REPORT OF GEOTECHNICAL EXPLORATION
CROSS CHARLOTTE TRAIL
ORR ROAD TO ROCKY RIVER ROAD
CHARLOTTE, NORTH CAROLINA

Prepared for:

Ms. Marie S. Sugar, P.E.
Kimley-Horn Associates, Inc.

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208

BOYLE Project No. 15-072-05
December 22, 2020

4340 Taggart Creek Road Suite G
Charlotte, NC 28208
Tel: 704-676-0778
Fax: 704-676-0596
www.boyleconsulting.com
N.C. License No. P-0109

December 22, 2020

VIA E-MAIL: Marie.Sugar@kimley-horn.com
Ms. Marie S. Sugar, PE
Kimley-Horn and Associates, Inc.
200 S. Tryon Street, Suite 200
Charlotte, North Carolina 28202

Subject: **Report of Geotechnical Exploration**
Cross Charlotte Trail
Orr Road to Rocky River Road
Charlotte, North Carolina
BOYLE Project No. 15-072-05

Dear Ms. Sugar:

As authorized by issuance of your "Letter of Intent" dated Nov 19, 2019, and "Standard Agreement for Professional Services" dated September 11, 2020, Boyle Consulting Engineers, PLLC (BOYLE) has performed a Geotechnical Exploration for the subject project in Charlotte, North Carolina. This report describes the work performed, presents the data obtained, and provides our recommendations relative to site preparation, pavements, and foundations. This report is intended for the use of Kimley-Horn and Associates and The City of Charlotte. The contents of this report should not be relied upon by any other entity without the express written consent of BOYLE.

We appreciate the opportunity to provide our professional services on this project. Please contact us should you have any questions pertaining to this report.

Sincerely,

BOYLE CONSULTING ENGINEERS, PLLC

Charles Boyle, P.E.
Principal Engineer
Registered, NC 19681

NORTH CAROLINA PROFESSIONAL SEAL 19681 ENGINEER Charles G. Boyle 12/22/20

Attachments

TABLE OF CONTENTS

PROJECT OVERVIEW

PROJECT INFORMATION

The City of Charlotte and Mecklenburg County have partnered to create a 26-mile trail and greenway system that will stretch from the City of Pineville north through the center of Charlotte up to the UNC-Charlotte campus and eventually end at the Cabarrus County line. Large portions of the trail will be along the Little Sugar Creek floodplain and points further north. The trail system will connect existing greenway/trail areas and provide access to adjacent neighborhoods and commercial areas.

Based on the information provided by Kimley-Horn Associates (KHA) in various electronic mail communications (including electronic drawings), BOYLE understands that this section of the new trail project will extend south from the intersection of North Tryon Street and Orr Road along the west shoulder of Orr Road. Approximately 600 feet from the intersection the trail crosses Orr Road and extends approximately 600 feet along the east shoulder of Orr Road. The trail access to Toby Creek extends from Orr Road between 5807 and 5621 Orr Road and terminates at the intersection of Rockland Drive and Autumnwood Lane. The main trail between Orr Road and Rockland Drive/Autumnwood Lane is approximately 2.2 miles. The main trail fronting Toby Creek includes trail access locations to North Hills Circle, Charlotte Hills Mobile Home Park, Kingswood Mobile Home Park, Donna Drive, and Foxborough Road. Based on the provided Cross Charlotte Trail Orr Road to Rocky River Road Progress Plans dated September 23, 2020 this section of the trail will consist mostly of a paved pedestrian/bike trail with six associated retaining walls ranging between approximately 4 feet of cut to approximately 6 feet of fill at wall locations and eight boardwalk style structures to accommodate creek crossings and severe grade changes with undulating terrain. BOYLE further understands that heavy equipment, such as a sewer vacuum truck or a small crane, occasionally may use the trail to access utilities and billboard signs located in this area.

SCOPE OF WORK

The conclusions and recommendations contained in this report are based on the results of 48 soil test borings and hand auger borings drilled/ advanced along the proposed trail alignment, and visual examination of representative soil samples and an engineering analysis of the results with respect to the outlined project information.

PURPOSE OF EXPLORATION

The purpose of this geotechnical exploration was to explore the soil and groundwater conditions at the site and to develop geotechnical engineering recommendations to guide in the design and construction of retaining walls, pedestrian bridges and pavements. We accomplished these objectives by the following:

1. drilling soil test borings to explore the subsurface soil conditions and collect samples for laboratory examination, testing, and classification,
2. measuring groundwater depths during and after the borings are completed to document the site groundwater conditions,
3. performing an engineering/geological site reconnaissance to observe the overall site conditions and detect issues that may not have been detected by the borings or indicated by published information,
4. performing a map records search of readily available geologic, topographic and soils information,
5. performing visual/manual examination of soil samples from the borings to evaluate pertinent engineering properties,
6. analyzing the field data to develop appropriate engineering recommendations and estimate soil parameters for use by your civil and/or structural engineering team.

FIELD EXPLORATION AND MAP RECORDS SEARCH

Details of the procedures used for the field exploration are presented in Appendix D of this report. Site specific details regarding these procedures follow.

SITE RECONNAISSANCE

Prior to our field exploration, multiple site visits were performed by various BOYLE personnel and KHA personnel. The project area currently is heavily wooded with both hardwood trees and scrub growth; however, the proposed alignment near Charlotte Hills Mobile Home Park follows an existing sewer easement.

MAP RECORDS SEARCH

The following map records were utilized to evaluate site groundwater and soil conditions:

- Geologic Map of the Charlotte 1°x 2° Quadrangle, North Carolina and South Carolina, dated 1988, published by the USGS;
- On-line 7.5-Minute Topographic Quadrangle, dated 2011, published by the USGS; and
- Soil Survey, Mecklenburg County, North Carolina, dated June 1980, published by the US Department of Agriculture.

SOIL TEST BORINGS

As proposed, BOYLE advanced soil test borings at the approximate site locations shown on the attached "Soil Test Boring Plan" (Appendix A, Figures 1-3). Hand auger borings at proposed retaining wall and boardwalk structure locations were performed at locations not accessible by vehicle-mounted drilling equipment due to terrain and the creek. The boring locations were selected and established in the field by BOYLE personnel. No survey equipment was used for the boring locations, so the boring locations shown on the "Boring Location Plan" should be considered approximate. Representative portions of the soil samples obtained were classified by an experienced geotechnical engineer in our laboratory. The "Soil Test Boring Records" are included in Appendix B, showing the soil descriptions, penetration resistances, and other subgrade characteristics.

The soil test/hand auger borings were extended to depths ranging from 3.0 to 50.0 feet below the existing ground surface using either an CME 550X ATV drill rig, Geoprobe 7822 Track Rig, Diedrich D50 Track Rig or hand auger equipment. For the soil test borings, hollow-stem, continuous flight augers were used to advance the borings into the ground. Standard Penetration Tests were performed at designated intervals in the soil test borings in general accordance with ASTM D-1586 to obtain data for estimating soil strength and consistency. In conjunction with the penetration testing, split-spoon soil samples were recovered for soil classification. For the hand auger borings, hand equipment was used to advance the borings into the ground. Blow counts (i.e. blows per increment, bpi) were measured in the hand auger borings with a Dynamic Cone Penetrometer (DCP) in general accordance with ASTM STP 399.

Borings B-15, B-20, HA-22, B-24, HA-27, B-28, HA-1, B-32, HA-33, B-35, B-39, and HA-46 terminated on weathered rock at depths ranging between 3.0 and 45.00 feet below existing ground surface. Hand auger borings HA-6, HA-41, HA-43 and HA-44 terminated on roots at depths ranging between 4.0 and 5.0 feet below existing ground surface. The remaining borings terminated in residual soils at their predetermined depths. Water level measurements were attempted at the termination of drilling.

LABORATORY EXAMINATION AND TESTING OF SOIL SAMPLES

Representative soil samples were selected and tested in a contract laboratory to check field classifications and to determine pertinent engineering properties. An experienced soil engineer classified each soil sample based on texture, plasticity, and laboratory test results (if applicable) in accordance with the Unified Soil Classification System (USCS). A brief explanation of the USCS is included in Appendix B. The soil engineer grouped the various soil types into the major strata noted on the "Soil Test Boring Records". The stratification lines designating the interfaces between earth materials on the "Soil Test Boring Records" and the profile are approximate; in situ, the transitions may be gradual.

SITE GEOLOGY AND SUBSURFACE CONDITIONS

SITE GEOLOGY

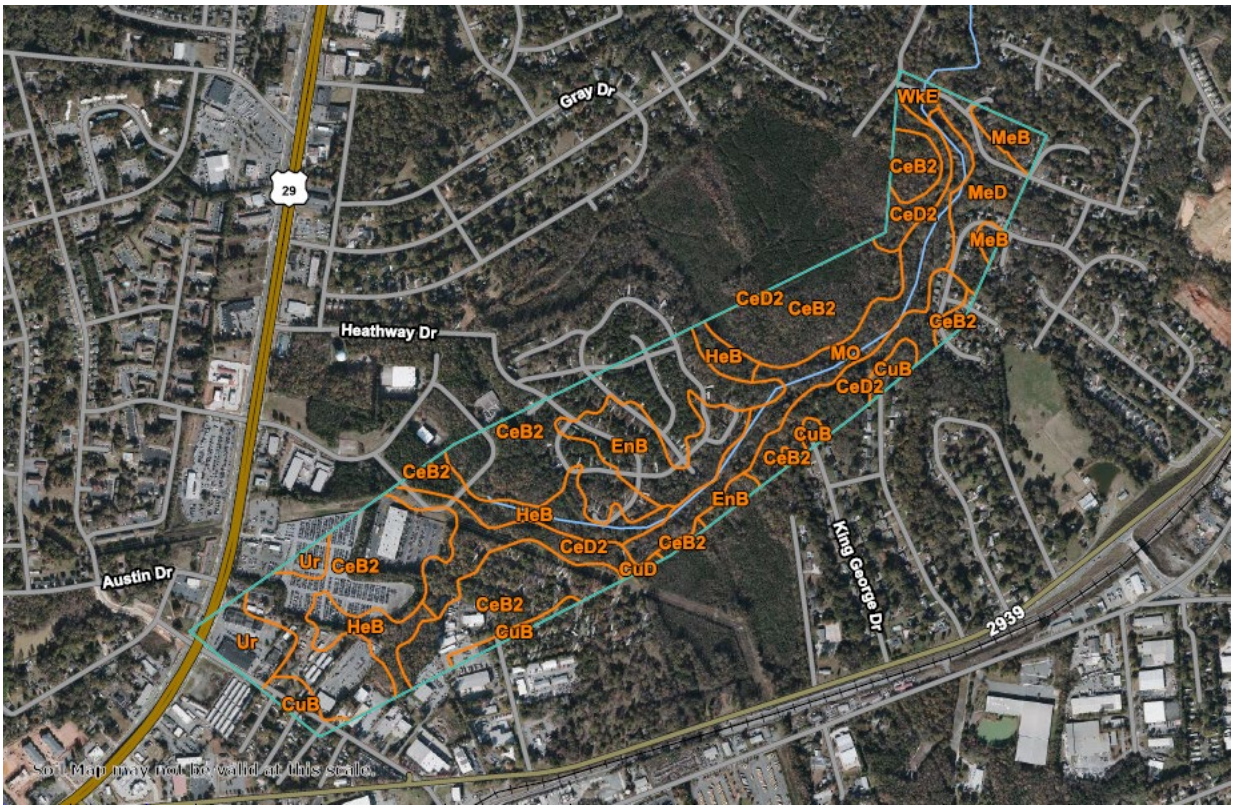
The project site is in the generally rolling terrain of the Piedmont Physiographic Province of North Carolina. The bedrock underlying the site is reported to be granite and granodiorite. This published information was confirmed by our observations of the soil samples of residual soil. Additional details of regional geology relative to the site area are presented in Appendix C. The Piedmont generally consists of low, rounded hills and long rolling (northeast to southwest trending) ridges with incised creeks and river channels. Based on the geologic map, the site is in the Charlotte Belt geologic province.

In-place chemical and physical weathering of parent rocks typically form residual soils in this geologic region. In areas not altered by erosion, alluvial deposition or the activities of man, the typical residual soil profile consists of clay-rich unconsolidated materials, transitioning to sandy silts and silty sands that generally become increasingly consolidated with depth. The boundary between soil and rock typically is not defined sharply. The transitional zone is

termed "partially weathered rock". Partially weathered rock is defined, for engineering purposes, as residual material with Standard Penetration Resistances in excess of 100 blows per foot (bpf). Weathering is facilitated by fractures, joints, and less resistant materials in the rock. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is common to find lenses and boulders of hard rock and zones of partially weathered rock within the soil mantle, well above the general bedrock level.

SOIL SURVEY

The soils in the Piedmont Physiographic Province typically consist of residuum (weathered in-place soils) derived from the underlying parent bedrock. According to the Mecklenburg County Soil Survey (US Department of Agriculture, dated June 1980), the soils underlying the site along the alignment are predominantly mapped as CeB2/CeD2 (Cecil sandy clay loam), CuB/CuD (Cecil-Urban land complex), EnB (Enon sandy loam), HeB (Helena sandy loam), MeB/MeD (Mecklenburg fine sandy loam), MO (Monacan loam), Ur (Urban land) and WkE (Wilkes loam). Additional details regarding the soil series relative to the site area is presented in Appendix C.



SOIL CHARACTERISTICS

Detailed information for each boring location is shown on the "Soil Test Boring Records" included in Appendix B. The descriptions below provide a general summary of the subsurface conditions encountered.

Surficial: Boring Locations typically had approximately 2.0 to 12.0 inches of topsoil.

Fill Material: Fill soils were encountered beneath the topsoil at borings B-10, B-11, B-13, B-16, B-17, and B-35. The fill soils extended to depths of 3.5 to 6.0 feet consisting of a mixture of soft to very stiff sandy silts/elastic silts/lean clays. Blow counts in the fill soils generally ranged from 3 to 16 bpf.

Residuum: Residual soils were encountered either at existing grades or beneath the surficial materials/fill soils. The residuum consisted of very soft to very hard sandy silts/lean clays and very loose to medium dense silty sands with blow counts ranging from 2 to 57 bpf, but with most blows less than 10 bpf.

Alluvium: Water deposited (i.e. alluvial) soils were encountered either at ground surface or beneath surficial material at Borings B-10 and B-39 and extended to depths of 6 feet below existing ground surface. The alluvial soils consisted of very soft to firm sandy clays and silts. Blow counts ranged from 2 to 5 bpf.

Partially Weathered Rock (PWR): Materials with blow counts more than 100 bpf were encountered at Borings B-15, B-20, B-24, B-28, B-32, B-35, and B-39. The PWR typically was sampled as silty sand. These borings terminated upon auger refusal in PWR at depths ranging from 27 to 43.5 feet below existing ground surface. Hand auger refusal due to rocky soil conditions was encountered at Borings HA-6, HA-22, HA-27, HA-31, HA-33 and HA-46 at depths ranging between 3 and 5 feet below the existing ground surface.

Groundwater Conditions: Groundwater was encountered during drilling at Borings B-2, B-8, B-9, B-10, B-11, B-14, B-20, HA-23, B-24, B-39, and HA-42 at depths ranging between 6.0 and 18.0 feet below the existing ground surface.

Groundwater should be anticipated around the existing drainage feature and wetlands areas. Groundwater levels may fluctuate several feet with seasonal rainfall variations and with changes in the water level in adjacent drainage features. Longer term monitoring in cased holes or piezometers would be required for a more accurate evaluation of the groundwater conditions.

ANALYSIS AND RECOMMENDATIONS

SITE DEVELOPMENT PRECAUTIONS

As expected adjacent to drainage features, and in previously developed urban areas, a variety of subsurface conditions were encountered. The following items are emphasized to help identify potential problems that may arise during construction activities.

Alluvial Soils: Soft, wet alluvial soils were encountered at the proposed pedestrian bridge and the adjacent floodplain/wetlands areas. These materials generally are not suitable for direct support of shallow foundations for the pedestrian bridge or for new fill placement without remediation.

BOARDWALK RECOMMENDATIONS

Pedestrian boardwalk systems typically consist of a rigid deck system supported by shallow or deep foundations (depending on the soil conditions).

Significant undercutting and replacement most likely will be required to provide a stable subgrade in the areas where the trail transitions between being asphaltic pavement and boardwalk. In these areas, in lieu of deep undercutting/replacement, BOYLE recommends performing a combination of partial undercutting and placement of geogrid. Undercutting should be performed to the depth required to provide a minimum depth of 5 feet of new fill. After the undercutting is performed, a geogrid such as Tensar BX1100, should be placed on the exposed subgrade. A minimum of 12 inches of compacted ABC stone should be placed on the geogrid. The ABC should be compacted to at least 95 percent of the material's modified Proctor maximum dry density (ASTM D-1557). Then the area can be backfilled to design subgrade with compacted engineered fill that is placed in accordance with the recommendations of this report

Structure #1

Based on the subsurface conditions encountered at Boring B-20, a deep foundation system will be required because soft, soils are present to depths of 10 feet below existing grades. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent residual/PWR materials at depths of 25 to 35 feet below existing grades. Both of these types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

Structure #2

Based on the subsurface conditions encountered at Boring B-28, a deep foundation system will be required because firm, soils are present to depths of 6 feet below existing grades. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent residual/PWR materials at depths of 10 to 20 feet below existing grades. Both of these types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

Structure #3

Based on the subsurface conditions encountered at Boring B-32, a deep foundation system will be required because firm, soils are present to depths of 6 feet below existing grades. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent residual/PWR materials at depths of 10 to 20 feet below existing grades. Both of these types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

Structure #4

Based on the subsurface conditions encountered at Boring B-47and B-48, , a shallow foundation may be suitable with foundation bearing pressures on the order of 2,500 to 3,000 psf with settlement less than one inch.

Structure #5

Based on the subsurface conditions encountered at Boring B-14 and B-15, a deep foundation system will be required because soft, soils are present to depths of 15 feet below existing grades at boring B-15. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent residual/PWR materials at depths of 20 to 30 feet below existing grades. Both of these types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

Structure #6

Based on the subsurface conditions encountered at Boring B-24, a shallow foundation may be suitable with foundation bearing pressures on the order of 2,500 to 3,000 psf with settlement less than one inch. Although a deep foundation system may be desired depending on the applied loading and deflection criteria. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent residual/PWR materials at depths of 15 to 25 feet below existing grades. Both types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

Structure #7

Based on the subsurface conditions encountered at Boring B-35, a deep foundation system will be required because, soft to firm soils are present to depths of 6 feet below existing grades. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent

residual/PWR materials at depths of 30 to 40 feet below existing grades. Both of these types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

Structure #8

Based on the subsurface conditions encountered at Boring B-39, a deep foundation system will be required because, soft to firm soils are present to depths of 8 feet below existing grades. The boardwalk structure can be supported by a deep foundation system consisting of either micropiles or driven timber piles designed to bear in the underlying competent residual/PWR materials at depths of 30 to 40 feet below existing grades. Both of these types of deep foundations may be designed for a maximum load of 15 tons. Drilled caissons and helical piers mostly likely are not feasible based on the subsurface conditions. We recommend that the deep foundation system be monitored during installation by a representative of the geotechnical engineer to verify that the foundations terminate in competent bearing materials.

