M E M O R A N D U M

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

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

BY: Daryl J. Greer, P.E.
Geotechnical Branch

DATE: November 9, 2015

SUBJECT: **Garrard/Mercer Counties**
FD52 040 0152 000-001
FD52 084 0152 018-019
BRO 5129 (012)
MARS No. 8469001D
KY 152 Bridge and Approaches over Herrington Lake
Retaining Wall @ Sta. 14+40
Item No. 7-1116.00
Geotechnical Engineering Structure Foundation Report

The geotechnical engineering structure foundation report for the subject project has been completed by Stantec Consulting Services, Inc. We have reviewed and concur with the recommendations as presented in this report.

A copy of the report is attached. If you have any questions, please contact this office at 502-564-2374.

Attachments

cc: W. McKinney
R. Powell
R. Sprague
M. Simpson
K. Caudill
R. Gossom
C. Raymer (WMB)
A. Crace (Stantec)
B. Greene

Report of Geotechnical Exploration

Retaining Wall at Sta. 14+40
KY 152 over Herrington Lake
Item No. 7-1116.00
Garrard and Mercer Counties, Kentucky
Project ID: S-151-2015

Prepared for:
WMB, Inc.
Lexington, Kentucky

November 5, 2015

Stantec Consulting Services Inc.
Design with community in mind
www.stantec.com

Stantec

Stantec Consulting Services Inc.
1409 North Forbes Road, Lexington KY 40511-2024

November 5, 2015 rpt_004_175562020

Charlie Raymer, PE
WMB, Inc.
1950 Haggard Court
Lexington, Kentucky 40505

Re: Report of Geotechnical Exploration
Retaining Wall at Sta. 14+40
KY 152 over Herrington Lake
Item No. 7-1116.00
Garrard and Mercer Counties, Kentucky
Project ID: S-151-2015

Dear Mr. Raymer:

Stantec Consulting Services Inc. (Stantec) is submitting the geotechnical engineering report for the referenced project with this letter. Also included are the subsurface data sheets presenting the boring layout, logs of borings, geotechnical notes for the retaining wall, as well as pertinent engineering analyses.

The referenced project also includes replacing the KY 152 bridge over Herrington Lake and relocating the approach roadways. In addition, there is a second retaining wall proposed for the project. The geotechnical considerations for the bridge, approach roadways, and second retaining wall are addressed under separate covers. This report presents results of the field exploration along with our recommendations for the design and construction of the retaining wall located near KY 152 Station 14+40. As always, we enjoy working with your staff and if we can be of further assistance, please contact our office.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Derek J. Gerdeman
Project Engineer

Adam Crace, PE
Senior Associate

/rws

Report of Geotechnical Exploration

Retaining Wall at Sta. 14+40
KY 152 over Herrington Lake
Item No. 7-1116.00
Garrard and Mercer Counties, Kentucky
Project ID: S-151-2015

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Item No. 7-1116.00
Garrard and Mercer Counties, Kentucky
Project ID: S-151-2015

1. Introduction

1.1. Project Overview

The Kentucky Transportation Cabinet (KYTC) is planning to replace the Kennedy Bridge, KY 152 over Herrington Lake. The existing bridge has been in service since 1933 and is currently operating under a reduced service load. It is proposed that a new bridge will be constructed just downstream of the existing bridge. As part of the bridge replacement project, short segments of roadway will be relocated and/or reconstructed at both ends of the bridge. Two retaining walls are also proposed as part of this project. The geotechnical considerations for the bridge and approach roadways are addressed under separate covers. This report addresses the geotechnical considerations associated with the retaining wall located from approximate station 14+40 to 15+49. The map provided in Appendix A illustrates the project location.

1.2. Structure Location and Description

Structure plans indicate the proposed gravity type retaining wall will be 109 feet in length beginning at KY 152 station 14+40, 48 feet Right and ending at station 15+49, 34 feet Right. Appendix B presents structure drawings received from the project designer, WMB Inc. (WMB) which depicts the proposed plan layout and profile of the retaining wall.

2. Site Topography and Geologic Conditions

The project area lies within the Bluegrass Physiographic Region of Kentucky. The Bluegrass Region is characterized by gently rolling hills with rich fertile soils. Weathering of the underlying limestone bedrock has produced caves, sinkholes, and springs. The proposed retaining wall is located close to the Kentucky River Palisades, which formed when the Kentucky River and its tributaries cut through the limestone bedrock to form high cliffs and steep gorges within the study area. Existing topographic relief at the site varies from approximate elevation 790 feet at the abutments to approximate elevation 550 feet below Herrington Lake.

Available geologic mapping (USGS Geologic Map of Bryantsville (1971) Quadrangle, Kentucky) indicates the site is underlain by limestone and possibly dolomite bedrock of the Middle Ordovician age. According to the USGS Quadrangle, the limestones are predominantly light gray to gray, micro-crystalline to fine grained, thin to medium bedded, with shale stringers. The dolomite is described as light gray to gray, micro-crystalline grained, and thick bedded.

Karst activity exists with the Bluegrass Physiographic Region of Central Kentucky. However, based on USGS Geologic mapping, no known karstic features are present in the project vicinity.

Based on USGS Geologic mapping, several unnamed faults are present within approximately one mile of the project location. The unnamed faults fall to the north, southwest and south of the project. The Kentucky River Fault Zone is also located near the project location. At the closest point, the Kentucky River Fault Zone is approximately 3.25 miles to the southeast of the project location. None of these faults are known to have been active within recent history.

Residual clayey and silty soils are the predominant soil type mapped within the area of the proposed retaining wall. Soils tend to be fairly thin in the vicinity of the project.

3. Summary of Borings

Three borings were drilled during the 2014 field exploration for the proposed retaining wall. The borings drilled consisted of one sample hole, one sample hole with rock core, and one rockline sounding. The borings were staked in the field by WMB survey personnel. The locations and logs of the borings are shown on the Subsurface Data Sheet located in Appendix C. Table 1 presents a summary of the borings drilled. All measurements are expressed in feet.

Table 1. Summary of Borings

Hole No.	Station, Offset	Surface Elevation	Top of Rock Elevation	Refusal/Begin Core Elevation	Length of Core[b]	Bottom of Hole Elevation
B-18	14+40, 60.0' Rt	787.9	784.6	784.6	9.8	774.8
B-19	14+95, 32.0' Rt	789.9	782.5[a]	782.5	N/C	782.5
B-20	15+49, 34.0' Rt	790.8	769.0[a]	769.0	N/C	769.0

a. Top of rock in this case indicates rock-like resistance to augering. An exact determination cannot be made without performing rock coring.

b. N/C denotes no rock coring performed.

