CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

Exhibit C

April 15, 2016
C16111

Mr. Randy Wiesner
City of Madison
Facilities Management & Sustainability
City Engineering Division
210 Martin Luther King Jr. Boulevard, Room 115
Madison, WI 53703

Re: Geotechnical Exploration Report
Proposed Modular Building
3514/3518 Cross Hill Drive
Madison, Wisconsin

Dear Mr. Wiesner:

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

PROJECT & SITE DESCRIPTIONS

We understand that a 304-sq ft, slab-on-grade modular building is planned in the central portion of the site. The building weighs approximately 77,000 lbs, and will be supported on a cast-in-place concrete mat slab foundation. The finish floor elevation is expected to be near to slightly above existing grade.

The building is proposed in an area that is grass lawn between two driveways to the north and south. A water tower, two buildings and a cellular tower exist to the southwest. Site grades generally slope down to the north.

SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling two Standard Penetration Test (SPT) borings to planned depths of 15 ft below existing site grades. Note that the borings ended at 5 to 7.5 ft below existing site grade due to auger refusal on probable weathered dolomite bedrock. The borings were drilled by Badger State Drilling (under subcontract to CGC) on April 7, 2016 using a truck-mounted CME-55 rotary drill rig equipped with hollow stem augers and an automatic SPT hammer. The boring locations were selected and located in the field by the City of Madison, who also surveyed the ground surface elevations. The boring locations are shown in plan on the Soil Boring Location Exhibit attached in Appendix B.

2921 Perry Street, Madison WI 53713
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The subsurface profiles at the boring locations were fairly similar and a generalized profile includes the following strata, in descending order:

- 6 to 8 in. of ***topsoil/topsoil fill***, over
- About 1.5 ft of ***sandy clay fill*** intermixed with gravel in Boring 1, followed by
- Medium dense to very dense ***probable weathered dolomite bedrock*** that extended to auger refusal at 5 to 7.5 ft below existing site grades.

Groundwater was not encountered in the borings to the maximum depth explored. Groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, nearby lake and river levels and other factors. 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, it is our opinion that the site is generally suitable for the proposed construction and that the building can be supported on a mat slab foundation. Our recommendations for site preparation and foundation design/construction are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Site Preparation

We recommend that the topsoil/vegetation be stripped/removed at least 5 ft beyond the proposed construction areas, including areas required for cuts and fills beyond the proposed building footprint. Although topsoil thicknesses were 6 to 8 in. in the borings, topsoil thicknesses could vary due to previous grading activities or natural causes. The topsoil can be stockpiled on-site and re-used as fill in landscaped areas or hauled off site. Trees and tree roots should be removed in conjunction with topsoil stripping.

Where fill placement is required, the soils below the topsoil should be recompacted and then evaluated by proof-rolling with a loaded tri-axle dump truck to check for loose/soft areas. If loose/soft areas are encountered, these areas should be undercut/replaced with granular backfill compacted to a minimum of 95% compaction based on modified Proctor methods (ASTM D 1557). Alternatively, loose/soft soils could potentially be stabilized with coarse aggregate (3-in. dense graded base, select crushed material, etc.) that is compacted into the subgrade until deflection ceases.

After the existing soils have been checked and are adequately undercut/stabilized, if required, fill placement to establish grades can begin. We recommend using granular soils as structural fill within the building footprint, as granular soils are generally easier to place and compact in a wider range of weather conditions compare to silt/clay soils. Weathered bedrock that will be used as fill should be crushed to a maximum particle size of 3 to 5 in. and contain at least 50% sand-sized particles and smaller (i.e., passing the No. 4 sieve). The fill/backfill should be compacted to a minimum of 95% compaction based on modified Proctor methods (ASTM D 1557). Note that as an alternative to granular soils, 3-in. dense graded base that is placed in 12 in. lifts and compacted with a heavy vibratory compactor can be used as fill/backfill. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

