Geotechnical Engineering Report

Fort McPherson Parking Deck
1701 Hardee Ave, SW
Atlanta, Georgia
January 24, 2017
Terracon Project No. 49165249A

Prepared For:
Guidon Design, Inc
Indianapolis, Indiana

Prepared By:
Terracon Consultants, Inc.
Atlanta, Georgia

January 24, 2017

Terracon

Guidon Design, Inc.
905 North Capitol Avenue, Suite 100
Indianapolis, Indiana 46204

Attn: Mr. Mark VanderWoude, PE

Re: Geotechnical Engineering Report
Fort McPherson Parking Deck
1701 Hardee Ave, SW
Atlanta, Georgia
Terracon Project No. 49165249A

Dear Mr. VanderWoude:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our Proposal Number P49165249FM (Revised), dated December 21, 2017, as authorized by you on December 21, 2016.

This report presents the results of the subsurface exploration and provides geotechnical engineering recommendations relative to earthwork and the design and construction of foundations and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Veronica V. Finol, E.I.T.
Senior Staff Geotechnical Engineer

Richard Mockridge, P.E.
Senior Consultant

GEORGIA REGISTERED No 12692 PROFESSIONAL ENGINEER RICHARD MOCKRIDGE

Copies to: Addressee (1 via e-mail)

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EXECUTIVE SUMMARY

A geotechnical engineering exploration has been performed for the proposed parking deck for the Fort McPherson VA Clinic located at 1701 Hardee Avenue, SW in Atlanta, Georgia. Terracon's geotechnical engineering scope of work included the advancement of eight soil test borings to depths of approximately 30 feet below existing site grades.

The following geotechnical engineering considerations were identified:

- All of the borings, but one boring, penetrated 3 to 10 feet of undocumented fill soils, exhibiting standard penetration resistance values ranging from 3 to 32 blows per foot (bpf). Trace amounts of decayed wood fragments, construction debris, and topsoil were encountered within the fill soils. Documentation of fill placement and quality control testing were not provided to us at the time of this report.

- Below the fill soils were Piedmont residual soils having standard penetration resistances of 8 to 77 blows per foot.

- Partially Weathered rock was encountered in two borings at depths of 28 feet below ground surface. We do not anticipate difficult excavation during construction.

- Groundwater was encountered in six of the borings at depths ranging from about 16 feet to 23 feet. 24-hour groundwater readings were also taken in two borings at depths ranging from about 15 feet to 17 feet below ground surface.

- Based on the assumed loads, and the subsurface conditions encountered during this exploration, we recommend the proposed parking garage to be supported by a ground improvement foundation system such as stone columns (geopiers/vibropiers). As an alternative option, a shallow foundation system could be implemented after undercutting the existing fill soils, and replacing with compacted engineered fill, crushed stone, or lean concrete.

Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
FORT MCPHERSON PARKING DECK
1701 HARDEE AVENUE SW
ATLANTA, GEORGIA

Terracon Project No. 49165249A
January 24, 2017

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed parking deck for the Fort McPherson VA Clinic located at 1701 Hardee Avenue SW in Atlanta, Georgia. Our geotechnical engineering scope of work for this project included the advancement of eight soil test borings to depths ranging from approximately 30 feet below existing site grades. Boring Logs along with a Site Location Plan and Boring Location Plan are included in Appendix A of this report.

The purpose of these services is to provide the following information and geotechnical engineering recommendations relative to the proposed project:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- slab-on-grade design and construction
- seismic considerations
- lateral earth pressures
- pavement thickness and construction

2.0 PROJECT INFORMATION

Our understanding of the project is based upon information provided in your e-mail received on December 13, 2016.

2.1 Project Description

Item	Description
Site layout	Refer to the Site Location Plan and Boring Location Plan (Exhibits A-1 and A-2 in the Appendix)
Building	The project will consist of a 180 foot wide by 300 foot long, 3 level parking deck.
Building construction, Assumed	We expect the additions to be of precast concrete construction.
Maximum loads, Assumed	Building: Column Load – 400 kips Continuous Load-Bearing Wall Loads – 3 to 5 klf Maximum Uniform Slab Load – 100 psf
Grading	Finished grades have not been provided; however, we assume to maximum cuts and fills to be less than 3 feet.
Free-standing retaining walls	Because of the ramps in the garage, some retaining walls will be needed. These will be braced at the top by the floor slab.
Below Grades	None

2.2 Site Location and Description

Item	Description
Location	The proposed site is inside the Fort McPherson VA Campus located at 1701 Hardee Avenue SW in Atlanta, Georgia.
Existing Improvements	Existing parking lot.
Current ground cover	Asphalt.
Existing topography	Most of the site is relatively flat and level. No topographic information has been provided to us.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The project site is located in the Piedmont Physiographic Province of Georgia which is characterized by medium to high grade metamorphic rocks and scattered igneous intrusions. The term metamorphic describes rocks that have been subjected to high temperatures and/or pressures, usually deep within the earth's crust. These high temperatures and pressures cause the textural and mineralogical characteristics of the original rock to be altered and can also cause certain rock types to fully melt, becoming what is known as magma. Magma is less dense than the surrounding solidified rock and tends to move upward through fractures and joints, displacing the surrounding rock. This rock type is known as an igneous intrusion. Metamorphic rocks are predominant in this region but, due to erosion and uplift, both of these rocks will eventually become exposed at the land surface.

The subsurface bedrock in this region has undergone differing rates of weathering, which often produces a considerable variation in depth to competent rock over short horizontal distances. It is also not unusual for lenses and boulders of hard rock and zones of partially weathered rock to be present within the soil mantle above the general bedrock level. The typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by sandy silts and silty sands, which often consist of saprolites (native soils which maintain the original fabric of the parent rock). Generally the soil becomes harder with depth to the top of parent crystalline rock or "massive bedrock" which occurs at depth.

The boundary between soil and rock is typically not sharply defined. A transitional zone termed "partially weathered rock" is normally found overlying bedrock. Partially weathered rock (PWR) is defined for engineering purposes as residual material with a standard penetration resistance exceeding 100 blows per foot (bpf).

According to the" Geology of the Greater Atlanta Region" (Bulletin 96) by McConnell and Abrams, 1984, the site is located within the Clarkston Formation. The bedrock geology within the immediate site vicinity consists of Precambrian to Paleozoic age materials, comprising of mica schist, gneiss, and amphibolite.