RETAINING WALL RECOMMENDATIONS

Based on existing grades, the retaining wall foundations will likely bear on near existing surface soils or residual soils at cut locations. The retaining walls can be supported adequately on shallow foundations bearing on the low-plasticity, competent fill/residual soils or newly placed suitable engineered fill. We anticipate undercutting/replacement of the very soft and very loose surficial soils encountered at boring locations HA-3, B-8, B-9, B-10, HA-41, and HA-42 may be required to planned bearing elevations. The foundation area can then be improved by placing single layer of small rip rap (i.e. 4 to 8-inch maximum diameter or NCDOT Class "A" rip rap/stone) and pushing it into the bearing soils with the bucket of a track hoe. The rip rap should be placed so that soil is visible between the individual stones. The rip rap should continue to be placed in single layers until the soil tightens up and the rip rap is no longer being pushed into the bearing soils. The stabilized area should be extended a minimum of 3 feet in front of the footing and to a minimum of 1 foot beyond the end of the grid lengths. This process should be started at a depth about 12 to 18 inches lower than the design bearing elevation. If the stabilized area is still below planned bearing elevation after the rip rap is placed, BOYLE recommends constructing a "stone burrito". The "stone burrito" should consist

of geofabric (such as Mirafi 500X or similar material) wrapped No. 57 stone. The geofabric should be overlapped a minimum of 3 feet. For foundations bearing in these materials, a maximum allowable soil bearing pressure of 2,500 psf may be used for foundation design. It may take several days for the area to "lock-up".

Design parameters for backfill properties (i.e., friction angle, active earth pressure, etc.) should use the values in the below table. These parameters are provided with the understanding the backfill soils will be like the soils encountered during this investigation.

SOIL PARAMETERS FOR WALL BACKFILL

Condition	Soil Weight (pcf)	Friction Angle (deg)	At rest (K_o)	Active (K_a)	Passive (K_p)
Restrained	120 pcf	28	0.5	NA	NA
Unrestrained	120 pcf	28	NA	0.33	NA
Horizontal	120 pcf	28	NA	NA	3.0

Any alluvial soils encountered during reconstruction should be removed and replaced as required with properly engineered fill soils to appropriate bearing elevations.

We recommend that the subgrade soils be observed by a representative of the geotechnical engineer prior to foundation installation. This is to assess their suitability for foundation support and confirm their consistency with the conditions upon which our recommendations are based and to make recommendations regarding undercutting if necessary.

It is essential in fill areas that a competent, stable subgrade be present prior to fill placement to ensure that the fill mass does not settle long-term. Please refer to the "Subgrade Preparation" section for further details.

For shallow foundations designed with a net allowable bearing pressure of 2,500 psf supported by competent residual soils or newly compacted engineered fill, total settlement of less than 1 inch can be anticipated under loaded conditions.

PAVEMENT RECOMMENDATIONS

The recommendations presented here are based on our experience with pavement performance for similar facilities and the assumption that the subgrade has been properly prepared as described in this report (i.e. proofrolled). The pavement thicknesses were not determined through pavement design procedures, such as the American Association of State Highways and Transportation Officials (AASHTO) method, which require actual vehicle traffic frequencies and weights. In addition, the pavement thicknesses are based on an assumed California Bearing Ratio (CBR) value of 4 to 5 which is typical for the types of soils encountered at the site which have been properly prepared and proofrolled.

Consideration should be given to the use of "light duty" classification for the asphaltic pavement section since most of traffic on the trail will be pedestrian/bicycle with the occasional maintenance vehicle (i.e. light duty truck, John Deere gator, etc.). A "light duty" asphaltic pavement section typically consists of 6 inches of compacted aggregate base course (ABC) overlain by 1.5 inches of intermediate course (Superpave I 19.0B) and 1.5 inches of surface course (Superpave S 9.5B). The ABC should be compacted to at least 98 percent of the material's modified Proctor maximum dry density (ASTM D-1557).

However, if occasionally larger vehicles, such as a small crane may use the trail to access utilities and billboard signs located in this area, a "heavy duty" classification for the asphaltic pavement section should be considered for the areas of the trail subjected to these occasional high loads. A "heavy duty" asphaltic pavement section typically consists of 8 inches of compacted ABC overlain by 2.5 inches of intermediate course (Superpave I 19.0B) and 2 inches of surface course (Superpave S 9.5B). The ABC should be compacted to at least 98 percent of the material's modified Proctor maximum dry density (ASTM D-1557).

Properly designed new pavements can be supported by the on-site residual soils or by newly placed compacted and tested engineered fill prepared in accordance with the recommendations in this report. We recommend that areas to provide support for engineered fill and any pavements be inspected carefully for soft surficial soils or unsuitable materials and proofrolled as recommended in this report. Areas which wave, rut, or deflect excessively and continue to do so after several passes of the proofroller should be undercut to firmer soils. The undercut areas should be backfilled in thin lifts with suitable compacted engineered fill. The proofrolling and undercutting operations should be monitored carefully by an experienced engineering technician working under the direct supervision of the geotechnical engineer.

Regardless of the pavement type constructed, it is essential to maintain the pavement system and to provide positive drainage to reduce infiltration of water into the subgrade soils. Allowing water in the subgrade may result in pavement failure and high maintenance costs. Periodic maintenance should be performed on the pavement sections to seal any surface cracks and to reduce infiltration of water into the subgrade.

CUT AND FILL SLOPES

Final project "fill" slopes should be designed to be 3 horizontal (H) to 1 vertical (V) or flatter; "cut" slopes should be designed to be 2 (H) to 1 (V) or flatter. The tops and bases of all slopes should be located a minimum of 10 feet from structural limits and a minimum of 5 feet from pavement/sidewalk limits. The fill slopes should be adequately compacted, as outlined herein, and all slopes (cut or fill) should be seeded and maintained after construction.

SUBGRADE PREPARATION

Subgrade preparation should begin with demolition/removal of any existing above/below ground structures/utilities and stripping of topsoil, rootmat, unsuitable/deleterious materials (i.e. plastic soils, construction debris, household trash, etc.) or any other unsuitable materials from structural areas. After stripping and prior to placement of new fill in areas below design grade and after rough grading is completed in other areas, the subgrade should be proofrolled with a 25 to 35-ton, four-wheeled, rubber-tired roller or similar approved equipment. The proofroller should make at least four passes over each location, with the last two passes perpendicular to the first two. Areas which wave, rut, or deflect excessively and continue to do so after several passes of the proofroller should be undercut to firmer soils. The undercut areas should be backfilled in thin lifts with suitable compacted engineered fill in accordance with the recommendations of this report. The proofrolling and undercutting operations should be monitored carefully by an experienced engineering technician working under the direct supervision of the geotechnical engineer.

ENGINEERED FILL

Fill used for raising site grade or for replacement of material that is undercut should be engineered fill as defined in the glossary of this report (Appendix E). The existing near surface

alluvial and residual soils at the site are suitable for re-use as general engineered fill after moisture conditioning.

Engineered fill should be placed and compacted in lifts of 6 inches or less in loose thickness and compacted to at least 95 percent of the material's standard Proctor maximum dry density (ASTM D-698). Fill should be placed at moisture contents between 2 percentage points below (dry) and 3 percentage points above (wet) the material's optimum moisture content (also based on ASTM D-698). Sufficient density tests should be performed on fill to help verify the adequacy of the compaction levels obtained.

CONSTRUCTION SURFACE/GROUNDWATER CONTROL

Groundwater was encountered during and after drilling locations B-2, B-8, B-9, B-10, B-11, B-14, B-20, HA-23, B-24, B-39, and HA-42 at depths ranging between 6 and 18 feet below existing ground surface. Since minimal cut/fills are anticipated, long-term groundwater levels at the site most likely will be below the proposed construction depths. Please refer to Appendix C for additional discussion regarding groundwater conditions and groundwater control techniques in the Piedmont region. BOYLE should be contacted for recommendations if groundwater is encountered during construction.

STANDARD OF CARE

Our evaluation of the subject site has been based on our current understanding of site conditions, project information provided to us, our observations, and data obtained from our exploration. If the project information is incorrect, or if project objectives are changed, please contact us so that our recommendations can be reviewed. In addition, BOYLE should be provided with copies of revised grading/erosion control plans for review. The discovery of any site or subsurface condition during construction which deviate from data outlined in this report should be reported to us for our re-evaluation. The assessment of site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was

beyond the scope of this exploration. If this report is unclear or presents conflicting recommendations, BOYLE should be notified promptly.

The analysis, conclusions, and recommendations submitted in this report are based on the data collected at the points shown on the attached "Soil Test Boring Location Plan" and observations made during site reconnaissance. This report does not reflect specific variations that may occur between test locations. The borings were located where site conditions/access permitted and as agreed upon with Kimley-Horn Associates and where it is believed representative conditions occur, but the full nature and extent of variations between borings and of subsurface conditions not encountered by any boring may not become evident until the course of construction. If significant variations become evident at any time before or during the course of construction, it will be necessary to make a re-evaluation of the conclusions and recommendations of this report and further exploration, observation, and/or testing may be required.

This report has been prepared in accordance with generally accepted standard soil and foundation engineering practices and makes no other warranties, either expressed or implied, as to the professional advice under the terms of our agreement and included in this report. The recommendations contained herein are made with the understanding that the contract documents between the owner and foundation or earthwork contractor or between the owner and the general contractor and the foundation, excavating and earthwork subcontractors, if any, shall require that the contractor certify that all work in connection with foundations, piles, caissons, compacted fills and other elements of the foundation or other support components are in place at the locations, with proper dimensions and plumb, as shown on the plans and specifications for the project.

Further, it is understood the contract documents will specify that the contractor will, upon becoming aware of apparent or latent subsurface conditions differing from those disclosed by the Limited Subsurface Investigation work, promptly notify the owner, both verbally to permit immediate verification of the change, and in writing, as to the nature and extent of the differing conditions and that no claim by the contractor for any conditions differing from those anticipated in the plans and specifications and disclosed by the soil studies will be allowed under the contract unless the contractor has so notified the owner both verbally and in writing, as required above, of such changed conditions. The owner will, in turn, promptly notify BOYLE

of the existence of such unanticipated conditions and will authorize such further investigation as may be required to properly evaluate these conditions.

Any specific recommendations made in this report as to on-site construction review by BOYLE will be authorized and funds and facilities for such review will be provided at the times recommended if BOYLE is to be held responsible for the recommendations.

Our evaluation of the subject site has been based on our current understanding of site conditions, project information provided to us, our observations, and data obtained from our exploration. If the project information is incorrect, or if project objectives are changed, please contact us so that our recommendations can be reviewed. In addition, BOYLE should be provided with copies of revised grading/erosion control plans for review. The discovery of any site or subsurface condition during construction which deviate from data outlined in this report should be reported to us for our re-evaluation. The assessment of site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this exploration. If this report is unclear or presents conflicting recommendations, BOYLE should be notified promptly.

The analysis, conclusions, and recommendations submitted in this report are based on the data collected at the points shown on the attached "Soil Test Boring Plan" and observations made during site reconnaissance. This report does not reflect specific variations that may occur between test locations. The borings were located where site conditions/access permitted and as agreed upon with Kimley-Horn Associates and where it is believed representative conditions occur, but the full nature and extent of variations between borings and of subsurface conditions not encountered by any boring may not become evident until the course of construction. If significant variations become evident at any time before or during construction, it will be necessary to make a re-evaluation of the conclusions and recommendations of this report and further exploration, observation, and/or testing may be required.

This report has been prepared in accordance with generally accepted standard soil and foundation engineering practices and makes no other warranties, either expressed or implied, as to the professional advice under the terms of our agreement and included in this report. The recommendations contained herein are made with the understanding that the contract documents between the owner and foundation or earthwork contractor or between the owner

and the general contractor and the foundation, excavating and earthwork subcontractors, if any, shall require that the contractor certify that all work in connection with foundations, piles, caissons, compacted fills and other elements of the foundation or other support components are in place at the locations, with proper dimensions and plumb, as shown on the plans and specifications for the project.

Further, it is understood the contract documents will specify that the contractor will, upon becoming aware of apparent or latent subsurface conditions differing from those disclosed by the Limited Subsurface Investigation work, promptly notify the owner, both verbally to permit immediate verification of the change, and in writing, as to the nature and extent of the differing conditions and that no claim by the contractor for any conditions differing from those anticipated in the plans and specifications and disclosed by the soil studies will be allowed under the contract unless the contractor has so notified the owner both verbally and in writing, as required above, of such changed conditions. The owner will, in turn, promptly notify BOYLE of the existence of such unanticipated conditions and will authorize such further investigation as may be required to properly evaluate these conditions.

Any specific recommendations made in this report as to on-site construction review by BOYLE will be authorized and funds and facilities for such review will be provided at the times recommended if BOYLE is to be held responsible for the recommendations.

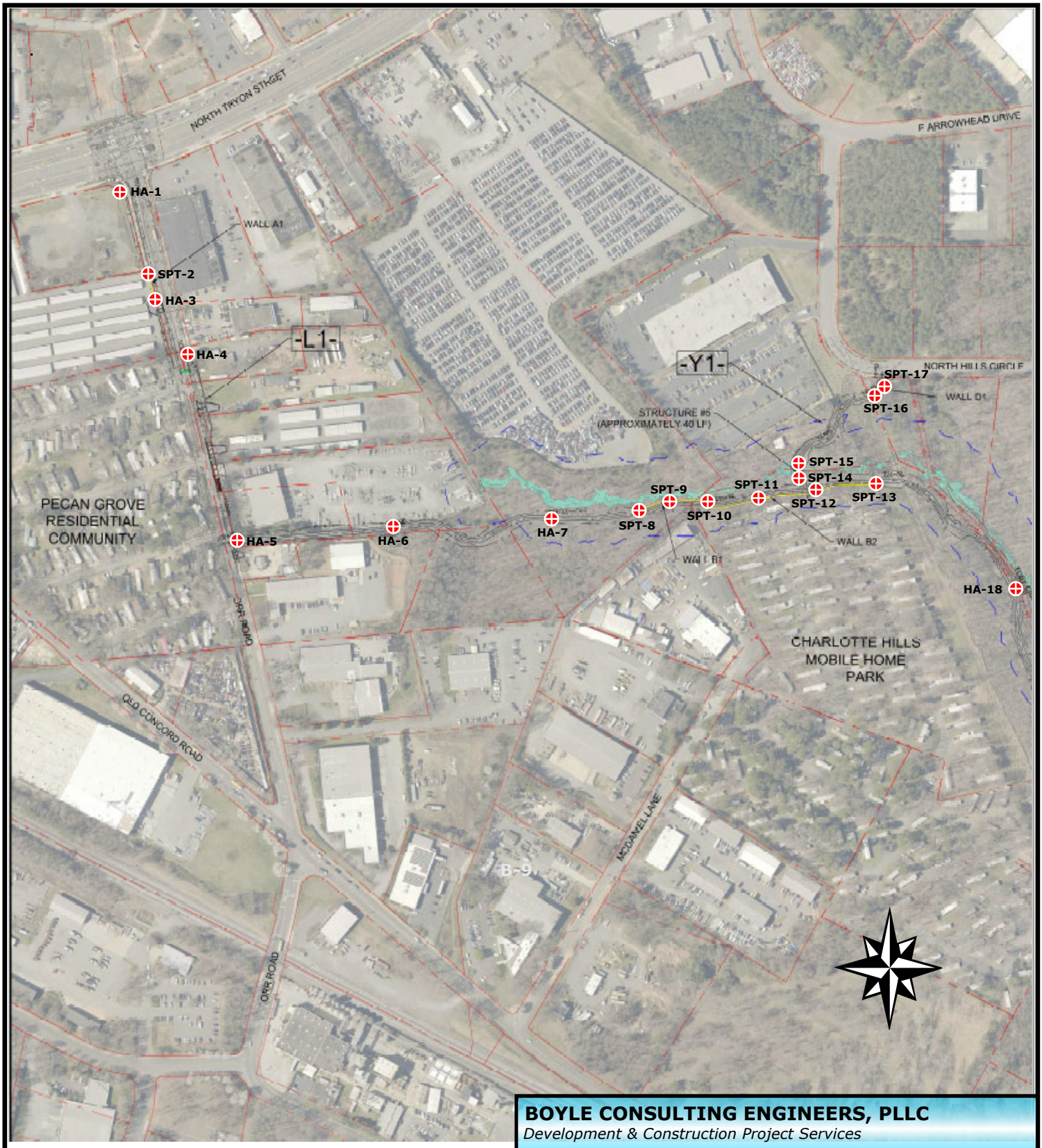
APPENDIX

Appendices for Geotechnical Exploration

Appendix A	Soil Test Boring Plan
Appendix B	Soil Test Boring Records Unified Soil Classification Reference Notes for Boring Logs
Appendix C	Regional Geology, Soils and Groundwater
Appendix D	Procedures Regarding Field Logs and Samples
Appendix E	Definitions & Terminology

APPENDIX A

BORING LOCATION PLAN



Legend:
Approx. Boring Location

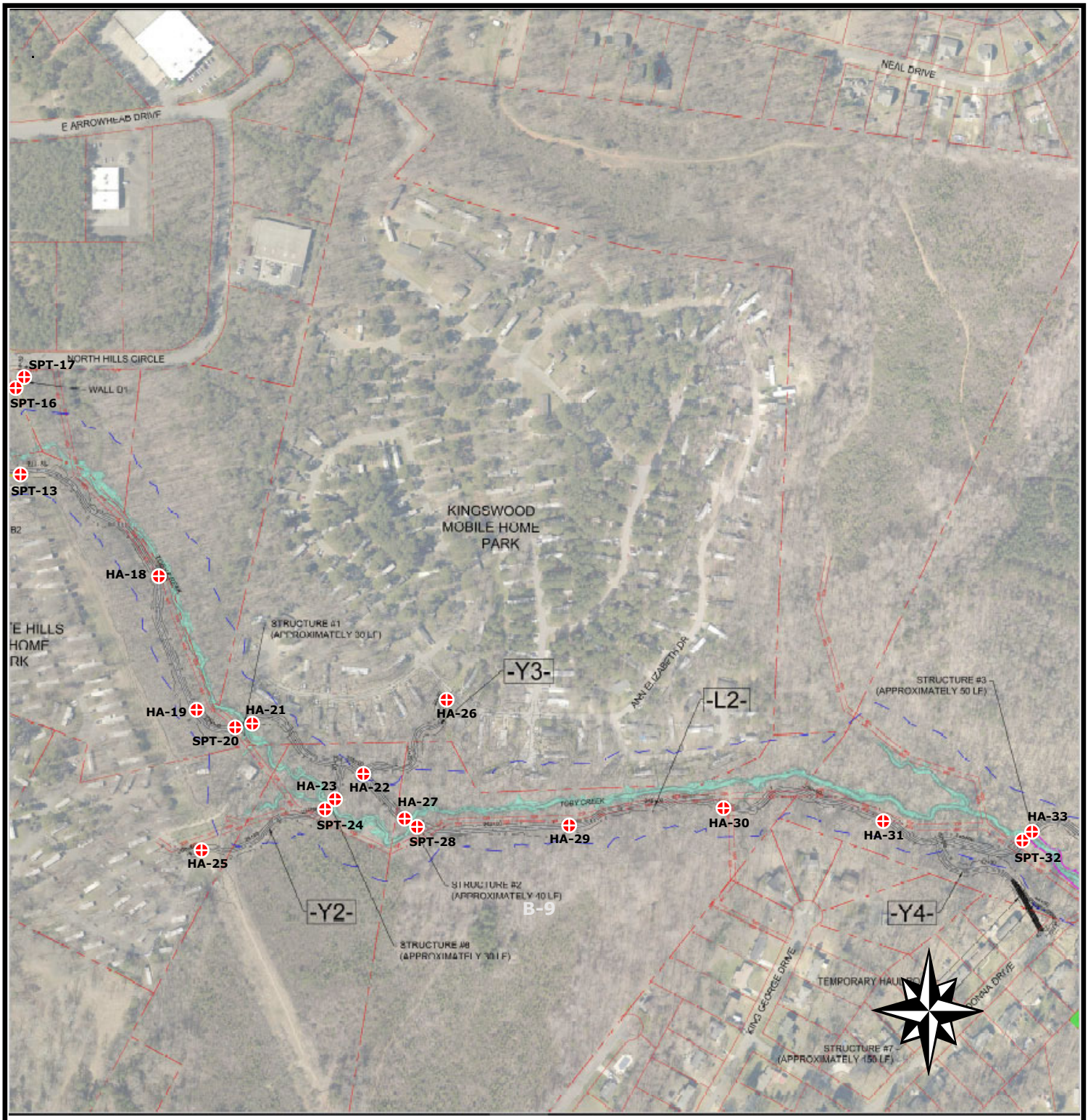
HA/SPT-X

Reference:
"Cross Charlotte Trail – Orr to Rocky River Plan and Profile dated September 23, 2020.

