STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-5323	1	18

REFERENCE: B-5323

PROJECT: 46037

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *GRANVILLE*

PROJECT DESCRIPTION *BRIDGE NO. 143 ON SR 1442 (DAVE WINSTON RD.) OVER JOHN H. KERR RESERVOIR*

SITE DESCRIPTION *14+66.00 -L-*

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CAUTION NOTICE

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PERSONNEL

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CAROLINA DRILLING

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INVESTIGATED BY *C.T. TANG, PE*

DRAWN BY *C.T. TANG, PE*

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SUBMITTED BY *C.T. TANG, PE*

DATE *DECEMBER 2018*

NORTH CAROLINA PROFESSIONAL SEAL 047389 ENGINEER CHIEN-TING TANG

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
B-5323	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
- [X] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] 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: B5323-3 AT 15+38.02 -BL-, N:101 3820.548 E:211 4596.542.

ELEVATION: 308.45 FEET

NOTES:

BORINGS FOR END BENT NO. 1 AND NO. 2 WERE PERFORMED BY NCDOT IN MARCH 2010 AND THE LOGS ARE INCORPORATED INTO THIS REPORT.

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
B-5323	2A

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)

From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.

STRUCTURE

- INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities
- BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets
- VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets
- BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity
- DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces
- LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes

DECREASING INTERLOCKING OF ROCK PIECES ⇩

SURFACE CONDITIONS

VERY GOOD	GOOD	FAIR	POOR	VERY POOR
Very rough, fresh unweathered surfaces	Rough, slightly weathered, iron stained surfaces	Smooth, moderately weathered and altered surfaces	Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments	Slickensided, highly weathered surfaces with soft clay coatings or fillings

DECREASING SURFACE QUALITY ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos. P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

COMPOSITION AND STRUCTURE

- **A.** *Thick bedded, very blocky sandstone The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.*
- **B.** *Sandstone with thin interlayers of siltstone*
- **C.** *Sandstone and siltstone in similar amounts*
- **D.** *Siltstone or silty shale with sandstone layers*
- **E.** *Weak siltstone or clayey shale with sandstone layers*
- **C, D, E,** and **G** - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H.**
- **F.** *Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure*
- **G.** *Undisturbed silty or clayey shale with or without a few very thin sandstone layers* → **H.** ***Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.***

→ Means deformation after tectonic disturbance

SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces	GOOD - Rough, slightly weathered surfaces	FAIR - Smooth, moderately weathered and altered surfaces	POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	**VERY POOR** - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings
70				
60	A			
50		B	C	D E
40				
30				F
20				
		G		H 10

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
B-5323	3

SITE PLAN

0 30 60

FEET

JOHN H KERR RESERVOIR

14 BENT LINES 15 16

RIP-RAP

JS

BRIDGE NO.143

EB1-A B1-A B2-A B3-A EB2-A

-L- SR 1442 (DAVE WINSTON RD)

TO SR 1431 (GRASSY CREEK RD)

TO SR 1444 (WILLIAMSON RD)

EB1-B B1-B B2-B B3-B EB2-B

TOP OF RAIL #1
STA.13+89 -L-,
10 FT RT
EL.311.3 FT

TOP OF RAIL #2
STA.15+44 -L-,
10 FT RT
EL.311.3 FT

JOHN H KERR RESERVOIR

SKEW = 90 DEG.

PROJECT REFERENCE NO.	SHEET NO.
B-5323	4

PROFILE ALONG -L- CENTERLINE

0 20 40
FEET
VE = 2

Ⓐ **ROADWAY EMBANKMENT** BITUMINOUS CONCRETE

Ⓑ **ROADWAY EMBANKMENT** AGGREGATE BASE COURSE

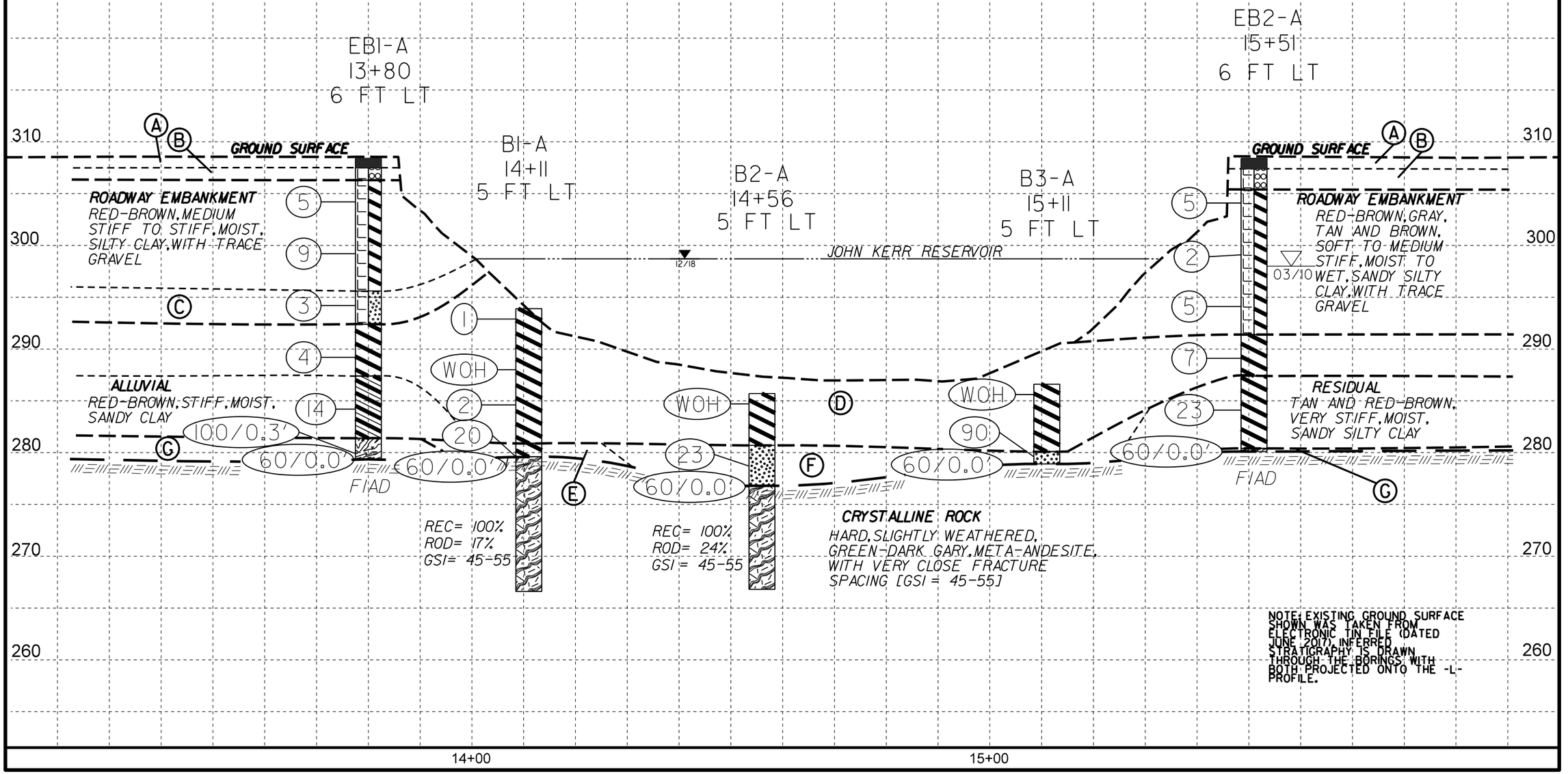
Ⓒ **ROADWAY EMBANKMENT** BROWN AND GRAY-GREEN, VERY LOOSE, SATURATED, CLAYEY SILTY SAND, WITH SOME GRAVEL

