CRESTLINE SANITATION DISTRICT

MEMORANDUM

DATE: **August 8, 2024**

TO: **BOARD OF DIRECTORS**
Crestline Sanitation District

FROM: **DAWN GRANTHAM**
General Manager

SUBJECT: **Engineering Report from Webb Associates for the Hillside Stabilization at Seeley Creek WWTP**

A. RECOMMENDATION

I recommend the approving the engineering report from Webb Associates for the failed slope at Seeley Creek WWTP behind the clarifier. The engineering report has be separated into two documents, one for the temporary urgent repair now and the other for a permanent slope repair, which will commence in the Spring of 2025.

B REASON FOR RECOMMENDATION

I have met with the engineers and reviewed the reports. I believe the temporary fix can be done before the winter starts.

C. FISCAL INFORMATION

Webb Associates mentioned that there is still an unused amount for the contract and is willing to assist in overseeing the urgent repair on the slope.

D. ATTACHMENTS

Engineering reports from Webb Associates.

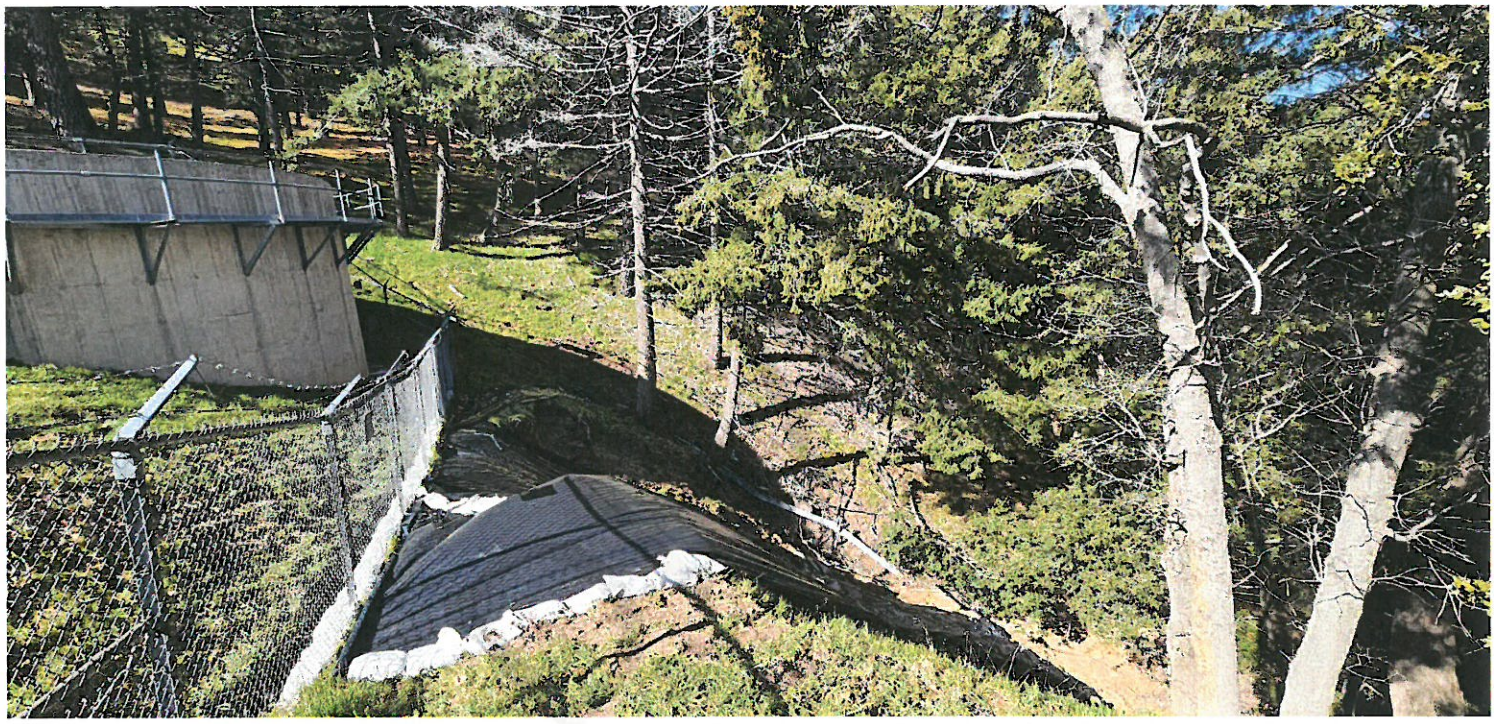
Converse Consultants
Geotechnical Engineering
Environmental & Groundwater Science
Inspection & Testing Services

GEOTECHNICAL SLOPE DISTRESS INVESTIGATION REPORT

SEELEY CREEK WASTEWATER TREATMENT PLANT CLARIFIER AREA

City of Crestline, San Bernardino County, California

CONVERSE PROJECT NO. 24-81-141-01



Prepared For:

ALBERT WEBB AND ASSOCIATES

3788 McCray Street
Riverside, California 92506

Presented By:

CONVERSE CONSULTANTS

2021 Rancho Drive, Suite 1
Redlands, CA 92373
909-796-0544

August 7, 2024

Converse Consultants
Geotechnical Engineering, Environmental & Groundwater Science, Inspection & Testing Services

August 7, 2024

Mr. Bradley Sackett
Senior Engineer
Albert A. Webb Associates
3788 McCray Street
Riverside, California 92506

Subject: **GEOTECHNICAL SLOPE DISTRESS INVESTIGATION REPORT**
Seeley Creek Wastewater Treatment Plant Clarifier Area
City of Crestline, San Bernardino County, California
Converse Project No. 24-81-141-01

Dear Mr. Sackett,

Converse Consultants (Converse) is pleased to submit this slope distress investigation report for the Seeley Creek Wastewater Treatment Plant Clarifier Area located in the unincorporated community of Crestline in San Bernardino County, California. This report was prepared in accordance with our proposal dated March 18, 2024, and your Subconsultant Agreement, Project Code 2024-0159, authorization dated April 3, 2024.

Based upon our field investigation, laboratory data, and analyses, the Wastewater Treatment Plant Clarifier slope area can be repaired from a geotechnical standpoint, provided the recommendations presented in this report are incorporated into the design and construction of the project.

We appreciate the opportunity to be of continued service to Albert A. Webb Associate and the Crestline Sanitation District. If you should have any questions, please do not hesitate to contact us at 909-474-2847.

CONVERSE CONSULTANTS

Hashmi S. E. Quazi, PhD, GE, PE
Principal Engineer

Dist.: 1/Addressee
1/Crestline Sanitation District; Attn; Ms. Dawn Grantham
CN/RLG/HSQ/kvg

PROFESSIONAL CERTIFICATION

This report has been prepared by the following professionals whose seals and signatures appear herein.

The findings, recommendations, specifications, and professional opinions contained in this report were prepared in accordance with the generally accepted professional engineering and engineering geologic principle and practice in this area of Southern California. We make no other warranty, either expressed or implied.

In the event that changes to the property occur, or additional, relevant information about the property is brought to our attention, the conclusions contained in this report may not be valid unless these changes and additional relevant information are reviewed, and the recommendations of this report are modified or verified in writing.

Catherine Nelson, GIT
Senior Staff Geologist

Robert L. Gregorek II, PG, CEG
Senior Geologist

Hashmi S. Quazi, PhD, PE, GE
Principal Engineer

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1.0 INTRODUCTION

This report contains preliminary findings and recommendations for the slope distress investigation of the Seeley Creek Wastewater Treatment Plant Clarifier Area located in the unincorporated community of Crestline in San Bernardino County, California. The project location is shown in Figure No. 1, *Approximate Site Location Map*.

The purposes of this investigation were to determine the nature and engineering properties of the subsurface soils and bedrock, analyze surficial and deep-seated slope stability and provide repair recommendations, as needed.

This report is written for the project described herein and is intended for use solely by the Albert A. Webb Associate and the Crestline Sanitation District. It should not be used as a bidding document but may be made available to the potential contractors for information on factual data only. For bidding purposes, the contractors should be responsible for making their own interpretation of the data contained in this report.

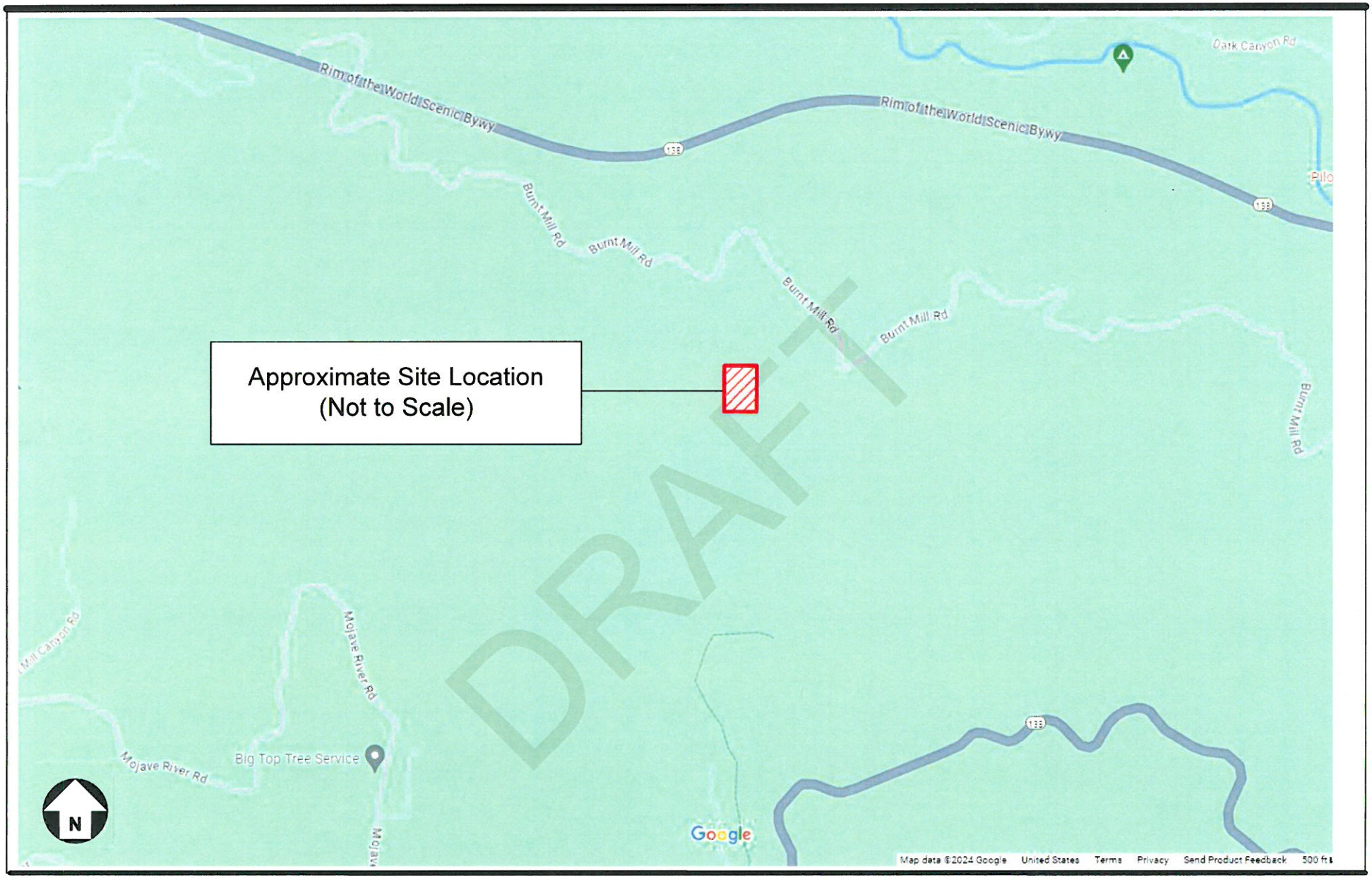
2.0 PROJECT AND SITE DESCRIPTION

The existing clarifier area with adjacent slope distress is located at the southwest portion of the Seeley Creek Wastewater Treatment Plant facility, in Crestline, San Bernardino County, California.

The site has nearly flat areas as well as descending and ascending slope areas surrounding the existing clarifier. The descending slope area north of the clarifier appears to be graded while the ascending slope areas south and east of the clarifier appear to be partially graded and natural. The near flat portions east of the clarifier are partially paved with asphalt. Based on a previous slope evaluation report and conversations with Crestline Sanitation District representative the descending slope area north of the wastewater treatment plant clarifier area tank has an existing slope failure or surficial failure that has had continued movement and erosion since about 2005. Evidence of other slope movement or surficial creep appears to exist at the edge of the pavement at the top of slope east of the clarifier and portions of the ascending slopes south and east of the clarifier. Crestline Sanitation District representatives also indicated that there are concerns the clarifier appears to have some tilting, settlement and/or movement.

3.0 SCOPE OF WORK

The scope of this investigation included project set-up, subsurface exploration, laboratory testing, engineering analysis, and preparation of this report, as described in the following sections.



Project: Seeley Creek Wastewater Treatment Plant
Location: CA-138
City of Crestline, San Bernardino County, California

For: Albert Webb and Associates

Approximate Site Location Map

Project No.
23-81-141-01

Converse Consultants

Figure No.
1

3.1 Document Review

We reviewed the reference geotechnical evaluation report by Converse (2005), geologic maps, aerial photographs, groundwater data, and other information pertaining to the project area to assist in the evaluation of any geologic hazards that may be present.

3.2 Project Set-up

The project set-up consisted of the following tasks.

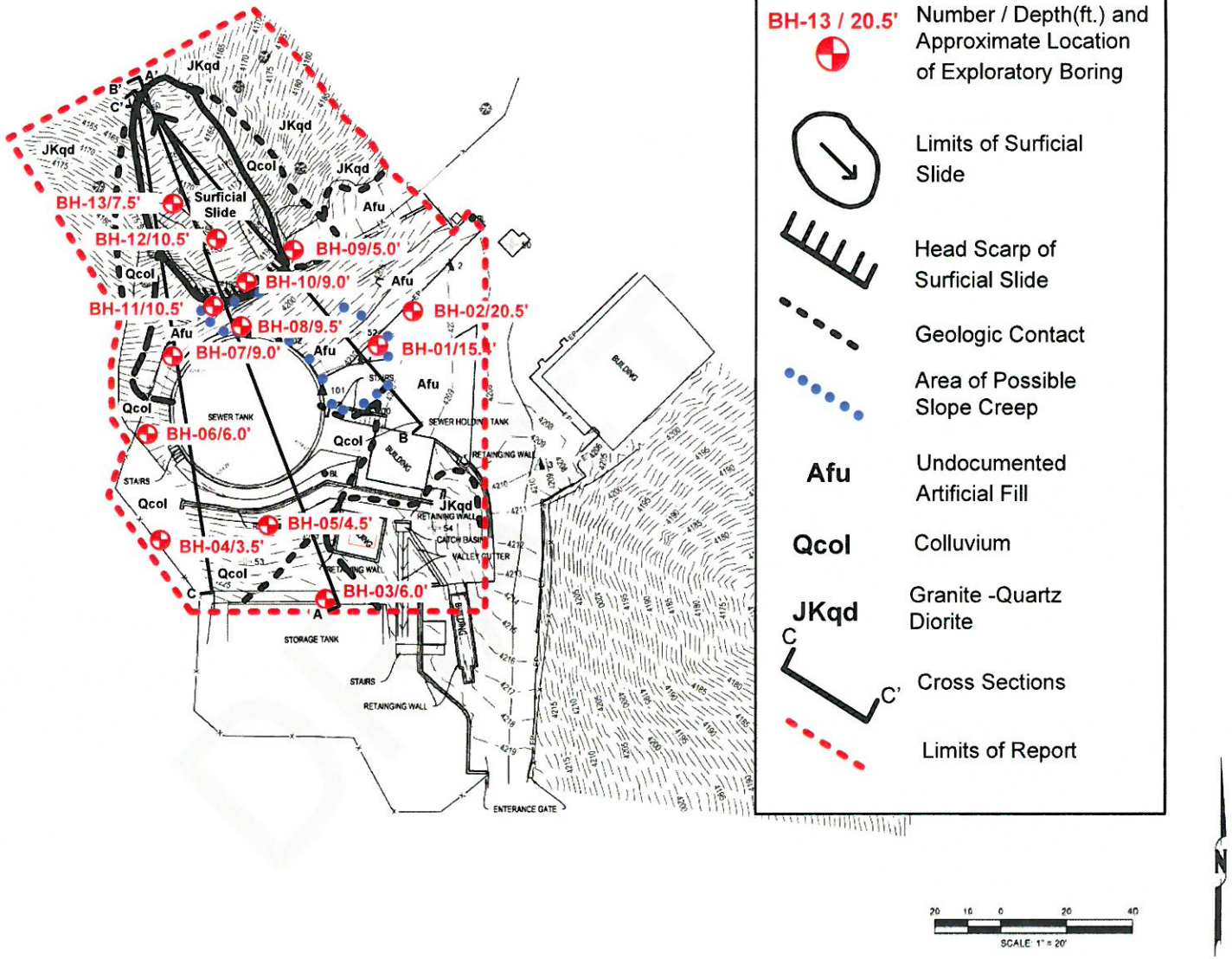
- Performed a site visit with representatives of Albert A. Webb Associates and the Crestline Sanitation District on March 8, 2024, to evaluate the existing conditions and equipment access.
- Review of information and site plans regarding the project and scope of work information transmitted by Albert A. Webb Associates and the Crestline Sanitation District, via e-mail and our phone conversations, from March 5 to 15, 2024.
- Review of a previous slope evaluation report for the area and the local geologic information.
- A brief review of aerial photograph which was provided for existing site conditions.
- And Google Earth aerial photograph for previous site conditions.
- Conducted a field reconnaissance, staked boring locations, and verified that the drilling contractor had access.
- Notified Underground Service Alert (USA) and the Crestline Sanitation District at least 48 hours prior to drilling to clear the boring location of any conflict with existing underground utilities.
- Engaged a California-licensed driller to drill the hollow-stem auger exploratory borings.

