PRELIMINARY GEOTECHNICAL INVESTIGATION
For
PROPOSED MIXED-USE DEVELOPMENT
525 Water Street and 111 Market Street
APN'S 008-332-35 and 10
Santa Cruz, California

Prepared
For
JAN HOCHHAUSER
Santa Barbara, California

Prepared By
DEES & ASSOCIATES, INC.
Geotechnical Engineers
Project No. SCR-1830
JANUARY 2024

Dees & Associates, Inc.
Geotechnical Engineers
501 Mission Street, Suite 8A Santa Cruz, CA 95060 Phone (831) 427-1770

January 24, 2024 Project No. SCR-1830

JAN HOCHHAUSER
122 East Arrellaga Street
Santa Barbara, California 93101

Subject: Preliminary Geotechnical Investigation

Reference: Proposed Mixed-Use Development
525 Water Street and 111 Market Street
APN's 008-332-35 and 10
Santa Cruz, California

Dear Mr. Hochhauser:

As requested, we have completed a preliminary geotechnical investigation for the mixed-use development proposed at the referenced site. The purpose of our investigation was to evaluate the soil conditions at the site and provide preliminary geotechnical recommendations for the proposed improvements.

This report presents the results, conclusions, and recommendations of our investigation. If you have any questions regarding this report, please call our office.

Very truly yours,

DEES & ASSOCIATES, INC.

Rebecca L. Dees
Geotechnical Engineer
G.E. 2623

Copies: 1 to Addressee

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GEOTECHNICAL INVESTIGATION

Introduction

This report presents the results of our preliminary geotechnical investigation for the proposed mixed-use development proposed at 525 Water Street and 111 Market Street in Santa Cruz, California.

Purpose and Scope

The purpose of our preliminary investigation was to explore and evaluate surface and near surface soil conditions at the site and develop preliminary geotechnical recommendations for design and construction of the proposed improvements.

The specific scope of our services was as follows:

1. Site reconnaissance and review of available data in our files pertinent to the site and vicinity.

2. Exploration of subsurface conditions consisting of logging and sampling of two (2) exploratory borings drilled 50 feet deep.

3. Laboratory testing to evaluate the engineering properties of the subsoils.

4. Engineering analysis and evaluation of the resulting field and laboratory test data. Based on our findings, we have developed preliminary geotechnical recommendations for the proposed development.

5. Preparation of this report presenting the results of our investigation.

Project Location and Description

The project site is comprised of two parcels located at 525 Water Street and 111 Market Street in Santa Cruz, California. The nearly level, 0.75-acre combined site is bordered by Water Street to the south, Market Street to the east, commercial buildings to the west and single-family residences to the north.

The site is currently developed with a 11,000 square foot single-story building and paved parking. We understand the existing improvements will be removed and a new five-story building with first and second floor parking is proposed. The new building will occupy the majority of the site. The building will be used for both residential and commercial use.

Field Investigation

Subsurface conditions at the site were explored on November 28, 2023 with two (2) exploratory borings drilled to 50 feet. Our borings were advanced with 8-inch diameter hollow stem augers advanced with truck mounted drilling equipment. The approximate locations of our exploratory borings are indicated on our boring site plan, Figure 2.

Representative soil samples were obtained from the exploratory borings at selected depths, or at major strata changes. These samples were recovered using the 3.0-inch O.D. Modified California Sampler (L) or the Standard Terzaghi Sampler (T). The penetration resistance blow counts for the (L) and (T) noted on the boring logs were obtained as the sampler was dynamically driven into the in-situ soil. The process was performed by dropping a 140-pound hammer a 30-inch free fall distance and driving the sampler 6 to 18 inches and recording the number of blows for each 6-inch penetration interval. The blows recorded on the boring logs represent the accumulated number of blows that were required to drive the last 12 inches. The blow counts indicated on the logs have been converted to equivalent standard penetration test (SPT) values.

