STEWART

STRONGER BY DESIGN

GEOTECHNICAL ENGINEERING REPORT

SAM'S BRANCH GREENWAY PHASE II

City Road to O'Neil Street
Clayton, North Carolina

August 21, 2015

GEOTECHNICAL ENGINEERING REPORT

SAM'S BRANCH GREENWAY – PHASE II

City Road to O'Neil Street
Clayton, North Carolina

August 21, 2015

Prepared For:

Town of Clayton
Park & Recreation
715 Amelia Church Rd
Clayton, NC

Prepared By:

STEWART
2201 Brentwood Road
Suite 105
Raleigh, NC 27604

Stewart Project No.: H14009.00

Donald W. Brown Jr., PE, LEED AP
Manager of Construction Services
NC License No. 028422

Stewart Engineering License No. C-1051

TABLE OF CONTENTS

1 PROJECT INFORMATION

1.1 Project Understanding

The information presented in this section was utilized in the geotechnical evaluation. Therefore, if any of the noted information is incorrect or has changed, please inform us so that we may amend the recommendations presented in this report, if appropriate or necessary. As we understand it, the project will consist of the following:

1.1.1 Trail

The greenway trail will consist of a new 10-foot wide asphalt trail primarily along one main line (-L-) that connects Legend Park on City Road to the existing Sam's Branch (Phase I) trailhead on O'Neil Street. One short, ~50-foot long spur (-Y1- line) will extend off of the main line to connect to the Legend Park parking lot and a second ~75-foot spur (-Y2-) will connect the trail to Lake Drive. The overall trail will generally follow the existing topography with anticipated maximum cuts and fill on the order of 2 to 4 feet. The total project length is 1.29 miles.

1.1.2 Pedestrian Bridge

A pedestrian bridge will be constructed along the trail beginning at approximate –L- Station 34+83. Bridge 1 is a 60-foot long, single-span, prefabricated metal bridge that will cross Sam's Branch Creek. Concrete approach slabs, 10 feet in length, will be constructed at each end of the bridge

No heavy truck or equipment loading will be allowed on the bridge, but they will be designed to support moderate loads induced by ambulances and other vehicles/equipment up to 20,000 lb. (AASHTO H10 loading).

1.1.3 Boardwalks

There will be a total of six boardwalks. Boardwalks will consist of timber construction. Specific to the foundation, each bent will consist of two timber piles (8 feet center-to center, typ.) and a timber cap. Standard boardwalk spans will be 10 feet and/or 20 feet from cap to cap. Concrete approach slabs, 10 feet in length, will be constructed at each end of the bridge

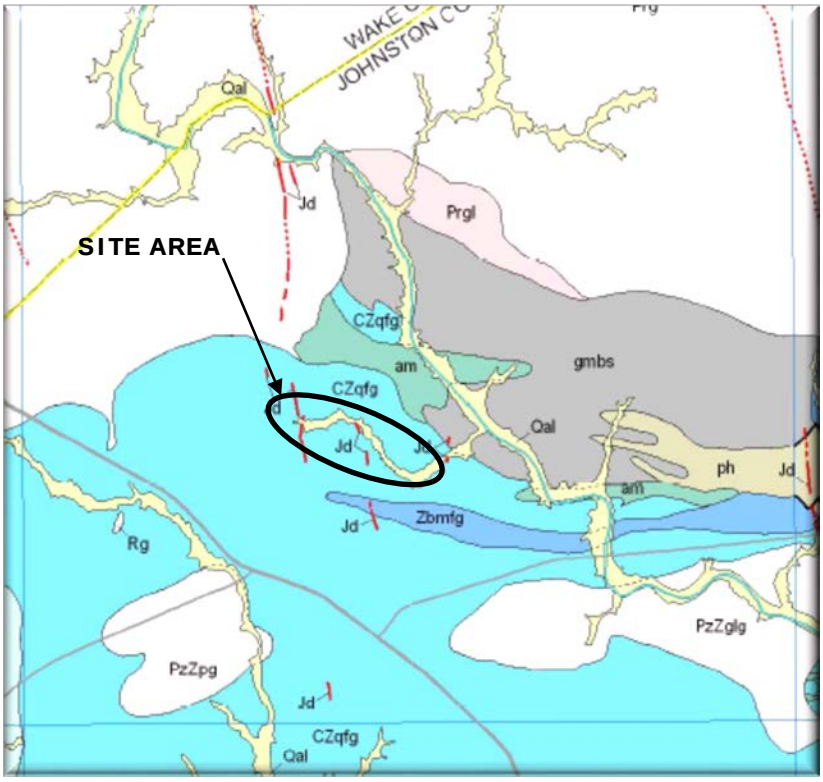
- Boardwalk 1 will be approximately 30 feet long and cross a delineated wetland beginning at approximate -L- Station 47+10. 10-foot spans only.
- Boardwalk 2 will be approximately 40 feet long and cross a small stream beginning at approximate -L- Station 52+25. 10-foot spans with 20-foot center span.
- Boardwalk 3 will be approximately 50 feet long and cross a delineated wetland beginning at approximate –L- Station 56+45. 10-foot spans only.
- Boardwalk 4 will be approximately 50 feet long and cross a delineated wetland beginning at approximate –L- Station 61+55. 10-foot spans only.
- Boardwalk 5 will be approximately 40 feet long and a small stream beginning at approximate –L- Station 65+45. 10-foot spans with 20-foot center span.
- Boardwalk 6 will be approximately 30 feet long and cross a small stream beginning at approximate –L- Station 71+20. 10-foot spans only.

1.2 Site Location and Generalized Description

The subject site is located in the just north of downtown Clayton, North Carolina. The trail will extend from Legend Park on City Road to an existing trailhead for Phase I of Sam's Branch Greenway on O'Neil Street. After traversing Legend Park, the trail will cross an earthen pond dam and then turn northeast at Lake Road into a wooded area. From Lake Road the trail is planned to extend to Sam's Branch Creek and cross it along the Peedin/Earp property boundary. Once on the Earp property, the trail will meander between open pasture and wooded segments to its termination at the Phase I trailhead. It should be noted that much of the alignment across the Earp property is along the same general corridor as an existing sanitary sewer easement (line to be installed in the future).

1.3 Geologic Area Overview

The project site is located within Clayton, North Carolina and lies near the eastern edge of the Piedmont Physiographic Province of the eastern United States. Review of the Preliminary Bedrock Geologic Map of the Raleigh 30' x 60' Quadrangle, North Carolina (compiled by T. W. Clark, D.E. Blake, E.F. Stoddard, P.A. Carpenter, III, and R.H. Carpenter, 2004) indicates that the site area is underlain by quartzofeldspathic gneiss and schist (CZqfg). Close to the creek the soils are typically classified as by Quaternary alluvium (Qal), which is material deposited by water during recent geologic time.



According to the aforementioned geologic map, and shown on the map excerpt above, the trail alignment crosses multiple mapped diabase (Jd) intrusion that generally trend north to south. Diabase in this area typically occurs in sills as well as dikes that can range from a few feet up to 100 feet wide. The diabase often weathers slower than the surrounding rock creating rounded boulders. When encountered during excavation, diabase generally requires hoe-ramming, blasting and/or hydraulic splitting to facilitate removal.

2 SUBSURFACE EXPLORATION

2.1 Field Testing

The subsurface conditions at Bridge 1 were evaluated with one soil test boring (B1-1), at the approximate location of End Bent 2. We were not granted access onto the Peedin Property so we were unable to perform a boring for End Bent 1. Boring B1-2 was advanced to an approximate depth of 44.3 feet below the current grade.

Subsurface conditions for three of the six boardwalks (Boardwalks 2, 5, and 6) were evaluated with one soil test boring apiece (BW2-1, BW5-1, and BW6-1). These soil test borings were advanced to depths ranging from approximately 18.6 feet to 24.9 feet below the existing ground surface. The subgrade conditions along proposed Boardwalk 1 were investigated with one hand auger boring (BW1-1) that was advanced to refusal at a depth of approximately 5.4 feet below the existing ground surface. Within each of the hand auger boring, the strength of the subgrade was evaluated using a Sowers-style dynamic-cone penetrometer (DCP) testing at approximate 1-foot intervals. Please note that Boardwalks 3 and 4 were added to the project after completion of the geotechnical fieldwork; however, both structures had trail borings (L-8 and L-9) in close proximity, which were used for the assessments of their foundations.

The subsurface conditions along the trail were evaluated with a total of eight soil test borings (L-1, L-2, and L-5 thru L-10) to depths ranging from approximately 8.8 feet to 10 feet below the current grade. The trail was also evaluated with two hand auger borings (L3 and L-4) to depths of approximately 14 to 36 inches below the current grade. Beside each of these hand auger borings, the strength of the subgrade was also evaluated using a dual-mass cone penetrometer (DMCP).

