REQUEST FOR STATEMENT OF QUALIFICATIONS

PWC2223039

Design-Build Services Line 54-Inch Outfall
Research Drive to I-95

Date of Issue: February 8, 2023
RFQ Deadline: March 14, 2023
2:00 p.m.

Direct all inquiries concerning this RFQ to:

Tanya Hazlett
Procurement Advisor
Tanya.hazlett@faypwc.com
910-223-1429

Contents

REQUEST FOR STATEMENT OF QUALIFICATIONS FOR DESIGN-BUILD SERVICES
LINE 54-INCH OUTFALL, RESEARCH DRIVE TO I-95
FAYETTEVILLE PUBLIC WORKS COMMISSION

In accordance with North Carolina General Statutes (NCGS) 143-64.31, the Fayetteville Public Works Commission (PWC) is seeking the services of a qualified Design-Builder (DB) to provide design and construction services for the following project (Project):

PURPOSE AND BACKGROUND

PWC owns and maintains a 47-year-old, 54-inch diameter reinforced concrete pipe (RCP) gravity sanitary sewer outfall that runs between the west side of US Route 301 and the Rockfish Creek Water Reclamation Facility. The Project involves the rehabilitation of a portion of the outfall between Research Drive and Interstate 95 (I-95) as shown in Figure 1 on Page 1 of Attachment A below. Previous closed-circuit television (CCTV) inspections indicate that this section of the outfall has significant hydrogen sulfide damage and needs rehabilitation. The outfall is located within an existing 50-foot-wide easement that runs along the north side of Rockfish Creek. Within this section of outfall, there is approximately 800 linear feet (LF) of a maintenance access road on the east side of I-95 that is not stable enough to support vehicular traffic. Additionally, this 800-foot portion includes approximately 200 LF of very unstable earth embankment. The 54-inch outfall is located within this embankment, and there is concern that the embankment could fail through erosion and utilization by maintenance vehicle traffic. Failure of this outfall would result in significant construction, environmental and social costs.

PWC retained Fleming and Associates (Fleming) to perform preliminary subsurface investigation and engineering services to evaluate bank and roadway conditions and develop options for bank stabilization and maintenance road improvements. Attachment A includes the following Reports:

- Report of Preliminary Subsurface Exploration and Geotechnical Evaluation Claude Lee Road – PWC Sewer Line (Building and Earth, April, 2021).
- Preliminary Engineering Report for Bank Stabilization and Access Roadway Stabilization at Rockfish Outfall (Fleming, October 28, 2021).

OBJECTIVE OF THE REQUEST

The Project scope includes but is not limited to the following: design and construction of bank stabilization measures; maintenance road drainage and grading; supplemental geotechnical investigations; establishing project access roads; borings under I-95 and Research Drive for by-pass pumping lines; lining approximately 4,000 LF of the sewer outfall between Research Drive and I-95.

The selected DB will be responsible for the following tasks:

- Project management and administration through project leadership and overall team coordination.
- Coordination between contractor, designer, sub-consultants, sub-contractors, outside agencies, and PWC.
- Identify opportunities for cost savings (i.e., value engineering).
- Project planning and scheduling.
- Survey the existing project location.

- Conduct geotechnical investigations to facilitate design of the needed repairs, beyond what is provided by PWC.
- Prepare design drawings of the proposed repairs, proposed bores under Research Drive and I-95, and the proposed rehabilitation of the outfall.
- Construction of the bores for bypass pumping.
- Rehabilitation of the 54-inch outfall utilizing a cured-in-place liner.
- Construction of the needed bank stabilization and associated access roads.
- Bypass pumping as needed to rehabilitate the existing outfall.
- Prepare necessary easement and encroachment maps.
- Constructability studies and reviews.
- Coordination of contract documents.
- Construction observation to verify the installation of the designed repairs.
- Provide record drawings and documents.

It is the intent of PWC to have the Project substantially complete by April 2027. The milestone completion dates are as follows:

- February 2026-Stabilize embankment and maintenance road improvements.
- February 2027-Lining the outfall.

The estimated budget for this work is $8,600,000.

Interested firms possessing the necessary qualifications and expertise to perform the scope of work outlined in the Project narrative are encouraged to submit a Statement of Qualifications for this project according to the following requirements.

GENERAL INFORMATION

- PWC shall not be held responsible for any oral instructions. Any changes to this Request for Qualifications (RFQ) will be in the form of a written addendum, which will be furnished to all registered RFQ holders.
- PWC reserves the right to reject any or all SOQ's, to waive any informality or irregularity in any SOQ received, and to be the sole judge of the merits of the respective SOQ received.
- The Design Build services shall be performed with one entity identified as the Design Builder. Services shall include all necessary activities to appropriately design the work and construct the Project. The contract will be divided into Phases, with Phase 1 being the agreement for the professional engineering services related to supplemental geotechnical investigations, site survey, design of the bank stabilization and maintenance road improvements, and bypass bores with the DB. PWC will enter into a contract for the design-build services. Upon mutual agreement with the DB, PWC and the DB will negotiate the scope, price, and special conditions for the construction phase.
- It is anticipated that the DB will consist of a general contractor and a professional engineering firm. Both firms shall be licensed in the State of North Carolina. The general contractor shall be a licensed utility contractor, with the following license classification:
  - Public Utilities – Water and Sewer: Unlimited.
  - Unclassified: Unlimited.
- The DB will be an integral member of the Project team consisting of the DB, representatives from PWC, and other consultants as required. It will be the responsibility of the DB to integrate the design and construction phases for developing the design,

conducting value engineering and constructability reviews, developing the Project schedules, preparing detailed construction cost estimates, studying labor conditions; and, in any other way deemed necessary, contributing to the development of the Project during each phase.

- The selected DB will be required to possess expertise in the following: structural, bank stabilization, by-pass boring, and roadway engineering design; bank stabilization construction; sheet pile wall construction; maintenance road improvements; installation of by-pass bores; sanitary sewer lining; easement acquisitions; and coordination with other agencies and/or contractors.
- The selected DB shall be prepared to provide the following services and must demonstrate expertise and past experience in providing these services in their submittal:
  - Design and construction of bank stabilization including sheet pile retaining walls.
  - Design and construction of bypass bore design via directional drilling and jack and bore methods.
  - Design and implementation of sanitary sewer lining.
  - Design and construction of road improvements (grading, drainage, retaining walls, stabilization, etc.).
  - Geotechnical investigations.
  - Surveying.
  - Value engineering.
  - Support PWC in completing easement acquisitions through preparation of maps for required easements, closure calculations, legal descriptions in word and pdf format.
  - Prepare required encroachment maps for submittal to NCDOT. Coordinate with NCDOT as needed for any necessary revisions and/or other requests for information.
- The DB assumes all design and construction risk and has direct authority over the sub-consultants and sub-contractors. The DB will act as the PWC's fiduciary and shall maintain a relationship of trust and confidence between itself and PWC. The Project will be an "open book" job whereby PWC may attend any and all meetings of the DB firm relating to the Project and have access to any and all books and records of the DB relating to the Project.
- The DB will assume all risk associated with delivering the Project and will be responsible for all construction means and methods.
- PWC's standards and details shall be incorporated into the design and shall be implemented during the construction phase. All plans shall be reviewed and approved by PWC prior to beginning construction.
- The successful DB firm shall be required to provide Performance and Payment Bonds under Article 3 of Chapter 44A of the North Carolina General Statutes in the amount of 100% of the contract amount.

RFQ SCHEDULE

Action	Responsibility	Date/Time
Mandatory Pre-Submittal Meeting	PWC/Vendors	Wednesday, February 22, 2023, 2:00 p.m.
Submit Written Questions	Vendors	Tuesday, February 28, 2023, 5:00 p.m.
Provide Response to Questions	PWC	Tuesday, March 7, 2023, 5:00 p.m.
Submit RFQ	Vendors	Tuesday, March 14, 2023, 2:00 p.m.
Award Contract	PWC	TBD

PRE-SUBMITTAL MEETING

A mandatory Pre-Submittal meeting will be held at **2:00 p.m., February 22, 2023**, in Conference Room 107, PWC Administration Building, 955 Old Wilmington Road, Fayetteville, North Carolina. PWC staff will discuss the scope of work, and general contract issues and respond to questions from the attendees. If you plan to respond to this RFQ as a Design-Build Team, consisting of two or more firms, a representative from each firm should be in attendance. Interested firms must email Tanya Hazlett, PWC Procurement Advisor at tanya.hazlett@faypwc.com of their intent to attend.

QUESTIONS

Questions regarding this Request for Qualifications shall be submitted in writing to the attention of Tanya Hazlett via e-mail to tanya.hazlett@faypwc.com, no later than **5:00 p.m., February 28, 2023**

QUALIFICATION STATEMENT REQUIREMENTS

The qualifications statement shall consist of the following information, tabbed as identified and in the order indicated below:

Section 1 – Letter of Transmittal (maximum of two (2) pages)

- Firm(s) name, year established, address, telephone number, fax number and contact person.
- Identify if the firm(s) is classified as a Disadvantaged Business Enterprise.
- Provide copies of Certificates of Insurance showing General Liability, Automotive, Worker's Compensation and Professional Liability Coverage (Certificate of Insurance will not count towards page limit). If two (2) or more firms are collaborating to form a Design-Build Team, then each individual firm shall meet the required insurance coverage.
- State any conflicts of interest your firm or any key individuals of the firm may have with the Project or PWC.
- Provide General Contractor's license number.

Section 2 – Personnel (20% of score)

- Specify professional qualifications of key management and staff personnel to be assigned to the Project. If two (2) or more firms are collaborating to form a Design-Build Team, then each firm shall provide the qualifications of key staff.
- Identify specialty, level of expertise, education, and any direct work experience on projects similar in scope to the one being proposed.

Note: Substitution of other personnel after the selection is made must be approved by PWC.

Section 3 –Contractors/Subcontractors (15% of score)

- Provide a list of licensed contractors, licensed sub-contractors, and licensed design professionals you propose to use on this project, OR provide your strategy for selecting

contractors and sub-contractors based on the requirements of Article 8 of Chapter 143 of the North Carolina General Statutes (competitive bidding procedures).

- The DB firm shall be required to certify that each licensed designer and sub-consultant who is a member of the Design-Build Team was selected based on "demonstrated competence and qualifications" under the qualifications-based selection process of the Mini-Brooks Act (N.C.G.S. 143-64.31).
- Provide a synopsis for each contractor or sub-contractor identified to be used on this project to include the size of staff, names of key personnel and services to be provided, as well as past experience. Specify the percentage of work anticipated to be attributed to these consultants.
- Identify any Disadvantaged Business Enterprises (DBE) or minority firms to be used.

Section 4 – Project and Project Management Experience (25% of score)

- Document expertise in those specific engineering and construction tasks and/or technologies required to successfully complete the scope of work associated with the Project.
- Provide a brief description of the firm's project management experience and style, including a description of quality control methods.
- Provide a brief description of similar projects completed in the last five (5) years.
- Provide names and contact numbers for references for similar projects.

Section 5 – Project Approach and Understanding (30% of score)

- Include a listing and description of each phase of the Project and identify key staff who will be assigned to each phase of the Project.
- Provide a proposed schedule for completing the work.
- Describe why your DB firm or Design-Build Team should be selected.

Ten percent (10%) of the submittal score will come from the firm's general qualifications including the completeness of the submittal, the firms operating history, insurance and licensing, and compliance with the RFQ requirements.

NOTE: The qualifications submittal shall be limited to the maximum number of one hundred (100) pages. This page limit includes the tabs and/or other dividers. Also, note that double-sided pages will be counted as two (2) pages. Failure to comply with the page limits will result in automatic disqualification of the submittal. The front and back cover and copies of Certificates of Insurance do not count towards the total page limit.

NOTE: No additional information regarding this project will be provided prior to the award. The interested DB shall focus their response to this RFQ on their qualifications to complete the work, and why they should be selected for the specific project.

SUBMISSION INSTRUCTIONS

A total of six (6) copies of the Statement of Qualifications are due in the PWC Procurement Office no later than 2:00 p.m., March 14, 2023.

Qualification packages should be mailed or delivered to:

Fayetteville Public Works Commission
Attention: Tanya Hazlett, Procurement Advisor
955 Old Wilmington Road
Fayetteville, North Carolina 28301

AWARDING OF PROJECTS

The Fayetteville Public Works Commission will consider and evaluate Statements of Qualifications in accordance with N.C.G.S. 143-128 and 143-64.31. Statements of Qualifications will be reviewed by a committee composed of PWC management and non-management personnel. Qualification packages will be ranked based on this review, which will consider the criteria as described above. PWC reserves the right to select one (1) or more DB to complete the Project and will attempt to negotiate a contract with the highest-ranked DB firm or Design-Build Team. Should the parties be unable to reach an agreement, the Fayetteville Public Works Commission reserves the right to continue scope and fee negotiations with the other firms, in order of their proposal rankings. PWC reserves the right to reject any or all submittals.

E-VERIFY

Consultant hereby acknowledges that "E-Verify" is the Federal E-Verify program operated by the US Department of Homeland Security and other Federal agencies which is used to verify the work authorization of newly hired employees pursuant to Federal law and in accordance with Article 2, Chapter 64 of the North Carolina General Statutes. Consultant further acknowledges that all employers, as defined by Article 2, Chapter 64 of the North Carolina General Statutes, must use E-Verify and after hiring an employee to work in the United States, shall verify the work authorization of the employee through E-Verify in accordance with North Carolina General Statutes §64-26(a). Consultant hereby pledges, attests, and warrants through execution of this Agreement that Consultant complies with the requirements of Article 2, Chapter 64 of the North Carolina General Statutes and further pledges, attests and warrants that any sub-consultants currently employed by or subsequently hired by Consultant shall comply with any and all E-Verify requirements. Failure to comply with the above requirements shall be considered a breach of this Agreement.

IRAN DIVESTMENT ACT

As mandated by North Carolina General Statute 147-86.59(a), Consultant hereby certifies that it is not listed on the Final Divestment List created by the North Carolina State Treasurer pursuant to North Carolina General Statute 147-86.58. Consultant further certifies that in accordance with North Carolina General Statute 147-86.59(b) that it shall not utilize any sub-consultant found on the State Treasurer's Final Divestment List. Consultant certifies that the signatory to this Contract is authorized by the Consultant to make the foregoing statement.

UTILIZATION OF SMALL BUSINESS CONCERNS

1) Definitions- As used in this contract –

a) HUBZone small business concern means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

b) Service-disabled veteran-owned small business concern –

i) Means a small business concern –

(1) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(2) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

ii) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16). Small business concern means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. Small disadvantaged business concern, consistent with 13 CFR 124.1002, means a small business concern under the size standard applicable to the acquisition, that –

iii) Is at least 51 percent unconditionally and directly owned (as defined at 13 CFR 124.105) by –

(1) One or more socially disadvantaged (as defined at 13 CFR 124.103) and economically disadvantaged (as defined at 13 CFR 124.104) individuals who are citizens of the United States; and

(2) Each individual claiming economic disadvantage has a net worth not exceeding $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

iv) The management and daily business operations of which are controlled (as defined at 13.CFR 124.106) by individuals, who meet the criteria in paragraphs (1)(i) and (ii) of this definition.

c) Veteran-owned small business concern means a small business concern –

i) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

ii) The management and daily business operations of which are controlled by one or more veterans.

d) Women-owned small business concern means a small business concern –

i) That is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

ii) Whose management and daily business operations are controlled by one or more women.

2) It is the policy of the United States that small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime Vendors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns.

3) The Vendor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Vendor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Vendor's compliance with this clause.

4) Vendors acting in good faith may rely on written representations by their subconsultants regarding their status as a small business concern, a veteran-owned small business concern, a service-disabled veteran-owned small business concern, a small disadvantaged business concern, or a women-owned small business concern.

5) The Vendor shall confirm that a subconsultant representing itself as a HUBZone small business concern is certified by SBA as a HUBZone small business concern by accessing the System for Award Management database or by contacting the SBA. Options for contacting the SBA include –

a) HUBZone small business database search application Web page at http://dsbs.sba.gov/dsbs/search/dsp_searchhubzone.cfm; or http://www.sba.gov/hubzone;

b) In writing to the Director/HUB, U.S. Small Business Administration, 409 3rd Street, SW., Washington DC 20416; or The SBA HUBZone Help Desk at hubzone@sba.gov.

ATTACHMENT A

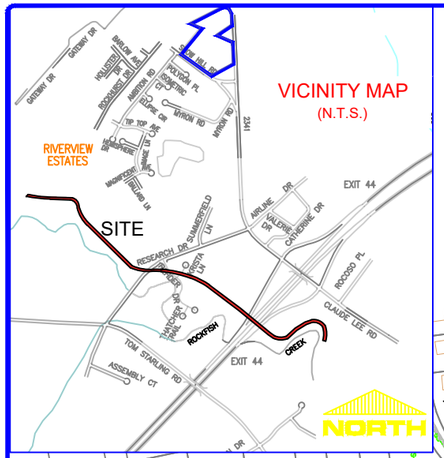
Figure F-1- Research to I-95 Project Scope

Report Of Preliminary Subsurface Exploration And Geotechnical Evaluation Claude Lee Road – PWC Sewer Line (Building and Earth, April, 2021).

Preliminary Engineering Report for Bank Stabilization and Access Roadway Stabilization at Rockfish Outfall (Fleming, October 28, 2021

*THIS DRAWING IS FOR REFERENCE PURPOSES ONLY AND IS NOT FOR CONSTRUCTION USE. SOME ITEMS ARE TO BE CONSIDERED NOT TO SCALE.

VICINITY MAP
(N.T.S.)



LEGEND

- PROPERTY LINE
- RIGHT OF WAY
- EX. SS MAIN
- EX. UTILITY EASEMENT
- PROP. TEMP. EASEMENT
- FENCE
- TREELINE
- PROPOSED BORES
- PROPOSED DRAINAGE
- PROPOSED NAIL WALL
- PROPOSED SHEET PILES
- ROAD IMPROVMENTS
- DISTURBED AREA
- EX. SSMH
- CREEK
- WORKING BENCH
- PROPOSED OUTFALL FOR CURED IN PLACE LINER

IMAGE LN
MAGNIFICENT AVE
BALLARD LN
SUMMERFIELD LN
CLAUDE LEE RD
PROPOSED NAIL WALL , SHEET PILE WALL & WORKING BENCH
PROPOSED TEMPORARY EASEMENTS
I-95 SOUTH
I-95 NORTH
SSMH
AREA OF BANK INSTABILITY
PROPOSED PERMANENT BYPASS DOUBLE CASING BORE
RESEARCH DRIVE
TRISTA LN
REHDER DR
THATCHER TRL
50' EXISTING PWC EASEMENT
ROCKFISH CREEK
STA. 64+00
PROJECT LIMITS
PROPOSED ROAD ACCESS IMPROVEMENTS WITH DRAINAGE SYSTEM
STA. 0+00
PROJECT LIMITS
(BEGIN BYPASS FOR LINING)
±4,000 LF OF 54" PROPOSED CURED IN PLACE LINER
TOM STARLING RD

GRAPHIC SCALE
200 0 100 200 400
(IN FEET)
HORIZ.: 1 inch = 200ft.
VERT.: 1 inch = N/Aft.

811 Know what's below. Call before you dig.

BY:
REVISIONS
DATE
SHEET SERIES:

DATE: 7/20/2022
SURVEY/QPS BY: FAYPWC
DRAWN BY: WDJ
CHECKED BY:
SCALE: HOR. 1"=200'
VERT. 1"= N/A

F1
1 OF 1

54" OUTFALL REHABILITATION
RESEARCH TO I-95 PROJECT SCOPE
FIGURE I

FAYETTEVILLE PUBLIC WORKS COMMISSION
WATER RESOURCES ENGINEERING
P.O. Box 1089, Fayetteville, NC 28302
955 Old Wilmington Road, Fayetteville, NC 28301

REPORT OF PRELIMINARY SUBSURFACE EXPLORATION
AND GEOTECHNICAL EVALUATION
CLAUDE LEE ROAD – PWC SEWER LINE
FAYETTEVILLE, NORTH CAROLINA
BUILDING & EARTH PROJECT NO.: **RD200783**

PREPARED FOR:
Fleming & Associates, PA

APRIL 23, 2021

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

610 Spring Branch Road
Dunn, North Carolina 28334
Ph: (910) 292-2085
www.BuildingAndEarth.com

April 23, 2021

Fleming & Associates, PA
1004 Hay Street
Fayetteville, North Carolina 28305

Attention: Mr. Steve Fleming, PE

Subject: Report of Preliminary Subsurface Exploration and Geotechnical Evaluation
Claude Lee Road – PWC Sewer Line
Fayetteville, North Carolina
Building & Earth Project No: RD200783

Mr. Fleming:

Building & Earth Sciences, LLP has completed an authorized preliminary subsurface exploration for the Fayetteville Public Works Commission's Claude Lee sewer line project located in Fayetteville, North Carolina.