The soils observed in the test borings were logged in the field and described in accordance with the Unified Soil Classification System (ASTM D2487 and ASTM D2488), Figure 3. The Test Boring Logs denote subsurface conditions at the locations and times observed, and it is not warranted they are representative of subsurface conditions at other locations or times.

Laboratory Testing

The laboratory testing program was directed toward a determination of the physical and engineering properties of the soils underlying the site. Moisture content and dry density tests were performed on representative undisturbed soil samples to determine the consistency of the soil and the moisture variation throughout the explored soil profile. Grain size analysis was performed to aid in classification of the soil. Atterberg Limits were determined on select fine-grained soils. The results of our field and laboratory testing appear on the boring logs, opposite the sample tested, Figures 4 and 5.

Subsurface Soil Conditions

The site is mapped as being underlain by Alluvial deposits, undifferentiated (Holocene), which is described as, “Unconsolidated, heterogeneous, moderately sorted silt and sand containing discontinuous lenses of clay and silty clay. Locally includes large amounts of gravel. May include deposits equivalent to both younger (Qyf) and older (Qof) flood-plain deposits in areas where these were not differentiated”.

Boring 1 encountered about 10 feet of silt/clay over clayey sands to a depth of about 25 feet. Silt and silt/clay were encountered below 25 feet. Boring 2 encountered about 10 feet of silt over bedded clayey sands and clay to a depth of about 41 feet then clay/silt to the base of our boring. The clays and silts are generally medium stiff to very stiff. The sandy soils were generally loose.

Groundwater

Groundwater was encountered 10 feet below grade in both borings. The boring logs denote groundwater conditions at the locations and times observed, and it is not warranted they are representative of groundwater conditions at other locations and times. Groundwater levels at the site may vary due to seasonal variations and other factors not evident during our investigation.

Seismicity

The following is a general discussion of seismicity in the project vicinity. A detailed discussion of seismicity is beyond the scope of our services.

The closest faults to the site are the San Andreas Fault, Zayante-Vergeles Fault, Monterey Bay-Tularcitos Fault and the San Gregorio Fault. The San Andreas Fault is the largest and most active of the faults in the site vicinity. However, each fault is considered capable of generating moderate to severe ground shaking. It is reasonable to assume that the proposed development will be subject to at least one moderate to severe earthquake from one of the faults during the next fifty years.

Fault	San Andreas	Zayante-Vergeles	San Gregorio	Monterey Bay - Tularcitos
Distance (mi.)	10.5	7.6	11.1	7.6
Direction	NE	NE	WSW	SW

The following ground motion parameters were determined using the ASCE 7 Hazard Tool and ASCE 7-16. The following values are valid only if the liquefaction potential is mitigated with soil modification. A site-specific response analysis may be required if the soils are not modified to mitigate liquefaction.

Seismic Design Parameters	**ASCE 7-16**
Site Class	D
Mapped Spectral Acceleration for Short Periods	S_s = 1.667 g
Mapped Spectral Acceleration for 1-second Period	S_1 = 0.639 g
5% Damped Spectral Response Acceleration for Short Period	S_{DS} = 1.111 g
5% Damped Spectral Response Acceleration for 1-Second Period	S_{D1} = N/A
Seismic Design Category	N/A
PGAm	0.769 g

Liquefaction

Liquefaction occurs when saturated fine grained sands, silts and sensitive clays are subject to shaking during an earthquake and the water pressure within the pores build up leading to loss of strength. An analysis of the liquefaction potential of the soils underlying the site was conducted using the computer program LiquefyPro (CivilTech). Seismic conditions were analyzed using the maximum expected peak ground acceleration (PGA_M) of 0.769g.

The results of our liquefaction analysis indicate sandy soils have a high potential for liquefaction. The sandy soils were generally encountered from about 10 to 25 feet in Boring 1. Interbedded sandy soils were encountered from about 10 feet to 41 feet in Boring 2. The full extent of potentially liquefiable soils was not determined in our borings and additional CPT testing is recommended at the site to further explore the subsoils.

Settlement
Total ground settlements associated with the design earthquake are predicted to be on the order of 9 inches. Differential settlements are expected to be on the order of 1 to 2 inches.

