



# URBAN ENGINEERS, INC.

**GEOTECHNICAL EXPLORATION REPORT  
PROPOSED PARKING GARAGE  
VETERANS AFFAIRS MEDICAL CENTER  
1601 KIRKWOOD HIGHWAY  
WILMINGTON, DELEWARE**

***Prepared  
for:***

**Bray Mooney Consulting, Inc.  
Chester, Pennsylvania**

**November 2013**

**Urban Project No. 2013280175.000**



## URBAN ENGINEERS, INC.

*Formulating Excellence®*

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November 18, 2013

Bray Mooney Consulting, Inc.  
410 East 21<sup>st</sup> Street  
Chester, PA 19013

Attn: Stephen J. Mooney, MS, PMP  
Principal

Re: Geotechnical Exploration Report  
Proposed Parking Garage  
Veterans Affairs Medical Center  
1601 Kirkwood Highway  
Wilmington, Delaware  
Urban Project No. 2013280175.000

Dear Steve:

We are pleased to submit herewith our geotechnical exploration report covering field and laboratory work together with our evaluation of subsurface conditions and recommendations for the captioned project.

We wish to thank you for the opportunity of assisting you in this project, and for your cooperation during the course of this exploration. In the event of questions, additional services or information on any of the above, please do not hesitate to contact our office.

Very truly yours,

URBAN ENGINEERS, INC.

David G. Machmer  
Geotechnical Engineering Practice Leader

DGM:clb

## TABLE OF CONTENTS

	<u>Page No.</u>
I. INTRODUCTION .....	1
II. PROPOSED CONSTRUCTION .....	1
III. FIELD AND LABORATORY EXPLORATION .....	2
IV. SITE CONDITIONS .....	2
V. ANALYSIS AND RECOMMENDATIONS .....	4
A. Foundations	
B. Lateral Earth Pressures	
C. Site Work	
VI. GENERAL.....	8
APPENDIX	
1. Site Location Map, Dwg. 1	
2. Boring Location Plan, Dwg. 2	
3. Subsurface Profiles, Dwgs. 3 and 4	
4. Test Boring Logs, B-1 through B-5	
5. Laboratory Test Data	
6. Burmister Soil Description System	
7. Unified Soil Classification System	
8. Important Information About Your Geotechnical Engineering Report	

## **I. INTRODUCTION**

This report presents the results of a geotechnical exploration performed for the proposed parking garage to be constructed for the Veterans Affairs Medical Center (VAMC) in Wilmington, Delaware (see Dwg. 1, appended). The objective of the exploration was to evaluate the subsurface conditions at the site as they relate to construction of the foundations for the proposed parking garage. Specifically, the scope of work was as follows:

1. Review site history,
2. Layout and drill test borings,
3. Coordinate the drilling operations and perform part-time drilling observation,
4. Conduct laboratory testing on selected subsurface samples to determine their engineering properties, and
5. Perform engineering analysis and evaluation, and prepare a written report to include recommendations from the geotechnical engineering viewpoint for the design and construction of the foundations for the proposed parking garage.

## **II. PROPOSED CONSTRUCTION**

The proposed parking garage will be about 270 ft. x 120 ft. in plan, as shown in Dwg. 2, appended. The proposed 4-level, helix-type parking structure will have a stairwell and elevator at the southeast corner, and a stairwell at the northwest corner. The ground floor will be set at Elevation 87.5 (NAVD88 Datum) at the east end and Elevation 83.45 at the west end, and will vary from about Elevation 81.6 to 93.7 between the east and west ends. No construction is planned beneath the ground floor. The structure will be constructed of precast concrete structural elements, and precast concrete panels, and column loads from the proposed construction are expected not to exceed 1,500 kips.

### **III. FIELD AND LABORATORY EXPLORATION**

Five (5) test borings were performed by CGC Geoservices, Wilmington, Delaware, on October 5, 14, 19, 26, and 27, 2013. A truck-mounted, diesel-powered drilling rig was used, and split-barrel sampling, penetration tests, and rock coring were performed in accordance with ASTM procedures and standard practices. The boring locations were marked in the field and ground surface elevations were obtained by Urban' survey corps. The drilling operations were observed on a part-time basis and coordinated by Urban's technician. The test boring locations are shown on Dwg. 2, and the results are presented on the boring logs included in the appendix.

All recovered subsurface samples were visually inspected in our laboratory, and the descriptions are presented on the boring logs. The testing of selected subsurface samples was also performed in our laboratory, and included the determination of moisture content, gradation, Atterberg Limits, and classifications of soils, and compressive strength of rock cores. The results are included in the appendix and discussed in the following sections.

### **IV. SITE CONDITIONS**

Geologically, the site lies in the "Piedmont" physiographic province of Delaware. The area is covered with silty and sandy soils formed from the weathering of the underlying gneiss bedrock. The underlying Ordovician age gneiss bedrock is Brandywine Blue Gneiss of the Wilmington Complex.

The proposed parking garage will be located to the west of the existing VAMC building. The site is currently a paved parking lot, with a few light standards located in the proposed construction area. The ground surface is sloping down to the west with a relief of about 6 ft. in the area of the proposed parking garage. About 12 in. of asphalt pavement and subbase was found at the ground surface in the borings. The subsurface materials encountered beneath the

pavement are presented graphically in the profiles on Dwgs. 3 and 4, appended, and are described in the following paragraphs.

A 4 ft. and 5 ft. thick layer of fill, consisting of brown to black silty soil with traces of organic matter, were found beneath the pavement in Borings B-1 and B-5. Testing performed on the fill indicates a "moderate" moisture content, and as indicated by the standard penetration test blow counts, the fill is in generally "medium stiff" condition.

A 3 ft. to 16 ft. thick layer of virgin brown and gray clayey silt and sand, little to some gravel, was found beneath the fill in Borings B-1 and B-5, and beneath the pavement elsewhere. The moisture content varies from "moderate" to "high," and the plasticity ranges from "slight" to "low." The Unified Soil Classifications vary from SP-SM to CL, and the consistency and relative density are generally "medium stiff" and "medium dense."

Multicolored silty and sandy gneiss saprolite, consisting of "highly decomposed" to "weathered" gneiss bedrock, was found at depths between 8 ft. and 16 ft. beneath the ground surface. Soil testing performed on the saprolite indicates "high" and "very high" moisture contents, and "moderate" plasticity. The soil classification is MH, and the consistency and relative density range from "medium stiff" to "hard" and "medium dense" to "very dense." High blow counts were experienced in portions of the saprolite, and refusal to drilling and sampling was met in Borings B-2, B-4, and B-5 at depths between 32 ft. and 46 ft.

Black to white gneiss bedrock was found at depths of 49.8 ft. in Boring B-1 and 56.6 ft. in Boring B-3. Ten (10) feet of rock coring was performed in Boring B-1, with core recoveries of 80% and 100%, and Rock Quality Designations of 44% and 94%. Testing performed on rock core samples indicates unconfined compressive strengths of 4,283 psi to 10,882 psi. Borings B-1 and B-3 were terminated in bedrock.

Water level observations were made at the time of drilling, and are noted on the logs and profiles. The readings indicate depths between 6.3 ft. and 9.8 ft., corresponding to elevations

between 78.5 and 76.0. These readings do not reflect periodic or seasonal variations in the groundwater levels.

## **V. ANALYSIS AND RECOMMENDATIONS**

### **A. Foundations**

#### Drilled Shafts

The "very high" loads from the parking garage should be carried down and supported on the underlying bedrock by means of deep foundations. We have evaluated various deep foundation schemes and recommend machine-drilled concrete-filled piers (drilled shafts). The drilled shafts are capable of carrying the very high structural loads down to bedrock, and can be designed such that only one pier is needed at each column location.

Straight-sided drilled shafts with minimum diameters of 24 in. and socketed in "relatively sound" gneiss bedrock are recommended for support of the proposed structure. The sockets are constructed by extending the shafts at a constant diameter into "relatively sound" gneiss. Drilled shafts socketed minimum depth of 3 ft. into "relatively sound" bedrock may be designed for a net allowable end bearing pressure of 50 ksf. The "relatively sound" gneiss bedrock is present beneath a zone of "weathered" schist bedrock. The thickness of the "weathered" schist bedrock zone is expected to be about 5 ft. For design purposes, the top of "relatively sound" bedrock may be assumed at depths of 62 ft. beneath the top of gneiss bedrock, corresponding to an elevation of about 23. A modulus of elasticity of 600 ksi may be assumed for the "relatively sound" gneiss bedrock.

Shaft resistance will be developed by adhesion (friction) within the "relatively sound" bedrock. The shaft resistance may be added to the drilled shaft capacity for down and uplift loads using allowable side friction applied to the shaft surface area of 4.5 ksf in the "relatively

sound" bedrock zone. The shaft resistance in the overburden fill and soil, and saprolite should be neglected.

The drilled shafts will have to be carried to "relatively sound" bedrock, which will be characterized by rock core recoveries greater than 85%. The construction of the sockets, utilizing a carbide rock bit, will commence at this elevation. As mentioned earlier, the thickness of the "decomposed" to "weathered" bedrock zone is estimated to vary upward to 5 ft., therefore, proper inspection and identification of bearing material during construction is imperative. Probe holes must be performed beneath the bottom of the sockets, to a distance of at least twice the socket diameter, to observe the condition of the rock beneath each shaft.

Casings may be required to install the drilled shafts through the overburden in order to prevent the sides from caving-in and to control ground water. The concrete should be placed within 2 hours of the completion of drilling, and the bottoms must be cleaned of all loose material and water immediately prior to placing concrete.

A frost depth of 32 in. may be used for the site. The capacities noted above are estimates and include a factor of safety of 3.0.

#### Ground Floor Slab

The ground floor slab may be placed on grade after removal of the existing fill and replacing with engineered fill, as described in the following sections. A modulus of subgrade reaction,  $k$ , of 95 pci may be used for design. The parking garage will be unheated and the subgrade below the lower level will be subjected to freezing. The slab should be designed to allow for possible movement from frost heave.

#### Seismic Site Classification

In accordance with the design maps in Figures 22-1 and 22-2, of Chapter 22 of the ASCE 7-10, the mapped earthquake ground motion parameters for the site are  $S_S = 0.195g$  and  $S_I = 0.059g$ . These parameters are representative of a "low" seismicity region, as indicated by



the VA, "Seismic Design Requirements," Publication H-18-8. Based on the test boring results the site is estimated to have a "Seismic Site Classification" of "D" (reference IBC 2003, 2006, or 2009). Assuming the structure classifies as an Occupancy Category of I, II, or III, a Seismic Design Category of "B" is expected to be appropriate (reference IBC 2003, 2006, or 2009).

#### Lateral Foundation Loads

Some of the drilled shaft foundations are expected to be subjected to lateral loads from the structural columns. The lateral deflections at the top of the foundations, and maximum moments and shear stresses within the foundation elements, can be estimated by soil-structure interaction calculations, such as those used in the computer program COM624. The following estimated parameters may be used in soil-structure interaction calculations.

**Estimated Subsurface Parameters for Lateral Deflection Analysis**

<i>Relation to Water Table</i>	<i>Subsurface Layer</i>	<i>Effective Unit Weight, <math>\gamma'</math></i>	<i>Angle of Internal Friction, <math>\phi</math></i>	<i>Cohesion, <math>c</math></i>	<i>Modulus of Lateral Subgrade Reaction, <math>k</math></i>
Above	Engineered Fill	135.0	32°	-	60 pci
	Brown and Gray Clayey Silt and Sand	135.0	32°	-	60 pci
Below	Brown and Gray Clayey Silt and Sand	80.0	32°	-	50 pci
	Saprolite	82.0	34°	-	70 pci
	Gneiss Bedrock, "Relatively Sound"	88.0	38°	2,100 psi	3,000 pci

#### **B. Lateral Earth Pressures**

Portions of the ground level of garage will extend upward to 5 ft. below the adjacent grades. The below grade walls will be subjected to earth pressures from backfill behind, and from pavement and ground loads above and behind, and will have to be designed to withstand these pressures. The following parameters may be used in computation of lateral earth pressures.

Unit Weight of Backfill, $\gamma$	= 135 pcf
Coefficient of Active Earth Pressures, $K_a$	= 0.33
Coefficient of Earth Pressures at Rest, $K_0$	= 0.5
Coefficient of Passive Earth Pressures, $K_p$	= 3.0
Friction Factor between Soil and Concrete, $\tan \delta$	= 0.30

### C. Site Work

The proposed construction area must be cleared of pavement and light pole foundations, and the existing fill should be removed from the proposed parking garage area. Filling to achieve grades in the proposed parking garage, and backfilling around foundations, must be performed with engineered fill. The engineered fill must be select granular off-site borrow material, free of deleterious matter and conforming to the following specifications.

#### Gradation Requirements

<u>Particle/Sieve Size</u>	<u>Percent Passing By Weight</u>
3"	100
3/8"	35 - 95
No. 4	25 - 90
No. 10	15 - 80
No. 40	10 - 45
No. 200	3 - 15
Liquid Limit, 25, max.	Plasticity Index, 7, max.

The filling must be in nearly horizontal layers not exceeding a loose thickness of 9 inches, and each layer must be compacted to a minimum 95% compaction as determined by ASTM D698 (Standard Proctor) method of compaction test. The in-place density of the compacted fill must be tested, and the ASTM D6938 (nuclear density gauge) method of in-place density measurement can be used. We recommend that representative testing be performed at minimum rates of 1 in-place density test on every 30 cu.yds. of engineered fill placed, and no fewer than 2 tests per lift.

Ground water was found as high as Elevation 78.5 in the area of the parking garage, and may be encountered in deeper excavations during construction. Ground water encountered in excavations can be handled by pumping from low points in the excavations. Proper site drainage should be maintained during construction so that storm water and ground water is drained quickly from the site. In contact with water and the movement of construction machinery, the siltier and clayier on-site materials will lose their strength and become soft. In the event of this occurrence, the softened soil will have to be over-excavated to undisturbed soil and replaced with engineered fill.

## **VI. GENERAL**

The site work, foundation subgrades, and drilled shaft installation, must be observed and tested by the soils engineers' representative. The recommendations and conclusions contained in this report are based on the information revealed in the course of our study and exploration. Any changes in the proposed construction or location must be brought to our attention. Unexpected conditions may be encountered during construction, because the site is a filled area, and any deviation may necessitate re-evaluation of our recommendations and changes may have to be considered. The report has been prepared based on the structural properties of the subsurface materials and does not address environmental aspects. Furthermore, we cannot be responsible for any conclusions drawn from the data included in this report other than those specifically stated. The report has not been prepared to be used directly as construction specifications. This report is intended for use with regards to the specific project discussed herein.

URBAN ENGINEERS, INC.

November 18, 2013

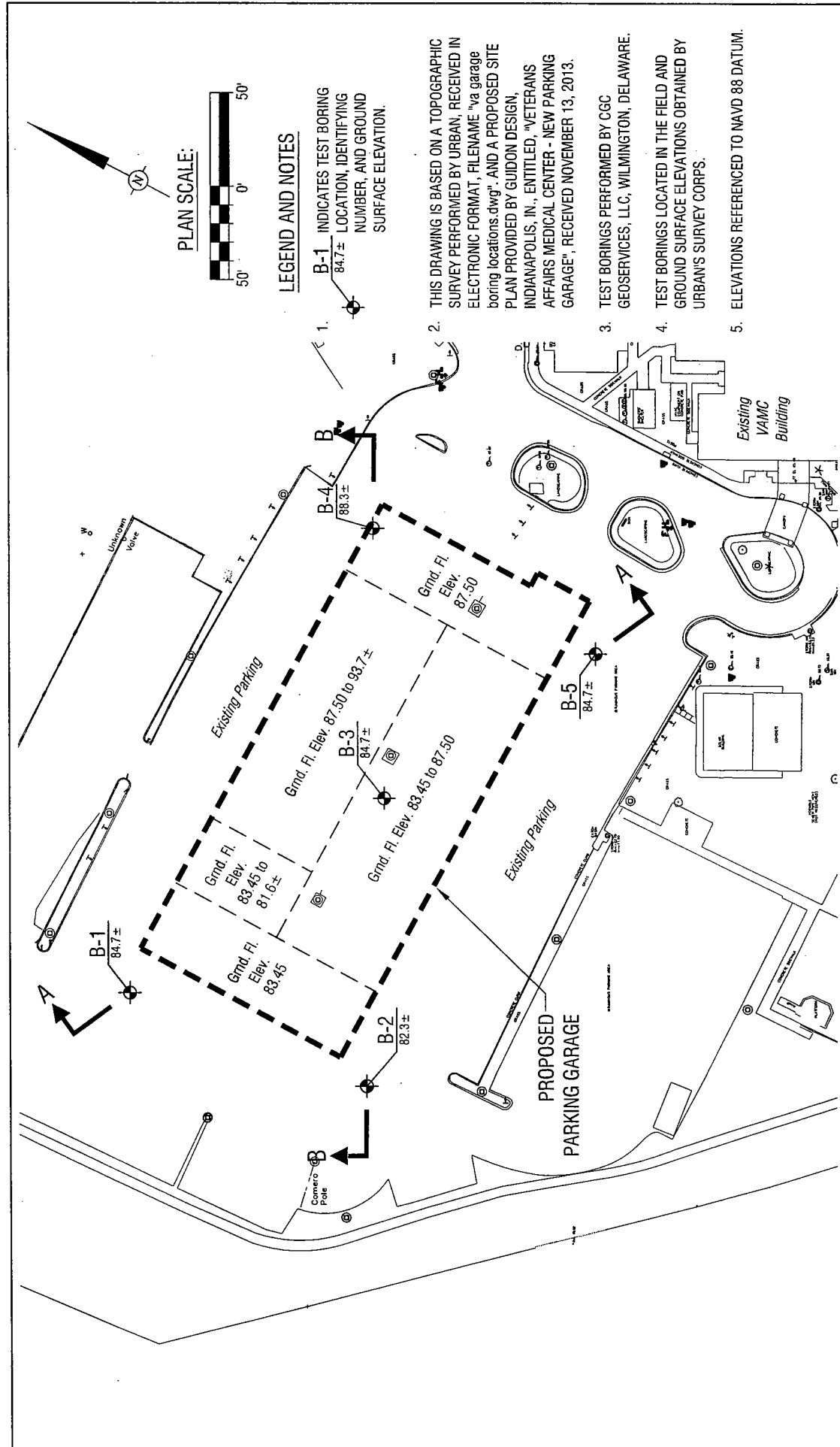
## **APPENDIX**

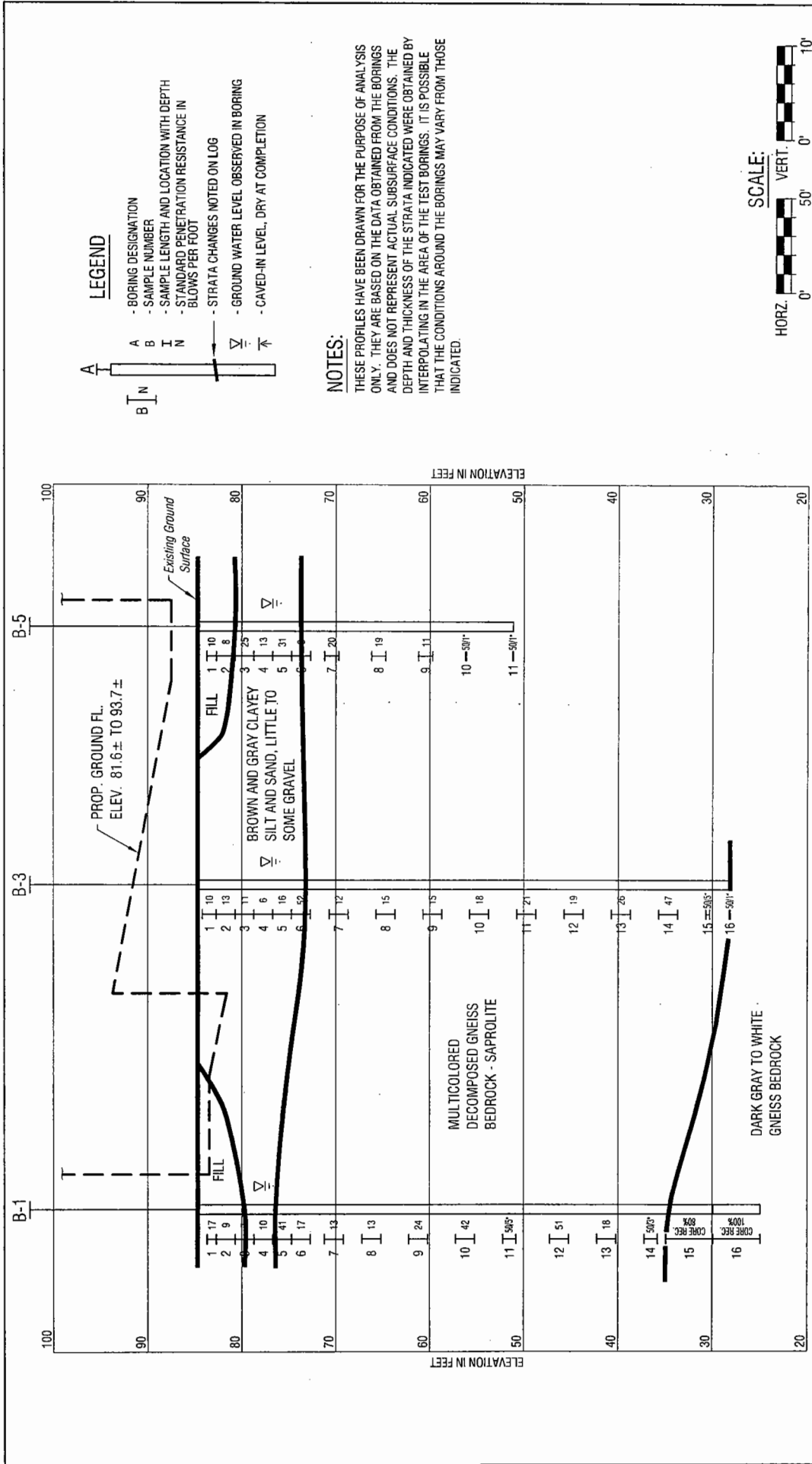


USGS QUADRANGLES REFERENCED:  
 WILMINGTON NORTH, DEL-PA  
 WILMINGTON SOUTH, DEL-NJ

SCALE: 1" = 2000'

SITE LOCATION MAP	DRAWN BY: O.J.K.	UFI NO. 2013280175.000	 <b>URBAN ENGINEERS, INC.</b> 530 Walnut Street Philadelphia, Pennsylvania 19106 (215) 922-8080	<b>PROPOSED PARKING GARAGE</b> <b>VETERANS AFFAIRS MEDICAL CENTER</b> 1601 KIRKWOOD HIGHWAY WILMINGTON DELAWARE
	CHECKED BY: D.G.M.	CAD NAME: 2013280175000		
	DATE: NOVEMBER, 2013	DWG. NO. 1		

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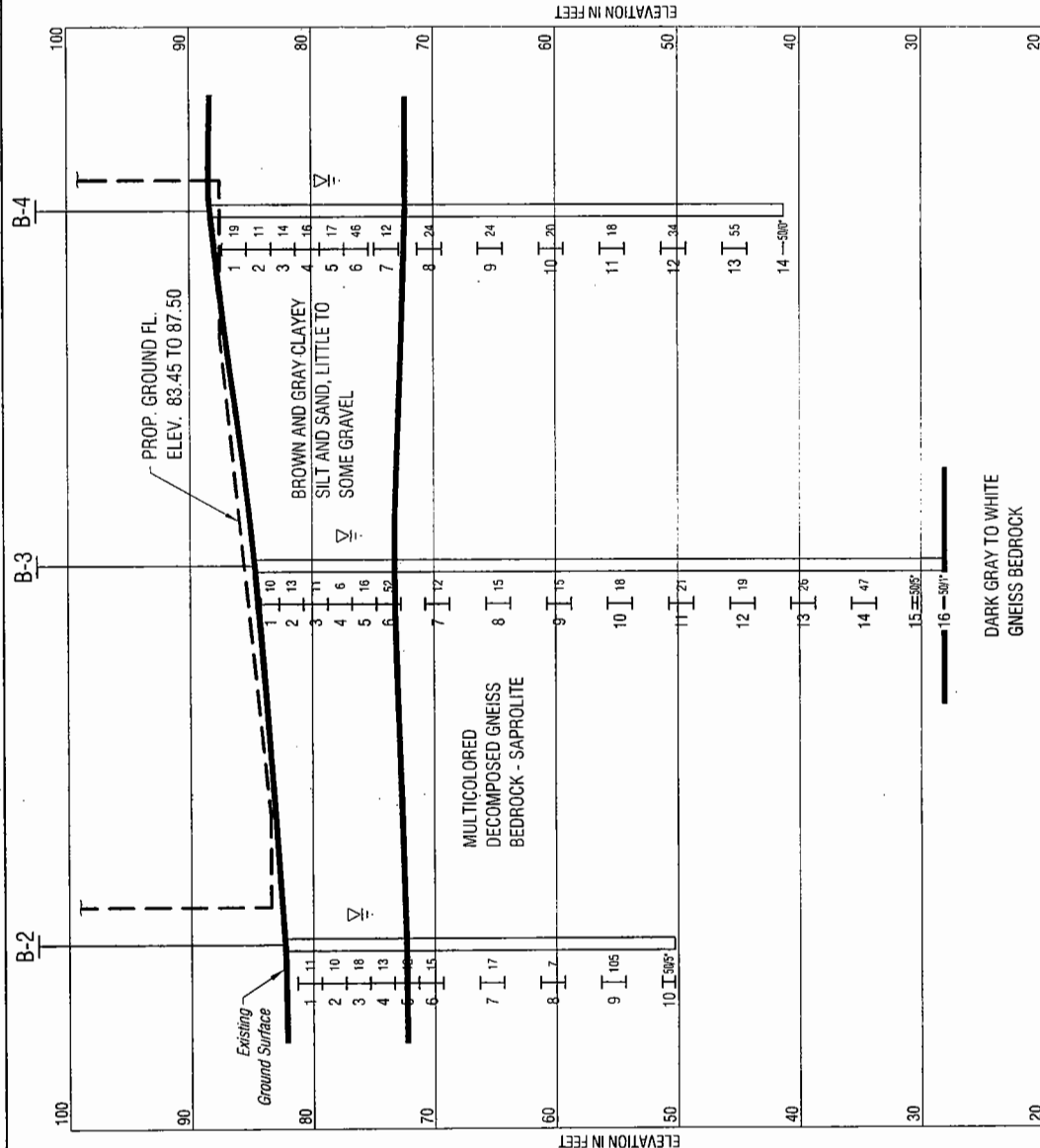
SECTION A-A

SUBSURFACE PROFILE

DRAWN BY:	D.J.K.	UEL NO.:	2013280175.000
CHECKED BY:	D.G.M.	CAD NAME:	2013280175000
DATE:	NOVEMBER, 2013	DWG. NO.:	3

URBAN ENGINEERS, INC.  
530 Walnut Street  
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(215) 922-9080

PROPOSED PARKING GARAGE  
VETERANS AFFAIRS MEDICAL CENTER  
1601 KIRKWOOD HIGHWAY  
WILMINGTON DELAWARE



FOR NOTES AND LEGEND SEE DRAWING 3

DATE		BY	REVISION	SECTION B-B				SUBSURFACE PROFILE		DRAWN BY: D.J.K.		UEI NO.: 2013280175.000	URBAN ENGINEERS, INC.		PROPOSED PARKING GARAGE	
DATE		BY	REVISION							CHECKED BY: D.G.M.		CAD NAME: 2013280175000	530 Walnut Street		VETERANS AFFAIRS MEDICAL CENTER	
DATE		BY	REVISION							DATE: NOVEMBER, 2013		DWG. NO.: 4	Philadelphia, Pennsylvania		1601 KIRKWOOD HIGHWAY	
													(215) 922-8080		WILMINGTON DELAWARE	



# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** W. Pond & D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler; NQ Rock Core Barrel

**Boring Number:** B-1  
**Ground Surface Elevation:** 84.7  
**Date Started:** 10-26-2013  
**Date Finished:** 10-27-2013

**Page:** 1 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
0					5 in. Asphalt pavement 7 in. Aggregate subbase	
	1	SS	1.0 - 2.0	7 - 10		
	2	SS	2.0 - 4.0	4 - 4 - 5 - 5	Gray and brown silt, little sand, trace gravel - Fill Brown to black silt, trace sand, gravel and organic matter - Fill	
5	3	SS	4.0 - 6.0	2 - 2 - 5 - 7		
	4	SS	6.0 - 8.0	4 - 4 - 6 - 6	Brown and gray clayey silt, trace sand and gravel Ditto	
	5	SS	8.0 - 10.0	7 - 13 - 28 - 32	Brown clayey silt, little sand, trace gravel into Brown gravel and sand, little silt	
10	6	SS	10.0 - 12.0	5 - 7 - 10 - 5	Brown to black sand, little gravel and clayey silt	
					Brown and orange micaceous clayey silt, trace sand	
15	7	SS	13.5 - 15.0	5 - 5 - 8		
					Gray and white micaceous clayey silt, trace sand - Saprolite	
	8	SS	17.5 - 19.5	4 - 5 - 8 - 9	Brown, gray, orange, and white micaceous clayey silt, trace sand - Saprolite	
20						
	9	SS	22.5 - 24.5	8 - 11 - 13 - 14	Brown and gray silt, little sand - Saprolite	
25						
	10	SS	27.5 - 29.5	16 - 14 - 28 - 28	Dark brown sand, little silt - Saprolite	
30						
	11	SS	32.5 - 33.4	28 - 50/5"	Black to white decomposed gneiss bedrock - Saprolite	
35						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 7.2 ft. during drilling



**URBAN ENGINEERS, INC.**  
 530 Walnut Street, 14th Floor  
 Philadelphia, Pennsylvania 19106-3685

Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-1  
**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** W. Pond & D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler; NQ Rock Core Barrel

**Boring Number:** B-1  
**Ground Surface Elevation:** 84.7  
**Date Started:** 10-26-2013  
**Date Finished:** 10-27-2013

**Page:** 2 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
35					Greenish black to brown decomposed gneiss bedrock - Saprolite	
	12	SS	37.5 - 39.5	16 - 24 - 27 - 31		
40					No recovery	
	13	SS	42.5 - 44.5	8 - 8 - 10 - 11		
45					Black to white decomposed gneiss bedrock - Saprolite	
	14	SS	47.5 - 48.2	16 - 50/3"		
50					Dark gray to white gneiss bedrock	
	15	RC	49.8 - 54.8	Rec. = 80%; RQD = 44%		
55					Ditto	
	16	RC	54.8 - 59.8	Rec. = 100%; RQD = 94%		
60					End of Boring at 59.8 ft.	
65						
70						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 See Page 1



**URBAN ENGINEERS, INC.**  
 530 Walnut Street, 14th Floor  
 Philadelphia, PA 19106-3685

Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-1  
**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-2  
**Ground Surface Elevation:** 82.3  
**Date Started:** 10-19-2013  
**Date Finished:** 10-19-2013

**Page:** 1 of 1

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
0					6 in. Asphalt pavement 6 in. Aggregate subbase	
	1	SS	1.0 - 3.0	3 - 5 - 6 - 8	Brown and gray silt, little sand, trace gravel	
	2	SS	3.0 - 5.0	4 - 5 - 5 - 6	Brown and gray silty clay, little sand	
5	3	SS	5.0 - 7.0	5 - 8 - 10 - 8	Brown and gray clayey silt, little sand, trace rock fragments	
	4	SS	7.0 - 9.0	4 - 5 - 8 - 17	Brown silt, some sand	
					Brown sand, little gravel and silt	
10	5	SS	9.0 - 11.0	9 - 9 - 3 - 3	Black micaceous silt and sand - Saprolite	
	6	SS	11.0 - 13.0	3 - 6 - 9 - 7	Dark gray to white micaceous silt, little sand - Saprolite	
15						
	7	SS	16.0 - 18.0	7 - 8 - 9 - 10	Ditto	
20						
	8	SS	21.0 - 23.0	3 - 3 - 4 - 4	Black, orange, and white micaceous silt, little sand - Saprolite	
25						
	9	SS	26.0 - 27.5	21 - 17 - 88	Light brown, white, and translucent quartz gravel, little sand, trace silt - Saprolite	
30						
	10	SS	31.0 - 31.4	50/5"	Black to orange sand and rock fragments - Saprolite	Auger refusal at 32 ft.
					End of Boring at 32 ft.	
35						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 6.3 ft. at completion



**URBAN ENGINEERS, INC.**

530 Walnut Street, 14th Floor  
 Philadelphia, Pennsylvania 19106-3685

Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-2

**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-3  
**Ground Surface Elevation:** 84.7  
**Date Started:** 10-5-2013  
**Date Finished:** 10-5-2013

**Page:** 1 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
0					6 in. Asphalt pavement 6 in. Aggregate subbase	
	1	SS	0.5 - 2.0	6 - 5 - 5		
	2	SS	2.0 - 4.0	2 - 6 - 7 - 10	Brown and gray clayey silt, little sand, trace gravel Brown and gray silt, little sand	
5	3	SS	4.0 - 6.0	2 - 4 - 7 - 6	gray and brown silty clay	
	4	SS	6.0 - 8.0	2 - 2 - 4 - 5	Ditto	
	5	SS	8.0 - 10.0	4 - 7 - 9 - 13	Brown sand, trace silt	
10	6	SS	10.0 - 12.0	6 - 32 - 20 - 6	Orangish brown gravel, some sand, trace silt	
					Brown to white clayey silt, some sand, little gravel - Saprolite	
15	7	SS	14.0 - 16.0	3 - 5 - 7 - 9	Brown to white clayey silt, little sand, trace gravel - Saprolite	
20	8	SS	19.0 - 21.0	4 - 6 - 9 - 10	Ditto	
25	9	SS	24.0 - 26.0	4 - 6 - 9 - 10	Reddish brown clayey silt, some sand, trace gravel - Saprolite	
30	10	SS	29.0 - 31.0	7 - 7 - 11 - 13	Brown to white clayey silt, little sand, trace gravel - Saprolite	
35						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 7.9 ft. at completion



**URBAN ENGINEERS, INC.**

530 Walnut Street, 14th Floor  
 Philadelphia, Pennsylvania 19106-3685

Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-3

**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-3  
**Ground Surface Elevation:** 84.7  
**Date Started:** 10-5-2013  
**Date Finished:** 10-5-2013

**Page:** 2 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
35	11	SS	34.0 - 36.0	6 - 10 - 11 - 14	Ditto	
40	12	SS	39.0 - 41.0	4 - 7 - 12 - 14	Ditto	
45	13	SS	44.0 - 46.0	7 - 12 - 14 - 26	Ditto	
50	14	SS	49.0 - 51.0	10 - 25 - 22 - 33	Brown to black clayey silt, little sand, trace gravel - Saprolite	
55	15	SS	54.0 - 54.4	50/5"	Brown sand, little silt and gravel - Saprolite (Low recovery)	Auger refusal at 56.6 ft. on possible Gneiss Bedrock
	16	SS	56.5 - 56.6	50/1"	No recovery	
					End of Boring at 56.6 ft.	
60						
65						
70						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 See Page 1



**URBAN ENGINEERS, INC.**  
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 Philadelphia, PA 19106-3685

Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-3  
**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-4  
**Ground Surface Elevation:** 88.3  
**Date Started:** 10-14-2013  
**Date Finished:** 10-14-2013

**Page:** 1 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
0					5 in. Asphalt pavement 7 in. Aggregate subbase	
	1	SS	1.0 - 3.0	8 - 12 - 7 - 7	Brown clayey silt, trace sand	
	2	SS	3.0 - 5.0	4 - 5 - 6 - 9	Brown and gray clayey silt, trace sand	
5	3	SS	5.0 - 7.0	5 - 7 - 7 - 6	Brown silt, trace sand and gravel	
	4	SS	7.0 - 9.0	4 - 7 - 9 - 12	Brown and light brown clayey silt, trace sand and gravel	
10	5	SS	9.0 - 11.0	3 - 6 - 11 - 17	Black, gray, and orange sand, some silty clay	
	6	SS	11.0 - 13.0	20 - 29 - 17 - 28	Dark to light brown sand, little clayey silt, trace gravel	
	7	SS	13.5 - 15.5	4 - 5 - 7 - 7	Dark to light brown silt, some sand, trace gravel	
15						
	8	SS	17.0 - 19.0	4 - 11 - 13 - 10	Brown and dark gray decomposed gneiss bedrock - Saprolite	
20						
	9	SS	22.0 - 24.0	9 - 10 - 14 - 14	Dark brown to orange silt, little sand - Saprolite	
25						
	10	SS	27.0 - 29.0	9 - 9 - 11 - 13	Black to light brown sand, little silt - Saprolite	
30						
	11	SS	32.0 - 34.0	7 - 8 - 10 - 12	Ditto	
35						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 9.8 ft. at completion



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Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-4

**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-4  
**Ground Surface Elevation:** 88.3  
**Date Started:** 10-14-2013  
**Date Finished:** 10-14-2013

**Page:** 2 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
35					Brown, white, and red sand and silt - Saprolite	
	12	SS	37.0 - 39.0	14 - 16 - 18 - 21		
40						
	13	SS	42.0 - 44.0	8 - 17 - 38 - 29	Ditto	Auger refusal at 46.5 ft.
45						
	14	SS	46.0 - 46.0	50/0"	No recovery	
					End of Boring at 46 ft.	
50						
55						
60						
65						
70						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 See Page 1



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Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-4

**Date:** Oct. 2013

# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-5  
**Ground Surface Elevation:** 84.7  
**Date Started:** 10-26-2013  
**Date Finished:** 10-26-2013

**Page:** 1 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
0					6 in. Asphalt pavement 6 in. Aggregate subbase	
	1	SS	1.0 - 2.0	4 - 6		
	2	SS	2.0 - 4.0	3 - 4 - 4 - 8	Brown and gray silt, little sand, trace gravel - Possible fill Brown to black clayey silt, trace sand and organics - Possible fill	Organic odor
5	3	SS	4.0 - 6.0	5 - 10 - 15 - 17		
	4	SS	6.0 - 8.0	5 - 7 - 6 - 8	Brown to light brown silt, trace sand and rock fragments Gray to brown silt, trace sand	
	5	SS	8.0 - 10.0	10 - 19 - 12 - 6	Brown sand, little gravel, trace silt	
10	6	SS	10.0 - 12.0	3 - 3 - 5 - 5	Orange clayey silt, some sand	
					Gray and brown micaceous silt and sand - Saprolite	
	7	SS	13.5 - 15.0	7 - 9 - 11	Brown to dark brown silt, some sand - Saprolite	
15						
	8	SS	18.5 - 20.0	10 - 10 - 9	Dark gray to white sand and silt - Saprolite	
20						
	9	SS	23.5 - 25.0	5 - 5 - 6	Brown silt, little sand - Saprolite	
25						
	10	SS	28.5 - 28.6	50/1"	No recovery	
30						
	11	SS	33.5 - 33.6	50/1"	Rock fragments - Saprolite	Low recovery
35					End of Boring at 34 ft.	Auger refusal

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

**Ground Water Data:**  
 8.0 ft. at completion



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Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-5  
**Date:** Oct. 2013



# RECORD OF SUBSURFACE EXPLORATION

**Project:** VAMC Wilmington - Parking Garage  
**Drilling Contractor:** CGC Geoservices  
 Wilmington, Delaware  
**Driller:** D. Wilson  
**Drilling Equipment:** Truck-mounted Dietrich D-50; Hollow Stem Augers  
 Standard Split Spoon Sampler

**Boring Number:** B-5  
**Ground Surface Elevation:** 84.7  
**Date Started:** 10-26-2013  
**Date Finished:** 10-26-2013

**Page:** 2 of 2

Depth (ft.)	Sample				Soil Descriptions	Remarks
	No.	Type	Depth (ft.)	Blow Counts		
35						at 36.2 ft.
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
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52						
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57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						

**Notes:** SS = Split Spoon Sample (ASTM D 1586)  
 ST = Shelby Tube Sample (ASTM D 1587)  
 RC = Rock Core Sample (ASTM D 2113)  
 Blow Counts for 6 in., based on 140 lb. hammer with 30 in. drop  
 WOH = Weight of Hammer

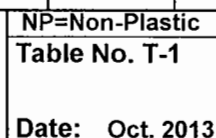
**Ground Water Data:**  
 See Page 1



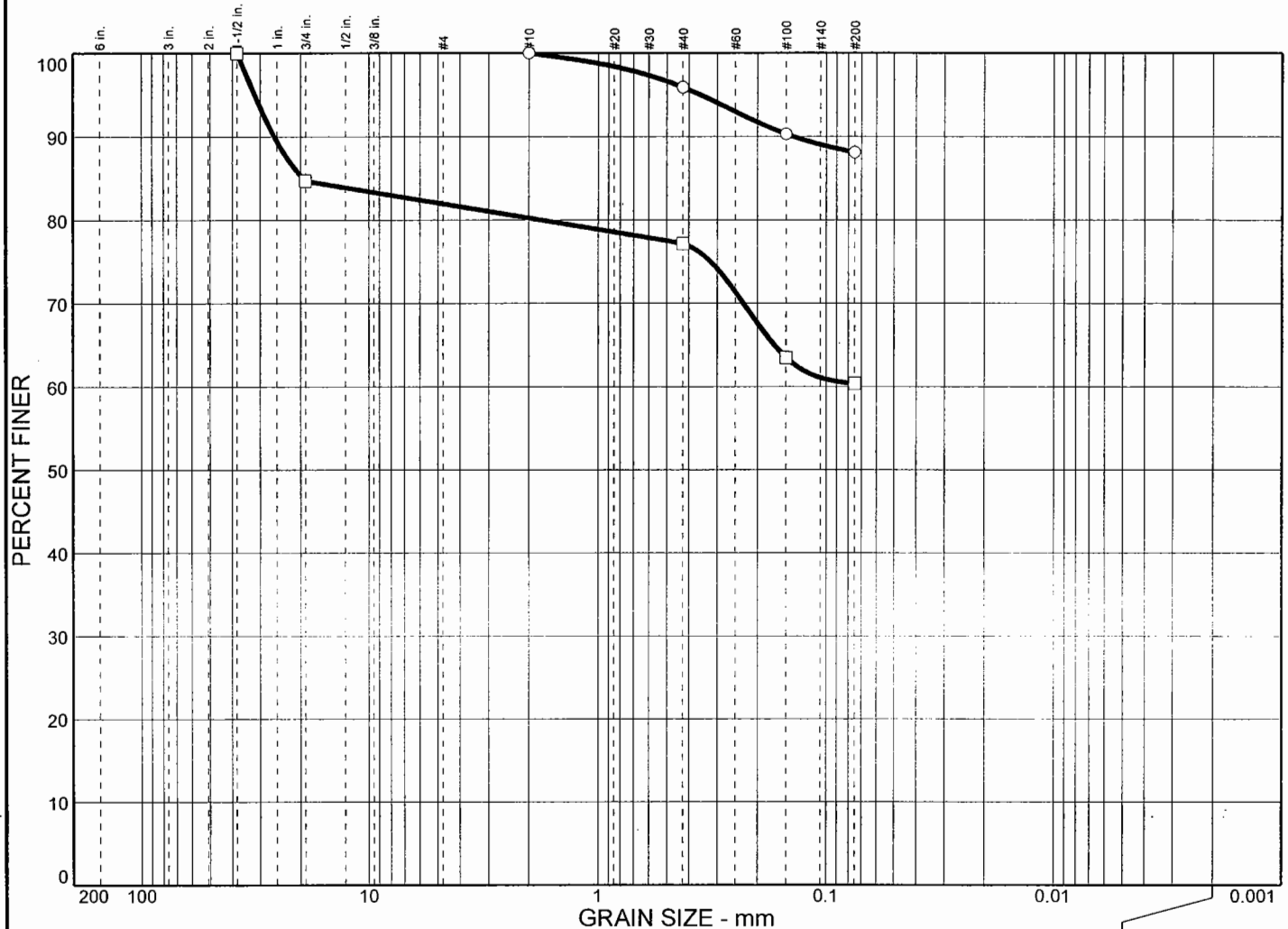
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Proposed Parking Garage  
 Veterans Affairs Medical Center  
 1601 Kirkwood Highway  
 Wilmington, Delaware

