CGC, Inc.
Construction • Geotechnical
Consulting Engineering/Testing

January 13, 2021
C20051-24

Mr. Matt Gall, LEED AP
City of Madison Department of Public Works
Engineering Division – Facilities and Sustainability
City-County Building, Room 115
210 Martin Luther King, Jr. Blvd.
Madison, Wisconsin 53703

Re: Geotechnical Exploration Report
Proposed Pavement Extension
City of Madison DPW – 121 E. Olin Ave.
Madison, Wisconsin

Dear Mr. Gall:

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 and pavement design/construction. We are sending you an electronic copy of this report, and we can provide a paper copy upon request.

PROJECT AND SITE DESCRIPTION

We understand that a southwestern pavement extension is planned at the existing City of Madison Department of Public Works facility at 121 East Olin Avenue. The area, situated on top of the former Olin Landfill, is currently being used for outside storage/stockpiling by the DPW. According to publicly-available topographic data (DCiMap; 1-ft contour lines), existing site grades generally slope from the southern perimeter of the site down towards the north/northeast, with ground surface elevations ranging between about EL 858 and 864 ft. Information as to anticipated traffic loads was not provided to us.

SUBSURFACE CONDITIONS

Subsurface conditions for this study were explored by drilling five Standard Penetration Test (SPT) soil borings to planned depths of 10 ft below current site grades at locations selected by the City in consultation with the DNR and field-staked by Burse personnel. The borings were drilled by Badger State Drilling (under subcontract to CGC) on December 24, 2020 using a track-mounted CME-45 rotary drill rig equipped with hollow stem augers and an automatic SPT hammer. The specific procedures used for drilling and sampling are described in Appendix A, and the boring locations are shown in plan on the Soil Boring Location Exhibit presented in Appendix B. Upon request of the DNR, we also prepared a photo documentation of the field exploration (drilling setup, existing condition of the project area, drilling and sampling procedures), which is included in Appendix A.

2921 Perry Street, Madison WI 53713
Telephone: 608/288-4100
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Ground surface elevations at the boring locations were estimated by CGC based on DCiMap 1-ft contour lines, and the elevations should therefore be considered approximate.

The subsurface profiles at the boring locations were fairly consistent, and involved various cohesive, fine-grained and granular ***fill*** soils, or a mixture therefore, which were also found to be intermixed with deleterious material in some of the samples (e.g., fabric, plastic, rubber, glass, wood, etc.). Note that topsoil thicknesses, if present, were difficult to determine due to rutting of the existing subgrades. The lean to silty clay fill soils were generally of very stiff to hard consistency, and the relative density of the fine-grained and granular fill soils ranged from about loose to dense. Natural moisture contents in representative clay samples were determined to range from 15.6% to 23.4%. Based on natural moisture contents, pocket penetrometer readings (q_p-values; an estimate of the unconfined compressive strength of cohesive soils) and SPT blow counts (N-values), the cohesive fill should generally be considered slightly compressible.

Groundwater was not encountered in the borings during or upon the completion of drilling. Groundwater levels are expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the level in nearby waterbodies and other factors.

A more detailed description of the site soil and groundwater conditions is presented on the individual soil boring logs attached in Appendix B, which also contain the laboratory test results.

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 planned pavement extension. However, based on the presence of existing mixed fill soils, some undercutting or stabilization may be required in order to develop stable conditions for pavements support. Our recommendations for site preparation 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 C.

1. Site Preparation

We recommend that topsoil and vegetation, if present, be stripped at least 10 ft beyond the proposed construction area, including areas requiring fill beyond the pavement limits. The topsoil can be stockpiled on-site and later re-used as fill in landscaped areas. After topsoil stripping, subgrades are generally anticipated to consist of very stiff to hard clay fill, but sandy/silty fill may also be encountered below the topsoil in isolated areas (e.g., near B-3). In areas remaining at-grade or requiring additional fill to establish pavement subgrade elevations, we recommend cohesive and fine-grained (clayey and silty) subgrades be statically recompacted (i.e., without vibration) and subsequently proof-rolled with a piece of heavy rubber-tire construction equipment, such as a loaded tri-axle dump truck, to check for soft/yielding areas. If soft/yielding areas are observed, these soils should be undercut and replaced with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) in accordance with our Recommended Compacted Fill

Specifications presented in Appendix D, or City of Madison requirements. Alternatively, 3-in. dense graded base (DGB) that is placed in loose 10-in. lifts and compacted until deflection ceases can also be used to restore grades in undercut areas. Granular (sandy and gravelly) subgrades should be thoroughly recompacted with a vibratory smooth-drum roller, and zones that remain loose after recompaction should be undercut and replaced or stabilized as described above.

