APPENDIX D – GEOTECHNICAL REPORT

GEOTILL Inc.

Geotechnical Engineering • Subsurface Exploration • Construction Testing and Material Engineering

GEOTECHNICAL ENGINEERING INVESTIGATION
Proposed EHRM Infrastructure Upgrade
950 Campbell Ave
West Haven, CT
GEOTILL Project No. 112452001

Prepared For:

Spees Design Build

Attn: Mr. Dominic Ditschler
Cad Technician

April 17, 2024

GEOTILL
ENGINEERING, INC.

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Geotechnical Engineering • Subsurface Exploration • Construction Testing and Material Engineering

April 17, 2024

Spees Design Build

Attention: Mr. Dominic Ditschler
Cad Technician

Re: Geotechnical Engineering Investigation
Proposed EHRM Infrastructure Upgrade
950 Campbell Ave
West Haven, CT
GEOTILL Project No. 112452001

Gentlemen:

Submitted herewith is the report of our geotechnical engineering investigation for the referenced project. This study was authorized in accordance with GEOTILL Proposal PE- 03021124 dated March 3, 2024.

This report contains the results of our field and laboratory-testing program, an engineering interpretation of this data with respect to the available project characteristics and recommendations to aid design and construction of foundations and other earth-connected phases of this project. We wish to remind you that we will store the samples for 30 days after which time they will be discarded unless you request otherwise.

We appreciate the opportunity to be of service to you on this project. If we can be of any further assistance, or if you have any questions regarding this report, please do not hesitate to contact either of the undersigned.

Sincerely,

GEOTILL INC.

Fawzy Ezzein

Fawzy Ezzein, Ph.D.
Project Engineer

STATE OF CONNECTICUT
MALEK SMADI
PEN.0031923
LICENSED
PROFESSIONAL ENGINEER

Malek Smadi

Malek Smadi, Ph.D., P.E.
Principal Engineer
(317) 449-0033 Ext. 101

Copies: Spees Design Build, Attn: Mr. Dominic Ditschler

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GEOTECHNICAL ENGINEERING INVESTIGATION

Proposed EHRM Infrastructure Upgrade
950 Campbell Ave
West Haven, CT
GEOTILL Project No. 112452001

1.0 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the project site by drilling two soil test borings and performing one infiltration test and to evaluate this data with respect to foundation concept and design for the Proposed EHRM Infrastructure Upgrade construction and pavement field design. Also included is an evaluation of the site with respect to potential construction problems and recommendations dealing with earthwork and quality control during construction.

2.0 PROJECT CHARACTERISTICS

Spees Design Build is planning the construction of a new MCR Building and EHRM Infrastructure Upgrade on a site located at 950 Campbell Ave, West Haven, CT. The location of the proposed construction site is shown on Figure 1 in the Appendix. The ground surface at the site is characterized as relatively flat and is currently grass covered.

The proposed construction will consist of New MCR Building and EHRM Infrastructure Upgrade. The general layout of the project is shown on Figure 2 in the Appendix. It is our understanding that the proposed finish floor elevation for the building is planned to be slightly above the existing grade. Therefore, it is assumed that up to about 2 ft. of fill will be required in some locations to establish the finish grade elevation for the building.

Details regarding structural loads are not available at this time. No unusual loading conditions or settlement restrictions have been specified.

3.0 GENERAL SUBSURFACE CONDITIONS

3.1 Subsurface Soil Conditions

The general subsurface conditions were investigated by drilling two (2) soil test borings (B-1 and B-2) to a depth of twenty (20) ft within the area of the proposed building and performing 1 infiltration test (P-1) to a depth of 5 ft as shown in the Boring Plan (Figure 2 in the Appendix). (B-1 and B-2) were offset 5 ft, and 9 ft respectively due to the existence of underground utilities. The subsurface conditions disclosed by the field investigation are summarized in the following paragraphs. Detailed descriptions of the subsurface conditions encountered in each test boring are presented on the test boring logs in the Appendix. The letters in parentheses following the soil descriptions are the soil classifications in general accordance with the Unified Soil Classification System. It should be noted that the stratification lines shown on the soil boring logs represent approximate transitions between material types. In-situ stratum changes could occur gradually or at slightly different depths.

All of the soil test borings revealed approximately 12.0 inches of topsoil on the surface. Soil test boring B-1 had very loose to dense and hard Fill Material from depths of 1.0 to 10.0 ft followed by hard sandy Clay (CL) from depths of 10.0 to 13.0 ft, and ended with medium dense to dense clayey silty Sand (SM) from depths of 13.0 ft to termination at 20.0 ft. Soil test boring B-2 had very loose to dense clayey Sand (SC) from depths of 1.0 to 6.0 ft and ended with medium dense to very dense silty Sand (SM) from depths of 6.0 ft to auger refusal at 18.0 ft. Both borings had layers of very loose soils which is an area of concern. The consistency of the cohesive soils and the density of the cohesionless soils were estimated based upon the results of the standard penetration test (ASTM D-1586).

Zones of very loose soil encountered at the site are summarized in the table shown below:

Very Loose Soils

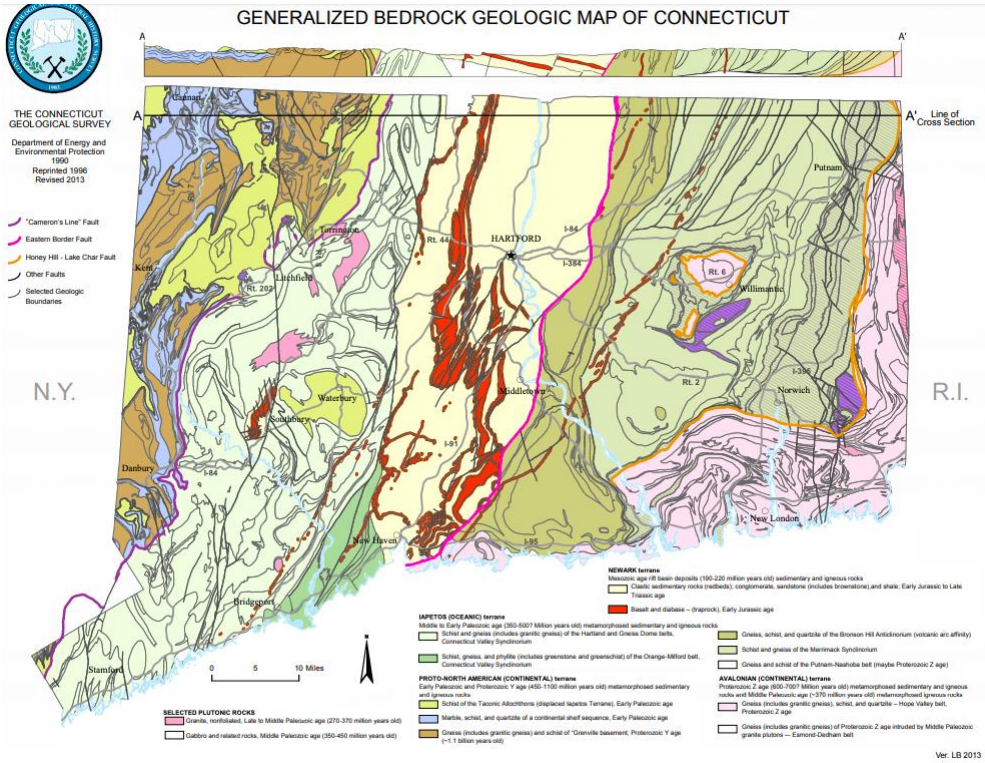
Boring No.	Soil Type	Depth, ft	Consistency/ Density
B-1	Fill Material	1.0 – 4.0	Very Loose
B-2	clayey Sand (SC)	1.0 – 4.0	Very Loose

