Geotechnical Engineering Report

Alston Ridge Greenway
Fuquay-Varina, North Carolina
May 11, 2021
Terracon Project No. 70205155

Prepared for:
Kimley Horn and Associates, Inc.
Raleigh, North Carolina

Prepared by:
Terracon Consultants, Inc.
Raleigh, North Carolina

May 11, 2021

Kimley Horn and Associates, Inc.
421 Fayetteville Street, Suite 600
Raleigh, North Carolina 27601

Attn: Ms. Rachel Marshaus, PE
P: (919) 653-2952
E: Rachel.Marshaus@kimley-horn.com

Re: Geotechnical Engineering Report
Alston Ridge Greenway
Old Adams Road Greenway to Bass Lake Greenway
Fuquay-Varina, North Carolina
Terracon Project No. 70205155

Dear Ms. Marshaus:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P70205155.Rev1 dated September 21, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations 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.

NORTH CAROLINA PROFESSIONAL SEAL 047922 5/11/2021 ENGINEER HUGO SANTANA

Hugo Santana, PE
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REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Alston Ridge Greenway

Old Adams Road Greenway to Bass Lake Greenway

Fuquay-Varina, North Carolina

Terracon Project No. 70205155

May 11, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Alston Ridge Greenway to connect greenways from Old Adams Road Greenway to Bass Lake Greenway in Fuquay-Varina, North Carolina. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Slope Stability
- Seismic site classification per IBC
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of fourteen (14) test borings to depths ranging from approximately 4 to 15 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located between the Old Adams Road Greenway to Bass Lake Greenway in Fuquay-Varina, North Carolina. The planned greenway will be approximately 2,400 linear feet. Approximate GPS coordinates for the site are: 35.6318,-78.8086 See **Site Location**

Item	Description
Existing Improvements	The proposed greenway connector trail is located in a wooded area.
Current Ground Cover	Moderately-heavily vegetated
Existing Topography	The site has soft to steep rolling hills and generally slopes down heading north along the alignment with gradual elevation differences of up to 44 feet along the alignment.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	A site layout and project details were provided by Kimley-Horn via e-mail, dated August 4, 2020 as well as the following documents: ■ Plan dated March 23, 2021 prepared by Kimley-Horn: *Alston_Survey Limits – COMMENTS.pdf; Alston_Survey Limits.dgn*
Project Description	The project includes approximately 2,400 feet of greenway trail that will connect the existing Old Adams Road greenway to the existing Bass Lake greenway.
Proposed Structures	The greenway trail will consist of asphalt paving and sections of boardwalk and boardwalk lookouts.
Maximum Loads	Based on e-mail correspondence, boardwalk capacities are based on a H-5 Vehicle Class load.
Grading/Slopes	Site grading is expected to stay near existing grade for the majority of the site with some areas possibly having +/-5 feet of cut/fill. Slopes at this site are anticipated to vary from 2:1 to 3:1.
Below-Grade Structures	Drainage culverts ranging from 18 to 30 inches.
Pavements	Approximately 1,900 feet of paved greenway trail. Pavements to follow NCDOT *Minimum Pavement Design Recommendations for Greenways*. Anticipated traffic is as follows: ■ Pedestrian Traffic ■ Light service vehicles The pavement design period is 20 years.

GEOTECHNICAL CHARACTERIZATION

Site Geology

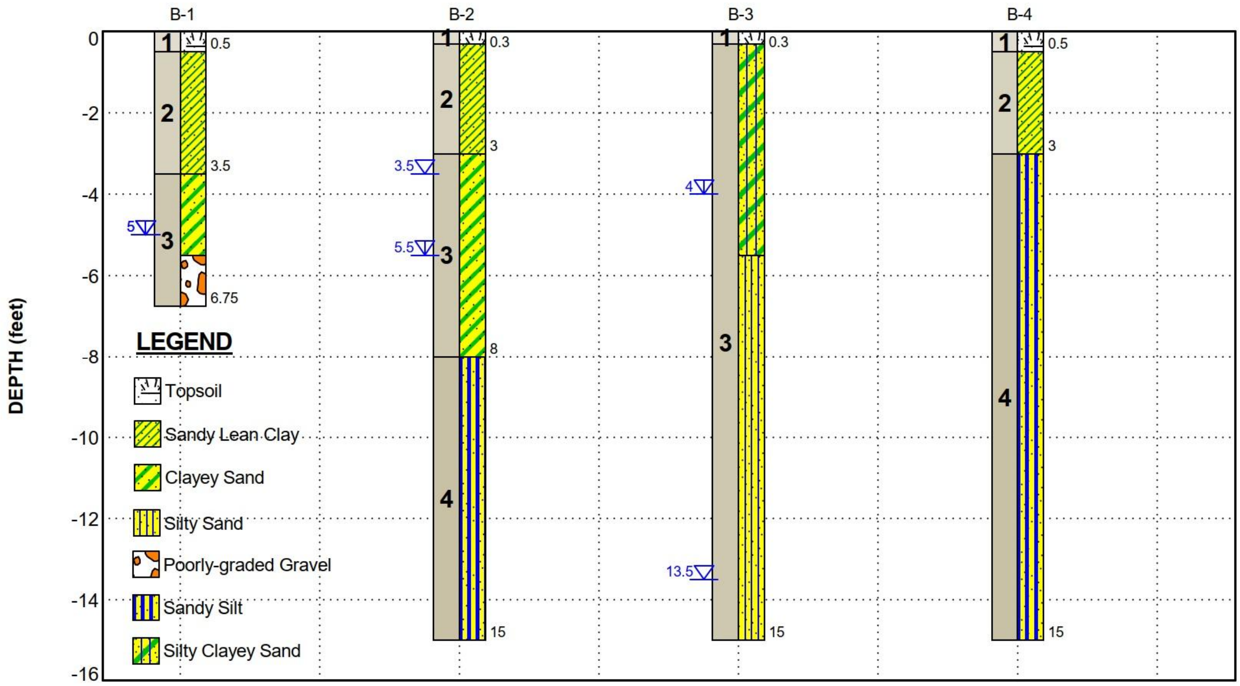
The project site is located in the Piedmont Physiographic Province – Raleigh Belt Formation, an area underlain by ancient igneous and metamorphic rocks. The residual soils in this area are the product of in-place chemical weathering of rock. The typical residual soil profile consists of clayey soils near the surface where soil weathering is more advanced, underlain by clayey / silty sands that generally become harder / denser with depth to the top of parent bedrock. In residual materials the transition from soil to rock occurs gradually over a vertical distance ranging from a few feet to tens of feet. According the *1985 Geologic Map of North* Carolina, the site is underlain by biotite gneiss and schist of the Cambrian/Late Proterozoic age.

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Topsoil**	--
2	**Sandy Lean Clay**	Soft to stiff
3	**Silty/Clayey Sand**	Very loose to medium dense
4	**Sandy SILT**	Medium stiff to Stiff



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Groundwater Conditions

The boreholes were observed while drilling for the presence and level of groundwater. Groundwater was encountered at borings B-1, B-2, and B-3 at depths between of 3.5 to 13.5 feet below the existing ground surface after drilling was completed.

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.

GEOTECHNICAL OVERVIEW

When prepared as described in this report, the site should be suitable for the support of the proposed structure on pile foundations and pavements.

Near-surface soils have low to moderate plasticity and moisture sensitive and could become unstable, especially after precipitation events, as well as with typical earthwork and construction traffic. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The geotechnical engineer should be retained during the earthwork construction phase of the project to perform necessary tests and observations during foundation and slab subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; and backfilling of excavations.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and pavements.

Site Preparation

Within the greenway area, strip and remove existing vegetation, topsoil, and remove tree stumps from proposed pavement areas. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction in proposed greenway paved areas. Stripped materials consisting of vegetation and organic materials should on be used in structural areas. If it is necessary to dispose of organic materials on-site, they should be placed in non-structural areas. After site clearing and prior to fill placement, the exposed subgrade soils in paved areas should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proof-roll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or modified by stabilizing with structural fill. Excessively wet material should either be removed or moisture conditioned and recompacted.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures, pavements or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Location for Placement
Low Plasticity Cohesive	CL, CL-ML ML, SM, SC	All locations and elevations.
High Plasticity Cohesive [2]	CH, MH	All locations and elevations except as noted below.
Granular	GW, GP, GM, GC, SW, SP, SM, SC	NCDOT ABC (crushed aggregate base course) beneath pavements or as replacement material in over-excavation areas.
On-Site Soils	CL, ML, SM, SC, SC-SM	All locations and elevations.

1. Structural and general fill should consist of approved materials 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 prior to use on this site.
2. CH or MH soils should not be used within 1 foot below finished grade in other structural fill areas.

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as Structural fill
Minimum Compaction Requirements [1, 2, 3]	98% of max. within 1 foot of finished pavement subgrade 95% of max. more than 1 foot below finished pavement subgrade	92% of max.
Water Content Range [1]	-3% to +3% of optimum	As required to achieve min. compaction requirements

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. High plasticity cohesive fill should not be compacted to more than 100% of standard Proctor maximum dry density.
3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).

Permanent Slopes

For permanent slopes in unreinforced compacted fill areas, recommended maximum configurations for on-site materials are as follows:

Material	Maximum Slope Horizontal:Vertical
Granular soils (on-site or imported sand/gravel with 12% to 50% fines)	3:1
Cohesive soils (on-site or imported)	2:1

If steeper slopes are required for site development, stability analyses should be completed to design the grading plan. The face of all slopes should be compacted to the minimum specification for fill embankments. Alternately, fill slopes can be overbuilt and trimmed to compacted material.

Grading and Drainage

All grades must provide effective drainage away from the greenway during and after construction and should be maintained throughout the life of the structure. Water retained next to the greenway can result in soil subgrade degradation greater than those discussed in this report.

Earthwork Construction Considerations

Shallow excavations are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of the pavement sections. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

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 Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

BOARDWALK FOUNDATIONS

Based on the encountered subsurface conditions, and upon our experience with similar subsurface conditions and structures, the planned pedestrian boardwalk can be supported on a driven timber pile foundation system.

The near surface loose silty/clayey sand soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential instability issues. Raising proposed grades can also reduce potential instability issues. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork section**.

Driven Piles Recommendations

We recommend supporting the pedestrian boardwalk with 8-inch diameter timber piles. The piles should extend through the soft to medium stiff clay and loose to medium dense sand materials and bear on the medium dense sand soils identified in our borings. On average, the suitable bearing stratum was encountered at approximately 14 feet below existing grade. Provided the piles are driven to medium dense sand soils, an 8-inch diameter timber pile driven to a minimum of 20 feet for the Boardwalk and 15 feet for the Boardwalk Lookout should provide an allowable axial capacity of 5 and 6 kips, respectively. Allowable capacities are based on a minimum factor-of-safety equal to 2.0 for skin friction and 3.0 for end bearing capacity. The allowable uplift capacity should be taken as approximately 90 percent of the weight of the pile. We recommend using cross bracing to account for lateral loads.