Fill soils are those soils that have been placed or reworked by man in conjunction with past construction grading, underground utility installation, farming or other previous activity at the site. Fill can be composed of different soil types from various sources and can contain debris from building demolition, organics, topsoil, trash, etc. The engineering properties of the fill depend primarily on its composition, density, and moisture content. To the best of our knowledge no documentation (e.g. density tests, etc.) exist relative to past fill placement. If such documentation exists, it should be provided to us for evaluation.

3.2 Typical Subsurface Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Stratum 1	9 to 10 inches	Pavement Section	---
Stratum 2	3 to 10 feet	Fill/ Possible Fill[1]- Sandy SILT Silty Sand	Stiff to Hard Very Loose to Medium Dense
Stratum 2	28 feet, and to boring termination.	Residual- Sandy SILT Silty SAND	Stiff to Very Stiff Loose to Very Dense
Stratum 3	Below boring termination.	Partially Weathered Rock[2]	Very Dense

[1] Encountered in all the borings, except Boring B-7. We note that minor amounts of decayed wood fragments, construction debris and trace of topsoil were encountered within the fill.
[2] Encountered in Borings B-4 and B-7 from 28 to 30 feet.

Laboratory tests were conducted on selected soil samples and the test results are presented on the boring logs. Specific conditions encountered at each boring location are indicated on the individual boring logs in Appendix A. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual.

3.3 Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was observed in Borings B-1 through B-6 at a depths of about 16 feet to 23 feet shortly after drilling, and at depths of about 15 to 17 feet after 24 hours. Due to the low permeability of the soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole in these materials.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

3.4 Laboratory Results

Select soil samples were subject to natural moisture content tests. The testing procedures are described in the Appendix. Natural moisture content of the tested samples varied from 11 to 43 percent. Please refer to boring records B-1, B-2, B-5 and B-7 for specific results.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on the subsurface exploration, and geotechnical engineering analyses, we anticipate support of the proposed parking deck on an improved soils foundation system consisting of stone columns.

Alternatively, the parking deck can be supported by a shallow foundation system designed using a net bearing capacity of 3,000 psf. This option will require undercutting of the existing fill soils from the entire deck footprint or selectively below foundations and backfilling with compacted engineered fill, crushed stone or lean concrete. If undercutting is limited to just below foundations some additional settlement of the soil supporting the lower slab should be expected

Some of the Piedmont residual soils at this site were derived from parent amphibolite bedrock. These soils typically display a very high moisture content, low unit weights, and high void ratio. These soils are prone to consolidation when loads are applied which could result in excessive settlement. Also, these soils typically provide poor subgrade support. Therefore, some subgrade stabilization and drying will be needed prior to construction. Drying should typically be possible during hot, dry summer months. If grading is performed during cool, wetter times of the year, drying will be difficult. Replacement of the high moisture content soils or chemical drying are typically required. A contingency for subgrade stabilization and drying should be included in the construction budget.

Geotechnical engineering recommendations for foundation systems and other earth related phases of the project are outlined below. The recommendations contained in this report are based upon the results of data presented herein, engineering analyses, and our current understanding of the proposed project.

4.2 Earthwork

We currently expect only minimal fills and cuts during earthwork operations. The following sections present recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations, slabs-on-grade, and pavements are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

We anticipate construction will be initiated by stripping the existing pavement section, any loose, soft or otherwise unsuitable material. Stripping depths between our boring locations and across the site could vary. We recommend actual stripping depths be evaluated by a representative of Terracon during construction. At this time if the option of undercutting of all fill within the deck footprint, and extending at least 10 feet beyond the perimeter is selected the old fill should be removed.

The fine grained soils encountered in the borings may be sensitive to disturbance from construction activity and water seepage. If precipitation occurs prior to or during construction, the near-surface soils could increase in moisture content and become more susceptible to disturbance. Construction activity should be monitored, and should be curtailed if the construction activity is causing subgrade disturbance. A Terracon representative can help with monitoring and developing recommendations to aid in limiting subgrade disturbance.

After stripping and undercutting if selected, proofrolling should be performed with heavy rubber tire construction equipment such as a fully loaded tandem-axle dump truck. A geotechnical engineer or his representative should observe proofrolling to aid in locating unstable subgrade materials. Proofrolling should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade and to reduce the amount of undercutting/remedial work required. Unstable materials located should be stabilized as directed by the engineer based on conditions observed during construction. Again, if amphibolitic soils are exposed, some subgrade remediation (undercutting/recompaction/stabilization) may be required. Also, if the old fill is not undercut, proofrolling will aid in detecting near surface soft/loose soils that should be remediated by undercutting and replacement or densification in place.

4.2.2 Materials Types

New engineered fill should consist of approved materials, free of organic material, debris and particles larger than about 3 inches. Soils for use as engineered fill material should conform to the following specifications:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Fine Grain Soils	CL and ML (LL<45; PI<25)	All locations and elevations
Granular Soils	SP, SM, SC, SW	All locations and elevations
On-site soils	SM, ML	All locations and elevations

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

4.2.3 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Material Type and Location[1, 2]	Per the Standard Proctor Test (ASTM D 698)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction[3]	
		Minimum	Maximum
Acceptable soil or approved imported fill soils:			
Beneath foundations and slabs:	95	-2%	+3%
Beneath pavements:	95	-2%	+3%
12 inches directly below pavements:	98	-2%	+3%
	Per the Modified Proctor Test (ASTM D 1557)		
Aggregate base (beneath slabs)	95	-3%	+3%
Aggregate base (beneath pavements)	98	-3%	+3%

1. Engineered fill materials should be placed in horizontal, loose lifts not exceeding 9 inches in thickness and should be thoroughly compacted. Where light compaction equipment is used, as is customary in utility trenches, the lift thickness may need to be reduced to achieve the desired degree of compaction. Soils removed which will be used as engineered fill should be protected to aid in preventing an increase in moisture content due to rain.
2. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
3. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction

Material Type and Location[1, 2]	Per the Standard Proctor Test (ASTM D 698)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction[3]	
		Minimum	Maximum
to be achieved without pumping when proofrolled. The fill should have a minimum dry unit of 90 pcf. We note that some of the amphibolitic soils may be of light unit weight and should not be used beneath structural elements.			