Apparent weathered dolomite bedrock was encountered as shallow as 0.5 to 2 ft below existing grade, and Auger refusal occurred at 5 to 7.5 ft below existing grades. The depth and consistency of the bedrock should be expected to vary across the site. If site grades will be lowered, we recommend that supplemental test pits be excavated to check for the depth to bedrock and ease (or difficulty) of excavation. Supplemental test pits are also recommended if deeper utilities are planned to check if bedrock will be encountered within the anticipated utility alignment depths and to determine the effort required to remove the bedrock. As a general "rule of thumb", it has been our experience that excavation to the level where auger refusal occurred in a soil boring can generally be completed with large conventional earthwork equipment (including a large excavator with a narrow bucket with rock teeth or single-point ripping tooth), and that excavation below the level where auger refusal occurred in the soil boring generally requires rock excavation techniques, such as a hydraulic hammer, blasting, etc. This general rule of thumb may not apply to narrow utility or footing excavations where bedrock fractures may be difficult to locate and exploit. Rock excavation considerations are included in Appendix E. We recommend that the bidding documents include a unit rate for bedrock removal in the event that harder bedrock is encountered. Weathered bedrock that will be used as fill should be crushed to maximum particle size of 3 to 5 in. and contain at least 50% sand-sized particles and smaller (i.e., passing the No. 4 sieve).

2. Foundation Design

Assuming the building will be founded fairly close to existing grades, the soils at foundation grade are generally expected to consist of apparent weathered dolomite bedrock, with cohesive fill possible based on Boring 1. If the mat slab foundation will bear on the cohesive fill soils, these soils should be checked, as described in the Site Preparation section of this report, with unsuitable soils being undercut and removed. To create a fairly uniform bearing layer for the slab foundation, we recommend including a minimum of 12 in. of compacted 1-in. or ¾-in. clear stone below the slab.

In our opinion, the building can be supported on a reinforced concrete mat slab foundations bearing on 12 in. of clear stone over weathered dolomite bedrock or suitable fill soils. The allowable bearing pressure is controlled by the cohesive soils, although if higher bearing pressure is required, the cohesive fill soils could be undercut/removed and replaced with engineered granular backfill. According, the following parameters should be used for foundation design:

- Maximum net allowable bearing pressure: 3,000 psf[1]

- Minimum foundation widths:
  -- Continuous wall footings: 18 in.
  -- Column pad footings: 30 in.

[1]A higher bearing pressure is likely applicable for foundations that bear on weathered dolomite bedrock. We can provide additional details, if needed.

Undercutting below footing grade will be required where unsuitable fill, native loose sand/silt or native cohesive soils with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soil) of less than 1.5 tsf are encountered at or slightly below footing grade. Where undercutting is required, the base of the undercut excavation should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Undercut grade can be restored with granular backfill compacted to at least 95% compaction (modified Proctor - ASTM D1557). Alternatively, undercuts can be restored with ¾-in. or 1-in. crushed clear stone or 3-in. dense graded base that is placed in maximum loose lifts of 12 in. and thoroughly compacted with a large vibratory compactor until deflection ceases.

CGC should be present during footing excavation to check whether subgrades are satisfactory for the design bearing pressure and to advise on corrective measures, where necessary. We recommend using a smooth-edged backhoe bucket for footing excavations in soil. Additionally, granular soils exposed at footing grade should be recompacted with a large vibratory plate compactor prior to formwork/concrete placement to densify soils loosened during the excavation process. Soils potentially susceptible to disturbance from compaction (e.g., silty or clayey soils) should be hand trimmed. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should be on the order of 1.0 and 0.5 in., respectively.

We understand that the proposed mat slab foundation will not extend to the conventional frost depth of 4 ft. As a result there is some minor risk of frost heave. If movement due to frost heave is not acceptable, we recommend undercutting the cohesive fill soils and shallower highly weathered bedrock that contains silt and clay seams to a depth of 4 ft below finish grade. Footing grade should then be re-stablished with non-frost-susceptible material such as ¾-in. or 1-in. crushed clear stone. The stone should be placed in maximum loose lifts of 12 in. and compacted with a large vibratory compactor until deflection ceases.