Following the development of a firm and stable subgrade, fill placement to establish site and pavement grades can proceed, where required. To the extent possible, we recommend using granular soils (i.e., sands/gravels) as structural fill within the upper 2 to 3 ft in pavement areas because these soils are relatively easy to place and compact in most weather conditions compared to clay/silt soils. Clay and silt soils excavated on-site are generally not recommended as fill within the upper several feel in the pavement subgrade profile because moisture conditioning by discing and drying (aeration) will likely be required to achieve desired compaction levels, which is highly weather-dependent (i.e., dry, warm and windy conditions) and could delay construction progress. In our opinion, clay/silt soils are best used as fill in landscaping or potentially as lower lifts in pavement areas provided the moisture contents can be sufficiently lowered from the natural states to facilitate compaction efforts. We recommend that fill withing pavement areas be compacted to at least 95% based on modified Proctor methods (ASTM D1557) following Appendix D guidelines. Periodic field density tests should be taken by CGC staff within the fill to document the adequacy of compactive effort.

Note that, due to the site being a former landfill, we recommend that an environmental consultant be retained to advise on the potential need for special handling of soils that are excavated and removed from the site, as well as other environmental issues.

2. Pavement Design

We anticipate that new pavement design will be controlled by the surficial clay fill that was encountered at most boring locations. Subgrades should be prepared as described in the Site Preparation section of this report, with recompaction/proof-rolling completed prior to base course and asphalt placement. *Some undercutting may be required where pavement subgrades have deteriorated due to repetitive construction traffic and/or wet weather, which should be expected for clay subgrades. Therefore, we recommend that the project budget include a generous contingency for pavement subgrade improvement, which could potentially include about 12 in. of additional coarse aggregate (e.g., 3-in. DGB) over biaxial geogrid (e.g., Tensar BX Type 1 or equivalent).* The areas requiring undercutting/stabilization and the depth of undercutting should be determined in the field by proof-rolling prior to installing the base course layer. The need for undercutting below the pavement section will likely be reduced where site grades are raised at least 2 ft above existing grade with high-quality granular fill.

Some asphalt pavement on this site, such as smaller parking areas or low traffic volume-driveways, if any, may be exposed to primarily automobile traffic with less than one 18-kip equivalent single axle load (ESAL) per day. In view of this, we have assumed Traffic Class I following Wisconsin Asphalt Pavement Association (WAPA) recommendations for smaller parking areas and driveways that are mainly used by light passenger vehicles. However, main sections of driveways are likely to experience heavier traffic loads from truck traffic. For pavement areas where trucks will routinely travel, we have assumed a traffic load of up to 5 ESALs per day and Traffic Class II according to WAPA. We have also included a heavy-duty pavement section where higher truck traffic loads (up to 50 ESALs per day, Traffic Class III) may be experienced. The pavement sections summarized in Table 1 below were selected assuming a Soil Support Value "SSV" of about 4.0 for a firm or adequately stabilized clay subgrade and a design life of 20 years.

TABLE 1 – Recommended Pavement Sections

Material	**Thicknesses (in.)**			**WDOT Specification** [(1)]
	Traffic Class I (Light Duty)	**Traffic Class II (Medium Duty)**	**Traffic Class III (Heavy Duty)**	
Bituminous Upper Layer [(2,3)]	1.75	1.75	2.0	Section 460, Table 460-1
Bituminous Lower Layer [(2,3)]	1.75	2.25	3.0	Section 460, Table 460-1
Dense Graded Base Course [(2,4)]	8.0	10.0	12.0	Sections 301 and 305
Total Thickness	**11.5**	**14.0**	**17.0**	

Notes:

1) Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications, and Wisconsin Asphalt Pavement Association *2020 Asphalt Pavement Design Guide*.

