CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

April 23, 2009
CM09024

Mr. Mart Olson
2529 Mariner Drive
Delafield, WI 53029-9324

Re: Preliminary Subsurface Exploration
Proposed Retail/Commercial Development
Oconomowoc Lake, Wisconsin

Dear Mr. Olson:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration for the project referenced above. The purpose of this exploration was to evaluate the subsurface conditions across the site and to present preliminary recommendations concerning the planned development, including identifying viable foundation alternatives for support of a building. Two copies of this report are provided for your use. An additional copy has been forwarded directly to Mr. Bill Minett of The Real Estate Company - Lake & Country, Inc.

PROJECT DESCRIPTION

We understand that the property is a 4± acre vacant parcel located along the south side of the frontage road for STH 16 and directly west of the Oconomowoc River in the Village of Oconomowoc Lake, Wisconsin. It is our understanding that future development of the parcel would likely consist of the construction of a one- to two-story, slab-on-grade structure. While building foundation loads are not known at this time, it is anticipated that structural loads will be relatively light (i.e., column and wall loads less than 60 kips and 3 klf, respectively). Building construction would apparently occur within the defined limits of a 9,000 sq ft building envelope near the southern portion of the parcel. Additional likely site improvements would include at-grade parking to the north and east of the building.

Based on discussions with the current owner, it is our understanding that the site has been subjected to some filling over the years, with an estimated 8 to 10 ft of undocumented fill placed on the site. The native soils below and surrounding the subject site are mapped as being comprised of highly compressible/organic soils.

336 S. Curtis Road
West Allis, WI 53214
Telephone: 414/443-2000
FAX: 414/443-2099

EXPLORATION PROGRAM

The subsurface conditions were explored by drilling a series of two (2) standard penetration test (SPT) borings within the general vicinity of the designated buildable limits near the south end of the parcel. The borings were originally planned to be drilled to a depth of 30 ft below the existing ground surface; however, due to the relatively thick compressible strata encountered, the borings were extended to a depth of 45 ft. The borings were terminated within the underlying natural granular stratum. The boring locations were field staked by the driller and the ground surface elevations at the borings determined by conventional leveling techniques. A nail pin located on the utility pole near the frontage road was used as a benchmark, with an established reference elevation of 870.19 ft. Specific procedures used for drilling and sampling are described in Appendix A. The approximate boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B.

SUBSURFACE CONDITIONS

In general, the soil borings reveal that a somewhat uniform soil profile exists over this portion of the parcel, consisting of the following (in descending order):

- 8.5 to 10.5 ft of ***man-made fills***;
- 27 to 30.5 ft of ***marsh deposits*** comprised of organic strata of fibrous peat, marl and organic silt; underlain by
- Medium dense ***granular soils*** described as fine to coarse sand with gravel.

The existing fills were quite variable and consist of layered deposits of sandy lean clays, foundry sand, fine to coarse sand with gravel, and/or crushed concrete rubble debris. Based on SPT data (i.e., N-values), the fill soils are typically in a very loose to loose condition.

The organic soils (i.e., peat, marl and organic silt) are similarly in a very loose to loose condition with N-values between 0 to 4 blows per foot.

Groundwater was observed within both borings during and upon completion of depths of 8 to 12 ft below the existing ground surface. Water levels can be expected to fluctuate based on seasonal variations in precipitation, infiltration, etc. and the stage of the nearby Oconomowoc River. More detailed information regarding the subsurface and groundwater conditions is presented on the boring logs contained in Appendix B.

DISCUSSION AND RECOMMENDATIONS

The following recommendations are somewhat general in nature due to limited information available regarding proposed site development plans. It will be necessary to confirm these preliminary recommendations with supplemental borings completed within the footprint of any planned future building, prior to final design.

