STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

JAMES H. TROGDON, III
SECRETARY

October 15, 2019

MEMORANDUM TO: Brian Hanks, P.E.
State Structures Engineer

ATTENTION: Jacquelyn Bowles, P.E.
Project Engineer

FROM: John L. Pilipchuk, L.G., P.E.
State Geotechnical Engineer

DS SLL DS CAY

DocuSigned by: John L. Pilipchuk 52C44B94B8BE444...

STATE PROJECT: 67044.1.1 (BR-0044)
COUNTY: ROCKINGHAM

DESCRIPTION: Replace Bridge No 780168 over Smith River on NC14/NC78

SUBJECT: Geotechnical Recommendations

The Geotechnical Engineering Unit has reviewed and presents the subsurface investigation and foundation recommendations prepared by Summit Design and Engineering Services, PLLC for the above referenced project.

☒ Roadway Subsurface Investigation (48) pages
☒ Geotechnical Report - Recommendations (5) pages

Please call John McCray at (919) 707-6890 or David Teague, PE at (919) 707-6877 if there are any questions concerning this memorandum.

Attachment

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STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BR-0044	1	48

REFERENCE: BR-0044

PROJECT: 67044

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 *ROCKINGHAM*

PROJECT DESCRIPTION *BRIDGE NO. 168 ON NC 14/NC 87 (N. VAN BUREN ROAD) OVER SMITH RIVER*

INVENTORY

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.

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 THE 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.

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.
2. 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.

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DATE *OCTOBER, 2019*

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10/16/2019
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
BR-0044	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 #40 #200	50 MX 30 MX 15 MX	50 MX 25 MX	51 MN 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 PI	— 6 MX		— NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
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 LOOSE MEDIUM DENSE DENSE VERY DENSE	< 4 4 TO 10 10 TO 30 30 TO 50 > 50	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	< 2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 > 30	< 0.25 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 > 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 SL — SHRINKAGE LIMIT	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	- 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
- 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
- [X] CME-550X
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 3.25" HOLLOW STEM AUGERS
- [ ] HARD FACED FINGER BITS
- [X] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [ ] TRICONE _____" TUNG.-CARB.
- [ ] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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

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:

ELEVATION: FEET

NOTES:

ELEVATIONS OBTAINED FROM br0044_ls_tin.tin (file dated 4/8/19).

NO SUBSURFACE PROFILE WAS INCLUDED IN THIS REPORT, MAINLY DUE TO THE SIGNIFICANT OFFSET DISTANCE OF THE BORINGS FROM CENTERLINE AND THE STEEP TOPOGRAPHY.

FIAD = FILLED IN AFTER DRILLING

DATE: 8-15-14

09/08/99

TIP PROJECT: BR-0044

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

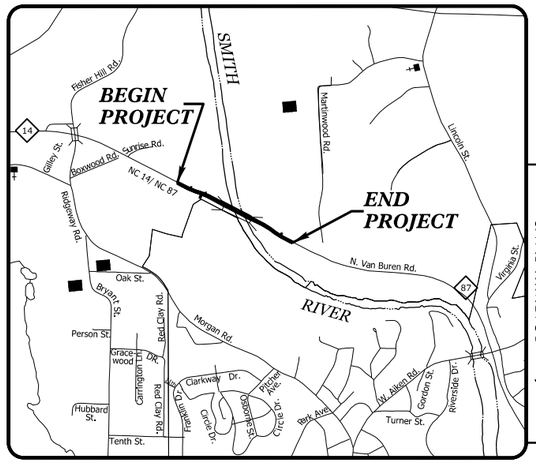
ROCKINGHAM COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BR-0044	2A	48

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
67044.1.1		PE

LOCATION: BRIDGE NO. 168 ON NC 14/NC 87 (N. VAN BUREN ROAD) OVER SMITH RIVER

TYPE OF WORK: GRADING, DRAINAGE, PAVING, AND STRUCTURE

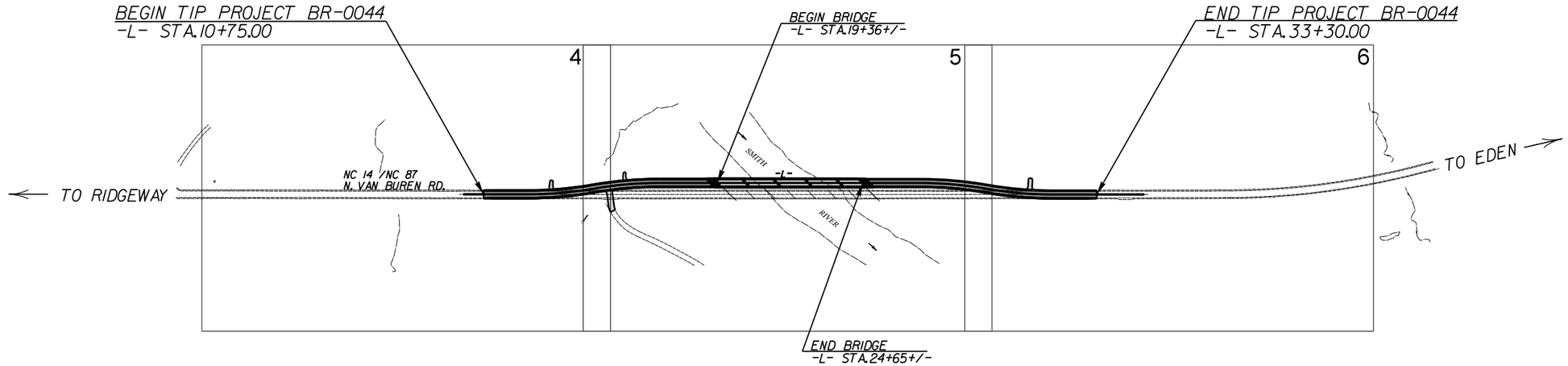


25% ROADWAY PLANS JANUARY 30, 2019

VICINITY MAP

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

NAD 83 NA 2011



CLEARING ON THE PROJECT SHALL BE TO THE LIMITS ESTABLISHED USING METHOD _

THIS PROJECT IS NOT WITHIN ANY MUNICIPAL BOUNDARIES

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CONTRACT:

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 2020 = 8,080
ADT 2040 = 8,400
K = 9 %
D = 55 %
T = 12 % *
V = 60 MPH
* (TTST 10% + DUAL 2%)
FUNC CLASS = PRINCIPAL ARTERIAL
REGIONAL TIER

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT BR-0044 = 0.328 MI
LENGTH STRUCTURE TIP PROJECT BR-0044 = 0.099 MI
TOTAL LENGTH TIP PROJECT BR-0044 = 0.427 MI

AECOM
NC FIRM LICENSE No: F-0342
701 Corporate Center Drive, Suite 475
Raleigh, NC 27607
(919) 854-6200 - (919) 854-6259(FAX)

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: APRIL 16, 2019

LETTING DATE: JANUARY 21, 2020

NEIL J. DEAN, P.E. — *PROJECT ENGINEER*
RADHA ATTALURI, P.E. — *PROJECT DESIGN ENGINEER*
DAVID STUTTS, P.E. — *NCDOT PROJECT MANAGER*

HYDRAULICS ENGINEER

P.E.
SIGNATURE:

ROADWAY DESIGN ENGINEER

P.E.
SIGNATURE:

STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION •

30-SEP-2019 14:50
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SUMMIT
DESIGN AND ENGINEERING SERVICES
919.732.3883 SUMMIT-ENGINEER.COM
504 Meadowland Drive, Hillsborough, NC 27278

October 9, 2019

WBS Number: 67044.1.1
TIP Number: BR-0044
Project ID: 34624
County: Rockingham
Description: Bridge No. 168 on NC 14/NC 87 (N. Van Buren Road) over Smith River

SUBJECT: Geotechnical Report - Roadway Subsurface Inventory

Project Description

The proposed 0.427-mile project is located just outside the municipal boundaries of Eden. The project will involve the replacement of Bridge No. 168 on NC 14/NC 87. The new bridge is currently proposed to be constructed approximately 45 feet north of the existing bridge. To accommodate the new bridge location, 0.328-miles of new roadway alignment and widening is proposed on NC 14/NC 87. The proposed earthworks are significant in some areas of the project corridor with some cut and fill sections exceeding 25 feet.

The geotechnical investigation was conducted from May 20, 2019 to June 13, 2019. Borings were advanced using a CME-550X drill machine equipped with an automatic hammer. Drill tooling was advanced using 3.25-inch hollow-stem augers. One hand auger was advanced at a boring location deemed to be inaccessible for the drill rig. Standard Penetration Tests (SPT) were performed at all other planned boring locations to provide subsurface information for roadway foundation and slope design/construction. Undisturbed samples were obtained in areas of significant proposed fill placement. No rock coring was performed during the roadway investigation. All investigations and reporting were performed in accordance with the NCDOT Geotechnical Engineering Unit's 2016 "Geotechnical Investigation and Recommendations Manual."

At the time of this report, 10 of the proposed 12 structure borings have been drilled as part of the geotechnical investigation for the new bridge. One structure boring, EB2-B, was determined to be useful to the roadway investigation and is included within this report. The remainder of the structure boring data will be available in the Structure Subsurface Investigation Report which will be turned in by Summit under a separate cover and at a later date.

The following alignments were investigated for this project:

Alignment	Station(±)
-L-	10+75.00 - 33+30.00

Physiography, Geography, and Geology

The project is located in far north-central North Carolina within the Piedmont Physiographic Province. Topography in the project area is characterized by gently rolling, well rounded hills and long low ridges with a couple hundred feet of elevation difference between the hills and valleys. In general, the topography within the project corridor would fit this description. Elevations along the project range from approximately 690 feet to approximately 540 feet above sea level. The topographic high occurs near the top of the first cut on the project at approximately 11+00, 100'LT. The topographic low occurs within the floodplain of the Smith River.

The project corridor is located within the Roanoke River Basin and it intersects the Smith River. River flow is now mostly controlled by an upstream dam near Martinsville, Virginia. Previous flooding events have led to the formation of a floodplain that is believed to reach approximately 600 feet in width where it intersects the centerline of the project. The river flows south from the project where it eventually merges with the Dan River. One unnamed tributary was observed within the project corridor at 15+29, 78'LT. It flows north where it eventually merges into the Smith River.

Geologically, the project corridor is located within the Sauratown Mountains Anticlinorium. The underlying bedrock consists of a complex mixture of metamorphic rock that has repeatedly been compressed, fractured, faulted, and folded. The rocks within this area are believed to be of a similar origin and age to the rocks found within the Western Blue Ridge. The eastern end of the project corridor falls within a mile of the western boundary of the Dan River Triassic Basin.

Soil Properties

Residual soils, soils derived from the weathering of rock, are the dominant soil origin within the project corridor. In general, the Residual soils underlying the project follow the typical weathering profile observed throughout the piedmont. The clays, when present, are usually found closer to the ground surface. The silts and sands are typically found deeper and closer to the parent rock source. However, much like the parent rocks that they weather from, the Residual soils can vary significantly in some areas in both composition and vertical/horizontal distribution. The compositional boundaries (also known as contacts) within the Residual soils are shown in the graphical section of this report as dashed lines. However, in reality, the contacts are much more likely gradational in nature. Meaning that the compositional changes between clay, silt, and sand occur gradually and over some vertical/horizontal distance. Highly plastic Residual clays (Plasticity Index value greater than 26) can be problematic during construction. They can negatively affect embankment stability, embankment settlement, subgrade stability, and may not be suitable for use as embankment material on the project.

Residual silty and sandy clays are prevalent throughout the project corridor and are typically present within 6 feet of the ground surface. They are generally not saprolitic and contain less visible mica than the silts and sands. SPT results in the Residual clays showed soil densities typically range from medium

stiff to stiff. No highly plastic clays were encountered during the investigation. Below is a summary of the results of laboratory testing conducted on the Residual clays present within the project corridor:

Sample No.	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve	AASHTO Classification
SS-1	43	18	20.0%	58%	A-7-6
SS-2	47	15	21.2%	49%	A-7-5
SS-11	47	21	17.3%	72%	A-7-6
SS-20	45	18	37.5%	53%	A-7-6
SS-21	59	23	41.6%	77%	A-7-5
SS-34	41	21	15.6%	54%	A-7-6
SS-35	28	12	15.7%	51%	A-6
SS-90	34	16	12.9%	44%	A-6
SS-62	34	15	18.7%	51%	A-6
AVERAGES	**42**	**18**	**22.3%**	**57%**	

Residual clayey and sandy silts are common throughout the project corridor and typically underlie the clays. These soils can be saprolitic and are usually micaceous. SPT results in the Residual silts showed soil densities that typically ranged from medium stiff to stiff with some soft and very stiff areas. Softer areas typically corresponded with areas of higher moisture content. Below is a summary of the results of laboratory testing conducted on the Residual silts present within the project corridor:

Sample No.	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve	AASHTO Classification
SS-12	36	2	18.0%	52%	A-4
SS-13	29	0	14.8%	43%	A-4
SS-24	25	2	13.2%	51%	A-4
SS-66	25	8	17.2%	48%	A-4
SS-91	48	8	22.9%	72%	A-5
AVERAGES	**33**	**4**	**17.2%**	**53%**	

Residual silty sands are also common throughout the project corridor and typically underlie the clays and/or silts. The sands are generally saprolitic and micaceous with trace to little amounts of gravel-sized crystalline rock fragments. SPT results in the Residual sands showed soil densities that typically ranged from loose to dense with some very loose and very dense areas. Below is a summary of the results of laboratory testing conducted on the Residual sands:

Sample No.	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve	AASHTO Classification
SS-3	38	0	12.5%	33%	A-2-4
SS-28	30	2	8.4%	25%	A-2-4
AVERAGES	**34**	**1**	**10.5%**	**29%**	

Alluvial soils, soils that have been transported and deposited by water, were encountered within the project corridor. Alluvial deposition typically occurs in topographically low areas. These soils are often very near or even below the water table and are typically wet to saturated. As a consequence of their high moisture content and nature of deposition, alluvial soils typically exhibit very soft to soft/very loose to loose soil densities. They also can contain highly plastic clays and sometimes significant amounts of organic matter. Depending on their characteristics, Alluvial soils can be problematic during and after construction. They can negatively impact embankment stability, embankment settlement, and subgrade stability.

Alluvial silty and sandy clays were commonly encountered within the floodplain of the Smith River. SPT results in the Alluvial clays showed soil densities that typically ranged from medium stiff to stiff. Below is a summary of the results of laboratory testing conducted on the Alluvial clays present within the project corridor:

Sample No.	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve	AASHTO Classification
SS-31	41	14	25.0%	73%	A-7-6
SS-38	41	14	28.6%	57%	A-7-6
SS-42	44	17	21.1%	45%	A-7-6
AVERAGES	**42**	**15**	**24.9%**	**58%**	

Alluvial sandy silts are also present within the floodplain. SPT results in the Alluvial silts showed soil densities that typically ranged from medium stiff to stiff. Below is a summary of the results of the laboratory testing conducted on the Alluvial silts present within the project corridor:

Sample No.	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve	AASHTO Classification
SS-33	30	9	20.5%	53%	A-4
SS-39	32	8	20.9%	48%	A-4
AVERAGES	**31**	**9**	**20.7%**	**51%**	

Alluvial silty sands were also encountered within the floodplain but were not laboratory tested. These sands were typically field classified as moist to wet and SPT results showed soil densities were typically loose. Approximate locations where Alluvial soils are believed to be present within the project corridor will be highlighted in the “Areas of Special Geotechnical Interest” section of this text report.

Roadway Embankment soils from the construction of existing NC 14/NC 87 are present throughout the project corridor. Roadway Embankment soils are often quite similar to the local Residual soils that they are typically sourced from. However, they often have a “reworked” appearance, with a large variation in grain size. They can contain little to trace amounts of organic material, gravel, cobbles, boulders and/or other types of debris. If properly constructed, Roadway Embankment soils typically do not present major issues during future construction projects. However, some older Roadway Embankment fills across the state can be poorly compacted, contain highly plastic clays, perched water, and even miscellaneous debris such as tree trunks.

