

REFERENCE: B-4729

PROJECT: 38502

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

STRUCTURE
SUBSURFACE INVESTIGATION

COUNTY CHATHAM
PROJECT DESCRIPTION BRIDGE NO. 306 ON SR 1303
(BEN SMITH RD) OVER NORTH PRONG ROCKY
RIVER
SITE DESCRIPTION 13+58.00 -L-

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STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-4729	1	13

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PERSONNEL

CT TANG, EI

CAROLINA DRILLING

M. RAEFORD

T. POGGIE

G. EISTER

W. HAMILL

INVESTIGATED BY CT TANG, EI

DRAWN BY D BROWN, PE

CHECKED BY CT TANG, EI

SUBMITTED BY D BROWN, PE

DATE MARCH 2017



DocuSigned by:
Donald W. Brown Jr. 4/20/2017

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SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION, GRADATION, ROCK DESCRIPTION, TERMS AND DEFINITIONS, SOIL LEGEND AND AASHTO CLASSIFICATION, CONSISTENCY OR DENSENESS, TEXTURE OR GRAIN SIZE, SOIL MOISTURE - CORRELATION OF TERMS, PLASTICITY, COLOR, MISCELLANEOUS SYMBOLS, RECOMMENDATION SYMBOLS, ABBREVIATIONS, EQUIPMENT USED ON SUBJECT PROJECT, FRACTURE SPACING, BEDDING, INDURATION, NOTES.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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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)

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (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

SURFACE CONDITIONS

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

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.

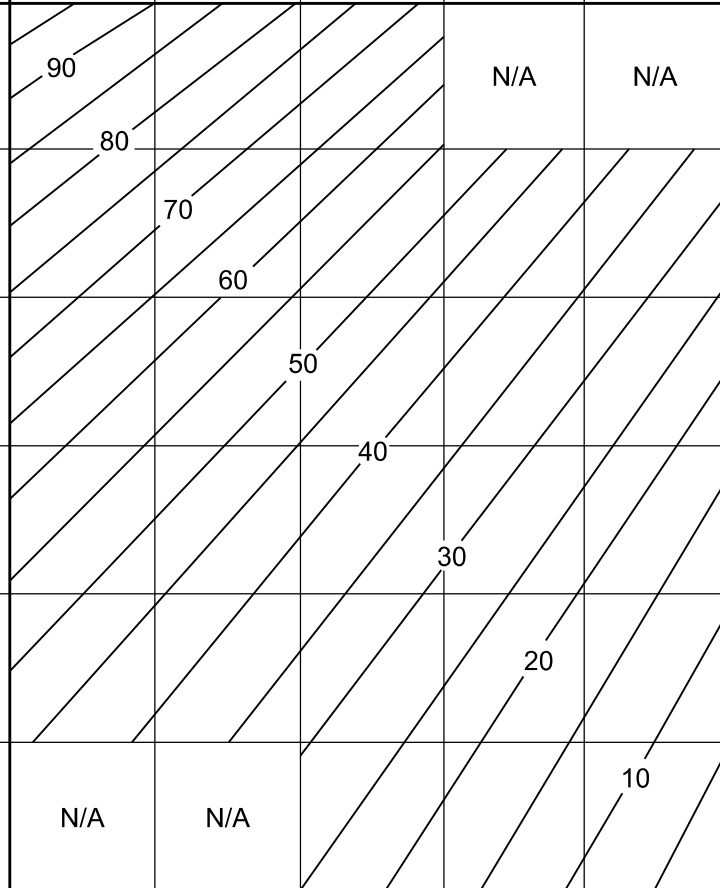
COMPOSITION AND STRUCTURE

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
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DECREASING INTERLOCKING OF ROCK PIECES

INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities	90				N/A	N/A
BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets	80	70				
VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets		60	50			
BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity			40			
DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces				30		
LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes					20	
						10
	N/A	N/A				



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 inter-layers 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**