3.2 Groundwater

Ground water observations are made during the drilling operations by noting the depth of water on the drilling tools and in the open boreholes following withdrawal of the drilling augers. No free ground water was noted in test borings upon completion and on tooling during drilling activities. It should be noted that short-term ground water readings in the test borings are not usually a reliable indication of the actual ground water level and that fluctuations in the level of the ground water should be expected due to variations in rainfall and other factors.

3.3 Geology

West Haven is a city in New Haven County, Connecticut, it lies within the state's diverse geological regions: eastern and western highlands made of older, metamorphic rock, and a central valley primarily consisting of basalt covered by sandstone. Connecticut boasts a variety of rock types, including granite, basalt, sandstone, limestone, marble, schist, and slate. Pegmatite, an economically important rock, is prevalent in the state, with notable occurrences in Branchville and Middletown. The geological foundation of Connecticut developed from west to east, with the oldest rock formations, part of the Precambrian Grenville Massif, dating back 1.3 billion years in Kent and the state, forming the eastern edge of the Laurentia continental plate.



3.4 Site Seismic Class

Based on geologic mapping, the results of the test borings, it is our opinion that the subsurface conditions at this site meet the criteria for Site Class C based on Section 1613.3.2 of the International Building Code (Chapter 20 of ASCE 7-16 "Minimum Design Loads for Buildings and Other Structures"). The basic seismic parameters are summarized in the following table:

Basic Parameters

Name	Value	Description
S_S	0.2	MCE_R ground motion (period=0.2s)
S_1	0.054	MCE_R ground motion (period=1.0s)
S_{MS}	0.26	Site-modified spectral acceleration value
S_{M1}	0.08	Site-modified spectral acceleration value
S_{DS}	0.173	Numeric seismic design value at 0.2s SA
S_{D1}	0.054	Numeric seismic design value at 1.0s SA

3.5 Infiltration

One (1) infiltration test was performed to establish the infiltration rate. The location is shown in Figure 3 of the appendix. We understand that the results of the testing will be used to prepare a preliminary design for the proposed stormwater BMP that will be used at the project site. We drilled a soil boring and installed casing (solid four-inch ID) to the proposed depth at 5 ft. The casing was inserted within the augers before the augers were extracted. We removed any smeared soiled surfaces and provided a natural soil interface into which water may percolate. We removed all loose material from the casing, a two-inch layer of clean sand backfill was placed to protect the bottom from scouring and sediment. We Backfilled the annulus around the bottom of the casing with at least 24 inches around the casing with hydrated granular bentonite.

Casing was filled with potable water to the top of casing and allowed to pre-soak for 24 hours, once pre-soak period has completed, we filled the top of the casing with potable water and monitor water level (measured drop from the top of the casing) until termination and stabilization criteria has been established based on the state and local stormwater requirements. Measurements were made using an electric water level probe indicator. We Repeated this procedure (filling the casing each time) a minimum of three additional times.

Upon completion of the testing, the casing was immediately pulled, and the boring backfilled. The final field rate is reported in inches per hour as shown below.

Table 1: Infiltration Test Results

Boring #	**Depth** (ft)	**Percolation Rate** (in/hr)	**Infiltration Rate*** (in/hr)
P-1	5	8.27 in/hr	0.22

4.0 SUMMARY OF FINDINGS AND RECOMMENDATIONS

The following findings and recommendations have been developed on the basis of the previously described project characteristics (Section 2.0) and subsurface conditions (Section 3.0). If there is any change in these project criteria, including project location on the site, a review should be made by this office.

4.1 Footings

Our findings show that the proposed building can be supported on shallow spread footings provided that any unsuitable materials or any uncontrolled fill material or any soft soils are identified and removed at the proposed footing locations. It is recommended to undercut and replace the upper 4 feet with engineered fill in the area of footings. Footings that bear on firm natural soil (or on well-compacted engineered fill that is placed over firm natural soil) can be designed for a net allowable soil pressure of 2,500 lbs/sq.ft for both column (square type) and wall (strip type) footings. It is important that the soil at the base of each footing excavation be carefully inspected as described in Section 5.3 to ensure that pockets of soft natural soils and any uncontrolled fill materials are identified and removed from beneath the footings and that the footings will bear on suitable materials.

In using net pressure, the weight of the footing and backfill over the footing, including the weight of the floor slab, need not be considered; hence, only loads applied at or above the finished floor need to be used for dimensioning the footings. Wall footings should be at least 2 ft. wide and column footings should be at least 3 ft. wide for bearing capacity considerations.

All exterior footings and footings in unheated areas should be located at a depth of at least 4 ft. below the final exterior grade for frost protection. Interior footings can be located at nominal depths below the finished floor provided the topsoil and other undesirable materials are removed at the footing locations.

Provided that the footings are designed as prescribed herein and inspected as outlined in Section 5.3, it is estimated that the total and differential foundation settlements should not exceed about 1 in. and 1/2 in., respectively. Careful field control will contribute substantially to minimizing the settlements.