Roadway Embankment sandy and clayey silts were the predominate soil type found within the existing embankment fills of NC 14/NC 87. SPT results in the Roadway Embankment silts showed soil densities that typically range from medium stiff to stiff. Below is a summary of the results of the laboratory testing conducted on the Roadway Embankment silts present within the project corridor:

Sample No.	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve	AASHTO Classification
S-1	35	0	18.6%	40%	A-4
SS-81	32	3	22.2%	43%	A-4
SS-70	32	0	20.3%	41%	A-4
AVERAGES	**33**	**1**	**20.4%**	**41%**	

Silty sands were also encountered within the Roadway Embankment but were not laboratory tested. They were typically found immediately below the existing pavement structure. These sands were typically field classified as dry and SPT results indicated densities ranging from medium dense to dense.

Rock Properties

Crystalline and Weathered Rock were encountered in several areas within the project corridor. Analysis of rock fragments retrieved from SPT testing seemed to indicate that the underlying bedrock mostly consists of a Biotite Gneiss and/or Schist. This schist may be interlayered with metagraywacke in some areas.

Crystalline Rock was not encountered within 6 feet of proposed grade during the investigation and is not anticipated to be a major factor during the construction of the roadway. However, this does not guarantee that it won't be encountered in some small areas during construction. The interlayering of compositionally different rock types and repeated past deformation events have caused fracturing, faulting, and folding of these rock units. This combined with differential weathering occurring over millions of years could cause the Crystalline Rock "line" to be quite erratic and unpredictable in some areas.

Weathered Rock was encountered within 6 feet of proposed grade in a few areas. It is in these areas that the chances of encountering small areas of Crystalline Rock are greatest. Because of this, approximate locations where Weathered Rock is believed to be present within six feet of proposed grade will be highlighted in the "Areas of Special Geotechnical Interest" section of this text report. Along that same line of thinking, small areas of Weathered Rock could be encountered within cuts that are believed to primarily be through Residual soil.

Groundwater Properties

The field investigation was conducted during a period of average rainfall. Groundwater was only encountered in 3 of the 17 total borings. Top of water table elevations varied from 594.6 feet to 542.9 feet above sea level. An average water table elevation of 571.5 feet above sea was calculated within the project corridor. Below is a summary of the locations and elevations groundwater was encountered within the project corridor:

Boring ID	Station(±)	Offset	Elevation(ft)
L_1400LT	14+00	50'LT	594.6
L_1478LT	14+78	81'LT	577.0
L_2500LT	25+00	40'LT	542.9

On the western side of the Smith River, groundwater was encountered in two borings (L_1400LT & L_1478LT). Both borings were down in a low area near the headwaters of a small tributary that flows north and eventually empties into the Smith River. In the floodplain on the east side of the river, groundwater was encountered within one boring (L_2500LT). While it was only encountered in only one boring, groundwater is believed to be present throughout most of the floodplain. This is mostly due to the numerous borings within the floodplain that caved immediately after drilling. The caving was likely the result of wet and unstable soils that could not handle the tripping out of the drill tooling. Groundwater was not encountered within six feet of proposed grade is not anticipated to be a factor during construction of the roadway. However, it could be a factor for any potential undercut for embankment stability in the floodplain or the low area from 14+00 - 15+00 left.

A visual reconnaissance for water wells was conducted throughout the project corridor. This was used in conjunction with the final survey file to attempt to identify water wells within or adjacent to the proposed right of way of the project. Properly abandoned wells are not included in the following list. Some water well locations are well hidden, and it is possible that some wells were missed or misidentified by the final survey and/or visual reconnaissance. The following water wells were identified within the project corridor:

Alignment	Station(±)	Offset
-L-	17+16	38'LT

Areas of Special Geotechnical Interest

Alluvial Soils - During the geotechnical investigation, areas of Alluvial soils were observed and encountered. Alluvial soils can be problematic during and after construction. They can negatively impact embankment stability, embankment settlement, and subgrade stability. More detailed information on these soils can be found in the "Soil Properties" section of this text report. The following approximate locations listed below show areas where Alluvial soils are believed to be present within the project corridor:

Alignment	Station(±)	Offset
-L-	18+89- 29+32	Left & Right

Weathered Rock - During the geotechnical investigation, Weathered Rock was encountered in several areas. Weathered Rock could present issues with excavation during construction, especially if unanticipated areas of Crystalline Rock are present within these zones. More detailed information on the rocks underlying the project corridor can be found in the "Rock Properties" section of this text report. The following approximate locations listed below show areas where Weathered Rock is believed to be present within six feet of proposed grade:

Alignment	Station(±)	Offset
-L-	10+75 - 11+25	Left & Right
-L-	16+75 - 18+50	Left

Appendix A

Bulk Samples – California Bearing Ratio (CBR)

L_1100LT
(-L-) 11+00, 100’LT
0.0 – 15.0 ft.
S – 1

L_1800LT
(-L-) 18+00, 20’LT
0.0 – 15.0 ft.
S – 2

References

North Carolina Geological Survey, 1985, Geologic map of North Carolina: North Carolina Geological Survey, General Geologic Map, scale 1:500000.

The Geology of the Carolinas, J. Wright Horton, Jr., and Victor A. Zullo

Groundwater Science, Charles R. Fitts

DocuSigned by:
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Respectfully Submitted,

Brett Smith, PG
Project Geologist
Summit Design and Engineering Services, PLLC

PROJECT REFERENCE NO.	SHEET NO.
BR-0044	4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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Prepared in the Office of: AECOM
NC FIRM LICENSE Nos F-0342
701 Corporate Center Drive, Suite 475
Raleigh, NC 27607
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NAD 83 NA 2011

10+00

15+00

11+00
100'LT

12+00
100'LT

14+78
81'LT

14+00
50'LT

11+50
25'LT

RESIDUAL

RESIDUAL

RESIDUAL

WEATHERED ROCK

WEATHERED ROCK

CONC DITCH

CENTURY LINK, COPPER

4' FDPS

CONC DITCH

-L-

ROADWAY EMBANKMENT

ROADWAY EMBANKMENT

TO FISHER HILL RD

N VAN BUREN RD
NC 14/NC 87 31.5' BST

BEGIN PROJECT TIP BR-0044
STA 10+75.00

MATCHLINE -L- STA 15+00
SEE SHEET 5

REVISIONS

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PROJECT REFERENCE NO.	SHEET NO.
BR-0044	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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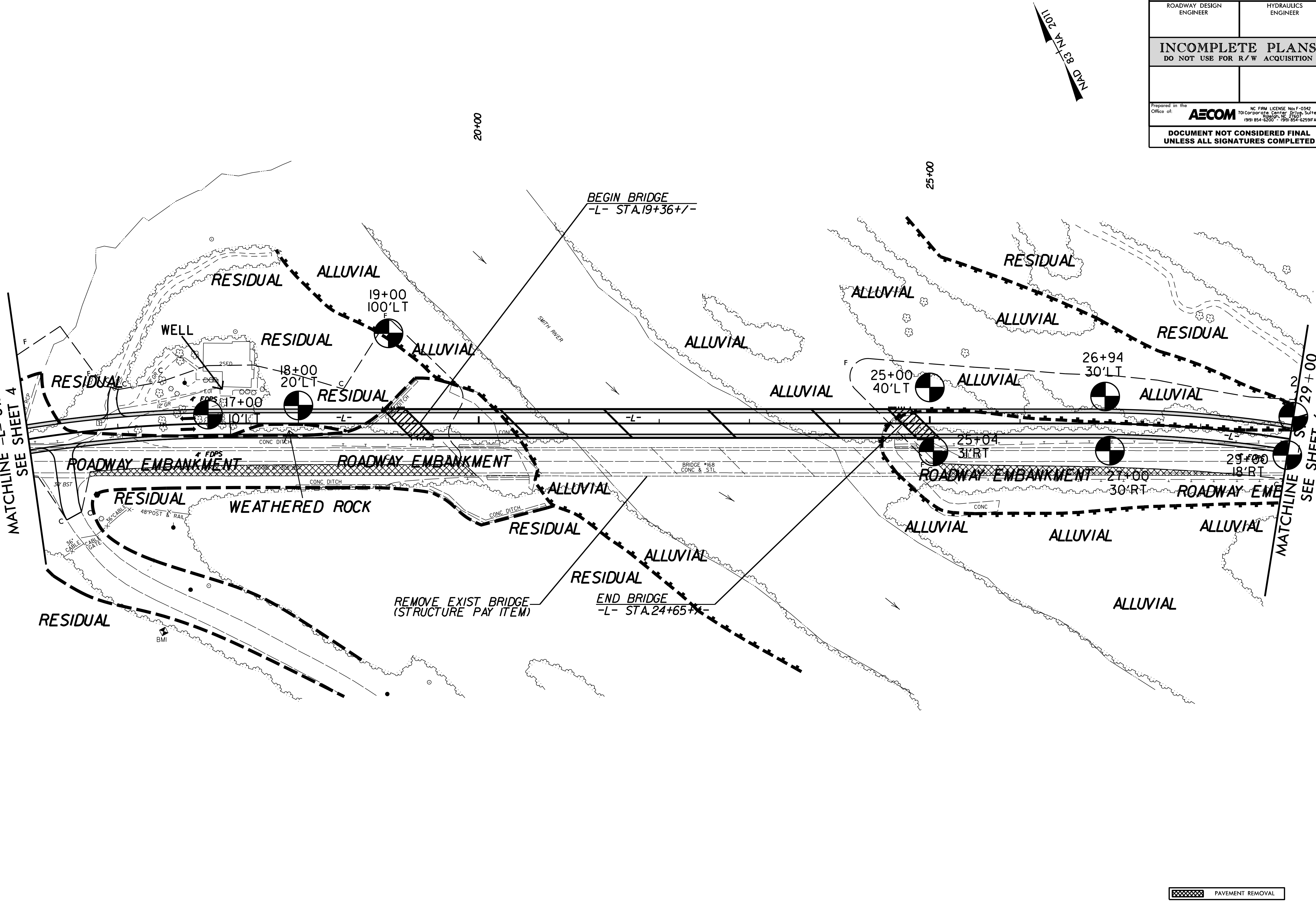

REVISIONS

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PROJECT REFERENCE NO.	SHEET NO.
BR-0044	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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NAD 83 NA 2011

REVISIONS

5/14/99

30+00

35+00

29+00 25'LT

30+50 40'LT

32+50 45'LT

STA 29+00

RESIDUAL

RESIDUAL

RESIDUAL

ROADWAY EMBANKMENT

-L-

31+00 13'RT

32+50 13'RT

MATCHLINE -L- STA 29+00
SEE SHEET 5 OF 11

ANKMENT

ALLUVIAL

RESIDUAL

ALLUVIAL

RESIDUAL

ALLUVIAL

ALLUVIAL

FDPS

CONC DITCH

CONC

MTL GATE

POST

BM2

24" RCP

11" GR

SHED

CONC

CONC DITCH

BL-11

N VAN BUREN RD
NC 14/NC 87 31' BST

TO EAST AIKEN RD

END PROJECT TIP BR-0044
STA 33+30.00

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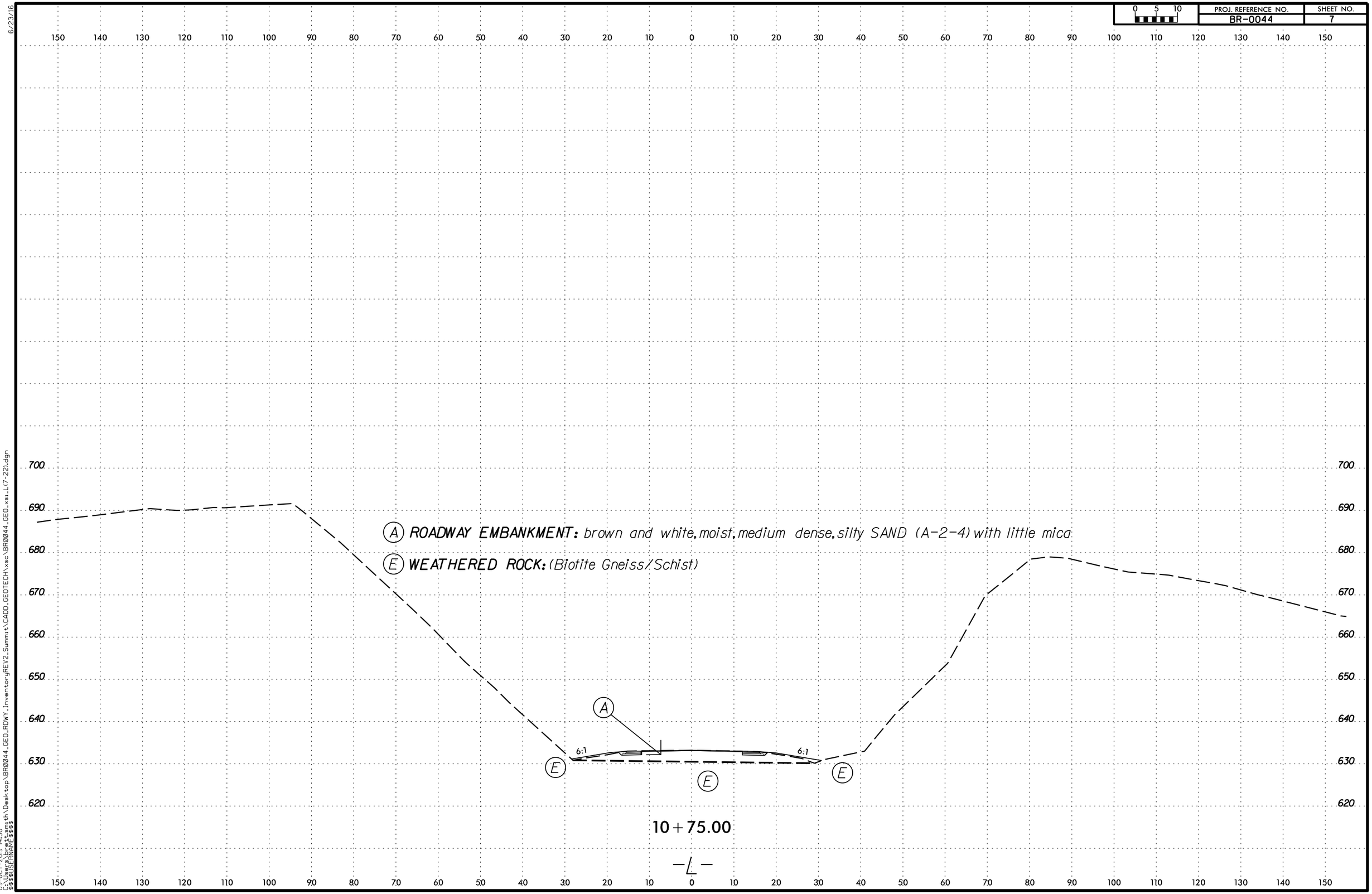

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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	8

(A) **ROADWAY EMBANKMENT:** *brown and white, moist, medium dense, silty SAND (A-2-4) with little mica*

(B) **RESIDUAL:** *red to red-brown, moist, stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-5/A-7-6)*

(D) **RESIDUAL:** *brown, tan, and white, dry, loose to very dense, saprolitic, silty SAND (A-2-4) with trace to some mica*

(E) **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*

SS-1
SS-2
SS-3
S-1

L 1100LT
11+00
100'LT

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-1	100'LT	11+00	0.0' - 1.5'	A-7-6(8)	43	18	19.0	23.5	14.0	43.5	92	82	58	20.0	N/A
SS-2	100'LT	11+00	3.8' - 5.3'	A-7-5(5)	47	15	23.9	28.1	16.6	31.4	87	74	49	21.2	N/A
SS-3	100'LT	11+00	8.8' - 10.3'	A-2-4(0)	38	0	31.6	42.9	15.7	9.8	89	73	33	12.5	N/A
S-1	100'LT	11+00	0.0' - 15.0'	A-4(0)	32	3	27.4	33.4	23.9	15.3	93	78	45	N/A	N/A

11
14
7
8
9
14
20
28
39
69
93
98
100/0.9
100/0.6
100/0.8

B T
DRY
(05/19)

2:1
4:1
6:1
6:1
4:1
2:1

11+00.00
-L-

PROJ. REFERENCE NO.	SHEET NO.
BR-0044	9

(A) **ROADWAY EMBANKMENT:** *brown and white, moist, medium dense, silty SAND (A-2-4) with little mica*

(B) **RESIDUAL:** *red to red-brown, moist, stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-5/A-7-6)*

(D) **RESIDUAL:** *brown, tan, and white, dry to moist, loose to very dense, saprolitic, silty SAND (A-2-4) with trace to some mica*