Stantec personnel performed drilling and sampling operations in December, 2014. The drill crews operated a truck-mounted drill rig equipped with hollow-stem augers as well as wire line rock coring tools.

The Subsurface Data Sheet in Appendix C provides a boring layout that depicts the location of the boring in relation to the planned structure as well as a graphical log presenting the results of the drilling, sampling, and laboratory testing programs. Refer

to Appendix D for the Coordinate Data Submission Form summarizing the as-drilled boring location, surface elevation, and associated latitude and longitude.

4. Soil and Bedrock Conditions

Drilling operations for the proposed retaining wall indicate that soils range from approximately 3 feet to 21 feet in thickness along the length of the proposed retaining wall. Soils were described as lean clay, brown in color, moist in terms of natural moisture content, having medium stiff to stiff consistency, fine grained, and containing some chert fragments. The rock core specimens obtained in the boring consist primarily of limestone. The limestone was described as light gray in color, medium- to thick-bedded, medium- to microcrystalline-grained, and having shale partings. It should be noted a clayfilled zone was encountered below top of rock on boring B-18. This zone does not appear to be continuous along the footprint of the wall.

The project engineer determined the location of the base of weathered rock in the boring. The percent recovery and rock quality designation (RQD) were also determined for each core run.

The RQD is defined as the sum of all core pieces longer than four inches, divided by the total length of the coring run. KYTC modifies the RQD by excluding from the sum those portions of core which can be broken by hand pressure. The resultant is multiplied by 100 to express the RQD in percent. The RQD provides a simple quantitative indication of rock competency. A detailed graphical log of the boring is presented on the Subsurface Data Sheet in Appendix C.

5. Laboratory Testing

5.1. General

All laboratory tests were performed in accordance with the applicable AASHTO or Kentucky Methods soil and rock testing specifications. Laboratory testing consisted of natural moisture content, grain size-sieve analyses (silt plus clay determinations), soil classifications, and unconfined compressive strength tests on cohesive soil specimens. Engineering staff used the test results to establish material properties for subsequent engineering analyses. The following paragraphs provide discussions of the laboratory testing program and its results.

5.2. Laboratory Testing of Standard Penetration Test Samples

Laboratory testing of the SPT samples included natural moisture content, grain-size sieve analysis (silt plus clay determination), and standard engineering classification testing. The SPT soil samples tested classify as CL according to USCS and as A-7-6 based on the AASHTO classification system. The Subsurface Data Sheet provided in Appendix C depicts the results of the laboratory testing of SPT samples adjacent to the appropriate graphical log.

5.3. Testing of Cohesive Soils/Undisturbed (Shelby) Tube Samples

Borings drilled for the subject retaining wall included undisturbed (Shelby) tube sampling within predominantly cohesive soil horizons. Stantec's soils laboratory extruded the tubes and trimmed six-inch specimens. The laboratory testing program consisted of natural moisture content determinations, particle-size sieve analyses, engineering classification, unit weight determinations, unconfined compressive strength testing, and one-dimensional consolidation testing. The following paragraphs provide further discussion of the test results.

5.3.1. Engineering Classification Test Results for Cohesive Samples

Stantec performed engineering classification testing on selected Shelby tube specimens. Classification index testing included sieve and hydrometer analyses, Atterberg limits, and specific gravity. The soils tested on Shelby tube specimens classify as CL and CH according to the Unified Soil Classification System (USCS), and as A-7-6 based on the American Association of State Highway and Transportation Officials (AASHTO) classification system. The Subsurface Data Sheet provided in Appendix C depicts the results of the classification testing adjacent to the graphical logs.

5.3.2. Unconfined Compressive Strength Testing

Four unconfined compressive strength tests were performed by Stantec to obtain information used in estimating total stress strength parameters representative of the cohesive soil horizons. Table 3 summarizes the data obtained from this testing. The Subsurface Data Sheet provided in Appendix C also depicts the results of the unconfined compressive strength testing adjacent to the appropriate graphical log.

Table 2. Summary of Unconfined Compressive Strength Tests

Hole No.	Station and Offset	Test Interval (ft)	Unit Weight (pcf)		Moisture Content (%)	Unconfined Compressive Strength (psf)	Estimated Cohesive (psf)
			Wet	Dry			
B-20	15+49, 34.0' Rt	10.2 – 10.7	126.9	104.2	21.7	2200	1100
B-20	15+49, 34.0' Rt	20.5 – 21.0	115.5	86.0	34.3	1920	960

The unconfined compressive strength can be used to estimate the bearing capacity and cohesion of a soil material. The value of cohesion used for engineering analysis is generally estimated to be one-half of the unconfined compressive strength for cohesive soils.

5.3.3. One-Dimensional Consolidation Testing

Stantec's laboratory performed one-dimensional consolidation testing on selected samples extruded from the Shelby tubes to provide initial void ratio and consolidation parameters utilized in settlement analyses. The results of the consolidation tests are summarized in Table 3.

Table 3. Summary of One-Dimensional Consolidation Tests

Hole No.	Station and Offset	Test Interval (ft)	Initial Void Ratio (e_o)	Compression Index (C_c)	Recompression Index (C_r)	Preconsolidation Pressure (P_c) (psf)
B-20	15+49, 34.0' Rt	10.7 – 11.2	0.719	0.303	0.063	16,200

6. Retaining Wall Analyses

6.1. General

The gravity wall configuration evaluated for the subject retaining structure was developed based on plan view and profile drawings provided by WMB. This project will be designed using the Load and Resistance Factor Design (LRFD) methodology. LRFD is a design approach in which applicable failure and serviceability conditions can be evaluated considering the uncertainties associated with loads and materials resistances. Where applicable, the following engineering analyses followed the current AASHTO LRFD guidelines. This report provides recommendations for design and construction of a cast-in-place gravity retaining wall bearing on a yielding foundation.

6.2. External Stability

Stantec evaluated the external stability (sliding, eccentricity, and bearing capacity) of the gravity wall at the tallest section which is located at KY 152 Station 15+28. For the purposes of modeling the gravity wall, the stem was estimated to be one foot and the batter on the front of the wall was estimated to be 1:12 (H:V). The base width of the wall was modeled at 1.0 times the wall height. These wall dimensions are in accordance with Case II of Standard Drawing RGX – 002 with the exception that the base width shall be increased to 1.0 times the wall height.

The friction angles used in the analyses were ϕ = 38 degrees for the granular backfill behind the wall and δ = 29 degrees for the contact between the concrete retaining wall and granular embankment behind the wall. Due to vehicular traffic being able to operate near the top of the retaining wall, a 2-foot soil surcharge load was also considered in the analyses.