4.2.4 Grading and Drainage

Adequate positive drainage should be provided during construction and maintained throughout the life of the development to prevent an increase in moisture content of the foundation, pavement and backfill materials. Surface water drainage should be controlled to prevent undermining of fill slopes and structures during and after construction.

Gutters and downspouts that drain water a minimum of 10 feet beyond the footprint of the proposed structures are recommended. This can be accomplished through the use of splash-blocks, downspout extensions, and flexible pipes that are designed to attach to the end of the downspout. Splash-blocks should also be considered below hose bibs and water spigots.

It is recommended that all exposed earth areas be seeded to provide protection against erosion as soon as possible after completion. Seeded areas should be protected until the vegetation is established. Sprinkler systems should not be installed behind or in front of walls without the approval of the civil engineer and wall designer.

4.2.5 Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of slab and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to slab and pavement construction and observed by Terracon.

Surface water should not be allowed to pond on the site and soak into the soil during construction. Construction staging should provide drainage of surface water and precipitation away from the building and pavement areas. Any water that collects over or adjacent to construction areas should be promptly removed, along with any softened or disturbed soils.

All excavations should be sloped or braced as required by OSHA regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current Occupational Health and Safety Administration (OSHA) Excavation and Trench Safety Standards.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied or inferred.

4.3 Foundation Support

Due to the relatively heavy structural loads, and the presence of undocumented fill soils, we recommend that the proposed new parking deck be supported by a ground improvement system such as stone columns (geopiers/vibropiers). Additionally, a shallow foundation system can also be considered as an option after undercutting the existing fill soils over the entire footprint or selectively from beneath foundations if the owner is aware of and willing to accept the possibility of greater than normal amount of settlement of the lower level slab-on-grade.

4.3.1 Stone Columns

We recommend supporting the proposed parking deck on a ground improvement system such as stone columns. Stone columns are designed and constructed by proprietary design-build contractors. Locally these typically include Hayward Baker, Geopier Foundation Company, and others. These companies can provide design and pricing information for the various improvement systems:

The Geopier support elements are typically constructed by drilling a hole, removing a volume of soil, and then building a bottom bulb of clean, open-graded stone while vertically pre-stressing and pre-straining subsoils underlying the bottom bulb. The Geopier shaft is built on top of the bottom bulb, using open-graded base course stone placed in thin lifts. Geopier elements are a proprietary subgrade reinforcing system and should be designed and constructed by an installer licensed by the Geopier Foundation Company, Inc.

Stone columns are constructed in a similar manner except the hole can be formed with a large vibrator which forces the soil aside as it is extended into the ground thereby densifying the surrounding soils. Pre-drilling for stone columns can be required in dense soils and/or to speed construction. Once the design depth is obtained, the vibrator remains in the hole and is typically lifted about 2 to 4 feet from the bottom of the hole which is filled about ¼ full with stone, often No. 67 or 57 Stone. The vibrator then penetrates the stone to the bottom of the hole and is withdrawn to about the top of the stone layer and then allowed to re-penetrate about two-thirds of the stone lift. The re-penetration process is repeated in increments between one-quarter to one-third the stone lift thickness. The remainder of the hole is filled to the existing ground surface in this manner. Stone columns are also designed and installed by specialized contractors.

The installer of either system should provide detailed design calculations sealed by a professional engineer licensed in the State of Georgia. The design calculations should demonstrate that the Vibropier/Geopier soil improved system is estimated to control long-term total and differential settlements. The specialty contractor should warrant their work as well as the maximum total and differential settlements they predict. We recommend the design parameters be verified by a full-scale modulus test (similar to a pile load test) performed in the field. Terracon should be retained to monitor the modulus test and subsequent production Vibropier/Geopier installation.

Spread footings supported on stone columns can typically be designed for maximum net allowable bearing pressures between 3,000 to 6,000 psf. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Wall bearing footings and isolated column footings should have minimum widths recommended by the design-build contractor. Perimeter footings and footings beneath unheated areas should bear at least 1½ feet below lowest adjacent finished grade for frost protection. Additional savings can often be achieved where spread footings are designed for higher bearing pressures.

The selected design-build contractor should pay special attention to the widely variation of soil conditions at the site. We have seen in similar jobs deep loose zones that result in greater than allowable settlement as the stone columns transfer loading to this loose zone. The design-build contractor will need this report and a foundation drawing which indicates Dead Load (DL) and Live Load (LL) at each footing location to perform the level of assessment needed at this site.

4.3.2 Shallow Foundations

Design recommendations for shallow foundations for the parking deck are presented below. The foundations can bear on either residual soils or compacted engineered fill, stone or lean concrete extending to residual soils. Undercutting of the existing fill soils is required. Again, undercutting can encompass the entire structure footprint (plus a minimum of 10 feet beyond the perimeter) or selectively beneath just the foundation as described under Section 4.3.3.

Description	Column	Wall
Net allowable bearing pressure [1]	3,000 psf	3,000 psf
Minimum dimensions	24 inches	18 inches
Minimum embedment below finished grade for frost protection [2]	18 inches	18 inches
Approximate total settlement [3]	<1 inch	<1 inch
Estimated differential settlement [3]	<¾ inch between columns	<¾ inch over 40 feet
Ultimate coefficient of sliding friction	0.35	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes the existing fill will be undercut and replaced with compacted engineered fill, stone or lean concrete.
2. The recommended minimum embedment is also to reduce the effects of seasonal moisture variations in the subgrade soils. Applies to perimeter footings and footings beneath unheated areas.
3. The above settlement estimates assume the foundations bear on residual soils, or compacted engineered soils, stone or lean concrete extended to residual soils. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, and the quality of the earthwork operations. Settlement may be greater if unsuitable conditions are not discovered and remediated during construction.

