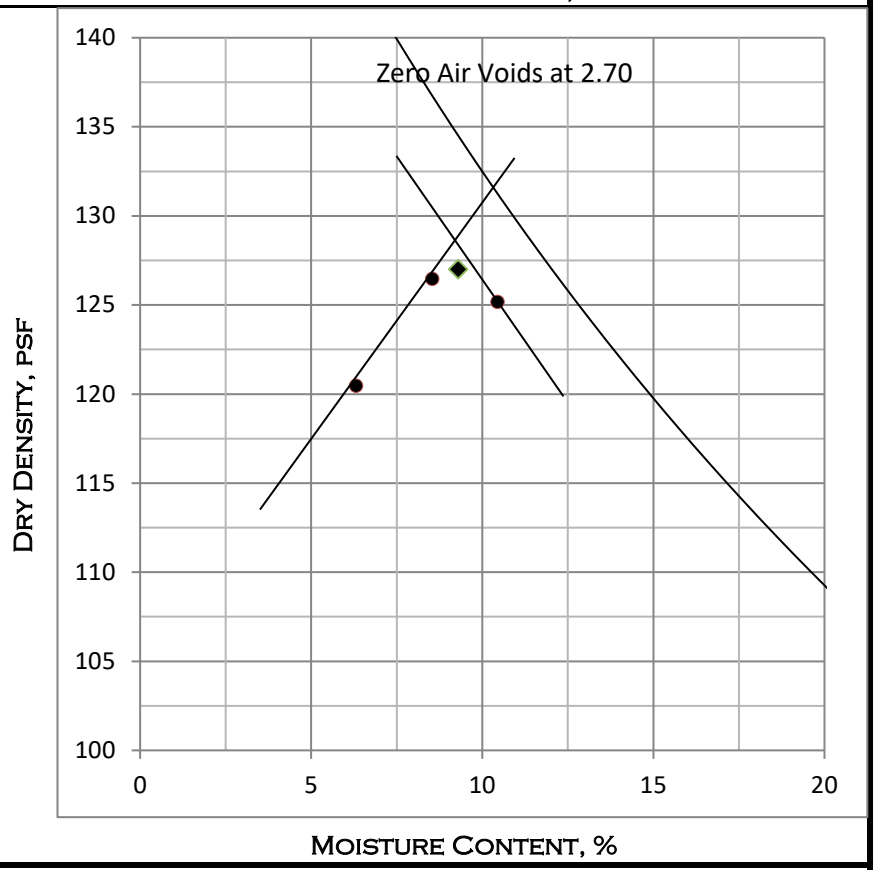
Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
1/4"	6.3		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.18		
#30	0.600		
#40	0.425		
#50	0.300		
#100	0.150		
#200	0.075		

ASTM D1557B Moisture Density Relationship

Maximum Dry Density, pcf: 127.0

Optimum Mosture Content, %: 9.3



Coarse and Fine Quality Tests

D-3744 Coarse Durability:	
D-3744 Fine Durability:	
D-2419 Sand Equivalency:	
D-2844 R Value at 300psi:	
R Value Expansion Press at 300 psi:	
CTM-227 Cleanliness Value:	

Fine Material Tests

ASTM D-4318 Liquid Limit:	Specification:
ASTM D-4318 Plastic Limit:	Specification:
ASTM D-4318 Plasticity Index:	Specification:
-40 Soil Classification:	
D-4829 Expansion Index $(EI)_{50\%}$:	Specification:
D-4829 Expansion Potential:	Specification:
Caltrans CTM216 Maximum Wet Density,g/cc:	

Comments:

Berlogar Stevens & Associates
ASTM Test Summary

Project Name:	**Rooney Sand Hill**	**Project Number:**	**4245.200**
Client:		Date Reported:	06/12/23
Attention:		Date Received:	06/08/23
Sample ID:	**TP12 at 2-1/2 to 5ft**	**Invoice Number:**	**23080**
Material Description:	Silty Clay with Claystone Olive Brown	Reported By:	G Suckow

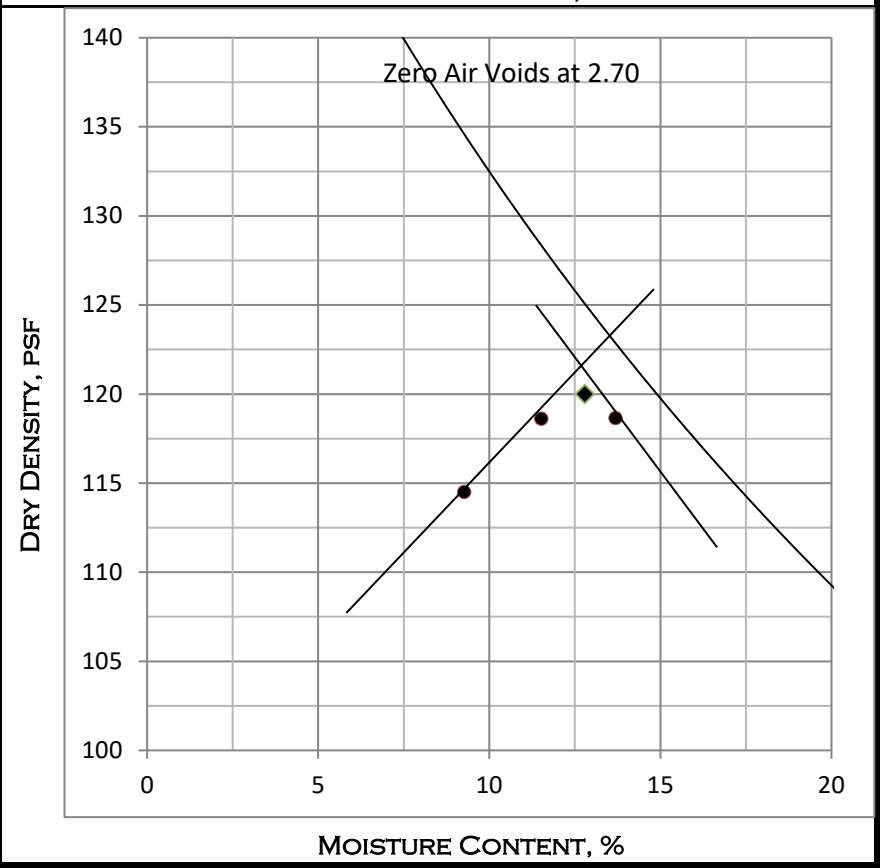
Sieve Analysis ASTM C136 CTM 202

Sieve Size		Percent	
US	mm	Passing	Specifications
3"	75.0		
2-1/2"	63.5		
2"	50.0		
1-1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
1/4"	6.3		
#4	4.75		
#8	2.36		
#10	2.00		
#16	1.18		
#30	0.600		
#40	0.425		
#50	0.300		
#100	0.150		
#200	0.075		

ASTM D1557B Moisture Density Relationship

Maximum Dry Density, pcf: 120.0

Optimum Mosture Content, %: 12.8



Coarse and Fine Quality Tests

D-3744 Coarse Durability:	
D-3744 Fine Durability:	
D-2419 Sand Equivalency:	
D-2844 R Value at 300psi:	
R Value Expansion Press at 300 psi:	
CTM-227 Cleanliness Value:	

Fine Material Tests

ASTM D-4318 Liquid Limit:	Specification:
ASTM D-4318 Plastic Limit:	Specification:
ASTM D-4318 Plasticity Index:	Specification:
-40 Soil Classification:	
D-4829 Expansion Index $(EI)_{50\%}$:	Specification:
D-4829 Expansion Potential:	Specification:
Caltrans CTM216 Maximum Wet Density,g/cc:	

Comments:

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June 27, 2023

Berlogar Stevens & Associates
1220 Quarry Ln., Suite C
Pleasanton, CA 94566
Attn: Abbas Abdollahi

Re: Thermal Analysis of Native Soil Samples
Rooney/Sand Hill – Livermore, CA (Project No. 4245.200)

The following is the report of thermal dryout characterization tests conducted on four (4) native soil samples from the referenced project sent to our laboratory.

Thermal Resistivity Tests: The samples were tested at the 'optimum' moisture content and 90% of the modified Proctor dry density ***provided by Berlogar Stevens & Associates***. The tests were conducted in accordance with the IEEE standard 442-2017. The results are tabulated below and the thermal dryout curves are presented in **Figures 1 to 4.**

Sample ID, Description, Thermal Resistivity, Moisture Content and Density

Sample ID	Depth (ft)	Effort (%)	Description (Berlogar Stevens & Associates)	Thermal Resistivity (°C-cm/W)		Moisture Content (%)	Dry Density (lb/ft^3)
				Wet	Dry		
Test Pit 9	2-4	90	Sandy clay w/ sandstone	75	196	14	104
Test Pit 10	1.5-4	90	Sandy clay w/ sandstone, light brown	71	187	14	105
Test Pit 11	2-4	90	Sandy clay, red brown	56	146	9	114
Test Pit 12	2.5-5	90	Silty clay w/ claystone, olive brown	67	178	13	108

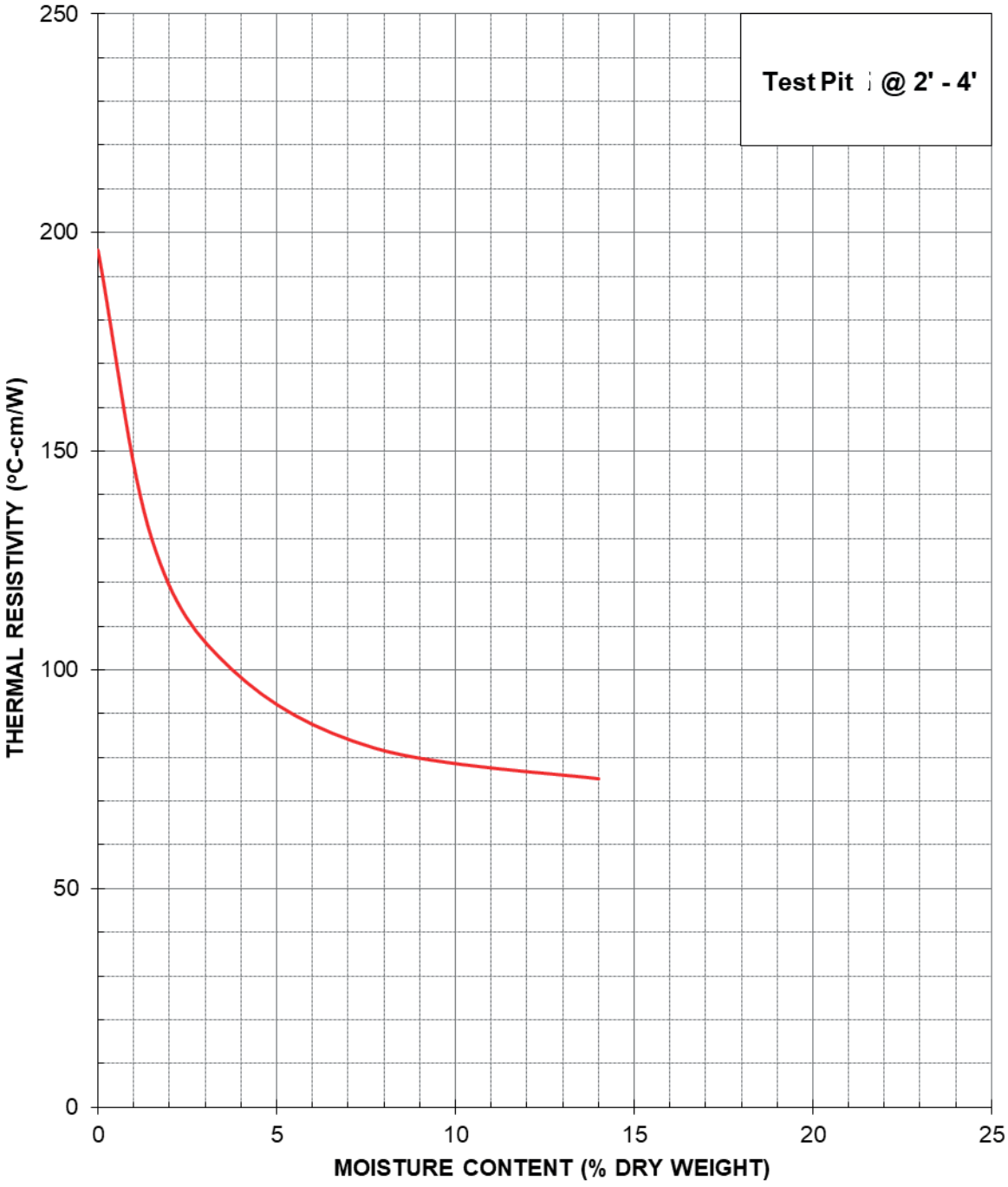
Comments: The thermal characteristic depicted in the dryout curves apply for the soils at their respective test dry density.

