GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 East 50th Street North
Sioux Falls, South Dakota 57104
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January 3, 2017

Codington County
14 1st Avenue SE
Watertown, South Dakota 57201

Attn: Lee Gabel

Subj: Preliminary Geotechnical Exploration
Proposed Justice Facility
Codington County
U.S. Highway 212
Watertown, South Dakota
GeoTek #16-E56

Introduction

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

Project Location & Description

The project site is located northwest of the intersection of U.S. Highway 212 and 25th Street SW in Watertown, South Dakota. Currently, the site is vacant and snow covered. A grade change of approximately 10 feet occurs across the site. The site slopes downward from the north to the south.

Test Borings

We performed six (6) test borings at the site on December 21, 2016. A test boring location map is attached showing the relative location of the test borings. The ground surface elevations at the test boring locations were determined by using the top of the fire hydrant located at the south edge of the site as a benchmark. An arbitrary elevation of 100.0 feet was used for the benchmark. A test boring location map, showing the relative location of the test borings, is attached at the conclusion of this report.

Subsurface Conditions

The subsurface conditions encountered at the test boring locations consisted of 1 ½ feet to 2 ½ feet of topsoil materials overlying fine alluvium soils and glacial till soils. The glacial till soils were the predominant soil type encountered and extended to the termination depth of the test borings.

The topsoil materials consisted of lean clay soils. The fine alluvium soils consisted of lean clay soils and lean clay with sand soils. The glacial till soils consisted of lean clay with sand soils and sandy lean clay soils.

The consistency or relative density of the soils is indicated by the standard penetration resistance ("N") values as shown on the boring logs. A description of the soil consistency or relative density based on the "N" values can be found on the attached Soil Boring Symbols and Descriptive Terminology data sheet.

Groundwater Levels

Measurements to record the groundwater levels were made at the test boring locations. The time and level of the groundwater readings are recorded on the boring logs. Groundwater was measured at a depth of 14 feet at test borings 2 and 3. Groundwater did not enter the boreholes at the remaining test borings at the time of our measurements.

The water levels indicated on the boring logs may or may not be an accurate indication of the depth or lack of subsurface groundwater. The limited length of observation restricts the accuracy of the measurements. A long period of time is generally required for subsurface water to stabilize in the boreholes. Long term groundwater monitoring was not included in our work scope.

Laboratory Testing

Select samples from the test borings were submitted to the laboratory for testing. The tests consisted of moisture content, dry density 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.

Project Information

We understand that a new justice facility may be constructed at the site. The proposed justice facility will consist of a building and pavement areas. No loading information is available and no grading plans have been developed.

Discussion

The test borings encountered 1 ½ feet to 2 ½ feet of topsoil materials overlying fine alluvium soils and glacial till soils. It is our opinion that the topsoil materials are not suitable for support of the footings or floor slab of the proposed building. Regarding the fine alluvium soils and glacial till soils, it is our opinion that these two (2) soil types have different supporting characteristics (net allowable soil bearing capacities). In our opinion, a net allowable soil bearing capacity of up to 2,000 pounds per square foot (psf) could be expected for the fine alluvium soils, while a net allowable soil bearing capacity of up to 3,500 psf could be expected for the glacial till soils.

In our opinion, the site preparation within the footing areas of the building would depend on which net allowable soil bearing pressure is used for the design of the footings. If a net allowable soil bearing pressure of up to 2,000 psf is used, then the site preparation in the footing areas of the building would likely consist of removing the topsoil materials in order to expose the fine alluvium soils or glacial till soils. If a net allowable soil bearing pressure of up to 3,500 psf is used, then the

site preparation in the footing areas of the building would likely consist of removing the topsoil materials and fine alluvium soils in order to expose the glacial till soils. If the excavation required to expose the fine alluvium soils or glacial till soils extends below the bottom-of-footing elevation, then granular structural fill would need to be placed and compacted up to the bottom-of-footing elevation. If soft/wet soils are encountered at the bottom of the excavations, then drainage rock may be needed at the bottom of the excavated areas.

