**M E M O R A N D U M**

**TO:** Mark Hite, P.E., L.S.
Director
Division of Structural Design

**BY:** Bart Asher, P.E., L.S.
TEBM, Geotechnical Branch

**DATE:** June 19, 2015

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**SUBJECT:** **Bullitt County**
**FD52 015 1417 002-003 D**
**BRZ 0503 (234)**
**MARS No. 9038301D**
**Item No. 5-1081.00**
**KY 1417 (Martin Hill Rd)**
**Replace Bridge over Knob Creek**
**Geotechnical Engineering Structure Foundation Report**

## 1.0 LOCATION AND DESCRIPTION

The geotechnical investigation for this structure has been completed. The .DGN files for the structure Subsurface Data Sheets have been made available on ProjectWise and through email for use in development of the structure plans. The project involves the replacement of the bridge over Knob Creek on KY 1417, which has failed due to a flood event. The bridge is approximately 1000 feet south-east of the intersection of KY 1526 (Knob Creek Road) and KY 1417.

## 2.0 SITE GEOLOGIC CONDITIONS

This structure is located in the Valley Station Quadrangle (GQ-962). The geologic mapping indicates that the bedrock at this site consists primarily of the New Providence Shale Member of the Borden Formation. Alluvium and terrace deposits overlie the bedrock. There appears to be some artificial fill on the bridge approaches.

Bridge Failure with view of previous scour countermeasures

## 3.0 FIELD INVESTIGATION

The drilling for this project was performed by the KYTC Geotechnical Branch. Five borings were drilled for this structure. Three of the borings were sample and core holes and two were mechanical rockline soundings. The drill crew delivered soil and rock core samples to the KYTC Geotechnical Branch in Frankfort, where a geologist logged the rock cores and the laboratory tested the soils.

From reviewing available mapping, Knob Creek has a history of meandering substantially. It would appear that this meandering, coupled with the scour of the material supporting the abutments and scour of the embankment were the cause of the bridge failure. Apparently, the existing abutments were reused on the superstructure replacement in the 1970's. Retrofitting of the old abutments was evident in the field. The foundation type is unknown, but was likely spread footings on soil. It would appear that numerous scour countermeasure attempts have been employed at this location in the past.

## 4.0 SUBSURFACE CONDITIONS

Laboratory testing was completed by the KYTC Geotechnical Branch. Subsurface conditions were fairly uniform across the project site. The depths to bedrock ranged from 25.4 to 25.8 feet at the end bents with refusal elevations varying from 474.1 to 475.7 feet. The depth to bedrock at the proposed pier location was 15.4 feet with a top of rock elevation of 471.8 feet.

Bedrock consisted of gray clayey and silty shale. The Division of Materials obtained unconfined compressive strengths on a number of bedrock samples which had been selected and wrapped appropriately by a geologist in the field to avoid degradation prior to testing. Unconfined compression testing ranged from 164 to 6870 psi for the bedrock samples. The upper layers of bedrock are considered to be potentially scourable.

The overburden materials were typically silts, sands and gravels. The soil samples were designated as GM, SM and ML in the Unified Soil Classification System, and as A-1, A-2, A-4 and A-6 using the AASHTO Method. Visually the material in the creek is very coarse and consists primarily of rounded creek gravels. Grab samples were taken in the creek for use in the scour analysis at the pier. Those results are located in the appendix.

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## 5.0 ENGINEERING ANALYSIS AND FOUNDATION RECOMENDATIONS

Due to the meandering nature of the creek and the highly scourable nature of the materials in the area, drilled shafts will be the preferred alternate for all foundation locations. It is recommended that the end bent shafts be designed in such a way that additional spans can be added if further meandering of the stream occurs.

**5.1** **End Bent 1** –Use drilled shafts constructed in accordance with the Special Note for Drilled Shafts, current edition. The shaft tips shall extend approximately a minimum of 2 ½ shaft diameters below the bottom of permanent casing. Drilled shafts were evaluated for axial loading, and the attached tables provide the resulting capacities and resistances for Load & Resistance Factor Design (LFRD) methods. The following table contains relevant elevations needed to both complete the design and determine plan quantities for the drilled shafts.

**End Bent 1 Estimated Drilled Shaft Elevations**

| | Elevations (ft) | | | |
|---|---|---|---|---|
| EB No. | Estimated Top of Rock | Estimated Base of Weathered Rock | Estimated Bottom of Permanent Casing/Top of Rock Socket | Highest Allowable Shaft Tip[1] |
| 1 | 475.7 | 473.5 | 473.0 | 464.0 |

Notes:
[1] The highest tip elevation shown is based on a 3.5 foot diameter shaft. Deeper shaft tips may be required. The shaft tip shall extend a minimum of 2.5 shaft diameters below the bottom of permanent casing.

**5.2** **Pier 1** - Use drilled shafts constructed in accordance with the Special Note for Drilled Shafts, current edition. The shaft tips shall extend approximately a minimum of 2 ½ shaft diameters below the bottom of permanent casing. Drilled shafts were evaluated for axial loading, and the attached tables provide the resulting capacities and resistances for Load & Resistance Factor Design (LFRD) methods. The following table contains relevant elevations needed to both complete the design and determine plan quantities for the drilled shafts.

**Pier 1 Estimated Drilled Shaft Elevations**

| Pier No. | Elevations (ft) | | | |
|---|---|---|---|---|
| | Estimated Top of Rock | Estimated Base of Weathered Rock | Estimated Bottom of Permanent Casing/Top of Rock Socket | Highest Allowable Shaft Tip[1] |
| 1 | 471.8 | 471.0 | 470.5 | 461 |

Notes:
[1] The highest tip elevation shown is based on a 3.5 foot diameter shaft. Deeper shaft tips may be required. The shaft tip shall extend a minimum of 2.5 shaft diameters below the bottom of permanent casing.

**5.3** **Bent 2** – Use drilled shafts constructed in accordance with the Special Note for Drilled Shafts, current edition. The shaft tips shall extend approximately a minimum of 2 ½ shaft diameters below the bottom of permanent casing. Drilled shafts were evaluated for axial loading, and the attached tables provide the resulting capacities and resistances for Load & Resistance Factor Design (LFRD) methods. The following table contains relevant elevations needed to both complete the design and determine plan quantities for the drilled shafts.

| End Bent 2 Estimated Drilled Shaft Elevations | | | | |
|---|---|---|---|---|
| | Elevations (ft) | | | |
| EB No. | Estimated Top of Rock | Estimated Base of Weathered Rock | Estimated Bottom of Permanent Casing/Top of Rock Socket | Highest Allowable Shaft Tip[1] |
| 2 | 475.0 | 474.0 | 473.5 | 464.0 |
| Notes:<br>[1] The highest tip elevation shown is based on a 3.5 foot diameter shaft. Deeper shaft tips may be required. The shaft tip shall extend a minimum of 2.5 shaft diameters below the bottom of permanent casing. | | | | |

**5.4** **Scour Analysis** – Results of a scour analyses for the pier was provided to this office. It is estimated that there will be approximately 5 ft of scour at the pier location. If the foundations are designed and constructed in accordance with recommendations in this report, scour should not be an issue at the pier.

Slope protection will be required at the bridge spill through slopes meeting the requirements of Section 703 and 805 of the Standard Specifications for Road and Bridge Construction. The slope protection shall extend to 1 foot above 100-year high water elevation. Place a Type I Geotextile Fabric, in accordance with Sections 214 and 843 of the Standard Specifications for Road and Bridge Construction, between the embankment and the slope protection.