BOYLE CONSULTING ENGINEERS, PLLC
Development & Construction Project Services

Boring Location Plan
Cross Charlotte Trail
Orr Road to Rocky River Road
Charlotte, North Carolina
BOYLE Project No. 15-072-05

Date: 12/22/20	Drawn By: RM	Scale: NTS	Figure: 1



Legend:
Approx. Boring Location

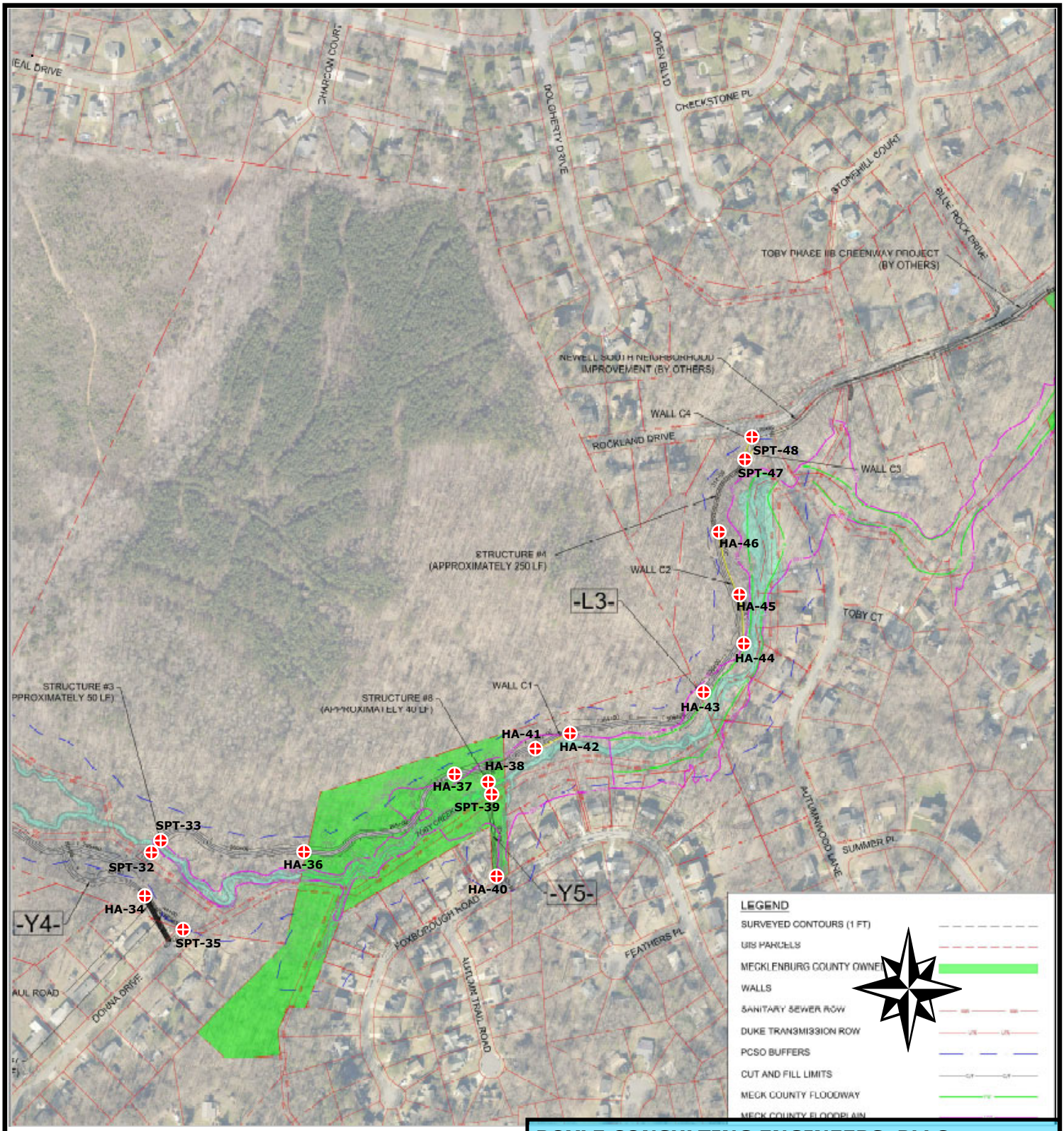
HA/SPT-X

Reference:
"Cross Charlotte Trail – Orr to Rocky River Plan and Profile dated September 23, 2020.

BOYLE CONSULTING ENGINEERS, PLLC
Development & Construction Project Services

Boring Location Plan
Cross Charlotte Trail
Orr Road to Rocky River Road
Charlotte, North Carolina
BOYLE Project No. 15-072-05

Date: 12/22/20	Drawn By: RM	Scale: NTS	Figure: 2



Legend:
Approx. Boring Location

HA/SPT-X

Reference:
"Cross Charlotte Trail – Orr to Rocky River Plan and Profile dated September 23, 2020.

BOYLE CONSULTING ENGINEERS, PLLC
Development & Construction Project Services

Boring Location Plan
Cross Charlotte Trail
Orr Road to Rocky River Road
Charlotte, North Carolina
BOYLE Project No. 15-072-05

Date: 12/22/20	Drawn By: RM	Scale: NTS	Figure: 3

APPENDIX B

SOIL TEST BORING RECORDS

UNIFIED SOIL CLASSIFICATION

REFERENCE NOTES FOR BORING LOGS

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-1

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

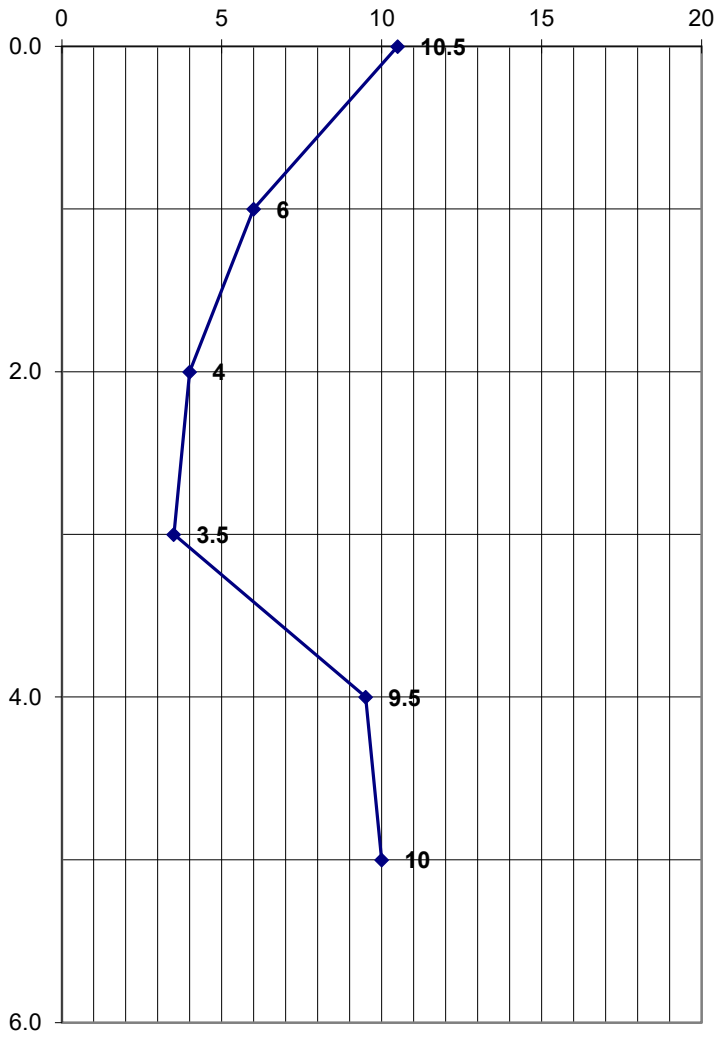
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
RESIDUUM - Stiff Brown Sandy SILT (ML)	0.0		
RESIDUUM - Firm Brown Sandy SILT (ML)	1.0		
RESIDUUM - Soft Brown Sandy SILT (ML)	2.0		
RESIDUUM - Soft Tan Clayey Sandy SILT (ML)	3.0		
GRAVEL (GM)	4.0		
RESIDUUM - Stiff Tan Brown Clayey Sandy SILT (ML)	5.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-2

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 18.00 ft / Elev -18.00 ft AD

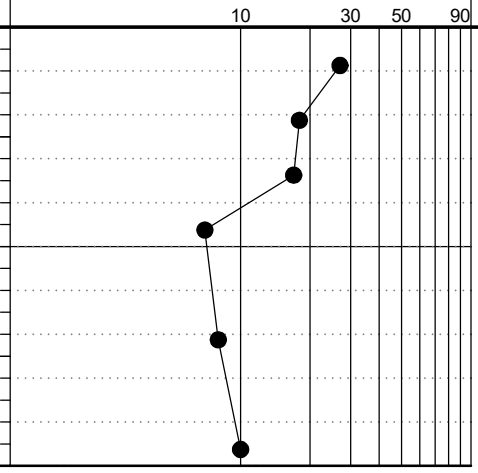
PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION: Orr Rd. to W. Rocky River Rd.	**PROJECT NO:** 15-072-05	**DRILL METHOD:** ASTM D-1586	**NOTES:**
CHECKED BY: R. Price	**DATE DRILLED:** 11/30/2020	**DRILL RIG:** ATV 550X	

DEPTH (ft)	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	BLOW COUNTS (N VALUE)
0	RESIDUUM - Very Stiff Red Orange Silty CLAY (CL)			27
3.5	RESIDUUM - Very Stiff Red Orange Silty CLAY (CL)		-5	18
6	RESIDUUM - Very Stiff Red Orange Clayey SILT (ML)			17
8.5	RESIDUUM - Firm Red Orange Clayey SILT (ML)		-10	7
13.5	RESIDUUM - Firm Red Orange Clayey SILT (ML)		-15	8
▼				
18.5	RESIDUUM - Stiff Red Orange Clayey SILT (ML)		-20	10
20	Boring terminated at 20 feet. Borehole caved at 18.3 feet.			

STANDARD PENETRATION TEST DATA (blows/foot) ●



DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-3

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

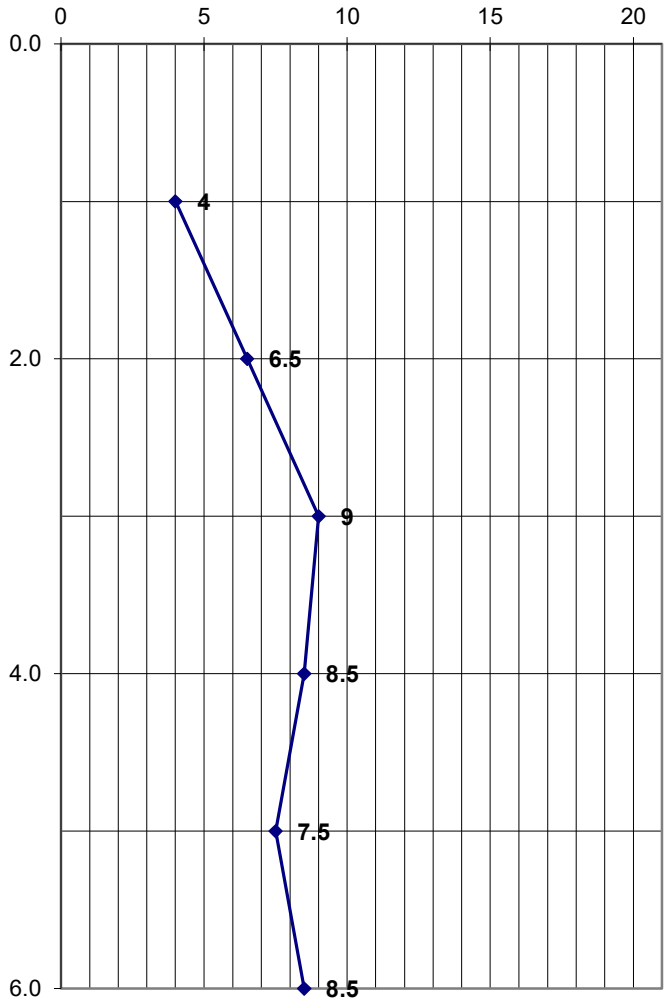
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
RESIDUUM - Soft Red Silty CLAY (CL)	1.0		
RESIDUUM - Firm Red Silty CLAY (CL)	2.0		
RESIDUUM - Stiff Red Silty CLAY (CL)	3.0		
RESIDUUM - Stiff Red Silty CLAY (CL)	4.0		
RESIDUUM - Firm Red Silty CLAY (CL)	5.0		
RESIDUUM - Stiff Red Silty CLAY (CL)	6.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-4

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

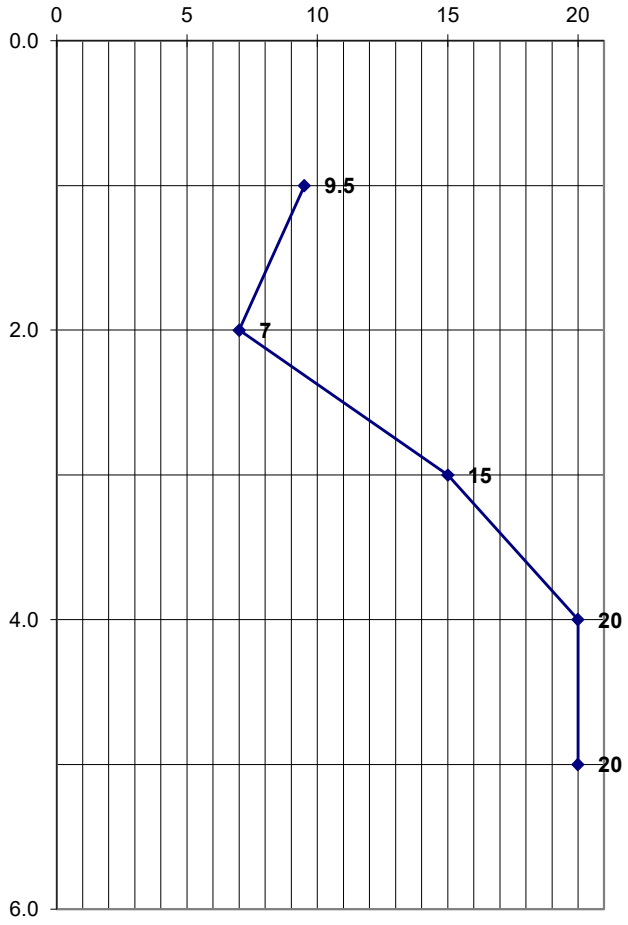
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 12 inches	0.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	1.0	
RESIDUUM - Firm Red Clayey Sandy SILT (ML)	2.0	
RESIDUUM - Stiff Red Sandy SILT (ML)	3.0	
RESIDUUM - Very Stiff Red Sandy SILT (ML)	4.0	
RESIDUUM - Very Stiff Tan Brown Sandy SILT (ML)	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-5

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

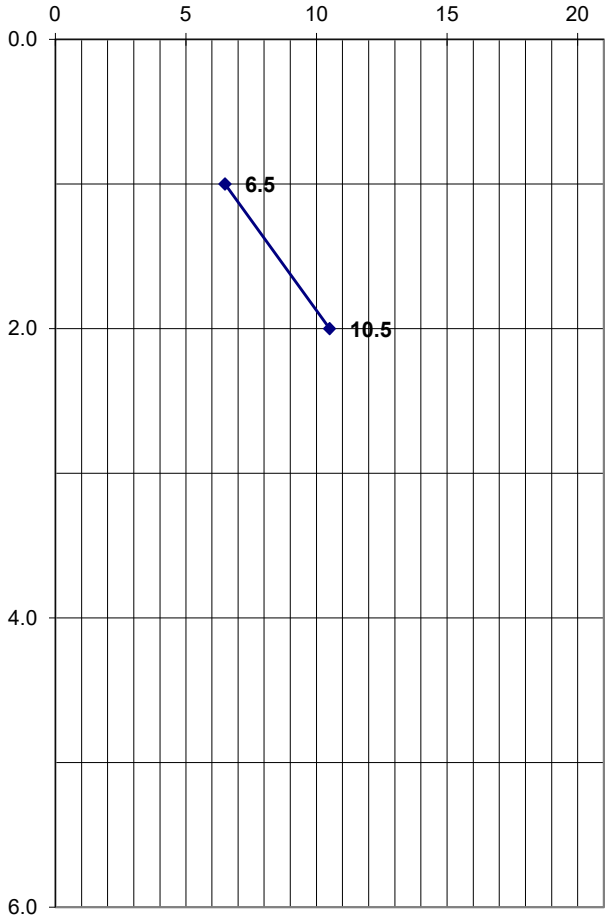
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
RESIDUUM - Firm Brown Sandy SILT (ML)	0.0		
RESIDUUM - Firm Brown Sandy SILT (ML)	1.0		
RESIDUUM - Stiff Brown Sandy SILT (ML)	2.0		
PARTIALLY WEATHERED ROCK - Auger Refusal	3.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-6

