ECS Southeast, LLP

Geotechnical Engineering Report

Fayetteville Raeford Road Projects

3101 Raeford Road
Fayetteville, North Carolina

ECS Project No. 33:5380

November 6, 2020

ECS SOUTHEAST, LLP
"Setting the Standard for Service"
Geotechnical • Construction Materials • Environmental • Facilities
NC Registered Engineering Firm F-1078
NC Registered Geologists Firm C-406
SC Registered Engineering Firm 3245

November 6, 2020

Mr. Albert James
Columbia Development
1845 St Julian Place
Columbia, SC 29204

ECS Project No. 33:5380

Reference: Geotechnical Engineering Report
Fayetteville Raeford Road Projects
3101 Raeford Road
Fayetteville, North Carolina

Dear Mr. James:

ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to Columbia Development during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLP

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NORTH CAROLINA PROFESSIONAL SEAL 013751 ENGINEER WINSLOW E. GOINS
11/6/20

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APPENDICES

EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- Structural loading for the proposed construction was not provided to us at the time this report was prepared. However, based on the assumed framing and anticipated construction material type, we estimate maximum column and wall loads will be less than 50 kips and 2 kips per linear foot, respectively.

- Provided the subgrades are prepared as recommended in this report, the planned buildings may be supported by conventional shallow foundations consisting of column or strip footings bearing on compacted structural fill and natural soils sized using a net allowable soil bearing pressure of 2,500 psf.

- Very loose and very soft soils were encountered within the top 3 feet in the areas represented by Borings B-1 through B-4 and B-9. Depending on the final foundation elevations, undercutting the very loose and very soft soils at these locations, in addition to other localized areas between and away from the borings may be required.

- The above recommended net allowable bearing pressure is based on the assumption that any very loose to loose soils encountered at the footing elevations are either densified in place or undercut and replaced as discussed in this report.

1.0 INTRODUCTION

The purpose of this study was to provide geotechnical information for the design of buildings and pavements for the proposed Chipotle and Panda Express restaurants. The project will include two buildings, paved parking and drive areas, and a dumpster pad. The recommendations developed for this report are based on project information supplied by Mr. Albert James with Columbia Development.

Our services were provided in accordance with our Proposal No. 33:4606-R1, dated October 19, 2020, as authorized by Mr. Albert James with Columbia Development on October 19, 2020, which includes our Terms and Conditions of Service.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project.

The report includes the following items.

- Observations from our site reconnaissance including current site conditions.
- A brief review of the published geologic conditions.
- A description of the field exploration and laboratory tests performed and a characterization of the subsurface conditions.
- Recommended allowable soil bearing pressure for conventional shallow foundations.
- Recommendations for slab-on-grade design and construction.
- Recommendations for design and construction of the pavements.
- Evaluation of the on-site soil characteristics encountered in the soil borings, including suitability of the on-site materials for reuse as engineered fill, compaction requirements and suitable material guidelines.
- Logs of the soil borings prepared in accordance with the standard practice for geotechnical engineering.
- Results of the laboratory tests performed.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE

The subject site is located at 3101 Raeford Road in Fayetteville, North Carolina. The site consists of two contiguous parcels identified by the Cumberland County Online GIS Database as Parcel Identification Numbers (REID) 0427016098000 (2.05 acres) and 0427018027000 (0.4 acre) both owned by Christ United Methodist Church of Fayetteville. The approximate location of the site is shown on Figure 2.1.1 and included on the Site Location Diagram in Appendix A.

At the time of our field exploration, the property was developed with an existing church building and the associated pavements. We have assumed the existing building and pavements will be demolished as part of the planned development. The existing ground surface is relatively flat with approximate elevations, taken from Google Earth, ranging from 211 to 213 feet.

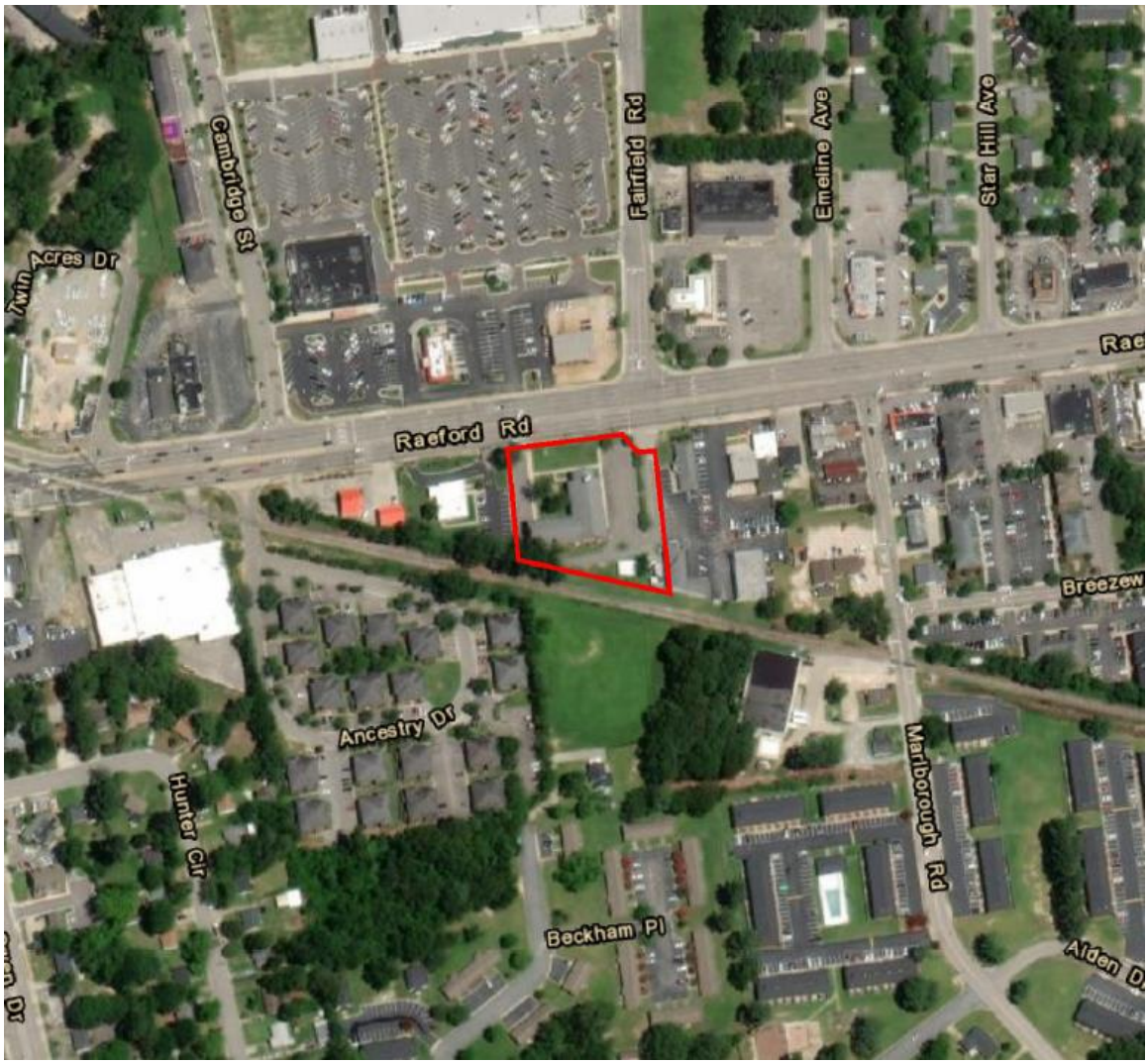


Figure 2.1.1. Site Location

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned development:

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Building Footprints	Approximately 2,325 square feet (Chipotle) Approximately 2,300 square feet (Panda Express)
# of Stories	Single-story
Usage	Restaurant
Framing	Wood-framed structure with slabs-on-grade (assumed)
Column Loads	50 kips maximum (assumed)
Wall Loads	2 kips per linear foot maximum (assumed)
Finish Floor Elevation	±2 feet of existing grades (assumed)

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

Our exploration procedures are explained in greater detail in Appendix B including the insert titled Subsurface Exploration Procedures. Our scope of work included drilling nine borings. Our borings were located with a handheld GPS unit and their approximate locations are shown on the Boring Location Diagram in Appendix A.

3.2 LABORATORY TESTING

Each sample was visually classified on the basis of texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols, and ASTM D2487 Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System (USCS)). After classification, the samples were grouped in the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

The laboratory testing consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests performed on representative soil samples included three natural moisture content tests, three percent passing sieve number 200 (wash sieve) tests, and three Atterberg limits tests.

3.3 SUBSURFACE CHARACTERIZATION

The site is located in the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain is composed of seven terraces, each representing a former level of the Atlantic Ocean. Soils in this area generally consist of sedimentary materials transported from other areas by the ocean or rivers. These deposits vary in thickness from a thin veneer along the western edge of the region to more than 10,000 feet near the coast. The sedimentary deposits of the Coastal Plain rest upon consolidated rocks similar to those underlying the Piedmont and Mountain Physiographic Provinces. In general, shallow unconfined groundwater movement within the overlying soils is largely controlled by topographic gradients. Recharge occurs primarily by infiltration along higher elevations and typically discharges into streams or other surface water bodies. The elevation of the shallow water table is transient and can vary greatly with seasonal fluctuations in precipitation.

The generalized subsurface conditions encountered in the borings are described below. For soil stratification at a particular test location, the respective boring log found in Appendix B should be reviewed.

Approximate Depth (ft.)	Stratum	Description	Ranges of SPT(1) N-values (bpf)
0 to 0.75 (Surface Cover)	N/A	Borings B-1, B-6 and B-8 encountered approximately 2 to 4 inches of asphalt underlain by approximately 3 to 5 inches of aggregate base course (ABC) stone. The other borings encountered approximately 3 to 6 inches of topsoil	N/A
0.75 to 3	I	Very Loose to Loose SAND (SP-SM, SM) and Very Soft Sandy SILT (ML)	2 to 10
3 to 20	II	Medium Dense to Dense SAND (SC, SM, SP, and SP-SC) and Firm to Very Stiff Sandy SILT (ML) and Sandy CLAY (CL)	7 to 37

Notes:
(1) Standard Penetration Testing

3.4 GROUNDWATER OBSERVATIONS

Water levels were measured in our borings as noted on the boring logs in Appendix B. Groundwater was not encountered in the borings at the time of drilling to the depths explored. We observed borehole caving at approximate depths of 5 to 13 feet which may be an indicator of groundwater presence. Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors.

4.0 DESIGN RECOMMENDATIONS

4.1 FOUNDATIONS

Provided subgrades and structural fills are prepared as recommended in this report, the proposed structure can be supported by shallow foundations including column footings and continuous wall footings. We recommend the foundation design use the following parameters:

Design Parameter	Column Footing	Wall Footing
Net Allowable Bearing Pressure(1)	2,500 psf	2,500 psf
Acceptable Bearing Soil Material	Stable Natural Soil or Compacted Structural Fill	
Minimum Width	24 inches	18 inches
Minimum Footing Embedment Depth (below slab or finished grade) (2)	12 inches	12 inches
Estimated Total Settlement (3)	Less than 1 inch	Less than 1 inch
Estimated Differential Settlement (4)	Less than ½ inch between columns	Less than ½ inch

Notes:
(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) For bearing considerations and frost penetration requirements.
(3) Based on assumed structural loads. If final loads are different, ECS must be contacted to update foundation recommendations and settlement calculations.
(4) Based on maximum column/wall loads and variability in borings. Differential settlement can be re-evaluated once the foundation plans are more complete.

4.2 SLABS ON GRADE

The on-site natural soils are considered suitable for support of the floor slabs. Assuming the finished floor elevation is around the current site elevations, it appears that the slabs for the structure will bear on the near-surface natural soils and/or approved structural fill. These materials are suitable for the support of a slab-on-grade; however, there may be areas of soft or yielding soils that should be removed and replaced with compacted structural fill in accordance with the recommendations included in this report. The following graphic depicts our soil-supported slab recommendations:

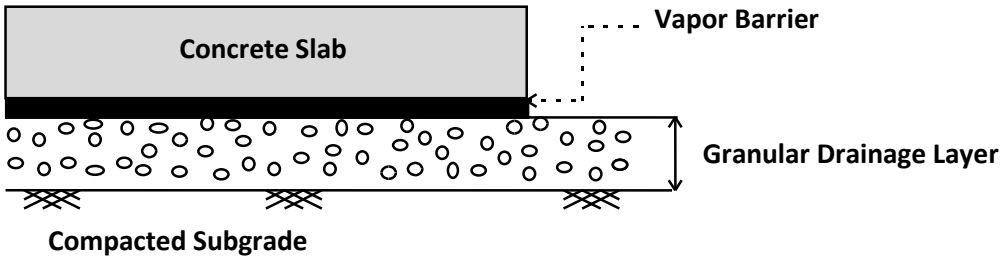


Figure 4.2.1 Slab-on-Grade Section

1. Drainage Layer Thickness: 4 inches, minimum
2. Drainage Layer Material: GRAVEL (GP, GW), SAND containing <12% fines (SP, SW, SP-SM, SW-SM)
2. Subgrade Compacted to at least 98% of the Maximum Dry Density per ASTM D698

Subgrade Modulus: Provided the Structural Fill and Granular Drainage Layer are constructed in accordance with our recommendations, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 150 pci (lbs./cu. inch). The modulus of subgrade reaction value is based on 1 ft by 1 ft plate load test data and CBR correlations for similar soils.