Ⓓ **ALLUVIAL** DARK GRAY AND BROWN, VERY SOFT TO MEDIUM STIFF, WET TO SATURATED, SILTY CLAY, WITH SOME GRAVEL, TRACE WOOD FRAGMENTS, LEAVES AND ORGANICS

Ⓔ **RESIDUAL** BROWN, VERY STIFF, SATURATED, SILTY CLAY, WITH SOME ROCK FRAGMENTS

Ⓕ **RESIDUAL** BROWN AND GRAY, MEDIUM DENSE TO VERY DENSE, SATURATED, SILTY SAND, WITH SOME ROCK FRAGMENTS

Ⓖ **WEATHERED ROCK** META-ANDESITE



NOTE: EXISTING GROUND SURFACE SHOWN WAS TAKEN FROM ELECTRONIC TIN FILE (DATED JUNE 2017). INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE -L- PROFILE.

HORIZ. SCALE (FEET) 0 10 20

VE = 1

CROSS SECTION AT END BENT #1

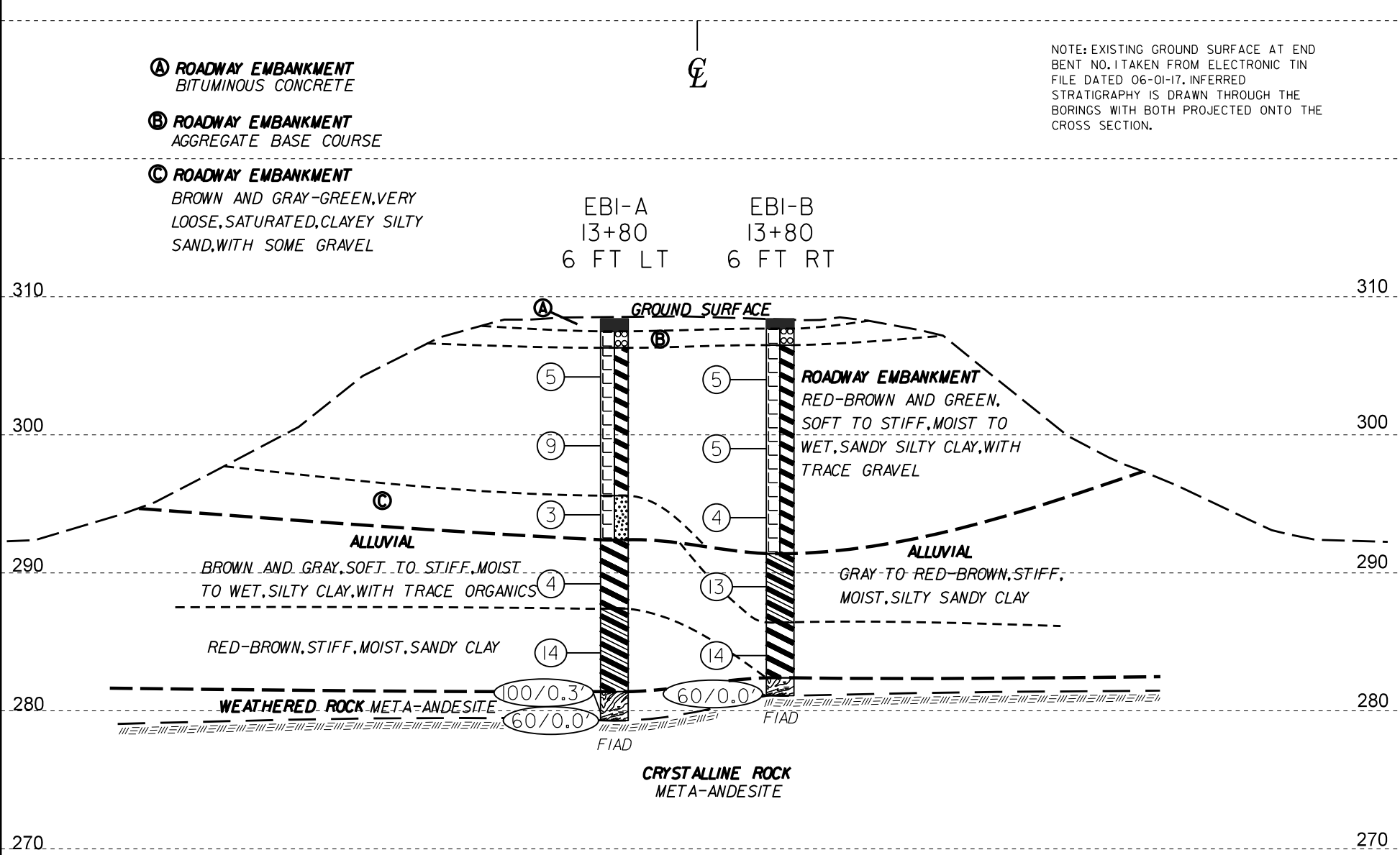
Ⓐ **ROADWAY EMBANKMENT**
BITUMINOUS CONCRETE

Ⓑ **ROADWAY EMBANKMENT**
AGGREGATE BASE COURSE

Ⓒ **ROADWAY EMBANKMENT**
BROWN AND GRAY-GREEN, VERY LOOSE, SATURATED, CLAYEY SILTY SAND, WITH SOME GRAVEL

℄

NOTE: EXISTING GROUND SURFACE AT END BENT NO. 1 TAKEN FROM ELECTRONIC TIN FILE DATED 06-01-17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.



