Geotechnical Engineering Exploration and Analysis

Proposed Roadways and Stormwater Management
Hidden Valley Residential Subdivision
Eastwind Lane
Fond du Lac, Wisconsin

Prepared for:

Excel Engineering, Inc.
Fond du Lac, Wisconsin

March 12, 2025
Project No. 1G-2501037

GILES
ENGINEERING ASSOCIATES, INC.

GILES
ENGINEERING ASSOCIATES, INC.
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

- Dallas, TX
- Los Angeles, CA
- Manassas, VA
- Milwaukee, WI

March 12, 2025

Excel Engineering, Inc.
100 Camelot Drive
Fond du Lac, WI 54935

Attention: Grant Duchac
Senior Project Manager

Subject: Geotechnical Engineering Exploration and Analysis
Proposed Roadways and Stormwater Management
Hidden Valley Residential Subdivision
Eastwind Lane
Fond du Lac, Wisconsin
Project No. 1G-2501037

Dear Mr. Duchac:

As requested, Giles Engineering Associates, Inc. conducted a *Geotechnical Engineering Exploration and Analysis* for the proposed project. The accompanying report describes the services that were performed, and it provides geotechnical-related findings, conclusions, and recommendations that were derived from those services.

We sincerely appreciate the opportunity to provide geotechnical consulting services for the proposed project. Please contact the undersigned if there are questions about the report or if we may be of further service.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC.

Grace C. Hill
Staff Professional

Colleen Finley

Colleen M. Finley, P.E.
Geotechnical Department Manager

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HIDDEN VALLEY RESIDENTIAL SUBDIVISION
FOND DU LAC, WISCONSIN
PROJECT NO. 1G-2501037

GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT
HIDDEN VALLEY RESIDENTIAL SUBDIVISION
FOND DU LAC, WISCONSIN
PROJECT NO. 1G-2501037

1.0 SCOPE OF SERVICES

This report provides the results of the *Geotechnical Engineering Exploration and Analysis* that Giles Engineering Associates, Inc. ("Giles") conducted for the proposed development. The *Geotechnical Engineering Exploration and Analysis* included a geotechnical subsurface exploration program, geotechnical laboratory services, and geotechnical engineering. The scope of each service area was narrow and limited as directed by our client and based on our understanding and assumptions about the proposed project. Each service area is briefly described later. Environmental consulting was beyond Giles' scope for this project.

Geotechnical-related recommendations are provided in this report for design and construction of roadways. Also, information is provided regarding stormwater infiltration within the proposed infiltration basin areas. Site preparation recommendations are given but are only preliminary because the means and methods of site preparation will depend on factors that were unknown when this report was prepared. Those factors include, but are not limited to, the weather before and during construction, the subsurface conditions that are exposed during construction, and the final details of the proposed project.

2.0 SITE DESCRIPTION

The subject site is located at the northwest corner of Eastwind Lane and County Road K in Fond du Lac, Wisconsin. The site is shown on the *Test Boring Location Plan*, enclosed as Figure 1 in Appendix A. When the test borings (discussed below) were performed, the site was vacant and used for agricultural purposes with surrounding woodlands and wetlands. Topographically the site generally sloped down to the north and northwest. Based on topographic contours shown on the *Soil Boring Plan*, dated January 3, 2025, prepared by Excel Engineering, the ground surface elevations at the site were between ±El. 791 and ±El. 843.

3.0 PROJECT DESCRIPTION

Proposed Pavement Areas

The proposed development will include new roadways, as shown on the *Test Boring Location Plan*. It is assumed that the roadways will be paved with asphalt-concrete. Because Giles was not provided with traffic information, the pavement recommendations provided later are based on arbitrarily assumed traffic conditions.

Stormwater Management Device

A stormwater management basin is planned to be constructed in the northeast area of the site, in the area of Test Borings 9 and 10. Details regarding the stormwater management basin were not provided, therefore it is assumed that the basin will be several feet below the ground surface.

Due to the site's rolling topography, and because significant grade changes are expected for site development, it is critical that Giles review the project plans before construction to determine if this report needs to be revised based on the final planned elevations and pavement grades.

4.0 GEOTECHNICAL SUBSURFACE EXPLORATION PROGRAM

To explore subsurface conditions, ten geotechnical test borings were conducted at the site, using a mechanical drill-rig. Test Borings 1 through 8 were conducted in the proposed pavements areas and Test Borings 9 and 10 were conducted in the proposed stormwater management areas. Each test boring was advanced to ±21 feet below-ground, as planned. The test boring locations were provided by Excel Engineering and Giles positioned the test boring locations onsite using a Trimble® R2 receiver. Approximate locations of the test borings are shown on the *Test Boring Location Plan*.

Samples were collected from each test boring, at certain depths, using the Standard Penetration Test (SPT), conducted with the drill rig. A brief description of the SPT is given in Appendix B, along with descriptions of other field procedures. Immediately after sampling, select portions of SPT samples were placed in glass jars that were labeled at the site for identification. A Standard Penetration Resistance value (N-value) was determined from each SPT. N-values are reported on the *Test Boring Logs*, which are records of the test borings.

The boreholes were backfilled upon completion; however, backfill materials will likely settle or heave, creating a hazard that can injure people and animals. Borehole areas should, therefore, be carefully and routinely monitored by the property owner or others; settlement and heave of backfill materials should be repaired immediately. Giles will not monitor or repair boreholes.

The ground elevations at the test boring locations are based on topographic contour lines shown on the *Soil Boring Plan*, dated January 3, 2025, prepared by Excel Engineering. The test boring elevations are noted on the *Test Boring Logs* and are assumed to be accurate within about one foot.

5.0 GEOTECHNICAL LABORATORY SERVICES

Soil samples that were retained from the test borings were transported to Giles' geotechnical laboratory, where they were classified using the descriptive terms and particle-size criteria shown on the *General Notes* in Appendix D, and by using the Unified Soil Classification System (ASTM

D 2488) as a general guide. Classifications are shown on the *Test Boring Logs*, along with horizontal lines that show estimated depths of material change. Field-related information pertaining to the test borings is also shown on the *Test Boring Logs*. For simplicity and abbreviation, terms and symbols are used on the *Test Boring Logs;* the terms and symbols are defined on the *General Notes*.

Samples that were retained from Test Boring 9 and 10 (conducted in the proposed stormwater management areas) were also visually classified using the USDA textural classification system, in general accordance with the guidelines provided in the *Field Book for Describing and Sampling Soils* (USDA, Sept. 2012). USDA classifications of the retained samples are shown on the Wisconsin DSPS *Soil Evaluation – Storm* logs, enclosed in Appendix A. Laboratory procedures are briefly described in Appendix C. Supplemental information regarding soil classifications, including the USDA and USCS soil classification systems, is included in the *Soil Classification Notes* enclosure within Appendix D.

Calibrated penetrometer resistance, unconfined compression (without measured strain), and moisture content tests were performed on select samples to evaluate their general engineering properties. Test results are on the *Test Boring Logs*. Because SPT samples were used, which are categorized as disturbed samples, results of the strength-related tests are approximate. Laboratory procedures are briefly described in Appendix C.

6.0 MATERIAL CONDITIONS

Because material sampling at the test borings was discontinuous, it was necessary to estimate conditions between sample intervals. Estimated conditions at the test borings are briefly discussed in this section and are described in more detail on the *Test Boring Logs*. This report is based only on the estimated conditions shown on the *Test Boring Logs.*

6.1. Surface Materials

Topsoil that was between ±1 and ±12 inches thick was at the surface of the test borings. Topsoil generally consisted of lean clay with estimated trace to little amounts of sand and organic matter.

6.2. Native Soil

Native soil was below the surface materials and extended to the 21-foot termination depth at the test borings. In general, the native soil primarily consisted of lean clay, but sandy silt and silty clay were encountered below a depth of ±16½ feet at Test Borings 9 and 10. Based on laboratory testing, the native soil exhibited very stiff to hard comparative consistencies.

7.0 GROUNDWATER CONDITIONS

Water and wet soils were encountered below a depth of approximately ±16½ feet below-ground at Test Borings 9 and 10 but was deeper than the ±21-foot termination depth at the other test boring locations when the test borings were conducted. However, the site is likely subject to perched groundwater conditions, where water accumulates within the cohesive soils or above relatively dense native soils. Groundwater conditions at the site will likely fluctuate depending on precipitation, surface run-off, and other factors.