The purpose of this preliminary exploration and evaluation has been to assess general subsurface conditions at the site and to address applicable geotechnical aspects of the proposed construction. Recommendations in this report are based on a physical reconnaissance of the site and observation and classification of subsurface samples recovered from sixteen (16) soil test borings drilled along the sewer alignment. Confirmation of anticipated subsurface conditions during construction is an essential part of geotechnical services.

We appreciate the opportunity to provide consultation services for the proposed project. If you have any questions regarding the information in this report or need any additional information, please call us.

Respectfully Submitted,

BUILDING & EARTH SCIENCES, LLP
North Carolina Firm Engineering License Number F-1081

NORTH CAROLINA PROFESSIONAL SEAL No. 24482 ENGINEER KURT A. MILLER

Nathan Anderson, E.I.T.
Staff Professional

Kurt A. Miller, P.E.
Regional Vice President

Malcolm D. Barrett, P.E., P.G. (VA)
Senior Geotechnical Engineer

Table of Contents

1.0 PROJECT & SITE DESCRIPTION

An existing (approximately 46-year-old) PWC (Fayetteville Public Works Commission) 54-inch RCP sewer pipeline lies to the south of Claude Lee Road and east of I-95 in Fayetteville, North Carolina The line runs parallel to Rockfish Creek. We understand that apparent signs of slope instability and surface erosion affecting the pipe have been observed in the past few years. To mitigate observed conditions, various options for stabilizing the site are under consideration, including:

1. Relocation of the line to a different location.
2. Re-building as a pile supported line along the same alignment and at the same depth, and
3. Stabilizing the slope below the existing line using a sheet pile retaining system.

Each of these are addressed, on a preliminary basis, in the following paragraphs.

In addition to the stabilization, a new roadway providing access along the pipeline, approximately from station 49+50 to 58+00, is required to facilitate repair of the existing line in this location.

Photographs depicting site layout and conditions are presented in the figures below.

Figure 1: Approximate Vicinity Map of Existing Sewer Line (Google Earth)

Figure 2: Site Conditions along ROW

Figure 3: Site Conditions along ROW

2.0 SCOPE OF SERVICES

Drilling for the authorized subsurface exploration was performed during the period February 25 through March 5, 2021 in conformance with our proposal RD22783R1, dated November 23, 2020. Occasionally some modification to work scopes appearing in our proposals is required to provide for proper evaluation of encountered subsurface conditions. Modification to the scope for this project has included performance of 10 additional moisture content tests for evaluation of subsurface moisture conditions. No other modifications to the work scope were required to complete this work.

The purpose of the geotechnical exploration has been to assess general subsurface conditions at specific boring locations and to gather data on which to base a preliminary geotechnical evaluation with respect to the project. Subsurface exploration for this project consisted of thirteen (13) soil SPT borings and three (3) Kessler DCP borings; soil classification has only been performed in the SPT borings. The site was drilled using a CME 550X ATV drill rig equipped with a manual hammer; DCP borings were performed with a hand auger and ASTM compliant dynamic cone penetrometer.

Soil boring sites were field located by a representative of our staff using a Garmin GPSmap 64. As such, boring positions appearing on the Boring Location Plan, attached to this report, should be considered approximate. A boring plan was provided to the client prior to commencement of field work.

Soil samples recovered during our site investigation were visually classified and specific samples were selected by the project engineer for laboratory analysis. The laboratory analyses consisted of:

Test	ASTM	No. of Tests
Natural Moisture Content	D2216	50
Atterberg Limits	D4318	16
Material Finer Than No. 200 Sieve by Washing	D1140	16
Unconfined Compression Test on Soil Samples	D2166	4

Table 1: Laboratory Testing Summary

Results of the laboratory analyses are presented on the attached Boring Logs and in tabular form in the report Appendix. Descriptions of laboratory tests that were performed are also included in the Appendix. Results of the field exploration and laboratory testing have been used to provide preliminary evaluation of:

- Pile support of a new pipeline along the alignment of the existing pipeline;
- Measures to address slope stability below the pipeline; and
- General recommendations for construction of a roadway to access the pipeline where it is to be repaired (approximately from station 49+50 to 58+00).

This report also provides or addresses:

- Summary of existing surface conditions.
- A description of the subsurface conditions encountered at the boring locations.
- Site preparation considerations including material types to be expected during grading as well as recommendations regarding handling and treatment of unsuitable soils, if encountered.
- Compaction requirements and recommended criteria to establish suitable surfaces for structural backfill.
- Boring logs detailing the materials encountered with soil classifications, penetration values, and groundwater levels (if measured).
- Presentation of laboratory test results.
- Recommendations for lateral earth pressure.
- Preliminary evaluation for pile depths to support the existing sewer.
- Recommendations to stabilize the subgrade soils for truck access.
- Recommendations for installation of drainage elements to collect and discharge surface water run-off down gradient of the right-of-way.
- A profile of the material encountered along the length of the force main.
- Plans and maps showing the location of the project and our onsite work

3.0 GEOTECHNICAL SITE CHARACTERIZATION

The following paragraphs are intended to provide a general characterization of the pipeline site from a geotechnical engineering perspective. It is not the intention of this report to address every potential geotechnical matter that may arise, nor to provide every possible interpretation of conditions identified. The following condition descriptions and subsequent geotechnical recommendations are based, in part, on the assumption significant changes in subsurface conditions do not occur between boreholes. However, anomalous conditions can occur due to variations in existing fill that may be present at the site, or due to natural variations in site geologic conditions. It will therefore be necessary to evaluate the assumed conditions during site grading and foundation installation.

3.1 GEOLOGY

Appearing on the USGS *Geologic Map of North Carolina*, the project site is situated within the Cape Fear Formation of the North Carolina Coastal Plain and is characterized by undivided, surficial soil deposits. These soils have been deposited over time as a result of erosion from rains and streams flowing toward the Atlantic Ocean. Per the literature, the general site area is underlain by sediments consisting of unconsolidated clay, silt, and sand, commonly with mica and feldspar. These soils were deposited in a fairly dynamic receding ocean environment which occurred during the Cenozoic (65 million years of age) era. Conditions encountered in borings drilled for this study generally correlate to the published geological information.

3.2 EXISTING SURFACE CONDITIONS

At the time of our field work, the site was described as situated in rolling terrain, with elevations in the work area vicinity ranging from about 76 to 132 feet NAVD (Google Earth Aerial Imagery). The existing sewer line lies in a cleared right-of-way parallel to Rockfish Creek. Other than the clear right-of-way, the site is heavily wooded. From review of historical aerial imagery, it appears the site has had the same general configuration since at least 1993.

3.3 SUBSURFACE CONDITIONS

A generalized stratification summary has been prepared using data from the soil test borings and is presented in the table below. The stratification depicts general soil conditions and stratum types encountered during our field investigation.

Stratum No.	Typical Thickness	Description	Consistency / Relative Density
1	14 in.	Topsoil	N/A
2	1.0 – 10.0 ft.	Fill – Silty Sand (SM), Poorly Graded Sand with Silt (SP-SM), Clayey Sand (SC)	Very Loose to Medium Dense
3	1.2 – 15.0 ft.	Clayey Sand (SC), Silty Sand (SM), and Poorly Graded Sand with Silt (SP-SM) [Coastal Plain]	Very Loose to Very Dense
4	1.5 – 14.5 ft.	Lean Clay (CL) and Sandy Lean Clay (CL) [Coastal Plain]	Medium Stiff to Hard
5	1.5 – 11.5 ft.	Fat Clay (CH) and Sandy Fat Clay (CH) [Coastal Plain]	Soft to Hard (Typically Very Stiff to Hard)

Table 2: Stratification Summary

Subsurface soil profiles have also been prepared using data obtained from specific borings. These are presented in the Appendix. For specific details regarding information obtained from individual soil borings, please refer to the Boring Logs included in the Appendix. Ground surface elevations at the boring sites, reported on the logs and throughout this report, were estimated using the Google Earth elevation tool.

3.3.1 TOPSOIL

Topsoil was only encountered in boring B-12, extending from the surface to a depth of approximately 14 inches. No testing has been performed to verify these soils meet requirements of "topsoil". Topsoil depths reported on the boring logs should only be considered an estimate as topsoil thickness may vary in unexplored portions of the site.

3.3.2 FILL – SILTY SAND (SM), POORLY GRADED SAND WITH SILT (SP-SM), CLAYEY SAND (SC)

Existing fill soils classified as silty sand (SM), poorly graded sand with silt (SP-SM), and clayey sand (SC) was observed in 12 SPT borings during subsurface exploration. Fill extends from the surface in these borings to depths of approximately 1.0 to 13.5 feet.

The fill soils are further described as very loose to medium dense, light to dark brown, fine to medium grained, and moist to wet, with common trace amounts of organics. SPT "N" values in this material range from 1 to 22, with values in the range of 2 to 6 blows per foot considered representative.

3.3.3 Clayey Sand (SC), Silty Sand (SM), and Poorly Graded Sand with Silt (SP-SM)

Naturally occurring Coastal Plain soils classified as clayey sand (SC), silty sand (SM), and poorly graded sand with silt (SP-SM) were encountered in 11 of the SPT borings, generally beginning below the fill layer. Soils in this layer are further described as very loose to very dense, brown to gray, fine to medium grained, and moist to wet. SPT N-values in the stratum range from 2 to 50+ blows per foot; low relative density soils (N≤10 for manual hammer) were encountered consistently within the upper 15 feet of the stratum in borings B-01, B-02, B-03, B-06, and B-15.

Wash 200 grain size and Atterberg limits tests were performed on six samples collected from this layer. The testing indicates 13 to 48 percent passing the #200 sieve, a liquid limit range of non-plastic to 37, and a plasticity index range of 22 to non-plastic. This material is classified SC, SM, or SP-SM in accordance with the USCS classification system.

3.3.4 Lean Clay (CL) and Sandy Lean Clay (CL)

In-situ cohesive soils classified as lean clay (CL) and sandy lean clay (CL) were observed in 9 SPT borings, typically splitting the SC/SM/SP-SM layer described above. SPT N-values in this soil layer range from 5 to 50+ blows per foot, with values above 15 considered representative. Soils of this stratum are further described as medium stiff to hard, gray to brownish yellow, fine grained, and dry to wet.

Laboratory classification testing was performed on three soil samples collected from this stratum. Testing indicates the soil has a liquid limit of 36 to 47 and a plasticity index of 20 to 24, with 52 to 88 percent passing the No. 200 sieve. These data correspond to a USCS CL classification.

3.3.5 Fat Clay (CH) and Sandy Fat Clay (CH)

Naturally occurring soils classified as fat clay (CH) and sandy fat clay (CH) were observed in 7 SPT borings, generally occurring beneath the CL or SC/SM/SP-SM layer described above and extending to depths of boring termination. These soils are further described as typically very stiff to hard, dark gray to dark red, dry to moist. Standard penetration test N-values in this material range from 3 to 50+ BPF, with values above 15 BPF considered representative. Laboratory classification testing was performed on two soil samples collected from this stratum. Testing indicates the soil has a liquid limit of 51 to 74, a plasticity index of 28 to 47, with 63 to 93 percent passing the No. 200 sieve. These data correspond to a USCS CH classification.

3.3.6 Auger Refusal

Auger refusal is the drilling depth at which a borehole can no longer be advanced using soil drilling procedures. Auger refusal can occur on hard soil, boulders, buried debris or bedrock. Coring is required to sample material below auger refusal. Auger refusal did not occur in borings drilled for this study; all borings were terminated at planned depths. It is noted borings drilled to 50 ft. depths (B-01 through B-05) encountered dense sand (N > 50) and hard clay (N > 30) were encountered at depths from about 17 to 38.5 feet below the surface (estimated elevations between 50 and 60 ft.). This stiff stratum is locally referred to as the Cape Fear formation.

3.3.7 Groundwater

Groundwater was encountered in 6 of the borings at time of drilling at depths ranging from 3 to 41 feet. Each borehole was left open at conclusion of drilling for 24 hours to measure stabilized groundwater depths. Groundwater was measured at depths 0 to 24.5 feet in 13 borings after 24 hours. All borings were backfilled after 24-hour measurements were taken. Groundwater data is summarized in the following table. Natural moisture content data suggests observed groundwater is "perched" in water bearing strata, and is not necessarily associated with either a local or a regional groundwater table. Water may also be associated with springs emanating from the adjacent hillside.

Boring No.	Depth at Time of Drilling (ft.)	Approximate Elevation ATD (ft.)	Stabilized Depth at 24-hours (ft.)	Approximate Elevation at 24-hours (ft.)
B-01	Not encountered	--	14.5	65.5
B-02	Not encountered	--	16.0	63.0
B-03	38.0	40.0	24.5	53.5
B-04	Not encountered	--	4.5	74.5
B-05	24.0	60.0	7.5	76.5
B-06	41.0	49.0	21.5	68.5
B-07	Not encountered	--	6.5	83.5
B-08	3.0	88.0	0.0	91.0
B-09	Not encountered	--	4.0	89.0
B-10	Not encountered	--	6.5	89.5
B-11	Not measured	--	Not measured	--
B-12	5.0	86.0	0.0	91.0
B-13	Not measured	--	Not measured	--
B-14	Not measured	--	Not measured	--
B-15	5.0	78.0	3.0	80.0
B-16	Not encountered	--	4.5	79.5

Table 3: Groundwater Observation Summary

4.0 SITE CONDITIONS AND SEWER LINE STABILIZATION CONSIDERATIONS

We understand the 54" RCP sewer line was constructed about 46 years ago within the previously described PWC right-of-way. In order to effect repairs to the pipeline, a roadway along the right-of-way will require repair and stabilization.

Slope instability is considered a factor in observed pipeline distress. According to plan EC4 prepared by PWC and dated April 24, 2019, slope instability occurs between station 57+00 and 60+00. PWC plans to repair the existing sewer line between manhole MH7 (sta. 46+29) and manhole MH9 (sta. 58+00). Epoxy lining is proposed as the initial repair method. Other than the proposed epoxy lining, prior to completion of any in-place stabilization measures slope stability analysis is recommended to evaluate the slope stability, and to identify the effects of instability on the proposed repair methods.

Under consideration are two measures to assure the pipeline is maintained in a long-term stable configuration. These are installation of a sheet pile retaining wall near the slope base, and support of a replacement pipeline (steel in place of RCP) on pile supported cradles that would not be affected by slope failure. Rigorous slope stability analysis is recommended prior to implementation of either of these measures.

4.1 ROADWAY STABILIZATION

In order to access the pipeline right-of-way, repairs to the existing roadway along the right of way will be required. Current conditions precluding roadway use are:

- Shallow water impoundment on the roadway surface, possibly associated with springs,
- Occasional very soft conditions that will not adequately support vehicle traffic,
- Sluffing of material from up-slope onto the roadway drive lane, thus blocking passage.

These conditions, while precluding use of the roadway, are considered minor and the result of relative neglect. In order to make for a stable and usable roadway, we make the following recommendations:

1. Initial repair should include dozing the roadbed, removal of excessive or large vegetation and grading areas where soil materials have blocked passage.

2. During initial grading, measures to keep runoff from leaving the down-slope side of the roadbed are recommended. This will keep roadway materials from eroding and washing downhill. Where possible, a roadside ditch or shallow swale should be placed along the uphill side of the roadway to manage storm and seepage water.
3. Where excessively soft zones in the resulting (post dozer and regrade) subgrade are encountered, stabilizing the roadbed with AASHTO No. 2 or No. 3 stone will likely result in a sufficiently stable condition for support of the roadway surface. Excessively soft zones can be stabilized with geogrid. Where used, geogrid should be overrlain by at least 12-inches of stone that is compatible with the grid selected. For instance, Tensar TX-190 geogrid should be used with AASHTO No. 2 or No. 3 stone, while Tensar TX-160 should be used with AASHTO No. 57 or ABC stone. The former is recommended for use in this application.
4. During the initial grading process, drains should be installed beneath the roadway to manage storm and seepage water that will accumulate on the uphill side of the roadway. Drains consisting of 4-inch perforated pipe embedded in an envelope of AASHTO No. 57 stone are recommended at 50 ft. intervals along and beneath the roadway. The drains should extend from the upslope side of the roadway to daylight on the downslope side, and should be hydraulically connected to the up-slope roadside ditches or swales. Stone envelopes should extend 4-inches around the piping on all sides, and the stone should be wrapped in non-woven filter fabric meeting the general specification of Mirafi type 140N fabric.
5. Following roadbed stabilization, a pavement section consisting of 6 to 8-inches of crushed ABC stone over geotextile fabric meeting the general specification of Mirafi RS380i is recommended.

4.2 General Slope Stability Analyses

Prior to selection of permanent pipeline stabilization measures, a thorough slope stability analysis is recommended in order to evaluate the effects of any long-term slope instability on the pipeline, post-repair. Stability analysis should include drilling of test borings in lines normal to the slope of the hill. Borings should be drilled to the relatively stiff strata (Cape Fear formation) described above at about 50 ft. intervals beginning 150 feet above the right of way and extending to the slope toe. Two lines of test borings, extending through zones suspected of being unstable, are recommended. We note that this will require extensive dozer work to access the boring sites.

Test borings should be located by survey methods in order to provide accurate information for slope modeling. Results of the stability analysis will then be used to develop recommendations for use in design of the pipeline stabilization measures.

4.3 Pile Supported Pipeline – General Recommendations

Under consideration is replacement of a portion of the existing pipeline with steel pipe supported on a driven pile system. The steel piping will be installed below grade, along the same alignment and at the same invert elevation as the existing line. The objective of the pile support system will be to provide support to the pipe in the event of a general slope failure.

Prior to implementation of this system, slope stability analysis is recommended to assess lateral loading that may be applied to the piles in the event of a general slope failure. Such a failure could result in extreme earth pressures on the pipe and piling system. Results of the stability analysis can then be used to estimate capacity requirements, both uplift and compression, on loaded piles.

For purposes of preliminary design, pile capacity estimates have been prepared. Estimates for typical 18-to-24-inch steel pipe piles, as well as HP12x53 piles have been evaluated. Estimated pile capacities with depth are summarized in Tables 4 through 7, below. Pile capacity calculations have been performed in accordance with FHWA Publication No. NHI-06-088.

Estimated Pile Capacities – 18 in. Pipe Piles		
Pile Depth (ft.)	Capacity (kips)	
	Ultimate	Recommended (FS=3)
10	19	6
12	57	19
14	69	23
16	74	24
18	79	26
20	94	31

Table 4: Estimated Pile Capacities by Depth (18" Pipe Pile)

Estimated Pile Capacities – 20 in. Pipe Piles		
Pile Depth (ft.)	Capacity (kips)	
	Ultimate	Recommended (FS=3)
10	26	8
12	64	21
14	82	27
16	89	29
18	97	32
20	105	35

Table 5: Estimated Pile Capacities by Depth (20" Pipe Pile)

Estimated Pile Capacities – 24 in. Pipe Piles		
Pile Depth (ft.)	Capacity (kips)	
	Ultimate	Recommended (FS=3)
10	44	14
12	78	26
14	109	36
16	118	39
18	129	43
20	140	46

Table 6: Estimated Pile Capacities by Depth (24" Pipe Pile)

Estimated Pile Capacities – HP12x53 H-Piles		
Pile Depth (ft.)	Capacity (kips)	
	Ultimate	Recommended (FS=3)
10	23	7
12	61	20
14	69	23
16	78	26
18	88	29
20	100	33

Table 7: Estimated Pile Capacities by Depth (HP12x53 H-Pile)

4.4 Sheet Pile and Tie-Back Slope Stabilization

A proposed method of providing stability to the slope where instability may affect the pipe line is installation of a sheet pile wall at the base of the slope (proximate to Rockfish Creek). At this writing, these plans are in a very preliminary stage.