13+65

SKEW = 90 DEG.

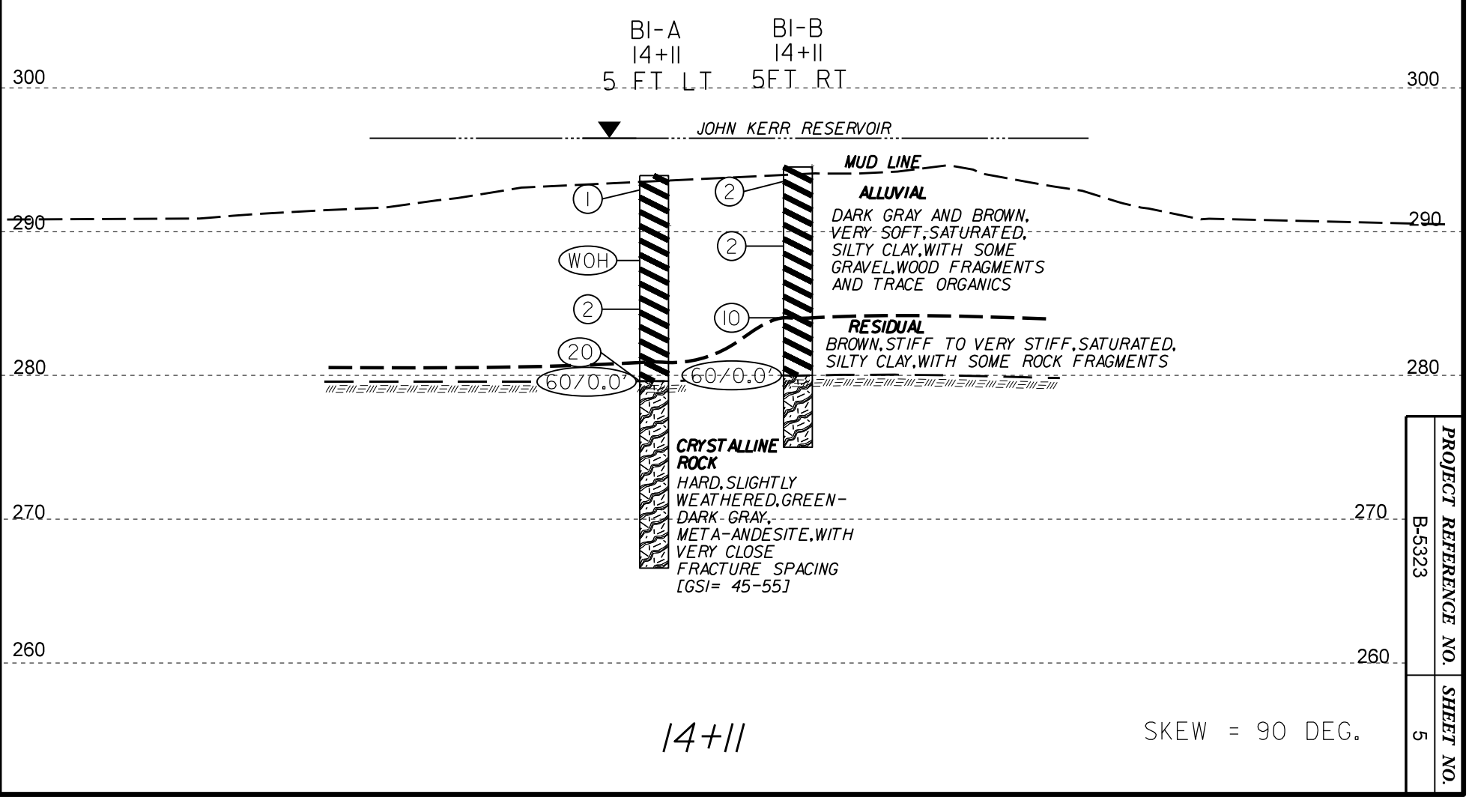
HORIZ. SCALE (FEET) 0 10 20

VE = 1

CROSS SECTION AT BENT #1

℄

NOTE: EXISTING GROUND SURFACE AT BENT NO. 1 TAKEN FROM ELECTRONIC TIN FILE DATED 06-01-17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.



14+11

SKEW = 90 DEG.

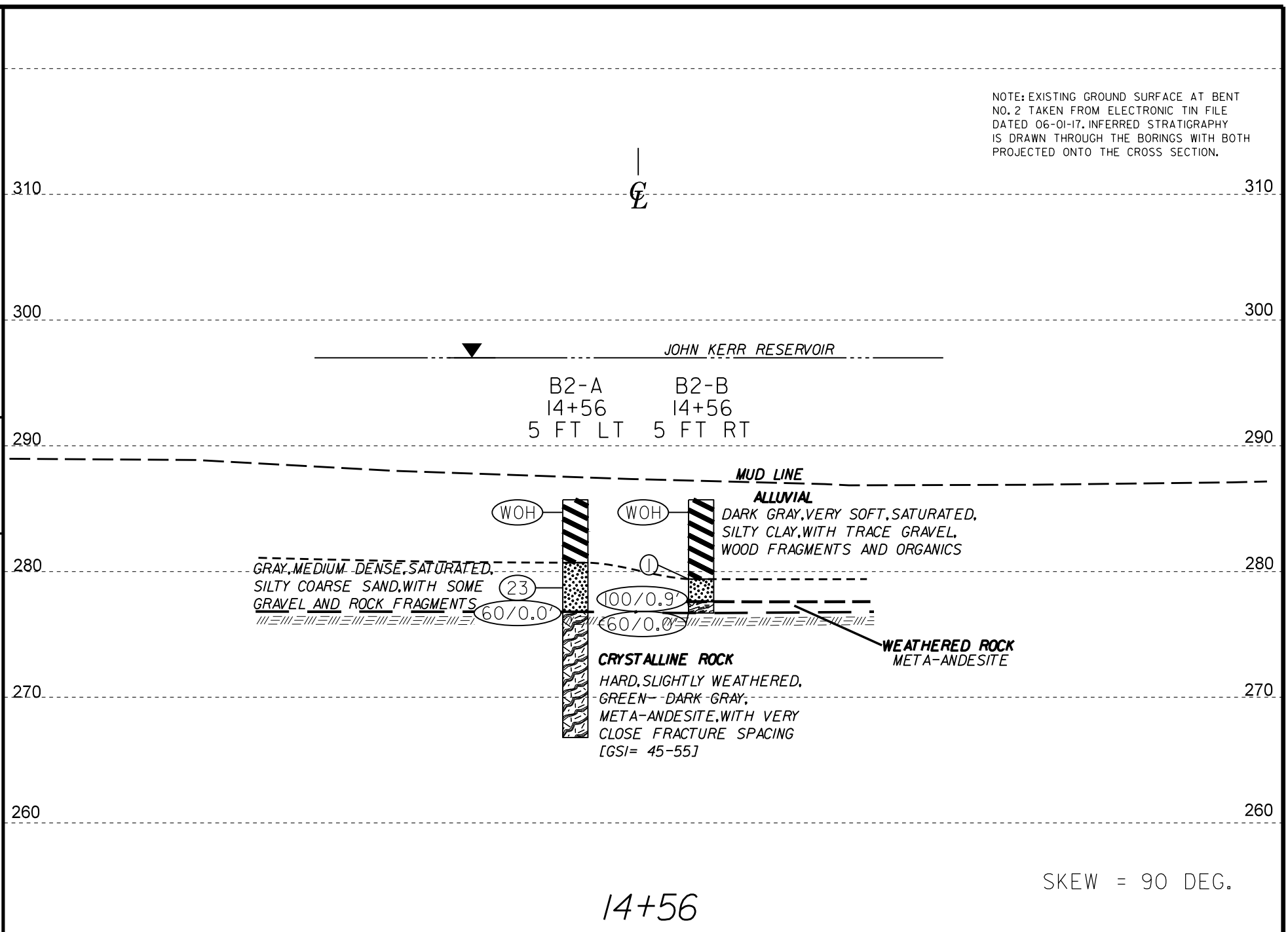
PROJECT REFERENCE NO.	SHEET NO.
B-5323	5