Vapor Barrier: Before the placement of concrete, a vapor barrier may be placed on top of the granular drainage layer to provide additional protection against moisture penetration through the floor slab. When a vapor barrier is used, special attention should be given to surface curing of the slab to reduce the potential for uneven drying, curling and/or cracking of the slab. Depending on proposed flooring material types, the structural engineer and/or the architect may choose to eliminate the vapor barrier.

Slab Isolation: Soil-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab such as in a drop down footing/monolithic slab configuration, the slab should be designed with suitable reinforcement and load transfer devices to avoid overstressing of the slab.

4.3 PAVEMENTS

Design Traffic Loading: Detailed traffic loading information for the project is not available at this time. We have assumed a design traffic loading of up to 10,000 ESALs in 20 years for light duty pavements and up to 50,000 ESALs in 20 years, for heavy duty pavements.

Subgrade Characteristics: Based on the results of our borings, it appears that the soils that will be exposed as pavement subgrades consist mainly of Silty SAND (SM). California Bearing Ratio (CBR) testing was not performed as part of this study. For section thickness design purposes, a CBR value of 7 has been selected. The pavement design assumes subgrades consist of suitable materials evaluated by ECS and placed and compacted to at least 98 percent of the maximum dry density as determined by the standard Proctor test (ASTM D 698) in accordance with the project specifications.

Minimum Material Thicknesses: Pavements for the project are expected to consist of light duty parking areas and heavy duty pavements in truck traffic areas. We recommend the following minimum pavement sections for the project.

PROPOSED PAVEMENT SECTIONS			
MATERIAL	**FLEXIBLE PAVEMENT**		**RIGID PAVEMENT**
	Light Duty	**Heavy Duty**	
Portland Cement Concrete (f'_c = 4000 psi, air-entrained)	-	-	5 inches
Asphaltic Concrete Surface Course (S9.5B)	2 inches	2 inches	-
Aggregate Base Course	6 inches	8 inches	4 inches

In general, heavy duty sections are areas that will be subjected to trucks, buses, or other similar vehicles including main drive lanes of the development. Light duty sections are appropriate for vehicular traffic and parking areas.

ECS should be allowed to review these recommendations and make appropriate revisions based upon the formulation of the final traffic design criteria for the project. It is important to note that the design sections do not account for construction traffic loading.

It should also be noted that these design recommendations may not satisfy the North Carolina Department of Transportation traffic guidelines. Any roadways constructed for public use and to be dedicated to the State for repair and maintenance must be designed in accordance with the State requirements.

Large, front loading trash dumpsters frequently impose concentrated front wheel loads on pavements during loading. This type of loading typically results in rutting of bituminous pavements and ultimately pavement failures and costly repairs. Therefore, we suggest that the pavements in trash drive-thru areas utilize the aforementioned Portland Cement Concrete (PCC) pavement section. It may be prudent to use rigid pavement sections in areas planned for heavy truck traffic. Appropriate steel reinforcing and jointing should also be incorporated into the design of PCC pavements.

The soil subgrade should be smooth-rolled and proofrolled prior to ABC placement. Areas that pump, rut, or are otherwise unstable should be re-compacted or undercut and replaced. The ABC should conform to the gradation, liquid limit, plasticity index, resistance to abrasion, and soundness per Section 1005 of the 2012 NCDOT Standard Specifications for Roads and Structures.

The ABC should be placed and be compacted in accordance with Section 520 of the 2012 NCDOT Standard Specifications for Roads and Structures. The ABC should be placed in a single lift. It should be spread after end-dumping on previously-placed ABC to prevent rutting and degradation of the relatively clean sand subgrade soils by rubber-tired dump trucks. The ABC should be compacted to at least 98 percent of its modified Proctor maximum dry unit weight per ASTM D1557 or AASHTO T180 (as modified by NCDOT), provided nuclear density testing is performed. Otherwise, at least 100% compaction is recommended.

To confirm that the specified degree of compaction is being obtained, field compaction testing should be performed in each ABC lift by the geotechnical engineer's representative. We recommend that compaction tests be performed at a minimum frequency of one test per 5,000 square feet per lift in pavement areas.

Minimum Material Lift Thickness: The minimum lift thickness for S9.5B is 1.0 inch and the maximum lift thickness for S9.5B is 1.5 inches. For sections with more than 1.5 inches of S9.5B surface asphalt, it should be placed in two lifts of equal thickness. Asphalt pavement S9.5B should be compacted to least 90.0 percent of the material's specific gravity G_{mm}.

Drainage: An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the aggregate base course layer, softening of the subgrades and other problems related to the deterioration of the pavement can be expected. This is particularly important at the site due to the moisture sensitive near-surface soils. Furthermore, good drainage should help reduce the possibility of the subgrade materials becoming saturated during the normal service period of the pavement.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

5.1.1 Previous Site Development

When reviewing our recommendations, please note that there are existing structures on this site, and that previous grading activities have occurred on this site. Our experience with previously graded sites indicates that unexpected conditions can exist that were not encountered by the soil test borings. Unexpected conditions could include areas of soft or loose fill, debris-laden fill, and other obstructions or conditions. These conditions should be addressed by on-site engineering evaluation by ECS during construction.

5.1.2 Demolition

Site demolition should include the removal of the existing building, asphalt pavement, concrete slabs, underground utilities, and any other buried structures from the proposed construction areas. Any underground utilities that may exist within the proposed building areas should be relocated, and any within proposed pavement areas should be evaluated by the design team and relocated or filled with grout, if necessary. Excavations or cavities resulting from demolition should be backfilled with compacted structural backfill.

5.1.3 Stripping and Grubbing

The subgrade preparation should consist of stripping vegetation, rootmat, topsoil, existing fill, and any soft or unsuitable materials from the 10-foot expanded building and 5-foot expanded pavement limits, and 5 feet beyond the toe of structural fills. The borings encountered approximately 3 or 6 inches of topsoil. ECS should be retained to verify that topsoil and unsuitable surficial materials have been removed prior to the placement of structural fill or construction of structures.

5.1.4 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by an ECS field technician. The exposed subgrade should be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of an ECS technician. This procedure is intended to assist in identifying any localized yielding materials.

Where proofrolling identifies areas that are unstable or "pumping" subgrade those areas should be repaired prior to the placement of any subsequent Structural Fill or other construction materials. Methods of stabilization include undercutting, moisture conditioning, or chemical stabilization. The situation should be discussed with ECS to determine the appropriate procedure. Test pits may be excavated to explore the shallow subsurface materials to help in determining the cause of the observed unstable materials, and to assist in the evaluation of appropriate remedial actions to stabilize the subgrade.