The soil test borings were advanced utilizing an ATV-mounted CME 550 drill rig utilized 2¼- inch hollow-stem, continuous flight augers in general accordance with ASTM D1586. At predetermined intervals, soil samples were obtained with a split-barrel sampler (standard 2-inch O.D.). The sampler was rested on the bottom of the borehole and driven to a penetration of 18 inches (or fraction thereof) with blows of an automatic 140-pound drop hammer falling 30 inches. Of the 18 inches, the number of hammer blows required to achieve 6 inches of penetration is recorded for three consecutive segments. The sum of the blow counts for the second and third 6-inch segment is termed the Standard Penetration Test (SPT) resistance, or N-value. The N-values referenced herein and shown on the support documents (i.e. logs, profiles, etc.) in the Appendices of this report are the actual, field-recorded blow counts and do not include correction factors for hammer energy or overburden soil pressures.

The soil and samples obtained during the drilling operations were placed in labeled containers and transported to our laboratory where they were visually-manually classified and logged by our geotechnical staff. The soil samples will be stored for two months before discarding.

The previously mentioned DMCP is a testing instrument consisting of a slender rod with a 60-degree conical tip and an interchangeable drop weight (10.1 lb or 17.6 lb). The DMCP is advanced in a continuous-drive process with blow counts recorded every two inches. The results of the DMCP are typically correlated to in-situ field condition California Bearing Ratio (CBR) values, which are used to design pavement.

The Sowers-style DCP used for this evaluation is a test instrument consisting of a slender rod with a 45-degree conical tip and an integrated 15-pound drop-hammer (20-inch drop height). The conical tip is driven through three 1¾-inch increments, unless tip refusal is encountered, and the hammer blow counts are recorded. The blow counts for the second and third increments are averaged to provide a

value that is used to judge the strength of the soil at that test depth. DCP values are typically correlated to standard penetration Test (SPT) N-values and/or a soil bearing capacity.

The Boring Logs, Hand Auger Logs, and DMCP Test Data Sheets are included in Appendix B of this report.

2.2 Subsurface Conditions

The following is a subsurface description of a generalized nature, provided to highlight the major soil strata encountered. The stratification of the subgrade materials illustrated on the logs represents the conditions at the actual test locations; therefore, variations should be expected between borings. Stratigraphy boundaries only represent the approximate depth/elevation of a noticed material change but the transition between material types is typically gradual. Also note that the elevations mentioned herein were interpolated from the available topographic data and should be considered approximate.

2.2.1 Trail

With the exception of borings L-1 and L-3, topsoil was encountered in each boring along the trail ranging in thickness approximately 2 to 10 inches. Boring L-1 encountered a 4-inch gravel layer at the surface.

Hand auger boring B-3 was performed on the existing earthen dam off of Lake Drive and encountered fill from the ground surface. The fill was comprised of Silty SAND (SM) and Fat CLAY (CH). The fill contained gravel, which prevent hand auger advancement deeper than 1.2 feet.

Alluvial was encountered in one of the 10 trail borings (L-8) to an approximate depths of 3 feet below the existing grade. The alluvial soil encountered consists of soft Sandy SILT (ML).

The residual soils encountered at ground surface generally consisted of very soft to firm Silty Fat CLAY (CH) and some stiff Clayey Elastic SILT (MH). Below these soils, and below the above-mentioned alluvium, the residual soils are general comprised of soft to hard Sandy SILT (ML) and medium dense Silty SAND (SM).

Weathered rock was encountered in three of the 10 trail borings (L-6, L-8, and L-9) at depths ranging from approximately 4.5 to 8 feet below the current ground surface. The weathered rock consists of schist.

Groundwater was encountered in three of the 10 trail borings (L-7, L-8, and L-10) at approximate depths ranging from 4.3 to 9 feet below the existing grade at the time of drilling.

2.2.2 Bridge 1

Bridge 1

The boring at End Bent 2 of Bridge 1 initially encountered approximately 6 inches of topsoil at the ground surface. Subsequently, alluvium was encountered to a depth of approximately 5.5 feet below the existing grade. The alluvium consisted of soft Sandy SILT (ML) over very loose, well-graded SAND (SW). Weathered rock (schist) was encountered beneath the alluvium at an approximate depth of 34.5 feet (el. 180.5 ft) below the current grade.

Groundwater was encountered at a depth of approximately 4 feet (el. 211 ft) below the ground surface after a stabilization period of 24+ hours.

2.2.3 Boardwalks

Boardwalk 1

The hand auger boring (BW1-1) performed for Boardwalk 1 initially encountered roughly 8 inches of topsoil. Below the topsoil, BW1-1 encountered alluvium to the refusal depth of approximately 5.4 feet below the existing grade. The alluvium consisted of Sandy Lean CLAY (CL) over Silty SAND (SM) with trace fine gravel.

Groundwater was encountered at an approximate depth of 1 foot below the ground surface in boring BW1-1 at the time of testing.

Boardwalk 2

Boardwalk 2 was explored with one soil test boring (BW2-1), which initially encountered a topsoil layer at the ground surface approximately 5 inches thick. Below the topsoil in boring BW2-1, very loose to loose alluvial Silty SAND (SM) extended to a depth of approximately 4.5 feet. The alluvial soil is underlain by residuum consist of stiff to very stiff Sandy SILT (ML). Weathered rock (schist) was encountered at approximate 12 feet below the current ground surface.

Groundwater was encountered during drilling at an approximate depth of 4 feet below the ground surface in boring BW2-1.

Boardwalk 3

Boardwalk 3 was added after our fieldwork was complete. As such, no borings were performed along its alignment. However, two of the trail borings (L-8 and L-9) were performed within a few hundred feet of the ends of the boardwalk and thus were are utilized in our analyses for Boardwalk 3.

Boring L-8 initially encountered 10 inches of topsoil over soft alluvial Sandy SILT (ML) that extends to approximately 3 below the existing grade. Residual soil consisting of dense Silty SAND (SM) was encountered below the alluvium and extends to weathered rock (schist) at approximately 6.5 feet below the current grade.

Boring L-9 initially encountered 5 inches of topsoil over firm residual Fat CLAY (CH) that extends to approximately 3 below the existing grade. Residual soil consisting of medium dense Silty SAND (SM) was encountered below the alluvium and extends to weathered rock (schist) at approximately 8 feet below the current grade.

Groundwater was encountered at an approximate depth of 5.7 feet below the ground surface in boring L-8 at the time of drilling.

Boardwalk 4

Boardwalk 4 was added after our fieldwork was complete. As such, no borings were performed along its alignment. However, one trail boring (L-9) was performed within a few hundred feet of the beginning of the boardwalk and thus was are utilized in our analyses for Boardwalk 4.

Boardwalk 5

Boardwalk boring BW5-1 encountered soft alluvial Silty SAND (SM) to a depth of approximately 3 feet below the current ground surface. Beneath the alluvial, boring BW5-1 encountered residuum consisting of very stiff to hard Sandy SILT (ML). Weathered rock (schist) was encountered beneath at an approximate depth of 12 feet below the existing grade.

Groundwater was encountered at a depth of approximately 12 feet below the ground surface in boring BW5-1 at the time of drilling.

Boardwalk 6

Boardwalk boring BW6-1 initially encountered a thin, 2-inch veneer of topsoil. Underlying the topsoil, alluvium consisting of loose to medium dense sand was encountered to a depth of approximately 5.5 feet below the existing grade. The alluvial soils were underlain by residuum to a depth of approximately 22 feet below the existing grade. The residual soils consisted of stiff to hard Sandy SILT (ML). Weathered rock (schist) was encountered at an approximate depth of 22 feet below the current grade.

Groundwater was encountered at an approximate depth of 22 feet below the ground surface at the time of drilling in boring BW6-1.

3 DESIGN RECOMMENDATIONS

3.1 Trail

3.1.1 Subgrade Preparation

Initially, all topsoil, vegetation, and any other unsatisfactory/deleterious materials should be removed from the proposed alignment for a lateral distance of at least 2 feet beyond the trail edges.

After stripping, the exposed subgrade soils should be scarified, moisture-conditioned to within ±3 percent of the material's optimum water content, and then compacted as required by Section 500 of the NCDOT Standard Specifications for Roads and Structures (SSRS). Fill selection and compaction requirements shall also be in accordance with the SSRS.

The subgrade should also be proofrolled using a tandem-axle dump truck weighing at least 15 tons to verify stability. Proofrolling should occur at three stages of trail construction – proofrolling of the existing grade prior to placing fill in low areas; proofrolling of the finished subgrade prior to stone base placement; and then proofrolling the stone base prior to paving. Proofrolling should be performed in the presence of the owner's testing agency so that recommendations can be provided for areas that perform poorly.

Based on the field data and our observations along the trail corridor, we expect that most of the existing surficial soils before Bridge 1 will provide a suitable base on which to construct the proposed trail. However, much of the trail alignment after the bridge exhibited a soft ground surface and/or ponded water that are expected to require repair. These areas are shown in Table 1 below.

Table 1: Anticipated Trail Repair Areas

Alignment	Approx. Begin Sta.	Approx. End Sta.	Approx. Length (ft)	Comments
-L-	43+00	47+10	410	Soft/wet ground
-L-	48+50	50+00	150	Soft/wet ground
-L-	54+00	56+45	245	Soft ground
-L-	61+00	61+45	45	Soft/wet ground
-L-	73+00	76+72	372	Soft ground

Note: The observations above were noted during our fieldwork in April/May 2015, during a dry period (no recent rain).