Lateral forces on a shallow spread footing can be resisted by the passive lateral earth pressure against the side of the footing and by friction between the subgrade soil and the base of the footing. An allowable passive pressure of 500 lbs./sq.ft can be used for that portion of the footing that is below a depth of 2.5 ft. below the final exterior grade (no portion of the footing above this depth should be used for lateral resistance). An allowable coefficient of friction (between the base of the footing and the underlying soil) of 0.3 can be used in conjunction with the minimum downward load on the base of the footing.

Uplift forces on the footings can be resisted by the weight of the footings and the soil material that is placed over the footings. It is recommended that the soil weight be limited to that immediately above and within the perimeter of the footings (unless a much higher factor of safety is used). A total soil unit weight of 110 lbs./cu. ft. can be used for

the backfill material above the footings, provided it is compacted as recommended in Section 5.2. It is also recommended that a factor of safety of at least 1.3 be used for calculating uplift resistance from the footings (provided only the weight of the footing, and the soil immediately above it, is used to resist uplift forces).

4.2 Floor Slabs

Floor slabs can be supported on firm existing soils or on compacted structural fill. The slab subgrade should be prepared and inspected as described in Section 5.1 of this report.

It is recommended that all floor slabs be "floating," that is, fully ground supported and not structurally connected to walls or foundations. This is to minimize the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation. Although the movements are estimated to be within the tolerable limits for structural safety, such movements could be detrimental to the slabs if they were rigidly connected to the foundations.

It is furthermore recommended that the floor slab be supported on a 6-in. layer of relatively clean granular material such as sand and gravel or crushed stone. This is to help distribute concentrated loads and equalize moisture conditions beneath the slab. Provided that a minimum of 6 in. of granular material is placed below the slab, a modulus of subgrade reaction (k30) of 125 lbs./cu.in. can be used for design of the floor slabs.

4.3 Site Grading

Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation soils. The exterior grade should be sloped away from the structure to prevent ponding of water.

5.0 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Since this investigation identified actual subsurface conditions only at the test boring locations, it was necessary for our geotechnical engineers to extrapolate these conditions in order to characterize the entire project site. Even under the best of circumstances, the conditions encountered during construction can be expected to vary somewhat from the test boring results and may, in the extreme case, differ to the extent that modifications to the foundation recommendations become necessary. Therefore, we recommend that GEOTILL be retained as the geotechnical consultant through the earth-related phases of this project to correlate actual soil conditions with test boring data, identify variations, conduct additional tests that may be needed, and recommend solutions to earth-related problems that may develop.

5.1 Site Preparation

All areas that will support floor slabs and pavements should be properly prepared. After rough grade has been established in cut areas and prior to placement of fill in all fill areas, the exposed subgrade should be carefully inspected by the geotechnical engineer or a qualified soils technician by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft soil and other undesirable materials or soft fill material should be removed. All loose sandy soils should be compacted. The exposed subgrade should furthermore be inspected by proof-rolling with suitable equipment to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed should be removed and replaced with well-compacted, engineered fill as outlined in Section 5.2.

Care should be exercised during the grading operations at the site. Due to the nature of the near surface soils, the traffic of construction equipment may create pumping and general deterioration of the shallower soils, especially if excess surface water is present. The grading, therefore, should be done during a dry season, if at all possible.

5.2 Fill Compaction

All engineered fill beneath floor slabs, footings and pavements should be compacted to a dry density of at least 98 percent of the standard Proctor maximum dry density (ASTM D-698). The compaction should be accomplished by placing the fill in about 8 in. (or less) loose lifts and mechanically compacting each lift to at least the specified minimum dry density. Field density tests should be performed on each lift as necessary to ensure that adequate moisture conditioning and compaction is being achieved.

Compaction of any fill by flooding is not considered acceptable. This method will generally not achieve the desired compaction and the large quantities of water will tend to soften the foundation soils.

All-natural soils encountered in the test borings made at this site are considered suitable as general fill material. The need for some aeration or modification of any clayey soils should be expected before they can be placed and compacted to the specified density.

5.3 Foundation Excavations

The soil at the base of each footing excavation should be inspected by a geotechnical engineer or a qualified soils technician to ensure that all loose, soft or otherwise undesirable material is removed at footing locations and that the footing will bear on satisfactory material. At the time of such inspection, it will be necessary to make hand auger borings or use a hand penetration device in the base of the footing excavation to ensure that the soils below the base are satisfactory for support of the footing. The soils should be probed to a minimum depth of 3 ft. below the bottom-of-footing elevation.

Where undercutting is required to remove unsuitable materials and it is inconvenient to lower the footing, the proposed footing elevation may be re-established by backfilling after all undesirable materials have been removed. The undercut excavation beneath each footing should extend to suitable bearing soils. The dimensions of the excavation base

should be determined by imaginary planes extending outward and downward on a 2 (vertical) to 1 (horizontal) slope from the base perimeter of the footing (see Figure 4 in the Appendix). The entire excavation should then be refilled with engineered fill. The engineered fill should be limited to well-graded sand and gravel or crushed stone compacted to the minimum dry density recommended in Section 5.2; or flowable fill or lean concrete may be used. Special care should be exercised to remove any sloughed, loose, or soft materials near the base of the excavation slopes. In addition, special care should be taken to "tie-in" the compacted fill with the excavation slopes with benches as necessary. This is to ensure that no pockets of loose or soft materials will be left in place along the excavation slopes below the foundation bearing level.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition such as from disturbance, rain and freezing. Surface run-off water should be drained away from the excavation and not allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not practical, the footing excavations should be adequately protected.

5.4 Construction Dewatering

Based upon the ground water data obtained during drilling operations, it appears that dewatering is not required for the excavations during construction. In cases where cohesive soils are encountered in the base of excavations, it is expected that such dewatering can probably be handled by conventional dewatering methods such as pumping from sumps. However, more extensive dewatering will be required where silty or sandy soils are encountered in the base of the excavation. The best dewatering system for each case must be determined at the time of construction based upon actual field conditions.

5.5 Construction Monitoring

We recommend that geotechnical engineer or designee be retained to continuously evaluate and test the subgrade and footing excavations before forming and placing steel or concrete. If the soils upon which the footings are to be constructed become soft or disturbed, or if

unsuitable materials are encountered, these materials should be removed and replaced with acceptable structural fill or as directed by the engineer.

Concrete strength and consistency tests should also be carried out, in accordance with the project specifications.