Please contact us if you have any questions or if we can be of further assistance.

Geotherm USA

Nimesh Patel

THERMAL DRYOUT CURVE



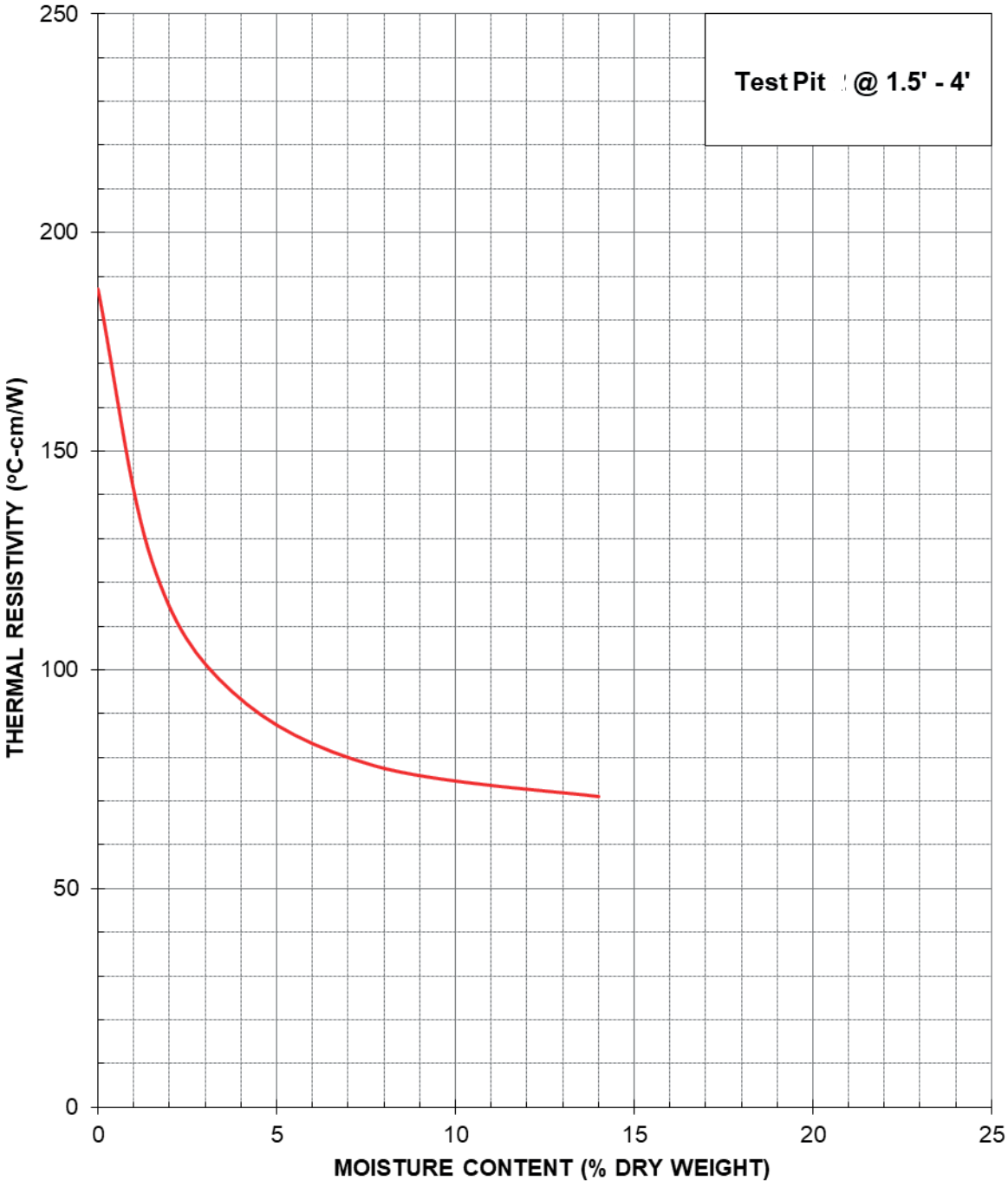
Berlogar Stevens & Associates (Project No. 4245.200)

Rooney/Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Samples

June 2023 **Figure 1**

THERMAL DRYOUT CURVE



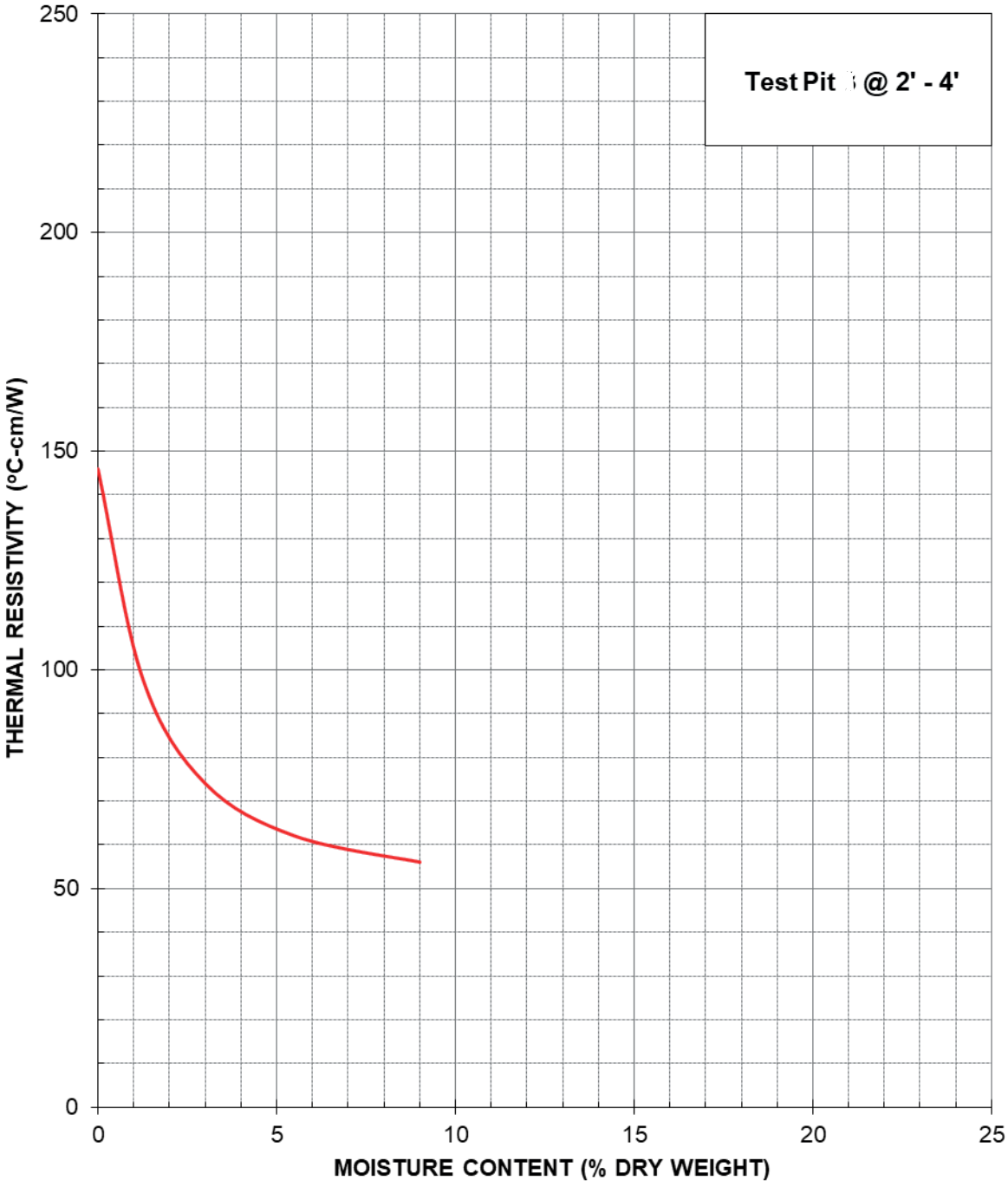
Berlogar Stevens & Associates (Project No. 4245.200)

Rooney/Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Samples

June 2023 **Figure 2**

THERMAL DRYOUT CURVE



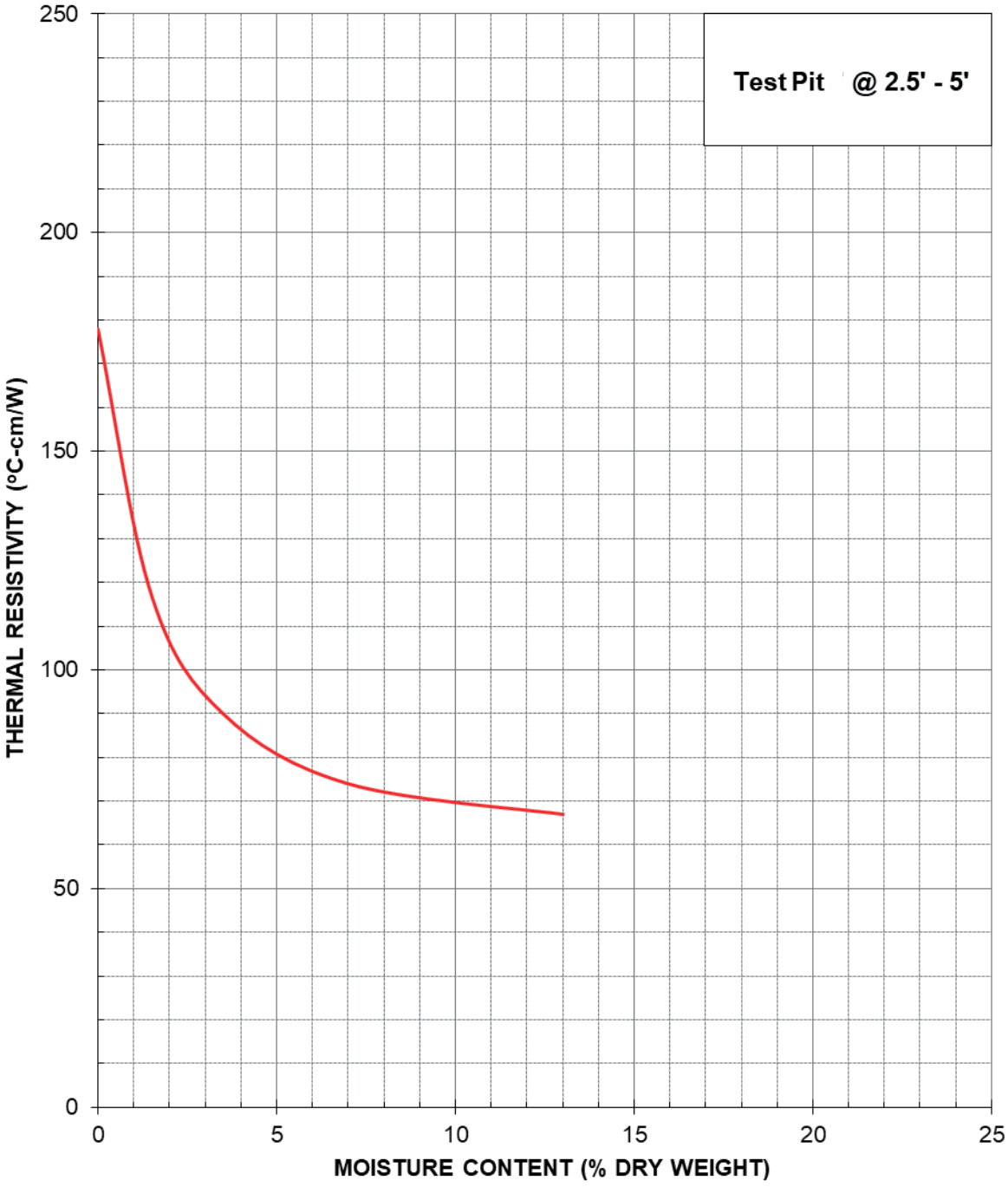
Berlogar Stevens & Associates (Project No. 4245.200)