Loss of Soil Strength
Liquefied soils lose strength during and immediately following liquefaction. Foundations should not rely on the potentially liquefiable soils for support. A significant reduction in bearing capacity in the soils overlying the liquefied soils should be also be expected.

Lateral Spreading
Lateral spreading occurs when liquefied soil loses strength and the soil starts to flow and move sideways. Our analysis indicates there is a potential for over 7 feet of cumulative lateral spreading to occur in the liquefied soils.

Sand Boils
Sand boils are caused when water pressures are relieved at the ground surface and the upward movement of groundwater causes soil to rise to the ground surface creating a mound of soil at the surface. There is a moderate potential for sand boils to develop at the ground surface.

Landsliding
The site is situated on very gently sloping ground and there are no slopes located near the site. There is a very low potential for landslides to affect the proposed development.

DISCUSSIONS AND CONCLUSIONS

Based on the results of our preliminary investigation, the proposed development is feasible if the liquefaction and lateral spreading hazards are mitigated. Primary geotechnical concerns for the project include mitigating settlements and lateral spreading associated with liquefaction of the subsoils, providing adequate support for foundations, site drainage and designing the structure to resist strong seismic shaking.

Current building codes require lateral spreading (over 18 inches) to be mitigated with either deep foundations that penetrate the soil layers that are susceptible to lateral spreading or by modifying the soil to mitigate the lateral spreading potential. We do not have enough soil data to determine if deep piers are a viable option for mitigating lateral spreading. With the data we have to date, the piers would have to be founded below about 30 to 40 feet before they will have any resistance to lateral soil movement. Very large lateral forces would be exerted against the piers during lateral spreading. The piers will need to be embedded well below the aforementioned depths to resist lateral pressures.

Ground modification to mitigate liquefaction and lateral spreading is feasible at the site. Ground modification generally consists of densifying the soils or changing the make-up of the soil. Soil densification by compaction grouting or soil mixing to create cement-treated soil columns are potential options for mitigating the lateral spreading potential at the site.

The lateral spreading potential has to be mitigated regardless of the foundation type chosen, except in the case of very deep piles that are designed to resist lateral spreading forces. However, lateral spreading can be mitigated without having to mitigating all zones of liquefaction. The depth and extent of liquefaction mitigation will depend on the foundation type and anticipated loads of the proposed structure. In general, mat slab foundations will require liquefaction to be mitigated to a greater depth than spread footing foundations.

The surface soils consist of clay that have a relatively low bearing capacity. For preliminary purposes, an allowable bearing capacity of 350 psf may be assumed for mat slabs supported on the clayey surface soils in combination with full-depth liquefaction mitigation and an allowable bearing capacity of 1,500 psf may be assumed for shallow spread footings supported on the clayey surface soils in combination with partial liquefaction mitigation. Drilled piers, in combination with liquefaction mitigation, can also be used. Due to the presence of thinly layered clays and sands, it is difficult to develop a preliminary pier capacity with the information gathered so far. The capacity of piers will need to be based on a more in-depth soil investigation and laboratory testing program.

It is also possible to replace the upper clayey soils with imported granular soil that has a higher capacity than the on-site soils. The depth of replacement will depend on the foundation loads, but a depth of 5 to 10 feet is a reasonable assumption for preliminary purposes. There is groundwater at 10 feet and groundwater may need to be lowered to facilitate soil replacement and compaction. The side walls of any excavations will need to be sloped back or shored. Shoring, in the form of soil improvement, could be integrated into the liquefaction mitigation program.

Site drainage will be an important consideration for the proposed development. The surface soils have low permeability and are not suited for on-site retention and the proposed improvements will occupy most of the site leaving limited room available for storing stormwater. Stormwater will most likely need to be directed to off-site facilities.

The site is located in a highly seismic region near several major fault zones. The proposed improvements will most likely experience strong seismic shaking during the design lifetime. Structures should be designed to resist seismic shaking in accordance with current building code requirements.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report is preliminary in nature and should not be used for design of improvements. Additional subsurface exploration and analysis is required for development of geotechnical design-level recommendations and criteria for the project.

2. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside our control. Therefore, this report should not be relied upon after a period of three years without being reviewed by a soil engineer.

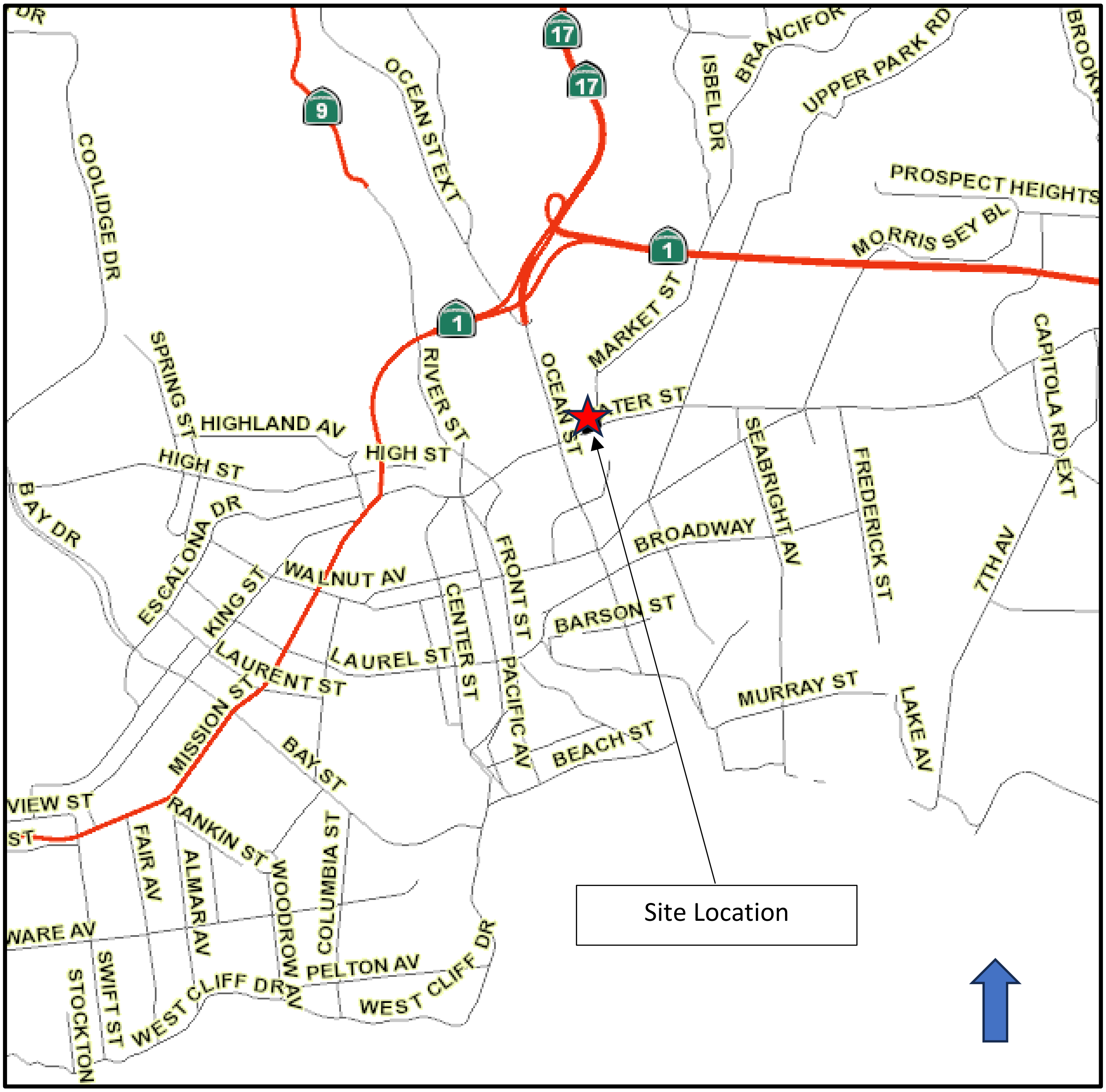
APPENDIX A

Site Vicinity Map

Boring Site Plan

Unified Soil Classification System

Test Boring Logs



SITE VICINITY MAP
Figure 1

BORING SITE PLAN
Figure 2

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS* MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE (THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	**GRAVELS** MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS (< 5% FINES)	**GW**	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing Not meeting all gradation requirements for GW	
		GRAVELS WITH FINES (>12% FINES)	**GM**	Silty gravels, gravel-sand-silt mixtures	Non plastic fines or fines with low plasticity Atterberg limits below "A" line or PI < 4	Above "A" line with 4 < PI < 7 are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Plastic fines Atterberg limits above "A" line with PI > 7	
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS (<5% FINES)	**SW**	Well-graded sands, gravelly sands, little or no fines	Wide range in grain sizes and substantial amounts of all intermediate sizes missing	
			SP	Poorly graded sands, gravelly sands, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing Not meeting all gradation requirements for SW	
		SANDS WITH FINES (>12% FINES)	**SM**	Silty sands, sand-silt mixtures	Non plastic fines or fines with low plasticity Atterberg limits below "A" line or PI < 4	Limits plotting in hatched zone with 4 < PI < 7 are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Plastic fines Atterberg limits above "A" line with PI > 7	
FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE (THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	SILTS AND CLAYS (LIQUID LIMIT < 50)		**ML**	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	SILTS AND CLAYS (LIQUID LIMIT > 50)		**MH**	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of medium to high plasticity, organic silts		