Based on the soil test borings, we anticipate undercutting of very loose and very soft near-surface natural soils will be necessary in localized areas of the site (for example, near Borings B1 through B-4 and B-9). Undercut excavations should be backfilled with properly placed and compacted structural fill. Use of geotextiles and select granular fill may be recommended by ECS during construction to reduce the required undercut depths and/or aid in stabilization of subgrades.

5.1.5 Site Temporary Dewatering

Based upon our subsurface exploration at this site, as well as significant experience on sites in nearby areas of similar geologic setting, we believe construction dewatering at this site will be mainly limited to removing accumulated rain water and some minor seepage from the support of excavation.

Dewatering operations, if required, can be handled by the use of conventional submersible pumps directly in the excavation or temporary trenches to direct the flow of water and to remove water from the excavation. If temporary sump pits are used, we recommend they be established at an elevation 3 to 5 feet below the bottom of the excavation subgrade or bottom of footing. A perforated 55 gallon drum or other temporary structure could be used to house the pump. We recommend continuous dewatering of the excavations using pumps during construction.

5.2 EARTHWORK OPERATIONS

Structural Fill: Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Satisfactory Structural Fill Materials: Materials satisfactory for use as structural fill should consist of inorganic soils with the following engineering properties and compaction requirements.

STRUCTURAL FILL INDEX PROPERTIES	
Subject	**Property**
Building and Pavement Areas	LL < 40, PI < 20
Max. Particle Size	3 inches
Max. Organic Content	5% by dry weight

STRUCTURAL FILL COMPACTION REQUIREMENTS	
Subject	**Requirement**
Compaction Standard	Standard Proctor, ASTM D698
Required Compaction	98% of Max. Dry Density within top 12 inches, and 95% elsewhere
Moisture Content	-3 to +3 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction

On-Site Borrow Suitability: The on-site soils meeting the classifications for recommended satisfactory structural fill, plus meeting the restrictions on organic content and debris, may be used as structural fill. We anticipate that the majority of soils encountered in the borings within the anticipated excavation depths will be satisfactory for use as compacted structural fill. On-site soils used as structural fill will require careful moisture control in order to achieve compaction and stability.

Fill Placement: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and frozen or frost-heaved soils should be removed prior to placement of structural fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

5.3 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structure. It is important to have ECS observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated.

Slab Subgrade Verification: A representative of ECS should be called to observe exposed subgrades within the expanded building limits prior to structural fill placement to assure that adequate subgrade preparation has been achieved. Proofrolling using a drum roller or loaded dump truck should be performed in their presence at that time. Once subgrades have been determined to be firm and stable, structural fill can be placed.

If there will be a significant time lag between the site grading work and final grading of concrete slab areas prior to the placement of the design floor slab section materials, a representative of ECS should be called to verify the condition of the prepared soil subgrade. Prior to final floor slab section construction, the soil subgrade may require scarification, moisture conditioning, and re-compaction to restore stable conditions.

5.4 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrades should be observed and probed for stability by ECS. Any loose or unsuitable materials encountered should be removed and replaced with suitable compacted Structural Fill, or pipe stone bedding material.

Utility Backfilling: The granular bedding material (often AASHTO #57 stone) should be at least 4 inches thick, but not less than that specified by the civil engineer's project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for structural fill and fill placement.

Excavation Safety: Excavations and slopes should be constructed and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing, constructing, and maintaining stable temporary excavations and slopes. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by Columbia Development. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

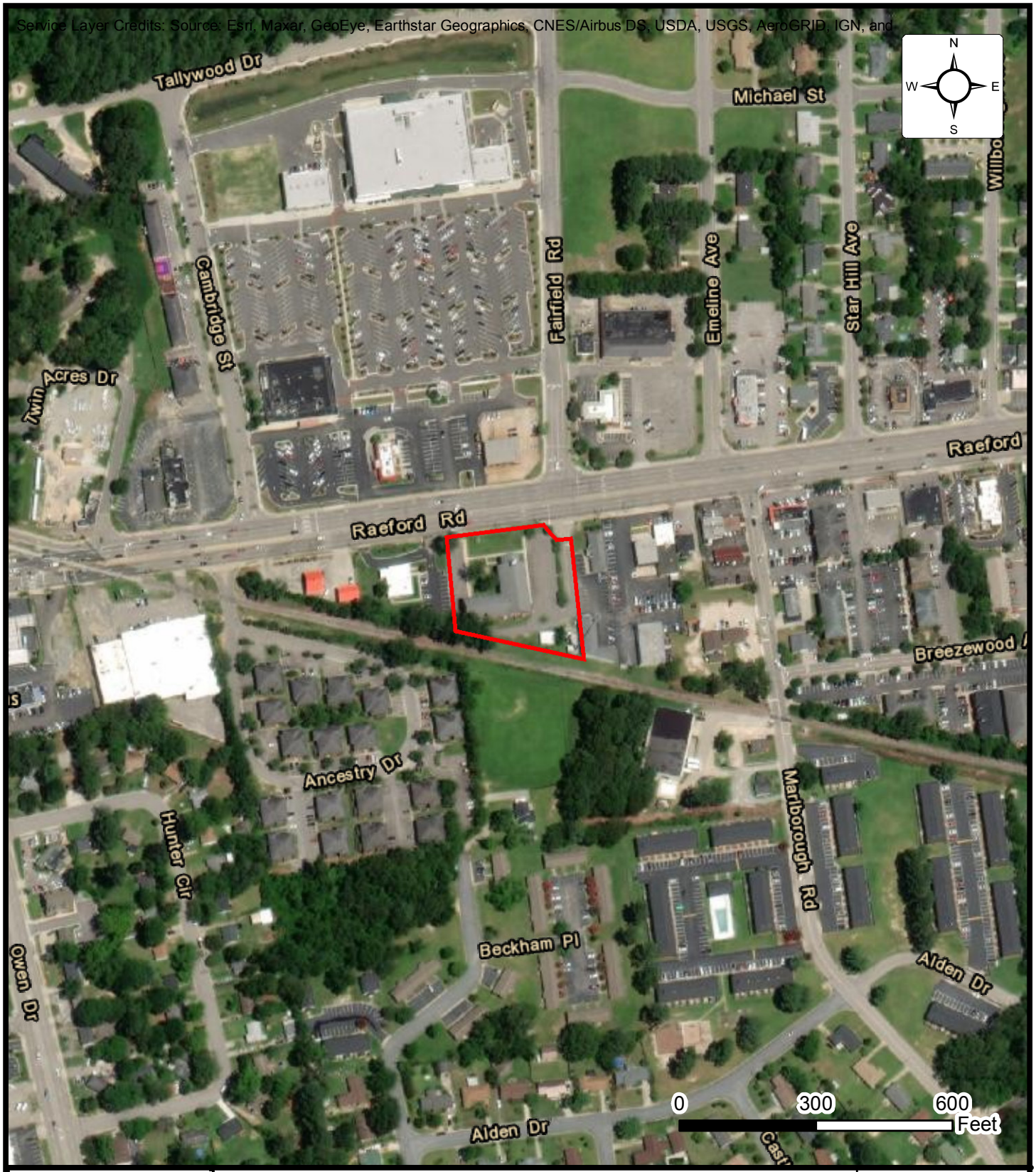
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Diagrams & Reports