HORIZ. SCALE (FEET) 0 10 20

VE = 1

CROSS SECTION AT BENT #2

NOTE: EXISTING GROUND SURFACE AT BENT NO. 2 TAKEN FROM ELECTRONIC TIN FILE DATED 06-01-17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.



SKEW = 90 DEG.

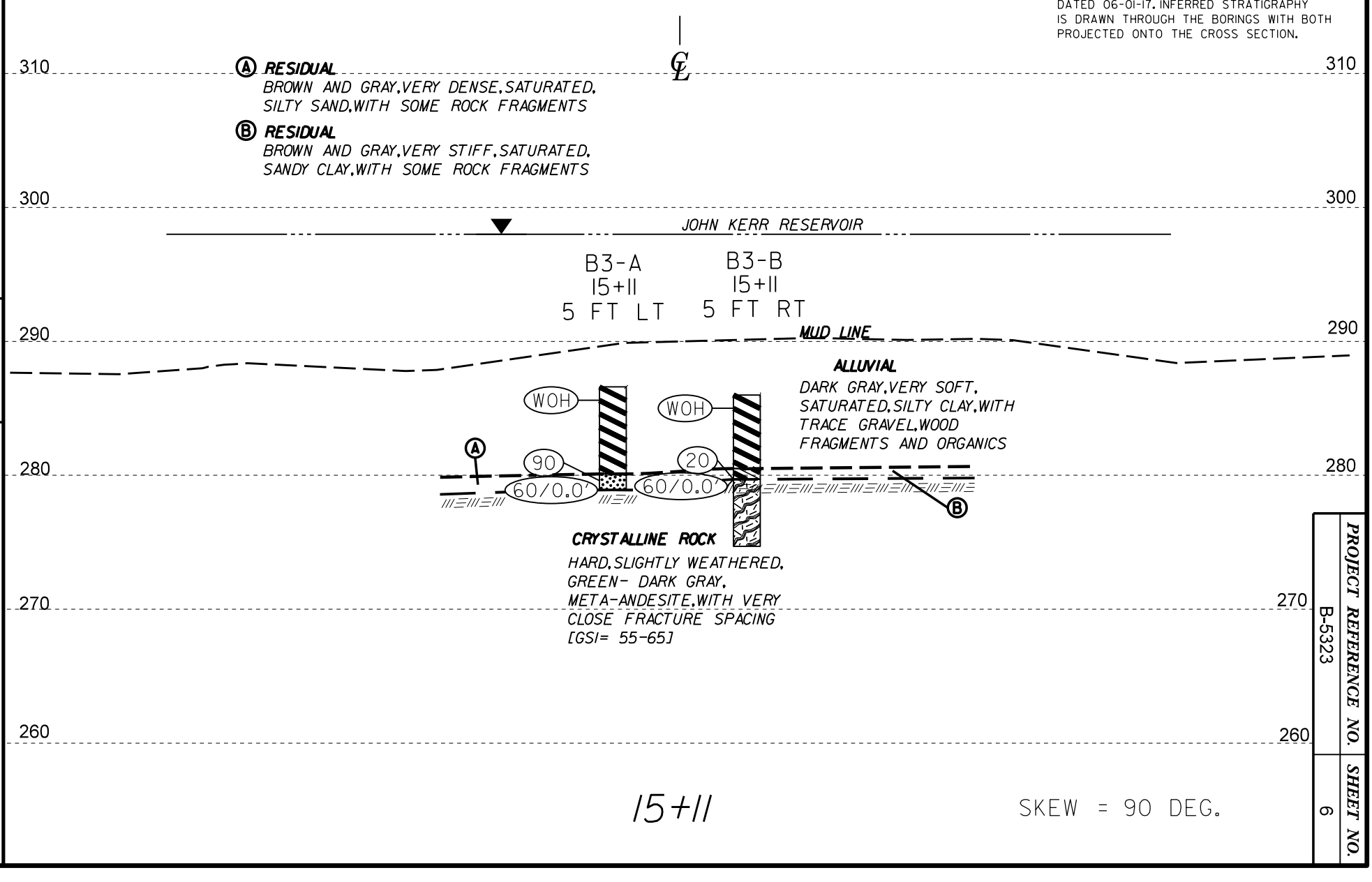
14+56

HORIZ. SCALE (FEET) 0 10 20

VE = 1

CROSS SECTION AT BENT #3

NOTE: EXISTING GROUND SURFACE AT BENT NO. 3 TAKEN FROM ELECTRONIC TIN FILE DATED 06-01-17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.



SKEW = 90 DEG.