Boardwalk					
	Soil Parameters			Axial Parameters	
Depth (feet bgs)	Assumed Total Unit Weight, γ_T (pcf)	Cohesion c (psf)	Friction Angle Φ	Allowable Skin Friction (lbs per lineal foot)	Allowable End Bearing Capacity (lbs)
1 – 3	110	300	--	150	--
3 – 8	110	--	30	90	1,365
8+	110	--	31	165	2,375

Boardwalk Lookout					
	Soil Parameters			Axial Parameters	
Depth (feet bgs)	Assumed Total Unit Weight, γ_T (pcf)	Cohesion c (psf)	Friction Angle Φ	Allowable Skin Friction (lbs per lineal foot)	Allowable End Bearing Capacity (lbs)
1 – 3	110	600	--	225	--
3 – 8	110	600	29	120	1,200
8 – 12	110	3,000	31	185	2,565
12+	110	6,000	32	285	3,825

Timber piles should be treated Southern Yellow Pine and meet the requirements of ASTM D 25 for round timber end bearing piles. The pile size should be specified in terms of a minimum tip circumference (25 inches for 8-inch diameter). Pressure-treat timber piles according to AWPA C3. Apply the treatment to the piles after all millwork is completed.

We recommend that piles be spaced on-center no closer than three times the pile butt diameter or width. The minimum spacing should be maintained to prevent the pile group compression load capacity from being significantly less than the summation of individual pile capacities. This spacing restriction also serves to limit surface heave and to reduce the possibility of damaging previously installed piles.

Driven Pile Construction Considerations

The hammer used for this project should be large enough to penetrate the pile through the existing fill, alluvial, and residual soils and into the very dense or hard residual soils without introducing excessive driving stresses. Based upon the subsurface conditions and our previous experience, Terracon recommends that a hammer with a rated energy of at least 10,000 foot-pounds be used to drive the piles. Terracon requests an opportunity to perform pile driving analyses after the type of hammer; pile cushion and driving procedures are proposed by the contractor.

In order to minimize damage to the timber piles during driving, we recommend limiting the compressive driving stress to three times the allowable design stress and using a steel driving shoe attached to the pile toe. Driving should be terminated immediately if refusal (i.e., 4 blows per inch for timber) is reached to minimize damaging the piles. Overdriving of the timber piles can result in the crushing of fibers or brooming of the pile head.

Actual tip elevations should be determined in the field by a representative of Terracon during pile driving operations, using a suitable pile driving formula. If needed, the driving resistance can be determined by a wave equation driving analysis performed by the geotechnical engineer. Complete driving and installation records should be maintained. For each pile driven, driving records should include as a minimum: pile type and dimensions, pile tip and cut-off elevations, butt deviation, time of driving, plumbness, penetration resistance values for each foot and any incidents relevant to the pile foundation installation such as pile damage or break-down of driving equipment.

A Terracon representative should observe pile driving operations. Each pile should be observed and checked for buckling, crimping and alignment in addition to recording penetration resistance, depth of embedment, and general pile driving operations.

The pile driving process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the pile installation process including soil/rock and groundwater conditions encountered, consistency with expected conditions, and details of the installed pile.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 15 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Support characteristics of subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade, such as soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade.

Existing Subgrade Condition

The existing subgrade soils consisted of medium dense silty and clayey sand soils with in-situ CBR values as outlined below.

Boring	USCS Classification	Average CBR Value[1]
DCP-1	CL	6
DCP-2	SC	9.5
DCP-3	CL	5
DCP-4	SC	27
DCP-5	SC	20
DCP-6	SC	10.5
DCP-7	ML	10
DCP-8	CL	6.5
DCP-9	CL	10
DCP-10	CL	11

1. Average in-situ CBR of the upper 2 feet.

Pavement Design Parameters

A subgrade CBR of 6 was used for the pavement designs, and a modulus of subgrade reaction of 100 pci was used for the PCC pavement designs. The values were empirically derived based upon the in-situ CBR results, our experience with similar subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A modulus of rupture of 600 psi was used for pavement concrete.

Pavement Section Thicknesses

The following table provides options for AC and PCC Sections:

Greenway Asphaltic Concrete Design Alternatives			
Option 1 **Full Depth Asphaltic Concrete**		**Option 2** **Asphaltic Concrete over Aggregate Base Course**	
Layer	**Layer Thickness (inches)**	**Layer**	**Layer Thickness (inches)**
AC Surface [1]	1.5	AC Surface [1]	2
AC Base [1,2]	2.5	NCDOT ABC	6

1. All materials should meet the current North Carolina Department of Transportation (NCDOT) Mix Design Criteria found in Table 610-3 (updated December 6, 2017) of the Standard Specifications for Roads and Structures.
   - AC Surface - NCDOT Mix Type S9.5B
   - AC Base - NCDOT Mix Type I19.0B
2. Placed in a single lift.

Greenway Portland Cement Concrete Design and Boardwalk Approach		
Layer	**Thickness (inches)**	
	Light Duty [1]	**Boardwalk Approach** [3]
PCC [2]	4	6
NCDOT ABC [2]	as needed[4]	as needed[4]

1. See **Project Description** for more specifics regarding traffic classifications.
2. All materials should meet the current North Carolina Department of Transportation (NCDOT) Standard Specifications for Highway and Bridge Construction.
3. In areas of anticipated traffic or concentrated loads (e.g. end approach slabs), and areas with repeated turning or maneuvering of vehicles.
4. Use aggregate base course as needed to stabilize the subgrade

Concrete for rigid pavements should have a minimum 28-day compressive strength of 4,000 psi, and be placed with a maximum slump of 4 inches. Although not required for structural support, a minimum 4-inch thick base course layer is recommended to help reduce potential 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. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its “green” state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Pavement design methods are intended to provide structural sections with adequate thickness over a subgrade such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of a potentially expansive clay subgrade such as the soils encountered throughout the site. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. It is, therefore, important to minimize moisture changes in the subgrade to reduce shrink/swell movements.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Rigid PCC pavements will perform better than ACC in areas where short-radii turning and braking are expected (i.e., entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325. PCC pavements should be provided with mechanically reinforced joints (doweled or keyed) in accordance with ACI 330.

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. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections 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. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

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 paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- 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.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations 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.

Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) 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.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

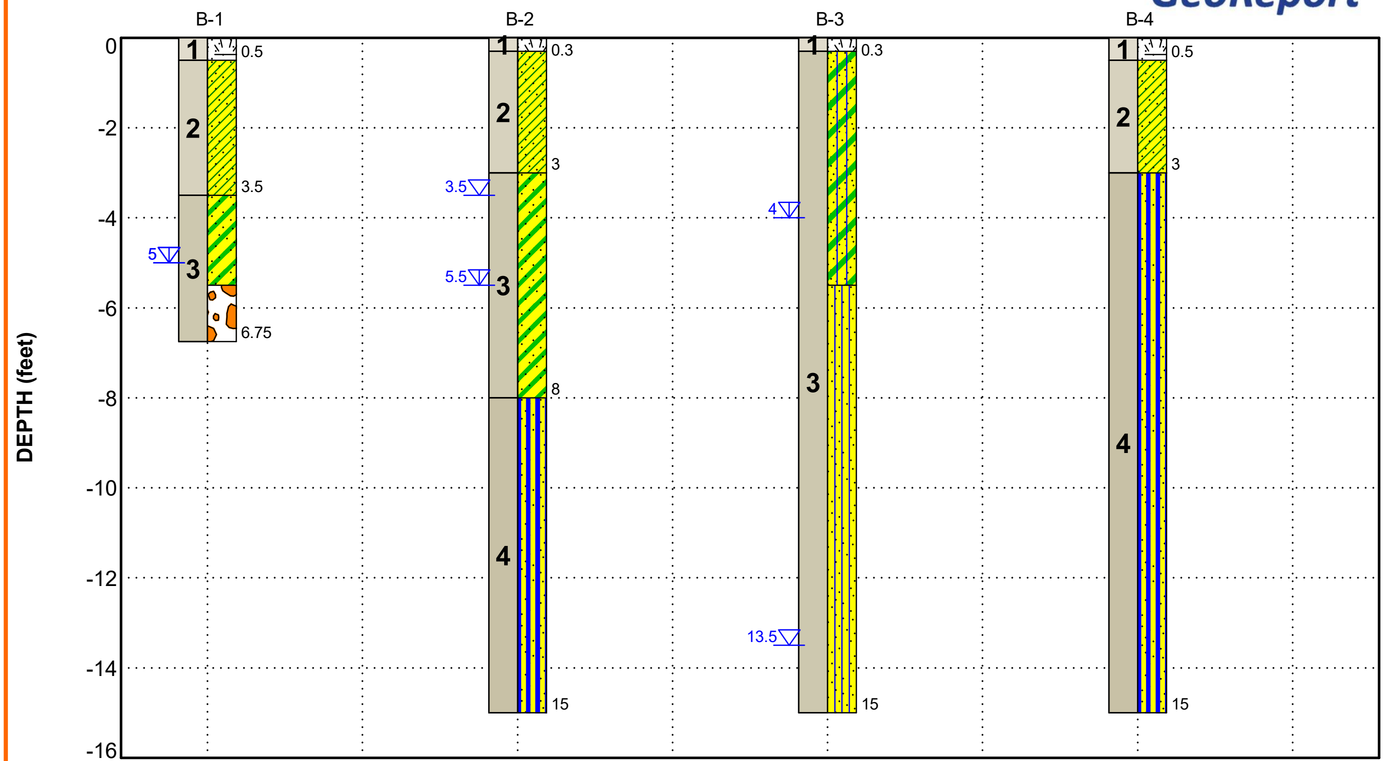
Contents:

GeoModel

GEOMODEL

Alston Ridge Greenway ■ Holly Springs, NC
Terracon Project No. 70205155

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Tosoil	--
2	Sandy Lean CLAY	Soft to medium stiff
3	Silty/Clayey SAND	Loose to medium dense
4	Sandy SILT	Medium stiff to stiff

LEGEND

- Topsoil
- Poorly-graded Gravel
- Silty Sand
- Sandy Lean Clay
- Sandy Silt
- Clayey Sand
- Silty Clayey Sand

- First Water Observation
- Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
4	7 to15 or auger refusal	Boardwalks
10	4 or auger refusal	Pavement

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained from Google Earth. If a more precise elevation and boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Boardwalk Subsurface Exploration Procedures: The soil test borings were performed by advancing 2-1/4 inch diameter hollow stem augers with a track-mounted Diedrich D-50 rotary drill rig. Samples of the soil encountered in the borings were obtained using the split barrel sampling procedure. In the split barrel sampling procedure, the number of blows required to advance a standard 2-inch outer diameter split barrel sampler from 6 to 18 inches of the typical total 18 or 24-inch penetration by means of a 140 pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. Four soil samples were taken in the upper 10 feet, and at 5-foot intervals below thereafter.

The samples collected in the field were tagged for identification, sealed to reduce moisture loss as appropriate, and taken to our laboratory for further examination, testing, and classification. A field log of each boring was 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 the engineer's interpretation of the field logs and include modifications based on laboratory observation and/or testing of the samples.

An 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 be 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.

At boring B-1, testing was performed using a Sower's Dynamic Cone Penetrometer (DCP) due to access issues. The boring was advanced using a standard 3-inch hand auger at intervals of 1 foot and DCP testing performed at each interval. DCP were performed in accordance with ASTM D6951 "Standard Test Method for Use of the Dynamic Cone Penetrometer". The loose surficial soils were removed by augering through the topsoil layer. Upon completion of testing, the borings were backfilled with auger cuttings prior to the drill crew leaving the site.

