SOIL AND FOUNDATION
ENGINEERING REPORT

PROPOSED WOOD-FRAME MUSEUM BUILDNG
CUMBERLAND COUNTY HISTORICAL SOCIETY
884 YE GREATE (MAIN) STREET
BLOCK 9, LOT 18.01
GREENWICH TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY

FOR

CUMBERLAND COUNTY HISTORICAL SOCIETY BOARD OF TRUSTEES

June 25, 2024

UNDERWOOD ENGINEERING COMPANY

U.E. Reference No.:

W.O. #: 24-4007

UNDERWOOD ENGINEERING COMPANY

SOIL & FOUNDATION ENGINEERING

1 Keystone Avenue. Suite 300, Cherry Hill, NJ 08003

Christopher T. Koss, P.E. **Phone (856) 933-1818**

6/25/2024

Cumberland County Historical Society Board of Trustees
P.O. Box 16
Greenwich, NJ 08323

RE : Soil and Foundation Engineering Report
Proposed Wood-Frame Museum Building
Cumberland County Historical Society
884 Ye Greate (Main) Street
Greenwich Township, NJ

U.E. Reference No.:
W.O. #: 24-4007

Sir/Madame:

Underwood Engineering Company has been retained by the Cumberland County Historical Society to perform a soil investigation, analysis and to make recommendations for the most suitable foundation system for the above referenced project. Presented herewith is the required information.

We appreciate the opportunity of working with you on this project. If we may be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
Underwood Engineering Company

Christopher T. Koss, P.E.

Table of Contents

I SITE DESCRIPTION

A. Location

The building site is located at 884 Ye Greate (Main) Street in Greenwich Township, Cumberland County, New Jersey. The subject parcel is also known as Block 9, Lot 18.01 on the local tax maps.

B. Surface Conditions

The proposed building area is presently wooded. Based on the site survey information and building location envelope provided, the proposed building area is considered flat, with a ground surface elevation of El.: 13.

C. Site Plan

A site survey showing the existing conditions in the proposed building location provided was prepared Tedesco Engineering, LLC dated 1/11/19 entitled "Existing Conditions Plan – Cumberland County Historical Society, Block 9, Sheet 8, Lot 18.01, Greenwich Township, Cumberland County, New Jersey."

II PROJECT DESCRIPTION

A. Type of Structure

The project is to consist of the proposed construction of a one-story wood-frame museum building. The proposed structure is to measure 128 feet in length, 32 feet in width and 20 feet in height. Framework for the proposed dwelling is to be wood with concrete floor slabs on grade.

B. Loads & Spacings

Loads and spacings are anticipated to be typical for this type of construction, i.e., no extraordinary loads are anticipated.

C. Finished Floor Elevations

The proposed finished floor elevation is anticipated to be El.: 14.5 ft. Only minor fills are anticipated to achieve design soil subgrade elevation.

III FIELD INVESTIGATION & SUBSURFACE CONDITIONS

A. Field Investigation

1) Borings

The field investigation consisted of two (2) soil borings advanced to a depth of twenty (20) feet with standard penetration resistance per ASTM D-1586. The findings and locations are shown in Appendices A and B to include the Boring Location Plan and Soil Boring Log.

The site soils encountered consisted generally of the following profile beneath six (6) inches of topsoil:

Stratified deposits of loose to medium dense fine sands with trace to little silt and clay. Based on the standard penetration test (SPT) data recorded during drilling and sampling operations, the granular soils encountered are considered loose to depths of approximately four (4) to six (6) feet, becoming medium dense at these approximate depths. Both of the test borings completed were terminated in medium dense granular soils at a depth of twenty (20) feet below the existing ground surface.

See attached Soil Boring Logs (Appendix B) for more detailed soil descriptions and profiles.

2) Water Table

The ground water table was encountered at a depth of **eight (8) feet below the surface** as evidenced by direct observation and saturation of the soil samples.

It should be noted that the ground water data presented on the individual boring logs may not be representative of daily or seasonal variations in the ground water level.

IV RECOMMENDATIONS

A. Earthwork

1) Existing Topsoil & Deleterious Conditions

All existing topsoil, trees and associated root matter, vegetation and all deleterious materials are to be removed from the proposed building areas.

2) Construction Dewatering

The dewatering specifications should be of a type capable of maintaining the water table a minimum of two (2) feet below the prevailing excavation bottom during the excavations as well as during backfill operations. As stated above, groundwater and/or perched water levels encountered during construction may vary from those encountered during soil boring operations due to seasonal variations or other climatic conditions. Should perched water be encountered during foundation excavations and utility trenches, etc., temporary dewatering may be required i.e. installation of sump pits/pumps.