Using the above parameters, LRFD checks for eccentricity (overturning) and sliding were satisfied. The required bearing capacity (Meyerhof Stress) was also determined to be 2,801 psf. The results of the external stability analyses are presented in Table 2.

Table 4. Summary of Retaining Wall Analyses

Wall Dimension		Required Bearing Capacity (psf)	Capacity Demand Ratio	
Height (ft)	Width (ft)		Overturning	Sliding
12.0	12.0	2,801	6.0	1.0

6.3. Bearing Capacity Analyses

Based on the results of the drilling operations conducted for the subject retaining wall it is estimated that the retaining wall will bear directly on existing foundation soils. Based upon the information derived from drilling, sampling, and laboratory testing operations conducted along the planned wall alignment, a nominal bearing capacity estimate was performed for comparison with the induced wall loading. The estimate of nominal bearing capacity (q_n) for the gravity wall is based on methods outlined in the current AASHTO LRFD Bridge Design Specifications, Section 10.6.3 and the US Army Corps of Engineers "Bearing Capacity of Soils", EM 1110-1-1905.

Review of the soil profile developed along the wall alignment in conjunction with the planned bearing elevations indicate the wall will be founded on existing foundation soils. Thus, the bearing capacity will be controlled by the short-term strength of the clays. Using a cohesion value of 1000 psf for the existing foundation soils, the nominal bearing capacity for the foundation soils is on the order of 5,480 psf.

The resistance factors for permanent retaining walls are outlined in Table 11.5.7-1 of the AASHTO LRFD Bridge Design Specifications and for gravity walls it was shown to be 0.55. Using a resistance factor of 0.55, the factored bearing capacity for foundation soils is on the order of 3,010 psf. A review of the Meyerhof uniform pressure/required bearing capacity values determined for the gravity wall, the applied bearing pressures are less than the factored bearing capacity. Therefore, it is recommended that the gravity wall bear directly on existing foundation soils.

6.4. Settlement Analyses

Stantec performed settlement analyses at a select location in order to develop an estimated settlement along the wall alignment. Based on the planned bearing elevations and over excavation depths previously discussed, it appears that the wall will bear within existing foundation materials. Settlement parameters for the foundations soils were estimated based on the results of the previously discussed drilling, sampling, and laboratory testing programs. Consolidation parameters for the clay type soils were derived from the results of one-dimensional consolidation testing.

The applied pressures used in the analyses were based on the LRFD Service I load combinations and the resulting Meyerhof uniform pressure distribution beneath the wall using soil as the retained fill. The results of the analyses indicate the potential for up to approximately 0.9 inches of settlement of the soils beneath the gravity wall.

6.5. Global Slope Stability

Stantec evaluated the global stability of the anticipated gravity wall configuration utilizing the SLOPE/W software, a slope stability program distributed by GEO-SLOPE International, LTD., of Calgary, Alberta, Canada. SLOPE/W is a special-purpose computer code designed to analyze the stability of earth slopes using two-dimensional limit equilibrium methods. Short-term analyses, using total-stress shear-strength parameters for foundations and embankment materials, simulate conditions that will exist immediately following completion of the embankments. Long-term analyses, using effective-stress shear-strength parameters, simulate conditions that will exist long after the embankment is constructed and excess pore pressures within the foundation materials have dissipated. Table 5 presents a summary of the slope stability analyses performed for the gravity wall option.

Table 5. Summary of Global Slope Stability Analyses for Gravity Wall

Location	Global Slope Stability	
	Short Term	Long Term
Station 15+39	3.9	2.7

The factors of safety presented in Table 5 meet or exceed the minimum target values outlined in the KYTC Geotechnical Manual and indicate the retaining wall configurations should exhibit adequate stability as proposed.

7. Conclusions and Recommendations

Stantec developed the following recommendations based upon reviews of available data, information obtained during the field exploration, results of engineering analyses, and discussions with WMB personnel. The recommendations are also based on the structure configuration presented in drawings provided by WMB and are specific to the wall height and geometry discussed herein.

7.1. Design of the subject retaining wall shall be in accordance with the 2014 AASHTO LRFD Bridge Design Specifications.

7.2 Wall dimensions shall be in accordance with Case II of the Kentucky Department of Highways Standard Drawing RGX – 002 with the exception that the base width shall be increased to 1.0 times the wall height.

7.3. Wall footings shall be designed using a nominal bearing capacity of 5,480 psf. Based on the resistance factors in the 2014 AASHTO RFD Bridge Design Specifications the resistance factor for a gravity wall is 0.55 so the factored bearing capacity would be 3,010 psf.

7.4. Non-erodible Granular Embankment shall be placed in the entire area between the wall and a 1:1 (H:V) line sloping upward and away from the base of the heel of the wall to the top of the wall.

7.5. Granular Embankment used as backfill shall be non-erodible and shall conform to the requirements of Section 805 of the current Kentucky Transportation Cabinet Standard Specifications for Road and Bridge Construction. Contrary to Section 805 of the Standard Specifications, the maximum size limit shall be reduced to 4 inches. The Granular Embankment material shall be wrapped with Type IV geotextile fabric in accordance with Sections 214 and 843 of the current Kentucky Transportation Cabinet Standard Specifications for Road and Bridge Construction to provide separation from the clay embankment and/or foundation materials.

7.6. It is estimated that the embankment material behind the retaining wall will consist of granular embankment. Using an estimated $\overline{\phi}$ = 38°, the following fluid pressures are applicable:

Slope of Backfill	Equivalent Fluid Pressure
Level	30 psf
3:1 (H:V)	32 psf
2:1 (H:V)	40 psf

7.7. The footing width of the gravity wall shall be no less than 1.0 times the total wall height (including embedment). The Designer shall verify wall stability based on final wall design dimensions.

7.8. The minimum wall embedment shall be 2 feet as measured from the ground surface in front of the wall to the base of the footing.

7.9. Drainage systems behind the wall will be necessary. The drainage systems shall consist of 4-inch diameter pipe with weep-holes installed at the locations as indicated by Standard Drawing RGX 002-08 or by the Designer, and/or perforated pipe installed at the base of the wall and "daylighted" to promote dewatering of the granular backfill.

7.10. **A plan note should be included by the Designe**r: Foundation excavations should be properly braced/shored to provide adequate safety to people working in or around the excavations. Bracing should be performed in accordance with applicable federal, state, and local guidelines.

7.11. **A plan note should be included by the Designer:** Structure excavation shall be completed just prior to foundation construction in order to prevent the bedrock from being exposed for an extended period of time and deteriorating. Rock excavation may be required to reach the required bearing elevation of the wall.