(E) **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*

L 1150LT
11+50
25'LT

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11
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BT
DRY
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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	10

Ⓐ **ROADWAY EMBANKMENT:** *brown and white, moist, medium dense, silty SAND (A-2-4) with little mica*

Ⓑ **RESIDUAL:** *red-brown, moist, stiff, moderately plastic, silty CLAY (A-7-6) with some sand*

Ⓒ **RESIDUAL:** *orange, moist, medium stiff to stiff, saprolitic, sandy SILT (A-4) with little to some clay*

Ⓓ **RESIDUAL:** *tan and white, dry to wet, loose to very dense, saprolitic, silty SAND (A-2-4) with trace to little mica*

Ⓔ **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-11	100'LT	12+00	0.0' - 1.5'	A-7-6(15)	47	21	12.1	19.2	16.1	52.5	98	93	72	17.3	N/A
SS-12	100'LT	12+00	4.0' - 5.5'	A-4(0)	36	2	17.3	33.4	20.6	28.6	88	80	52	18.0	N/A
SS-13	100'LT	12+00	9.0' - 10.5'	A-4(0)	29	0	26.5	40.3	19.2	14.0	98	84	43	14.8	N/A

SS-11
SS-12
SS-13
L 1200LT
12+00
100'LT

12
11
7
9
11
8
21
21
46
59
100/0.9
89
85

B.T.
DRY
(05/19)

2:1
4:1
6:1
6:1
4:1

730 720 710 700 690 680 670 660 650 640 630 620 610 600 590

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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	11

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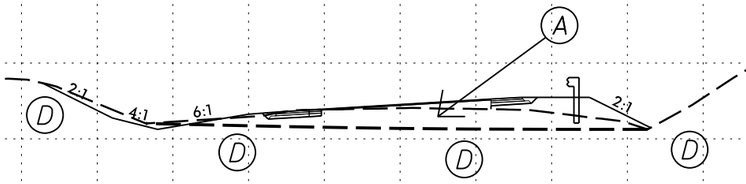
(A) **ROADWAY EMBANKMENT:** *brown and white, moist, medium dense, silty SAND (A-2-4) with little mica*

(D) **RESIDUAL:** *tan and white, dry to wet, loose to very dense, saprolitic, silty SAND (A-2-4) with trace to little mica*



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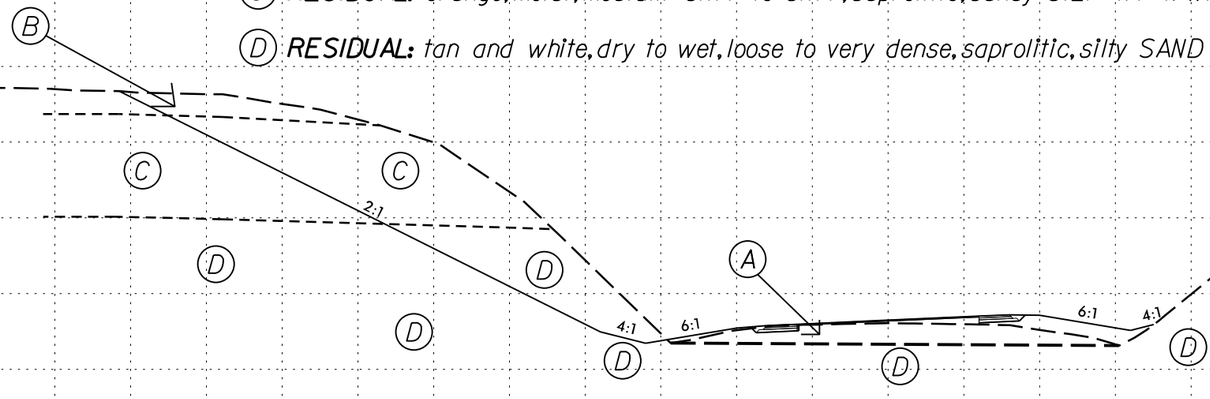
690 680 670 660 650 640 630 620 610

(A) **ROADWAY EMBANKMENT:** *brown and white, moist, medium dense, silty SAND (A-2-4) with little mica*

(B) **RESIDUAL:** *red-brown, moist, stiff, moderately plastic, silty CLAY (A-7-6) with some sand*

(C) **RESIDUAL:** *orange, moist, medium stiff to stiff, saprolitic, sandy SILT (A-4) with little to some clay*

(D) **RESIDUAL:** *tan and white, dry to wet, loose to very dense, saprolitic, silty SAND (A-2-4) with trace to little mica*



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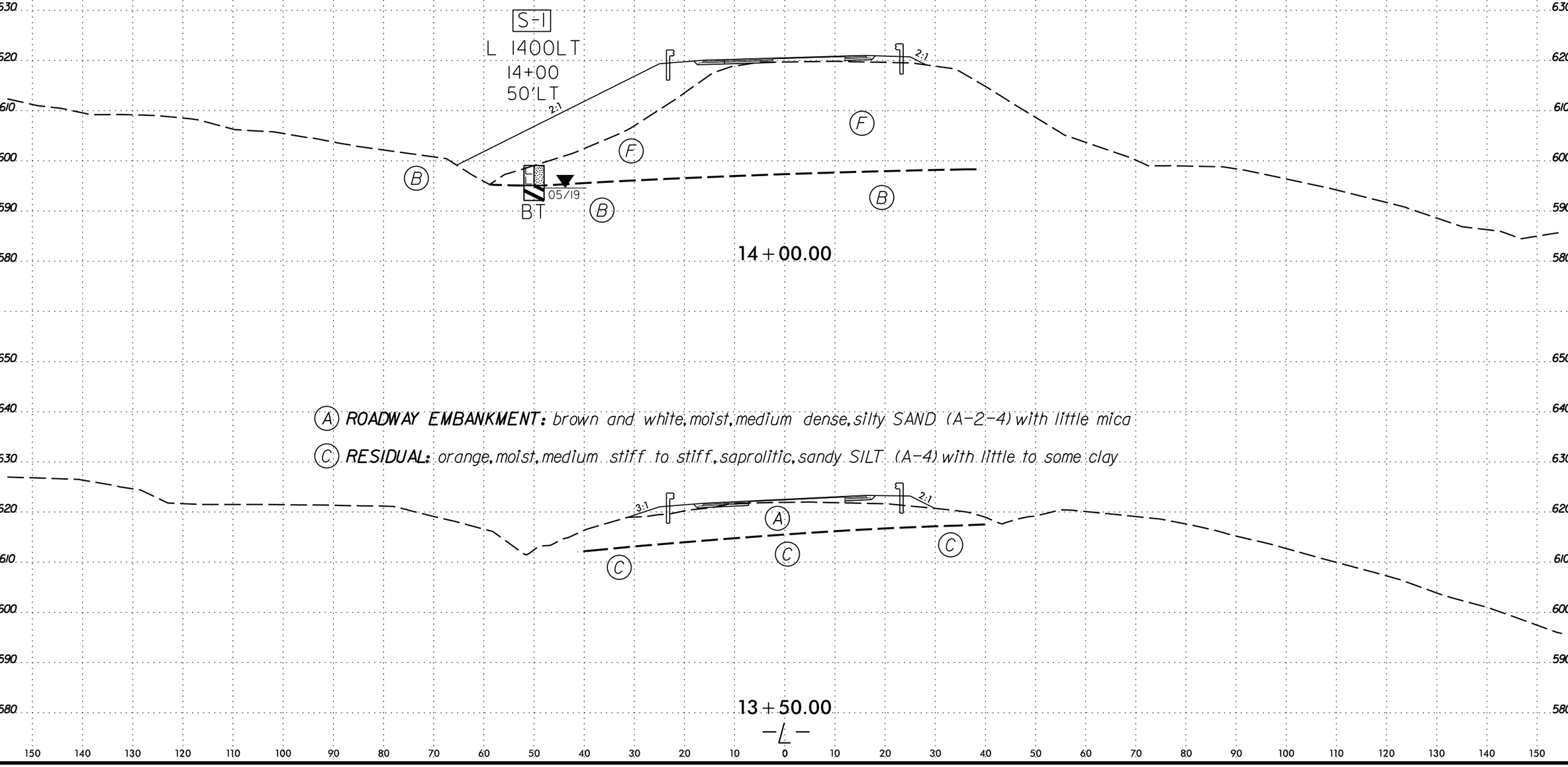
PROJ. REFERENCE NO.	SHEET NO.
BR-0044	12

Ⓕ **ROADWAY EMBANKMENT:** brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay

Ⓑ **RESIDUAL:** brown, wet to saturated, stiff to very stiff, moderately plastic, highly sandy, silty CLAY (A-7-6)

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
S-1	50'LT	14+00	0.0' - 1.0'	A-4(0)	35	0	30.2	34.1	20.2	15.5	90	74	40	18.6	N/A

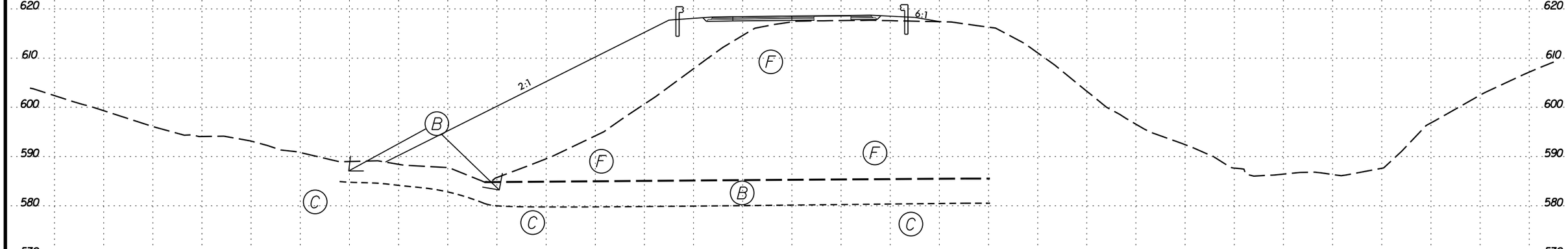


0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	13

Ⓕ **ROADWAY EMBANKMENT:** *brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay*

Ⓑ **RESIDUAL:** *brown to red-brown, moist to wet, medium stiff to stiff, moderately plastic, silty CLAY (A-7-5/A-7-6) with some sand*

Ⓒ **RESIDUAL:** *brown and gray, wet to saturated, soft, saprolitic, sandy SILT (A-4)*



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(F) **ROADWAY EMBANKMENT:** *brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay*

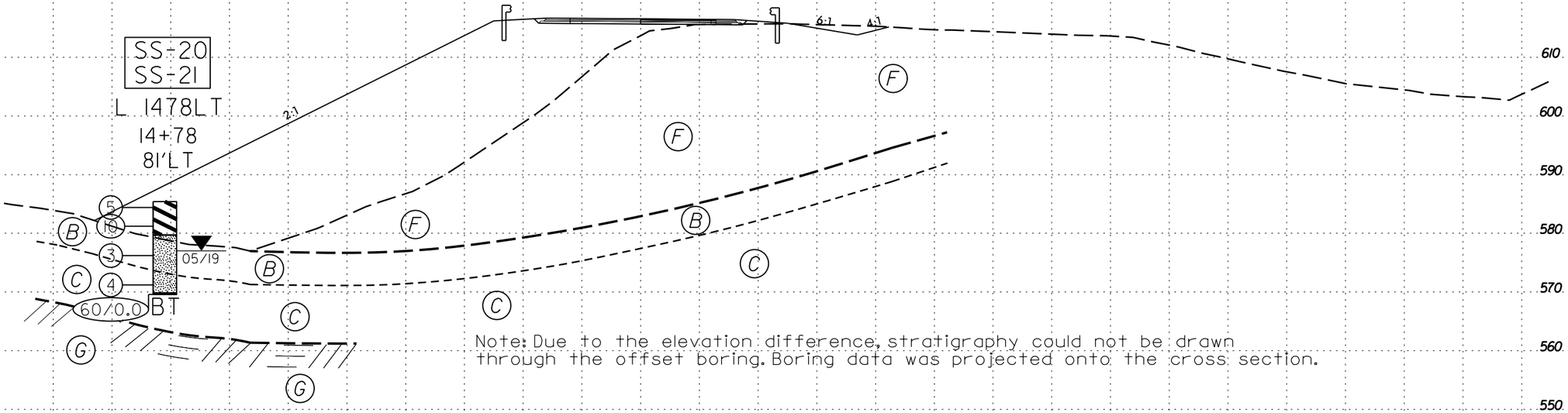
(B) **RESIDUAL:** *brown to red-brown, moist to wet, medium stiff to stiff, moderately plastic, silty CLAY (A-7-5/A-7-6) with some sand*

(C) **RESIDUAL:** *brown and gray, wet to saturated, soft, saprolitic, sandy SILT (A-4)*

(G) **CRYSTALLINE ROCK:** *(Biotite Gneiss/Schist)*

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-20	81'LT	14+78	0.0' - 1.5'	A-7-6(7)	45	18	19.1	18.8	21.7	40.4	79	71	53	37.5	N/A
SS-21	81'LT	14+78	3.2' - 4.7'	A-7-5(20)	59	23	9.7	20.6	24.5	45.3	100	95	77	41.6	N/A



Note: Due to the elevation difference, stratigraphy could not be drawn through the offset boring. Boring data was projected onto the cross section.

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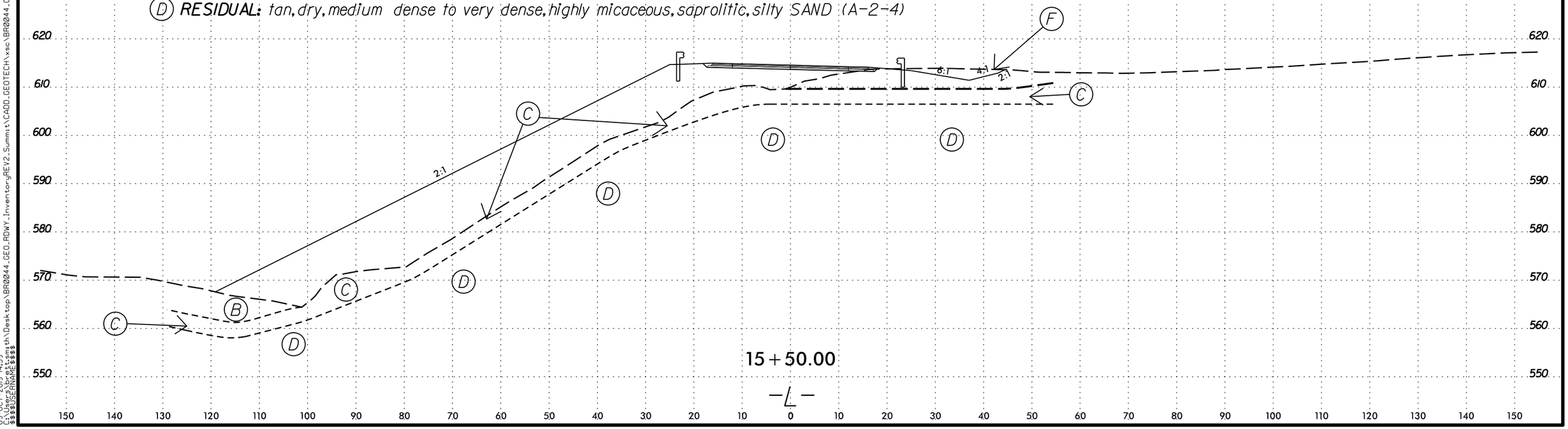
Ⓕ **ROADWAY EMBANKMENT:** *brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay*

Ⓑ **RESIDUAL:** *brown to red-brown, moist, medium stiff to stiff, moderately plastic, silty CLAY (A-7-5/A-7-6) with some sand*

Ⓒ **RESIDUAL:** *brown, red-tan, and gray, dry, soft to very stiff, saprolitic, sandy SILT (A-4) with some clay*

Ⓓ **RESIDUAL:** *tan, dry, medium dense to very dense, highly micaceous, saprolitic, silty SAND (A-2-4)*

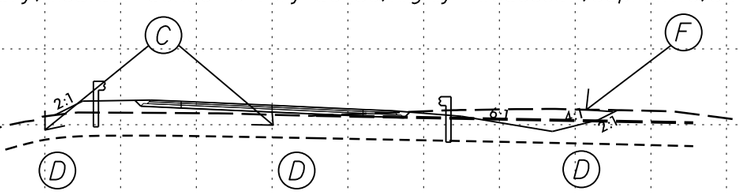


0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	16

(F) **ROADWAY EMBANKMENT:** brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay

(C) **RESIDUAL:** red-tan, dry, very stiff, saprolitic, sandy SILT (A-4) with some clay

(D) **RESIDUAL:** tan, dry, medium dense to very dense, highly micaceous, saprolitic, silty SAND (A-2-4)



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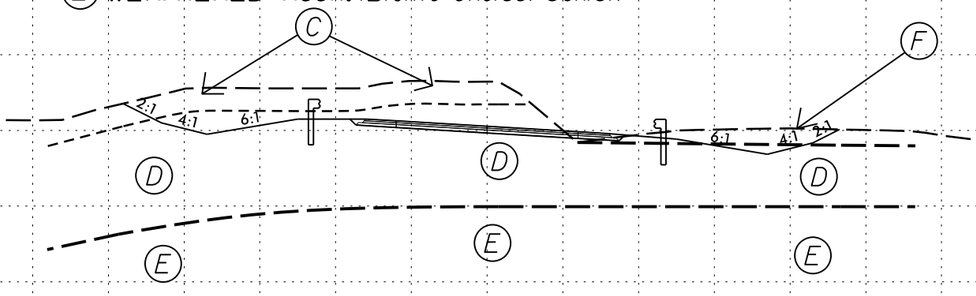
0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	17

(F) **ROADWAY EMBANKMENT:** brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay

(C) **RESIDUAL:** red-tan, dry, very stiff, saprolitic, sandy SILT (A-4) with some clay

(D) **RESIDUAL:** tan, dry, medium dense to very dense, highly micaceous, saprolitic, silty SAND (A-2-4)

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)



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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	18

(F) **ROADWAY EMBANKMENT:** brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay

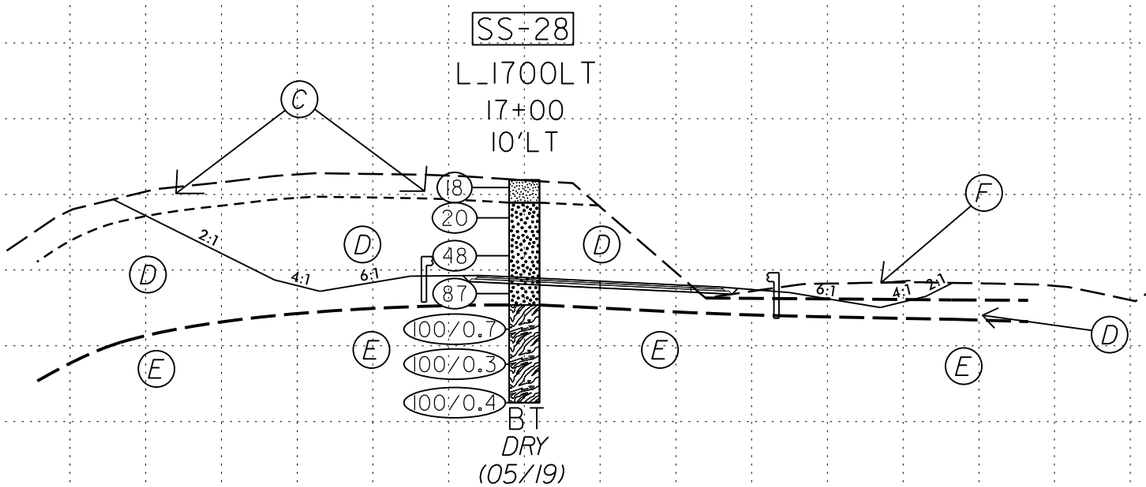
(C) **RESIDUAL:** red-tan, dry, very stiff, saprolitic, sandy SILT (A-4) with some clay

(D) **RESIDUAL:** tan, dry, medium dense to very dense, highly micaceous, saprolitic, silty SAND (A-2-4)

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-28	10'LT	17+00	4.0' - 5.5'	A-2-4(0)	30	2	23.3	55.9	13.7	7.1	71	64	25	8.4	N/A



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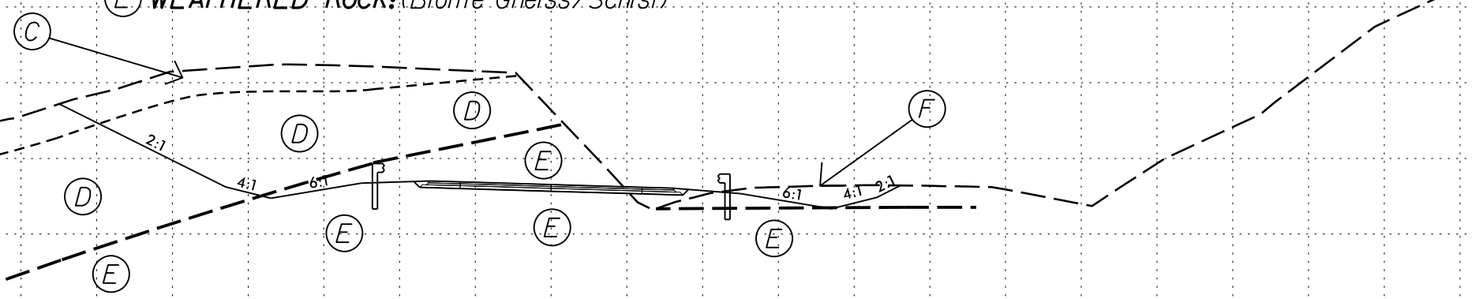
0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	19

Ⓕ **ROADWAY EMBANKMENT:** *brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay*

Ⓒ **RESIDUAL:** *red-tan, dry to moist, medium stiff to very stiff, sandy SILT (A-4) with some clay*

Ⓓ **RESIDUAL:** *red-white and tan, dry, medium dense to very dense, highly micaceous, saprolitic, silty SAND (A-2-4)*

Ⓔ **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*



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(F) **ROADWAY EMBANKMENT:** brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay

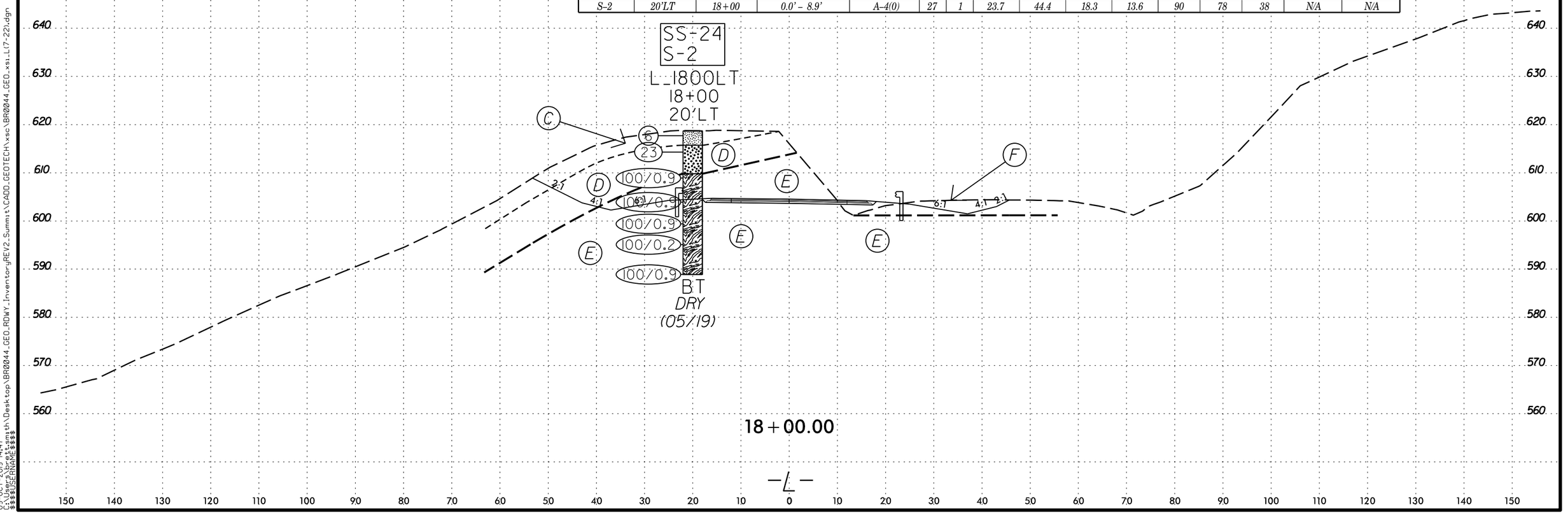
(C) **RESIDUAL:** tan, moist, medium stiff, sandy SILT (A-4) with some clay

(D) **RESIDUAL:** red-white, dry, medium dense, silty SAND (A-2-4)

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-24	20'LT	18+00	0.0' - 1.5'	A-4(0)	25	2	17.8	41.4	17.0	23.8	98	91	51	13.2	N/A
S-2	20'LT	18+00	0.0' - 8.9'	A-4(0)	27	1	23.7	44.4	18.3	13.6	90	78	38	N/A	N/A



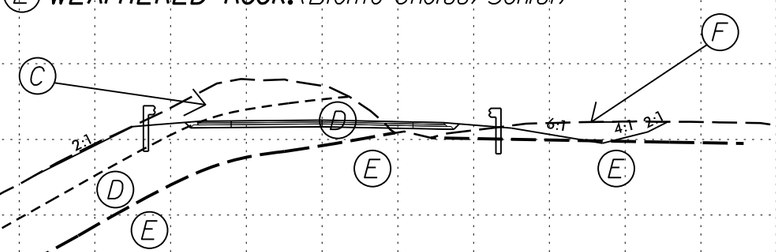
0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	21

(F) **ROADWAY EMBANKMENT:** brown, moist, medium stiff to stiff, sandy SILT (A-4) with little clay

(C) **RESIDUAL:** tan, moist, medium stiff, sandy SILT (A-4) with some clay

(D) **RESIDUAL:** red-white, dry, medium dense, silty SAND (A-2-4)

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)



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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	22

(F) **ROADWAY EMBANKMENT:** tan to red-brown, moist to wet, soft to stiff, sandy SILT (A-4) with little to some mica

(H) **ALLUVIAL:** brown, dry, loose, micaceous, silty SAND (A-2-4)

(I) **ALLUVIAL:** brown, moist to wet, medium stiff to stiff, slightly plastic, highly sandy, silty CLAY (A-7-6)

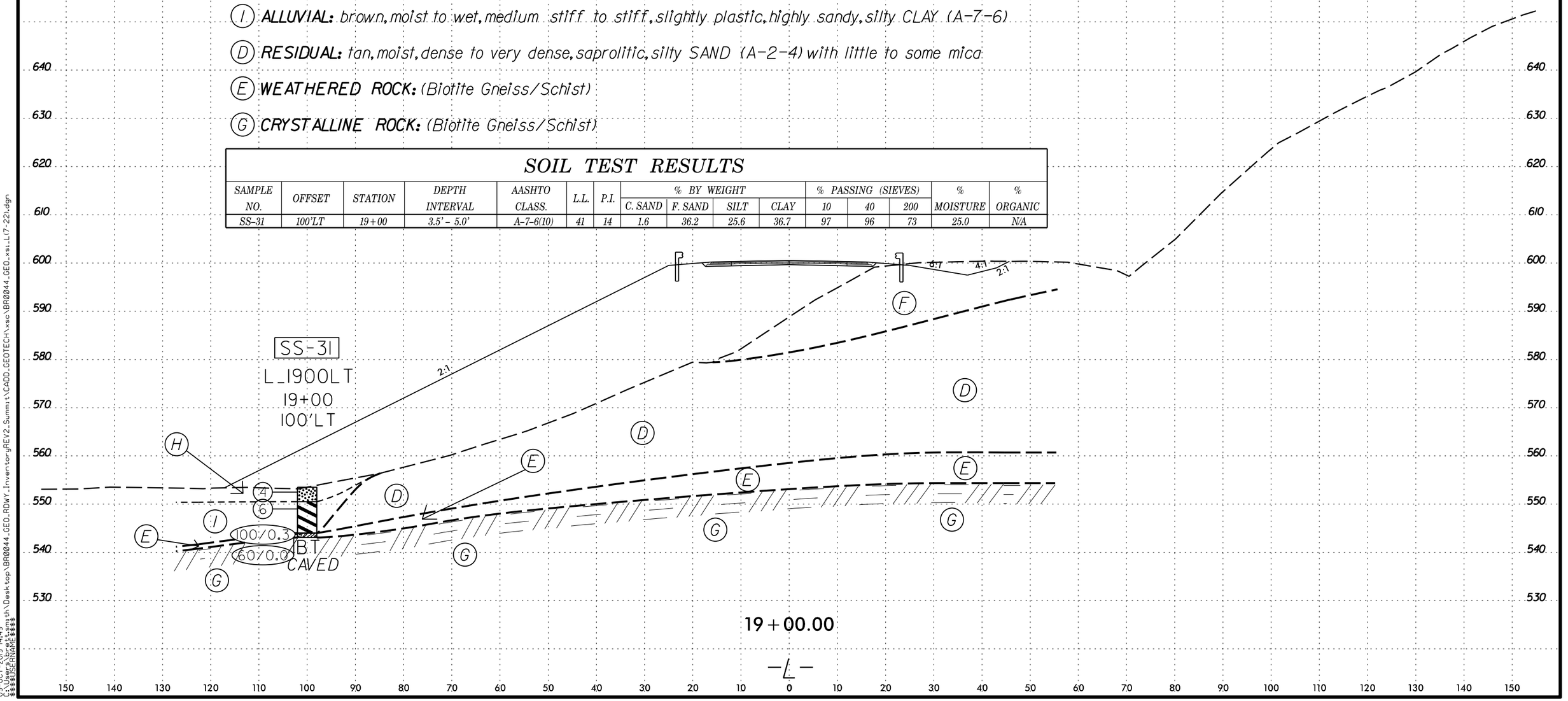
(D) **RESIDUAL:** tan, moist, dense to very dense, saprolitic, silty SAND (A-2-4) with little to some mica

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)

(G) **CRYSTALLINE ROCK:** (Biotite Gneiss/Schist)

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-31	100'LT	19+00	3.5' - 5.0'	A-7-6(10)	41	14	1.6	36.2	25.6	36.7	97	96	73	25.0	N/A



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(F) **ROADWAY EMBANKMENT:** red, brown, and tan, moist to wet, soft to very stiff, sandy SILT (A-4) with little clay, trace mica and gravel

(H) **ALLUVIAL:** brown, moist to wet, loose, silty SAND (A-2-4) with little mica

(J) **ALLUVIAL:** brown, moist to wet, medium stiff, sandy SILT (A-4) with some clay and trace organics

(I) **ALLUVIAL:** gray, wet, medium stiff, sandy CLAY (A-6) with some mica and trace organics

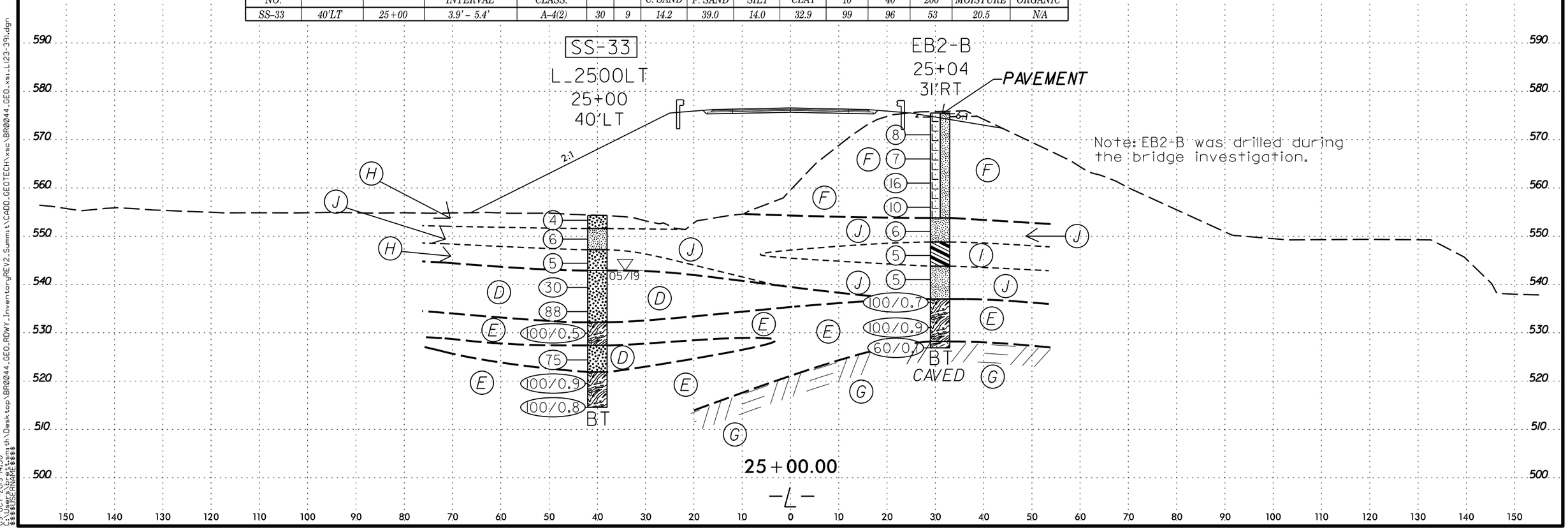
(D) **RESIDUAL:** brown and white, saturated, dense to very dense, saprolitic, silty SAND (A-2-4) with little mica and gravel-sized rock fragments

