

MEMORANDUM

S-119-2022

cc:

J. VanZee
C. VanZee
D. Alexander
C. Allen
G. Couch
S. Hale
P. Weddington
B. Campbell
K. Sandefur

TO: Michael Carpenter, P.E.
Director, Division of Structural Design

FROM: Adam Ross, P.E.
TEBM, Geotechnical Services Branch

BY: Robert McDonald, P.E.
Geotechnical Services Branch,
Structure Foundation Section



DATE: June 19th, 2023

SUBJECT: Letcher County
1100 FE02 067 0550 004-005
Bridge #: 067B00023N
KY-805
Bridge Replacement
over Potter Fork
Item #: 12-0000.00
Geotechnical Engineering Structure Foundation Report

1.0 LOCATION AND DESCRIPTION

The geotechnical investigation for this structure has been completed. The DGN file for the subsurface data sheet has been made available on ProjectWise and through email for use in development of structure plans. The drilling for the project was performed by one of the KYTC, Geotechnical Branch, Central Office Drill Crews.

This structure is part of a maintenance bridge replacement project. The existing 44 ft long single-span bridge will be replaced by a new single-span configuration. It is located on KY-805 over Potter Fork, at mile point 4.2. Located approximately 0.8 mile Southeast of Fleming-Neon, KY. (**Lat: 37.186245, Long: -82.696979**)

2.0 SITE GEOLOGIC CONDITIONS

This structure is located in the Jenkins West Geologic Quadrangle (GQ# 1126). The geologic mapping indicates that the bedrock at this site consists primarily of the Pikeville formation of the Breathitt Group.

3.0 FIELD INVESTIGATION

Two (2) borings were taken for this structure. The two (2) borings taken were sample and core holes. The drill crew delivered rock cores and soil samples to the KYTC Geotechnical Branch in Frankfort, where a geologist logged the rock cores and the soils were classified and tested in the Branch's soils laboratory.

During the site's geotechnical investigation, electric lines were present on the North and West sides of the bridge, telephone lines were present on the North and East sides of the Bridge. Fiber optic lines were present parallel to the south side of the existing bridge. (**See attached Driller's Logbook Plan Sketch and Site Photos.**)

4.0 LABORATORY TESTING

The laboratory soil testing was completed by the Geotechnical Branch. The soil samples obtained from the borings were determined to consist of inorganic silty-sands. The soil samples were designated as SM using the Unified Soil Classification System.

5.0 SUBSURFACE CONDITIONS

Depths to refusal were 25.7 ft. The rock cores obtained for this location revealed dark-gray, clayey-silty, non-durable shales. Which were underlain by gray to dark-gray, fine to coarse grained, durable sandstone. KY RQD values for the rock cores taken at this proposed bridge location ranged from 0% to 48% and core recoveries ranged from 12% to 100%. **Utilizing an assumed datum with an elevation of 500 ft at the existing bridge deck**, the variations in top of rock/auger refusal elevations at the substructure units are provided below.

<u>Substructure Unit</u>	<u>Refusal Elev.</u>
• End Bent 1.....	474.5 ft. (Hole #1 location)
• End Bent 2.....	474.0 ft. (Hole #2 location)

6.0 ENGINEERING ANALYSIS

6.1 End Bent 1 & End Bent 2

Use end bearing **H-Pile foundations** seated in bedrock with spill through slopes for End Bents 1 & 2. Slope protection will be required as a scour abatement measure on the 2H: 1V spill-thru slopes at the end bents with the use of piles. Local scour can be negated with the use of slope protection.

A wave equation analysis was performed for this location. Based on this analysis it will be possible to drive 12” or 14” H-piles to bedrock and practical refusal without encountering excessive blow counts or damaging the pile. The contractor shall submit the proposed pile driving system to the Department for approval prior to the installation of the first pile. Approval of the pile driving system by the Engineer will be subject to satisfactory field performance of the pile driving procedures. A hammer with a rated energy between 25 and 35 kip-ft will be required to drive the H-piles to practical refusal without encountering excessive blow counts or damaging the piles.

6.2 Scour Considerations

No scour analysis was performed. For H-Pile foundations subsequently driven to bedrock with spill through slopes (2H:1V spill-through slopes), slope protection will be required at the bridge meeting the requirements of Sections 703 & 805 of the Standard Specifications for Road and Bridge Construction, current edition. Place a Class I (Slope Protection) Geotextile Fabric, in accordance with Sections 214 & 843 of the Standard Specifications for Road and Bridge Construction, current edition, between the embankment and the slope protection. The effects of local scour on the end bents can be negated through the use of the aforementioned cyclopean protection.