7.12. Prior to placement of any concrete or reinforcing steel in a foundation excavation, the excavation bottom should be clean, and all soft, wet, or loose materials should be removed. In no case should concrete be placed upon compressible or water-softened materials.

7.13. If the designer requires more information or would like to investigate other foundation alternates or wall types, contact Stantec.

7.14. Based on the results of the drilling, a clay filled zone was encountered in Boring No. B-18. It is recommended that this wall be constructed directly on existing foundation soils. If the zones near Boring No. B-18 are uncovered and not clay filled, the contractor should be prepared to refill those areas with properly compacted clay.

7.15. The contractor may encounter bedrock between Stations 14+40 to 14+60 during excavation for the base of the wall. The bedrock within the footprint of the wall should be undercut a minimum of 2 feet below the base of the wall. The resulting excavation shall be backfilled with approved soil material compacted in maximum eight inch loose lifts to a maximum dry density of 98 percent standard Proctor value at a moisture content within +/- 2 percent of optimum.

8. Closing

8.1. The conclusions and recommendations presented herein are based on data and subsurface conditions from the borings drilled during the geotechnical exploration using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions between borings.

8.2 General soil and rock descriptions and indicated boundaries are based on an engineering interpretation of all available subsurface information and may not necessarily reflect the actual variation in subsurface conditions between borings and samples. Collected data and field interpretation of conditions encountered in individual borings are shown on the drafted sheets in Appendix C.

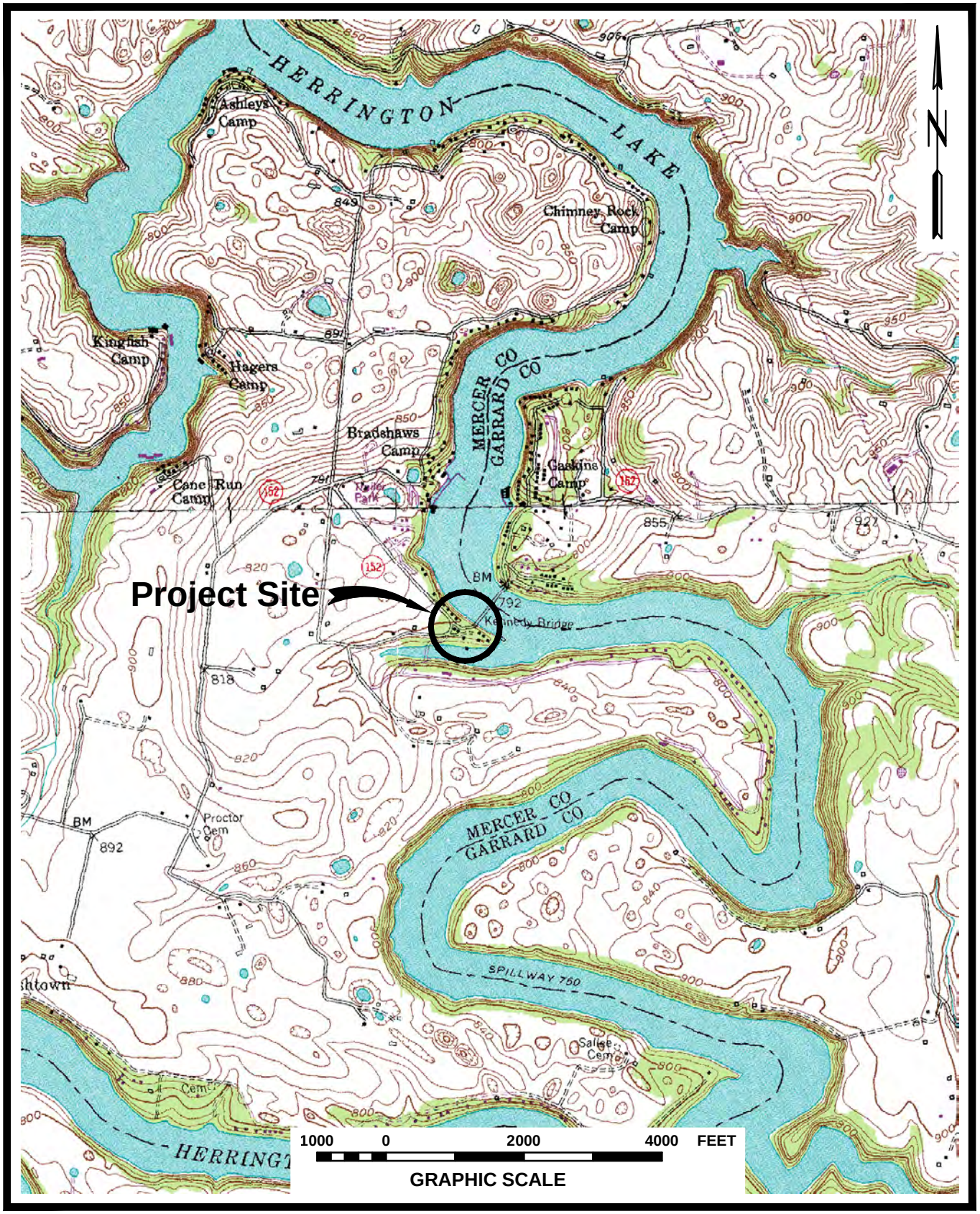
8.3. The observed water levels and/or conditions indicated on the boring logs are as recorded at the time of exploration. These water levels and/or conditions may vary considerably, with time, according to the prevailing climate, rainfall, tail water elevations and/or other factors and are otherwise dependent on the duration of and methods used in the exploration program.

8.4. Stantec exercised sound engineering judgment in preparing the subsurface information presented herein. This information has been prepared and is intended for design and estimating purposes. Its presentation on the plans or elsewhere is for the purpose of providing intended users with access to the same information. This subsurface information interpretation is presented in good faith and is not intended as a substitute for independent interpretations or judgments of the Contractor.

8.5. All structure details shown herein are for illustrative purposes only and may not be indicative of the final design conditions shown in the contract plans.