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)

(G) **CRYSTALLINE ROCK:** (Biotite Gneiss/Schist)

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-33	40'LT	25+00	3.9' - 5.4'	A-4(2)	30	9	14.2	39.0	14.0	32.9	99	96	53	20.5	N/A



0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	24

(F) **ROADWAY EMBANKMENT:** red, brown, and tan, moist to wet, soft to very stiff, sandy SILT (A-4) with little clay, trace mica and gravel

(H) **ALLUVIAL:** brown, moist to wet, loose, silty SAND (A-2-4) with little mica

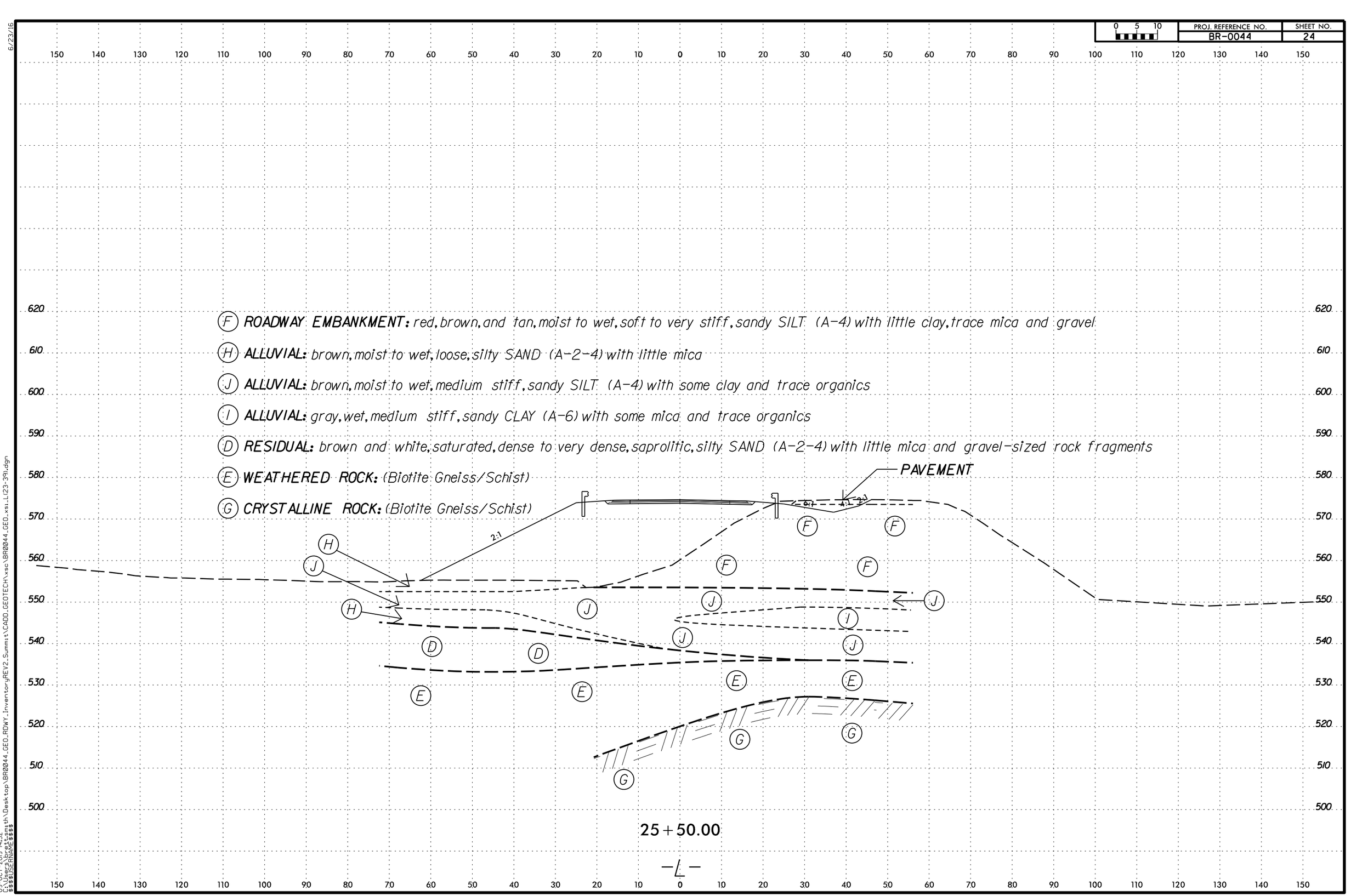
(J) **ALLUVIAL:** brown, moist to wet, medium stiff, sandy SILT (A-4) with some clay and trace organics

(I) **ALLUVIAL:** gray, wet, medium stiff, sandy CLAY (A-6) with some mica and trace organics

(D) **RESIDUAL:** brown and white, saturated, dense to very dense, saprolitic, silty SAND (A-2-4) with little mica and gravel-sized rock fragments

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)

(G) **CRYSTALLINE ROCK:** (Biotite Gneiss/Schist)



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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	25

Ⓐ **ROADWAY EMBANKMENT:** *black, gray, and red-brown, dry, dense, silty SAND (A-2-4) with little gravel*

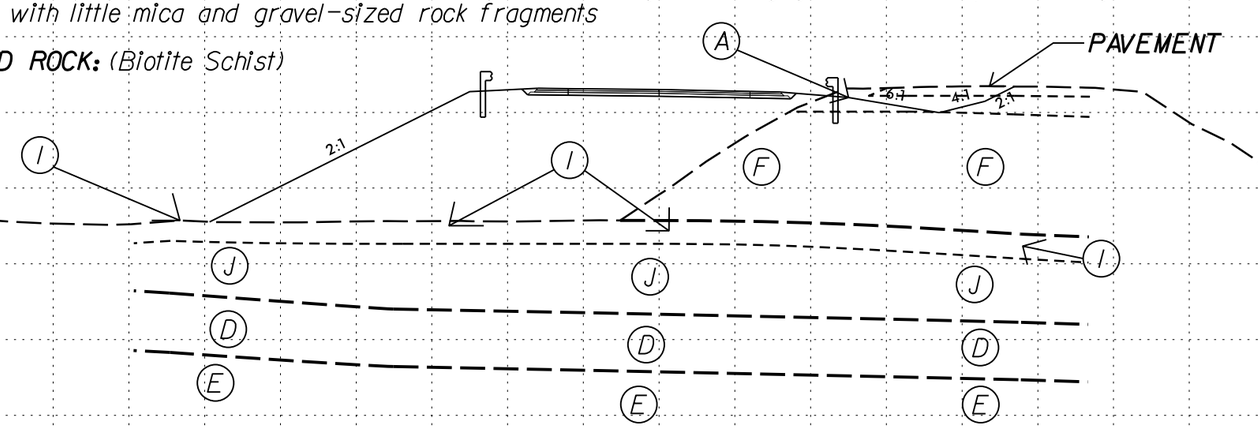
Ⓕ **ROADWAY EMBANKMENT:** *red, brown, and tan, moist to wet, soft to stiff, sandy SILT (A-4) with little clay and trace mica*

Ⓘ **ALLUVIAL:** *red-brown, brown, and gray, moist to wet, medium stiff, slightly plastic, highly sandy, silty CLAY (A-7-6) with trace mica*

Ⓙ **ALLUVIAL:** *brown, moist to wet, medium stiff to stiff, sandy SILT (A-4) with some clay*

Ⓓ **RESIDUAL:** *brown, gray, and white, wet to saturated, very loose to very dense, highly micaceous, saprolitic, silty SAND (A-2-4) with little mica and gravel-sized rock fragments*

Ⓔ **WEATHERED ROCK:** *(Biotite Schist)*



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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	26

(A) **ROADWAY EMBANKMENT:** *black, gray, and red-brown, dry, dense, silty SAND (A-2-4) with little gravel*

(F) **ROADWAY EMBANKMENT:** *red, brown, and tan, moist to wet, soft to stiff, sandy SILT (A-4) with little clay and trace mica*

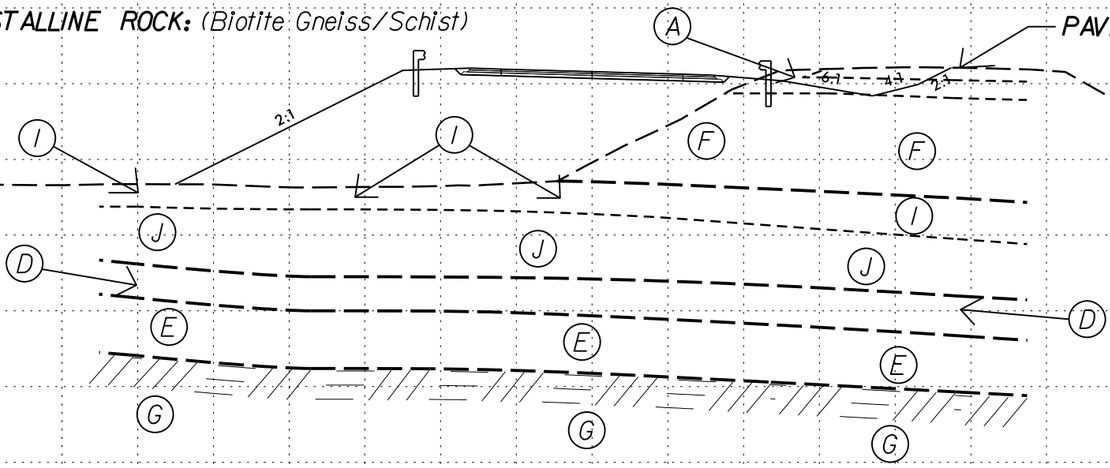
(I) **ALLUVIAL:** *red-brown, brown, and gray, moist to wet, medium stiff, slightly plastic, highly sandy, silty CLAY (A-7-6) with trace mica*

(J) **ALLUVIAL:** *brown, moist to wet, stiff, sandy SILT (A-4) with some clay*

(D) **RESIDUAL:** *brown to gray, wet, very loose, highly micaceous, silty SAND (A-2-4)*

(E) **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*

(G) **CRYSTALLINE ROCK:** *(Biotite Gneiss/Schist)*



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(A) **ROADWAY EMBANKMENT:** black, gray, and red-brown, dry, dense, silty SAND (A-2-4) with little gravel

(F) **ROADWAY EMBANKMENT:** red, brown, and tan, moist to wet, soft to stiff, sandy SILT (A-4) with little clay and trace mica

(I) **ALLUVIAL:** red-brown, brown, and gray, moist to wet, medium stiff, slightly plastic, highly sandy, silty CLAY (A-7-6) with trace mica

(J) **ALLUVIAL:** brown, moist to wet, stiff, sandy SILT (A-4) with some clay

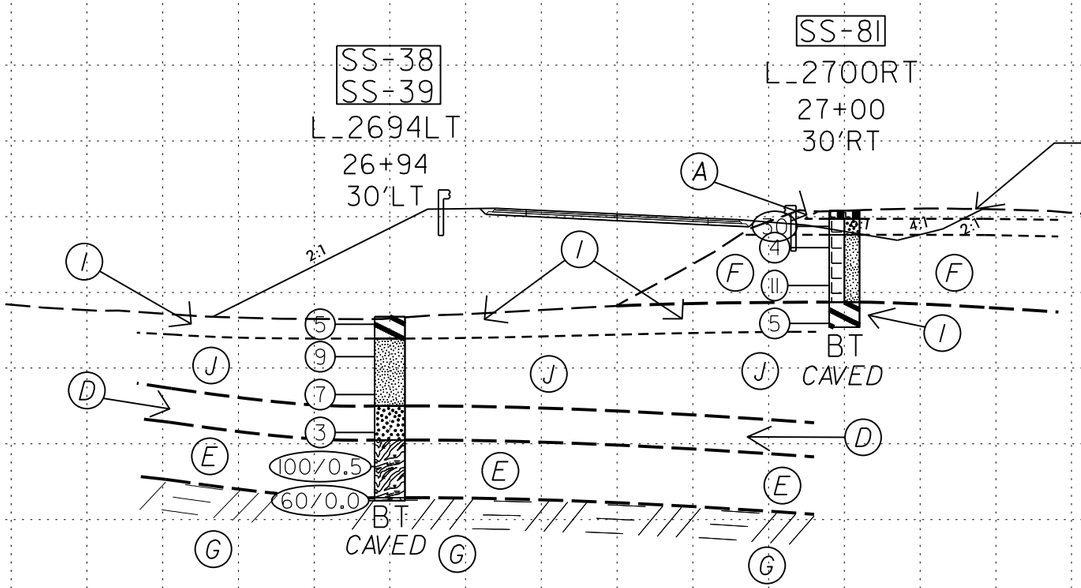
(D) **RESIDUAL:** brown to gray, wet, very loose, highly micaceous, silty SAND (A-2-4)

(E) **WEATHERED ROCK:** (Biotite Gneiss/Schist)

(G) **CRYSTALLINE ROCK:** (Biotite Gneiss/Schist)

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-38	30'LT	26+94	0.0' - 1.5'	A-7-6(6)	41	14	16.0	27.2	14.9	42.0	89	82	57	28.6	N/A
SS-39	30'LT	26+94	4.3' - 5.8'	A-4(2)	32	8	13.8	45.2	10.0	31.0	98	96	48	20.9	N/A
SS-81	30'RT	27+00	3.9' - 5.4'	A-4(0)	32	3	28.4	31.4	20.8	19.4	92	77	43	22.2	N/A



650 640 630 620 610 600 590 580 570 560 550 540 530 520

150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	28

(A) **ROADWAY EMBANKMENT:** *black, gray, and red-brown, dry, dense, silty SAND (A-2-4) with little gravel*

(F) **ROADWAY EMBANKMENT:** *red, brown, and tan, moist to wet, soft to stiff, sandy SILT (A-4) with little clay and trace mica*

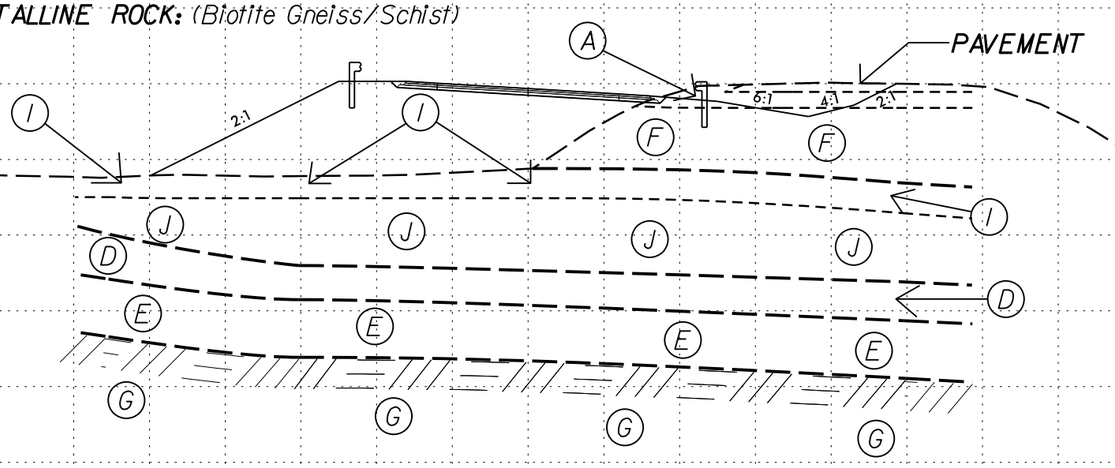
(I) **ALLUVIAL:** *red-brown, brown, and gray, moist to wet, medium stiff, slightly plastic, highly sandy, silty CLAY (A-7-6) with trace mica*