3.3 Subsurface Exploration

Our subsurface investigation consisted of the following.

Two exploratory borings (BH-01 through BH-02) were drilled on May 24, 2024, using a truck-mounted CME 75 drill rig equipped with 8-inch diameter hollow-stem augers and 11 exploratory borings (BH-03 and BH-13) were drilled on May 28 and 31, 2024, using a hand auger, to investigate the subsurface conditions. Borings BH-01 through BH-02 were each drilled to an approximate depth of 18.0 feet to 20.5 feet below ground surface (bgs). Borings BH-03 and BH-13 were drilled to depths of approximately 3.5 feet to 10.5 feet bgs.

Approximate boring locations are indicated in Figure No. 2, *Approximate Boring Locations Map*. For a description of the field exploration and sampling program, see Appendix A, *Field Exploration*.



Project: Seeley Creek Wastewater Treatment Plant
Location: CA-138
City of Crestline, San Bernardino County, California

Approximate Boring Locations and Geologic Map

Project No. 24-81-141-01

For: Stantec Consulting Services

Converse Consultants

Figure No. 2

3.4 Laboratory Testing

Representative soil samples were tested in the laboratory to aid in the soils classification and to evaluate the relevant engineering properties of the site soils. These tests included the following.

- *In-situ* moisture contents and dry densities (ASTM D2216 and D2937)
- Expansion Index (ASTM D4829)
- Soils Corrosivity (CTM 643, 422, 417, 532)
- Grain size analysis (ASTM D6913)
- Maximum dry density and optimum-moisture content (ASTM D1557)
- Direct shear (ASTM D3080)
- Consolidation (ASTM D2435)

For *in-situ* moisture and dry density data, see the Logs of Borings in Appendix A, *Field Exploration*. For a description of the laboratory test methods and test results, see Appendix B, *Laboratory Testing Program.*

3.5 Slope Stability Evaluation

The proposed slopes were analyzed to evaluate the anticipated slope stability conditions. The conditions analyzed included the stability of the underlying soils and bedrock, the stability of the underlying soils and bedrock under earthquake conditions, and the stability of the surficial soils and compacted fill in both dry and saturated conditions.

3.6 Analysis and Report Preparation

Data obtained from the field exploration and laboratory testing program was compiled and evaluated. Geotechnical analyses of the compiled data were performed, and this report was prepared to present our findings, conclusions, and recommendations for the project.

4.0 SITE CONDITIONS

A general description of the subsurface conditions, various materials and groundwater conditions encountered at each location during our field exploration is discussed below.

4.1 Subsurface Profile

Based on the exploratory borings and laboratory test results, the subsurface soil and bedrock at the site includes undocumented artificial fill, colluvium and Mesozoic and/or Jurassic granitic rock consisting of quartz diorite. In addition, a surficial slide exists on the descending slope on the northern portion of the site. The following is a description of each soil unit encountered.

4.1.1 Artificial Fill

Undocumented artificial fill was encountered in borings BH-01, BH-02, BH-07, BH-08 and BH-011 from the surface to approximately 1.0 foot to 7.0 feet bgs with some areas as much as 8.0 feet to 9.0 feet thick. These fills are likely associated with the construction of the Seeley Creek Wastewater Treatment Plant Clarifier facility. This material was a silty sand that was generally fine to coarse grains, had trace clay, contained roots and rootlets, was loose to medium dense, moist and brown in color.

4.1.2 Colluvium

Colluvium was encountered in all of the borings below the artificial fill or the surface and was approximately 0.5 foot to 8.0 feet think. Some areas may be as much as 9.0 feet to 10.0 feet thick. This material was a fine to coarse-grained silty sand and clayey sand, loose to medium dense, moist to wet, and various shades of orange, yellow and brown. Based on exploratory boring and geologic cross sections there may be up to approximately 3 feet of potentially compressible colluvium below the foundation of about the outer 5 feet to 10 feet of the northern portion of the wastewater treatment plant clarifier.

4.1.3 Bedrock

Granite bedrock consisting of quartz diorite was encountered in every boring except borings BH-09 and BH-13 at depths of 3.0 feet to 10.0 bgs to the maximum depths explored. The bedrock may be as much as 11.0 feet to 13.0 feet bgs. This unit was generally moderately hard to very hard, moist to locally wet, moderately to intensely weathered, locally friable and generally excavated as sand to silty sand with fine to coarse grains, with varying shades of yellow and brown.

4.1.4 Surficial Slide

Surficial slide debris was encountered within the descending slope northern portion of the site, below the wastewater treatment plant clarifier tank, in borings BH-10, BH-12 and BH-13 from the surface to approximately 5.0 feet to 7.0 feet bgs, were explored, may be as much as 8.0 feet to 9.0 feet thick. This material was a fine to coarse-grained silty sand and clayey sand, loose, moist to wet, and various shades of yellow and brown.

For a detailed description of the subsurface materials encountered in the exploratory borings, see Drawing Nos. A-2 through A-14, *Logs of Borings/Test Pits* in Appendix A, *Field Exploration*.

4.2 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Depending on the extent and

location below finish subgrade, expansive soils can have a detrimental effect on structures.

Based on the 2 laboratory tests conducted during this investigation the expansion index of the upper 15 feet of the general site soils was 1, corresponding to a very low potential.

4.3 Collapse Potential

Soil deposits subjected to collapse/hydro-consolidation generally exist in regions of moisture deficiency. Collapsible soils are generally defined as soils that have potential to suddenly decrease in volume upon increase in moisture content even without an increase in external loads. Moreover, some soils may have a different degree of collapse/hydro-consolidation based on the amount of proposed fill or structure loads. Soils susceptible to collapse/ hydro-consolidation include wind-blown silt, weakly cemented sand, and silt where the cementing agent is soluble (e.g., soluble gypsum, halite), alluvial or colluvial deposits within semi-arid to arid climate, and certain weathered bedrock above the groundwater table.

Granular soils may have a potential to collapse upon wetting in arid climate regions. Collapse/hydro-consolidation may occur when the soluble cements (carbonates) in the soil matrix dissolve, causing the soil to densify from its loose/low density configuration from deposition.

The degree of collapse of a soil can be defined by the collapse potential value, which is expressed as a percentage of collapse of the total sample using the Collapse Potential Test (ASTM D4546). According to the ASTM guideline, the severity of collapse potential is commonly evaluated by the following Table No. 1, *Collapse Potential Values*.

Table No. 1, Collapse Potential Values

Collapse Potential Value (%)	Severity of Problem
0	None
0.1 to 2	Slight
2.1 to 6.0	Moderate
6.0 to 10.0	Moderately Severe
>10	Severe

Three consolidation tests were also conducted for this project. A collapse potential of 1.1 percent at a depth of 4.0 feet bgs in boring BH-07 was measured. A collapse potential of 0.1 percent at a depth of 5.0 feet bgs in boring BH-08 was measured. A collapse potential of 0.2 percent at a depth of 2.0 feet bgs in boring BH-10 was measured. These indicate only a slight problem at the site. Collapse potential distress is typically considered a concern when collapse potential is over 2% (LA County, 2013).

4.4 Groundwater

Groundwater was not encountered in the any exploratory borings to the maximum drilled depth of 20.5 feet bgs. Historically high groundwater within the project area varies between elevations correlating to the top of the slope and toe of the slope. We anticipate historic high groundwater is deeper than approximately 50 feet bgs from the top of the slope. The groundwater level could vary depending upon the seasonal precipitation. Shallow perched groundwater may be present locally, particularly following precipitation or irrigation events.

A review of available near-by water well information was conducted using the USGS National Water Information database, California Department of Water Resources Water Data Library, and GeoTracker database (SWRCB, 2024). With an expanded analysis within a 2.0-mile radius of the centralized coordinates 34.2599 N, 117.3059 W, no historical groundwater elevation data was found in each database.

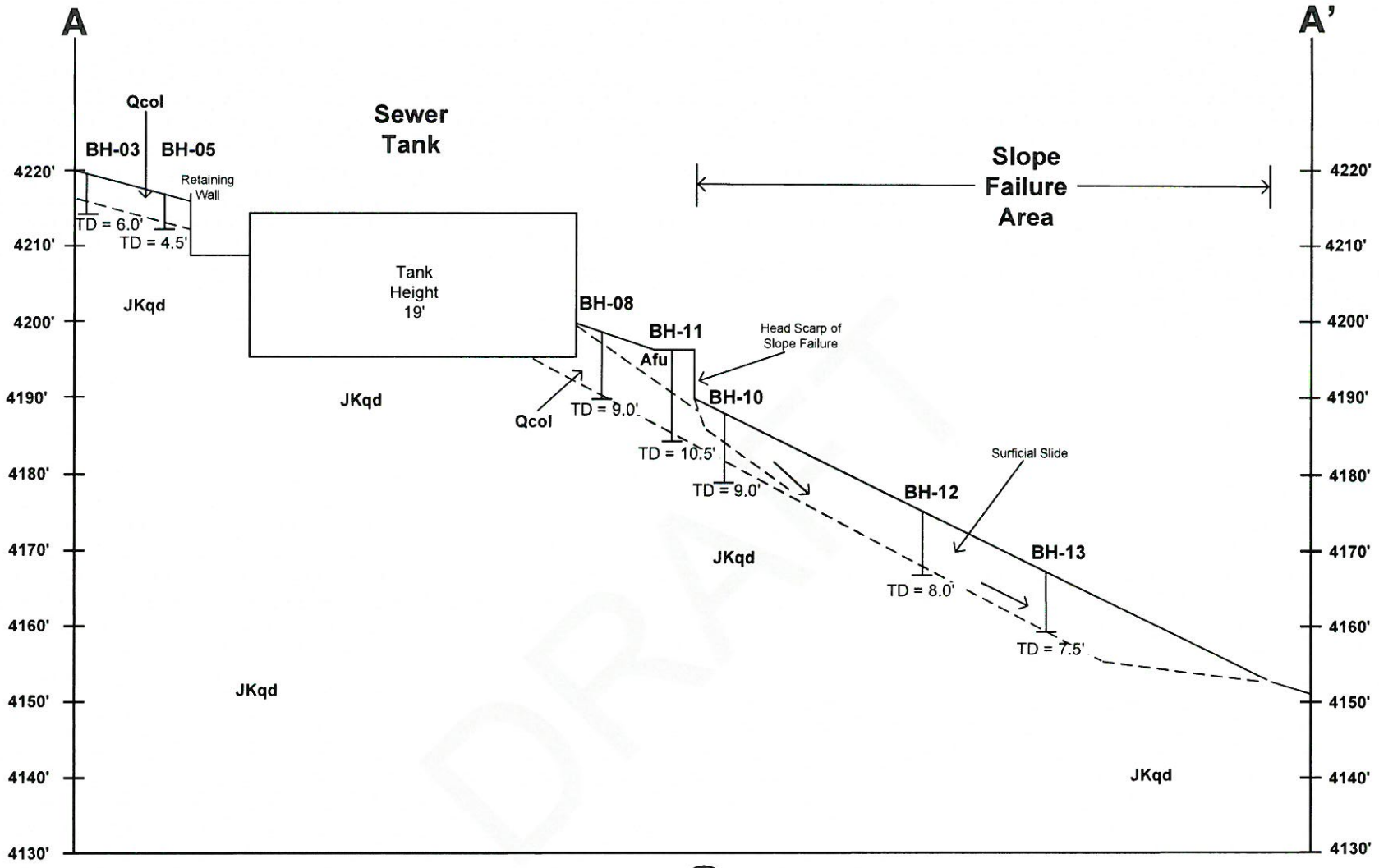
4.5 Excavatability

The subsurface soil materials at the site are expected to be excavatable by conventional heavy-duty earth moving equipment. However, difficult excavation may occur in excavations where very hard bedrock is encountered. The phrase "conventional heavy-duty excavation equipment" is intended to include commonly used equipment such as excavators, scrapers, and trenching machines. It does not include hydraulic hammers ("breakers"), jackhammers, blasting, or other specialized equipment and techniques used to excavate hard earth materials. Selection of an appropriate excavation equipment models should be done by an experienced earthwork contractor. Converse recommends selecting a contractor familiar with the remediation of similar bedrock slopes.

4.6 Subsurface Variations

Based on results of the subsurface exploration and our experience, some variations in the continuity and nature of subsurface conditions within the project site should be anticipated. Because of the uncertainties involved in the nature and depositional characteristics of the earth material at the site, care should be exercised in interpolating or extrapolating subsurface conditions between or beyond the boring locations. If, during construction, subsurface conditions differ significantly from those presented in this report, this office should be notified immediately so that recommendations can be modified, if necessary.

A detailed description of the earth materials encountered during our field exploration is presented in Appendix A, *Field Exploration.* Figure Nos. 4a through 4c, *Geologic Cross Sections A-A' through C-C'*, is provided to illustrate current surface and subsurface conditions by using data from the exploratory borings drilled on May 24 to 31, 2024.



*BH-07 projected approx. 5 feet to southeast.
Qa: Young axial-channel deposits, young alluvial-fan deposits, and eolian deposits.

Horizontal scale: 1" = 20'
Vertical scale: 1" = 20'

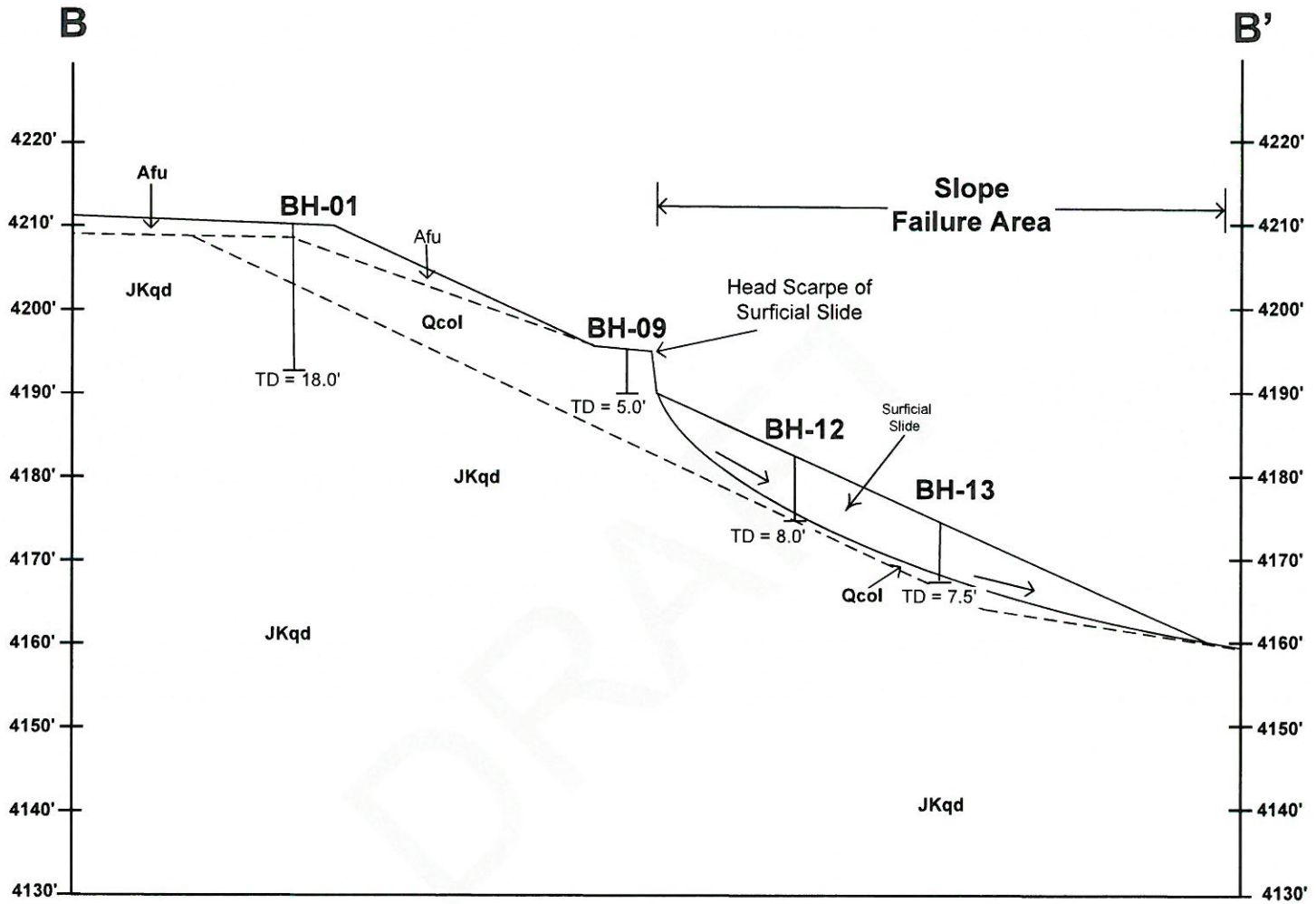
Project: Crestline Camp Seely
Location: City of Crestline, San Bernardino County, CA
For: Webb Associates/ Crestline Sanitation District

GEOLOGIC CROSS SECTION A-A'

Project No.
24-81-141-01

Converse Consultants

Figure No.
4a



Horizontal scale: 1" = 20'
Vertical scale: 1" = 20'

*BH-07 projected approx. 3 feet to northeast.
Qa: Young axial-channel deposits, young alluvial-fan deposits, and eolian deposits.