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations. Interior footings should bear a minimum of 12 inches below finished grade. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

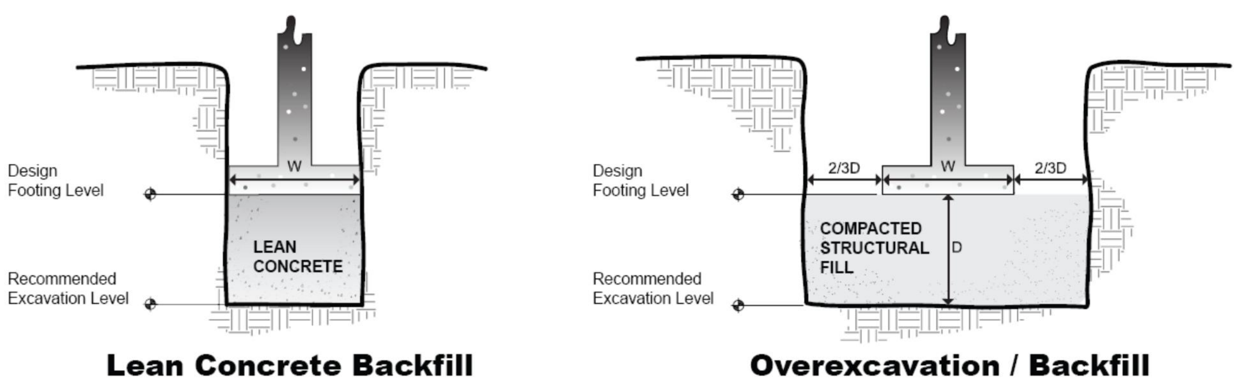
Footings, foundations, and masonry walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ from those presented in this report, supplemental recommendations will be required. These evaluations are very important at this site due to the existence of undocumented fills.

4.3.3 Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose soil and rock prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, or frozen, the affected soil should be removed prior to placing concrete. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open over night or for an extended period of time. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

If unsuitable bearing soils are encountered in footing excavations of if the option of undercutting only below foundations is selected, the excavations should be extended deeper to suitable soils and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The footings could also bear on properly compacted backfill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with well-graded granular material placed in lifts of 9 inches or less in loose thickness and compacted to at least 95 percent of the material's maximum standard Proctor dry density (ASTM D-698). The overexcavation and backfill procedure is described in the figure below.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

Areas of loose soils may be encountered at foundation bearing depth after excavation is completed for footings. When such conditions exist beneath planned footing areas, the subgrade soils should be surficially compacted prior to placement of the foundation system. If sufficient compaction can not be achieved in-place, the loose soils should be removed and replaced with engineered fill. For placement of engineered fill below footings, the excavation should be widened laterally, at least eight inches for each foot of fill placed below footing base elevations.

4.4 Seismic Considerations

Code Used	Site Classification
2015 International Building Code (IBC) [1]	D [2]

1. In general accordance with the *2015 International Building Code, which refers to ASCE7*
2. The *2015 International Building Code (IBC)* requires a site soil profile characterization extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100 foot soil profile determination. . Borings for the building extended to a maximum depth of approximately 30 feet and this Seismic Site Class definition considers that medium dense to very dense silty sand continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths could be performed to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a higher seismic site class.

4.5 Slab-On-Grade

4.5.1 Slab- On-Grade Design Recommendations

DESCRIPTION	VALUE
Lower level slab-on-grade	Concrete slab-on-grade.
Slab support	Minimum 12 inches of approved on-site or imported soils placed and compacted in accordance with Earthwork section of this report.
Subbase	4-inch compacted layer of free draining, granular subbase material
Modulus of subgrade reaction	125 pounds per square inch per in (psi/in) for point loading conditions for a soil subgrade prepared as recommended in this report.

1. Lower level slab should be structurally independent of any footings or walls to reduce the possibility of slab cracking caused by differential movements between the slab and foundation. The slabs should be appropriately reinforced to support the proposed loads.
2. We recommend subgrades be maintained at the proper moisture condition until lower level slab and pavements are constructed. If the subgrade should become desiccated prior to construction of slabs and pavements, the affected material should be removed or the materials scarified, moistened, and recompacted. Upon completion of grading operations, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the slabs.
3. The slab design may include a capillary break, comprised of free-draining, compacted, granular material, at least 4 inches thick.

A subgrade prepared and tested as recommended in this report should provide adequate support for the slab on grade.

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

The use of a vapor retarder or barrier could be considered beneath concrete slabs on grade.

4.5.2 Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the slab subgrade may not be suitable for placement of base rock and concrete and corrective action may be required.

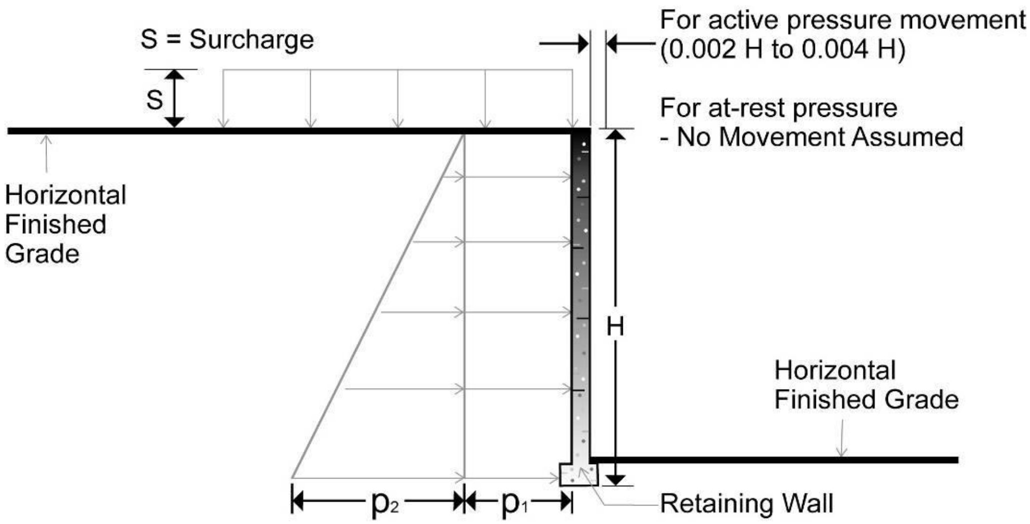
We recommend the area underlying the slab be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. Subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base rock and concrete.

4.6 Lateral Earth Pressures

4.6.1 Lateral Earth Pressure Design Recommendations

The lateral earth pressure recommendations herein are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls. Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop recommendations for the design of such wall systems upon request.

