



**GEOTEK ENGINEERING
& TESTING SERVICES, INC.**

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Sioux Falls, South Dakota 57104
Phone 605-335-5512 Fax 605-335-0773

October 28, 2016

City of Windom
444 9th Street
P.O. Box 38
Windom, Minnesota 56101

Attn: Al Baloun – Parks & Recreation Director

Subj: Geotechnical Exploration
Swimming Pool Facility
Island Park
Windom, Minnesota
GeoTek #16-B98

Introduction

This correspondence presents our reporting of the geotechnical exploration program for the referenced project. Our work was performed in accordance with your authorization.

Project Location

The existing swimming pool facility is located within Island Park in Windom, Minnesota. An existing swimming pool and bathhouse currently occupy the site.

Field & Laboratory Data

Ground Surface Elevations & Test Boring Locations

The ground surface elevations at the test boring locations were determined by using the top of the manhole located south of the bathhouse as a benchmark. An arbitrary elevation of 100.0 feet was used as the benchmark. Based on the benchmark datum, the ground surface elevations at the test boring locations varied from 101.6 feet at test boring 2 to 101.8 feet at test borings 1 and 5. A test boring location map is attached at the conclusion of this report showing the relative location of the test borings.

Subsurface conditions

We performed five (5) test borings on October 3, 2016. Of the five (5) test borings, four (4) were performed outside of the fence with a truck equipped with hollow-stem auger and one (1) was performed using hand-operated equipment through the concrete deck adjacent to the existing swimming pool.

The test borings encountered 11 feet to 14 ½ feet of existing fill materials overlying fine alluvium soils, mixed alluvium soils and glacial till soils. The existing fill materials consisted of lean clay soils and sand soils. The fine alluvium soils consisted of lean clay with sand soils. The mixed alluvium soils consisted of sandy lean clay soils and clayey sand soils. The glacial till soils consisted of sandy lean clay soils. We would like to point out that it is difficult to determine if the lower portions of the existing fill materials are native soils.

We wish to point out that the subsurface conditions at other times and locations at the property may differ from those found at our test boring locations. If different conditions are encountered during construction, then it is important that you contact us so that our recommendations can be reviewed.

Laboratory Testing

Select samples from the test borings were submitted to the laboratory for testing. The tests consisted of moisture content, dry density, sieve analysis (#200 sieve wash) and unconfined compressive strength. The results of the laboratory tests are shown on the boring logs adjacent to the samples upon which the tests were performed.

Water Levels

Groundwater was measured at depths of 8 feet and 9 feet at test borings 1 through 4 (elevations 94.3 feet to 93.1 feet). Measurable groundwater did not enter the borehole at test boring 5 at the time of our measurement.

Project Information

The existing swimming pool was constructed in the 1960s and was renovated in the 1980s. When the existing swimming pool facility was developed, we understand that several feet of fill material was placed to achieve the design elevations.

We understand that the City of Windom is considering a renovation or reconstruction of the existing swimming pool facility. The existing swimming pool facility consists of the following: a swimming pool, a pool deck and a bathhouse. We understand that a net allowable soil bearing pressure of 1,500 pounds per square foot (psf) to 2,000 psf is desired for the renovations or reconstruction. If the renovations are performed, then we understand that a new pool section (rebar and concrete) will be placed within the existing swimming pool and the pool deck will be replaced. The renovations to the existing bathhouse would consist of constructing a full roof above the top of the bathhouse.

Discussion

The results of the test borings and laboratory tests indicate that the upper 20 feet of the soil profile has limited bearing capacity, is very compressible and is susceptible to frost heave and construction disturbance. With that said, the owner of the facility will need to weigh the risks and options associated with the renovations or reconstruction.

With the renovations, movement could occur because the supporting characteristics of the subgrade soils would not be improved. In addition, mitigation of potential frost heave would not be addressed beneath the swimming pool. However, if the pool deck is replaced, then a sufficient

thickness of granular material could be placed beneath the slab in order to minimize the movement due to frost.