If completed, the general plan would be to drive sheet piling to the relatively stiff/dense (Cape Fear) soil layers reported on the test boring logs. Data from the logs suggests these strata occur at elevations in the range 50 to 60 feet, which roughly corresponds to the elevation of Rockfish Creek, situated at the slope toe. Driving sheet piles into this formation will likely be difficult. Therefore, driving at some point above the creek will likely be required to provide purchase to for the pile tips. Lateral support can be improved though the use of tie-backs drilled and anchored into the stiff soil layers.

Additional test borings to evaluate conditions along proposed sheet pile wall alignments are recommended to develop geotechnical parameters for use in the retaining structure design. Also, loads on the wall should be estimated base upon slope stability analysis.

5.0 GENERAL SITE CONSTRUCTION RECOMMENDATIONS

General recommendations for use in planning pipeline repair are presented in the following paragraphs.

5.1 INITIAL SITE PREPARATION

Where new construction is planned, or where grade raise fill is to be placed, all trees, roots, topsoil and deleterious materials should be removed. In the area where an access road is to be constructed, it is recommended that vegetation be stripped. A geotechnical engineer should observe stripping and grubbing operations to confirm all unsuitable materials are removed from locations for proposed construction.

Materials disturbed during clearing operations should be stabilized in place or, if necessary, undercut to undisturbed materials and backfilled with properly compacted, approved structural fill.

During site preparation activities, the contractor should identify borrow source materials that will be used as structural fill and provide samples to the testing laboratory so that conformance to the Structural Fill requirements outlined below and appropriate moisture-density relationship curves can be determined.

5.2 Structural Fill

Requirements for structural fill on this project are as follows:

Soil Type	USCS Classification	Property Requirements	Placement Location
Sand and Gravel	GW, GP, GM, SW, SP, SM or combinations	Maximum 2" particle size	Areas where the material can be confined, and adequate drainage provided
Clayey/Silty Sand and Gravel	SM, SC, GC	LL<50, PI<25, γ_d>100 pcf	All areas – some confining condition may be required
Clay	CL, CH	N/A	Not recommended for use
Silt	ML, MH	N/A	Not recommended for use
On-site soils	SC, SM, SP-SM, CH, CL	As noted above.	SC, SM, SP-SM: Areas where the material can be confined, and adequate drainage provided CH, CL: Not recommended for use

Table 8: Structural Fill Requirements

Notes:

1. All structural fill should be free of vegetation, topsoil, and any other deleterious materials. The organic content of materials to be used for fill should be less than 3 percent.
2. LL indicates the soil Liquid Limit; PI indicates the soil Plasticity Index; γ_d indicates the maximum dry density as defined by the density standard outlined in the table below.
3. Laboratory testing of the soils proposed for fill must be performed in order to verify their conformance with the above recommendations.
4. Any fill to be placed at the site should be reviewed by the geotechnical engineer.

Placement requirements for structural fill are as follows:

Specification	Requirement
Lift Thickness	8" loose, 6" compacted
Density	98 Percent minimum per ASTM D-698
Moisture	For cohesive soil, ±2 percent of optimum moisture as defined by the above standard. For cohesionless soils with greater than 12 percent passing the US Standard No. 200 sieve, ±3 percent of optimum moisture as defined above. Moisture requirement is waived for cohesionless soils with less than 12 percent passing the No. 200 sieve.
Density Testing Frequency	1 test per 2,500 S.F., minimum 2 tests per lift

Table 9: Structural Fill Placement Requirements

5.2.1 GROUNDWATER AND DRAINAGE CONSIDERATIONS

Groundwater was encountered at stabilized depths ranging from near-surface to 24.5 feet. Groundwater will likely be encountered during construction, particularly during undercutting operations. It should further be noted that fluctuations in water levels could occur due to seasonal variations in rainfall. The contractor must be prepared to remove groundwater seepage from excavations if encountered during construction. Excavations extending below groundwater levels will require dewatering systems (such as well points, sump pumps or trench drains). The contractor should evaluate the most economical and practical dewatering method.

It is noted that cut slope faces will likely be susceptible to erosion. Additionally, the likelihood of surficial slides, sloughing, and shallow failures is greatly increased in areas where shallow groundwater is present. Water should not be allowed to pond at the toe or crest of cuts, nor should water be allowed to flow over slope faces. Interceptor ditches should be constructed at proper locations to promote the collection and removal of excess water. Recommended locations for interceptor and collection channels include the crest and the toe of the slopes and at benches within the slope, as applicable.

Permanent drains will likely be required in areas exhibiting continual seepage. The drains will serve to collect and remove water that continues to seep into the area and reduce the potential of water infiltrating subgrade soils.

6.0 CLOSING AND LIMITATIONS

This preliminary report was prepared for Fleming & Associates, for specific application to the Claude Lee Road PWC Sewer Line located in Fayetteville, North Carolina. The information in this report is not transferable. This report should not be used for a different development on the same property without first being evaluated by the engineer.

The recommendations in this report were based on the information obtained from our field exploration and laboratory analysis. The data collected is representative of the locations tested. Variations are likely to occur at other locations throughout the site. Engineering judgment was applied in regards to conditions between borings. It will be necessary to confirm the anticipated subsurface conditions during construction.

This report has been prepared in accordance with generally accepted standards of geotechnical engineering practice. No other warranty is expressed or implied. In the event that changes are made, or anticipated to be made, to the nature, design, or location of the project as outlined in this report, Building & Earth must be informed of the changes

and given the opportunity to either verify or modify the conclusions of this report in writing, or the recommendations of this report will no longer be valid.

The scope of services for this project did not include any environmental assessment of the site or identification of pollutants or hazardous materials or conditions. If the owner is concerned about environmental issues Building & Earth would be happy to provide an additional scope of services to address those concerns.

This report is intended for use during design and preparation of specifications and may not address all conditions at the site during construction. Contractors reviewing this information should acknowledge that this document is for design information only.

An article published by the Geoprofessional Business Association (GBA), titled *Important Information About Your Geotechnical Report*, has been included in the Appendix. We encourage all individuals to become familiar with the article to help manage risk.

Appendix Table of Contents

GEOTECHNICAL INVESTIGATION METHODOLOGIES

The subsurface exploration, which is the basis of the recommendations of this report, has been performed in accordance with industry standards. Detailed methodologies employed in the investigation are presented in the following sections.

DRILLING PROCEDURES – STANDARD PENETRATION TEST (ASTM D1586)

At each boring location, soil samples were obtained at standard sampling intervals with a split-spoon sampler. The borehole was first advanced to the sample depth by augering and the sampling tools were placed in the open hole. The sampler was then driven 18 inches into the ground with a 140-pound manual hammer free-falling 30 inches. The number of blows required to drive the sampler each 6-inch increment was recorded. The initial increment is considered the "seating" blows, where the sampler penetrates loose or disturbed soil in the bottom of the borehole.

The blows required to penetrate the final two (2) increments are added together and are referred to as the Standard Penetration Test (SPT) N-value. The N-value, when properly evaluated, gives an indication of the soil's strength and ability to support structural loads. Many factors can affect the SPT N-value, so this result cannot be used exclusively to evaluate soil conditions.

Samples retrieved from the boring locations were labeled and stored in plastic bags at the jobsite before being transported to our laboratory for analysis. The project engineer prepared Boring Logs summarizing the subsurface conditions at the boring locations.

DUAL MASS DYNAMIC CONE PENETRATION TESTING (KESSLER DCP)

Dynamic Cone Penetration (DCP) tests were performed to estimate the in-place soil consistency and in-place California Bearing Ratio (CBR) of the subsurface soils by in-situ methods.

The DCP tests were performed starting at the top of existing subgrade to the desired depth of investigation. The DCP test was performed using the Kessler DCP with Dual Mass Hammer. A cone tip with base diameter of 0.79 inches and tip angle of 60 degrees was driven into the

UNDISTURBED SAMPLING

Soil samples are obtained using Shelby tube samplers. The Shelby tube is a three (3) inch diameter, thin walled sampling tube that allows for relatively undisturbed sampling of soil. The undisturbed or thin-walled tube sampling is conducted in general accordance with ASTM D1587. The sampling procedure consists of augering to the sample depth, then cleaning out the open borehole and continuously pushing the thin-walled, metal Shelby tube into the soil. The Shelby tubes are carefully withdrawn from the borehole to reduce the possibility of disturbing the sample. The ends of the Shelby tube are sealed in the field and the tubes are transported to the laboratory for testing.

BORING LOG DESCRIPTION

Building & Earth Sciences, Inc. used the gINT software program to prepare the attached boring logs. The gINT program provides the flexibility to custom design the boring logs to include the pertinent information from the subsurface exploration and results of our laboratory analysis. The soil and laboratory information included on our logs is summarized below:

DEPTH AND ELEVATION

The depth below the ground surface and the corresponding elevation are shown in the first two columns.

SAMPLE TYPE

The method used to collect the sample is shown. The typical sampling methods include Split Spoon Sampling, Shelby Tube Sampling, Grab Samples, and Rock Core. A key is provided at the bottom of the log showing the graphic symbol for each sample type.

SAMPLE NUMBER

Each sample collected is numbered sequentially.

BLOWS PER INCREMENT, REC%, RQD%

When Standard Split Spoon sampling is used, the blows required to drive the sampler each 6-inch increment are recorded and shown in column 5. When rock core is obtained the recovery ration (REC%) and Rock Quality Designation (RQD%) is recorded.

SOIL DATA

Column 6 is a graphic representation of four different soil parameters. Each of the parameters use the same graph, however, the values of the graph subdivisions vary with each parameter. Each parameter presented on column 6 is summarized below:

- N-value- The Standard Penetration Test N-value, obtained by adding the number of blows required to drive the sampler the final 12 inches, is recorded . The graph labels range from 0 to 50.
- Qu – Unconfined Compressive Strength estimate from the Pocket Penetrometer test in tons per square foot (tsf). The graph labels range from 0 to 5 tsf.
- Atterberg Limits – The Atterberg Limits are plotted with the plastic limit to the left, and liquid limit to the right, connected by a horizontal line. The difference in the plastic and liquid limits is referred to as the Plasticity Index. The Atterberg Limits test results are also included in the Remarks column on the far right of the boring log. The Atterberg Limits graph labels range from 0 to 100%.
- Moisture – The Natural Moisture Content of the soil sample as determined in our laboratory.

SOIL DESCRIPTION

The soil description prepared in accordance with ASTM D2488, Visual Description of Soil Samples. The Munsel Color chart is used to determine the soil color. Strata changes are indicated by a solid line, with the depth of the change indicated on the left side of the line and the elevation of the change indicated on the right side of the line. If subtle changes within a soil type occur, a broken line is used. The Boring Termination or Auger Refusal depth is shown as a solid line at the bottom of the boring.

GRAPHIC

The graphic representation of the soil type is shown. The graphic used for each soil type is related to the Unified Soil Classification chart. A chart showing the graphic associated with each soil classification is included.

REMARKS

Remarks regarding borehole observations, and additional information regarding the laboratory results and groundwater observations.

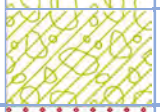
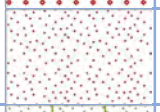
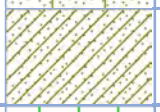
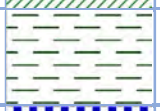
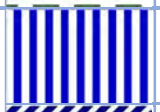
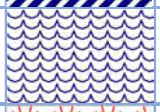
Major Divisions			Symbols		Group Name & Typical Description
			Lithology	Group	
Coarse Grained Soils *More than 50% of material is larger than No. 200 sieve size*	**Gravel and Gravelly Soils** *More than 50% of coarse fraction is larger than No. 4 sieve*	**Clean Gravels** *(Less than 5% fines)*		**GW**	*Well-graded gravels, gravel – sand mixtures, little or no fines*
				**GP**	*Poorly-graded gravels, gravel – sand mixtures, little or no fines*
		Gravels with Fines *(More than 12% fines)*		**GM**	*Silty gravels, gravel – sand – silt mixtures*
				**GC**	*Clayey gravels, gravel – sand – clay mixtures*
	Sand and Sandy Soils *More than 50% of coarse fraction is smaller than No. 4 sieve*	**Clean Sands** *(Less than 5% fines)*		**SW**	*Well-graded sands, gravelly sands, little or no fines*
				**SP**	*Poorly-graded sands, gravelly sands, little or no fines*
		Sands with Fines *(More than 12% fines)*		**SM**	*Silty sands, sand – silt mixtures*
				**SC**	*Clayey sands, sand – clay mixtures*
Fine Grained Soils *More than 50% of material is smaller than No. 200 sieve size*	**Silts and Clays** *Liquid Limit less than 50*	**Inorganic**		**ML**	*Inorganic silts and very find sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity*
				**CL**	*Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays*
		Organic		**OL**	*Organic silts and organic silty clays of low plasticity*
	Silts and Clays *Liquid Limit greater than 50*	**Inorganic**		**MH**	*Inorganic silts, micaceous or diatomaceous fine sand, or silty soils*
				**CH**	*Inorganic clays of high plasticity*
		Organic		**OH**	*Organic clays of medium to high plasticity, organic silts*
Highly Organic Soils				**PT**	*Peat, humus, swamp soils with high organic contents*

Table 1: Soil Classification Chart (based on ASTM D2487)

Building & Earth Sciences classifies soil in general accordance with the Unified Soil Classification System (USCS) presented in ASTM D2487. Table 1 and Figure 1 exemplify the general guidance of the USCS. Soil consistencies and relative densities are presented in general accordance with Terzaghi, Peck, & Mesri's (1996) method, as shown on Table 2, when quantitative field and/or laboratory data is available. Table 2 includes Consistency and Relative Density correlations with N-values obtained using either a manual hammer (60 percent efficiency) or automatic hammer (90 percent efficiency). The *Blows Per Increment* and *SPT N-values* displayed on the boring logs are the unaltered values measured in the field. When field and/or laboratory data is not available, we may classify soil in general accordance with the Visual Manual Procedure presented in ASTM D2488.

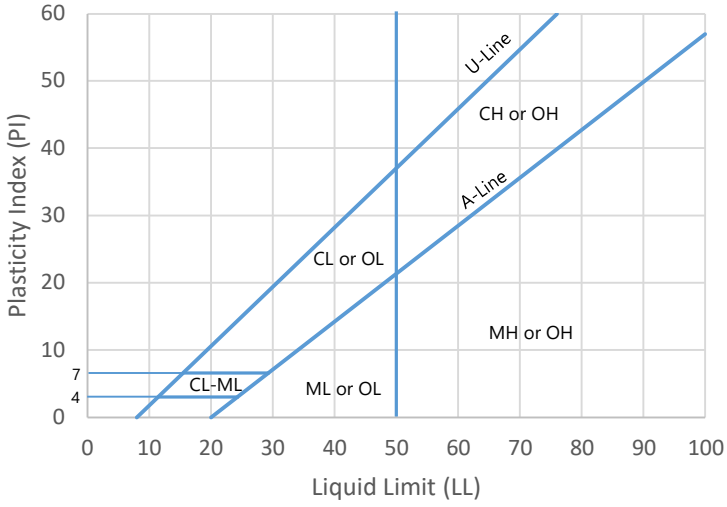


Figure 1: Plasticity Chart (based on ASTM D2487)

Non-cohesive: Coarse-Grained Soil			**Cohesive: Fine-Grained Soil**			
SPT Penetration (blows/foot)		**Relative Density**	**SPT Penetration (blows/foot)**		**Consistency**	**Estimated Range of Unconfined Compressive Strength (tsf)**
			Automatic Hammer*	Manual Hammer		
Automatic Hammer*	Manual Hammer		< 2	< 2	Very Soft	< 0.25
0 - 3	0 - 4	Very Loose	2 - 3	2 - 4	Soft	0.25 – 0.50
3 - 8	4 - 10	Loose	3 - 6	4 - 8	Medium Stiff	0.50 – 1.00
8 - 23	10 - 30	Medium Dense	6 - 12	8 - 15	Stiff	1.00 – 2.00
23 - 38	30 - 50	Dense	12 - 23	15 - 30	Very Stiff	2.00 – 4.00
> 38	> 50	Very Dense	> 23	> 30	Hard	> 4.00

Table 2: Soil Consistency and Relative Density (based on Terzaghi, Peck & Mesri, 1996)

* - Modified based on 80% hammer efficiency

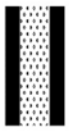
	Standard Penetration Test ASTM D1586 or AASHTO T-206		Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399
	Shelby Tube Sampler ASTM D1587		No Sample Recovery
	Rock Core Sample ASTM D2113		Groundwater at Time of Drilling
	Auger Cuttings		Groundwater as Indicated

Table 1: Symbol Legend

Soil	Particle Size	U.S. Standard
Boulders	Larger than 300 mm	N.A.
Cobbles	300 mm to 75 mm	N.A.
Gravel	75 mm to 4.75 mm	3-inch to #4 sieve
Coarse	75 mm to 19 mm	3-inch to ¾-inch sieve
Fine	19 mm to 4.75 mm	¾-inch to #4 sieve
Sand	4.75 mm to 0.075 mm	#4 to #200 Sieve
Coarse	4.75 mm to 2 mm	#4 to #10 Sieve
Medium	2 mm to 0.425 mm	#10 to #40 Sieve
Fine	0.425 mm to 0.075 mm	#40 to #200 Sieve
Fines	Less than 0.075 mm	Passing #200 Sieve
Silt	Less than 5 µm	N.A.
Clay	Less than 2 µm	N.A.

Table 2: Standard Sieve Sizes

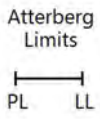
	Standard Penetration Test Resistance calculated using ASTM D1586 or AASHTO T-206. Calculated as sum of original, field recorded values.		A measure of a soil's plasticity characteristics in general accordance with ASTM D4318. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL).
	Unconfined compressive strength, typically estimated from a pocket penetrometer. Results are presented in tons per square foot (tsf).		Percent natural moisture content in general accordance with ASTM D2216.

Table 3: Soil Data

Hollow Stem Auger	Flights on the outside of the shaft advance soil cuttings to the surface. The hollow stem allows sampling through the middle of the auger flights.
Mud Rotary / Wash Bore	A cutting head advances the boring and discharges a drilling fluid to support the borehole and circulate cuttings to the surface.
Solid Flight Auger	Flights on the outside bring soil cuttings to the surface. Solid stem requires removal from borehole during sampling.
Hand Auger	Cylindrical bucket (typically 3-inch diameter and 8 inches long) attached to a metal rod and turned by human force.

Table 4: Soil Drilling Methods

Descriptor	Meaning
Trace	Likely less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

Table 5: Descriptors

Manual Hammer	The operator tightens and loosens the rope around a rotating drum assembly to lift and drop a sliding, 140-pound hammer falling 30 inches.
Automatic Trip Hammer	An automatic mechanism is used to lift and drop a sliding, 140-pound hammer falling 30 inches.
Dynamic Cone Penetrometer (Sower DCP) ASTM STP-399	Uses a 15-pound steel mass falling 20 inches to strike an anvil and cause penetration of a 1.5-inch diameter cone seated in the bottom of a hand augered borehole. The blows required to drive the embedded cone a depth of 1-3/4 inches have been correlated by others to N-values derived from the Standard Penetration Test (SPT).

Table 6: Sampling Methods

Non-plastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Table 7: Plasticity

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, usually soil is below water table.