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



EARTH PRESSURE COEFFICIENTS

Earth Pressure Conditions	Coefficient For Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Granular - 0.29	35	(0.29)S	(35)H
	Sandy silt/Silty Sand - 0.36	45	(0.36)S	(45)H
At-Rest (Ko)	Granular - 0.46	55	(0.46)S	(55)H
	Sandy silt/Silty Sand - 0.53	65	(0.53)S	(65)H
Passive (Kp)	Granular - 3.4	400	---	---
	Sandy silt/Silty Sand – 2.8	330	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted between 95 and 98 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.35 should be used as the ultimate coefficient of friction between the footing and the underlying soil.

To aid in reducing the potential for hydrostatic pressure behind walls, we recommend a perimeter drain be installed at the foundation wall with a collection pipe leading to a reliable discharge. If adequate drainage is not possible, then combined hydrostatic and lateral earth pressures should be calculated for granular backfill using an equivalent fluid weighing 80 and 90 pcf for active and at-rest conditions, respectively. For silty backfill, an equivalent fluid weighing 85 and 95 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

Dampproofing of the walls below the ground surface is also recommended to aid in preventing seepage of water into the structure during situations of heavy rains and or temporary high water table conditions above the bedrock surface that may not drain immediately.

4.7 Pavements

The following paragraphs present recommendations, and discussions of pavements. These comments should not be construed to constitute a quantitative design. Terracon would be pleased to provide such design after we are provided with traffic volume and perform the necessary laboratory testing.

4.7.1 Subgrade Preparation

On most project sites, the site grading is accomplished relatively early in the construction phase and fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other delivery vehicles disturbs the subgrade and many surface irregularities are filled in with loose soils or crushed stone to temporarily improve subgrade conditions. As a result, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

We recommend the moisture content and density of the top 12 inches of the subgrade be evaluated and the pavement subgrades be proofrolled within two days prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

After proofrolling and repairing subgrade deficiencies, the entire subgrade should be scarified and developed as recommended in Section **4.2** of the **Earthwork** section this report to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

4.7.2 Pavement Design Considerations

Traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. However, we anticipate that traffic loads will be produced primarily by automobile traffic and occasional delivery and trash removal trucks. The thickness of pavements subjected to heavy truck traffic should be determined using expected traffic volumes, vehicle types, and vehicle loads and should be in accordance with local, city or county ordinances.

Pavement thickness can be determined using AASHTO, Asphalt Institute and/or other methods if specific wheel loads, axle configurations, frequencies, and desired pavement life are provided. Terracon can provide thickness recommendations for pavements subjected to loads other than personal vehicle and occasional delivery and trash removal truck traffic if this information is provided, and perform the necessary laboratory testing and analysis.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to parking lots and drives should slope down from pavement edges at a minimum 2%;
- The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote proper surface drainage;
- Install pavement drainage surrounding areas anticipated for frequent wetting (e.g., garden centers, wash racks);
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils;
- Place compacted, low permeability backfill against the exterior side of curb and gutter; and,

- Place curb, gutter and/or sidewalk directly on low permeability subgrade soils rather than on unbound granular base course materials.

4.7.3 Estimates of Minimum Pavement Thickness

A quantitative pavement design was not performed. However, based on our past experience with similar site usage in this area, we recommend the following typical pavement section be considered.

Material	Automobiles Only Thickness (inches)	Combined Automobiles and Occasional Trucks Thickness (inches)	GDOT
Subgrade	Upper 12 inches of existing soil or engineered fill	Upper 12 inches of existing soil or engineered fill	98% of Standard Proctor MMD, -2 to +3% OMC
Aggregate Base	6	8	GAB, Section 815 and 310
Asphalt Binder Course	-	1¾	SP19 - Section 400, 424, 824 and 828
Asphalt Surface Course	2	1¼	SP9.5 - Section 400, 424, 824 and 828

The graded aggregate base should be compacted to a minimum of 98 percent of the material's modified Proctor (ASTM D-1557, Method C) maximum dry density. Where base course thickness exceeds 6 inches, the material should be placed and compacted in two or more lifts of equal thickness.

The listed pavement component thicknesses should be used as a guide for pavement systems at the site for the traffic classifications stated herein. These recommendations assume a 20-year pavement design life. If pavement frequencies or loads will be different than that specified Terracon should be contacted and allowed to review these pavement sections.

Asphalt concrete aggregates and base course materials should conform to the Georgia Department of Transportation (GDOT) "Standard Specifications for Construction of Transportation System". Current GDOT asphalt surface courses are Superpave mixes.

We expect that a Portland cement concrete (PCC) pavement be utilized in entrance and exit sections, as well as the lower level slab on grade, or other areas where extensive wheel maneuvering is expected. We recommend a minimum of 6½ inches of PCC underlain by 4 inches of GAB. Although not required for structural support, the base course layer is recommended to help reduce potentials for slab curl, shrinkage cracking, and subgrade "pumping" through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Portland cement concrete should be designed with proper air-entrainment and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing. Adequate reinforcement and number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI requirements. The joints should be sealed as soon as possible (in accordance with sealant manufacturer's instructions and ACI requirements) to minimize infiltration of water into the soil.

4.7.4 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

We recommend drainage be included at the bottom of the GAB layer at the storm structures to aid in removing water that may enter this layer. Drainage could consist of small diameter weep holes excavated around the perimeter of the storm structures. The weep holes should be excavated at the elevation of the GAB and soil interface. The excavation should be covered with No. 57 stone which is encompassed in Mirafi 140 NL or approved equivalent which will aid in reducing fines from entering the storm system.