15+11

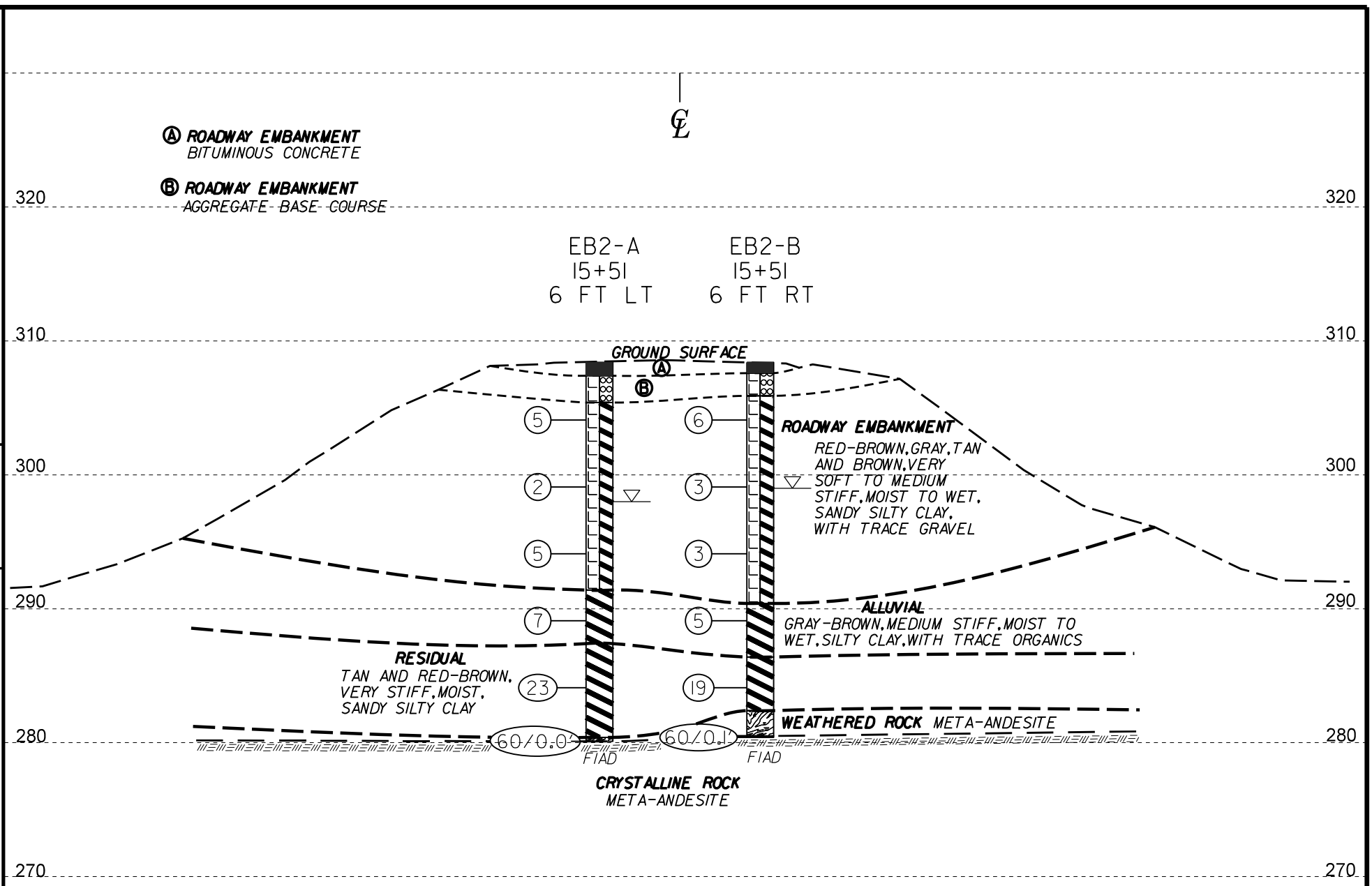
PROJECT REFERENCE NO. B-5323

SHEET NO. 6

HORIZ. SCALE (FEET) 0 10 20

VE = 1

CROSS SECTION AT END BENT #2



NOTE: EXISTING GROUND SURFACE AT END BENT NO. 2 TAKEN FROM ELECTRONIC TIN FILE DATED 06-01-17. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.

15+67

SKEW = 90 DEG.

HORIZ. SCALE (FEET) 0 10 20

PROJECT REFERENCE NO.	SHEET NO.
B-5323	7

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** Bruinsma, C. M.	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+80	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 308.4 ft	**TOTAL DEPTH** 29.1 ft	**NORTHING** 1,013,525	**EASTING** 2,114,452	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE DIEDRICH D-50		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Contract Driller	**START DATE** 03/02/10	**COMP. DATE** 03/02/10	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) — DEPTH (ft)
310										
										308.4 — GROUND SURFACE — 0.0
										307.5 — Bituminous Concrete — 0.9
										306.3 — Aggregate Base Course — 2.1
305	305.2	3.2	1	2	3	5	SS-1	M		**ROADWAY EMBANKMENT** Red-Brown, Sandy Silty Clay, with Trace Gravel
300	300.2	8.2	3	4	5	9		M		
295	295.2	13.2								295.6 — 12.8
			2	1	2	3	SS-2	Sat.		Brown and Gray-Green, Clayey Silty Sand, with Some Gravel
290	290.2	18.2								292.4 — 16.0
			1	2	2	4	SS-3	W		**ALLUVIAL** Brown, Silty Clay, with Trace Organics
285	285.2	23.2								287.4 — 21.0
			5	6	8	14	SS-4	M		Red-Brown, Sandy Clay
280	280.2	28.2								281.4 — 27.0
	279.3	29.1	100/0.3'			100/0.3' 60/0.0'				**WEATHERED ROCK** 279.3 — Brown and Gray-Green, Meta-Vocanic Rock (Meta-Andesite) — 29.1 Boring Terminated with Standard Penetration Test Refusal at Elevation 279.3 ft on Crystalline Rock (Meta-Andesite)
			60/0.0'							