Site Location Diagram
Boring Location Diagram

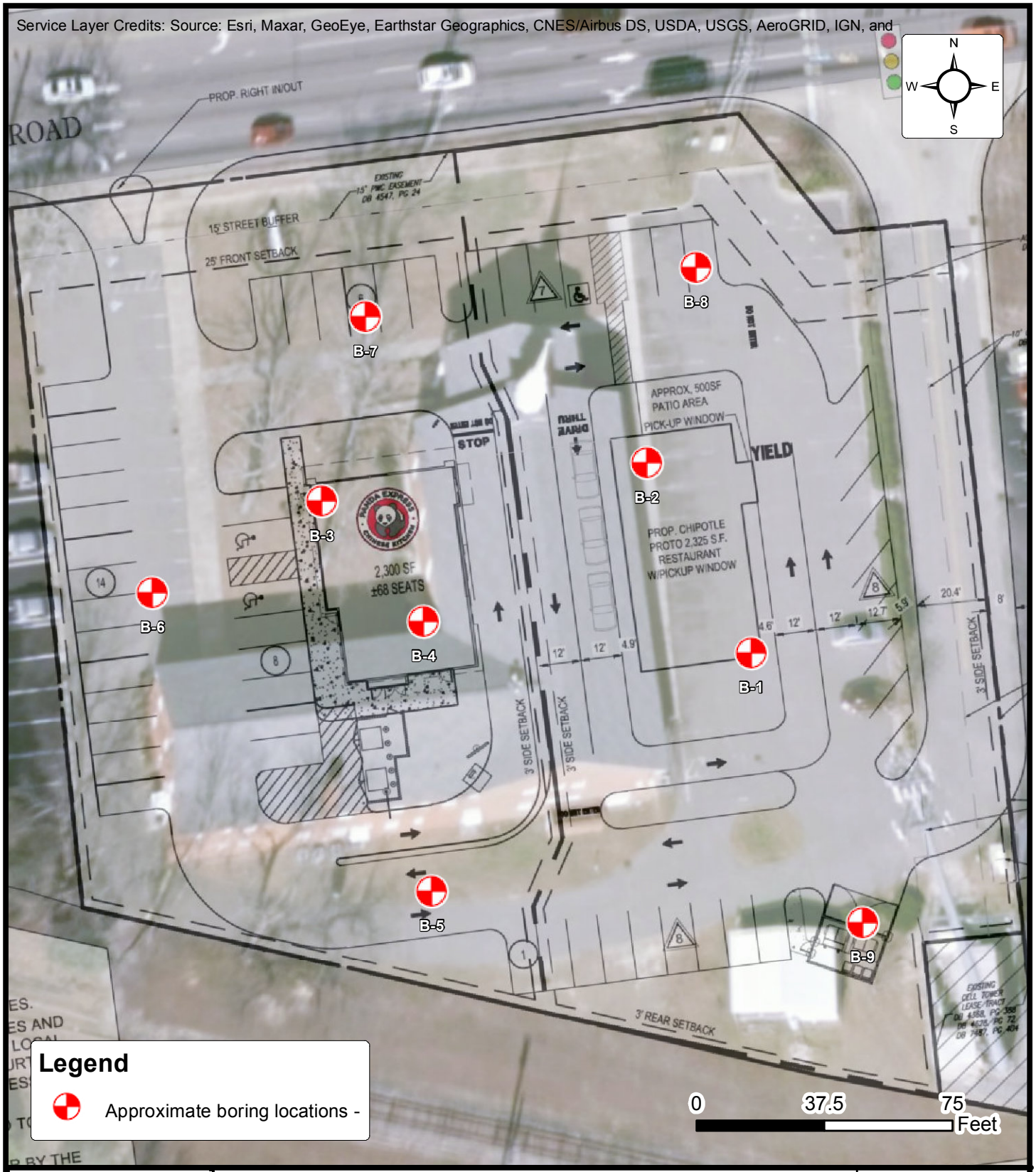


Site Location Diagram
FAYETTEVILLE RAEFORD ROAD

3101 RAEFORD ROAD, FAYETTEVILLE, NC

COLUMBIA DEVELOPMENT

ENGINEER	BB
SCALE	AS NOTED
PROJECT NO.	33:5380
SHEET	FIGURE 1
DATE	11/2/2020



Boring Location Diagram
FAYETTEVILLE RAEFORD ROAD

3101 RAEFORD ROAD, FAYETTEVILLE, NC

COLUMBIA DEVELOPMENT

ENGINEER	BB
SCALE	AS NOTED
PROJECT NO.	33:5380
SHEET	FIGURE 2
DATE	11/2/2020

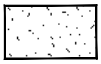
APPENDIX B – Field Operations

Reference Notes for Boring Logs
Subsurface Exploration Procedure: Standard Penetration Test (SPT)
Boring Logs B-1 through B-9

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]


ASPHALT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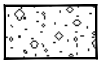
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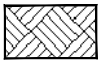
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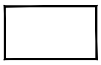
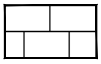
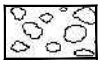
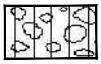

VOID


BRICK

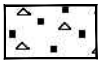

AGGREGATE BASE COURSE

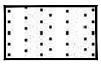

GW **WELL-GRADED GRAVEL**
gravel-sand mixtures, little or no fines

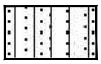

GP **POORLY-GRADED GRAVEL**
gravel-sand mixtures, little or no fines


GM **SILTY GRAVEL**
gravel-sand-silt mixtures

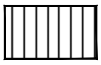

GC **CLAYEY GRAVEL**
gravel-sand-clay mixtures

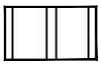

SW **WELL-GRADED SAND**
gravelly sand, little or no fines

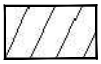

SP **POORLY-GRADED SAND**
gravelly sand, little or no fines


SM **SM SILTY SAND**
sand-silt mixtures

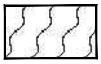

SC **CLAYEY SAND**
sand-clay mixtures

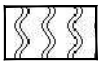

ML **SILT**
non-plastic to medium plasticity

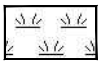

MH **ELASTIC SILT**
high plasticity


CL **LEAN CLAY**
low to medium plasticity


CH **FAT CLAY**
high plasticity


OL **ORGANIC SILT or CLAY**
non-plastic to low plasticity


OH **ORGANIC SILT or CLAY**
high plasticity


PT **PEAT**
highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

WATER LEVELS[6]