3) Proofrolling & Densification

The exposed subgrades for concrete slabs on grade are to be proofrolled with a vibratory compactor in the presence of the soil engineer to detect and repair any unsuitable soil conditions and to attain a uniform firm subgrade throughout. Any loose soils encountered may be densified by proofrolling and further compaction by additional passes if necessary.

4) Structural Fill Placement

Bring existing grade up to the desired elevation with a granular type soil that complies with the following specifications or soils which are reviewed and approved by the soil engineer and compact it to within the specifications listed under **Compaction**, unless approved by the Soils Engineer.

SIEVE SIZE	Percent by Weight Passing Square Mesh Sieve
2”	100
3/4”	70-100
#4	30-80
#50	10-35
#200	5-12

It is strongly recommended that bulk samples of material to be used as load bearing structural fill be taken and tested prior to the commencement of work so that moisture / density relationships (compaction) can be determined.

5) On Site Soils

On site granular soils, as approved by the Soil Engineer, are suitable for use as load-bearing fill but will require strict moisture control due to the presence of fine grain material (i.e. silt and clay). If on site soils are

used as structural fill, they must be placed under favorable weather conditions for the soils to dry within optimum moisture content ranges. This is extremely important in order to properly compact the soils as specified herein. If inclement weather is a factor, the onsite soils may be unsuitable, and provisions should be taken to import suitable structural fill materials.

6) Backfilling & Densification of Load-Bearing Fill

Building subgrades may be brought up to desired elevation with approved on-site soils or imported structural fill in lifts no greater than ten (10) inches loose thickness and compacted to 95% of the material's maximum dry density per ASTM D-698 as illustrated below. Materials compacted by hand operated equipment shall be placed in lifts no greater than four (4) inches loose thickness.

7) Compaction

All backfill and fill materials should be compacted to the degree noted in the following table in accordance with ASTM D-698 latest standard.

Building Area	% Maximum Dry Density (ASTM D-698)
Supporting Foundations	95%
Supporting Floor Slabs	95%
Pavements	95%
Site (Non-Load Bearing)	90%

8) Foundation Compaction

All exposed foundation subgrades are to be compacted by two (2) passes with a jumping jack compactor immediately prior to the placement of the foundation elements.

B. Building Foundation

1) Type

The proposed building is to be supported by a spread footing foundation system.

2) Elevation

The footings may be placed at any elevation provided the minimum depth criteria is met and the recommendations listed herein are performed.

3) Minimum Depth of Foundation

All footing bottoms are to be founded at least three (3) feet beneath or away from atmospherically exposed final soil subgrade.

4) Allowable Bearing Values

The proposed spread footings may be designed for a maximum allowable bearing capacity of 2,000 Pounds per Square Foot provided that the requirements under **Earthwork** are adhered to strictly.

5) Settlements

Using the allowable bearing value and following the recommendations under **Earthwork** will keep total and differential settlements negligible.

C. Lateral Earth Pressures

The following values may be used for calculating lateral earth pressures:

Active Earth Pressure Coefficient, $K_A = 0.32$

At Rest Earth Pressure Coefficient, $K_R = 0.40$

Passive Earth Pressure Coefficient, $K_P = 4.00$

Unit Weight of Soil, $\gamma = 120$ lbs. / ft^3

The above values assume a porous, free draining backfill soil.

D. Concrete Floor Slabs

Concrete floor slabs may be placed on grade provided they are underlain by a minimum of four (4) inches of porous material and all soft areas are to be removed and repaired as recommended under **Earthwork**.

V INSPECTION

It is imperative that all earthwork operations be inspected full time by a qualified representative of the Soil Engineer, especially the proofrolling operations and all footing subgrades immediately prior to placing the footing concrete. Foundation excavation evaluations should be performed to confirm that the design allowable bearing pressure is available. Footing subgrade evaluations should be performed through a combination of visual observation and hand rod probing in conjunction with comparison to the test borings. Concrete placement should be performed immediately after footing subgrade evaluations are made to prevent exposure and potential weakening of foundation subgrades.

VI QUALIFICATIONS

Our recommendations are based on the subsurface conditions as revealed by the test borings, and on the assumptions outlined in the Project Description and Site Description sections of this report.

Our recommendations are also based on the assumption that the provisions for strict field inspection will be followed as outlined.

