SUBSURFACE EXPLORATION REPORT
INFILTRATION BASINS
I-95 BUSINESS / US 301 FROM NC 87 SOUTH TO NC 59
CUMBERLAND COUNTY, NORTH CAROLINA
WBS NO: 45849.1.FR1
TIP NO: W-5519
F.A. NO.: N/A

S&ME Project No: 1305-15-073

Prepared for:

State of N.C. Department of Transportation
Division of Highways
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699-1589

Prepared By:

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July 27, 2015
S&ME, Inc. N.C. PE Firm License No. F-0176

July 27, 2015

State of N.C. Department of Transportation
Division of Highways
Geotechnical Engineering Unit
1589 Mail Service Center
Raleigh, North Carolina 27699-1589

Attention: Mr. Mohammed A. Mulla, P.E. CPM
Contract and Statewide Services Manager

Reference: **Subsurface Exploration Report**
Infiltration Basins
I-95 Business/US 301 from NC 87 South to NC 59
Cumberland County, North Carolina
WBS No: 45849.1.FR1
Tip No: W-5519
F.A. No: N/A
S&ME Project No: 1305-15-073

Dear Mr. Mulla:

S&ME, Inc. (S&ME) has completed the authorized subsurface exploration for the above referenced project. The purpose of our investigation was to explore subsurface conditions at the site and provide soil profile descriptions, elevation of the seasonal high groundwater table and in-situ saturated hydraulic conductivity testing. Our services were completed in general accordance with S&ME Proposal No.13-1500387 dated July 23, 2015. The North Carolina Department of Transportation (NCDOT) issued S&ME a verbal Notice to Proceed for our investigation July 16, 2015. This report presents the findings of the exploration. A hand auger boring location plan, soil profile descriptions, in-situ hydraulic conductivity test results, seasonal high water table elevations, are provided in the Appendix.

S&ME appreciates the opportunity to provide our professional services on this project. If you have any questions concerning information presented herein, please do not hesitate to contact us.

Respectfully submitted,

S&ME, Inc.

Not considered "FINAL" unless all signatures are completed.

Paul Masten, LSS
Soil Scientist
N.C. License Number 1329

Abner F. Riggs, Jr., PE
Senior Geotechnical Engineer
N.C. Registration Number 14155

PROJECT INFORMATION

On July 22, 2015, S&ME performed soil evaluations at 4 locations to assist NCDOT with design of stormwater best management practices (BMPs) associated with proposed roadway improvements to I-95 Business/US Highway 301 in Fayetteville, Cumberland County, North Carolina. NCDOT provided Mr. Abner Riggs, Jr., P.E. with S&ME coordinates for the test locations. All four of the test locations are located adjacent to existing roadways and are in the road median/shoulder with shallow, surface topsoil being the only fill observed.

Mr. Paul Masten, S&ME soil scientist, conducted an evaluation of the soils within the test areas identified by NCDOT. The soil scientist evaluation was conducted to evaluate the suitability of the soil properties relative to Stormwater Management permitted by the North Carolina Department of Environment and Natural Resources – Land Quality Section (NCDENR-LQS). S&ME visited the site on July 22, 2015 and performed the evaluation with hand auger borings at each test location to a depth of approximately 8 feet below the existing ground surface (bgs).

FIELD EXPLORATION

The soil scientist investigation was conducted to evaluate the seasonal high water table (SHWT) elevations and in-situ soil permeability rate (in-situ saturated hydraulic conductivity testing). S&ME personnel conducted four (4) in-situ saturated hydraulic conductivity (Ksat) tests on July 22, 2015 at field test locations identified by NCDOT.

Ksat measurements were performed with a compact constant-head permeameter. Hand augers were used to excavate soils for the SHWT evaluations and for the Ksat measurements.

SHWT AND KSAT TESTING RESULTS

Seasonal High Water Table (SHWT) Determination

The SHWT evaluations were performed by advancing hand auger borings to a depth of approximately 8 feet (bgs) at the proposed stormwater best management practice (BMP) areas. The locations of the SHWT evaluations were approximated in the field with a Trimble GeoXT handheld Global Positioning Unit on July 17, 2015. During the hand auger investigation, soils were evaluated by a Licensed Soil Scientist for evidence of SHWT influence. This evaluation involved observing the actual moisture content in the soil and observing the soil matrix and mottle colors. Depending on the soil texture, the soil color will indicate processes that are driven by seasonally high water table fluctuations, such as iron reduction and oxidation and organic matter staining.

