

January 26, 2017

Mr. Austin Gottlob
Baughman Company
315 Ellis Street
Wichita, KS 67211

SUBJECT: Geotechnical Exploration
Firefly Way Addition
Wichita, Kansas
GSI Job No. 1773008

Dear Mr. Gottlob:

This letter presents the results of the geotechnical exploration and testing services performed by GSI Engineering, LLC (GSI) at the above referenced site.

The proposed project will be located near East 29th Street North and Greenwich Road in Wichita, Kansas. We understand the project will consist of a new residential development with associated detention/retention ponds.

Field Exploration

We drilled two borings for this geotechnical exploration on January 18, 2017 with a CME 55 track-mounted drilling rig using 3.25-inch inside diameter hollow stem augers. We drilled one boring in the northeast corner of the site and one boring in the southwest corner of the site to a depth of approximately 20 feet below the site grade at the time of our exploration. The locations of the borings in relation to existing and proposed features are indicated on the boring location plan included with this letter.

Our drill crew obtained soil samples at the intervals shown on the boring logs included with this letter. Recovered samples were sealed in plastic containers, labeled, and protected for transportation to the laboratory for further examination, testing, and classification.

We obtained split-barrel samples (designated "Split Spoon" or "S" samples) while performing Standard Penetration Tests (SPT) with a 1-3/8 inch I.D. thick-walled sampler, driven using an automatic hammer in general accordance with ASTM D1586, "Penetration Test and Split-Barrel Sampling of Soils." The "N" value, reported in blows per foot (bpf), equals the number of blows required to drive the sampler through the last 12 inches of the 18-inch sample interval using a 140-pound hammer falling 30 inches.

Our drilling personnel prepared field boring logs during drilling operations. These field logs report drilling and sampling methods, sampling intervals, groundwater measurements and the subsurface

conditions we encountered. At the conclusion of drilling, our drill crew made groundwater measurements and backfilled the borings in accordance with Kansas state regulations.

Laboratory Classification

Our engineering staff reviewed the field boring logs to outline the depth, thickness and extent of the soil strata. The samples taken from the borings were examined in our laboratory and visually classified in general accordance with ASTM D2488, "Description and Identification of Soils (Visual-Manual Procedure)." We established a testing program to evaluate the engineering properties of the recovered samples. A GSI technician performed laboratory testing in general accordance with the following current ASTM test methods:

- Moisture Content (ASTM D2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock")
- Atterberg Limits (ASTM D4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils")

Moisture content tests were used to evaluate the existing moisture condition of the soils. The Atterberg limits tests were used to help classify the soils under the Unified Soils Classification System and to evaluate the plasticity characteristics of the soils.

The following data summarize our laboratory test results. We used these data to develop the allowable bearing values, anticipated settlements, and other geotechnical design criteria for the project.

- Natural Moisture Content..... 18.7 to 30.2%
- Liquid Limit..... 54 to 85
- Plastic Limit..... 19 to 26
- Plasticity Index..... 30 to 59
- Standard Penetration Test (SPT 'N' blows per foot)..... 8 to 28

Based on the results of the laboratory classification and testing program, we reviewed and supplemented the field logs to arrive at the final logs as presented with this letter. The final logs represent our interpretation of the field logs and reflect the additional information obtained from the laboratory classification. Stratification boundaries indicated on the boring logs were based on observations made during drilling, an extrapolation of information obtained by evaluating samples from the boring, and comparisons of similar engineering characteristics. Locations of these boundaries are approximate and the transitions between soil types may be gradual rather than clearly defined.

Subsurface Conditions

Although we observed some variability in subsurface conditions, we developed a general soil profile based on our exploration. The materials we encountered within the depths of exploration generally comprised fat clay overlying shale bedrock. General descriptions of the strata we encountered are presented below, while more detailed subsurface information is presented on the boring logs attached to this letter. Please note that the indicated depths are relative to the site grade at the time of our exploration.

Stratum 1

We encountered fat clay in both of our borings underlying a 6-inch topsoil layer and extending to a depth of 18.5 feet. This material was generally described as black, grayish brown, olive gray, or

strong brown and very moist. We measured Standard Penetration Test (SPT) N-values between 8 and 28 blows per foot (bpf), indicating the fat clay is generally in a stiff to very stiff condition.

Stratum 2

We encountered shale bedrock underlying the fat clay materials at a depth of 18.5 feet and extending to the termination depth of the borings at 20 feet. This material was generally described as olive, very soft rock in a decomposed condition. We measured SPT N-values between 23 and 28 bpf.

Groundwater Conditions

Our drill crew made water level observations during drilling and after completion of the borings to evaluate groundwater conditions. We did not encounter groundwater in any of our soil borings. However, the slow percolation rate of the on-site fat clay and shale can cause water to pond or become perched for extended time periods. In addition, the shale in this vicinity can contain thin sand lenses or desiccation cracks that can transport water laterally.

The groundwater conditions we observed during our exploration program should not be construed to represent an absolute or permanent condition. Uncertainty is involved with short-term water level observations in boreholes.

The free groundwater surface or groundwater table within unconfined aquifers is generally a subdued reflection of surface topography. Water generally flows downward from upland positions (recharge zones) to low lying areas or surface water bodies (discharge zones). As such, the groundwater level and the amount and level of any perched water on the site may be expected to fluctuate with variations in precipitation, site grading, drainage and adjacent land use.

Suitability of On-Site Material for Liner Material

The fat clay in the upper 18.5 feet of our soil borings is generally suitable for reuse as pond liner material if properly placed and compacted. If desiccated, the fat clay may excavate in a blocky manner and may require additional earthwork to reduce the blocky clay into material of an inch or less in size which can be used to construct a liner. The use of soil pulverizing equipment, a recycling unit, disc harrows or other similar equipment may be required to reduce desiccated fat clay to a size appropriate for use as soil liner material.

Please note that specific recommendations regarding liner thickness and permeability requirements are beyond the scope of this exploration.

Closure

We appreciate this opportunity to be of service in the geotechnical exploration phase of this project and are prepared to assist you as the project progresses. Please contact us if you have any questions concerning this report or any of our other consulting or testing services.

Respectfully submitted,
GSI Engineering, LLC

Matthew N. Tye, I.E.
Staff Engineer

Thomas C. Kettler, Jr., P.E.
Senior Engineer



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BORING LOCATION PLAN
BROOKFIELD ADDITION
WICHITA, KANSAS

BORING LOG No. B-1										
BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER					
B-1	See Boring Location Plan			A. Thornburg	J. Lear					
WATER LEVEL OBSERVATIONS		TYPE OF SURFACE		DRILL RIG						
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	Grass	CME 55T						
N.E.		3.25-inch Inside Diameter Hollow Stem Augers		20.0 ft.						
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	SOIL DESCRIPTION		USCS CLASS.	MC %	Dry Dens. pcf	q _u ksf	ELEV. FT.
				COLOR, CONSISTENCY, MOISTURE						
				GEOLOGIC DESCRIPTION & OTHER REMARKS						
				6" TOPSOIL						
	S-1	8		FAT CLAY: black, very moist, stiff, roots			26.5			
				LL=54; PL=24; PI=30						
	S-2	10		- as above			27.3			
5	S-3	18		grayish brown, very stiff, iron, rust stains, trace roots, trace sand, else as above			20.7			
				LL=60; PL=19; PI=41						
10	S-4	24		grayish brown to olive gray, else as above		CH	20.7			
15	S-5	28		- strong brown, else as above			18.7			
20	S-6	28		SHALE: olive, decomposed, very soft rock, iron, rust stains			24.0			
				Bottom of Boring @ 20'						

BORING LOG No. B-2										
BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER					
B-2	See Boring Location Plan			A. Thornburg	J. Lear					
WATER LEVEL OBSERVATIONS		TYPE OF SURFACE		DRILL RIG						
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	Grass	CME 55T						
N.E.		3.25-inch Inside Diameter Hollow Stem Augers		20.0 ft.						
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	SOIL DESCRIPTION		USCS CLASS.	MC %	Dry Dens. pcf	q _u ksf	ELEV. FT.
				COLOR, CONSISTENCY, MOISTURE						
				GEOLOGIC DESCRIPTION & OTHER REMARKS						
				6" TOPSOIL						
	S-1	16		FAT CLAY: grayish brown, very moist, medium stiff, trace rust stains, trace roots			30.2			
	S-2	16		- very stiff, else as above			25.5			
5	S-3	21		olive gray, trace iron, blocky, else as above			27.4			
10	S-4	23		- as above		CH	25.6			
				LL=76; PL=23; PI=53						
15	S-5	23		- as above			27.5			
20	S-6	23		SHALE: olive, decomposed, very soft rock, iron, rust stains			23.7			
				Bottom of Boring @ 20'						

KEY TO SYMBOLS

Symbol Description

Strata symbols

Topsoil

High plasticity clay

Shale

Notes:

- The exploratory borings were drilled on January 18, 2017 using 3.25-inch inside diameter hollow stem augers.
- These logs are subject to the limitations, conclusions, and recommendations in this report.
- Results of tests conducted on samples recovered are reported on the logs.