			OH	Organic clays of medium to high plasticity, organic silts		

*Gravels and sands with 5% to 12 % fines are borderline cases requiring use of dual symbols.

RELATIVE DENSITY OF SANDS AND GRAVELS

DESCRIPTION	BLOW / FT**
VERY LOOSE	0 – 4
LOOSE	4 – 10
MEDIUM DENSE	10 – 30
DENSE	30 – 50
VERY DENSE	OVER 50

CONSISTENCY OF SILTS AND CLAYS

DESCRIPTION	BLOWS / FT**
VERY SOFT	0 – 2
SOFT	2 – 4
FIRM	4 – 8
STIFF	8 – 16
VERY STIFF	16 – 32
HARD	OVER 32

**Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. 12 vertical inches.

Figure 3

TEST BORING LOG

SCR-1830
Water Street/Market Street

LOGGED BY: BD	DATE DRILLED: 11/28/23	BORING TYPE: 8 Inch Hollow Stem	BORING NO: 1

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
-		1.5 inches AC/4 inches AB										
1				4								
-	1-1	Very dark gray Sandy SILT/CLAY, very moist, very stiff	CL/	5								
2	T		ML	8	13		22.9					
-												
3												
-												
4												
-												
5				1								
-	1-2	Very dark gray SILT/CLAY, wet, medium stiff		2								
6	T			1	3		29.4					
-												
7												
-												
8												
-												
9		Contact Unknown										
-												
10				3								
-	1-3	Dark yellow brown Clayey SAND, saturated, loose	SC	1								
11	T			3	4		26.8				35.1	
-												
12												
-												
13												
-												
14												
-				3								
15				4								
-	1-4	Dark gray Clayey SAND, saturated, loose	SC	3	7							
16	T											
-												
17												
-												
18												
-												
19												
-												
20				3								
-	1-5	Very dark gray Clayey SAND, saturated, medium dense	SC	4								
21	T			5	9		27.6				37.5	
-												
22												
-												
23												
-												
24												
-		Contact Unkown										
25												

FIGURE 4

* Blow count converted:
L = Field Blow Count / 2

TEST BORING LOG

SCR-1830
Water Street/Market Street

LOGGED BY: BD	DATE DRILLED: 11/28/23	BORING TYPE: 8 Inch Hollow Stem	BORING NO: 1 continued