6.0 FIELD INVESTIGATION

Two soil test borings were drilled at the locations shown on the Boring Plan (Figure 2 in the Appendix), and 1 infiltration test was performed to a depth of 5 ft. The borings were extended to depths of 20 ft. below the existing site grade. Split-spoon samples were obtained by the standard penetration test procedures (ASTM D-1586) at 2.5 ft intervals to a depth of 10 ft below the existing ground and at 5.0 ft intervals elsewhere.

Logs of the borings showing visual descriptions of all soil strata encountered using the Unified Soil Classification System are included in the Appendix. Ground water observations, sampling information, and other pertinent field data and observations are also included. In addition, a sheet defining the terms and symbols used on the log and explaining the standard penetration test procedure is provided immediately following the boring log.

7.0 LABORATORY INVESTIGATION

The disturbed samples were inspected and classified in accordance with the Unified Soil Classification System and the boring log was edited as necessary. To aid in classifying the soils and to determine general soil characteristics and natural moisture tests were performed on selected samples. The results of these tests are included on the boring logs.

8.0 LIMITATIONS OF STUDY

An inherent limitation of any geotechnical engineering study is that conclusions must be drawn on the basis of data collected at a limited number of discrete locations. The recommendations provided in this report were developed from the information obtained from the test boring which depicts the subsurface conditions only at the specific boring location and at the particular time designated on the log. Soil conditions at other locations may differ from conditions occurring at this boring location. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report after performing on-site observations during the excavation period and noting the characteristics of any variation.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. This company is not responsible for the independent conclusions, opinions, or recommendations made by others based on the field exploration and laboratory test data presented in this report. The scope of our geotechnical engineering services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, ground water, or surface water within or beyond the site studied.

APPENDIX

Figure 1 - Vicinity Map (a-b)

Figure 2 - Boring Plan (a-d)

Figure 3 - Design Illustration - Footings in Undercut Areas

Test Boring Logs

"Field Classification System for Soil Exploration"

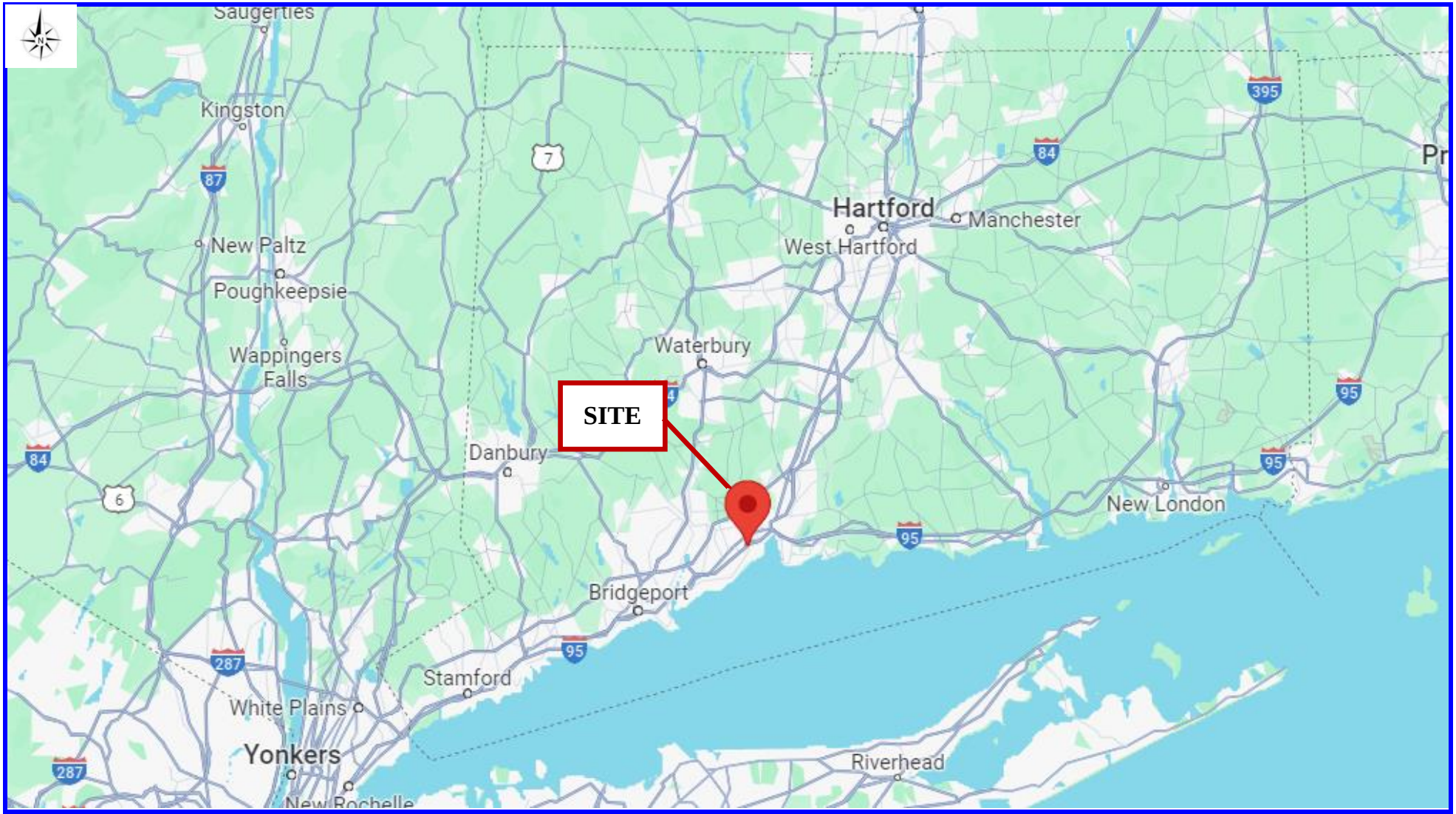


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FIGURE NO. 1 a – VICINITY MAP

Project: **Proposed EHRM Infrastructure Upgrade**
950 Campbell Ave
West Haven, CT