**5.5** **Embankment -** Little to no additional fill, in addition to what has been present in the past, is anticipated. Settlement at the end bents is not of geotechnical concern. Any new embankment shall be built of durable rock. Foundation Embankment Benches shall be constructed in accordance with Standard Drawing RGX-010 at the locations listed below and/or as directed by the engineer. Soil cuts and fills must be 2H:1V or flatter.

### 5.6 Drilled Shaft Recommendations

**5.6.1** Permanent casing is required through the overburden. It should be noted in the plans that the permanent casing is incidental to the unit bid price for Drilled Shaft, Common or Drilled Shaft-Solid Rock.

**5.6.2** Use permanent casing that is 6 inches larger in diameter than the proposed rock socket shaft diameter to the top of rock socket/bottom of permanent casing elevations noted above.

**5.6.3** Require a 4 inch minimum rebar cover in the uncased rock sockets.

**5.6.4** For Load & Resistance Factor Design (LRFD), evaluate the total factored axial resistances using the attached Drilled Shaft Axial Capacity Tables considering the capacity developed in the uncased rock sockets. The factored nominal and axial resistances must exceed the factored loads at the strength limit state. The shaft tips shall extend a minimum of 2 ½ shaft diameters below the bottom of permanent casing. Longer uncased sockets may be required to satisfy axial or lateral load design criteria.

**5.6.5** Design the shafts neglecting any lateral resistance above the top of the uncased rock socket. Perform lateral load analysis using the geotechnical parameters provided in the attached Idealized Soil and Bedrock Profile. These parameters may be used to perform analyses using LPILE Plus or other similar software. Some of the parameters may not be required to input, depending on the version of software utilized.

**5.6.6** The bedrock at this location weathers when exposed to air and water. The shaft steel and concrete must be placed within 24 hours after excavation of the shaft. The contractor may be required to take the shaft deeper, at no expense to KYTC, if the bedrock excavation is left open in excess of 24 hours.

## 6.0 ROADWAY RECOMMENDATIONS

### 6.1 Design Recommendations

**6.1.1** The project should be designed for a 2 foot subgrade using a CBR design value of 2.0.

**6.1.2** An average soil shrinkage value of two (2) percent is estimated for this project. This value should be applied to the formula for calculating the Apparent Shrinkage as outlined in the Design Manual.

## 7.0 STRUCTURE PLAN NOTES

Add the following plan notes, as necessary depending on the foundation types chosen, at the appropriate locations in the plans.

**7.1** Temporary shoring, sheeting, cofferdams, and/or dewatering methods may be required to facilitate foundation construction.

**7.2** Slope protection will be required on the bridge spill through slopes up to 1 foot above 100-year high water elevation. The slope protection shall meet the requirements of Section 703 and 805 of the Standard Specifications for Road and Bridge Construction, current edition. Place a Type I Geotextile Fabric, in accordance with Sections 214 and 843 of the Standard Specifications for Road and Bridge Construction, current edition, between the embankment and slope protection.

**7.3** Construct Drilled Shafts in accordance with the plans and the Special Note for Drilled Shafts.

**7.4** Permanent casing is incidental to the unit bid price for "Drilled Shaft - __-inch (Common)" or "Drilled Shaft - __-inch (Solid Rock)" as applicable.

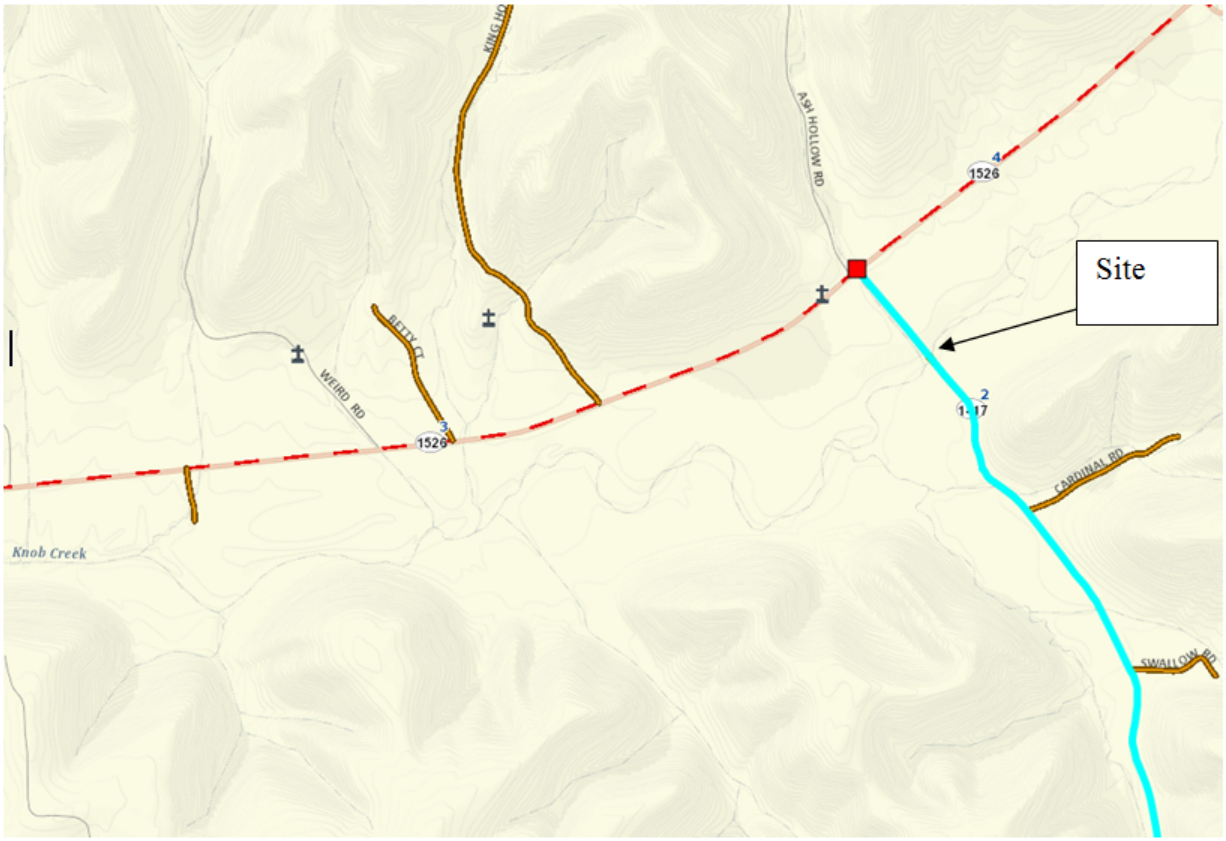
**7.5** The bedrock at this location weathers when exposed to air and water. The shaft steel and concrete must be placed within 24 hours after excavation of the shaft. The contractor may be required to take the shaft deeper, at no expense to KYTC, if the bedrock excavation is left open in excess of 24 hours

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.