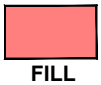

WL (First Encountered)


WL (Completion)


WL (Seasonal High Water)


WL (Stabilized)

FILL AND ROCK


FILL


POSSIBLE FILL


PROBABLE FILL


ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE:
STANDARD PENETRATION TEST (SPT) - ASTM D 1586
Split-Barrel Sampling

The Standard Penetration Test (SPT) is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The SPT N-value (or blow counts), when corrected and correlated, can be used to approximate the engineering properties of soils for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a 2-inch outer diameter split-barrel (split-spoon) sampler into the soil by dropping a 140-lb hammer a height of 30 inches at the desired test depth.
- Recording the number of hammer blows required to drive the split-spoon sampler a distance of 18 to 24 inches (in 3 or 4 increments of 6 inches each).
- The SPT N-value (blows per foot) is determined by summing the blow counts for the 2nd and 3rd six-inch internals.
- The boring is advanced* to the desired depths and additional SPTs are performed.
- SPT tests are typically performed at 2½-foot intervals within the upper 10 feet of the boring and 5-foot intervals thereafter.
- Soil samples are obtained at each test depth for visual classification and laboratory testing.
- The drill rig is equipped with either an automatic hammer or a rope and cathead driving assembly. The automatic hammer generally delivers more energy to the sampler than the standard cathead assembly.
- Although the differences in energy will vary, it is common to assume the automatic hammer delivers about 1.3 times the energy of the cathead assembly.
- The uncorrected N-values recorded in the field are typically reported on the soil test boring logs.

*Drilling methods may vary, but the predominant drilling methods used for SPT are the open hole fluid rotary (mud rotary) drilling and hollow-stem auger drilling.

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-1**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION:			LOSS OF CIRCULATION
3101 Raeford Road, Fayetteville, North Carolina 28303			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **212.0**

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

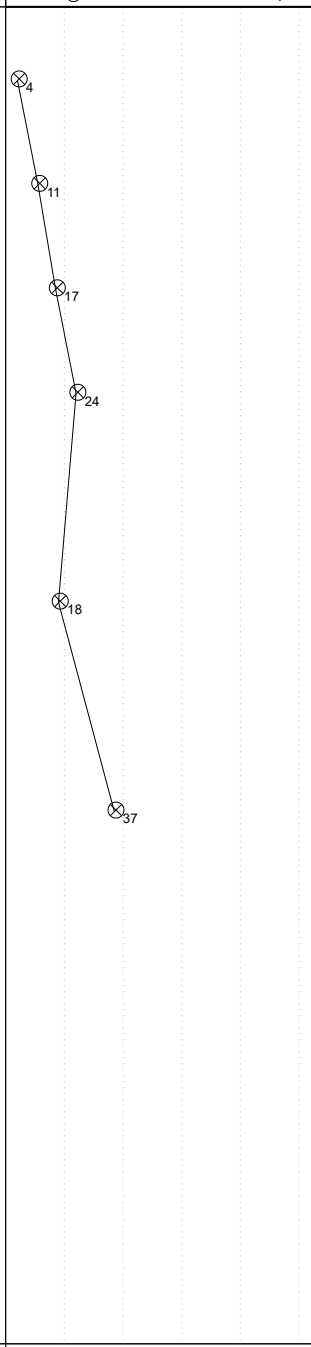
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Asphalt Thickness[2"]			
					ABC Stone Thickness[3"]			
	S-1	SS	18	18	(SM) SILTY FINE TO MEDIUM SAND, tan, moist, very loose			3-2-2 (4)
	S-2	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, orange, tan, moist, medium dense			3-5-6 (11)
5	S-3	SS	18	18			207	5-8-9 (17)
	S-4	SS	18	18				9-10-14 (24)
10							202	
					(CL) SANDY LEAN CLAY, red, gray, moist, very stiff			
	S-5	SS	18	18				5-8-10 (18)
15							197	
					(SP) FINE TO MEDIUM SAND, orange, moist, dense			
	S-6	SS	18	18				13-18-19 (37)
20					**END OF DRILLING AT 20.0 FT**		192	
25							187	
30							182	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**13.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-2**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION: **3101 Raeford Road, Fayetteville, North Carolina 28303**			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **212.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[4"]			
	S-1	SS	18	18	(ML) SANDY SILT, tan, moist, very soft			1-1-1 (2)
	S-2	SS	18	18	(ML) SANDY SILT, red, orange, moist, firm			3-3-4 (7)
5	S-3	SS	18	18	(ML) SANDY SILT, red, orange, moist, stiff to very stiff		207	3-5-8 (13)
	S-4	SS	18	18				8-13-16 (29)
10							202	
	S-5	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, gray, orange, moist, dense			11-17-20 (37)
15							197	
	S-6	SS	18	18				9-11-20 (31)
20					**END OF DRILLING AT 20.0 FT**		192	
25							187	
30							182	

Plastic Limit Water Content Liquid Limit

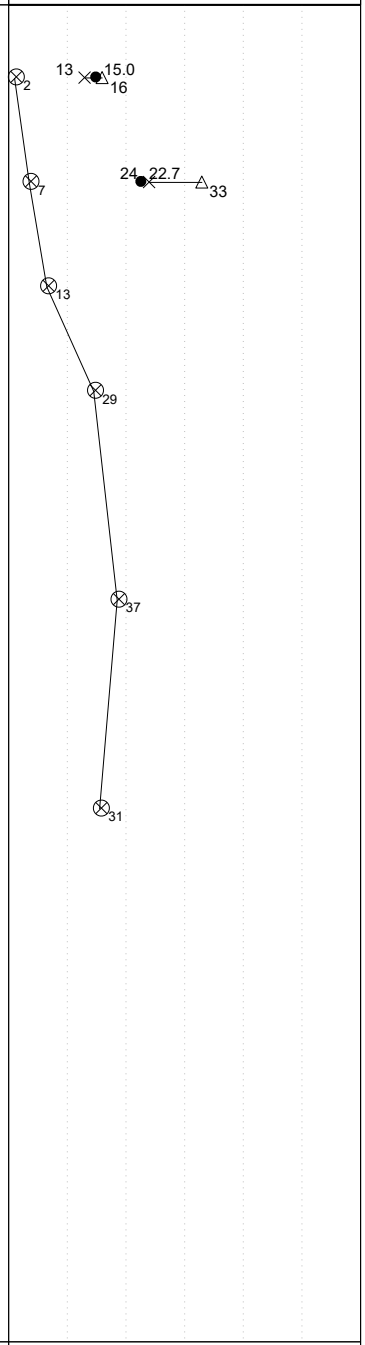
STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**12.00**
WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75**	LOGGED BY:	DRILLING METHOD: **HSA**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-3**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION:			LOSS OF CIRCULATION
3101 Raeford Road, Fayetteville, North Carolina 28303			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **212.0**