For repair of these areas, we recommend budgeting for 24 inches of undercut, backfilled with compacted ABC stone over a layer of geogrid (Tensar TX-160 or equivalent). Where applicable, the depth of undercut can be reduced if the conditions warrant and the owner's testing agency deems it acceptable. The undercut of unsuitable subgrade soils should extend a minimum of 2 feet laterally beyond the edge of asphalt.

It should be further noted that at-grade construction is heavily contingent of recent/current weather conditions. As such, construction in the wet season may render the trail's subgrade unsatisfactory for support as compared to the same subgrade in the drier season.

3.1.2 Asphalt Pavement

The flexible pavement design shown in Table 2 is based on the standard 20-year design life and the N.C. Department of Transportation Interim Pavement Design Procedure, 2000 (with 2007 updates). We have assumed that typical loading will consist of 10 maintenance vehicles (pick-up trucks) per week.

Table 2: Asphalt Pavement Section

Layer	Layer Thickness (in.)
Surface Course (S9.5B)	2
Aggregate Base Course (ABC)	8*

**The stone base can be reduced to 6 inches if a separation geotextile (NCDOT Type 4) or geogrid (Tensar TX5) is placed between the stone base and underlying subgrade soil.*

All materials and workmanship should comply with the NCDOT's Standard Specifications as it pertains to asphalt pavement. We also recommend using the sampling and testing criteria contained the Standard Specifications.

3.2 Bridge Foundation

Bridge 1 is a 60-foot long, single-span, prefabricated metal bridge beginning at approximate station 33+83 on –L- line. The bridge will span Sam's Branch Creek, which is the boundary between the Peedin property and the Earp Property. The bottom of cap (BOC) elevations for End Bents 1 and 2 are 207.97 feet and 208.27 feet, respectively, and will be supported by driven steel H-piles. The end bent loading conditions used in our foundation design are as shown in Table 3, which were provided by Stewart's in-house bridge designers. The standard NCDOT Foundation Recommendations and recommended Plan Notes are attached in Appendix D of this report.

Table 3: Bridge 1 Design Loads (Factored)

Condition	Max. Load per Pile (kips)
Axial*	61.7
Lateral	2.5 (transverse) 10.6 (longitudinal)

**Compression load. No uplift capacity needed.*

Please note that the minimum tip elevations in the attached recommendations are based on a design scour elevation (DSE) of 208 feet at both end bents. Also note that since we were unable to drill at End Bent 1, we have assumed the subsurface conditions below End Bent 1 are the same as those encountered below End Bent 2.

3.3 Boardwalk Foundations

This greenway will include eight boardwalks as discussed in Section 1.1.3 of this report. Each boardwalk will be designed to support moderate loads induced by ambulances and other vehicles/equipment up to 10,000 lb (AASHTO H5 loading). The boardwalks will consist of timber construction. Specific to the foundation, each bent will consist of two timber piles located approximately 8 feet center-to center with a timber cap. Standard design calls for plumb piles; however, some piles will require battering to resist lateral loading. Boardwalks will utilize 10-foot and/or 20-foot spans varying unsupported (above-grade) pile lengths. Based on information provided by Stewart's in-house bridge designers, the pile loading conditions (per pile) are as shown in Table 4.

Table 4: Boardwalk Design Loads (Factored), per pile*

Load	10-foot Span	20-foot Span
Axial - Compression, kips	9.2	14.2
Axial - Tension, kips	0.6	1.2
Lateral, kips	1.0	1.4

**Based on a 2-pile bent*

Table 5 presents the estimated pile embedment depths required for axial capacity when driven with small impact and vibratory hammers. Table 5 also indicates the minimum tip depths that plumb piles must reach in order to achieve the necessary lateral capacity. All provided depths are relative to the ground surface at the each pile location and scour has been ignored.

Table 5: Boardwalk Pile Depths

Condition	10-foot Span	20-foot Span
Boardwalk #1 (Max. 2 feet unsupported pile)		
Estimated Pile Depth, ft	11.5	n/a
Minimum Tip Depth, ft	12*	n/a
Boardwalk #2 (Max. 3.5 feet unsupported pile)		
Estimated Pile Depth, ft	11.5	12
Minimum Tip Depth, ft	12*	12
Boardwalk #3 (Max. 3 feet unsupported pile)		
Estimated Pile Depth, ft	6.5	n/a
Minimum Tip Depth, ft	9*	n/a
Boardwalk #4 (Max. 2 feet unsupported pile)		
Estimated Pile Depth, ft	7.5	n/a
Minimum Tip Depth, ft	10*	n/a

Table 5: Boardwalk Pile Depths (cont'd)

Condition	10-foot Span	20-foot Span
Boardwalk #5 (Max. 2.5 feet unsupported pile)		
Estimated Pile Depth, ft	11	12
Minimum Tip Depth, ft	11	11
Boardwalk #6 (Max. 2 feet unsupported pile)		
Estimated Pile Depth, ft	15	n/a
Minimum Tip Depth, ft	12	n/a

Please note that the required tip depths for Boardwalks 1 thru 4 are deeper than the anticipated driving refusal elevation (denoted by *). Where this condition is encountered, we recommend the following to achieve the necessary lateral and/or uplift capacity:

Boardwalks 1 and 2 – We recommend pile-excavation to the minimum tip depth in Table 5 or pile battering to driving refusal (not less than 8 feet embedded). For these structures pile excavation should be at least 2 inches smaller than the diameter of the pile to enable development of skin friction between the pile and surrounding soil.

Boardwalk 3 - We recommend pile-excavation to the minimum tip depth in Table 5 or battered pile excavation to a minimum depth of 6 feet below the ground surface. Pile excavation for Boardwalk 3 should be at least 6 inches larger than the largest pile diameter. The pile should be installed in the center of the excavation and the annulus should be tremie grouted from tip elevation. A minimum grout column of 6 feet should be placed to provide the necessary grout-to-ground bond for uplift resistance. The remainder of the annulus (if any) can be backfilled with pea gravel (#78 stone). Anchoring with helical piers is also a viable option to provide additional uplift for Boardwalk 3 if the NCDOT will allow their use. Helical piers to be designed by others.

Boardwalk 4 - We recommend pile-excavation to the minimum tip depth in Table 5 or pile battering to driving refusal (not less than 8 feet embedded). For this structure pile excavation should be at least 2 inches smaller than the diameter of the pile to enable development of skin friction between the pile and surrounding soil. If piles are battered to provide the lateral stability in leiu of pile excavation, a third pile per bent will be required to achieve the necessary uplift capacity. Anchoring with helical piers is also a viable option to provide additional uplift if the NCDOT will allow their use. Helical piers to be designed by others.

In order to establish the pile driving (blow count) criteria, the subsurface data herein and hammer submittal information should be used to perform a wave equation analysis of pile driving (WEAP). We recommend a pile driving resistance factor (φ) of 0.6 for the conditions encountered during our exploration and thus driving resistances of 15.5 kips and 24 kips should be used for piles supporting 10-foot and 20-foot spans, respectively.

The boardwalk piles can be advanced with impact or vibratory pile driving equipment; however, if piles are set with a vibratory hammer we recommend establishing a "refusal" criteria" or other means by which to verify that adequate pile capacity has been attained. This can be accomplished by correlating the vibratory penetration with drop hammer blows and/or PDA tests. Furthermore at least one pile within

each 100-foot segment of boardwalk must be struck with an impact hammer after vibratory installation to verify adequate capacity. However, please note that the testing agency reserves the right to have additional piles struck with the impact hammer.

Piles should be installed under continuous monitoring by a geotechnical engineer or representative thereof in order to make field judgments of pile penetration and to check for appropriate size, length, materials, splicing and defects. Piles should be monitored during driving for handling, location, plumbness, hammer performance, and penetration.