**Attachments:**

- **Project Location Map**
- **Subsurface Data Sheet**
- **Idealized Soil and Bedrock Profile**
- **Drilled Shaft Axial Capacity Tables**
- **Pier Grab Sample Testing for Scour Analysis**
- **Bridge Layout Sheet**
- **Coordinate Data Sheet**

# Project Location Map



SHEET LOCATION:

FILE NAME: $$$$design$file$specification$$$$

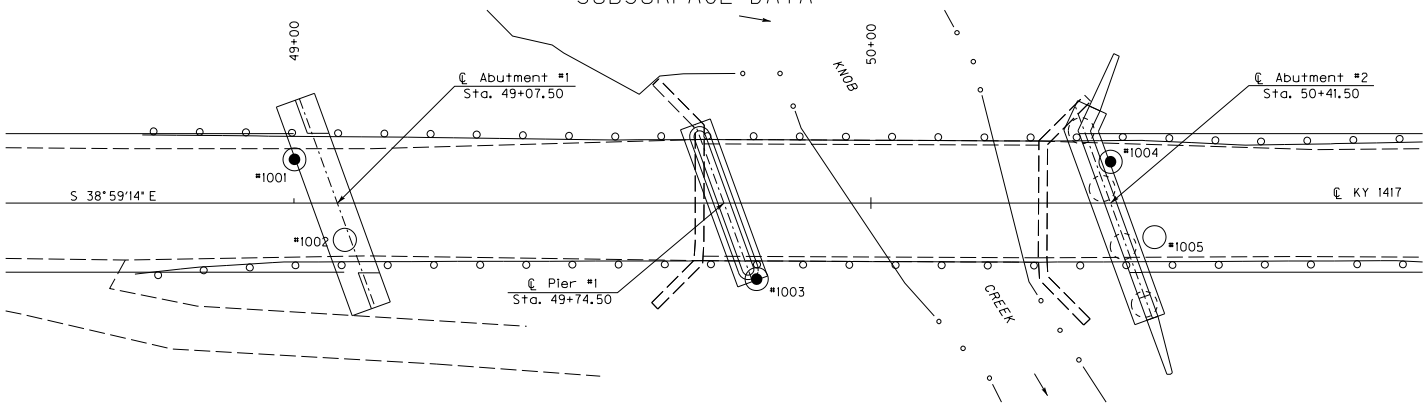
USERNAME: $$$$USER$$$$

DATE: $$$$DATE$$$$

E-SHEET NAME:

# SUBSURFACE DATA

Plan Scale 1" = 10'

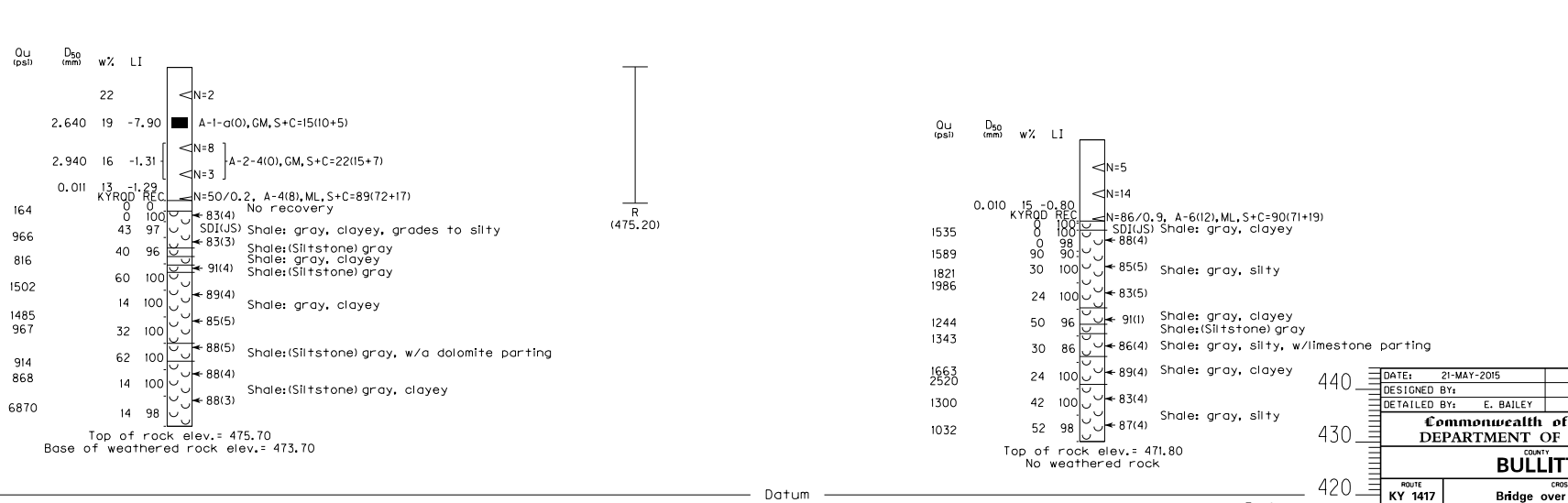



Profile Scale:
Vertical 1" = 10'
Horizontal not to scale

ABUTMENT ONE — PIER ONE

APPROXIMATE ROADWAY GRADE ELEV. = 500.97

| Hole No. | 1001 | 1002 | 1003 |
|---|---|---|---|
| Station | 49+00.07 | 49+08.79 | 49+80.17 |
| Offset | 7.60 ft. Lt. | 6.40 ft. Rt. | 13.20 ft. Rt. |
| Elev. (NAVD 88 datum) | 500.90 | 501.00 | 487.20 |




| | |
|---|---|
| DATE: 21-MAY-2015 | CHECKED BY |
| DESIGNED BY: | |
| DETAILED BY: E. BAILEY | B. ASHER |

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: BULLITT

ROUTE: KY 1417 — CROSSING: Bridge over Knob Creek

**SUBSURFACE DATA**

PREPARED BY: Division of Structural Design
GEOTECHNICAL BRANCH

SHEET NO.

DRAWING NO. 00000

S-055-15

ITEM NUMBER
5-1081.00

SHEET LOCATION:

FILE NAME: $$$$design$file$specification$$$$

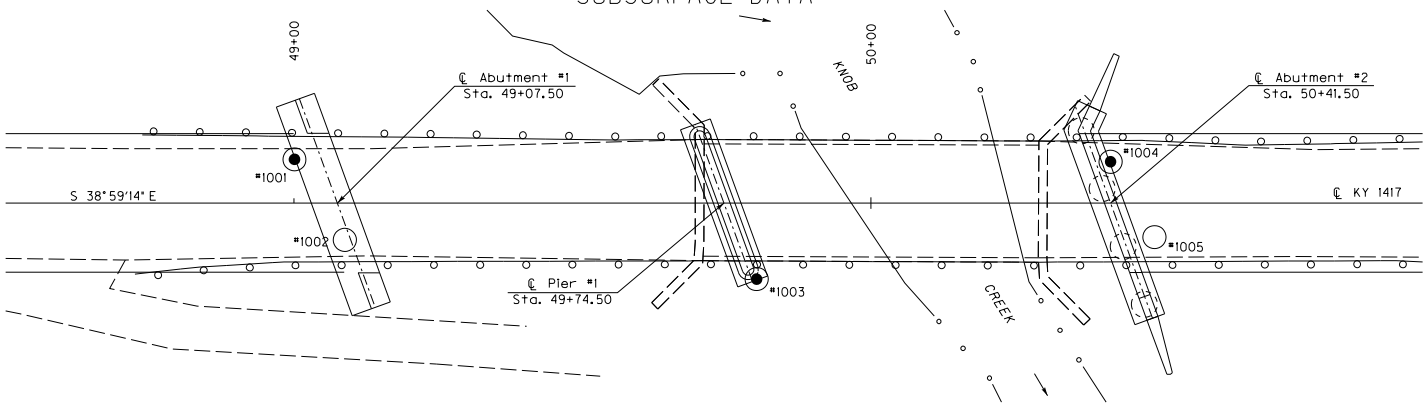
USERNAME: $$$$USER$$$$

DATE: $$$$DATE$$$$

E-SHEET NAME:

# SUBSURFACE DATA

Plan Scale 1" = 10'