Appendix A

Location Map



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LOCATION MAP
RETAINING WALL AT STATION 14+40
GARRARD/MERCER COUNTIES, KENTUCKY
Portions of USGS 7 1/2-minute Topographic Maps
(BRYANTSVILLE, WILMORE QUADRANGLES) SHOWING PROJECT SITE

Appendix B

Designer Drawings

COUNTY OF	ITEM NO.	SHEET NO.
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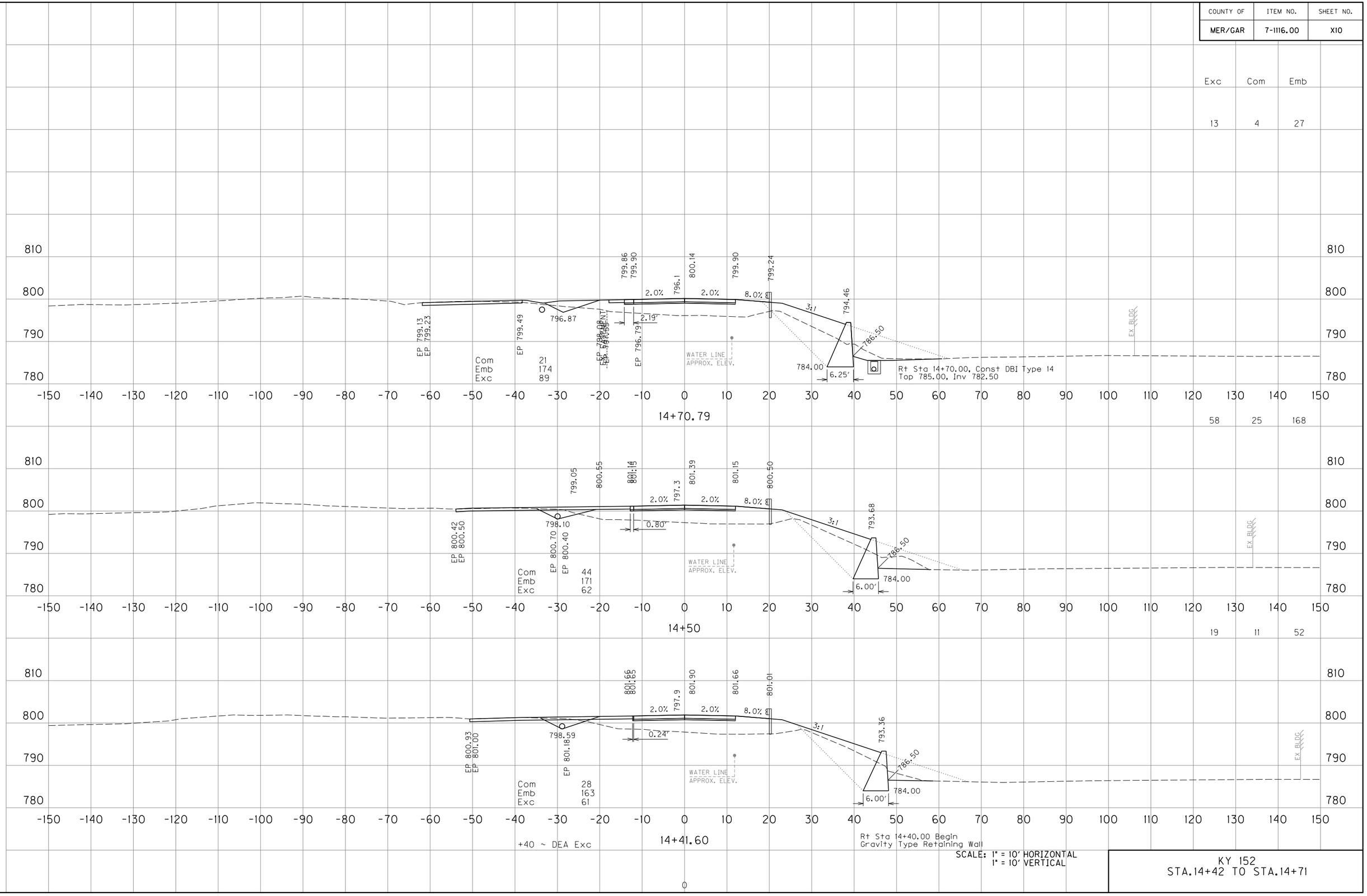

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1" = 10' VERTICAL

KY 152
STA.14+42 TO STA.14+71

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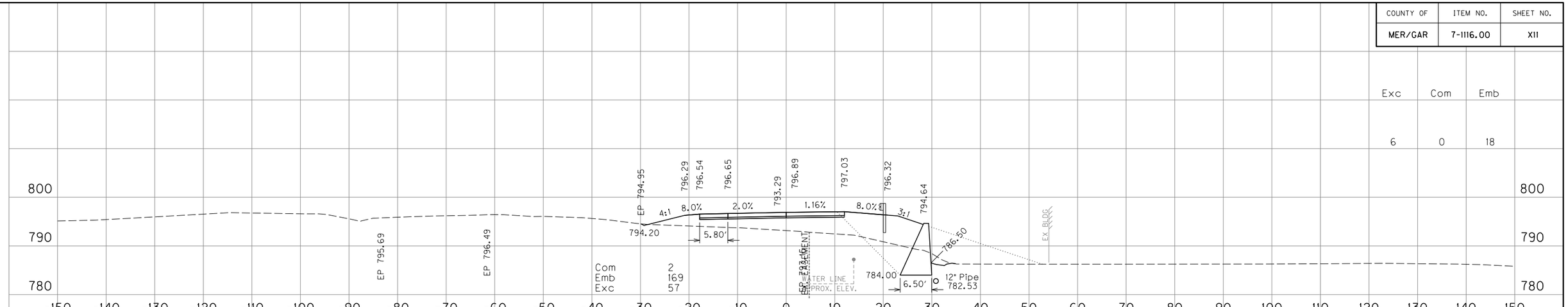

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15+05.07

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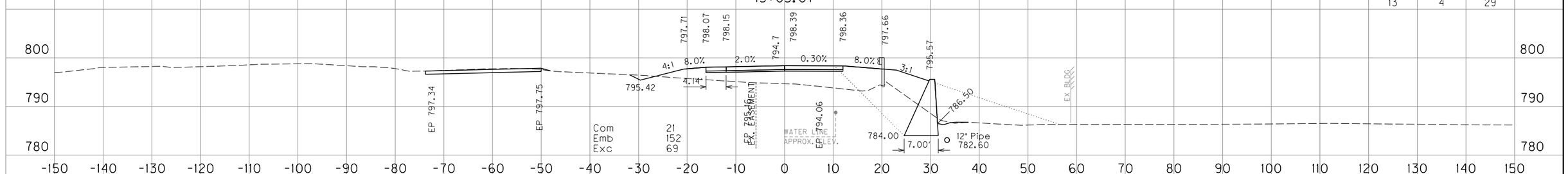