After augering to the test depth, the cone point is seated 2 inches into the undisturbed bottom of the hole to be sure the cone is completely embedded. The cone point is further driven 1-3/4-inch using the ring weight hammer falling 20-inch. These blows are counted and recorded. A second and third penetration test is performed by driving the cone point additional 1-3/4-inch increments.

Pavement Subsurface Exploration Procedures: For test locations through the proposed greenway pavement areas, Kessler DCP tests were performed at 10 locations. The DCP test was advanced to a depth of approximately 3 feet below r the existing ground surface. After the DCP test was completed, the drill rig was used to advance a 2-1/4 inch solid stem auger or hand auger to a depth of approximately 4 feet below existing site grades. The auger was then withdrawn to observe and collect representative samples of the subgrade soils. Collected samples were stored in appropriate containers and labeled for transport to our laboratory. The open boreholes were observed for the presence of water for the brief period they remained open. Before demobilizing from the site, the drill crew used auger cuttings and soils borrowed from on site to backfill the open boreholes.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Alston Ridge Greenway ■ Fuquay-Varina, North Carolina

May 11, 2021 ■ Terracon Project No. 70205155

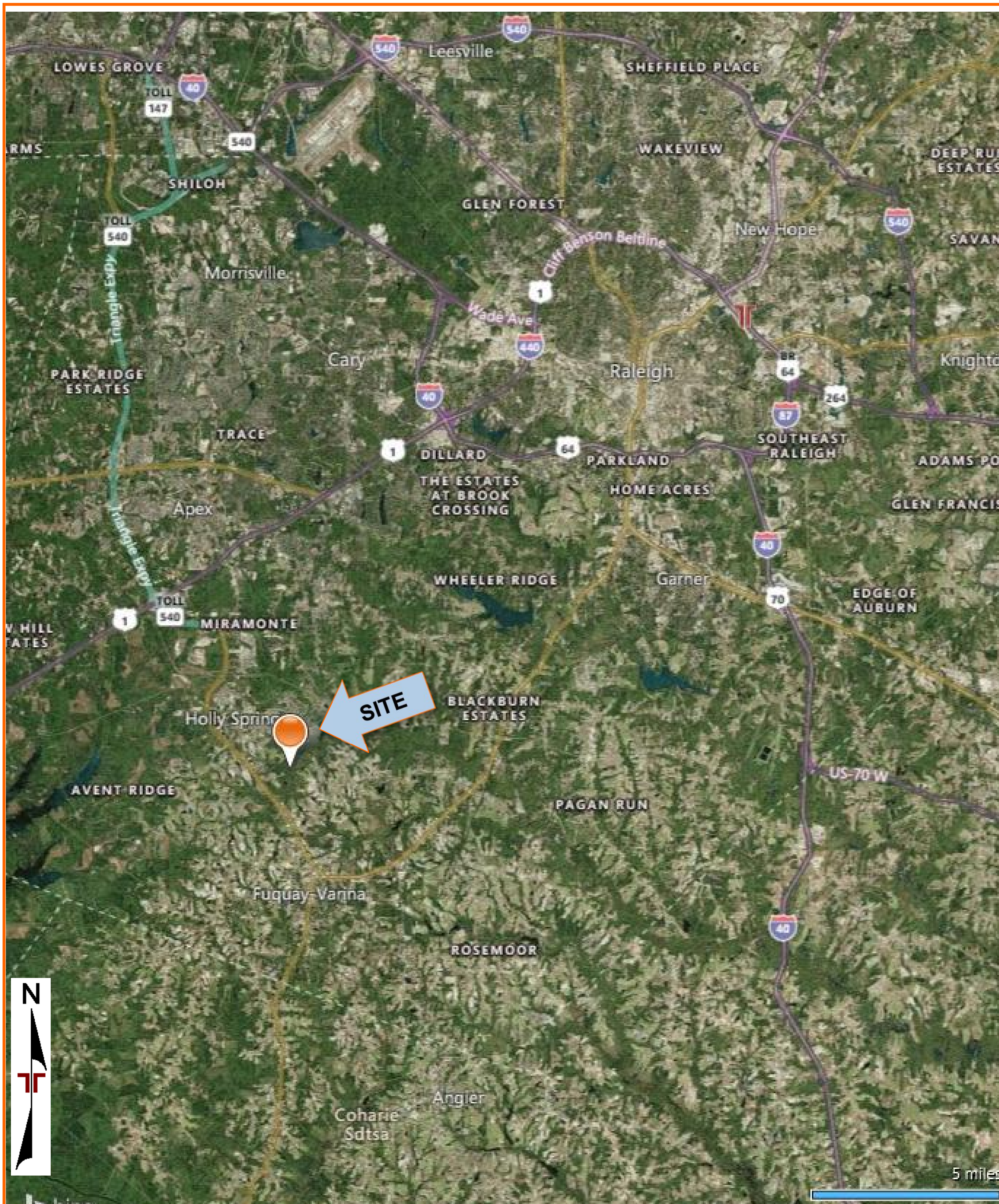


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

SITE LOCATION

Alston Ridge Greenway ■ Fuquay-Varina, North Carolina

May 11, 2021 ■ Terracon Project No. 70205155

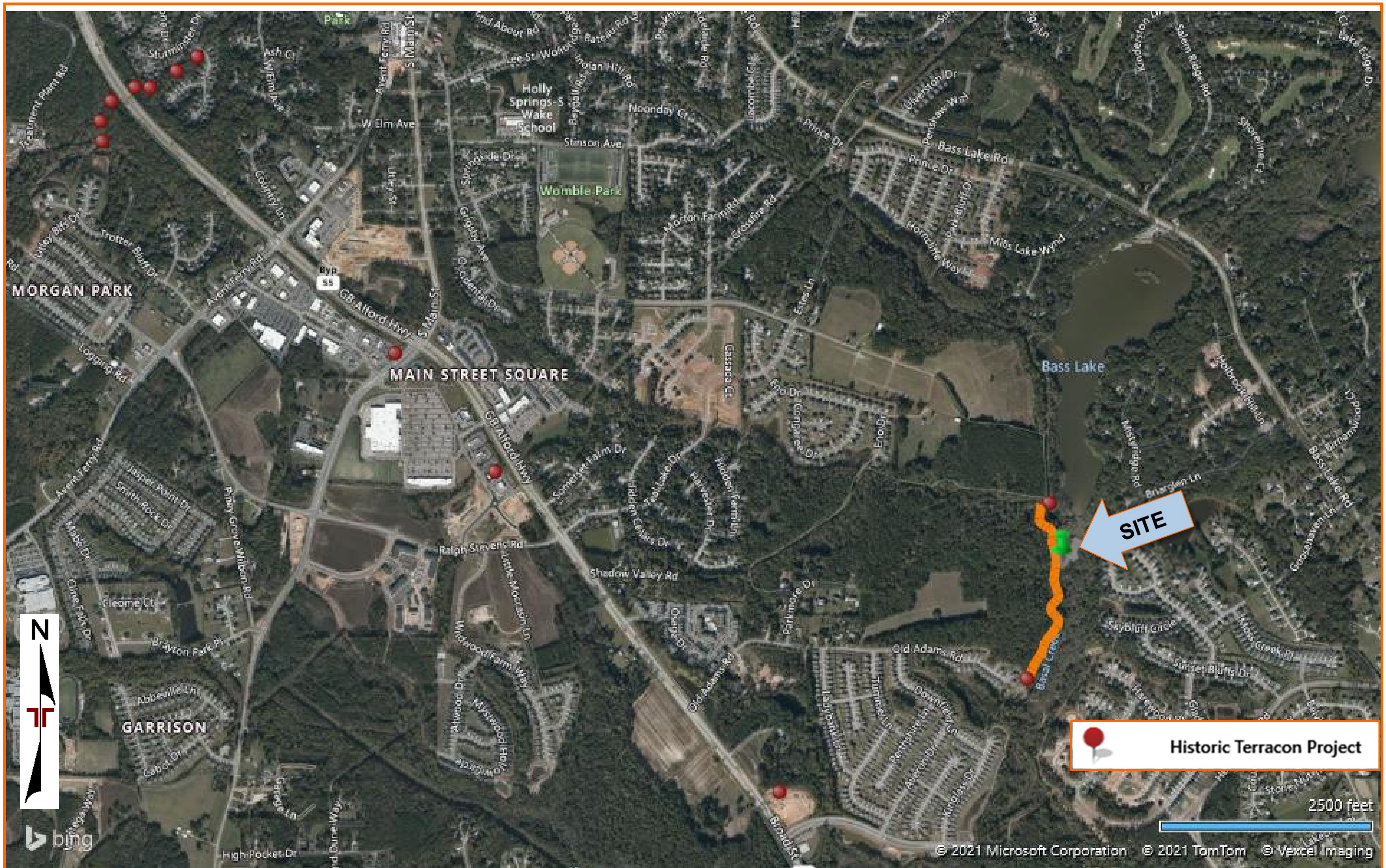


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Alston Ridge Greenway ■ Fuquay-Varina, North Carolina

