

LOMBARDO ASSOCIATES, INC.

188 Church Street

Newton, Massachusetts 02458

www.LombardoAssociates.com

Tel: 617-964-2924

Fax: 617-332-5477

[Pio@LombardoAssociates.com](mailto: Pio@LombardoAssociates.com)

PN: 6681

December 3, 2020

Nelson Malwitz, Chairman
 Brookfield WPCA
 53 Commerce Road, Unit 1
 Brookfield, CT 06804

Dear Mr. Malwitz:

Re: Candlewood Lake Wastewater Management Plan
 Borings

Pursuant to BWPCA direction, a subsurface borings program was designed and implemented as best as possible due to concerns on damaging utilities. Attached is the borings report. The data suggests that rock and dewatering, while in localized areas will be required, should not have a significant impact on project costs to cause adding additional allowances as part of the project's budget cost estimates. This is in part due to the proposed wastewater collection system being a hybrid gravity-pressure septic tank effluent system which would likely be at 4 +/- feet below grade. Also the use of clean outs vs. manholes, as required with conventional wastewater gravity systems, will minimize costs. The borings effort highlighted the need for detailed utility maps to be prepared for the proposed sewerage areas as part of the project's design efforts.

If you have any questions on this matter, please do not hesitate to contact me by telephone (617) 964-2924 or E-mail [Pio@LombardoAssociates.com](mailto: Pio@LombardoAssociates.com).

Yours truly,



Pio S. Lombardo, P.E.
 President

Candlewood Lake Area Borings		
Boring #	Prelim Depth to Bedrock (ft)	Depth to GW (ft)
B-1	4	
B-2	3.5	
B-3	>8	6.5
B-4	7.5	
B-5	>8	5
B-6	>8	
B-15	7	
B-16	>8	
B-17	5.5	
B-21	>8	
B-22	>8	
B-23	>8	
B-24	>8	
13	Borings	
62%	Sites > 8 feet	
15%	2+/- feet rock removal req'd	see note 1
Note (1) As excavations are expected to be < 5 feet, dewatering requirements should be minimal		

November 30, 2020

Lombardo Associates, Inc.
188 Church Street
Newton, Ma 02458



Attn: Mr. Pio Lombardo – Principal
P: (317) 964 2924
E: pio@lombardoassociates.com

Re: Subsurface Exploration Services Letter Report
Brookfield Candlewood Lake Area WWMP
Candlewood Lake Community Area
Brookfield, Connection
Terracon Project No. J2205056

Dear Mr. Lombardo:

At your request, we have prepared this letter report to provide the results of the subsurface investigation, which was performed for the proposed project. The services described in this letter were performed in general accordance with our proposal dated October 15, 2020, Reference Number PJ2205056.

PROJECT DESCRIPTION

An exploration program consisting of twenty-two (22) test borings was proposed by Lombardo Associates, Inc. The program was prepared to assess the extent of rock removal for installation of new sewer system throughout Candlewood Lake Community. During our pre-task planning, Terracon contacted Connecticut Call Before You Dig (CBYD) for public underground utility survey. In addition, Terracon retained a private utility survey specialist, who utilized Ground Penetration Radar (GPR) and Electromagnetic (EM) Scanning Utility Locator to locate underground utilities at all proposed exploration locations. During the survey, the specialist noted there are many unknown underground plastic waterlines within the areas of the proposed exploration locations in the Candlewood Lake Community. Terracon along with our contractors made the efforts of contacting local water suppliers and agencies. Due to the limitations of GPR and EM technologies on detecting plastic pipes, and consulting with local residents, it was concluded that locating these underground privately-owned plastic water lines is beyond our scope of work.



Subsurface Exploration Services Letter Report

Brookfield Candlewood Lake Area WWMP ■ Brookfield, Connection

November 30, 2020 ■ Terracon Project No. J2205056



FINDINGS

Based on these thirteen (13) test borings, auger refusal was encountered at depths between 3.5 to 7.5 feet below existing grades in five (5) test borings, which were B-1, B-2, B-4, B-15, and B-17. Standard auger refusal is defined as auger penetration of less than 6 inches under 500 psi of auger-feed down pressure for minimum of 10 minutes. However, the refusal should be a functional definition as an inability to advance despite increasing torque and down-feed pressure applied by the drill rig. The auger refusal implies the relative density of the material encountered be denser than the density of soil and the material can be either bedrock or boulder.