(J) **ALLUVIAL:** *brown, moist to wet, stiff, sandy SILT (A-4) with some clay*

(D) **RESIDUAL:** *brown to gray, wet, very loose, highly micaceous, silty SAND (A-2-4)*

(E) **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*

(G) **CRYSTALLINE ROCK:** *(Biotite Gneiss/Schist)*



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(A) **ROADWAY EMBANKMENT:** *brown, white, black, gray, and red-brown, dry, medium dense to dense, silty SAND (A-2-4) with little gravel*

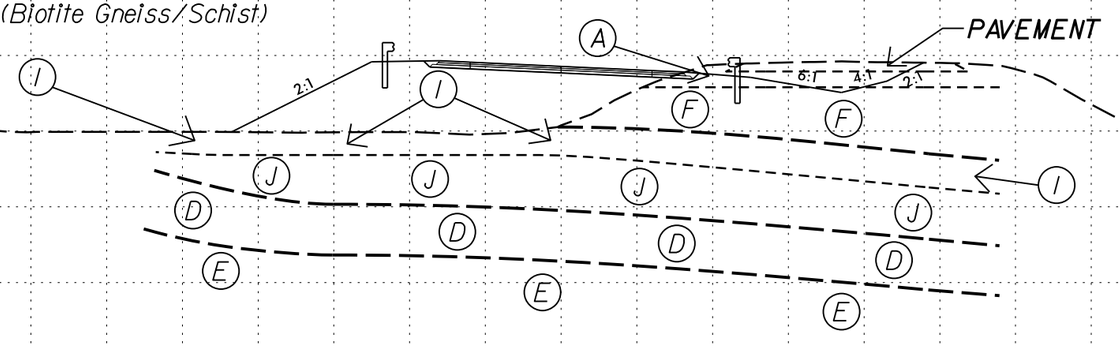
(F) **ROADWAY EMBANKMENT:** *red-brown, tan, and gray, moist to wet, soft to stiff, sandy SILT (A-4) and clayey SILT (A-5) with little to trace mica, gravel, and organics*

(I) **ALLUVIAL:** *red-brown, brown, and gray, moist to wet, medium stiff to stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-6) with trace mica*

(J) **ALLUVIAL:** *brown, moist to wet, stiff, sandy SILT (A-4) with some clay*

(D) **RESIDUAL:** *brown to gray, wet, very loose, highly micaceous, silty SAND (A-2-4)*

(E) **WEATHERED ROCK:** *(Biotite Gneiss/Schist)*



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0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	30

150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

620 610 600 590 580 570 560 550 540

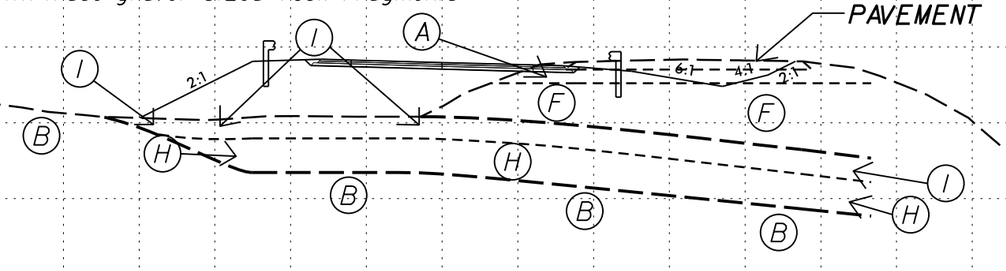
(A) **ROADWAY EMBANKMENT:** *gray, white, and brown, dry, medium dense, silty SAND (A-2-4) with little gravel*

(F) **ROADWAY EMBANKMENT:** *red-brown, tan, and gray, moist to wet, medium stiff, sandy SILT (A-4) and clayey SILT (A-5) with little to trace mica, gravel, and organics*

(I) **ALLUVIAL:** *red-brown, moist to wet, medium stiff to stiff, moderately plastic, highly sandy, silty CLAY (A-7-6) with trace mica*

(H) **ALLUVIAL:** *white and red-brown, moist, medium dense, silty SAND (A-2-4) with little gravel*

(B) **RESIDUAL:** *red-brown, wet, medium stiff, moderately plastic, highly sandy, silty CLAY (A-7-6) with trace gravel-sized rock fragments*



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(A) **ROADWAY EMBANKMENT:** *gray, white, and brown, dry, medium dense, silty SAND (A-2-4) with little gravel*

(F) **ROADWAY EMBANKMENT:** *red-brown, tan, and gray, moist to wet, medium stiff, sandy SILT (A-4) and clayey SILT (A-5) with little to trace mica, gravel, and organics*

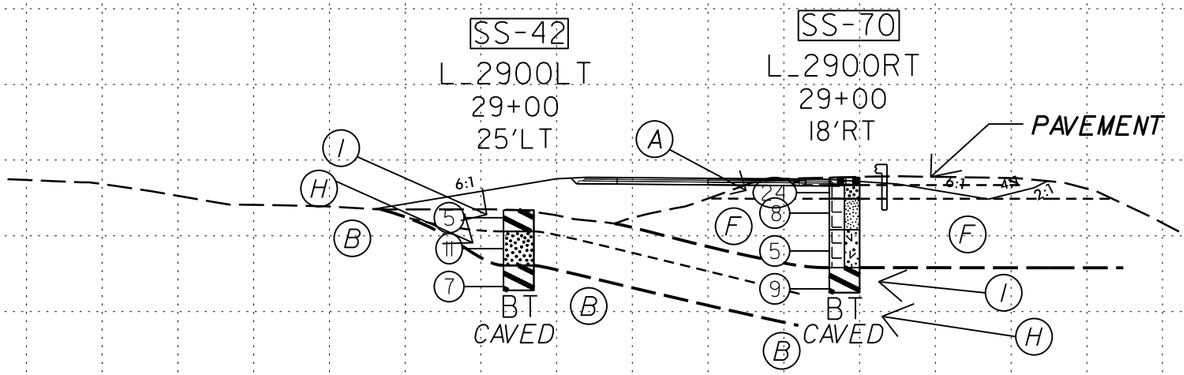
(I) **ALLUVIAL:** *red-brown, moist to wet, medium stiff to stiff, moderately plastic, highly sandy, silty CLAY (A-7-6) with trace mica*

(H) **ALLUVIAL:** *white and red-brown, moist, medium dense, silty SAND (A-2-4) with little gravel*

(B) **RESIDUAL:** *red-brown, wet, medium stiff, moderately plastic, highly sandy, silty CLAY (A-7-6) with trace gravel-sized rock fragments*

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-42	25'LT	29+00	0.0' - 1.5'	A-7-6(4)	44	17	22.7	24.3	21.1	31.9	78	69	45	21.1	N/A
SS-70	18'RT	29+00	3.7' - 5.2'	A-4(0)	32	0	24.6	33.6	22.8	19.0	86	75	41	20.3	N/A



PROJ. REFERENCE NO.	SHEET NO.
BR-0044	32

0 5 10

150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

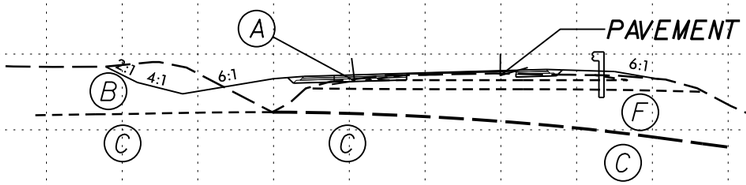
610 600 590 580 570 560 550

Ⓐ **ROADWAY EMBANKMENT:** *black and gray, moist, dense, silty SAND (A-2-4) with some gravel*

Ⓕ **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

Ⓑ **RESIDUAL:** *red, moist, medium stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-6) and sandy CLAY (A-6) with trace mica*

Ⓒ **RESIDUAL:** *red-orange, moist, medium stiff to very stiff, sandy SILT (A-4) with some clay and little to some mica*



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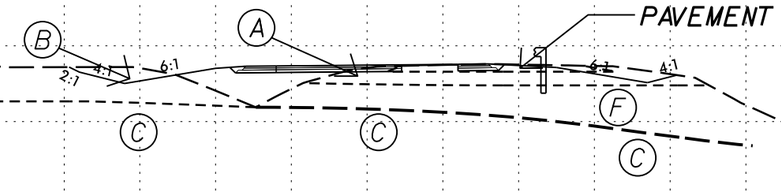
620 610 600 590 580 570 560 550

Ⓐ **ROADWAY EMBANKMENT:** *black and gray, moist, dense, silty SAND (A-2-4) with some gravel*

Ⓕ **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

Ⓑ **RESIDUAL:** *red, moist, medium stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-6) and sandy CLAY (A-6) with trace mica*

Ⓒ **RESIDUAL:** *red-orange, moist, medium stiff to very stiff, sandy SILT (A-4) with some clay and little to some mica*



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(A) **ROADWAY EMBANKMENT:** *black and gray, moist, dense, silty SAND (A-2-4) with some gravel*

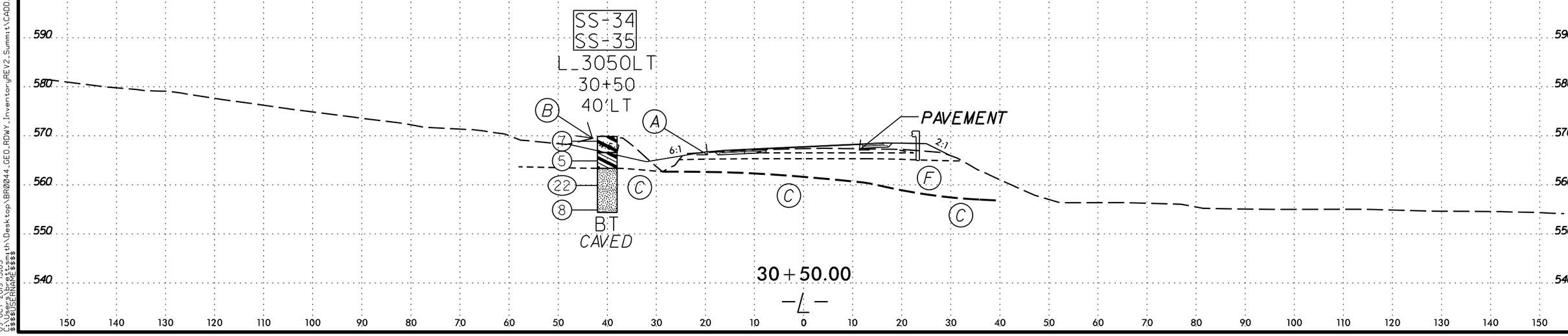
(F) **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

(B) **RESIDUAL:** *red, moist, medium stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-6) and sandy CLAY (A-6) with trace mica*

(C) **RESIDUAL:** *red-orange, moist, medium stiff to very stiff, sandy SILT (A-4) with some clay and little to some mica*

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-34	40'LT	30+50	0.0' - 1.5'	A-7-6(8)	41	21	15.7	28.7	14.0	41.6	89	82	54	15.6	N/A
SS-35	40'LT	30+50	4.0' - 5.5'	A-6(3)	28	12	19.2	33.5	14.3	32.9	96	89	51	15.7	N/A



(A) **ROADWAY EMBANKMENT:** *black and gray, moist, dense, silty SAND (A-2-4) with some gravel*

(F) **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

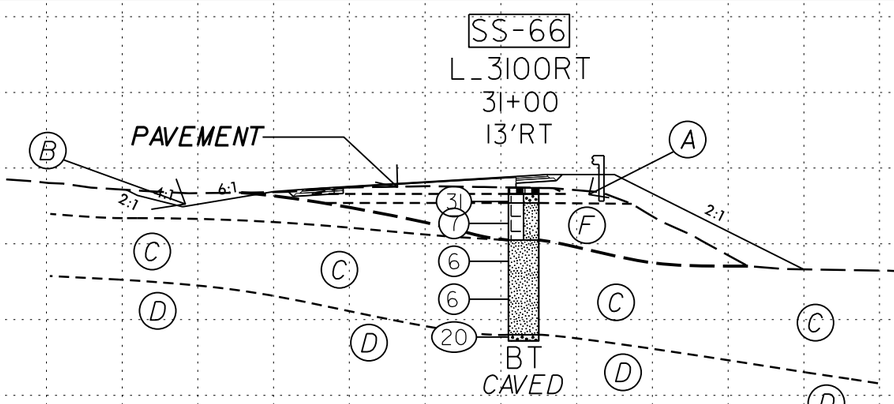
(B) **RESIDUAL:** *red, moist, medium stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-6) and sandy CLAY (A-6) with trace mica*

(C) **RESIDUAL:** *red-orange, red-brown, and brown, moist to wet, medium stiff to very stiff, sandy SILT (A-4) with some clay and little to some mica*

(D) **RESIDUAL:** *red-brown and white, moist, medium dense, silty SAND (A-2-4) with some gravel-sized rock fragments and trace mica*

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-66	13'RT	31+00	8.7' - 10.2'	A-4(1)	25	8	21.6	33.3	18.0	27.1	95	86	48	17.2	N/A



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150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

630 620 610 600 590 580 570 560 550 540 530

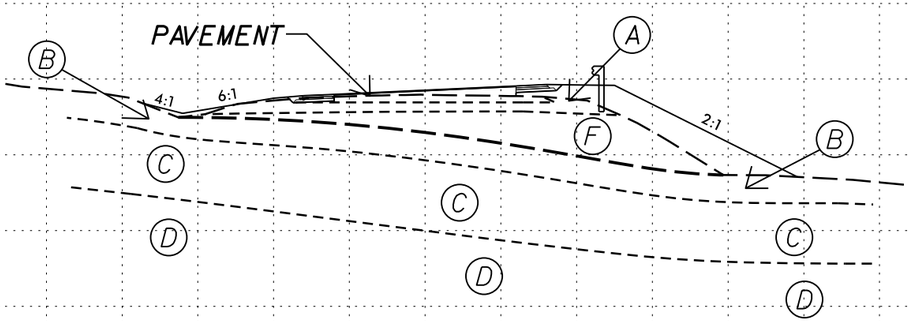
Ⓐ **ROADWAY EMBANKMENT:** *black and gray, moist, dense, silty SAND (A-2-4) with some gravel*

Ⓕ **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

Ⓑ **RESIDUAL:** *red to red-brown, moist, medium stiff to stiff, slightly to moderately plastic, highly sandy, silty CLAY (A-7-6) and sandy CLAY (A-6) with trace mica*

Ⓒ **RESIDUAL:** *red-orange, red-brown, and brown, moist to wet, medium stiff to very stiff, sandy SILT (A-4) with some clay and little to some mica*

Ⓓ **RESIDUAL:** *red-brown and white, moist, medium dense, silty SAND (A-2-4) with some gravel-sized rock fragments and trace mica*



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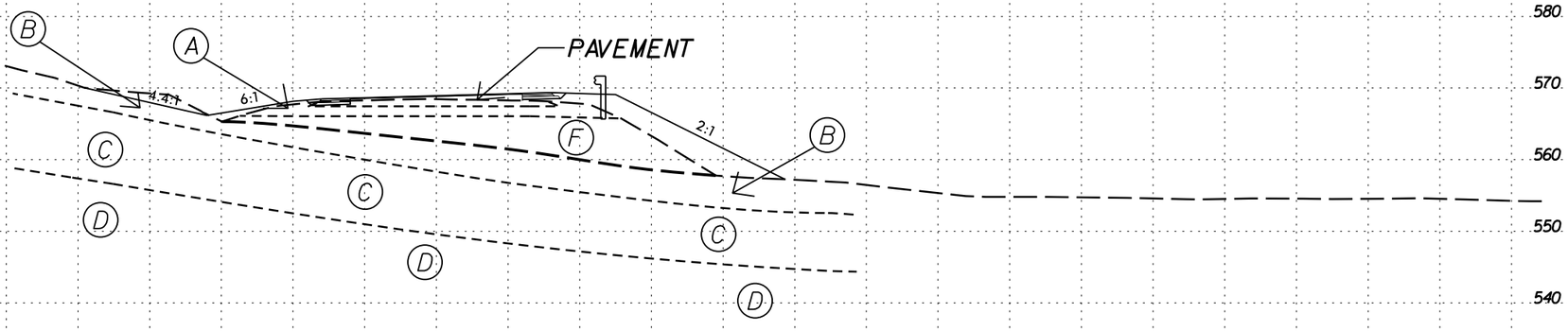
(A) **ROADWAY EMBANKMENT:** *brown to gray, moist, medium dense, silty SAND (A-2-4) with some gravel*