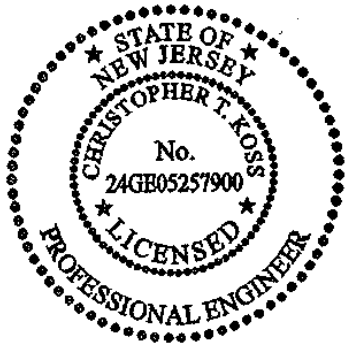
This report does not reflect any variations which may be encountered during construction.

We should be informed immediately of such conditions so that we may modify our conclusions and recommendations, if necessary.

Underwood Engineering Company will not be responsible for variations in subsurface soils encountered in areas other than those tested.

Respectfully submitted,
Underwood Engineering Company

Christopher T. Koss, P.E.



Appendix A
Boring Location Plan


Ye Greate St
2
1

Appendix B
Boring Log

CLIENT: Cumberland County Historical Society

PROJECT: Cumberland County Historical Society

884 Ye Greate Street

Greenwich, NJ

DATE: 6/6/2024

BORING No.: TB-1

UNDERWOOD ENGINEERING COMPANY

1 Keystone Avenue, Suite 300, Cherry Hill, NJ 08003

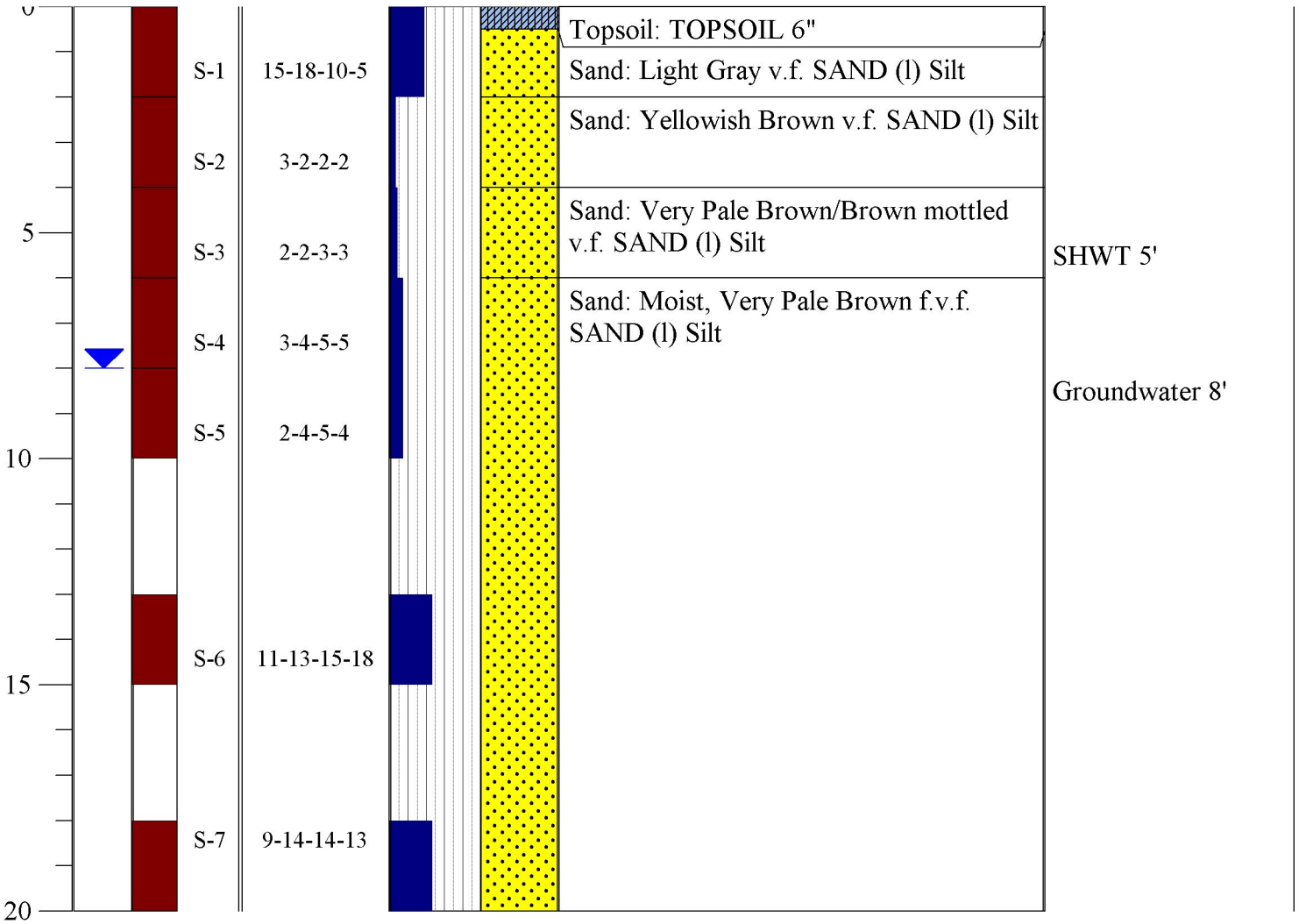
Ph.# 856.933.1818 Fx.# 856.933.3121

Christopher T. Koss, P.E.