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

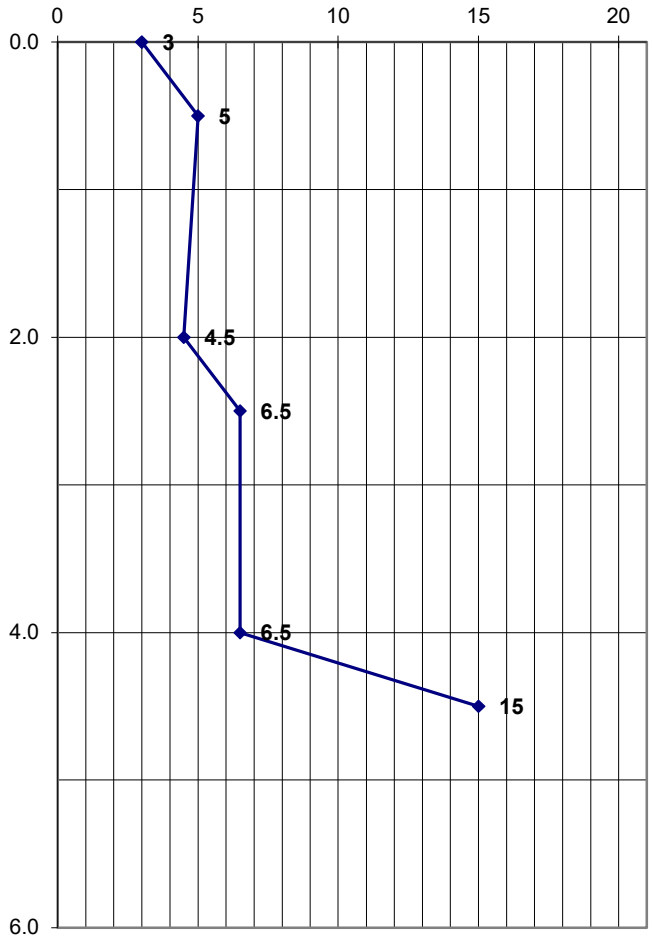
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 6 inches	0.0	
RESIDUUM - Firm Red Brown Sandy SILT (ML)	0.5	
RESIDUUM - Soft Tan Orange Sandy SILT (ML)	2.0	
RESIDUUM - Firm Grey Tan Orange Clayey Sandy SILT (ML)	2.5	
RESIDUUM -Stiff Grey Tan Orange Clayey Sandy SILT (ML)	4.0	
HAND AUGER REFUSAL	4.5	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-7

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

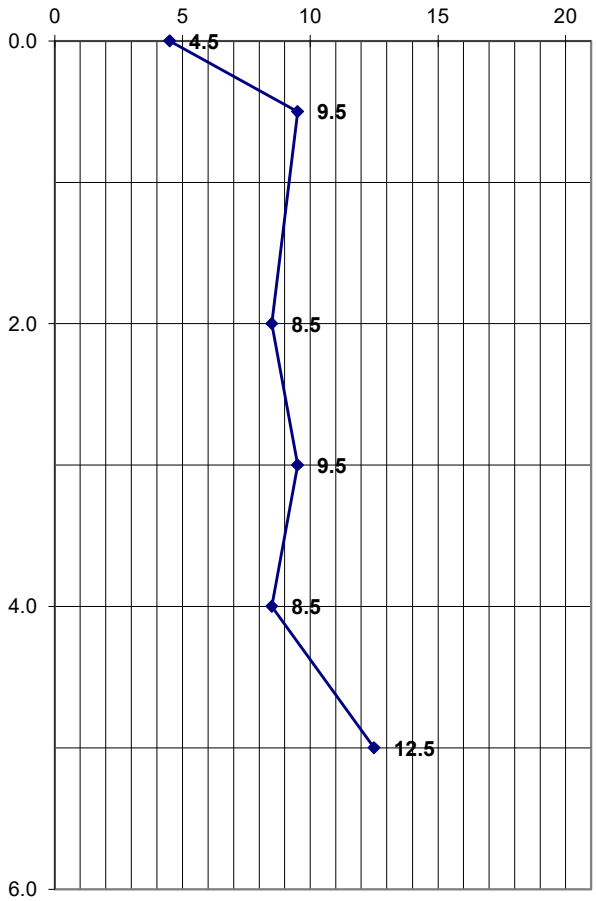
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 6 inches	0.0	
RESIDUUM - Stiff Tan Orange Sandy SILT (ML)	0.5	
RESIDUUM - Firm Tan Orange Sandy SILT (ML)	2.0	
RESIDUUM - Stiff Tan Orange Sandy SILT (ML)	3.0	
RESIDUUM - Firm Tan Grey SILT (ML)	4.0	
RESIDUUM - Stiff Tan Grey SILT (ML)	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-8

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 9.00 ft / Elev -9.00 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	12/9/2020	Geoprobe 7822	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.5		RESIDUUM - Firm White Silty CLAY (CL)				8
3.5		RESIDUUM - Firm Brown White Sandy SILT (ML)		-5		6
6		RESIDUUM - Soft Brown White Sandy SILT (ML)				4
8.5		RESIDUUM - Soft Brown White Sandy SILT (ML)		-10		4
13.5		RESIDUUM - Stiff Brown White Sandy SILT (ML)		-15		12
18.5		RESIDUUM - Stiff Brown White Sandy SILT (ML)		-20		15

10 30 50 90

Boring terminated at 20 feet. Borehole caved at 12.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-9

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 10.00 ft / Elev -10.00 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	12/9/2020	Geoprobe 7822	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.5		RESIDUUM - Firm White Silty CLAY (CL)				5
3.5		RESIDUUM - Very Soft Brown Grey Sandy SILT (ML)		-5		2
6		RESIDUUM - Firm Brown Grey Sandy SILT (ML)				5
8.5		RESIDUUM - Firm Brown Grey Sandy SILT (ML) ▼		-10		6
13.5		RESIDUUM - Firm Brown Grey Sandy SILT (ML)		-15		8
18.5		RESIDUUM - Firm Brown Grey Sandy SILT (ML)		-20		8

10 30 50 90

Boring terminated at 20 feet. Borehole caved at 11.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-10

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 11.20 ft / Elev -11.20 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/27/2020	D-50	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.4		FILL - Soft Grey Tan Brown Sandy SILT w/ roots (ML)				4
3.5		ALLUVIUM - Very Soft Orange Tan Grey Sandy SILT (ML)		-5		2
6		RESIDUUM - Very Stiff Orange Tan Grey Sandy SILT (ML)				17
8.5		RESIDUUM - Very Stiff Orange Tan Grey Sandy SILT (ML)		-10		24
10	▼					
13.5		RESIDUUM - Very Stiff Grey Tan Sandy SILT (ML)		-15		21
18.5		RESIDUUM - Stiff Tan Brown Sandy SILT (ML)				14
20				-20		

10 30 50 90

Boring terminated at 20 feet. Borehole caved at 16.4 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-11

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 11.50 ft / Elev -11.50 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/27/2020	D-50	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.3		FILL - Stiff Moist Red Tan Sandy CLAY (CL)				11
3.5		FILL - Firm Moist Red Tan Sandy CLAY (CL)		-5		7
6		RESIDUUM - Firm Red grey Tan Sandy SILT (ML)				6
8.5		RESIDUUM - Very Stiff Red Grey Tan Sandy SILT (ML)		-10		16
10		▼				
13.5		RESIDUUM - Very Stiff Tan Grey Brown Sandy SILT (ML)		-15		16
18.5		RESIDUUM - Stiff Tan Grey Brown Sandy SILT (ML)				15
20				-20		

10 30 50 90

Boring terminated at 20 feet. Borehole caved at 13.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-12

ELEVATION: 0 ft

GROUND WATER: AT TIME OF DRILLING ---

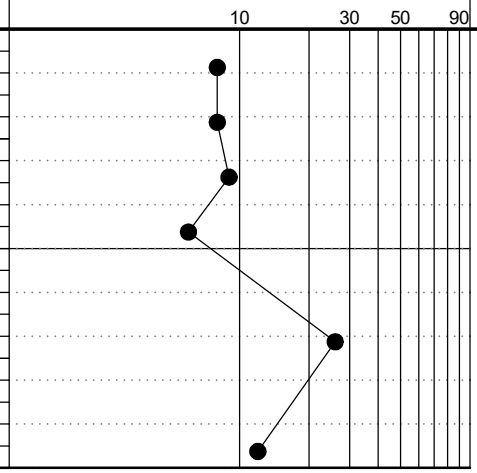
AFTER DRILLING ---

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/26/2020	D-50	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.3		RESIDUUM - Firm Tan Sandy SILT (ML)				8
3.5		RESIDUUM - Firm Tan Sandy SILT (ML)		-5		8
6		RESIDUUM - Stiff Tan Sandy SILT (ML)				9
8.5		RESIDUUM - Firm Tan Sandy SILT (ML)		-10		6
13.5		RESIDUUM - Very Stiff Tan Sandy SILT (ML)		-15		26
18.5		RESIDUUM - Medium Dense Brown Tan Silty SAND (SM)		-20		12
20		Boring terminated at 20 feet. Borehole dry and caved at 16.0 feet.				



DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-13

ELEVATION: 0 ft

GROUND WATER: AT TIME OF DRILLING ---

AFTER DRILLING ---

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/29/2020	ATV 550X	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.3		FILL - Very Soft Red/Tan Sandy CLAY (CL)				1
3.5		RESIDUUM - Stiff Orange SILT (ML)		-5		9
6		RESIDUUM - Stiff Orange SILT (ML)				11
8.5		RESIDUUM - Firm Orange Black SILT (ML)		-10		8
13.5		RESIDUUM - Firm Orange Brown Tan SILT (ML)		-15		7
18.5		RESIDUUM - Firm Brown Tan White SILT (ML)		-20		8
20		Boring terminated at 20 feet. Borehole dry and caved at 16.5 feet.		-25		
30				-30		
40				-35		
50				-40		
				-45		
				-50		

10 30 50 90

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-14

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

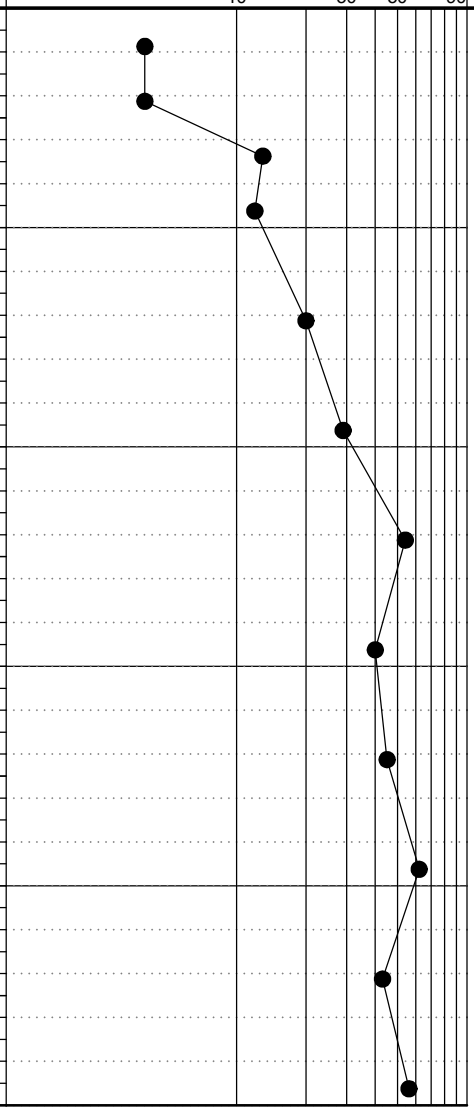
▼ AFTER DRILLING 9.00 ft / Elev -9.00 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/26/2020	D-50	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.3		RESIDUUM - Very Loose Tan Silty SAND (SM)				4
3.5		RESIDUUM - Very Loose Tan Silty SAND (SM)		-5		4
6		RESIDUUM - Medium Dense Tan Silty SAND (SM)				13
8.5		RESIDUUM - Medium Dense Tan Silty SAND (SM)		-10		12
13.5		RESIDUUM - Very Stiff Tan Sandy SILT (ML)		-15		20
18.5		RESIDUUM - Very Stiff Tan Sandy SILT (ML)		-20		29
23.5		RESIDUUM - Very Hard Tan Sandy SILT (ML)		-25		54
28.5		RESIDUUM - Hard Tan Sandy SILT (ML)		-30		40
33.5		RESIDUUM - Hard Orange Sandy SILT (ML)		-35		45
38.5		RESIDUUM - Very Hard Grey Orange Sandy SILT (ML)		-40		62
43.5		RESIDUUM - Hard Tan Sandy SILT (ML)		-45		43
48.5		RESIDUUM - Very Hard Tan Sandy SILT (ML)		-50		56



Boring terminated at 50 feet. Borehole caved at 20.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-15

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 10.00 ft / Elev -10.00 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	12/9/2020	Geoprobe 7822	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.5		RESIDUUM - Stiff Tan Silty CLAY (CL)				9
3.5		RESIDUUM - Firm Grey Sandy CLAY (CL)		-5		7
6		RESIDUUM - Firm Brown Tan Silty CLAY (CL)				8
8.5		RESIDUUM - Stiff Tan Yellow Clayey SILT (ML) ▼		-10		9
13.5		RESIDUUM - Soft Tan Yellow Clayey SILT (ML)		-15		4
18.5		RESIDUUM - Very Stiff Tan Yellow Clayey SILT (ML)		-20		23
23.5		PARTIALLY WEATHERED ROCK sampled as Tan Yellow Clayey SILT (ML)		-25		50/2"
25		PARTIALLY WEATHERED ROCK sampled as Tan Yellow Clayey SILT (ML)				50/0"
		Boring terminated at 27 feet. Borehole caved at 24.3 feet.				

10 30 50 90

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-16

ELEVATION: 0 ft

GROUND WATER: AT TIME OF DRILLING ---

AFTER DRILLING ---

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	11/30/2020	ATV 550X	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		FILL - Stiff Red Silty CLAY (CL)				10
3.5		FILL - Firm Red Silty CLAY (CL)		-5		7
6		FILL - Firm Orange Grey Silty CLAY (CL)				8
8.5		RESIDUUM - Firm Grey Sandy SILT (ML)		-10		6
13.5		RESIDUUM - Very Stiff Brown White Sandy SILT (ML)		-15		16
18.5		RESIDUUM - Stiff Grey Brown White Sandy SILT (ML)		-20		13

10 30 50 90

Boring terminated at 20 feet. Borehole caved at 18.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-17

ELEVATION: 0 ft

GROUND WATER: AT TIME OF DRILLING ---

AFTER DRILLING ---

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	11/30/2020	ATV 550X	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil - 3 inches				
0.3		FILL - Firm Red Sandy SILT (ML)				7
3.5		FILL - Stiff Red Orange Sandy SILT (ML)		-5		11
6		FILL - Very Stiff Red Orange Sandy SILT (ML)				16
8.5		FILL - Stiff Red Orange Sandy SILT (ML)		-10		10
13.5		FILL - Stiff Red Orange Sandy SILT (ML)		-15		11
18.5		RESIDUUM - Stiff Brown Fine Sandy CLAY (CL)		-20		9

10 30 50 90

Boring terminated at 20 feet. Borehole caved at 17.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-18

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

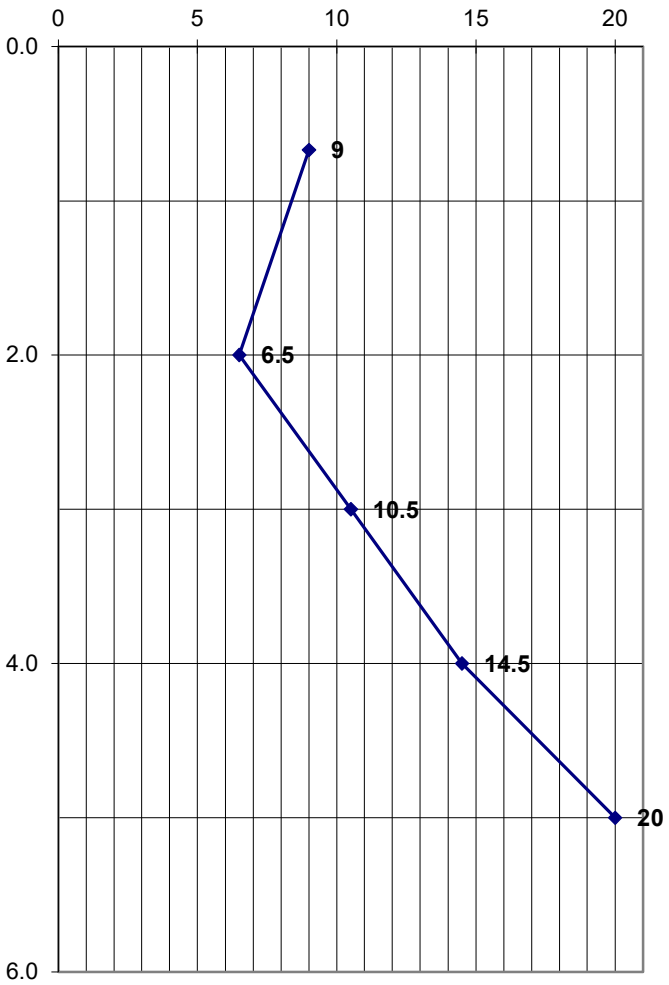
PROJECT: **Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION: **Charlotte, North Carolina**
BOYLE JOB NO.: **15-072-05**
DATE DRILLED: **Misc.**

DRILLING INFORMATION

LOCATION.:
DRILLING METHOD: **Hand-Auger**
SAMPLING METHODS: **ASTM STP-399**
HAMMER WT./DROP **15 lb., 20 in.**

Description	Depth		Elevation
Topsoil - 8 inches	0.0		
RESIDUUM - Stiff Brown Sandy SILT (ML)	0.7		
RESIDUUM - Firm Brown Sandy SILT (ML)	2.0		
RESIDUUM - Stiff Grey Sandy SILT (ML)	3.0		
RESIDUUM - Stiff Orange Brown Sandy SILT (ML)	4.0		
RESIDUUM - Very Stiff Orange Brown Sandy SILT (ML)	5.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



During Drilling: None
After Drilling: None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-19

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

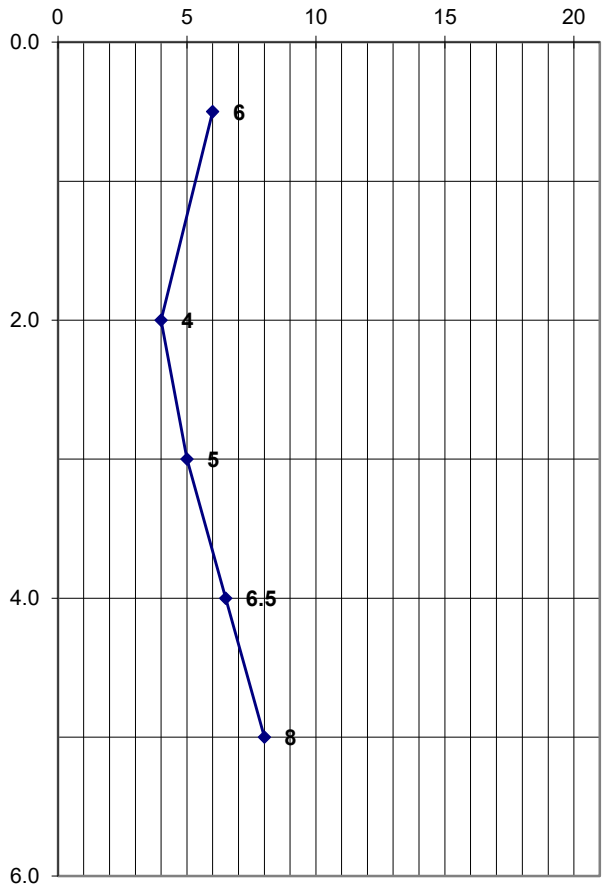
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 6 inches	0.0	
RESIDUUM - Firm Brown Sandy SILT (ML)	0.5	
RESIDUUM - Soft Tan Plastic CLAY (CH) and Soft Tan Sandy SILT (ML)	2.0	
RESIDUUM - Firm Tan Sandy SILT (ML)	3.0	
RESIDUUM - Firm Tan Brown Sandy SILT (ML) w/ small amounts of plastic clays	4.0	
RESIDUUM - Loose Grey Brown Tan Silty SAND (SM) w/ small amounts of plastic clays	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-20

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 11.00 ft / Elev -11.00 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/26/2020	D-50	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.3		RESIDUUM - Firm Brown Red Sandy SILT (ML)				7
3.5		RESIDUUM - Firm Brown Red Sandy SILT (ML)		-5		6
6		RESIDUUM - Soft Grey Sandy Silty CLAY (CL)				3
8.5		RESIDUUM - Stiff Brown Sandy SILT (ML) ▼		-10		13
13.5		RESIDUUM - Very Stiff Brown Sandy SILT (ML)		-15		16
18.5		RESIDUUM - Very Stiff Brown Sandy SILT (ML)		-20		18
23.5		RESIDUUM - Very Hard Brown Sandy SILT (ML)		-25		57
28.5		RESIDUUM - Dense Tan White Silty SAND (SM)		-30		35
33.5		PARTIALLY WEATHERED ROCK sampled as Tan White Silty SAND (SM)		-35		50/4"
38.5		PARTIALLY WEATHERED ROCK sampled as Tan White Silty SAND (SM)		-40		50/4"
43.5		PARTIALLY WEATHERED ROCK sampled as Tan White Silty SAND (SM)		-45		50/5"

Boring terminated at 45 feet. Borehole caved at 40.0 feet.