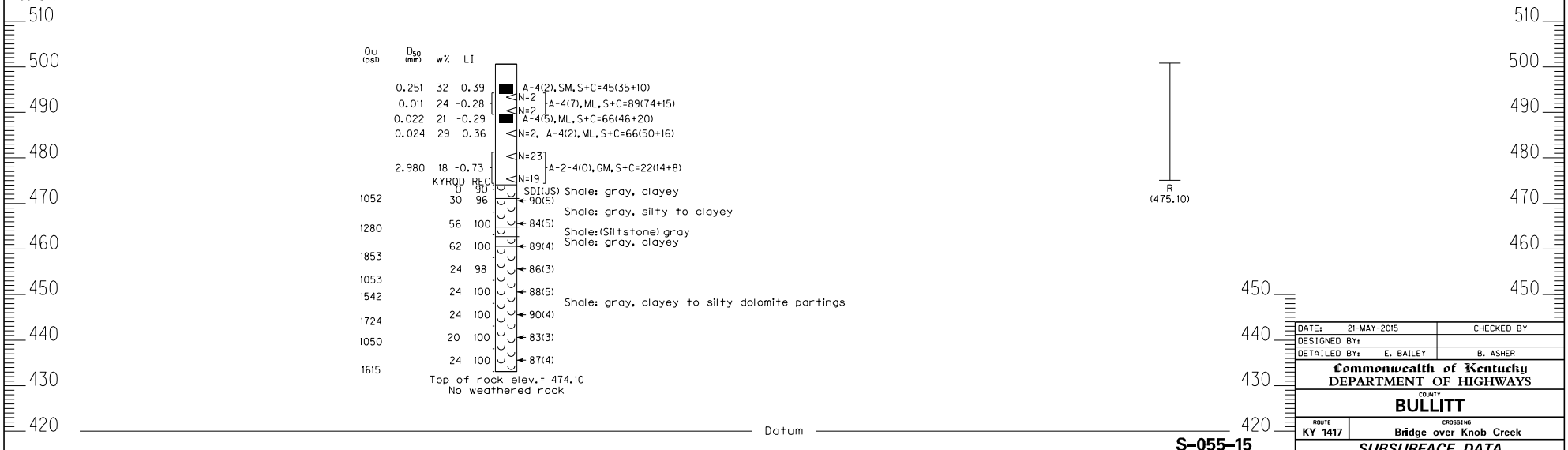



Profile Scale:
Vertical 1" = 10'
Horizontal not to scale

ABUTMENT TWO

APPROXIMATE ROADWAY GRADE ELEV. = 500.80

| Hole No. | 1004 | 1005 |
|---|---|---|
| Station | 50+41.51 | 50+49.12 |
| Offset | 7.20 ft. Lt. | 5.90 ft. Rt. |
| Elev. (NAVD 88 datum) | 500.60 | 500.80 |




| | |
|---|---|
| DATE: 21-MAY-2015 | CHECKED BY |
| DESIGNED BY: | |
| DETAILED BY: E. BAILEY | B. ASHER |

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: BULLITT

ROUTE: KY 1417 | CROSSING: Bridge over Knob Creek

**SUBSURFACE DATA**

S-055-15

ITEM NUMBER: 5-1081.00

PREPARED BY: Division of Structural Design
GEOTECHNICAL BRANCH

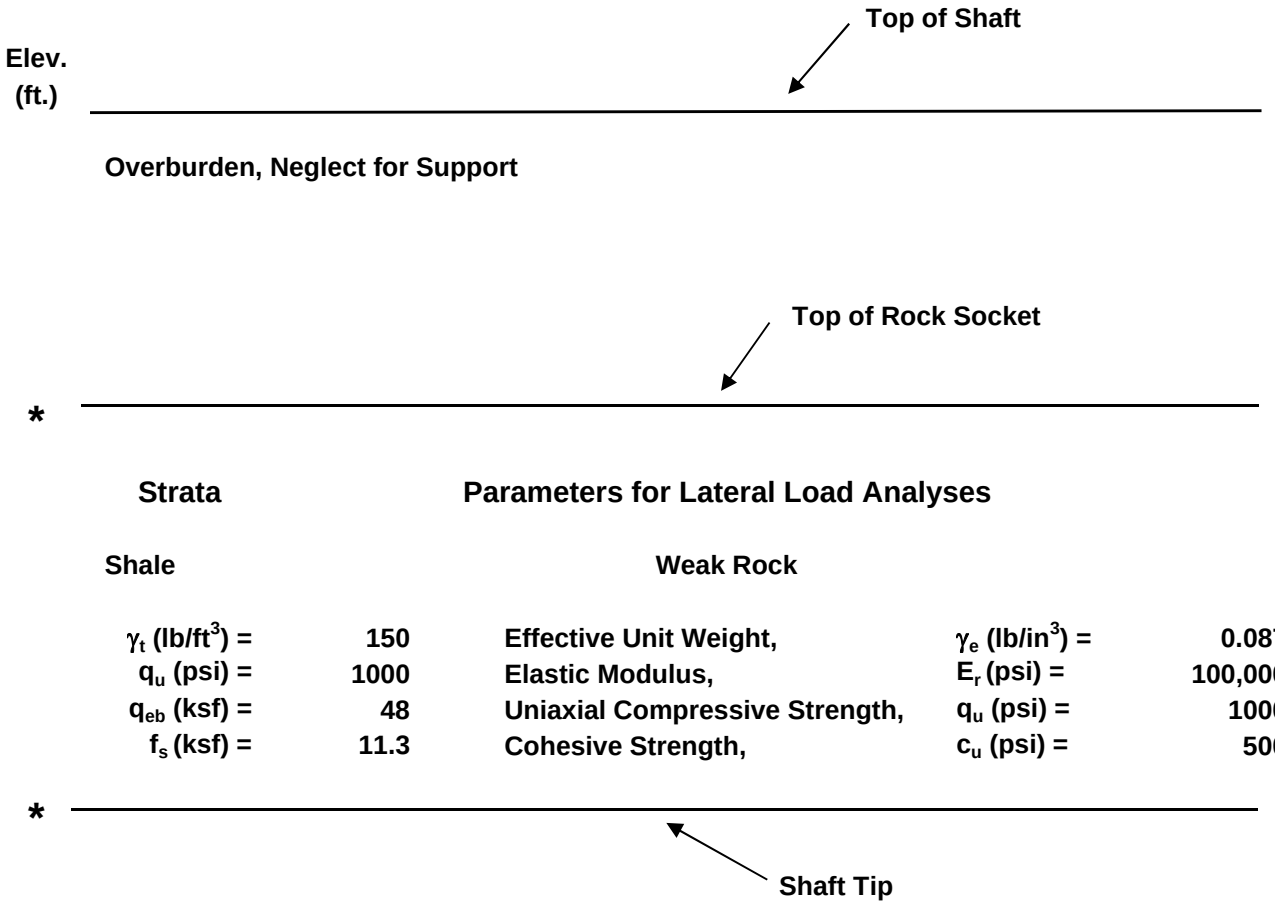
SHEET NO.