3. Seismic Design Category

In our opinion, the average soil/rock properties in the upper 100 ft of the site (based on the presence of apparent weathered dolomite bedrock with SPT blow counts (N-values) of more than 50 blows/ft, on average) may be characterized as a very dense soil/soft rock soil profile. This characterization would place the site in Site Class C for seismic design according to the International Building Code (see Table 1613.5.2).

CONSTRUCTION CONSIDERATIONS

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

- Due to the potentially sensitive nature 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.

- 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, we generally do not expect that groundwater will be encountered in the building excavation. 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 shallow sump pits.

- Due to the widespread presence of apparent weathered dolomite bedrock, bedrock excavation may be required during utility installations. Bedrock excavation was discussed in the Site Preparation section of this report and in Appendix E. Supplemental test pits are recommended along proposed utility alignments if deeper utilities are planned.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation 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;
- Foundation 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.

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

William W. Wuellner, P.E.
Senior Geotechnical Engineer

Encl:	Appendix A -	Field Exploration
	Appendix B -	Soil Boring Location Exhibit
		Logs of Test Borings (2)
		Log of Test Boring-General Notes
		Unified Soil Classification System
	Appendix C -	Document Qualifications
	Appendix D -	Recommended Compacted Fill Specifications
	Appendix E -	Rock Excavation Considerations

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Two Standard Penetration Test (SPT) borings were drilled to planned depths of 15 ft below existing site grades. Note that the borings ended at 5 to 7.5 ft below existing site grade due to auger refusal on probable weathered dolomite bedrock. The borings were drilled by Badger State Drilling (under subcontract to CGC) on April 7, 2016 using a truck-mounted CME-55 rotary drill rig equipped with hollow stem augers and an automatic SPT hammer. The boring locations were selected and located in the field by the City of Madison, who also surveyed the ground surface elevations. The boring locations are shown in plan on the Soil Boring Location Exhibit attached in Appendix B.

In each boring, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. <u>Boring Procedures between Samples</u>

   The boring is extended downward, between samples, by a hollow-stem auger.