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

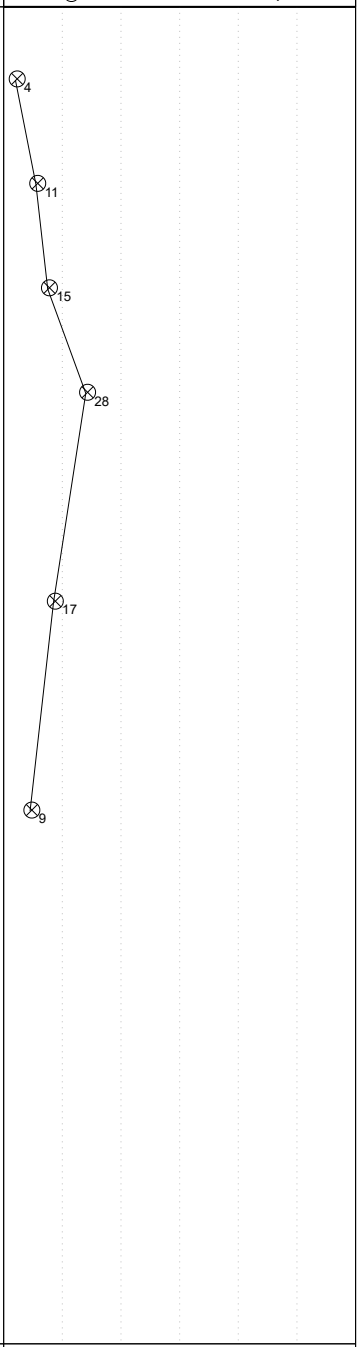
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[4"]			
	S-1	SS	18	18	(SM) SILTY FINE TO MEDIUM SAND, tan, moist, very loose			2-2-2 (4)
	S-2	SS	18	18	(SM) SILTY FINE TO MEDIUM SAND, tan, orange, moist, medium dense			3-5-6 (11)
5	S-3	SS	18	18			207	3-7-8 (15)
	S-4	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, orange, moist, medium dense			10-13-15 (28)
10							202	
	S-5	SS	18	12				8-7-10 (17)
15							197	
	S-6	SS	18	18	(CL) SANDY LEAN CLAY, gray, red, moist, stiff			5-4-5 (9)
20					**END OF DRILLING AT 20.0 FT**		192	
25							187	
30							182	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**12.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-4**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION:			LOSS OF CIRCULATION
3101 Raeford Road, Fayetteville, North Carolina 28303			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **211.0**

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

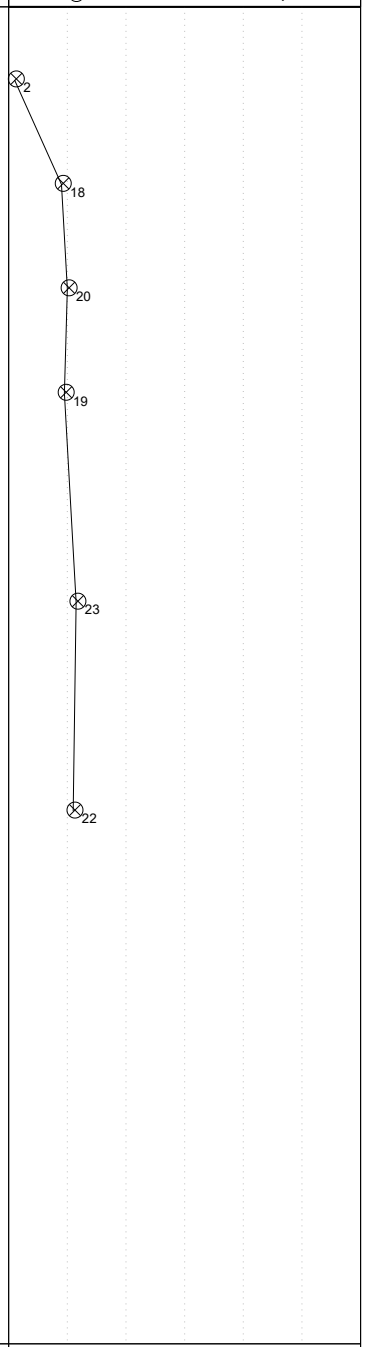
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[6"]			
	S-1	SS	18	18	(ML) SANDY SILT, tan, moist, very soft			2-1-1 (2)
	S-2	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, orange, tan, moist, medium dense			5-8-10 (18)
5	S-3	SS	18	18			206	5-8-12 (20)
	S-4	SS	18	18				6-8-11 (19)
10							201	
	S-5	SS	18	18	(CL) SANDY LEAN CLAY, red, gray, moist, very stiff			7-12-11 (23)
15							196	
	S-6	SS	18	18	(SP) FINE TO MEDIUM SAND, orange, gray, moist, medium dense			8-10-12 (22)
20					**END OF DRILLING AT 20.0 FT**		191	
25							186	
30							181	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**12.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-5**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION: **3101 Raeford Road, Fayetteville, North Carolina 28303**			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **211.0**

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[3"]			
	S-1	SS	18	12	(SM) SILTY FINE TO MEDIUM SAND, brown, moist, loose			5-5-5 (10)
	S-2	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, orange, tan, moist, medium dense			4-5-7 (12)
5							206	
	S-3	SS	18	18				4-7-9 (16)
	S-4	SS	18	18	(SP-SC) FINE TO MEDIUM SAND WITH CLAY, orange, moist, medium dense			9-12-15 (27)
10					**END OF DRILLING AT 10.0 FT**		201	
15							196	
20							191	
25							186	
30							181	

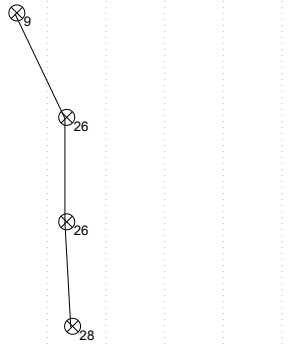
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**6.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-6**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION: **3101 Raeford Road, Fayetteville, North Carolina 28303**			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **212.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Asphalt Thickness[4"]			
					ABC Stone Thickness[5"]			
	S-1	SS	18	12	(SP-SM) FINE TO MEDIUM SAND WITH SILT, tan, gray, moist, loose			9-5-4 (9)
	S-2	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, tan, orange, moist, medium dense			9-11-15 (26)
5							207	
	S-3	SS	18	18				8-11-15 (26)
	S-4	SS	18	18	(SP-SC) FINE TO MEDIUM SAND WITH CLAY, orange, red, moist, medium dense			9-11-17 (28)
10					**END OF DRILLING AT 10.0 FT**		202	
15							197	
20							192	
25							187	
30							182	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**5.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Other CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-7**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Fayetteville Raeford Road Projects	**J And L Drilling Inc**

SITE LOCATION: **3101 Raeford Road, Fayetteville, North Carolina 28303**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:	BOTTOM OF CASING
			213.0	

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[5"]			
	S-1	SS	18	18	(SM) SILTY FINE TO MEDIUM SAND, tan, moist, loose			1-2-4 (6)
	S-2	SS	18	18	(SC) CLAYEY SAND, tan, orange, moist, medium dense			5-7-12 (19)
5	S-3	SS	18	18			208	5-8-15 (23)
	S-4	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, red, orange, moist, medium dense			8-12-15 (27)
10					**END OF DRILLING AT 10.0 FT**		203	
15							198	
20							193	
25							188	
30							183	

Plastic Limit Water Content Liquid Limit

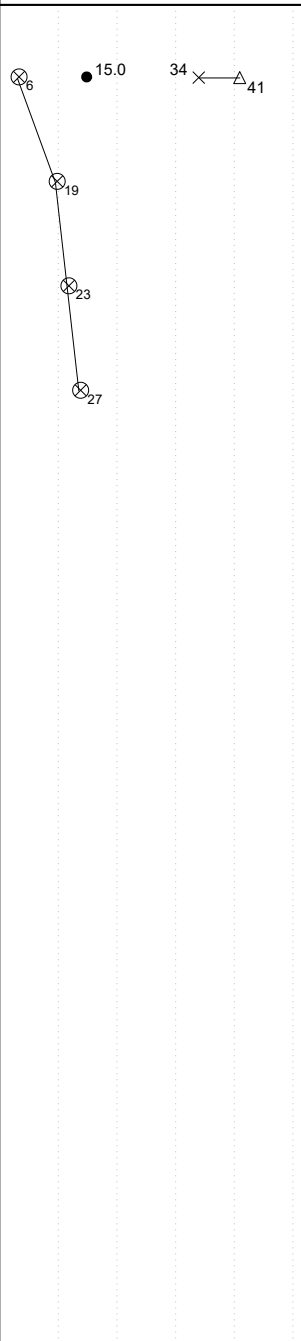
STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**7.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-8**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION: **3101 Raeford Road, Fayetteville, North Carolina 28303**			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **213.0**

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

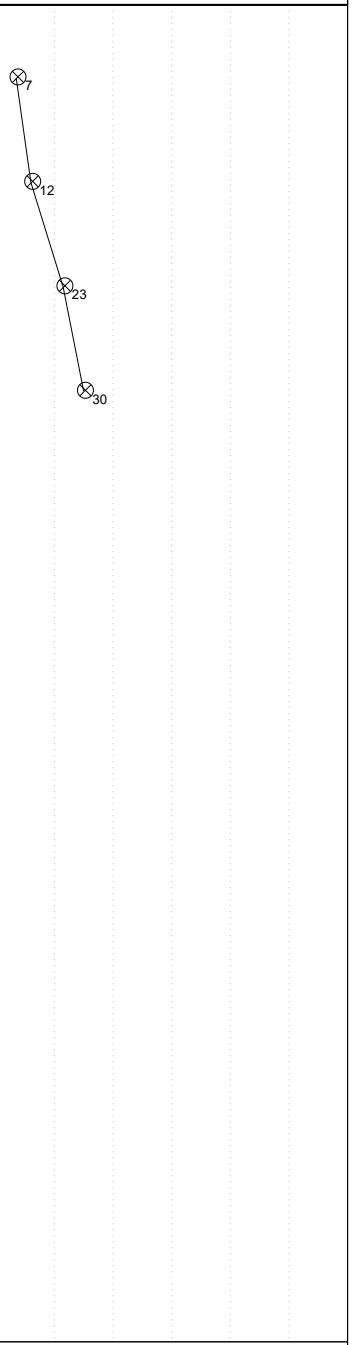
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Asphalt Thickness[3"]		
					ABC Stone Thickness[4"]		
	S-1	SS	18	18	(SP-SM) SAND WITH SILT, gray, tan, moist, loose		4-3-4 (7)
	S-2	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, orange, tan, moist, medium dense		3-5-7 (12)
5	S-3	SS	18	18		208	8-10-13 (23)
	S-4	SS	18	18	(SP-SC) FINE TO MEDIUM SAND WITH CLAY, gray, red, moist, medium dense		10-16-14 (30)
10					**END OF DRILLING AT 10.0 FT**	203	
15						198	
20						193	
25						188	
30						183	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**6.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Columbia Development	**33:5380**	**B-9**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Fayetteville Raeford Road Projects	**J And L Drilling Inc**		
SITE LOCATION:			LOSS OF CIRCULATION
3101 Raeford Road, Fayetteville, North Carolina 28303			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **212.0**

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

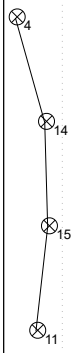
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[4"]			
	S-1	SS	18	18	(SP-SM) FINE TO MEDIUM SAND WITH SILT, tan, gray, moist, very loose			3-2-2 (4)
	S-2	SS	18	12	(SC) CLAYEY FINE TO MEDIUM SAND, red to orange, moist, medium dense			5-6-8 (14)
5							207	
	S-3	SS	18	12				4-7-8 (15)
	S-4	SS	18	18	(SC) CLAYEY FINE TO MEDIUM SAND, tan, orange, moist, medium dense			4-5-6 (11)
10					**END OF DRILLING AT 10.0 FT**		202	
15							197	
20							192	
25							187	
30							182	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Oct 27 2020**	CAVE IN DEPTH:	**6.00**
▼ WL (Completion) **NE**	BORING COMPLETED: **Oct 27 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck CME 75** / LOGGED BY:	DRILLING METHOD:	**HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC (%)	Soil Type	Atterberg Limits			Percent Passing No. 200 Sieve	Moisture - Density		LBR (%)	Organic Content (%)
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-2	S-1	1-2.5	15	*ML	16	13	3	56.6				
B-2	S-2	3.5-5	22.7	*ML	33	24	9	54.0				
B-7	S-1	1-2.5	15	*SM	41	34	7	37.9				

Notes: See test reports for test method, *ASTM D2488

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Fayetteville Raeford Road Projects
Client: Columbia Development
Project No.: 33:5380
Date Reported:

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Fayetteville	6151 Raeford Road Suite A Fayetteville, NC 28304	(910)401-3288 (910)323-0539

Tested by	Checked by	Approved by	Date Received
awiggs	djohnson	djohnson	