APPENDIX A

SITE AERIAL
BORING LOCATION DIAGRAMS

PROJECT REFERENCE NO.	SHEET NO.
H14009.00 (U-5530LB)	A1

SITE PLAN

PROJECT REFERENCE NO.	SHEET NO.
H14009.00 (U-5530LB)	A2

SITE PLAN

0 100 200

FEET

PKF

PKF

N14°10'23"E 133.39'

N14°58'49"E 175.69'

CITY ROAD
60' RIGHT OF WAY

APPROXIMATE LOCATION OF ANNEXATION LINE
PER CITY RECORDS (DB 2267, PG 629)

N/F
TOWN OF CLAYTON
PIN 166909073278
NO DEED BOOK FOUND
PB 1, PG 205

CENTERLINE OF SANTS BRANCH
IS THE PROPERTY LINE

TIMBER
7TREE
WF W/ ROPE
5'CLF
9TREE
INV=270.05'
8"PVC
INV=270.20'
3,5'CLF
GATE
BFP
WM
12'CLF
BUILDING
OVERHANG
FF=272,53'
FF=272.52'
FF=281.80'
WATER
FOUNTAIN
6" BRICK WALL
534.36'
EIP
EIP
BIKE PATH
N77°37'01"W 1677.63' TOTAL
INV=246.69'
EDGE OF WATER
L-1
L-2
L-3
1143.27'
(HA)
10+00
15+00
20+00
25+00
30PT
16TREE
23TREE
23TREE
26PT
13TREE
14TREE
11TREE
13TREE
11TREE
TREE
WV
14LI
16LI
14LI
12TREE
WWP
12LS
14LS
19PT
15LS
11LS
14LS
13LS
7LS
12LS
10LS
12LS
19PT
18PT
22PT
3TREE
7TREE
TTON SPINDLE
N/F
J.O. BOODSON HEIRS
PIN 166909063854
DB 432, PG 20
N/F
HARVEY B. GORDON
PIN 166909060338
NO DEED BOOK FOUND
N/F
TOWN OF CLAYTON
PIN 166909171164
NO DEED BOOK FOUND
PB 1, PG 205
N/F
HARVEY B. GORDON
PIN 166909161729
NO DEED BOOK FOUND
WF SF14
WF SF12
WF SF13
WF SF11
WF SF10
WF SF9
WF SF8
WF SF7
WF SF6
INV=229,90'
24"RCP
INV=230,12'
WF SF2
WF SF3
WF SF4
WF SF5
JS
N/F
TOWN OF CLAYTON
PIN 166909171164
NO DEED BOOK FOUND
PB 1, PG 205
BIKE PATH
WF WB12
WF WB11
WF WB10
WF WB9
WF WB8
WF WB7
WF WB6
WF WB5
WF WB4
WF WB3
WF WB2
LIMITS OF WETLAND STUDY
WF WC9
WF
INV=247.96'
RIM=249.00'
OUT=247.00'
ROCKS
EIP
4CF
MB
2CF
3CF
10LI
6CF
WM
EIP
N/F
HARVEY B. GORDON
PIN 166909163779
NO DEED BOOK FOUND
N/F
GERALD G.
PIN 1669
DB 3998

PROJECT REFERENCE NO.	SHEET NO.
H14009.00 (U-5530LB)	A3

SITE PLAN

0 100 200

FEET

N/F
ALLEN LESTER MIMS, JR
PIN 1659089911
DB 1141, PG 108

N/F
RAYMOND ELMORE EARP, JR. IRREVOCABLE TRUST
PIN 1669039384997
DB 3697, PG 735
PB 8, PG 73

N/F
TOWN OF CLAYTON
PIN 1669037117
NO DEED BOOK FOUND
PB 1, PG 205

N/F
EDNA S. PEEDIN
PIN 1669103693
DB 527, PG 89

N/F
EDNA S. PEEDIN
PIN 1669103693
DB 527, PG 89

N/F
EDNA S. PEEDIN
PIN 1669103693
DB 527, PG 89

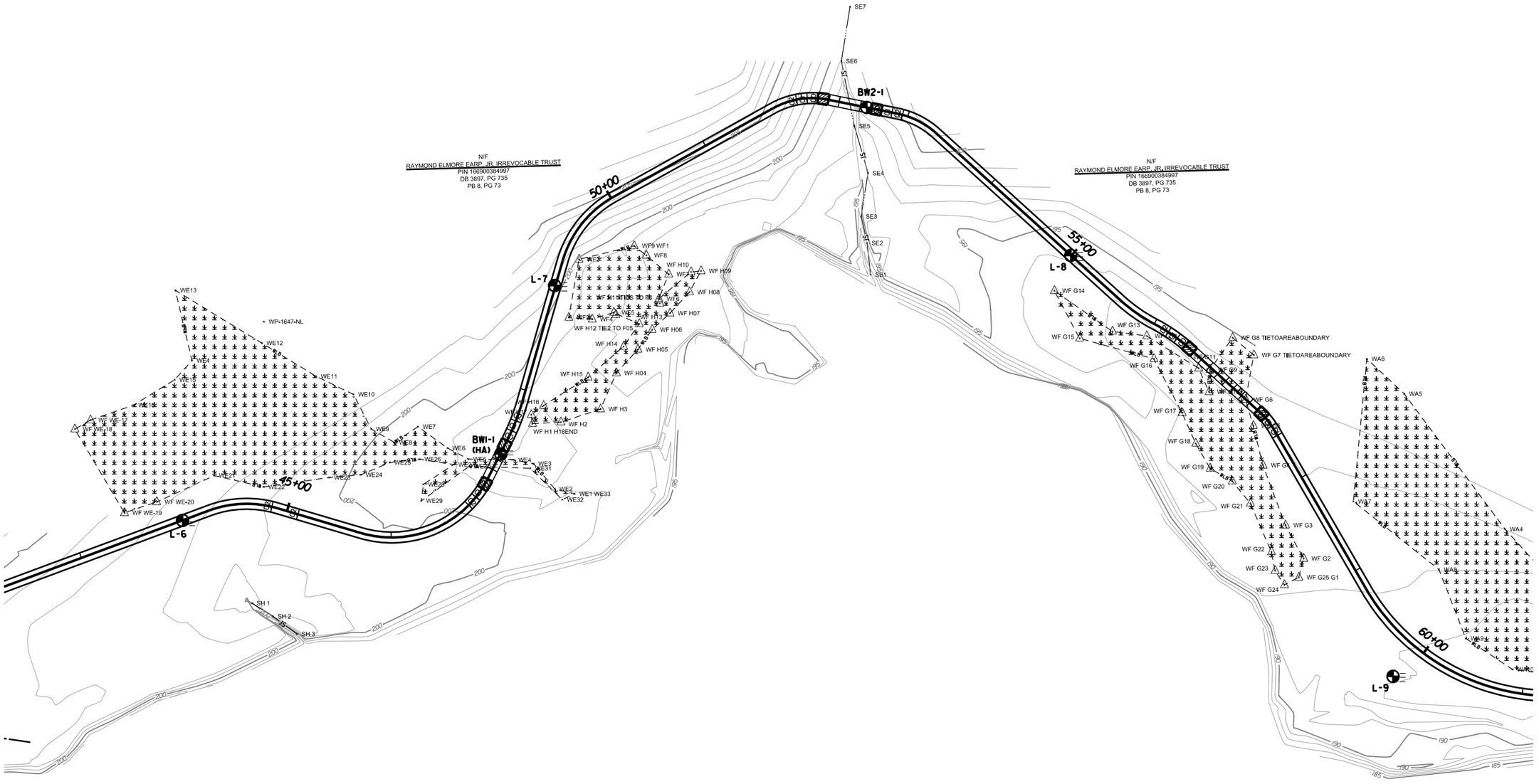
EIR
N87°33'03"E 132.30'
THIS LINE PER PB 8, PG 73
N00°26'57"W 126.60'
S68°43'05"W 128.80'
N81°48'57"W 868.00'
S00°26'57"E 581.40'
EIP
35+00
40+00
30+00
L-5
L-4
(HA)
+00
BIKE PATH
WOOD BOARDWALK
8'CLF
LIMITS OF WETLAND STUDY
WF WC1
WF WC2
WF WC3
WF WC4
WF WC5
WF WC6
WF WC7
WF WC8
WF WC9
WF WC10
WF WC11
WF WC12
WF WC13
WF WC14
WF WC15
WF WC16
WF WC17
WF C18
WF WC19
WF WC20
WF WC21
WF WC22
WF WC23 END
WF WD1
WF WD2
WF WD3
WF WD4
WF WD5
WF WD6
WF WD7
WF SG1
WF SG2
WF SG3
WF SG4
WF SG5

PROJECT REFERENCE NO.	SHEET NO.
H14009.00 (U-5530LB)	A4

SITE PLAN

0 100 200

FEET

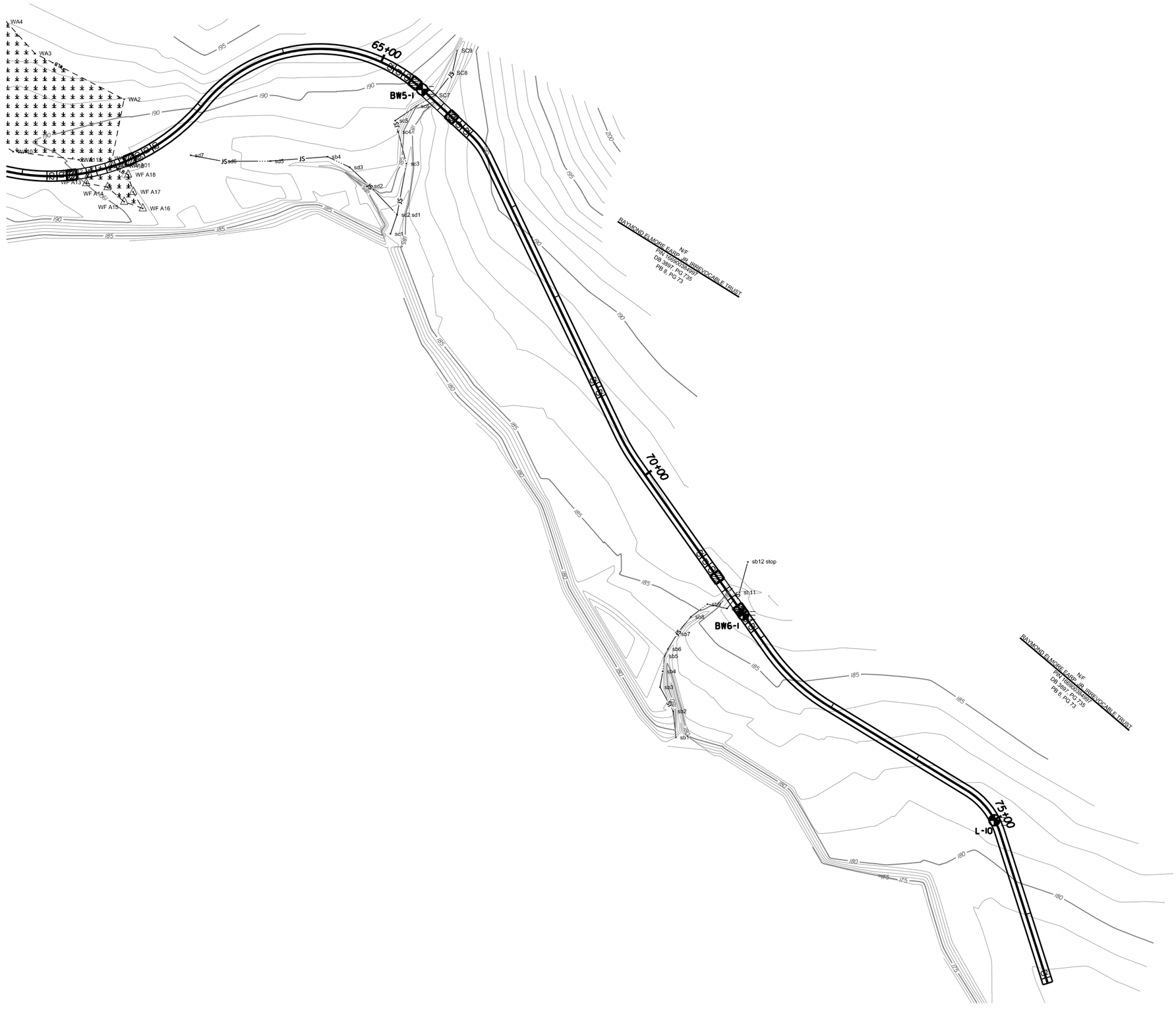


PROJECT REFERENCE NO.	SHEET NO.
H14009.00 (U-5530LB)	A5

SITE PLAN

0 100 200

FEET



APPENDIX B

BORING LOGS & HAND AUGER LOGS
LEGEND TO SOIL DESCRIPTIONS
DMCP TEST DATA

BORING LOG: B1-2

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/22/15 **LOGGED BY** EM
GROUND SURFACE EL. 212 ft **BORING DEPTH** 44.3 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 4 ft **CAVE-IN** 4 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.5	OL	**TOPSOIL**	211.5		.0	SS	1	1	
	ML	**ALLUVIAL:** SOFT, BROWN, SANDY SILT, MOIST			1.5			1 2	3
3.0			209.0						
	SW	VERY LOOSE, BROWN-TAN, GRAVELLY COARSE TO FINE SAND, TRACE SILT, SATURATED			3.5	SS	2	WOH WOH 1	1
5.5			206.5		5.0				
		RESIDUAL: FIRM TO VERY STIFF, BROWN-GRAY, MICACEOUS, SANDY SILT, WET			6.0	SS	3	1 2 3	5
					7.5				
					8.5	SS	4	2 2 3	5
					10.0				
					13.5	SS	5	8 4 6	10
					15.0				
	ML				18.5	SS	6	1 3 4	7
					20.0				
					23.5	SS	7	5 7 12	19
					25.0				
					28.5	SS	8	3 6 12	18
					30.0				
34.5			177.5		33.5	SS	9	13 23 50/3"	50/3"
		WEATHERED ROCK: SAMPLED AS GRAY-TAN, SANDY SILT (ML)			34.8				
	WR				38.5 39.0	SS	10	50/6"	50/6"
44.3			167.7		43.5 44.3	SS	11	23 50/4"	50/4"

BORING TERMINATED

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

HAND AUGER BORING LOG: BW1-1 (HA)

STEWART

PROJECT SAM'S BRANCH GREENWAY - PHASE II **CLIENT** TOWN OF CLAYTON

PROJECT NUMBER H14009.00 **LOCATION** CLAYTON, NC

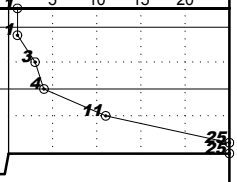
DATE 05/04/15 **LOGGED BY** EM **NOTES:**

GROUND ELEVATION 199 ft **BORING DEPTH** 5.4 ft

WL AT TIME OF AUGERING 1 ft

WL AFTER AUGERING FIAD

DEPTH (ft)	USCS SYMBOL	MATERIAL DESCRIPTION	ELEVATION (ft)	GWL (ft)	MOISTURE CONTENT(%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT(%)	DCP BLOW COUNTS	⊙ AVG DCP* (BPI) ⊙
0.7	OL	**TOPSOIL**	198.3	▽					1 1 2	
	CL	**ALLUVIAL:** BROWN, SANDY CLAY, TRACE ROOTS, WET							1 1 1	
3.0			196.0						3 3 4	
	SM	BROWN, SILTY MEDIUM TO FINE SAND, TRACE FINE GRAVEL, SATURATED							2 1 7	
5.4			193.6						8 10 12	
		AUGER REFUSAL							24 25 25	



BORING LOG: BW2-1

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/21/15 **LOGGED BY** EM
GROUND SURFACE EL. 198 ft **BORING DEPTH** 19.3 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 4 ft **CAVE-IN** 6.2 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.4	OL	**TOPSOIL**	197.7		.0	SS	1	1	
	SM	**ALLUVIAL:** VERY LOOSE TO LOOSE, BROWN, SILTY FINE SAND, TRACE ROOTS, MOIST TO SATURATED			1.5			1	2
		INCLUDES GRAVEL BELOW ~ 3 FT		▽ 194	3.5	SS	2	6	
4.5			193.5		5.0			7	14
	ML	**RESIDUAL:** STIFF TO HARD, BROWN, MICACEOUS, SANDY SILT, WET		191.8	6.0	SS	3	9	
					7.5			11	25
					8.5	SS	4	14	
12.0			186.0		10.0			3 9 25	34
	WR	**WEATHERED ROCK:** SCHIST - SAMPLED AS GRAY, SILTY FINE SAND (SM)			13.5	SS	5	13	
					14.5			50/6"	50/6"
19.3		BORING TERMINATED	178.7		18.5 19.3	SS	6	23 50/4"	50/4"

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: BW5-1

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/20/15 **LOGGED BY** EM
GROUND SURFACE EL. 189 ft **BORING DEPTH** 18.6 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 12.1 ft **CAVE-IN** 13 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
	ML	**ALLUVIAL:** SOFT, BROWN, SANDY SILT, TRACE ROOTS, MOIST			.0 1.5	SS	1	1 2 2	**4**
3.0			186.0						
	ML	**RESIDUAL:** VERY STIFF TO HARD, TAN TO BROWN, SANDY SILT, MOIST			3.5 5.0	SS	2	5 8 18	**26**
					6.0 7.5	SS	3	8 10 12	**22**
		WEATHERED ROCK FRAGMENTS BELOW ~ 8 FT			8.5 10.0	SS	4	18 18 17	**35**
12.0			177.0	▽ 176.9					
	WR	**WEATHERED ROCK:** SCHIST - SAMPLED AS TAN-GRAY, SANDY SILT (ML)		176	13.5 13.7	SS	5	50/2"	**50/2"**
18.6			170.4		18.5 18.6	SS	6	50/1"	**50/1"**
		BORING TERMINATED							

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: BW6-1

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/20/15 **LOGGED BY** EM
GROUND SURFACE EL. 186 ft **BORING DEPTH** 24.9 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 22 ft **CAVE-IN** 19.1 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.2	OL	**TOPSOIL**	185.8		.0	SS	1	2 2 2	4
	SM	**ALLUVIAL:** LOOSE TO MEDIUM DENSE, BROWN-ORANGE, SILTY MEDIUM TO FINE SAND, WITH TRACE MEDIUM GRAVEL, MOIST			1.5				
					3.5	SS	2	9 7 5	12
5.5			180.5		5.0				
		RESIDUAL: STIFF TO HARD, ORANGE-TAN, SANDY SILT, MOIST TO WET			6.0	SS	3	2 5 10	15
					7.5				
					8.5	SS	4	4 4 16	20
	ML				10.0				
					13.5	SS	5	9 11 15	26
					15.0				
				166.9	18.5	SS	6	31 40 32	72
					20.0				
22.0			164.0	164					
	WR	**WEATHERED ROCK:** SCHIST - SAMPLED AS BROWN, SANDY SILT (ML)			23.5	SS	7	20 36 50/5"	50/5"
24.9			161.1		24.9				
		BORING TERMINATED							

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: L- 1

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/17/15 **LOGGED BY** EM
GROUND SURFACE EL. 279 ft **BORING DEPTH** 10 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** DRY **CAVE-IN** 6.4 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.4	GW	**GRAVEL**	278.6						
3.0	MH	**RESIDUAL:** STIFF, RED-BROWN, CLAYEY ELASTIC SILT, MOIST	276.0		1.0 / 2.5	SS	1	4 5 7	**12**
	ML	STIFF TO SOFT, ORANGE-BROWN, SANDY SILT, WITH TRACE MICA, MOIST		272.6	3.5 / 5.0	SS	2	2 4 5	**9**
					6.0 / 7.5	SS	3	2 2 3	**5**
10.0		BORING TERMINATED	269.0		8.5 / 10.0	SS	4	2 2 2	**4**

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

STEWART

BORING LOG: L- 2

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/17/15 **LOGGED BY** EM
GROUND SURFACE EL. 264 ft **BORING DEPTH** 10 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** DRY **CAVE-IN** 7 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.2	OL	**TOPSOIL**	263.8		.0	SS	1	1 1 1	2
3.0	CH	**RESIDUAL:** VERY SOFT, ORANGE-BROWN, SILTY FAT CLAY, WITH ROOTS, WET	261.0		1.5				
	MH	STIFF, ORANGE-BROWN, CLAYEY ELASTIC SILT, WITH TRACE FINE SAND, MOIST			3.5	SS	2	3 5 8	13
8.0			256.0	257	5.0				
					6.0	SS	3	2 4 6	10
	ML	STIFF, PURPLE-ORANGE, SANDY SILT, MOIST			7.5				
10.0			254.0		8.5	SS	4	3 5 8	13
		BORING TERMINATED			10.0				

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

HAND AUGER BORING LOG: L- 3 (HA)

STEWART

PROJECT SAM'S BRANCH GREENWAY - PHASE II **CLIENT** TOWN OF CLAYTON

PROJECT NUMBER H14009.00 **LOCATION** CLAYTON, NC

DATE 05/04/15 **LOGGED BY** EM **NOTES:**

GROUND ELEVATION 247 ft **BORING DEPTH** 1.2 ft

WL AT TIME OF AUGERING DRY

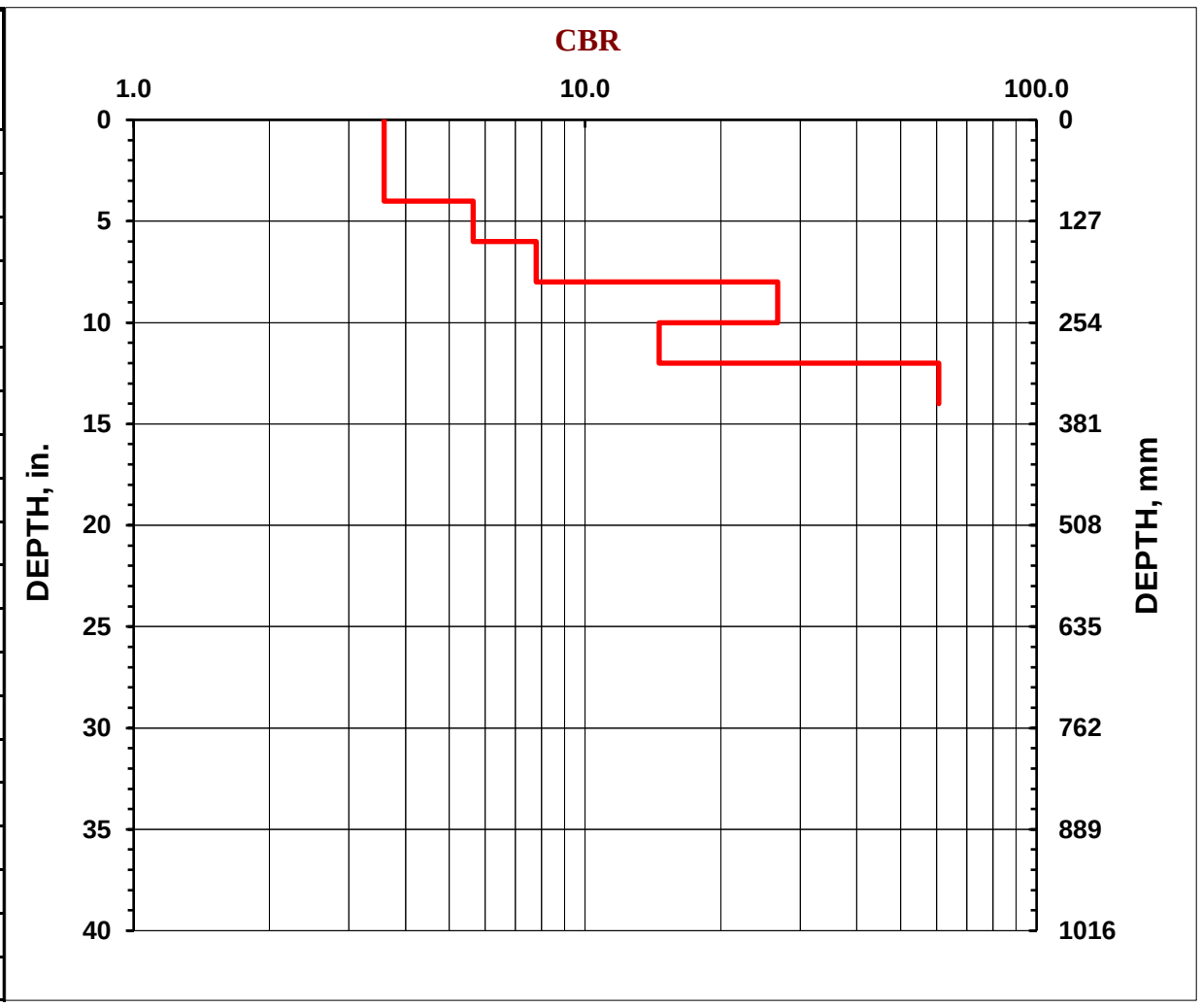
WL AFTER AUGERING FIAD

DEPTH (ft)	USCS SYMBOL	MATERIAL DESCRIPTION	ELEVATION (ft)	GWL (ft)	MOISTURE CONTENT(%)	ATTERBERG LIMITS		FINES CONTENT(%)
						LIQUID LIMIT	PLASTICITY INDEX	
0.7	SM	**FILL**: BROWN, SILTY SAND WITH TRACE GRAVEL AND ROOTS, MOIST	246.3					
1.2	CH	BROWN, SILTY FAT CLAY WITH TRACVE MICA AND SOME GRAVEL, MOIST	245.8					
		AUGER REFUSAL						

DUAL MASS CONE PENTROMETER (DMCP) TEST DATA

Project:	**SAM'S BRANCH GREENWAY**	**Test ID:**	**L-3**
Location:	**CLAYTON, NORTH CAROLINA**	**Station:**	**High plasticity Clay**
Client:	**TOWN OF CLAYTON**	**Date:**	**5/4/2015**

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
2	0	2
2	50.8	2
2	101.6	2
3	152.4	2
4	203.2	2
12	254	2
7	304.8	2
25	355.6	2



Hammer Type:
1 = 17.6 lb
2 = 10.1 lb

Top	Bottom	
0	0.7	**TOPSOIL**
0.7	1.2	**FILL:** BROWN SILTY CLAY, SOME MEDIUM TO FINE GRAVEL, TRACE ROOTS & MICA, MOIST
1.2		HAND AUGER REFUSAL.

HAND AUGER BORING LOG: L- 4 (HA)

STEWART

PROJECT SAM'S BRANCH GREENWAY - PHASE II **CLIENT** TOWN OF CLAYTON

PROJECT NUMBER H14009.00 **LOCATION** CLAYTON, NC

DATE 05/04/15 **LOGGED BY** EM **NOTES:**

GROUND ELEVATION 225 ft **BORING DEPTH** 3 ft

WL AT TIME OF AUGERING DRY

WL AFTER AUGERING FIAD

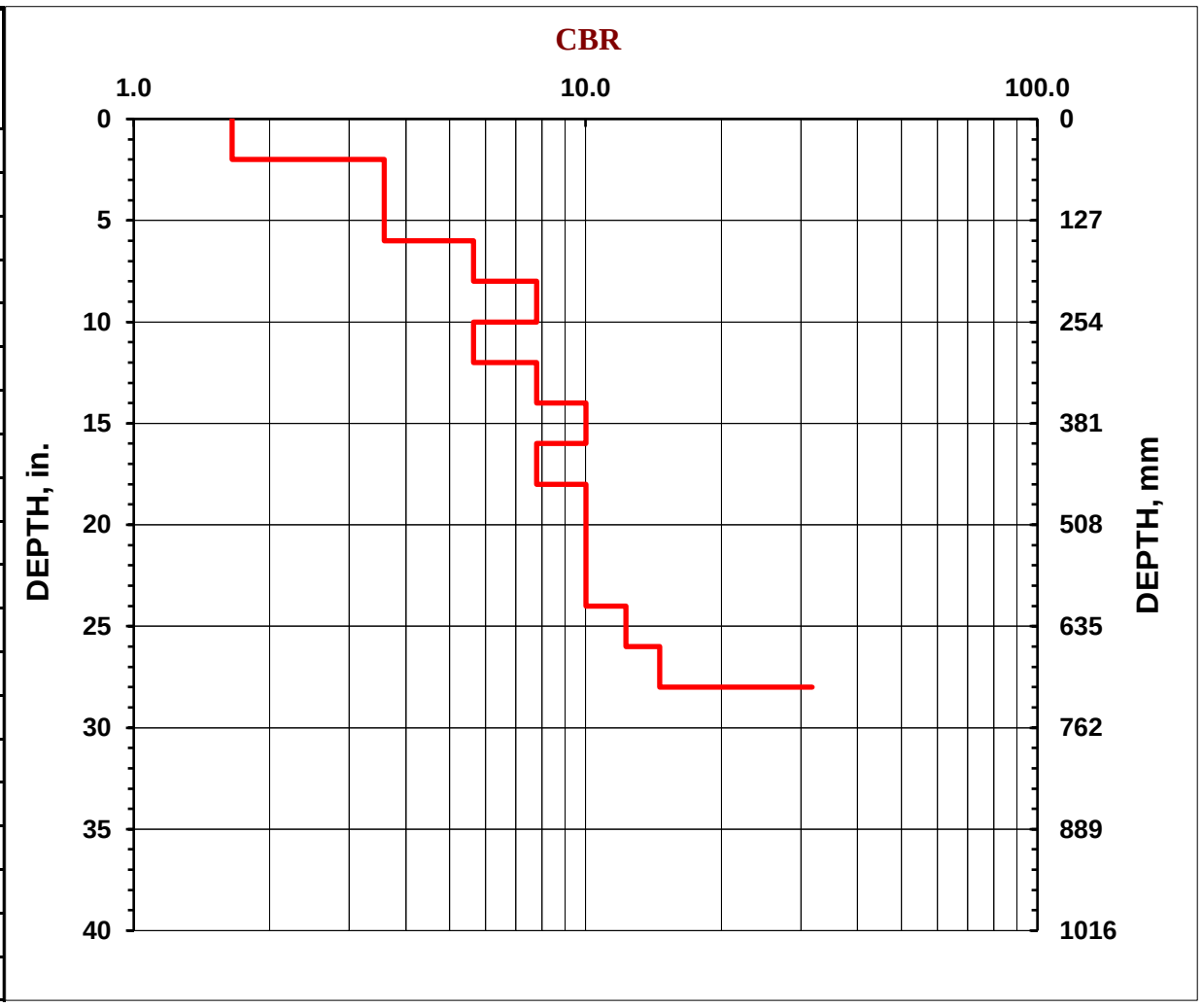
DEPTH (ft)	USCS SYMBOL	MATERIAL DESCRIPTION	ELEVATION (ft)	GWL (ft)	MOISTURE CONTENT(%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT(%)
0.5	OL	**TOPSOIL**	224.5					
	CH	**RESIDUAL**: ORANGE-BROWN, SILTY FAT CLAY WITH FINE SAND, MOIST						
3.0			222.0					
		BORING TERMINATED						

DUAL MASS CONE PENTROMETER (DMCP) TEST DATA

Project: SAM'S BRANCH GREENWAY
Location: CLAYTON, NORTH CAROLINA
Client: TOWN OF CLAYTON

Test ID: L-4
Station: High plasticity Clay
Date: 5/4/2015

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
2	0	2
1	50.8	2
2	101.6	2
2	152.4	2
3	203.2	2
4	254	2
3	304.8	2
4	355.6	2
5	406.4	2
4	457.2	2
5	508	2
5	558.8	2
5	609.6	2
6	660.4	2
7	711.2	2



Hammer Type:
1 = 17.6 lb
2 = 10.1 lb

Top	Bottom	
0	0.7	**TOPSOIL**
0.7	3	**RESIDUAL:** ORANGE BROWN SILTY CLAY (CH) WITH FINE SAND & ROOTS, MOIST
3		HAND AUGER TERMINATED.

STEWART

BORING LOG: L- 5

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/22/15 **LOGGED BY** EM
GROUND SURFACE EL. 208 ft **BORING DEPTH** 10 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** DRY **CAVE-IN** 6.9 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.4	OL	**TOPSOIL**	207.6		0	SS	1	1 2 2	4
3.0	CH	**RESIDUAL:** SOFT, ORANGE-GRAY, SILTY FAT CLAY, WITH FINE SAND, TRACE ROOTS, MOIST	205.0		1.5				
	ML	STIFF TO HARD, YELLOW, ORANGE, AND GRAY, MICACEOUS, SANDY SILT, WITH SOME MICA, MOIST		201.1	3.5 5.0	SS	2	2 5 7	12
					6.0 7.5	SS	3	5 5 7	12
10.0		BORING TERMINATED	198.0		8.5 10.0	SS	4	16 20 23	43

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: L- 6

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/22/15 **LOGGED BY** EM
GROUND SURFACE EL. 202 ft **BORING DEPTH** 8.8 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** DRY **CAVE-IN** 6 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.4	OL	**TOPSOIL**	201.6		0	SS	1	1 2 2	4
3.0	ML	**RESIDUAL:** SOFT, BROWN, SANDY SILT, WITH TRACE ROOTS, WET	199.0		1.5				
4.5	SM	TAN-GRAY, SILTY FINE SAND, MOIST	197.5		3.5	SS	2	10 7 50/5"	50/5"
8.8	WR	**WEATHERED ROCK:** SCHIST - SAMPLED AS GRAY, SILTY FINE SAND (SM)	193.2	196	4.9 6.0 6.5	SS	3	50/6"	50/6"
		BORING TERMINATED			8.5 8.8	SS	4	50/4"	50/4"

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

NOTE(S): STANDING WATER NEARBY.

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: L- 7

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

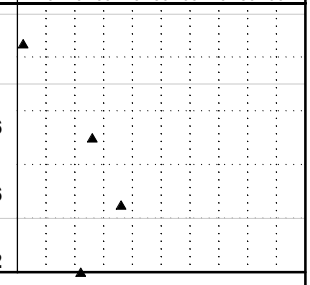
DATE DRILLED 04/21/15 **LOGGED BY** EM
GROUND SURFACE EL. 201 ft **BORING DEPTH** 10 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 4.3 ft **CAVE-IN** 9.6 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.4	OL	**TOPSOIL**	200.6		0.0	SS	1	2	
	CH	**RESIDUAL:** VERY SOFT, DARK BROWN, SILTY FAT CLAY, WITH TRACE MEDIUM TO FINE GRAVEL AND FINE SAND, WET			1.5			1	**2**
3.0			198.0					1	
	ML	VERY STIFF TO HARD, BROWN-ORANGE AND GRAY, MICACEOUS, SANDY SILT, WET		196.7	3.5	SS	2	4	
					5.0			10	**26**
					6.0	SS	3	16	
8.0			193.0		7.5			9	
								14	**36**
								22	
10.0	SM	MEDIUM DENSE, GRAY-BROWN, SILTY FINE SAND, WITH MICA, WET	191.0	191.4	8.5	SS	4	9	
					10.0			9	**22**
								13	

BORING TERMINATED

NOTE(S): STANDING WATER NEARBY.

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90



Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: L- 8

STEWART

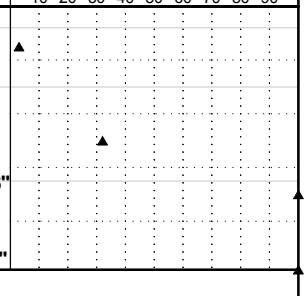
PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/21/15 **LOGGED BY** EM
GROUND SURFACE EL. 194 ft **BORING DEPTH** 9.8 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 5.7 ft **CAVE-IN** 6.9 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.8	OL	**TOPSOIL**	193.2		.0	SS	1	1 1 2	3
3.0	ML	**ALLUVIAL:** SOFT, BROWN, SANDY SILT, WITH ROOTS, MOIST	191.0		1.5				
6.5	SM	**RESIDUAL:** DENSE, ORANGE-BROWN, SILTY FINE SAND, WITH MICA, WET	187.5	▽ 188.3	3.5 5.0	SS	2	9 11 21	32
9.8	WR	**WEATHERED ROCK:** SCHIST - SAMPLED AS TAN, SILTY FINE SAND (SM)	184.2	187.1	6.0 7.0	SS	3	29 50/6"	50/6"
		BORING TERMINATED			8.5 9.8	SS	4	9 16 50/3"	50/3"

NOTE(S): STANDING WATER NEARBY.

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90



Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: L- 9

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/22/15 **LOGGED BY** EM
GROUND SURFACE EL. 191 ft **BORING DEPTH** 9 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** DRY **CAVE-IN** 6 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.4	OL	**TOPSOIL**	190.6		.0	SS	1	1 2 6	8
3.0	CH	**RESIDUAL:** FIRM, ORANGE, SILTY FAT CLAY, WITH FINE SAND, TRACE ROOTS, MOIST	188.0		1.5				
	SM	MEDIUM DENSE, TAN-GRAY, SILTY FINE SAND, WITH MICA, MOIST		185	3.5	SS	2	3 5 11	16
8.0			183.0		5.0 6.0	SS	3	10 11 16	27
9.0	WR	**WEATHERED ROCK:** SCHIST - SAMPLED AS GRAY, SILTY FINE SAND (SM)	182.0		7.5 8.5	SS	4	50/6"	**50/6"**
		BORING TERMINATED			9.0				

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90
PL MC LL
10 20 30 40 50 60 70 80 90
☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90

NOTE(S): STANDING WATER NEARBY.

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

BORING LOG: L-10

STEWART

PROJECT NAME SAM'S BRANCH GREENWAY - PHASE II
CLIENT TOWN OF CLAYTON
PROJECT NUMBER H14009.00
LOCATION CLAYTON, NC

DATE DRILLED 04/22/15 **LOGGED BY** EM
GROUND SURFACE EL. 182 ft **BORING DEPTH** 10 ft
DRILLING CONTRACTOR SOIL DRILLING SERVICES, INC.
TIME OF DRILLING: **WL** 9 ft **CAVE-IN** 6.7 ft
DRILLING METHOD H.S. AUGER **AUGER SIZE** 2-1/4 INCH
AFTER DRILLING: **WL** FIAD **CAVE-IN** FIAD
DRILL RIG CME 550 **HAMMER TYPE** AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE-IN (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)
0.3	OL	**TOPSOIL**	181.7		.0	SS	1	1	
	CH	**RESIDUAL:** VERY SOFT, GRAY, SILTY FAT CLAY, WITH TRACE FINE SAND AND ROOTS, WET			1.5			1 0	**1**
3.0			179.0						
	ML	VERY STIFF TO HARD, TAN-ORANGE, SANDY SILT, WITH WEATHERED ROCK FRAGMENTS AND TRACE CLAY, MOIST			3.5	SS	2	4 9 10	**19**
				175.3	5.0 6.0	SS	3	11 17 17	**34**
8.0			174.0		7.5				
10.0	SM	MEDIUM DENSE, TAN-BROWN, SILTY COARSE TO FINE SAND, WITH WEATHERED ROCK FRAGMENTS AND SOME CLAY, WET	172.0	173	8.5 10.0	SS	4	9 8 17	**25**

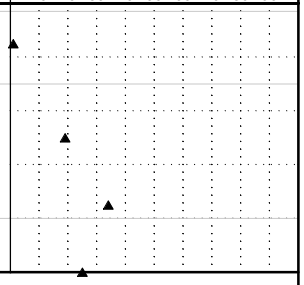
BORING TERMINATED

NOTE(S): SOFT/WET GROUND SURFACE.

▲ SPT N-VALUE (BPF) ▲
10 20 30 40 50 60 70 80 90

PL MC LL
10 20 30 40 50 60 70 80 90

☐ FINES CONTENT (%) ☐
10 20 30 40 50 60 70 80 90



Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

UNIFIED SOIL CLASSIFICATION (ASTM D-2487)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LOW PLASTICITY (LEAN) CLAY
			PI>4 AND PLOTS<"A" LINE	ML	LOW PLASTICITY SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	HIGH PLASTICITY (FAT) CLAY
			PI PLOTS <"A" LINE	MH	HIGH ELASTICITY SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

MATERIAL TYPES ENCOUNTERED ONSITE

- Alluvium (CL)
- Alluvium (ML)
- Alluvium (SM)
- Alluvium (SW)
- Fat Clay (CH)
- Fill - Fat Clay (CH)
- Fill - Silty Sand (SM)
- Gravel
- Elastic Silt (MH)
- Silt (ML)
- Silty Sand (SM)
- Topsoil / Organic Layer
- Weathered Rock

SAMPLE TYPES

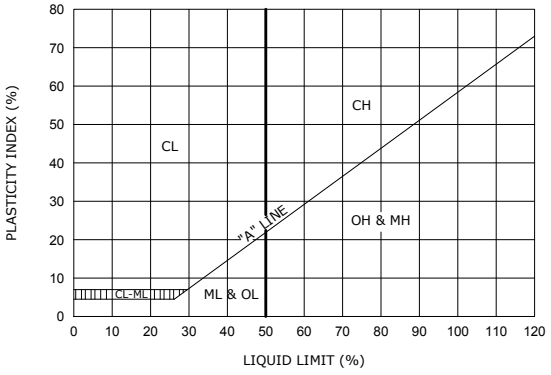
- DCP Test
- Split Spoon

ADDITIONAL ABBREVIATIONS, TERMS, & SYMBOLS

SPT	-	STANDARD PENETRATION TEST	DRY	-	REQUIRES WETTING TO REACH OPTIMUM
BPF	-	BLOWS PER FOOT	MOIST	-	AT OR NEAR OPTIMUM
PL	-	PLASTIC LIMIT	WET	-	REQUIRES DRYING TO REACH OPTIMUM
LL	-	LIQUID LIMIT	SAT	-	SATURATED, NEARLY LIQUID
MC	-	MOISTURE CONTENT	TRACE	-	< 5%
SS	-	SPLIT SPOON	FEW	-	5 - 10%
WL	-	WATER LEVEL	LITTLE	-	15 - 25%
USCS	-	UNIFIED SOIL CLASSIFICATION SYSTEM	SOME	-	30 - 45%
WOH	-	WEIGHT OF HAMMER			
WOR	-	WEIGHT OF RODS			
FIAD	-	FILLED IMMEDIATELY AFTER DRILLING			
EOD	-	END OF DAY			

- WATER LEVEL AT TIME OF DRILLING
- WATER LEVEL AFTER DRILLING (EG. 12 HR, 24 HR, EOD, ETC.)
- CAVE-IN LEVEL (AT LAST WL READING)

PLASTICITY CHART



PENETRATION RESISTANCE

(RECORDED AS BLOWS PER 6 IN.)

SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	UNDRAINED SHEAR STRENGTH (KSF)
VERY LOOSE	< 4	VERY SOFT	< 3	0 - 0.25
LOOSE	4 - 9	SOFT	3 - 4	0.26 - 0.50
MEDIUM DENSE	10 - 30	MEDIUM STIFF (FIRM)	5 - 8	0.51 - 1.0
DENSE	31 - 50	STIFF	9 - 15	1.1 - 2.0
VERY DENSE	> 50	VERY STIFF	16 - 30	2.1 - 4.0
		HARD	>30	> 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

STEWART

LEGEND TO SOIL DESCRIPTIONS

PROJECT NUMBER: H14009.00

APPENDIX C

SITE PHOTOGRAPHS

Photograph #1: Boardwalk 5 crossing.

Photograph #2: Wet/soft ground conditions in the vicinity of Boardwalk 4.

Photograph #3: Boardwalk 1 crossing.

Photograph #4: Boardwalk 2 crossing.

APPENDIX D

NCDOT FOUNDATION RECOMMENDATIONS

FOUNDATION RECOMMENDATIONS

PROJECT		DESCRIPTION	Bridge No. 1 on Sam's Branch
TIP NO.	U-5530LB		Greenway
COUNTY	Johnston		
STATION	34 + 13.00 -L-		

	INITIALS	DATE
DESIGN	DB	8/24/15
CHECK		

P.E. SEAL

SIGNATURE

	BENT STATION	FOUNDATION TYPE	FACTORED RESISTANCE	ADDITIONAL INFORMATION
END BENT 1	33 + 83.00 -L-	Cap on HP 12 x 53 Steel H-Piles	35 Tons/Pile	Bottom of Cap Elev. = 207.97 ft Average Estimated Pile Length = 45 ft Number of Piles/Cap = 3
END BENT 2	34 + 43.00 -L-	Cap on HP 12 x 53 Steel H-Piles	35 Tons/Pile	Bottom of Cap Elev. = 208.27 ft Average Estimated Pile Length = 45 ft Number of Piles/Cap = 3

(SEE NOTES ON PLANS AND COMMENTS ON FOLLOWING PAGES.)

Bridge No. 1 on Sam's Branch Greenway Johnston County

FOUNDATION RECOMMENDATIONS NOTES ON PLANS

1. FOR PILES, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.

2. PILES AT END BENT NOS. 1 AND 2 ARE DESIGNED FOR A FACTORED RESISTANCE OF 35 TONS PER PILE.

3. DRIVE PILES AT END BENT NO. 1 AND 2 TO A REQUIRED DRIVING RESISTANCE OF 60 TONS PER PILE. THIS REQUIRED DRIVING RESISTANCE INCLUDES ADDITIONAL RESISTANCE FOR DOWNDRAG AND SCOUR.

4. INSTALL PILES AT END BENT NOS. 1 AND 2 TO A TIP ELEVATION NO HIGHER THAN 180 FT.

5. THE SCOUR CRITICAL ELEVATION FOR END BENT NOS. 1 AND 2 IS ELEVATION 204 FT. SCOUR CRITICAL ELEVATIONS ARE USED TO MONITOR POSSIBLE SCOUR PROBLEMS DURING THE LIFE OF THE STRUCTURE.

6. TESTING PILES WITH THE PDA DURING DRIVING, RESTRIKING OR REDRIVING MAY BE REQUIRED. THE ENGINEER WILL DETERMINE THE NEED FOR PDA TESTING. FOR PDA TESTING, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS (AND FOR PILE DRIVING CRITERIA, SEE PILE DRIVING CRITERIA PROVISION).