

| STATE | STATE PROJECT REFERENCE NO. | SHEET NO. | TOTAL SHEETS |
|-------|-----------------------------|-----------|--------------|
| N.C.  | DIVISION 13                 | 1         | 6            |

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

**STRUCTURE  
SUBSURFACE INVESTIGATION**

PROJ. REFERENCE NO. DIVISION 13 F.A. PROJ. NA  
COUNTY BUNCOMBE  
PROJECT DESCRIPTION CULVERT NO. 315 OVER  
WISE BRANCH ON SR 3437

SITE DESCRIPTION \_\_\_\_\_

**CONTENTS**

| <u>SHEET</u> | <u>DESCRIPTION</u> |
|--------------|--------------------|
| 1            | TITLE SHEET        |
| 2-2A         | LEGEND             |
| 3            | SITE PLAN          |
| 4-6          | BORE LOG REPORT    |

PERSONNEL  
P. OREE  
S. BUCHANAN  
N. MILLER  
SOIL DRILLING  
SERVICES

INVESTIGATED BY P. OREE  
CHECKED BY S. BUCHANAN  
SUBMITTED BY N. MILLER  
DATE MAY 2012

**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. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

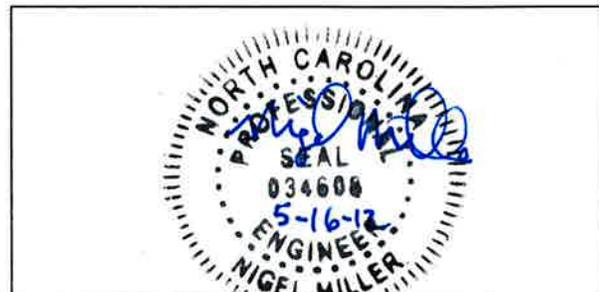
GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION, AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THIS PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IS IT CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

DRAWN BY: S. KITTS



**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**  
**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**

**SOIL DESCRIPTION**

SOIL IS CONSIDERED TO BE THE 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 STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. 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-4, A-5 | A-6, A-7    |
| SYMBOL                                |  |                |                                 |       |  |       |              |       |                   |          |             |
| % PASSING                             | 50 MX<br>30 MX<br>15 MX                  | 50 MX<br>25 MX | 10 MX                           | 35 MX | 35 MX                                    | 35 MX | 35 MX        | 36 MN | 36 MN             | 36 MN    | 36 MN       |
| LIQUID LIMIT                          | 6 MX                                     | NP             | 40 MX                           | 41 MN | 40 MX                                    | 41 MN | 40 MX        | 41 MN | 40 MX             | 41 MN    | 40 MX       |
| PLASTIC INDEX                         | 0  | 0              | 0                               | 0     | 4 MX                                     | 0     | 0            | 0     | 0                 | 0        | 0           |
| GROUP INDEX                           | 0  | 0              | 0                               | 0     | 0  | 0     | 0            | 0     | 0                 | 0        | 0           |
| USUAL TYPES OF MAJOR MATERIALS        | STONE FRAGS, GRAVEL, AND SAND            | FINE SAND      | SILTY OR CLAYEY GRAVEL AND SAND |       | SILTY SOILS                              |       | CLAYEY SOILS |       | MUCK, PEAT        |          |             |
| GEN. RATING AS A SUBGRADE             | EXCELLENT TO GOOD                        |                |                                 |       | FAIR TO POOR                             |       |              |       | FAIR TO POOR      | POOR     | UNSATURABLE |

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

| PRIMARY SOIL TYPE                          | COMPACTNESS OR CONSISTENCY                                       | RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)   | RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/F <sup>2</sup> ) |
|--|--|--|---|
| GENERALLY GRANULAR MATERIAL (NON-COHESIVE) | VERY LOOSE<br>LOOSE<br>MEDIUM DENSE<br>DENSE<br>VERY DENSE       | <4<br>4 TO 10<br>10 TO 30<br>30 TO 50<br>>50         | N/A   |
| GENERALLY SILT-CLAY MATERIAL (COHESIVE)    | VERY SOFT<br>SOFT<br>MEDIUM STIFF<br>STIFF<br>VERY STIFF<br>HARD | <2<br>2 TO 4<br>4 TO 8<br>8 TO 15<br>15 TO 30<br>>30 | <0.25<br>0.25 TO 0.50<br>0.5 TO 1.0<br>1 TO 2<br>2 TO 4<br>>4   |

| TEXTURE OR GRAIN SIZE             |      |      |      |      |       |       |
|-----------------------------------|------|------|------|------|-------|-------|
| U.S. STD. SIEVE SIZE OPENING (MM) | 4    | 10   | 40   | 60   | 200   | 270   |
|                                   | 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<br>IN. 12 | 75<br>3      | 2.0                    | 0.25              | 0.05       | 0.005      |