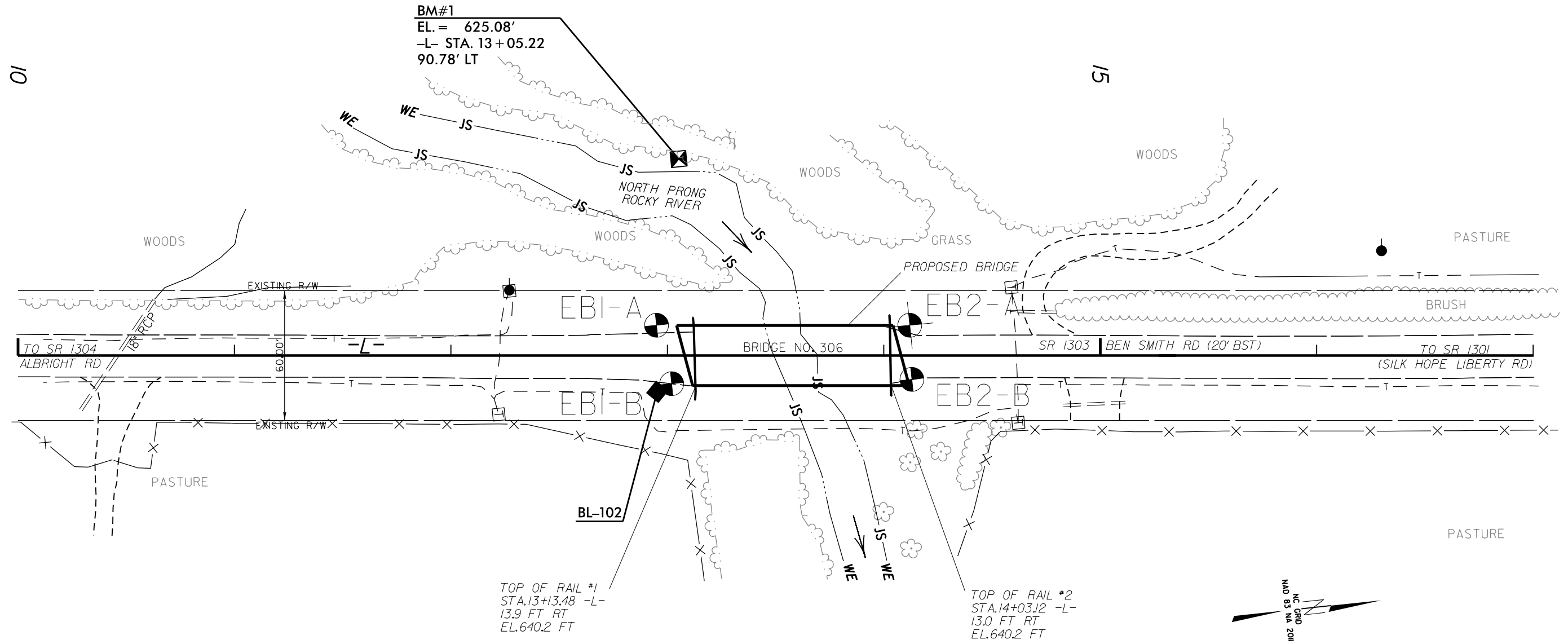
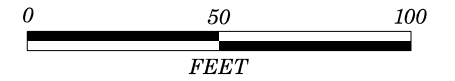
C, D, E, and G - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H**.