Regarding the reconstruction, significant ground preparations or an alternative foundation system would be needed to improve the supporting characteristics of the subgrade soils. The significant ground preparations would involve performing a complete overexcavation of the existing fill materials beneath the swimming pool, pool deck and bathhouse. An extensive dewatering system would be needed with the significant ground preparations. Placement of crushed rock at the bottom of the excavations would also be needed. Regarding potential frost movement, the overexcavated areas would be backfilled with a granular material. In our opinion, the granular material would provide adequate frost protection if the material is drained. A partial overexcavation of the existing fill materials could also be considered; however, the risk of movement or settlement increases if a portion of the existing fill materials are left in place.

In regards to the alternative foundation system, it is our opinion that a series of rammed aggregate piers could be installed. The rammed aggregate could be used to reinforce the existing fill materials; however, some overexcavating would still be needed to mitigate potential frost movement.

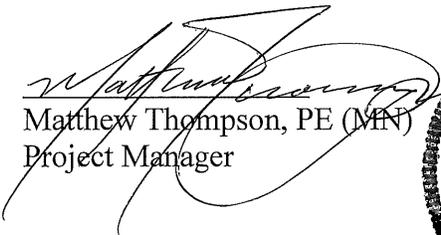
Remarks

We trust this report provides you with the necessary information at this time. We can provide specific recommendations once it is determined if renovations or reconstruction will be performed. If you have any questions or require additional information, please contact our office.

GeoTek Engineering & Testing Services, Inc.



Brennen Ahlers, PE (SD)
Project Manager



Matthew Thompson, PE (MN)
Project Manager





FIGURE 1
 PROJECT SITE MAP
 PROPOSED SWIMMING POOL RENOVATIONS
 ISALND PARK
 WINDOM, MN

ACAD\GEOTEK\BRENNEN\16-B98

PROJECT#: 16-B98

DRAWN BY: JLS

CHECKED BY:

GEOTEK ENGINEERING &
 TESTING SERVICES, INC.