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

| PLASTICITY      |                       |              |
|-----------------|-----------------------|--------------|
| NONPLASTIC      | PLASTICITY INDEX (PI) | DRY STRENGTH |
| LOW PLASTICITY  | 0-5                   | VERY LOW     |
| MED. PLASTICITY | 6-15                  | SLIGHT       |
| HIGH PLASTICITY | 16-25                 | MEDIUM       |
|                 | 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.  
 UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)  
 GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES 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 WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

**COMPRESSIBILITY**

SLIGHTLY COMPRESSIBLE LIQUID LIMIT LESS THAN 31  
 MODERATELY COMPRESSIBLE LIQUID LIMIT EQUAL TO 31-50  
 HIGHLY COMPRESSIBLE LIQUID LIMIT GREATER THAN 50

| PERCENTAGE OF MATERIAL  |                |                   |                |
|-------------------------|----------------|-------------------|----------------|
| ORGANIC MATERIAL        | GRANULAR SOILS | SILT - CLAY SOILS | OTHER MATERIAL |
| TRACE OF ORGANIC MATTER | 2 - 3%         | 3 - 5%            | TRACE          |
| LITTLE ORGANIC MATTER   | 3 - 5%         | 5 - 12%           | LITTLE         |
| MODERATELY ORGANIC      | 5 - 10%        | 12 - 20%          | SOME           |
| HIGHLY ORGANIC          | >10%           | >20%              | HIGHLY         |

**GROUND WATER**

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

**MISCELLANEOUS SYMBOLS**

|  |  |  |                              |  |                     |
|--|--|--|------------------------------|--|---------------------|
|  | ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION      |  | TEST BORING                  |  | TEST BORING W/ CORE |
|  | SOIL SYMBOL  |  | AUGER BORING                 |  | SPT N-VALUE         |
|  | ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT |  | CORE BORING                  |  | SPT REFUSAL         |
|  | INFERRED SOIL BOUNDARY                             |  | MONITORING WELL              |  |                     |
|  | INFERRED ROCK LINE                                 |  | PIEZOMETER INSTALLATION      |  |                     |
|  | ALLUVIAL SOIL BOUNDARY                             |  | SLOPE INDICATOR INSTALLATION |  |                     |
|  | DIP & DIP DIRECTION OF ROCK STRUCTURES             |  | CONE PENETROMETER TEST       |  |                     |
|  |  |  | SOUNDING ROD                 |  |                     |