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.**

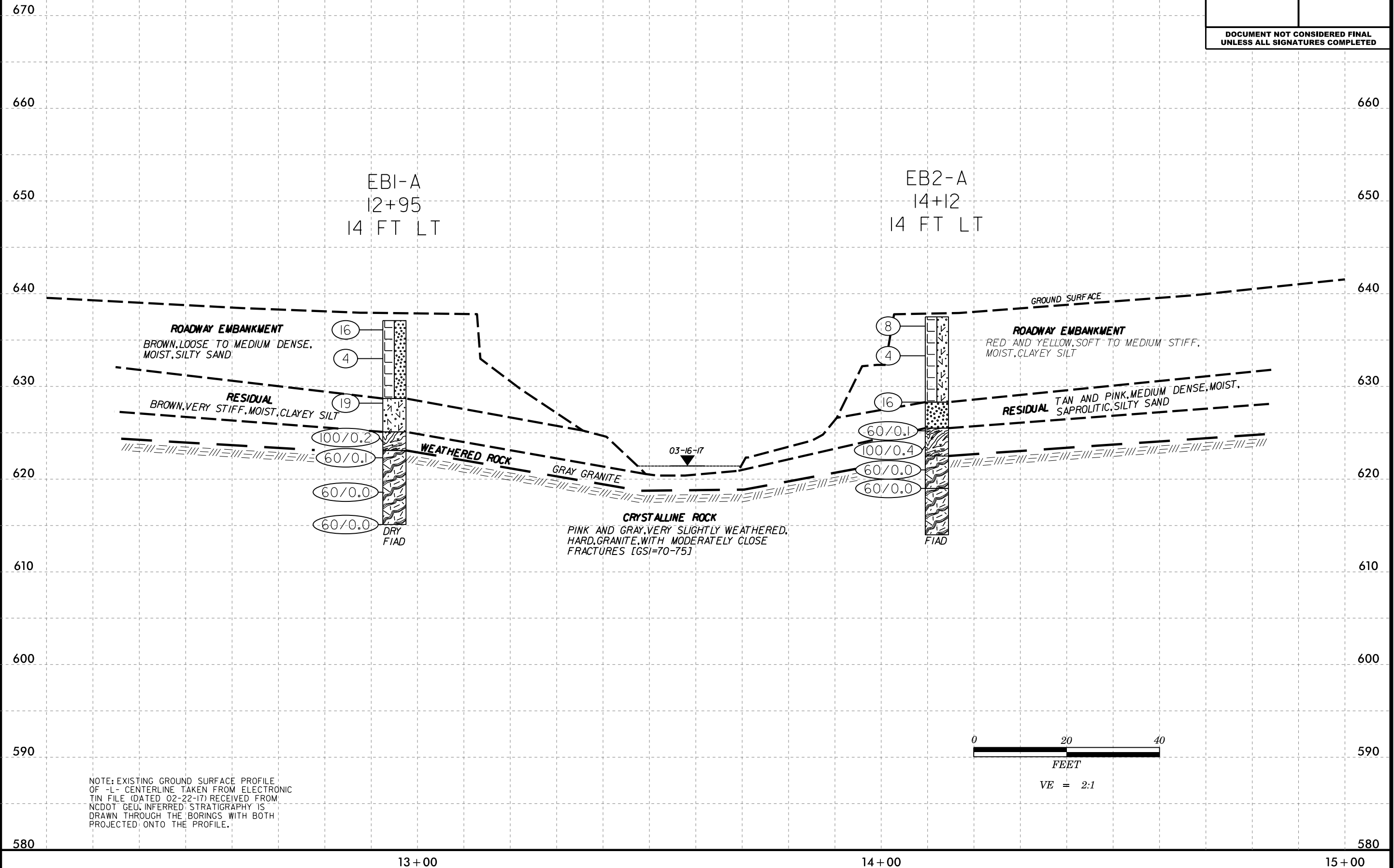
→ Means deformation after tectonic disturbance

SITE PLAN

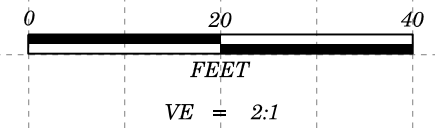


SKREW = 75 DEG.