It is important to note that the groundwater conditions discussed herein are only an approximation based on the colors and moisture conditions of the retained soil samples and the depth that water was encountered within the test borings. Groundwater conditions could differ from the conditions described above, and the water table could be higher or lower than estimated. If a more precise determination of the water table depth is needed, groundwater observation wells can be installed and monitored over a sufficient timeframe. Giles can install and monitor observations wells at the site, if requested.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1. Roadway Pavement Recommendations

Roadways will be constructed for the proposed development. The proposed roadways are shown on the *Test Boring Location Plan*. It is assumed that the road is planned to be constructed of asphalt-concrete pavement with an aggregate base course. However, traffic-related information was not provided to us. Therefore, recommendations are provided herein based on an assumed traffic condition of fifteen 18-kip Equivalent Single Axle Loads (ESALs) per day. The recommended pavement section assumes no increase in traffic volume and no changes in vehicle type or traffic pattern. Also, it is assumed that the ESALs noted above will be in one direction for each lane.

It is important that the project owner, developer, civil engineer, other design professionals, and governing municipalities involved with the project confirm that the ESALs noted above are appropriate for the expected traffic conditions, vehicle types, and axle loadings. If requested, Giles can provide supplemental pavement recommendations based upon other traffic conditions, vehicle types, and axle loads. The recommended pavement section could underperform or fail prematurely if the design ESALs are exceeded.

Based on the roadway area test borings (Test Borings 1 through 8), it is expected that pavement support materials will typically consist lean clay, which is a relatively poor subgrade material. Therefore, the recommended pavement section was developed based on an assumed field CBR value of 3 and a *Modulus of Subgrade Reaction* (K_{V1}) value of 75 psi/in. Engineered fill that is placed in proposed pavement areas is recommended to have a field CBR value and a *Modulus of Subgrade Reaction* (K_{V1}) value at least equal to these design values. Fill is recommended to be placed and compacted per this report.

Considering that high moisture cohesive material that was encountered near the surface of the test borings and because of perched groundwater, the pavement subgrade will likely need to be improved, especially if construction is during or after adverse weather. The need for subgrade improvement should be determined during construction with the assistance of a geotechnical engineer. Depending on the site conditions during construction, an aggregate subbase underlain by geotextile or geogrid might need to be beneath the recommended pavement sections, provided herein. Also, the geotechnical engineer should provide recommendations for subgrade improvement based on the site conditions.

The following table shows the recommended thicknesses for hot-mix asphalt (HMA) pavement with an aggregate base-course. State specifications are also included in the table. The recommended pavement sections are based on the traffic conditions described above.

TABLE 1
RECOMMENDED ASPHALT-CONCRETE PAVEMENT

Materials	Thickness	Wisconsin DOT Standard Specifications
Hot Mix Asphalt Surface Course	1.5 inches	Section 460
Hot Mix Asphalt Binder Course	2.5 inches	Section 460
Dense-Graded Aggregate Base Course	9 inches	Section 305 1¼-inch Crushed Stone

General Pavement Considerations

The pavement recommendations assume that the pavement subgrade will be prepared in accordance with this report, the base course will be properly drained, and a geotechnical engineer will observe and test pavement construction. Pavement was designed based on AASHTO design parameters for a twenty-year design period, but the actual service life will likely be much less, especially considering the moisture-sensitive soil and perched groundwater. Pavement distress should be expected. Local codes may require specific testing to determine soil-support characteristics, and a minimum pavement section might be required.

8.2. Preliminary Stormwater Infiltration Screening

Test Borings 9 and 10 were in the proposed stormwater management basin areas; the approximate locations of these test borings are shown on the *Test Boring Location Plan*. Details regarding the proposed basins were not provided, therefore it is assumed that the basins will be several feet deep. Because of the low permeability native soil and groundwater conditions that were encountered at the test borings, Giles considers the proposed stormwater management areas to be exempt from stormwater infiltration requirements per section NR 151.124(4)(c) of the Wisconsin Administrative Code and WDNR 1002 guidelines.

8.3. Site Preparation Recommendations

This section deals with preparation of pavement and engineered fill areas. The means and methods of site preparation will greatly depend on the weather conditions before and during construction, the subsurface conditions that are exposed during earthwork operations, and the finalized details of the proposed development. Therefore, only generalized site preparation recommendations are given.

In addition to being generalized, the following site preparation recommendations are abbreviated; the *Guide Specifications* in Appendix D gives further recommendations. The *Guide Specifications* should be read along with this section. Also, the *Guide Specifications* are recommended to be used as an aid to develop the project specifications.

Stripping and Removal

Surface vegetation, trees and bushes (including root-balls), topsoil, and other unsuitable materials are recommended to be removed from the proposed building areas, pavement areas, and other structural areas. Stripping should extend at least several feet beyond proposed development areas, where feasible.

Proof-Rolling and Fill Placement

After the recommended stripping and removal, and once the site is cut (lowered) as needed, the subgrade is recommended to be proof-rolled with a fully-loaded, tandem-axle dump truck (or other suitable construction equipment) to help locate unstable soil based on subgrade deflection caused by wheel loads of the proof-roll equipment. All areas of the site are recommended to be proof-rolled and, where feasible, proof-rolling should extend at least several feet beyond development limits; however, proof-roll equipment should not travel near excavations. It is recommended that a geotechnical engineer observe proof-roll operations and evaluate the subgrade stability based on those observations. Areas that are not safely accessible to proof-roll equipment are recommended to be evaluated and approved by a geotechnical engineer using appropriate means and methods.

Because of the shallow perched groundwater conditions and moisture- and disturbance-sensitive native soil, it is expected that unstable materials will be encountered during subgrade preparation. Unsuitable material is recommended to be removed and replaced with engineered fill or improved. Recommendations for subgrade improvement should, however, be made by a geotechnical engineer based on the site conditions during construction. Depending on the conditions during construction, areas requiring soil improvement might be large and improvement methods might need to extend significantly below the planned subgrade. Areas requiring subgrade improvement should be defined during construction with the assistance of a geotechnical engineer. Specific improvement methods should be determined during construction on an area-by-area basis. Where subgrade improvement is needed, it might be necessary to construct “test strips” to determine the most cost-effective and appropriate means of developing a suitable subgrade. Furthermore, as discussed in Section 8.1, an aggregate subbase underlain by geotextile or geogrid might need to be beneath the recommended pavement sections, depending on the site conditions during construction.

The site is recommended to be raised, where necessary, to the planned finished grade with engineered fill immediately after the subgrade is confirmed to be stable and suitable to support the proposed development. Engineered fill is recommended to be placed in relatively thin layers (lifts) that are uniform in elevation. Each layer of engineered fill is recommended to be compacted to at least 95 percent of the fill material's maximum dry density determined from the Standard Proctor compaction test (ASTM D698). As an exception, the in-place dry density of engineered fill within one foot of the pavement subgrade is recommended to be compacted to at least 100 percent of the fill's maximum dry density. The water content of fill material is recommended to be uniform and within a narrow range of the optimum moisture content, also determined by the Standard Proctor compaction test. Item Nos. 4 and 5 of the *Guide Specifications* give move information pertaining to selection and compaction of engineered fill.

Engineered fill that does not meet the density and water content requirements is recommended to be replaced with new fill, or scarified to a sufficient depth (likely 6 to 12 inches, or more), moisture-conditioned, and compacted to the required density. A subsequent lift of fill should only be placed after a geotechnical engineer confirms that the previous lift was properly placed and compacted. Subgrade soil will likely need to be recompacted immediately before construction since equipment traffic and adverse weather may reduce soil stability.

Use of Site Soil as Engineered Fill

Site soil that does not contain adverse organic content or other deleterious materials, as noted in the *Guide Specifications,* could be used as engineered fill to raise site grades. However, site soil will likely need to be moisture-conditioned (uniformly moistened or dried) prior to use as engineered fill. If construction is during adverse weather (discussed in the following section), drying site soil will likely not be feasible. In that case, aggregate fill (or other fill material with a low water-sensitivity) might need to be imported to the site. Recommendations regarding fill selection, placement, and compaction are given in the *Guide Specifications*.

8.4. Generalized Construction Considerations

Adverse Weather

Site soil is moisture sensitive and will become unstable when exposed to adverse weather, such as rain, snow, and freezing temperatures. Therefore, it might be necessary to remove or stabilize the upper 6 to 12 inches (or more) of soil due to adverse weather, which commonly occurs during late fall, winter, and early spring. At least some over-excavation or stabilization of unstable soil should be expected if construction is during or after adverse weather. Because site preparation is weather dependent, bids for site preparation and other earthwork activities should consider the time of year that construction will be conducted.