May 11, 2021 ■ Terracon Project No. 70205155

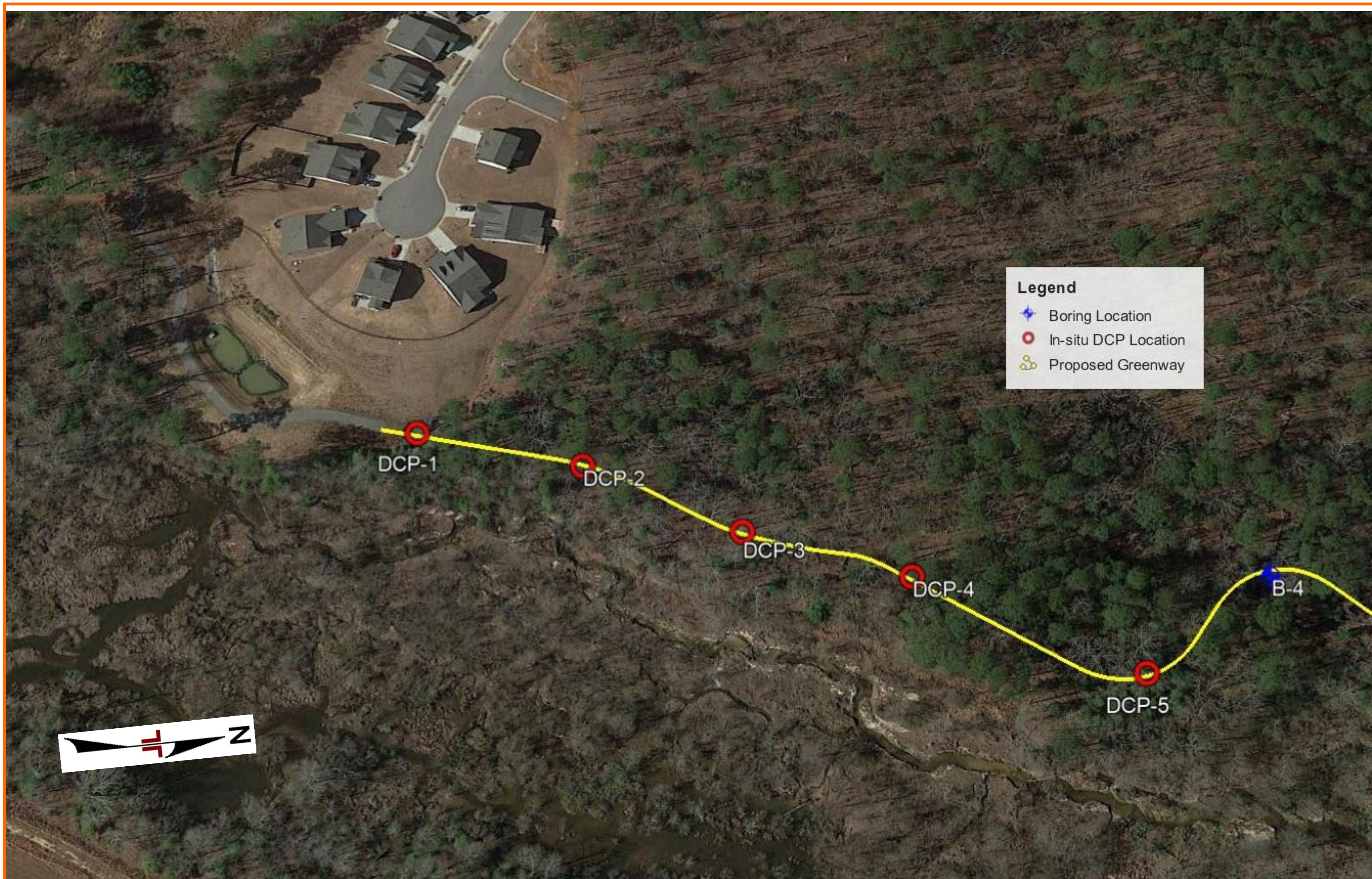


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH MAPS

EXPLORATION PLAN

Alston Ridge Greenway ■ Fuquay-Varina, North Carolina

May 11, 2021 ■ Terracon Project No. 70205155

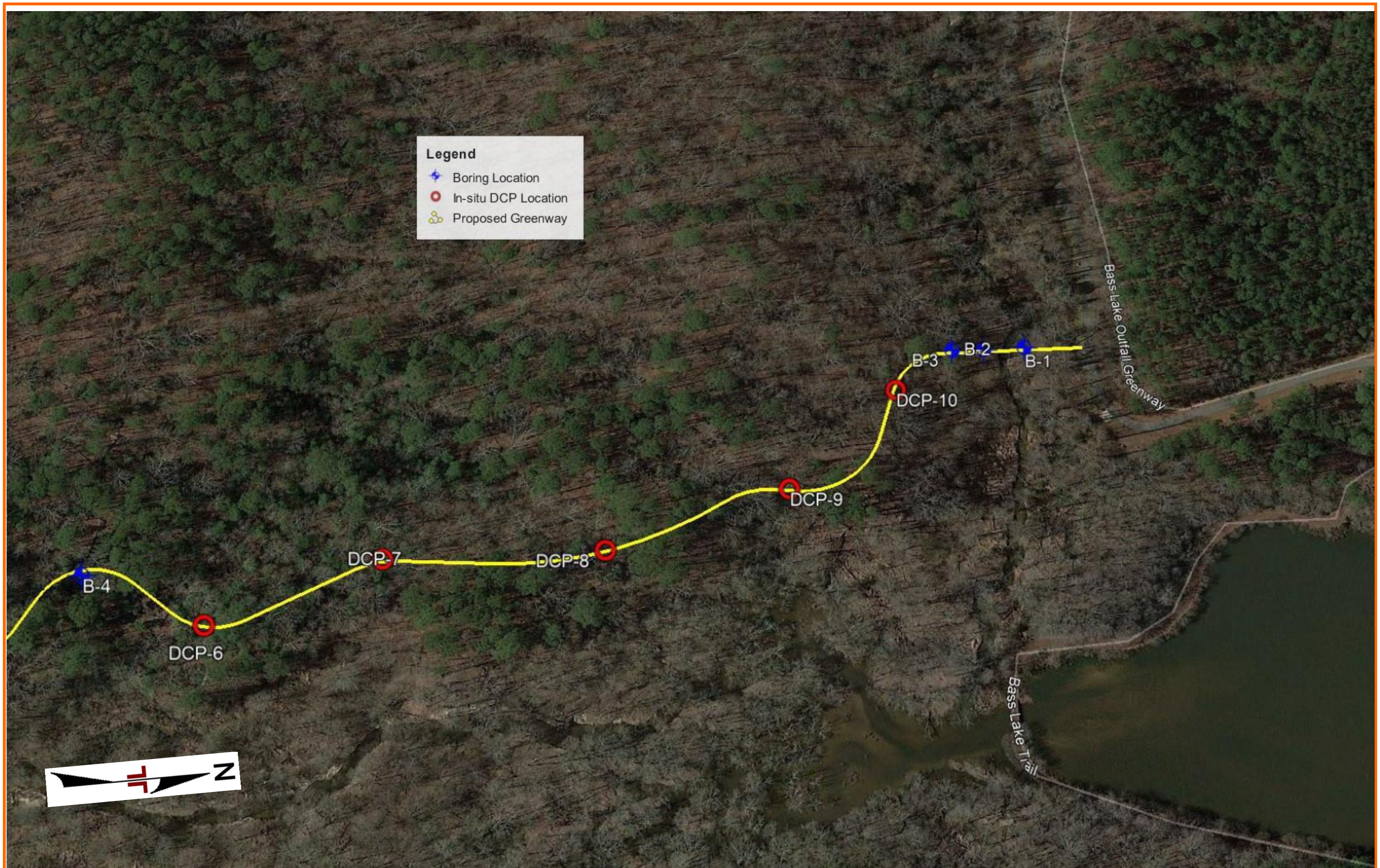


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-4)
DCP Logs (DCP-1 through DCP-10)
Atterberg Limits
In-situ CBR Logs (10 pages)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Alston Ridge Greenway

**CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC**

**SITE: Old Adams Road
Holly Springs, NC**

LOCATION See Exploration Plan

Latitude: 35.6340° Longitude: -78.8087°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.5	**TOPSOIL**										
2		3.5	**SANDY LEAN CLAY (CL)**, red, orange and light gray, wet, soft			↓	2-2-2						
						↓	2-2-1						
3		5.5	**CLAYEY SAND (SC)**, fine to medium grained, gray, wet to saturated, medium dense			↓	3-7-9						
				5	▽	↓	11-10-9						
		7.2	**POORLY GRADED GRAVEL (GP)**, medium to coarse grained, brown and orange, saturated, medium dense, Hand auger refusal at 6.75 feet			↓	11-12-15						
						↓	18-17-25						
			Boring Terminated at 7.2 Feet										

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

Hammer Type: Sower's Dynamic Cone Penetrometer
1.75 inches per blow

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While hand augering*

▽ *At completion of hand augering*

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-28-2021	Boring Completed: 04-28-2021
Drill Rig: N/A	Driller: Z. Marples
Project No.: 70205155	

BORING LOG NO. B-2

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6339° Longitude: -78.8087°

MODEL LAYER	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1	0.3	**TOPSOIL**										
2	3.0	**SANDY LEAN CLAY (CL)**, trace roots, fine grained, gray and red-brown, wet, soft			X	1-1-1 N=2						
3	8.0	**CLAYEY SAND (SC)**, with rock fragments, fine to coarse grained, tan and gray, wet, loose to medium dense	5	▽ (while drilling); ▼ (at completion)	X	3-8-9 N=17						
					X	2-3-3 N=6						
4	15.0	**SANDY SILT (ML)**, micaceous, fine grained, tan, brown, and black, wet, medium stiff	10	Cave-in	X	2-2-3 N=5						
			15		X	2-3-3 N=6						

Boring Terminated at 15 Feet

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

Hammer Type: Automatic

Advancement Method:
Hollow stem augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

▼ *At completion of drilling*

Cave-in at a depth of 9.5 feet

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: D-50	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. B-3

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6338° Longitude: -78.8087°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.3 **TOPSOIL**										
3		**SILTY CLAYEY SAND (SC-SM)**, trace roots, trace rock fragments, fine to coarse grained, tan and gray, moist to wet, very loose to loose			X	WOH-1-2 N=3				18.6		25-18-7
				▽	X	3-3-2 N=5						
		5.5	5									
		SILTY SAND (SM), fine to coarse grained, black, white, and tan, wet, loose to medium dense			X	3-3-4 N=7						
				Cave-in	X	3-4-4 N=8				29.0		NP
			10									
				▽	X	8-6-6 N=12						
		15.0	15									

Boring Terminated at 15 Feet

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

Hammer Type: Automatic

Advancement Method:
Hollow stem augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While drilling*
- ▽ *At completion of drilling*
- *Cave-in at a depth of 10.0 feet*

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: D-50	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. B-4

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6308° Longitude: -78.8082°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.5	**TOPSOIL**										
2		3.0	**SANDY LEAN CLAY (CL)**, fine to coarse grained, orange-brown, moist, medium stiff			X	3-3-3 N=6						
4		15.0	**SANDY SILT (ML)**, micaceous, fine grained, gray, tan, black, and brown, moist, medium stiff to stiff			X	4-4-4 N=8						
				5		X	3-4-3 N=7						
						X	3-7-5 N=12						
				10	Cave-in (10.1 ft)								
						X	5-8-8 N=16				21.9		43-34-9
			Boring Terminated at 15 Feet	15									

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

Hammer Type: Automatic

Advancement Method:
Hollow stem augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Cave-in at a depth of 10.1 feet

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: D-50	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-1

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6285° Longitude: -78.8091°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
2		4.0	**SANDY LEAN CLAY (CL)**, fine to coarse grained, orange-brown, moist										
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-10

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6336° Longitude: -78.8085°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
2		4.0	**SANDY LEAN CLAY (CL)**, trace roots, fine to coarse grained, red-brown and white, wet										
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-2

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6290° Longitude: -78.8089°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4 **TOPSOIL**										
		CLAYEY SAND (SC), trace roots, fine to coarse grained, orange-brown, moist										
		1.5										
3		**SILTY SAND (SM)**, fine grained, tan, moist										
		4.0										
		Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-3

PROJECT: **Alston Ridge Greenway**

CLIENT: **Kimley-Horn and Associates Inc Raleigh, NC**

SITE: **Old Adams Road Holly Springs, NC**

LOCATION See Exploration Plan

Latitude: 35.6294° Longitude: -78.8086°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4 **TOPSOIL**										
2		**SANDY LEAN CLAY (CL)**, trace roots, fine grained, red-brown, wet 2.0										
3		**SILTY SAND (SM)**, fine grained, orange-brown, wet 4.0										
		Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-4

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC

SITE: Old Adams Road
Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6299° Longitude: -78.8084°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
3		2.0	**CLAYEY SAND (SC)**, trace roots, fine to coarse grained, red-brown, wet										
2		4.0	**SANDY LEAN CLAY (CL)**, trace rock fragments, trace roots, fine to coarse grained, red-brown and tan, wet										
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-5

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC

SITE: Old Adams Road
Holly Springs, NC

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.6305° Longitude: -78.8079° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4 **TOPSOIL**										
3		**CLAYEY SAND (SC)**, with rock fragments, fine to coarse grained, tan, wet 4.0										
		Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-6

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC

SITE: Old Adams Road
Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6312° Longitude: -78.8079°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
3		3.0	**CLAYEY SAND (SC)**, trace rock fragments, fine to coarse grained, tan, wet										
2		4.0	**SANDY LEAN CLAY (CL)**, fine to coarse grained, tan and white, wet										
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-7

PROJECT: Alston Ridge Greenway

**CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC**

**SITE: Old Adams Road
Holly Springs, NC**

LOCATION See Exploration Plan

Latitude: 35.6318° Longitude: -78.8081°

MODEL LAYER	GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
4		2.0	**SANDY SILT (ML)**, trace roots, fine grained, tan, wet										
3		4.0	**SILTY SAND (SM)**, fine grained, tan, wet										
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-8

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC

SITE: Old Adams Road
Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6325° Longitude: -78.8080°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
2		4.0	**SANDY LEAN CLAY (CL)**, trace roots, fine grained, brown, wet			Hand					21.1		36-19-17
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

BORING LOG NO. DCP-9

PROJECT: Alston Ridge Greenway

CLIENT: Kimley-Horn and Associates Inc Raleigh, NC

SITE: Old Adams Road Holly Springs, NC

LOCATION See Exploration Plan

Latitude: 35.6331° Longitude: -78.8082°

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.4	**TOPSOIL**										
2		4.0	**SANDY LEAN CLAY (CL)**, trace roots, trace rock fragments, fine grained, red-brown and white, wet										
			Boring Terminated at 4 Feet										

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

Hammer Type: Kessler Dynamic Cone Penetrometer
See attached CBR Plots

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were not determined.

