CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

November 5, 2015
C15423-5

Mr. Bill Dunlop
JSD Professional Services, Inc.
161 Horizon Drive, Suite 101
Verona, WI 53593

Re: Geotechnical Exploration
Kettle Park West Phase 2 Roadways
Stoughton, WI

Dear Mr. Dunlop:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions within the proposed construction area and to provide geotechnical recommendations regarding site preparation, utility installation and pavement design/construction. We are sending you an electronic copy of this report for your use and can provide paper copies upon request.

PROJECT DESCRIPTION / SITE CONDITIONS

Asphalt paved roads are planned for Phase 2 at Kettle Park West in Stoughton, WI. The roadway alignment is presented on the Soil Boring Location Map presented in Appendix A. Grades trend downward toward the south/southeast based on ground surface elevations at the boring elevations, varying from EL 944.1 to EL 917.1 ft (USGS Datum). The majority of the borings were drilled in a corn field, except B-6 that was drilled in an active construction area as Phase 1 was being graded.

SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling six Geoprobe soil borings to depths of 20 to 30 ft below existing site grades. The locations were selected by and marked in the field by JSD Professional Services, who also determined elevations. The borings were drilled on October 23, 2015 by Badger State Drilling (under subcontract to CGC) using a track-mounted Geoprobe drill rig. Each boring was extended to about 5 ft below invert depth of utilities to be installed in that area. The boring locations are shown in plan on the Soil Boring Location Map attached in Appendix A.

The subsurface profile at the boring locations is uniform and can generally be described by the following strata (in descending order):

2921 Perry Street, Madison WI 53713
Telephone: 608/288-4100
FAX: 608/288-7887

- About 12 in. of ***topsoil*** (estimated by drillers); over
- 1.5 to 6.5 ft of stiff to very stiff ***lean clay***; over
- ***Sand*** with varying proportions of silt and gravel with scattered cobbles and boulders to the maximum depth explored.

Groundwater was not encountered in the borings during or shortly after drilling. Although groundwater levels are expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration and other factors, they are expected to remain below the excavation depths anticipated for this project. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration program, it is our opinion that this site is generally suitable for the proposed construction. Our recommendations for site preparation, utility installation and pavement design/construction are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix B.

1. Site Preparation

As the initial step regarding site development along the roadway alignments, we recommend that surficial topsoil be stripped to at least 5 ft beyond the proposed construction areas, including areas required for cuts and fills beyond the pavement limits. The topsoil can be stockpiled on-site and re-used as fill in landscape areas. We recommend that additional shallow hand-dug holes be performed on the site to further evaluate topsoil thickness because past farming activities often result in highly variable results. Following stripping, the exposed subgrades are expected to consist primarily of natural clay soils. Exposed soils in areas to receive fill should be proof-rolled with a loaded tri-axle dump truck to check for soft/yielding areas. If loose, soft or yielding areas are detected, they should be undercut/removed. Grade should be re-established using granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D 1557) or stabilized with 3-in. dense graded base (DGB) compacted into the subgrade until no further deflection is evident.

We recommend using on-site granular soils from cut areas as fill because sand/gravel soils are relatively easy to place and compact. Clay/silt soils are not recommended as structural fill because moisture conditioning will likely be required to achieve desired compaction levels, which could delay construction progress, especially in late fall to early spring. We recommend that fill/backfill be compacted to at least 95% compaction (ASTM D1557) in accordance with our Recommended Compacted Fill Specifications presented in Appendix C. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

2. Utility Construction

Based on the available soil and groundwater information, it appears that utility installation can proceed using traditional open cut methods. Dewatering will likely not be required. It is expected that excavation sidewalls will be sloped back for relatively shallow installations (i.e., less than 8 ft in depth) and that a trench shield and/or internal bracing will be used for deeper excavations. The following are our recommendations regarding trench excavation, dewatering, and backfilling:

- Excavation: Open cuts should be sloped and/or braced in accordance with OSHA guidelines. Slopes of 1H:1V for clays and 1.5:1V for sands (or flatter) through the on-site soil deposits are generally expected to be at least temporarily stable. Temporary bracing should be designed by a registered professional engineer.

- Rock Removal: Bedrock was not encountered within the drilling depths and therefore bedrock removal is not anticipated.