To protect soil from adverse weather, the site surface is recommended to be smoothly graded and contoured during construction to divert surface water from construction areas. Contoured subgrades are recommended to be rolled with a smooth-drum compactor before precipitation to "seal" the surface. Furthermore, construction traffic should be restricted to certain aggregate-covered areas to control traffic-related soil disturbance. Foundation, floor slab, and pavement construction should begin immediately after suitable support is confirmed.

Dewatering

Excavations are expected to be above the water table; however, some dewatering might be necessary due to perched groundwater and precipitation. Water that accumulates in construction areas is recommended to be removed along unsuitable soil as soon as possible. Filtered sump pumps, drawing water from sump pits excavated in the bottom of construction trenches, are expected to be adequate to remove water that collects in shallow excavations. Excavated sump pits should be fully lined with geotextile and filled with free-draining crushed stone, such as crushed stone that meets the gradation requirements of ASTM No. 57 aggregate.

Excavation Stability

Excavations are recommended to be made in accordance with current OSHA excavation and trench safety standards and other applicable requirements. Sides of excavations might need to be benched, sloped, or braced to maintain or develop a safe work environment. Temporary shoring must be designed according to applicable regulatory requirements. Contractors are responsible for excavation safety.

Draintile

Draintile may exist at the site, considering that the site has been used as agriculture land. Draintile is recommended to be relocated around the proposed development and discharged to a suitable location on a permanent basis. Draintile should not be plugged, since it might drain large areas. Draintile that is damaged should be repaired and relocated, as needed.

8.5. Recommended Construction Materials Testing

This report was prepared assuming that a geotechnical engineer will perform Construction Materials Testing ("CMT") services during construction of the proposed development. It might be necessary for Giles to provide supplemental geotechnical recommendations based on the results of CMT services and specific details of the project not known at this time.

9.0 BASIS OF REPORT

This report is strictly based on the project description given in Section 3.0. Giles must be notified if the project description or our assumptions are not accurate; revision of this report might be necessary. This report assumes that the proposed development will be designed and constructed according to the codes that govern construction at the site.

The conclusions and recommendations in this report are based on the estimated subsurface conditions shown on the *Test Boring Logs*. Giles must be notified if the subsurface conditions that are encountered during construction differ from those shown on the *Test Boring Logs*; revision of this report might be necessary. General comments and limitations of this report are given in the appendix.

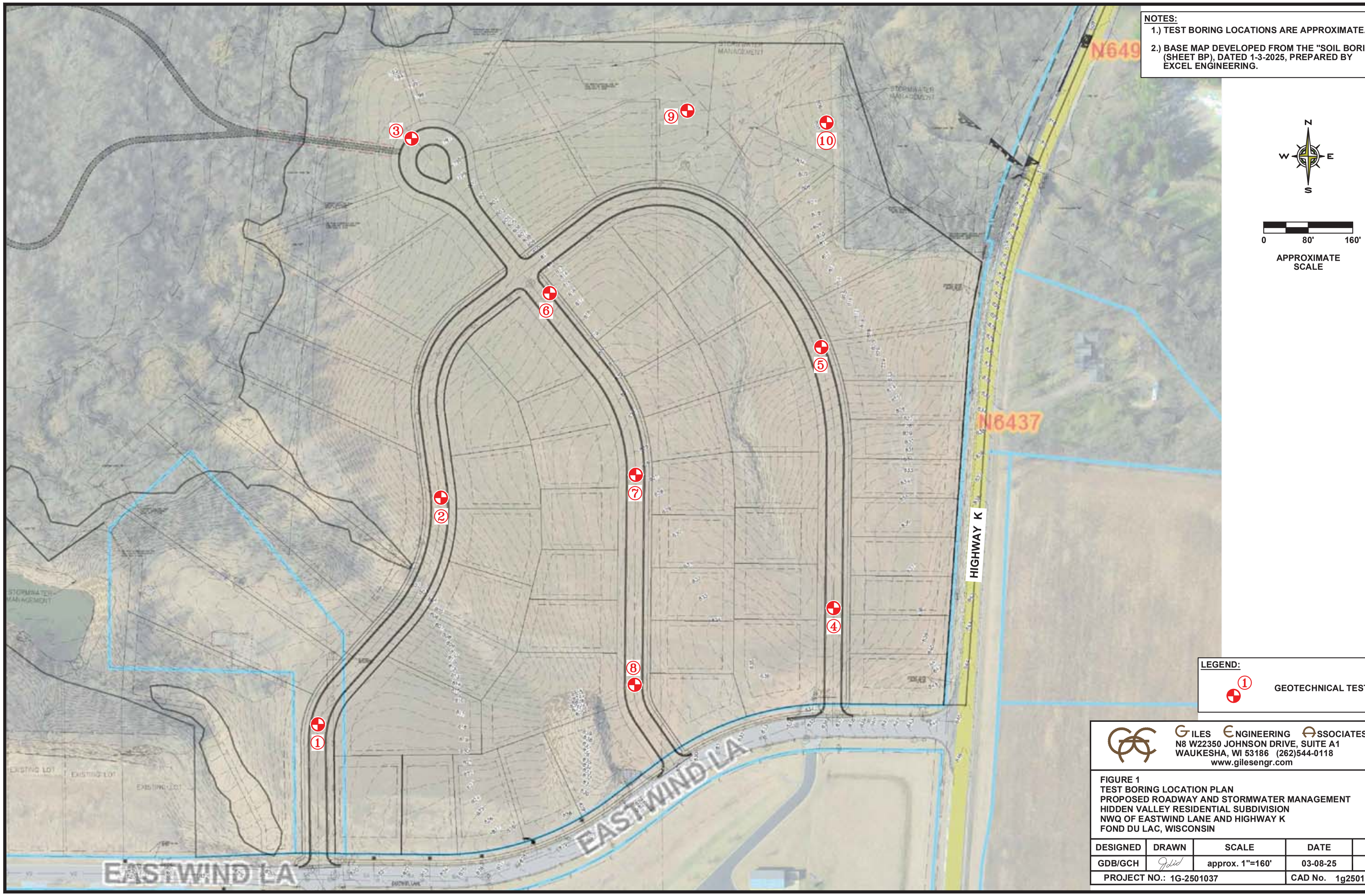
The conclusions and recommendations in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.

APPENDIX A

FIGURES AND TEST BORING LOGS

The Test Boring Location Plan contained herein was prepared based upon information supplied by *Giles'* client, or others, along with *Giles'* field measurements and observations. The diagram is presented for conceptual purposes only and is intended to assist the reader in report interpretation.

The Test Boring Logs and related information enclosed herein depict the subsurface (soil and water) conditions encountered at the specific boring locations on the date that the exploration was performed. Subsurface conditions may differ between boring locations and within areas of the site that were not explored with test borings. The subsurface conditions may also change at the boring locations over the passage of time.



NOTES:

1.) TEST BORING LOCATIONS ARE APPROXIMATE.

2.) BASE MAP DEVELOPED FROM THE "SOIL BORING PLAN" (SHEET BP), DATED 1-3-2025, PREPARED BY EXCEL ENGINEERING.