With the fine alluvium soils (net allowable soil bearing pressure of up to 2,000 psf), we recommend limiting column loads to 100 kips and wall/strip loads of 4 kips per lineal foot. With the glacial till soils (net allowable soil bearing pressure of up to 3,500 psf), we recommend limiting column loads to 200 kips and wall/strip loads of 8 kips per lineal foot.

In the floor slab areas of the building, the site preparation would likely consist of removing the topsoil materials in order to expose the fine alluvium soils or glacial till soils. If the excavation required to expose the fine alluvium soils or glacial till soils extends below the bottom-of-slab elevation, then granular structural fill would need to be placed and compacted up to the bottom-of-slab elevation.

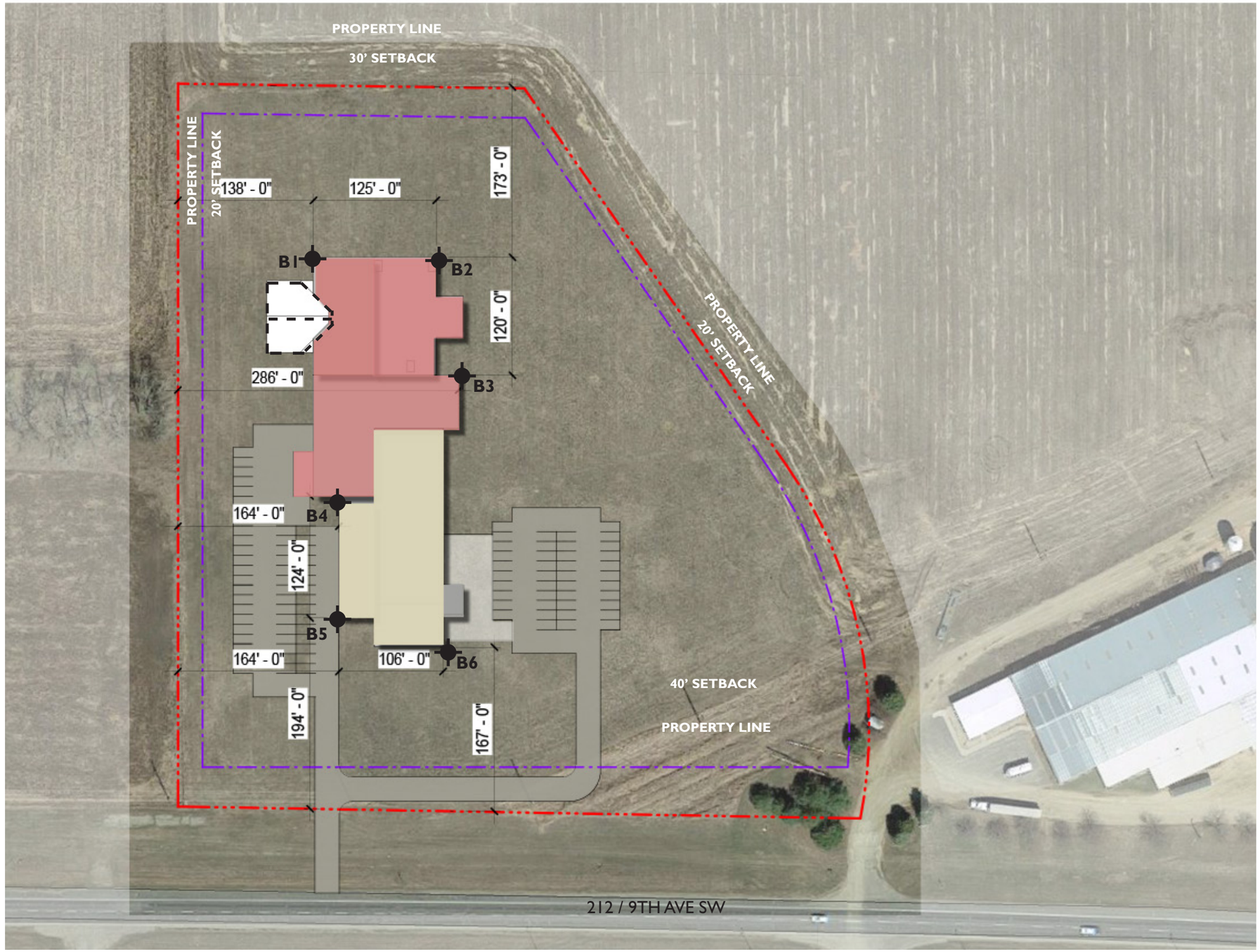
As an option, the on-site clay materials could be used as fill during initial site grading to achieve the design elevation within the building footprint. This option would depend on the grading plan, the floor slab loads and the net allowable soil bearing pressure used. Once specific plans are developed, we could provide comments and recommendations regarding the use of the on-site clay materials as fill.

Remarks

As specific plans are developed, we recommend that additional test borings and laboratory tests be performed for each lot. We trust this report provides you with the necessary information for the project. If you have any questions or require additional information, please contact our office.

GeoTek Engineering & Testing Services, Inc.

Brennen Ahlers, PE
Project Manager



SCALE: 1" = 100'-0"

Codington County Justice Facilities Study

SOIL BORING LOCATIONS

September 20, 2016 Project #: 2117.01

Codington County South Dakota

BKV GROUP

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-E56** BORING NO. **1 (1 of 1)**

PROJECT **Preliminary Geotechnical Exploration, Proposed Codington County Justice Facility, US Highway 212, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 107.1 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LAB WC	LAB D	LAB LL	LAB PL	LAB QU
	LEAN CLAY: very dark brown, frozen to 1' then moist, (CL)	TOPSOIL			1	HSA					
2½											
	LEAN CLAY: brown, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	24	100			
3½											
	LEAN CLAY: mottled brown and gray, moist, firm, (CL)	FINE ALLUVIUM									
			8		3	SPT	26	95			
6											
	LEAN CLAY WITH SAND: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL									
			9		4	SPT					
			9		5	SPT					
			9		6	SPT					
14½											
	LEAN CLAY: brown, moist, stiff, (CL)	GLACIAL TILL	10		7	SPT					
19½											
	LEAN CLAY WITH SAND: brown, moist, stiff, (CL)	GLACIAL TILL	14		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

START 12-21-16 COMPLETE 12-21-16 12:44 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-21-16	2:34 pm	21	--	19	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-E56.GPJ GEOTEKENG.GDT 12/30/16

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-E56** BORING NO. **2 (1 of 1)**

PROJECT **Preliminary Geotechnical Exploration, Proposed Codington County Justice Facility, US Highway 212, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 106.3 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	LEAN CLAY: very dark brown, frozen to 1' then moist, (CL)	TOPSOIL			1	HSA					
2	**LEAN CLAY**: brown, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	21	101			
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	10		3	SPT	14	116			5000
			12		4	SPT					
			14		5	SPT					
			13		6	SPT					
14½	**SANDY LEAN CLAY**: mottled brown and gray, moist to wet, stiff, (CL)	GLACIAL TILL	12		7	SPT					
19½	**LEAN CLAY WITH SAND**: brown, moist, stiff, (CL)	GLACIAL TILL	15		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

START 12-21-16 COMPLETE 12-21-16 11:51 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-21-16	2:38 pm	21	--	18	▼ 14
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-E56.GPJ GEOTEKENG.GDT 12/30/16

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-E56** BORING NO. **3 (1 of 1)**

PROJECT **Preliminary Geotechnical Exploration, Proposed Codington County Justice Facility, US Highway 212, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 105.9 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	LEAN CLAY: very dark brown, frozen to 1' then moist, (CL)	TOPSOIL			1	HSA					
2½	**LEAN CLAY**: brown, moist, firm, (CL)	FINE ALLUVIUM	5		2	SPT					
4½	**SANDY LEAN CLAY**: a little gravel, mottled brown and gray, moist, firm, (CL)	GLACIAL TILL	8		3	SPT					
			7		4	SPT					
			6		5	SPT					
			7	▼	6	SPT					
14½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm to stiff, (CL)	GLACIAL TILL	8		7	SPT					
			11		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-21-16	2:39 pm	21	--	18	▼ 14
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-21-16 COMPLETE 12-21-16 11:10 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-E56.GPJ GEOTEKENG.GDT 12/30/16

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-E56** BORING NO. **4 (1 of 1)**

PROJECT **Preliminary Geotechnical Exploration, Proposed Codington County Justice Facility, US Highway 212, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 104.1 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	LEAN CLAY: very dark brown, frozen to 1' then moist, (CL)	TOPSOIL			1	HSA					
1½	**LEAN CLAY WITH SAND**: brown, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	15	116			2200
4½	**SANDY LEAN CLAY**: a little gravel, mottled brown and gray, moist, firm, (CL)	MIXED ALLUVIUM	5		3	SPT					
6	**LEAN CLAY WITH SAND**: mottled brown and gray, moist, firm, (CL)	FINE ALLUVIUM	8		4	SPT	26	99			
9½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	9		5	SPT					
			11		6	SPT					
			15		7	SPT					
			16		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-21-16	2:33 pm	--	--	19	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-21-16 COMPLETE 12-21-16 1:54 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-E56.GPJ GEOTEKENG.GDT 12/30/16

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-E56** BORING NO. **5 (1 of 1)**

PROJECT **Preliminary Geotechnical Exploration, Proposed Codington County Justice Facility, US Highway 212, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 101.0 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	LEAN CLAY: very dark brown, frozen to 1' then moist, (CL)	TOPSOIL			1	HSA					
2½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	11		2	SPT	15	115			
			9		3	SPT	16	116			3600
			11		4	SPT					
			13		5	SPT					
			13		6	SPT					
			14		7	SPT					
			15		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-21-16	2:31 pm	21	--	19	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-21-16 COMPLETE 12-21-16 2:31 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-E56.GPJ GEOTEKENG.GDT 12/30/16

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **16-E56** BORING NO. **6 (1 of 1)**

PROJECT **Preliminary Geotechnical Exploration, Proposed Codington County Justice Facility, US Highway 212, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 101.1 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	LEAN CLAY: very dark brown, frozen to 1' then moist, (CL)	TOPSOIL			1	HSA					
2½	**LEAN CLAY**: brown, moist, firm, (CL)	FINE ALLUVIUM	5		2	SPT	21	102			
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm to very stiff, (CL)	GLACIAL TILL	8		3	SPT	14	118			
			9		4	SPT					
			12		5	SPT					
			12		6	SPT					
			13		7	SPT					
			17		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

START 12-21-16 COMPLETE 12-21-16 10:37 am

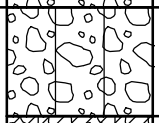
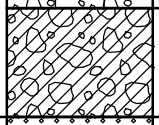
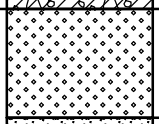
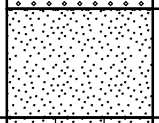
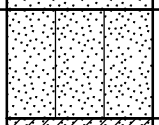
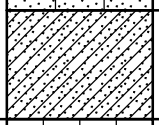
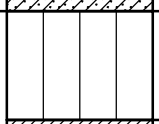
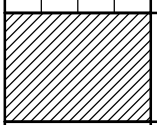
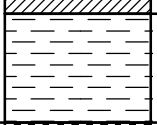
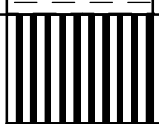
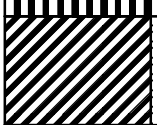
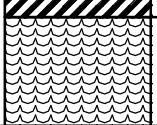
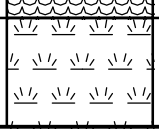
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-21-16	2:41 pm	21	--	17	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 16-E56.GPJ GEOTEKENG.GDT 12/30/16

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50			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
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				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

Symbol	Definition
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

Symbol	Definition
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

Density		Consistency
Term	N-Value	Term
Very Loose	0-4	Soft
Loose	5-8	Firm
Medium Dense	9-15	Stiff
Dense	16-30	Very Stiff
Very Dense	Over 30	Hard

PARTICLE SIZES

Term	Particle Size
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

Term	Definition
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

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