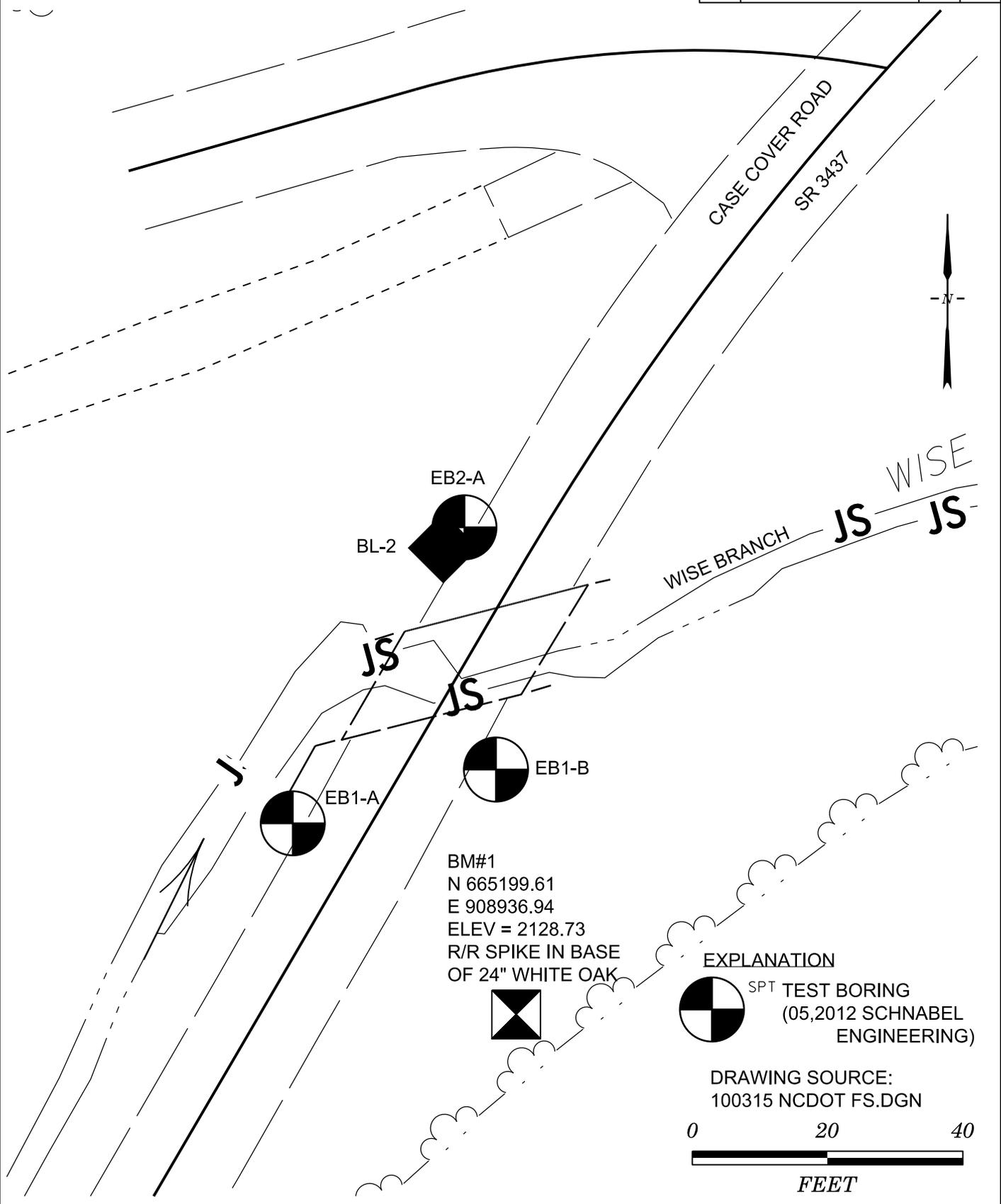
| ABBREVIATIONS                  |                          |                                  |
|--------------------------------|--------------------------|----------------------------------|
| AR - AUGER REFUSAL             | MED. - MEDIUM            | YST - VANE SHEAR TEST            |
| BT - BORING TERMINATED         | MICA - MICACEOUS         | WEA. - WEATHERED                 |
| CL - CLAY                      | MOD. - MODERATELY        | γ <sub>u</sub> - UNIT WEIGHT     |
| CPT - CONE PENETRATION TEST    | NP - NON PLASTIC         | γ <sub>d</sub> - DRY UNIT WEIGHT |
| CSE. - COARSE                  | ORG. - ORGANIC           | <b>SAMPLE ABBREVIATIONS</b>      |
| DMT - DILATOMETER TEST         | PMT - PRESSUREMETER TEST | S - BULK                         |
| DPT - DYNAMIC PENETRATION TEST | SAP. - SAPROLITIC        | SS - SPLIT SPOON                 |
| e - VOID RATIO                 | SD. - SAND, SANDY        | ST - SHELBY TUBE                 |
| F - FINE                       | SL. - SILT, SILTY        | RS - ROCK                        |
| FOSS. - FOSSILIFEROUS          | SLL. - SLIGHTLY          | RT - RECOMPACTED TRIAXIAL        |
| FRAC. - FRACTURED, FRACTURES   | TCR - TRICONE REFUSAL    | CBR - CALIFORNIA BEARING RATIO   |
| FRAGS. - FRAGMENTS             | w - MOISTURE CONTENT     |                                  |
| HI. - HIGHLY                   | v - VERY                 |                                  |