DRAWING NO. 00000

# IDEALIZED SOIL AND BEDROCK PROFILE

**Bullitt Co. KY 1417 over Knob Creek**
**End Bent 1 and 2 and Pier 1**

**BBA** **6/19/2015**




* **Elevations vary and are provided in the report body.**

| ADDITIONAL DATA FOR GEOTECHNICAL CALCULATIONS ONLY: | |
|---|---|
| min. $f'_c$ (psi) = | 3500 |
| $p_a$ (psi) = | 14.7 |

# Load and Resistance Factor Design (LRFD)

## DRILLED SHAFT AXIAL RESISTANCE TABLE

### Bullitt Co. KY 1417 over Knob Creek
**End Bent 1 and 2 and Pier 1**

**Rock Socket Diameter = 3.5 feet**
**Rock Socket Diameter = 42 inches** **42174**

| Rock Socket Length (ft.) | Nominal Unit Side Shear $q_{ss}$ (ksf) | Nominal Unit End Bearing $q_{eb}$ (ksf) | Nominal Side Resistance $R_{sr}$ (kips) | Nominal End Bearing Resistance $R_{eb}$ (kips) | Factored Side Resistance $\phi R_{sr}$ (kips) | Factored End Bearing Resistance $\phi R_{eb}$ (kips) | Total Factored Axial Resistance $\phi R_t$ (kips) | Total Factored Uplift Resistance $\phi R_{tu}$ (kips) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | |
| 1.0 | 11.3 | 48 | 124 | 462 | 62 | 231 | 293 | 50 |
| 2.0 | 11.3 | 48 | 248 | 462 | 124 | 231 | 355 | 99 |
| 3.0 | 11.3 | 48 | 373 | 462 | 186 | 231 | 417 | 149 |
| 4.0 | 11.3 | 48 | 497 | 462 | 248 | 231 | 479 | 199 |
| 5.0 | 11.3 | 48 | 621 | 462 | 311 | 231 | 542 | 248 |
| 6.0 | 11.3 | 48 | 745 | 462 | 373 | 231 | 604 | 298 |
| 7.0 | 11.3 | 48 | 870 | 462 | 435 | 231 | 666 | 348 |
| 8.0 | 11.3 | 48 | 994 | 462 | 497 | 231 | 728 | 398 |
| >>> 9.0 | 11.3 | 48 | 1118 | 462 | 559 | 231 | 790 | 447 |
| 10.0 | 11.3 | 48 | 1242 | 462 | 621 | 231 | 852 | 497 |
| 11.0 | 11.3 | 48 | 1367 | 462 | 683 | 231 | 914 | 547 |
| 12.0 | 11.3 | 48 | 1491 | 462 | 745 | 231 | 976 | 596 |
| 13.0 | 11.3 | 48 | 1615 | 462 | 808 | 231 | 1039 | 646 |
| 14.0 | 11.3 | 48 | 1739 | 462 | 870 | 231 | 1101 | 696 |
| 15.0 | 11.3 | 48 | 1864 | 462 | 932 | 231 | 1163 | 745 |
| 16.0 | 11.3 | 48 | 1988 | 462 | 994 | 231 | 1225 | 795 |
| 17.0 | 11.3 | 48 | 2112 | 462 | 1056 | 231 | 1287 | 845 |
| 18.0 | 11.3 | 48 | 2236 | 462 | 1118 | 231 | 1349 | 895 |
| 19.0 | 11.3 | 48 | 2361 | 462 | 1180 | 231 | 1411 | 944 |
| 20.0 | 11.3 | 48 | 2485 | 462 | 1242 | 231 | 1473 | 994 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| AASHTO Table 10.5.5.2.4-1 | | | Resistance Factor, $\phi$ | | 0.50 | 0.50 | | 0.40 |

>>> = Min. Socket Length

D (ft.) = 3.5

# Load and Resistance Factor Design (LRFD)

## DRILLED SHAFT AXIAL RESISTANCE TABLE

### Bullitt Co. KY 1417 over Knob Creek
**End Bent 1 and 2 and Pier 1**

**Rock Socket Diameter = 4.0 feet**
**Rock Socket Diameter = 48 inches** **42174**

| Rock Socket Length (ft.) | Nominal Unit Side Shear $q_{ss}$ (ksf) | Nominal Unit End Bearing $q_{eb}$ (ksf) | Nominal Side Resistance $R_{sr}$ (kips) | Nominal End Bearing Resistance $R_{eb}$ (kips) | Factored Side Resistance $\phi R_{sr}$ (kips) | Factored End Bearing Resistance $\phi R_{eb}$ (kips) | Total Factored Axial Resistance $\phi R_t$ (kips) | Total Factored Uplift Resistance $\phi R_{tu}$ (kips) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | |
| 1.0 | 11.3 | 48 | 143 | 603 | 71 | 302 | 373 | 57 |
| 2.0 | 11.3 | 48 | 285 | 603 | 143 | 302 | 444 | 114 |
| 3.0 | 11.3 | 48 | 428 | 603 | 214 | 302 | 516 | 171 |
| 4.0 | 11.3 | 48 | 570 | 603 | 285 | 302 | 587 | 228 |
| 5.0 | 11.3 | 48 | 713 | 603 | 357 | 302 | 658 | 285 |
| 6.0 | 11.3 | 48 | 856 | 603 | 428 | 302 | 729 | 342 |
| 7.0 | 11.3 | 48 | 998 | 603 | 499 | 302 | 801 | 399 |
| 8.0 | 11.3 | 48 | 1141 | 603 | 570 | 302 | 872 | 456 |
| 9.0 | 11.3 | 48 | 1283 | 603 | 642 | 302 | 943 | 513 |
| >>> 10.0 | 11.3 | 48 | 1426 | 603 | 713 | 302 | 1015 | 570 |
| 11.0 | 11.3 | 48 | 1569 | 603 | 784 | 302 | 1086 | 627 |
| 12.0 | 11.3 | 48 | 1711 | 603 | 856 | 302 | 1157 | 685 |
| 13.0 | 11.3 | 48 | 1854 | 603 | 927 | 302 | 1229 | 742 |
| 14.0 | 11.3 | 48 | 1997 | 603 | 998 | 302 | 1300 | 799 |
| 15.0 | 11.3 | 48 | 2139 | 603 | 1070 | 302 | 1371 | 856 |
| 16.0 | 11.3 | 48 | 2282 | 603 | 1141 | 302 | 1442 | 913 |
| 17.0 | 11.3 | 48 | 2424 | 603 | 1212 | 302 | 1514 | 970 |
| 18.0 | 11.3 | 48 | 2567 | 603 | 1283 | 302 | 1585 | 1027 |
| 19.0 | 11.3 | 48 | 2710 | 603 | 1355 | 302 | 1656 | 1084 |
| 20.0 | 11.3 | 48 | 2852 | 603 | 1426 | 302 | 1728 | 1141 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| AASHTO Table 10.5.5.2.4-1 | | | Resistance Factor, $\phi$ | | 0.50 | 0.50 | | 0.40 |