In our opinion, the site can be developed. However, the presence of surficial unengineered fills and the underlying compressible, organic soil deposits encountered on the site may require special site preparation or special foundation systems. Construction of the building on the existing soil conditions, with no other subsurface preparation, could result in significant total and differential settlements of the structure, leading to structural distress. Therefore, we recommend that alternative methods of foundation preparation or foundation support be considered for development of the site.

From a geotechnical perspective, it is our opinion that the most desirable means of supporting any future building would involve utilizing a deep foundation system such as driven displacement piles. While an undercutting and replacement scheme can sometimes be used in such a situation, we believe that such a method would not be economically feasible or practical in this case, due to the thickness of the organic soils and the shallow groundwater conditions. Alternatives to a deep foundation system are offered, but do not eliminate the risks of settlement associated with the underlying compressible deposits. Brief discussion regarding the alternatives are presented in the following sections of this report.

1. <u>Deep Foundation</u>

A deep foundation system utilizes supporting members, such as driven displacement piles, beneath the proposed building. This type of foundation system would transmit the structure loads through the surficial fills and underlying compressible soils into more competent soils beneath. A number of different types of piles would be suitable, including timber and steel pipe piles. Actual depths required should be determined at the time of construction by a soils engineer. For estimating purposes, however, we believe that average lengths in the range of 65 to 75 ft or greater below existing grade would be required for a 10- to 15-ton capacity.

Due to the potential downward drag forces acting on the piles from the consolidation of the compressible soils adjacent to the piles, the pile design must take these forces into consideration. It is possible that these downward forces could be considerable, possibly exceeding the weight of the building load and requiring longer piles.

Estimated pile lengths will extend well below the depth explored by this preliminary exploration. To better establish design capacities and determine actual required pile lengths, additional borings should be performed once a building design has been developed. Use of this foundation system would also require that floor slabs be structurally supported.

2. Surcharging

An alternative to a deep foundation system would be to apply a surcharge to the site. Surcharging would involve preloading the building area with a temporary layer of fill (in addition to the existing fills used to establish current site grades) equal to or greater than the weight of the building, thereby inducing consolidation in the compressible soils prior to building construction. Once anticipated settlement has been achieved, the excess fill can be removed. The building can then be supported on conventional shallow foundations, designed for an allowable bearing pressure on the order of 1500 to 2000 psf.

If such a method of site preparation is considered, we would recommend that laboratory testing in the form of consolidation tests be performed on the compressible subsoils. Consolidation tests would provide an estimate of the total settlements that could be expected under an applied load, and would provide an indication as to the length of time the settlement would take.

The surcharge should be applied to the building area and a minimum of 20 ft beyond the building, in each direction. If the surcharge load is not provided in parking areas, some settlement of those areas could result.

A disadvantage of utilizing a surcharging scheme is that the consolidation of soils under the surcharge load could take several months of time. However, the time requirement could be reduced by utilizing a larger amount of fill for the surcharge load.

With this approach, some re-engineering of the existing fills within the building footprint would still be required. Such measures would likely include a partial undercut/refill approach below footings and possibly floor slabs to address the loose condition of the existing fills.

3. Engineered Pad Utilizing Geogrids

In the event planned future development is limited to a thickened-slab, metal clad storage type of lightweight buildings, an engineered pad could be developed below the building footprint(s) consisting of multiple layers of biaxial geogrids and compacted engineered granular fill. The development of such a pad would minimize the potential for "differential" settlement to occur within the building's footprint, but would not reduce the risk of "total" settlement of the building due to on-going consolidation of the compressible organic strata below the site.

Specific details regarding the design of such a pad are beyond the scope of this preliminary exploration and/or report. Similar to the other alternatives presented, supplemental borings and specialized testing (i.e., consolidation testing, etc.) are recommended to evaluate this approach and to provide an estimate of expected total settlements.