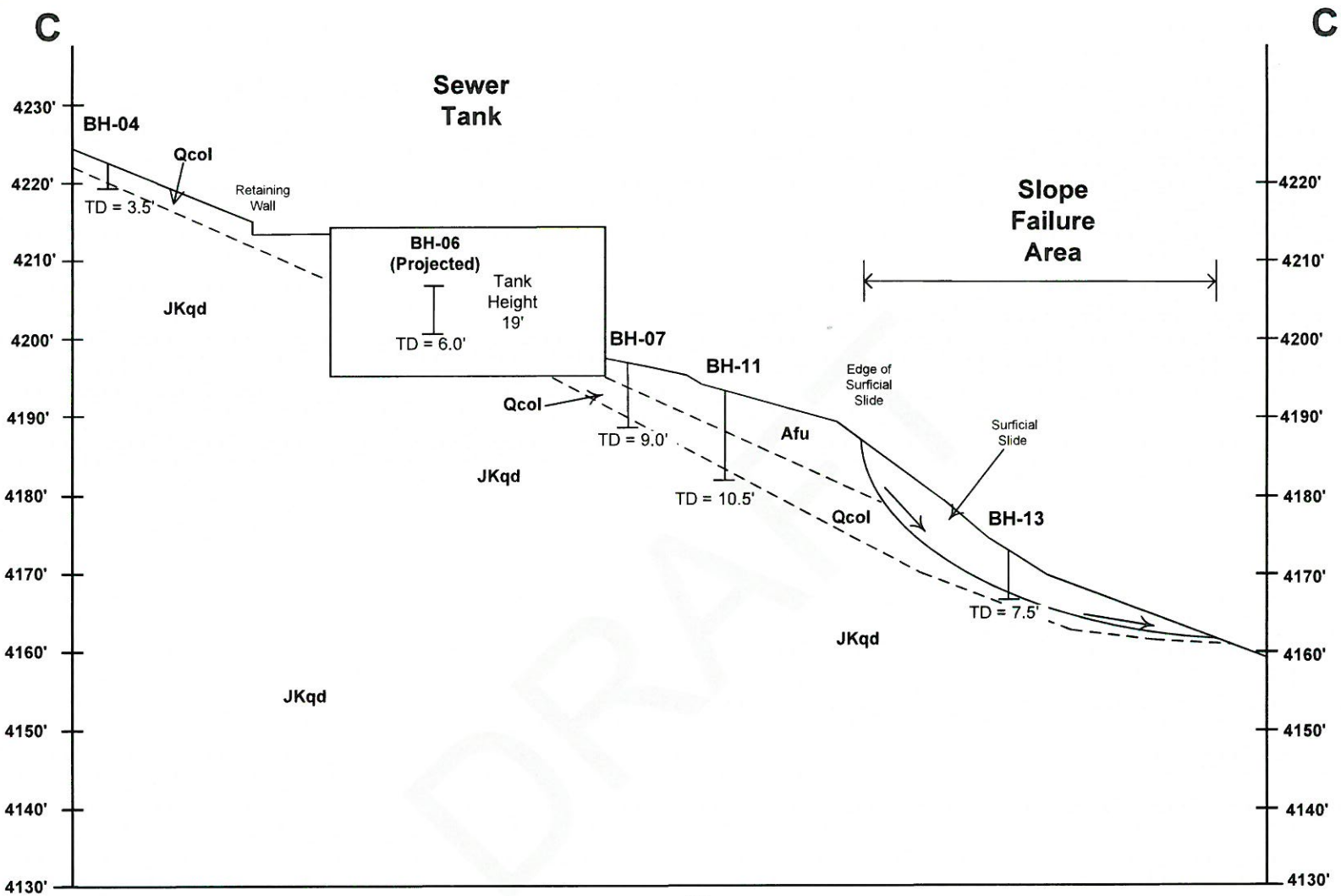
Project: Camp Seely
Location: City of Crestline, San Bernardino County, CA
For: Webb Associates, Crestline Sanitation District

GEOLOGIC CROSS SECTION B-B'

Project No.
24-81-141-01

Converse Consultants

Figure No.
4b



*BH-06 projected from approx. 18 feet to southwest.
*BH-10 projected from approx. 24 feet to the southwest.
*SM=Qa: Young axial-channel deposits, young alluvial-fan deposits, and eolian deposits.

Horizontal scale: 1" = 20'
Vertical scale: 1" = 20'

Project: Seeley Creek Wastewater Treatment Plant
Location: City of Crestline, San Bernardino County, CA

For: Webb Associates/ Crestline Sanitation District

GEOLOGIC CROSS SECTION C-C'

Project No.
24-81-141-01

Converse Consultants

Figure No.
4c

4.7 Caving

Caving was not encountered in any of the exploratory borings. Localized caving may occur in excavations that extend into granular or saturated soils that are encountered on-site.

5.0 GEOLOGIC CONDITIONS

5.1 Local Geology

The site is generally underlain by undocumented artificial fill, Holocene age colluvium and Mesozoic and/or Jurassic granitic rock consisting of quartz diorite. A portion of the descending slope on the northern portion of the site is underlain by a surficial slide.

5.2 Faulting

No portion of the project site is located within a currently designated State of California or San Bernardino County Earthquake Fault Zone (CGS, 2007; San Bernardino County, 2024). The nearest active fault is the Cleghorn Fault approximately 1.86 kilometers (1.16 miles) from the project site.

Table No. 2, *Summary of Regional Faults,* summarizes selected data of known faults capable of seismic activity within 100 kilometers of the proposed project site (using centralized coordinate 34.2599N and 117.3059W. The data presented below was calculated using the National Seismic Hazard Maps Database and other published geologic data.

Table No. 2, Summary of Regional Faults

Fault Name and Section	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
Cleghorn	1.86	Strike slip	25	3.0	6.80
S. San Andreas	6.62	Strike slip	390	n/a	8.02
North Frontal (West)	7.16	Reverse	50	1.0	7.20
San Jacinto	10.82	Strike slip	215	n/a	7.83
Cucamonga	15.35	thrust	28	5.0	6.70
Helendale-So Lockhart	37.62	Strike slip	114	0.6	7.40
San Jose	39.00	Strike Slip	20	0.5	6.70
Sierra Madre Connected	42.87	reverse	76	2.0	7.30
North Frontal (East)	47.29	Thrust	27	0.5	7.00
Chino, alt 2	47.77	Strike slip	29	1.0	6.80
Chino, alt 1	47.84	Strike slip	24	1.0	6.70
Clamshell-Sawpit	49.85	Reverse	16	0.5	6.70
Elsinore; W+GI+T+J+CM	54.42	Strike slip	241	N/A	7.85

Fault Name and Section	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
S. San Andreas; BG+CO	57.59	Strike slip	125	N/A	7.39
Pinto Mtn	58.51	Strike Slip	74	2.5	7.30
Lenwood- Lockhart- Old Woman Springs	59.17	Strike slip	145	0.9	7.50
Raymond	64.03	Strike slip	22	1.5	6.80
Johnson Valley (No)	64.39	Strike slip	35	0.6	6.90
Puente Hills (Coyote Hills)	65.63	Thrust	17	0.7	6.90
Elsinore; T+J+CM	66.14	Strike slip	169	N/A	7.64
Landers	71.11	Strike slip	95	0.6	7.40
Puente Hills (Santa Fe Springs)	75.21	Thrust	11	0.7	6.70
Elysian Park (Upper)	76.30	Reverse	20	1.3	6.70
So Emerson- Copper Mtn	76.46	Strike slip	54	0.6	7.10
Gravel Hills-Harper Lk	76.54	Strike slip	65	0.7	7.10
San Joaquin Hills	78.79	Thrust	27	0.5	7.10
Verdugo	79.50	Reverse	55	0.5	6.90
Puente Hills (LA)	82.34	Thrust	29	0.7	7.00
Burnt Mtn	83.73	Strike slip	21	0.6	6.80
Calico-Hidalgo	84.85	Strike slip	117	1.8	7.40
Eureka Peak	85.30	Strike slip	19	0.6	6.70
Hollywood	86.69	Strike slip	17	1.0	6.70
Blackwater	87.22	Strike slip	60	0.5	7.10
San Gabriel	90.00	Strike slip	71	1.0	7.30
Newport Inglewood Connected alt 1	90.88	Strike slip	208	1.3	7.50
Sierra Madre (San Fernando)	91.20	Thrust	18	2.0	6.70
Santa Monica Connected alt 2	91.78	Strike slip	93	2.4	7.40
Newport Inglewood (Offshore)	93.16	Strike slip	66	1.5	7.00
Pisgah-Bullion Mtn-Mesquite Lk	94.89	Strike slip	88	0.8	7.30
Northridge	98.95	Thrust	33	1.5	6.90

(Source : https://earthquake.usgs.gov/cfusion/hazfaults_2008_search/)

5.3 Seismic Design Parameters

Seismic parameters based on the 2022 California Building Code (CBSC, 2022) and ASCE 7-16 are provided in the following table. These parameters were determined using a coordinate (34.2664N and 117.6129W) and the Seismic Design Maps ATC online tool.

Table No. 3, 2022 CBC Seismic Design Parameters

Seismic Parameters	
Site Coordinates	34.2664N and 117.6129W
Site Class	D*
Risk Category	III
Mapped Short period (0.2-sec) Spectral Response Acceleration, S_s	2.138g
Mapped 1-second Spectral Response Acceleration, S_1	0.734g
Site Coefficient (from Table 11.4-1), F_a	1.00
Site Coefficient (from Table 11.4-2), F_v	2.50
MCE 0.2-sec period Spectral Response Acceleration, S_{MS}	2.138g
MCE 1-second period Spectral Response Acceleration, SM_1	1.835g
Design Spectral Response Acceleration for short period S_{DS}	1.425g
Design Spectral Response Acceleration for 1-second period, S_{D1}	1.223g
Site Modified Maximum Peak Ground Acceleration, PGA_M	0.966g

** Stiff Soil Classification*

6.0 SLOPE STABILITY ANALYSIS

The anticipated gross stability of stabilizing the surficial slide within the existing slope, below the wastewater treatment plant clarifier, by replacing it with a compacted stabilization fill slope, at a gradient 2:1 horizontal to vertical (h:v) or fatter, under static conditions was evaluated using the Slide 8.0 software (RocScience, 2018). Pseudostatic analyses using a seismic coefficient of 0.15 were performed in order to evaluate the stability of the slopes during a large earthquake. The distressed slope in question was evaluated only for dry static and pseudo static conditions. This slope area was selected as a worst-case condition due to their heights, slope ratio and materials encountered. The purpose of the analyses was to evaluate the anticipated factors of safety against failure of the proposed stabilization fill slope under a variety of conditions. The proposed stabilization fill slope was determined to be stable. The slope location and cross section is presented in Figures No. 2 and 4a through 4c.

In addition, the surficial stability of the upper 4 feet of the proposed stabilization fill slope was evaluated under dry and saturated conditions. The proposed temporary stabilization fill slope was determined to be temporarily surficially stable.

A detailed description of the input parameters and analytical methods for gross and surficial stability are presented in Appendix C, *Slope Stability Analysis*. The resulting factors of safety are summarized in Tables Nos. C-2 and C-3, Factors of Safety Against Slope Failure.

Geologic mapping of the surface and subsurface exploration of the distressed slope in question, below the wastewater treatment plant clarifier in question, determined that the primary mode of failure is a surficial slide of approximately 4 feet to 8 feet of previously placed undocumented artificial fill and the colluvial soil within the subject slope. The surficial stability of the upper 4 feet of the previously placed undocumented artificial fill and colluvium in the existing subject slope was also evaluated under saturated conditions as was determined to be unstable.

Therefore, we believe the primary cause of slope failure to be saturation of the previously placed undocumented artificial fill and the upper colluvial soils from repeated rain events over the years following construction as well as by surficial discharge of water from the above the distressed area. **Therefore, it is important that the water be controlled and directed away from the slope face, especially in the area of surficial slope failure.**

7.0 SURFICIAL SLIDE REPAIR, SETTLEMENT AND DRAINAGE RECOMMENDATIONS

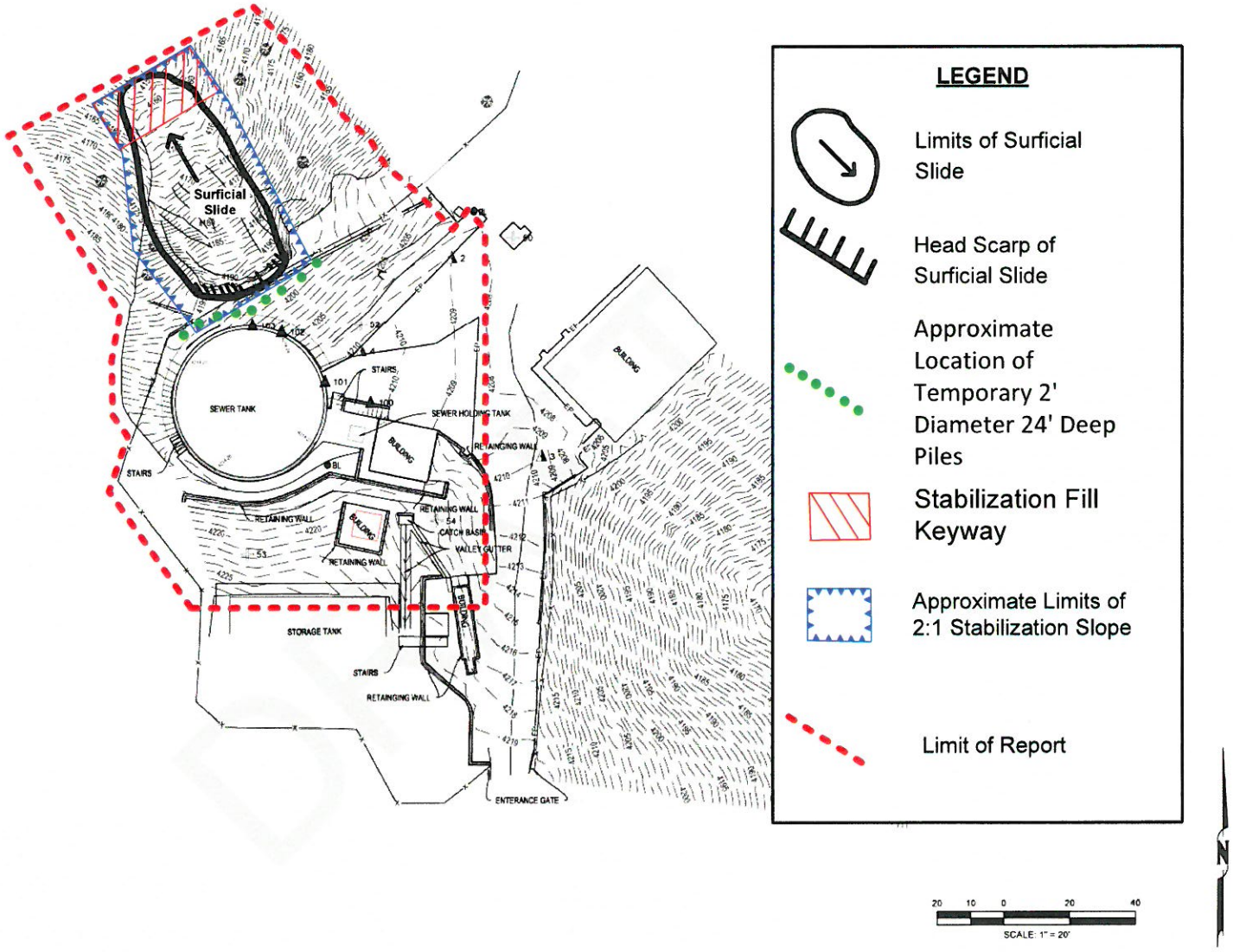
The following are recommendations for mitigation measures of the exiting distressed slope conditions.