LEGEND:

① GEOTECHNICAL TEST BORING

GILES ENGINEERING ASSOCIATES, INC.
N8 W22350 JOHNSON DRIVE, SUITE A1
WAUKESHA, WI 53186 (262)544-0118
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FIGURE 1
TEST BORING LOCATION PLAN
PROPOSED ROADWAY AND STORMWATER MANAGEMENT
HIDDEN VALLEY RESIDENTIAL SUBDIVISION
NWQ OF EASTWIND LANE AND HIGHWAY K
FOND DU LAC, WISCONSIN

DESIGNED	DRAWN	SCALE	DATE	REVISED
GDB/GCH	GCH	approx. 1"=160'	03-08-25	--
PROJECT NO.: 1G-2501037			CAD No. 1g2501037-blp	

BORING NO. & LOCATION:
1

SURFACE ELEVATION:
817 feet

COMPLETION DATE:
03/03/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±8" Topsoil: Brown lean Clay, trace Sand and Organic Matter-Moist										±16" Frost
Red-Brown lean Clay, trace Sand and Gravel-Moist			1-SS	14		3.0		35		
		815	2-SS	7		3.3		31		
	5		3-SS	16	3.9	4.0		28		
		810	4-SS	16	5.0	4.5+		18		
	10		5-SS	17	5.0	4.5+		26		
		805								
	15		6-SS	16	5.0	4.5+		27		
		800								
	20		7-SS	14		4.5+		28		

Boring Terminated at about 21 feet (EL. 796')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
2

SURFACE ELEVATION:
812 feet

COMPLETION DATE:
03/03/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±6" Topsoil: Brown lean Clay, little Sand and Organic Matter-Very Moist			1-SS	7		3.0		31		±16" Frost
Red-Brown lean Clay, trace Sand and Gravel-Moist		810	2-SS	18		4.5+		22		
	5		3-SS	19	8.2	4.5+		23		
		805	4-SS	18	5.2	4.5+		23		
	10		5-SS	15	5.0	4.5+		26		
		800								
	15		6-SS	15		4.5+		27		
		795								
	20		7-SS	14	4.7	4.5+		26		

Boring Terminated at about 21 feet (EL. 791')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
3

SURFACE ELEVATION:
796.3 feet

COMPLETION DATE:
03/03/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±8" Topsoil: Brown lean Clay, little Sand and Organic Matter-Moist										±8" Frost
Red-Brown lean Clay, trace Sand and Gravel-Moist		795	1-AU					28		
			2-SS	13		4.5+		23		
	5		3-SS	11	5.0	4.5+		27		
		790								
			4-SS	26	6.6	4.5+		21		
	10		5-SS	15	5.2	4.5+		18		
		785								
	15		6-SS	12	4.5	4.0		35		
		780								
	20		7-SS	14	3.7	3.8		36		

Boring Terminated at about 21 feet (EL. 775.3')

	Water Observation Data	Remarks:
∇	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION: 4

SURFACE ELEVATION: 831 feet

COMPLETION DATE: 02/28/25

FIELD REP: COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±2" Topsoil: Brown lean Clay, little Sand and Organic Matter-Moist		830	1-SS	11		1.0		33		
Red-Brown lean Clay, trace Sand and Gravel-Moist			2-SS	20	6.2	4.5+		22		
	5	825	3-SS	18	8.2	4.5+		19		
			4-SS	19	5.2	4.5+		22		
	10	820	5-SS	17				23		(a)
	15	815	6-SS	14	5.4	4.5+		29		
	20	810	7-SS	14	6.0	4.5+		25		

Boring Terminated at about 21 feet (EL. 810')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	(a) Poor Sample Recovery
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
5

SURFACE ELEVATION:
819 feet

COMPLETION DATE:
02/28/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±4" Topsoil: Brown lean Clay, trace Sand and Organic Matter-Moist			1-SS	7		3.5		29		
Red-Brown lean Clay, trace Sand and Gravel-Moist			2-SS	16		4.5+		22		
		815								
	5		3-SS	20		4.5+		24		
			4-SS	21	6.2	4.5+		26		
		810								
	10		5-SS	14	4.5	4.5+		23		
		805								
	15		6-SS	13		4.0		29		
		800								
	20		7-SS	12		4.3		31		

Boring Terminated at about 21 feet (EL. 798')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
6

SURFACE ELEVATION:
814 feet

COMPLETION DATE:
03/03/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±10" Topsoil: Brown lean Clay, trace Sand and Organic Matter-Moist			1-AU					28		±8" Frost
Red-Brown lean Clay, trace Sand and Gravel-Moist			2-SS	18	7.0	4.5+		22		
		810								
	5		3-SS	17	6.2	4.5+		20		
			4-SS	24	6.2	4.5+		20		
		805								
	10		5-SS	60				18		
		800								
	15		6-SS	14				29		(a)
		795								
	20		7-SS	17	6.4	4.5+		36		

Boring Terminated at about 21 feet (EL. 793')

Water Observation Data

▽ Water Encountered During Drilling:
▼ Water Level At End of Drilling:
░ Cave Depth At End of Drilling:
▼ Water Level After Drilling:
▓ Cave Depth After Drilling:

Remarks:

(a) No SPT Sample Recovery - Auger Sample Obtained

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
7

SURFACE ELEVATION:
826 feet

COMPLETION DATE:
03/03/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±8" Topsoil: Brown lean Clay, trace Sand and Organic Matter-Moist		825	1-SS	10		2.5		28		±14" Frost
Red-Brown lean Clay, little Sand, trace Gravel-Moist			2-SS	21		4.5+		19		
Red-Brown lean Clay, trace Sand and Gravel-Moist	5	820	3-SS	20	8.5	4.5+		26		
			4-SS	23		4.5+		22		
	10	815	5-SS	20	7.0	4.5+		21		
	15	810	6-SS	19	5.0	4.5+		24		
	20	805	7-SS	19	4.5	4.3		29		

Boring Terminated at about 21 feet (EL. 805')

	Water Observation Data	Remarks:
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION: 8	# TEST BORING LOG	**GILES ENGINEERING ASSOCIATES, INC.**
SURFACE ELEVATION: 825.5 feet	PROPOSED ROADWAYS AND STORMWATER MANAGEMENT EASTWIND LANE FOND DU LAC, WISCONSIN	
COMPLETION DATE: 03/03/25		
FIELD REP: COLLIN BUCKO	PROJECT NO: 1G-2501037	

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±1" Topsoil: Brown lean Clay, trace Sand and Organic Matter-Moist		825	1-SS	9		4.3		24		±14" Frost
Red-Brown lean Clay, trace Sand and Gravel-Moist			2-SS	21		4.5+		19		
	5	820	3-SS	20		4.5+		18		
			4-SS	19		4.5+		23		
	10	815	5-SS	18	5.4	4.5+		26		
	15	810	6-SS	17		4.5+		22		
	20	805	7-SS	11		4.5+		27		

Boring Terminated at about 21 feet (EL. 804.5')

	Water Observation Data	**Remarks:**
▽	Water Encountered During Drilling:	
▼	Water Level At End of Drilling:	
░	Cave Depth At End of Drilling:	
▼	Water Level After Drilling:	
▓	Cave Depth After Drilling:	

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION:
9

SURFACE ELEVATION:
799 feet

COMPLETION DATE:
03/03/25

FIELD REP:
COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±12" Topsoil: Dark Brown lean Clay, trace Sand and Organic Matter-moist			1-AU					39		±10" Frost
Red-Brown lean Clay, trace Sand and Gravel-Moist			2-SS	19	6.2	4.5+		22		
		795								
	5		3-SS	17	3.4	3.0		26		
			4-SS	18		4.5		21		
		790								
	10		5-SS	18		4.5		22		
			6-SS	16	4.0	3.5		36		
		785								
	15		7-SS	8	2.1	2.0		38		
	∇									
Gray Sandy Silt, trace Gravel-Wet			8-SS	39						
		780								
Gray Silty Clay, little Sand, trace Gravel-Moist	20		9-SS	18		4.0		14		

Boring Terminated at about 21 feet (EL. 778')

	Water Observation Data
∇	Water Encountered During Drilling: 16.5 ft.
▼	Water Level At End of Drilling:
░	Cave Depth At End of Drilling:
▼	Water Level After Drilling:
▓	Cave Depth After Drilling:

Remarks:

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

BORING NO. & LOCATION: 10

SURFACE ELEVATION: 806 feet

COMPLETION DATE: 02/28/25

FIELD REP: COLLIN BUCKO

TEST BORING LOG

PROPOSED ROADWAYS AND STORMWATER MANAGEMENT

EASTWIND LANE
FOND DU LAC, WISCONSIN

PROJECT NO: 1G-2501037

GILES ENGINEERING ASSOCIATES, INC.