SHWT evaluations are based on secondary evidence and not on direct groundwater level measurements. Groundwater levels fluctuate for numerous reasons and these findings do not indicate that groundwater levels have not or will not rise above the noted depths. The

attached roadway Plan Sheet No. 4, identifies the approximate SHWT test locations and Table 1 identifies the approximated SHWT depths.

Test locations IB-1 and IB-4 were located adjacent to the west of the southbound travel lanes of I-95 Business/US Highway 301. Test locations IB-2 and IB-3 were located east of the northbound travel lanes of I-95 Business/US Highway 301. Shallow topsoil surface fill was observed at each of the locations.

Test location IB-1 was located in the road median/shoulder on the west side of I-95 Business/US 301. Soils at IB-1 consisted of loamy sand topsoil (fill) from 0 to 3 inches underlain by four horizons of fine sand and loamy sand from 3 to 48 inches underlain by one horizon of sandy loam from 48 to 96 inches. The surface soil (fill) was identified with soil matrix Munsell colors of 10YR 3/2 (very dark grayish brown); the first subsurface horizon was 2.5Y 6/4 (light yellowish brown); the next subsurface horizon was 2.5Y 7/4 (pale yellow) with 10YR 5/6 (yellowish brown) and 2.5Y 6/3 (light yellowish brown) streaks; the next subsurface horizon was 2.5Y 6/4 (light yellowish brown); the next subsurface horizon was 2.5Y 6/6 (olive yellow); the next subsurface horizon was 10YR 5/6 (yellowish brown) with 2.5Y 6/3 (light yellowish brown) and 7.5YR 5/6 (strong brown) streaks. Evidence of a SHWT was observed not observed within 8 feet of the ground surface.

Test location IB-2 was located in the road median/shoulder on the east side of I-95 Business/US 301. Soils at IB-2 consisted of loamy sand topsoil (fill) from 0 to 4 inches underlain by fine sand from 4 to 33 inches and three horizons of sandy clay loam from 33 to 96 inches. The surface soil (fill) was identified with a soil matrix Munsell color of 10YR 3/2 (very dark grayish brown); the first subsurface horizon was 2.5Y 6/4 (light yellowish brown); the next horizon was 10YR 4/6 (yellowish brown); the next horizon was 7.5YR 5/8 (strong brown); the next horizon was 10YR 5/8 (yellowish brown) with 2.5YR 5/8 (red streaks). Evidence of a SHWT was not observed within 8 feet of the ground surface.

Test location IB-3 was located in the road median/shoulder on the east side of I-95 Business/US 301. Soils at IB-3 consisted of loamy sand topsoil (fill) from 0 to 5 inches. Soil beneath the fill consisted of fine sand from 5 to 37 inches, underlain by two horizons of sandy clay loam from 37 to 84 inches and sandy loam with plinthitic (dense, very hard) soil materials from 84 to 96 inches. The surface soil (fill) was identified with a soil matrix Munsell color of 10YR 3/2 (very dark grayish brown); the first subsurface horizon was 2.5Y 6/4 (light olive yellow); the next subsurface horizon was 10YR 4/6 (dark yellowish brown); the next two subsurface horizons were 10YR 5/8 (yellowish brown) with 10YR 6/2 (light brownish gray) redox depletions and 7/5YR 5/8 (strong brown) and 5YR 4/6 (red) redox concentrations. Evidence of a SHWT was observed at 43 inches below the ground surface.

Test location IB-4 was located in the road median/shoulder on the east side of I-95 Business/US 301. Soils at IB-4 consisted of loamy sand topsoil (fill) from 0 to 2 inches. Soil beneath the fill consisted of fine sand from 2 to 24 inches, underlain by two horizons

of sandy clay loam from 24 to 80 inches and sandy loam with plinthitic (dense, very hard) soil materials from 80 to 96 inches. The surface soil (fill) was identified with a soil matrix Munsell color of 10YR3/2 (very dark grayish brown); the first subsurface horizon was 2.5Y 6/4 (light olive yellow); the next subsurface horizon was 10YR 4/6 (dark yellowish brown); the next subsurface horizon was 10YR 5/6 (yellowish brown) with 10YR 6/2 (light brownish gray) redox depletions and 2.5YR 4/6 (red) redox concentrations; the next subsurface horizon was 7.5YR 5/8 (strong brown) with 10YR 6/2 (light brownish gray) redox depletions and 2.5YR 5/8 (red) redox depletions. Evidence of a SHWT was observed at 30 inches below the ground surface.

The ground surface elevations at the test locations were determined by S&ME personnel using a tripod level scope and measuring rod and the elevation of nearby benchmark (BM PK Nail B9534 on Linwood Road: Elevation 194.06 feet) provided to S&ME by NCDOT on July 20, 2015.