PROFILE ALONG -L- CENTERLINE BRIDGE NO. 306



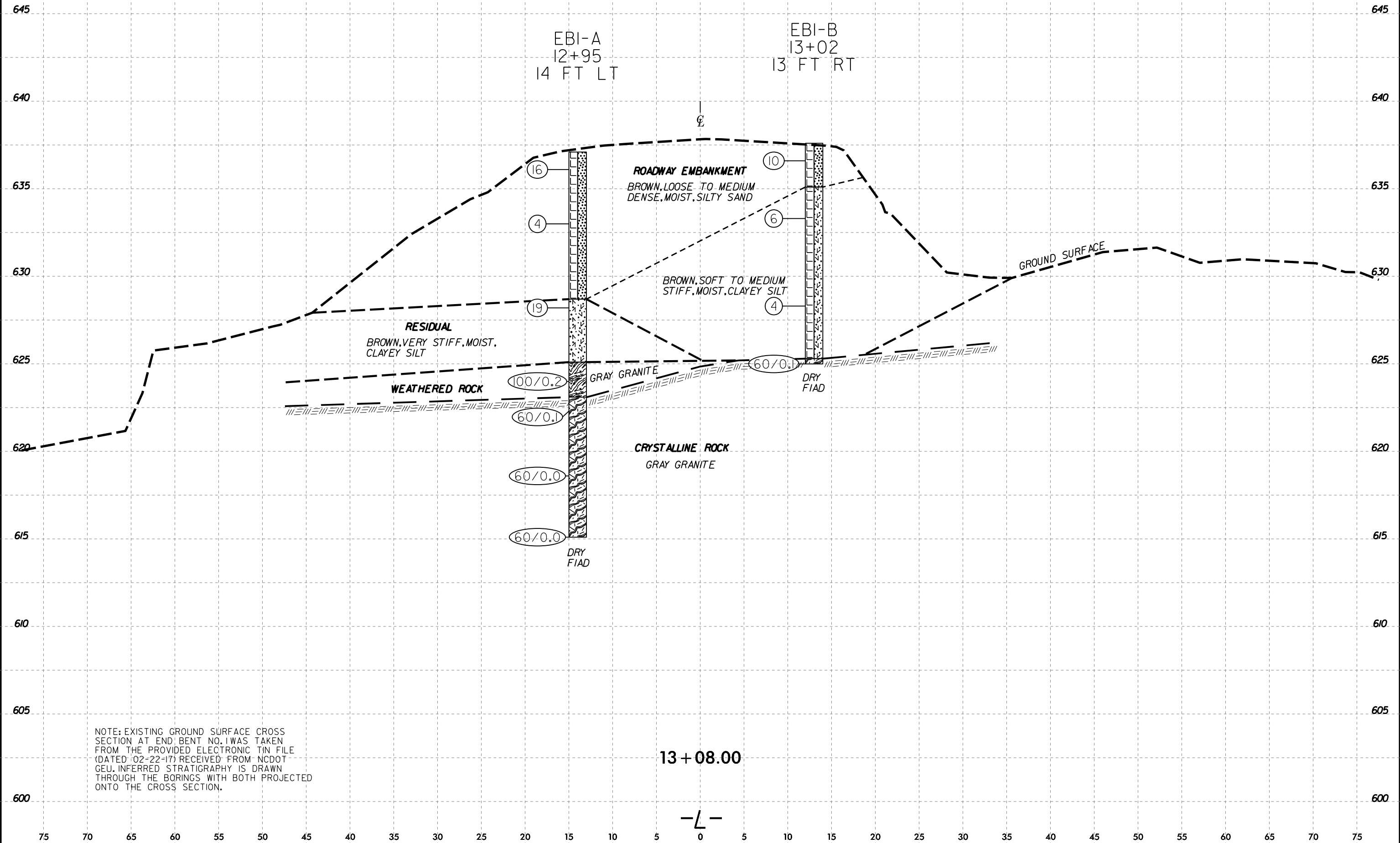
NOTE: EXISTING GROUND SURFACE PROFILE OF -L- CENTERLINE TAKEN FROM ELECTRONIC TIN FILE (DATED 02-22-17) RECEIVED FROM NCDOT GEL. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.