MATERIAL DESCRIPTION	Depth (ft)	Elevation	Sample No. & Type	N	Q_u (tsf)	Q_p (tsf)	Q_s (tsf)	W (%)	PID	NOTES
±6" Topsoil: Brown lean Clay, trace Sand and Organic Matter-Moist										
Red-Brown lean Clay, trace Sand and Gravel-Moist		805	1-SS	7		2.0		28		
			2-SS	18		4.5+		23		
	5	800	3-SS	17		4.0		30		
			4-SS	14				29		(a)
	10	795	5-SS	14		4.5		30		
			6-SS	14	3.7	4.0		35		
	15	790	7-SS	13	4.3	4.5+		34		
Gray Sandy Silt, little Gravel-Wet	▽		8-SS	24						
	20	785	9-SS	15						

Boring Terminated at about 21 feet (EL. 785')

	Water Observation Data
▽	Water Encountered During Drilling: 16.5 ft.
▼	Water Level At End of Drilling:
░	Cave Depth At End of Drilling:
▼	Water Level After Drilling:
▓	Cave Depth After Drilling:

Remarks:

(a) No SPT Sample Recovery - Auger Sample Obtained

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

Wisconsin Department of Safety and Professional Services
Division of Industry Services
4822 Madison Yards Way
PO Box 7302
Madison, WI 53707

Phone: 608-266-2112
Web: http://dsps.wi.gov
Email: dsps@wisconsin.gov

Program: Plumbing
Web: https://dsps.wi.gov/Pages/Programs/Plumbing

Soil and Site Evaluation – Stormwater Infiltration

In accordance with SPS 382.365, 385, Wis. Adm. Code, and WDNR Standard 1002

Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)]

Page 1 of 2

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include, but is not limited to: vertical and horizontal reference point (BM); direction and percent of slope; scale or dimensions; north arrow; and BM referenced to nearest road.

PLEASE PRINT ALL INFORMATION

COUNTY
Fond du Lac

PARCEL ID

PROPERTY OWNER

PROPERTY OWNER'S MAILING ADDRESS

CITY, STATE, ZIP CODE
PHONE

PROPERTY LOCATION
Govt. Lot_NW ¼, NE ¼, S18, T15N, R18E
Lot #, Block #, Subd. Name or CSM #: ________________
Municipality: Fond du Lac
☒ City ☐ Village ☐ Town
Nearest Road: Highway K

Drainage area____________________ ☐sq. ft. ☐acres

Test site suitable for (check all that apply):
☐ Site not suitable
☐ Reuse
☐ Irrigation
☐Bioretention
☐Subsurface Dispersal System
☐Other ________________________

HYDRAULIC APPLICATION TEST METHOD
☐ Morphological Evaluation
☐ Double Ring Infiltrometer
☐ Other: (specify)
____

SOIL MOISTURE
Date of test pits:
2/28/2025 & 3/3/2025

USDA-NRCS WETS VALUE:
☐ Dry = 1
☐ Normal = 2
☐ Wet = 3

9 #OBS. ☐ Pit ☒ Boring Ground Surface Elevation 799 ft. Elevation of Limiting Factor 782.5 ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
A	0-12	10 YR 4/4	--	SiCL	1, VF, SBK	M, FR	A, S	<5	80	0.04
B/C	12-198	5 YR 4/4	--	SiCL	1, VF, SBK	M, FI	C, W	5	90	0.04
C	198-228	5 YR 5/1	--	SiL	MA	M, FI	G, W	10	70	0.13
C	228-252	5 YR 5/1		SiCL	MA	M, FR	--	10	75	0.04

Comments: Water encountered at 16.5 feet below ground.

10 #OBS. ☐ Pit ☒ Boring Ground Surface Elevation 806 ft. Elevation of Limiting Factor 789.5 ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
A	0-6	10 YR 3/3	--	SiCL	1, VF, SBK	M, FR	A, S	<5	80	0.04
B/C	6-198	5 YR 4/4	--	SiCL	1, VF, SBK	M, FI	C, W	5	90	0.04
C	198-252	5 YR 5/1	--	SiL	MA	M, FI	--	15	70	0.13

Comments: Water encountered at 16.5 feet below ground.

Overall Site Comments:

Michelle L. Peed, P.G.
Name (Please Print)

Signature

P.G. No.: 1370-13
Credential Number

N8 W22350 Johnson Drive, Waukesha, WI
Address

February 28 and March 3, 2025
Date Evaluation Conducted

(262) 544-0118
Phone Number

APPENDIX B

FIELD PROCEDURES

The field operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) designation D

420 entitled “Standard Guide for Sampling Rock and Rock” and/or other relevant specifications. Soil samples were preserved and transported to *Giles’* laboratory in general accordance with the procedures recommended by ASTM designation D 4220 entitled “Standard Practice for Preserving and Transporting Soil Samples.” Brief descriptions of the sampling, testing and field procedures commonly performed by *Giles* are provided herein.

GENERAL FIELD PROCEDURES

Test Boring Elevations

The ground surface elevations reported on the Test Boring Logs are referenced to the assumed benchmark shown on the Boring Location Plan (Figure 1). Unless otherwise noted, the elevations were determined with a conventional hand-level and are accurate to within about 1 foot.

Test Boring Locations

The test borings were located on-site based on the existing site features and/or apparent property lines. Dimensions illustrating the approximate boring locations are reported on the Boring Location Plan (Figure 1).

Water Level Measurement

The water levels reported on the Test Boring Logs represent the depth of “free” water encountered during drilling and/or after the drilling tools were removed from the borehole. Water levels measured within a granular (sand and gravel) soil profile are typically indicative of the water table elevation. It is usually not possible to accurately identify the water table elevation with cohesive (clayey) soils, since the rate of seepage is slow. The water table elevation within cohesive soils must therefore be determined over a period of time with groundwater observation wells.

It must be recognized that the water table may fluctuate seasonally and during periods of heavy precipitation. Depending on the subsurface conditions, water may also become perched above the water table, especially during wet periods.

Borehole Backfilling Procedures

Each borehole was backfilled upon completion of the field operations. If potential contamination was encountered, and/or if required by state or local regulations, boreholes were backfilled with an “impervious” material (such as bentonite slurry). Borings that penetrated pavements, sidewalks, etc. were “capped” with Portland Cement concrete, asphaltic concrete, or a similar surface material. It must, however, be recognized that the backfill material may settle, and the surface cap may subside, over a period of time. Further backfilling and/or re-surfacing by *Giles’* client or the property owner may be required.

FIELD SAMPLING AND TESTING PROCEDURES

Auger Sampling (AU)

Soil samples are removed from the auger flights as an auger is withdrawn above the ground surface. Such samples are used to determine general soil types and identify approximate soil stratifications. Auger samples are highly disturbed and are therefore not typically used for geotechnical strength testing.

Split-Barrel Sampling (SS) – (ASTM D-1586)

A split-barrel sampler with a 2-inch outside diameter is driven into the subsoil with a 140-pound hammer free-falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the “Standard Penetration Resistance” or N-value is an index of the relative density of granular soils and the comparative consistency of cohesive soils. A soil sample is collected from each SPT interval.

Shelby Tube Sampling (ST) – (ASTM D-1587)

A relatively undisturbed soil sample is collected by hydraulically advancing a thin-walled Shelby Tube sampler into a soil mass. Shelby Tubes have a sharp cutting edge and are commonly 2 to 5 inches in diameter.

Bulk Sample (BS)

A relatively large volume of soils is collected with a shovel or other manually-operated tool. The sample is typically transported to *Giles'* materials laboratory in a sealed bag or bucket.

Dynamic Cone Penetration Test (DC) – (ASTM STP 399)

This test is conducted by driving a 1.5-inch-diameter cone into the subsoil using a 15-pound steel ring (hammer), free-falling a vertical distance of 20 inches. The number of hammer-blows required to drive the cone 1¾ inches is an indication of the soil strength and density, and is defined as “N”. The Dynamic Cone Penetration test is commonly conducted in hand auger borings, test pits and within excavated trenches.

- Continued -

Ring-Lined Barrel Sampling – (ASTM D 3550)

In this procedure, a ring-lined barrel sampler is used to collect soil samples for classification and laboratory testing. This method provides samples that fit directly into laboratory test instruments without additional handling/disturbance.

Sampling and Testing Procedures

The field testing and sampling operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the field testing (i.e. N-values) are reported on the Test Boring Logs. Explanations of the terms and symbols shown on the logs are provided on the appendix enclosure entitled “General Notes”.

APPENDIX C

LABORATORY TESTING AND CLASSIFICATION

The laboratory testing was conducted under the supervision of a geotechnical engineer in accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Brief descriptions of laboratory tests commonly performed by *Giles* are provided herein.

LABORATORY TESTING AND CLASSIFICATION

Photoionization Detector (PID)

In this procedure, soil samples are “scanned” in *Giles’* analytical laboratory using a Photoionization Detector (PID). The instrument is equipped with an 11.7 eV lamp calibrated to a Benzene Standard and is capable of detecting a minute concentration of **certain** Volatile Organic Compound (VOC) vapors, such as those commonly associated with petroleum products and some solvents. Results of the PID analysis are expressed in HNu (manufacturer’s) units rather than actual concentration.