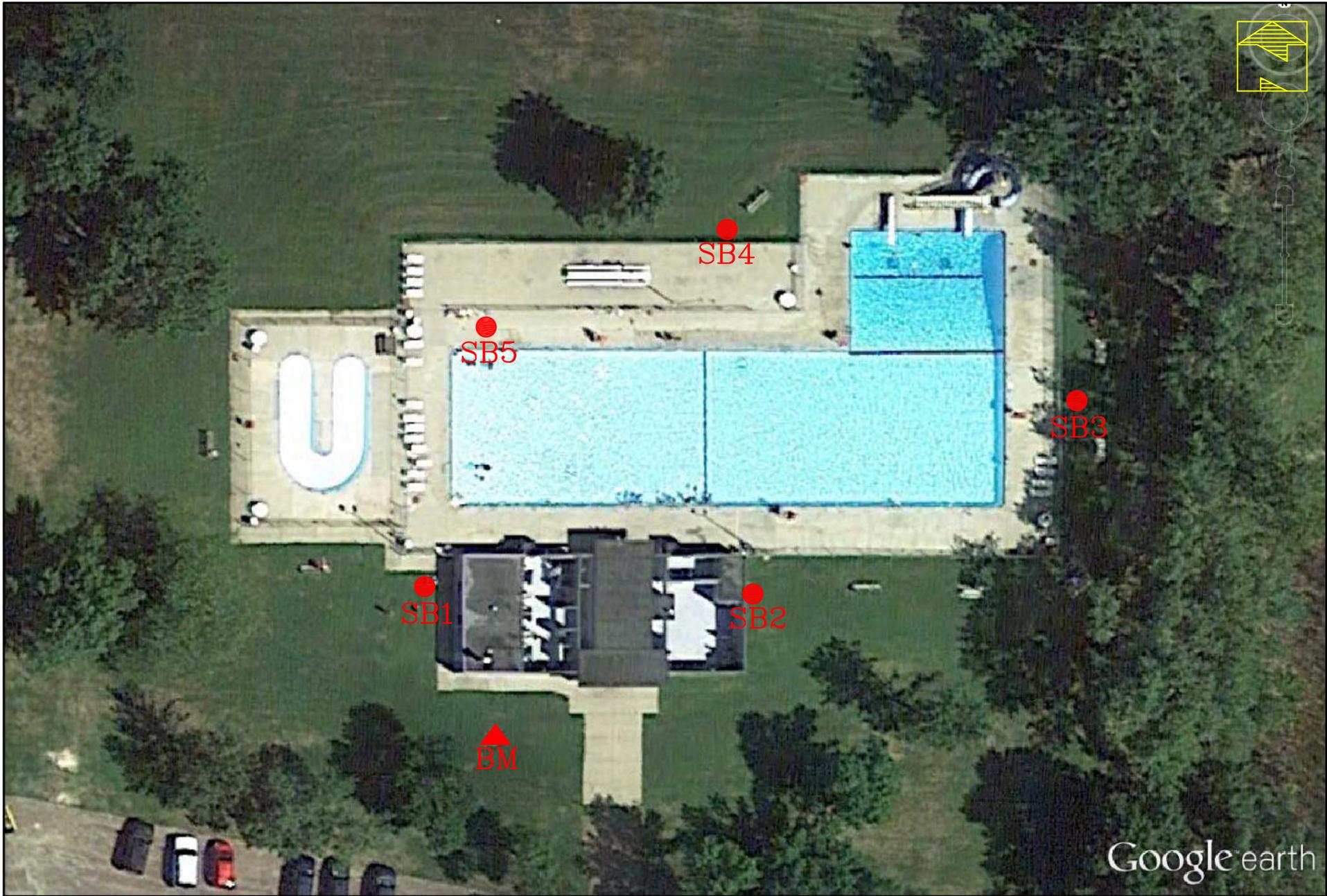


FIGURE 2
 TEST BORING LOCATION MAP
 PROPOSED SWIMMING POOL RENOVATIONS
 ISALND PARK
 WINDOM, MN

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GEOTECHNICAL TEST BORING LOG

GEOTEK # 16-B98 BORING NO. 1 (1 of 1)
 PROJECT Proposed Swimming Pool Renovations, Island Park, Windom, MN

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>101.8 ft</u>														
1	FILL, MOSTLY LEAN CLAY: very dark brown, moist	FILL				1	HSA								
	FILL, MOSTLY LEAN CLAY: dark brown, moist	FILL	2			2	SPT	22	101						
4½	FILL, MIXTURE OF CLAY AND SAND: very dark brown, moist	FILL	9			3	SPT								
7½	FILL, MIXTURE OF CLAY AND SAND: very dark brown, wet, % passing #200 sieve = 52% (CL)	FILL (POSSIBLE MIXED ALLUVIUM)	2	▼		4	SPT	17	115						
			2			5	SPT	20	108						
12	LEAN CLAY WITH SAND: dark brown, wet, soft, (CL)	FINE ALLUVIUM	2			6	SPT	29	96						600
14½	LEAN CLAY WITH SAND: mottled brown and gray, wet, soft, (CL)	FINE ALLUVIUM	4			7	SPT								
19½	SANDY LEAN CLAY: a little gravel, gray, moist, firm, (CL)	GLACIAL TILL	8			8	SPT								
21	Bottom of borehole at 21 feet.														

GEOTECHNICAL TEST BORING 16-B98.GPJ GEOTEKENG.GDT 10/28/16

WATER LEVEL MEASUREMENTS						START	COMPLETE
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD	
10-3-16	5:58 pm	21	--	14	▼ 8.0	3.25" ID Hollow Stem Auger	
--	--	--	--	--	--		
--	--	--	--	--	--		
--	--	--	--	--	--	CREW CHIEF	Mike Wagner



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GEOTECHNICAL TEST BORING LOG

GEOTEK # 16-B98

BORING NO. 2 (1 of 1)