Contraction scour was not evaluated for this bridge. A proposed bridge profile and scour calculations have not been provided to this office. It can be performed as described in the KYTC Geotechnical Manual, Section GT-606-1. Assuming the contraction scour depth extended to bedrock. To do this, construct a vertical line from the toe of the spill-thru slope where the stone slope protection terminates, down to the contraction scour depth, for the respective end bent.

Then construct a 1:1 (45°) line back towards the end bent until it intercepts the pile line. The piles can then either be designed to withstand the potential unsupported length, the pile cap can be set down to that depth to avoid any unsupported length, or a combination of these measures can be employed.

6.3 Embankment Analysis

Embankment stability is not considered to be a concern at this location. The current in-place embankment slopes appear to be stable. Embankment is to be constructed at slopes the same as those currently in existence or a 2H: 1V, whichever is flatter. If any additional/new embankment is to be constructed at slopes steeper than those currently in existence or a 2H: 1V, please contact the geotechnical branch for further analysis.

In view of the minimal new embankment heights at the end bents, settlement is not believed to be a concern at this location.

The designer should feel free to contact the Geotechnical Branch at 502-564-2374 for further recommendations or if any questions arise pertaining to this project.

7.0 FOUNDATION RECOMMENDATIONS:

7.1 End Bent 1 & End Bent 2 with Extended Wingwalls/Pile Caps:

- 7.1.1 **End Bent 1 with Extended Wingwall/Pile Cap:** Use pre-drilled end-bearing steel H-Piles driven to bedrock with approximate pile tip elevations of 474.5 ft. We recommend a resistance factor (f_c) of 0.5 to determine the maximum nominal resistance of the pile.
- 7.1.2 **End Bent 2 with Extended Wingwall/Pile Cap:** Use pre-drilled end-bearing steel H-Piles driven to bedrock with approximate pile tip elevations of 474 ft. We recommend a resistance factor (f_c) of 0.5 to determine the maximum nominal resistance of the pile.
- 7.1.3 Values for the parameters needed for lateral load analysis can be found on the attached Idealized Soil and Bedrock Profile/ Parameters for Lateral Load Analysis Sheet.
- 7.1.4 For determining practical refusal for point-bearing steel H-Piles, we recommend using Case 2.

7.2 Plan Notes

(Include the notes below at appropriate locations in the plans.)

- 7.2.1 **PRACTICAL REFUSAL:** Drive point bearing piles to practical refusal. For this project minimum blow requirements are reached after total penetration becomes ½ inch or less for 10 consecutive blows, practical refusal is obtained after the pile is struck an additional 10 blows with total penetration of ½ inch or less. Advance the production piling to the driving resistances specified above and to depths determined by test pile(s) and subsurface data sheet(s). Immediately cease driving operations if the pile visibly yields or becomes damaged during driving. If hard driving is encountered because of dense strata or an obstruction, such as a boulder before the pile is advanced to the depth anticipated, the Engineer will determine if more blows than the average driving resistance specified for practical refusal is required to further advance the pile. Drive additional production and test piles if directed by the Engineer.
- 7.2.2 **HAMMER CRITERIA:** A hammer with a rated energy of between 25 and 35 kip-ft will be required to drive the H-piles to practical refusal without encountering excessive blow

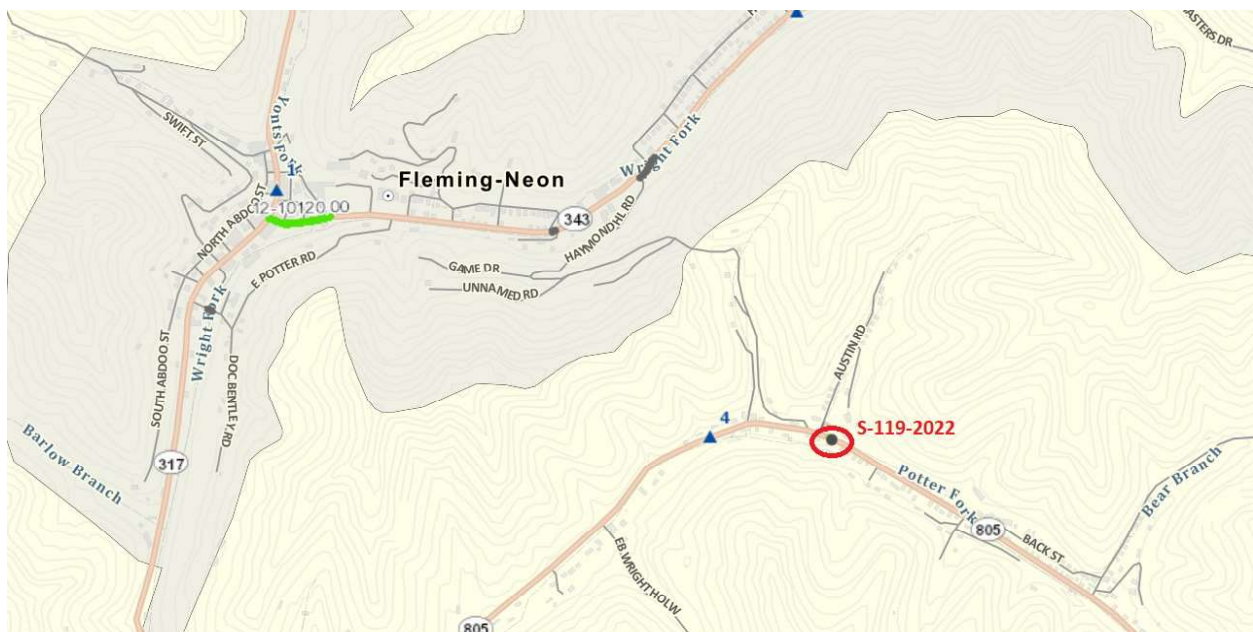
counts or damaging the pile. The contractor shall submit the proposed pile driving system to the Department for approval prior to the installation of the first pile. Approval of the pile driving system by the Engineer will be subject to satisfactory field performance of the pile driving procedures.