- Dewatering: Based on observations made during the field exploration, groundwater infiltration into shallow excavations is generally not expected to be a problem.

- Manholes: Firm sands are anticipated at subgrade level for the manhole bases. The exposed soils should be recompacted before manhole construction and stabilized as needed if loose sands are encountered. At-rest lateral earth pressures for sand backfill are estimated at 60 psf/ft of depth.

- Backfilling - Excavation backfilling may proceed using the following guidelines:

  A. Both clayey and sandy excavation spoils may be used to backfill the utility trenches above the pipe and associated granular bedding material in landscaped areas. *However, we recommend that granular soils be used as backfill below paved areas because they are relatively easy to place and compact in most weather conditions.* The clayey soils on site will likely require some moisture conditioning prior to placement and compaction, which could delay construction progress. Granular soils with cobbles and boulders should not be used in direct contact with utility lines.

  B. Backfill material should be placed in accordance with recommendations presented in Appendix C of this report. Compaction recommendations below pavements should meet City of Stoughton requirements and include:

- Depths greater than 3 ft below grade: 90% modified Proctor (ASTM D1557)

- Final 3 ft: 95% modified Proctor

3. Pavement Design

The clay soils encountered across the site will control the pavement design, as we anticipate that the pavement subgrades will generally consist of both clay and possibly sand soils after topsoil stripping and filling. Prior to fill placement (where required), the subgrade should be proof-rolled and prepared as described in the Site Preparation section above. The following parameters should be used to develop the design pavement sections:

AASTHO classification	A-4/A-6
Frost group index	F-3
Design group index	12
Soil support value	4.2
Subgrade modulus, k (pci)	150
Resilient Modulus, M_R, psi	3,000
Estimated CBR value	2-3

These design parameters are based on the following assumptions:

1. The subgrade has been closely monitored.
2. The subgrade has been thoroughly and adequately compacted.
3. Wet zones have been dried, drained or removed.
4. Pockets of dissimilar material have been removed, replaced or mixed to achieve a homogeneous subgrade.
5. Adequate subgrade drainage has been achieved.

(Reference: WisDOT, *Geotechnical Bulletin No. 1)*

Using the above-mentioned soil parameters, we have provided a medium to heavy duty pavement section recommendation in Table 1 below. The pavement design assumes up to 3000 cars and 100 design daily equivalent 18-kip truck single axle loads (ESALs), a 20 year design life, and regular maintenance. Alternative pavement designs for different traffic count data are also acceptable providing they are based on the given design parameters. Because of the potential for shallow marginal clays at or below subgrade levels, we recommend including a contingency for undercutting and stabilization with 3-in. DGB (or other coarse aggregate). It has been our experience that clay or silt soils with pocket penetrometer readings of less than about 1.5 tsf will likely require undercutting after proof-rolling, as described above.

TABLE 1
RECOMMENDED PAVEMENT SECTION

Material	Thickness (in.)	WDOT Specification[1]
Bituminous Upper Layer (Surface Course)	1.75	Section 460, Table 460-1, 9.5 mm
Bituminous Lower Layer (Binder Course)	2.25	Section 460, Table 460-1, 12.5 mm
Dense Graded Base Course	10.0	Sections 301 and 305, 1 ¼ and 3 in.
TOTAL THICKNESS	14.0	

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications.

2. Compaction requirements:
   - Bituminous concrete: Refer to Section 460-3.
   - Base course: Refer to Section 301.3.4.2, Standard Compaction

3. Section 460, Table 460-2 of the *Standard Specifications.* Mixture Type E-1 is recommended.

4. Special measures regarding drainage below the pavements do not appear necessary at this time due to the lack of near-surface groundwater.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of some of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Contingencies in the project budget for subgrade stabilization in pavement areas should be increased if the project schedule requires that work proceed during adverse weather conditions.
- Earthwork construction during the early spring or late fall could be complicated

as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.

- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.
- Based on observations made during the field exploration, groundwater infiltration into footing excavations is not expected to be a problem. However, water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and pavement subgrade construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Utility excavation/subgrade preparation; and
- Concrete placement.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

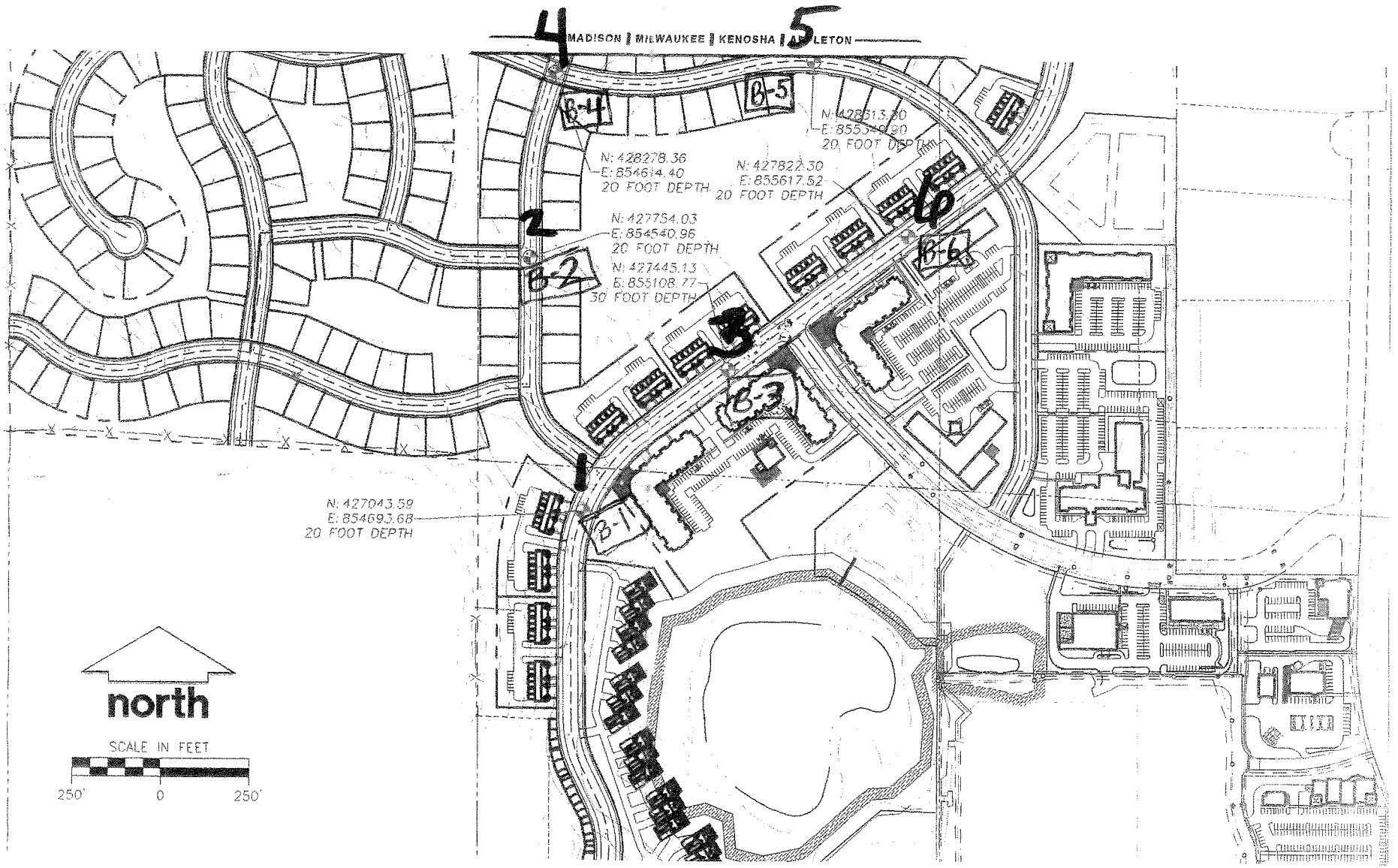
Michael N. Schultz, P.E.
Principal/Consulting Professional

David S. Staab, P.E., LEED AP
Consulting Professional

Encl: Appendix A - Soil Boring Location Map
Logs of Test Borings (6)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix B - Document Qualifications
Appendix C - Recommended Compacted Fill Specifications

APPENDIX A

SOIL BORING LOCATION MAP
LOGS OF TEST BORINGS (6)
LOG OF TEST BORING – GENERAL NOTES
UNIFIELD SOIL CLASSIFICATION SYSTEM



Legend

⌖ Denotes approximate soil boring location and number

Notes

1. Soil borings performed by Badger State Drilling on October 23, 2015.
2. Base map provided by JSD Professional Services, Inc.
3. Boring locations staked by JSD.