7.1 Surficial Slide

The area of the surficial slide, indicated on Figure No. 2, *Approximate Boring Locations Map.* The approximately 3 feet to 13 feet of artificial fill, colluvium and slide debris soil should be overexcavated into competent undisturbed bedrock and replaced as a compacted stabilization fill slope. At the base of the surficial slumps a keyway should be excavated. The keyway should be approximately 4 feet to 5 feet deep and extend to a width of at least 15 feet into competent undisturbed bedrock. The back cut for the stabilization fill slope should be no steeper than a 2:1 (h:v). The approximate location of a 2:1 (h;v) stabilization fill slope and keyway are indicated on Figure No. 3, *Approximate Locations of Temporary Remedial Grading and Temporary Piles Map*. The actual design of the 2:1 (h;v) stabilization fill slope should be accomplished by a California licensed Civil Engineer and should also be reviewed by the geotechnical consultant.

7.2 Temporary Piles

A temporary pile system should be used to maintain support of the wastewater treatment plant clarifier tank for the construction of the back cut slope for the recommended stabilization fill slope. The pile temporary piles should be installed at least 5 feet away from the wastewater treatment plant clarifier tank and prior to remedial grading of the surficial slide. The approximate location of the recommended temporary shoring piles is indicated on Figure No. 3, *Approximate Locations of Remedial Grading and Temporary Piles Map*.



Project: Seeley Creek Wastewater Treatment Plant

Location: CA-138
City of Crestline, San Bernardino County, California

Approximate Locations of Remedial Grading and Temporary Piles Map

Project No. 24-81-141-01

For: Stantec Consulting Services

Converse Consultants

Figure No. 3

7.2.1 Preliminary Temporary Pile Design

For design of the temporary pile shoring system the following should be used.

- Pile Size and Type: 24-inch CIDH
- Pile Length: 24 feet
- Pile Group: 1 Row, 9 piles, 6 feet Spacing (Actual number or piles depends on design of 2:1 h:v stabilization fill slope by California licensed Civil Engineer.)
- Assumed Lateral Load: 205 kip
- No skin friction for the upper 9 feet
- Tip resistance was neglected
- Max lateral deflection: 1.020 inch

All temporary pile shoring should be designed by an experienced California licensed Civil Engineer and installed by experienced contractors. The temporary pile shoring design should also be reviewed by a geotechnical consultant to verify the soil parameters used in the design are in conformance with geotechnical report.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1987 and current amendments, and the Construction Safety Act should be met.

It is recommended that Converse review plans and specifications for proposed shoring and that a Converse representative observes the installation of shoring. A licensed surveyor should be retained to establish monuments on shoring and the surrounding ground prior to excavation. Such monuments should be monitored for horizontal and vertical movement during construction. Results of the monitoring program should be provided immediately to the project Structural (shoring) Engineer and Converse for review and evaluation. The adjacent wastewater treatment plant clarifier tank elements should be photo-documented prior to construction.

7.3 Temporary Fill Slope for Placement of Temporary Pile Shoring

Due to the sloping conditions below the wastewater treatment plant clarifier tank a temporary stabilization fill slope should be placed in order to create a level working area for installation of the temporary shoring piles, prior to construction of the ultimate 2:1 (h:v) stabilization fill slope. This can also be an option to provide temporary stability if construction timing due to rain/snow seasons if needed. The temporary fill slope can be constructed at a 1.5 (h:v) with a keyway establish at the toe of the slope at an approximately elevation from 4,175 to 4,180. The keyway should be approximately 7 feet to 8 feet deep and extend to a width of at least 10 feet horizontally into competent undisturbed bedrock. The back cut for the stabilization fill slope should be no steeper than a 1:1 (h:v) above the keyway. The actual design of the 1.5:1 (h;v) temporary stabilization fill slope should be accomplished by a California licensed Civil Engineer and should also be reviewed by the geotechnical consultant.

7.4 Settlement

As previously stated above there may be up to approximately 3 feet of potentially compressible colluvium below the foundation of about 5 feet to 10 feet of the northern portion of the wastewater treatment plant clarifier tank. Based on exploration, laboratory test and analysis there may be an additional total static settlement below the northern portion of the wastewater treatment plant clarifier tank of approximately 1.3 inches to 2.4 inches. The static differential settlement can be taken as equal to one-half of the static total settlement over a lateral distance of 45 feet. A structural engineer should be consulted to determine if this may be tolerable or if any mitigation measures should be taken.

7.5 Top of Slope Drainage Control

The primary cause of slumping in the distressed slope areas appears to be saturation of the surficial soils during rain events, due to the direction of flow going over and down the slope face. **Therefore, it is important that the water be controlled and directed away from the slope face, especially in the area of slumping.** The design of this system should be performed by a civil engineer.

7.6 Erosion Control

The overexcavation and recompaction of the surficial slide will leave the surface of the slope face bare of vegetation. It is important that the slope be revegetated before the next large rain event, to prevent the erosion of the surface of the repairs. Other areas that are currently not vegetated, or where vegetation has been removed in the course of repairs should be similarly revegetated to prevent surficial erosion.

8.0 EARTHWORK RECOMMENDATIONS

8.1 General Evaluation

This section contains our general recommendations regarding earthwork and remedial grading for the project. These recommendations are based on the results of our field exploration, laboratory tests, our experience with similar projects, and data evaluation as presented in the preceding sections. These recommendations may require modification by the geotechnical consultant based on observation of the actual field conditions during grading.

Prior to the start of construction, all existing underground utilities and appurtenances should be located at the project site. Such utilities should either be protected in-place or removed and replaced during construction as required by the project specifications. All excavations should be conducted in such a manner as not to cause loss of bearing and/or lateral support of existing utilities and structure.

All debris, surface vegetation, deleterious material, surficial soils containing roots and perishable materials and demolished materials should be stripped and removed from the areas of the site to be graded.

The final bottom surfaces of all excavations should be observed and approved by the project geotechnical consultant prior to placing any fill. However, localized, deeper over-excavation could be encountered, based on findings and testing by the geotechnical consultant during grading of the final bottom surfaces of all excavations. Therefore, some variations in the depth and lateral extent of overexcavation recommended in this report should be anticipated.

8.2 Overexcavation/Remedial Grading

The site is generally underlain by approximately 3.0 to 8.0 feet of potentially compressible soils (artificial fill, colluvium and surficial slide debris), and locally as much as 9.0 feet to 13.0, which may be prone to future settlement under the surcharge of foundation, improvements and/or fill loads. Therefore, these materials should be over-excavated to competent bedrock within all areas of proposed remedial grading and other improvements and replaced with compacted fill soils. All over-excavations should extend horizontally at least 3.0 feet or equal to the depth of over-excavation, whichever is greater, outside the limits of remedial grading.

If isolated pockets of very soft, loose, eroded, or pumping soil are encountered, the unstable soil should be excavated as needed to expose undisturbed, firm, and unyielding soils.

The contractor should determine the best manner to conduct the excavations, such that there are no losses of bearing and/or lateral support to the existing structures or utilities (if any).

Areas to receive fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition, and recompacted to at least 90 percent relative compaction (based on ASTM Test Method D1557).

8.3 Subdrains

Slope subdrains should be placed on in the back cut of the recommended stabilization slope and the temporary fill slope. following overexcavation of unsuitable soil materials to competent bedrock. The subdrains should be placed on bedrock against the back cut and consist of a 4-inch perforated schedule 40 PVC pipe, or equivalent, encased in at least 6 cubic feet per linear foot of 1/2-inch to 3/4-inch crushed gravel, wrapped in filter fabric (Mirafi 140 or equivalent). The first subdrain level should be placed at the base of the temporary stabilization fill slope, just above the keyway. Other subdrains should be spaced at least every 15 vertical feet. The subdrains should have outlets consisting of 4-

inch solid schedule 40 PVC pipe, or equivalent at no more than 50 foot spacing. The actual locations of the slope subdrain should be determined by a geologist.

8.4 Engineered Fill

No fill should be placed until excavations and/or natural ground preparation have been observed by the geotechnical consultant. The soils and bedrock encountered within the project site are generally considered suitable for re-use as compacted fill. Excavated soils should be processed, including removal of roots and debris, removal of oversized particles, mixing, and moisture conditioning, before placing as compacted fill. On-site soils used as fill should meet the following criteria.

- No particles larger than 6 inches in largest dimension.
- Free of all organic matter, debris, or other deleterious material.
- Expansion Index of 20 or less.
- Shear strength of at least have a friction angel of 28 degrees and cohesion of 220.

Based on field investigation and laboratory testing results, the on-site soils may be suitable as fill materials. Imported materials, if required, should meet the above criteria prior to being used as compacted fill.

Any imported fills should be tested and approved by geotechnical representative at least 72 hours (which only includes normal working days) prior to delivery to the site.

8.5 Compacted Fill Placement

Surfaces to receive fills should be scarified to a depth of 6 inches. The soil should be moisture conditioned to within ±3 percent of optimum moisture content for coarse soils and 0 to 3 percent above optimum moisture content for fine soils. The scarified soils should be recompacted to at least 90 percent of the laboratory maximum dry density. Fill soils should be evenly spread in horizontal lifts not exceeding 8 inches in uncompacted thickness.

All fill placed at the site should be compacted to at least 90 percent of the laboratory maximum dry densities as determined by ASTM Standard D1557 test method unless a higher compaction is specified herein.

Fill materials should not be placed, spread or compacted during unfavorable weather conditions. When site grading is interrupted by heavy rain, filling operations should not resume until the geotechnical consultant approves the moisture and density conditions of the previously placed fill.

The project geotechnical consultant should observe the placement of fill and conduct in-place field density tests to check for adequate moisture content and relative compaction as required by the project specifications. Where less than the required relative

compaction is indicated, additional compactive efforts should be applied and the soil moisture conditioned as necessary, until the required relative compaction is attained.

8.6 Site Drainage

Adequate positive drainage should be provided away from the site and excavation areas to prevent ponding during construction.

9.0 CONSTRUCTION RECOMMENDATIONS

Temporary sloped excavations and shoring design recommendations are presented in the following sections.

9.1 General

Prior to the start of construction, all existing underground utilities should be located at the project site. Such utilities should either be protected in-place or removed and replaced during construction as required by the project specifications.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act, and the Construction Safety Act should be met. The soils exposed in cuts should be observed during excavation by the geotechnical consultant and the competent person designated by the contractor. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

9.2 Temporary Sloped Excavations

Surfaces exposed in slope excavations should be kept moist but not saturated to minimize raveling and sloughing during construction. Adequate provisions should be made to protect the slopes from erosion during periods of rainfall. Surcharge loads, including construction equipment, should not be placed within 5 feet of the unsupported excavation edge. Stockpiled soils with a height higher than 6 feet will require greater distance from excavation edges.

If excavation occurs near existing structures, special construction considerations would be required during excavation to protect these existing structures during construction.

9.3 Permanent Fill Slopes

Fill slopes placed above existing sloped surfaces should be constructed with keyways. When fill is placed against existing slopes steeper than 5:1 H:V, the new fill slopes should be keyed and benched to provide increased lateral support after removal of the unsuitable surficial soils, when present.

Benches should be constructed no wider than 2 feet laterally, no bench should be taller vertically than it is horizontally.

Fill slopes should be properly compacted out to the slope face. This may be achieved by either overbuilding then cutting back to the compacted core, frequent back rolling, or by utilizing other methods that meet the intent of the project specifications. The fill slope face should be track rolled to achieve compaction.

9.4 Slope Maintenance and Erosion Control

Existing and proposed slopes, and landscaped areas require periodic inspections and maintenance for proper upkeep and to help assure their continued stability. Most soil erosion problems are associated with water and site drainage. Maintaining adequate positive drainage and slope planting is important for erosion control. Drainage related items requiring periodic inspection and maintenance include:

- Side swales, and non-erosive drainage devices should be installed to prevent water from flowing uncontrolled over the tops of slopes. It is important that these devices be maintained and free of obstruction.
- Periodic inspections of the slope areas, interceptor drains, terrace drains, and down drains should be performed to check for proper operation. These drainage devices should be checked before the winter rainy season and before and after major storms.
- Interceptor drains, terrace drains, down drains, drainpipes, catch basins and drainage devices should be kept clean of debris and maintained in good working order to provide adequate drainage for slope areas. Control joints and cracks in concrete or asphalt drainage devices should be sealed and/or resealed to prevent infiltration of water into slope soils. The drainage devices should be routinely checked for proper operation and cleared of silt and debris.
- Rodent activity should be controlled to prevent loosening of soils and water penetration. Animal burrows should be filled with compacted soils since they may cause diversion of surface runoff, promote accelerated erosion, or cause shallow slope failures.
- Slope areas disturbed by foot traffic, trails, erosion and gullies should be repaired with compacted soils and re-planted to prevent slope erosion. Site users should be encouraged to use designated trails, pathways, stairways and service roads for access.
- Slope planting should be maintained for erosion control. Nylon and jute netting can be used to protect and maintain exposed slope surfaces until a dense growth of vegetation has been established. Graded slopes may require more time to establish plant growth. The optimal goal of planting is to achieve a dense growth of vegetation (which includes plants of varying root depths) requiring little watering. Bare spots, areas of little growth and areas with deteriorated mesh or plant cover, may have to be re-seeded and/or replanted with new mesh and plants for erosion

control. Loose soils, plant cuttings and debris should not be permitted to accumulate on the slopes.

- Landscape watering should be controlled and be just sufficient to sustain plant growth. Seasonal adjustments to the amount of watering should be performed prudently, with periodic monitoring and regulation. Slope areas should not be over-watered. Sprinkler and irrigation systems should be maintained and adjusted to prevent overwatering of slopes and landscaping. Irrigation leaks should be stopped and repaired as soon as possible to prevent wasting of water and soil erosion. Wet spots may indicate a leaking or broken water line or control valve.

10.0 GEOTECHNICAL SERVICES DURING CONSTRUCTION

The project geotechnical consultant should review plans and specifications as the project design progresses. Such review is necessary to identify design elements, assumptions, or new conditions which require revisions or additions to our geotechnical recommendations.

The project geotechnical consultant should be present to observe conditions during construction. Geotechnical observation and testing should be performed as needed to verify compliance with project specifications. Additional geotechnical recommendations may be required based on subsurface conditions encountered during construction.

11.0 CLOSURE

This report is prepared for the project described herein and is intended for use solely by Albert A. Webb Associate and the Crestline Sanitation District, and their authorized agents, to assist in the design and construction of the proposed project. Our findings and recommendations were obtained in accordance with generally accepted professional principles practiced in geotechnical engineering. We make no other warranty, either expressed or implied.

Converse Consultants is not responsible or liable for any claims or damages associated with interpretation of available information provided to others. Site exploration identifies actual soil conditions only at those points where samples are taken, when they are taken. Data derived through sampling and laboratory testing is extrapolated by Converse employees who render an opinion about the overall soil conditions. Actual conditions in areas not sampled may differ. In the event that changes to the project occur, or additional, relevant information about the project is brought to our attention, the recommendations contained in this report may not be valid unless these changes and additional relevant information are reviewed, and the recommendations of this report are modified or verified in writing. In addition, the recommendations can only be finalized by observing actual subsurface conditions revealed during construction. Converse cannot be held responsible for misinterpretation or changes to our recommendations made by others during construction.

As the project evolves, continued consultation and construction monitoring by a qualified geotechnical consultant should be considered an extension of geotechnical investigation services performed to date. The geotechnical consultant should review plans and specifications to verify that the recommendations presented herein have been appropriately interpreted, and that the design assumptions used in this report are valid. Where significant design changes occur, Converse may be required to augment or modify the recommendations presented herein. Subsurface conditions may differ in some locations from those encountered in the explorations, and may require additional analyses and, possibly, modified recommendations.

Design recommendations given in this report are based on the assumption that the recommendations contained in this report are implemented. Additional consultation may be prudent to interpret Converse's findings for contractors, or to possibly refine these recommendations based upon the review of the actual site conditions encountered during construction. If the scope of the project changes, if project completion is to be delayed, or if the report is to be used for another purpose, this office should be consulted.

12.0 REFERENCES

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Appendix A

Field Exploration

APPENDIX A

FIELD EXPLORATION

Our field investigation included a site reconnaissance and a subsurface exploration program consisting of drilling hollow stem and hand auger soil borings. During the site reconnaissance, the surface conditions were noted, and the borings were marked at locations relevant to obtaining adequate data for our analysis. The approximate boring locations were established in the field by reference to existing street centerlines and other visible features. The locations should be considered accurate only to the degree implied by the method used.

Two exploratory borings (BH-01 through BH-12) were drilled on May 24, 2024, using a truck-mounted CME 75 drill rig equipped with 8-inch diameter hollow-stem augers and 11 exploratory borings (BH-03 and BH-13) were drilled on May 28 and 31, 2024, using a hand auger, to investigate the subsurface conditions. Borings BH-01 through BH-02 were each drilled to an approximate depths of 18.0 feet to 20.5 feet below ground surface (bgs). Borings BH-03 and BH-13 were drilled to a depth of approximately 3.5 feet to 10.5 feet bgs.

Encountered materials were continuously logged by a Converse geologist and classified in the field by visual classification in accordance with the Unified Soil Classification System. Where appropriate, the field descriptions and classifications have been modified to reflect laboratory test results.