4.7.5 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching, etc) and global maintenance (e.g., surface sealing, etc.). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Joints or any cracks in pavement areas that develop should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

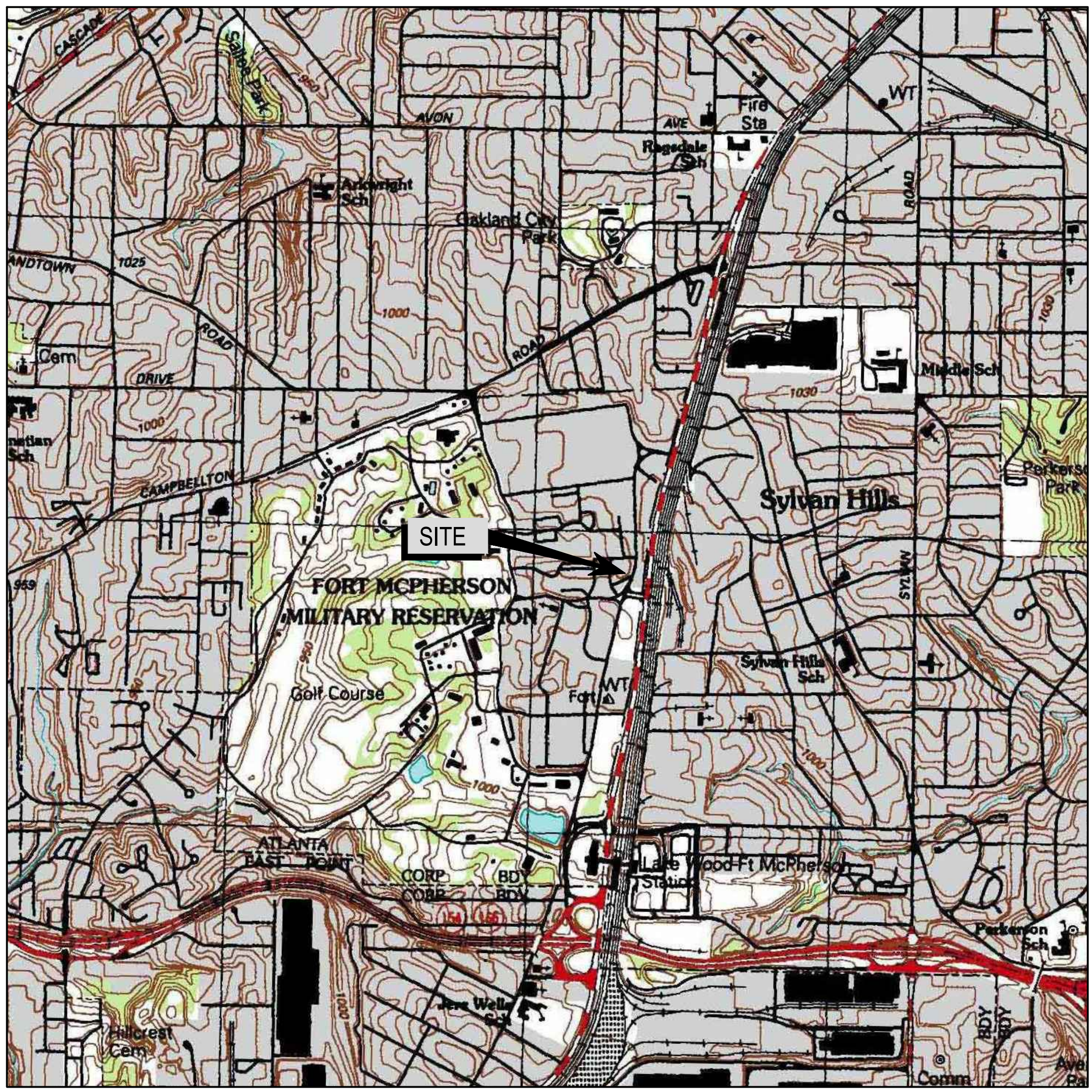
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria, etc) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

UNITED STATES — DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY



SCALE 1:24 000

1 .5 0 KILOMETERS 1 2

1000 0 METERS 1000 2000

1 .5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000

FEET

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE

SOUTHWEST ATLANTA, GA

1997

7.5 MINUTE SERIES (TOPOGRAPHIC)

N

*INDICATES WHICH MAP SITE IS LOCATED ON

Project Mngr: VF	Project No. 49165249A	Terracon Consulting Engineers and Scientists 2105 Newpoint Place, Ste. 600 Lawrenceville, GA 30043 (770) 623-0755 (770) 623-9628	SITE LOCATION PLAN GEOTECHNICAL ENGINEERING REPORT FORT MCPHERSON PARKING DECK 1701 HARDEE AVENUE SW ATLANTA, GA
Drawn By: RLW	Scale: AS SHOWN		
Checked By: VF/MRF	File No. GEO49165249A-1		
Approved By: VF	Date: JAN. 2017		

EXHIBIT

A-1

LEGEND

APPROXIMATE BORING LOCATION

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr:	VF	Project No.	49165249A
Drawn By:	RLW	Scale:	AS SHOWN
Checked By:	VF/MRF	File No.	GEO49165249A-2
Approved By:	VF	Date:	JAN. 2017

Terracon
Consulting Engineers and Scientists
2105 Newpoint Place, Ste. 600 Lawrenceville, GA 30043
(770) 623-0755 (770) 623-9628

BORING LOCATION PLAN

GEOTECHNICAL ENGINEERING REPORT

FORT MCPHERSON PARKING DECK

1701 HARDEE AVENUE SW

ATLANTA, GA

EXHIBIT

A-2

Field Exploration Description

The boring locations were staked by Terracon personnel. Distances from these locations to the reference features indicated on the attached diagram are approximate and estimated. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with ATV-mounted rotary drill rig using hollow stem augers to advance the boreholes. Representative soil samples were obtained by the split-barrel sampling procedure. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N). These values are indicted on the borings logs at the depths of occurrence. This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs. The samples were sealed and taken to the laboratory for testing and classification.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

The samples were classified in the laboratory based on visual observation, texture and plasticity. The descriptions of the soils indicated on the boring logs are in general accordance with the enclosed General Notes and the Unified Soil Classification System. Estimated group symbols according to the Unified Soil Classification System are given on the boring logs. A brief description of this classification system is attached to this report.

Laboratory Testing

As part of the testing program, all samples were examined in the laboratory by experienced personnel and classified in accordance with the attached General Notes and the Unified Soil Classification System based on the texture and plasticity of the soils. The group symbol for the Unified Soil Classification System is shown in the appropriate column on the boring logs and a brief description of the classification system is included with this report in the Appendix.