PROJECT Proposed Swimming Pool Renovations, Island Park, Windom, MN

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>101.6 ft</u>														
1	FILL, MOSTLY LEAN CLAY: very dark brown, moist	FILL				1	HSA								
	FILL, MOSTLY LEAN CLAY: brown, moist	FILL	2			2	SPT								
4½	FILL, MOSTLY LEAN CLAY: dark brown, moist	FILL	4			3	SPT								
7	FILL, MOSTLY SAND: coarse grained, brown, wet	FILL	4	▼		4	SPT								
8½	FILL, MIXTURE OF CLAY AND SAND: very dark brown, wet, % passing #200 sieve = 59%	FILL (POSSIBLE MIXED ALLUVIUM)	2			5	SPT								
						9	SH	28	101						
			2			6	SPT								
14½	LEAN CLAY WITH SAND: dark brown and, wet, soft, (CL)	FINE ALLUVIUM	2			7	SPT								
19½	SANDY LEAN CLAY: a little gravel, gray, moist, very stiff, (CL)	GLACIAL TILL	16			8	SPT								
21	Bottom of borehole at 21 feet.														

WATER LEVEL MEASUREMENTS

START 10-3-16 COMPLETE 10-3-16 12:49 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
10-3-16	5:59 pm	21	--	12	▼ 8.0	3.25" ID Hollow Stem Auger
--	--	--	--	--	--	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-B98.GPJ GEOTEKENG.GDT 10/28/16



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-B98**

BORING NO. **3 (1 of 1)**

PROJECT **Proposed Swimming Pool Renovations, Island Park, Windom, MN**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>101.7 ft</u>														
1	FILL, MOSTLY LEAN CLAY: very dark brown, moist	FILL			1	HSA									
	FILL, MIXTURE OF CLAY AND SAND: brown, moist	FILL	10		2	SPT	13								
			4		3	SPT	22								
8½			9		4	SPT	15	117							
	FILL, MOSTLY LEAN CLAY: very dark brown, wet, % passing #200 sieve = 59%	FILL (POSSIBLE FINE ALLUVIUM)	3		5	SPT	24	104							
			6		6	SPT									
13½	CLAYEY SAND: fine grained, brown, waterbearing, very loose, (SC)	MIXED ALLUVIUM	3		7	SPT									
19½	SANDY LEAN CLAY: a little gravel, gray, moist, stiff, (CL)	GLACIAL TILL	11		8	SPT									
21	Bottom of borehole at 21 feet.														

GEOTECHNICAL TEST BORING - 16-B98.GPJ - GEOTEKENG.GDT - 10/28/16

WATER LEVEL MEASUREMENTS

START 10-3-16 COMPLETE 10-3-16 3:08 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
10-3-16	6:03 pm	21	--	14	9.0	3.25" ID Hollow Stem Auger
--	--	--	--	--	--	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-B98**

BORING NO. **4 (1 of 1)**

PROJECT **Proposed Swimming Pool Renovations, Island Park, Windom, MN**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
					NO.	TYPE	WC	D	LL	PL	QU			
0 1/2	SURFACE ELEVATION <u>101.7 ft</u> FILL, MOSTLY LEAN CLAY: very dark brown, moist FILL, MIXTURE OF CLAY AND SAND: brown, moist	FILL				1	HSA							
		FILL	4			2	SPT							
			5			3	SPT							
7 1/2	FILL, MOSTLY LEAN CLAY: very dark brown, moist to wet	FILL (POSSIBLE FINE ALLUVIUM)	5	▼		4	SPT	17						
10 1/2	FILL, MIXTURE OF CLAY AND SAND: brown, wet	FILL (POSSIBLE MIXED ALLUVIUM)	3			5	SPT	24						
			3			6	SPT							
14 1/2	SANDY LEAN CLAY: mottled brown and gray, wet, soft, (CL)	MIXED ALLUVIUM	2			7	SPT							
19 1/2	SANDY LEAN CLAY: a little gravel, gray, moist, stiff, (CL)	GLACIAL TILL	11			8	SPT							
21	Bottom of borehole at 21 feet.													