Notes:

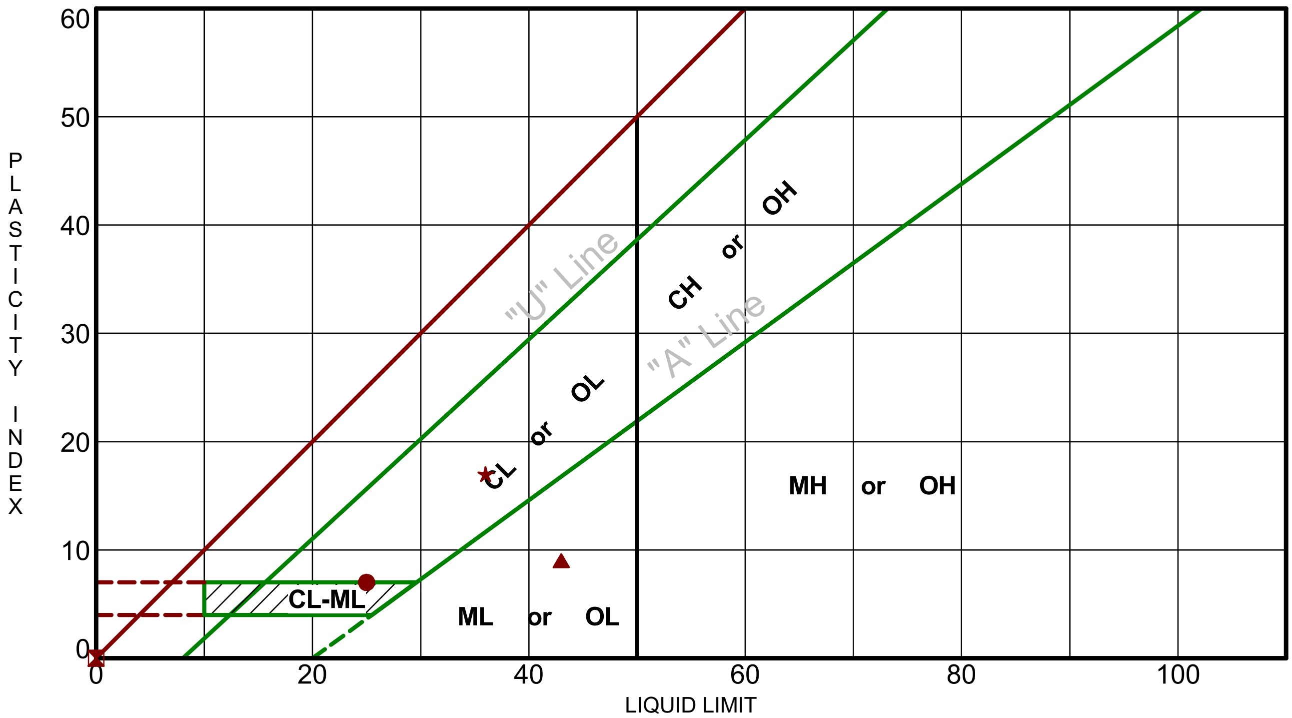
WATER LEVEL OBSERVATIONS

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Started: 04-23-2021	Boring Completed: 04-23-2021
Drill Rig: N/A	Driller: J. Turnage
Project No.: 70205155	

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-3	1 - 2.5	25	18	7	48.1	SC-SM	SILTY, CLAYEY SAND
⊠	B-3	8.5 - 10	NP	NP	NP	34.5	SM	SILTY SAND
▲	B-4	13.5 - 15	43	34	9	51.1	ML	SANDY SILT
★	DCP-8	2 - 4	36	19	17	65.7	CL	SANDY LEAN CLAY

PROJECT: Alston Ridge Greenway

SITE: Old Adams Road
Holly Springs, NC

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

PROJECT NUMBER: 70205155

CLIENT: Kimley-Horn and Associates Inc
Raleigh, NC

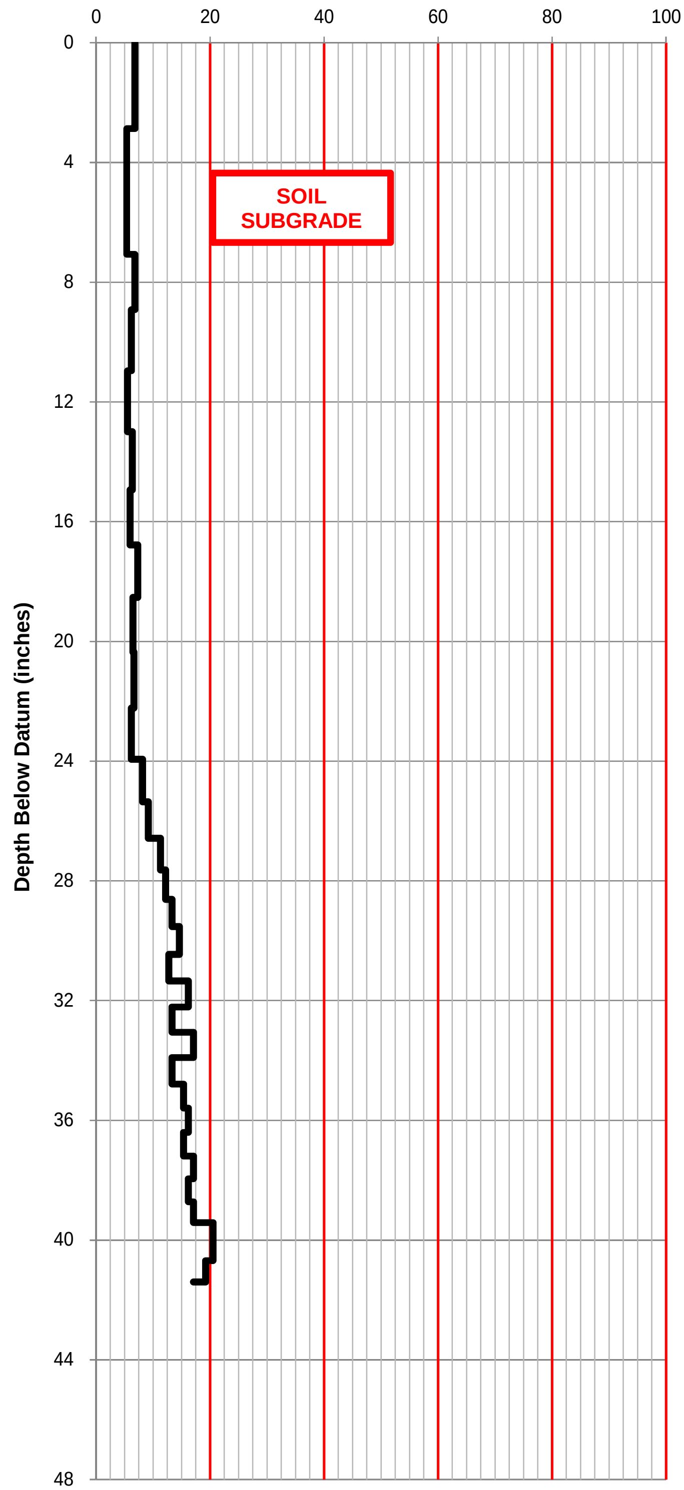
DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-1	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.62853	-78.80913

CUMULATIVE PENETRATION IN CENTIMETERS

4.5											
10.1											
15.7											
20.2											
25.1											
30.6											
35.4											
40.5											
44.7											
49.4											
54.0											
58.9											
62.7											
66.1											
68.9											
71.5											
73.9											
76.1											
78.6											
80.6											
83.0											
84.9											
87.3											
89.4											
91.4											
93.5											
95.4											
97.4											
99.3											
100.9											
102.5											
104.2											
106.1											

CORRELATED CBR VALUES



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

Terracon
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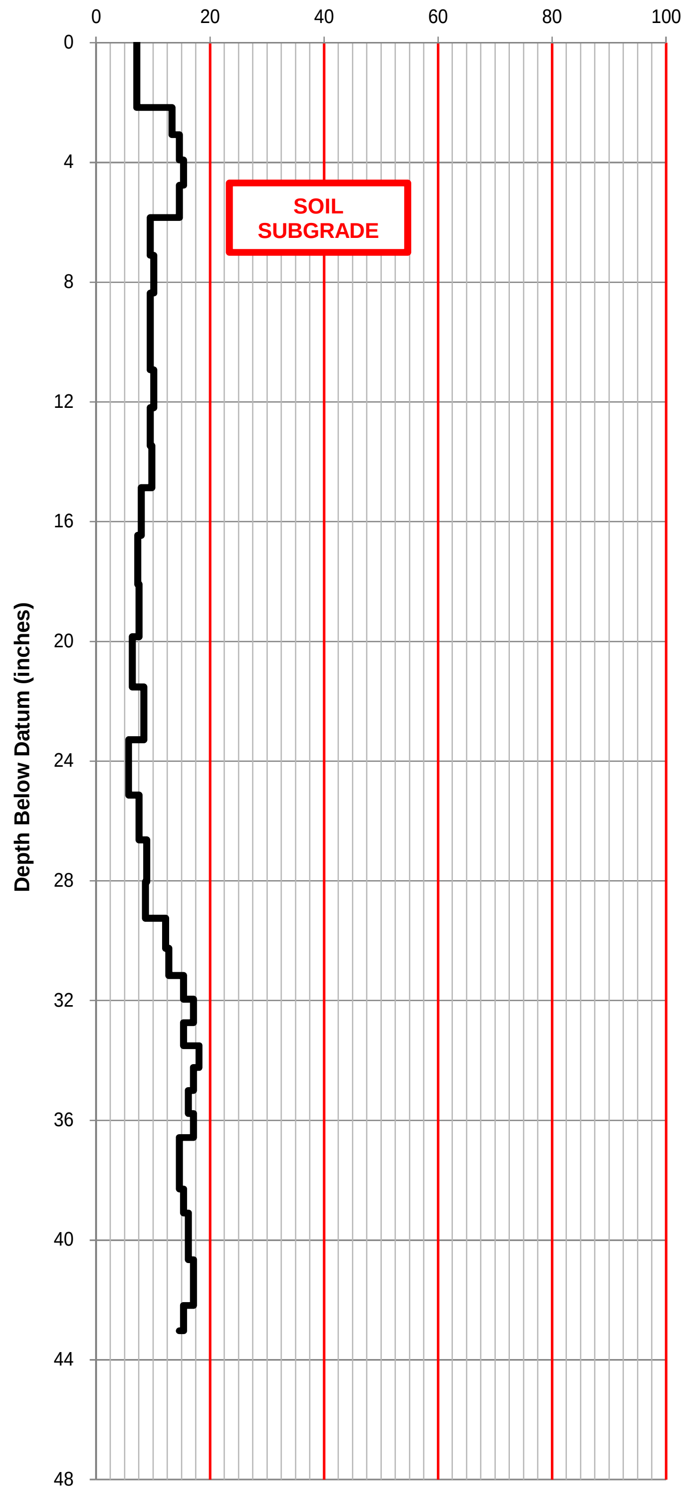
DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-2	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.62899	-78.80891