15+00

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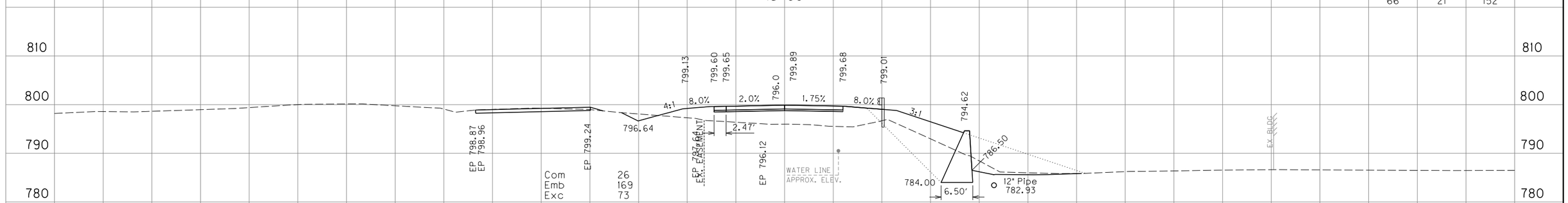

14+75

SCALE: 1" = 10' HORIZONTAL
1" = 10' VERTICAL

KY 152
STA.14+75 TO STA.15+25

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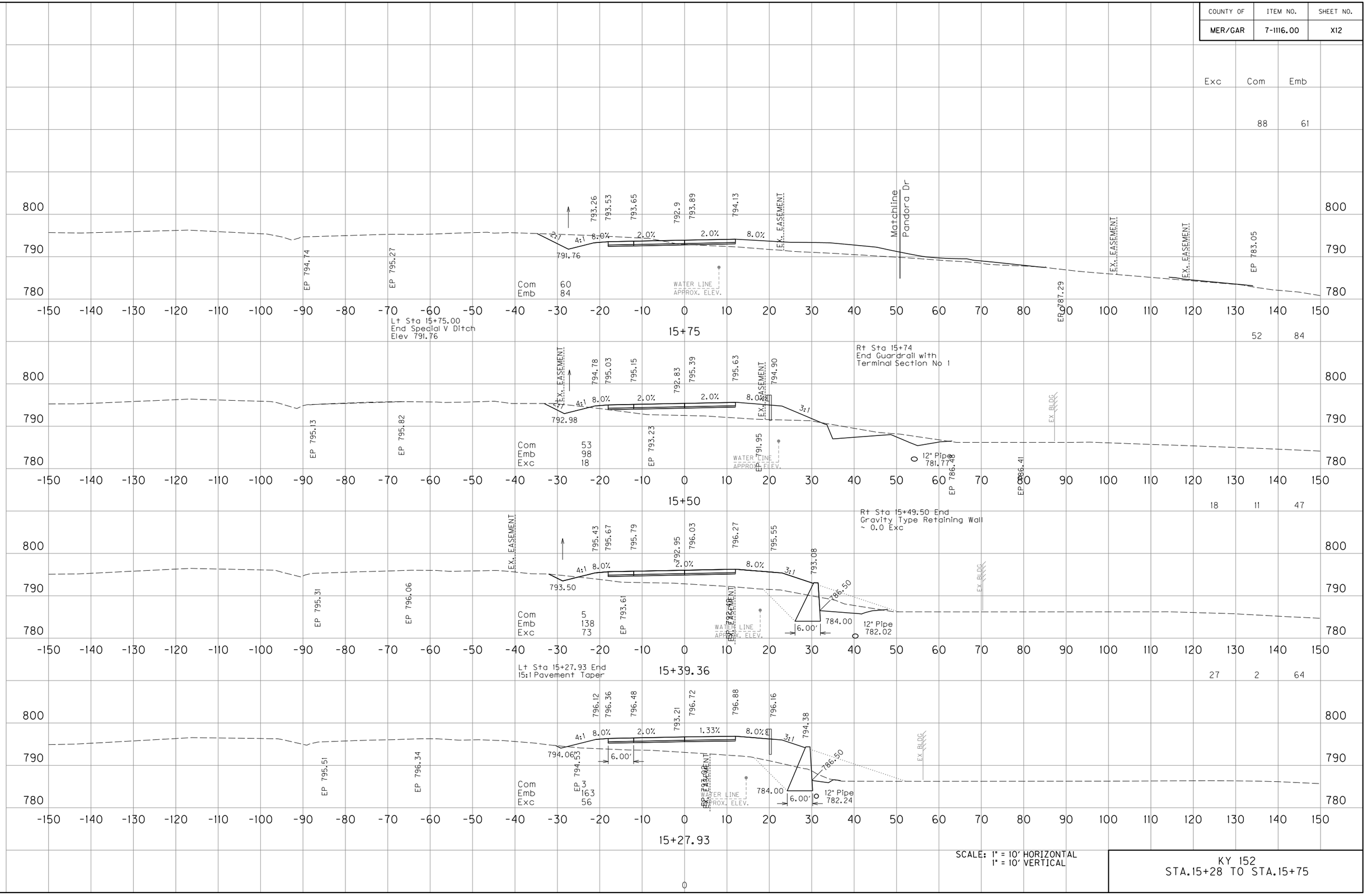

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KY 152
STA.15+28 TO STA.15+75

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Appendix C

Subsurface Data Sheets

GEOTECHNICAL NOTES

for Cast-in-Place Concrete Gravity Retaining Wall

1. Design of the subject retaining wall shall be in accordance with the 2014 AASHTO LRFD Bridge Design Specifications.

2. Wall dimensions shall be in accordance with Case II of the Kentucky Department of Highways Standard Drawing RGX-002 with the exception that the base width shall be increased to 1.0 times the wall height.

3. Wall footings shall be designed using a nominal bearing capacity of 5,480 psf. Based on the resistance factors in the 2014 AASHTO RFD Bridge Design Specifications the resistance factor for a gravity wall is 0.55 so the factored bearing capacity would be 3,010 psf.

4. Non-erodible Granular Embankment shall be placed in the entire area between the wall and a 1:1 (H:V) line sloping upward and away from the base of the heel of the wall to the top of the wall.

5. Granular Embankment used as backfill shall be non-erodible and shall conform to the requirements of Section 805 of the current Kentucky Transportation Cabinet Standard Specifications for Road and Bridge Construction. Contrary to Section 805 of the Standard Specifications, the maximum size limit shall be reduced to 4 inches. The Granular Embankment material shall be wrapped with Type IV geotextile fabric in accordance with Sections 214 and 843 of the current Kentucky Transportation Cabinet Standard Specifications for Road and Bridge Construction to provide separation from the clay embankment and/or foundation materials.

6. It is estimated that the embankment material behind the retaining wall will consist of granular embankment. Using an estimated ϕ = 38°, the following fluid pressures are applicable:

Slope of Backfill	Equivalent Fluid Pressure
Level	30 psf
3:1 (H:V)	32 psf
2:1 (H:V)	40 psf

7. The footing width of the gravity wall shall be no less than 1.0 times the total wall height (including embedment). The Designer shall verify wall stability based on final wall design dimensions.