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

3) Mixture Type LT bituminous; refer to Section 460, Table 460-2 of the *Standard Specifications*. Mixture type MT is recommended in heavy duty traffic areas. Note that an "H Grade" asphalt surface layer is recommended where there will be slow moving heavy truck traffic making turning movements.

4) The upper 4 in. should consist of 1¼-in. DGB; the bottom part of the layer can consist of 3-in. DGB.

The recommended pavement sections assume that regular maintenance (crack sealing, etc.) will occur, as needed. Note that if traffic volumes are greater than those assumed, CGC should be allowed to review the recommended pavement sections and adjust them accordingly. Alternative pavement designs based on past City of Madison projects may prove acceptable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

Where concrete pavement may be used, such as in pavement areas subjected to concentrated wheel loads (e.g., dumpster pads, etc.), we recommend that the concrete pavement be at least 6-in. thick, be underlain by at least 6 in. of DGB and contain adequate reinforcement for crack control. Concrete slabs underlain by a minimum 6-in. thick dense graded base layer over a firm or stabilized subgrade can be designed utilizing a subgrade modulus of 150 pci. Note that a thicker pavement section (more than 6 in. of concrete) may be required depending on pavement loads, which should be evaluated by a structural engineer.

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 with coarse aggregate in pavement areas should be increased if the project schedule requires that work proceed during adverse weather conditions.

- Earthwork construction during the late fall through early spring 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 the observations made during our field exploration, we do not anticipate groundwater to be encountered during pavement subgrade preparation. However, water accumulating at the bottom of excavations as a result of precipitation or seepage should be quickly removed, with dewatering means and methods being the contractor's responsibility.

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 foundation construction proceed in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping and subgrade proof-rolling/compaction;
- Fill/backfill placement and compaction; 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.

Tim F. Gassenheimer, EIT, CST
Staff Engineer

Ryan J. Portman, PE, CST
Consulting Professional/Field Supervisor

Encl: Appendix A - Field Exploration
Photo Documentation
Appendix B - Soil Boring Location Exhibit
Logs of Test Borings (5)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications

APPENDIX A

FIELD EXPLORATION
PHOTO DOCUMENTATION

APPENDIX A

FIELD EXPLORATION

Subsurface conditions for this study were explored by drilling five Standard Penetration Test (SPT) soil borings to planned depths of 10 ft below current site grades. The borings were sampled at 2.5-ft intervals, and the samples were obtained in general accordance with specifications for standard penetration testing, ASTM D1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

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

2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (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 driller as these services 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 to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System (USCS). The final boring logs prepared by the engineer, including laboratory test results, along with a Soil Boring Location Exhibit and a description of the Unified Soil Classification System are presented in Appendix B.

Upper left: Existing site conditions.

Upper right: Existing site conditions.

Lower left: Existing site conditions.

Lower right: Drill rig approaching B-3; apparent monitoring well in foreground.

Left: Wood lath marking the location of B-3.

Right: Wood lath marking the location of B-4.

Upper left: Drill rig set up at B-3 with support truck next to it.

Upper right: Flatbed of support truck set up for preparing field logs.

Lower left: Drill rig in operation.

Lower right: 2-¼ in. hollow-stem augers with center rod.

Left: Two-man drilling crew setting up at B-3.

Right: Two-man drilling crew while drilling with hollow-stem augers between sampling intervals.

Left: Hollow-stem auger drilling with auger cuttings accumulating around the borehole.

Upper right: Spoils containing deleterious material (plastic shreds).

Lower right: Deleterious material (plastic pieces and shreds of fabric) from the borehole.

Upper left: Deleterious material (fabric shreds) intermixed with soil.

Lower left: Spoils pile.

Right: Shoe insole produced from borehole.

Left: Hollow-stem auger drilling with auger section attached to Kelly bar.

Right: Hollow-stem auger section sticking out of borehole, uncoupled from the drill rig's Kelly bar; center rod with attached center bit being pulled out of the augers to prepare for sampling.