GROUND SURFACE ELEVATION: NA

GROUNDWATER DATA	
DEPTH	Hours After Completion
8 ft	▽ Sample Saturated with Water

METHOD OF ADVANCING BORING	DEPTH (FT.)
CONTINUOUS SPLIT SPOON SAMPLE	0 to 10 ft
AUGERS	10 to 18 ft
2" O.D. SPLIT SPOON	18 to 20 ft



*FIELD CLASSIFICATION ONLY. SOIL CLASSIFICATION FOR PARTICULAR USES SHOULD BE ASCERTAINED BY LABORATORY TESTS.

N - STANDARD PENETRATION RESISTANCE PER 12" (140 lb. HAMMER, 30" DROP)

CLIENT: Cumberland County Historical Society

PROJECT: Cumberland County Historical Society

884 Ye Greate Street

Greenwich, NJ

DATE: 6/6/2024

BORING No.: TB-2

UNDERWOOD ENGINEERING COMPANY

1 Keystone Avenue, Suite 300, Cherry Hill, NJ 08003

Ph.# 856.933.1818 Fx.# 856.933.3121

Christopher T. Koss, P.E.

GROUND SURFACE ELEVATION: NA

GROUNDWATER DATA	
DEPTH	Hours After Completion
8 ft	▽ Sample Saturated with Water

METHOD OF ADVANCING BORING	DEPTH (FT.)
CONTINUOUS SPLIT SPOON SAMPLE	0 to 10 ft
AUGERS	10 to 18 ft
2" O.D. SPLIT SPOON	18 to 20 ft

Depth (ft)	Groundwater	Sampling Interval	Sample #	Blows	N-Values	Lithology	Soil Description*	Notes:
0							Topsoil: TOPSOIL 6"	
			S-1	2-3-2-2			Sand: Brown v.f. SAND (s) Clay (tr) Silt	
			S-2	2-2-3-2			Sand: Brown v.f. SAND (l) Silt (l) Clay	
5			S-3	3-4-8-6				
	▽		S-4	4-5-7-10			Sand: Very Pale Brown f.v.f. SAND (l) Silt	Groundwater 8'
			S-5	7-7-7-10				
10								
			S-6	7-7-12-15				
15								
			S-7	8-11-12-14				
20								

*FIELD CLASSIFICATION ONLY. SOIL CLASSIFICATION FOR PARTICULAR USES SHOULD BE ASCERTAINED BY LABORATORY TESTS.

N - STANDARD PENETRATION RESISTANCE PER 12" (140 lb. HAMMER, 30" DROP)

Appendix C
Mechanical Sieve (Gradation) Analysis Results

Underwood Engineering, Inc.
1 Keystone Ave, Suite 300
Cherry Hill, New Jersey 08003
(856) 933-1818
Mailing: PO Box 3520, Cherry Hill, NJ 08034