Table 8: Moisture Condition

Stratified	Alternating layers of varying material or color with layers at least ½ inch thick.
Laminated	Alternating layers of varying material or color with layers less than ¼ inch thick.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensides	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

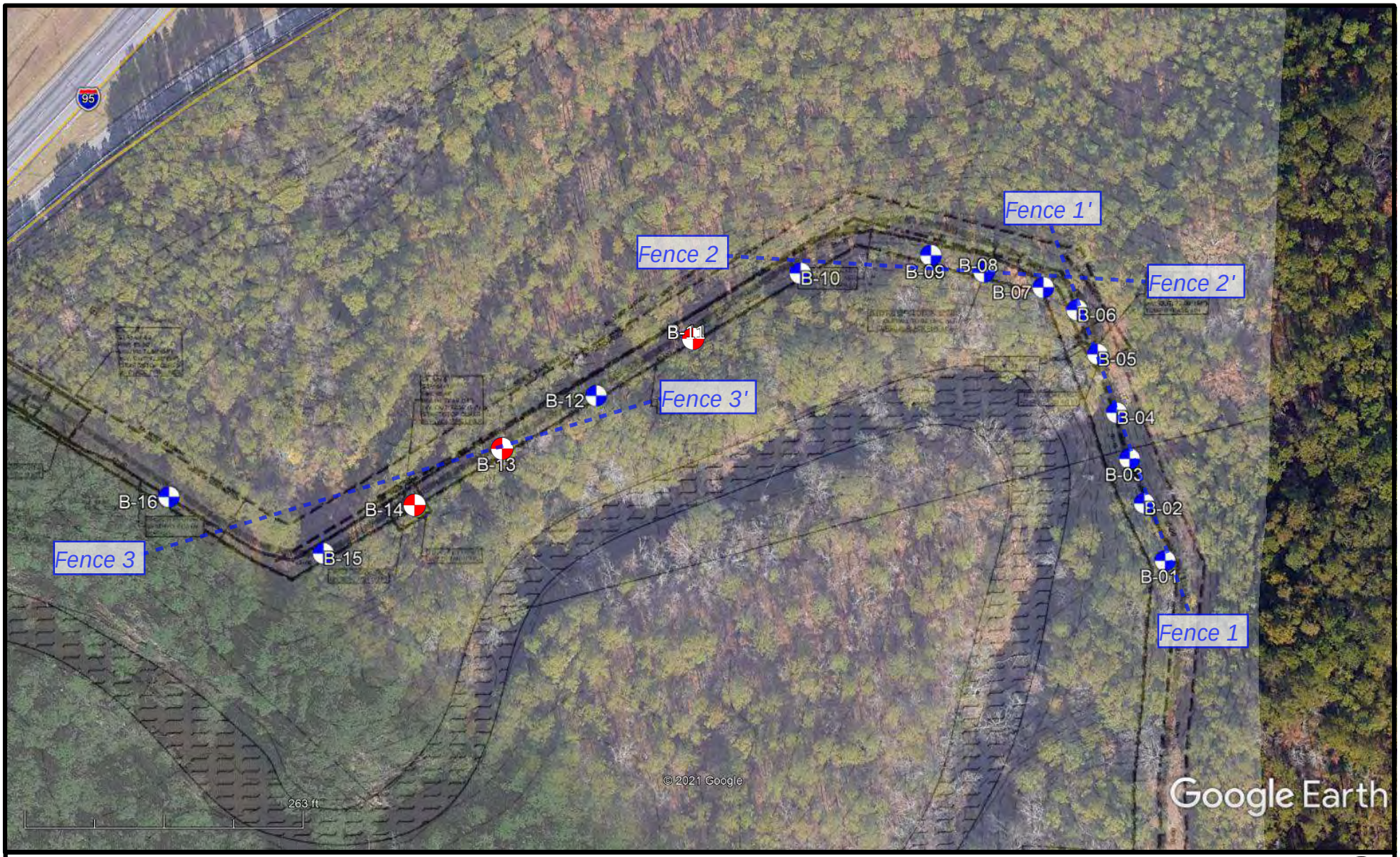
Table 9: Structure

KEY TO HATCHES

Hatch	Description	Hatch	Description	Hatch	Description
	GW - Well-graded gravels, gravel – sand mixtures, little or no fines		Asphalt		Clay with Gravel
	GP - Poorly-graded gravels, gravel – sand mixtures, little or no fines		Aggregate Base		Sand with Gravel
	GM - Silty gravels, gravel – sand – silt mixtures		Topsoil		Silt with Gravel
	GC - Clayey gravels, gravel – sand – clay mixtures		Concrete		Gravel with Sand
	SW - Well-graded sands, gravelly sands, little or no fines		Coal		Gravel with Clay
	SP - Poorly-graded sands, gravelly sands, little or no fines		**CL-ML** - Silty Clay		Gravel with Silt
	SM - Silty sands, sand – silt mixtures		Sandy Clay		Limestone
	SC - Clayey sands, sand – clay mixtures		Clayey Chert		Chalk
	ML - Inorganic silts and very find sands, rock flour, silty or clayey fine sands or clayey silt with slight plasticity		Low and High Plasticity Clay		Siltstone
	CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		Low Plasticity Silt and Clay		Till
	OL - Organic silts and organic silty clays of low plasticity		High Plasticity Silt and Clay		Sandy Clay with Cobbles and Boulders
	MH - Inorganic silts, micaceous or diatomaceous fine sand, or silty soils		Fill		Sandstone with Shale
	CH - Inorganic clays of high plasticity		Weathered Rock		Coral
	OH - Organic clays of medium to high plasticity, organic silts		Sandstone		Boulders and Cobbles
	PT - Peat, humus, swamp soils with high organic contents		Shale		Soil and Weathered Rock

Table 1: Key to Hatches Used for Boring Logs and Soil Profiles

BORING LOCATION PLAN



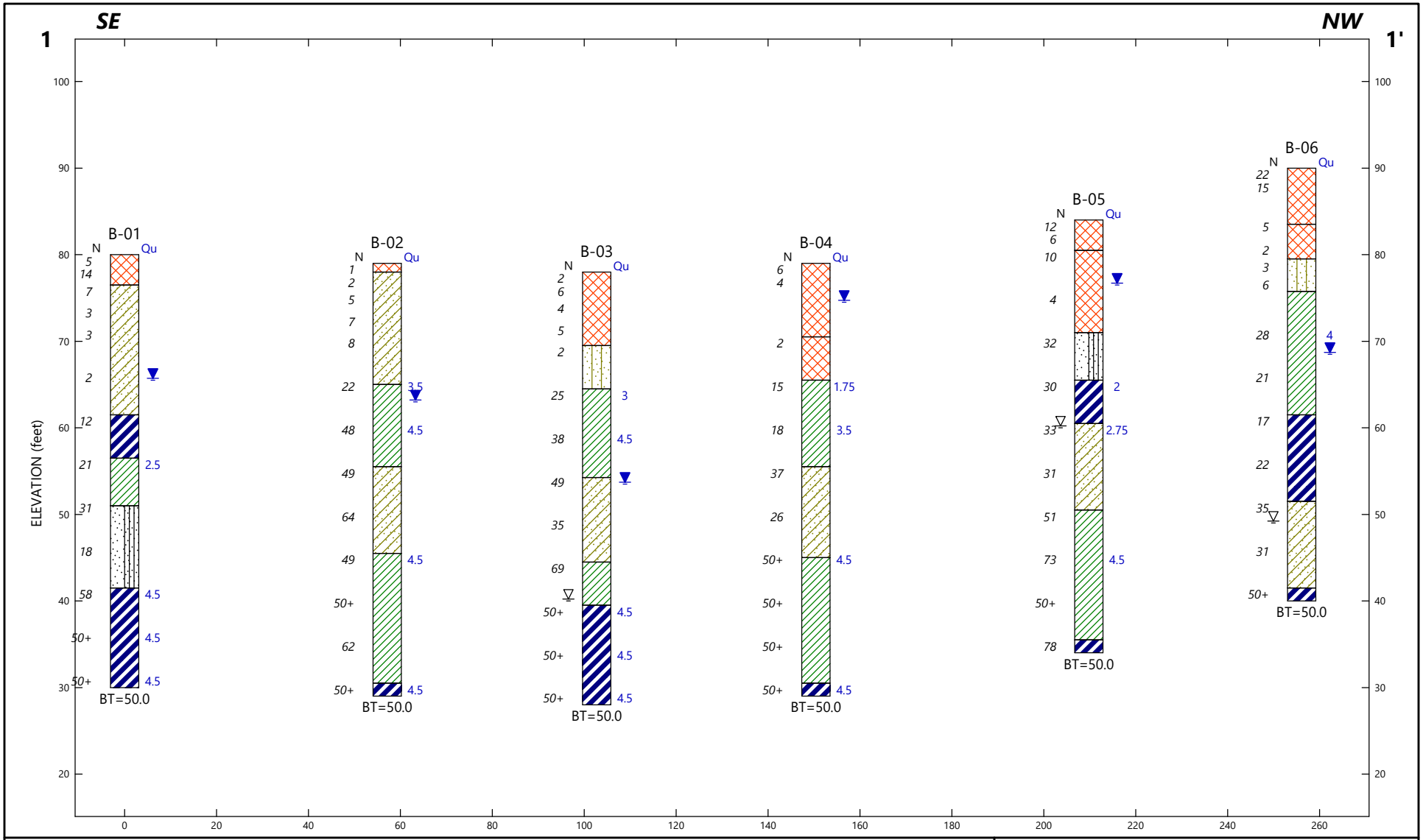
Boring Location Kessler DCP Location N

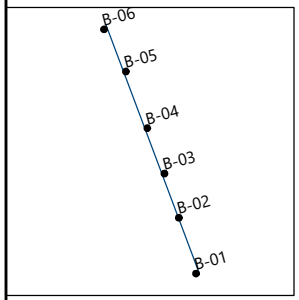
Boring Location Map

BUILDING & EARTH

BES Project #:	RD200783	**Address:**	Claude Lee Road
Drawing Source:	**Outfall Rehabilitation (Sheet EC4)**	**City:**	**Fayetteville, NC**
Client:	Fleming & Associates		
Project:	Claude Lee Road Sewer Outfall		**Figure 1**

SUBSURFACE SOIL PROFILES





Site Map Scale 1 inch equals 190 feet

Key to Hatches

- Fill
- USCS Low Plasticity Clay
- USCS Clayey Sand
- USCS Poorly-graded Sand with Silt
- USCS High Plasticity Clay
- USCS Silty Sand

Legend

BT=Boring Termination, TPT=Test Pit Terminated
AR=Auger Refusal, ER=Excavation Refusal
N=Standard Penetration Test N-Value
Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
Water Level Reading at time of drilling.
Water Level Reading after drilling.

0 — 31
Horizontal Scale (feet)
Vertical Exaggeration: 2x

Building & Earth Sciences, Inc.
610 Spring Branch Road, Dunn, NC 28334

Claude Lee Road Sewer Outfall
Fayetteville, NC

Fence 1-1': Subsurface Profile

PROJECT NO: RD200783	PLATE NO: 1-1'	DATE: 3/25/21

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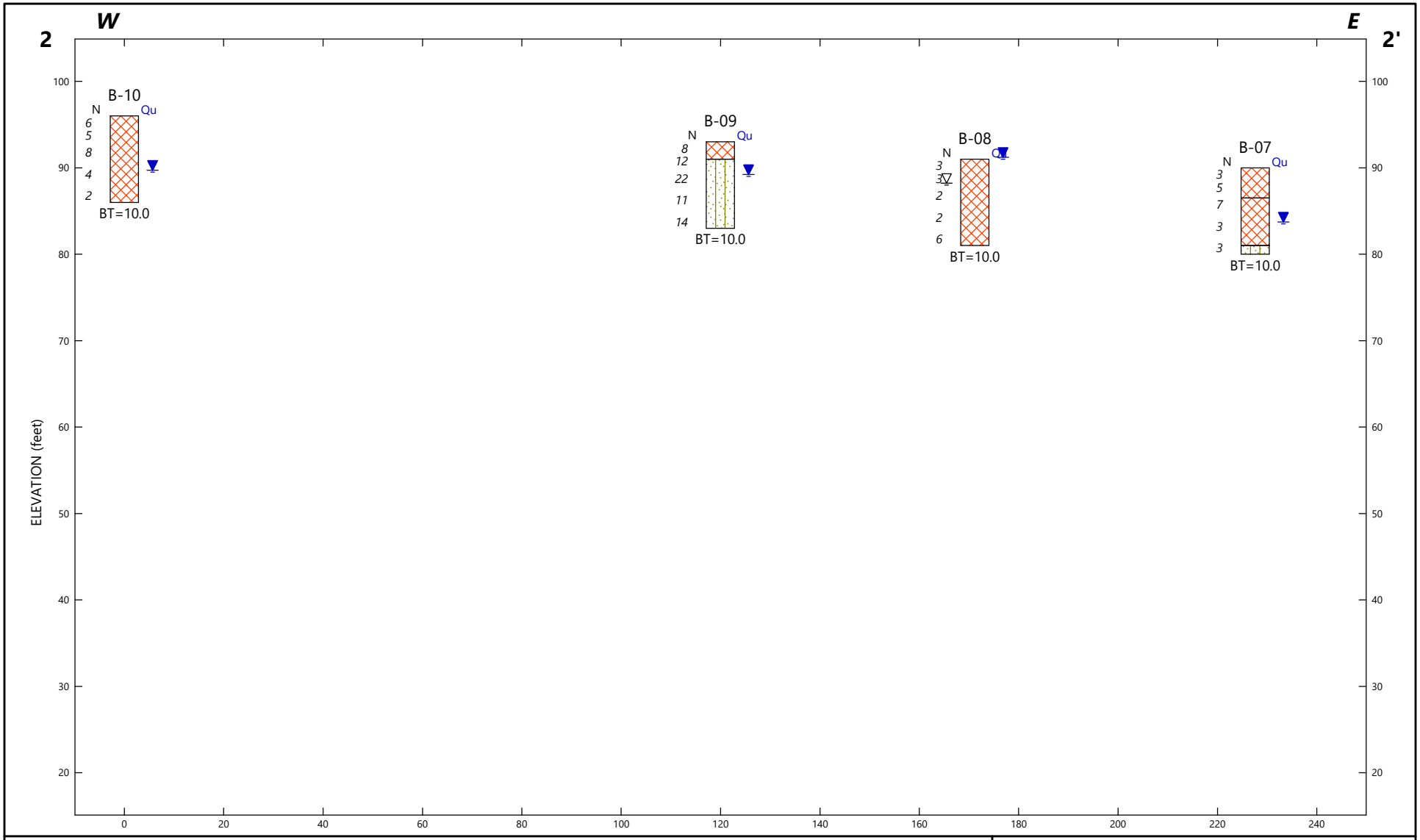
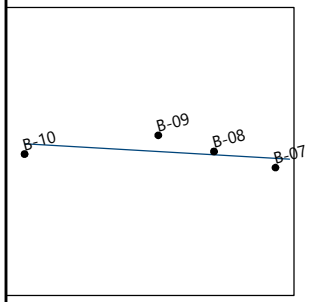
Geotechnical, Environmental, and Materials Engineers





Site Map Scale 1 inch equals 175 feet

Key to Hatches

Fill

USCS Silty Sand

Legend

BT=Boring Termination, TPT=Test Pit Terminated
AR=Auger Refusal, ER=Excavation Refusal
N=Standard Penetration Test N-Value
Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
▽ Water Level Reading at time of drilling.
▼ Water Level Reading after drilling.

0 28

Horizontal Scale (feet)
Vertical Exaggeration: 1.5x

Building & Earth Sciences, Inc.
610 Spring Branch Road, Dunn, NC 28334

Claude Lee Road Sewer Outfall
Fayetteville, NC

Fence 2-2': Subsurface Profile

PROJECT NO: RD200783	PLATE NO: 2-2'	DATE: 3/25/21

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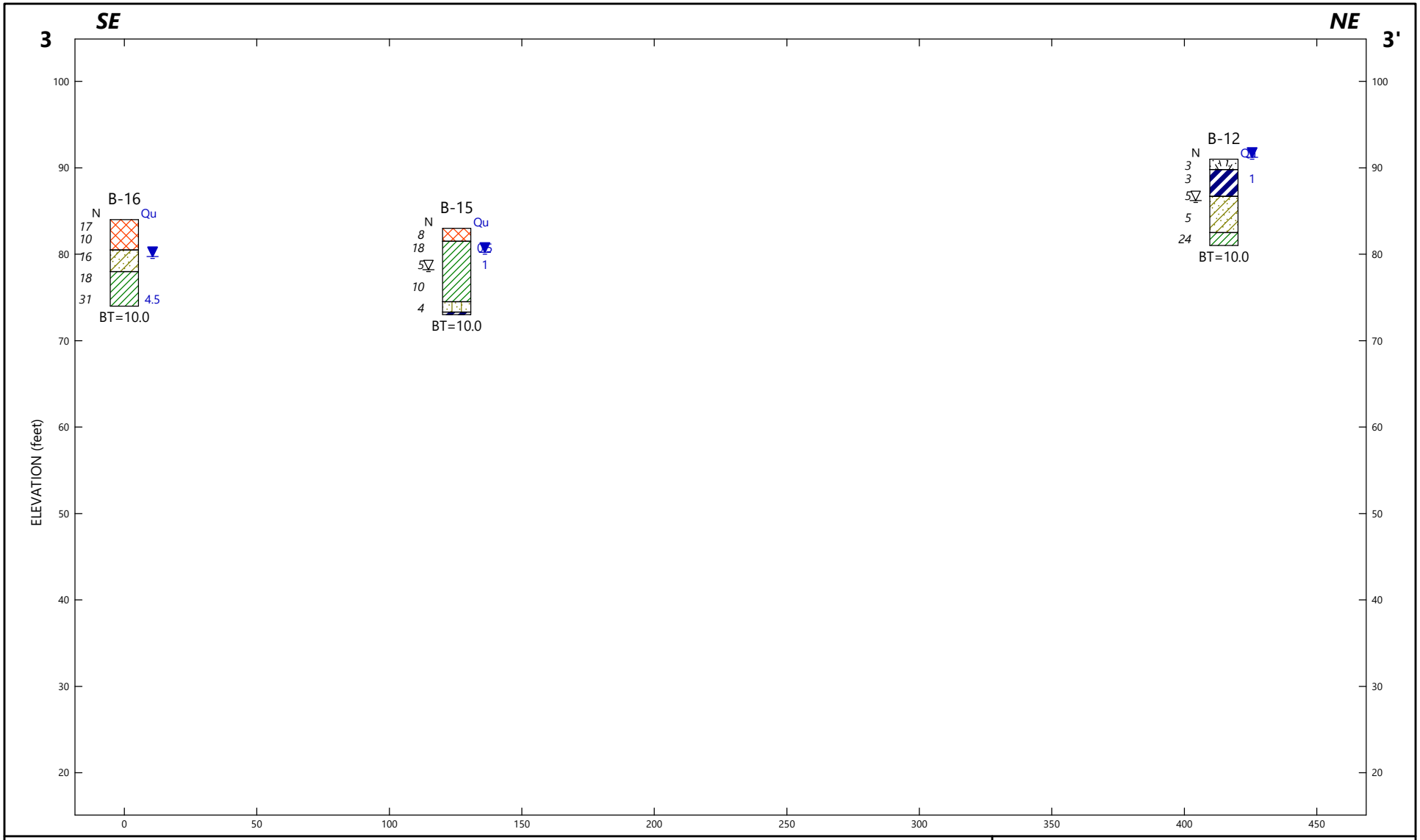


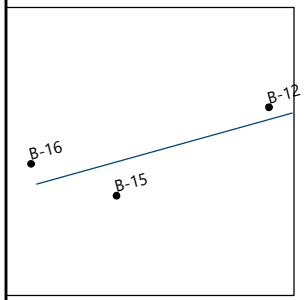
Key to Hatches

- Topsoil
- USCS High Plasticity Clay
- USCS Clayey Sand
- USCS Low Plasticity Clay
- Fill
- USCS Silty Sand

Legend

BT=Boring Termination, TPT=Test Pit Terminated
AR=Auger Refusal, ER=Excavation Refusal
N=Standard Penetration Test N-Value
Qu=Unconfined compressive strength estimate from pocket penetrometer test (tsf)
▽ Water Level Reading at time of drilling.
▼ Water Level Reading after drilling.