CROSS SECTION ALONG END BENT NO. 1 BRIDGE NO. 306

EBI-A
12+95
14 FT LT

EBI-B
13+02
13 FT RT

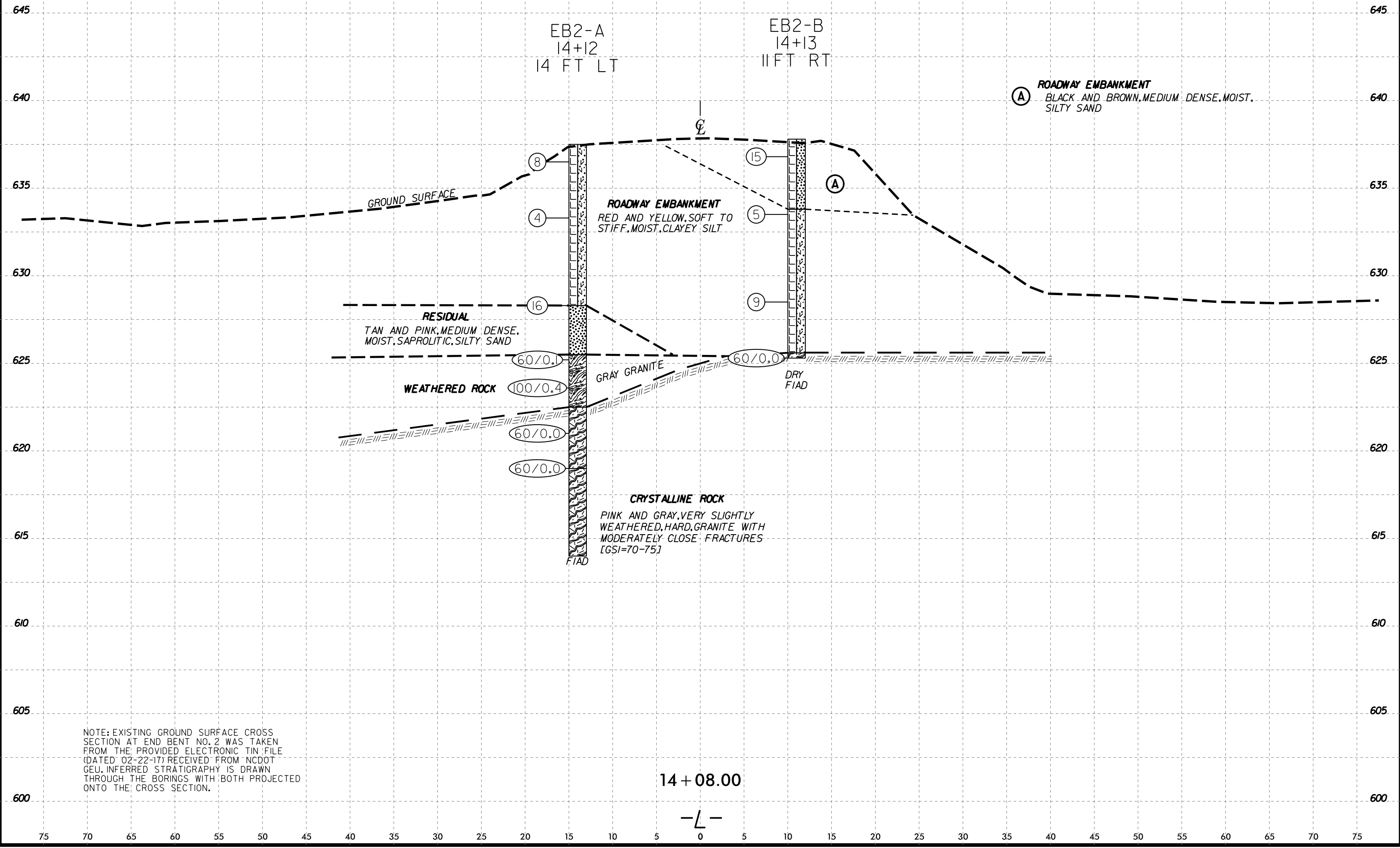


NOTE: EXISTING GROUND SURFACE CROSS SECTION AT END BENT NO. 1 WAS TAKEN FROM THE PROVIDED ELECTRONIC TIN FILE (DATED 02-22-17) RECEIVED FROM NCDOT GEU. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.

-L-

CROSS SECTION ALONG END BENT NO. 2 BRIDGE NO. 306

VE = 2:1



NOTE: EXISTING GROUND SURFACE CROSS SECTION AT END BENT NO. 2 WAS TAKEN FROM THE PROVIDED ELECTRONIC TIN FILE (DATED 02-22-17) RECEIVED FROM NCDOT GEU. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 38502.1.1		TIP B-4729		COUNTY CHATHAM		GEOLOGIST C.T. TANG										
SITE DESCRIPTION Bridge No. 306 on SR 1303 (Ben Smith Rd.) over North Prong Rocky River							GROUND WTR (ft)									
BORING NO. EB1-A		STATION 12+95		OFFSET 14 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 637.1 ft		TOTAL DEPTH 22.0 ft		NORTHING 756,452		EASTING 1,843,276										
DRILL RIG/HAMMER EFF./DATE BRI2974 CME-45C 84% 05/04/2016			DRILL METHOD H.S. Augers + Mud Rotary		HAMMER TYPE Automatic											
DRILLER M. RADFORD		START DATE 03/16/17		COMP. DATE 03/16/17		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
640																
	637.1	0.0	3	5	11									637.1	0.0	GROUND SURFACE
	634.0	3.1	2	1	3									634.0	3.1	ROADWAY EMBANKMENT Brown, Silty Sand, with Some Gravel
	629.2	7.9	47	12	7									629.2	7.9	
	624.2	12.9	100/0.2											624.2	12.9	RESIDUAL Brown, Clayey Silt, with Some Rock Fragments
	622.4	14.7	60/0.1											622.4	14.7	WEATHERED ROCK Granite
	618.6	18.5	60/0.0											618.6	18.5	CRYSTALLINE ROCK Granite
	615.1	22.0	60/0.0											615.1	22.0	Boring Terminated by Roller Cone Refusal at Elevation 615.1 ft in Crystalline Rock