Left: Split-spoon sampler being attached to center rod, which will be lowered into the borehole through the hollow-stem auger sections to sample the borehole bottom.

Right: SPT sampling with split-spoon sampler (not visible – at bottom of borehole) attached to center rod; note pink chalk marks on center rod at 6-in. centers: SPT sampling involves driving the sampler 18 in. below the (current) bottom of the borehole, and blows from the automatic SPT hammer required to advance the sampler 6 in. are being recorded on field logs. First, the sampler is seated 6 in. into the ground, and the total blows required to advance the sampler over the final 12 in. is designated the Standard Penetration Resistance (N-value) of the sample.

Left: Drill rig tower with winch on top to pull and lower center rod with center bit or split-spoon sampler, Kelly bar in center, automatic SPT hammer (yellow tube) on the right.

Right: Detached center bit during SPT sampling.

Upper left: Split-spoon barrel after sampling with extracted soil sample in it; tip of sampler at bottom of picture.

Lower left: Box containing glass jars for soil samples and bags of bentonite chips.

Right: Hollow-stem auger lead section pulled off hole after completing B-3; deleterious material wrapped around augers.

Left: B-3 upon completion of drilling after augers have been pulled; note warm air rising from the borehole and condensing.

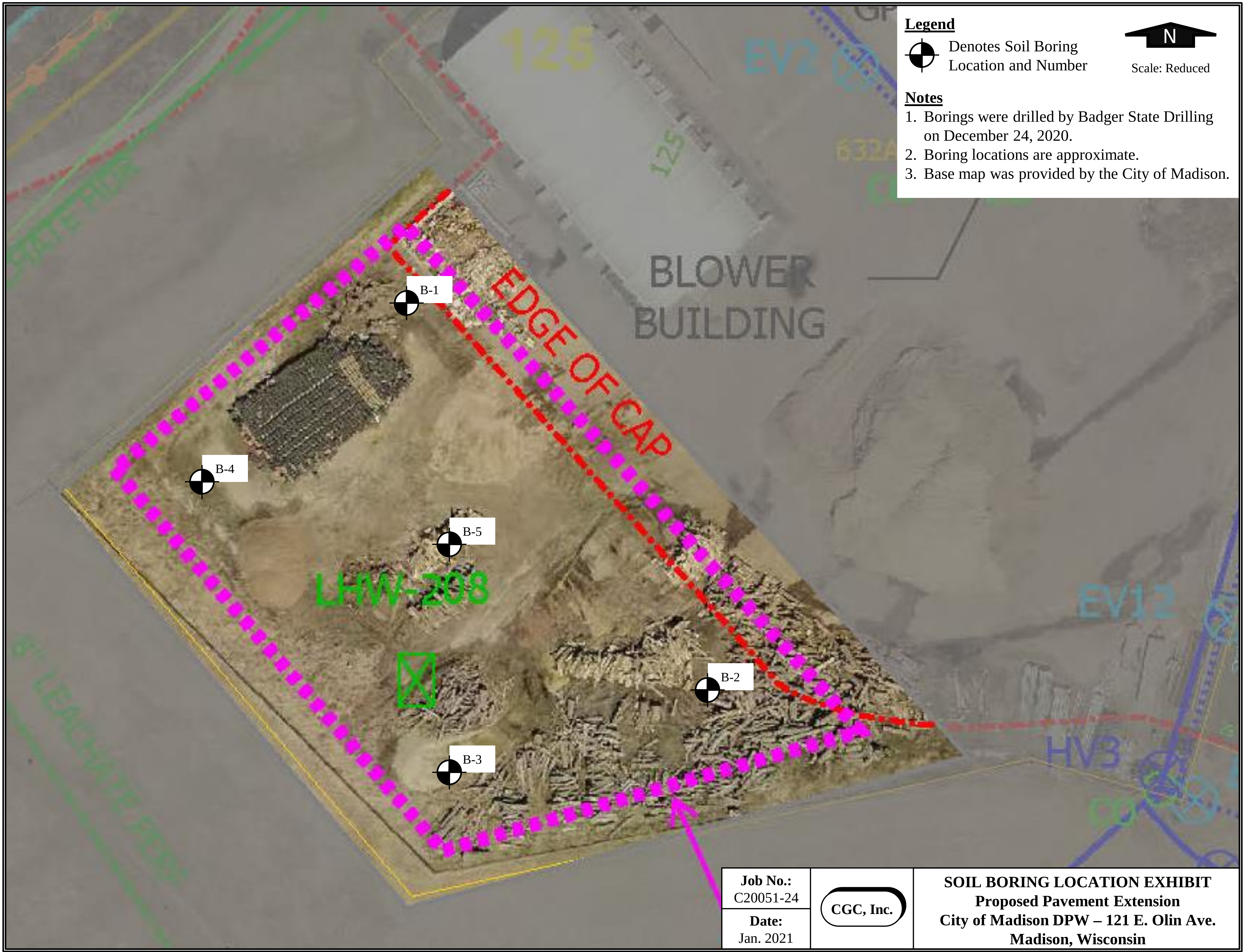
Right: B-3 being backfilled with bentonite chips after completion.