0 — 53
Horizontal Scale (feet)
Vertical Exaggeration: 3.5x



Site Map Scale 1 inch equals 325 feet

Building & Earth Sciences, Inc.
610 Spring Branch Road, Dunn, NC 28334

Claude Lee Road Sewer Outfall
Fayetteville, NC

Fence 3-3': Subsurface Profile

PROJECT NO: RD200783	PLATE NO: 3-3'	DATE: 3/25/21

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BORING LOGS

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-01

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95867,-78.88812

LOCATION: Fayetteville, NC
DATE DRILLED: 2/25/21
WEATHER: Partly Cloudy, 60s
ELEVATION: 80
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
	80								
		☒	1	1 2		Sample 1 M: 13.6%	SILTY SAND (SM): loose, dark brown, fine grained, moist, (FILL)		
		☒	2	3 4		Sample 2 LL: NP PL: NP PI: NP M: 22.2% F: 15.6%	3.5 medium dense, with some organics 76.5		
5	75	☒	3	6 8			CLAYEY SAND (SC): loose, gray, fine to medium grained, moist, with some mica, (COASTAL PLAIN)		
		☒	4	4 4					
		◯	5	3 2		Sample 3 LL: 31 PL: 17 PI: 14 M: 20.8% F: 23%	loose, wet, with few organics		
10	70			1 2					
				2 2		Sample 4 M: 37.6%			
		☒	6	1 2		Sample 6 M: 30.5%	very loose, dark gray ▼		No water was encountered at time of drilling, but stabilized at 14.5 feet (EL 65.5).
15	65			2 1			18.5 61.5		
		☒	7	4 6		Sample 7 M: 18.8%	FAT CLAY (CH): stiff, gray, fine grained, moist, with trace mica, (COASTAL PLAIN)		
20	60			6			23.5 56.5		
		☒	8	7 9		Sample 8 M: 28.5%	LEAN CLAY (CL): very stiff, dark gray, fine grained, moist, with trace mica, (COASTAL PLAIN)		
25	55			12			29.0 51.0		
		☒	9	8 14		Sample 9 M: 15.7%	POORLY GRADED SAND WITH SILT (SP-SM): dense, gray, fine to medium grained, wet, (COASTAL PLAIN)		
30	50			17					
		☒	10	6 9		Sample 10 M: 23.4%	medium dense		
35	45			9			38.5 41.5		
		☒	11	12 19		Sample 11 M: 18.5%	FAT CLAY (CH): hard, dark gray, brown, fine grained, moist, with trace mica, (COASTAL PLAIN)		
40	40			39					
		☒	12	27 50/4		Sample 12 M: 15.0%	dry		
45	35					Sample 13 LL: 51 PL: 23 PI: 28 M: 16.2% F: 63.4%			Boring cave-in at 46 feet.
		☒	13	29 50/3			50.0 moist 30.0		Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.
50	30						Boring Terminated at 50 feet.		
	25								

SAMPLE TYPE ☒ Split Spoon ◯ No Recovery

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-02

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95882, -78.88818

LOCATION: Fayetteville, NC
DATE DRILLED: 2/25/21
WEATHER: Partly Cloudy, 60s
ELEVATION: 79
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	79								
		X	1	2 1		Sample 1 M: 31.2%	1.0 SILTY SAND (SM): very loose, dark brown, fine grained, moist, (FILL)	78.0	
		X	2	0 1		Sample 2 M: 18.8%	CLAYEY SAND (SC): very loose, brown, fine to medium grained, wet, (COASTAL PLAIN)		
5	75	X	3	1 1		Sample 3 M: 24.9%	loose, gray, moist, with some mica		
		X	4	2 2		Sample 4 LL: 40 PL: 18 PI: 22 M: 23.4% F: 47.5%			
10	70	X	5	3 3 2		Sample 5 M: 24.4%			
				5 4 4					
15	65	X	6	4 7 11		Sample 6 M: 19.9%	14.0 medium dense	65.0	
				11			LEAN CLAY (CL): very stiff, gray, fine grained, moist, with trace mica, (COASTAL PLAIN)		No water was encountered at time of drilling, but stabilized at 16 feet (EL 63).
20	60	X	7	12 19 29		Sample 7 M: 19.8%	hard, dark gray, reddish yellow		
25	55	X	8	15 20 29		Sample 8 M: 14.8%	23.5 CLAYEY SAND (SC): dense, dark gray, fine to medium grained, moist, with trace mica, (COASTAL PLAIN)	55.5	
		X	9	17 25 39	>>	Sample 9 LL: 29 PL: 16 PI: 13 M: 17.7% F: 12.6%	very dense		
30	50								
35	45	X	10	11 24 25		Sample 10 M: 19.9%	33.5 LEAN CLAY (CL): hard, dark gray, brownish yellow, fine grained, moist, with trace mica, (COASTAL PLAIN)	45.5	
40	40	X	11	15 28 50/4	>>	Sample 11 M: 15.6%			
45	35	X	12	20 26 36	>>	Sample 12 M: 15.7%	dry		Boring cave-in at 48 feet.
50	30	X	13	34 41 50/4		Sample 13 M: 14.7%	48.5	30.5	
							50.0 FAT CLAY (CH): hard, dark gray, dark red, fine grained, with trace mica, (COASTAL PLAIN)	29.0	Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.
	25						Boring Terminated at 50 feet.		

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

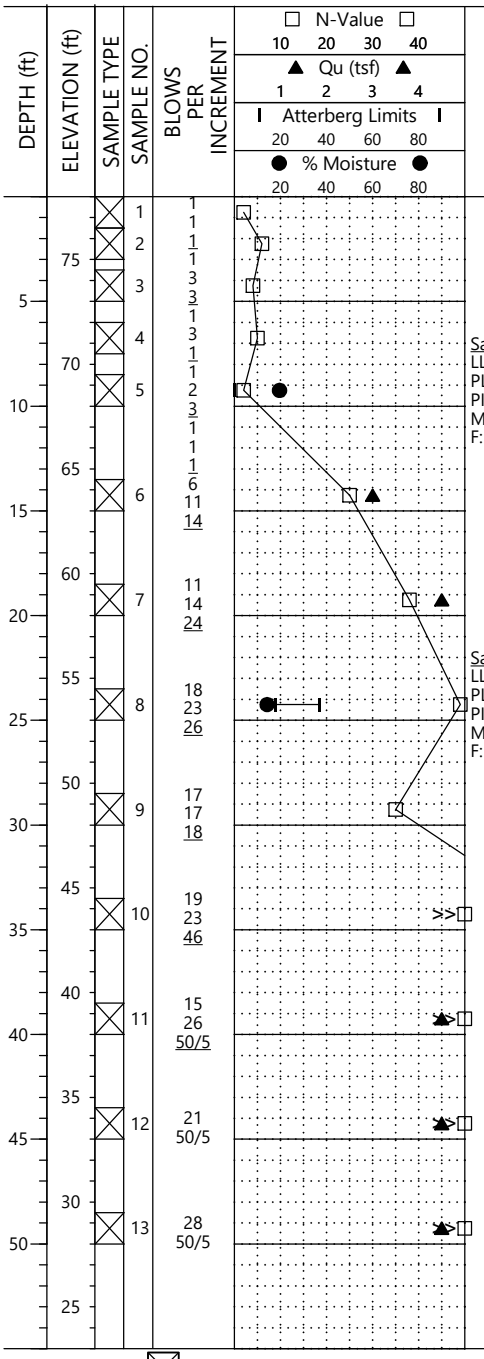
Designation: B-03

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95894, -78.88823

LOCATION: Fayetteville, NC
DATE DRILLED: 2/26/21
WEATHER: Rainy, 40s
ELEVATION: 78
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham



SOIL DESCRIPTION			GRAPHIC	REMARKS
SILTY SAND (SM): very loose, dark brown, fine to medium grained, wet, with few organics, (FILL) loose, wet	8.5	69.5		
SILTY SAND (SM): very loose, light brown, fine to medium grained, wet, (COASTAL PLAIN)	13.5	64.5		
LEAN CLAY (CL): very stiff, gray, reddish yellow, fine grained, wet, with some mica, (COASTAL PLAIN) hard	23.8	54.3		
CLAYEY SAND (SC): dense, gray, fine to medium grained, wet, with trace mica, (COASTAL PLAIN)	33.5	44.5		Groundwater encountered at 38 feet (EL 40) at time of drilling and stabilized at 24.5 feet (EL 53.5).
LEAN CLAY (CL): hard, grayish brown, fine grained, moist, (COASTAL PLAIN)	38.5	39.5		
FAT CLAY (CH): hard, gray, reddish yellow, fine grained, moist, with trace mica, (COASTAL PLAIN) gray, dark red, dry	50.0	28.0		Boring cave-in at 39 feet.
Boring Terminated at 50 feet.				Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL
REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH
LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-04

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95906, -78.88828

LOCATION: Fayetteville, NC
DATE DRILLED: 3/1/21
WEATHER: Rainy, 60s
ELEVATION: 79
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	79								
		X	1	3 3		Sample 1 M: 15.4%	SILTY SAND (SM): loose, dark brown, fine to medium grained, moist, with few organics, (FILL)		
		X	2	3 1		Sample 2 M: 15.8%	very loose		
5	75	■	3	2 2					No water was encountered at time of drilling, but stabilized at 4.5 feet (EL 74.5).
		◯	4			Sample 5 LL: 29 PL: 24 PI: 5 M: 33.7% F: 10.3%	8.5 / 70.5		
	70	X	5	3 1 1			POORLY GRADED SAND WITH SILT (SP-SM): very loose, dark brown, fine to medium grained, moist, (FILL)		Boring cave-in at 7 feet.
10							13.5 / 65.5		
	65	X	6	5 7 8		Sample 6 LL: 74 PL: 27 PI: 47 M: 30.2% F: 92.6%	LEAN CLAY (CL): stiff, gray, brownish yellow, fine grained, moist		
15									
	60	X	7	5 7 11		Sample 7 M: 20.4%	very stiff		
20							23.5 / 55.5		
	55	X	8	12 15 22		Sample 8 M: 16.2%	CLAYEY SAND (SC): dense, gray, fine to medium grained, moist, with trace mica, (COASTAL PLAIN)		
25									
	50	X	9	8 12 14		Sample 9 M: 19.0%			
30									
	45	X	10	14 33 50/2		Sample 10 M: 14.2%	34.0 / very dense / 45.0		
35							LEAN CLAY (CL): hard, gray, brownish yellow, fine grained, moist, with trace mica, (COASTAL PLAIN)		
	40	X	11	24 50/5	>>	Sample 11 M: 16.5%			
40									
	35	X	12	23 46 50/5	>>	Sample 12 M: 15.2%			
45							48.5 / 30.5		
	30	X	13	18 33 50/1		Sample 13 M: 19.6%	50.0 FAT CLAY (CH): hard, dark gray, dark red, fine grained, dry, (COASTAL PLAIN) / 29.0		Borehole backfilled on date drilled unless otherwise noted.
50							Boring Terminated at 50 feet.		Consistency/Relative Density based on correction factor for Manual hammer.
	25								

SAMPLE TYPE: X Split Spoon; ■ Shelby Tube; ◯ No Recovery

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-05

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95921, -78.88835

LOCATION: Fayetteville, NC
DATE DRILLED: 3/1/21
WEATHER: Rainy, 60s
ELEVATION: 84
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	80		1	2 5		Sample 1 M: 14.3%	SILTY SAND (SM): medium dense, dark brown, fine grained, moist, with few organics, (FILL)		
			2	7 2		Sample 2 M: 16.9%	3.5 loose 80.5		
5			3	2 3		Sample 3 M: 18.3%	POORLY GRADED SAND WITH SILT (SP-SM): loose, black, fine grained, moist, with some organics, (FILL)		
			4	3 3 5			▼		
10	75		5	5 1 1		Sample 5 M: 24.0%	very loose		Groundwater encountered at 24 feet (EL 60) at time of drilling and stabilized at 7.5 feet (EL 76.5).
				3			13.0 71.0		
15	70		6	7 9 23		Sample 6 M: 29.4%	POORLY GRADED SAND WITH SILT (SP-SM): very loose, gray, fine to medium grained, wet, (COASTAL PLAIN) dense		
							18.5 65.5		
20	65		7	5 7 23		Sample 7 M: 27.0%	FAT CLAY (CH): very stiff, gray, fine grained, wet, (COASTAL PLAIN)		
							23.5 60.5		
25	60		8	13 15 18		Sample 8 M: 18.8%	CLAYEY SAND (SC): dense, dark gray, brownish yellow, red, fine grained, wet, (COASTAL PLAIN)		
						Sample 9 LL: 26 PL: 17 PI: 9 M: 20.1% F: 13.3%			
30	55		9	12 12 19			gray, fine to medium grained, wet, with trace mica		
							33.5 50.5		
35	50		10	16 18 33	>>	Sample 10 LL: 36 PL: 15 PI: 21 M: 19.3% F: 64%	LEAN CLAY (CL): hard, gray, brownish yellow, fine grained, moist, with trace mica, (COASTAL PLAIN)		
40	45		11	28 31 42		Sample 11 M: 18.2%			Boring cave-in at 39 feet.
45	40		12	33 50/3	>>	Sample 12 M: 11.5%			
							48.5 35.5		
50	35		13	26 37 41	>>	Sample 13 M: 18.1%	50.0 FAT CLAY (CH): hard, gray, fine grained, moist, with trace mica, (COASTAL PLAIN) 34.0		Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.
	30						Boring Terminated at 50 feet.		

SAMPLE TYPE ☒ Split Spoon ■ Shelby Tube

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

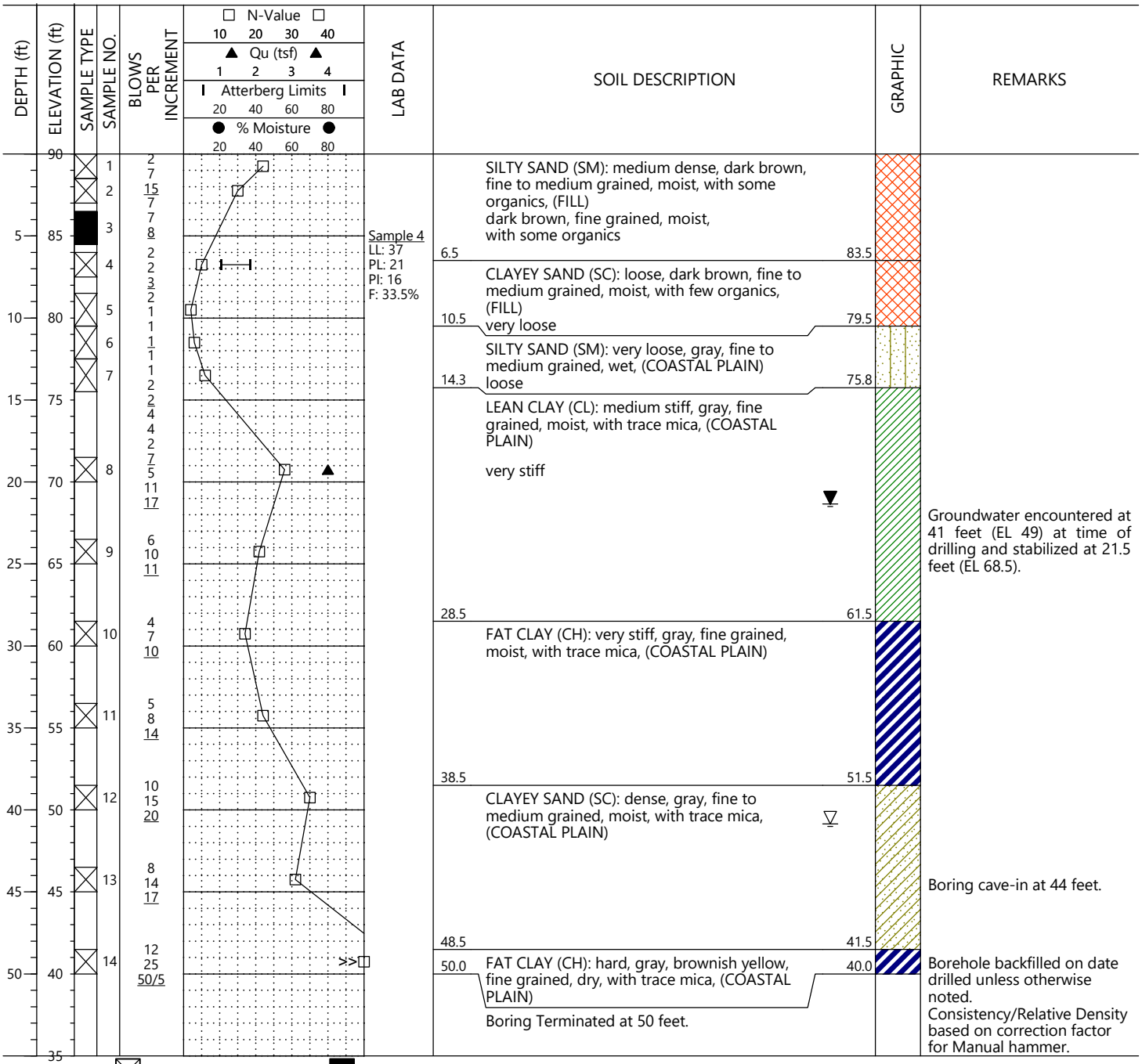
LOG OF BORING

Designation: B-06

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME:	Claude Lee Road Sewer Outfall	LOCATION:	Fayetteville, NC
PROJECT NUMBER:	RD200783	DATE DRILLED:	3/2/21
DRILLING METHOD:	Hollow Stem Auger	WEATHER:	Sunny, 40s
EQUIPMENT USED:	CME 550X ATV	ELEVATION:	90
HAMMER TYPE:	Manual	DRILL CREW:	J&L Drilling
BORING LOCATION:	34.95933, -78.88843	LOGGED BY:	B. Pham



SAMPLE TYPE ☒ Split Spoon ■ Shelby Tube

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-07

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME:	Claude Lee Road Sewer Outfall	LOCATION:	Fayetteville, NC
PROJECT NUMBER:	RD200783	DATE DRILLED:	3/2/21
DRILLING METHOD:	Hollow Stem Auger	WEATHER:	Sunny, 40s
EQUIPMENT USED:	CME 550X ATV	ELEVATION:	90
HAMMER TYPE:	Manual	DRILL CREW:	J&L Drilling
BORING LOCATION:	34.95939, -78.88853	LOGGED BY:	B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	90	☒	1	1 1 2			SILTY SAND (SM): very loose, dark brown, light brown, fine grained, moist, with some organics, (FILL)		
3.5	86.5						loose		
5	85	☒	2 3	1 2 3		Sample 4 LL: 27 PL: 17 PI: 10 F: 26.9%	CLAYEY SAND (SC): loose, dark brown, light brown, fine to medium grained, wet, (FILL)		
9.0	81.0						very loose, grayish brown, yellow, with occasional clay seams		No water was encountered at time of drilling, but stabilized at 6.5 feet (EL 83.5). Boring cave-in at 7 feet.
10.0	80.0	☒	4 5	3 4 1 1 2 1 1 2			SILTY SAND (SM): very loose, gray, fine to medium grained, wet, (COASTAL PLAIN)		
10	80						Boring Terminated at 10 feet.		
15	75								
20	70								
25	65								
30	60								
35	55								
40	50								
45	45								
50	40								Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.
	35								

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-08

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95943, -78.88872

LOCATION: Fayetteville, NC
DATE DRILLED: 3/2/21
WEATHER: Sunny, 40s
ELEVATION: 91
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	90	☒	1	1			CLAYEY SAND (SC): very loose, dark brown, fine grained, moist, with some organics, (FILL) wet, with few organics		Groundwater encountered at 3 feet (EL 88) at time of drilling and stabilized at 0 feet (EL 91).
		☒	2	2					
5	85	☒	3	1					Boring cave-in at 5 feet.
		☒	4	1					
10	80	☒	5	1		Sample 5 LL: 32 PL: 18 PI: 14 F: 37.9%	10.0 loose 81.0		
				2			Boring Terminated at 10 feet.		
15	75			4					
20	70								
25	65								
30	60								
35	55								
40	50								
45	45								
50	40								Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-09

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95947, -78.88889

LOCATION: Fayetteville, NC
DATE DRILLED: 3/2/21
WEATHER: Sunny, 40s
ELEVATION: 93
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	93								
			1	2 4					
			2	4 4					
5	90		3	5 7					
			4	4 10					
			5	12 2					
10	85			3 8					
				4 8					
15	80			6					
20	75								
25	70								
30	65								
35	60								
40	55								
45	50								
50	45								
	40								

2.0 — CLAYEY SAND (SC): loose, brown, fine grained, moist, with trace organics and mica, (FILL) medium dense — 91.0

SILTY SAND (SM): dark gray, fine grained, moist, with trace mica, (COASTAL PLAIN) medium dense, dark gray, light gray, yellow

10.0 — 83.0

Boring Terminated at 10 feet.