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** Bruinsma, C. M.	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 13+80	**OFFSET** 6 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 308.4 ft	**TOTAL DEPTH** 27.3 ft	**NORTHING** 1,013,521	**EASTING** 2,114,463	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE DIEDRICH D-50		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Contract Driller	**START DATE** 03/02/10	**COMP. DATE** 03/02/10	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
310										
										308.4 — GROUND SURFACE — 0.0
										307.7 — Bituminous Concrete — 0.7
										306.5 — Aggregate Base Course — 1.9
305	305.0	3.4	2	2	3	5		M		**ROADWAY EMBANKMENT** Red-Brown and Green, Silty Clay, with Trace Gravel
300	300.0	8.4	3	2	3	5		M		
295	295.0	13.4	2	1	3	4		W		291.4 — *with Gravel from 16 to 17 Feet* — 17.0
290	290.0	18.4	5	5	8	13		M		**ALLUVIAL** Gray to Red-Brown, Silty Sandy Clay
285	285.0	23.4	7	7	7	14		M		286.4 — 22.0
	281.1	27.3	60/0			60/0				Gray, Silty Clay
										282.4 — 26.0
										WEATHERED ROCK 281.1 — Gray-Green, Meta-Vocanic Rock (Meta-Andesite) — 27.3 Boring Terminated with Standard Penetration Test Refusal at Elevation 281.1 ft on Crystalline Rock (Meta-Andesite)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 14+11	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 293.9 ft	**TOTAL DEPTH** 27.3 ft	**NORTHING** 1,013,550	**EASTING** 2,114,467	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/06/18	**COMP. DATE** 12/06/18	**SURFACE WATER DEPTH** 2.6ft	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) / DEPTH (ft)
										WATER SURFACE (12/06/18)
295										
	293.9	0.0	1	0	1	1		Sat.		293.9 MUD LINE 0.0 **ALLUVIAL** Dark Gray and Brown, Silty Clay, with Some Gravel, Wood Fragments and Trace Organics
290										
	289.0	4.9	WOH	WOH	WOH	0		Sat.		
285	285.6	8.3	WOH	WOH	2	2		Sat.		
	280.6	13.3	14	20	60/0.0'	60/0.0'	RS-1			280.9 13.0 279.6 **RESIDUAL** 14.3 Brown, Silty Clay, with Some Rock Fragments **CRYSTALLINE ROCK** Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 45-55] [REC = 100%, RQD = 17%]
280										
275										
270										266.6 27.3 Boring Terminated at Elevation 266.6 ft in Crystalline Rock (Meta-Andesite)

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 14+11	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 293.9 ft	**TOTAL DEPTH** 27.3 ft	**NORTHING** 1,013,550	**EASTING** 2,114,467	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/06/18	**COMP. DATE** 12/06/18	**SURFACE WATER DEPTH** 2.6ft	
CORE SIZE NQ	**TOTAL RUN** 13.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
279.6											Begin Coring @ 14.3 ft
	279.6	14.3	3.0	7:07 8:26 3:16	(3.0) 100%	(0.6) 20%	RS-1	(13.0) 100%	(2.2) 17%	279.6	**CRYSTALLINE ROCK** 14.3 Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 45-55]
	276.6	17.3	5.0	5:01 5:20 3:16 4:21 3:24	(5.0) 100%	(0.8) 16%					
275											
	271.6	22.3	5.0	4:02 3:33 3:02 5:37 4:50	(5.0) 100%	(0.8) 16%					
270											
	266.6	27.3								266.6	27.3 Boring Terminated at Elevation 266.6 ft in Crystalline Rock (Meta-Andesite)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 14+11	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 294.5 ft	**TOTAL DEPTH** 19.5 ft	**NORTHING** 1,013,544	**EASTING** 2,114,478	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/03/18	**COMP. DATE** 12/03/18	**SURFACE WATER DEPTH** 4.3ft	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	WATER	LOG	SOIL AND ROCK DESCRIPTION
295										ELEV. (ft) DEPTH (ft)
	294.5	0.0	1	1	1	2		Sat.		294.5 MUD LINE 0.0
290	290.0	4.5	WOH	1	1	2		Sat.		**ALLUVIAL** Dark Gray, Silty Clay, with Some Rock Fragments and Trace Organics
285	285.0	9.5	WOH	5	5	10		Sat.		284.0 10.5 **RESIDUAL** Brown, Silty Clay, with Some Rock Fragments
280	280.0	14.5	60/0.0'			60/0.0				280.0 14.5 **CRYSTALLINE ROCK** Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 45-55] [REC = 26%, RQD = 14%]
275										275.0 19.5 Boring Terminated at Elevation 275.0 ft in Crystalline Rock (Meta-Andesite)

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 14+11	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 294.5 ft	**TOTAL DEPTH** 19.5 ft	**NORTHING** 1,013,544	**EASTING** 2,114,478	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/03/18	**COMP. DATE** 12/03/18	**SURFACE WATER DEPTH** 4.3ft	
CORE SIZE NQ	**TOTAL RUN** 5.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
280											Begin Coring @ 14.5 ft
	280.0	14.5	4.0	1:14	(0.3) 8%	(0.3) 8%		(1.3) 26%	(0.7) 14%		280.0 **CRYSTALLINE ROCK** 14.5 Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 45-55]
				1:09							
	276.0	18.5		2:15							
275	275.0	19.5	1.0	7:18	(1.0) 100%	(0.4) 40%					275.0 19.5 Boring Terminated at Elevation 275.0 ft in Crystalline Rock (Meta-Andesite)
				5:40							

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 14+56	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 285.7 ft	**TOTAL DEPTH** 18.9 ft	**NORTHING** 1,013,590	**EASTING** 2,114,487	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/05/18	**COMP. DATE** 12/05/18	**SURFACE WATER DEPTH** 11.3ft	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) / DEPTH (ft)
										WATER SURFACE (12/05/18)
295										
290										
285	285.7	0.0	WOH	WOH	WOH	0		Sat.		285.7 MUD LINE 0.0 **ALLUVIAL** Dark Gray, Silty Clay, with Trace Wood Fragments, Leaves and Organics
280	279.7	6.0	8	9	14	23		Sat.		280.7 5.0 Gray, Silty Coarse Sand, with Some Gravel and Rock Fragments
275	276.8	8.9	60/0.0"			60/0.0"	RS-2			276.8 8.9 **CRYSTALLINE ROCK** Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 45-55] [REC = 100%, RQD = 24%]
270										266.8 18.9 Boring Terminated at Elevation 266.8 ft in Crystalline Rock (Meta-Andesite)

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 14+56	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 285.7 ft	**TOTAL DEPTH** 18.9 ft	**NORTHING** 1,013,590	**EASTING** 2,114,487	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/05/18	**COMP. DATE** 12/05/18	**SURFACE WATER DEPTH** 11.3ft	
CORE SIZE NQ	**TOTAL RUN** 10.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
276.8											Begin Coring @ 8.9 ft
275	276.8	8.9	5.0	9:49 7:13 7:20 7:59 7:15	(5.0) 100%	(0.6) 12%		(10.0) 100%	(2.4) 24%		276.8 **CRYSTALLINE ROCK** 8.9 Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 45-55]
270	271.8	13.9	5.0	5:01 5:20 2:52 5:14 7:35	(5.0) 100%	(1.8) 36%	RS-2				266.8 18.9 Boring Terminated at Elevation 266.8 ft in Crystalline Rock (Meta-Andesite)
	266.8	18.9									