Moisture Content (w) (ASTM D 2216)

Moisture content is defined as the ratio of the weight of water contained within a soil sample to the weight of the dry solids within the sample. Moisture content is expressed as a percentage.

Unconfined Compressive Strength (qu) (ASTM D 2166)

An axial load is applied at a uniform rate to a cylindrical soil sample. The unconfined compressive strength is the maximum stress obtained or the stress when 15% axial strain is reached, whichever occurs first.

Calibrated Penetrometer Resistance (qp)

The small, cylindrical tip of a hand-held penetrometer is pressed into a soil sample to a prescribed depth to measure the soils capacity to resist penetration. This test is used to evaluate unconfined compressive strength.

Vane-Shear Strength (qs)

The blades of a vane are inserted into the flat surface of a soil sample and the vane is rotated until failure occurs. The maximum shear resistance measured immediately prior to failure is taken as the vane-shear strength.

Loss-on-Ignition (ASTM D 2974; Method C)

The Loss-on-Ignition (L.O.I.) test is used to determine the organic content of a soil sample. The procedure is conducted by heating a dry soil sample to 440°C in order to burn-off or “ash” organic matter present within the sample. The L.O.I. value is the ratio of the weight loss due to ignition compared to the initial weight of the dry sample. L.O.I. is expressed as a percentage.

Particle Size Distribution (ASTB D 421, D 422, and D 1140)

This test is performed to determine the distribution of specific particle sizes (diameters) within a soil sample. The distribution of coarse-grained soil particles (sand and gravel) is determined from a "sieve analysis," which is conducted by passing the sample through a series of nested sieves. The distribution of fine-grained soil particles (silt and clay) is determined from a "hydrometer analysis" which is based on the sedimentation of particles suspended in water.

Consolidation Test (ASTM D 2435)

In this procedure, a series of cumulative vertical loads are applied to a small, laterally confined soil sample. During each load increment, vertical compression (consolidation) of the sample is measured over a period of time. Results of this test are used to estimate settlement and time rate of settlement.

Classification of Samples

Each soil sample was visually-manually classified, based on texture and plasticity, in general accordance with the Unified Soil Classification System (ASTM D-2488-75). The classifications are reported on the Test Boring Logs.

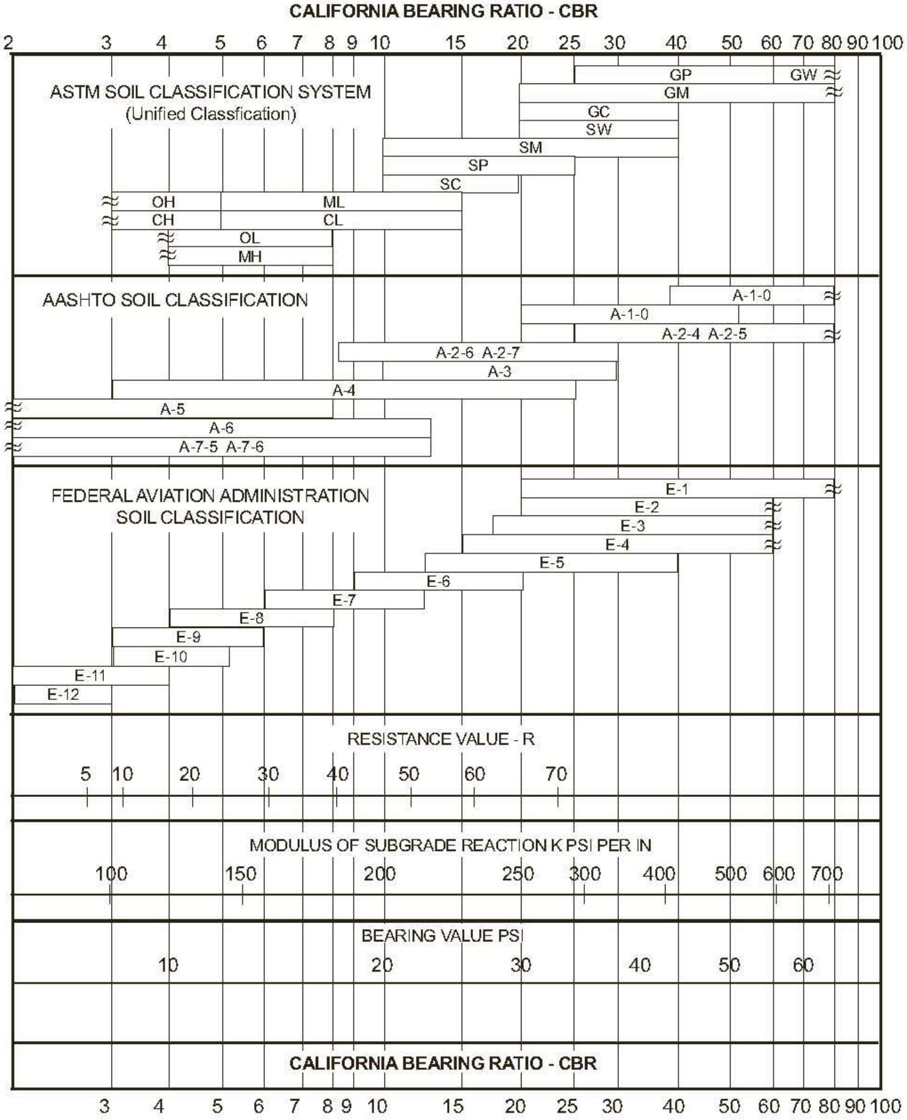
Laboratory Testing

The laboratory testing operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the laboratory tests are provided on the Test Boring Logs or other appendix enclosures. Explanation of the terms and symbols used on the logs is provided on the appendix enclosure entitled "General Notes."

California Bearing Ratio (CBR) Test ASTM D-1833

The CBR test is used for evaluation of a soil subgrade for pavement design. The test consists of measuring the force required for a 3-square-inch cylindrical piston to penetrate 0.1 or 0.2 inch into a compacted soil sample. The result is expressed as a percent of force required to penetrate a standard compacted crushed stone.

Unless a CBR test has been specifically requested by the client, the CBR is estimated from published charts, based on soil classification and strength characteristics. A typical correlation chart is below.



APPENDIX D

GENERAL INFORMATION

AND
IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL REPORT

GENERAL COMMENTS

The soil samples obtained during the subsurface exploration will be retained for a period of thirty days. If no instructions are received, they will be disposed of at that time.

This report has been prepared exclusively for the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. Copies of this report may be provided to contractor(s), with contract documents, to disclose information relative to this project. The report, however, has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project architect, structural engineer, and/or civil engineer. Reproduction and distribution of this report must be authorized by the client and *Giles*.

This report has been based on assumed conditions/characteristics of the proposed development where specific information was not available. It is recommended that the architect, civil engineer and structural engineer along with any other design professionals involved in this project carefully review these assumptions to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein. The project plans and specifications may also be submitted to *Giles* for review to ensure that the geotechnical related conclusions and recommendations provided herein have been correctly interpreted.

The analysis of this site was based on a subsoil profile interpolated from a limited subsurface exploration. If the actual conditions encountered during construction vary from those indicated by the borings, *Giles* must be contacted immediately to determine if the conditions alter the recommendations contained herein.

The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.

GUIDE SPECIFICATIONS FOR SUBGRADE AND GRADE PREPARATION FOR FILL, FOUNDATION, FLOOR SLAB AND PAVEMENT SUPPORT; AND SELECTION, PLACEMENT AND COMPACTION OF FILL SOILS USING STANDARD PROCTOR PROCEDURES

1. Construction monitoring and testing of subgrades and grades for fill, foundation, floor slab and pavement; and fill selection, placement and compaction shall be performed by an experienced soils engineer and/or his representatives.

2. All compaction fill, subgrades and grades shall be (a) underlain by suitable bearing material; (b) free of all organic, frozen, or other deleterious material, and (c) observed, tested and approved by qualified engineering personnel representing an experienced soils engineer. Preparation of subgrades after stripping vegetation, organic or other unsuitable materials shall consist of (a) proof-rolling to detect soil, wet yielding soils or other unstable materials that must be undercut, (b) scarifying top 6 to 8 inches, (c) moisture conditioning the soils as required, and (d) recompaction to same minimum in-situ density required for similar materials indicated under Item 5. Note: compaction requirements for pavement subgrade are higher than other areas. Weather and construction equipment may damage compacted fill surface and reworking and retesting may be necessary to assure proper performance.