CUMULATIVE PENETRATION IN CENTIMETERS

4.3											
6.7											
8.9											
11.0											
13.2											
16.5											
19.6											
22.9											
26.2											
29.3											
32.6											
35.8											
39.7											
43.9											
48.0											
52.8											
56.5											
61.8											
65.9											
69.4											
73.0											
75.6											
78.1											
80.2											
82.1											
84.2											
86.0											
87.9											
89.9											
91.8											
94.0											
96.2											
98.3											
100.3											
102.3											
104.2											
106.1											
108.2											
110.4											

CORRELATED CBR VALUES



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

Terracon
Consulting Engineers and Scientists

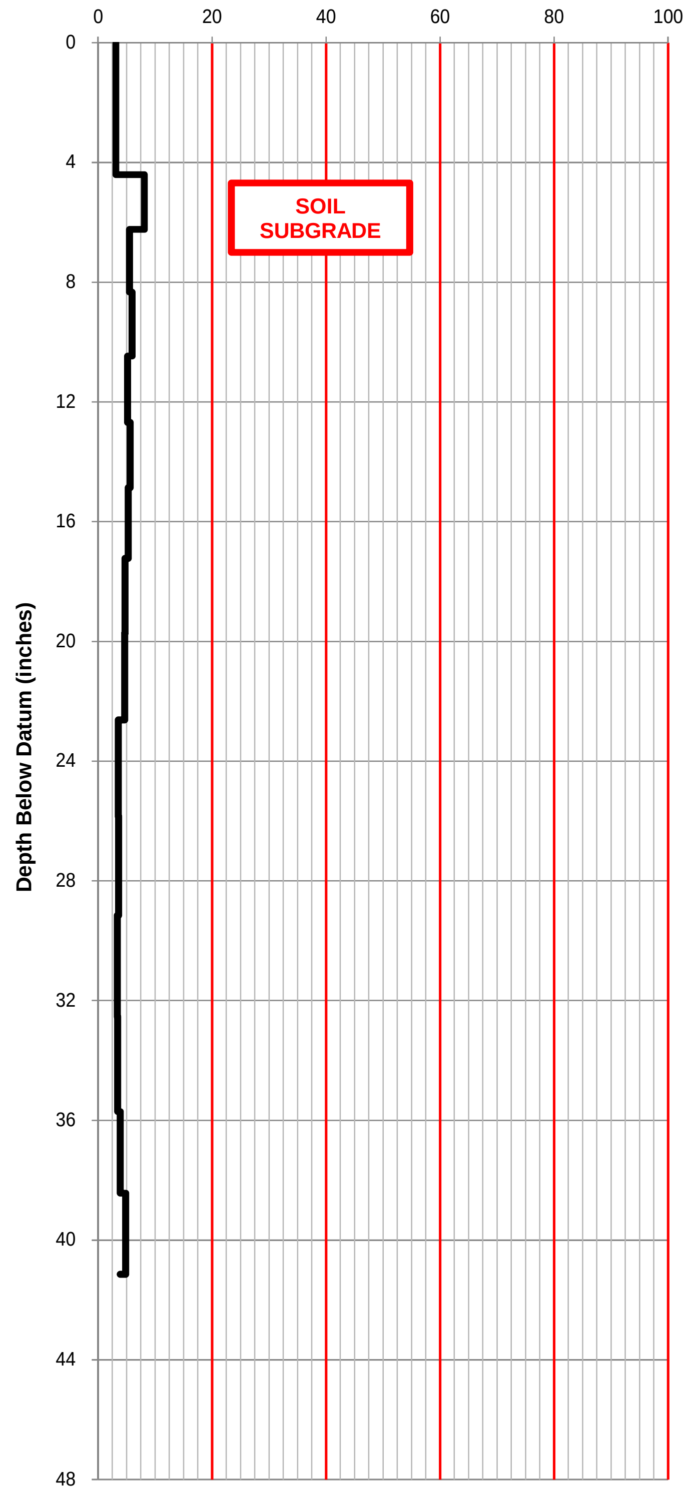
DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-3	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.62941	-78.80861

CUMULATIVE PENETRATION IN CENTIMETERS

9.3											
13.1											
18.6											
23.7											
29.5											
34.9											
40.6											
46.9											
53.3											
61.6											
69.7											
78.4											
86.9											
94.5											
100.7											
108.3											

CORRELATED CBR VALUES



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

Terracon
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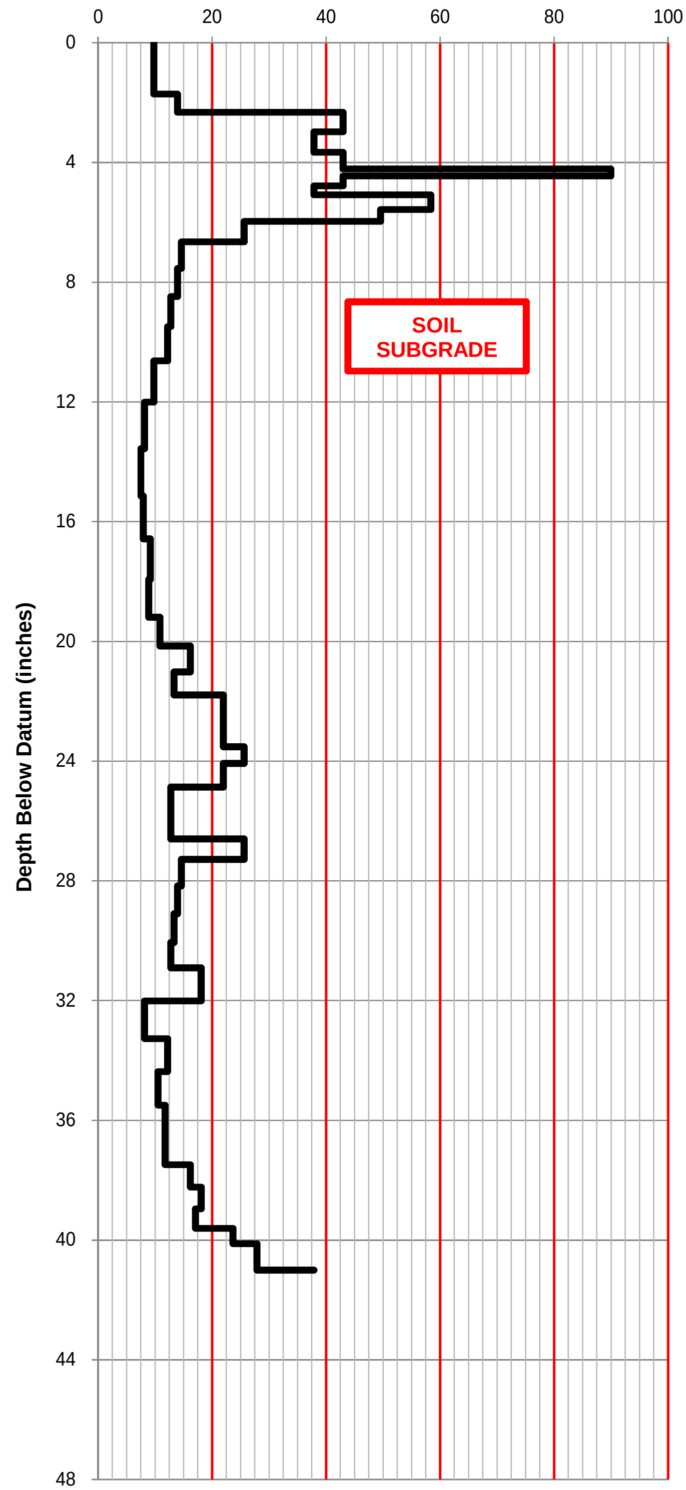
DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-4	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.62987	-78.80838

CORRELATED CBR VALUES



CUMULATIVE PENETRATION IN CENTIMETERS
3.2
5.5
6.3
7.1
8.0
8.9
9.7
10.5
10.9
11.7
12.6
13.2
13.8
14.5
15.8
18.0
20.3
22.8
25.4
28.6
32.4
36.5
40.4
43.8
47.3
50.2
52.2
54.6
56.1
57.6
59.1
60.4
61.9
64.4
66.9
68.2
70.4
72.7
75.1
77.6
79.4
83.2
85.8
88.8
91.5
94.2
96.2
98.0
99.9
101.3
102.5
103.7
104.6

Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

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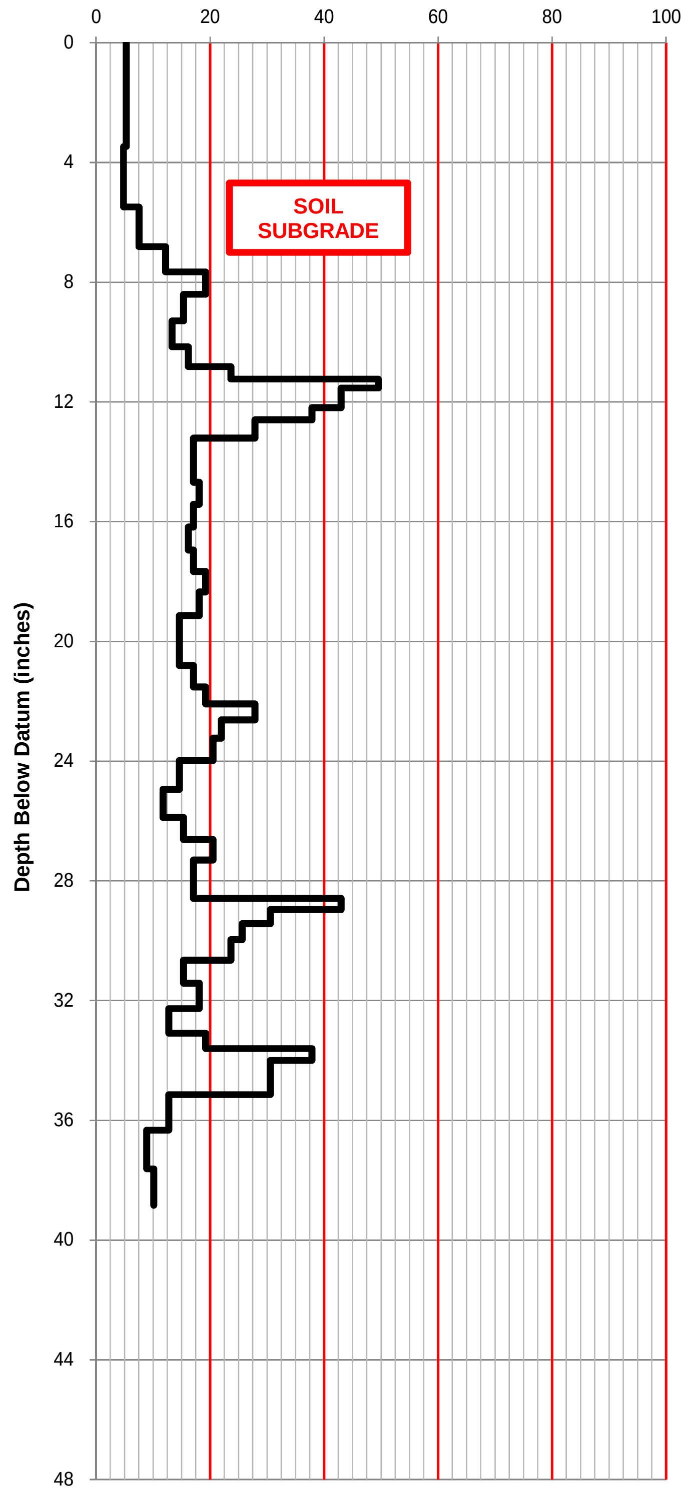
DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-5	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.63046	-78.80793