| EQUIPMENT USED ON SUBJECT PROJECT           |  |   |
|---|--|---|
| <b>DRILL UNITS:</b>                         | <b>ADVANCING TOOLS:</b>  | <b>HAMMER TYPE:</b>   |
| <input type="checkbox"/> MOBILE B-___       | <input type="checkbox"/> CLAY BITS                                   | <input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL |
| <input type="checkbox"/> BK-51              | <input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER                  | <b>CORE SIZE:</b>   |
| <input type="checkbox"/> CME-45C            | <input type="checkbox"/> 8" HOLLOW AUGERS                            | <input type="checkbox"/> -B___  |
| <input checked="" type="checkbox"/> CME-550 | <input type="checkbox"/> HARD FACED FINGER BITS                      | <input type="checkbox"/> -N___  |
| <input type="checkbox"/> PORTABLE HOIST     | <input type="checkbox"/> TUNG.-CARBIDE INSERTS                       | <input type="checkbox"/> -H___  |
|   | <input type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER | <b>HAND TOOLS:</b>  |
|   | <input type="checkbox"/> TRICONE ___ ' STEEL TEETH                   | <input type="checkbox"/> POST HOLE DIGGER                                     |
|   | <input type="checkbox"/> TRICONE ___ ' TUNG.-CARB.                   | <input type="checkbox"/> HAND AUGER   |
|   | <input type="checkbox"/> CORE BIT                                    | <input type="checkbox"/> SOUNDING ROD   |
|   | <input checked="" type="checkbox"/> HOLLOW STEM AUGERS               | <input type="checkbox"/> VANE SHEAR TEST                                      |

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**  
**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**

| ROCK DESCRIPTION   |   | TERMS AND DEFINITIONS   |                   |
|--|---|---|-------------------|
| <p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. 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:</p> |   | <p><b>ALLUVIUM (ALLUV.)</b> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.<br/> <b>AQUIFER</b> - A WATER BEARING FORMATION OR STRATA.<br/> <b>ARENACEOUS</b> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.<br/> <b>ARGILLACEOUS</b> - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.<br/> <b>ARTESIAN</b> - 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.<br/> <b>CALCAREOUS (CALC.)</b> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.<br/> <b>COLLUVIUM</b> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.<br/> <b>CORE RECOVERY (REC.)</b> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.<br/> <b>DIKE</b> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.<br/> <b>DIP</b> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.<br/> <b>DIP DIRECTION (DIP AZIMUTH)</b> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.<br/> <b>FAULT</b> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.<br/> <b>FISSILE</b> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.<br/> <b>FLOAT</b> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.<br/> <b>FLOOD PLAIN (FP)</b> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.<br/> <b>FORMATION (FM.)</b> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.<br/> <b>JOINT</b> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.<br/> <b>LEDGE</b> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.<br/> <b>LENS</b> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.<br/> <b>MOTTLED (MOT.)</b> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.<br/> <b>PERCHED WATER</b> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.<br/> <b>RESIDUAL (RES.) SOIL</b> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.<br/> <b>ROCK QUALITY DESIGNATION (ROD)</b> - 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.<br/> <b>SAPROLITE (SAP.)</b> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.<br/> <b>SILL</b> - 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.<br/> <b>SLICKENSIDE</b> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.<br/> <b>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</b> - NUMBER OF BLOWS IN 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.<br/> <b>STRATA CORE RECOVERY (SREC.)</b> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.<br/> <b>STRATA ROCK QUALITY DESIGNATION (SRQD)</b> - 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.<br/> <b>TOPSOIL (TS.)</b> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p> |                   |
| <p><b>WEATHERED ROCK (WR)</b></p>   | <p>NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES &gt; 100 BLOWS PER FOOT IF TESTED.</p>  |   |                   |
| <p><b>CRYSTALLINE ROCK (CR)</b></p>   | <p>FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.</p>   |   |                   |
| <p><b>NON-CRYSTALLINE ROCK (NCR)</b></p>    | <p>FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.</p>  |   |                   |
| <p><b>COASTAL PLAIN SEDIMENTARY ROCK (CP)</b></p>   | <p>COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.</p>  |   |                   |
| WEATHERING   |   |   |                   |
| FRESH  | ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.   |   |                   |
| VERY SLIGHT (V SL.)  | 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 (SL.)   | 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. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i>   |   |                   |
| 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. <i>IF TESTED, YIELDS SPT N VALUES &gt; 100 BPF</i>  |   |                   |
| VERY SEVERE (V SEV.)   | ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &lt; 100 BPF</i> |   |                   |
| 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 GROUDED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.  |   |                   |
| SOFT   | CAN BE GROUDED 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 FINGER NAIL.  |   |                   |
| FRACTURE SPACING   |   | BEDDING   |                   |
| <b>TERM</b>  | <b>SPACING</b>  | <b>TERM</b>   | <b>THICKNESS</b>  |
| VERY WIDE  | MORE THAN 10 FEET   | VERY THICKLY BEDDED   | > 4 FEET          |
| WIDE   | 3 TO 10 FEET  | THICKLY BEDDED  | 1.5 - 4 FEET      |
| MODERATELY CLOSE   | 1 TO 3 FEET   | THINLY BEDDED   | 0.16 - 1.5 FEET   |
| CLOSE  | 0.16 TO 1 FEET  | VERY THINLY BEDDED  | 0.03 - 0.16 FEET  |
| VERY CLOSE   | LESS THAN 0.16 FEET   | THICKLY LAMINATED   | 0.008 - 0.03 FEET |
|  |   | THINLY LAMINATED  | < 0.008 FEET      |
| INDURATION   |   |   |                   |
| FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE 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.   |   |                   |
|  |   | <p><b>BENCH MARK:</b> BM #1 LOCATED S08°55'51"E 69.82' FROM BL-2,<br/> R/R SPIKE IN BASE OF 24" WHITE OAK<br/> ELEVATION: 2128.73 FT.</p>   |                   |
| NOTES:   |   |   |                   |