STANDARD PENETRATION TEST DATA (blows/foot) ●: 10, 30, 50, 90

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

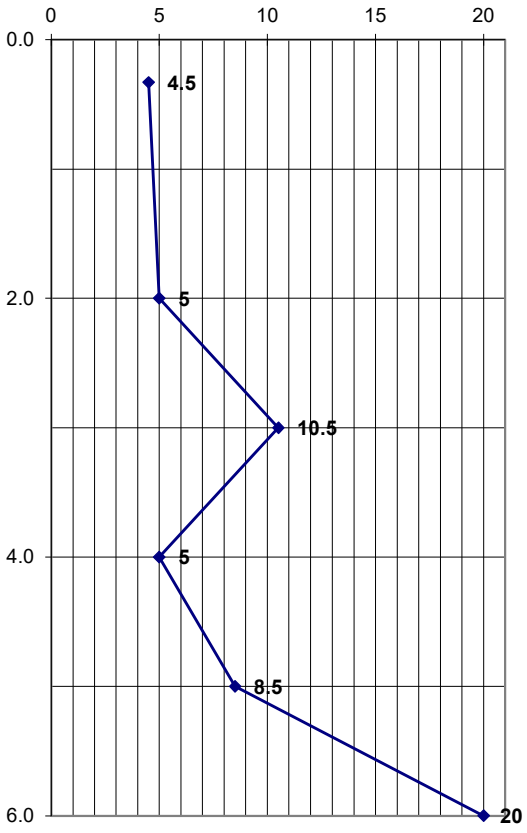
BORING NO.: HA-21

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 4 inches	0.0	
RESIDUUM - Loose Brown Clayey SAND (SM)	0.3	
RESIDUUM - Loose Brown Clayey SAND (SM)	2.0	
RESIDUUM - Medium Dense Brown Clayey SAND (SM)	3.0	
RESIDUUM - Loose Grey Brown Clayey SAND (SM)	4.0	
RESIDUUM - Loose Grey Brown Clayey SAND (SM)	5.0	
RESIDUUM - Medium Dense Grey Brown Clayey SAND (SM)	6.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

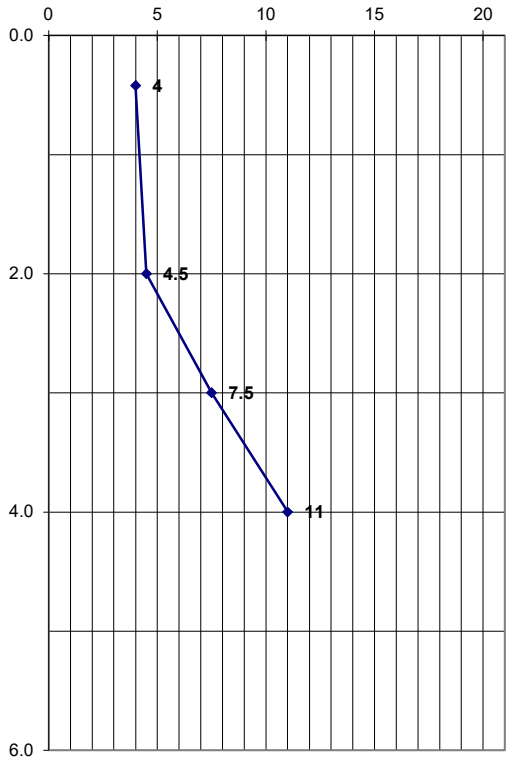
BORING NO.: HA-22

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 5 inches	0.0	
RESIDUUM - Very Loose Tan Silty SAND (SM)	0.4	
RESIDUUM - Loose Tan Silty SAND (SM)	2.0	
RESIDUUM - Loose Tan Silty SAND (SM)	3.0	
RESIDUUM - Medium Dense Tan Silty SAND (SM) Refusal on Rock at 4 FT	4.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

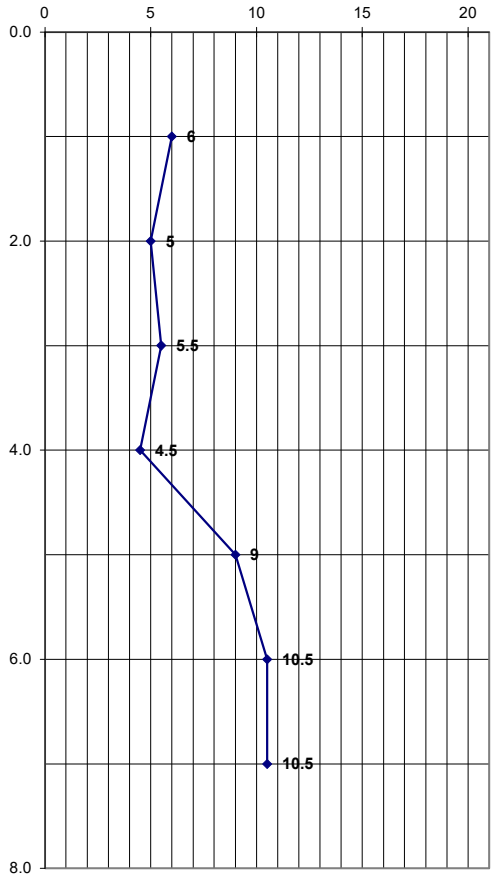
BORING NO.: HA-23

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
RESIDUUM - Firm Red Brown SILT (ML)	1.0		
RESIDUUM - Firm Red Brown SILT (ML)	2.0		
RESIDUUM - Firm Red Brown SILT (ML)	3.0		
RESIDUUM - Soft Red Brown SILT (ML)	4.0		
RESIDUUM - Stiff Grey Sandy CLAY (CL)	5.0		
RESIDUUM - Stiff Grey Sandy CLAY (CL)	6.0		
RESIDUUM - Loose Brown Silty SAND (SM) Water @ 7 Feet	7.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-24

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 6.50 ft / Elev -6.50 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/29/2020	ATV 550X	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.7		RESIDUUM - Very Stiff Orange Brown Tan SILT (ML)				17
3.5		RESIDUUM - Stiff Brown Grey Orange SILT (ML)		-5		12
6		RESIDUUM - Stiff Brown Grey Orange SILT (ML)				14
8.5		RESIDUUM - Stiff Brown Grey Orange SILT (ML)		-10		13
13.5		RESIDUUM - Hard Brown Grey Orange Sandy SILT (ML)		-15		36
18.5		PARTIALLY WEATHERED ROCK sampled as Brown Grey Orange Sandy SILT (ML)		-20		50/4"
23.5		PARTIALLY WEATHERED ROCK sampled as Brown Grey Orange Sandy SILT (ML)		-25		50/3"
28.5		PARTIALLY WEATHERED ROCK sampled as Brown Grey Orange Sandy SILT (ML)		-30		50/2"

Boring terminated at 30 feet. Borehole caved at 17.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-25

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

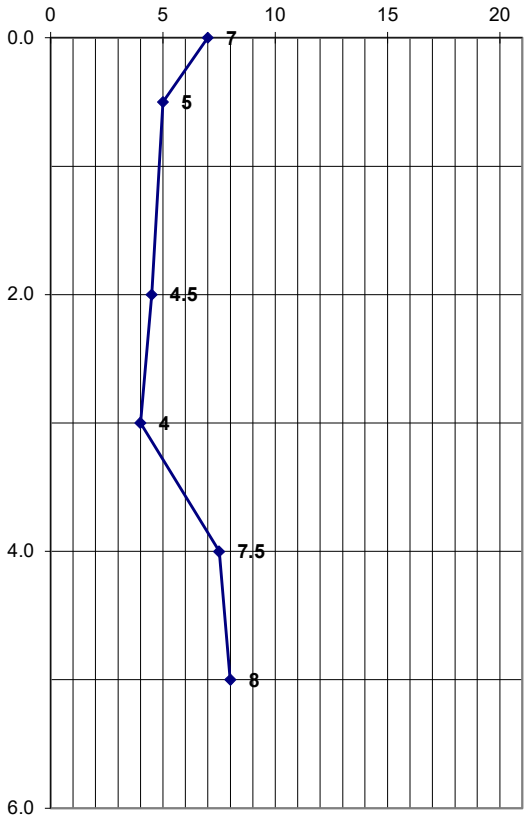
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 6 inches	0.0	
RESIDUUM - Firm Red Silty CLAY (CL)	0.5	
RESIDUUM - Firm Red Silty CLAY (CL)	2.0	
RESIDUUM - Soft Red Silty CLAY (CL)	3.0	
RESIDUUM - Firm Red Silty CLAY (CL)	4.0	
RESIDUUM - Firm Red Silty CLAY (CL)	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-26

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

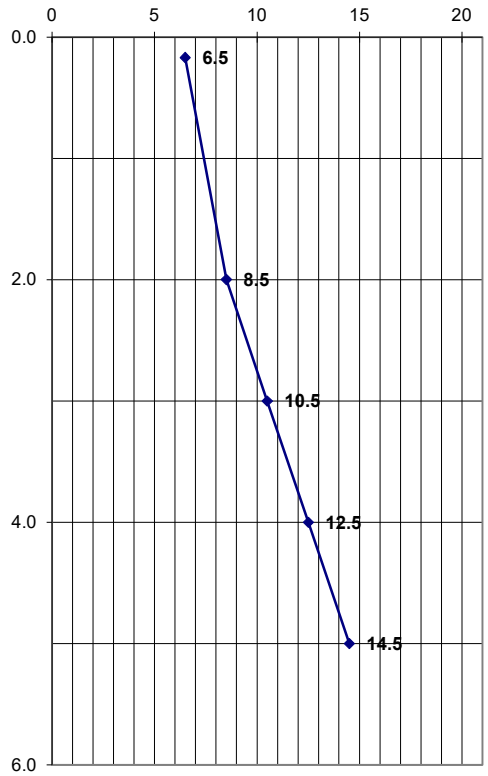
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 2 inches	0.0	
RESIDUUM - Firm Red Sandy SILT (ML)	0.2	
RESIDUUM - Stiff Red Sandy SILT (ML)	2.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	3.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	4.0	
RESIDUUM - Stiff Black Tan Brown Sandy SILT (ML)	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

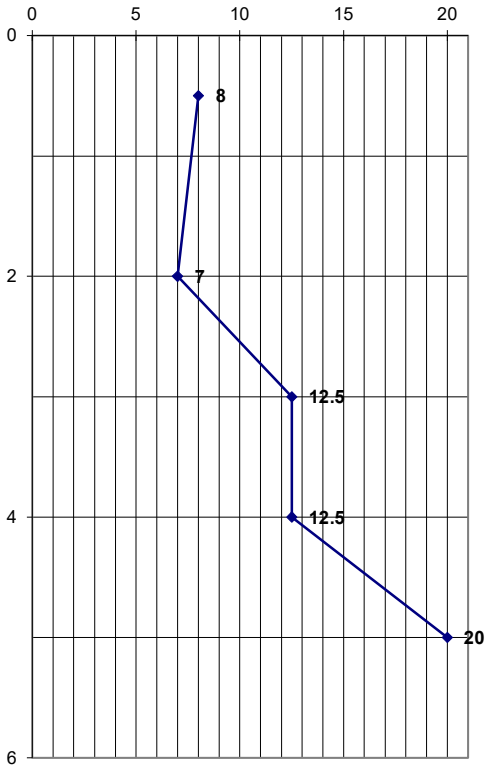
BORING NO.: HA-27

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 6 inches	0.0	
RESIDUUM - Firm Tan Silty CLAY (CL)	0.5	
RESIDUUM - Firm Tan Silty CLAY (CL)	2.0	
RESIDUUM - Medium Dense Tan Silty SAND (SM) w/ rock fragments	3.0	
RESIDUUM - Medium Dense Tan Silty SAND (SM) w/ rock fragments	4.0	
RESIDUUM - Medium Dense Tan Silty SAND (SM) w/ rock fragments	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-28

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 5.00 ft / Elev -5.00 ft AD

PROJECT NAME: Cross Charlotte Greenway		**DRILLING COMPANY** CG2	
PROJECT LOCATION: Orr Rd. to W. Rocky River Rd.	**PROJECT NO:** 15-072-05	**DRILL METHOD:** ASTM D-1586	**NOTES:**
CHECKED BY: R. Price	**DATE DRILLED:** 10/28/2020	**DRILL RIG:** ATV 550X	

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	BLOW COUNTS (N VALUE)
0	Topsoil		
0.7	FILL - Firm Brown/Orange Sandy SILT (ML)		6
3.5	RESIDUUM - Firm Orange Brown SILT (ML)	-5	7
6	RESIDUUM - Medium Dense Black White Silty SAND (SM)		19
8.5	RESIDUUM - Medium Dense Brown Orange White SAND (SM)	-10	30
13.5	RESIDUUM - Medium Dense Brown Orange White SAND (SM)	-15	29
18.5	PARTIALLY WEATHERED ROCK sampled as Brown Orange White SAND (SM)	-20	50/5"
23.5	PARTIALLY WEATHERED ROCK sampled as Brown Orange White SAND (SM)	-25	50/2"
28.5	PARTIALLY WEATHERED ROCK sampled as Brown Orange White SAND (SM)	-30	50/3"
30	Boring terminated at 30 feet. Borehole caved at 13.6 feet.		

STANDARD PENETRATION TEST DATA (blows/foot) ●

10 30 50 90

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

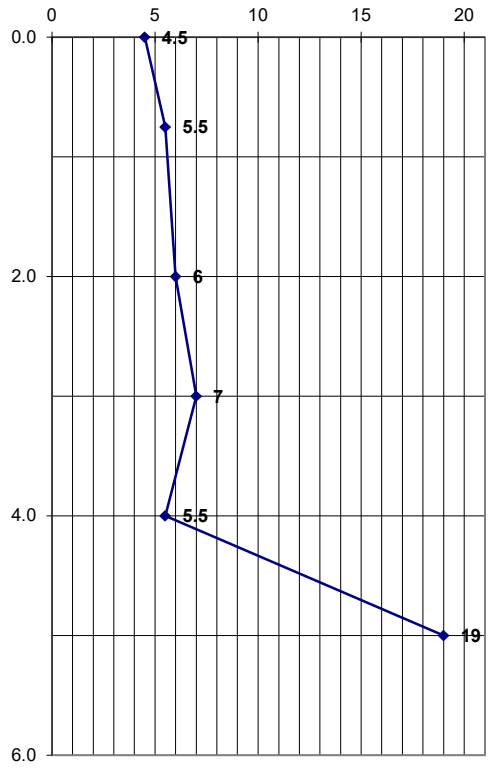
BORING NO.: HA-29

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
Topsoil - 9 inches	0.0		
RESIDUUM - Dark Brown Silty Medium Fine SAND (SM)	0.8		
RESIDUUM - Firm Brown Orange Sandy SILT (ML)	2.0		
RESIDUUM - Firm Brown Orange Sandy SILT (ML) w/ rock fragments	3.0		
RESIDUUM - Firm Brown Grey Sandy SILT (ML)	4.0		
RESIDUUM - Medium Dense Grey Orange Silty Clayey SAND (SM)	5.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

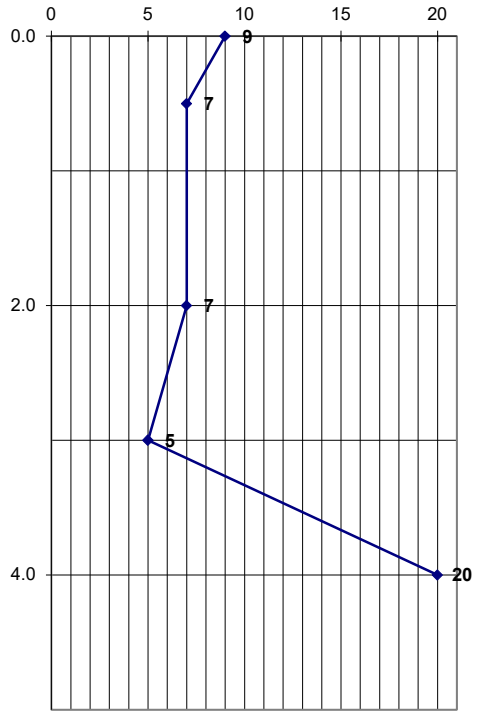
BORING NO.: HA-30

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
Topsoil - 6 inches	0.0		
RESIDUUM - Loose Dark Brown Silty Medium Fine SAND (SM)	0.5		
RESIDUUM - Firm Brown Grey Sandy SILT (ML)	2.0		
RESIDUUM - Firm Grey Orange Sandy SILT (ML) w/ clay	3.0		
RESIDUUM - Very Stiff Grey Orange Sandy SILT (ML) w/ clay	4.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

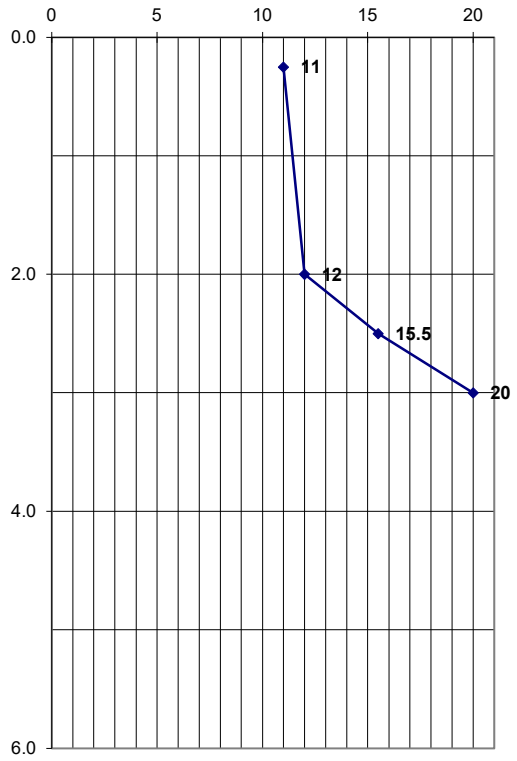
BORING NO.: HA-31

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
Topsoil - 4 inches	0.0		
RESIDUUM - Stiff Tan Brown Sandy SILT (ML)	0.3		
RESIDUUM - A1Stiff Brown Orange Sandy SILT (ML)	2.0		
RESIDUUM - Very Stiff Tan Grey Orange Sandy SILT (ML)	2.5		
Auger refusal at 3.0 feet	3.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