- 7.2.3 Slope protection will be required at the bridge meeting the requirements of Sections 703 & 805 of the Standard Specifications for Road and Bridge Construction, current edition. Place a Class I Geotextile Fabric, in accordance with Sections 214 & 843 of the Standard Specifications for Road and Bridge Construction, current edition, between the embankment and the slope protection.
- 7.2.4 Cofferdams and/or dewatering methods will be required to facilitate foundation construction of spread footings and/or pile caps.
- 7.2.5 Construct the embankments in accordance with Special Provision 69.
- 7.2.6 Temporary sheeting and/or shoring may be required for installation of pile caps.

Attachments:

- **Project Location Map**
- **Subsurface Data Sheet**
- **Parameters for Lateral Load Analysis**
- **Drillers Logbook Plan Sketch**
- **Photos at Existing Bridge Location**

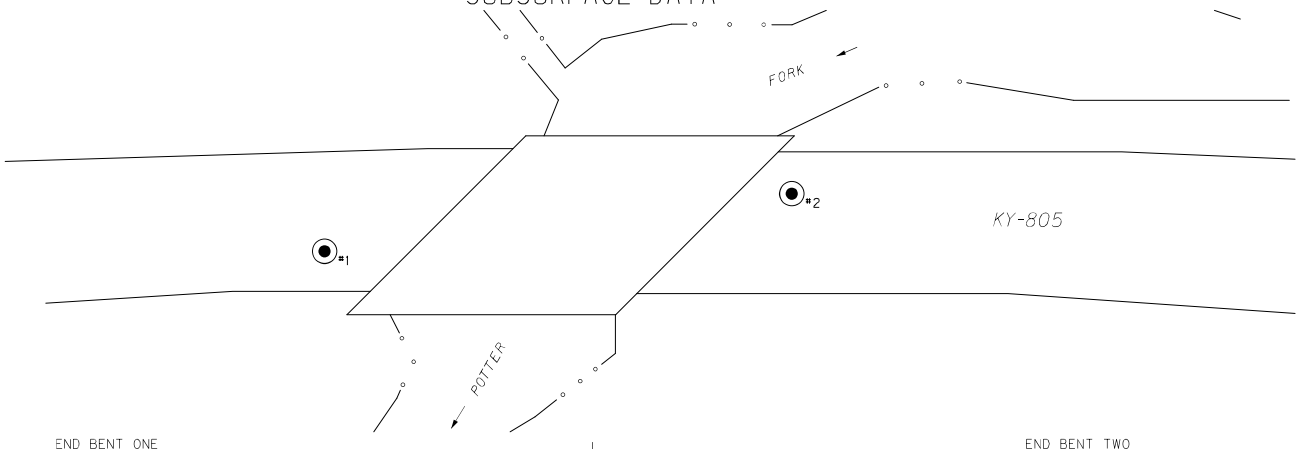
Project Location Map:



(Maintenance bridge replacement. The proposed structure is located on KY-805 over Potter Fork, at mile point 4.2. Located approximately 0.8 mile Southeast of Fleming-Neon, KY.)