| | |
|---|---|
| >>> = Min. Socket Length | D (ft.) = 4.0 |

# Load and Resistance Factor Design (LRFD)

## DRILLED SHAFT AXIAL RESISTANCE TABLE

### Bullitt Co. KY 1417 over Knob Creek
**End Bent 1 and 2 and Pier 1**

**Rock Socket Diameter = 4.5 feet**
**Rock Socket Diameter = 54 inches** **42174**

| Rock Socket Length (ft.) | Nominal Unit Side Shear $q_{ss}$ (ksf) | Nominal Unit End Bearing $q_{eb}$ (ksf) | Nominal Side Resistance $R_{sr}$ (kips) | Nominal End Bearing Resistance $R_{eb}$ (kips) | Factored Side Resistance $\phi R_{sr}$ (kips) | Factored End Bearing Resistance $\phi R_{eb}$ (kips) | Total Factored Axial Resistance $\phi R_t$ (kips) | Total Factored Uplift Resistance $\phi R_{tu}$ (kips) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | |
| 1.0 | 11.3 | 48 | 160 | 763 | 80 | 382 | 462 | 64 |
| 2.0 | 11.3 | 48 | 321 | 763 | 160 | 382 | 542 | 128 |
| 3.0 | 11.3 | 48 | 481 | 763 | 241 | 382 | 622 | 193 |
| 4.0 | 11.3 | 48 | 642 | 763 | 321 | 382 | 703 | 257 |
| 5.0 | 11.3 | 48 | 802 | 763 | 401 | 382 | 783 | 321 |
| 6.0 | 11.3 | 48 | 963 | 763 | 481 | 382 | 863 | 385 |
| 7.0 | 11.3 | 48 | 1123 | 763 | 562 | 382 | 943 | 449 |
| 8.0 | 11.3 | 48 | 1283 | 763 | 642 | 382 | 1023 | 513 |
| 9.0 | 11.3 | 48 | 1444 | 763 | 722 | 382 | 1104 | 578 |
| 10.0 | 11.3 | 48 | 1604 | 763 | 802 | 382 | 1184 | 642 |
| 11.0 | 11.3 | 48 | 1765 | 763 | 882 | 382 | 1264 | 706 |
| >>> 12.0 | 11.3 | 48 | 1925 | 763 | 963 | 382 | 1344 | 770 |
| 13.0 | 11.3 | 48 | 2086 | 763 | 1043 | 382 | 1425 | 834 |
| 14.0 | 11.3 | 48 | 2246 | 763 | 1123 | 382 | 1505 | 898 |
| 15.0 | 11.3 | 48 | 2407 | 763 | 1203 | 382 | 1585 | 963 |
| 16.0 | 11.3 | 48 | 2567 | 763 | 1283 | 382 | 1665 | 1027 |
| 17.0 | 11.3 | 48 | 2727 | 763 | 1364 | 382 | 1745 | 1091 |
| 18.0 | 11.3 | 48 | 2888 | 763 | 1444 | 382 | 1826 | 1155 |
| 19.0 | 11.3 | 48 | 3048 | 763 | 1524 | 382 | 1906 | 1219 |
| 20.0 | 11.3 | 48 | 3209 | 763 | 1604 | 382 | 1986 | 1283 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| AASHTO Table 10.5.5.2.4-1 | | | Resistance Factor, $\phi$ | | 0.50 | 0.50 | | 0.40 |

| | |
|---|---|
| >>> = Min. Socket Length | D (ft.) = 4.5 |

# Load and Resistance Factor Design (LRFD)

## DRILLED SHAFT AXIAL RESISTANCE TABLE

### Bullitt Co. KY 1417 over Knob Creek
**End Bent 1 and 2 and Pier 1**

**Rock Socket Diameter = 5.0 feet**
**Rock Socket Diameter = 60 inches** **42174**

| Rock Socket Length (ft.) | Nominal Unit Side Shear $q_{ss}$ (ksf) | Nominal Unit End Bearing $q_{eb}$ (ksf) | Nominal Side Resistance $R_{sr}$ (kips) | Nominal End Bearing Resistance $R_{eb}$ (kips) | Factored Side Resistance $\phi R_{sr}$ (kips) | Factored End Bearing Resistance $\phi R_{eb}$ (kips) | Total Factored Axial Resistance $\phi R_t$ (kips) | Total Factored Uplift Resistance $\phi R_{tu}$ (kips) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | | | | | |
| 1.0 | 11.3 | 48 | 178 | 942 | 89 | 471 | 560 | 71 |
| 2.0 | 11.3 | 48 | 357 | 942 | 178 | 471 | 649 | 143 |
| 3.0 | 11.3 | 48 | 535 | 942 | 267 | 471 | 739 | 214 |
| 4.0 | 11.3 | 48 | 713 | 942 | 357 | 471 | 828 | 285 |
| 5.0 | 11.3 | 48 | 891 | 942 | 446 | 471 | 917 | 357 |
| 6.0 | 11.3 | 48 | 1070 | 942 | 535 | 471 | 1006 | 428 |
| 7.0 | 11.3 | 48 | 1248 | 942 | 624 | 471 | 1095 | 499 |
| 8.0 | 11.3 | 48 | 1426 | 942 | 713 | 471 | 1184 | 570 |
| 9.0 | 11.3 | 48 | 1604 | 942 | 802 | 471 | 1273 | 642 |
| 10.0 | 11.3 | 48 | 1783 | 942 | 891 | 471 | 1363 | 713 |
| 11.0 | 11.3 | 48 | 1961 | 942 | 980 | 471 | 1452 | 784 |
| 12.0 | 11.3 | 48 | 2139 | 942 | 1070 | 471 | 1541 | 856 |
| >>> 13.0 | 11.3 | 48 | 2317 | 942 | 1159 | 471 | 1630 | 927 |
| 14.0 | 11.3 | 48 | 2496 | 942 | 1248 | 471 | 1719 | 998 |
| 15.0 | 11.3 | 48 | 2674 | 942 | 1337 | 471 | 1808 | 1070 |
| 16.0 | 11.3 | 48 | 2852 | 942 | 1426 | 471 | 1897 | 1141 |
| 17.0 | 11.3 | 48 | 3030 | 942 | 1515 | 471 | 1986 | 1212 |
| 18.0 | 11.3 | 48 | 3209 | 942 | 1604 | 471 | 2076 | 1283 |
| 19.0 | 11.3 | 48 | 3387 | 942 | 1693 | 471 | 2165 | 1355 |
| 20.0 | 11.3 | 48 | 3565 | 942 | 1783 | 471 | 2254 | 1426 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| AASHTO Table 10.5.5.2.4-1 | | | Resistance Factor, $\phi$ | | 0.50 | 0.50 | | 0.40 |

>>> = Min. Socket Length

D (ft.) = 5.0

# Kentucky Transportation Cabinet

Division of Structural Design, Geotechnical Branch
Wash Gradation and Classification Sheet
Tested by: Chris Groves

Mod. 4/21/9
Mod. 12/06/

| | | | | | |
|---|---|---|---|---|---|
| **Tracking No.** | BAG #1 | **Hole No.** | 1003 | **Depth (ft.)** | 1-2.5 |
| **Lab ID No.** | | | | | A-1-a |
| | | **Liquid Limit** | 0 | | |
| **Dry Sample Wt. + Can (g)** | 2846 | **Plastic Limit** | 0 | | |
| **Wt. of Can. (g)** | 317.9 | **Plasticity Index** | 0 | | |
| **Total Dry Sample Wt. (g)** | 2528.1 | **Borderline or Dual** | Use silt (M) symbol | | |

| Sieve Size | Grams Retained | Percent Retained | Percent Passing |
|---|---|---|---|
| 4 " Sieve (100 mm) | 0 | 0.0 | 100.0 |
| 3 " Sieve (75 mm) | 0 | 0.0 | 100.0 |
| 2 " Sieve (50 mm) | 0 | 0.0 | 100.0 |
| 1" Sieve (25.0 mm) | 460 | 18.2 | 81.8 |
| 3/4" Sieve (19 mm) | 270 | 10.7 | 71.1 |
| 3/8" Sieve (9.5 mm) | 901 | 35.6 | 35.5 |
| No. 4 (4.75 mm) | 476 | 18.8 | 16.7 |
| No. 10 (2 mm) | 210 | 8.3 | 8.4 |
| No. 40 (0.425 mm) | 78 | 3.1 | 5.3 |
| No. 200 (0.075 mm) | 26 | 1.0 | 4.2 |