Table 1: Seasonal High Water Table Determinations

	NCDOT I-95 Business/US Highway 301		
Test Location	**Elevation Ground Surface (feet)**	**Seasonal High Water Table Depth (feet bgs)**	**Elevation Seasonal High Water Table (feet)**
IB-1	192.1	> 8	< 184.1
IB-2	192.8	> 8	< 184.8
IB-3	192.9	3.6	189.3
IB-4	193.0	2.5	190.5

Please note that the seasonal high water table conditions encountered at IB-3 and IB-4 may represent perched water table conditions.

Constant Head Permeameter Saturated Hydraulic Conductivity Testing

S&ME performed the in-situ hydraulic conductivity (Ksat) testing by utilizing a compact constant head permeameter at each of the test locations. S&ME performed Ksat tests on July 22, 2015.

For the Ksat testing, a hand auger boring was advanced at each Test Location with a 2 inch diameter bucket. The water dissipating unit of the permeameter was lowered to the bottom of the hole and water was dispensed from the permeameter. The water was allowed to move through the unit until steady-state flow was achieved and then flow rates were recorded. The last three measurements were averaged to achieve the most representative value to express the saturated hydraulic conductivity. The soils at the test location depths were observed to consist of naturally occurring sand, sandy loam and sandy clay loam typical of the Sandhills region.

The Ksat rates were variable depending on location and ranged from 0.22 inches per hour (in/hr.) at IB-4 to 9.3 in/hr. at IB-3. Table 2 below summarizes the measured hydraulic conductivities and testing depths for the test locations.

Table 2: Calculated Hydraulic Conductivity Rates

TEST LOCATION	**TESTING HORIZON**	**TESTING INTERVAL** (inches bgs)	**HYDRAULIC CONDUCTIVITY RATE** (in/hr.)
IB-1	Bt1	48 to 54 inches	4.22 in/hr.
IB-2	Bt1/Bt2	39 to 45 inches	1.55 in/hr.
IB-3	E	20 to 26 inches	9.33 in/hr.
IB-4	Bt1	28 to 34 inches	0.22 in/hr.

The North Carolina Department of Environment and Natural Resources (NCDENR) Best Management Practices (BMP) Manual identifies a minimum infiltration rate of 0.52 inches per hour and a draw-down time of five days for stormwater runoff entering an infiltration system as well as a two-foot separation between the SHWT and the bottom of the infiltration device. However, NCDENR has issued draft Minimum Design Criteria (MDC) for stormwater treatment systems that identify a 72-hour draw down time to the bottom of an infiltration device, with no minimum infiltration rate and two-foot separation above SHWT with the option to reduce the separation to one foot if the applicant can show that the water table will return to its pre-storm elevation in five days or less. Although the MDC are still in draft form, they can be utilized at this time by following the Alternative Design Criteria provisions in 15A NCAC 2H .1008(h).

QUALIFICATIONS OF REPORT

This report has been prepared in accordance with generally accepted soil science and geotechnical engineering practice for specific application to this project. The findings contained in this report were based on the applicable standards of our profession at the time this report was prepared. No other warranty, expressed or implied, is made.

The findings submitted in this report are based, in part, upon the data obtained from the subsurface exploration. The nature and extent of subsurface variations between the locations evaluated may not become evident until construction. If variations appear evident, then the findings contained in this report may need to be re-evaluated.

REFERENCE: W-5519

PROJECT: 45849

SEE SHEET 2A FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

ROADWAY SUBSURFACE INVESTIGATION

COUNTY *CUMBERLAND*

PROJECT DESCRIPTION *I-95 BUSINESS /US301 FROM NC87 SOUTH TO NC59*

INFILTRATION BASINS

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	W-5519	1	12

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

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NOTES:
1. THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
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PERSONNEL

P. MASTEN

INVESTIGATED BY *P. MASTEN*

DRAWN BY *B. RATTI*

CHECKED BY *A.F. RIGGS JR, P.E.*

SUBMITTED BY *S&ME, INC.*

DATE *JULY 2015*

LICENSED SOIL SCIENTIST
PAUL MASTEN
1329
STATE OF NORTH CAROLINA

Not considered "FINAL" unless all signatures are completed.