| STATE | STATE PROJECT REFERENCE NO. | SHEET NO. | TOTAL SHEETS |
|-------|-----------------------------|-----------|--------------|
| N.C.  | DIVISION 13                 | 3         | 6            |

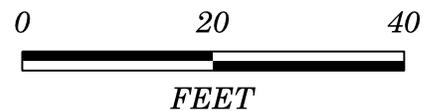


BM#1  
 N 665199.61  
 E 908936.94  
 ELEV = 2128.73  
 R/R SPIKE IN BASE  
 OF 24" WHITE OAK

**EXPLANATION**

 SPT TEST BORING  
 (05,2012 SCHNABEL  
 ENGINEERING)

DRAWING SOURCE:  
 100315 NCDOT FS.DGN



STATE PROJECT 100315  
 BUNCOMBE COUNTY, NORTH CAROLINA  
 NC DEPARTMENT OF TRANSPORTATION  
 SCHNABEL PROJECT NO. 12614017.00

CULVERT NO. 315  
 SITE PLAN



# NCDOT GEOTECHNICAL ENGINEERING UNIT BORELOG REPORT

|   |                     |                          |                         |
|---|---------------------|--------------------------|-------------------------|
| WBS Division 13   | TIP N/A             | COUNTY BUNCOMBE          | GEOLOGIST P. Oree       |
| SITE DESCRIPTION Culvert No. 100315 over Wise Branch on SR 3437 |                     |                          | GROUND WTR (ft)         |
| BORING NO. EB1-A  | STATION N/A         | OFFSET 10 ft LT          | ALIGNMENT -L-           |
| COLLAR ELEV. 2,125.3 ft   | TOTAL DEPTH 10.0 ft | NORTHING 665,228         | EASTING 908,904         |
| DRILL RIG/HAMMER EFF./DATE N/A                                  |                     | DRILL METHOD H.S. Augers | HAMMER TYPE Automatic   |
| DRILLER R. Cassell  | START DATE 05/09/12 | COMP. DATE 05/09/12      | SURFACE WATER DEPTH N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT |       |         | BLOWS PER FOOT |    |    |    |     | SAMP. NO. | LOG MOI | L O G | SOIL AND ROCK DESCRIPTION | DEPTH (ft) |      |
|-----------|-----------------|------------|------------|-------|---------|----------------|----|----|----|-----|-----------|---------|-------|---------------------------|------------|------|
|           |                 |            | 0.5ft      | 0.5ft | 0.5ft   | 0              | 25 | 50 | 75 | 100 |           |         |       |                           |            |      |
| 2130      |                 |            |            |       |         |                |    |    |    |     |           |         |       |                           |            |      |
| 2125      |                 |            |            |       |         |                |    |    |    |     |           |         |       |                           |            |      |
|           | 2,124.3         | 1.0        | 3          | 2     | 2       | 4              |    |    |    |     |           |         | W     |                           | 2,125.3    | 0.0  |
|           | 2,121.8         | 3.5        | 4          | 4     | 3       | 7              |    |    |    |     |           |         | W     |                           |            |      |
| 2120      | 2,119.3         | 6.0        | 4          | 25    | 38      |                |    |    |    |     |           |         | Sat.  |                           | 2,119.3    | 6.0  |
|           | 2,116.8         | 8.5        | 15         | 19    | 100/0.3 |                |    |    |    |     |           |         |       |                           | 2,116.8    | 8.5  |
|           | 2,115.3         | 10.0       | 60/0.0     |       |         |                |    |    |    |     |           |         |       |                           | 2,115.3    | 10.0 |
|           |                 |            |            |       |         |                |    |    |    |     |           |         |       |                           |            |      |