8. The minimum wall embedment shall be 2 feet as measured from the ground surface in front of the wall to the base of the footing.

9. Drainage systems behind the wall will be necessary. The drainage systems shall consist of 4-inch diameter pipe with weep-holes installed at the locations as indicated by Standard Drawing RGX 002-08 or by the Designer, and/or perforated pipe installed at the base of the wall and "daylighted" to promote dewatering of the granular backfill.

10. A plan note should be included by the Designer: Foundation excavations should be properly braced/shored to provide adequate safety to people working in or around the excavations. Bracing should be performed in accordance with applicable federal, state, and local guidelines.

11. A plan note should be included by the Designer: Structure excavation shall be completed just prior to foundation construction in order to prevent the bedrock from being exposed for an extended period of time and deteriorating. Rock excavation may be required to reach the required bearing elevation of the wall.

12. Prior to placement of any concrete or reinforcing steel in a foundation excavation, the excavation bottom should be clean, and all soft, wet, or loose materials should be removed. In no case should concrete be placed upon compressible or water-softened materials.

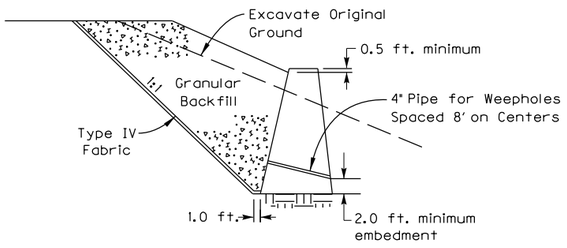
13. If the designer requires more information or would like to investigate other foundation alternates or wall types, contact Stantec.

14. Based on the results of the drilling, a clay filled zone was encountered in Boring No. B-18. It is recommended that this wall be constructed directly on existing foundation soils. If the zones near Boring No. B-18 are uncovered and not clay filled, the contractor should be prepared to refill those areas with properly compacted clay.

15. The contractor may encounter bedrock between Stations 14+40 to 14+60 during excavation for the base of the wall. The bedrock within the footprint of the wall should be undercut a minimum of 2 feet below the base of the wall. The resulting excavation shall be backfilled with approved soil material compacted in maximum eight inch loose lifts to a maximum dry density of 98 percent standard Proctor value at a moisture content within +/- 2 percent of optimum.

GRAVITY WALL GENERAL DIMENSIONS

Cast-in-Place Gravity Retaining Wall



Use the following soil strength parameters for design:

	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)
Retained Fill			
Granular Embankment	0	38	120
Foundation Soils			
Existing Clay	270	28	120

REVISION	DATE

DATE: JUNE, 2015	CHECKED BY
DESIGNED BY: AAC	
DETAILED BY: JRF	

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: GARRARD/MERCER

ROUTE: KY 152 | CROSSING: RETAINING WALL AT STA. 14+40

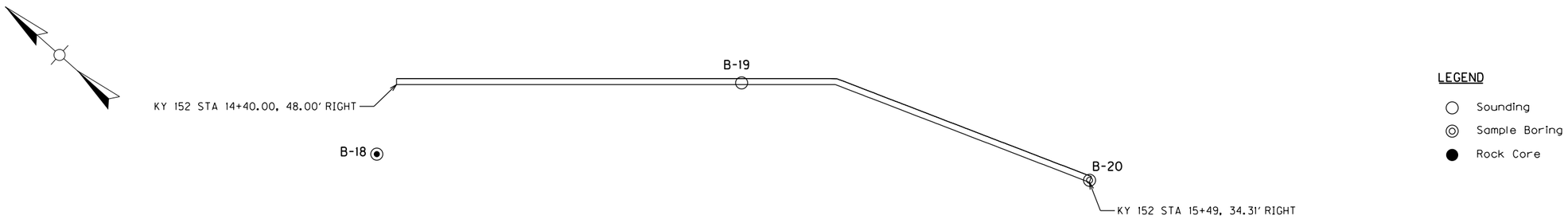
GEOTECHNICAL NOTES

ITEM NUMBER: 7-1116.00

PREPARED BY: Stantec

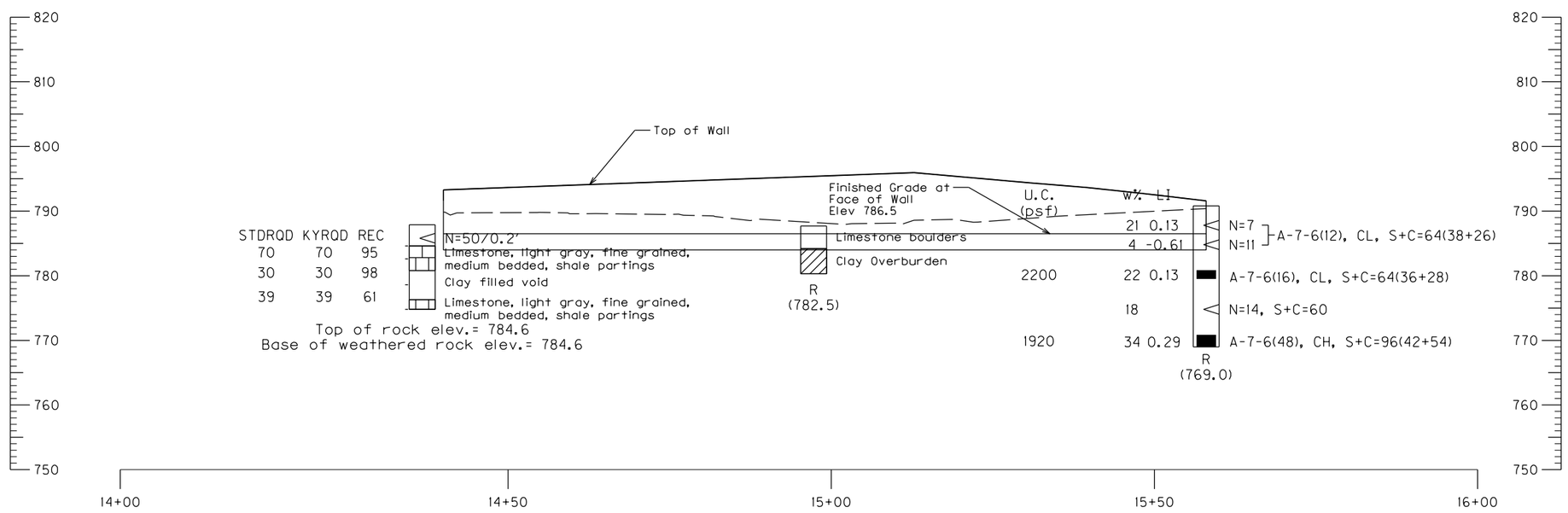
SHEET NO.