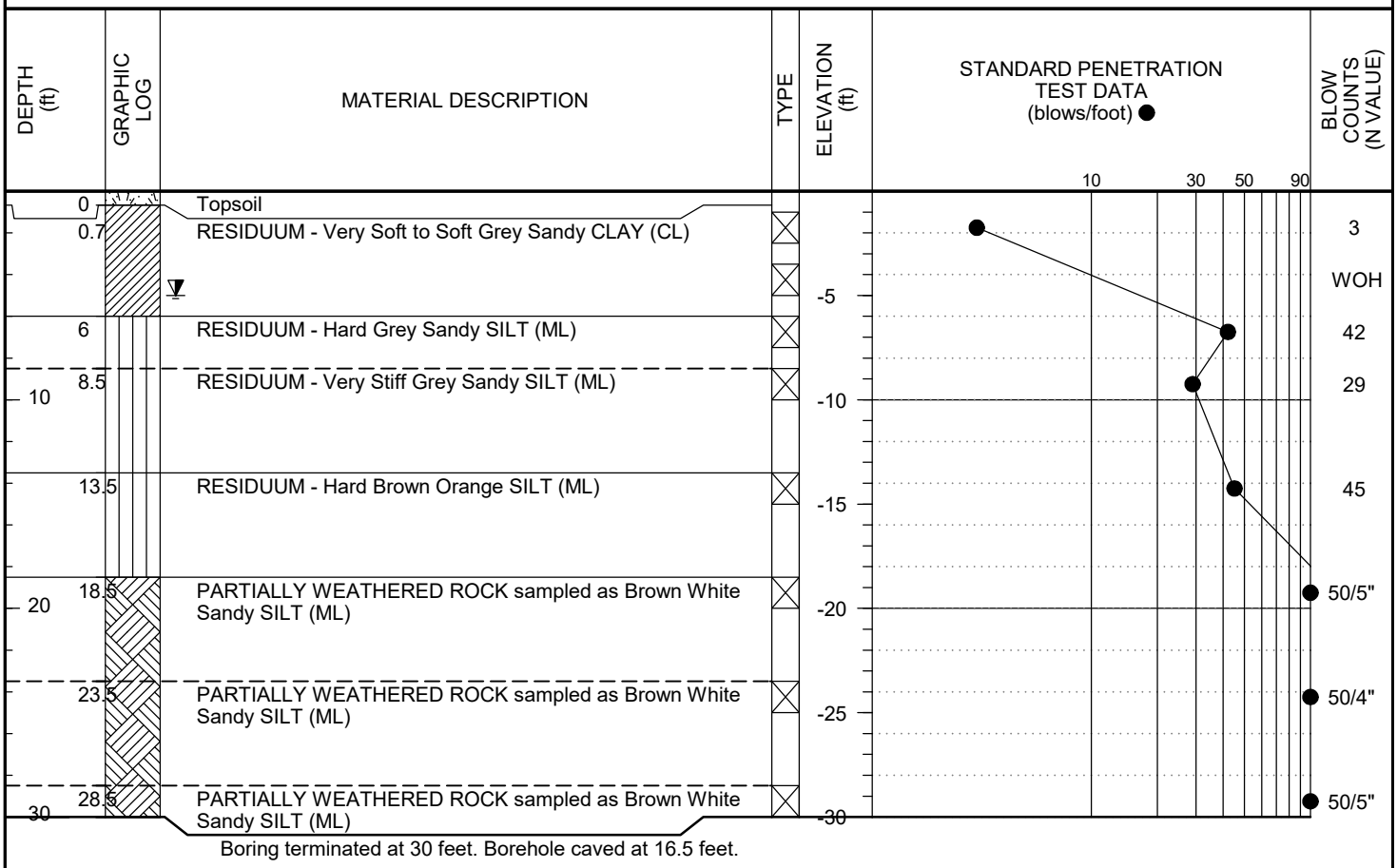
SOIL TEST BORING SPT-32

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 5.00 ft / Elev -5.00 ft AD

PROJECT NAME: Cross Charlotte Greenway		**DRILLING COMPANY** CG2	
PROJECT LOCATION: Orr Rd. to W. Rocky River Rd.	**PROJECT NO:** 15-072-05	**DRILL METHOD:** ASTM D-1586	**NOTES:**
CHECKED BY: R. Price	**DATE DRILLED:** 10/28/2020	**DRILL RIG:** ATV 550X	



Boring terminated at 30 feet. Borehole caved at 16.5 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

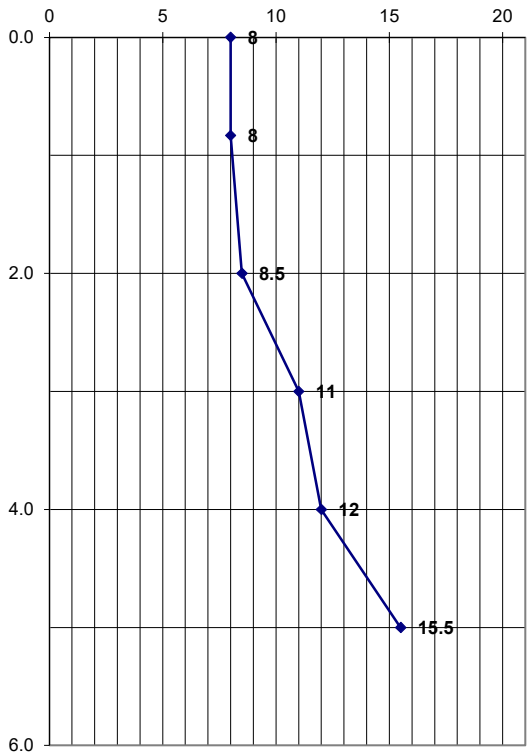
BORING NO.: HA-33

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 10 inches	0.0	
RESIDUUM - Loose Red Silty SAND (SM)	0.8	
RESIDUUM - Stiff Brown Sandy Silt	2.0	
RESIDUUM - Medium Dense Brown Silty SAND (SM) w/ clay	3.0	
RESIDUUM -Wet Medium Dense Brown Silty SAND (SM) w/ clay	4.0	
RESIDUUM - Medium Dense Brown Silty SAND (SM) Auger Refusal due to Rock	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

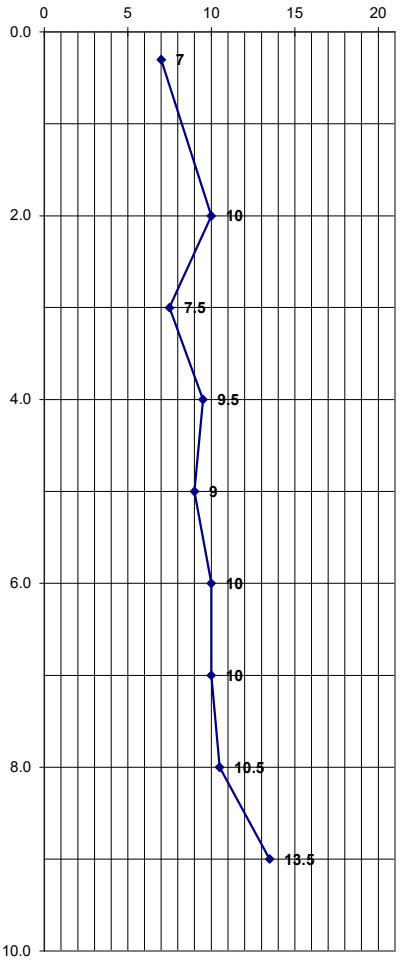
BORING NO.: HA-34

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Penetration - Blows per 1.75 - Inch I**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 4 inches	0.0	
RESIDUUM - Firm Red Sandy SILT (ML)	0.3	
RESIDUUM - Stiff Red Sandy SILT (ML)	2.0	
RESIDUUM - Firm Red Sandy SILT (ML) w/ mica	3.0	
RESIDUUM - Stiff Brown Sandy SILT (ML) w/ mica	4.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	5.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	6.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	7.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	8.0	
RESIDUUM - Stiff Tan Brown Sandy SILT (ML)	9.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-35

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 2.40 ft / Elev -2.40 ft AD

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	10/28/2020	ATV 550X	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.3		▼ FILL - Firm Red/Brown Sandy SILT (ML)				5
3.5		FILL - Soft Red/Brown Sandy SILT (ML)		-5		3
6		RESIDUUM - Stiff Red Orange SILT (ML)				9
8.5		RESIDUUM - Stiff Red Orange SILT (ML)		-10		9
13.5		RESIDUUM - Stiff White Brown Orange Sandy SILT (ML)		-15		9
18.5		RESIDUUM - Stiff White Brown Orange Sandy SILT (ML)		-20		9
23.5		RESIDUUM - Stiff White Brown Orange Sandy SILT (ML)		-25		9
28.5		RESIDUUM - Very Stiff White Brown Orange Sandy SILT (ML)		-30		23
33.5		RESIDUUM - Very Hard White Brown Orange Sandy SILT (ML)		-35		69
38.5		PARTIALLY WEATHERED ROCK sampled as White Brown Orange Sandy SILT (ML)		-40		50/5"
43.5		PARTIALLY WEATHERED ROCK sampled as White Brown Orange Sandy SILT (ML)		-45		50/3"
48.5		PARTIALLY WEATHERED ROCK sampled as White Brown Orange Sandy SILT (ML)		-50		50/1"

Boring terminated at 50 feet. Borehole caved at 21.0 feet.

STANDARD PENETRATION TEST DATA (blows/foot) ● — 10 30 50 90

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

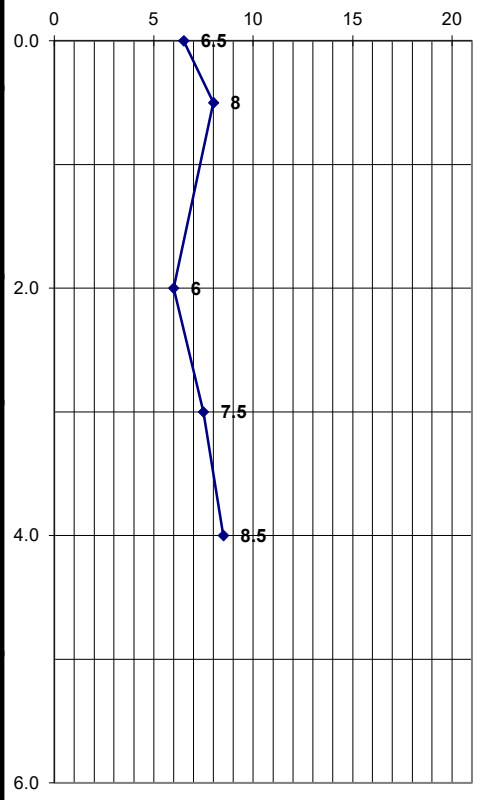
BORING NO.: HA-36

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 6 inches	0.0	
FILL - Firm Red Brown Sandy SILT (ML)	0.5	
RESIDUUM - Loose Brown Silty SAND (SM)	2.0	
RESIDUUM - Loose Grey Silty SAND (SM)	3.0	
RESIDUUM - Loose Grey Silty SAND (SM)	4.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

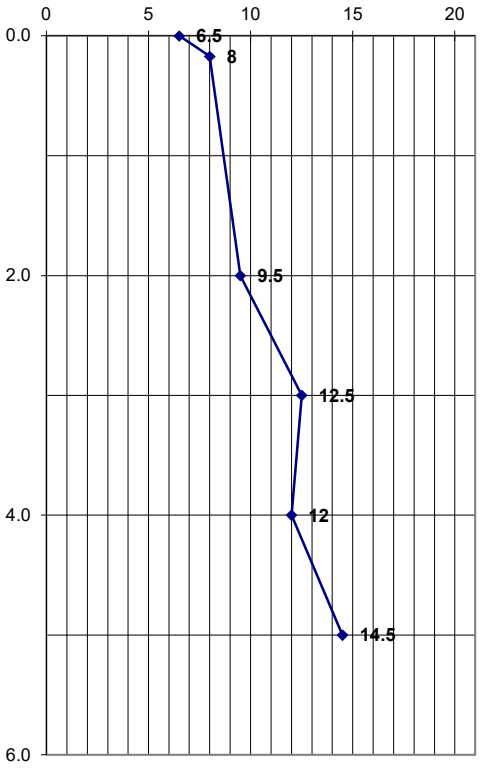
BORING NO.: HA-37

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 2 inches	0.0	
RESIDUUM - Firm Brown Sandy SILT (ML)	0.2	
RESIDUUM - Stiff Brown Grey Sandy SILT (ML)	2.0	
RESIDUUM - Stiff Brown Grey Sandy SILT (ML)	3.0	
RESIDUUM - Stiff Brown Grey Clayey Sandy SILT (ML)	4.0	
RESIDUUM - Stiff Brown Sandy SILT (ML)	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-38

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

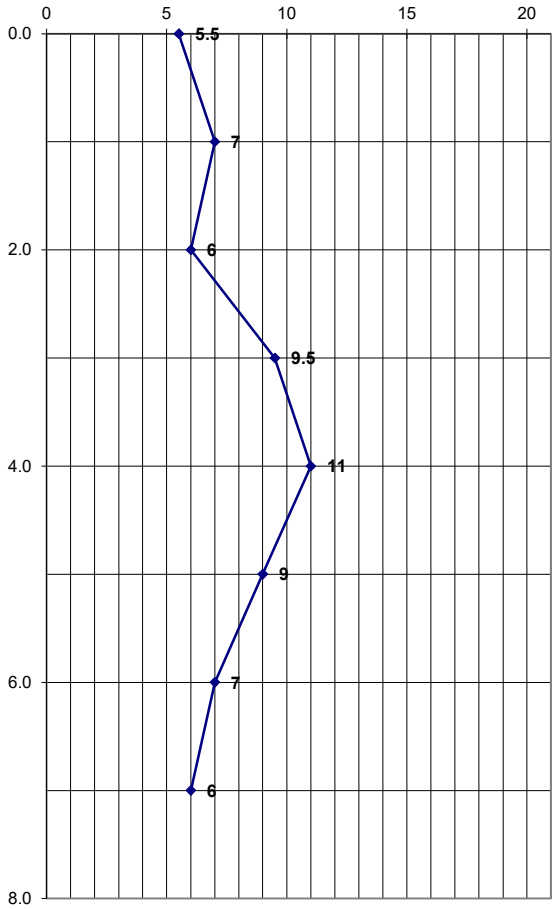
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
RESIDUUM - Loose Brown Silty SAND (SM)	0.0	
RESIDUUM - Loose Brown Silty SAND (SM)	1.0	
RESIDUUM - Loose Brown Silty SAND (SM)	2.0	
RESIDUUM - Loose Brown Silty SAND (SM)	3.0	
RESIDUUM - Medium Dense Grey SAND (SM)	4.0	
RESIDUUM - Loose Grey SAND (SM)	5.0	
RESIDUUM - Loose Grey SAND (SM)	6.0	
RESIDUUM - Loose Grey SAND (SM)	7.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-39

ELEVATION: 0 ft

GROUND WATER: ▽ AT TIME OF DRILLING ---

▼ AFTER DRILLING 6.00 ft / Elev -6.00 ft AD

PROJECT NAME: Cross Charlotte Greenway		**DRILLING COMPANY** CG2	
PROJECT LOCATION: Orr Rd. to W. Rocky River Rd.	**PROJECT NO:** 15-072-05	**DRILL METHOD:** ASTM D-1586	**NOTES:**
CHECKED BY: R. Price	**DATE DRILLED:** 11/30/2020	**DRILL RIG:** ATV 550X	

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	BLOW COUNTS (N VALUE)
0	Topsoil - 6 inches		
0.5	ALLUVIUUM - Firm Brown Sandy CLAY (CL)		5
3.5	ALLUVIUUM - Soft Grey Silty CLAY (CL)	-5	4
6	RESIDUUM - Firm Brown Sandy SILT (ML)		8
8.5	RESIDUUM - Stiff Brown Sandy SILT (ML)	-10	9
13.5	RESIDUUM - Stiff Brown Sandy SILT (ML)	-15	15
18.5	RESIDUUM - Medium Dense Brown Silty SAND (SM)	-20	31
23.5	RESIDUUM - Hard Brown Sandy SILT (ML) w/ rock fragments	-25	30
28.5	RESIDUUM - Hard Brown Sandy SILT (ML) w/ rock fragments	-30	38
33.5	RESIDUUM - Hard Brown Sandy SILT (ML) w/ rock fragments	-35	37
38.5	RESIDUUM - Hard Brown Sandy SILT (ML) w/ rock fragments	-40	34
43.5	PARTIALLY WEATHERED ROCK sampled as Brown Sandy SILT (ML)	-45	50/5"
48.5	PARTIALLY WEATHERED ROCK sampled as Brown Sandy SILT (ML)	-50	50/5"

STANDARD PENETRATION TEST DATA (blows/foot) ●

10 30 50 90

Boring terminated at 49.4 feet. Borehole caved at 39.3 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

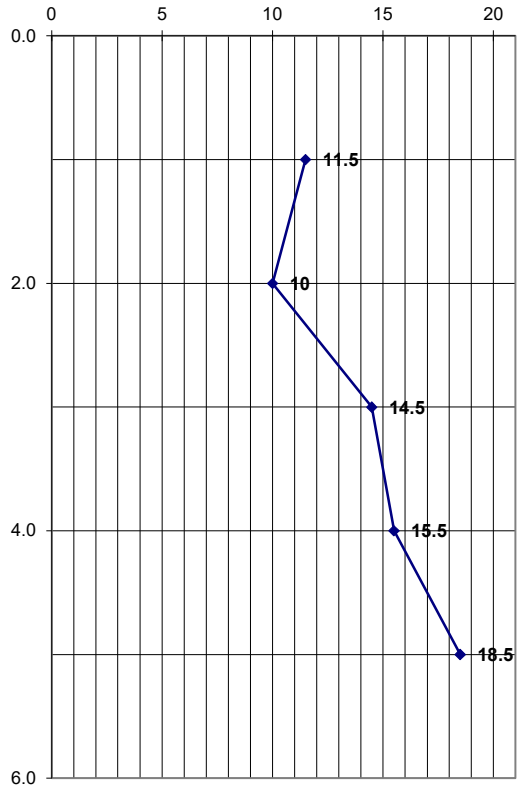
BORING NO.: HA-40

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
RESIDUUM - Brown Sandy SILT (ML)	0.0		
RESIDUUM - Stiff Brown Sandy SILT (ML)	1.0		
RESIDUUM - Stiff Brown Fine Sandy SILT (ML)	2.0		
RESIDUUM - Stiff Brown Sandy SILT (ML)	3.0		
RESIDUUM - Very Stiff Brown Sandy SILT (ML)	4.0		
RESIDUUM - Very Stiff Brown Sandy SILT (ML)	5.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-41