Rooney/Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Samples

June 2023 **Figure 3**

THERMAL DRYOUT CURVE



Berlogar Stevens & Associates (Project No. 4245.200)

Rooney/Sand Hill – Livermore, CA

Thermal Analysis of Native Soil Samples

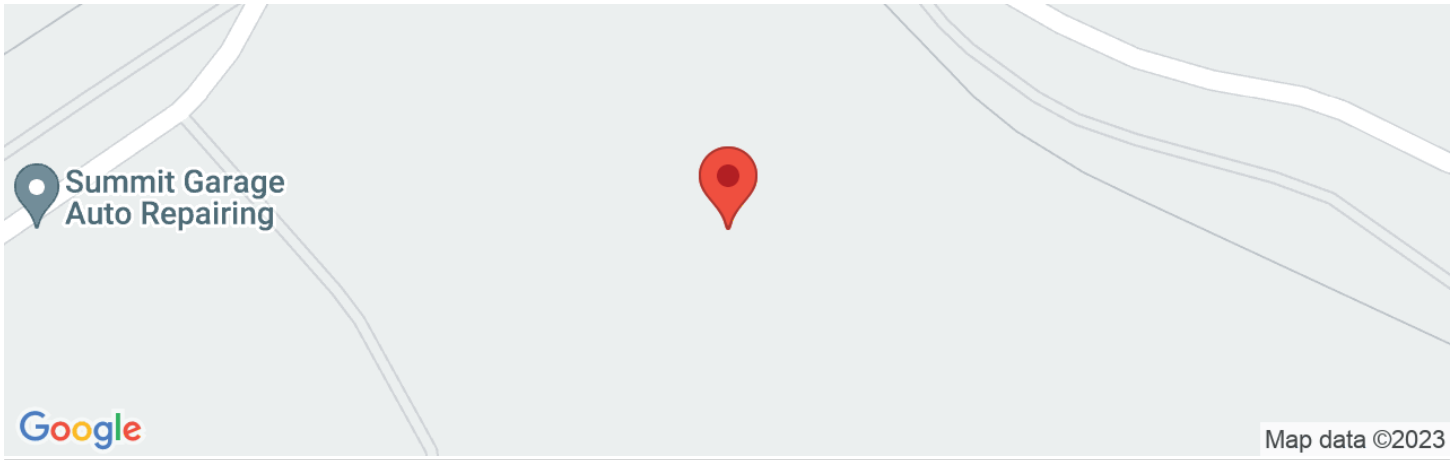
June 2023 **Figure 4**

APPENDIX J

Seismic Analysis Results

Turbine No. 3

Latitude, Longitude: 37.743660, -121.655488



Date	6/25/2023, 12:39:44 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.646	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.975	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.317	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.666	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.799	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.735	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.905	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.646	Factored deterministic acceleration value. (0.2 second)
S1RT	0.607	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.667	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.666	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.731	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.911	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.91	Mapped value of the risk coefficient at a period of 1 s
C_V	1.229	Vertical coefficient

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Turbine No. 4

Latitude, Longitude: 37.741140, -121.655806

Date	6/25/2023, 12:40:50 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.664	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.997	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.331	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.673	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.808	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.746	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.918	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.664	Factored deterministic acceleration value. (0.2 second)
S1RT	0.611	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.672	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.673	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.736	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.91	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.909	Mapped value of the risk coefficient at a period of 1 s
C_V	1.233	Vertical coefficient

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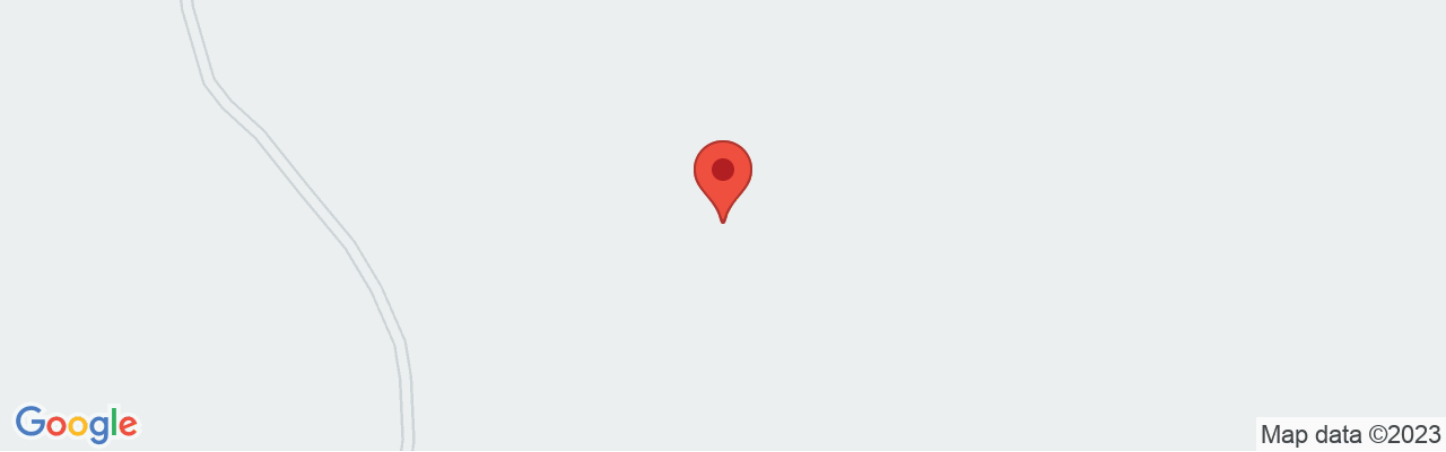
Turbine No. 5

Latitude, Longitude: 37.739640, -121.653110



Date	6/25/2023, 12:41:31 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.655	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.986	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.324	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.669	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.803	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.742	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.914	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.655	Factored deterministic acceleration value. (0.2 second)
S1RT	0.609	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.67	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.669	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.734	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.91	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.909	Mapped value of the risk coefficient at a period of 1 s
C_V	1.231	Vertical coefficient

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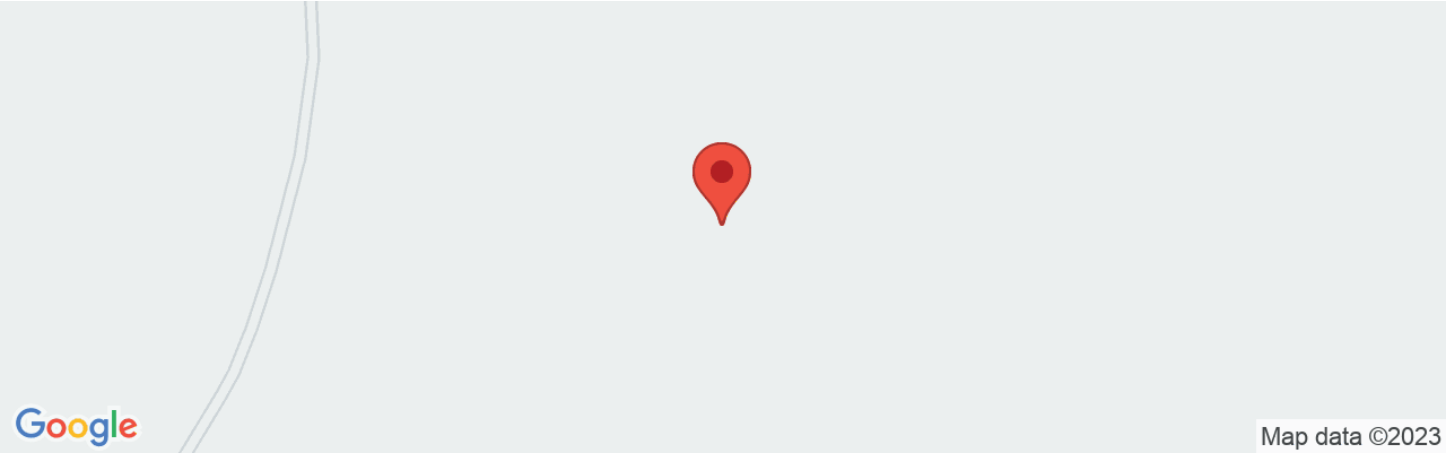
While the information presented on this website is believed to be correct, SEAOC /OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this website.

Turbine No. 6

Latitude, Longitude: 37.736755, -121.652220



Date	6/25/2023, 12:50:33 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.667	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	2	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.333	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.674	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.809	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.751	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.925	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.667	Factored deterministic acceleration value. (0.2 second)
S1RT	0.612	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.674	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.674	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.739	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.91	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.909	Mapped value of the risk coefficient at a period of 1 s
C_V	1.233	Vertical coefficient

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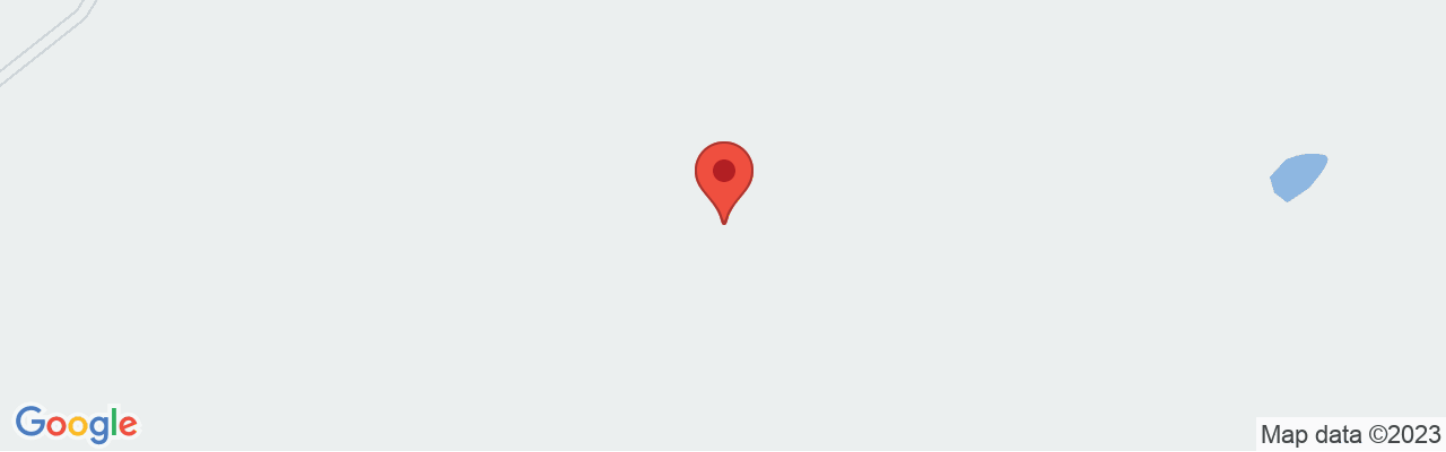
Turbine No. 7

Latitude, Longitude: 37.733373, -121.651283



Date	6/25/2023, 12:51:14 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.681	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.017	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.345	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.68	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.816	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.762	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.939	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.681	Factored deterministic acceleration value. (0.2 second)
S1RT	0.616	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.678	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.68	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.744	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.909	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.909	Mapped value of the risk coefficient at a period of 1 s
C_V	1.236	Vertical coefficient

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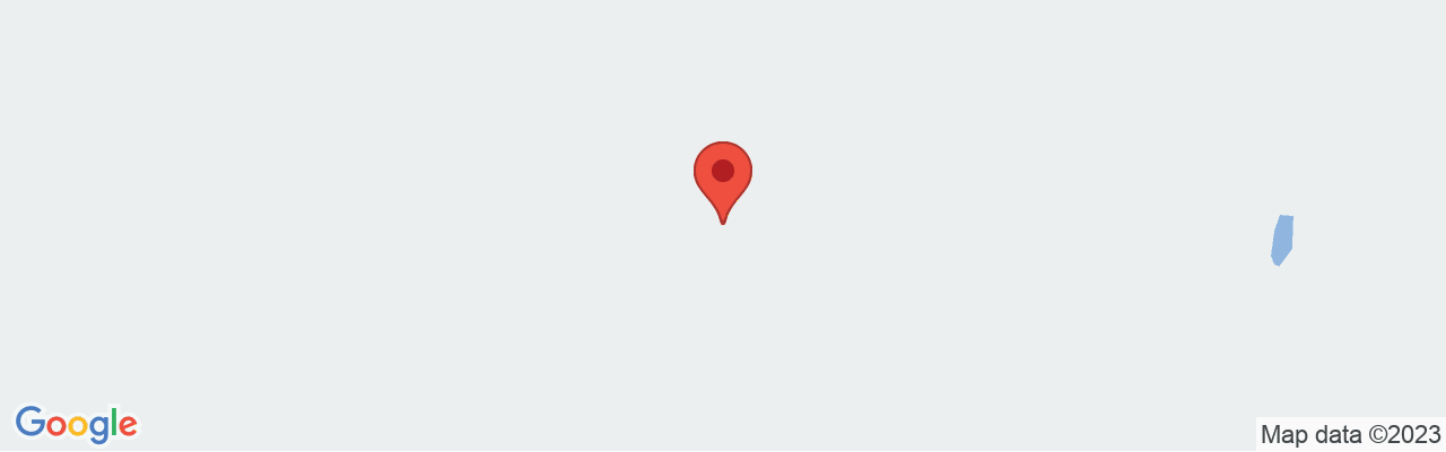
Turbine No. 8

Latitude, Longitude: 37.737823, -121.644018



Date	6/25/2023, 12:51:45 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.607	MCE_R ground motion. (for 0.2 second period)
S_1	0.599	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.929	Site-modified spectral acceleration value
S_{M1}	0.839	Site-modified spectral acceleration value
S_{DS}	1.286	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.401	Site amplification factor at 1.0 second
PGA	0.65	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.78	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.715	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.885	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.607	Factored deterministic acceleration value. (0.2 second)
S1RT	0.599	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.658	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.65	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.723	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.91	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.91	Mapped value of the risk coefficient at a period of 1 s
C_V	1.221	Vertical coefficient

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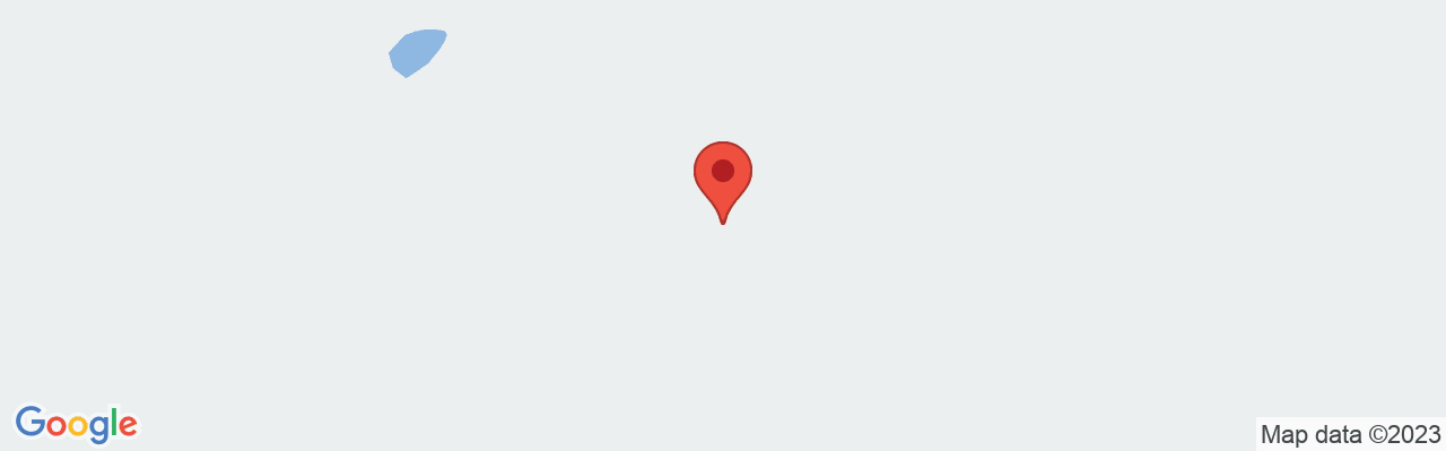
Turbine No. 9

Latitude, Longitude: 37.732439, -121.642925



Date	6/25/2023, 12:52:12 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.634	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.96	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.307	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.661	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.793	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.734	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.908	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.634	Factored deterministic acceleration value. (0.2 second)
S1RT	0.605	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.665	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.661	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.732	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.909	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.91	Mapped value of the risk coefficient at a period of 1 s
C_V	1.227	Vertical coefficient

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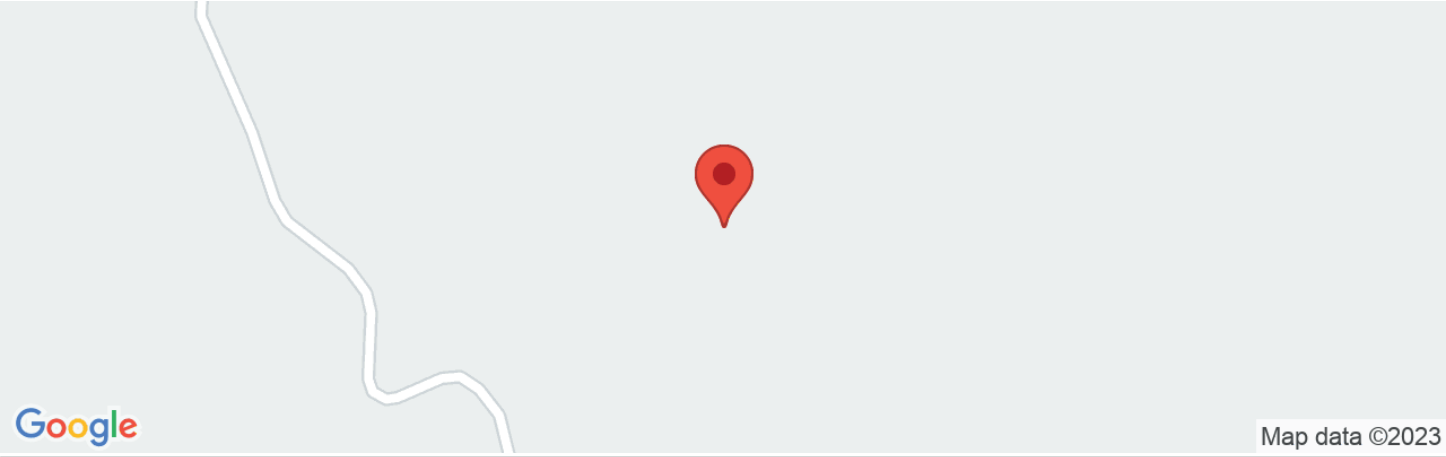
Turbine No. 17

Latitude, Longitude: 37.774336, -121.617123



Date	6/25/2023, 12:52:46 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.483	MCE_R ground motion. (for 0.2 second period)
S_1	0.518	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.78	Site-modified spectral acceleration value
S_{M1}	0.768	Site-modified spectral acceleration value
S_{DS}	1.186	Numeric seismic design value at 0.2 second SA
S_{D1}	0.512	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.482	Site amplification factor at 1.0 second
PGA	0.599	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.719	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.483	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.617	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.518	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.562	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.599	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.619	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.917	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.197	Vertical coefficient

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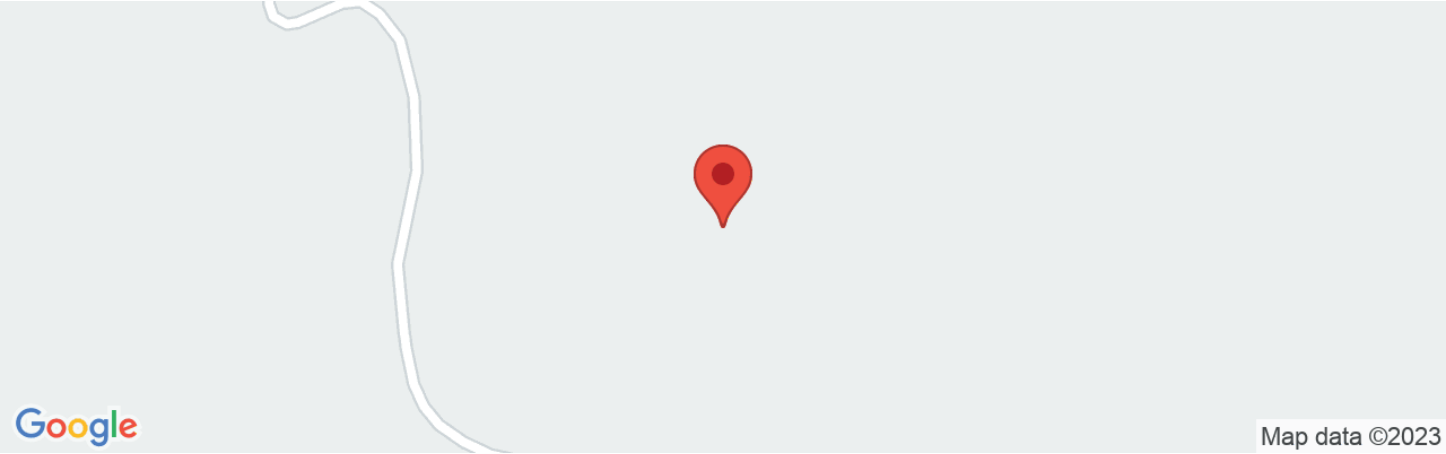
Turbine No. 18

Latitude, Longitude: 37.771522, -121.616188



Date	6/25/2023, 12:53:16 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.489	MCE_R ground motion. (for 0.2 second period)
S_1	0.52	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.489	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.993	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.588	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.647	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.489	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.624	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.52	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.564	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.588	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.621	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.917	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.398	Vertical coefficient

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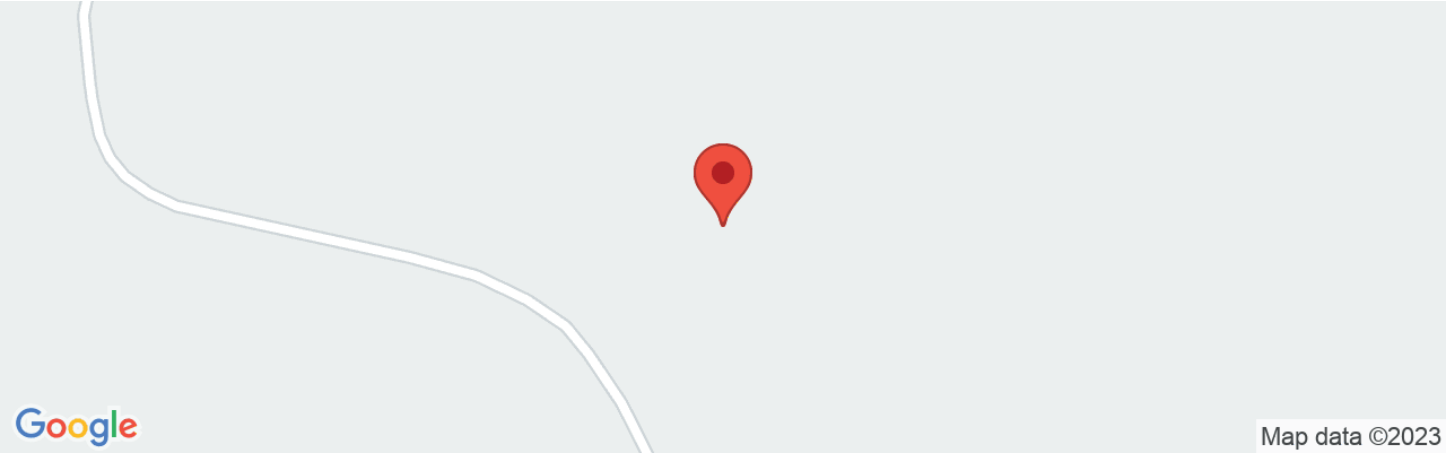
Turbine No. 19

Latitude, Longitude: 37.769667, -121.613202



Date	6/25/2023, 12:54:06 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.485	MCE_R ground motion. (for 0.2 second period)
S_1	0.518	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.782	Site-modified spectral acceleration value
S_{M1}	0.768	Site-modified spectral acceleration value
S_{DS}	1.188	Numeric seismic design value at 0.2 second SA
S_{D1}	0.512	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.482	Site amplification factor at 1.0 second
PGA	0.582	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.698	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.485	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.62	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.518	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.562	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.582	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.62	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.917	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.197	Vertical coefficient

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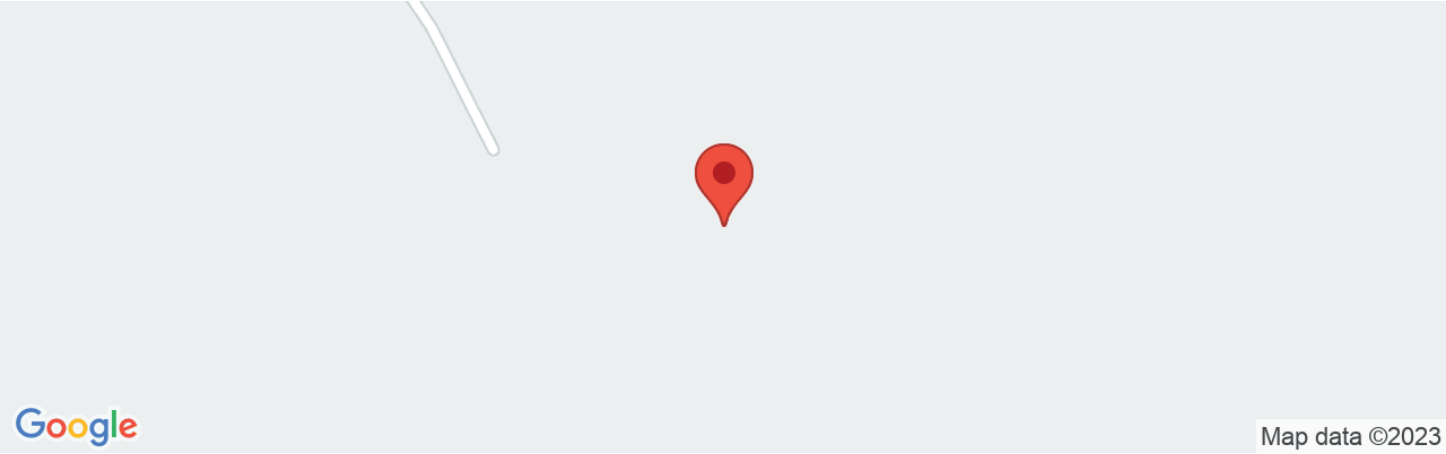
Turbine No. 20-20a

Latitude, Longitude: 37.766851, -121.611393



Date	6/25/2023, 12:56:32 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.488	MCE_R ground motion. (for 0.2 second period)
S_1	0.519	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.786	Site-modified spectral acceleration value
S_{M1}	0.768	Site-modified spectral acceleration value
S_{DS}	1.19	Numeric seismic design value at 0.2 second SA
S_{D1}	0.512	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.481	Site amplification factor at 1.0 second
PGA	0.589	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.707	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.488	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.624	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.519	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.562	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.589	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.621	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.916	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.198	Vertical coefficient

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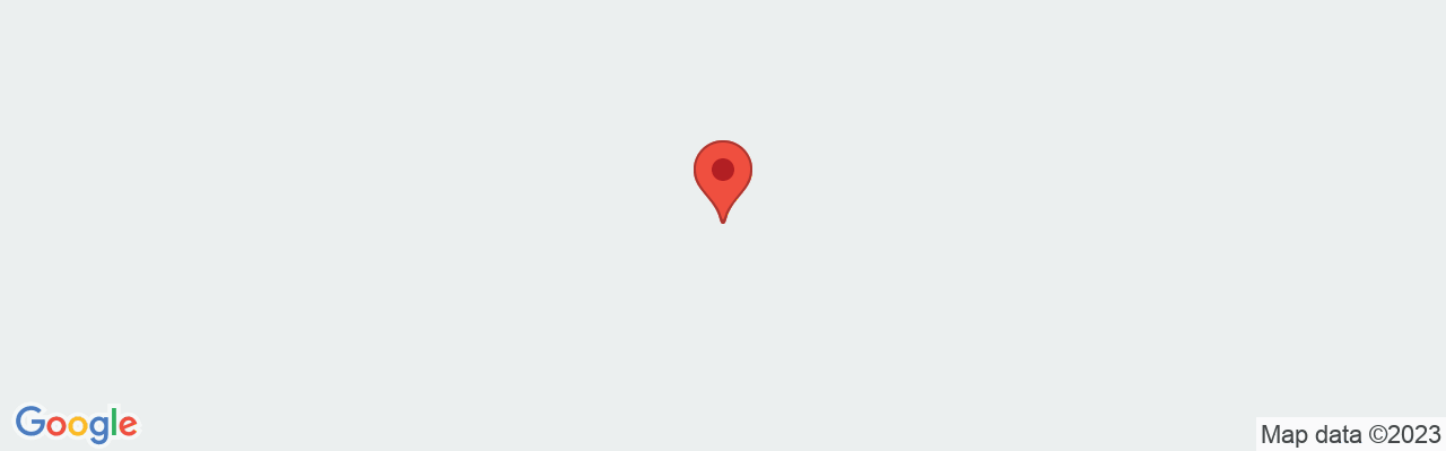
Turbine No. 21

Latitude, Longitude: 37.765243, -121.610310



Date	6/25/2023, 12:58:00 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.49	MCE_R ground motion. (for 0.2 second period)
S_1	0.519	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.49	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.993	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.595	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.654	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.49	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.626	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.519	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.563	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.595	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.622	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.916	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.398	Vertical coefficient

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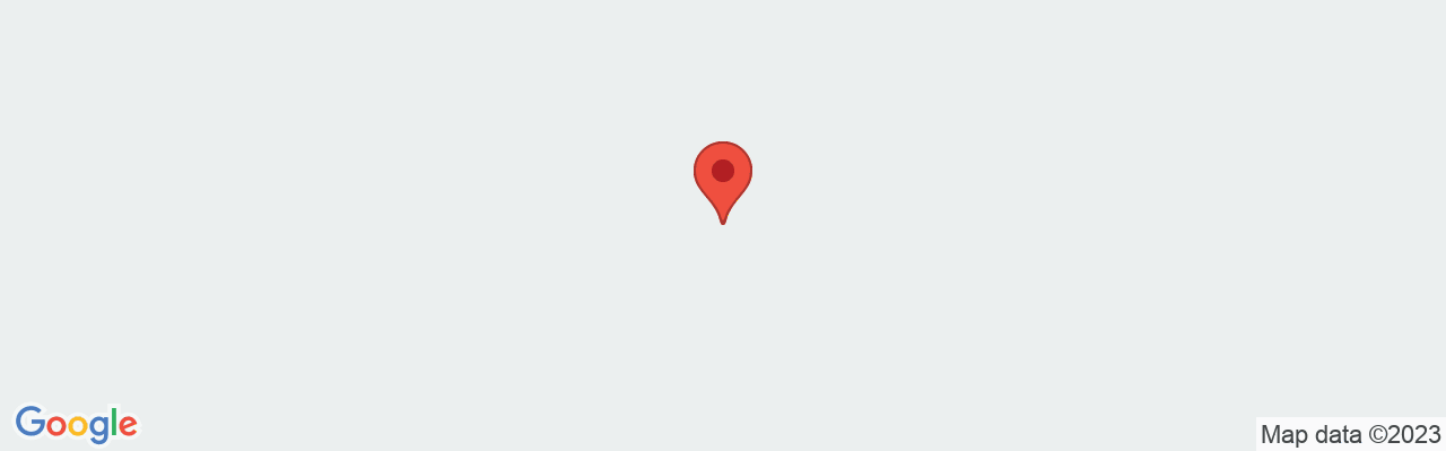
Turbine No. 22

Latitude, Longitude: 37.761318, -121.607580



Date	6/25/2023, 12:58:39 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.493	MCE_R ground motion. (for 0.2 second period)
S_1	0.52	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.792	Site-modified spectral acceleration value
S_{M1}	0.769	Site-modified spectral acceleration value
S_{DS}	1.195	Numeric seismic design value at 0.2 second SA
S_{D1}	0.513	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.48	Site amplification factor at 1.0 second
PGA	0.613	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.735	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.493	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.632	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.513	Factored deterministic acceleration value. (0.2 second)
S1RT	0.52	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.564	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.613	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.623	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.915	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.199	Vertical coefficient

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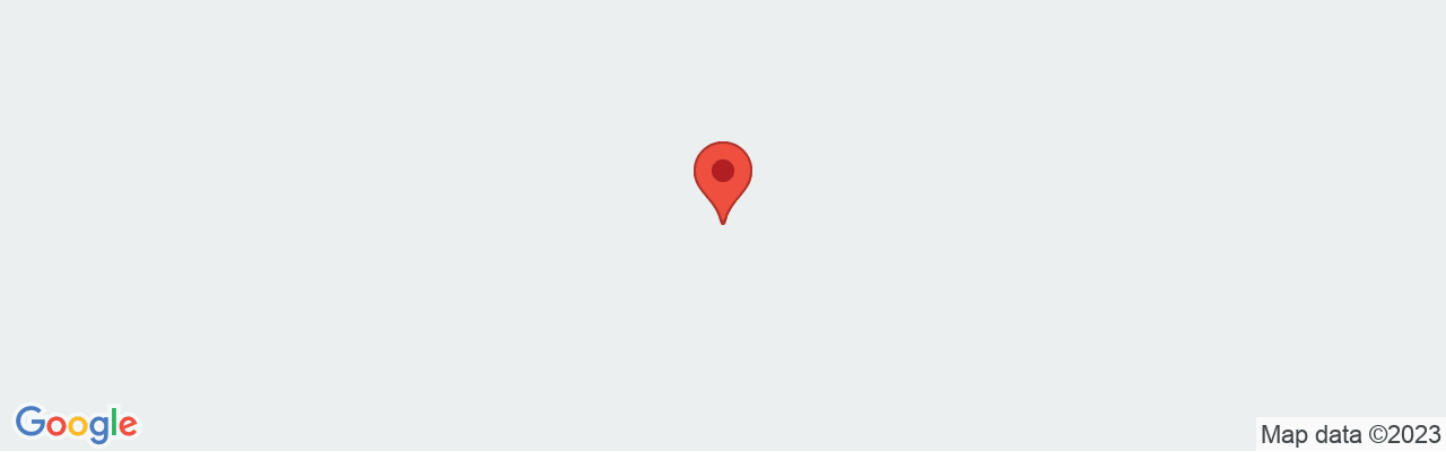
Turbine No. 23

Latitude, Longitude: 37.759959, -121.603995



Date	6/25/2023, 12:59:28 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.485	MCE_R ground motion. (for 0.2 second period)
S_1	0.516	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.783	Site-modified spectral acceleration value
S_{M1}	0.766	Site-modified spectral acceleration value
S_{DS}	1.188	Numeric seismic design value at 0.2 second SA
S_{D1}	0.511	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.484	Site amplification factor at 1.0 second
PGA	0.62	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.744	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.485	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.624	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.542	Factored deterministic acceleration value. (0.2 second)
S1RT	0.516	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.56	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.624	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.62	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.915	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.197	Vertical coefficient

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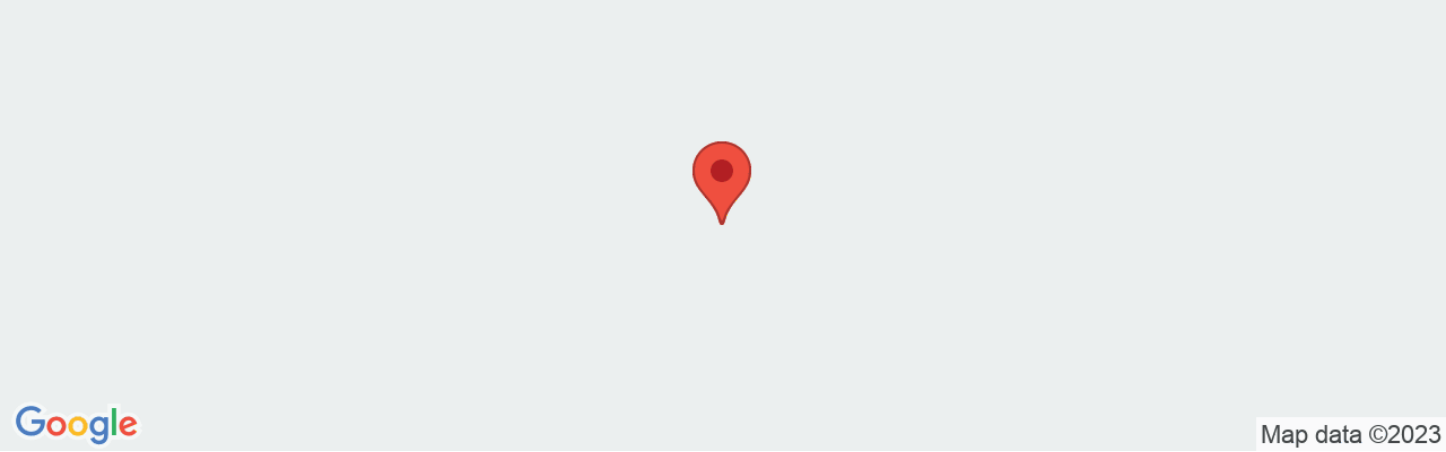
Turbine No. 24

Latitude, Longitude: 37.757776, -121.601539



Date	6/25/2023, 12:59:55 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.484	MCE_R ground motion. (for 0.2 second period)
S_1	0.516	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.781	Site-modified spectral acceleration value
S_{M1}	0.765	Site-modified spectral acceleration value
S_{DS}	1.187	Numeric seismic design value at 0.2 second SA
S_{D1}	0.51	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.484	Site amplification factor at 1.0 second
PGA	0.619	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.743	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.484	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.623	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.573	Factored deterministic acceleration value. (0.2 second)
S1RT	0.516	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.559	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.637	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.619	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.914	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.197	Vertical coefficient

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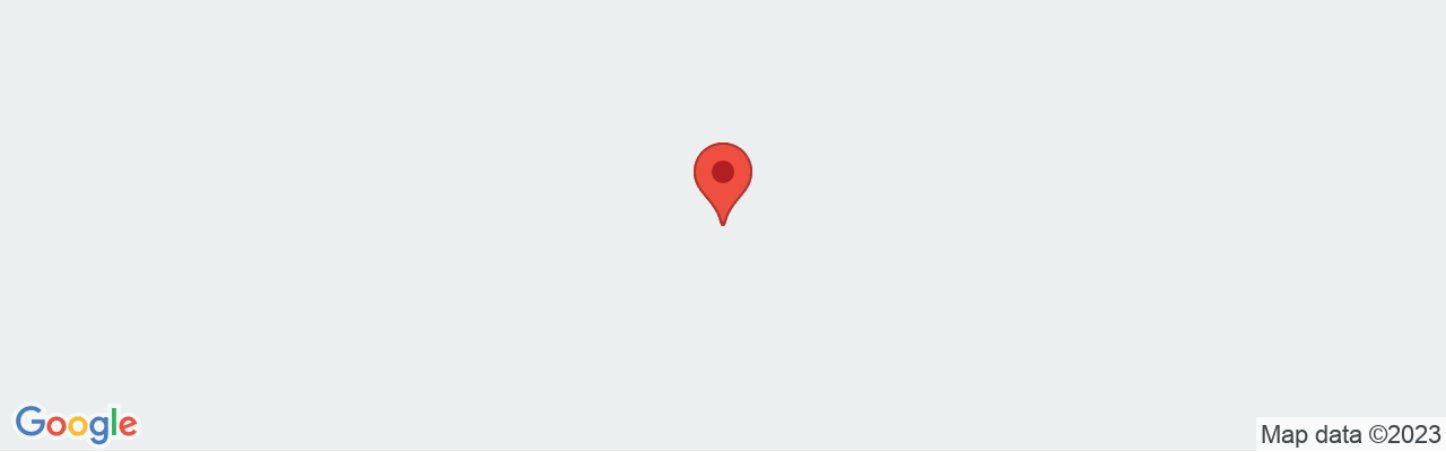
Turbine No. 25

Latitude, Longitude: 37.755067, -121.608696



Date	6/25/2023, 1:00:42 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.518	MCE_R ground motion. (for 0.2 second period)
S_1	0.527	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.821	Site-modified spectral acceleration value
S_{M1}	0.777	Site-modified spectral acceleration value
S_{DS}	1.214	Numeric seismic design value at 0.2 second SA
S_{D1}	0.518	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.473	Site amplification factor at 1.0 second
PGA	0.634	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.76	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.518	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.661	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.566	Factored deterministic acceleration value. (0.2 second)
S1RT	0.527	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.573	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.634	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.634	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.914	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.92	Mapped value of the risk coefficient at a period of 1 s
C_V	1.204	Vertical coefficient

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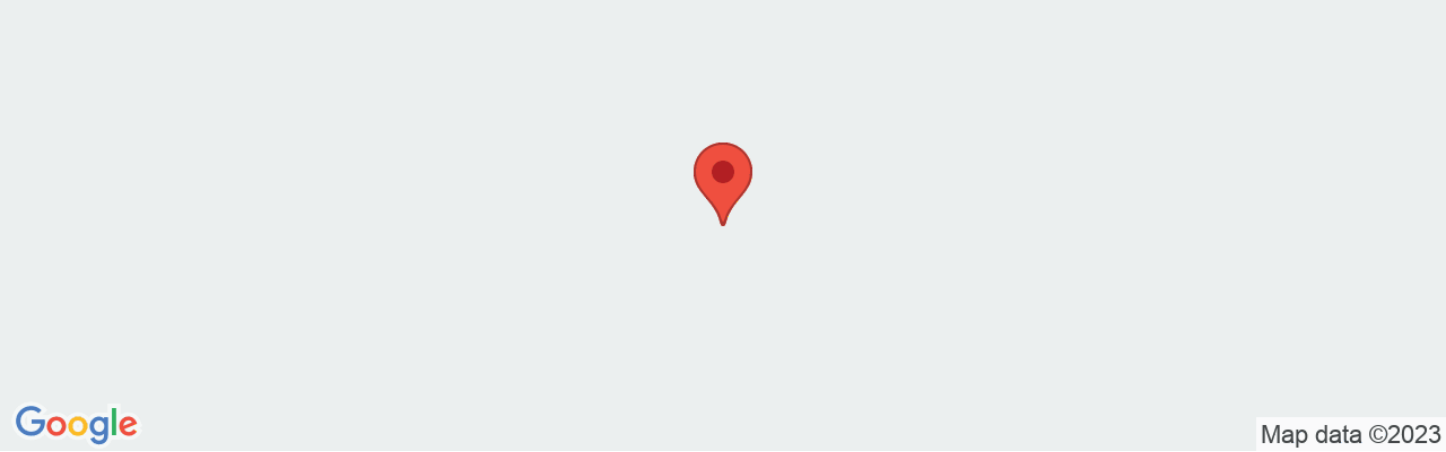
Turbine No. 26

Latitude, Longitude: 37.753797, -121.599593



Date	6/25/2023, 1:01:19 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.491	MCE_R ground motion. (for 0.2 second period)
S_1	0.517	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.491	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.994	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.622	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.684	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.491	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.632	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.62	Factored deterministic acceleration value. (0.2 second)
S1RT	0.517	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.561	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.655	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.622	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.913	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.922	Mapped value of the risk coefficient at a period of 1 s
C_V	1.398	Vertical coefficient

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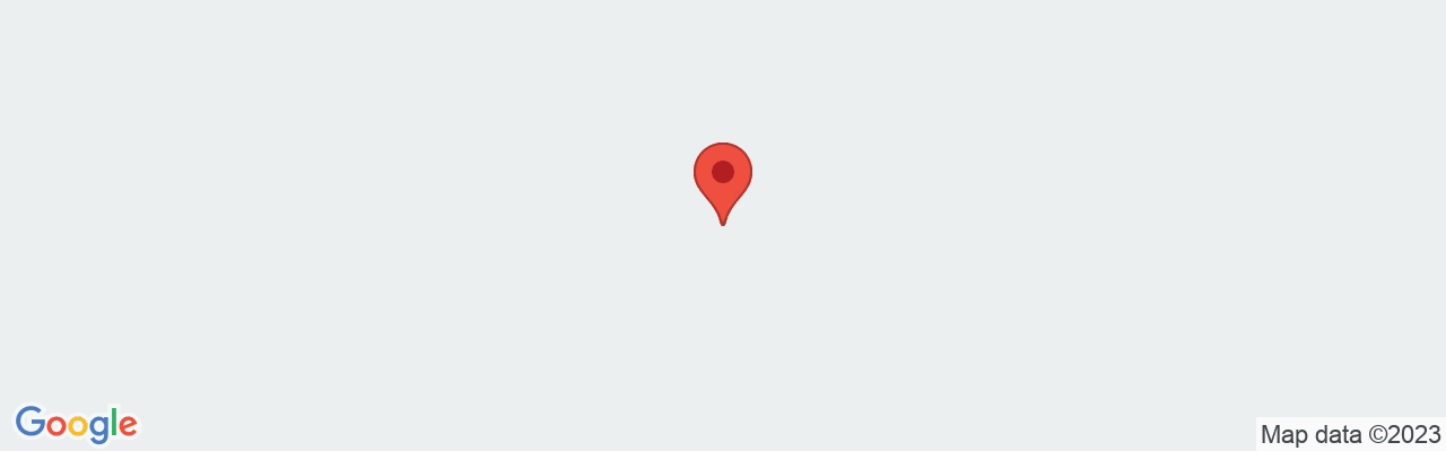
Turbine No. 27

Latitude, Longitude: 37.754561, -121.594164



Date	6/25/2023, 1:01:49 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.474	MCE_R ground motion. (for 0.2 second period)
S_1	0.511	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.769	Site-modified spectral acceleration value
S_{M1}	0.761	Site-modified spectral acceleration value
S_{DS}	1.179	Numeric seismic design value at 0.2 second SA
S_{D1}	0.507	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.489	Site amplification factor at 1.0 second
PGA	0.615	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.738	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.474	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.612	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.636	Factored deterministic acceleration value. (0.2 second)
S1RT	0.511	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.554	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.662	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.615	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.914	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.923	Mapped value of the risk coefficient at a period of 1 s
C_V	1.195	Vertical coefficient

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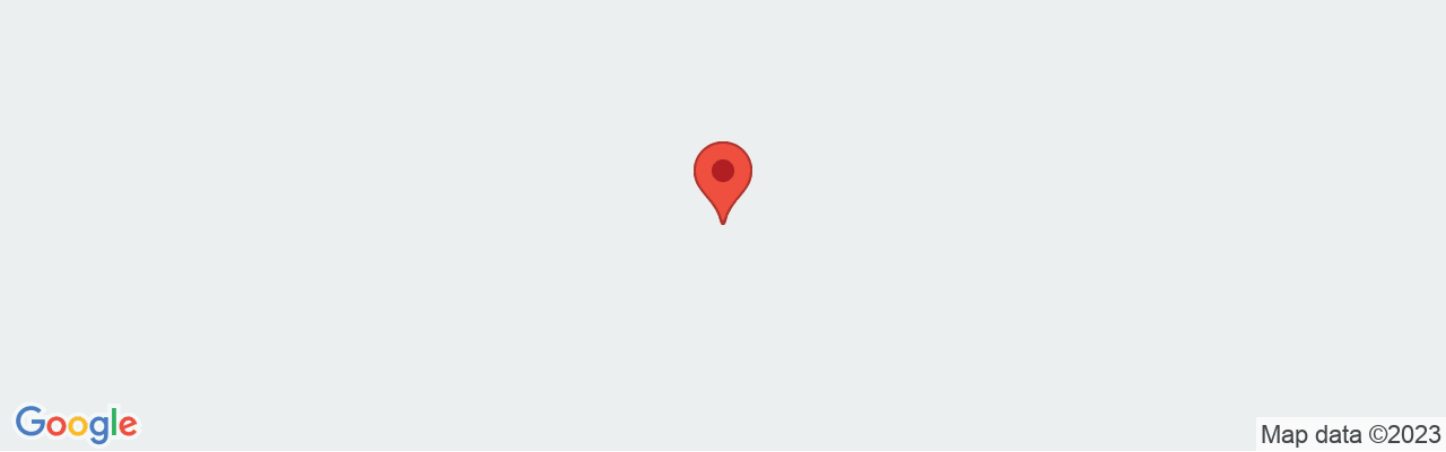
Turbine No. 28

Latitude, Longitude: 37.748321, -121.610581



Date	6/25/2023, 1:02:15 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.548	MCE_R ground motion. (for 0.2 second period)
S_1	0.537	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.858	Site-modified spectral acceleration value
S_{M1}	0.786	Site-modified spectral acceleration value
S_{DS}	1.238	Numeric seismic design value at 0.2 second SA
S_{D1}	0.524	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.463	Site amplification factor at 1.0 second
PGA	0.647	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.776	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.548	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.697	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.62	Factored deterministic acceleration value. (0.2 second)
S1RT	0.537	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.585	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.655	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.647	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.912	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.918	Mapped value of the risk coefficient at a period of 1 s
C_V	1.21	Vertical coefficient

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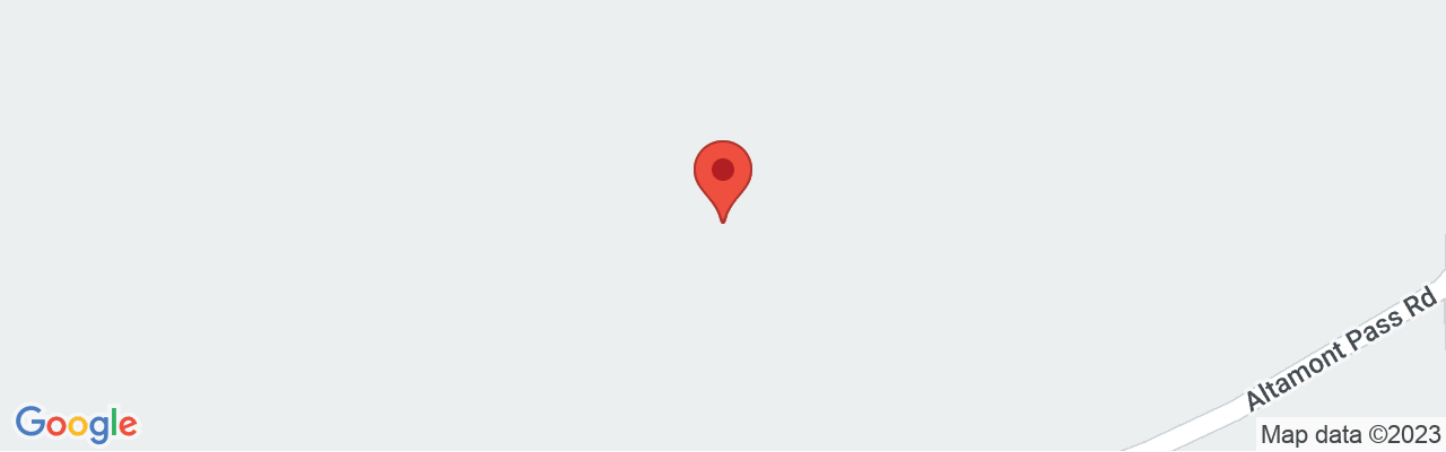
Turbine No. 29

Latitude, Longitude: 37.743305, -121.611697



Date	6/25/2023, 1:03:05 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.572	MCE_R ground motion. (for 0.2 second period)
S_1	0.546	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.886	Site-modified spectral acceleration value
S_{M1}	0.793	Site-modified spectral acceleration value
S_{DS}	1.258	Numeric seismic design value at 0.2 second SA
S_{D1}	0.529	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.454	Site amplification factor at 1.0 second
PGA	0.658	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.79	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.572	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.725	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.662	Factored deterministic acceleration value. (0.2 second)
S1RT	0.546	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.595	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.671	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.658	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.912	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.917	Mapped value of the risk coefficient at a period of 1 s
C_V	1.214	Vertical coefficient

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AML Midway Substation

Latitude, Longitude: 37.747388, -121.598352

Date	6/25/2023, 12:36:26 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.51	MCE_R ground motion. (for 0.2 second period)
S_1	0.523	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.812	Site-modified spectral acceleration value
S_{M1}	0.773	Site-modified spectral acceleration value
S_{DS}	1.208	Numeric seismic design value at 0.2 second SA
S_{D1}	0.515	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.477	Site amplification factor at 1.0 second
PGA	0.63	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.757	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.51	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.655	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.69	Factored deterministic acceleration value. (0.2 second)
S1RT	0.523	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.568	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.683	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.63	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.912	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.921	Mapped value of the risk coefficient at a period of 1 s
C_V	1.202	Vertical coefficient

DISCLAIMER

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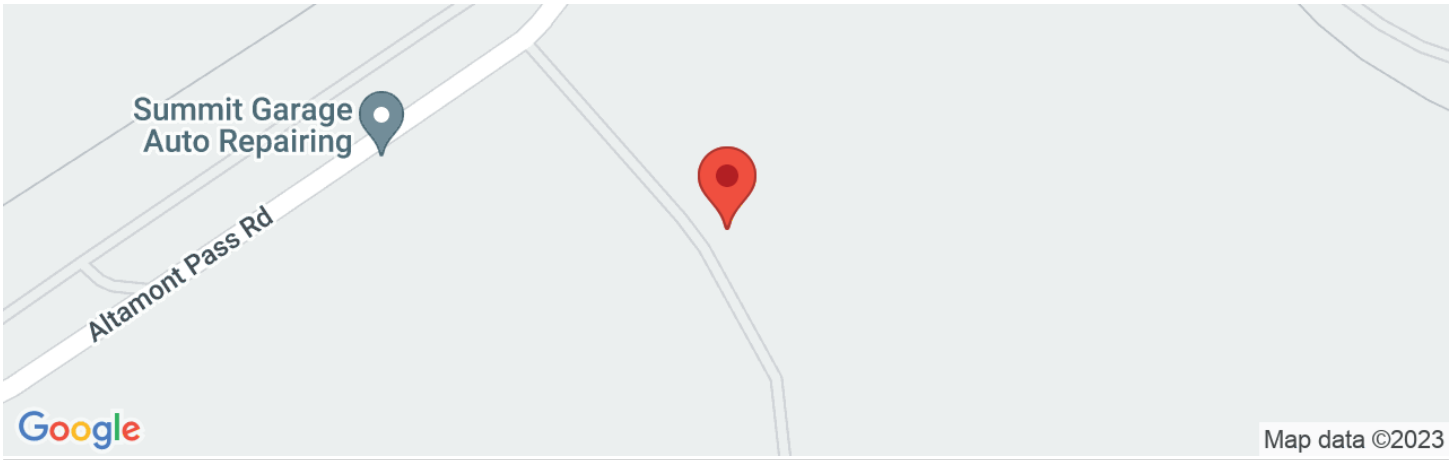
Zond Substation

Latitude, Longitude: 37.743112, -121.658771



Date	6/25/2023, 12:38:53 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.672	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.006	Site-modified spectral acceleration value
S_{M1}	0.84	Site-modified spectral acceleration value
S_{DS}	1.338	Numeric seismic design value at 0.2 second SA
S_{D1}	0.56	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.676	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.811	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.749	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.922	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.672	Factored deterministic acceleration value. (0.2 second)
S1RT	0.612	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.673	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.676	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.737	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.91	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.91	Mapped value of the risk coefficient at a period of 1 s
C_V	1.234	Vertical coefficient

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APPENDIX K

Corrosion Testing

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

25 May 2023

Job No. 2305015
Cust. No 10598

Mr. Abbas Abdollahi
Berlogar Stevens & Associates
1220 Quarry Lane, Suite C
Pleasanton, CA 94566

Subject: Project No.: 4245.203
Project Name: Rooney/San Hill
Corrosivity Analysis – ASTM Test Methods with Brief Evaluation

Dear Mr. Abdollahi:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on May 10, 2023. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurements, Samples No. 001 and No. 004 are classified as "moderately corrosive", Samples No. 002 and No. 003 are classified as "mildly corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations for all samples is none detected with a reporting limit of 15 mg/kg.

The sulfate ion concentrations ranged from none detected to 19 mg/kg and are determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations.

The pH of the soils ranged from 8.02 to 8.29, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials ranged from 250-mV to 300-mV. All samples are indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Berlogar Stevens & Associates
Client's Project No.: 4245.200
Client's Project Name: Rooney/Sand Hill
Date Sampled: Not Indicated
Date Received: 10-May-23
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 24-May-2023

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (As Received) (ohms-cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
2305015-001	Turbine 6 @ 2-3.5'	250	8.06	-	3,000	-	N.D.	N D
2305015-002	Turbine 19 @ 2.5-4'	280	8.28	-	8,000	-	N.D.	N.D.
2305015-003	Turbine 24 @ 2-3.5'	300	8.29	-	8,000	-	N.D.	N.D.
2305015-004	Turbine 29 @ 2-3.5'	280	8.02	-	2,800	-	N.D.	19

Method:	ASTM D1498	ASTM D4972	ASTM G57	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	13-May-2023	15-May-2023	-	15-May-2023	-	16-May-2023	16-May-2023

* Results Reported on "As Received" Basis

N.D. - None Detected

Cheri McMillen
Chemist

Quality Control Summary - **All laboratory quality control parameters were found to be within established limits**

APPENDIX L

Geotechnical Investigation Report for Site Grading

Via E-Mail and Mail

BERLOGAR STEVENS & ASSOCIATES

April 4, 2023 (Revised May 11, 2023)
Job No. 4245.200

Mr. Todd Hopper
Viracocha Wind LLC
402 West Broadway, Suite 400
San Diego, California 92101

Subject: Geotechnical Investigation for Site Grading
Rooney/ Sand Hill – 20 Wind Turbine Sites and Access Roads
Altamont Pass Road
Alameda County, California

Dear Mr. Hopper:

This provides our Geotechnical Investigation Report for Site Grading for access roads to facilitate construction of 20 wind turbines to be constructed as part of the Rooney/Sand Hill Wind Turbine project in Alameda County.

The site is located northeast of Livermore, and extends on north and south of Altamont Pass Road as shown on Plate 1, Vicinity Map. The locations of the proposed 20 wind turbines (WT) and 1 alternate wind turbine (20A) at the site are shown on Plate 2, Site Plan. We have reviewed the grading plans prepared by dk Consulting dated January 31, 2023. This geotechnical investigation report will be utilized for construction of the wind turbine pads and the access roads. A second geotechnical report presenting foundation design recommendations is in process.

The following describes the proposed improvements.

- Demolition of prior wind turbine foundations in the areas to be graded. Underground utilities associated with the previously existing turbines will be removed as needed during grading for the wind turbine pads, electric substation pads, laydown areas and access roads.

- Constructing access roads for transporting pre-manufactured wind turbine parts and equipment to the new wind turbine pads and laydown areas. Generally, the access roads are planned to be approximately 24 feet wide. Grading will consist of cuts and fills up to the order of 15 feet in depth at slope ratios of 2H:1V and 3H:1V.

- Constructing pads at each wind turbine location for equipment and crane staging in order to construct the wind turbine structures. The pads will be approximately 350 feet in size. Each wind turbine pad will be primarily cut (typically 5 + 10 feet), with fills up to approximately 10 feet thick on the downhill margins at some locations.

PURPOSE AND SCOPE OF SERVICES

The purpose of this investigation was to evaluate the proposed project with respect to site soil, bedrock and groundwater conditions, and to provide geotechnical conclusions and recommendations for the site grading necessary for the design and construction of the planned grading for this wind turbine project. The scope of our services included a review of available geologic/geotechnical literature, field reconnaissance, field exploration, laboratory testing, engineering analyses and preparation of this report.

FIELD EXPLORATION

Our field exploration consisted of excavating a continuous trench approximately 100 feet in length at each turbine site and drilling Diamond Core Borings approximately 90 feet in depth at Turbine Sites 22 and 28 supplemented with 8 backhoe test pits. The test pits were excavated with rubber tire backhoe to depths of up to 8 feet below the ground surface (bgs). The approximate Trench and Test Pit locations are shown on the Site Plan. Materials encountered in the Test Pits were visually classified in the field and a log was recorded. Bulk samples were collected from the Test Pits at various depths. The test pits were loosely backfilled and wheel rolled.

SITE CONDITIONS

SURFACE CONDITIONS

The Site Plan shows the existing topography of the site as provided by dk Consulting. The physical site characteristics are described as follows:

- Several miles of existing gravel access roads provide access to the existing wind turbines. These access roads connect to Altamont Pass Road.
- Grasses and weeds cover the hillsides, with some small, sporadic bushes. Limited rock outcrops are visible mostly along the ridge tops.
- Remnants of smaller wind turbines are located on the ridge tops along the access roads. The existing wind turbine foundations and underground utilities outside the grading limits will remain.
- The proposed new wind turbines are to be located on ridge tops that generally trend north-northwest.

SUBSURFACE CONDITIONS

Alluvium mantles the lower, flatter lying valleys of the site with some colluvium located in drainages between hillsides. The access roads traverse bedrock areas as well as areas underlain by alluvium and colluvium.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

We conclude that, from a geotechnical engineering standpoint, construction of the proposed site grading for the wind turbines, access roads, electric substations, and related improvements is feasible, provided that the conclusions and recommendations contained in this report are incorporated into the design and construction of the project.

The geotechnical engineer should review exposed cut slope conditions during grading to determine if the exposed conditions are as anticipated. Additionally, keyway and bench key cuts should be reviewed by the geotechnical engineer during grading to establish the appropriate depth of keyway and/or bench key.

GENERAL SITE PREPARATION AND GRADING

Our general site preparation and grading recommendations are as follows:

1. The areas to be graded should be cleared of debris, surface vegetation, and existing abandoned utilities and former wind turbine foundations.
2. Areas to receive engineered fill should be scarified at least 12 inches, moisture conditioned to not less than 3 percent over the optimum moisture content, and compacted to at least 90 percent relative compaction (ASTM D1557). In cut areas exposing bedrock, scarification may not be necessary. The geotechnical engineer will determine the necessity of scarifying cut bedrock areas prior to placing fill.
3. The on-site soil and excavated bedrock are generally suitable for engineered fill, provided it:
    - Is free of debris and deleterious matter.
    - Has an organic content of less than 3 percent by weight.
    - Has a maximum particle size of 12 inches.

4. Large rock fragments over 12 inches in size can be placed in the Balance Fill areas or placed below a depth of 8 feet in deep fill areas. The large rock fragments should be placed such that they are not nested and so that soil fill can be placed and compacted between the large rock fragments.

5. Engineered fill should be moisture conditioned and compacted as follows:

   All fill should be compacted to at least 90 percent relative compaction at a moisture content of at least 3 percent over the optimum moisture content.

6. Fill and backfill should be placed in thin lifts (normally 8 to 12 inches in loose lift thickness depending on the compaction equipment), properly moisture conditioned, and compacted as specified above.

7. Fill slopes should be constructed at slope gradients no steeper than 2 horizontal to 1 vertical (2H:1V).

8. Fill slopes less than about 20 feet tall and located near ridge tops or flat ground should have a 20-foot wide bench key and slope into the bedrock or competent soil at a 5 percent gradient. Where the existing ground is flatter than 8H:1V, the existing ground should be scarified 1 foot and compacted prior to placement of engineered fill. Where the existing ground is steeper than 8H:1V, benches should be constructed into the hillside approximately 1 equipment width as the fill is being placed.

9. Fill slopes more than about 20 feet tall or located on steep slopes should have a keyway that is at minimum 20 feet wide or half the fill slope height, whichever is greater, and slope into the bedrock at a 5 percent gradient. Sub-drainage may be recommended based on exposed conditions. Subdrain pipes should typically be at least 4 inches in diameter. Perforated subdrain pipes should be surrounded by and be underlain by at least 4 inches of Class 2 Permeable Material, as defined in Section 68-2.02F3 of the State of California Standard Specifications. Subdrains can daylight below the fill slope. If significant seepage is observed during grading, additional subdrains should be installed as recommended by the Geotechnical Engineer.

10. The grading contractor should GPS survey the locations of all subdrains and promptly submit the latitude, longitude, and elevations to the Civil and Geotechnical Engineers at the end of grading.

11. Cut slopes in bedrock should be constructed at slope gradients no steeper than 2H:1V. The soil engineer should review cut slope conditions during grading.

12. Surface drainage should be directed away from the top of fill slopes by sloping the ground surface at least 2 percent. Site grading should be performed to prevent water from ponding.

13. Relative compaction refers to the in-place dry density of the soil expressed as a percentage of the maximum dry density determined by ASTM D1557 compaction test procedure. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

14. Observations and soil density tests should be carried out during grading and backfill operations to assist the contractor in obtaining the required degree of compaction and proper moisture content. Where the compaction is outside the range required, additional compaction effort and adjustment of moisture content should be made until the specified compaction and moisture conditioning is achieved.

15. The Geotechnical Engineer should be notified at least 48 hours prior to any grading and backfill operations. The procedure and methods of grading may then be discussed between the contractor and the Geotechnical Engineer.

TURBINE PAD GRADING

The grading recommendations provided above can be used for grading the proposed turbine pads. The upper foot of turbine pads should be compacted to at least 95 percent relative compaction. The Geotechnical Engineer will determine the necessity of scarifying and compacting cut bedrock during grading. The Geotechnical Engineer should be provided crane data and proposed crane loading that will be imposed during turbine erection. Recommendations for allowable loading on the graded Turbine pads can be provided at that time.

ACCESS ROAD GRADING

The grading recommendations provided above should be used for grading the proposed access roads.

The exposed subgrade should be scarified at least 1 foot and compacted to at least 95 percent relative compaction for non-expansive soil. In keyways and bench keys exposing hard bedrock, scarification may not be necessary. The Geotechnical Engineer will determine the necessity of scarifying cut bedrock areas in the field prior to placing fill.

It is our understanding that construction equipment will be driven on the access roads prior to placement of an aggregate base layer. Generally, it is anticipated that where subgrade cuts into bedrock on ridges, the subgrade should generally be stable (depending on the time of year that grading commences). Subgrade located in areas underlain by alluvium or colluvium will likely be less stable (again, depending on the time of year grading commences). Upon completion of grading, the temporary access roads will be surfaced with Class 2 Aggregate Base. These access roads will be converted to ranch roads upon completion of grading and construction of the project. The Class 2 Aggregate Base should be moisture conditioned and compacted with a smooth drum roller to not less than 95% relative compaction (ASTM D1557). The thickness of the Class 2 Aggregate Base will be determined once loading imposed by Construction Equipment is available.

SEISMIC HAZARDS

California Geologic Survey Seismic Hazard Zones mapping is available only for the portion of the project pertaining to Turbines 3 through 9. The mapped Seismic Hazard Zones are presented on Plate 4. No indications of landsliding were encountered in 100 feet long Exploration Trenches at each Turbine Site. We judge that the risk of Earthquake-Induced Landslides to the Planned Turbine Sites is low.

ADDITIONAL SOIL ENGINEERING SERVICES

Prior to construction, our firm should be provided the opportunity to review the plans and specifications to determine if the recommendations of this report have been implemented in those documents. We would appreciate the opportunity to meet with the contractors prior to the start of site grading to discuss the procedures and methods of construction. This can facilitate the performance of the construction operation and minimize possible misunderstanding and construction delays.

To a degree, the performance of the proposed project is dependent on the procedures and quality of the construction. Therefore, we should provide observations of the contractor's procedures and the exposed soil conditions, and field and laboratory testing during site preparation and grading, placement and compaction of fill. These observations will allow us to check the contractor's work for conformance with the intent of our recommendations and to observe any unanticipated soil conditions that could require modification of our recommendations.

LIMITATIONS

The conclusions and recommendations of this report are based upon the information provided to us regarding the proposed project, subsurface conditions encountered at the field exploration locations, and professional judgment. This investigation has been conducted in accordance with currently accepted standards of geotechnical engineering practice; no other warranty is expressed or implied.

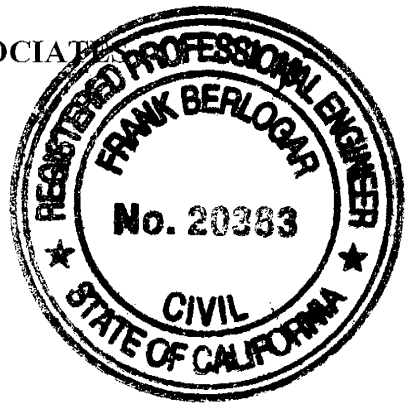
The field exploration locations were determined by pacing from the existing surface features. Site conditions described in the text are those existing at the time of our field explorations and are not necessarily representative of such conditions at other locations and times.

The logs show subsurface conditions at the locations and on the dates indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. In the event that changes in the nature, design or location of the proposed project are planned, or if subsurface conditions differ from those described in this report, then the conclusions and recommendations in this report shall be considered invalid, unless the changes are reviewed and the conclusions and recommendations modified or approved in writing.

We trust this report provides the necessary information at this time. If you have any questions, please contact us. It has been our pleasure to provide professional services to Viracocha Wind LLC for this project.

Respectfully submitted,

BERLOGAR STEVENS & ASSOCIATES



Frank Berlogar
RCE 20383

FB:mc

Attachments:

Plate 1 – Vicinity Map
Plate 2 – Regional Geologic Map
Plate 3 - Site Plan
Plate 4 – Seismic Hazard Zones
Appendix A – Trench Logs
Test Pit Logs
Appendix B Diamond Core Logs and Photographs
Appendix C Laboratory Test Results

Copies: Addressee
Stacey Gella, dk Consulting

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