(F) **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

(B) **RESIDUAL:** *red-brown to brown, moist, medium stiff to stiff, slightly to moderately plastic, sandy CLAY (A-6) with trace mica*

(C) **RESIDUAL:** *orange-white and red-brown, moist, medium stiff to stiff, saprolitic, clayey SILT (A-5) and sandy SILT (A-4) with trace to some mica and trace cobble-sized rock fragments*

(D) **RESIDUAL:** *white-brown, moist, medium dense, saprolitic, silty SAND (A-2-4) with some mica*



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Ⓐ **ROADWAY EMBANKMENT:** *brown to gray, moist, medium dense, silty SAND (A-2-4) with some gravel*

Ⓕ **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

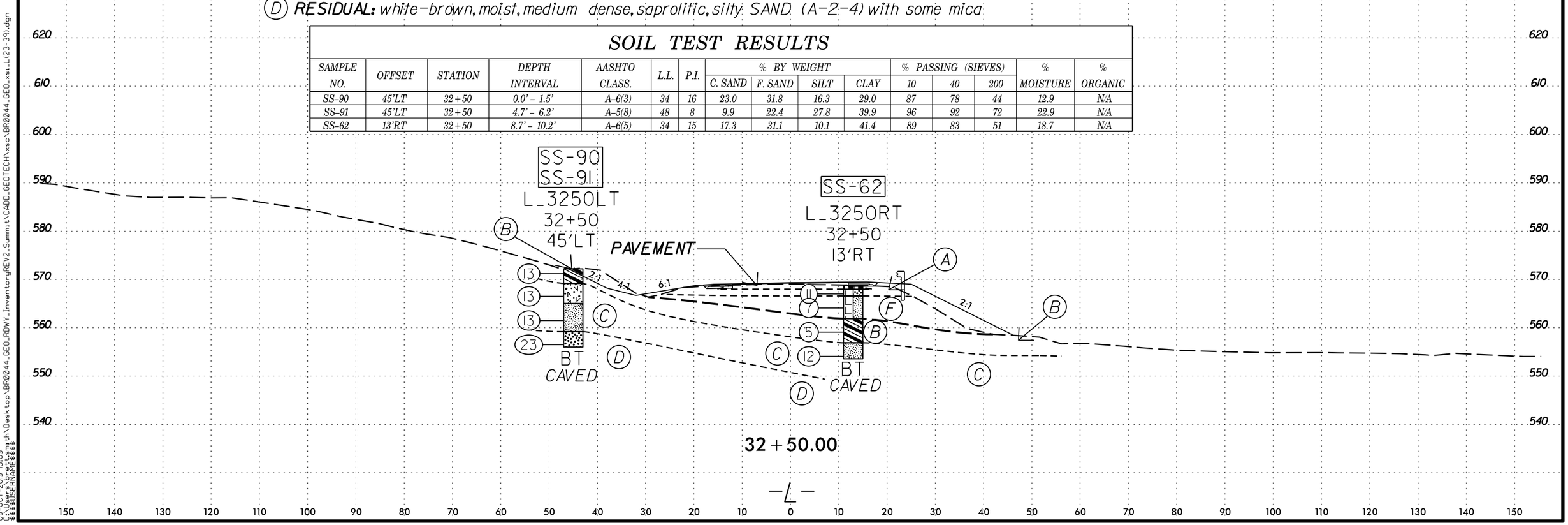
Ⓑ **RESIDUAL:** *red-brown to brown, moist, medium stiff to stiff, slightly to moderately plastic, sandy CLAY (A-6) with trace mica*

Ⓒ **RESIDUAL:** *orange-white and red-brown, moist, medium stiff to stiff, saprolitic, clayey SILT (A-5) and sandy SILT (A-4) with trace to some mica and trace cobble-sized rock fragments*

Ⓓ **RESIDUAL:** *white-brown, moist, medium dense, saprolitic, silty SAND (A-2-4) with some mica*

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-90	45'LT	32+50	0.0' - 1.5'	A-6(3)	34	16	23.0	31.8	16.3	29.0	87	78	44	12.9	N/A
SS-91	45'LT	32+50	4.7' - 6.2'	A-5(8)	48	8	9.9	22.4	27.8	39.9	96	92	72	22.9	N/A
SS-62	13'RT	32+50	8.7' - 10.2'	A-6(5)	34	15	17.3	31.1	10.1	41.4	89	83	51	18.7	N/A



0 5 10	PROJ. REFERENCE NO.	SHEET NO.
	BR-0044	38

6/23/16

150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

630 620 610 600 590 580 570 560 550 540

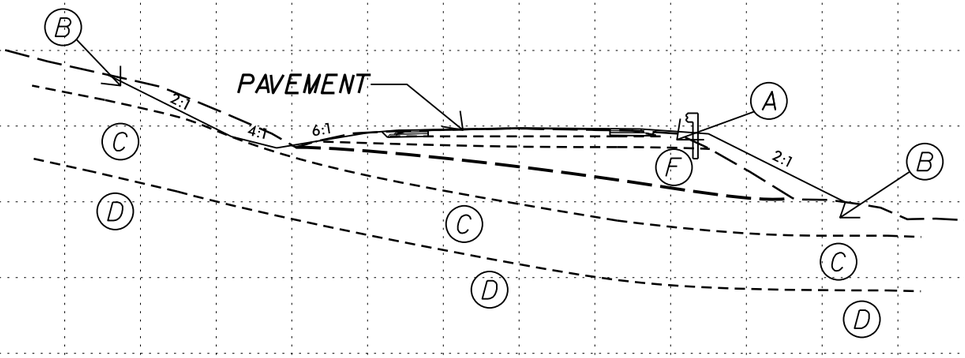
(A) **ROADWAY EMBANKMENT:** *brown to gray, moist, medium dense, silty SAND (A-2-4) with some gravel*

(F) **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

(B) **RESIDUAL:** *red-brown to brown, moist, medium stiff to stiff, slightly to moderately plastic, sandy CLAY (A-6) with trace mica*

(C) **RESIDUAL:** *orange-white and red-brown, moist, medium stiff to stiff, saprolitic, clayey SILT (A-5) and sandy SILT (A-4) with trace to some mica and trace cobble-sized rock fragments*

(D) **RESIDUAL:** *white-brown, moist, medium dense, saprolitic, silty SAND (A-2-4) with some mica*



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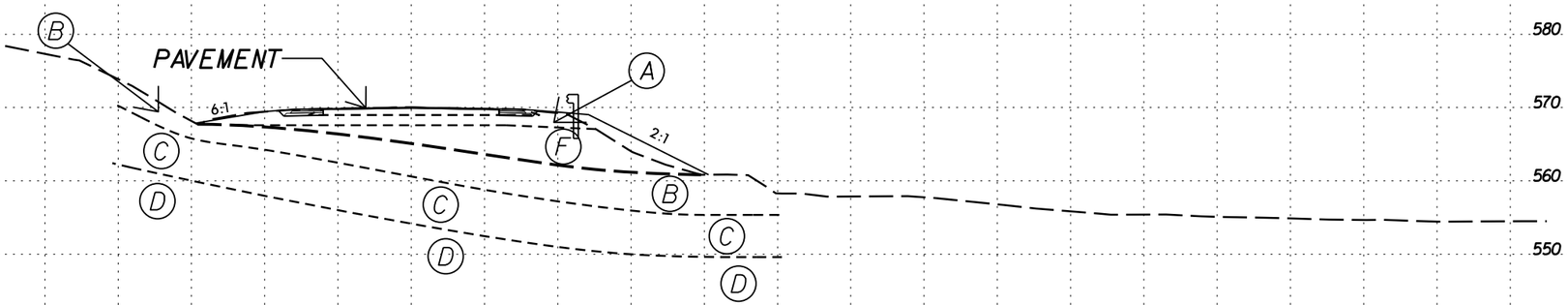
(A) **ROADWAY EMBANKMENT:** *brown to gray, moist, medium dense, silty SAND (A-2-4) with some gravel*

(F) **ROADWAY EMBANKMENT:** *red-brown, moist, medium stiff, sandy SILT (A-4) with some mica*

(B) **RESIDUAL:** *red-brown to brown, moist, medium stiff to stiff, slightly to moderately plastic, sandy CLAY (A-6) with trace mica*

(C) **RESIDUAL:** *orange-white and red-brown, moist, medium stiff to stiff, saprolitic, clayey SILT (A-5) and sandy SILT (A-4) with trace to some mica and trace cobble-sized rock fragments*

(D) **RESIDUAL:** *white-brown, moist, medium dense, saprolitic, silty SAND (A-2-4) with some mica*



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PROJECT REFERENCE NO.	SHEET NO.
BR–0044	40

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

APPENDIX A
LABORATORY RESULTS (CALIFORNIA BEARING RATIO TESTING)

REFERENCE: BR–0044

PROJECT: 67044

Prepared in the Office of:
SUMMIT DESIGN AND ENGINEERING SERVICES
NC FIRM LICENSE No: P-0339 and C-487
504 Meadowlands Drive
Hillsborough, NC 27278
(919) 732-3883
(919) 732-6676 (FAX)

M & T Form 503

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAY
MATERIALS & TESTS UNIT
SOILS LABORATORY

T. I. P. No. BR-0044

REPORT ON SAMPLES OF Replace Bridge No. 780168 over the Smith River

Project	67044.1.1	**County**	Rockingham	**Owner**	Geotech
Date: Sampled	May, 2019	**Received**		**Reported**	7/5/19
Sampled from	Roadway Investigation		**By**	Geotech	
Submitted by	Brett Smith			2008	**Standard Specifications**

7/5/19

TEST RESULTS

Proj. Sample No.		S-1	S-2				
Boring No.		L 1100LT	L 1800LT				
Retained #4 Sieve	%	0	0				
Passing #10 Sieve	%	93	90				
Passing #40 Sieve	%	78	78				
Passing #200 Sieve	%	45	38				

MINUS NO. 10 FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - #60	%	27.4	23.7				
Fine Sand Ret - #270	%	33.4	44.4				
Silt 0.05 - 0.005 mm	%	23.9	18.3				
Clay < 0.005 mm	%	15.3	13.6				
Passing #40 Sieve	%	83.8	87.0				
Passing #200 Sieve	%	48.4	42.8				

L. L.		32	27				
P. I.		3	1				
AASHTO Classification		A-4	A-4				
Group Index		0	0				
pH		N/A	N/A				
Station		11+00	18+00				
OFFSET		100'LT	20'LT				
ALIGNMENT		-L-	-L-				
Depth (Ft)		0.0	0.0				
	to	15.0	8.9				
Natural Moisture %		N/A	N/A				

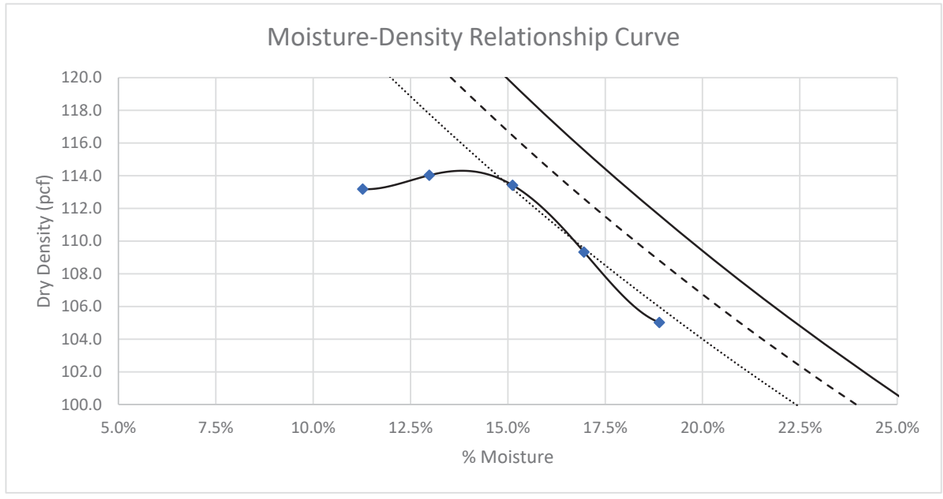
Aaron Hackett
Soils Engineer

SUMMIT
DESIGN AND ENGINEERING SERVICES
504 Meadowlands Drive, Hillsborough, NC 27278
Phone // 919.732.3883 Web // www.summitde.net

Standard Moisture-Density Relationship Report

ASTM D698

Project Number	**18-0173.I55**	Date	**6/27/2019**
Project Name	**BR-0044**	Sample Number	**S-1**
Client	**NCDOT**		
Sample Description		Maximum Dry Density	**114.3 pcf**
Sample Location	**L_1100LT**	Optimum Moisture	**13.8%**



Natural Moisture:		Rammer Type:	**Manual**
Specific Gravity:	**2.60 (Assumed)**	Preparation Method:	**Dry**
Liquid Limit:		Method:	**A**
Plasticity Index:		Oversize Correction:	**Not Required**
% Fines:			
% Sand:			
% Gravel:			

Aaron Hackett, EI
Lab Manager

Jeff Elliott, PE
CMT & SI Department Manager

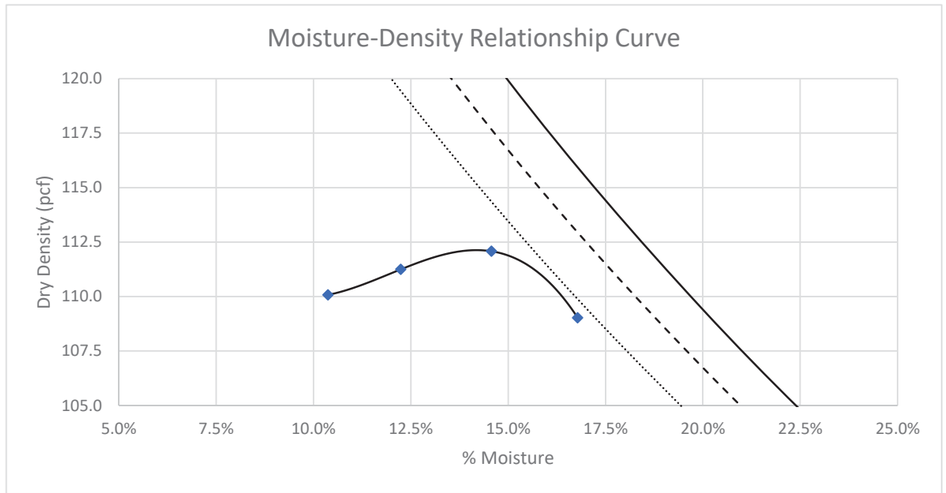
SUMMIT
DESIGN AND ENGINEERING SERVICES

504 Meadowlands Drive, Hillsborough, NC 27278
Phone // 919.732.3883 Web // www.summitde.net

Standard Moisture-Density Relationship Report

ASTM D698

Project Number	**18-0173.I55**	Date	**6/27/2019**
Project Name	**BR-0044**	Sample Number	**S-2**
Client	**NCDOT**		
Sample Description		Maximum Dry Density	**112.1 pcf**
Sample Location	**L_1800LT**	Optimum Moisture	**14.2%**



Natural Moisture:		Rammer Type:	**Manual**
Specific Gravity:	**2.60 (Assumed)**	Preparation Method:	**Dry**
Liquid Limit:		Method:	**A**
Plasticity Index:		Oversize Correction:	**Not Required**
% Fines:			
% Sand:			
% Gravel:			

Aaron Hackett, EI
Lab Manager

Jeff Elliott, PE
CMT & SI Department Manager

SUMMIT
DESIGN AND ENGINEERING SERVICES

Report on California Bearing Ratio (ASTM D 1883/AASHTO T 193)

Date	**6/27/2019**	Project Name	**BR-0044**
Sample No.	**CBR Run #1**	Project No.	**18-0173.I55**
Sample Location	**L_1100LT**	Client	**NCDOT**

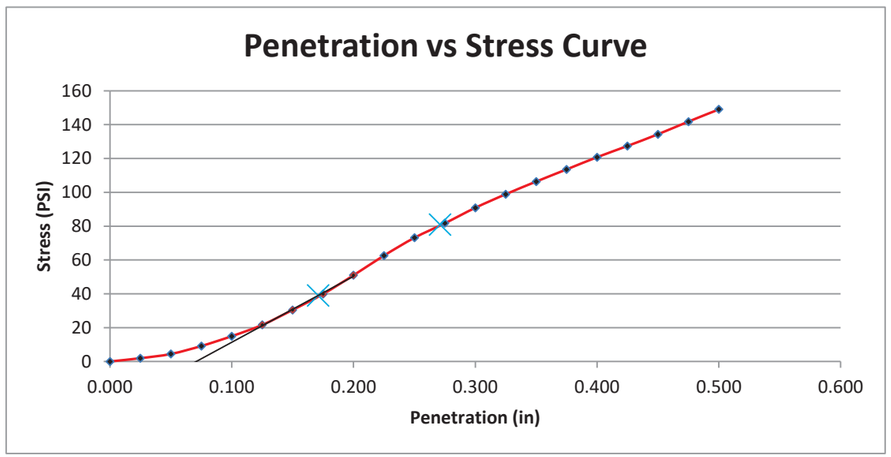
Proctor and Classification Data		CBR Preparation Data	
Sample Description	**0**	Rammer Used	**5.5 lbs**
Classification	**0**	Compaction Method	**3 Layers, 56 Blows**
Max. Dry Density	**114.3**	Surcharge Amount	**10 lbs**
Optimum Moisture	**13.8%**	Soaked/Unsoaked	**Soaked**

CBR Results

Compaction Moisture Content	**13.5%**	Dry unit weight (lbs/cu.ft)	**112.8**
Moisture Content of Top 1" After Soaking	**21.3%**	Percent of Max. Dry Density	**98.7%**
Swell	**N/A**		

CBR Values

Penetration (in)	**0.171**	**0.271**
Stress (psi)	**39.00**	**81.00**
CBR	**3.9**	**5.4**



Remarks: Zero-point correction applied. All material passed the 3/4" sieve.