Date: 11/2015	CGC, Inc.	**SOIL BORING LOCATION MAP** **Kettle Park West Phase 2 Roadways** **Stoughton, Wisconsin**
Job No. C15423-5		

CGC Inc.

LOG OF TEST BORING

Project **Kettle Park West**
Phase 2 Roadways
Location **Stoughton, Wisconsin**

Boring No. **1**
Surface Elevation (ft) **917.1**
Job No. **C15423-5**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						12 in. ± TOPSOIL (OL)					
						Stiff to Very Stiff, Brown Lean CLAY (CL)	(1.5-2.25)	25.5			
					5		(1.0)	18.8			
						Becomes Less Stiff with Depth					
					10	Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
					15	Brown Fine to Coarse SAND, Some Gravel, Little Silt (SP-SM)					
					20	End Boring at 20 ft					
						Backfilled with Bentonite Chips					
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/23/15** End **10/23/15**
Driller **BSD** Chief **MG** Rig **Geoprobe**
Logger **MG** Editor **MNS**
Drill Method **Geoprobe**

CGC Inc.

LOG OF TEST BORING

Project: **Kettle Park West**
Phase 2 Roadways
Location: **Stoughton, Wisconsin**

Boring No. **2**
Surface Elevation (ft) **936.3**
Job No. **C15423-5**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						12 in. ± TOPSOIL (OL)					
						Stiff, Brown Lean CLAY (CL)	(1.5)	26.8			
						Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
					5						
					10						
					15						
					20	Brown Fine to Coarse SAND, Little Gravel and Silt (SP-SM)					
						End Boring at 20 ft					
						Backfilled with Bentonite Chips					
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/23/15** End **10/23/15**
Driller **BSD** Chief **MG** Rig **Geoprobe**
Logger **MG** Editor **MNS**
Drill Method **Geoprobe**

CGC Inc.

LOG OF TEST BORING

Project: **Kettle Park West**
Phase 2 Roadways
Location: **Stoughton, Wisconsin**

Boring No. **3**
Surface Elevation (ft) **923.1**
Job No. **C15423-5**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						12 in. ± TOPSOIL (OL)					
						Very Stiff, Brown Lean CLAY (CL)	(3.5)	23.3			
					5	Brown Fine to Medium SAND, Some Gravel and Silt, Scattered Cobbles and Boulders (SM)					
					10						
					15						
					20						
					25						
					30	Brown Fine to Coarse SAND, Little to Some Gravel and Silt (SP-SM/SM)					
						End Boring at 30 ft					
						Backfilled with Bentonite Chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/23/15** End **10/23/15**
Driller **BSD** Chief **MG** Rig **Geoprobe**
Logger **MG** Editor **MNS**
Drill Method **Geoprobe**

CGC Inc.

LOG OF TEST BORING

Project **Kettle Park West**
Phase 2 Roadways
Location **Stoughton, Wisconsin**

Boring No. **4**
Surface Elevation (ft) **944.1**
Job No. **C15423-5**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					0	12 in. ± TOPSOIL (OL)					
						Very Stiff, Brown Lean CLAY (CL)	(2.5)	21.5			
					5	Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
					10						
					15						
					20	End Boring at 20 ft					
						Backfilled with Bentonite Chips					
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/23/15** End **10/23/15**
Driller **BSD** Chief **MG** Rig **Geoprobe**
Logger **MG** Editor **MNS**
Drill Method **Geoprobe**

CGC Inc.

LOG OF TEST BORING

Project **Kettle Park West**
Phase 2 Roadways
Location **Stoughton, Wisconsin**

Boring No. **5**
Surface Elevation (ft) **933.6**
Job No. **C15423-5**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					0	12 in. ± TOPSOIL (OL)					
						Stiff, Brown Lean CLAY (CL)	(1.5)	17.9			
					5	Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
					10						
					15						
					20	End Boring at 20 ft					
						Backfilled with Bentonite Chips					
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/23/15** End **10/23/15**
Driller **BSD** Chief **MG** Rig **Geoprobe**
Logger **MG** Editor **MNS**
Drill Method **Geoprobe**

CGC Inc.