Material Test Report

Report No: MAT:24-4318-S01
Issue No: 1

Client: Cumberland County Historical Society **CC:**

Project: Cumberland County Historical Society GEO
Main St Greenwich NJ

AASHTO ACCREDITED

Submitted By: Caitlynn M. Brevik
Date of Issue: 6/17/2024

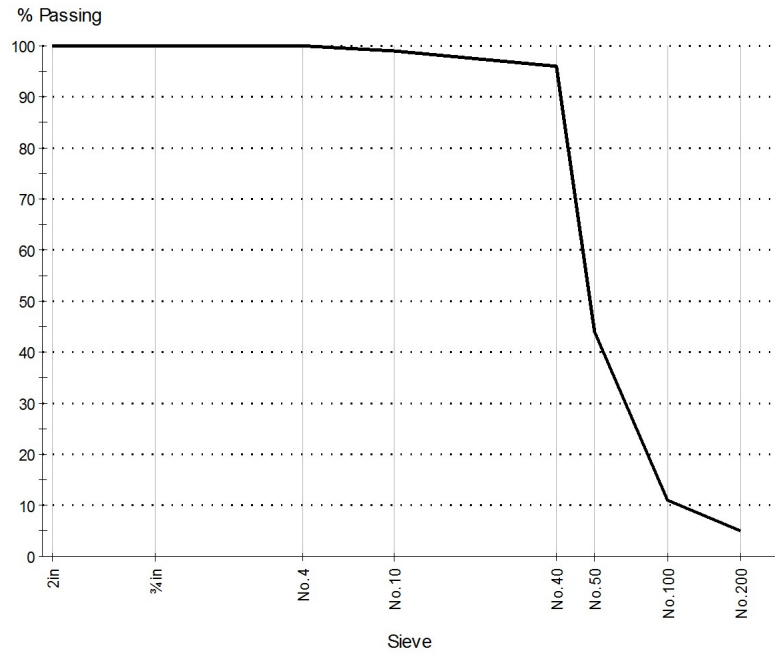
Sample Details

Sample ID	24-4318-S01
Date Sampled	6/6/2024
Source	Soil Boring
Material	c.f. SAND, (tr) Silt & Clay
Specification	I-5 plus No. 100 Sieve
Location	TB-1 at 13ft to 15ft

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	21.9	
Method		B	
Tested By		Caitlynn M. Brevik	
Date Tested		6/10/2024	

Particle Size Distribution



Method: AASHTO T 27, AASHTO T 11

Date Tested: 6/10/2024
Tested By: Caitlynn M. Brevik

Sieve Size	% Passing	Limits
2in	100	
¾in	100	
No.4	100	
No.10	99	
No.40	96	
No.50	44	
No.100	11	
No.200	5.1	

Comments

c.f. SAND, (tr) Silt & Clay

Appendix D
General Soil Terms

General Soil Terms

Particle Sizes	
Boulders	Greater than 2 inches (305mm)
Cobbles	3 inches (76.233) to 12 inches (305mm)
Gravel-coarse	3/4 inches (19.05mm) to 3 inches (76.2mm)
Gravel-fine	No. 4- 3/16 inches (4 75mm) to 3/4 inches (19.05mm)
Sand-coarse	No. 10 (2.00mm) to No. 4 (4 75mm)
Sand-medium	No. 40 (0.425mm) to No. 10 (2.00.)
Sand-fine	No. 200 (0.075mm) to No. 40 (0.425mm)
Silt	0.005mm to 0.074mm
Clay	Less than 0.005mm

Classifications

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent-Minor Constituents
(Percentage by weight)

Trace – 1 to 12%	Trace – 1 to 12%
Adjective – 12 to 35% (clayey, silty, etc.)	Little – 12 to 23
	Some – 23 to 33%
	And – Over 35%

Cohesive Soils

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with other major soil constituent as modifier: i.e. silty clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils: i.e. silty clay, trace of sand, little gravel

Consistency	Unconfined Compressive Strength (psf)	Approximate Range of (N)
Very Soft	Below 500	0-2
Soft	500-1000	3-4
Medium	1000-2000	5-8
Stiff	2000-4000	9-15
Very Stiff	4000-8000	16-30
Hard	8000-16000	31-50
Very Hard	Over 16000	Over 50

Consistency of cohesive soils is bases upon an evaluation of the observed resistance to deformation under load and not upon Standard Penetration Resistance (N)

Cohesionless Soils

Density Classification	Relative Density	Approximate Range of (N)
Very Loose	0-15	0-4
Loose	16-35	5-10
Medium Compact	36-65	11-30
Compact	66-85	31-50
Very Compact	86-100	Over 50

Relative Density of Cohesionless Soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

Standard Penetration Test (ASTM D 1586) – A 2.0” outside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

Appendix E
Important Information about Your Geotechnical Engineering Report-ASFE

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS, AND PROJECTS

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Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely to the client. No one except you should rely on your geotechnical engineering report without first conferring with the GEOTECHNICAL engineer who prepared it. And no one-not even you should apply the report for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING REPORT IS BASES ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences: the general nature of the structure involved, its size, and configuration: the location of the structure on the site: and the other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on geotechnical engineering report that was:

*not prepared for you,
*not prepared for your project,
*not prepared for the specific site explored, or
*completed before important project changes were made

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

*the function of the proposed structure, as when its changed from a parking garage to an office
building, or from a light industrial plant to a refrigerated warehouse
*elevation, configuration, location, orientation, or weight off the proposed structure,
*composition of the design team, or
*project ownership

As general rule, always inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is bases on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINIONS

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render and opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over rely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE ENGINEERR'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

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Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer.

A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional studies. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.
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READ RESPONSIBILITY PROVISIONS CLOSELY

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Some clients, design professionals, and contractors do no recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled “limitations”, many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

GEOENVIRONMENTAL CONCERNS ARE NOT CONVERED

The equipment, techniques and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.