Aaron Hackett
Lab Manager

Jeff Elliott, P.E.
CMT & SI Dept. Manager

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Report on California Bearing Ratio (ASTM D 1883/AASHTO T 193)

Date	6/27/2019	Project Name	BR-0044
Sample No.	CBR Run #2	Project No.	18-0173.I55
Sample Location	L_1100LT	Client	NCDOT

Proctor and Classification Data

Sample Description	0
Classification	0
Max. Dry Density	114.3
Optimum Moisture	13.8%

CBR Preparation Data

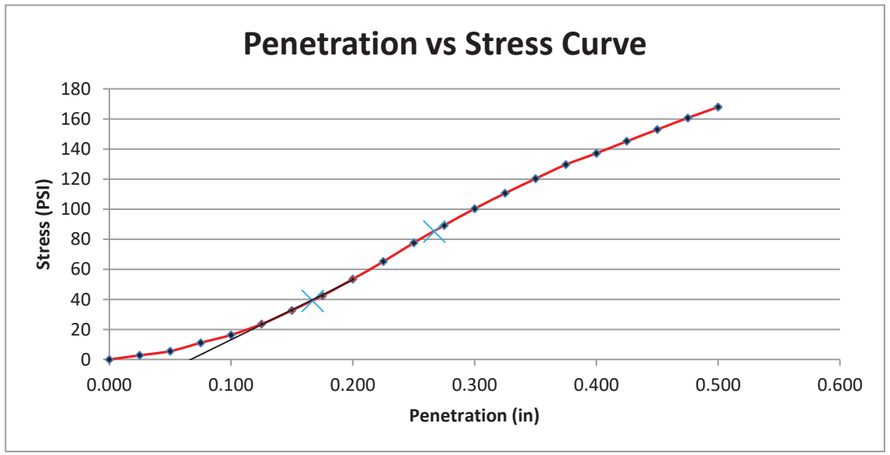
Rammer Used	5.5 lbs
Compaction Method	3 Layers, 56 Blows
Surcharge Amount	10 lbs
Soaked/Unsoaked	Soaked

CBR Results

Compaction Moisture Content	13.5%
Moisture Content of Top 1" After Soaking	21.0%
Swell	2.9%
Dry unit weight (lbs/cu.ft)	114.1
Percent of Max. Dry Density	99.8%

CBR Values

Penetration (in)	0.167	0.267
Stress (psi)	39.00	85.00
CBR	3.9	5.7



Remarks:

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Aaron Hackett
Lab Manager

Jeff Elliott, P.E.
CMT & SI Dept. Manager

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DESIGN AND ENGINEERING SERVICES

Report on California Bearing Ratio (ASTM D 1883/AASHTO T 193)

Date	6/27/2019	Project Name	BR-0044
Sample No.	CBR Run #1	Project No.	18-0173.I55
Sample Location	L_1800LT	Client	NCDOT

Proctor and Classification Data

Sample Description	0
Classification	0
Max. Dry Density	112.1
Optimum Moisture	14.2%

CBR Preparation Data

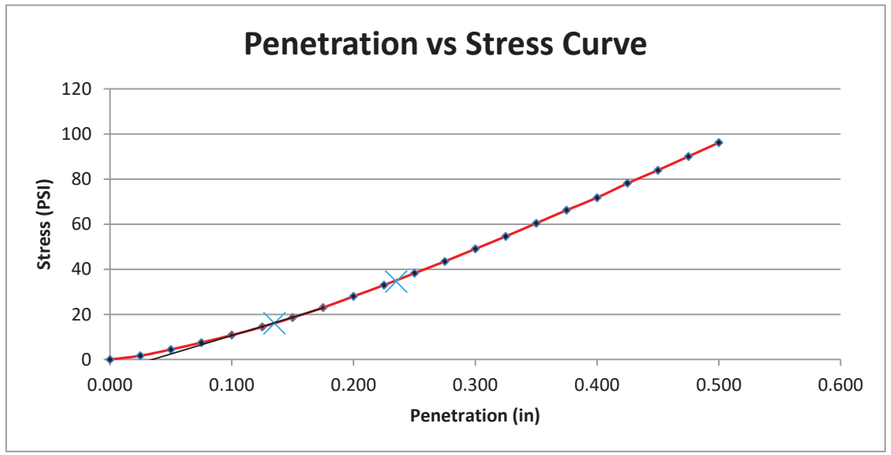
Rammer Used	5.5 lbs
Compaction Method	3 Layers, 56 Blows
Surcharge Amount	10 lbs
Soaked/Unsoaked	Soaked

CBR Results

Compaction Moisture Content	16.4%
Moisture Content of Top 1" After Soaking	17.6%
Swell	N/A
Dry unit weight (lbs/cu.ft)	108.5
Percent of Max. Dry Density	96.8%

CBR Values

Penetration (in)	0.135	0.235
Stress (psi)	16.00	34.60
CBR	1.6	2.3



Remarks:

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Aaron Hackett
Lab Manager

Jeff Elliott, P.E.
CMT & SI Dept. Manager

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DESIGN AND ENGINEERING SERVICES

Report on California Bearing Ratio (ASTM D 1883/AASHTO T 193)

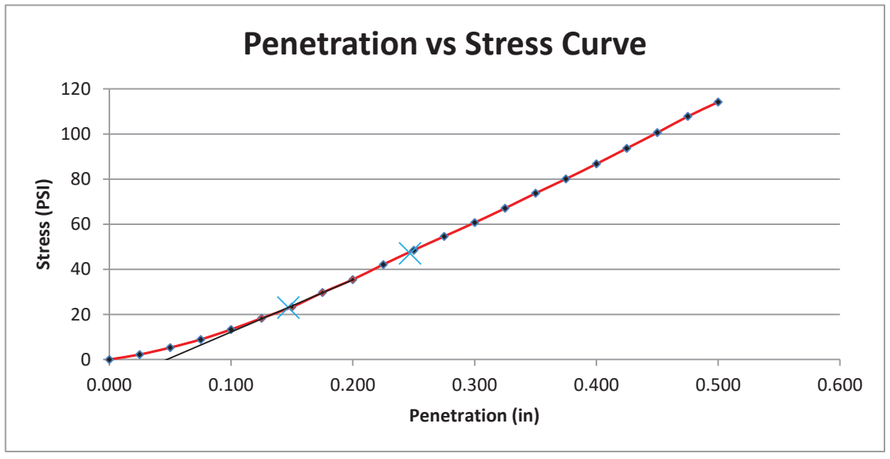
Date	6/27/2019	Project Name	BR-0044
Sample No.	CBR Run #2	Project No.	18-0173.I55
Sample Location	L_1800LT	Client	NCDOT

Proctor and Classification Data		CBR Preparation Data	
Sample Description	0	Rammer Used	5.5 lbs
Classification	0	Compaction Method	3 Layers, 56 Blows
Max. Dry Density	112.1	Surcharge Amount	10 lbs
Optimum Moisture	14.2%	Soaked/Unsoaked	Soaked

CBR Results

Compaction Moisture Content	16.4%	Dry unit weight (lbs/cu.ft)	108.9
Moisture Content of Top 1" After Soaking	17.8%	Percent of Max. Dry Density	97.1%
Swell	0.0%		

CBR Values		
Penetration (in)	0.147	0.247
Stress (psi)	23.00	47.00
CBR	2.3	3.1



Remarks:

Zero-point correction applied. All material passed the 3/4" sieve.

Aaron Hackett
Lab Manager

Jeff Elliott, P.E.
CMT & SI Dept. Manager

SUMMIT
DESIGN AND ENGINEERING SERVICES
919.732.3883 SUMMIT-ENGINEER.COM
504 Meadowland Drive, Hillsborough, NC 27278

October 8, 2019

WBS Number: 67044.1.1
TIP Number: BR-0044
Project ID: 34624
County: Rockingham
Description: Bridge No. 168 on NC 14/NC 87 (N. Van Buren Road) over Smith River

Subject: Geotechnical Report – Design and Construction Recommendations

Summit Design and Engineering Services, PLLC has completed a subsurface investigation for this project and presents the following recommendations.

I. Slope / Embankment Stability

A. Slope Design
We recommend that all roadway slopes be constructed at a ratio of 2:1 (H:V) or flatter.

B. Undercut for Embankment Stability
Recommend 2,000 cubic yards of Undercut for Embankment Stability to be included in the project contract as a contingency item to be used at the discretion of the Engineer. All undercut should be computed as material to be wasted. However, some material may be used outside of the pavement section at the discretion of the Engineer.

C. Geotextile for Soil Stabilization
Recommend 2,000 square yards of Geotextile for Soil Stabilization be included in the project contract, as follows:

1. 2,000 square yards for contingency areas of Undercut for Embankment Stability to be placed prior to the placement of Select Granular Material as noted in **Section I.B.**

II. Subgrade Stability

A. Subsurface Drainage
Recommend 300 linear feet of Subdrain pipe used for Underdrain (Roadway Standard Drawing 815.03) be included in the project contract as a contingency item to be used at the discretion of the Engineer.

B. Grade Point Undercut
Recommend 100 cubic yards be included in the project contract for Grade Point Undercut.

C. Undercut for Subgrade Stability
Recommend 200 cubic yards of Undercut for Subgrade Stability be included in the project contract as a contingency item to be used at the discretion of the Engineer.

D. Aggregate Subgrade
Recommend 100 cubic yards of 12-inch Shallow Undercut for Aggregate Subgrade be included in the project contract as a contingency item to be used at the discretion of the Engineer.

E. Geotextile for Soil Stabilization
Recommend 500 square yards of Geotextile for Soil Stabilization to be included in the project contract, as follows:

1. 200 square yards for contingency areas of Undercut for Subgrade Stability to be placed prior to placement of Select Granular Material as noted in **Section II.C.**

2. 300 square yards for contingency areas of Aggregate Subgrade to be placed prior to the placement of Class IV Subgrade Stabilization Material as noted in **Section II.D.**

III. Borrow Specifications

A. Borrow Criteria
Common borrow for slope/embankment construction to subgrade shall meet Statewide Criteria for acceptance of Borrow Material (Section 1018-2 A).

B. Class IV Subgrade Stabilization Material
Recommend 200 tons of Class IV Subgrade Stabilization Material to be used as backfill for Shallow Undercut on Geotextile for Soil Stabilization, as follows:

1. 200 tons on Geotextile for Soil Stabilization for contingency areas of Aggregate Subgrade as noted in **Section II.D.**

C. Select Granular Material
Recommend 2,200 cubic yards of Select Granular Material for embankment stability and subgrade stability on Geotextile for Soil Stabilization, as follows:

1. 2,000 cubic yards on Geotextile for Soil Stabilization for contingency areas of Undercut for Embankment Stability as noted in **Section I.B.**

2. 200 cubic yards on Geotextile for Soil Stabilization for contingency areas of Undercut for Subgrade Stability as noted in **Section II.C.**

Select Material for embankment construction on Geotextile for Soil Stabilization shall meet the criteria outlined in Standard Specifications, Article 1016-3 Class II or III. Construction utilizing Select Granular Material should follow section 265-3 of the Standard Specifications.

D. Shrinkage Factor

A shrinkage factor of 20 percent is recommended for calculation of earthwork on this project.

IV. Miscellaneous

A. Reduction of Unclassified Excavation - Clearing and Grubbing

A loss of 1,000 cubic yards of unclassified excavation is estimated on this project due to clearing and grubbing.

B. Water Wells

Water wells were identified within the proposed right-of-way at the following locations:

Line	Station (±)	Offset
-L-	17+16	38'LT

Water wells should be abandoned per Standard Specification 205.

Sincerely,

SUMMIT DESIGN AND ENGINEERING SERVICES, PLLC
Firm's NC License No. P-0339

Brett Smith, P.G.
Project Geologist

DocuSigned by:
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10/16/2019

Harold D. Pruitt, P.E.
Senior Design Engineer

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Harold D. Pruitt
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10/16/2019

Don Dewey, P.E.
Vice President – Geotechnical Engineering

DocuSigned by:
Don Dewey
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
Summary of Quantities

WBS No.: 67044.1.1 County: Rockingham Project Engineer: Harold Pruitt, P.E.

TIP No.: BR-0044 Field Office: Summit Project Geologist: Brett Smith, P.G.

Description: Bridge No. 168 on NC 14/NC 87 (N. Van Buren Road) over Smith River

Pay Item No.	Pay Item/ Quantity Adjustment	Spec Book Section No. or Special Provision (SP) Reference	Report Section	Alignment	Begin Station	End Station	Quantity	Units
0015000000-N	Sealing Abandoned Wells	205 - Sealing Abandoned Wells	IV. B	Varies	N/A	N/A	1	EA
						Total Quantity of Sealing Abandoned Wells =	**1**	**EA**
0036000000-E	Undercut Excavation	225 - Roadway Excavation	I. B	Contingency	N/A	N/A	2,000	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. B	Varies	N/A	N/A	100	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. C	Contingency	N/A	N/A	200	CY
						Total Quantity of Undercut Excavation =	**2,300**	**CY**
0195000000-E	Select Granular Material	265 - Select Granular Material	III. C	Contingency	N/A	N/A	2,000	CY
0195000000-E	Select Granular Material	265 - Select Granular Material	III. C	Contingency	N/A	N/A	200	CY
						Total Quantity of Select Granular Material =	**2,200**	**CY**
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	I. C	Contingency	N/A	N/A	2,000	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. E	Contingency	N/A	N/A	200	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. E	Contingency	N/A	N/A	300	SY
						Total Quantity of Geotextile for Soil Stabilization =	**2,500**	**SY**
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. D	Contingency	N/A	N/A	100	CY
						Total Quantity of Shallow Undercut =	**100**	**CY**
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. B	Contingency	N/A	N/A	200	TON
						Total Quantity of Class IV Subgrade Stabilization =	**200**	**TON**
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. A	Contingency	N/A	N/A	300	LF
						Total Quantity of 6" Perforated Subdrain Pipe =	**300**	**LF**

These Items Only Impact Earthwork Totals								
N/A	Loss Due to Clearing & Grubbing	200 - Clearing and Grubbing	IV. A	N/A	N/A	N/A	1,000	CY
N/A	Shrinkage Factor	235 - Embankments	III. D	N/A	N/A	N/A	20	%