WBS 38502.1.1		TIP B-4729		COUNTY CHATHAM		GEOLOGIST C.T. TANG										
SITE DESCRIPTION Bridge No. 306 on SR 1303 (Ben Smith Rd.) over North Prong Rocky River							GROUND WTR (ft)									
BORING NO. EB1-B		STATION 13+02		OFFSET 13 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 637.6 ft		TOTAL DEPTH 12.6 ft		NORTHING 756,455		EASTING 1,843,303										
DRILL RIG/HAMMER EFF./DATE BRI2974 CME-45C 84% 05/04/2016			DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER M. RADFORD		START DATE 03/16/17		COMP. DATE 03/16/17		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
640																
	637.6	0.0	5	5	5									637.6	0.0	GROUND SURFACE
	634.3	3.3	2	2	4									634.3	3.3	ROADWAY EMBANKMENT Brown, Silty Sand, with Some Gravel
	629.3	8.3	1	1	3									629.3	8.3	ROADWAY EMBANKMENT Brown, Clayey Silt, with Trace Gravel
	625.1	12.5	60/0.1											625.1	12.5	CRYSTALLINE ROCK Granite
														625.0	12.6	Boring Terminated with Standard Penetration Test Refusal at Elevation 625.0 ft in Crystalline Rock

NCDOT BORE DOUBLE B4729_GEO_BRDG0306_BH.GPJ NC_DOT.GDT 04/10/17

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 38502.1.1		TIP B-4729		COUNTY CHATHAM		GEOLOGIST C.T. TANG										
SITE DESCRIPTION Bridge No. 306 on SR 1303 (Ben Smith Rd.) over North Prong Rocky River							GROUND WTR (ft)									
BORING NO. EB2-A		STATION 14+12		OFFSET 14 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 637.5 ft		TOTAL DEPTH 23.5 ft		NORTHING 756,567		EASTING 1,843,287										
DRILL RIG/HAMMER EFF./DATE BRI2974 CME-45C 84% 05/04/2016			DRILL METHOD H.S. Augers + Mud Rotary		HAMMER TYPE Automatic											
DRILLER M. RADFORD		START DATE 03/16/17		COMP. DATE 03/16/17		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
640																
	637.5	0.0	1	4	4									637.5	GROUND SURFACE	0.0
															ROADWAY EMBANKMENT	
															Red and Yellow, Clayey Silt, with Trace Gravel	
635	634.3	3.2	2	2	2											
630	629.3	8.2	2	4	12											
	625.3	12.2														
	624.0	13.5														
	621.0	16.5														
	619.0	18.5														
615																

WBS 38502.1.1		TIP B-4729		COUNTY CHATHAM		GEOLOGIST C.T. TANG	
SITE DESCRIPTION Bridge No. 306 on SR 1303 (Ben Smith Rd.) over North Prong Rocky River							GROUND WTR (ft)
BORING NO. EB2-A		STATION 14+12		OFFSET 14 ft LT		ALIGNMENT -L-	
COLLAR ELEV. 637.5 ft		TOTAL DEPTH 23.5 ft		NORTHING 756,567		EASTING 1,843,287	
DRILL RIG/HAMMER EFF./DATE BRI2974 CME-45C 84% 05/04/2016			DRILL METHOD H.S. Augers + Mud Rotary		HAMMER TYPE Automatic		
DRILLER M. RADFORD		START DATE 03/16/17		COMP. DATE 03/16/17		SURFACE WATER DEPTH N/A	
CORE SIZE NQ		TOTAL RUN 5.0 ft					
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RQD (ft) %	SAMP. NO.
619	619.0	18.5	5.0		(4.5) 90%	(4.5) 90%	
615	614.0	23.5					

ELEV (ft)	LOG	DESCRIPTION AND REMARKS
619.0		Begin Coring @ 18.5 ft
619.0		CRYSTALLINE ROCK Pink and Gray, Very Slightly Weathered, Hard, Granite, with Moderately Close Fractures [GSI=70-75]
614.0		Boring Terminated at Elevation 614.0 ft In Crystalline Rock