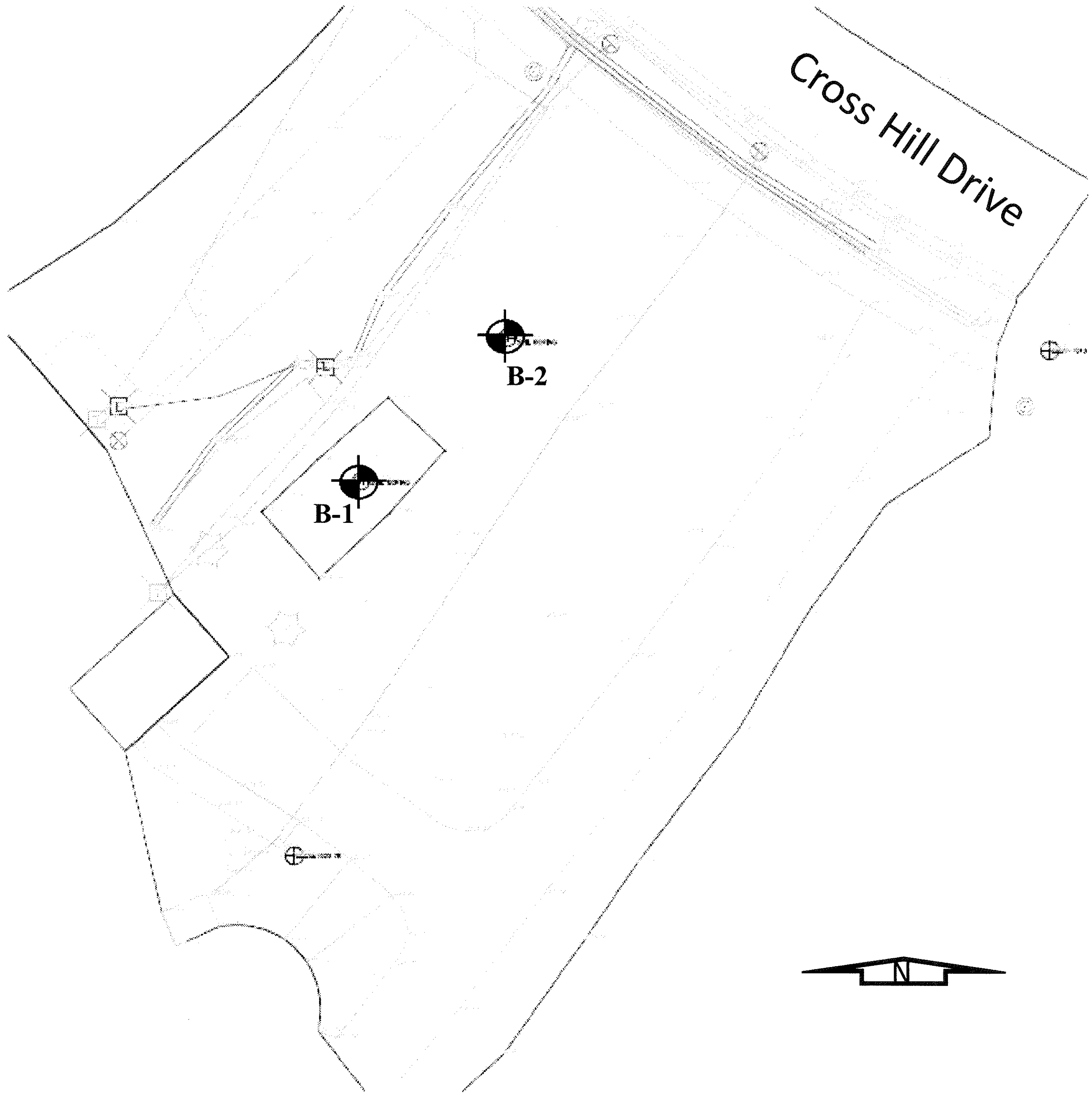
2. <u>Standard Penetration Test and Split-Barrel Sampling of Soils</u>
   (ASTM Designation: D 1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as environmental site assessment activities were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite (where required) to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soil samples were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION EXHIBIT
LOGS OF TEST BORINGS (14)
LOG OF TEST BORING – GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Scale: Unknown

Legend

Denotes Boring Location and Number

Notes

1. Borings drilled by Badger State Drilling on April 7, 2016.
2. Base map provided by City of Madison.
3. Boring locations are approximate.

Job No. C16111	CGC, Inc.	**SOIL BORING LOCATION EXHIBIT** **Proposed Building** **3514/3518 Cross Hill Drive** **Madison, WI**
Date: 04/2016		

CGC Inc.

LOG OF TEST BORING

Project: Proposed Building
3514/3518 Cross Hill Drive
Location: Madison, WI

Boring No.: 1
Surface Elevation (ft): 1013.5
Job No.: C16111
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
						8 in. TOPSOIL FILL (OL)					
1		12	M	24		FILL: Brown/Dark Brown Sandy Lean Clay Intermixed with Gravel					
						Medium Dense to Very Dense, Tan to Light Yellow Gray Gravelly Fine to Coarse SAND, Some Silt (SM - Probable Weathered Dolomite Bedrock)					
2		2	M	50/4"							
					5						
3		2	M	50/2"							
						End Boring/Auger Refusal at 7.5 ft Backfilled with Cuttings					
					10						

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW   Upon Completion of Drilling NW
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 4/7/16 End 4/7/16
Driller BSD Chief MC Rig CME-55
Logger KD Editor DAS
Drill Method 2.25" HSA; Autohammer

CGC Inc.