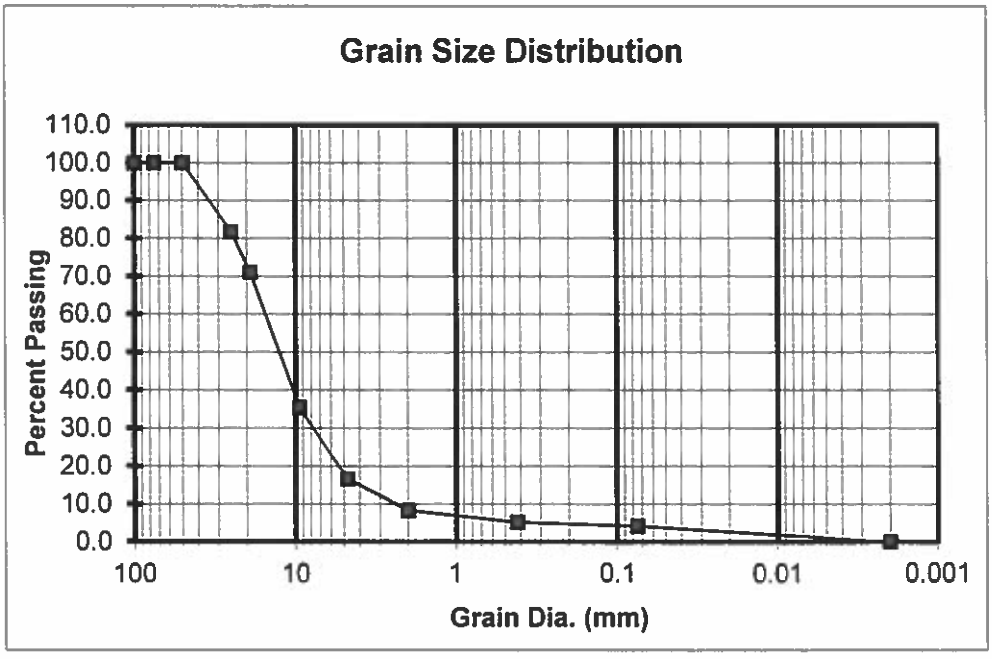
(0)

100
75
50
25
19
9.5
4.75
2
0.42
0.075
0.002

| | | | | |
|---|---|---|---|---|
| **D60 (mm)** | 15.303 | **Cu** | 6.44 | |
| **D50 (mm)** | 12.599 | **Cc** | 1.66 | |
| **D30 (mm)** | 7.763 | **Gravel Gradation Criteria** | | Well graded |
| **D10 (mm)** | 2.375 | **Sand Gradation Criteria** | | Well graded |

| | |
|---|---|
| **AASHTO Classification** | A-1-a |
| **Group Index** | (0) |
| **Unified Classification** | GW |

Must Check Gradation Curve and Plasiticity for Correct Answer



# Kentucky Transportation Cabinet

Division of Structural Design, Geotechnical Branch
Wash Gradation and Classification Sheet
Tested by: Chris Groves

Mod. 4/21/9
Mod. 12/06/

**Tracking No.** BAG #2 **Hole No.** 1003 40RT **Depth (ft.)** 1-2.5
**Lab ID No.**

A-1-a

**Liquid Limit** 0
**Plastic Limit** 0
**Plasticity Index** 0
**Borderline or Dual** Use silt (M) symbol

**Dry Sample Wt. + Can (g)** 3400
**Wt. of Can. (g)** 313.9
**Total Dry Sample Wt. (g)** 3086.1

| Sieve Size | Grams Retained | Percent Retained | Percent Passing |
|---|---|---|---|
| 4 " Sieve (100 mm) | 0 | 0.0 | 100.0 |
| 3 " Sieve (75 mm) | 0 | 0.0 | 100.0 |
| 2 " Sieve (50 mm) | 0 | 0.0 | 100.0 |
| 1" Sieve (25.0 mm) | 185 | 6.0 | 94.0 |
| 3/4" Sieve (19 mm) | 276 | 8.9 | 85.1 |
| 3/8" Sieve (9.5 mm) | 994 | 32.2 | 52.9 |
| No. 4 (4.75 mm) | 845 | 27.4 | 25.5 |
| No. 10 (2 mm) | 378 | 12.2 | 13.2 |
| No. 40 (0.425 mm) | 159 | 5.2 | 8.1 |
| No. 200 (0.075 mm) | 54 | 1.7 | 6.3 |

(0)

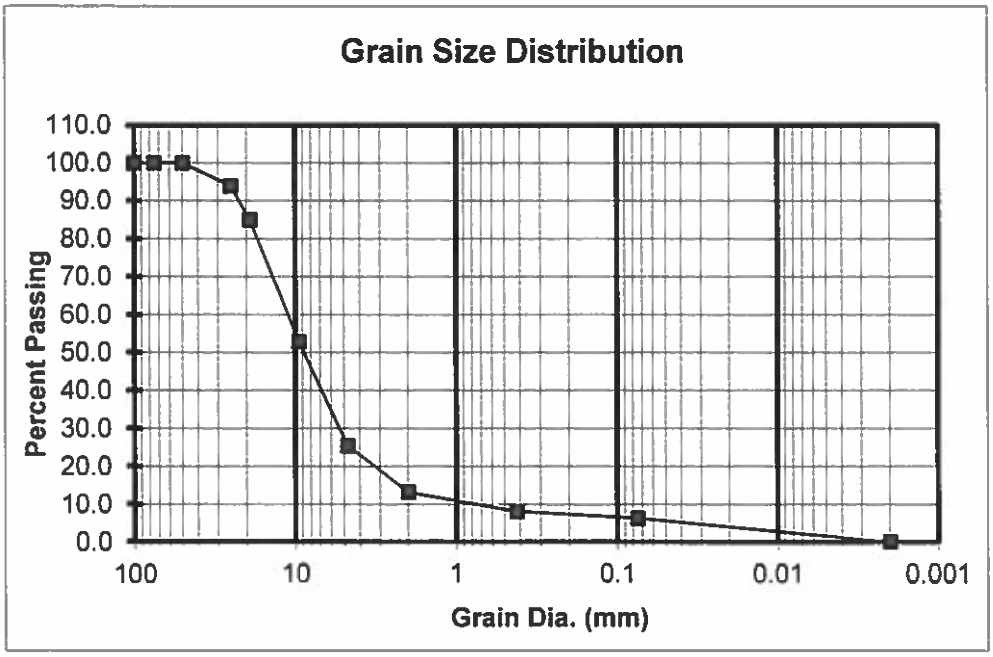
100
75
50
25
19
9.5
4.75
2
0.42
0.075
0.002