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
26	1-6 T	Black SILT, wet, medium stiff	ML	5 3 5	8							
27												
28												
29												
30												
31	1-7 T	Very dark gray CLAY with Sand, wet, medium stiff	CL	4 3 3	6		45.9					21.3
32												
33												
34												
35												
36	1-8 T	Very dark gray SILT, saturated, stiff	ML	6 7 8	15							
37												
38												
39												
40												
41	1-9 T	Very dark gray SILT, saturated, stiff	CL/ ML	5 5 10	15		29.1					
42												
43												
44												
45												
46	1-10 T	Dark gray SILT/CLAY, wet, very stiff	CL/ ML	7 8 12	20							7.7
47												
48												
49												
50												
51	1-11 T	Gray Sandy SILT/CLAY, wet, very stiff Boring Terminated at 51.5 Feet Groundwater Encountered at 10 Feet	CL/ ML	7 8 9	17		31.5					

FIGURE 4a

* Blow count converted:
L = Field Blow Count / 2

TEST BORING LOG

SCR-1830
Water Street/Market Street

LOGGED BY: BD	DATE DRILLED: 11/28/23	BORING TYPE: 8 Inch Hollow Stem	BORING NO: 2

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
-		AC AB										
1		FILL, Yellow brown medium to coarse SAND with SILT, dry-	SP									
-	2-1	damp, medium dense		7								
2	T	Very dark gray SILT, damp-moist, medium stiff		2								
-			ML	3	5		24.2					
3												
-												
4												
-												
5				3								
-	2-2			3								
6	T	Dark gray brown Sandy SILT, moist, medium stiff	ML	4	7		22.0					
-												
7												
-												
8												
-												
9												
-		Contact unknown										
10		▼ Groundwater at 10 feet		5								
-	2-3			8								
11	T	Dark brown Clayey SAND, moist to very moist, medium dense	SC	9	17		25.1				34.8	
-												
12												
-												
13												
-												
14												
-												
15				4								
-	2-4	Water seeps at 15.25. feet		5								
16	T	Very dark gray CLAY, very moist, stiff		7	12							
-			CL									
17												
-		Contact unknown										
18												
-												
19												
-												
20		Very dark gray fine to medium grained Silty SAND, saturated,	SM									
-	2-5	loose		3			25.4				18.4	
21	T			2								
-		Dark gray brown Sandy CLAY, wet, medium stiff		3	5		33.5					14.7
22			CL									
-												
23												
-												
24												
-		Contact Unknown										
26												

FIGURE 5

* Blow count converted:
L = Field Blow Count / 2

TEST BORING LOG

SCR-1830
Water Street

LOGGED BY: BD | **DATE DRILLED: 11/28/23** | **BORING TYPE: 8 Inch Solid Stem** | **BORING NO: 2 continued**

Depth	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
- 26 - 27	2-6 T	Dark gray fine SAND with Silt, saturated, loose to medium dense	SP	7 6 8	14		21.6				9.9	
- 28 - 29 -												
30 - 31	2-7 T	Dark gray fine SAND, wet, medium dense		16 7 10	17							
		Very dark gray CLAY, wet, very stiff	CL									
- 32 - 33 - 34 -												
35 - 36	2-8 T	Gray Sandy CLAY/SILT, saturated, medium stiff	CL/ ML	3 4 7	11		36.8					
- 37 - 38 - 39 -		Contact Unknown										
40 - 41	2-9 T	Very dark gray fine SAND, saturated, medium dense	SP	6 15 12	27							
- 42		Very dark gray CLAY, saturated, hard	CL									
- 43 - 44 -												
45 - 46	2-10 T	Very dark gray CLAY/SILT, saturated, hard	CL/ ML	14 10 15	25							
- 47 ↕		Break-in-log from 47 to 50 feet										
50 - 51 -	2-11 T	Dark gray Sandy CLAY/SILT, saturated, very stiff	CL/ ML	6 6 7	13		29.1					

Boring Terminated at 51.5 Feet
Groundwater Encountered at 10 Feet

FIGURE 5a

* Blow count converted:
L = Field Blow Count / 2