NCDOT BORE SINGLE DIVISION 13 BUNCOMBE CITY CULVERT 100315.GPJ NC\_DOT.GDT 5/16/12

GROUND SURFACE 0.0

**ALLUVIAL**  
BROWN, FINE TO MEDIUM GRAINED SANDY SILT, WITH TRACE FINE GRAINED GRAVEL, SLIGHTLY MICACEOUS

RESIDUAL  
BROWN, FINE TO MEDIUM GRAINED SANDY SILT, WITH TRACE COARSE GRAINED GRAVEL

**WEATHERED ROCK**  
WEATHERED ROCK (GNEISS)  
Boring Terminated at Elevation 2,115.3 ft On Crystalline Rock (Gneiss)





# NCDOT GEOTECHNICAL ENGINEERING UNIT BORELOG REPORT

|   |                     |                          |                         |
|---|---------------------|--------------------------|-------------------------|
| WBS Division 13   | TIP N/A             | COUNTY BUNCOMBE          | GEOLOGIST P. Oree       |
| SITE DESCRIPTION Culvert No. 100315 over Wise Branch on SR 3437 |                     |                          | GROUND WTR (ft)         |
| BORING NO. EB2-A  | STATION N/A         | OFFSET 10 ft LT          | ALIGNMENT -L-           |
| COLLAR ELEV. 2,123.6 ft   | TOTAL DEPTH 19.0 ft | NORTHING 665,272         | EASTING 908,929         |
| DRILL RIG/HAMMER EFF./DATE N/A                                  |                     | DRILL METHOD H.S. Augers | HAMMER TYPE Automatic   |
| DRILLER R. Cassell  | START DATE 05/09/12 | COMP. DATE 05/09/12      | SURFACE WATER DEPTH N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT |       |       | BLOWS PER FOOT |    |    |    |     | SAMP. NO. | LOG MOI | L O G | SOIL AND ROCK DESCRIPTION | DEPTH (ft)  |   |     |
|-----------|-----------------|------------|------------|-------|-------|----------------|----|----|----|-----|-----------|---------|-------|---------------------------|---|---|-----|
|           |                 |            | 0.5ft      | 0.5ft | 0.5ft | 0              | 25 | 50 | 75 | 100 |           |         |       |                           |   |   |     |
| 2125      |                 |            |            |       |       |                |    |    |    |     |           |         |       |                           |   |   |     |
|           | 2,122.6         | 1.0        |            |       |       |                |    |    |    |     |           |         |       |                           | 2,123.6   | GROUND SURFACE  | 0.0 |
| 2120      | 2,120.1         | 3.5        | 3          | 2     | 2     |                |    |    |    |     |           | M       |       |                           | <b>ALLUVIAL</b><br>BROWN, FINE TO MEDIUM GRAINED SANDY SILT, WITH TRACE ROOTS AND FINE GRAINED GRAVEL, SLIGHTLY MICACEOUS |   |     |
|           | 2,117.6         | 6.0        | 2          | 1     | 1     |                |    |    |    |     |           | M       |       | 2,117.6                   |   | 6.0   |     |
| 2115      | 2,115.1         | 8.5        | 6          | 5     | 5     |                |    |    |    |     |           |         |       |                           |   | <b>RESIDUAL</b><br>GRAY TO GRAYISH BROWN, FINE TO MEDIUM GRAINED SANDY SILT, MODERATELY MICACEOUS |     |
| 2110      | 2,110.1         | 13.5       | 3          | 1     | 2     |                |    |    |    |     |           | W       |       |                           |   |   |     |
|           | 2,104.6         | 18.5       | 5          | 9     | 8     |                |    |    |    |     |           | W       |       | 2,104.6                   | 19.0  |   |     |
| 2105      | 2,104.6         | 18.5       | 16         | 100/0 |       |                |    |    |    |     |           |         |       |                           | Boring Terminated at Elevation 2,104.6 ft On Crystalline Rock (Gneiss)  |   |     |

NCDOT BORE SINGLE DIVISION 13 BUNCOMBE CITY CULVERT 100315.GPJ NC\_DOT.GDT 5/16/12