LOG OF TEST BORING

Project **Kettle Park West**
Phase 2 Roadways
Location **Stoughton, Wisconsin**

Boring No. **6**
Surface Elevation (ft) **918.5**
Job No. **C15423-5**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						12 in. ± TOPSOIL (OL)					
						Stiff to Very Stiff, Brown Lean CLAY (CL)	(2.5)	24.0			
					5		(1.5)	25.9			
						Soft Near 6.5 ft	(0.5)	25.2			
						Brown Fine to Coarse SAND, Some Gravel, Little to Some Silt (SP-SM/SM)					
					10	Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
					15						
					20	End Boring at 20 ft					
						Backfilled with Bentonite Chips					
					25						
					30						
					35						

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling _____
Time After Drilling _____
Depth to Water _____ ▼
Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/23/15** End **10/23/15**
Driller **BSD** Chief **MG** Rig **Geoprobe**
Logger **MG** Editor **MNS**
Drill Method **Geoprobe**

CGC, Inc.

LOG OF TEST BORING
General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	"N" Value
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Consistency

Term	q_u-tons/sq. ft
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4 – 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

Plasticity

Term	Plastic Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

CS – Continuous Sampling
RC – Rock Coring: Size AW, BW, NW, 2"W
RQD – Rock Quality Designation
RB – Rock Bit/Roller Bit
FT – Fish Tail
DC – Drove Casing
C – Casing: Size 2 ½", NW, 4", HW
CW – Clear Water
DM – Drilling Mud
HSA – Hollow Stem Auger
FA – Flight Auger
HA – Hand Auger
COA – Clean-Out Auger
SS - 2" Dia. Split-Barrel Sample
2ST – 2" Dia. Thin-Walled Tube Sample
3ST – 3" Dia. Thin-Walled Tube Sample
PT – 3" Dia. Piston Tube Sample
AS – Auger Sample
WS – Wash Sample
PTS – Peat Sample
PS – Pitcher Sample
NR – No Recovery
S – Sounding
PMT – Borehole Pressuremeter Test
VS – Vane Shear Test
WPT – Water Pressure Test

Laboratory Tests

q_a – Penetrometer Reading, tons/sq ft
q_a – Unconfined Strength, tons/sq ft
W – Moisture Content, %
LL – Liquid Limit, %
PL – Plastic Limit, %
SL – Shrinkage Limit, %
LI – Loss on Ignition
D – Dry Unit Weight, lbs/cu ft
pH – Measure of Soil Alkalinity or Acidity
FS – Free Swell, %

Water Level Measurement

▽ - Water Level at Time Shown
NW – No Water Encountered
WD – While Drilling
BCR – Before Casing Removal
ACR – After Casing Removal
CW – Cave and Wet
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% 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 (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more 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 of 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 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

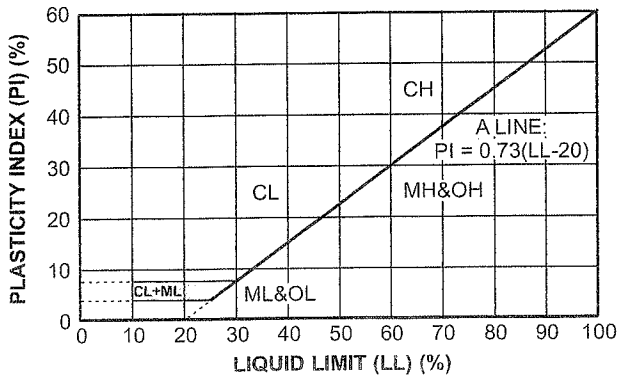
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



APPENDIX B

DOCUMENT QUALIFICATIONS

APPENDIX B
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

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.

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 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. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we 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 OPINION

Site exploration identifies subsurface conditions only at those points where surface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement 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 over-rely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion, geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's recommendations if we do 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 CGC 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 such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's 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 GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in ASFE 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 CGC, a member of ASFE, for more information.

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APPENDIX C

RECOMMENDED COMPACTED FILL SPECIFICATIONS

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CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

Table 1
Gradation of Special Fill Materials

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55			
No. 40			5-20	8-28	10-35	75 (2)		
No. 100						15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction.*
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

Table 2
Compaction Guidelines

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)