SUBSURFACE DATA

Plan Scale 1" = 10'



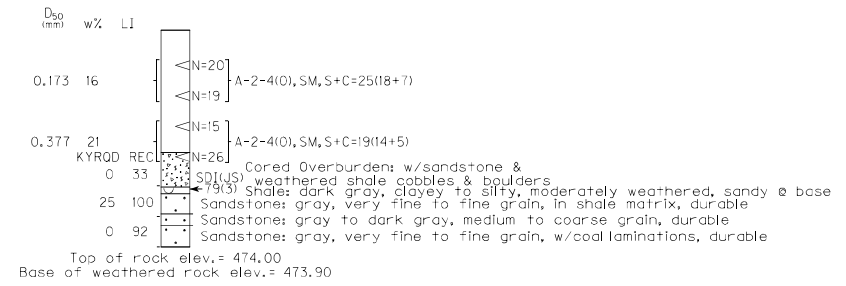
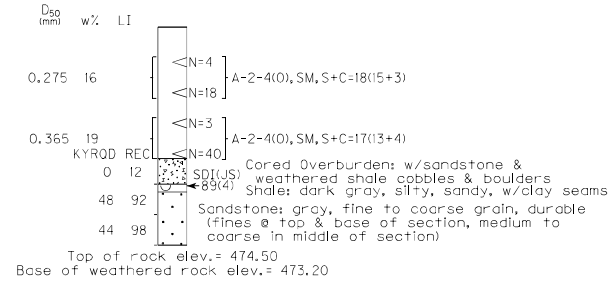
Profile Scale:
Vertical 1" = 10'
Horizontal not to scale

APPROXIMATE ROADWAY GRADE ELEV. = 500.00

Hole No.
Station
Offset
Elev.
(Assumed datum)

1
0+00.00
9.00 ft. Rt.
500.20

2
0+86.00
9.00 ft. Lt.
499.70



	REVISION	DATE	PREPARED BY	DATE: 15-JUNE-2023	CHECKED BY	ROUTE KY 805	ITEM NO.	COUNTY OF
			Division of Structural Design Geotechnical Branch	DESIGNED BY:			CROSSING	12-0000
				DETAILED BY: E. BAILEY	R. McDONALD	Bridge over Potter Fork	SHEET NO.	DRAWING NUMBER
								S-119-2023

IDEALIZED SOIL AND BEDROCK PROFILE

Letcher Co., Item #: 12-0000.00, S-119-2022, 067B00023N
 KY-805 Bridge over Potter Fork
 End Bent 1 & 2

RDM 6/19/2023

Approximate
 Elev. (ft)**

500	<table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Overburden</td> <td style="width: 33%; text-align: center;">Sand without Free Water (Reese)</td> <td style="width: 34%;"></td> </tr> <tr> <td style="vertical-align: top; padding-top: 10px;"> Y_t (lb/ft³) = 120 Y_e (lb/ft³) = 120 </td> <td style="vertical-align: top; padding-top: 10px;"> Effective Unit Weight, Friction Angle, Soil Modulus Parameter, </td> <td style="vertical-align: top; padding-top: 10px;"> Y_e (lb/in³) = 0.069 ϕ(deg) = 32° K (lb/in³) = 25 </td> </tr> </table>	Overburden	Sand without Free Water (Reese)		Y_t (lb/ft ³) = 120 Y_e (lb/ft ³) = 120	Effective Unit Weight, Friction Angle, Soil Modulus Parameter,	Y_e (lb/in ³) = 0.069 ϕ (deg) = 32° K (lb/in ³) = 25
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	Water Table Depth = 6 ft						
495	<table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Overburden</td> <td style="width: 33%; text-align: center;">Sand with Free Water (Reese)</td> <td style="width: 34%;"></td> </tr> <tr> <td style="vertical-align: top; padding-top: 10px;"> Y_t (lb/ft³) = 120 Y_e (lb/ft³) = 57.6 </td> <td style="vertical-align: top; padding-top: 10px;"> Effective Unit Weight, Friction Angle, Soil Modulus Parameter, </td> <td style="vertical-align: top; padding-top: 10px;"> Y_e (lb/in³) = 0.033 ϕ(deg) = 32° K (lb/in³) = 20 </td> </tr> </table>	Overburden	Sand with Free Water (Reese)		Y_t (lb/ft ³) = 120 Y_e (lb/ft ³) = 57.6	Effective Unit Weight, Friction Angle, Soil Modulus Parameter,	Y_e (lb/in ³) = 0.033 ϕ (deg) = 32° K (lb/in ³) = 20
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	H-Pile Tip						

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Bands

1	4.5	th	ker	Fog ₃
Type	SPT			
	3	SPT		
	2	SPT		

Type
Flintless stone
Sandstone

Grid: -4-4-4-4-4-4-
Floor: =1=1=1=1=

UG 7500023N

Letcher Co.