At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- In-situ Water Content

BORING LOG NO. B-1

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

SITE: 1701 Hardee Avenue SW, Atlanta, Georgia

LOCATION

Latitude: 33.709445° Longitude: -84.42937°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**ASPHALT**, 4 Inches					
0.8	**GRANULAR BASE**, 6 Inches					
5.0	**FILL - SANDY SILT (ML)**, trace topsoil, trace decayed wood fragments, red-brown, black, stiff			X	5-5-6 N=11	16
				X	3-6-8 N=14	13
8.0	**RESIDUUM - SILTY SAND (SM)**, fine to medium grained, trace clay, red-brown, medium dense	5		X	7-9-10 N=19	16
13.0	**SANDY SILT (ML)**, trace mica, red-brown, orange, purple, stiff	10		X	4-5-6 N=11	33
	SILTY SAND (SM), fine to medium grained, trace quartz fragments, with mica, white, medium dense	15	▼	X	4-5-10 N=15	25
	- less quartz fragments, purple, brown, loose	20		X	3-4-4 N=8	30
	- medium dense	25		X	4-8-8 N=16	43
30.0	- trace quartz fragments, with mica, purple, orange	30		X	2-5-5 N=10	32

Boring Terminated at 30 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▼ *16 Feet After 2 Hours*

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/14/2017	Boring Completed: 1/14/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

BORING LOG NO. B-2

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

SITE: 1701 Hardee Avenue SW
Atlanta, Georgia

LOCATION

Latitude: 33.709449° Longitude: -84.429004°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)
0.4	**ASPHALT**, 5 Inches					
0.8	**GRANULAR BASE**, 4 Inches					
3.0	**FILL - SANDY SILT (ML)**, trace clay, trace rock fragments, red-brown, stiff			X	4-5-7 N=12	19
5.0	**FILL - SILTY SAND (SM)**, fine to medium grained, with rock fragments, trace topsoil, gray, medium dense			X	7-12-10 N=22	11
	RESIDUUM - SILTY SAND (SM), fine to medium grained, trace clay, red-brown, orange, medium dense	5		X	4-5-7 N=12	
	- red-brown	10		X	4-6-11 N=17	
	- medium grained, less clay, gray, pink, leached	15		X	4-8-9 N=17	
	- with mica, orange, tan	20	▽ (22 ft)	X	4-8-9 N=17	
		25		X	5-7-7 N=14	
30.0	- brown, pink	30		X	5-7-9 N=16	
	Boring Terminated at 30 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *22 Feet While Drilling*

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/14/2017	Boring Completed: 1/14/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

BORING LOG NO. B-3

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

SITE: 1701 Hardee Avenue SW, Atlanta, Georgia

LOCATION

Latitude: 33.709384° Longitude: -84.428534°

DEPTH (Ft.)	Description
0.4	**ASPHALT**, 5 Inches
0.8	**GRANULAR BASE**, 4 Inches
	FILL - SANDY SILT (ML), trace clay, trace rock fragments, red-brown, stiff
	- trace topsoil
6.0	**RESIDUUM - SANDY SILT (ML)**, trace mica, red-brown, stiff
13.0	**SILTY SAND (SM)**, fine to medium grained, with mica, orange, brown, medium dense
	- black, tan, pink
	- with quartz fragments, tan, white, very dense
	- less quartz fragments, black, brown, dense
30.0	***Boring Terminated at 30 Feet***

Sample Depth (Ft., approx.)	Field Test Results
1.0–2.5	7-5-7 N=12
3.5–5.0	5-7-9 N=16
6.0–7.5	5-6-9 N=15
8.5–10.0	5-6-8 N=14
13.5–15.0	5-5-6 N=11
18.5–20.0	7-14-13 N=27
23.5–25.0	38-28-30 N=58
28.5–30.0	12-25-20 N=45

Water level observed at 15 ft.

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

15 Feet At 24 Hours

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/7/2017

Boring Completed: 1/7/2017

Drill Rig: D50+

Driller: Jorge

Project No.: 49165249A

BORING LOG NO. B-4

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

**SITE: 1701 Hardee Avenue SW
Atlanta, Georgia**

LOCATION

Latitude: 33.70924° Longitude: -84.429361°

GRAPHIC LOG DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)
0.4	**ASPHALT**, 5 Inches					
0.8	**GRANULAR BASE**, 5 Inches					
3.0	**FILL - SILTY SAND (SM)**, trace topsoil, fine to medium grained, brown, medium dense			X	5-6-8 N=14	
	RESIDUUM - SANDY SILT (ML), trace clay, red-brown, very stiff	5		X	7-11-13 N=24	
8.0	- stiff			X	5-7-7 N=14	
	SILTY SAND (SM), fine to medium grained, purple, brown, medium dense	10		X	8-5-6 N=11	
	- orange, tan	15		X	4-7-10 N=17	
	- with mica, purple, brown, black	20	▼	X	6-10-12 N=22	
28.0	- dense	25		X	5-17-25 N=42	
30.0	**PARTIALLY WEATHERED ROCK - SAMPLED AS SILTY SAND**, fine to medium grained, purple, brown, very dense	30		X	9-25-50/4" 75/10"	
	Boring Terminated at 30 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▼ *19 Feet After 2 Hours*

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/14/2017	Boring Completed: 1/14/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

BORING LOG NO. B-5

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

**SITE: 1701 Hardee Avenue SW
Atlanta, Georgia**

LOCATION

Latitude: 33.709189° Longitude: -84.428813°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)
0.4	**ASPHALT**, 5 Inches					
0.8	**GRANULAR BASE**, 4 Inches					
	FILL - SANDY SILT (ML), trace clay, red-brown, stiff			X	4-5-8 N=13	21
	- trace construction debris, very stiff			X	6-11-8 N=19	15
5.0	**RESIDUUM - SILTY SAND (SM)**, fine to medium grained, red-brown, black, medium dense	5		X	7-11-13 N=24	19
	- with mica, orange, brown			X	7-10-9 N=19	21
		10				
	- pink, orange, brown			X	7-6-6 N=12	19
		15	▼ (17 ft)			
				X	14-7-9 N=16	15
		20				
				X	7-8-10 N=18	17
		25				
	- gray, dense			X	7-15-15 N=30	20
30.0	***Boring Terminated at 30 Feet***	30				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▼ *17 Feet At 24 Hours*

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/7/2017	Boring Completed: 1/7/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