CORRELATED CBR VALUES

CUMULATIVE PENETRATION IN CENTIMETERS
5.7
11.9
16.0
18.6
20.3
22.4
24.8
26.8
28.2
28.9
29.7
30.5
31.4
32.6
34.5
36.4
38.2
40.1
42.1
44.0
45.7
47.5
49.7
51.9
53.8
55.5
56.7
58.2
59.8
62.0
64.7
66.8
68.4
70.3
72.2
73.0
74.1
75.4
76.8
78.9
80.7
83.2
84.9
85.8
86.9
88.0
90.5
94.0
97.1
100.2



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

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DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-6	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.63122	-78.80793

CORRELATED CBR VALUES

CUMULATIVE PENETRATION IN CENTIMETERS

3.2	104.1
8.1	105.1
11.1	105.8
13.4	
15.5	
17.9	
21.0	
24.9	
27.9	
30.4	
33.2	
36.4	
39.1	
42.2	
45.3	
49.0	
52.8	
56.3	
59.5	
61.6	
63.7	
66.5	
68.5	
69.8	
71.0	
72.2	
72.8	
73.4	
73.8	
75.6	
78.2	
80.3	
81.2	
82.0	
82.7	
83.7	
85.2	
86.2	
87.3	
88.7	
89.6	
90.5	
91.3	
92.4	
93.2	
94.4	
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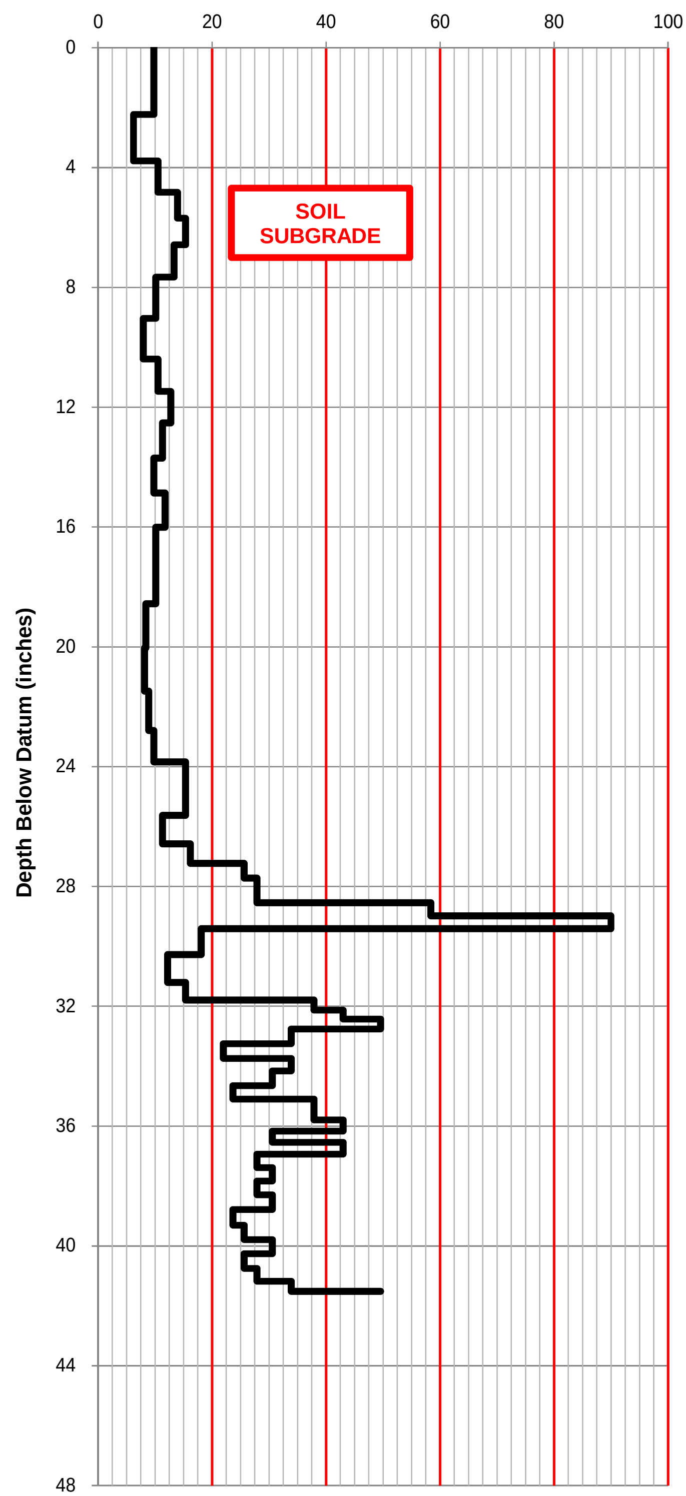
97.8	
99.2	
100.5	
101.6	
102.9	



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

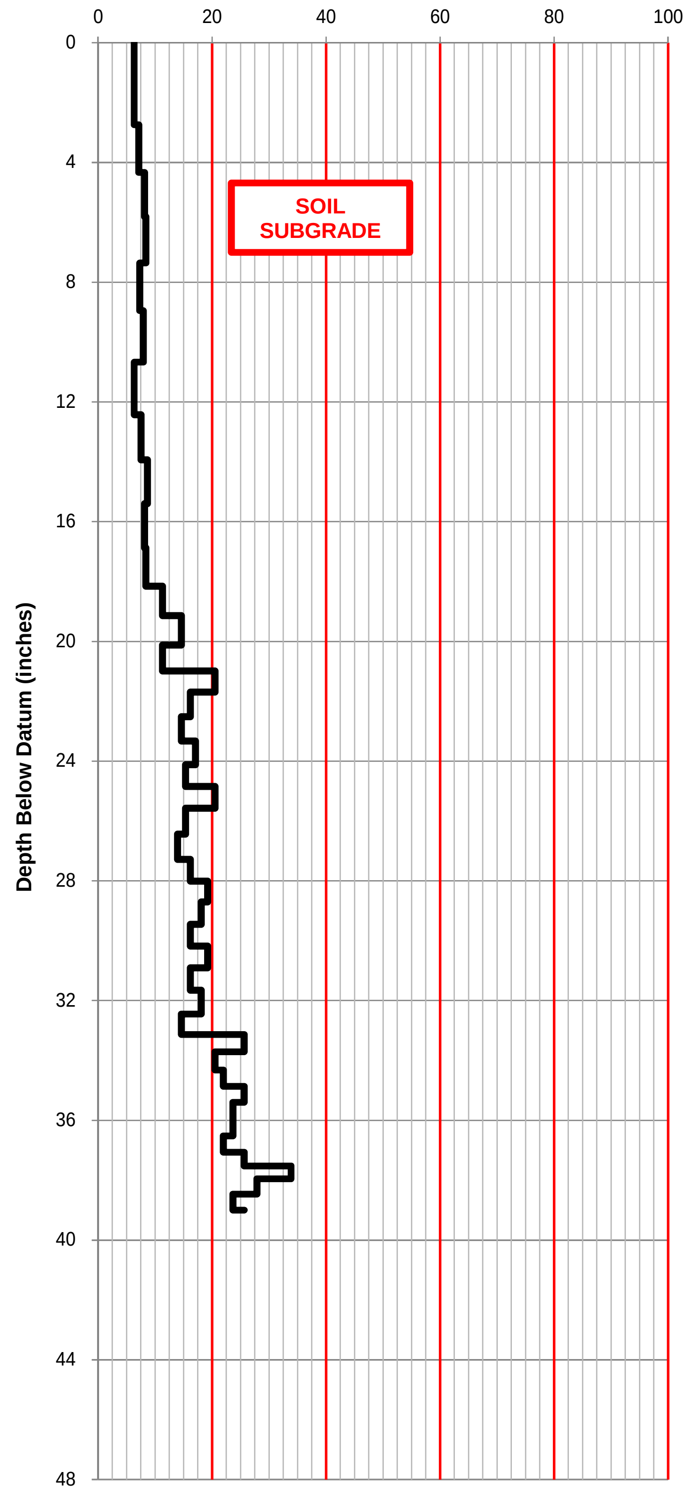
Terracon
Consulting Engineers and Scientists

DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-7	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.63180	-78.80810

CORRELATED CBR VALUES

CUMULATIVE PENETRATION IN CENTIMETERS
4.8
9.1
12.9
16.6
20.8
24.7
29.5
33.6
37.2
41.0
44.7
47.5
49.7
52.5
54.1
56.1
58.3
60.2
62.3
63.9
66.0
68.3
70.3
72.0
73.8
75.8
77.5
79.5
81.3
83.5
84.8
86.4
87.9
89.2
90.6
92.0
93.5
94.8
95.8
97.0
98.4
99.7



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

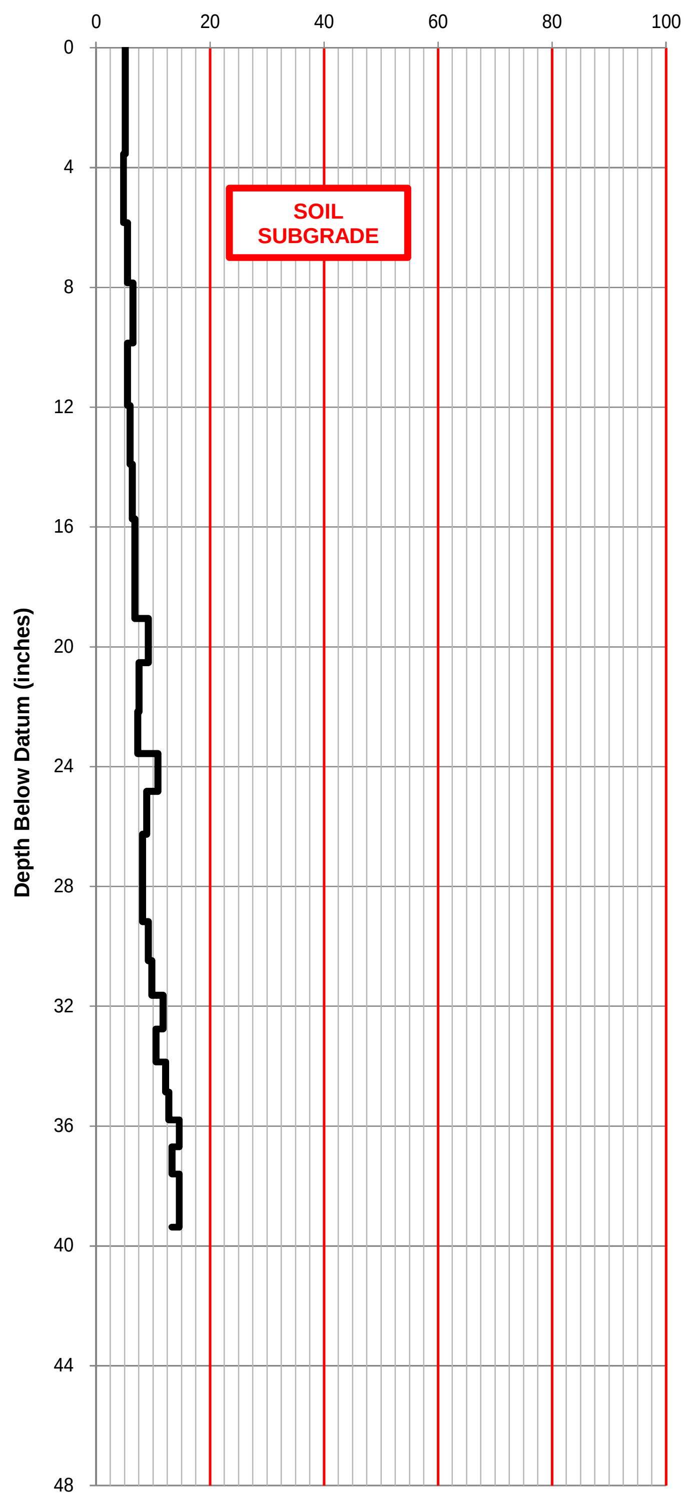
Terracon
Consulting Engineers and Scientists

DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-8	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.63252	-78.80802

CORRELATED CBR VALUES

CUMULATIVE PENETRATION IN CENTIMETERS
5.9
12.1
17.6
22.3
27.8
32.9
37.7
42.2
46.7
50.1
54.2
58.4
61.3
64.8
68.6
72.4
75.8
79.0
81.7
84.7
87.3
89.8
92.0
94.4
96.6
98.8
101.2



Notes:

SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

Terracon
Consulting Engineers and Scientists

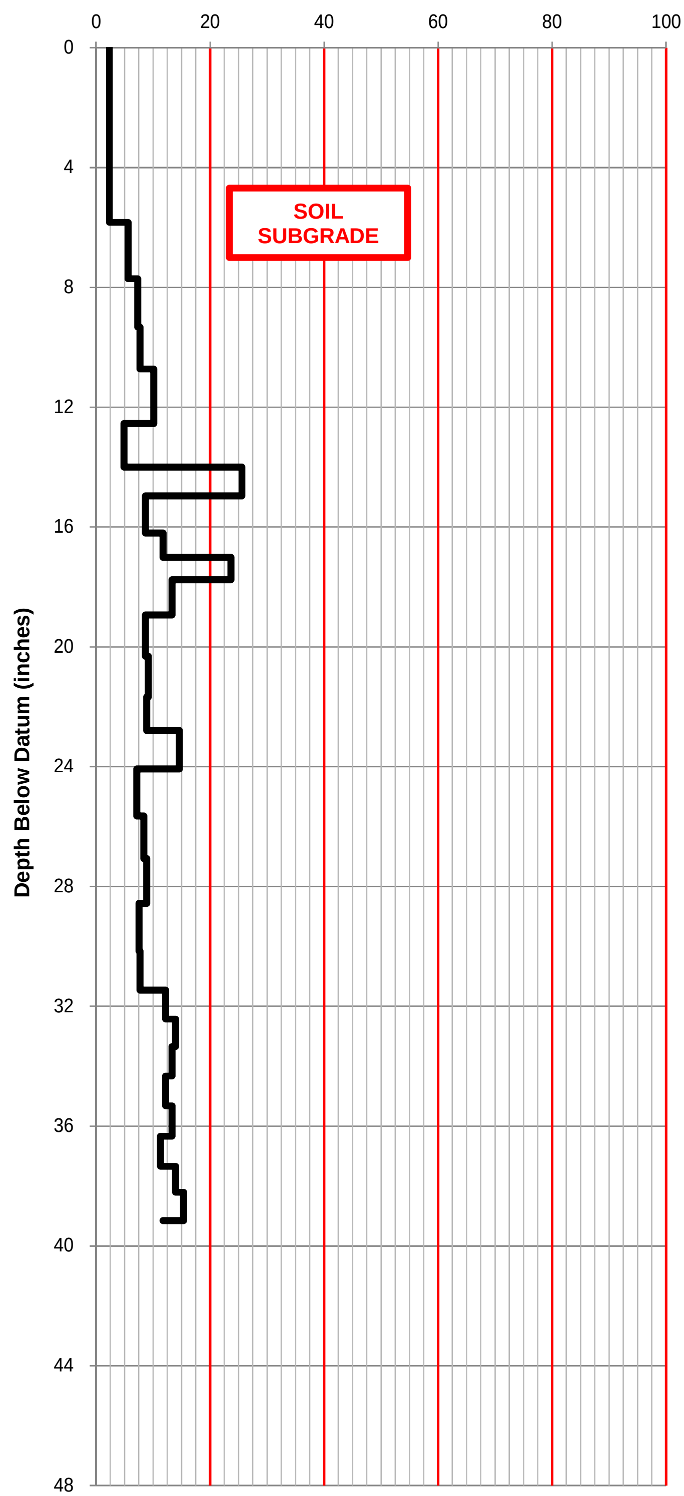
DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR	PROJECT NUMBER	BORING	PROJECT MANAGER
	70205155	DCP-9	SANTANA, H.
	COUNTY	GEOLOGIST	TECHNICIANS
	WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.63315	-78.80816

CUMULATIVE PENETRATION IN CENTIMETERS

12.1											
17.5											
21.7											
25.7											
28.8											
34.9											
36.2											
39.8											
42.5											
43.9											
46.3											
49.9											
53.3											
56.8											
59.0											
63.3											
67.0											
70.5											
74.6											
78.6											
81.2											
83.5											
85.9											
88.5											
90.9											
93.7											
96.0											
98.1											
100.8											

CORRELATED CBR VALUES



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

Terracon
Consulting Engineers and Scientists

DYNAMIC CONE PENETROMETER DATA AND IN-SITU CBR

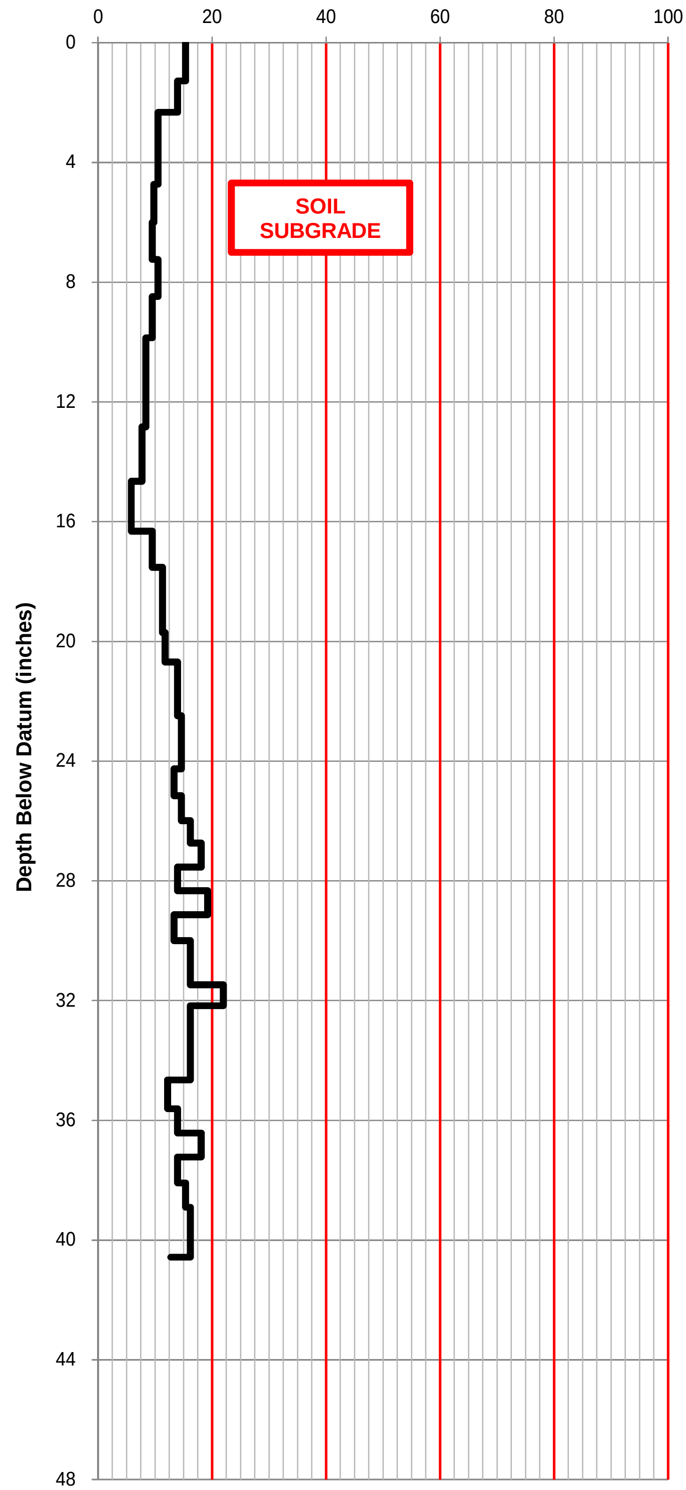
PROJECT NUMBER	BORING	PROJECT MANAGER
70205155	DCP-10	SANTANA, H.
COUNTY	GEOLOGIST	TECHNICIANS
WAKE	RUSSEK, S.C.	TURNAGE, J. / KELLY, N.

TEST LOCATION DESCRIPTION			DATE RUN
ALSTON RIDGE GREENWAY			4/23/2021
DATUM	CUT / FILL	LATITUDE	LONGITUDE
SG	GRADE	35.63357	-78.80853

CUMULATIVE PENETRATION IN CENTIMETERS

2.1
4.4
7.4
10.4
13.6
16.9
19.9
23.2
26.9
30.6
34.6
39.8
43.1
45.9
48.7
51.4
53.7
56.0
58.2
60.4
62.8
65.0
67.0
68.8
71.1
72.8
75.2
77.2
79.2
80.7
82.7
84.7
86.7
89.3
91.6
93.4
95.7
97.8
99.8
101.8
104.3

CORRELATED CBR VALUES



Notes:
SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade (Approximately 1 foot below the existing ground surface)

Terracon
Consulting Engineers and Scientists

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING		WATER LEVEL		FIELD TESTS		
	Split Spoon		▽ Water Initially Encountered		N	Standard Penetration Test Resistance (Blows/Ft.)
			▽ Water Level After a Specified Period of Time		(HP)	Hand Penetrometer
			▼ Water Level After a Specified Period of Time		(T)	Torvane
			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.		(DCP)	Dynamic Cone Penetrometer
					(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.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

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

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**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 / Liquid limit - not dried < 0.75	OL	Organic clay [K,L,M,N]
					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 / Liquid limit - not dried < 0.75	OH	Organic clay [K,L,M,P]
					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-in. (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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.