3. In overexcavation and fill areas, the compacted fill must extend (a) a minimum 1 foot lateral distance beyond the exterior edge of the foundation at bearing grade or pavement subgrade and down to compacted fill subgrade on a maximum 0.5(H):1(V) slope, (b) 1 foot above footing grade outside the building, and (c) to floor subgrade inside the building. Fill shall be placed and compacted on a 5(H):1(V) slope or must be stepped or benched as required to flatten if not specifically approved by qualified personnel under the direction of an experienced soil engineer.

4. The compacted fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as “contaminated”, and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) and Plasticity Index (ASTM D-424) of 30 and 15, respectively, unless specifically tested and found to have low expansive properties and approved by an experienced soils engineer. The top 12 inches of compacted fill should have a maximum 3-inch-particle diameter and all underlying compacted fill a maximum 6-inch-diameter unless specifically approved by an experienced soils engineer. All fill materials must be tested and approved under the direction of an experienced soils engineer prior to placement. If the fill is to provide non-frost susceptible characteristics, it must be classified as a clean GW, GP, SW or SP per the Unified Soil Classification System (ASTM D-2487).

5. For structural fill depths less than 20 feet, the density of the structural compacted fill and scarified subgrade and grades shall not be less than 95 percent of the maximum dry density as determined by Standard Proctor (ASTM-698) with the exception of the top 12 inches of pavement subgrade which shall have a minimum in-situ density of 100 percent of maximum dry density, or 5 percent higher than underlying fill materials. Where the structural fill depth is greater than 20 feet, the portions below 20 feet should have a minimum in-place density of 100 percent of its maximum dry density of 5 percent greater than the top 20 feet. The moisture content of cohesive soil shall not vary by more than -1 to +3 percent and granular soil ±3 percent of the optimum when placed and compacted or recompacted, unless specifically recommended/approved by the soils engineer monitoring the placement and compaction. Cohesive soils with moderate to high expansion potentials (PI>15) should, however, be placed, compacted and maintained prior to construction at a moisture content 3±1 percent above optimum moisture content to limit further heave. The fill shall be placed in layers with a maximum loose thickness of 8 inches for foundations and 10 inches for floor slabs and pavement, unless specifically approved by the soils engineer taking into consideration the type of materials and compaction equipment being used. The compaction equipment should consist of suitable mechanical equipment specifically designed for soil compaction. Bulldozers or similar tracked vehicles are typically not suitable for compaction.

6. Excavation, filling, subgrade and grade preparation shall be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs and seepage water encountered shall be pumped or drained to provide a suitable working platform. Springs or water seepage encountered during grading/foundation construction must be called to the soil engineer’s attention immediately for possible construction procedure revision or inclusion of an underdrain system.

7. Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below-grade walls (i.e. basement walls and retaining walls) must be properly tested and approved by an experienced soils engineer with consideration for the lateral pressure used in the wall design.

8. Whenever, in the opinion of the soils engineer or the Owner’s Representatives, an unstable condition is being created either by cutting or filling, the work shall not proceed into that area until an appropriate geotechnical exploration and analysis has been performed and the grading plan revised, if found necessary.

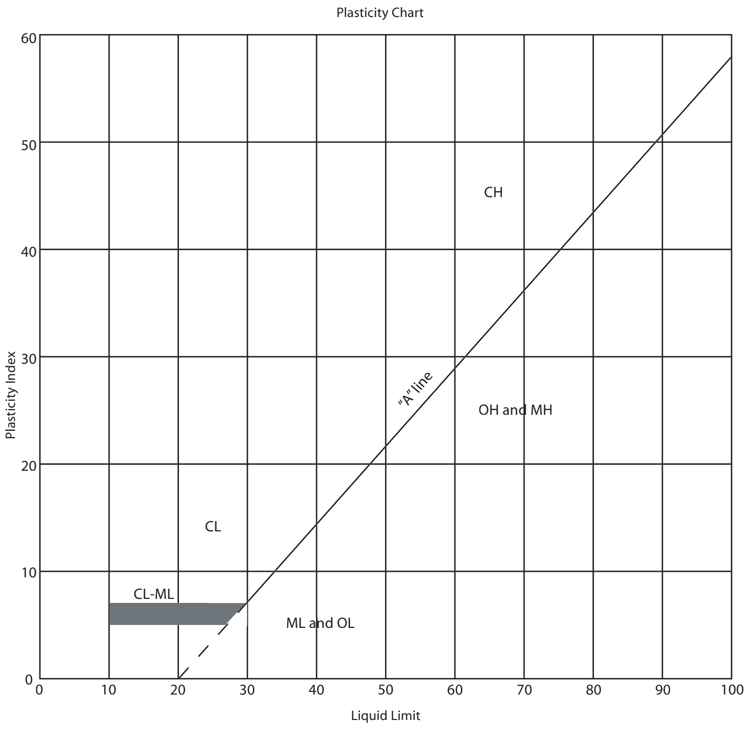
CHARACTERISTICS AND RATINGS OF UNIFIED SOIL SYSTEM CLASSES FOR SOIL CONSTRUCTION *

Class	Compaction Characteristics	Max. Dry Density Standard Proctor (pcf)	Compressibility and Expansion	Drainage and Permeability	Value as an Embankment Material	Value as Subgrade When Not Subject to Frost	Value as Base Course	Value as Temporary Pavement	
								With Dust Palliative	With Bituminous Treatment
GW	Good: tractor, rubber-tired, steel wheel or vibratory roller	125-135	Almost none	Good drainage, pervious	Very stable	Excellent	Good	Fair to poor	Excellent
GP	Good: tractor, rubber-tired, steel wheel or vibratory roller	115-125	Almost none	Good drainage, pervious	Reasonably stable	Excellent to good	Poor to fair	Poor	
GM	Good: rubber-tired or light sheepsfoot roller	120-135	Slight	Poor drainage, semipervious	Reasonably stable	Excellent to good	Fair to poor	Poor	Poor to fair
GC	Good to fair: rubber-tired or sheepsfoot roller	115-130	Slight	Poor drainage, impervious	Reasonably stable	Good	Good to fair **	Excellent	Excellent
SW	Good: tractor, rubber-tired or vibratory roller	110-130	Almost none	Good drainage, pervious	Very stable	Good	Fair to poor	Fair to poor	Good
SP	Good: tractor, rubber-tired or vibratory roller	100-120	Almost none	Good drainage, pervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SM	Good: rubber-tired or sheepsfoot roller	110-125	Slight	Poor drainage, impervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SC	Good to fair: rubber-tired or sheepsfoot roller	105-125	Slight to medium	Poor drainage, impervious	Reasonably stable	Good to fair	Fair to poor	Excellent	Excellent
ML	Good to poor: rubber-tired or sheepsfoot roller	95-120	Slight to medium	Poor drainage, impervious	Poor stability, high density required	Fair to poor	Not suitable	Poor	Poor
CL	Good to fair: sheepsfoot or rubber-tired roller	95-120	Medium	No drainage, impervious	Good stability	Fair to poor	Not suitable	Poor	Poor
OL	Fair to poor: sheepsfoot or rubber-tired roller	80-100	Medium to high	Poor drainage, impervious	Unstable, should not be used	Poor	Not suitable	Not suitable	Not suitable
MH	Fair to poor: sheepsfoot or rubber-tired roller	70-95	High	Poor drainage, impervious	Poor stability, should not be used	Poor	Not suitable	Very poor	Not suitable
CH	Fair to poor: sheepsfoot roller	80-105	Very high	No drainage, impervious	Fair stability, may soften on expansion	Poor to very poor	Not suitable	Very poor	Not suitable
OH	Fair to poor: sheepsfoot roller	65-100	High	No drainage, impervious	Unstable, should not be used	Very poor	Not suitable	Not suitable	Not suitable
Pt	Not suitable		Very high	Fair to poor drainage	Should not be used	Not suitable	Not suitable	Not suitable	Not suitable

* "The Unified Classification: Appendix A - Characteristics of Soil, Groups Pertaining to Roads and Airfields, and Appendix B - Characteristics of Soil Groups Pertaining to Embankments and Foundations," Technical Memorandum 357, U.S. Waterways Ixperiment Station, Vicksburg, 1953.