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B2-B	**STATION** 14+56	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 285.7 ft	**TOTAL DEPTH** 9.0 ft	**NORTHING** 1,013,584	**EASTING** 2,114,498	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER J. Anderson	**START DATE** 12/04/18	**COMP. DATE** 12/04/18	**SURFACE WATER DEPTH** 12.6ft	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) WATER SURFACE (12/04/18) DEPTH (ft)
295										
290										
285	285.7	0.0	WOH	WOH	WOH	0		Sat.		285.7 MUD LINE 0.0 **ALLUVIAL** Dark Gray, Silty Clay, with Trace Gravel and Organics
280	280.4	5.3	WOH	WOH	1	1		Sat.		279.4 6.3 Gray, Silty Coarse Sand
	278.1	7.6	25	75/0.4'		100/0.9'		Sat.		277.6 8.1 276.7 **WEATHERED ROCK** 9.0 Meta-Andesite Boring Terminated with Standard Penetration Test Refusal at Elevation 276.7 ft on Crystalline Rock (Meta-Andesite)
	276.7	9.0	60/0.0'			60/0.0'				

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B3-A	**STATION** 15+11	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 286.6 ft	**TOTAL DEPTH** 7.7 ft	**NORTHING** 1,013,639	**EASTING** 2,114,512	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER J. Anderson	**START DATE** 12/04/18	**COMP. DATE** 12/04/18	**SURFACE WATER DEPTH** 11.4ft	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										WATER SURFACE (12/04/18)
295										
290										
285	286.6	0.0	WOH	WOH	WOH	0		Sat.		286.6 MUD LINE 0.0 **ALLUVIAL** Dark Gray, Silty Clay, with Trace Gravel and Organics
280	280.6	6.0	3	20	70	90		Sat.		280.1 6.5 278.9 **RESIDUAL** 7.7 Brown and Gray, Silty Sand, with Some Rock Fragments Boring Terminated with Standard Penetration Test Refusal at Elevation 278.9 ft on Crystalline Rock (Meta-Andesite)
	278.9	7.7	60/0.0'			60/0.0'				

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B3-B	**STATION** 15+11	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 286.0 ft	**TOTAL DEPTH** 11.3 ft	**NORTHING** 1,013,634	**EASTING** 2,114,522	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/04/18	**COMP. DATE** 12/04/18	**SURFACE WATER DEPTH** 12.2ft	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) WATER SURFACE (12/04/18) DEPTH (ft)
295										
290										
	286.0	0.0								286.0 MUD LINE 0.0
285			WOH	WOH	WOH	0		Sat.		**ALLUVIAL** Dark Gray, Silty Clay, with Trace Wood Fragments and Gravel
280	280.2	5.8	20	60/0.0'		60/0.0'		Sat.		280.5 5.5
								Sat.		279.7 6.3 **RESIDUAL** Brown and Gray, Sandy Clay, with Some Rock Fragments
275							RS-3			**CRYSTALLINE ROCK** Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 55-65] [REC = 88%, RQD = 66%] 274.7 11.3 Boring Terminated at Elevation 274.7 ft in Crystalline Rock (Meta-Andesite)

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** C.T. Tang	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. B3-B	**STATION** 15+11	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 286.0 ft	**TOTAL DEPTH** 11.3 ft	**NORTHING** 1,013,634	**EASTING** 2,114,522	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE BRI3895 CME-55 96% 04/19/2018		DRILL METHOD Mud Rotary	HAMMER TYPE Automatic	
DRILLER J. Anderson	**START DATE** 12/04/18	**COMP. DATE** 12/04/18	**SURFACE WATER DEPTH** 12.2ft	
CORE SIZE NQ	**TOTAL RUN** 5.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
279.7											Begin Coring @ 6.3 ft
	279.7	6.3	5.0	11:36 5:40 5:01 5:48 8:51	(4.4) 88%	(3.3) 66%		(4.4) 88%	(3.3) 66%	279.7	**CRYSTALLINE ROCK** 6.3 Hard, Slightly Weathered, Green-Dark Gray, Meta-Andesite, with Very Close Fracture Spacing [GSI = 55-65]
275	274.7	11.3					RS-3			274.7	11.3 Boring Terminated at Elevation 274.7 ft in Crystalline Rock (Meta-Andesite)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** Bruinsma, C. M.	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 15+51	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** 10.4
COLLAR ELEV. 308.4 ft	**TOTAL DEPTH** 28.3 ft	**NORTHING** 1,013,676	**EASTING** 2,114,528	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE DIEDRICH D-50		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Contract Driller	**START DATE** 03/02/10	**COMP. DATE** 03/02/10	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION / ELEV. (ft)	DEPTH (ft)
310											
										308.4 GROUND SURFACE	0.0
										307.4 Bituminous Concrete	1.0
										Aggregate Base Course	
305	305.1	3.3	2	3	2	5		M		305.4 **ROADWAY EMBANKMENT** Red-Brown, Gray, Tan and Brown, Sandy Silty Clay, with Trace Gravel	3.0
300	300.1	8.3	WOH	1	1	2	SS-7	M			
295	295.1	13.3	WOH	1	4	5		W			
290	290.1	18.3	1	3	4	7		W		291.4 **ALLUVIAL** Gray-Brown, Silty Clay, with Trace Organics	17.0
285	285.1	23.3	8	11	12	23		M		287.4 **RESIDUAL** Tan and Red-Brown, Sandy Silty Clay	21.0
	280.1	28.3	60/0			60/0				280.4 **WEATHERED ROCK** Brown and Green, Meta-Vocanic Rock (Meta-Andesite)	28.0
										280.1 Boring Terminated with Standard Penetration Test Refusal at Elevation 280.1 ft on Crystalline Rock (Meta-Andesite)	28.3

WBS 46037.1.1	**TIP** B-5323	**COUNTY** GRANVILLE	**GEOLOGIST** Bruinsma, C. M.	
SITE DESCRIPTION Bridge No. 143 on SR 1442 (Dave Winston Rd.) over John H. Kerr Reservoir				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 15+51	**OFFSET** 6 ft RT	**ALIGNMENT** -L-	**0 HR.** 9.4
COLLAR ELEV. 308.4 ft	**TOTAL DEPTH** 28.0 ft	**NORTHING** 1,013,670	**EASTING** 2,114,539	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE DIEDRICH D-50		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Contract Driller	**START DATE** 03/02/10	**COMP. DATE** 03/02/10	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	
310											
										308.4 GROUND SURFACE	0.0
										307.6 Bituminous Concrete	0.8
										305.9 Aggregate Base Course	2.5
305	305.1	3.3	2	3	3	6		M		**ROADWAY EMBANKMENT** Red-Brown, Sandy Silty Clay, with Trace Gravel	
300	300.1	8.3	2	1	2	3		M			
295	295.1	13.3	1	1	2	3		M			
290	290.1	18.3	2	2	3	5	SS-5	M		290.4 **ALLUVIAL** Gray-Brown, Silty Clay, with Trace Organics	18.0
285	285.1	23.3	6	8	11	19	SS-6	M		286.4 **RESIDUAL** Red-Brown, Sandy Silty Clay	22.0
	280.5	27.9	60/0.1			60/0.1				282.4 **WEATHERED ROCK** Brown and Green, Meta-Vocanic Rock (Meta-Andesite)	26.0
										280.5 **CRYSTALLINE ROCK** Brown and Green, Meta-Vocanic Rock (Meta-Andesite)	27.9
										280.4 Boring Terminated with Standard Penetration Test Refusal at Elevation 280.4 ft in Crystalline Rock (Meta-Andesite)	28.0

LAB TEST RESULTS

STEWART

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D7012

WBS No.: 46037.1.1
TIP No.: B-5323
County: Granville
Description: Bridge No. 143 on SR 1442 (Dave Winston Road) over John Kerr Reservoir

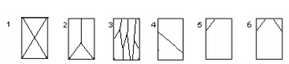
Test Date: 12/12/2018
Tested By: J. Evans

Test No.	1	2	3	
Boring ID	B1-A	B2-A	B3-B	
Station	14+11	14+56	15+11	
Sample ID	RS-1	RS-2	RS-3	
Sample Depth, ft	14.8	16.7	9	
Core Length #1, in.	4.169	4.181	4.132	
Core Length #2, in.	4.167	4.182	4.134	
Core Length #3, in.	4.168	4.180	4.133	
Avg. Core Length, in.	4.168	4.181	4.133	
Core Dia. #1, in.	1.977	1.979	1.978	
Core Dia. #2, in.	1.977	1.979	1.978	
Avg. Core Dia., in.	1.977	1.979	1.978	
Length/Dia. Ratio	2.11	2.11	2.09	
X-Sectional Area, in^2	3.07	3.08	3.07	
Weight, lb	1.24	1.24	1.23	
Unit Weight, pcf	167.47	166.62	167.36	
Break Type	3	3	3	
Load at Failure, lb	50,330	25,334	63,711	
Correction Factor	1.00	1.00	1.00	
Comp. Strength, psi	**16,396**	**8,236**	**20,734**	
Comp. Strength, ksf	**2,361**	**1,186**	**2,986**	

Rock Descriptions:

Test 1: Dark Gray, Slight Weathered, Hard, Meta-Andesite, with Very Close Fracture Spacing
Test 2: Dark Gray, Slight Weathered, Hard, Meta-Andesite, with Very Close Fracture Spacing
Test 3: Dark Gray, Slight Weathered, Hard, Meta-Andesite, with Very Close Fracture Spacing

Break Types:



PROJECT REFERENCE NO.	SHEET NO.
B–5323	16

CORE PHOTOGRAPHS

BORING BI-A (BOTTOM THREE ROWS) AND BI-A (UPPER ROW)

BI-A: STA. 14+11 -L-, 5 FT LT
CORE DEPTH: 14.3 FT TO 27.3 FT

BI-B: STA. 14+11 -L-, 5 FT RT
CORE DEPTH: 14.5 FT TO 19.5 FT

START OF CORING
RUN #2 (BI-B) 18.5 FT

END OF CORING (BI-B)
19.5 FT

START OF CORING (BI-B)
RUN #1 14.5 FT

START OF CORING (BI-A)
RUN #1 14.3 FT

CORING (BI-A) RUN #2
17.3 FT

CORING (BI-A) RUN #3
22.3 FT

END OF CORING
(BI-A) 27.3 FT

0 1 2

FEET

PROJECT REFERENCE NO.	SHEET NO.
B–5323	17

CORE PHOTOGRAPHS

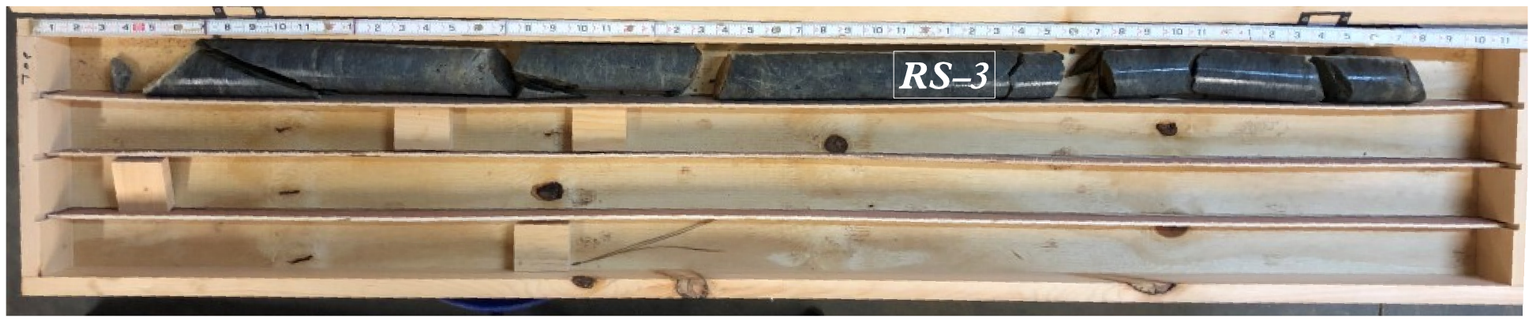
BORING B2-A
STA. 14+56 -L-, 5 FT LT
CORE DEPTH: 8.9 FT TO 18.9 FT

START OF CORING
RUN #1 8.9 FT
START OF CORING
RUN #2 13.9 FT

END OF
CORING
18.9 FT

BORING B3-B
STA. 15+11 -L-, 5 FT RT
CORE DEPTH: 6.3 FT TO 11.3 FT

START OF CORING
RUN #1 6.3 FT



END OF
CORING
11.3 FT

0 1 2

FEET

PROJECT REFERENCE NO.	SHEET NO.
B–5323	18

SITE PHOTOGRAPH

BRIDGE 143

PHOTOGRAPH NO.1.: VIEW LOOKING NORTHEAST.

DATE: 9-15-14