The remaining locations were drilled to the anticipated exploration depth of 8 feet below grade. The auger spoils were classified using the Unified Soil Classification System (USCU). They are in agreement with the surficial geology of glacial till material. A rock outcrop was only observed at the location of B-1 and was seen on either side of the road where the boring was drilled. Since we did not collect rock cores at any of the locations, we can only infer that bedrock was encountered based on drilling activity and “rock flour” seen in the auger spoils.

Glacial till was observed in all of the borings, whether bedrock was encountered or not. Based on our inspection and soil classification on the auger cuttings, the materials are between Poorly-Graded Sand with silt (SP-SM) and gravel, Silty Sand (SM) with gravel, or Sandy Silt (ML). Cobbles and boulders varied between locations and should be anticipated for removal upon the beginning of the sewer line installation.

Groundwater was also observed at two (2) of the boring locations, B-3 & B-5, and was monitored at 6.5 feet and 5.0 feet below ground surface, respectively. Groundwater can vary with the season; however, which may cause the groundwater to either rise or fall. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower. The groundwater surface should be checked prior to construction to assess its effect on site work and other construction activities.

Our initial exploration program included 22 borings throughout the project boundary. Nine of these locations were on town roads and were completed efficiently. The remaining thirteen borings, however, were located on private roads, and four of these locations were drilled under the assumption that all of the underground utilities were cleared in the general vicinity of the markouts, including water valves that connected from the main water line to the houses. After discussions with employees at the community’s clubhouse and Travis Hyatt with Scalzo Property Management (Scalzo), we learned that there are no plans that display these connections to the houses and can only be inferred with the assistance of a representative from Scalzo who would need to come to the site. Although we did hire a private utility subcontractor, the water valves could not be identified due to their small size and material. The drilling program was halted upon learning this information and the remaining nine (9) borings within the private community were not drilled. The termination was in agreement with Lombardo Associates, Inc.

Subsurface Exploration Services Letter Report

Brookfield Candlewood Lake Area WWMP ■ Brookfield, Connecticut

November 30, 2020 ■ Terracon Project No. J2205056



Sincerely,

Terracon Consultants, Inc.

A handwritten signature in black ink, appearing to read "Jennifer S. Journack". The signature is fluid and cursive.

Jennifer S. Journack

Geologist

A handwritten signature in black ink, appearing to read "Shengkai Tu". The signature is fluid and cursive.

Shengkai Tu, P.E.

Geotechnical Dept. Mgr

Reviewed by: Carl W. Thunberg, P.E., Authorized Project Reviewer

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Location
13	8 or auger refusal	See Exploration Plan

Boring Layout and Elevations: Lombardo Associates, Inc. provided the boring layout and coordinates. During our site reconnaissance, the majority of the borings were offset due to either overhead wire lines or underground utilities. New coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ± 15 feet). If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the test borings with a truck-mounted drill rig using continuous solid stem flight augers. Borings were advanced to a maximum depth of 8 feet or auger refusal. Soil samples were not collected, but the soil cuttings were monitored and classified in accordance with the United Soil Classification System (USCS) using the terms of gravel, sand, silt, and clay. The key purpose of this subsurface exploration program was to determine the depth of bedrock at each proposed boring location. If rock was encountered shallower than 8 feet below grade, rock coring was not performed, but the depth to probable bedrock was recorded. We observed and recorded groundwater levels during drilling. For safety purposes, all borings were backfilled with auger cuttings and capped with cold patch after their completion.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location

Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Brookfield Candlewood Lake Area WWMP ■ Brookfield, Connection
November 30, 2020 ■ Terracon Project No. J2205056

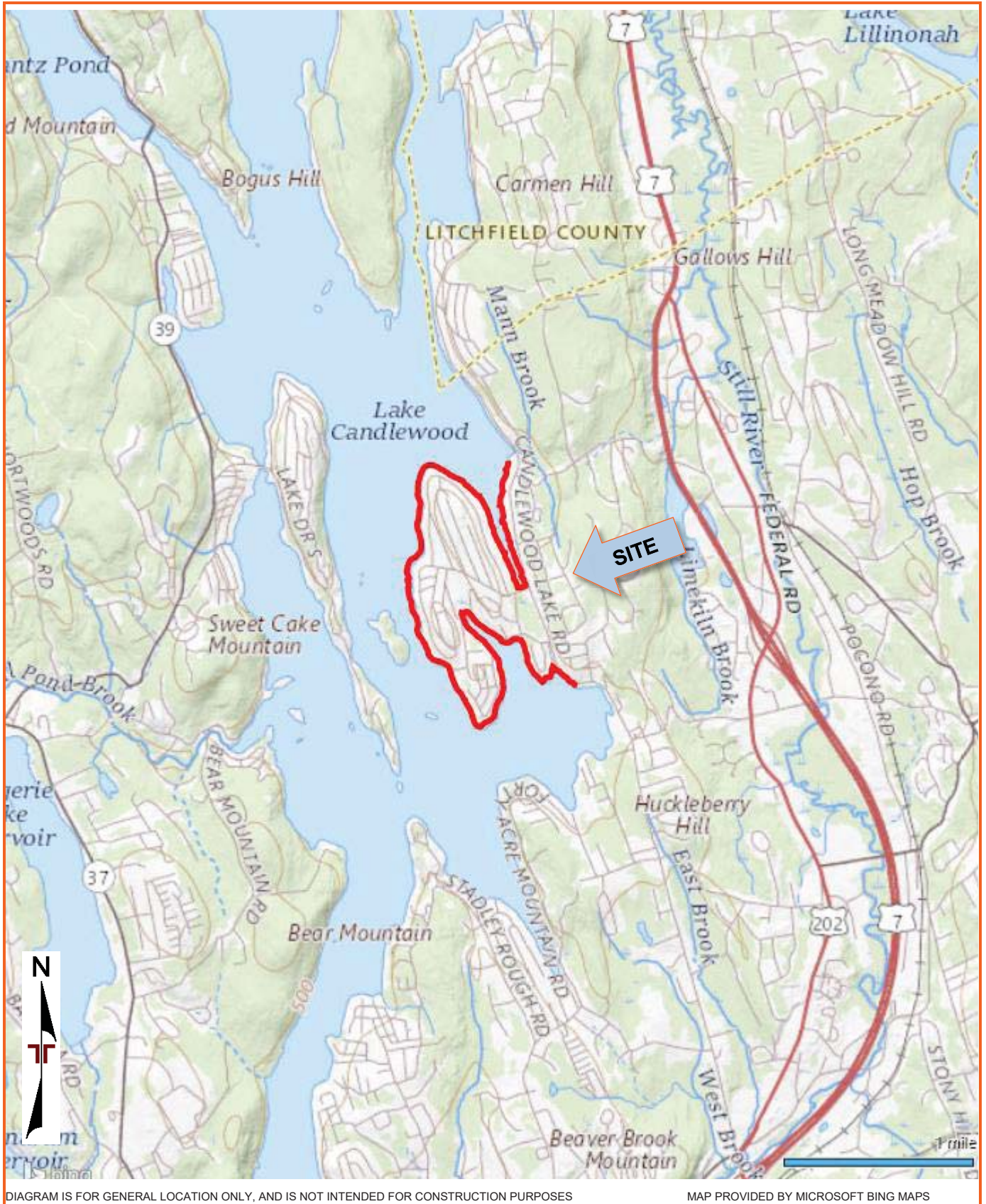


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Brookfield Candlewood Lake Area WWMP ■ Brookfield, Connection
November 30, 2020 ■ Terracon Project No. J2205056

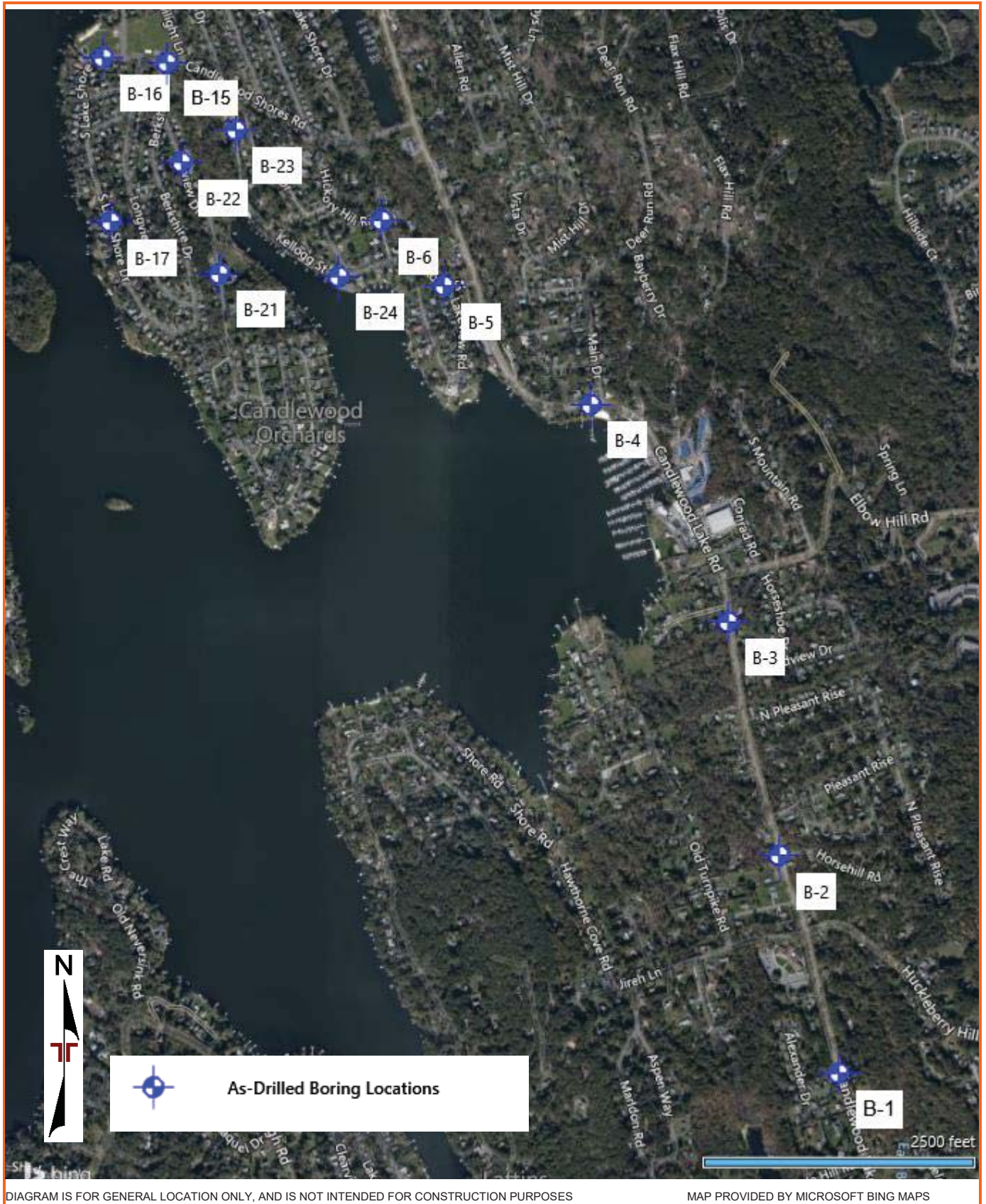


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Summary Table

Note: All attachments are one page unless noted above.

Boring I.D.	Boring Coordinates		Depth to Bedrock (ft)*	Soil Classification of Spoils	Remarks**
B-1	41.4523	-73.4181	4.0	Brown Silty Sand with gravel	Rock outcrop observed on either side of road
B-2	41.4579	-73.4201	3.5	Brown Poorly-Graded Sand with silt & gravel	Auger refusal at 5.5 ft below grade
B-3	41.4634	-73.4217	N/E	Brown to gray-brown Silty Sand with gravel	Groundwater observed at 6.5 ft below grade
B-4	41.4691	-73.4266	7.5	Brown Silty Sand and sandy Silt	
B-5	41.4722	-73.4314	N/E	Brown Poorly-Graded Sand with silt & gravel to sandy Silt	Groundwater observed at 5.0 ft below grade
B-6	41.4738	-73.4338	N/E	Brown Poorly-Graded Sand with silt & gravel to sandy Silt	
B-15	41.4779	-73.4415	7.0	Brown Poorly-Graded Sand with silt & gravel to Silty Sand	Auger refusal at 7.0 ft below grade
B-16	41.4780	-73.4427	N/E	Brown Silty Sand to sandy Silt	
B-17	41.4748	-73.4429	5.5	Brown Poorly-Graded Sand with silt to Silty Sand	Auger refusal at 6.5 ft below grade
B-21	41.4731	-73.4391	N/E	Brown Poorly-Graded Sand with silt & gravel to sandy Silt	
B-22	41.4756	-73.4405	N/E	Brown Silty Sand with gravel to sandy Silt	
B-23	41.4761	-73.4384	N/E	Brown Silty Sand with gravel to sandy Silt	
B-24	41.4724	-73.4350	N/E	Brown Poorly-Graded Sand with silt & gravel to Silty Sand	

* Depths to bedrock are only assumed based on auger refusal.

** All borings went to depths of 8 ft unless noted otherwise.

N/E = Not encountered

SUPPORTING INFORMATION

Contents:

Unified Soil Classification System

Note: All attachments are one page unless noted above.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}	
			PI plots below "A" line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
	Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