WATER LEVEL MEASUREMENTS

START 10-3-16 COMPLETE 10-3-16 4:13 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
10-3-16	6:06 pm	21	--	8	▼ 8.0	3.25" ID Hollow Stem Auger
--	--	--	--	--	--	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-B98.GPJ GEOTEKENG.GDT 10/28/16



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>16-B98</u>						BORING NO. <u>5 (1 of 1)</u>											
PROJECT <u>Proposed Swimming Pool Renovations, Island Park, Windom, MN</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>101.8 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown, moist, 4" of concrete at the surface					FILL			1	HA							
5	FILL, MOSTLY LEAN CLAY: dark brown and black, moist					FILL			2	SS							
7½	FILL, MIXTURE OF CLAY AND SAND: very dark brown, wet					FILL (POSSIBLE MIXED ALLUVIUM)			3	SS	20						
11	LEAN CLAY WITH SAND: dark brown, moist, (CL)					FINE ALLUVIUM			4	SS	22	104					
15	Bottom of borehole at 15 feet.								5	SS							
									6	SS							
WATER LEVEL MEASUREMENTS							START	<u>10-3-16</u>	COMPLETE	<u>10-4-16 7:48 am</u>							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
10-4-16	7:48 am	15	--	--	--	3" Hand Auger											
--	--	--	--	--	--												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF	Mike Wagner										

GEOTECHNICAL TEST BORING 16-B98.GPJ GEOTEKENG.GDT 10/28/16

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<p>COARSE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p>GRAVEL AND GRAVELLY SOILS</p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	<p>SAND AND SANDY SOILS</p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SM	SILTY SANDS, SAND - SILT MIXTURES
	<p>FINE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT LESS THAN 50</p>		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT GREATER THAN 50</p>			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
<p>HIGHLY ORGANIC SOILS</p>				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
<p>HIGHLY ORGANIC SOILS</p>				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING LOG SYMBOLS AND DESCRIPTIVE TERMINOLOGY

SYMBOLS FOR DRILLING AND SAMPLING

<u>Symbol</u>	<u>Definition</u>
Bag	Bag sample
CS	Continuous split-spoon sampling
DM	Drilling mud
FA	Flight auger; number indicates outside diameter in inches
HA	Hand auger; number indicates outside diameter in inches
HSA	Hollow stem auger; number indicates inside diameter in inches
LS	Liner sample; number indicates outside diameter of liner sample
N	Standard penetration resistance (N-value) in blows per foot
NMR	No water level measurement recorded, primarily due to presence of drilling fluid
NSR	No sample retrieved; classification is based on action of drilling equipment and/or material noted in drilling fluid or on sampling bit
SH	Shelby tube sample; 3-inch outside diameter
SPT	Standard penetration test (N-value) using standard split-spoon sampler
SS	Split-spoon sample; 2-inch outside diameter unless otherwise noted
WL	Water level directly measured in boring
▼	Water level symbol

SYMBOLS FOR LABORATORY TESTS

<u>Symbol</u>	<u>Definition</u>
WC	Water content, percent of dry weight; ASTM:D2216
D	Dry density, pounds per cubic foot
LL	Liquid limit; ASTM:D4318
PL	Plastic limit; ASTM:D4318
QU	Unconfined compressive strength, pounds per square foot; ASTM:D2166

DENSITY/CONSISTENCY TERMINOLOGY

<u>Density</u>	<u>Consistency</u>
<u>Term</u>	<u>Term</u>
Very Loose	Soft
Loose	Firm
Medium Dense	Stiff
Dense	Very Stiff
Very Dense	Hard

N-Value

0-4
5-8
9-15
16-30
Over 30

PARTICLE SIZES

<u>Term</u>	<u>Particle Size</u>
Boulder	Over 12"
Cobble	3" – 12"
Gravel	#4 – 3"
Coarse Sand	#10 – #4
Medium Sand	#40 – #10
Fine Sand	#200 – #40
Silt and Clay	passes #200 sieve

DESCRIPTIVE TERMINOLOGY

<u>Term</u>	<u>Definition</u>
Dry	Absence of moisture, powdery
Frozen	Frozen soil
Moist	Damp, below saturation
Waterbearing	Pervious soil below water
Wet	Saturated, above liquid limit
Lamination	Up to ½" thick stratum
Layer	½" to 6" thick stratum
Lens	½" to 6" discontinuous stratum

GRAVEL PERCENTAGES

<u>Term</u>	<u>Range</u>
A trace of gravel	2-4%
A little gravel	5-15%
With gravel	16-50%