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

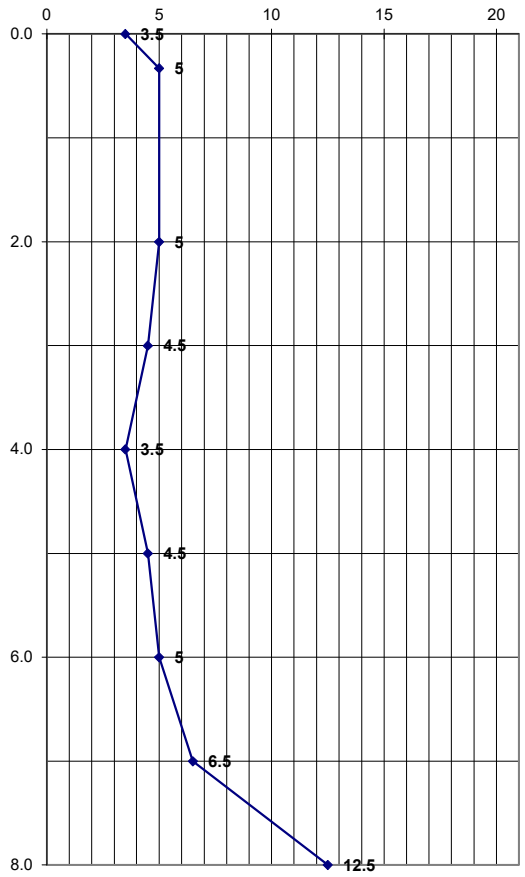
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**1/0/1900**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
TOPSOIL - 4 inches	0.0	
RESIDUUM - Stiff Red Brown SILT (ML)	0.3	
RESIDUUM - Stiff Red Brown SILT (ML)	2.0	
RESIDUUM - Firm Red Brown SILT (ML)	3.0	
RESIDUUM - Firm Red Brown SILT (ML)	4.0	
RESIDUUM - Firm Red Grey CLAY (CL)	5.0	
RESIDUUM - Stiff Red Grey CLAY (CL)	6.0	
RESIDUUM - Stiff Red Grey CLAY (CL)	7.0	
RESIDUUM - Very Stiff Red Grey CLAY (CL) REFUSUAL-ROOT A1	8.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-42

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

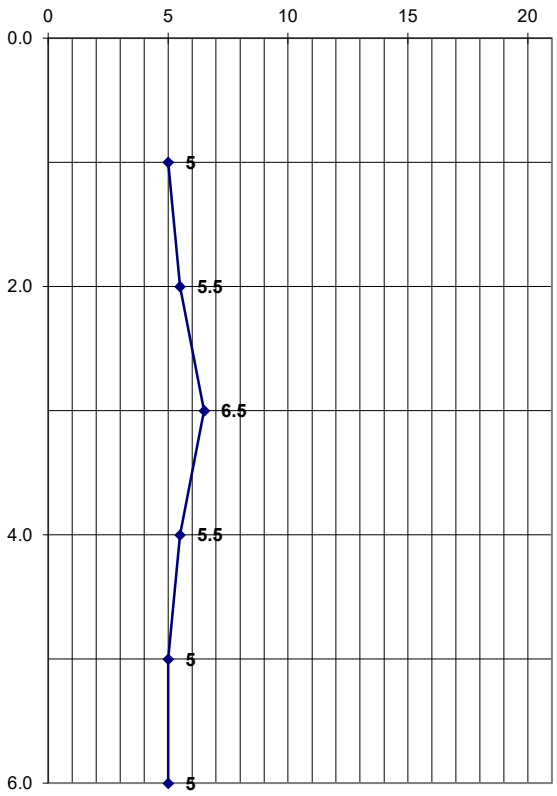
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth		Elevation
RESIDUUM - Loose Brown SAND (SM)	1.0		
RESIDUUM - Loose Brown SAND (SM)	2.0		
RESIDUUM - Loose Brown Silty SAND (SM)	3.0		
RESIDUUM - Firm Brown Silty CLAY (CL)	4.0		
RESIDUUM - Loose Brown Silty SAND (SM)	5.0		
RESIDUUM - Firm Wet Grey Silty CLAY (CL)	6.0		

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-43

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

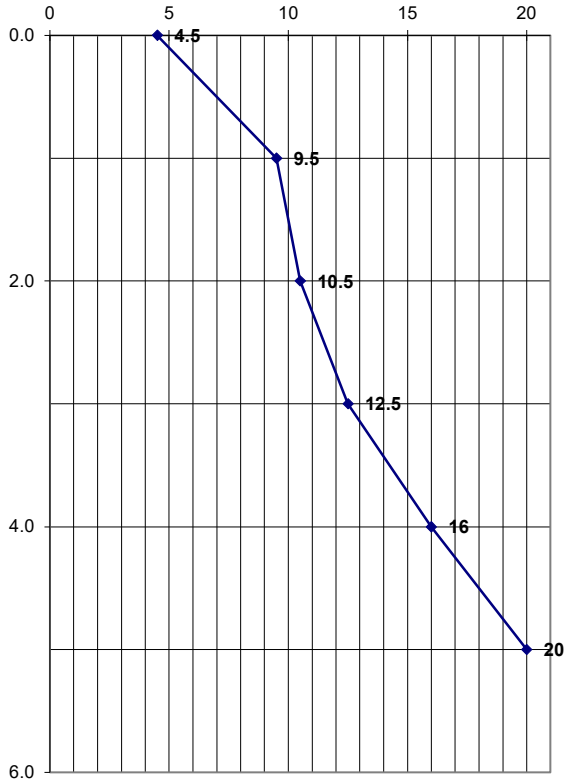
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 12 inches	0.0	
RESIDUUM - Loose Red Brown Silty SAND (SM)	1.0	
RESIDUUM - Medium Dense Red Brown Silty SAND (SM)	2.0	
RESIDUUM - Medium Dense Brown Silty SAND (SM) w/ rock fragments	3.0	
RESIDUUM - Medium Dense Brown Silty SAND (SM) w/ rock fragments	4.0	
RESIDUUM - Medium Dense Brown Silty SAND (SM) w/ rock fragments HAND AUGER REFUSAL	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

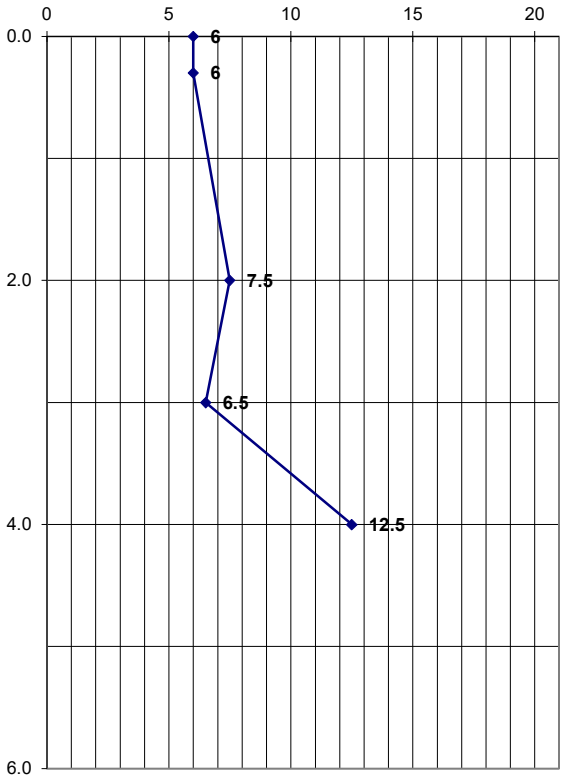
BORING NO.: HA-44

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**	LOCATION.:	
SITE LOCATION:	**Charlotte, North Carolina**	DRILLING METHOD:	**Hand-Auger**
BOYLE JOB NO.:	**15-072-05**	SAMPLING METHODS:	**ASTM STP-399**
DATE DRILLED:	**Misc.**	HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
Topsoil - 4 inches	0.0	
RESIDUUM - Firm Brown Red SILT (ML)	0.3	
RESIDUUM - Firm Brown Red SILT (ML)	2.0	
RESIDUUM - Firm Brown Red SILT (ML)	3.0	
RESIDUUM - Stiff Brown Red SILT (ML) HAND AUGER REFUSAL ROOTS @ 4 FT	4.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS
4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-45

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

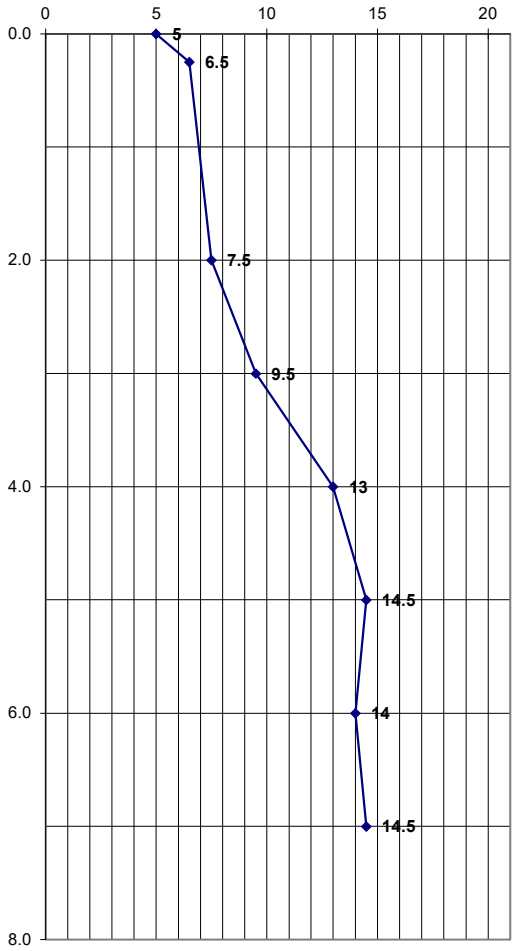
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**Misc.**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
TOPSOIL - 3 inches	0.0	
RESIDUUM - Stiff Red Orange SILT (ML)	0.3	
RESIDUUM - Stiff Red Orange SILT (ML)	2.0	
RESIDUUM - Stiff Red Orange SILT (ML)	3.0	
RESIDUUM - Med+A1ium Dense Yellow Brown Silty SAND (SM)	4.0	
RESIDUUM - Medium Dense Yellow Brown Silty SAND (SM)	5.0	
RESIDUUM - Medium Dense Yellow Brown Silty SAND (SM)	6.0	
RESIDUUM - Medium Dense Yellow Brown Silty SAND (SM)	7.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

4340-G Taggart Creek Road
Charlotte, NC 28208
Phone: (704) 676-0778
Fax: (704) 676-0596

SOIL TEST BORING RECORD

BORING NO.: HA-46

GSE*: Unknown (Cut)/Fill: **AT GRADE**

PROJECT INFORMATION

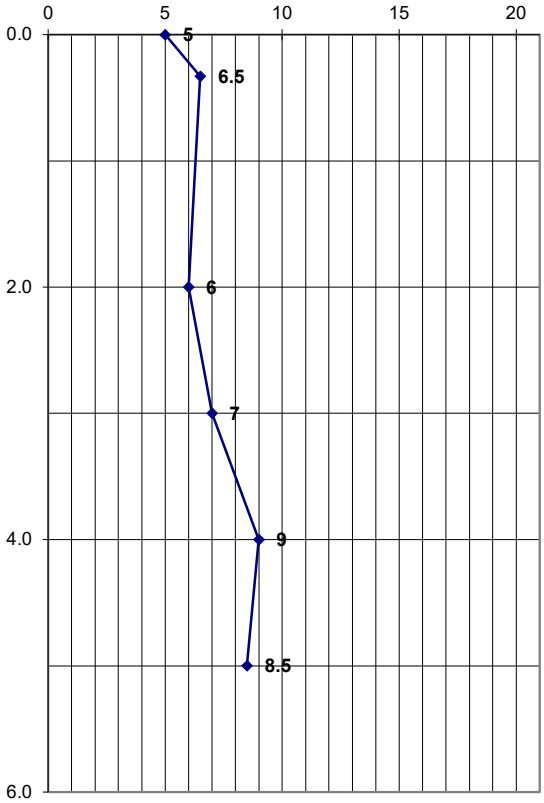
PROJECT:	**Cross Charlotte Trail: Orr Road to Rocky River Road**
SITE LOCATION:	**Charlotte, North Carolina**
BOYLE JOB NO.:	**15-072-05**
DATE DRILLED:	**4/28/2020**

DRILLING INFORMATION

LOCATION.:	
DRILLING METHOD:	**Hand-Auger**
SAMPLING METHODS:	**ASTM STP-399**
HAMMER WT./DROP	**15 lb., 20 in.**

Description	Depth	Elevation
TOPSOIL - 4 inches	0.0	
RESIDUUM - Firm Red Brown Sandy SILT (ML)	0.3	
RESIDUUM - Firm Red Brown Sandy SILT (ML)	2.0	
RESIDUUM - Firm Red Brown Sandy SILT (ML)	3.0	
RESIDUUM - Stiff Red Brown Sandy SILT (ML)	4.0	
RESIDUUM - Stiff Red Brown Sandy SILT (ML) HAND AUGER REFUSAL A1	5.0	

Penetration - Blows per 1.75 - Inch Increment (bpi)



Groundwater Levels (feet)

During Drilling	After Drilling
None	None

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-47

ELEVATION: 0 ft

GROUND WATER: AT TIME OF DRILLING ---

AFTER DRILLING ---

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	12/14/2020	D-50	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil				
0.5		RESIDUUM - Very Stiff Orange Brown SILT (ML)				19
3.5		RESIDUUM - Hard Orange Brown SILT (ML)		-5		33
6		RESIDUUM - Very Hard Orange Brown SILT (ML)				50/"
8.5		RESIDUUM - Very Hard Orange Brown SILT (ML)		-10		80
13.5		PARTIALLY WEATHERED ROCK sampled as Orange Brown SILT (ML)		-15		50/4"
18.5		RESIDUUM - Very Hard Orange Brown SILT (ML)		-20		76
23.5		RESIDUUM - Hard Orange Brown SILT (ML)		-25		44
28.5		PARTIALLY WEATHERED ROCK sampled as Orange Brown SILT (ML)		-30		50/4"

10 20 30

10 30 50 90

Boring terminated at 29.0 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

BOYLE CONSULTING ENGINEERS

SOIL TEST BORING SPT-48

ELEVATION: 0 ft

GROUND WATER: AT TIME OF DRILLING ---

AFTER DRILLING ---

PROJECT NAME: Cross Charlotte Greenway

DRILLING COMPANY CG2

PROJECT LOCATION:	**PROJECT NO:**	**DRILL METHOD:**	**NOTES:**
Orr Rd. to W. Rocky River Rd.	15-072-05	ASTM D-1586	
CHECKED BY:	**DATE DRILLED:**	**DRILL RIG:**	
R. Price	12/10/2020	ATV 550X	

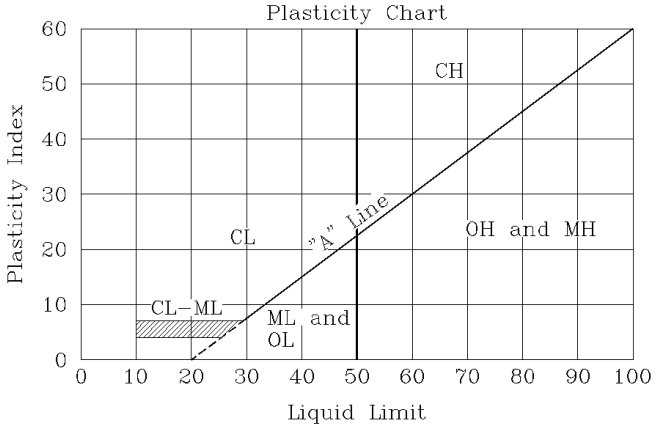
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	TYPE	ELEVATION (ft)	STANDARD PENETRATION TEST DATA (blows/foot) ●	BLOW COUNTS (N VALUE)
0		Topsoil			10 30 50 90	
0.5		RESIDUUM - Stiff Brown Sandy SILT (ML)			●	9
3.5		RESIDUUM - Very Stiff Brown Sandy SILT (ML)		-5	●	19
6		PARTIALLY WEATHERED ROCK sampled as Brown Sandy Silt (ML)			●	50/5"
8.5		RESIDUUM - Very Hard Brown Sandy SILT (ML)		-10	●	62
10						
13.5		PARTIALLY WEATHERED ROCK sampled as Brown Sandy Silt (ML)		-15	●	50/3"
15		PARTIALLY WEATHERED ROCK sampled as Brown Sandy Silt (ML)			●	50/0"
20				-20		

Boring terminated at 16 feet.

DEPTH MEASUREMENTS ARE SHOWN TO ILLUSTRATE THE GENERAL STRATIFICATIONS ENCOUNTERED AT THE BORING LOCATIONS.

BORING, SAMPLING AND PENETRATION TEST DATA IS IN GENERAL ACCORDANCE WITH ASTM D-1586.

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-Grained Soils (More than half of the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieves size)	Clean Gravels (Little or no fines)	GW		Well graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve Depending on the percentage of the fines (fraction smaller than No. 200 sieve size), Coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP More than 12% GM, GC, SM, SC 5 to 12% Borderline cases requiring dual symbols[b]	$C_u=D_{60}/D_{10}$ greater than 4 $C_c= (D_{30})^2/(D_{10} \times D_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines	GM[a]	d u	Silty Gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
			GC		Clayey Gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean Sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u=D_{60}/D_{10}$ greater than 6 $C_c= (D_{30})^2/(D_{10} \times D_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines	SM[a]	d u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
			SC		Clayey sands, sand-clay mixtures		Atterberg limits below "A" line with P.I. greater than	
Fine-Grained Soils (More than half of material is smaller than No. 200 sieve)	Silts and Clays (Liquid Limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid Limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays (i.e. Bull Tallow)			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic Soils		Pt		Peat and other highly organic soils			



Reference: Winterkorn & Fang, 1975 (ASTM D-2487)

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

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

BOYLE CONSULTING ENGINEERS

Unified Soil Classification System

REFERENCE NOTES FOR SOIL TEST BORING RECORDS

I. Drilling and Sampling Symbols:

SS:	Split Spoon Sampler	GSE:	Ground Surface Elevation
ST:	Shelby Tube Sampler	PG:	Proposed Grade
RC:	Rock Core; NX, BX, AX	BS:	Bulk Sample of Cuttings
NQ:	Rock Core, 2-1/16" Diameter	PA:	Power Auger (no sample)
PM:	Pressuremeter	HSA:	Hollow Stem Auger
DC:	Dutch Cone Penetrometer	WS:	Wash Sample
REC:	Recovery of Core Run (%)	RQD:	Rock Quality of Core Run

Standard Penetration (Blows/Ft) refers to the blows per foot of a 140 lb hammer falling 30 inches on a 2 inch O.D. split spoon sample, as specified in ASTM D-1586. The blow count is commonly referred to as the N value. Autohammer refers to an automatic hammer as opposed to the manual "Cathead" and rope type. Core Drilling meets ASTM D-2113

II. Correlation of Penetration Resistances to Soil Properties:

Relative Density of Cohesionless Soils

SPT-N	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51 or more	Very Dense

Consistency of Cohesive Soils

SPT-N	Consistency
0 - 1	Very Soft
2 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 – 30	Very Stiff
31 or more	Hard

III. Unified Soil Classification Symbols:

GP:	Poorly Graded Gravel	ML:	Low Plasticity Silts
GW:	Well Graded Gravel	MH:	High Plasticity Silts
GM:	Silty Gravel	CL:	Low Plasticity Clays
GC:	Clayey Gravel	CH:	High Plasticity Clays
SP:	Poorly Graded Sands	OL:	Low Plasticity Organics
SW:	Well Graded Sands	OH:	High Plasticity Organics
SM:	Silty Sands	CL-ML:	Dual Classification (Typical)
SC:	Clayey Sands		

IV. Water Level Measurement Symbols:

▼ WL: Water Level

▽ WL: While Sampling

▽ WD: While Drilling

DCD: Dry Caved Depth

WCD: Wet Caved Depth

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clays and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

BOYLE CONSULTING ENGINEERS

APPENDIX C

REGIONAL GEOLOGY, SOILS AND GROUNDWATER

REGIONAL GEOLOGY, SOILS AND GROUNDWATER

Regional Geology of the Piedmont

Geologists subdivide the Piedmont into geologic "belts," each having a somewhat different set of characteristics as noted below. The belts are discussed in the order in which they are geographically located in a west to east manner.