Scale: **NTS**

GEOTILL PROJECT # 112452001

DATE: April 17, 2024

CLIENT: Spees Design Build

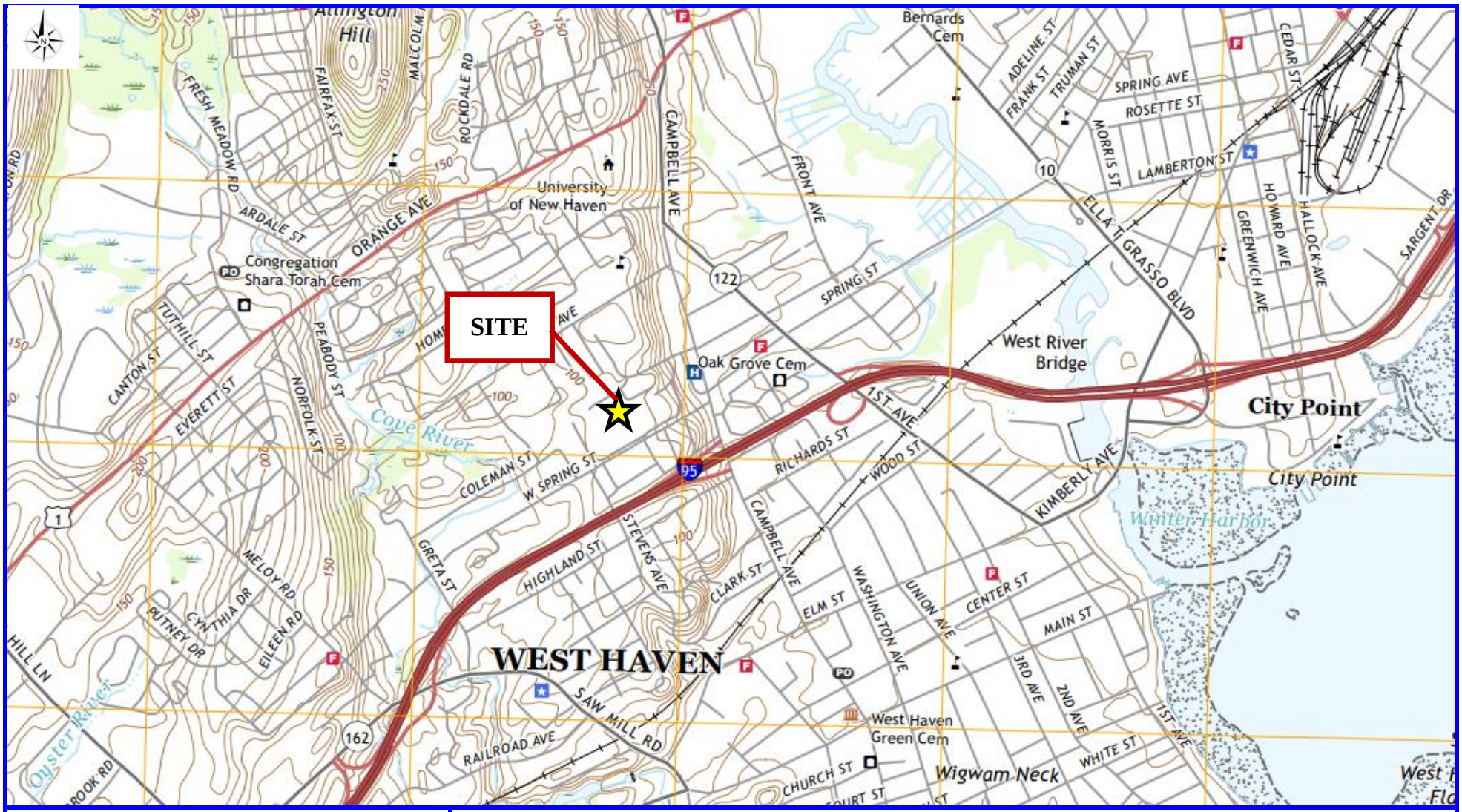

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FIGURE NO. 1 b – VICINITY MAP

Project: **Proposed EHRM Infrastructure Upgrade**
950 Campbell Ave
West Haven, CT

Scale: **NTS**

GEOTILL PROJECT # 112452001	**DATE: April 17, 2024**	**CLIENT: Spees Design Build**