NCDOT BORE DOUBLE B4729_GEO_BRDG0306_BH.GPJ NC_DOT.GDT 04/10/17

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 38502.1.1		TIP B-4729		COUNTY CHATHAM		GEOLOGIST C.T. TANG										
SITE DESCRIPTION Bridge No. 306 on SR 1303 (Ben Smith Rd.) over North Prong Rocky River							GROUND WTR (ft)									
BORING NO. EB2-B		STATION 14+13		OFFSET 11 ft RT		ALIGNMENT -L-	0 HR. Dry									
COLLAR ELEV. 637.8 ft		TOTAL DEPTH 12.5 ft		NORTHING 756,566		EASTING 1,843,312	24 HR. Dry									
DRILL RIG/HAMMER EFF./DATE BRI2974 CME-45C 84% 05/04/2016				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER M. RADFORD		START DATE 03/16/17		COMP. DATE 03/16/17		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100			ELEV. (ft)	DEPTH (ft)		
640																
	637.8	0.0	5	9	6	15						M		637.8	0.0	GROUND SURFACE
635	634.5	3.3	2	3	2							M		633.8	4.0	ROADWAY EMBANKMENT Black and Brown, Silty Sand, with Trace Grass Roots
												M				Red, Clayey Silt, with Trace Gravel
630	629.5	8.3	2	3	6							M				
	625.3	12.5												625.6	12.2	CRYSTALLINE ROCK Granite
														625.3	12.5	Boring Terminated with Standard Penetration Test Refusal at Elevation 625.3 ft in Crystalline Rock

NCDOT BORE DOUBLE B4729_GEO_BRDG0306_BH.GPJ NC_DOT.GDT 04/10/17



**UNCONFINED COMPRESSIVE STRENGTH
OF INTACT ROCK CORE SPECIMEN**
ASTM D7012

WBS No.: 38502.1.1
 TIP No.: B-4729
 County: Chatham

Test Date: 3/31/2017
 Tested By: J. Evans

Description: Bridge No. 306 on SR 1303 over North Prong of Rocky River

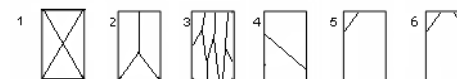
Test No.	1	2		
Boring ID	EB2-A	EB2-A		
Station	14+12	14+12		
Sample ID	RS-1	RS-2		
Sample Depth, ft	21.2	21.5		
Core Length #1, in.	4.180	3.920		
Core Length #2, in.	4.080	3.950		
Avg. Core Length, in.	4.130	3.935		
Core Dia. #1, in.	1.988	1.988		
Core Dia. #2, in.	1.988	1.988		
Avg. Core Dia., in.	1.988	1.988		
Length/Dia. Ratio	2.10	1.97		
X-Sectional Area, in ²	3.10	3.10		
Weight, g	not tested	545.9		
Unit Weight, pcf	not tested	169.9		
Break Type	2	1		
Load at Failure, lb	42,450	29,800		
Correction Factor	1.00	1.00		
Comp. Strength, psi	13,676	9,601		
Comp. Strength, ksf	1,969	1,382		

Rock Descriptions:

Test 1 & 2: Pink and gray, very slightly weathered, hard, granite with moderately close fractures

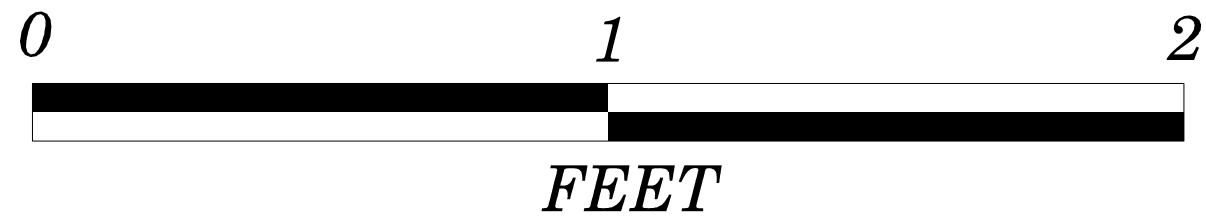
Test 2: Diagonal fracture face appeared to show very slight sign of weathering.

Break Types:



CORE PHOTOGRAPH

BORING EB2-A
STA. 14+12 -L-, 14 FT LT
DEPTH: 18.5 FT TO 23.5 FT



SITE PHOTOGRAPH



PHOTOGRAPH NO. 1: VIEW LOOKING SOUTH FROM END BENT NO. 2.