Inner Piedmont Belt - The Inner Piedmont Belt is the most intensely deformed and metamorphosed segment of the Piedmont. These metamorphic rocks range from 500 to 750 million years in age and include gneiss and schist that have been intruded by younger granitic rocks. The northeast-trending Brevard fault zone forms much of the boundary between the Blue Ridge and the Inner Piedmont belts.

Kings Mountain Belt - The belt consists of moderately deformed and metamorphosed volcanic and sedimentary rocks. The rocks are about 400 to 500 million years old.

Milton Belt - This belt consists of gneisses, schist and metamorphosed intrusive rocks.

Charlotte Belt -The belt consists mostly of 300 to 500 million years old igneous rocks such as granite, diorite and gabbro.

Carolina Slate Belt - This belt consists of a band of heated and deformed volcanic and sedimentary rocks stretching from Georgia through the Carolinas into Virginia and was the site of a series of oceanic volcanic islands about 550 to 650 million years ago. The rocks have been subjected to heat and pressure (metamorphism) over geologic time since their formation. The major rock type encountered in this belt is not slate, but includes a variety of metavolcanic and metasedimentary rocks. The metavolcanics include tuffs, rhyolitic, dacitic and andesitic flows and breccias; the metasediments include slate, mudstones, sericite schist, and argillite. The belt is also known for its numerous abandoned gold mines and prospects.

Triassic basins - Some sites may be located in Triassic lowland, one of several trough shaped basins that occur in the Piedmont Physiographic Province. The basins are filled with sedimentary rocks that formed about 190 to 200 million years ago when faulting activity caused long narrow areas to drop several thousand feet relative to the surrounding areas. Soil and rock materials were eroded from the adjacent areas and deposited in inland fresh water lakes within the troughs to eventually form sedimentary rocks. The Triassic rocks consist of sandy and clayey sandstone, siltstone, mudstone, and shale. Isolated calcareous (limestone) zones exist in the fine-grained rocks, and occasional coal beds are interbedded with dark-colored shales and siltstones. Conglomerate and fanglomerate are found along both the eastern and western margins of the basins.

Basic igneous rocks, commonly classed as diabase, have been intruded in the form of dikes and sills into the Triassic rocks. The great majority of these dikes tend in a northwesterly direction. The intrusives are massive, crystalline, unmetamorphosed diabase rocks that are dark brown, dark gray, or black in color. Outcrops of diabase are common in the form of boulders, which are produced by spheroidal weathering along the joints in the rocks.

Raleigh belt - The Raleigh belt contains granite, gneiss and schist and is considered to be an eastern version of the Charlotte Belt.

Eastern Slate Belt - This belt contains slightly metamorphosed volcanic and sedimentary rocks similar to those of the Carolina slate belt. The rocks are poorly exposed and partially covered by the Coastal Plain sediments. The 500 to 600 million years old metamorphic rocks are intruded by younger, approximately 300 million-year-old, granitic bodies.

The region has many gold mines arranged in zones within two physiographic provinces, the Piedmont and the Blue Ridge. Most of the deposits and the most productive mines are in the Piedmont province in Mecklenburg, Rowan, Cabarrus, and Davidson Counties of North Carolina. The first information on gold production in the area occurred in 1799, when a 17-pound nugget was found on the Reed plantation in Cabarrus County. This discovery and others on the Reed property stimulated interest in gold mining in the Southeastern States, and by 1825 mining was in full swing. Prospecting was likely also performed by farmers during the slower times of the year resulting in many shallow pits and diggings. The first production in North Carolina was from placers and saprolite; by 1850 several important lode mines were opened. Placer mining sometimes involved pumping water onto hillsides and washing the lighter-weight soil tows the creek leaving the heavier gold particles. Remains of placers currently appear as long deeply incised ravines. The lode mines were deeper and more extensive. Most mines were closed during the Civil War, but were reactivated after the war. Depth of the prospects and mines was often limited to the capacity of the dewatering pumps. Most mines were limited to 120 feet in depth until new pumps were developed in the 1900's.

Soils of the Piedmont

The Piedmont Province lies between the Coastal Plain and the Blue Ridge Mountains. The Piedmont physiographic province is characterized by its particular types of landforms and occupies about 45 percent of the area of the state. The Piedmont Province is a deeply eroded, plateau-like segment of the Appalachian Mountain System. The Piedmont in this region is about 80 to 120 miles wide. It is bounded on the northwest by the Blue Ridge Province and on the southeast by the Atlantic Coastal Plain Province. The plateau generally slopes southeastward from an elevation of about 1200 feet near the Blue Ridge to about 400 feet near the Coastal Plain. The Piedmont also is characterized by gently rolling, rounded hills and long low ridges with up to a few hundred feet of elevation difference between the hills and valleys. The Piedmont includes some relatively low mountains including the South Mountain and the Uwharrie Mountains.

The soils in the Piedmont Province consist mainly of residuum derived from the parent bedrock, which are found in various states of weathering. Although the residual saprolitic materials normally retain the structure of the original parent bedrock, they typically have a much lower density and exhibit strengths and other engineering properties typical of soil. In a mature undisturbed weathering profile of the Piedmont Province, the soils are generally found to be finer grained (or more clayey) at the surface where more extensive weathering has occurred. This near-surface finer-grained layer is often referred to as the upper clayey zone and is typically encountered from beneath topsoil to about 3 to 6 feet below the ground surface. Layers of clayey soils are rarely present beyond depths greater than 6 feet and tend to exist as thin seams, which decrease in thickness and frequency as depth increases. The particle size of the residual soils generally becomes larger and more granular with increasing depth and gradually changes first to partially weathered rock and finally to unweathered bedrock. The mineral composition of the parent rock and the environment in which weathering occurs largely control the resulting soil's engineering characteristics.

Some of the soils along the site drainage features and in the flood plain areas are water-deposited (alluvial) materials that have been eroded and washed down from adjacent higher ground. Alluvial soils often contain layers of rounded gravel and cobbles, interbedded with zones of soft compressible, fine grained soils. Such alluvial soils are usually soft since they have never been consolidated by pressures in excess of the existing overburden pressure. In some cases, particularly along major rivers channels, the alluvial soils were deposited such a long time ago that the river channel has eroded deeply into to bedrock leaving old floodplain soils "high and dry." These soils are called Terrace Deposits or sometimes Ancient Alluvium since they begin to reacquire some of the characteristics of residual soils.

Groundwater in the Piedmont

Groundwater is water that is found underground in the cracks and spaces in soil, sand partially weathered rock and bedrock. Groundwater is stored in and moves through layers of soil, sand and bedrock called aquifers. In the Piedmont, most aquifers are unconfined. *Unconfined aquifers* are those that are bounded by the water table. Some aquifers, however, lie beneath layers of impermeable materials. These are called *confined aquifers*, or sometimes *artesian aquifers*. A well in such an aquifer is called an *artesian well*. The water in these wells rises higher than the top of the aquifer because of confining pressure. If the water level rises above the ground surface a *flowing artesian well* occurs. The *piezometric surface* is the level to which the water in an artesian aquifer will rise.

During a geotechnical exploration, the borings or test pits penetrate the overlying soil/rock strata and sometimes reach the top of an aquifer, which corresponds to the top of groundwater often called the water table. The process of drilling the borings or excavating test pits often disturbs the walls of the borehole or excavation such that the water which may be present within the strata are partly prevented from immediately filling the borehole up to the *piezometric surface.* These water levels are those water levels actually measured in the borehole at the times indicated, usually as "time of boring" or "during drilling". The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clays and plastic silts, the accurate determination of water levels may require 24 hours up to several days for the water level to stabilize.

Depending largely upon topographic location and proximity to drainage features, ground-water levels may fluctuate several feet or up to 15 feet or more with typical seasonal and rainfall variations and with changes in the water level in adjacent drainage features. Normally, the highest ground-water levels occur in late winter and spring and the lowest levels occur in late summer and fall. At the time of this exploration water levels are probably intermediate between their seasonal extremes. Fluctuations in the ground-water level can be expected depending on variations in precipitation, run-off, and other factors not evident or apparent at the time of our subsurface exploration.

Sometimes water levels are recorded at elevations above the groundwater table. These water levels are indicative of perched water conditions. Perched water is surface water that has infiltrated the upper soil layers only to become trapped above deeper relatively impermeable soil or rock layers. Perched water is often encountered as small pockets or depressions within fill soil layers, above clayey soils and bedrock or partially weathered rock. The approximate quantity of perched water is not typically substantial; however, in some cases it can be significant.

The caved and dry depths noted on the soil test boring records may indicate the presence of ground water at or just below the indicated caved depth which likely caused the soils to

collapse into the hole. They may also be the result of soil cuttings left in the borehole upon removal of the drilling tools. We examine the profile of caved elevations and examine the boring logs for comments regarding moistness of soils below the caved depths to evaluate whether or not a caved depth is likely due to groundwater or the result of soil cuttings sloughing during removal of the drilling tools.

If groundwater is encountered during construction, we recommend that the groundwater table be lowered and maintained at a depth of at least 2-ft below bearing levels and excavation bottoms during construction. Adequate control of this groundwater could likely be accomplished by means of gravity ditches and pumping from gravel-lined, cased sumps. The contractor should be prepared to promptly remove surface water and perched water from the general construction area by similar methods. Some sites require more time or more complex approaches to properly dewater.

Lowering the groundwater level of larger site areas will increase the effective stress within the soils surrounding the face of the excavation. This will result in some ground surface settlement. The effect of this settlement on surrounding streets, utilities and particularly any nearby buildings should be considered during the planning for major dewatering systems.

Construction projects sometimes require a system consisting of underfloor drains below the building and vertical drains behind retaining walls. Such systems should be designed to drain by gravity (if possible) or at least drain by gravity to permanent sumps from which the water can then be pumped to outfalls to drain by gravity. The use of granular fill (washed stone) behind the below ground walls would be more traditional than a manufactured composite system (such as Miradrain or Enkedrain) due to the inability to access the drain materials for maintenance should problems develop. If manufactured products are used, they must be properly installed and must function over the life of the structure as designed.

APPENDIX D

PROCEDURES REGARDING FIELD LOGS AND SAMPLES

PROCEDURES REGARDING FIELDS LOGS AND SAMPLES

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering.

Specifically, field logs are prepared during performance of the drilling and sampling operations that are intended to portray essentially field occurrences, sampling locations, and other information.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soil engineers, and differences between the field logs and the final logs exist.

The engineer preparing the report reviews the field and laboratory logs, classifications and test data, and his judgment in interpreting this data, may make further changes.

Samples are taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty (60) days and are then discarded unless special disposition is requested by our client. Samples retained over a long period of time, even if sealed in jars, are subject to moisture loss, which changes the apparent strength of cohesive soil generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, an inspection of these samples should recognize this factor.

It is common practice in the soil and foundation engineering profession that field logs and laboratory data sheets not be included in engineering reports because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors submitting bids or proposals on work may have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs will be retained in our office for inspection by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have been and typically are made in the preparation of our final reports, to the contractor or subcontractors, before the firm submits the bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of the laboratory tests are generally shown on the boring logs or described in the extent of the report, as appropriate.

Soil Test Borings (ASTM D-1586)

Soil test borings are performed by mechanically twisting a continuous flight hollow-stem steel auger into the soil. Soil sampling and penetration testing are performed in general accordance with ASTM D-1586. At regular intervals, soil samples are obtained with a standard 1.4-inch I. D., 2-inch O. D., split-tube sampler. The sampler is first seated 6 inches to penetrate any loose cuttings, then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches is recorded and designated the "penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength and foundation supporting capability.

Representative portions of the obtained soil samples are placed in glass jars or plastic containers and transported to the laboratory. In the laboratory, the samples were examined by an engineering geologist or geotechnical engineer to verify the driller's field classifications.

Soil Test Borings (ASTM STP-399)

Soil test borings are made by mechanically twisting a solid-stem, continuous-flight solid steel auger into the soil. Soil samples are obtained at regular intervals. Soil classification and dynamic cone penetrometer testing in accordance with ASTM STP-399 is performed at each boring location. The penetration resistance value of the Dynamic Cone Penetrometer (DCP) test, when properly evaluated, can be an indicator of the soil's strength and foundation supporting capability. The DCP test records the average number of blows required to drive the test equipment a 1.75-inch increment by a 15-pound hammer falling 20 inches and is designated the "penetration resistance" or blowcount.

Representative portions of the soil samples obtained were classified in our laboratory. Soil test boring records are attached, showing the soil descriptions, penetration resistances, and other subgrade characteristics.

Test Pits

The excavatability of the existing materials in the subject area can be tested in the field with test pit excavations using a medium-duty backhoe (typically John Deere 310C or equivalent) which can explore to a depth of about 12 feet below the existing grade or a heavy-duty backhoe which can explore to a maximum depth of about 20 feet below the existing grade. Test pit excavations permit visual examination of a large portion (surface area) of exposed materials and allow direct observation of the relative ease or difficulty of excavation. Test pits also allow the collection of representative samples of the excavated materials. The test pit excavations are performed by others and observed by an engineering geologist or geotechnical engineer familiar with the general site area and area geology.

Observation Wells (Piezometers)

Water level readings taken during the field operations do not provide information on the long term fluctuations of the water table. When this information is required, observation wells are necessary to prevent the borings from caving. Observation wells (when installed) typically are constructed by inserting PVC plastic pipe to the desired depths. A closed end slotted portion of PVC pipe is attached to the bottom of the plastic pipe to allow subsurface water to enter the observation well. Clean sand is backfilled around the bottom slotted portion of the well. The remainder of the hole is backfilled with an impervious material, using a bentonite or mortar cap to seal out surface water. The top of the PVC pipe has a removable cover to seal out rainwater and surface water.

APPENDIX E

DEFINITIONS & TERMINOLOGY

DEFINITIONS & TERMINOLOGY

Alluvium - Soil and/or rock materials that have been transported by water such that much of the original structure or texture of the original material is lost or diminished.

Bedrock – Subsurface materials that cannot be excavated or pre-loosened with a track mounted backhoe having a minimum bucket curling force rating of at least 25,500 pounds (i.e. Caterpillar 225) and occupying an original volume of at least 1 cubic yard. Bedrock can be defined differently depending upon the type of project. Auger refusal is the generally accepted "top of bedrock"; however, zones of soft material may exist at lower elevations than the auger refusal. In such cases, bedrock is defined as material having a rock quality designation (RQD) of 90 or greater.

Blue Ridge Belt – mountainous area located on the eastern face of the Appalachian Mountains consisting of a variety of igneous and metamorphic rocks.

Building Limits - the plan outline of the exterior of the building (either wall or footing) perimeter.

Caved and dry depths – A measured depth of a borehole partially filled with soil checked 24 hours or more after being drilled. This phenomenon, sometimes designated as a "C-" on the soil test boring records, may indicate the presence of ground water at or just below the indicated depth which likely caused the soils to collapse into the hole. It also may be the result of soil cuttings left in the hole upon removal of the drilling tools.

Colluvium - Soil and/or rock materials that have been transported down slope in steep terrains and deposited along the slopes and at their toes.

Dikes and sills – Dikes and sills are igneous intrusions (similar to volcanic lava) that are substantially wider than they are thick (i.e. planar). Dikes often are steeply inclined or nearly vertical where sills are oriented horizontally or tabular. These igneous intrusions were injected along zones of weakness in existing bedrock, such as faults, fractured zones, and joint concentrations.

Engineered fill – Engineered fill soil generally shall be free of roots larger than 1-inch diameter and shall have a fibrous organic content less than 5 (five) percent by weight. Engineered fill should be an approved material, free of debris (no more than 5 percent by weight), and have a liquid limit and plasticity index less than 40 and 15, respectively. Fill used for raising site grade or for replacement of material that is undercut should be placed in lifts not exceeding 8 inches in loose thickness, moisture conditioned to within 2 percent of the optimum moisture content, and uniformly compacted to a minimum of 95 percent of the maximum density obtained in accordance with ASTM D-698, standard Proctor method. Soil types usually suitable for use as engineered fill include: SC, SM, SP, SW, GC, GM, GP, GW, ML, and CL. Locally, soil type MH is suitable for use as engineered fill with proper moisture conditioning.

Existing fill – Soil materials transported by man and placed by man into their current position. Existing fill may be documented or undocumented, suitable or unsuitable.

Geotechnical Exploration – A study that is performed after building and infrastructure positioning has occurred and preliminary grades have been estimated in order to identify potential problems with the building location and provide recommendations for building and pavement construction.

Ground water - The water levels are those water levels actually measured in the borehole at the times indicated. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clays and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize.

In situ – In the natural or original position or place.

Organics – Fibrous material derived from living or formerly living organisms usually plants such as limbs, roots, leaves and bark.

Partially weathered rock –An undisturbed residual material with standard penetration-resistances in excess of 100 blows per foot using ASTM D-1586 standards.

Physiographic – An area of similar topographic landforms and geomorphologic processes.

Piedmont - any area near the foot of a mountain, particularly the plateau extending from New York to Alabama east of the Blue Ridge and/or Appalachian Mountains and west of the Atlantic coastal plain.

Preliminary Geotechnical Exploration – A geotechnical exploration that is performed before building and infrastructure positioning has occurred and before preliminary grades have been estimated in order to identify potential problems with the building and infrastructure design and provide preliminary recommendations for building and pavement construction.

Rock - Subsurface materials that cannot be excavated or pre-loosened with a track mounted backhoe having a minimum bucket curling force rating of at least 25,500 pounds (i.e. Caterpillar 225) and occupying an original volume of at least ½ cubic yard. Mechanized auger refusal is the generally accepted "top of rock".

Saprolite or saprolitic – An undisturbed residual soil material weathered in-place that retains the visual appearance (coloration, foliation or cleavage, relict joints, etc.) of the parent bedrock and also retains a portion of the intergranular bond strength once present in the parent rock.

Soil – Materials such as sand, silt and clay that are readily excavated with regular duty grading equipment.

Standard Penetration - (Blows/Foot) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2 inch O.D. split spoon sampler, as specified in ASTM D-1586. The blow count commonly is referred to as the N-value.

Topsoil - Organic surficial soil containing more than 5 percent by weight fibrous organic material.

Unsuitable Soils – Unsuitable soils are determined on a site by site basis; however, there are several soil types that are typically considered unsuitable to provide support of building foundations. These are: CH-highly plastic clays, topsoil and highly organic soils (containing 10 percent or more organics by weight), and undocumented fills containing slag and/or other deleterious debris. Unsuitable and marginally unsuitable soil types often include CL, MH, OL, OH, and Pt (Peat).