LOG OF TEST BORING

Project: Proposed Building, 3514/3518 Cross Hill Drive
Location: Madison, WI

Boring No. 2
Surface Elevation (ft) 1011.3
Job No. C16111
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
						6 in. TOPSOIL FILL (OL)					
						Very Dense, Tan to Light Yellow Gray, Fine to Coarse SAND, Some Silt (SM - Probable Weathered Dolomite Bedrock)					
1		4	M	50/5"							
2		2	M	50/2"							
					5	End Boring/Auger Refusal at 5 ft Backfilled with Cuttings					
					10						

WATER LEVEL OBSERVATIONS

While Drilling NW   Upon Completion of Drilling NW
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 4/7/16 End 4/7/16
Driller BSD Chief MC Rig CME-55
Logger KD Editor DAS
Drill Method 2.25" HSA; Autohammer

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)		
	Clean Gravels (Less than 5% fines)	
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	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
	Clean Sands (Less than 5% fines)	
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	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 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 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

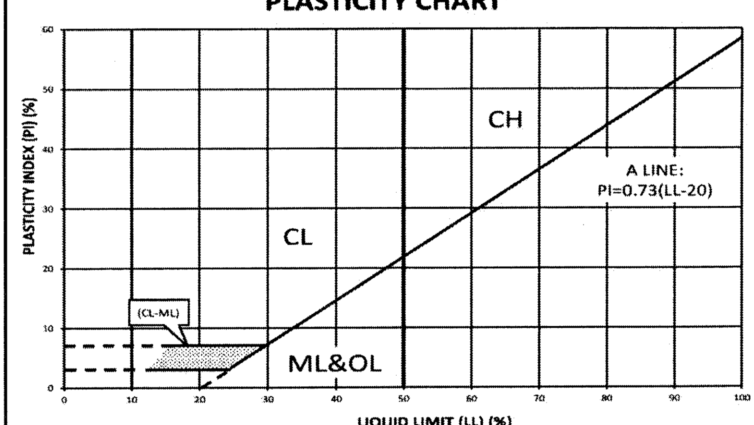
LABORATORY CLASSIFICATION CRITERIA

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 limts 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 limts above "A" line or 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 C

DOCUMENT QUALIFICATIONS

APPENDIX C
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 D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

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	Percent Compaction (1) 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)

APPENDIX E

ROCK EXCAVATION CONSIDERATIONS

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ROCK EXCAVATION CONSIDERATIONS

In order to minimize probable "rock" excavation expenses during construction, we suggest that project specifications incorporate the following:

A. It is assumed that all excavations to levels and dimensions required by the Contract Documents are earth excavation. Earth excavation includes removal and disposal of all materials encountered except rock/sound bedrock which is defined as natural materials which:

1. Cannot be excavated with a minimum 3/4 cubic yard capacity backhoe without drilling and blasting;

2. Cannot be economically removed with a one-tooth ripper on a D8 cat (or equivalent);

3. Requires the use of special equipment such as a pneumatic hammer;

4. Requires the use of explosives (after obtaining written permission of the owner).

B. Examples of material classified as rock are boulders 1/2 cubic yard or more in volume, bedrock, rock in ledges, and rock-hard cementitious aggregate deposits.

C. Do not proceed with rock excavation work until architect, engineer and/or testing firm (i.e., CGC) has taken the necessary measures to determine quantity of rock excavation required to complete the work. Measurements will be taken after properly stripped of earth by the contractor. Contractor will be paid the difference between the cost of rock and earth excavation based on an agreed upon unit price established prior to starting rock excavation.

A statement should also be included in the specifications to the effect that: "Stated models of earth excavation equipment are merely for purposes of defining the various excavation categories and are not intended to indicate the brand or type of equipment that is to be used."