Upper left: Backfilled borehole B-2.

Lower right: Semi truck and trailer for transporting the drill rig to and from job sites.

APPENDIX B

SOIL BORING LOCATION EXHIBIT
LOGS OF TEST BORINGS (5)
LOG OF TEST BORING-GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Legend

Denotes Soil Boring Location and Number

N

Scale: Reduced

Notes

1. Borings were drilled by Badger State Drilling on December 24, 2020.
2. Boring locations are approximate.
3. Base map was provided by the City of Madison.

Job No.: C20051-24	CGC, Inc.	**SOIL BORING LOCATION EXHIBIT**
Date: Jan. 2021		**Proposed Pavement Extension** **City of Madison DPW – 121 E. Olin Ave.** **Madison, Wisconsin**

LOG OF TEST BORING

CGC Inc.

Project: Proposed Pavement Extension
City of Madison DPW - 121 E. Olin Ave.
Location: Madison, Wisconsin

Boring No. 1
Surface Elevation (ft) 860±
Job No. C20051-24
Sheet 1 of 1

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

No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						FILL: Hard/Medium Dense, Gray/Brown (Mottled) Silty Clay to Silt, Trace to Little Sand					
1		16	M	11			(4.5+)	15.6			
						FILL: Medium Dense to Dense, Brown Fine to Medium Sand, Some Silt and Gravel, Scattered Cobbles					
2		18	M	50							
					5						
3		18	M	22							
						FILL: Very Loose to Loose/Stiff, Mixture of Grayish Brown to Brown Silt/Clay and Deleterious Material (Plastic, Rubber Pieces, Glass Fragments, etc.)					
4		8	M/W	4			(1.5)				
					10	End of Boring at 10 ft Boreole Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling NW
Time After Drilling
Depth to Water ▼
Depth to Cave in 6'

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

GENERAL NOTES

Start 12/24/20 End 12/24/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: **Proposed Pavement Extension**
City of Madison DPW - 121 E. Olin Ave.
Location: **Madison, Wisconsin**

Boring No. **2**
Surface Elevation (ft) **861±**
Job No. **C20051-24**
Sheet **1** of **1**

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

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						FILL: Very Stiff, Gray/Brown (Mottled) Lean to Silty Clay, Trace to Little Sand					
1		18	M	10			(2.5-3.75)	22.2			
						FILL: Loose, Brown Fine to Medium Sand, Some Silt and Gravel, Scattered Cobbles					
2		18	M	7							
					5						
						FILL: Loose, Gray to Brown Sandy Silt, Trace Gravel, Scattered Wood Pieces and Glass Fragments					
3		12	M	6							
						FILL: Dense, Gray to Dark Gray Sandy Silt to Silty Fine Sand, Some Gravel, Trace Organics					
4		18	M	31							
					10	End of Boring at 10 ft Boreole Backfilled with Bentonite Chips					

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	**12/24/20**	End	**12/24/20**		
Driller	**BSD**	Chief	**MC**	Rig	**CME-45**
Logger	**GB**	Editor	**TFG**		
Drill Method	**2.25" HSA; Autohammer**				

LOG OF TEST BORING

CGC Inc.

Project: Proposed Pavement Extension
City of Madison DPW - 121 E. Olin Ave.
Location: Madison, Wisconsin

Boring No.: 3
Surface Elevation (ft): 863±
Job No.: C20051-24
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
						FILL: Medium Dense, Grayish Brown to Brown Silty Fine to Medium Sand to Sandy Silt, Little Gravel					
1		18	M	16							
						FILL: Very Stiff to Hard, Gray to Grayish Brown Lean Clay, Trace to Little Sand					
2		18	M	9			(3.5-4.5)				
					5						
						FILL: Loose to Medium Dense/Very Stiff, Mixture of Grayish Brown to Brown Silt/Clay and Deleterious Material (Plastic, Fabric Shreds, Wood Pieces/Organic Matter, etc.)					
3		3	M	5			(2.5)				
4		2	M	16							
					10	End of Boring at 10 ft Boreole Backfilled with Bentonite Chips					

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 12/24/20 End 12/24/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: Proposed Pavement Extension
City of Madison DPW - 121 E. Olin Ave.
Location: Madison, Wisconsin

Boring No. 4
Surface Elevation (ft) 862±
Job No. C20051-24
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
						FILL: Very Stiff/Loose, Gray/Brown (Mottled) Silty Clay to Silt, Trace to Little Sand					
1		14	M	9			(3.25-3.5)	22.5			
2		18	M	25							
						FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt and Gravel, Scattered Cobbles					
					5						
3		14	M	16							
4		18	M	25							
					10	End of Boring at 10 ft					
						Boreole Backfilled with Bentonite Chips					

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 12/24/20 End 12/24/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: Proposed Pavement Extension
City of Madison DPW - 121 E. Olin Ave.
Location: Madison, Wisconsin

Boring No. 5
Surface Elevation (ft) 861±
Job No. C20051-24
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
						FILL: Very Stiff, Gray to Bluish Gray/Brown (Lightly Mottled) Lean Clay, Trace to Little Sand					
1		18	M	8			(2.25-3.25)	23.4			
						FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt and Gravel, Scattered Cobbles					
2		18	M	12							
					5						
						FILL: Very Stiff to Hard, Gray to Brown Sandy Lean Clay, Trace to Little Gravel, Scattered Brick Fragments					
3		12	M	34			(3.5-4.25)				
						FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt and Gravel, Scattered Cobbles					
4		18	M	28							
					10	End of Boring at 10 ft Boreole Backfilled with Bentonite Chips					

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 12/24/20 End 12/24/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
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

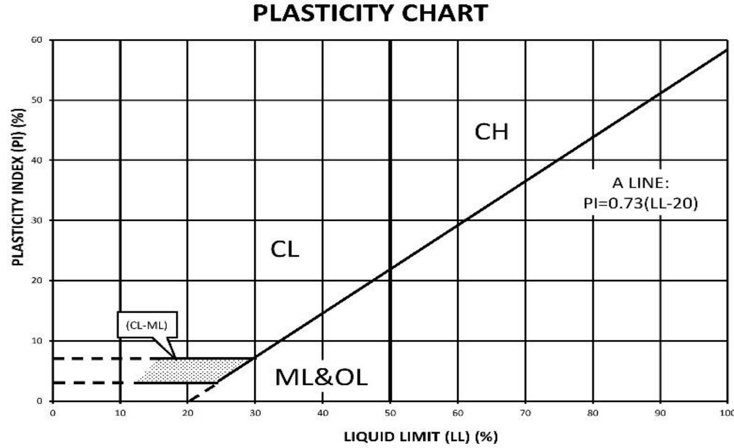
LABORATORY CLASSIFICATION CRITERIA

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

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

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.

READ THE FULL REPORT

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 geotechnical engineer performed the study. *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 subsurface 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 confirmation-dependent recommendations included in your report. *Those confirmation-dependent 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 confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront 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. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical 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 CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors 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 constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors 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 constructors 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 the risk of such outcomes, 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.

ENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any environmental 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 environmental 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, many 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 the Geotechnical Business Council (GBC) of Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of GBC, for more information.

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Geotechnical Business Council
of the Geoprofessional Business Association
8811 Colesville Road, Suite G 106
Silver Spring, MD 20910

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)