SIGNATURE DATE

SIGNATURE DATE

PROJECT REFERENCE NO.	SHEET NO.
W-5519	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE,

VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6			
SYMBOL														
% PASSING #10	50 MX													
#40	30 MX	50 MX	51 MN											
#200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
MATERIAL PASSING #40														
LL	—		—	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PI	6 MX		NP	10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	NO MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	< 4	
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	N/A
	DENSE	30 TO 50	
	VERY DENSE	> 50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	< 2	< 0.25
	SOFT	2 TO 4	0.25 TO 0.5
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	> 30	> 4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL — LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
OM — OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL — SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LL < 31
MODERATELY COMPRESSIBLE	LL = 31 - 50
HIGHLY COMPRESSIBLE	LL > 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	20 - 35%
HIGHLY ORGANIC	> 10%	> 20%	HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW — PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT, DPT, DMT, VST, PMT — TEST BORING
- AUGER BORING
- CORE BORING
- MW — MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING WITH CORE
- SPT N-VALUE

RECOMMENDATION SYMBOLS

- UNDERCUT EXCAVATION
- SHALLOW UNDERCUT
- UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE
- UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK
- UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [ ] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [ ] TRICONE _____" TUNG.-CARB.
- [ ] CORE BIT
- [ ] _____

HAMMER TYPE:
- [ ] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [ ] -N _____

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [X] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [X] AMOOZEMETER

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FOOT
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: PK NAIL B9534

N 446528.55 E 2027356.69 ELEVATION: 194.06 FEET

NOTES:

DATE: 8-15-14

09/08/99

TIP PROJECT: W-5519

CONTRACT: 45849

28-JUL-2015 10:49
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brafti AT BRAFTI-13500

See Sheet 1-A For Index of Sheets
See Sheet 1-B For Conventional Symbols

END PROJECT

BEGIN PROJECT

VICINITY MAP
(NTS)

ROW PLANS

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CUMBERLAND COUNTY

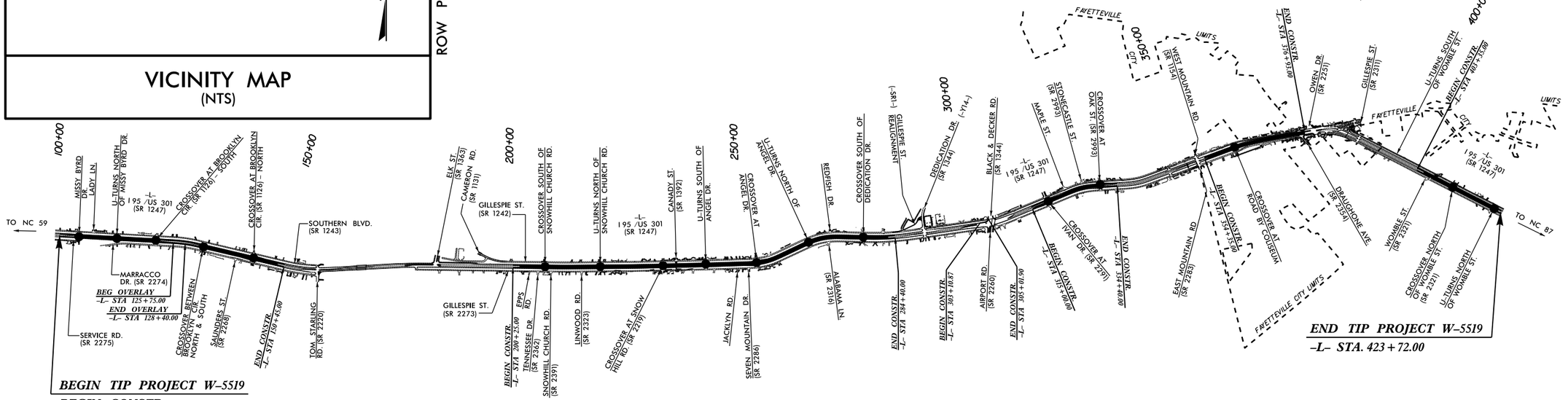
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	W-5519	2A	12

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
45849.1.FR1	HSIP-095-2(128)46	PE
45849.2.FR1	HSIP-095-2(128)46	R/W
45849.3.FR1	HSIP-095-2(128)46	CONST

LOCATION: I-95 BUSINESS /US 301 FROM NC 87 SOUTH TO NC 59

TYPE OF WORK: PAVING, GRADING, DRAINAGE, PAVEMENT MARKINGS AND SIGNING

NAD 83
NC GRID



NCDOT CONTACT: SEAN MATUSZEWSKI
PROJECT ENGINEER - DIVISION DESIGN CONSTRUCTION

A PORTION OF THIS PROJECT IS WITHIN MUNICIPAL BOUNDARIES OF THE CITY OF FAYETTEVILLE, N.C.

CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD II

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

GRAPHIC SCALES

PLANS: 50 25 0 50 100

PROFILE (HORIZONTAL): 50 25 0 50 100

PROFILE (VERTICAL): 10 5 0 10 20

DESIGN DATA

ADT 2015 = 26,160
ADT 2035 = 41,860
K = 10 %
D = 70 %
T = 9 % *
V = 60 MPH
* TTST = 9% DUAL N/A
FUNC CLASS = PRINCIPAL ARTERIAL
REGIONAL TIER

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT W-5519 = 3.747 mi.
LENGTH STRUCTURE TIP PROJECT W-5519 = 0.000 mi.
TOTAL LENGTH TIP PROJECT W-5519 = 3.747 mi.

Prepared for NCDOT In the Office of:

moffatt & nichol
1616 EAST MILLBROOK ROAD, SUITE 160
RALEIGH, NORTH CAROLINA 27609
(919) 781-4626 VOICE (919) 781-4869 FAX

2012 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: MAY 29, 2015

LETTING DATE: NOV. 17, 2015

TIM REID, P.E.
PROJECT ENGINEER

TRENT HUFFMAN, P.E.
PROJECT DESIGN ENGINEER

HYDRAULICS ENGINEER

moffatt & nichol
1616 EAST MILLBROOK ROAD, SUITE 160
RALEIGH, NORTH CAROLINA 27609
(919) 781-4626 VOICE (919) 781-4869 FAX

P.E.
SIGNATURE:

ROADWAY DESIGN ENGINEER

moffatt & nichol
1616 EAST MILLBROOK ROAD, SUITE 160
RALEIGH, NORTH CAROLINA 27609
(919) 781-4626 VOICE (919) 781-4869 FAX

P.E.
SIGNATURE:

STATE OF NORTH CAROLINA · DEPARTMENT OF TRANSPORTATION

PROJECT REFERENCE NO.	SHEET NO.
W-5519	3

SITE PLAN

0 100 200

FEET

B-9533

215

220

225

5

MISTY M & HUSBAND
TOMMIE R
MANNING
DB 9312 PG 18
PB 129 PG 42

15" RCP COULD NOT BE VERIFIED – RETAIN IF LOCATED

+45 150' LT EX R/W LT

+67 150' LT EX R/W LT

03009010

RETAIN DRY WELL

SR 1242 GILLESPIE ST 23' BST

I-95 BUSINESS – US-301 SOUTH 24' BST

I-95 BUSINESS – US-301 NORTH 25' BST

IB-1

IB-2

IB-3

IB-4

16" D.I.

12" D.I. FORCE MAIN

N 24° 49' 44.9" E

SR 2273 GILLESPIE ST 19' BST

SR 2332 LINWOOD RD 22' BST

B-9534

4' CHAIN LINK

4' WOOD

GRAVEL

BST

TDE

S&ME, INC. **SHEET 4**

SOIL PROFILE DESCRIPTIONS

Client:	NCDOT	Date:	7-22-15
Project Name:	I-95 Business/US 301 INFLPND	Project No.	W-5519
County:	Cumberland	State	NC
Location:	STA 217+80 64 FT LT –L-	Site/Field No.	IB-1
Soil Series:	Wagram		
Apparent Water Table:	>8 feet bgs	Seasonal High Water Table:	>8 feet bgs
Vegetation:	Grass	Slope:	1-2%
Hand Auger Boring Terminated at	8 feet bgs		

Horizon	Depth (ft)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0 – 0.25	10YR 3/2		ls	gr	v fr	
E1	0.25 – 0.92	2.5Y 6/4		fs	sg	loose	
E/Bt	0.92 – 2.7	2.5Y 7/4	10YR 5/6 2.5Y 6/3	ls	gr	v fr	
E2	2.7 – 3.6	2.5Y 6/4		fs	sg	loose	
E3	3.6 – 4.0	2.5Y 6/6		fs	sg	loose	
Bt1	4.0 – 8.0	10YR 5/6	2.5Y 6/3 7.5YR 5/6	sl	msbk	ss, sp, fr	

COMMENTS:

DESCRIBED BY: Paul Masten DATE: 7-22-15

S&ME, INC. **SHEET 5**

SOIL PROFILE DESCRIPTIONS

Client:	NCDOT	Date:	7-22-15
Project Name:	I-95 Business/US 301 INFLPND	Project No.	W-5519
County:	Cumberland	State	NC
Location:	STA 217+80 71 FT RT –L-	Site/Field No.	IB-2
Soil Series:	Wagram		
Apparent Water Table:	>8 feet bgs	Seasonal High Water Table:	>8 feet bgs
Vegetation:	Grass	Slope:	Flat
Hand Auger Boring Terminated at	8 feet bgs		

Horizon	Depth (ft)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0 – 0.33	10YR 3/2		ls	gr	fr	
E	0.33 – 2.8	2.5Y 6/4		fs	sg	loose	
Bt1	2.8 – 3.6	10YR 4/6		scl	wabk	ss, np, fr	
Bt2	3.6 – 6.6	7.5YR 5/8		scl	wsbk	ss, np, fr	
Bt3	6.6 – 8.0	10YR 5/8	2.5YR 5/8	scl	wsbk	ss, np, fr	

COMMENTS:

DESCRIBED BY: Paul Masten DATE: 7-22-15

S&ME, INC. **SHEET 6**

SOIL PROFILE DESCRIPTIONS

Client:	NCDOT	Date:	7-22-15
Project Name:	I-95 Business/US 301 INFLPND	Project No.	W-5519
County:	Cumberland	State	NC
Location:	STA 221+35 71 FT RT –L-	Site/Field No.	IB-3
Soil Series:	Wagram		
Apparent Water Table:	>8 feet bgs	Seasonal High Water Table:	3.6 feet bgs
Vegetation:	Grass	Slope:	Flat
Hand Auger Boring Terminated at	8 feet bgs		

Horizon	Depth (ft)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0 – 0.42	10YR 3/2		ls	gr	v fr	
E	0.42 – 3.1	2.5Y 6/4		fs	sg	loose	
Bt1	3.1 – 3.6	10YR 4/6		scl	wsbk	fr	
Bt2	3.6 – 7.0	10YR 5/8	10YR 6/2 7.5YR 5/8	scl	mabk	firm	
Bx	7.0 – 8.0	10YR 5/8	10YR 6/2 5YR 4/6	sl	gr	v fr	Plinthitic soil materials observed

COMMENTS:

DESCRIBED BY: Paul Masten DATE: 7-22-15

S&ME, INC. **SHEET 7**

SOIL PROFILE DESCRIPTIONS

Client:	NCDOT	Date:	7-22-15
Project Name:	I-95 Business/US 301 INFLPND	Project No.	W-5519
County:	Cumberland	State	NC
Location:	STA 222+59 67 FT LT –L-	Site/Field No.	IB-4
Soil Series:	Wagram		
Apparent Water Table:	>8 feet bgs	Seasonal High Water Table:	2.5 feet bgs
Vegetation:	Grass	Slope:	Flat
Hand Auger Boring Terminated at	5.2 feet bgs		

Horizon	Depth (ft)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0 – 0.17	10YR 3/2		ls	gr	v fr	
E	0.17 – 2.0	2.5Y 6/4		fs	sg	loose	
Bt1	2.0 – 2.5	10YR 4/6		scl	mabk	s, p, fr	
Bt2	2.5 – 6.7	10YR 5/6	10YR 6/2 2.5YR 4/6	scl	mabk	ss, sp, fr	
Bx	6.7 – 8.0	7.5YR 5/8	10YR 6/2 2.5YR 5/8	sl	gr	v fr	Plintihic soil materials observed

COMMENTS:

DESCRIBED BY: Paul Masten DATE: 7-22-15

S&ME Soil Prolife Descriptions Abbreviation Legend – I-95 Business/US Highway 301
Project No. 45849.1.FR1

Texture

sandy loam	sl
loamy sand	ls
fine sand	fs
sandy clay loam	scl

Structure

weak, subangular blocky	wsbk
moderate, subangular blocky	msbk
moderate, angular blocky	mabk
granular	gr
single grain	sg

Consistence

very friable	v fr
friable	fr

Seasonal High Water Table SHWT

Munsell Colors

2.5YR4/6	red
2.5YR5/8	red
5YR4/6	yellowish red
2.5Y6/3	light yellowish brown
2.5Y6/4	light yellowish brown
2.5Y6/6	olive yellow
2.5Y7/4	pale yellow
7.5YR5/6	strong brown
7.5YR5/8	strong brown
10YR3/2	very dark grayish brown
10YR4/6	dark yellowish brown
10YR5/6	yellowish brown
10YR5/8	yellowish brown
10YR6/2	light brownish gray

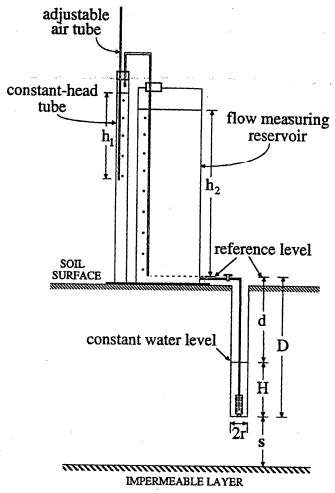
S&ME
"IN-SITU" CONSTANT HEAD PERMEAMETER

Date: 7/22/2015
Location: IB-1
Horizon: Bt1
Client: NCDOT
Project Name: I-95 Business/US Highway 301
Project #: W-5519
Location: N 446900 E 2027201
Elevation: 192.1 feet

Hole Depth:	4.50	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	4.80	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h_1):	4.30	Feet

Chamber Used: 0.11 Ft^2

Initial Water in Hole:	0.13	Feet
Final Water in Hole:	0.50	Feet



Ksat = CQ/(2PiH^2)

C = sinh^{-1} (H/r) - [(r/H)^2 + 1]$^{1/2}$ + r/H

sinh^{-1} = inverse hyperbolic sin of a number
H = Height of water in hole (cm)
r = radius of hole (cm)
Q = Constant Flow Rate (Gal/day)
= Cross Sectional Area of Resevior x Length of Drop in Water Column over Time

r = **0.08** ft
H = **0.50** ft

C = **1.68**
Q = **59.03** Gallons/Day

Time	Drop in Water Column (ft)	(cm)
9	0.141	4.30
12	0.105	3.20
15	0.089	2.70
18	0.098	3.00
21	0.112	3.40
24	0.121	3.70
27	0.128	3.90
30	0.148	4.50
33	0.141	4.30
36	0.148	4.50
Avg.	**0.145**	

Time (min) = **3**

Cross Sectional Area = **0.11** ft^2
Length of Drop in Water Column = **69.82** ft/day

K_{sat} = 63.14 Gallons/Day/ft^2

Cm/Hour	**10.72**
Inches/Hour =	**4.22**
Feet/Day	**8.44**

Note: Ksat calculations are based on average drop in Water Column (ft) after equilibrium is reached.

Prepared by: S&ME, Inc.
Paul Masten

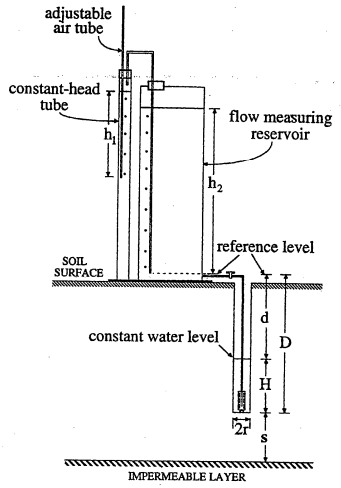
S&ME
"IN-SITU" CONSTANT HEAD PERMEAMETER

Date: 7/22/2015
Location: IB-2
Horizon: Bt1/Bt2
Client: NCDOT
Project Name: I-95 Business/US Highway 301
Project #: W-5519
Location: N 446844 E 2027323
Elevation: 192.8 feet

Hole Depth:	3.75	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	4.05	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h_1):	3.55	Feet

Chamber Used: 0.11 Ft^2

Initial Water in Hole:	0.33	Feet
Final Water in Hole:	0.50	Feet



$$Ksat = CQ/(2PiH^2)$$

$$C = \sinh^{-1}(H/r) - [(r/H)^2 + 1]^{1/2} + r/H$$

$\sinh^{-1}$ = inverse hyperbolic sin of a number
H = Height of water in hole (cm)
r = radius of hole (cm)
Q = Constant Flow Rate (Gal/day)
= Cross Sectional Area of Resevior x Length of Drop in Water Column over Time

r = **0.08** ft
H = **0.50** ft

C = **1.68**
Q = **21.75** Gallons/Day

Time	Drop in Water Column (ft)	(cm)
12	0.033	1.00
15	0.000	1.10
18	0.000	1.00
21	0.039	1.20
24	0.036	1.10
27	0.043	1.30
30	0.046	1.40
33	0.046	1.40
36	0.056	1.70
39	0.059	1.80
Avg.	**0.054**	

Time (min) = **3**

Cross Sectional Area = **0.11** ft^2
Length of Drop in Water Column = **25.72** ft/day

K_{sat} = 23.26 Gallons/Day/ft^2

Cm/Hour
Inches/Hour = 1.55
Feet/Day 3.11

Note: Ksat calculations are based on average drop in Water Column (ft) after equilibrium is reached.

Prepared by: S&ME, Inc.
Paul Masten

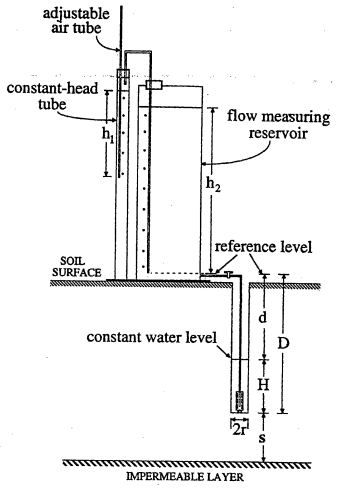
S&ME
"IN-SITU" CONSTANT HEAD PERMEAMETER

Date: 7/22/2015
Location: IB-3
Horizon: E
Client: NCDOT
Project Name: I-95 Business/US Highway 301
Project #: W-5519
Location: N 447167 E 2027473
Elevation: 192.9 feet

Hole Depth:	2.17	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.47	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h_1):	1.97	Feet

Chamber Used: 0.11 Ft^2

Initial Water in Hole:	0.33	Feet
Final Water in Hole:	0.50	Feet



0.02
0.11

Ksat = CQ/(2PiH^2)

C = sinh^{-1} (H/r) - [(r/H)^2 + 1]$^{1/2}$ + r/H

sinh^{-1} = inverse hyperbolic sin of a number
H = Height of water in hole (cm)
r = radius of hole (cm)
Q = Constant Flow Rate (Gal/day)
= Cross Sectional Area of Resevior x Length of Drop in Water Column over Time

r = **0.08** ft
H = **0.50** ft

C = **1.68**
Q = **130.48** Gallons/Day

Time	Drop in Water Column (ft)	(cm)
21	0.102	3.10
22	0.000	3.30
23	0.000	3.30
24	0.108	3.30
25	0.102	3.10
26	0.102	3.10
27	0.108	3.30
28	0.108	3.30
29	0.108	3.30
30	0.105	3.20
Avg.	**0.107**	

Time (min) = **1**

Cross Sectional Area = **0.11** ft^2
Length of Drop in Water Column = **154.33** ft/day

K_{sat} = 139.57 Gallons/Day/ft^2

Cm/Hour	**23.70**
Inches/Hour =	**9.33**
Feet/Day	**18.66**

Note: Ksat calculations are based on average drop in Water Column (ft) after equilibrium is reached.

Prepared by: S&ME, Inc.
Paul Masten

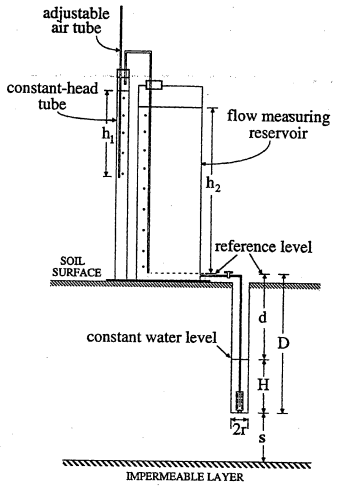
S&ME
"IN-SITU" CONSTANT HEAD PERMEAMETER

Date: 7/22/2015
Location: IB-4
Horizon: Bt1
Client: NCDOT
Project Name: I-95 Business/US Highway 301
Project #: W-5519
Location: N 447337 E 2027400
Elevation: 193.0 feet

Hole Depth:	2.83	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	3.13	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h_1):	2.63	Feet

Chamber Used: 0.11 Ft^2

Initial Water in Hole:	0.42	Feet
Final Water in Hole:	0.50	Feet



0.02
0.11

Ksat = CQ/(2PiH^2)

C = $\sinh^{-1}$ (H/r) - [(r/H)^2 + 1]$^{1/2}$ + r/H

$\sinh^{-1}$ = inverse hyperbolic sin of a number
H = Height of water in hole (cm)
r = radius of hole (cm)
Q = Constant Flow Rate (Gal/day)
= Cross Sectional Area of Resevior x Length of Drop in Water Column over Time

r = **0.08** ft
H = **0.50** ft

C = **1.68**
Q = **3.11** Gallons/Day

Time	Drop in Water Column (ft)	(cm)
3	0.098	3.00
6	0.000	0.40
9	0.000	0.20
12	0.007	0.20
15	0.010	0.30
18	0.007	0.20
21	0.010	0.30
24	0.007	0.20
27	0.007	0.20
30	0.010	0.30
Avg.	**0.008**	

Time (min) = **3**

Cross Sectional Area = **0.11** ft^2
Length of Drop in Water Column = **3.67** ft/day

K_{sat} = **3.32** **Gallons/Day/ft^2**

Cm/Hour	**0.56**
Inches/Hour =	**0.22**
Feet/Day	**0.44**

Note: Ksat calculations are based on average drop in Water Column (ft) after equilibrium is reached.

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