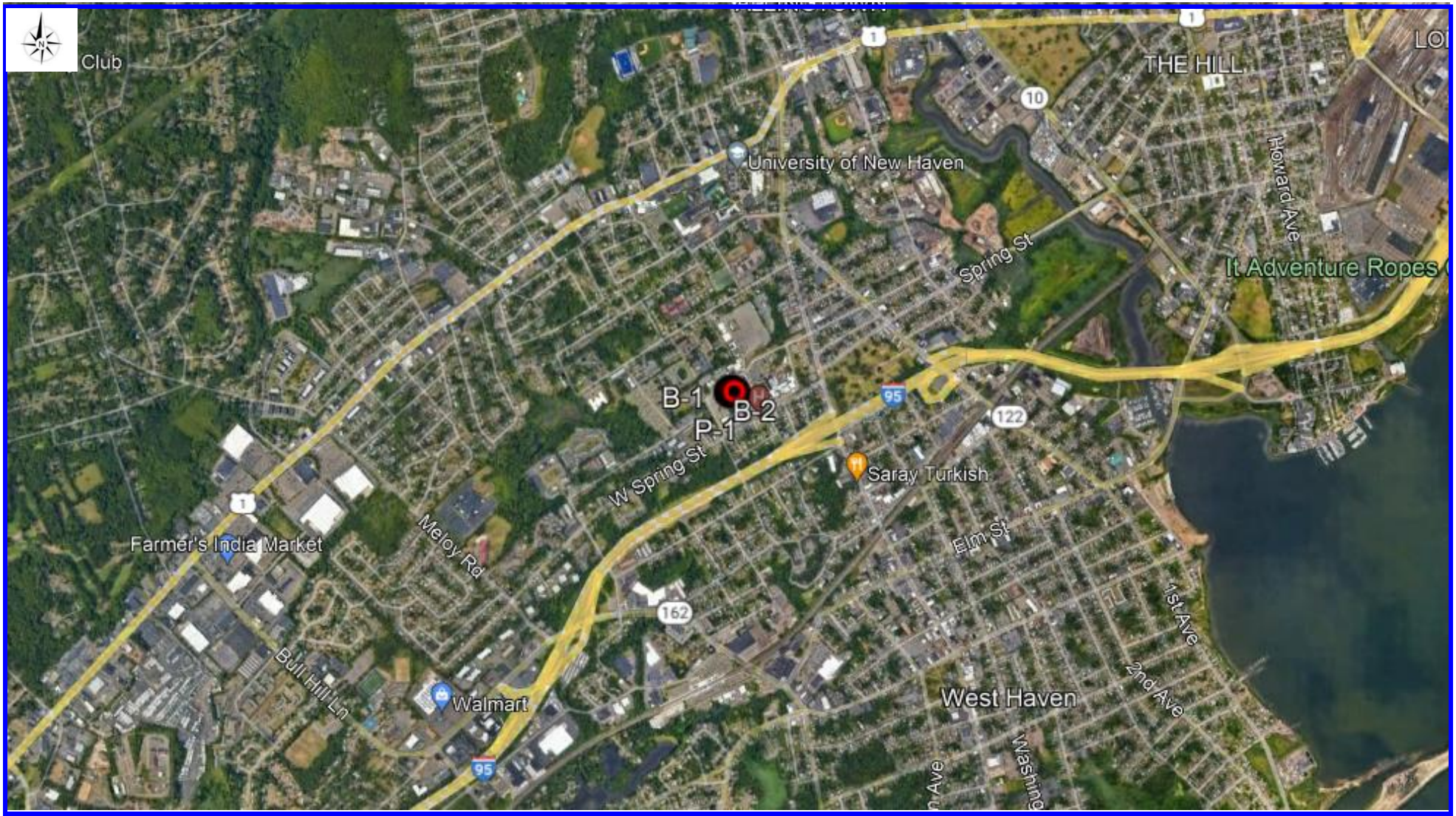

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FIGURE NO. 2 a – VICINITY MAP

Project: **Proposed EHRM Infrastructure Upgrade**
950 Campbell Ave
West Haven, CT

Scale: **NTS**

GEOTILL PROJECT # 112452001

DATE: April 17, 2024

CLIENT: Spees Design Build

GEOTILL ENGINEERING, INC.

FIGURE NO. 2 b – BORING MAP

Project: Proposed EHRM Infrastructure Upgrade
950 Campbell Ave
West Haven, CT

Scale: NTS

GEOTILL PROJECT # 112452001	DATE: April 17, 2024	CLIENT: Spees Design Build

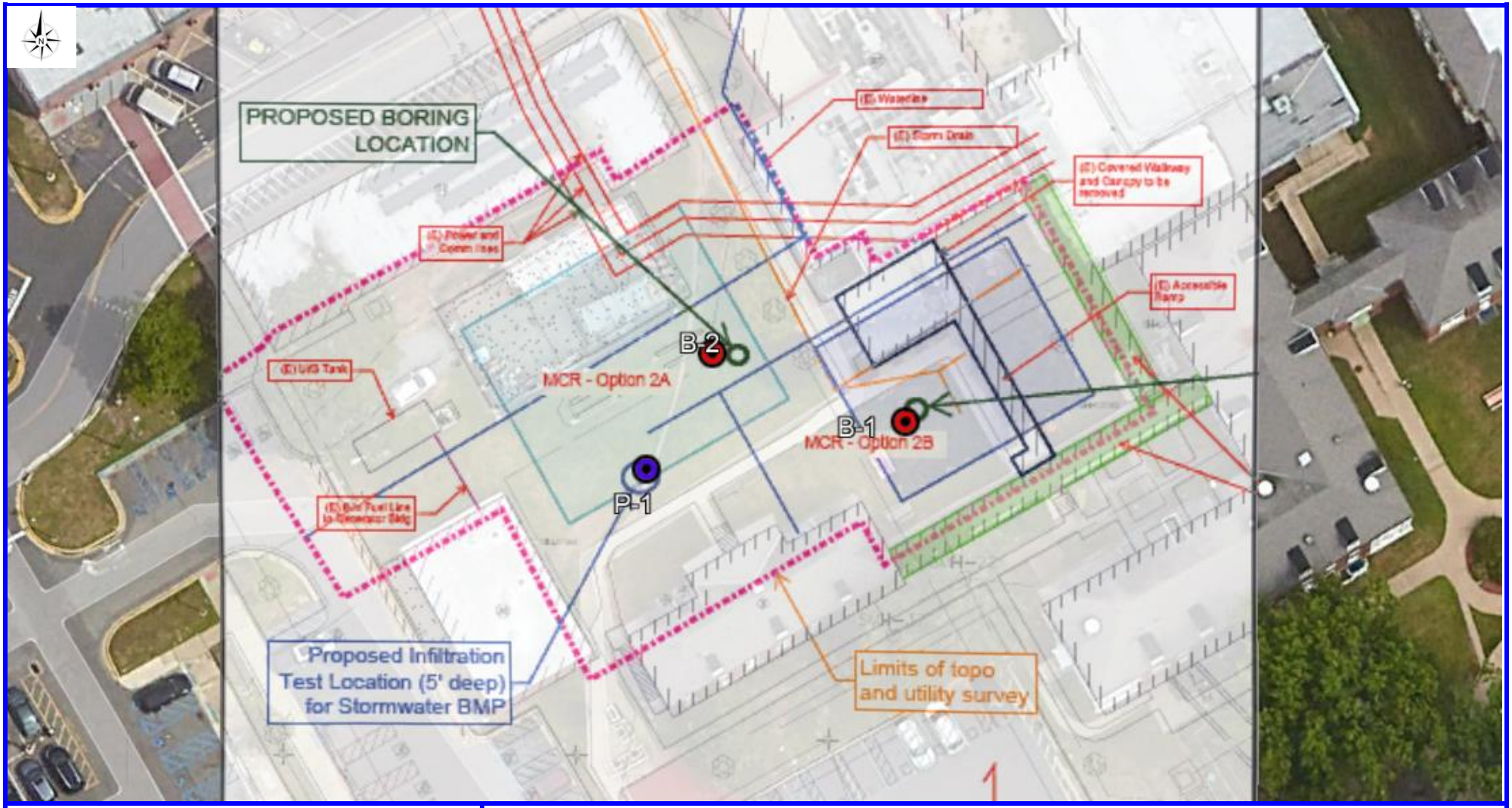

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FIGURE NO. 2 c – BORING MAP

Project: **Proposed EHRM Infrastructure Upgrade**
950 Campbell Ave
West Haven, CT