** Not suitable if subject to frost.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Major Divisions			*Group Symbols*		*Typical Names*	*Laboratory Classification Criteria*		
Coarse-grained soils (more than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	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[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtrues, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-grained soils (More than half 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			
			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			

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[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits, suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group sympols. For example GW-GC, well-graded gravel-sand mixture with clay binder.

GENERAL NOTES

SAMPLE IDENTIFICATION

All samples are visually classified in general accordance with the Unified Soil Classification System (ASTM D-2487-75 or D-2488-75)

DESCRIPTIVE TERM (% BY DRY WEIGHT)

Trace:	1-10%
Little:	11-20%
Some:	21-35%
And/Adjective	36-50%

PARTICLE SIZE (DIAMETER)

Boulders:	8 inch and larger
Cobbles:	3 inch to 8 inch
Gravel:	coarse - ¾ to 3 inch
	fine – No. 4 (4.76 mm) to ¾ inch
Sand:	coarse – No. 4 (4.76 mm) to No. 10 (2.0 mm)
	medium – No. 10 (2.0 mm) to No. 40 (0.42 mm)
	fine – No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt:	No. 200 (0.074 mm) and smaller (non-plastic)
Clay:	No 200 (0.074 mm) and smaller (plastic)

SOIL PROPERTY SYMBOLS

Dd:	Dry Density (pcf)
LL:	Liquid Limit, percent
PL:	Plastic Limit, percent
PI:	Plasticity Index (LL-PL)
LOI:	Loss on Ignition, percent
Gs:	Specific Gravity
K:	Coefficient of Permeability
w:	Moisture content, percent
qp:	Calibrated Penetrometer Resistance, tsf
qs:	Vane-Shear Strength, tsf
qu:	Unconfined Compressive Strength, tsf
qc:	Static Cone Penetrometer Resistance (correlated to Unconfined Compressive Strength, tsf)
PID:	Results of vapor analysis conducted on representative samples utilizing a Photoionization Detector calibrated to a benzene standard. Results expressed in HNU-Units. (BDL=Below Detection Limit)
N:	Penetration Resistance per 12 inch interval, or fraction thereof, for a standard 2 inch O.D. (1⅜ inch I.D.) split spoon sampler driven with a 140 pound weight free-falling 30 inches. Performed in general accordance with Standard Penetration Test Specifications (ASTM D-1586). N in blows per foot equals sum of N-Values where plus sign (+) is shown.
Nc:	Penetration Resistance per 1¾ inches of Dynamic Cone Penetrometer. Approximately equivalent to Standard Penetration Test N-Value in blows per foot.
Nr:	Penetration Resistance per 12 inch interval, or fraction thereof, for California Ring Sampler driven with a 140 pound weight free-falling 30 inches per ASTM D-3550. Not equivalent to Standard Penetration Test N-Value.

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon
ST:	Shelby Tube – 3 inch O.D. (except where noted)
CS:	3 inch O.D. California Ring Sampler
DC:	Dynamic Cone Penetrometer per ASTM Special Technical Publication No. 399
AU:	Auger Sample
DB:	Diamond Bit
CB:	Carbide Bit
WS:	Wash Sample
RB:	Rock-Roller Bit
BS:	Bulk Sample
Note:	Depth intervals for sampling shown on Record of Subsurface Exploration are not indicative of sample recovery, but position where sampling initiated

SOIL STRENGTH CHARACTERISTICS

COHESIVE (CLAYEY) SOILS

COMPARATIVE CONSISTENCY	BLOWS PER FOOT (N)	UNCONFINED COMPRESSIVE STRENGTH (TSF)
Very Soft	0 - 2	0 - 0.25
Soft	3 - 4	0.25 - 0.50
Medium Stiff	5 – 8	0.50 - 1.00
Stiff	9 – 15	1.00 - 2.00
Very Stiff	16 – 30	2.00 - 4.00
Hard	31+	4.00+

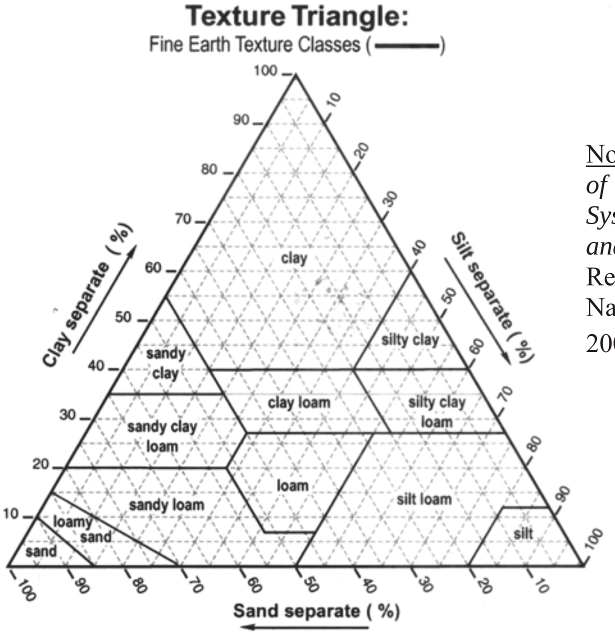
NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	BLOWS PER FOOT (N)
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	51+

DEGREE OF PLASTICITY	PI
None to Slight	0 - 4
Slight	5 - 10
Medium	11 - 30
High to Very High	31+

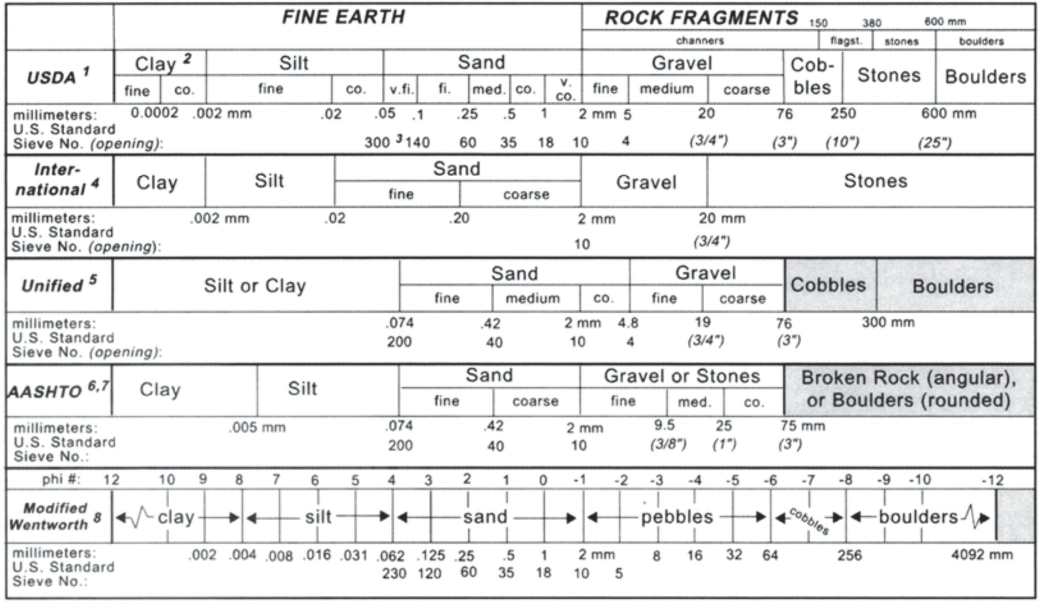
DEGREE OF EXPANSIVE POTENTIAL	PI
Low	0 - 15
Medium	15 - 25
High	25+

SOIL CLASSIFICATION NOTES



Note: *Texture Triangle* and *Comparison of Particle Size Classes in Different Systems* from *Field Book for Describing and Sampling Soil*, USDA Natural Resources Conservation Service National Soil Survey Center (September 2002).

Comparison of Particle Size Classes in Different Systems



1. Soil Survey Staff. 1995. Soil survey Laboratory information manual. USDA, Natural Resources Conservation Service, Soil Survey Investigations Report No. 45, Version 1.0, National Soil Survey Center, Lincoln, NE. 305 p.
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3. The Soil Survey Lab (Lincoln, NE) uses a no. 300 sieve (0.047 mm opening) for the USDA-sand/silt measurement. A no. 270 sieve (0.053 mm opening) is more readily available and widely used.
4. International Soil Science Society. 1951. *In*: Soil Survey Manual. Soil Survey Staff, USDA-Soil Conservation Service, Agricultural Handbook No. 18, U.S. Gov. Print. Office, Washington, D.C. 214 p.
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Important Information about This

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.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' 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 personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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