**Boring:** B-5  
**Date:** Oct. 2013

[illegible]

# Grain Size Distribution Test Report



	% + 3"	% GRAVEL	% SAND				% SILT		% CLAY	
○	0.0	0.0	11.9				88.1			
□	0.0	18.0	21.6				60.4			
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○	25	23								
□	27	19	19.5							

MATERIAL DESCRIPTION								USCS	AASHTO
○								ML	
□ Brown and gray clayey silt, little sand, trace rock fragments								CL	

<b>Project No.</b> 2013280175.000 <b>Client:</b> <b>Project:</b> Proposed Parking Garage Veterans Affairs Medical Center ○ <b>Source:</b> B-1 <b>Sample No.:</b> 4 <b>Elev./Depth:</b> 6.0-8.0 □ <b>Source:</b> B-2 <b>Sample No.:</b> 3 <b>Elev./Depth:</b> 5.0-7.0			<b>Remarks:</b> ○ □
Grain Size Distribution Test Report <b>URBAN ENGINEERS</b>			
Figure No. 1			

Grain size distribution curve for a soil sample. The graph plots Percent Finer (Y-axis, 0 to 100) against Grain Size in mm (X-axis, logarithmic scale from 200 to 0.075). The curve shows a well-graded soil with a peak at 100% finer for grain sizes down to approximately 4.75 mm. Key data points are marked: 100% finer at 4.75 mm (No. 4 sieve), 100% finer at 7.5 mm (No. 20 sieve), 100% finer at 10 mm (No. 20 sieve), 100% finer at 15 mm (No. 10 sieve), 100% finer at 20 mm (No. 10 sieve), 100% finer at 30 mm (No. 60 sieve), 100% finer at 40 mm (No. 40 sieve), 100% finer at 60 mm (No. 25 sieve), 100% finer at 100 mm (No. 15 sieve), 100% finer at 140 mm (No. 12 sieve), and 100% finer at 200 mm (No. 7.5 sieve).

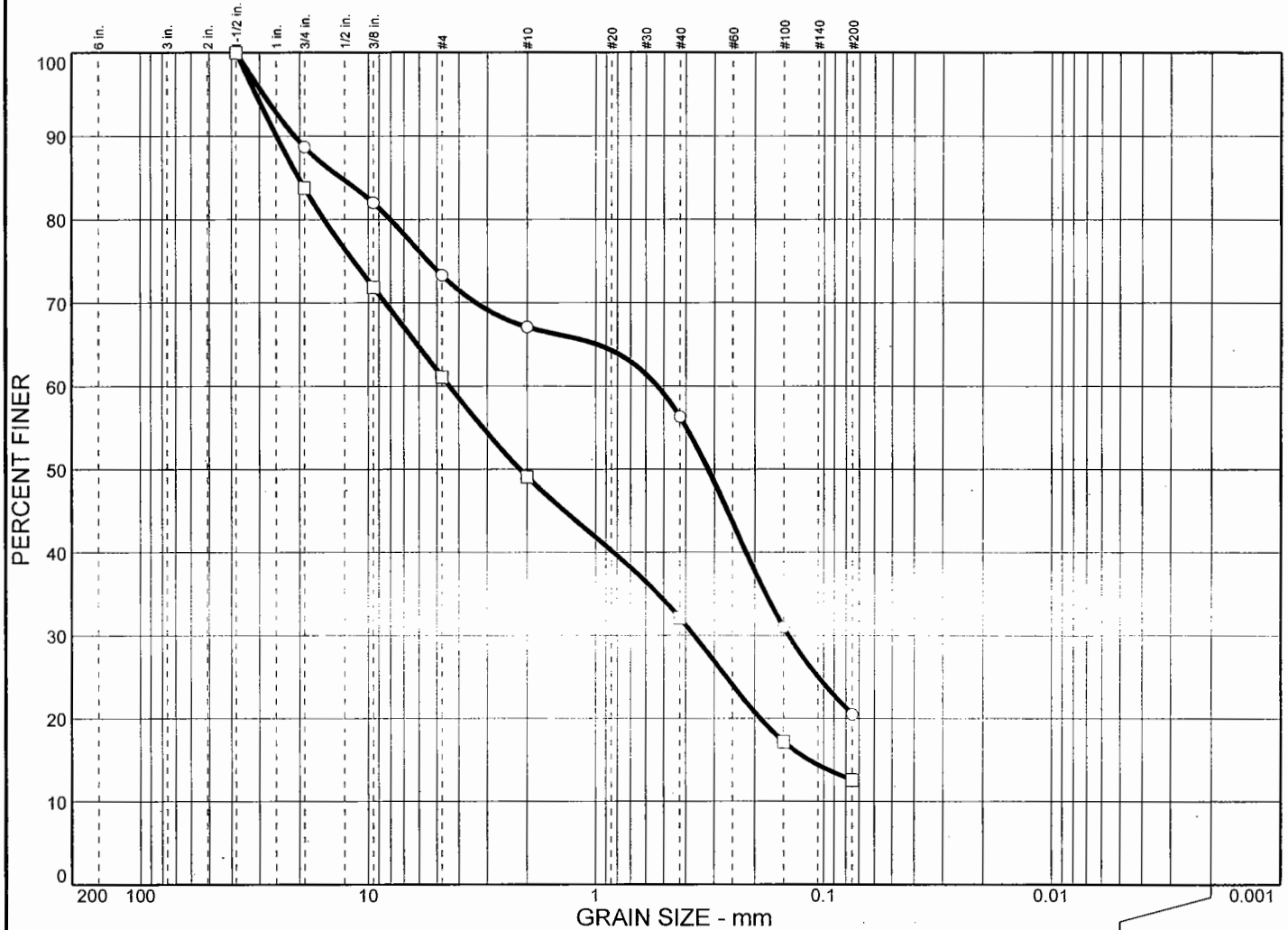
MATERIAL DESCRIPTION	USCS	AASHTO
<input type="radio"/> Brown sand, trace stil <input type="checkbox"/> Ditto	SP-SM MH	