Scale: **NTS**

GEOTILL PROJECT # 112452001

DATE: April 17, 2024

CLIENT: **Spees Design Build**

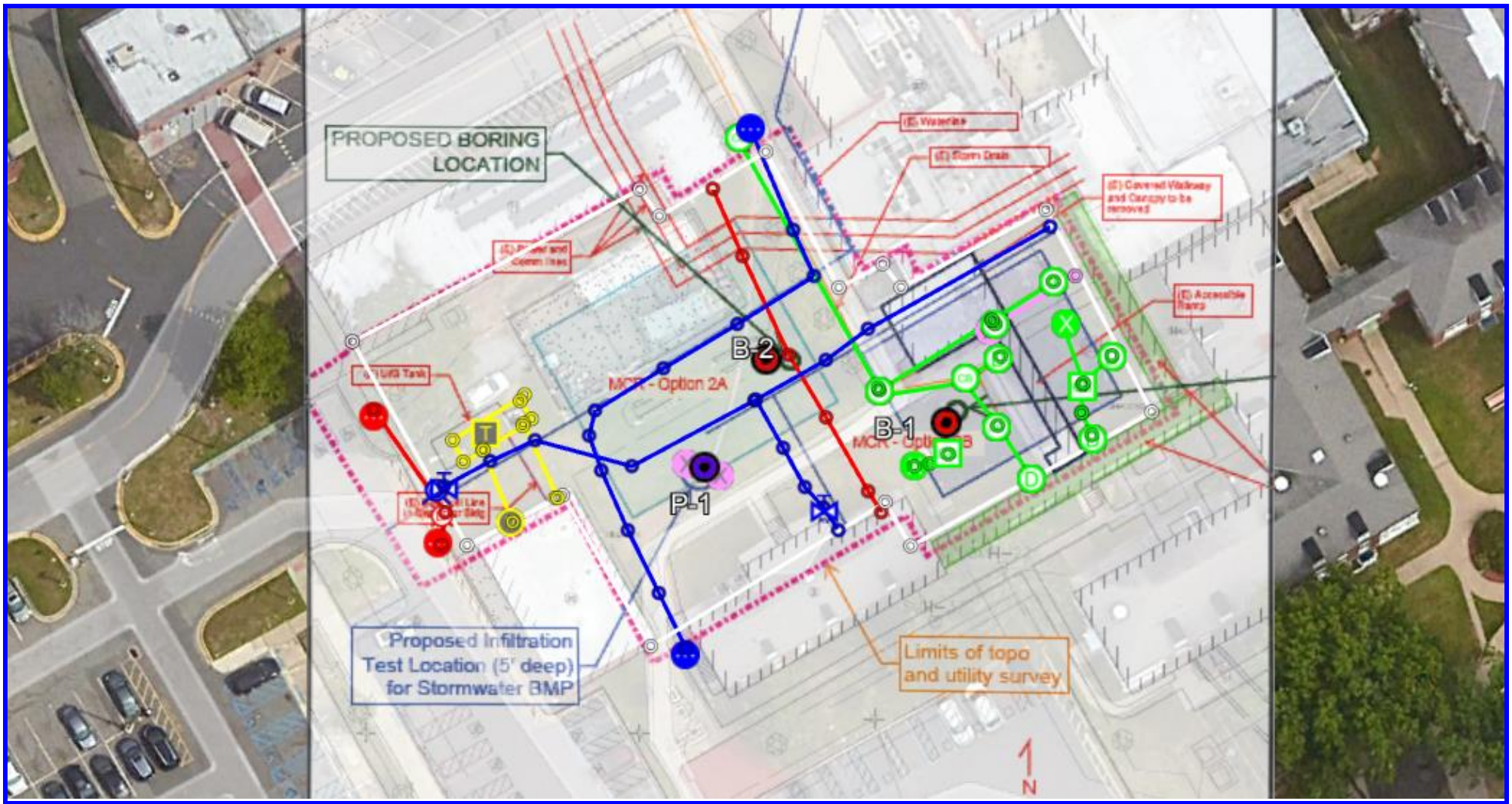

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FIGURE NO. 2 d – Private Utilities Locates

Project: **Proposed EHRM Infrastructure Upgrade**
950 Campbell Ave
West Haven, CT

Scale: **NTS**

GEOTILL PROJECT # 112452001	**DATE: April 17, 2024**	**CLIENT: Spees Design Build**

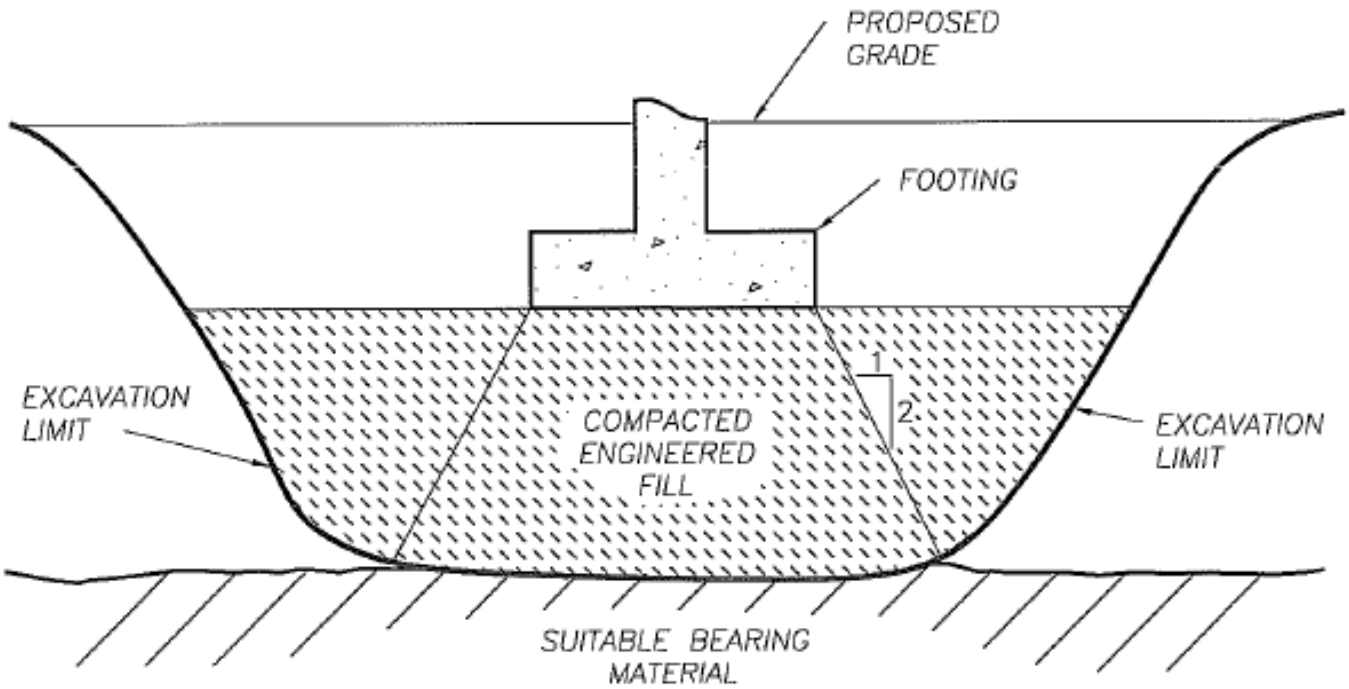

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FIGURE NO. 3 – DESIGN ILLUSTRATION
FOOTINGS IN UNDERCUT AREA

Project: **Proposed EHRM Infrastructure Upgrade**
950 Campbell Ave
West Haven, CT