No water was encountered at time of drilling, but stabilized at 4 feet (EL 89). Boring cave-in at 5 feet.

Borehole backfilled on date drilled unless otherwise noted.
Consistency/Relative Density based on correction factor for Manual hammer.

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-10

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95942, -78.88929

LOCATION: Fayetteville, NC
DATE DRILLED: 3/2/19
WEATHER: Sunny, 40s
ELEVATION: 96
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	95	⊠	1	3 3 3			SILTY SAND (SM): loose, brown, yellow, fine grained, moist, with occasional clay seams, (FILL)		
		⊠	2						
5	90	⊠	3	1 2 3					
		⊠	4	2 4 4			very loose, fine to medium grained, wet ▼		No water was encountered at time of drilling, but stabilized at 6.5 feet (EL 89.5).
10	85	⊠	5	1 2 2			10.0 86.0 Boring Terminated at 10 feet.		Boring cave-in at 7 feet.
15	80			2 1 1					
20	75								
25	70								
30	65								
35	60								
40	55								
45	50								
50	45								Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.

SAMPLE TYPE ⊠ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-11

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hand Auger
EQUIPMENT USED: Kessler DCP
HAMMER TYPE: Manual
BORING LOCATION: 34.95925, -78.88962

LOCATION: Fayetteville, NC
DATE DRILLED: 3/5/21
WEATHER: Sunny, 50s
ELEVATION: 93
DRILL CREW: Building & Earth
LOGGED BY: B. Pham/M. Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	93	DCP	1	8					Kessler DCP -- no samples collected.
			2	9					
	90		3	12					
5			4	12					
			5	10					
	85		6	13					
10			7	7					
				13					
	80			8					
15				10					
				8					
	75			9					
20				8					
				12					
	70								
25									
	65								
30									
	60								
35									
	55								
40									
	50								
45									Groundwater not encountered at time of drilling.
	45								Borehole backfilled on date drilled unless otherwise noted.
50									Consistency/Relative Density based on correction factor for Manual hammer.
	40								

SAMPLE TYPE: DCP Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-12

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME:	Claude Lee Road Sewer Outfall	LOCATION:	Fayetteville, NC
PROJECT NUMBER:	RD200783	DATE DRILLED:	3/2/21
DRILLING METHOD:	Hollow Stem Auger	WEATHER:	Sunny, 50s
EQUIPMENT USED:	CME 550X ATV	ELEVATION:	91
HAMMER TYPE:	Manual	DRILL CREW:	J&L Drilling
BORING LOCATION:	34.95911, -78.88993	LOGGED BY:	B. Pham

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	90	☒	1	2 1 2			1.2 TOPSOIL: 14 inches — 89.8		Groundwater encountered at 5 feet (EL 86) at time of drilling and stabilized at 0 feet (EL 91).
		☒	2	2 1 1			FAT CLAY (CH): soft, gray, fine grained, moist, with trace mica, (COASTAL PLAIN)		
5	85	☒	3	1 2 2			4.3 medium stiff — 86.7		
		☒	4	2 3 2			CLAYEY SAND (SC): loose, brownish yellow, fine to medium grained, moist, (COASTAL PLAIN)		Boring cave-in at 6 feet.
10	80	☒	5	2 3 4		Sample 5 LL: 47 PL: 23 PI: 24 F: 87.6%	8.5 — 82.5 10.0 LEAN CLAY (CL): very stiff, dark gray, fine grained, wet, with few mica, (COASTAL PLAIN) — 81.0 Boring Terminated at 10 feet.		
15	75			11 13					
20	70								
25	65								
30	60								
35	55								
40	50								
45	45								
50	40								Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-13

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME:	Claude Lee Road Sewer Outfall	LOCATION:	Fayetteville, NC
PROJECT NUMBER:	RD200783	DATE DRILLED:	3/5/21
DRILLING METHOD:	Hand Auger	WEATHER:	Sunny, 50s
EQUIPMENT USED:	Kessler DCP	ELEVATION:	88
HAMMER TYPE:	Manual	DRILL CREW:	Building & Earth
BORING LOCATION:	34.95897, -78.89022	LOGGED BY:	B. Pham/M. Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value (10 20 30 40) / Qu (tsf) (1 2 3 4) / Atterberg Limits (20 40 60 80) / % Moisture (20 40 60 80)	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	88		1	4					Kessler DCP -- no samples collected.
			2	5					
	85		3	10					
5			4	13					
			5	9					
	80		6	10					
10			7	12					
				13					
	75			8					
15				9					
				4					
	70			6					
20				3					
				5					
	65								
25									
	60								
30									
	55								
35									
	50								
40									
	45								
45									Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.
	40								
50									
	35								

SAMPLE TYPE — DCP Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
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PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

Designation: B-14

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME:	Claude Lee Road Sewer Outfall	LOCATION:	Fayetteville, NC
PROJECT NUMBER:	RD200783	DATE DRILLED:	3/5/21
DRILLING METHOD:	Hand Auger	WEATHER:	Sunny, 50s
EQUIPMENT USED:	Kessler DCP	ELEVATION:	84
HAMMER TYPE:	Manual	DRILL CREW:	Building & Earth
BORING LOCATION:	34.95882, -78.89050	LOGGED BY:	B. Pham/M. Lumpkin

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	N-Value / Qu (tsf) / Atterberg Limits / % Moisture	LAB DATA	SOIL DESCRIPTION	GRAPHIC	REMARKS
0	84		1	10					Kessler DCP -- no samples collected.
			2	11					
5	80		3	8					
			4	8					
			5	7					
			6	7					
10	75			4					
				6					
				3					
15	70			4					
				2					
				4					
20	65								
25	60								
30	55								
35	50								
40	45								
45	40								
50	35								
	30								Groundwater not encountered at time of drilling. Borehole backfilled on date drilled unless otherwise noted. Consistency/Relative Density based on correction factor for Manual hammer.

SAMPLE TYPE: DCP Cone Penetration

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

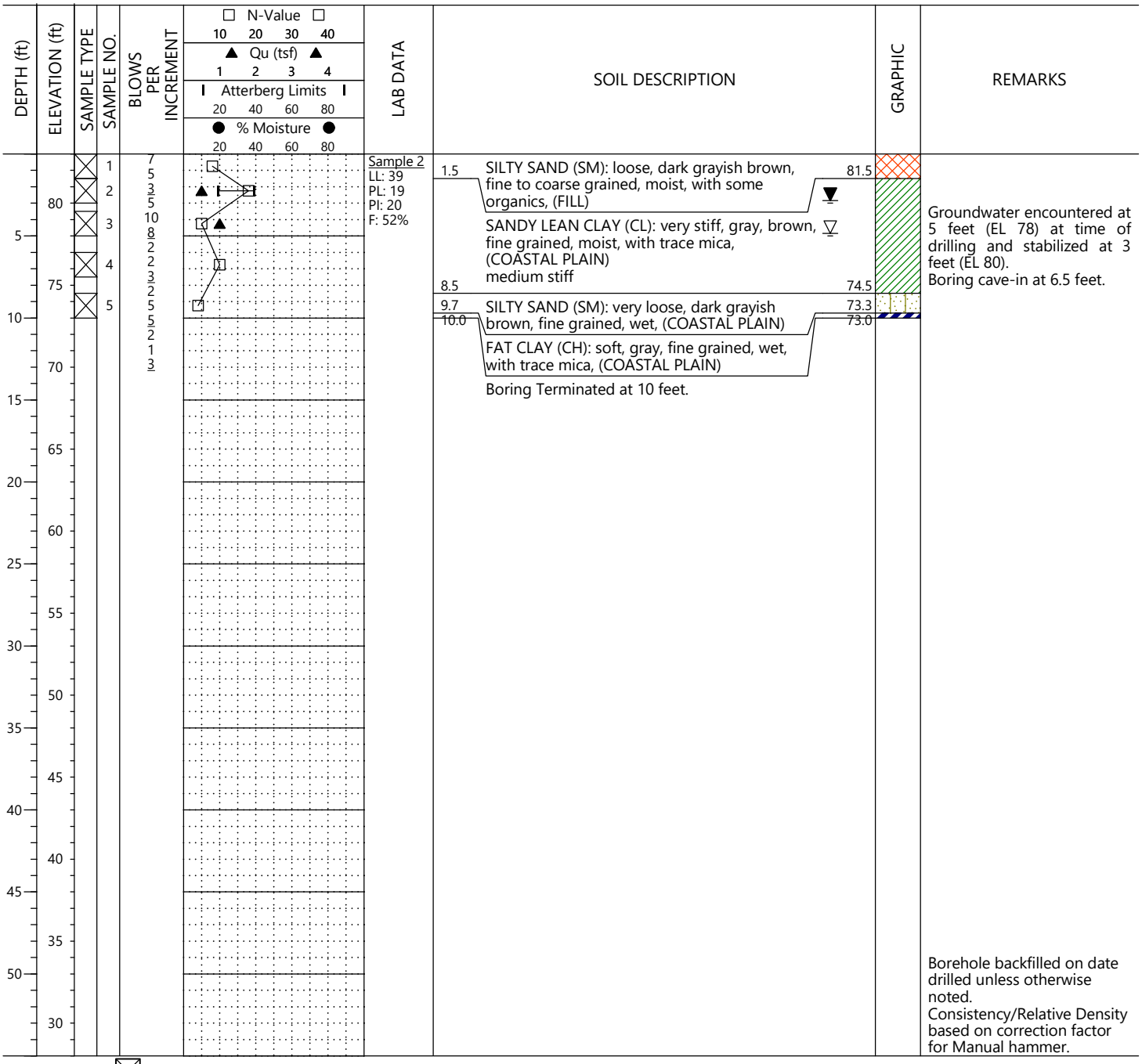
Designation: B-15

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95869, -78.89079

LOCATION: Fayetteville, NC
DATE DRILLED: 3/2/21
WEATHER: Sunny, 50s
ELEVATION: 83
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

LOG OF BORING

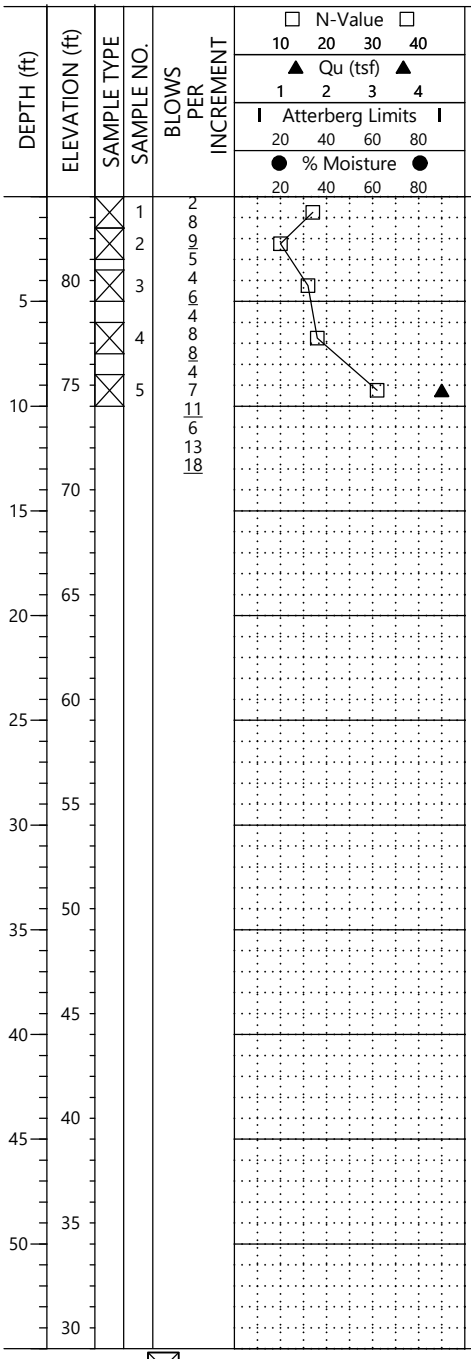
Designation: B-16

Sheet 1 of 1

610 Spring Branch Road
Dunn, NC 28334
Office: (910) 292-2085

PROJECT NAME: Claude Lee Road Sewer Outfall
PROJECT NUMBER: RD200783
DRILLING METHOD: Hollow Stem Auger
EQUIPMENT USED: CME 550X ATV
HAMMER TYPE: Manual
BORING LOCATION: 34.95884, -78.89127

LOCATION: Fayetteville, NC
DATE DRILLED: 3/2/21
WEATHER: Sunny, 50s
ELEVATION: 84
DRILL CREW: J&L Drilling
LOGGED BY: B. Pham



	SOIL DESCRIPTION		GRAPHIC
3.5	SILTY SAND (SM): medium dense, reddish yellow, fine to medium grained, moist, with trace mica, (FILL) loose, with occasional clay seams	80.5	
6.0	CLAYEY SAND (SC): medium dense, gray, yellow, red, fine to medium grained, moist, with trace mica, (COASTAL PLAIN)	78.0	
10.0	LEAN CLAY (CL): very stiff, gray, yellow, red, fine grained, moist, with few mica, (COASTAL PLAIN) hard	74.0	
	Boring Terminated at 10 feet.		

REMARKS

No water was encountered at time of drilling, but stabilized at 4.5 feet (EL 79.5).
Boring cave-in at 6 feet.

Borehole backfilled on date drilled unless otherwise noted.
Consistency/Relative Density based on correction factor for Manual hammer.

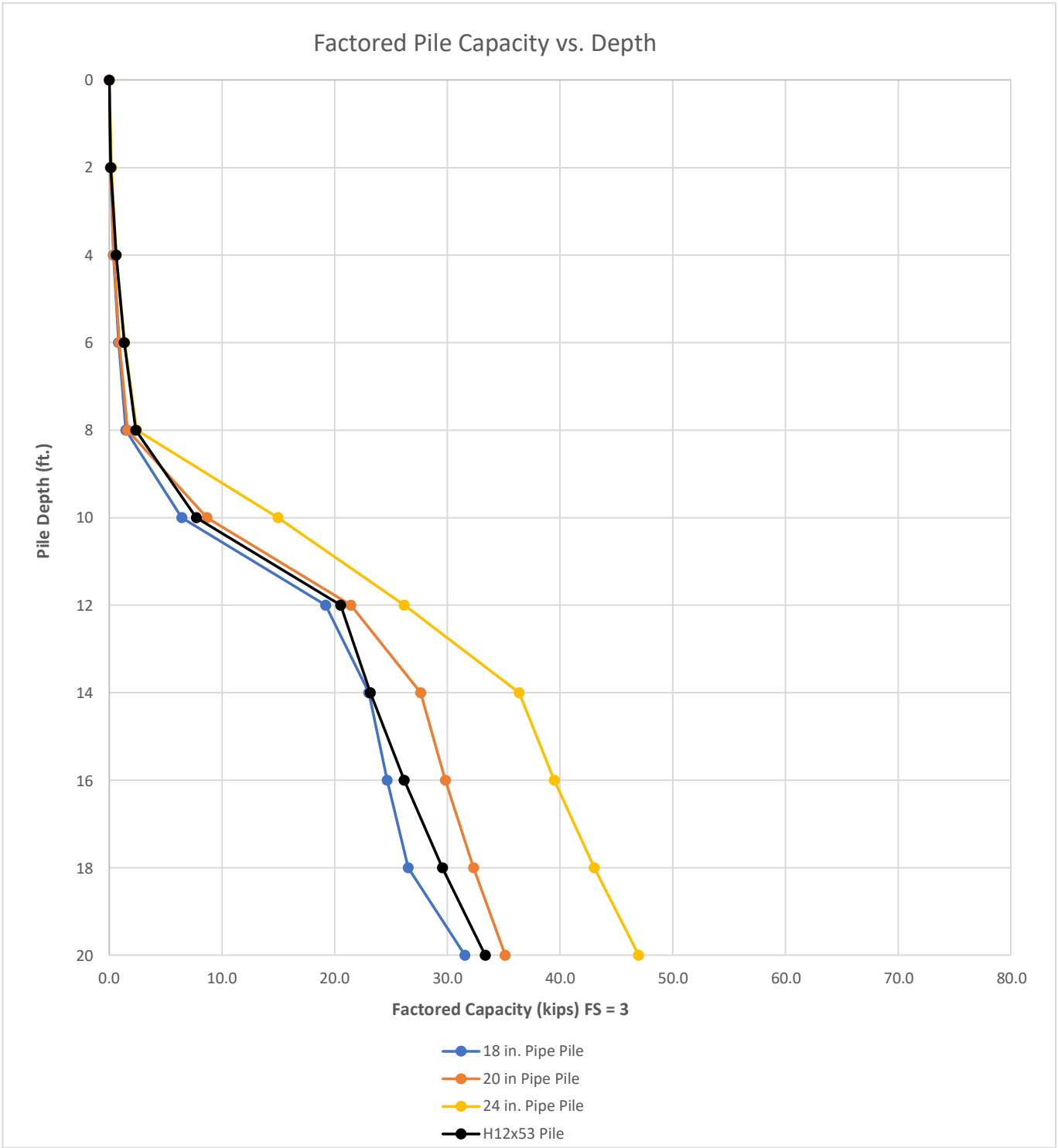
SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (AASHTO T-206)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
▽ GROUNDWATER LEVEL IN THE BOREHOLE AT TIME OF DRILLING
▼ STABILIZED GROUNDWATER LEVEL

REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED
Qu POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH

LL: LIQUID LIMIT **M:** NATURAL MOISTURE CONTENT
PL: PLASTIC LIMIT **F:** PERCENT PASSING NO. 200 SIEVE
PI: PLASTICITY INDEX

CALCULATIONS


Factored Pile Capacity vs. Depth
Pile Depth (ft.)
0
2
4
6
8
10
12
14
16
18
20
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Factored Capacity (kips) FS = 3
18 in. Pipe Pile
20 in Pipe Pile
24 in. Pipe Pile
H12x53 Pile

LABORATORY TEST PROCEDURES

A brief description of the laboratory tests performed is provided in the following sections.

DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D2488)

The soil samples were visually examined by our engineer and soil descriptions were provided. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate our visual descriptions with the Unified Soil Classification System (USCS).

NATURAL MOISTURE CONTENT (ASTM D2216)

Natural moisture contents (M%) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

ATTERBERG LIMITS (ASTM D4318)

The Atterberg Limits test was performed to evaluate the soil's plasticity characteristics. The soil Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid. The Plastic Limit is the moisture content at which the soil is between "plastic" and the semi-solid stage. The Plasticity Index (PI = LL - PL) is a frequently used indicator for a soil's potential for volume change. Typically, a soil's potential for volume change increases with higher plasticity indices.

MATERIAL FINER THAN NO. 200 SIEVE BY WASHING (ASTM D1140)

Grain-size tests were performed to determine the partial soil particle size distribution. The amount of material finer than the openings on the No. 200 sieve (0.075 mm) was determined by washing soil over the No. 200 sieve. The results of wash #200 tests are presented on the boring logs included in this report and in the table of laboratory test results.

UNCONFINED COMPRESSION TEST ON SOIL SAMPLES (ASTM D2166)

Unconfined compressive strength tests are performed on relatively undisturbed samples extruded from Shelby tubes. The unconfined compressive strength test provides indication of the approximate strength of cohesive soils in terms of total stresses. A tube sample is extruded and trimmed square to prepare a specimen with length to diameter ratio between 2.0 and 2.5. The specimen is placed in a loading device and subjected to a uniaxial compressive load. Load and deformation readings were recorded during each test. The sample is loaded until the load values decrease with increasing strain, or until the sample has experienced 15% strain. The unconfined compressive strength (Qu) is reported as the maximum stress value or stress value recorded at 15% strain, whichever occurred first.

LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

BORING NO.	DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE	CLASSIFICATION
B-01	0.0 - 1.5	13.6					
B-01	1.5 - 3.0	22.2	NP	NP	NP	16	SM
B-01	3.5 - 5.0	20.8	31	17	14	23	SC
B-01	6.0 - 7.5	37.6					
B-01	13.5 - 15.0	30.5					
B-01	18.5 - 20.0	18.8					
B-01	23.5 - 25.0	28.5					
B-01	28.5 - 30.0	15.7					
B-01	33.5 - 35.0	23.4					
B-01	38.5 - 40.0	18.5					
B-01	43.5 - 45.0	15.0					
B-01	48.5 - 50.0	16.2	51	23	28	63	CH
B-02	0.0 - 1.5	31.2					
B-02	1.5 - 3.0	18.8					
B-02	3.5 - 5.0	24.9					
B-02	6.0 - 7.5	23.4	40	18	22	48	SC
B-02	8.5 - 10.0	24.4					
B-02	13.5 - 15.0	19.9					
B-02	18.5 - 20.0	19.8					
B-02	23.5 - 25.0	14.8					
B-02	28.5 - 30.0	17.7	29	16	13	13	SC
B-02	33.5 - 35.0	19.9					
B-02	38.5 - 40.0	15.6					
B-02	43.5 - 45.0	15.7					
B-02	48.5 - 50.0	14.7					
B-03	8.5 - 10.0	19.6	NP	NP	NP	14	SM
B-03	23.5 - 25.0	14.2	37	18	19	17	SC
B-04	0.0 - 1.5	15.4					
B-04	1.5 - 3.0	15.8					
B-04	8.5 - 10.0	33.7	29	24	5	10	SP-SM
B-04	13.5 - 15.0	30.2	74	27	47	93	CH

TABLE L-1: General Soil Classification Test Results

Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic
[(1)] Indicates visual classification. WR indicates weathered rock.

LABORATORY TEST RESULTS

The results of the laboratory testing are presented in the following tables.

BORING NO.	DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING #200 SIEVE	CLASSIFICATION
B-04	18.5 - 20.0	20.4					
B-04	23.5 - 25.0	16.2					
B-04	28.5 - 30.0	19.0					
B-04	33.5 - 35.0	14.2					
B-04	38.5 - 40.0	16.5					
B-04	43.5 - 45.0	15.2					
B-04	48.5 - 50.0	19.6					
B-05	0.0 - 1.5	14.3					
B-05	1.5 - 3.0	16.9					
B-05	3.5 - 5.0	18.3					
B-05	8.5 - 10.0	24.0					
B-05	13.5 - 15.0	29.4					
B-05	18.5 - 20.0	27.0					
B-05	23.5 - 25.0	18.8					
B-05	28.5 - 30.0	20.1	26	17	9	13	SC
B-05	33.5 - 35.0	19.3	36	15	21	64	CL
B-05	38.5 - 40.0	18.2					
B-05	43.5 - 45.0	11.5					
B-05	48.5 - 50.0	18.1					
B-06	6.0 - 7.5		37	21	16	34	SC
B-07	6.0 - 7.5		27	17	10	27	SC
B-08	8.5 - 10.0		32	18	14	38	SC
B-12	8.5 - 10.0		47	23	24	88	CL
B-15	1.5 - 3.0		39	19	20	52	CL

TABLE L-1: General Soil Classification Test Results

Soils with a Liquid Limit (LL) greater than 50 and Plasticity Index (PI) greater than 25 usually exhibit significant volume change with varying moisture content and are considered to be highly plastic
(1) Indicates visual classification. WR indicates weathered rock.

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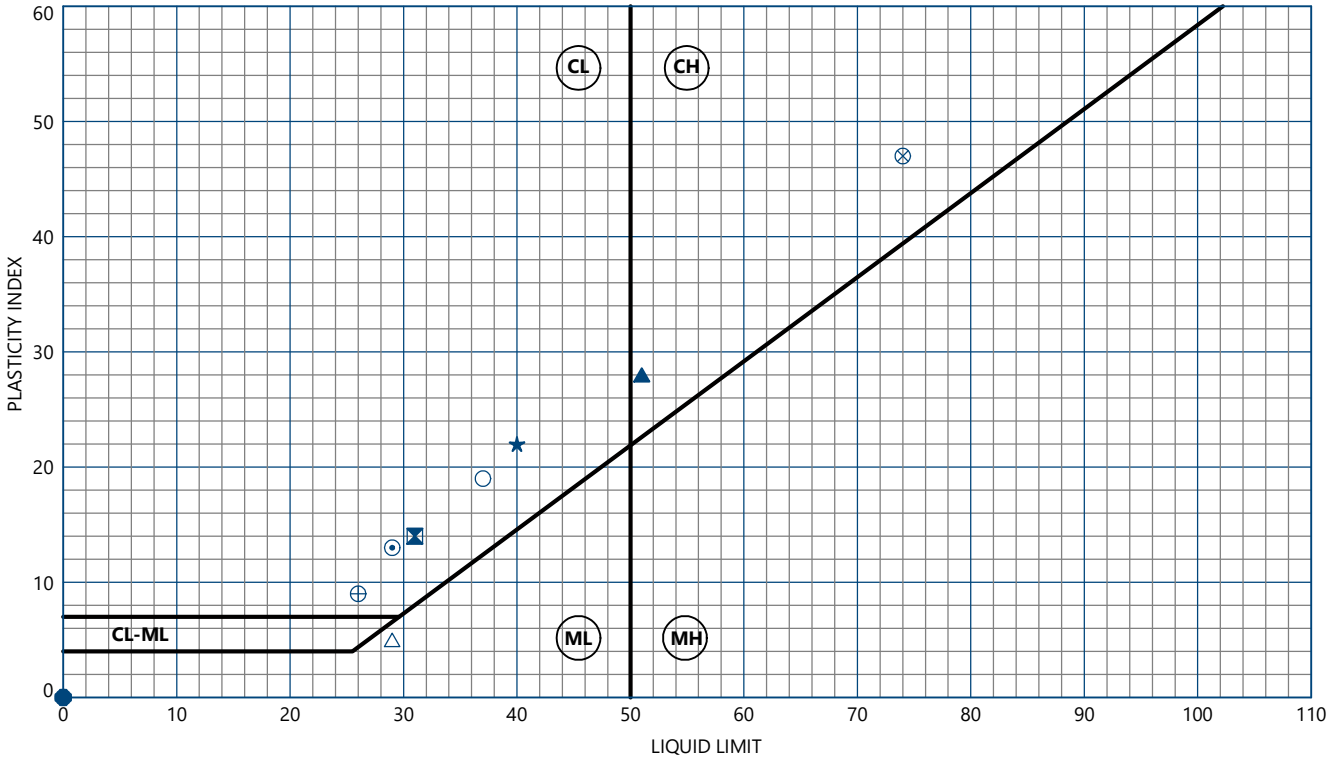
ATTERBERG LIMIT RESULTS
ASTM D4318-17

PROJECT NAME Claude Lee Road Sewer Outfall **PROJECT NUMBER** RD200783

CLIENT Fleming & Associates **PROJECT LOCATION** Fayetteville, NC



	SOURCE	DEPTH	LL	PL	PI	FINES	DESCRIPTION
●	B-01	1.5	NP	NP	NP	16	SILTY SAND(SM)
⊠	B-01	3.5	31	17	14	23	CLAYEY SAND(SC)
▲	B-01	48.5	51	23	28	63	SANDY FAT CLAY(CH)
★	B-02	6	40	18	22	48	CLAYEY SAND(SC)
⊙	B-02	28.5	29	16	13	13	CLAYEY SAND(SC)
✿	B-03	8.5	NP	NP	NP	14	SILTY SAND(SM)
○	B-03	23.5	37	18	19	17	CLAYEY SAND(SC)
△	B-04	8.5	29	24	5	10	POORLY GRADED SAND with SILT(SP-SM)
⊗	B-04	13.5	74	27	47	93	FAT CLAY(CH)
⊕	B-05	28.5	26	17	9	13	CLAYEY SAND(SC)

	EST MAX SIZE (mm)	ESTIMATED +NO. 40%	MOISTURE % AS RECEIVED	PREP METHOD	+NO. 40 REMOVAL METHOD	LL TYPE	LL EQUIPMENT	PL EQUIPMENT	GROOVING TOOL
●	25	38	22.2	Dry	Manual	Multipoint	Manual	Hand	Metal
⊠	10	35	20.8	Dry	Manual	Multipoint	Manual	Hand	Metal
▲	2	16	16.2	Dry	Manual	Multipoint	Manual	Hand	Metal
★	0.85	4	23.4	Dry	Manual	Multipoint	Manual	Hand	Metal
⊙	2	50	17.7	Dry	Manual	Multipoint	Manual	Hand	Metal
✿	9.5	48	19.6	Dry	Manual	Multipoint	Manual	Hand	Metal
○	2	49	14.2	Dry	Manual	Multipoint	Manual	Hand	Metal
△	4.75	40	33.7	Dry	Manual	Multipoint	Manual	Hand	Metal
⊗	0.85	1	30.2	Dry	Manual	Multipoint	Manual	Hand	Metal
⊕	2	33	20.1	Dry	Manual	Multipoint	Manual	Hand	Metal

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers
610 Spring Branch Road
Dunn, NC 28334
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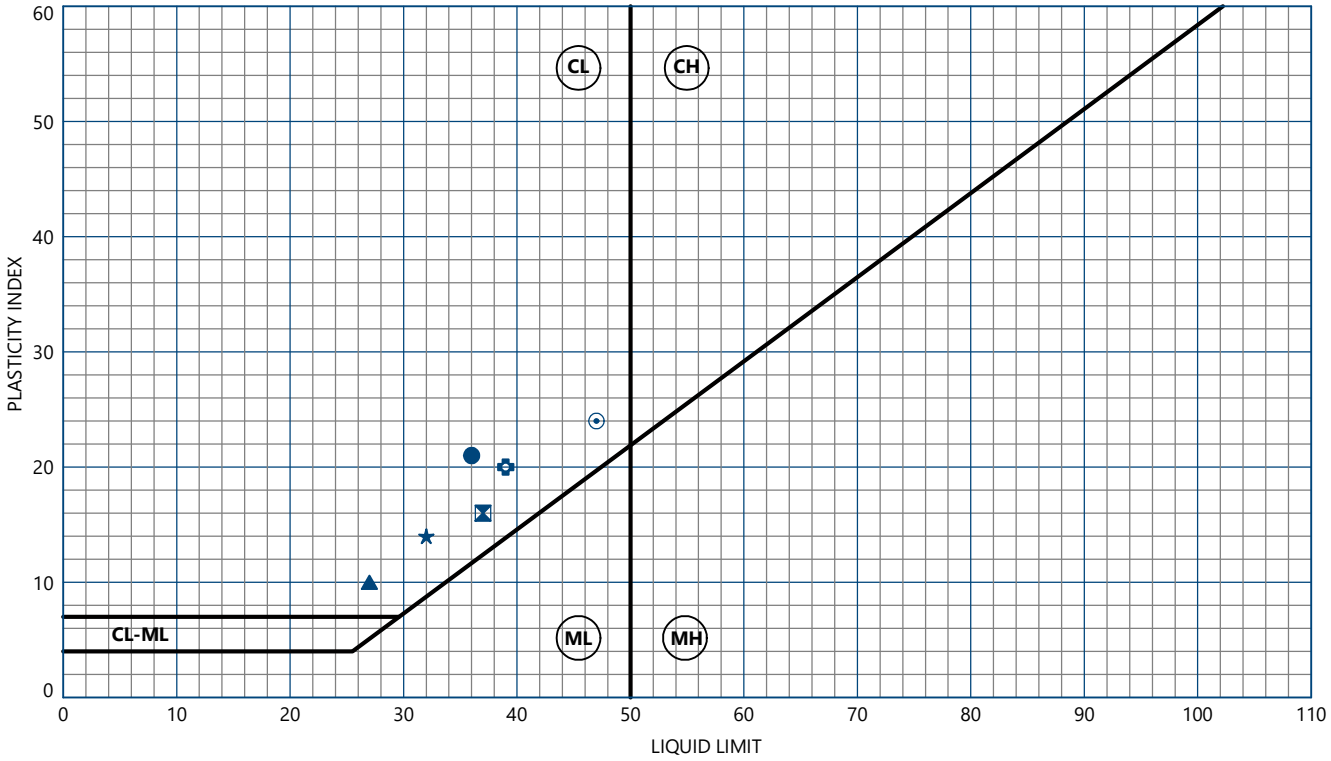
ATTERBERG LIMIT RESULTS
ASTM D4318-17

PROJECT NAME Claude Lee Road Sewer Outfall **PROJECT NUMBER** RD200783

CLIENT Fleming & Associates **PROJECT LOCATION** Fayetteville, NC



	SOURCE	DEPTH	LL	PL	PI	FINES	DESCRIPTION
●	B-05	33.5	36	15	21	64	SANDY LEAN CLAY(CL)
⊠	B-06	6	37	21	16	34	CLAYEY SAND(SC)
▲	B-07	6	27	17	10	27	CLAYEY SAND(SC)
★	B-08	8.5	32	18	14	38	CLAYEY SAND(SC)
⊙	B-12	8.5	47	23	24	88	LEAN CLAY(CL)
✿	B-15	1.5	39	19	20	52	SANDY LEAN CLAY(CL)

	EST MAX SIZE (mm)	ESTIMATED +NO. 40%	MOISTURE % AS RECEIVED	PREP METHOD	+NO. 40 REMOVAL METHOD	LL TYPE	LL EQUIPMENT	PL EQUIPMENT	GROOVING TOOL
●	0.85	3	19.3	Dry	Manual	Multipoint	Manual	Hand	Metal
⊠	9.5	30	Not tested	Dry	Manual	Multipoint	Manual	Hand	Metal
▲	2	27	Not tested	Dry	Manual	Multipoint	Manual	Hand	Metal
★	9.5	24	Not tested	Dry	Manual	Multipoint	Manual	Hand	Metal
⊙	0.85	1	Not tested	Dry	Manual	Multipoint	Manual	Hand	Metal
✿	9.5	19	Not tested	Dry	Manual	Multipoint	Manual	Hand	Metal

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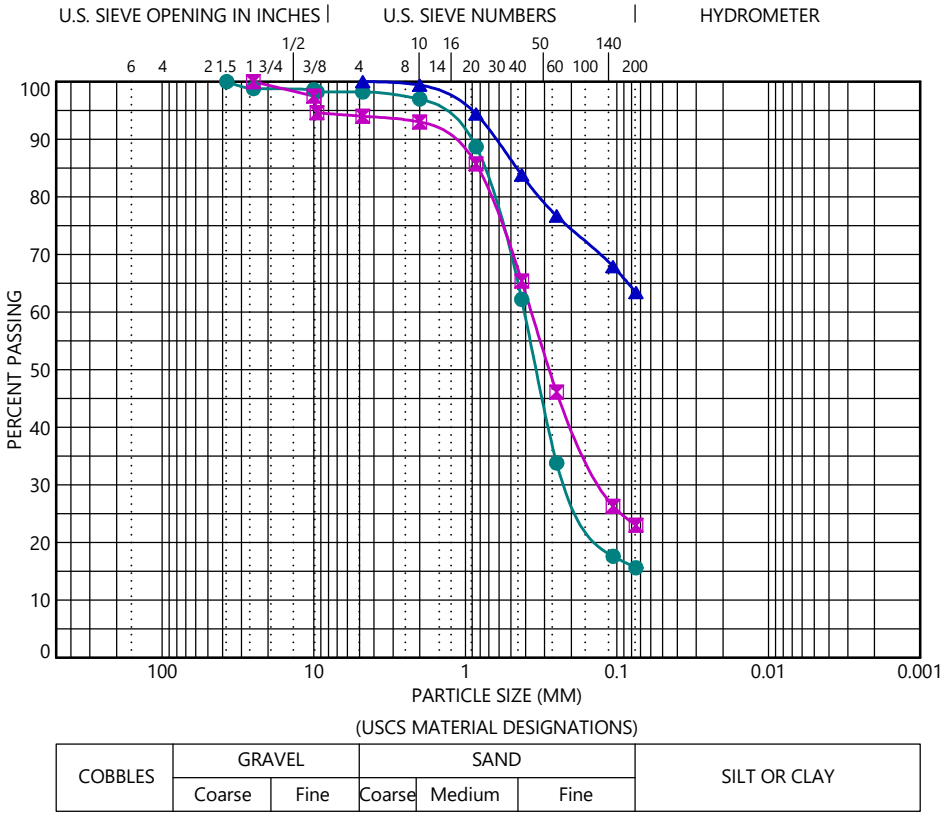
GRAIN SIZE DISTRIBUTION
ASTM D6913-17

PROJECT NAME Claude Lee Road Sewer Outfall **PROJECT NUMBER** RD200783

CLIENT Fleming & Associates **PROJECT LOCATION** Fayetteville, NC



(USCS MATERIAL DESIGNATIONS)

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

GENERAL SAMPLE AND TEST DATA

SOURCE: B-01
DEPTH: 1.5 FT SYMBOL: ●
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: SILTY SAND(SM)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-01
DEPTH: 3.5 FT SYMBOL: ⊠
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-01
DEPTH: 48.5 FT SYMBOL: ▲
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: SANDY FAT CLAY(CH)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

GRADATION TEST RESULTS

SOURCE: B-01 **DEPTH:** 1.5 FT **DESCRIPTION:** S-02

Sieve	1.5"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200						
Size (mm)	37.5	25	10	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075						
% Passing	100	99	99	98	98	97	89	62	34	18	16						
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
●	37.5	0.408	0.204		1.8	82.6		15.6		NP	NP	NP			Split Sieve Size: None		

SOURCE: B-01 **DEPTH:** 3.5 FT **DESCRIPTION:** S-03

Sieve	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200							
Size (mm)	25	10	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075							
% Passing	100	98	95	94	93	86	65	46	26	23							
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
⊠	25	0.366	0.124		6.0	71.0		23.0		31	17	14			Split Sieve Size: None		

SOURCE: B-01 **DEPTH:** 48.5 FT **DESCRIPTION:** S-13

Sieve	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200										
Size (mm)	4.75	2	0.85	0.425	0.25	0.106	0.075										
% Passing	100.0	99.4	94.4	83.8	76.7	67.9	63.4										
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
▲	4.75				0.0	36.6		63.4		51	23	28			Split Sieve Size: None		

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

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Dunn, NC 28334
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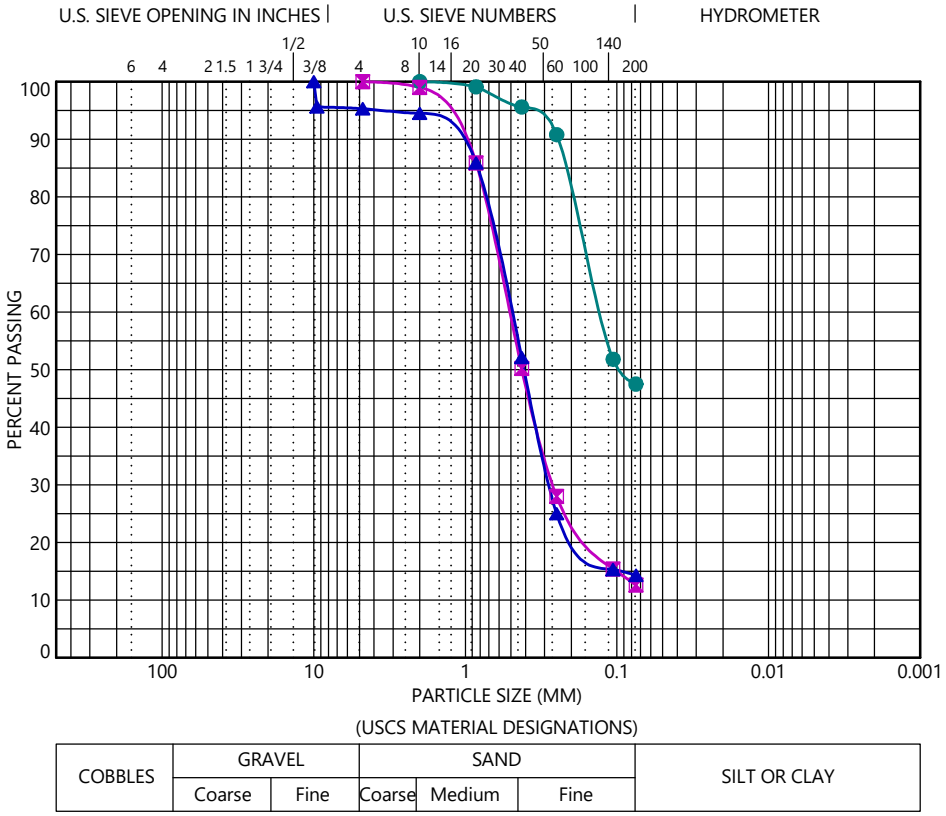
GRAIN SIZE DISTRIBUTION
ASTM D6913-17