DRAWING NO.



BORING LAYOUT

SCALE: 1"=10'



NOTES:

1. This sheet presents geotechnical data and recommendations. Refer to project plans, profiles, and cross sections for final alignment and grade.
2. Surface elevations are referenced to Mean Sea Level.

SCALE: 1" = 10'
(Vertical Only)

REVISION	DATE
DATE: JANUARY, 2015	CHECKED BY
DESIGNED BY: AAC	
DETAILED BY: JRF	

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
GARRARD/MERCER

ROUTE **KY 152** | CROSSING **RETAINING WALL AT STA. 14+40**

LAYOUT AND PROFILE

ITEM NUMBER **7-1116.00**

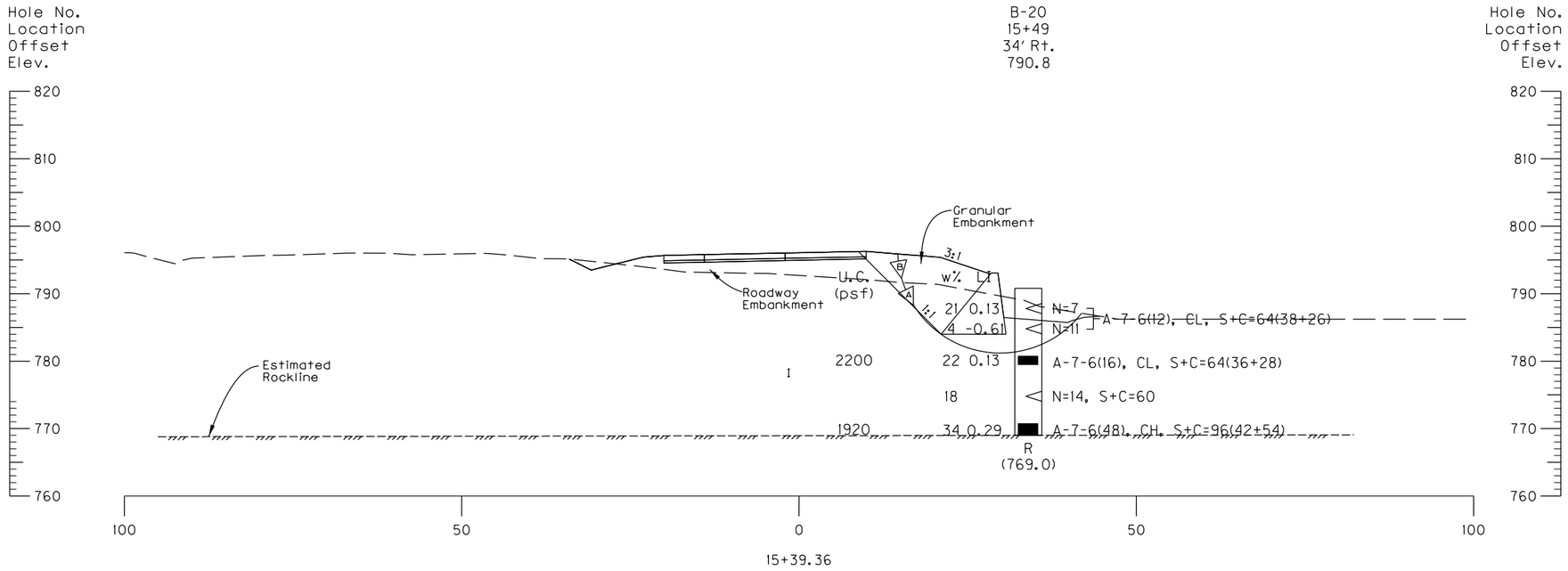
PREPARED BY Stantec

SHEET NO.

DRAWING NO.

FACTORS OF SAFETY		
SHORT TERM	A	3.9
LONG TERM	B	2.7

ESTIMATED SOIL STRENGTH PARAMETERS			
SOIL	I	ROADWAY EMBANKMENT	GRANULAR EMBANKMENT
SHORT TERM	γ = 120 pcf c = 1000 psf ϕ = 0°	γ = 120 pcf c = 1000 psf ϕ = 0°	γ = 120 pcf c = 0 psf ϕ = 38°
LONG TERM	γ = 120 pcf $\bar{c}$ = 270 psf $\bar{\phi}$ = 28°	γ = 120 pcf $\bar{c}$ = 270 psf $\bar{\phi}$ = 28°	γ = 120 pcf $\bar{c}$ = 0 psf $\bar{\phi}$ = 38°



NOTES:

1. This sheet presents geotechnical data and recommendations. Refer to project plans, profiles, and cross sections for final alignment and grade.
2. Surface elevations are referenced to Mean Sea Level.

SCALE: 1" = 10'
(Vertical Only)

Sheet 3 of 3

REVISION	DATE

DATE: JANUARY, 2015	CHECKED BY
DESIGNED BY: AAC	
DETAILED BY: JRF	

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
GARRARD/MERCER

ROUTE	CROSSING
KY 152	CROSS SECTION AT 15+39.36

STABILITY SECTION

ITEM NUMBER	PREPARED BY	SHEET NO.
7–1116.00	Stantec	DRAWING NO.

Appendix D

Coordinate Data Submission Form

COORDINATE DATA SUBMISSION FORM

KYTC DIVISION OF STRUCTURAL DESIGN -- GEOTECHNICAL BRANCH

County Mercer & Garrard **Date** 12/11/2014

Road Number KY 152

Survey Crew / Consultant WMB, Inc.

Contact Person James Napier, PE, PLS

Item # 7-1116.00

Mars # 84690

Project # BRO 5129, FD52 084 0152 018-019, FD 52 040 0152 000-001

Notes:

All boreholes were staked by WMB, Inc.'s field crew.
B-5, B-6, B-7, B-8, B-9, B-10 and B-11 were moved from their original locations a small distance. All these holes were drilled from a barge in Lake Herrington.
All holes were drilled by Stantec.

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

HOLE NUMBER	LATITUDE (Decimal Degrees)	LONGITUDE (Decimal Degrees)	HOLE NUMBER	STATION	OFFSET	ELEVATION (ft)
B-18	37.74550849	84.70603669	B-18	14+40.00	48.00' Rt	789.73
B-19	37.74539009	84.70590625	B-19	14+95.00	32.00' Rt	789.92
B-20	37.74524198	84.70581846	B-20	15+49.00	34.00' Rt	790.79