4. <u>Other Considerations</u>

a. <u>Utilities</u>

Regardless of the approach selected for support of any future building on the site, consideration should also be given to the potential for differential movement between the building and any underground utilities. In order to minimize serious differential movement, we recommend that flexible utility lines be used, if possible, or special support be provided.

b. <u>Pavement Areas</u>

Due to the relatively loose condition of the existing fills and the compressibility of the underlying organic soils, it should be recognized that differential and/or total settlements incurred across the site could negatively affect the long-term performance of future pavements, sidewalks, etc. and could result in increased maintenance costs. Measures can be taken to improve the condition of the existing surficial fills. Such measures include the reworking of the upper 2 to 3 ft of the fills and/or incorporating a biaxial geogrid below the flexible pavement section. The reworked fills on the site should be placed/compacted in accordance with our "Recommended Compacted Fill Specifications" included in Appendix C.

* * * * *

We trust that this information is sufficient for your planning purposes. The report is not intended to provide final design details and therefore, it is recommended that a supplemental subsurface exploration be performed prior to final design to confirm or modify the preliminary recommendations provided in this report. Additional information regarding the limitations of the preliminary recommendations provided in this report is discussed in Appendix D. Should you have any questions concerning the information in this report, or if we can provide more specific recommendations or additional consultation and testing services, please do not hesitate to contact us.

Sincerely,

CGC, Inc.

Nathan I. Springstead, E.I.T.
Staff Engineer

Jeff P. Simkowski, P.E.
Senior Consulting Professional

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

cc: Mr. Bill Minett, The Real Estate Company - Lake & Country, Inc.
(via email: bill@billminett.com)

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

The subsurface conditions at the project site were explored by drilling two Standard Penetration Test (SPT) borings on April 9, 2009. The borings were planned to be completed to a depth of 30 ft below ground surface; however, due to very loose and organic soils, the borings were extended to a depth of 45 ft. The borings, completed in general accordance with SPT procedures (ASTM D1586), were drilled using a truck-mounted, CME-45 rotary drill rig equipped with hollow-stem augers. The soil borings were completed by J&J Soil Testing, Ltd. (under subcontract to CGC, Inc.). Ground surface elevations at the boring locations were determined by methods described in this report.

During drilling, soil samples were typically obtained at 2.5 ft 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. Boring Procedures Between Samples

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

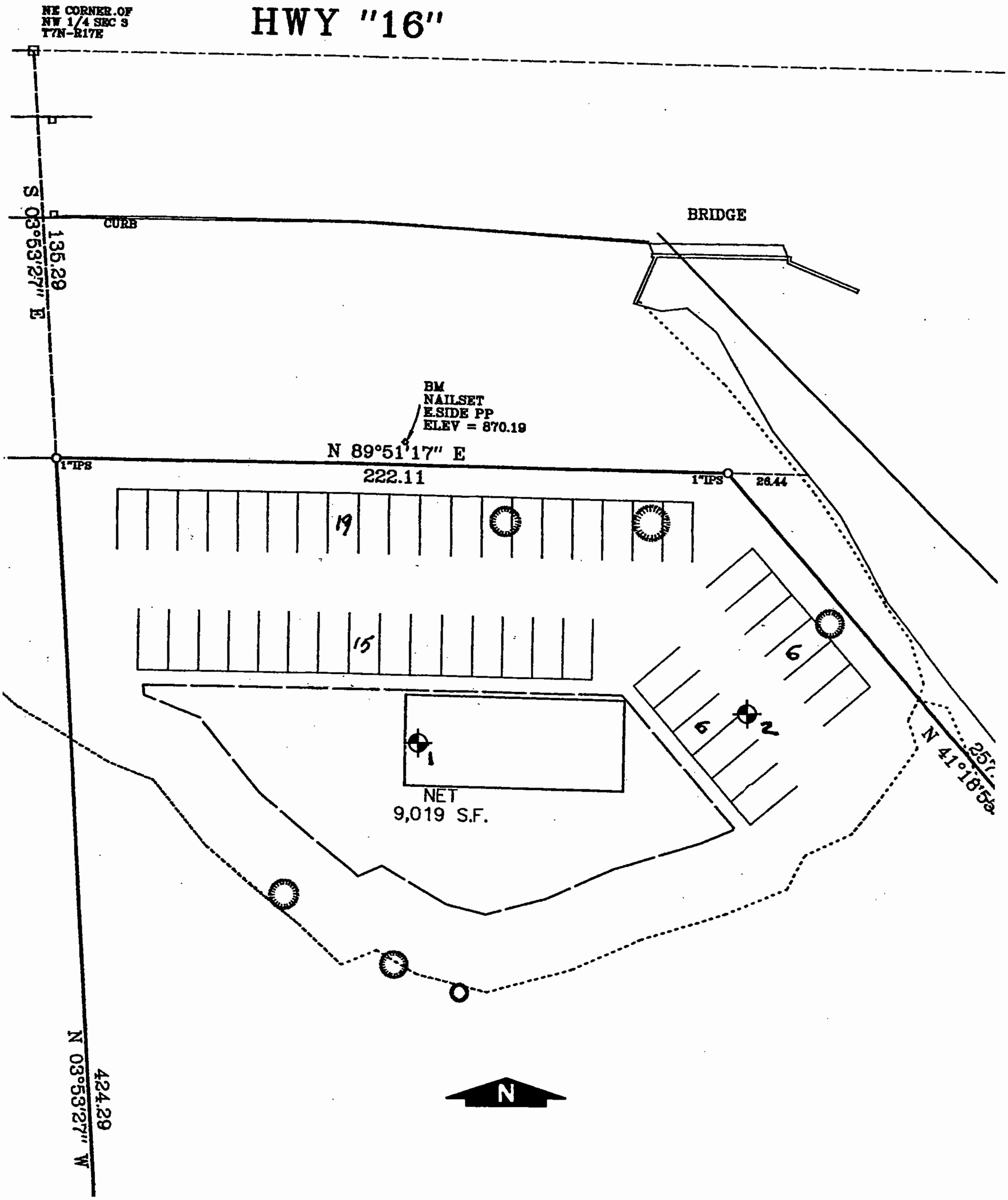
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D 1586)

   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 SPT boring portion of the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the samples for possible environmental contaminants was not conducted during the field exploration program, as environmental site assessment activities were not part of CGC's work scope.* Water level observations were made in the borehole during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the boreholes were backfilled in accordance with 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. 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 MAP
LOGS OF SOIL TEST BORINGS (2)
LOG OF TEST BORING - GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Legend

Denotes Approximate Soil Boring Location and Number

Note

1. Soil borings were conducted by J&J Soil Testing, Ltd. (under subcontract to CGC, Inc.) on April 9, 2009.
2. Base map provided by property owner.

Scale: Not to Scale				CGC, Inc.	**SOIL BORING LOCATION MAP** **Proposed Retail/Commercial Development** **Oconomowoc, Wisconsin**
DWN: --	APP'D: JPS	Date: 4/22/09	**CM09024**		

CGC,Inc.

LOG OF TEST BORING

Project	**Proposed Retail/Commercial Development**
	East Wisconsin Avenue
Location	**Oconomowoc Lake, Wisconsin**

Boring No.	1
Surface Elevation	869.5'
Job No.	CM09024
Sheet	1 of 2

336 S. Curtis Road • West Allis, WI 53214 • (414) 443-2000 • FAX (414) 443-2099

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	W	LL	PL	LI
1		4	M	9		FILL: Dark Brown to Brown Lean Clay, Little to Some Sand, Trace Gravel, Few Topsoil Inclusions	(1.5)				
2		8	M/W	3	5	FILL: Dark Brown to Black Sandy Lean Clay, Little Gravel, Trace Organic Clay					
3		12	M	8		FILL: Black Foundry Sand, Trace Slag					
4		7	M	3	10	Soft to Medium Stiff, Greenish Gray Lean CLAY; Trace Organics and Sand (CL) (PROBABLE FILL)	(0.5-1.0)				
5		10	M	4		Black Fibrous PEAT (PT)		295.0			
6A/B		18	M	2	15	Very Loose, Light Gray MARL; Trace Shells (OH)					
7		18	W	1	20			64.3			
8		18	M	1	25	Very Loose, Dark Greenish Gray Organic SILT (OL)		50.0			

(Log Continued on Page 2)

LOG OF TEST BORING

CGC,Inc.

Project	Proposed Retail/Commercial Development
	East Wisconsin Avenue
Location	Oconomowoc Lake, Wisconsin

Boring No.	1
Surface Elevation	869.5'
Job No.	CM09024
Sheet	2 of 2

336 S. Curtis Road • West Allis, WI 53214 • (414) 443-2000 • FAX (414) 443-2099

Sample No.	Rec (in.)	Moist	N	Depth (ft)	Soil Description					
					Very Loose, Dark Greenish Gray Organic SILT (OL)					
					Color change to gray below 27 ft					
9	18	M	1	30			37.3			
10	18	M	1	35						
					Loose to Medium Dense, Gray Fine to Coarse SAND with Gravel, Trace Silt (SP)					
11	12	W	18	40						
12	18	W	10	45						
					End of Boring at 45 ft Backfilled with Bentonite Chips					
				50						

WATER LEVEL OBSERVATIONS

While Drilling: 8' Upon Completion of Drilling: 11'

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	4/09/09	End	4/09/09		
Driller	J&J	Chief	JP	Rig	CME-45
Logger	JP	Editor	NS		
Drill Method	3¼" HSA/Plug				
	Cathead/Rope				

C:\DATA\LOGS\2009\09024 1.wpd

CGC,Inc.	**LOG OF TEST BORING** Project **Proposed Retail/Commercial Development** **East Wisconsin Avenue** Location **Oconomowoc Lake, Wisconsin**	Boring No. **2** Surface Elevation **868.3'** Job No. **CM09024** Sheet **1** of **2**

336 S. Curtis Road • West Allis, WI 53214 • (414) 443-2000 • FAX (414) 443-2099

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						FILL: Brown to Gray Brown Sandy Lean Clay, Little Gravel					
1A/B		18	M	12			(2.5)				
						FILL: Brown Clayey Fine to Coarse Sand, Little Gravel with Topsoil Inclusions					
2		4	M	1							
					5	FILL: Brown Sandy Lean Clay, Little Gravel					
3A/B		18	M	11		FILL: Dark Brown to Dark Gray Sandy Lean CLAY; Trace Organics and Gravel					
4		6	M/W	3							
					10	FILL: Crushed Concrete and Rubble, Wet					
						Black Fibrous PEAT (PT)					
5A/B		18	M	4				302.0			
						Very Loose, Light Gray MARL; Trace Shells (OH)					
6		18	W	1				73.1			
					15						
7		18	W	1							
					20						
8		18	W	0							
					25						

(Log Continued on Page 2)

CGC,Inc.	LOG OF TEST BORING	
	Project **Proposed Retail/Commercial Development**	Boring No. **2**
	East Wisconsin Avenue	Surface Elevation **868.3'**
	Location **Oconomowoc Lake, Wisconsin**	Job No. **CM09024**
		Sheet **2** of **2**

336 S. Curtis Road • West Allis, WI 53214 • (414) 443-2000 • FAX (414) 443-2099

Sample No.	Recovery	Moisture	N	Depth (ft)	Soil Description					
					Very Loose, Light Gray MARL; Trace Shells (OH)					
					Very Loose, Dark Greenish Gray Organic SILT (OL)					
9	18	M	2	30			50.4			
					Color change to gray below 32 ft					
10	18	W	1	35			43.0			
11	3	W	2	40						
					Medium Dense, Fine to Coarse SAND with Gravel, Trace Silt (SP)					
12	10	W	12	45						
					End of Boring at 45 ft Backfilled with Bentonite Chips					
				50						

WATER LEVEL OBSERVATIONS

While Drilling: 8' Upon Completion of Drilling: 12'

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	4/09/09	End	4/09/09		
Driller	J&J	Chief	JP	Rig	CME-45
Logger	JP	Editor	NS		
Drill Method	3¼" HSA/Plug				
	Cathead/Rope				

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	3/4" to 3"	3/4" to 3"
Fine	4.76 mm to 3/4"	#4 to 3/4"
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 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 Designator
RB--Rock Bit
FT--Fish Tail
DC--Drove Casing
C--Casing: Size 2 1/2", 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" Diameter Split-Barrel Sample
2ST--2" Diameter Thin-Walled Tube Sample
3ST--3" Diameter Thin-Walled Tube Sample
PT--3" Diameter 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_u--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--Caved 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.

UNIFIED SOIL CLASSIFICATION SYSTEM

COARSE-GRAINED SOILS

(More than half of material is larger than No. 200 seive size.)

GRAVELS More than half of coarse fraction larger than No. 4 sieve size	**Clean Gravels** (Little or no fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
	Gravels with Fines (Appreciable amount of fines)	
	GM d/u	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS More than half of coarse fraction smaller than No. 4 sieve size	**Clean Sands** (Little or no fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with Fines (Appreciable amount of fines)	
	SM d/u	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} X D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} X D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched 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:

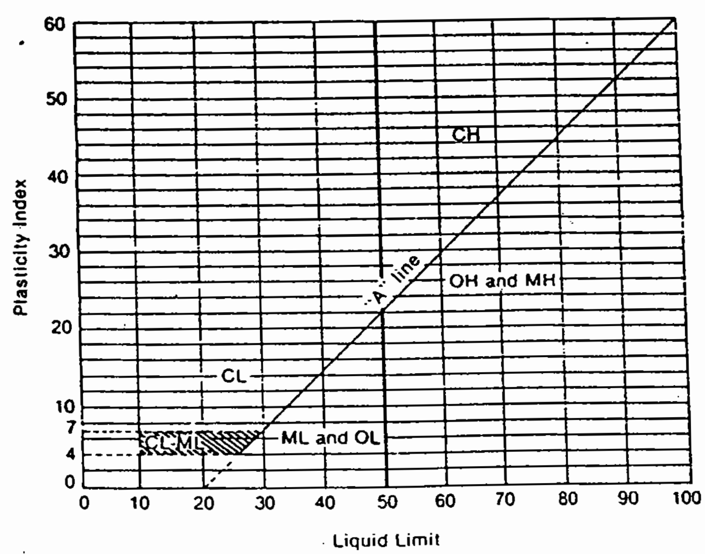
Less than 5 per cent	GW, GP, SW, SP
More than 12 per cent	GM, GC, SM, SC
5 to 12 per cent	Borderline cases requiring dual symbols

FINE-GRAINED SOILS

(More than half of material is smaller than No. 200 sieve.)

SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine 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

PLASTICITY CHART



For classification of fine-grained soils and fine fraction of coarse-grained soils.

Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols.

Equation of A-line: PI = 0.73 (LL - 20)

APPENDIX C

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX C

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

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. The rock, boulders or concrete pieces should contain finer material to fill in void spaces between the larger material.

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 a 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 1.

Table 1
Compaction Guidelines

Area	Percent Compaction+ Clay/Silt	Percent Compaction+ Sand/Gravel
Within 10 feet of building lines		
• Footing bearing soils	93-95	95
• Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab & thicker fill zones	92	95
Beyond 10 feet 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:

\+ Based on Modified Proctor (ASTM D 1557)

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.

APPENDIX D

DOCUMENT QUALIFICATIONS

APPENDIX D

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 OPINIONS

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 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.*

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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