PROJECT NAME Claude Lee Road Sewer Outfall **PROJECT NUMBER** RD200783

CLIENT Fleming & Associates **PROJECT LOCATION** Fayetteville, NC



(USCS MATERIAL DESIGNATIONS)

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

GENERAL SAMPLE AND TEST DATA

SOURCE: B-02
DEPTH: 6.0 FT SYMBOL: ●
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-02
DEPTH: 28.5 FT SYMBOL: ⊠
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-03
DEPTH: 8.5 FT SYMBOL: ▲
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: SILTY SAND(SM)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

GRADATION TEST RESULTS

SOURCE: B-02 **DEPTH:** 6.0 FT **DESCRIPTION:** S-04

Sieve	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200										
Size (mm)	2	0.85	0.425	0.25	0.106	0.075										
% Passing	100.0	99.1	95.6	90.8	51.8	47.5										
SYMBOL:	D100	D60	D30	D10	%Gravel	%Sand	%Silt	and	%Clay	LL	PL	PI	Cc	Cu	Composite Sieving: No	
●	2	0.127			0.0	52.5	47.5			40	18	22			Split Sieve Size: None	

SOURCE: B-02 **DEPTH:** 28.5 FT **DESCRIPTION:** S-09

Sieve	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200									
Size (mm)	4.75	2	0.85	0.425	0.25	0.106	0.075									
% Passing	100.0	99.0	85.9	50.2	28.0	15.4	12.6									
SYMBOL:	D100	D60	D30	D10	%Gravel	%Sand	%Silt	and	%Clay	LL	PL	PI	Cc	Cu	Composite Sieving: No	
⊠	4.75	0.514	0.262		0.0	87.4	12.6			29	16	13			Split Sieve Size: None	

SOURCE: B-03 **DEPTH:** 8.5 FT **DESCRIPTION:** S-05

Sieve	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200							
Size (mm)	10	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075							
% Passing	100	96	95	95	86	52	25	15	14							
SYMBOL:	D100	D60	D30	D10	%Gravel	%Sand	%Silt	and	%Clay	LL	PL	PI	Cc	Cu	Composite Sieving: No	
▲	10	0.5	0.276		4.7	81.0	14.3			NP	NP	NP			Split Sieve Size: None	

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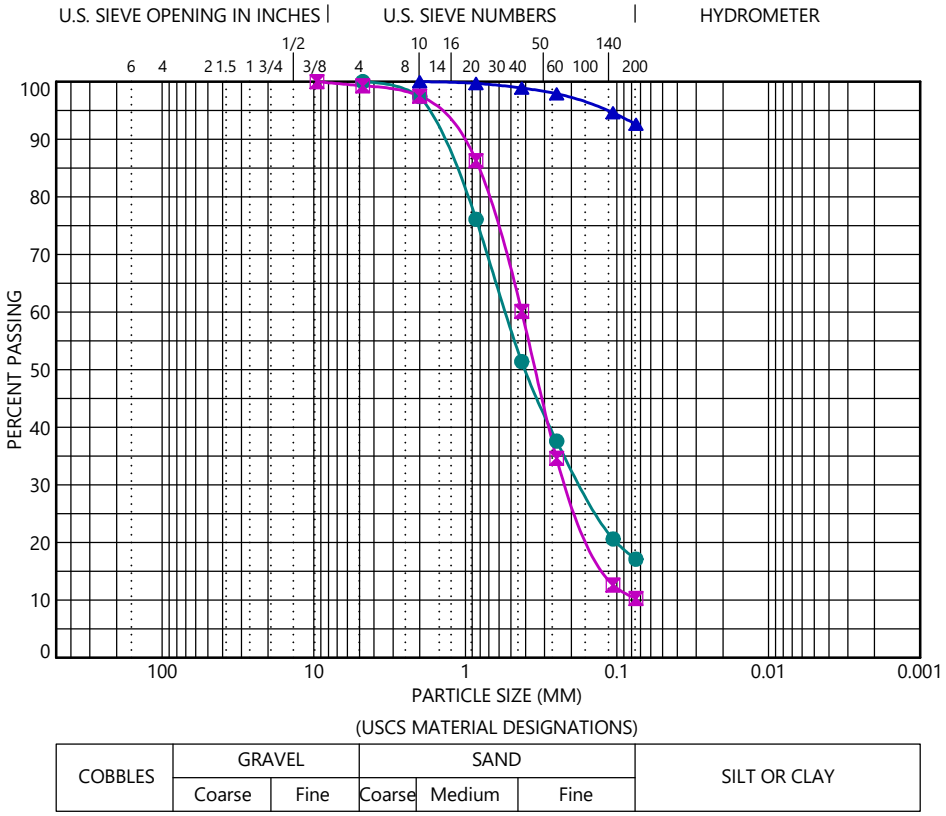
(910) 292-2085

GRAIN SIZE DISTRIBUTION
ASTM D6913-17

PROJECT NAME Claude Lee Road Sewer Outfall **PROJECT NUMBER** RD200783

CLIENT Fleming & Associates **PROJECT LOCATION** Fayetteville, NC



(USCS MATERIAL DESIGNATIONS)

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

GENERAL SAMPLE AND TEST DATA

SOURCE: B-03
DEPTH: 23.5 FT SYMBOL: ●
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-04
DEPTH: 8.5 FT SYMBOL: ⊠
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: POORLY GRADED SAND with SILT(SP-SM)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-04
DEPTH: 13.5 FT SYMBOL: ▲
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: FAT CLAY(CH)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

GRADATION TEST RESULTS

SOURCE: B-03 **DEPTH:** 23.5 FT **DESCRIPTION:** S-08

Sieve	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200										
Size (mm)	4.75	2	0.85	0.425	0.25	0.106	0.075										
% Passing	100.0	97.4	76.1	51.4	37.6	20.6	17.1										
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
●	4.75	0.541	0.17		0.0	82.9		17.1		37	18	19			Split Sieve Size: None		

SOURCE: B-04 **DEPTH:** 8.5 FT **DESCRIPTION:** S-05

Sieve	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200									
Size (mm)	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075									
% Passing	100	99	98	86	60	35	13	10									
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
⊠	9.5	0.424	0.209		0.7	89.0		10.3		29	24	5	1.44	5.92	Split Sieve Size: None		

SOURCE: B-04 **DEPTH:** 13.5 FT **DESCRIPTION:** S-06

Sieve	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200											
Size (mm)	2	0.85	0.425	0.25	0.106	0.075											
% Passing	100.0	99.7	98.9	97.9	94.6	92.6											
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
▲	2				0.0	7.4		92.6		74	27	47			Split Sieve Size: None		

BUILDING & EARTH
Geotechnical, Environmental, and Materials Engineers

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GRAIN SIZE DISTRIBUTION
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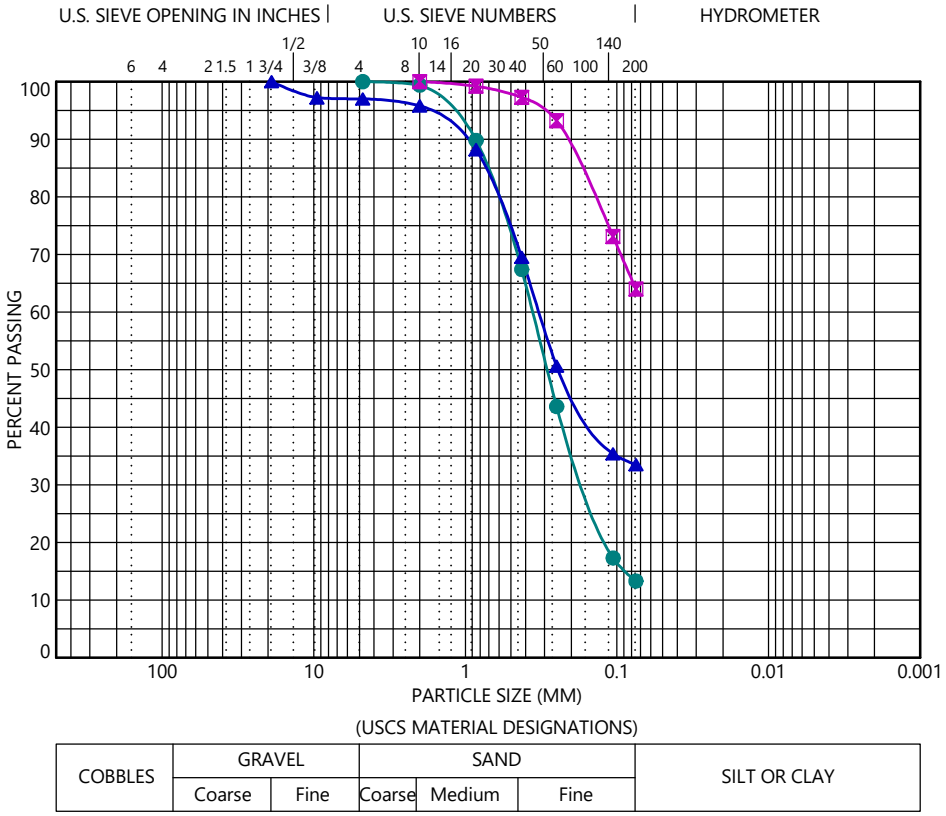
CLIENT Fleming & Associates **PROJECT LOCATION** Fayetteville, NC



(USCS MATERIAL DESIGNATIONS)

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

GENERAL SAMPLE AND TEST DATA

SOURCE: B-05
DEPTH: 28.5 FT SYMBOL: ●
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-05
DEPTH: 33.5 FT SYMBOL: ⊠
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: SANDY LEAN CLAY(CL)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-06
DEPTH: 6.0 FT SYMBOL: ▲
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

GRADATION TEST RESULTS

SOURCE: B-05 **DEPTH:** 28.5 FT **DESCRIPTION:** S-09

Sieve	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200										
Size (mm)	4.75	2	0.85	0.425	0.25	0.106	0.075										
% Passing	100.0	99.4	89.8	67.4	43.6	17.3	13.3										
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
●	4.75	0.36	0.16		0.0	86.7	13.3			26	17	9			Split Sieve Size: None		

SOURCE: B-05 **DEPTH:** 33.5 FT **DESCRIPTION:** S-10

Sieve	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200											
Size (mm)	2	0.85	0.425	0.25	0.106	0.075											
% Passing	100.0	99.2	97.3	93.2	73.1	64.0											
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
⊠	2				0.0	36.0	64.0			36	15	21			Split Sieve Size: None		

SOURCE: B-06 **DEPTH:** 6.0 FT **DESCRIPTION:** S-04

Sieve	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200								
Size (mm)	19	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075								
% Passing	100	97	97	96	88	70	51	35	34								
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
▲	19	0.326			3.0	63.5	33.5			37	21	16			Split Sieve Size: None		

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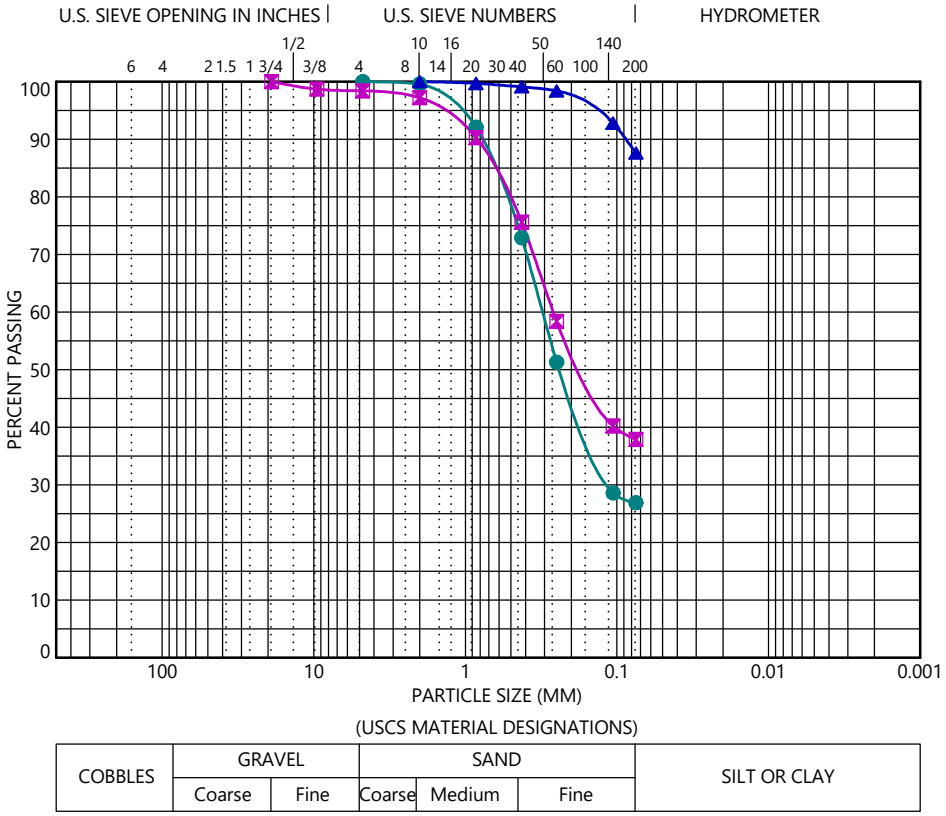

(USCS MATERIAL DESIGNATIONS)

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

GENERAL SAMPLE AND TEST DATA

SOURCE: B-07
DEPTH: 6.0 FT SYMBOL: ●
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-08
DEPTH: 8.5 FT SYMBOL: ⊠
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: CLAYEY SAND(SC)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

SOURCE: B-12
DEPTH: 8.5 FT SYMBOL: ▲
TESTED BY: J.Dailly TEST METHOD: B
SPECIMEN PROCUREMENT: Oven Dried
USCS: LEAN CLAY(CL)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

GRADATION TEST RESULTS

SOURCE: B-07 **DEPTH:** 6.0 FT **DESCRIPTION:** S-04

Sieve	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200										
Size (mm)	4.75	2	0.85	0.425	0.25	0.106	0.075										
% Passing	100.0	99.6	92.1	72.9	51.3	28.6	26.9										
SYMBOL:	D100	D60	D30	D10	%Gravel	%Sand	%Silt	and	%Clay	LL	PL	PI	Cc	Cu	Composite Sieving: No		
●	4.75	0.31	0.112		0.0	73.1	26.9			27	17	10			Split Sieve Size: None		

SOURCE: B-08 **DEPTH:** 8.5 FT **DESCRIPTION:** S-05

Sieve	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200								
Size (mm)	19	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075								
% Passing	100	99	98	97	90	76	58	40	38								
SYMBOL:	D100	D60	D30	D10	%Gravel	%Sand	%Silt	and	%Clay	LL	PL	PI	Cc	Cu	Composite Sieving: No		
⊠	19	0.263			1.6	60.5	37.9			32	18	14			Split Sieve Size: None		

SOURCE: B-12 **DEPTH:** 8.5 FT **DESCRIPTION:** S-05

Sieve	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200											
Size (mm)	2	0.85	0.425	0.25	0.106	0.075											
% Passing	100.0	99.7	99.1	98.4	92.8	87.6											
SYMBOL:	D100	D60	D30	D10	%Gravel	%Sand	%Silt	and	%Clay	LL	PL	PI	Cc	Cu	Composite Sieving: No		
▲	2				0.0	12.4	87.6			47	23	24			Split Sieve Size: None		

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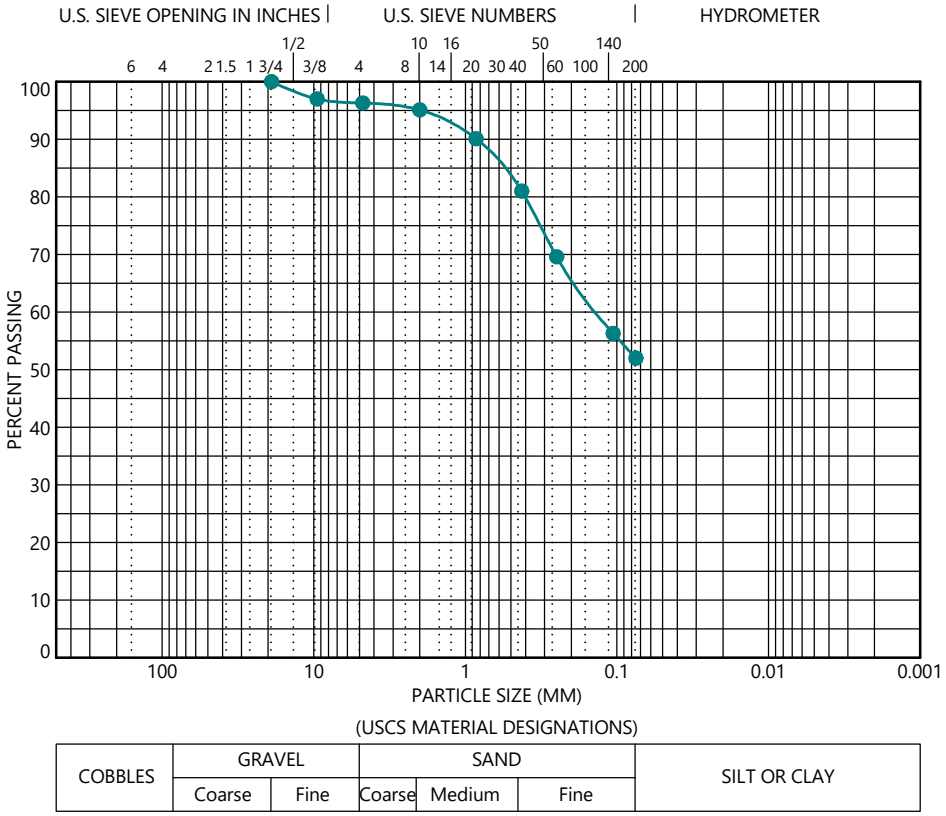

(USCS MATERIAL DESIGNATIONS)

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

GENERAL SAMPLE AND TEST DATA

SOURCE: B-15
DEPTH: 1.5 FT SYMBOL: ●
TESTED BY: J.Dailly TEST METHOD: A
SPECIMEN PROCUREMENT: Oven Dried
USCS: SANDY LEAN CLAY(CL)
DISPERSION: Shaking Apparatus
PRIOR TESTING:
EXCLUDED MATERIAL OR TEST PROBLEMS: None

GRADATION TEST RESULTS

SOURCE: B-15 **DEPTH:** 1.5 FT **DESCRIPTION:** S-02

Sieve	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200								
Size (mm)	19	9.5	4.75	2	0.85	0.425	0.25	0.106	0.075								
% Passing	100	97	96	95	90	81	70	56	52								
SYMBOL:	**D100**	**D60**	**D30**	**D10**	**%Gravel**	**%Sand**	**%Silt**	**and**	**%Clay**	**LL**	**PL**	**PI**	**Cc**	**Cu**	Composite Sieving: No		
●	19	0.135			3.7	44.3	52.0			39	19	20			Split Sieve Size: None		

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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Preliminary Engineering Report for Bank Stabilization and Access Roadway Stabilization at Rockfish Outfall (Fleming, October 28, 2021