Scale: **NTS**

GEOTILL PROJECT # 112452001

DATE: **April 17, 2024**

CLIENT: **Spees Design Build**

GEOTILL ENGINEERING, INC.
7732 Loma Ct
Fishers, IN 46038
317 449 0033
Fax 317 285 0609

TEST BORING LOG

CLIENT	Spees Design Build	BORING #	B-1
PROJECT NAME	EHRM Infrastructure Upgrade	JOB #	112452001
PROJECT LOCATION	950 Campbell Ave West Haven CT 06516	Latitude, Longitude	41.282861, -72.961411

DRILLING and SAMPLING INFORMATION

Date Started	3/27/24	Hammer Wt.	140	lbs.
Date Completed	3/27/24	Hammer Drop	30	in.
Drill Foreman	O. Cruello	Spoon Sampler OD	2	in.
Inspector	M. Smadi	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 110	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil = 12"	1.0		1	SS			1-2-2-4			
Reddish brown, moist, very loose, clayey Sand (Fill Material)	2.0		2	SS			1-1-2-3			
Reddish brown, moist, very loose, clayey silty Sand (Fill Material)	4.0		3	SS			5-15-21-18			
Reddish brown, slightly moist, dense, clayey silty Sand (Fill Material), with a trace of gravel	6.0	5	4	SS			15-22-20-17	10.0	1.25	
Reddish brown, moist, hard, sandy Clay (Fill Material), with a trace of gravel and rock fragments	8.0		5	SS			15-19-13-23	8.0	1.75	
Reddish brown, slightly moist, hard, sandy Clay (Fill Material), with gravel and cobbles	10.0	10	6	SS			22-30-28-22	14.0	0.25	
Reddish brown, moist, hard, sandy Clay (CL), with rock fragments and cobbles	13.0		7	SS			13-20-16-23			
Reddish brown, slightly moist to moist, medium dense to dense, clayey silty Sand (SM), with a trace of gravel	20.0	15	8	SS			13-11-14-18			
End of Boring 20 ft										

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Depth to Groundwater

Noted on Drilling Tools	Dry	ft.
At Completion	Dry	ft.
After _____ hours		ft.
Cave Depth		ft.

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- CA - Casing Advancer
- MD - Mud Drilling
- HA - Hand Auger

GEOTILL ENGINEERING, INC.
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TEST BORING LOG

CLIENT	Spees Design Build	BORING #	B-2
PROJECT NAME	EHRM Infrastructure Upgrade	JOB #	112452001
PROJECT LOCATION	950 Campbell Ave West Haven CT 06516	Latitude, Longitude	41.282914, -72.96162

DRILLING and SAMPLING INFORMATION

Date Started	3/27/24	Hammer Wt.	140	lbs.
Date Completed	3/27/24	Hammer Drop	30	in.
Drill Foreman	O. Cruello	Spoon Sampler OD	2	in.
Inspector	M. Smadi	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 108	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil = 12"	1.0		1	SS			1-3-2-5			
Dark brown, moist, very loose, clayey Sand (SC)	2.0									
Reddish brown, moist, very loose, clayey Sand (SC)	4.0		2	SS			3-3-2-3			
Reddish brown, moist, dense, clayey Sand (SC), with a trace of gravel, cobbles, and rock fragments	6.0	5	3	SS			12-20-26-20			
Reddish brown, moist, dense to very dense, silty Sand (SM)	10.0	10	4	SS			16-50/0"			
			5	SS			5-17-15-17			
Brown, slightly moist, medium dense, silty Sand (SM)	13.0		6	SS			10-14-13-11			
Grayish brown, moist, very dense, silty Sand (SM)	18.0	15	7	SS			28-36-41-27			
Auger Refusal 18 ft			8	SS			50/0"			

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Depth to Groundwater

Noted on Drilling Tools	Dry	ft.
At Completion	Dry	ft.
After _____ hours		ft.
Cave Depth		ft.

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- CA - Casing Advancer
- MD - Mud Drilling
- HA - Hand Auger

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS

(Silt, Sand, Gravel and Combinations)

Density

Very Loose	-	5 blows/ft or less
Loose	-	6 to 10 blows/ft
Medium Dense	-	11 to 30 blows/ft
Dense	-	31 to 50 blows/ft
Very Dense	-	51 blows/ft or more

Relative Proportions

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification

Boulders	-	8 inch diameter or more	
Cobbles	-	3 to 8 inch diameter	
Gravel	-	Coarse	- 1 to 3 inch
		Medium	- ½ to 1 inch
		Fine	- ¼ to ½ inch
Sand	-	Coarse	2.00mm to ¼ inch (dia. of pencil lead)
		Medium	0.42 to 2.00mm (dia. of broom straw)
		Fine	0.074 to 0.42mm (dia. of human hair)
Silt			0.074 to 0.002mm (cannot see particles)

COHESIVE SOILS

(Clay, Silt and Combinations)

Consistency

Very Soft	-	3 blows/ft or less
Soft	-	4 to 5 blows/ft
Medium Stiff	-	6 to 10 blows/ft
Stiff	-	11 to 15 blows/ft
Very Stiff	-	16 to 30 blows/ft
Hard	-	31 blows/ft or more

Plasticity

Degree of Plasticity	Plasticity Index
None to slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Standard Penetration Test — Driving a 2.0" O.D. 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary for GEOTILL to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6 inches of penetration on the drill log (Example — 6-8-9). The standard penetration test result can be obtained by adding the last two figures (i.e., 8 + 9 = 17 blows/ft). (ASTM D-1586-99).

Strata Changes — In the column "Soil Descriptions" on the drill log the horizontal lines represent strata changes. A solid line (_____) represents an actually observed change. A dashed line (_ _ _ _ _ _) represents an estimated change.

Ground Water observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

GEOTILL ENGINEERING, INC.