Elev./Depth: 19.0-21.0

100

Figure No. 2

# Grain Size Distribution Test Report



% + 3"	% GRAVEL		% SAND				% SILT		% CLAY	
○	0.0	26.7	52.8				20.5			
□	0.0	38.9	48.5				12.6			
LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>	
○		13.1	0.681	0.285	0.144					
□		20.2	4.42	2.15	0.368	0.116				
MATERIAL DESCRIPTION								USCS	AASHTO	
○ Dark to light brown sand, little clayey silt, trace gravel								SM		
□ Brown sand, little gravel, trace silt								SM		

Project No. 2013280175.000 Client:

Project: Proposed Parking Garage

Veterans Affairs Medical Center

○ Source: B-4

Sample No.: 6

Elev./Depth: 11.0-13.0

□ Source: B-5

Sample No.: 5

Elev./Depth: 8.0-10.0

Remarks:

○

□

Grain Size Distribution Test Report

**URBAN ENGINEERS**

Figure No.

3

## COMPRESSIVE STRENGTH OF ROCK CORES

TEST METHOD: ASTM D7012  
NOMINAL CORE DIAMETER = 2.0 INCH

Boring No.	Sample No.	Specimen No.	Approximate Specimen Depth (ft.)	Approximate Specimen Elevation (Proj. Datum)	Unconfined Compressive Strength (psi)	Remarks
B-1	15	1	51.3	33.4	7,662	
"	15	2	52.3	32.4	10,882	
"	16	1	57.2	27.5	6,436	
"	16	2	58.8	25.9	4,283	



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Compressive  
Strength  
Of  
Rock Cores

Proposed Parking Garage  
Veterans Affairs Medical Center  
1601 Kirkwood Highway  
Wilmington, Delaware

C-1 of 1

DATE:  
Nov. 2013

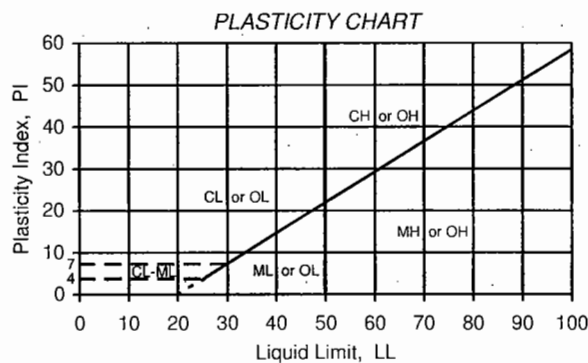
# SOIL CLASSIFICATION CHART

## UNIFIED SOIL CLASSIFICATION SYSTEM

Reference: ASTM D 2487

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL NAMES
<b>COARSE GRAINED SOILS</b>  More than 50% of Material Larger than No. 200 Sieve	<b>GRAVEL AND GRAVELLY SOILS</b>  More than 50% of coarse material retained on No. 4 Sieve	<b>CLEAN GRAVELS</b>  Little or No Fines	<b>GW</b>	Well graded gravels and gravel-sand mixtures, little or no fines
			<b>GP</b>	Poorly graded gravels and gravel-sand mixtures, little or no fines
		<b>GRAVELS WITH FINES</b>	<b>GM</b>	Silty gravels and gravel-sand-silt mixtures, little or no fines
			<b>GC</b>	Clayey gravels and gravel-sand-clay mixtures
	<b>SAND AND SANDY SOILS</b>  More than 50% of coarse material passing No. 4 Sieve	<b>CLEAN SANDS</b>  Little or No Fines	<b>SW</b>	Well graded sands and gravelly sands, little or no fines
			<b>SP</b>	Poorly graded sands and gravelly sands, little or no fines
		<b>SANDS WITH FINES</b>	<b>SM</b>	Silty sands, sand-silt mixtures
			<b>SC</b>	Clayey sand, sand-clay mixtures
<b>FINE GRAINED SOILS</b>  More than 50% of Material Smaller than No. 200 Sieve	<b>NON-PLASTIC TO MEDIUM PLASTIC SILTS AND CLAYS</b>  Liquid Limit less than 50		<b>ML</b>	Inorganic silts, clayey silts, or rock flour, or sandy and/or gravelly silts, which are non-plastic to medium plastic
			<b>CL</b>	Inorganic clays, lean clays, silty clays, or sandy and/or gravelly clays, which are non-plastic to medium plastic
			<b>OL</b>	Organic silts and organic silty clays, which are non-plastic to medium plastic
	<b>HIGHLY PLASTIC TO VERY HIGHLY PLASTIC SILTS AND CLAYS</b>  Liquid Limit greater than 50		<b>MH</b>	Inorganic silts or micaceous sands or silts, with high to very high plasticity
			<b>CH</b>	Inorganic clays or fat clays, with high to very high plasticity
			<b>OH</b>	Organic clays, with high to very high plasticity
	<b>HIGHLY ORGANIC SOILS</b>			<b>PT</b>

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATION



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## SOIL DESCRIPTION CHART

BASED ON THE SIMPLIFIED BURMISTER'S SYSTEM

### *OVERALL DESCRIPTIVE TERMS*

<i>SOIL COMPONENT</i>	<i>DESCRIPTIVE TERM</i>	<i>RANGE OF PROPORTIONS</i>
Principal Component	-	Largest Proportion
Minor Components	AND	35% to Largest Proportion
	SOME	20% to 35%
	LITTLE	10% to 20%
	TRACE	1% to 10%

### *FINE GRAINED SOIL DESCRIPTIVE TERMS*

<i>COMPONENT</i>	<i>DESCRIPTION</i>	<i>PLASTICITY INDEX</i>
SILT	Non-Plastic	0
CLAYEY SILT	Slight Plasticity	1 to 5
SILT & CLAY	Low Plasticity	5 to 10
CLAY & SILT	Medium Plasticity	10 to 20
SILTY CLAY	High Plasticity	20 to 40
CLAY	Very High Plasticity	> 40



**URBAN ENGINEERS, INC.**



# Important Information about Your Geotechnical Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*While you cannot eliminate all such risks, you can manage them. The following information is provided to help.*

## **Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects**

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* for 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.*

## **Read the Full Report**

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## **A Geotechnical Engineering Report Is Based 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 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 a 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 it's 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 of the proposed structure,
- composition of the design team, or
- project ownership.

As a 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 based 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 an 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 overrely 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

subsurface 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 to 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 Engineer's Logs**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and 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**

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 study.* 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.

### **Read Responsibility Provisions Closely**

Some clients, design professionals, and contractors do not 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 the risk of such outcomes, 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 Covered**

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.*

### **Obtain Professional Assistance To Deal with Mold**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

### **Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance**

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.



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