BORING LOG NO. B-6

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

**SITE: 1701 Hardee Avenue SW
Atlanta, Georgia**

LOCATION

Latitude: 33.709028° Longitude: -84.429565°

DEPTH	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)
0.3	**ASPHALT**, 4 Inches					
0.8	**GRANULAR BASE**, 5 Inches					
3.0	**FILL - SILTY SAND (SM)**, fine to medium grained, trace quartz fragments, brown, medium dense			X	8-15-12 N=27	
6.0	**RESIDUUM - SANDY SILT (ML)**, trace mica, red-brown, orange, stiff	5		X	5-7-7 N=14	
	SILTY SAND (SM), fine to medium grained, with mica, purple, brown, medium dense			X	5-10-11 N=21	
	- very dense	10		X	20-32-45 N=77	
	- medium dense	15		X	8-10-11 N=21	
		20		X	6-6-7 N=13	
	- brown, black	25	▼ (23 ft)	X	6-10-10 N=20	38
30.0		30		X	3-5-6 N=11	

Boring Terminated at 30 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *23 Feet While Drilling*

▼ *23 Feet After 4 Hours*

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/14/2017	Boring Completed: 1/14/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

BORING LOG NO. B-7

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

SITE: 1701 Hardee Avenue SW
Atlanta, Georgia

LOCATION
Latitude: 33.708986° Longitude: -84.429102°

DEPTH	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)
0.4	**ASPHALT**, 5 Inches					
0.8	**GRANULAR BASE**, 4 Inches					
	RESIDUUM - SANDY SILT (ML), trace clay, trace mica, red-brown, very stiff			X	8-11-11 N=22	
		5		X	7-10-11 N=21	
6.0	**SILTY SAND (SM)**, fine to medium grained, with mica, purple, brown, medium dense			X	5-8-10 N=18	24
	- dense	10		X	8-16-14 N=30	
	- medium dense	15		X	3-6-5 N=11	
		20		X	5-7-9 N=16	
	- gray, brown, dense	25		X	19-15-15 N=30	
28.0	**PARTIALLY WEATHERED ROCK - SAMPLED AS SILTY SAND**, fine to medium grained, with mica, pink, brown, red-brown, very dense			X	9-19-50/2" 69/2"	
30.0	***Boring Terminated at 30 Feet***	30				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings

See Exhibit A-3 for description of field procedures

See Appendix B for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
None Encountered While Drilling

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/14/2017	Boring Completed: 1/14/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

BORING LOG NO. B-8

PROJECT: Fort McPherson Parking Deck

CLIENT: Guidon Design, Inc.

SITE: 1701 Hardee Avenue SW Atlanta, Georgia

LOCATION
Latitude: 33.708925° Longitude: -84.428618°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**ASPHALT**, 4 Inches					
0.8	**GRANULAR BASE**, 6 Inches					
	FILL - SANDY SILT (ML), trace clay, trace wood fragments, red-brown, very stiff			X	7-8-8 N=16	
	- trace rock fragments, hard	5		X	12-18-14 N=32	
6.0	**FILL - SILTY SAND (SM)**, fine to medium grained, light gray, very loose			X	2-1-2 N=3	
8.0	**POSSIBLE FILL - SANDY SILT (ML)**, gray, medium stiff	10		X	2-3-3 N=6	
10.0	**RESIDUUM - SILTY SAND (SM)**, fine to medium grained, trace mica, orange, brown, medium dense	15		X	5-5-6 N=11	
		20		X	4-7-9 N=16	
		25		X	7-15-11 N=26	
30.0		30		X	7-10-13 N=23	
	Boring Terminated at 30 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Hollow Stem Auger	See Exhibit A-3 for description of field procedures	Notes:
Abandonment Method: Backfilled with soil cuttings	See Appendix B for explanation of symbols and abbreviations.	

WATER LEVEL OBSERVATIONS

None Encountered While Drilling

Terracon
2105 Newpoint Pl Ste 600
Lawrenceville, GA

Boring Started: 1/7/2017	Boring Completed: 1/7/2017
Drill Rig: D50+	Driller: Jorge
Project No.: 49165249A	

APPENDIX B

SUPPORTING DOCUMENTATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

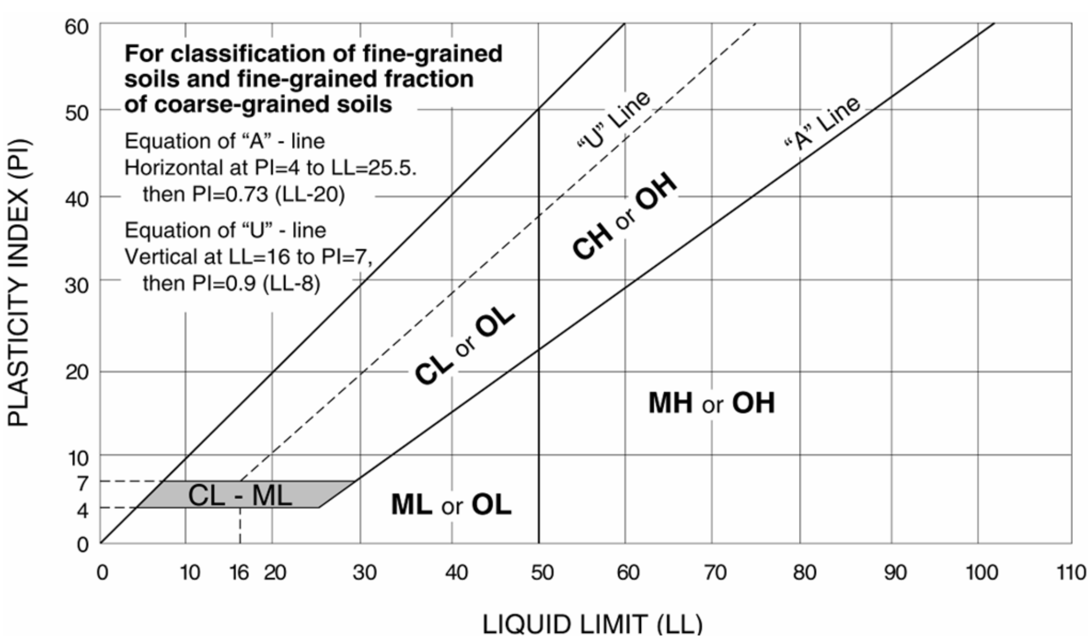
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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