Relatively undisturbed samples were obtained using California Modified Samplers (2.4 inches inside diameter and 3.0 inches outside diameter) lined with thin sample rings. The steel ring sampler was driven into the bottom of the borehole with successive drops of a 140-pound driving weight falling 30 inches. Blow counts at each sample interval are presented on the boring logs. Samples were retained in brass rings (2.4 inches inside diameter and 1.0 inch in height) and carefully sealed in waterproof plastic containers for shipment to the Converse laboratory. Bulk samples of typical soil types were also obtained.

Relatively undisturbed samples were obtained using California Modified Samplers (2.4 inches inside diameter and 3.0 inches outside diameter) lined with thin sample rings. The steel ring sampler was driven into the bottom of the borehole with successive drops of a 45-pound driving weight falling 24 inches. Blow counts at each sample interval are presented on the boring logs. Samples were retained in brass rings (2.4 inches inside diameter and 1.0 inch in height) and carefully sealed in waterproof plastic containers for shipment to the Converse laboratory. Bulk samples of typical soil types were also obtained.

The exact depths at which material changes occur cannot always be established accurately. Unless a more precise depth can be established by other means, changes in

material conditions that occur between drive samples are indicated on the logs at the top of the next drive sample.

Following the completion of logging and sampling, the drilled borings were backfilled with cement grout, and the hand augured borings were filled with soil cuttings and compacted with a tamping bar. Test pits were backfilled with excavated soil and tamped by hand. If construction is delayed, the surface may settle over time. We recommend the owner monitor the boring locations and backfill any depressions that might occur or provide protection around the boring locations to prevent trip and fall injuries from occurring near the area of any potential settlement.

For a key to soil symbols and terminology used in the boring logs, refer to Drawing Nos. A-1a and A-1b, *Unified Soil Classification and Key to Boring Log Symbols*. For logs of borings, see Drawing Nos. A-2 through A-14, *Logs of Borings*. Elevations presented in the logs of borings are based on the reference topographic survey map.

SOIL CLASSIFICATION CHART

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 4546)
CP	Compaction Curve (ASTM D 1557)
CR	Corrosion, Sulfates, Chlorides (CTM 643-99; 417; 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeablility (ASTM D 2434)
PA	Particle Size Analysis (ASTM D 6913 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301)
SE	Sand Equivalent (ASTM D 2419)
SG	Specific Gravity (ASTM D 854)
SW	Swell Potential (ASTM D 4546)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166)
	Unconfined Compression - Rock (ASTM D 7012)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 2937)

BORING LOG SYMBOLS

SAMPLE TYPE

- STANDARD PENETRATION TEST — Split barrel sampler in accordance with ASTM D-1586-84 Standard Test Method
- DRIVE SAMPLE — 2.42" I.D. sampler (CMS).
- DRIVE SAMPLE — No recovery
- BULK SAMPLE
- GROUNDWATER WHILE DRILLING
- GROUNDWATER AFTER DRILLING

DRILLING METHOD SYMBOLS

Auger Drilling | Mud Rotary Drilling | Dynamic Cone or Hand Driven | Diamond Core

UNIFIED SOIL CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-1a

For: Albert Webb and Associates

CONSISTENCY OF COHESIVE SOILS

Descriptor	Unconfined Compressive Strength (tsf)	SPT Blow Counts	Pocket Penetrometer (tsf)	CA Sampler	Torvane (tsf)	Field Approximation
Very Soft	<0.25	< 2	<0.25	<3	<0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	2 - 4	0.25 - 0.50	3 - 6	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	5 - 8	0.50 - 1.0	7 - 12	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	9 - 15	1.0 - 2.0	13 - 25	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	16 - 30	2.0 - 4.0	26 - 50	1.0 - 2.0	Readily indented by thumbnail
Hard	>4.0	>30	>4.0	>50	>2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS

Descriptor	SPT N_{60} Value (blows / foot)	CA Sampler
Very Loose	<4	<5
Loose	4- 10	5 - 12
Medium Dense	11 - 30	13 - 35
Dense	31 - 50	36 - 60
Very Dense	>50	>60

MOISTURE

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

PERCENT OF PROPORTION OF SOILS

Descriptor	Criteria
Trace (fine)/ Scattered (coarse)	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE

Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS

Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION/ Induration

Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptions and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), Section 2, for tables of additional soil description components and discussion of soil description and identification.

UNIFIED SOIL CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-1b

For: Albert Webb and Associates

LEGEND OF ROCK MATERIALS


IGNEOUS ROCK


SEDIMENTARY ROCK


METAMORPHIC ROCK

BEDDING SPACING

Description	Thickness/Spacing
Massive	Greater than 10 ft
Very Thickly Bedded	3 ft - 10 ft
Thickly Bedded	1 ft - 3 ft
Moderately Bedded	4 in - 1 ft
Thinly Bedded	1 in - 4 in
Very Thinly Bedded	1/4 in - 1 in
Laminated	Less than 1/4 in

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Leaching		
Description	Body of Rock	Fracture Surfaces		Texture	Leaching	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No leaching	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation, grain boundary conditions	All fracture surfaces are discolored or oxidized; surfaces friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Texture altered by chemical disintegration (hydration, argillation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

PERCENT CORE RECOVERY (REC)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

ROCK QUALITY DESIGNATION (RQD)

$$\frac{\Sigma \text{ Length of intact core pieces } \geq 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

RQD* indicates soundness criteria not met.

ROCK HARDNESS

Description	Criteria
Extremely Hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows
Very Hard	Cannot be scratched with a pocketknife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows.
Moderately Hard	Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily with a pocketknife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

Fracturing Spacing

Description	Observed Fracture Density
Unfractured	No fractures
Very Slightly Fractured	Core lengths greater than 3 ft.
Slightly Fractured	Core lengths mostly from 1 to 3 ft.
Moderately Fractured	Core lengths mostly 4 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
Very Intensely Fractured	Mostly chips and fragments.

REFERENCE Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

BEDROCK CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Log of Boring No. BH-01

Date Drilled: 5/24/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 4210 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		4" ASPHALT CONCRETE/5.5" AGGREGATE BASE						
		ARTIFICIAL FILL						
		SILTY SAND (SM): fine to coarse-grained, trace clay, moist, brown.	■	▒	4/7/7	17	104	
		COLLUVIUM						
5		**SILTY SAND (SM):** fine to coarse-grained, trace clay, moist, gray brown.	■		5/9/11	19	102	
		CLAYEY SAND (SC): fine to coarse-grained, trace silt, trace gravel up to 0.25 inches maximum dimension, slightly to moderately desiccated, very oxidated, roots and rootlets, stiff, moist, orangish brown.	■	▒	14/18/30	12	119	DS
		- @5.0': possible carbon pieces, large roots.						
10		**BEDROCK**						CP, DS
		QUARTZ DIORITE: fine to coarse-grained, trace clay, moderately weathered, slightly indurated, hard to very hard, slightly desiccated, black and orange oxidation spots, moist, yellowish brown	⊠	▒	18/31/50-4"			
		Excavates as: SILTY SAND (SM): fine to coarse-grained, trace clay, bedrock fragments up to 0.25 inches maximum dimension, moist, yellowish brown.	■	▒	50-5"	7		*disturbed, 1-ring*
15		- @13.0': very hard.						
		- @14.3': slightly weathered						
		End of boring at 18.0 feet below ground surface. No groundwater encountered. Boring backfilled with soil cuttings and tamped with an auger using the weight of the drill rig on 05/24/2024. Boring patched w/cold mix asphalt on 05/31/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-2

Log of Boring No. BH-02

Date Drilled: 5/24/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 4209 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		4" ASPHALT CONCRETE/0" BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, medium dense, moist, brown.	■	■	12/11/7	13	116	CP,CR, DS, EI, PA
5		**COLLUVIUM** **CLAYEY SAND (SM):** fine to coarse-grained, trace silt, moderately desiccated, weathered gravel, roots and rootlets, loose, moist, orangish brown.	■	■	5/4/3	16	99	DS
		- @6.0'-6.5': more grayish color.	■	■	13/19/30	11	113	
		BEDROCK **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, few gravel up to 0.5 inches maximum dimension, moderately to intensely weathered, orange and black oxidation staining, hard, moist, yellowish brown						
10		**Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly very coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.	■	■	13/18/22	11	111	CP,CR, EI, PA
15		- @10.0': moderately weathered, evidence of vertical jointing. - @13.0': tree root. - @15.0': tree root, moderately hard.	☒	■	10/11/15			
20		- @19.0': slightly to moderately weathered, hard. - @20.3': clayey silt seam.	☒	■	19/19/38			
		End of boring at 20.5 feet below ground surface. No groundwater encountered. Boring backfilled with soil cuttings and tamped with an auger using the weight of the drill rig on 05/24/2024. Boring patched w/cold mix asphalt on 05/31/2024.						

Log of Boring No. BH-03

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4221 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, roots and rootlets, loose to medium dense, moist, brown.		■	6/10	15		
5		**SILTY SAND (SM):** fine to coarse-grained, trace clay, slight orange oxidation staining, micaceous, moist, orangish brown.		■		11		
				■		16		
10		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, some clay, few gravel up to 0.5 inches maximum dimension, intensely weathered, massive, friable, moderately hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, some clay, bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.						
		End of boring at 6.0 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

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Project No. 24-81-141-01

Drawing No. A-4

Log of Boring No. BH-04

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4224 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 0.5 inches maximum dimension, roots and rootlets, moist, brown.				17		
		BEDROCK			9	18		
5		**QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, decomposed, massive, friable, micaceous, hard, moist to wet, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, moist, yellowish brown.						
		End of boring at 3.5 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

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Drawing No. A-5

Log of Boring No. BH-05

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4217.5 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 0.5 inches maximum dimension, slightly desiccated, black oxidation spots, roots and rootlets, loose to medium dense, moist, dark brown.	■		4/7	9	97	
5		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, friable, massive, orange oxidation staining, hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, moist, yellowish brown.			10			
		End of boring at 4.5 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
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Project No. 24-81-141-01

Drawing No. A-6

Log of Boring No. BH-06

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4209 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, roots and rootlets, loose, moist, brown.	■		4/4	13		*disturbed, 1-ring*
5		**SILTY SAND (SM):** fine to coarse-grained, trace clay, orange oxidation pockets, medium densemoist, dark orangish brown.	■		7/10	14	87	
10		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, massive, orange oxidation spots, roots and rootlets, hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, moist, yellowish brown.						
		End of boring at 6.0 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
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Drawing No. A-7

Log of Boring No. BH-07

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4197 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, roots and rootlets, trace debris, loose, moist, brown.	■		4/3			
5		**COLLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, slightly to moderately desiccated, orange oxidation pockets, loose to medium dense, wet, dark orangish brown.	■		6/6	11	97	C
					6/9			
10		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, orange oxidation staining, moderately hard to hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.						
15		End of boring at 9.0 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

Log of Boring No. BH-08

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4198 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, slightly desiccated, roots and rootlets, loose, dry to moist, brown.	■		3/3	14	88	
5		**COLLUVIUM** **SILTY SAND (SM):** fine to coarse grained, trace clay, slightly to moderately desiccated, orange oxidation pockets, loose to medium dense, moist, orangish brown. - @3.5': saturated.	■		3/6	26	89	C
		BEDROCK **QUARTZ DIORITE:** fine to coarse grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, orange oxidation staining, moderately hard to hard, moist, yellowish brown			5/9			
10		**Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.						
15		End of boring at 9.5 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

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Seeley Creek Wastewater Treatment Plant
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Project No. 24-81-141-01

Drawing No. A-9

Log of Boring No. BH-09

Date Drilled: 5/28/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4195 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 3.0 inches maximum dimension, medium dense, moist, brown.	■		12/20	14	106	
					10/11			
5		End of boring at 5.0 feet below ground surface due to refusal on large cobble. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/28/2024.						

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Project No. 24-81-141-01

Drawing No. A-10

Log of Boring No. BH-10

Date Drilled: 5/28/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4188 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		SLIDE DEBRIS **CLAYEY SAND (SC):** fine to coarse-grained, trace silt, very few gravel up to 0.5 inches maximum dimension, loose, moist, brown. **SILTY SAND (SM):** fine to coarse-grained, trace clay, loose, wet, brownish yellow.	■		3/1	23	81	C
5		**COLLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, slightly desiccated, roots and rootlets, orange oxidation staining, medium dense, wet, orangish brown.			8/11			
		BEDROCK **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, orange oxidation staining, moderately hard to hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.			14			
10								
15		End of boring at 9.0 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/28/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
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Project No. 24-81-141-01

Drawing No. A-11

Log of Boring No. BH-11

Date Drilled: 5/28/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4196 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 1.0 inches maximum dimension, loose, moist, brown.	■		4/7	14	92	
5		- @ 4.0': medium dense.		▨	7/8	18		
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, slightly desiccated, roots and rootlets, orange oxidation staining, moist, orangish brown.						
10		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, orange oxidation staining, moderately hard to hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.						
15		End of boring at 10.5 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/28/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
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Project No. 24-81-141-01

Drawing No. A-12

Log of Boring No. BH-12

Date Drilled: 5/28/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4181 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		SLIDE DEBRIS **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 0.5 inches maximum dimension, loose, moist, brown.	■		8	15		
5		- @5.0': medium dense. - @5.5': visible water on sample; possible seepage.			9/12			
		COLLUVIUM **SILTY SAND (SM):** fine to coarse-grained, trace clay, slightly desiccated, roots and rootlets, orange oxidation staining, wet, orangish brown.		▨				
10		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, orange oxidation staining, moderately hard to hard, moist, yellowish brown **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown.						
15		End of boring at 8.0 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/28/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-13

Log of Boring No. BH-13

Date Drilled: 5/28/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4170 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		SLIDE DEBRIS **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 2.0 inches maximum dimension, loose, moist, brown.	■		4/3	15	94	
5		- @4.0': wet, medium dense.	■		10	12	110	
		Bedrock **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately to intensely weathered, slightly friable, orange oxidation staining, moderately hard to hard, moist, yellowish brown		▨		11		
10		**Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, few gravel up to 0.5 inches maximum dimension, slightly desiccated, roots and rootlets, orange oxidation staining, wet, orangish brown.						
		End of boring at 7.5 feet below ground surface due to refusal on bedrock. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/28/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-14

Log of Boring No. BH-14

Date Drilled: 5/24/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 4211 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		4" ASPHALT CONCRETE/8" AGGREGATE BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, roots and rootlets, moist, brown. - @2.0': loose.			9/13/18	13	115	
5		**COLLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, moderately desiccated, orange oxidation staining, roots and rootlets, moist, orangish brown.			9/13/19	13	116	
		BEDROCK			16/21/27	18		
10		**QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, moderately weathered, massive, strong to moderate induration, orange oxidation staining, hard to moderately hard, near vertical jointing/dike, moist, yellowish brown						
		Excavates as: SILTY SAND (SM): fine to coarse-grained, trace clay, mostly coarse grains, medium dense, moist, yellowish brown.			18/50-6"	10	124	
15		- @7.0': very dense. - @13.0': slightly to moderately weathered, very hard, near vertical jointing/dike.						
		End of boring at 14.0 feet below ground surface. No groundwater encountered. Boring backfilled with soil cuttings and tamped with an auger usig the weight of the drill rig on 05/24/2024. Boring patched w/cold mix asphalt on 05/31/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-15

Log of Boring No. BH-15

Date Drilled: 5/24/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 8" DIAMETER HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 4215 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		3.5" ASPHALT CONCRETE/8" AGGREGATE BASE						
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, slightly desiccated, medium dense, moist, brown.			4/5/5	19	107	
5		**COLLUVIUM** **SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly coarse grains, moderately desiccated, orange oxidation staining, roots and rootlets, moist, orangish brown.			10/12/15	14	115	
					18/50-6"	8	122	
		BEDROCK **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, highly weathered, weakly indurated, orange oxidation staining, hard to moderately hard, moiat, yellowish brown						
10					18/31/50-5"			
		Excavates as: SILTY SAND (SM): fine to coarse-grained, trace clay, mostly coarse grains, few bedrock fragments up to 0.5 inches maximum dimension, moist, yellowish brown. - @7.0': multicolored oxidation staining, roots and rootlets. - @10.5': slightly to moderately weathered, approximately 45-50 degree jointing.						
15					50-4"	5	109	
		End of boring at 15.3 feet below ground surface. No groundwater encountered. Boring backfilled with soil cuttings and tamped with an auger usig the weight of the drill rig on 05/24/2024. Boring patched w/cold mix asphalt on 05/31/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-16

Log of Boring No. BH-16

Date Drilled: 5/31/2024 Logged by: Catherine Nelson Checked By: Robert Gregorek II

Equipment: 3" DIAMETER HAND AUGER Driving Weight and Drop: N/A

Ground Surface Elevation (ft): 4214 Depth to Water (ft, bgs): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS	MOISTURE (%)	DRY UNIT WT. (pcf)	OTHER
		ARTIFICIAL FILL **SILTY SAND (SM):** fine to coarse-grained, trace clay, few gravel up to 0.5 inches maximum dimension, moist, light brown.	■		11/13	15		
5		**BEDROCK** **QUARTZ DIORITE:** fine to coarse-grained, trace clay, mostly coarse grains, highly weathered, weakly indurated, orange oxidation staining, hard to moderately hard, moist, **Excavates as: SILTY SAND (SM):** fine to coarse-grained, trace clay, mostly very coarse grains, moist, yellowish brown.		▨				
10		End of boring at 5.0 feet below ground surface. No groundwater encountered. Boring backfilled with soil cuttings and tamped with a hand tamper bar on 05/31/2024.						

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. A-17

Appendix B

Laboratory Testing Program

APPENDIX B

LABORATORY TESTING PROGRAM

Tests were conducted in our laboratory, and in the labs of others we contract with, on representative soil samples for the purpose of classification and evaluation of their relevant physical characteristics and engineering properties. The amount and selection of tests were based on the geotechnical requirements of the project. Test results are presented herein and on the Logs of Borings in Appendix A, *Field Exploration*. The following is a summary of the laboratory tests conducted for this project.

In-Situ Moisture Content and Dry Density

Results of moisture content and dry density tests performed in general accordance with ASTM standard D2216 and D2937 on relatively undisturbed ring samples were used to aid in the classification of the soils and to provide quantitative measure of the *in-situ* dry density. Data obtained from this test provides qualitative information on strength and compressibility characteristics of site soils. For test results, see the Logs of Borings in Appendix A, *Field Exploration*.

Expansion Index (EI)

Two representative bulk samples were tested to evaluate the expansion potential and was conducted in general accordance with ASTM Standard D4829. The test results are included in the following table.

Table No. B-1, Expansion Index Test Result

Boring No.	Depth (feet)	Soil Description	Expansion Index	Expansion Potential
BH-02	0.0-5.0	Silty Sand (SM)	1	Very Low
BH-02	7.0-15.0	Silty Sand (SM)	1	Very Low

Soil Corrosivity (CR)

Two representative soil samples were tested to determine minimum electrical resistivity, pH, and chemical content, including chloride concentrations, and soluble sulfate. The purpose of these tests is to determine the corrosion potential of site soils when placed in contact with common construction materials. This test was performed by EGL in Arcadia, California in general accordance with Caltrans Tests 643, 422 and 417. The test result received from Kegan Labs is included in the following table.

Table No. B-2, Summary of Corrosivity Test Results

Boring No.	Sample Depth (feet)	pH (Caltrans 643)	Soluble Chlorides (Caltrans 422) ppm	Soluble Sulfate (Caltrans 417) ppm	Saturated Resistivity (Caltrans 643) Ohm-cm
BH-02	0.0-5.0	7.8	508	598	400
BH-02	7.0-15.0	6.1	39	99	6,030

Grain-Size Analysis

To assist in soil classification, mechanical grain-size analyses was performed on two select samples in accordance with the ASTM Standard D6913 test method. Grain-size distribution is summarized in the table below and plotted in Drawing No. B-1, *Grain Size Distribution Results*.

Table No. B-3, Grain Size Distribution Test Results

Test Pit No.	Depth (ft)	Soil Classification	% Gravel	% Sand	%Silt	%Clay
BH-02	0.0-5.0	Silty Sand (SM)	0.0	98.3	1.7	
BH-02	7.0-15.0	Silty Sand (SM)	12.0	84.3	3.7	

Maximum Dry Density Test (CP)

Three laboratory maximum dry density-moisture content relationship test was performed on 3 representative bulk samples of the upper 18 feet of soil and bedrock material. The testing was conducted in general accordance with ASTM Standard D1557 laboratory procedure. The test result is presented on Drawing No. B-2, *Moisture-Density Relationship Results*.

Table No. B-4, Summary of Moisture-Density Relationship Results

Boring No.	Depth (feet)	Soil Description	Optimum Moisture (%)	Maximum Density (lb/cft)
BH-01	8.0-18.0	Silty Sand (SM), Yellowish Brown	10.0	129.0
BH-02	0.0-5.0	Silty Sand (SM), Brown	10.0	130.5
BH-02	7.0-15.0	Silty Sand (SM), Yellowish Brown	10.5	130.0

Direct Shear (DS)

Direct shear testing was performed on one (3) relatively undisturbed sample and two (2) samples remolded to 90% of the laboratory maximum dry density, at soaked moisture conditions. The test was conducted in general accordance with ASTM D3080. For each test, three samples contained in brass sampler rings were placed, one at a time, directly into the test apparatus and subjected to a range of normal loads appropriate for the anticipated conditions. The soil and bedrock samples were then sheared at a constant strain rate of 0.025 inch/minute. Shear deformation was recorded until a maximum of about 0.250-inch shear displacement was achieved. Ultimate strength was selected from the shear-stress deformation data and plotted to determine the shear strength parameters. For test data, including sample density and moisture content, see Drawing Nos. B-3 through B-7, *Direct Shear Test Results,* and the following table:

Table No. B-5, Summary of Direct Shear Test Results

Boring No.	Depth (feet)	Soil Classification	Ultimate Strength Parameters	
			Friction Angle (degrees)	Cohesion (psf)
BH-01	8.0-9.5	Silty Sand (SM)	35	80
*BH-01	8.0-18.0	Silty Sand (SM)	30	320
*BH-02	0.0-5.0	Silty Sand (SM)	28	170
BH-02	4.0-5.5	Silty Sand (SM)	28	90
BH-06	5.0-6.0	Silty Sand (SM)	35	0

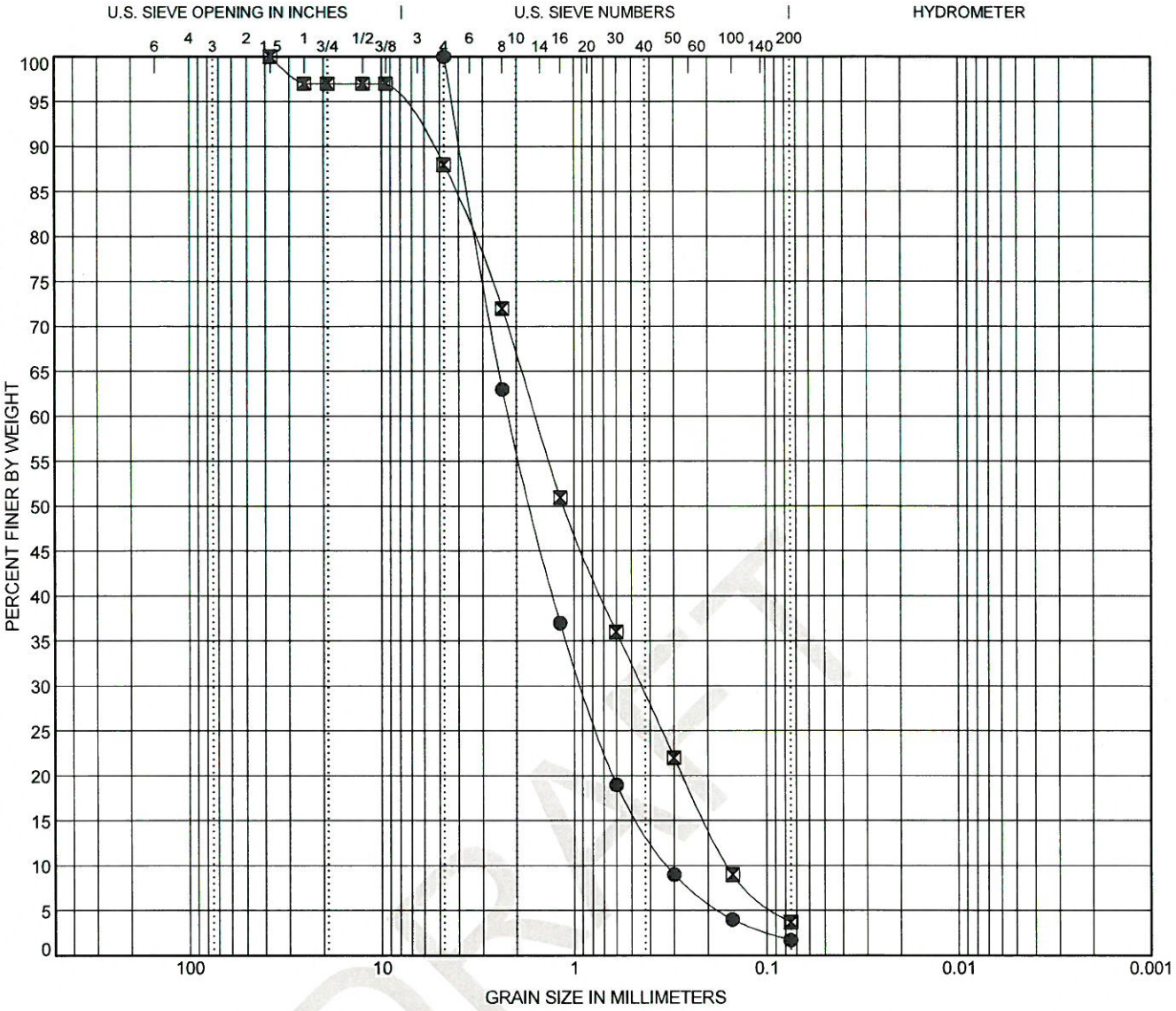
*Remolded to 90% of the maximum dry density

Consolidation

Three consolidation tests were conducted in accordance with ASTM Standard D2435 method. Data obtained from the test performed on relatively undisturbed ring samples were used to evaluate the settlement characteristics of the on-site soils under load. Preparation for these tests involved trimming the sample, placing it in a 1-inch-high brass ring, and loading it into the test apparatus, which contained porous stones to accommodate drainage during testing. Normal axial loads were applied to one end of the sample through the porous stones, and the resulting deflections were recorded at various time periods. The load was increased after the sample reached a reasonable state of equilibrium. Normal loads were applied at a constant load-increment ratio, successive loads being generally twice the preceding load. For test results, including sample density and initial moisture content, see Drawing No. B-8 through B-10, *Consolidation Test Results*.

Sample Storage

Soil samples presently stored in our laboratory will be discarded 30 days after the date of this report, unless this office receives a specific request to retain the samples for a longer period of time.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	BH-02	0.0-5.0	SILTY SAND (SM)				1.17	6.78
⊠	BH-02	7.0-15.0	SILTY SAND (SM)				0.79	10.04

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-02	0.0-5.0	4.75	2.179	0.907	0.322	0.0	98.3	1.7	
⊠	BH-02	7.0-15.0	37.5	1.588	0.446	0.158	12.0	84.3	3.7	

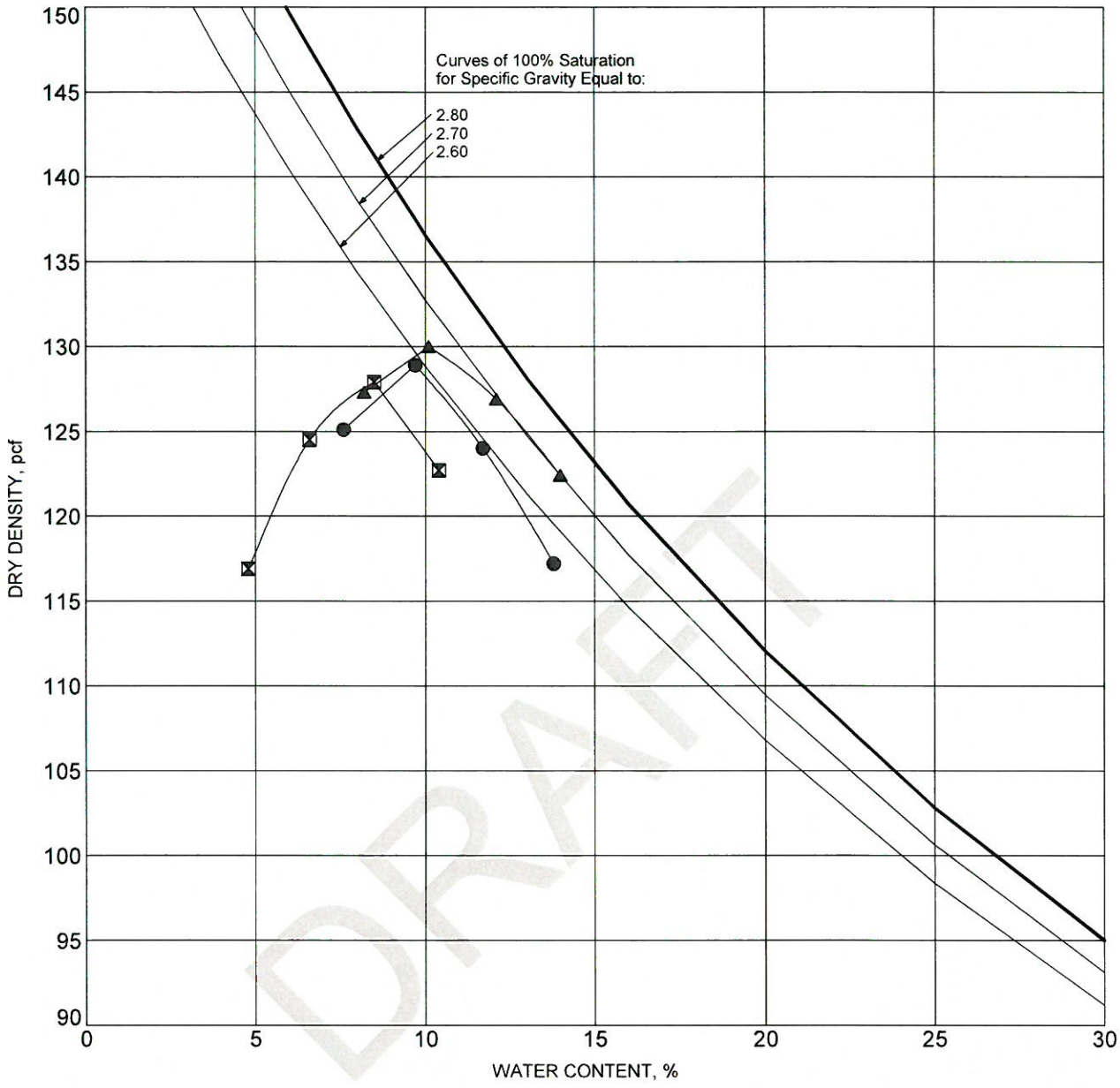
GRAIN SIZE DISTRIBUTION RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. 24-81-141-01

Drawing No. B-1



SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	ASTM TEST METHOD	OPTIMUM WATER, %	MAXIMUM DRY DENSITY, pcf
●	**BH-01**	**8.0-18.0**	**SILTY SAND (SM), Yellowish Brown**	**D1557 - A**	**10**	**129**
⊠	**BH-02**	**0.0-5.0**	**SILTY SAND (SM), Brown**	**D1557 - A**	**8**	**128**
▲	**BH-02**	**7.0-15.0**	**SILTY SAND (SM), Yellowish Brown**	**D1557 - A**	**10.5**	**130**

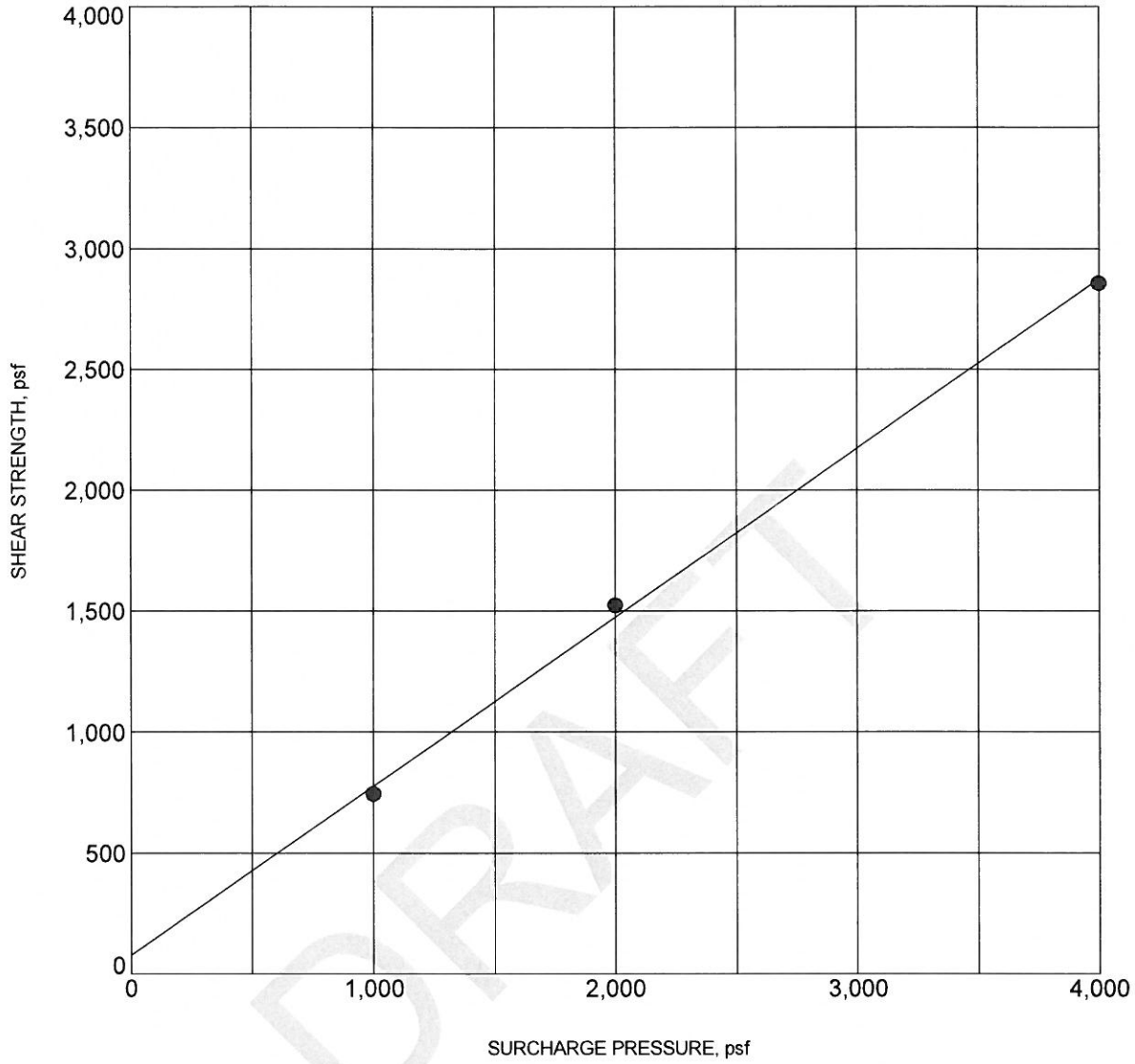
MOISTURE-DENSITY RELATIONSHIP RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-2**



BORING NO.	:	**BH-01**	DEPTH (ft)	:	**8.0-9.5**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**80**	FRICTION ANGLE (degrees)	:	**35**
MOISTURE CONTENT (%)	:	**12.0**	DRY DENSITY (pcf)	:	**115.9**

NOTE: Ultimate Strength.

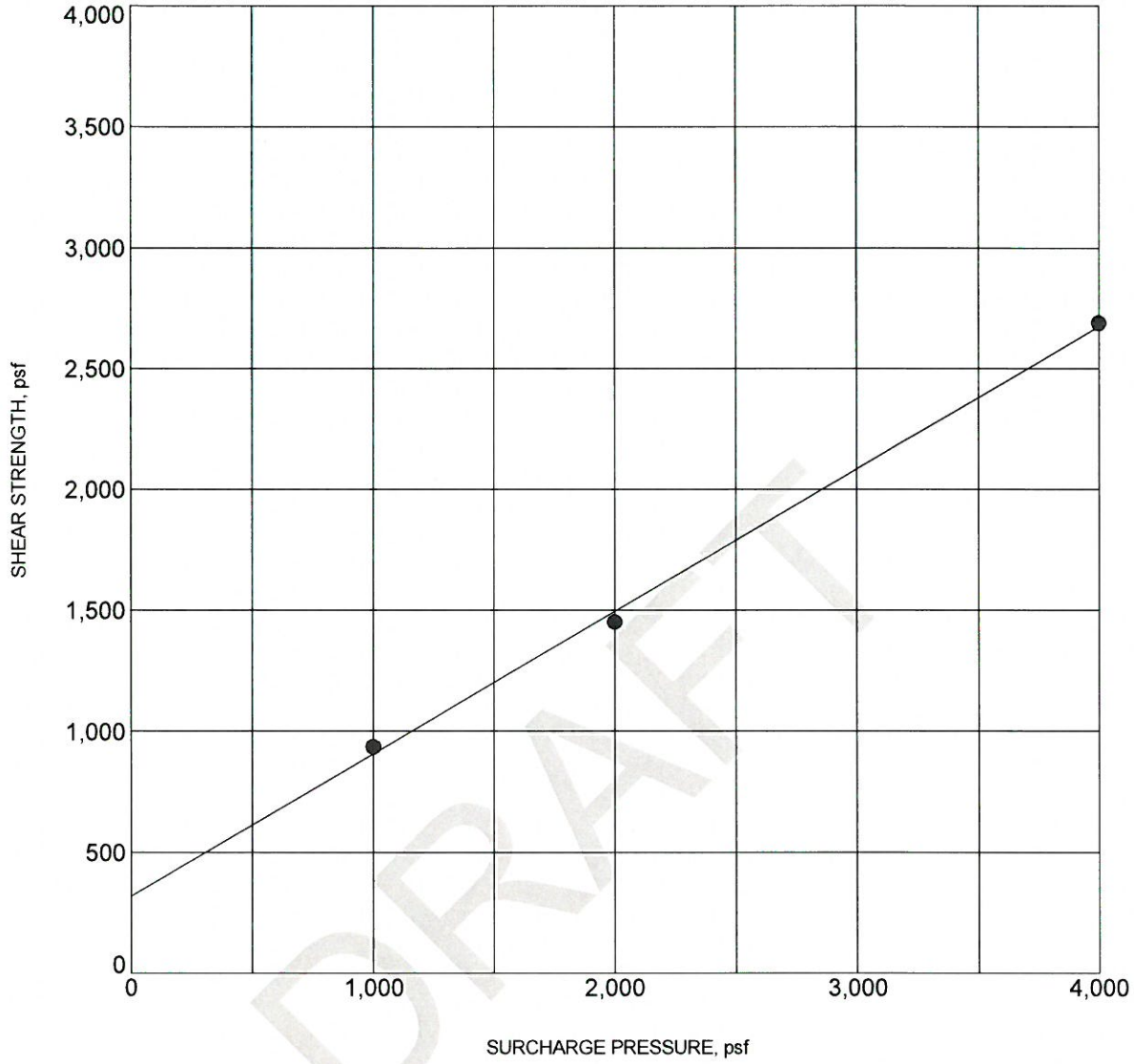
DIRECT SHEAR TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
250 CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-3**



BORING NO.	:	**BH-01**	DEPTH (ft)	:	**8.0-18.0**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**320**	FRICTION ANGLE (degrees)	:	**30**
MOISTURE CONTENT (%)	:	**10.0**	DRY DENSITY (pcf)	:	**116.6**

NOTE: Ultimate Strength.

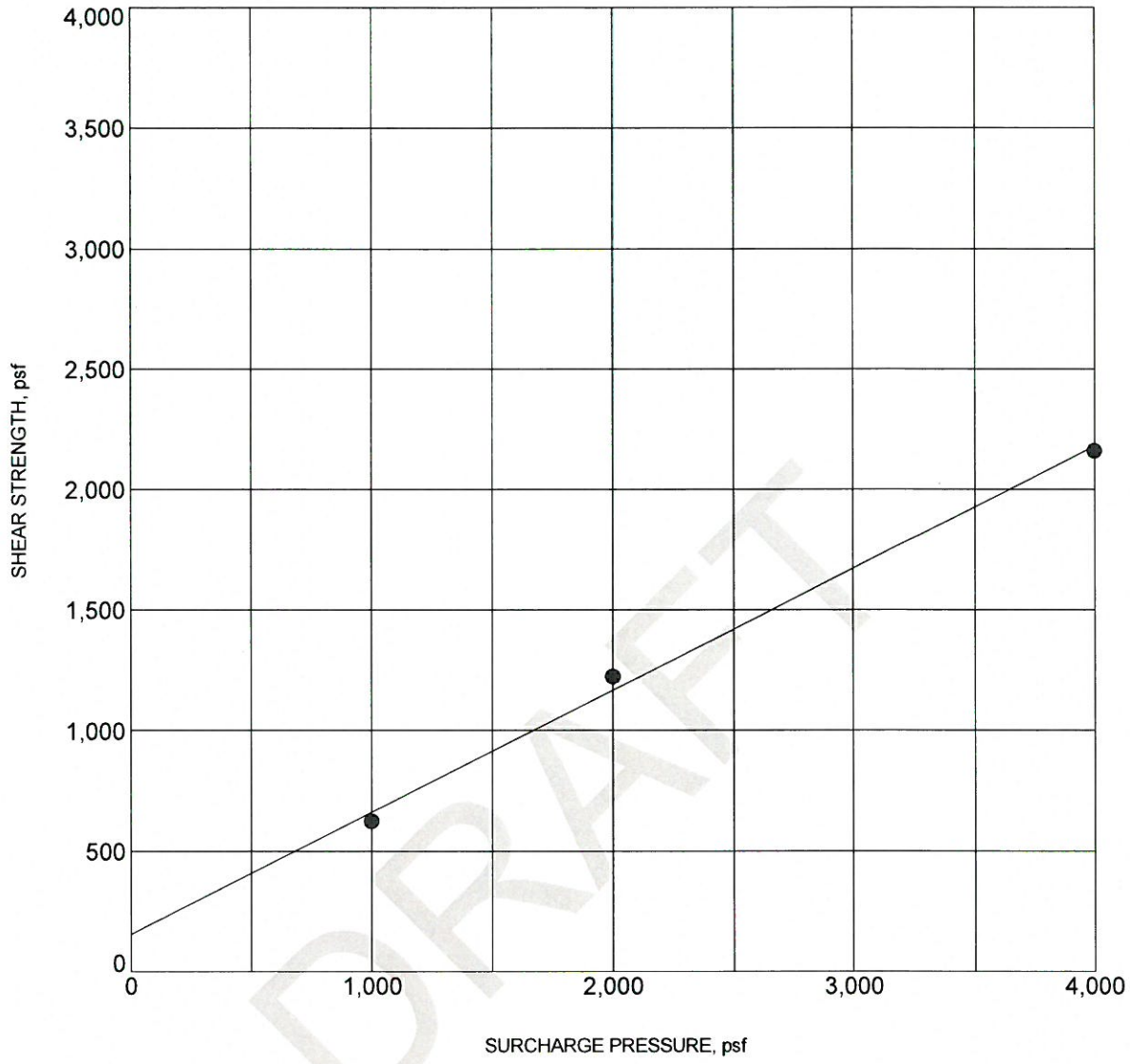
DIRECT SHEAR TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
250 CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-4**



BORING NO.	:	**BH-02**	DEPTH (ft)	:	**0.0-5.0**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**160**	FRICTION ANGLE (degrees)	:	**27**
MOISTURE CONTENT (%)	:	**8.0**	DRY DENSITY (pcf)	:	**110.4**

NOTE: Ultimate Strength.

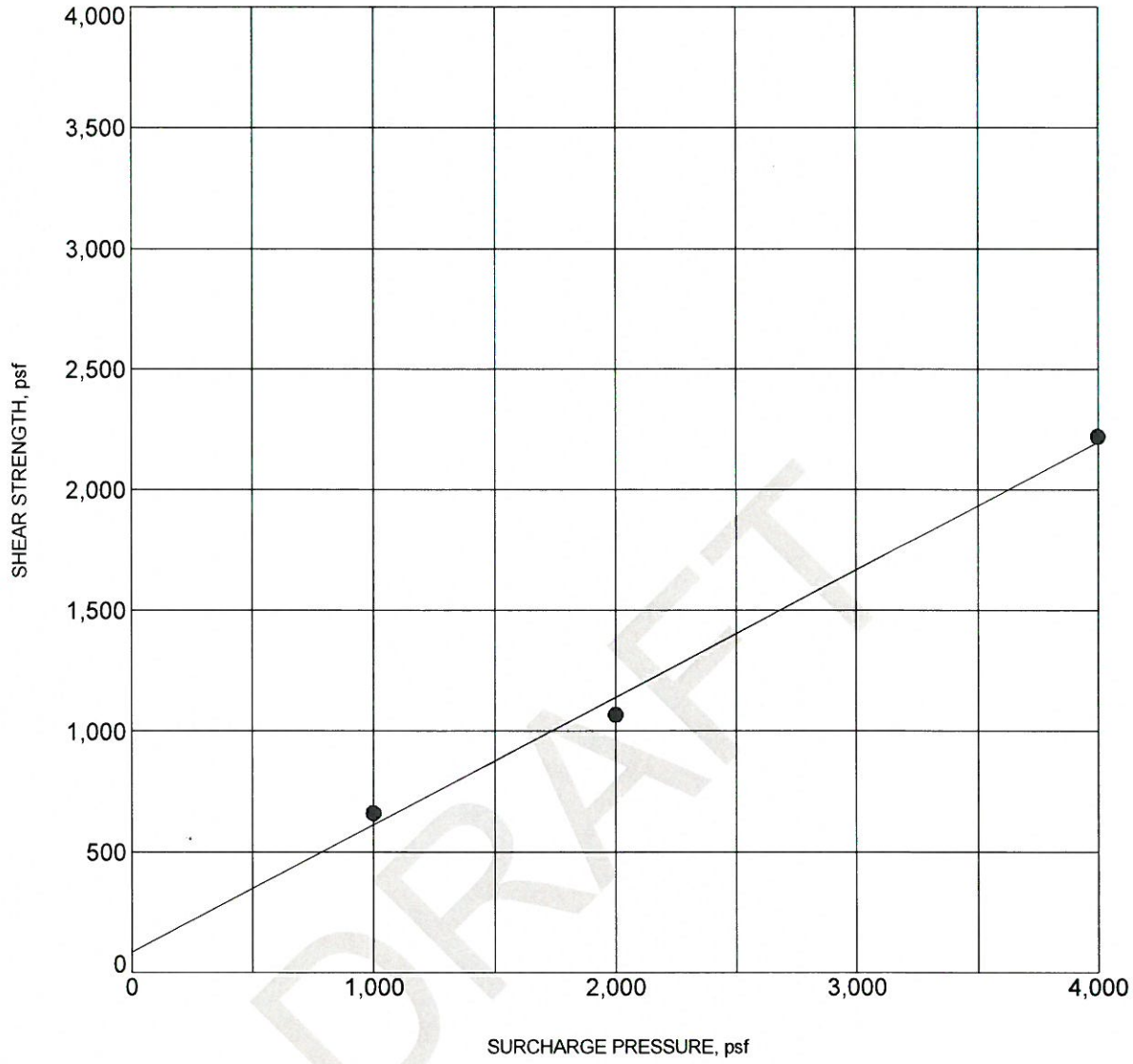
DIRECT SHEAR TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
250 CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-5**



BORING NO.	:	**BH-02**	DEPTH (ft)	:	**4.0-5.5**
DESCRIPTION	:	**SILTY SAND (M)**			
COHESION (psf)	:	**90**	FRICTION ANGLE (degrees)	:	**28**
MOISTURE CONTENT (%)	:	**15.0**	DRY DENSITY (pcf)	:	**95.4**

NOTE: Ultimate Strength.

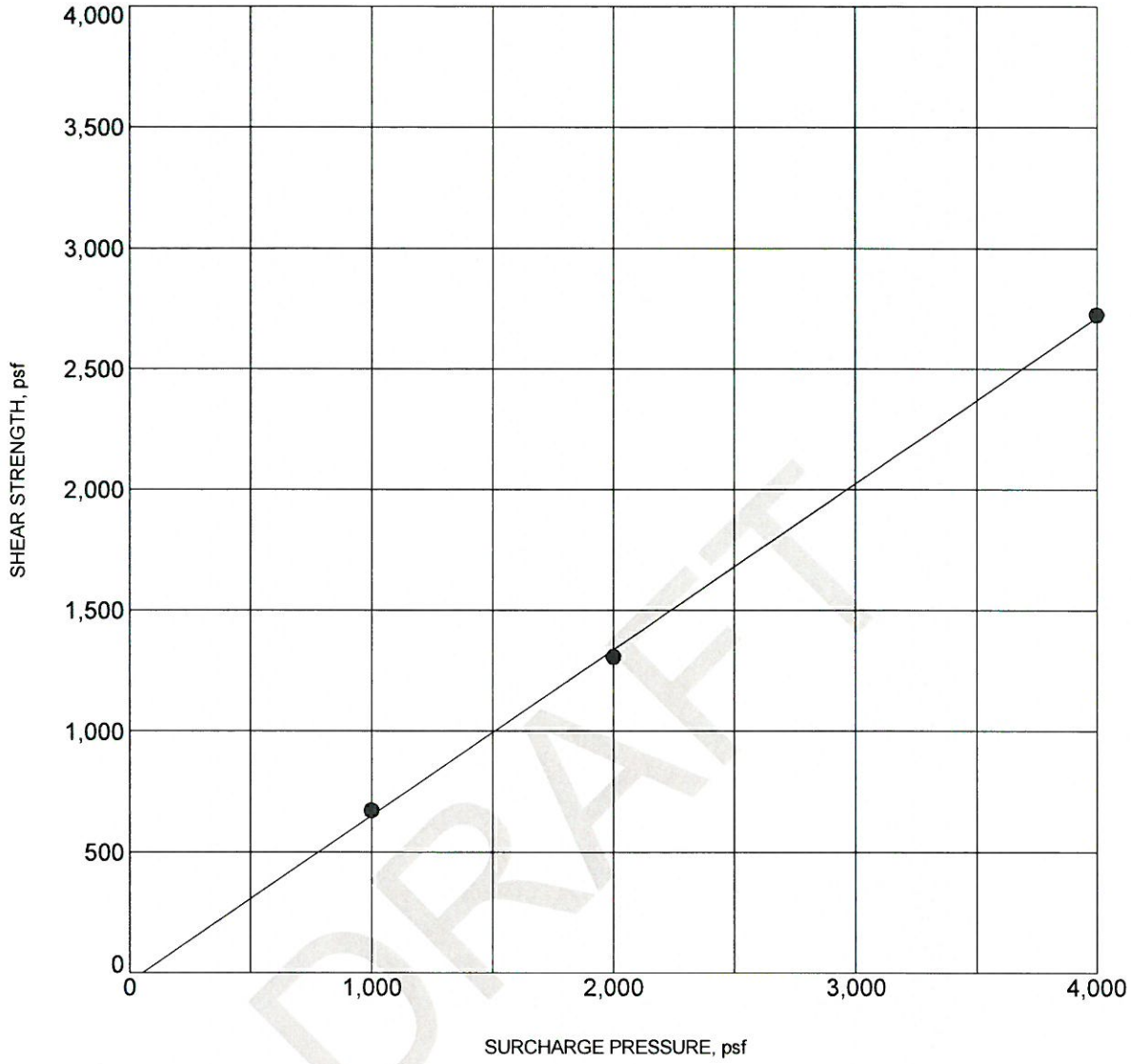
DIRECT SHEAR TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
250 CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-6**



BORING NO.	:	**BH-06**	DEPTH (ft)	:	**5.0-6.0**
DESCRIPTION	:	**SILTY SAND (SM)**			
COHESION (psf)	:	**0**	FRICTION ANGLE (degrees)	:	**35**
MOISTURE CONTENT (%)	:	**9.0**	DRY DENSITY (pcf)	:	**97.8**

NOTE: Ultimate Strength.

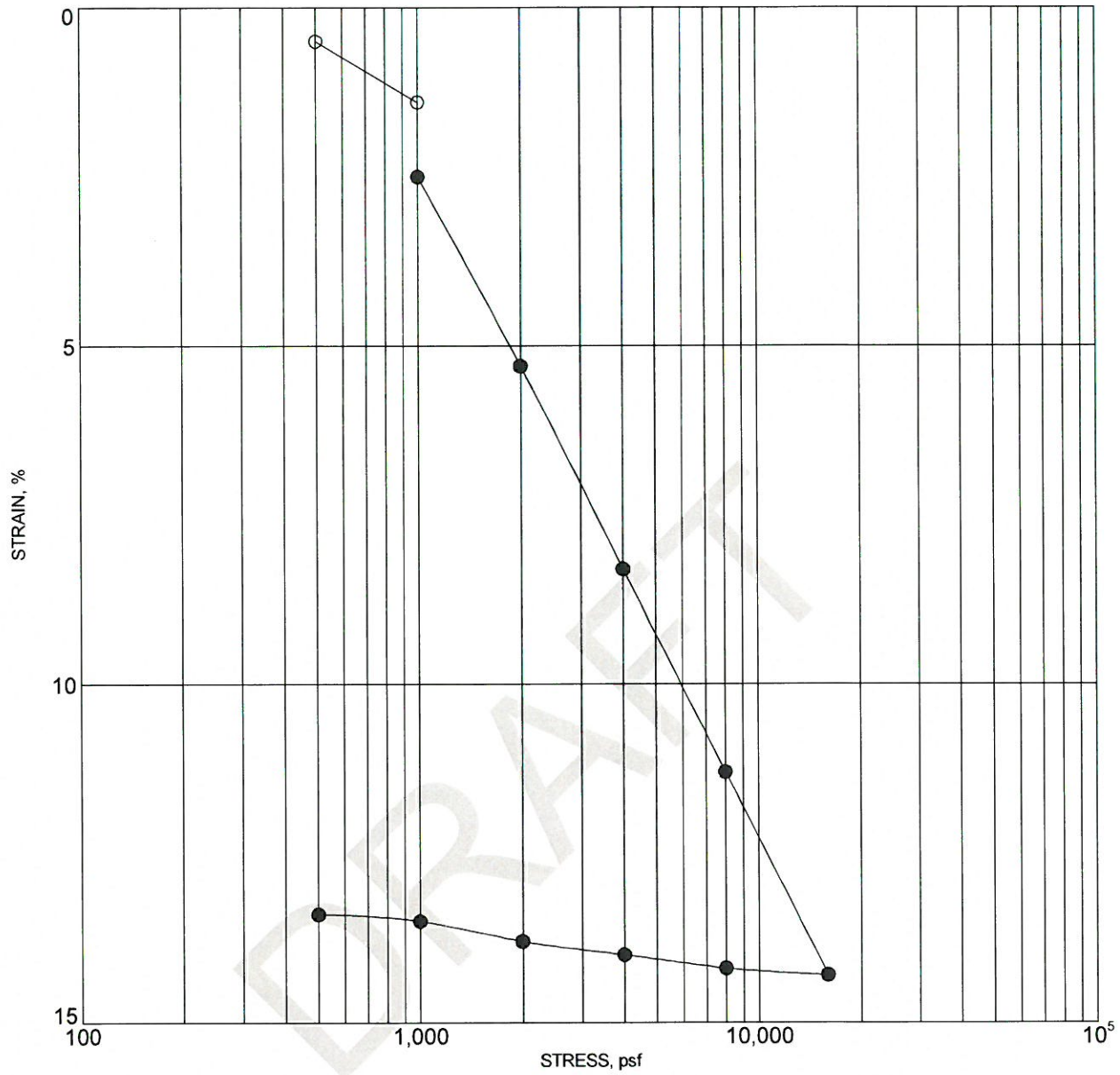
DIRECT SHEAR TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
250 CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-7**



BORING NO. :	BH-07	DEPTH (ft) :	4.0-5.5
DESCRIPTION :	SILTY SAND (SM)		

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL				
FINAL				

NOTE: SOLID CIRCLES INDICATE READINGS AFTER ADDITION OF WATER

CONSOLIDATION TEST RESULTS

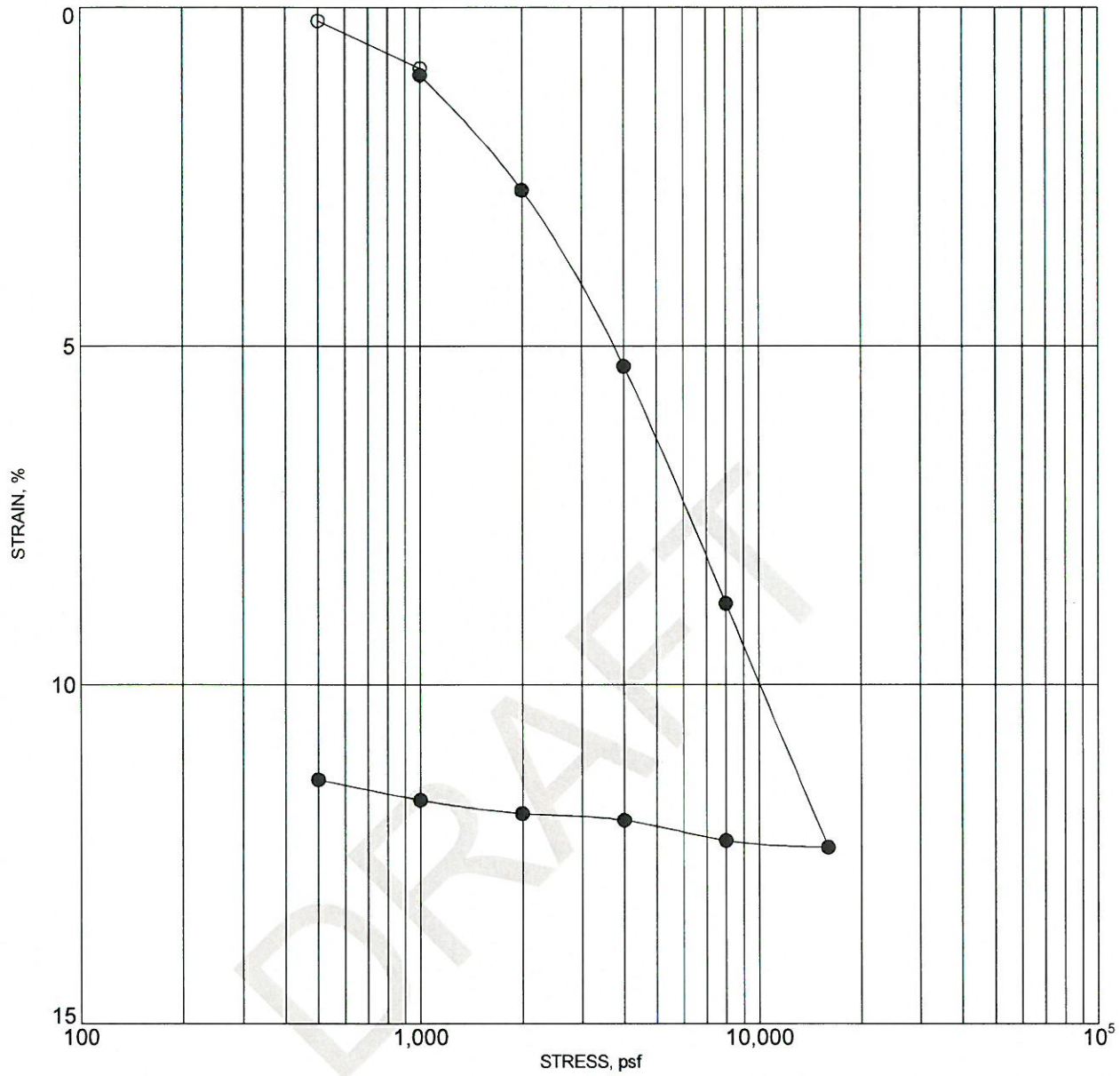
Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-8**

Project ID: 24-81-141-01.GPJ; Template: CONSOLIDATION



BORING NO. :	BH-08	DEPTH (ft) :	5.0-6.5
DESCRIPTION :	SILTY SAND (SM)		

MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL			
FINAL			

NOTE: SOLID CIRCLES INDICATE READINGS AFTER ADDITION OF WATER

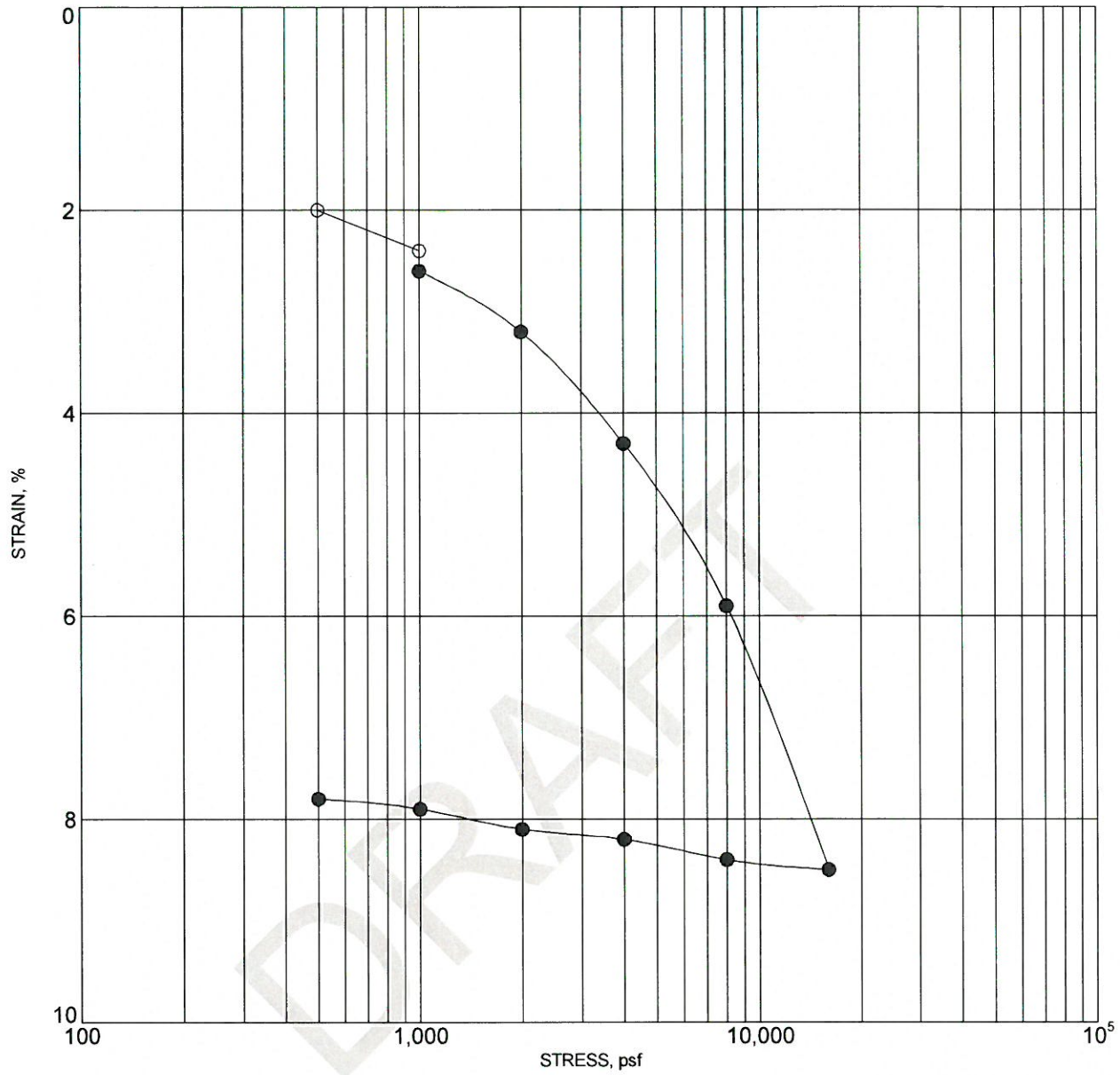
CONSOLIDATION TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-9**



BORING NO. :	BH-10	DEPTH (ft) :	2.0-3.0
DESCRIPTION :	SILTY SAND (SM)		

MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL			
FINAL			

NOTE: SOLID CIRCLES INDICATE READINGS AFTER ADDITION OF WATER

CONSOLIDATION TEST RESULTS

Converse Consultants

Seeley Creek Wastewater Treatment Plant
CA-138
City of Crestline, San Bernardino County, California

Project No. **24-81-141-01**

Drawing No. **B-10**

Appendix C

Slope Stability Analysis

APPENDIX C

SLOPE STABILITY ANALYSIS

The anticipated stability of the existing slope under static and pseudo static conditions were evaluated using the Slide 9.008 software (RocScience, 2020). Pseudostatic analyses using a seismic co-efficient of 0.15g were performed in order to evaluate the stability of the slopes during a large earthquake. These slopes were selected as a worst-case condition due to their heights, slope ratio and materials encountered. The purpose of the analysis was to evaluate the anticipated factors of safety against failure of the proposed slopes under a variety of configurations.

For all slope conditions, a Mohr-Coulomb soil strength model was assumed, and Factors of Safety (FOS) for slope stability were evaluated using the Bishop Simplified method.

The relevant soil parameters for the proposed slope including unit weight, friction angle and cohesion was derived from field and laboratory test data and are presented in the following table.

Table No. C-1, Soil Parameters

Conditions	Soil Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Compacted Fill	131.5	245	29
Colluvium (Ultimate)	113.4	125	32
Colluvium (Peak)	113.4	150	33
Bedrock (Ultimate)	128.7	140	35
Bedrock (Peak)	128.7	355	36

Auto Refine searches within predefined areas were utilized to determine the critical slip surface in each case. Slip surface limits (entrance and exit zones) were implemented to avoid modeling surficial slope failures which have a marginally lower overall factor of safety compared to deeper seated slip surfaces, but which are less relevant to the slope design.

Limit equilibrium methods for evaluating slope stability consider the static equilibrium of a soil mass above a potential failure surface. For conventional, two-dimensional methods of analysis; the slide mass above an assumed failure surface is first divided into vertical slices, then stresses are evaluated along the sides and base of each slice. The factor of safety against a slope failure (FS_{slope}) is defined as:

$$FS_{slope} = \frac{\text{shear strength of soil}}{\text{shear stress required for equilibrium}}$$

The strengths and stresses are computed along a defined failure surface located at the base of the vertical slices. The shearing resistance along the potential slip surface is computed, with appropriate Mohr-Coulomb strength parameters, as a function of the effective normal stress.

The following table and pages include figures presenting the results of the analyses.

Table No. C-2, Factors of Safety Against Slope Failure

Slope	Condition	Approx. Slope Height (feet)	FOS	Remarks
2:1 Stabilization Fill Slope Section A-A'	Static	50	1.77>1.5	Stable
	Pseudo-Static		1.40>1.1	Stable

The following table presents the results of the surficial slope stability analyses of the upper 4 feet of the natural slope.

Table No. C-3, Factors of Safety Against Surficial Slope Failure

Slope	Condition	Approx. Slope Angle	FOS	Remarks
Stabilization Fill Slope	Saturated	2H:1V	1.68>1.5	Stable