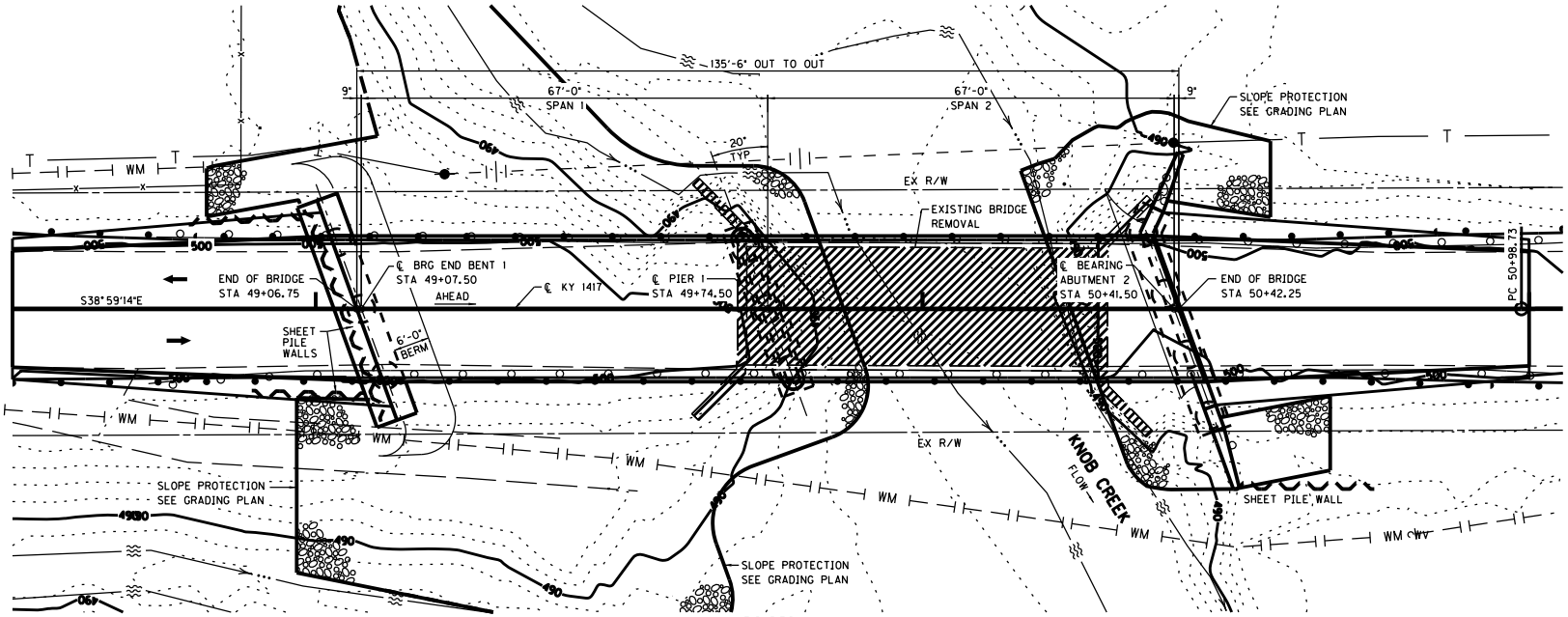
**D60 (mm)** 11.079
**D50 (mm)** 8.838
**D30 (mm)** 5.327
**D10 (mm)** 0.759

**Cu** 14.60
**Cc** 3.38
**Gravel Gradation Criteria** Poorly graded
**Sand Gradation Criteria** Poorly graded

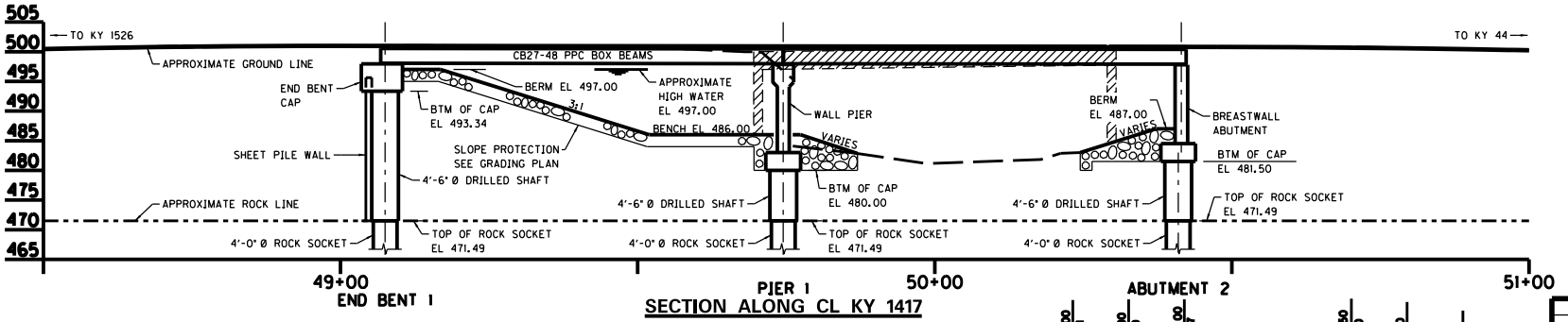
**AASHTO Classification** A-1-a
**Group Index** (0)
**Unified Classification** GP-GM

Must Check Gradation Curve and Plasiticity for Correct Answer

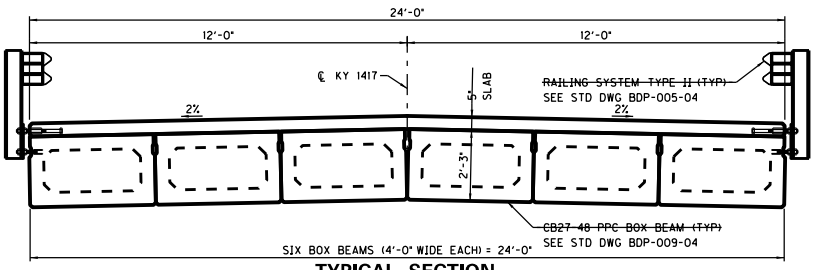




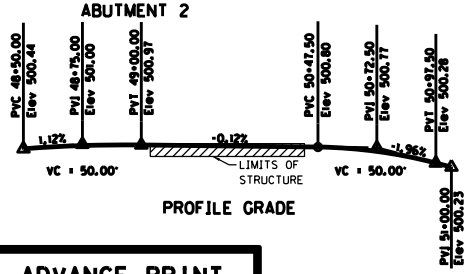

## PLAN




## SECTION ALONG CL KY 1417




## TYPICAL SECTION (LOOKING AHEAD)




## PROFILE GRADE

NOTE:
SEE ROADWAY PLANS FOR HORIZONTAL CURVE AND ALIGNMENT TIE-IN POINTS

**ADVANCE PRINT**
**NOT FOR CONSTRUCTION**

| REVISION | DATE |
|---|---|
| DATE: | CHECKED BY |
| DESIGNED BY: S. KING | R. CATRON |
| DETAILED BY: E. TRIMBLE | A. FARMER |

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: BULLITT

ROUTE: KY 1417 | CROSSING: KNOB CREEK

LAYOUT

ITEM NUMBER: 5-1081

PREPARED BY: Stantec

SHEET NO. S3

DRAWING NO. 27357

**COORDINATE DATA SUBMISSION FORM**

**KYTC DIVISION OF STRUCTURAL DESIGN -- GEOTECHNICAL BRANCH**

**County** Bullitt **Date** 3-Jun-15

**Road Number** KY-1417

**Survey Crew / Consultant** District-5

**Contact Person**

**Item #** 05-1081.00

**Mars #**

**Project #**

**Notes:**

**S-055-2015**

**Elevation Datum** (circle one) **NAVD88** **Assumed**

| HOLE NUMBER | LATITUDE (Decimal Degrees) | LONGITUDE (Decimal Degrees) | HOLE NUMBER | STATION | OFFSET | ELEVATION (ft) |
|---|---|---|---|---|---|---|
| 1 | 38.03077 | -85.807833 | 1 | 49+00.07 | -7.56 | 500.89 |
| 2 | 38.030727 | -85.807851 | 2 | 49+08.79 | 6.39 | 500.99 |
| 3 | 38.030563 | -85.807714 | 3 | 49+80.17 | 13.19 | 487.22 |
| 4 | 38.030467 | -85.807525 | 4 | 50+41.51 | -7.15 | 500.58 |
| 5 | 38.030429 | -85.807543 | 5 | 50+49.12 | 5.92 | 500.78 |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |