MEMORANDUM

TO: Jim Simpson, P.E.
Project Management Coordinator
Division of Highway Design

FROM: William Broyles, P.E.
Geotechnical Branch Manager
Division of Structural Design

BY: Jack L. Conway
Geotechnical Branch

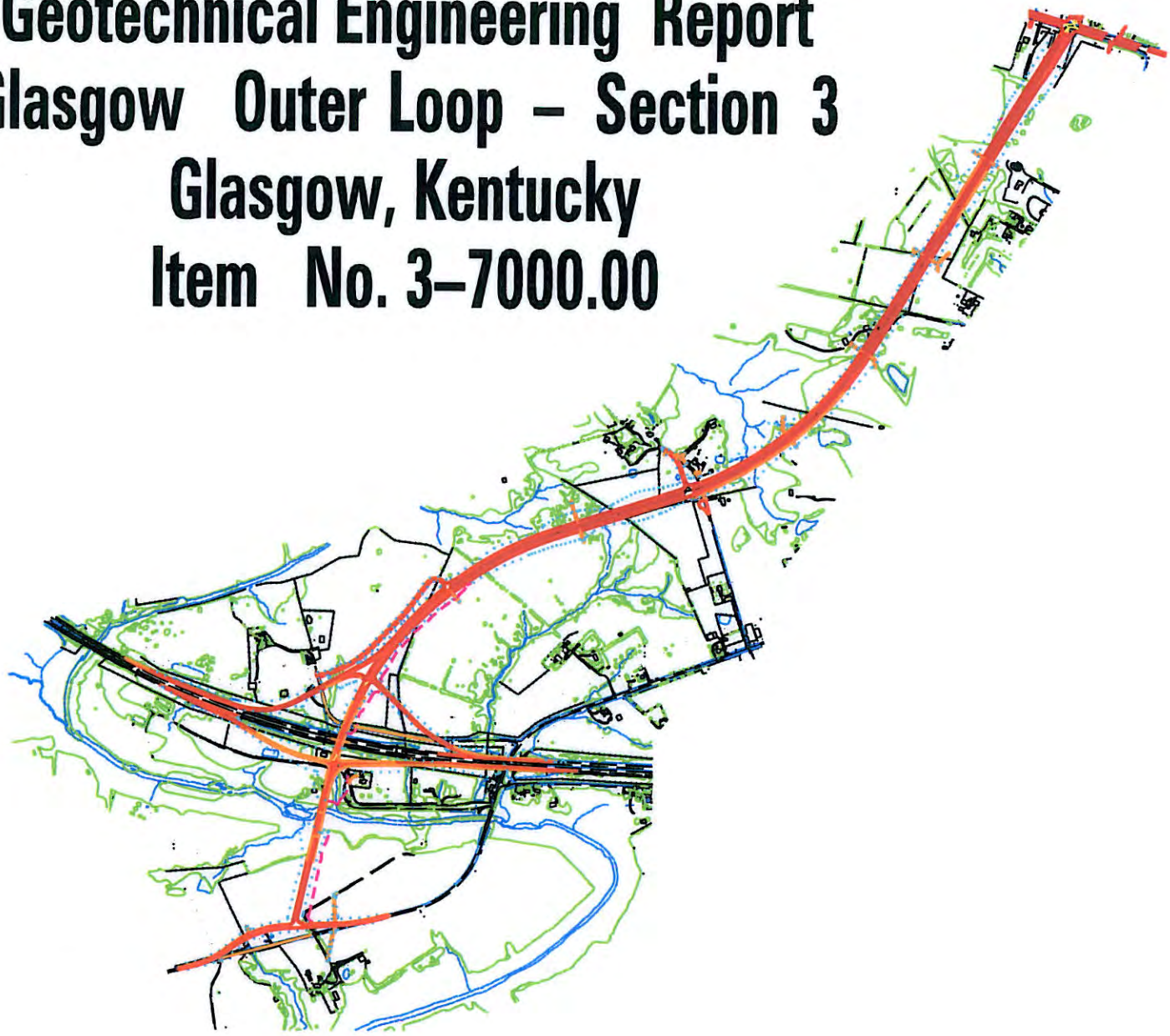
DATE: October 27, 2006

SUBJECT: Barren County
Glasgow Outer Loop – Section 3
Station 30+69.67 to 160+76.24
1100 C35 D625 FD04 1550 C005 E143
Item Number 3-7000.00
Mars Number 6565801D
Geotechnical Engineering Report

The geotechnical engineering report for the subject project has been completed by American Engineers, Inc. All drilling, sampling and testing were performed by the geotechnical consultant. The electronic files have been forwarded to AEI's design section for incorporation into the Roadway Plans. Attached is a copy of the report.

cc: Division of Design (Plan Processing Section)
TEBM for Pavement Design
Division of Construction
TEBM for Construction (Bowling Green) - 2 copies
TEBM for Preconstruction (Bowling Green)
American Engineers, Inc. (letter only)
Attachment

Geotechnical Engineering Report
Glasgow Outer Loop – Section 3
Glasgow, Kentucky
Item No. 3–7000.00



AEI
AMERICAN ENGINEERS, INC.
PROFESSIONAL ENGINEERING

AEI

AMERICAN ENGINEERS, INC.

PROFESSIONAL ENGINEERING

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October 25, 2006

Mr. Jack Conway, P.G.
Kentucky Department of Highways
Division of Structural Design
Geotechnical Branch
1236 Wilkinson Boulevard
Frankfort, KY 40601-1200

RE: Geotechnical Engineering Report
Glasgow, Kentucky
Section 3 Glasgow Outer Loop
Item No. 3-7000.00

Dear Mr. Conway:

American Engineers, Inc. (AEI) is pleased to submit the Geotechnical Engineering report for Section 3 of the Glasgow Outer Loop.

Results and updates of the field exploration, laboratory testing, and recommendations for design and construction of the roadway are presented in this report. A legend sheet, soil profile sheets, final cut stability sections and embankment stability sections are also included with this submittal.

If there are any questions or comments please do not hesitate to contact us.

Sincerely,
AMERICAN ENGINEERS, INC.

Kyle Barron

Kyle Barron, E.I.T.
Project Engineer

Dennis Mitchell

Dennis Mitchell, P.E.
Project Manager

Geotechnical Engineering Report
Glasgow Outer Loop
Section 3
Glasgow, Kentucky
Item No. 3-7000.00

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1 Location and Description

The Kentucky Department of Transportation is in the planning stage of constructing the third section of a bypass along the northwestern portion of the city of Glasgow in Barren County, Kentucky. Project plans developed by American Engineers, Inc. (AEI), indicate the new construction will consist of a four lane divided highway providing two lanes of traffic in either direction, with various frontage roads and access ramps. Section 3 of the Outer Loop will extend from KY 1297 to US 68/KY 80. The project begins at Mainline Station 30+69.67, near the intersection of the proposed centerline of KY 1297. From this point, the alignment travels in a northeastern direction then turns in an eastern direction for approximately 1 mile until it turns to the northeast again and ends at Mainline Station 160+76.24 which is approximately 140 feet from the existing centerline to US 68/KY 80. The project mainline is approximately 2.5 miles long.

In addition to the Outer Loop mainline, a section of KY 1297 will be realigned along with a new Frontage Road and a new approach for Bob Lewis Road. The new section of KY 1297 will begin at Station 36+50 and will intersect the Mainline at Station 50+00 (Mainline Station 30+50) and then proceed until it ends at Station 59+70. Project plans indicate that this new portion of KY 1297 will consist of a 2 lane undivided highway consisting of 12 foot lanes. Construction of the new Frontage Road will begin at Station 31+96.02 which is at an intersection point with the existing C. Morgan Road. The Frontage Road will continue for approximately 1,800 feet where it will end at Station 50+00 which intersects the Mainline at Mainline Station 70+25. The Frontage Road will consist of a 2 lane undivided roadway with 10 foot lanes. Bob Lewis Road will be divided by the Mainline with the section north of the Mainline receiving a new alignment. The alignment will start at Station 44+25, where it will tie into the existing Bob Lewis Road and it will end at Station 50+00.09 which is where it ties into Mainline Station 70+25. The new alignment for Bob Lewis Road will be a 2 lane undivided roadway with 9 foot lanes.

The project includes the construction of two (2) new bridges and widening of an existing bridge. The first bridge will be constructed over Beaver Creek at Mainline Station 42+22. This bridge will be a 2 span PCIB Type VII structure. The second bridge will be constructed over the existing Louie B. Nunn Parkway at Mainline Station 50+57.07. This bridge will also be a 2 span PCIB Type VII structure. The existing Louie B. Nunn Parkway bridge over KY 1297 will be widened for ramp additions. At Parkway Station 70+55.72 right of centerline, the existing structure will be widened for the construction of

Ramp 1. Ramp 1 will begin at Station 97+57.89 and ends at Station 125+40.94. At Parkway Station 70+83.53 left of centerline, the existing structure will be widened for the construction of Ramp 4. Ramp 4 begins at Station 400+00 and ends at Station 421+96 (Mainline Station 58+00). Ramp 2 will begin at Station 200+00 and end at Station 220+35.71 (Mainline Station 47+88). Ramp 3 will begin at Station 295+75.06 and end at Station 328+11.13. Each ramp will be a single 15 foot lane. The reports of the geotechnical explorations for these structures will be issued under separate covers.

The proposed alignment is illustrated on a portion of the Glasgow North and Glasgow South USGS 7½ Minute Topographic Maps as well as on the USGS Geologic Quadrangles for Glasgow North and Glasgow South, both found in Appendix 1.

2 Topography and Drainage

The project is located in the southern portion of Central Kentucky within the Pennyrile (Mississippian Plateau) Physiographic Region. This region is typically underlain by Mississippian aged limestones. The topography of the region can be characterized as a moderately to deeply dissected upland area. Natural stream erosion through the stratified sedimentary bedrock has produced a dendritic drainage pattern. The proposed alignment will traverse drainage swales which direct surface water to Beaver Creek and its tributaries. Low lying areas adjacent to these drainage swales have the tendency to become wet and soft during periods of precipitation.

The maximum natural topographic high for the project occurs at Mainline Station 145+50 with an elevation of 789 feet. The maximum natural topographic low for the project occurs at Mainline Station 43+00 with an elevation of 577 feet therefore the maximum topographic relief for the project is 212 feet. The maximum vertical relief along the finished grade of the Mainline alignment is approximately 112 feet with the highest point being at Station 150+00 which has an approximate elevation of 766 feet. The lowest point along the alignment occurs at Station 52+50 with an approximate elevation of 654 feet.

3 Geology

Available geologic mapping (*USGS Geologic Map of the Glasgow North and Glasgow South Quadrangles, Kentucky 1963 & 1965)* indicates that the project is underlain by alluvium, the Salem and Warsaw Limestone formation of the Upper Mississippian Series, and the Fort Payne Formation (in general descending order of lithology) of the Lower Mississippian Series.

The alluvium is found in larger stream valleys and is described as poorly sorted clay, sand, and gravel.

The Salem and Warsaw limestone formation is described as medium dark gray, coarse to very coarse grained, thick bedded with faint to prominent light gray silty and argillaceous laminae. The shale is described as dark blueish gray to olive gray, fissile, silty,

calcareous, and fossiliferous. The dolomitic siltstone found within this formation is described as light yellowish gray to medium gray banded by light to medium dark gray laminae. This siltstone weathers along laminae to shaly and flaggy fragments and to yellowish brown residual soil. Karst features in the Salem and Warsaw limestone formation are not as common as in the overlying St. Louis Limestone, but the possibility of karst features in the subsurface could exist.

The Fort Payne Formation consists of dolomitic limestone, clastic limestone, and dolomitic siltstone. The dolomitic limestone is described as being cherty and banded by light yellowish gray to medium dark gray laminae and is fine to medium grained and medium to thick bedded. The clastic limestone is light yellowish gray to light gray, very coarse grained and very thick bedded to massive. It is locally crudely crossbedded and consists of poorly sorted fragments of crinoid stems and subordinate amounts of other fossil debris. The dolomitic siltstone is lithologically similar to that in the Salem and Warsaw Limestone. Formation is deeply weathered to yellowish brown residual soil containing fragments and nodules of chert, quartz geodes, and silicified segments of crinoid stems.

Structure contours, drawn on the top of the unexposed Chattanooga Shale which is in the Upper Devonian Series and lies beneath the Fort Payne Formation, show the bedrock to be relatively level, dipping approximately 1% to the northeast. No faults or other geologic features are shown in the immediate vicinity of the site. The geologic mapping does indicate that commercial quantities of natural gas and oil have been produced within the region. Numerous active and abandoned oil wells are shown within the vicinity of the project with most being to the northwest of the proposed beginning of the project.

The geologic map of the Glasgow South Quadrangle depicts numerous enclosed drainage basins and other potential karst features attributed to the Salem and Warsaw Limestone Formation. As it pertains to the proposed alignments, there are no enclosed drainage basins or depressions on the project mapping.

4 Drilling and Sampling

4.1 General

A boring plan was developed by AEI and approved by the KYTC Geotechnical Branch of the Division of Structural Design for the proposed alignments. This boring plan was the basis for the field staking which occurred concurrent with AEI's mobilization of field crews and equipment. The Geotechnical Branch's Memorandum dated January 7, 2003 concerning the boring plan may be found in Appendix II. This original boring plan was modified on March 12, 2003, due to changes recommended by the KYTC Geotechnical Branch. These supplemental boring plans can also be found in Appendix II.

Drilling and sampling operations were conducted by AEI personnel beginning in January of 2004. Drilling operations included rock core borings, disturbed and undisturbed soil sampling and rockline soundings. Drilling was performed using truck-mounted drill rigs

assisted by a bulldozer. Subsurface information was not obtained for the mainline alignment at station 46+00 and the Ramp 2 alignment at stations 208+00, 211+00, and 214+00 due to access being denied to AEI drill crews and equipment by the property owners.

4.2 Rock Core Borings

Rock core borings were drilled at critical cut sections along the roadway alignments. These cores were logged in the field by AEI's field geologist. Once the borings were completed, the cores were taken to AEI's Glasgow, Kentucky office where the logs were finalized by the project geologist. The depth to the rock disintegration zone (RDZ), percent recovery, and rock quality designation (RQD) were determined for each core run. The predominant rock types in the project area are limestone and shale. Detailed rock core descriptions can be found on the cut stability sections in Appendix III. When the overburden depth was greater than ten (10) feet an offset boring was performed and an observation well installed. Undisturbed soil samples were obtained from the offset borings for triaxial and soil classification testing.

4.3 Disturbed Soil Sampling

Soil borings were completed on approximate 200-foot intervals along the proposed roadway alignments to provide information concerning the types and thicknesses of the residual soils. These borings were performed using 3¼ inch continuous flight hollow stem augers and a truck-mounted drill rig. The on-site geologist logged the soil cuttings, which were sampled from the auger flights. Particular attention was given to the colors, textures, plasticities, relative moisture contents, and consistencies of the recovered materials. Soil cuttings were collected from each boring at regular depth intervals to provide samples for natural moisture content testing. Bulk samples of predominant soil types were obtained to provide samples for engineering classification, moisture-density, and California Bearing Ratio (CBR) testing, as necessary. Logs of the soil profile borings are shown on the soil profile sheets included in Appendix III.

4.4 Undisturbed Soil Sampling

Sample borings were drilled at critical embankment locations and at cut stability locations where the overburden depths at rock core locations exceeded ten (10) feet. Undisturbed thin-walled (Shelby) tube samples were collected on five (5) foot intervals to provide samples for shear-strength and unconfined compressive strength testing. Standard Penetration Tests (SPT) were performed in borings which produced poor Shelby Tube recoveries due to granular soils, or rock and gravel fragments. Selected undisturbed samples were selected for consolidated-undrained triaxial compression tests, unconfined compressive strength and soil classification testing. Logs of these borings are depicted graphically on the stability sections in Appendix III.

4.5 Rockline Soundings

Rockline soundings were drilled along the alignments during the field exploration. Generally, rockline soundings were drilled at the left and/or right ditchline, and/or the centerline every 100 feet throughout the cut intervals to provide top of rock information. This rock information was used to supplement top or rock data obtained by the disturbed soil borings and rock cores. This information indicates that the depths to bedrock vary significantly across the project. These varying top of rock depths are characteristic of the limestone formations found within the project area and this region of the state. Summary tables of the rockline sounding information can be found on the cut stability sections in Appendix III.

5 Laboratory Testing and Results

5.1 General

All laboratory tests, with the exception of triaxial compression tests, were performed by AEI. Each test was performed in accordance with applicable AASHTO and Kentucky Methods of soil and rock testing specifications. The results of the laboratory testing are depicted on the appropriate soil profile sheets and stability sections in Appendix III.

5.2 Disturbed Soil Drilling and Testing

Soil classification tests, which include particle size analyses, Atterberg limits, and specific gravities, were performed on selected bulk samples obtained from the disturbed soil borings. The selected samples were representative of soils encountered in fill sections. In addition to the soil classification tests, standard Proctor moisture density, and CBR tests were performed on selected bulk samples representative of the predominant soils encountered within cut sections.

Soil thicknesses varied from three (3) feet to thirty one (31) feet with an average thickness of 13.3 feet in the borings performed along the alignments. The predominant soil types along the alignment are CH (51%) with lesser instances of CL (40%) and ML (9%) according to the Unified Soils Classification System (USCS), and as A-7-6 (56%), A-6 (23%), A-4 (16%) and A-7-5-11 (5%) according to the AASHTO classification system. A summary of laboratory testing of bulk samples can be found in Appendix IV.

CBR test results for the bag samples ranged from 1.5 for Soil 15, which classified as a CH at Mainline Station 89+85, to 10.1 for Soil 16 which classified as a CL material located at Mainline Station 92+00. At KY 1297 Station 44+00, a CBR test was performed which resulted in a 10.1 for Soil 29 which classified as a CL material. A design CBR value of two (2) was estimated for this project utilizing Yoder's 90^{th} percentile method.

Natural moisture contents were determined from the soil cutting samples taken from the disturbed soil borings. In general, these test results indicate that the soils can be

categorized as damp to wet based on a range of dry, damp, moist, wet and saturated moisture conditions. In general, the moisture contents of the soils encountered were above or near their plastic limits.

The soils encountered in the borings along the alignment are residual which means they were derived in-situ from a weathering process of the parent rock formations. Excavations in these soils will encounter occasional bedrock remnants in the form of rock fragments or slabs of various sizes as well as chert fragments and layers. Topsoil thicknesses ranged from approximately 0.1 feet to 2 feet with average thickness of 0.6 feet.

5.3 Undisturbed Soil Testing

Undisturbed (Shelby) tube samples were obtained from critical embankment stability locations, as well as critical cut stability locations where the overburden was greater than ten (10) feet deep. Soil samples were extruded from the tubes and trimmed into six-inch specimens. These specimens were described visually along with obtaining wet and dry unit weights and natural moisture contents. Specimens were selected for soil classification, unconfined compressive strength testing, unconsolidated-undrained triaxial testing, and consolidated-undrained triaxial testing. The results of these tests are indicated graphically on the corresponding cross-sections in Appendix III and are discussed in the following sections.

5.3.1 Engineering Classification Testing

Soil classification testing was conducted on six-inch sections of the extruded undisturbed tube specimens obtained during the field exploration. The majority of the tube samples represent residual soils derived from the chemical and physical in-place weathering of the parent bedrock. The results of the laboratory classification testing of the undisturbed tube samples are shown in Table 1 below.

Table 1: Summary of Laboratory Classifications of Undisturbed Tube Specimens

USCS Classification	Percentage of Samples Tested	AASHTO Classification	Percentage of Samples Tested
CL	41	A-2-7	1
CH	44	A-4	6
ML	1	A-6	27
CL-ML	1	A-7-5	3
GC	9	A-7-6	63
SC	3		
SM	1		

5.3.2 Strength Testing

Unconfined compressive strength testing was performed on selected undisturbed tube samples to provide information from which total stress shear-strength parameters could be estimated. The values of the unconfined compressive strength testing ranged from 259 psf to 2550 psf. The results of the unconfined compressive strength tests are presented on the appropriate stability sections in Appendix III and summarized in Appendix IV.

5.3.3 Consolidated-Undrained Triaxial Testing

Consolidated-undrained (CU) triaxial testing with pore pressure measurements was performed on selected six-inch specimens cut from extruded undisturbed tube samples. These tests were performed to determine the effective stress shear-strength parameters to be used in intermediate term and long term loading conditions during slope stability analyses. The results of the CU triaxial tests are depicted on the appropriate stability sections in Appendix III and are summarized in Appendix IV.

6 Slope Stability and Settlement Analyses

6.1 Slope Stability Analyses

6.1.1 Cut Stability Analyses

Cut slope recommendations were based upon review of the rock cores obtained at critical cut sections, soil thickness at these locations, associated laboratory testing and slope stability analyses, local geology, and AEI's experience from past design of cut slopes with similar subsurface conditions.

Critical soil cut sections were evaluated for intermediate term and long term slope stability. The REAME (Rotational Equilibrium Analyses of Multi-Layered Embankments) computer program was utilized to perform the analyses. The REAME program assumes a circular (rotational) failure surface and calculates the factor of safety based on the Simplified Bishop method of slices. Intermediate term analysis uses effective stress shear strength parameters of the residual materials to simulate conditions after excess pore pressures have dissipated and the groundwater table is positioned at its maximum anticipated height within the cut. Long term analysis uses effective stress shear strength parameters to simulate conditions that will exist long after the cut is constructed and excess pore pressures within the materials have dissipated and the groundwater table has been lowered due to the presence of the cut. For the long term loading condition, the KYTC requires that the effective cohesion of the materials be reduced by 80% to account for the potential swelling and softening of cohesive material upon exposure in cuts.

The KYTC Geotechnical Manual presents target factors of safety for slope stability situations. These values are summarized in Table 2.

Table 2. Slope Stability Analysis Target Factors of Safety				
	Short Term	Intermediate Term	Long Term	Rapid Drawdown
Roadway Embankments	1.1-1.3	***	1.4-1.6	1.0-1.2
Bridge Approach Slopes	1.2-1.4	***	1.6-1.8	1.0-1.2
Cut Slopes in Soil	1.2-1.4	1.2-1.4	1.4-1.6	***

Based on a review of the soil types and thicknesses encountered within the cut intervals, the majority of cuts will be made in cohesive soils. Shear strength parameters for the residual materials were derived from soil classification data and consolidated-undrained triaxial shear strength tests discussed in section 5 of this report. Some parameters were taken from the Naval Facilities Engineering Command Design Manual 7.02.

Results of slope stability analyses, including predicted minimum factors of safety and failure surfaces, assigned soil shear strength parameters, and modeled groundwater table positions are presented on the appropriate cut stability sections in Appendix III. A summary of the results of the cut stability analyses is provided in Table 3.

Table 3. Summary of Cut Stability Analyses				
		Slope Geometry	Factors of Safety	
Station	Offset	(H:V)	Intermediate Term	Long Term
Mainline				
33+00	Left	2:1	3.8	1.5
57+00	Right	2:1	5.4	2.0
70+00	Right	2:1	4.9	2.0
77+00	Left	2:1	2.4	1.5
85+00	Left	3:1	2.7	1.5
92+00	Left	2.5:1	1.8	1.5
95+00	Left	2.5:1	2.3	1.4
125+00	Left	2:1	7.1	2.7
149+00	Left	2:1	4.6	1.7
153+00	Left	2:1	2.7	1.4
157+00	Right	2:1	2.1	1.5
KY 1297				
47+00	Right	2:1	3.2	1.5
Ramp 3				
312+50	Right	2.5:1	2.2	1.5
Ramp 4				
415+00*	Right	2:1	*	*

* Cut stability analyses were not performed at Station 415+00 along alignment Ramp 4 due to the overburden depth of the rock core being less than 10 feet in depth. It is assumed that 2:1 (H:V) slopes in this cut interval will be acceptable.

As can be seen in Table 3, 2.5:1 (H:V) and 3:1 (H:V) soil slopes are required at a several stations to meet the minimum KYTC target factor of safety. The cut interval from Mainline Station 74+00 to Station 99+00 shows the acceptable factors of safety transition from a 2:1 (H:V) to 3:1 (H:V) then end with slopes of 2.5:1 (H:V). Since the 3:1 (H:V) is the controlling slope, it is recommended that this cut interval maintain this slope throughout. In the cut interval from Mainline Station 145+50 to Station 160+76, the 3:1 (H:V) slope is only required by a single station. It is recommended that the 3:1 (H:V) slope be constructed throughout this cut interval to maintain uniformity. For the purposes of maintaining a uniform soil slope, all stations within a cut interval were evaluated based on the same slope geometry. Table 4 summarizes the slope geometries recommended to achieve the minimum KYTC target factor of safety within each cut interval.

A cut stability analysis was performed along the Ramp 3 alignment at Station 312+50 which resulted in a 2.5:1 (H:V) to achieve a passing factor of safety. At approximately Ramp 3 Station 310+00 100 feet right, there exists Parrish Cemetery. A cut stability analysis was performed at Station 310+00. Since an undisturbed soil boring was not performed at this location, a cross section was cut at this station and the parameters used for the cut stability section at Station 312+50 were duplicated. Upon performing a long term and intermediate term analysis for this station, it was determined that 2:1 (H:V) slopes would be acceptable for Stations 309+00 through 310+50 and from there they should transition to a 2.5:1 (H:V) slope for the remainder of the cut interval.

Table 4. Recommended Soil Slope Geometries within Cut Intervals

Cut Interval	Recommended Soil Slope Geometry (H:V)	Cut Interval	Recommended Soil Slope Geometry (H:V)
Mainline		**KY 1297**	
30+00 - 37+00	2:1	41+00 – 56+00	2:1
55+00 - 61+00	2:1	**Ramp 3**	
66+00 – 72+00	2:1	309+00 - 314+00*	2.5:1
74+00 - 99+00	3:1	**Ramp 4**	
123+50 - 128+00	2:1	413+00 – 417+00	2:1
145+50 - 160+76	2:1		

* See the previous paragraph for information concerning this cut interval.

** Cut stability analyses were performed assuming the cut slopes at maximum steepness allowed with the minimum required factors of safety maintained. However, the slopes may be flatter as determined by the deign engineer. Cut stability sections showing the results of these analyses are included in this report.

The bedrock encountered in the rock core borings drilled along the project route correlates well with the available geologic mapping. The cores were obtained at critical cut sections and consist primarily of limestone and shale. The limestone belongs to the Salem and Warsaw Formation and to the Fort Payne Formation, while the shale belongs to the Salem and Warsaw Formation. The Salem and Warsaw Limestone is described as

being a medium dark gray, coarse to very coarse grained, thick bedded, containing faint to prominent light gray silty and argillaceous laminae. This formation contains dolomitic siltstone which weathers along laminae to shaly, flaggy fragments and to yellowish brown residual soil.

The Fort Payne Formation is described as having dolomitic limestone, clastic limestone, and dolomitic siltstone. The dolomitic limestone is cherty, banded by laminae, fine to medium grained, and medium to thick bedded. The clastic limestone is very coarse grained, very thick bedded to massive which is crudely crossbedded and consists of poorly sorted fragments of crinoid stems and other fossil debris. The dolomitic siltstone is deeply weathered to yellowish brown residual soil containing fragments and nodules of chert, quartz geodes, and silicified segments of crinoid stems. The base of the RDZ noted at each rock core position is based upon visual observations of the recovered rock cores.

6.1.2 Embankment Stability Analyses

Critical embankment sections were evaluated for the short term and long term conditions using REAME. Short term analyses, using total stress strength parameters for foundation and embankment materials, simulate conditions that will exist immediately following completion of the embankments. Long-term analyses, utilizing effective stress shear strength parameters simulate conditions that will exist long after the embankment is constructed and excess pore pressure has dissipated. Table 2 indicates the KYTC's required target factors of safety.

Based on subsurface conditions encountered along the project alignment, it is apparent that the majority of material available for embankment construction will consist of cohesive soils from roadway excavation. Shear strength parameters for the embankment and foundation soils were derived from the soil classification test suite, unconfined compressive strength tests and consolidated undrained triaxial shear strength tests described in Section 5 of this report. Some parameters were taken from the Naval Facilities Engineering Command Design Manual 7.02. Shear strength parameters used for the embankment and foundation materials are shown on the appropriate embankment stability sections in Appendix III.

Results of slope stability analyses, including predicted minimum factors of safety, predicted failure surfaces, and modeled groundwater table positions are present graphically on the appropriate stability sections in Appendix III. A summary of the results of the embankment stability analyses can be found in Table 5.

Table 5. Summary of Embankment Stability Analyses				
			Factors of Safety	
Station		Slope Geometry	Short Term	Long Term
Mainline				
40+00*	Left	2:1	1.8	1.6
49+00*	Left	2:1	1.5	1.6
105+00	Left	2:1	1.8	1.4
142+00	Right	2:1	2.2	1.9
Ramp 1				
107+00	Right	2:1	2.2	1.9
Ramp 2				
218+00	Right	2:1	1.4	1.4

* These sections include granular embankment construction.

As can be seen in Table 5, 2:1 (H:V) soil slopes are sufficient to meet the minimum KYTC target factors of safety.

7 Special Considerations

7.1 Sinkholes

Although no enclosed drainage basins or depressions were identified within the construction limits of this project, there are several depicted on the Glasgow South Quadrangle. These features are typical of this region of the state where karst activity is common.

Rock coring operations encountered voids or clay seams in the bedrock at various locations along the proposed alignments. See Geotechnical Note 8.26 for recommendations regarding sinkhole repair in the event that a surface opening presents itself.

Although this area does not appear to have an abundance of sinkholes, the Salem and Warsaw Limestone formation is known to be susceptible to the development of karst features. The project area is susceptible to future karst related problems due to groundwater removing soil particles via underground streams and to ground subsidence due to collapsed voids or caverns within the bedrock. Although this is not considered a serious hindrance to roadway construction, there are no assurances that future problems related to karst activity will not occur.

7.2 Special Embankment Requirements

In order to achieve the minimum required factor of safety for the embankment at Mainline Stations 40+00 and 49+00, it will be necessary to place Granular Embankment

Material at the base of the embankment on both the left and right sides. Please refer to the appropriate embankment stability section in Appendix III.

8 Geotechnical Notes

8.1 Clearing and grubbing of embankment areas shall be performed in compliance with Section 202 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

8.2 Removal of any existing structures and other obstructions shall be performed in accordance with Section 203 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

8.3 Erosion control and water pollution prevention measures shall be performed as necessary to maintain compliance with Sections 212 and 213 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

8.4 In accordance with Section 206 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction, all channel changes and special ditches shall be constructed prior to placement of any embankment materials adjacent to them. Materials excavated from these areas may be utilized in construction of the embankments, but may require aeration to the proper moisture contents prior to compaction, handling, hauling, stockpiling and/or manipulating these materials.

8.5 The moisture content of embankment and subgrade materials shall not vary from the optimum moisture, as determined by KM 64-511, by more than plus or minus two (2) percent. This moisture content requirement shall have equal weight with the density requirement when determining the acceptability of embankment or subgrade construction, as is stated in Section 206 and 207 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

8.6 All soils, whether from roadway excavation or borrow, may require manipulation to obtain proper moisture contents prior to compaction. Direct payment shall not be permitted for re-handling, hauling, stockpiling, and/or manipulation of soils.

8.7 The Contractor shall conduct grading operations in such a manner that soil from roadway excavation can be stockpiled separately or otherwise manipulated so that ample quantities are available for a chemically stabilized roadbed meeting specifications in Section 208 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Remnant layers of limestone and chert were encountered during drilling operations in the soil overburden. These zones may require special handling during construction by the Contractor so that the proposed soil subgrade materials are essentially free of

remnants, boulders and large rock fragments, which if included in the subgrade might create less uniform and undesirable conditions. No extra payment shall be permitted for rehandling, hauling, stockpiling, and/or manipulating these materials.

8.8 The Contractor shall conduct grading operations in such a manner that limestone obtained from roadway excavation can be stockpiled separately or otherwise manipulated so that ample quantities are available for those areas requiring said material. No direct payment will be allowed for such necessary manipulation as stockpiling, double handling the material, and/or hauling. Limestone shall not be wasted unless prior approval is obtained from the Engineer.

8.9 The Contractor is responsible for conducting any operations necessary to excavate the cut areas to the required typical sections. The cost of these operations shall be incidental to the earthwork.

8.10 Additional stripping and/or undercutting may be required at the following approximate locations, and other locations, to provide for the removal of any deep organic materials present within pasture fields and other areas and as directed by the Engineer.

Approximate Station Locations	
Mainline	**KY 1297**
32+00	50+00
34+00	**Ramp 1**
40+00	103+00
67+00	106+00
68+00	107+00
83+00	**Ramp 2**
86+00	218+00
146+00	**Ramp 4**
148+00	414+00
	416+00
	418+00

8.11 As directed by the Engineer, adequate drainage shall be provided for any natural spring outlets encountered within the construction limits, whether shown on the plans or not, by constructing spring box inlets, if there is a defined throat, in accordance with the Kentucky Department of Highways Standard Drawings RDX-010-04 or RDX-011-04. The outlet pipes should extend to the downstream embankment toes for discharging water onto exterior grades. If there is no defined throat then a one (1) foot drainage blanket wrapped with Type IV Geotextile Fabric shall be used.

8.12 As directed by the Engineer, existing bituminous concrete located at a distance greater than three feet below the proposed subgrade elevation within the limits of

new roadway embankments, shall be scarified or broken until all cleavage planes are destroyed, or the pavement shall be removed entirely as conditions demand. This shall be performed in compliance with Section 206 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Subgrade materials remaining after removal of pavements may need to be stabilized prior to placement of new pavement sections, as directed by the Engineer.

Approximate Station Limits
Mainline
52+20 – 52+40

8.13 As directed by the Engineer, existing bituminous concrete, at the following approximate location, which is positioned less than three feet from proposed subgrade level shall be undercut a minimum of two feet beneath proposed subgrade level and backfilled with suitable subgrade material.

Approximate Station Limits
Ramp 4
411+90 – 412+20

8.14 Any saturated and soft subgrade soils encountered during subgrade preparations within new cuts shall be drained and stabilized using a twelve (12) inch thick lift of non-erodible Granular Embankment meeting the requirements of Section 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. The coarse aggregate shall be wrapped (top and bottom) with Type IV Geotextile Fabric in accordance with Sections 214 and 843 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. In addition, a four (4) inch diameter pipe underdrain system shall be installed within the coarse aggregate and daylighted on the outslope at the appropriate locations to reduce the possibility of trapping water beneath the pavement subgrade.

Approximate Station Limits	
Mainline	**KY 1297**
31+00 – 37+00	41+00 – 43+00
38+00 – 39+00	45+00 – 49+00
55+00 – 57+00	**Ramp 4**
59+00 – 61+00	419+50 – 421+00
67+00 – 71+00	**Bob Lewis Road**
74+00 – 81+00	45+00 – 47+00
85+00 – 87+00	**Frontage Road**
93+00 – 99+00	37+00 – 39+00
147+00 – 149+00	
151+00 – 153+00	

8.15 Any saturated, soft, and unstable areas encountered within embankment foundation limits and/or any other areas as specified by the Engineer shall be drained and stabilized using a twelve (12) inch thick lift of non-erodible Granular Embankment meeting the requirements of Section 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. The coarse aggregate shall be wrapped (top and bottom) with Type III Geotextile Fabric in accordance with Sections 214 and 843 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. A minimum 1-foot thick working platform shall be constructed in such areas.

For use in establishing bid quantities, it is recommended that the quantities of coarse aggregate and fabric be based on stabilizing the following approximate intervals:

Approximate Station Limits	
Mainline	**Ramp 3**
38+00 – 39+00	303+00 – 305+00
72+00 – 74+00	**Frontage Road**
101+00 – 103+00	33+00 – 35+00

8.16 As directed by the Engineer, a two-foot thickness of broken limestone excavated from beneath the RDZ, or other suitable materials, shall be utilized to fill full-width and stabilize the existing drainage swales or stream channels located within the limits of the roadway embankment. The broken rock material shall also be placed over all adjacent areas that may be soft and saturated. Positive drainage of these abandoned stream channels shall be maintained to reduce the possibility of trapping water within the roadway embankments.

For use in establishing bid quantities, it is recommended that the quantities of coarse aggregate be based on stabilizing the following approximate stations:

Approximate Station Limits	
Mainline	**Ramp 3**
72+00 – 74+00	303+75
87+50 – 88+25	**Ramp 4**
104+75	417+00 – 419+00
142+00 – 143+50	**Frontage Road**
Ramp 1	33+50 – 35+00
107+00 – 108+00	

8.17 Embankment foundation benches/slope serrations and perforated pipe underdrains shall be constructed at the following approximate locations in accordance with Standard Drawings RGX-010 and RDP-006, project cross-sections, and as directed by the Engineer. The benches shall be constructed one at a time

beginning with the lowest bench. Each bench shall be backfilled prior to the excavation of the next bench.

Approximate Station Limits	
Mainline	**Ramp 1**
39+00 – 40+50	109+00 – 112+00
103+50 – 104+00	

8.18 The pond located at Ramp 2 Station 213+00 80' Right is within a roadway embankment area and shall be entirely or partially drained, as directed by the Engineer. Soft/saturated material shall be removed and/or stabilized prior to construction of the embankments. Stabilization shall be in accordance with Geotechnical Note 16.

8.19 Conventional transverse benches shall be constructed and perforated pipe underdrains installed at the following approximate locations in accordance with Kentucky Department of Highways Standard Drawings RDP-005 and RDP-006, project cross-sections (as applicable), and as directed by the Engineer. Contrary to Standard Drawing RDP-006, transverse benches and perforated pipe underdrains shall be installed in both uphill and downhill transition areas between cuts and fills.

Approximate Station Limits	
Mainline	**KY 1297**
36+70	40+50
53+90	**Ramp 3**
61+25	301+00
65+65	305+20
71+80	**Ramp 4**
74+00	416+75
87+50	419+60
99+60	**Frontage Road**
123+50	32+80
127+80	36+00
135+00	42+10
145+50	48+90

8.20 Perforated pipes for subgrade drainage shall be installed at vertical sags and at the upgrade ends of structures, in accordance with Kentucky Department of Highways Standard Drawing RDP-005 and/or as directed by the Engineer. Contrary to Standard Drawing RDP-005, such drains shall be installed even when a rock roadbed is being constructed. These drainage features shall be installed at the following approximate locations:

Approximate Station Locations	
Mainline	**Ramp 2**
39+65	207+75
49+30	**Ramp 3**
52+50	314+00
125+50	**Ramp 4**
KY 1297	403+90
48+00	413+00
Ramp 1	**Bob Lewis Road**
109+00	49+00
118+90	**Frontage Road**
	34+00

8.21 Subsurface information has not been obtained at the following stations because of denied access to the property by the landowner.

Approximate Station Locations	
Mainline	**Ramp 2**
46+00	208+00 – 214+00

8.22 Although no obvious surface openings were noted in the surface depressions listed in Section 3, in the course of geotechnical exploration, it is possible that such features may be encountered during roadway construction. Unless otherwise specified, all open sinkholes and/or solution cavities within the limits of construction which are not to accept drainage, whether shown on the plans or not, shall be filled and/or capped in accordance with Section 215 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction, and as directed by the Engineer.

8.23 The bridge approach embankment sections shall include pile cores at the end bent locations to facilitate installation of the foundation systems. The core material shall be free of rock fragments larger than three (3) inches maximum dimension, and any other obstructions which would interfere with foundation installation. Construction of the pile cores shall be in accordance with KYTC Special Provision No. 69 (current edition), Standard Drawings RGX-100 and RGX-105 and Sections 206 and 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Erodible materials shall not be used in construction of pile cores.

8.24 Recommendations for design and construction of the bridges and their approach embankments to be constructed on this project have not been provided since structure layouts are not yet available. AEI will provide recommendations upon completion of the field exploration and subsequent laboratory testing and engineering analyses.

9 Design Recommendations

9.1 An average soil shrinkage value of two (2) percent is recommended for soil to be excavated on the project. This value is to be used in calculating an "apparent" shrinkage value in accordance with Section 61-03.04160 of the Kentucky Transportation Cabinet Division of Design Guidance Manual. This shrinkage value should be applied only to soil positioned above the top of rock. A shrink/swell value of zero (0) should be applied to Rock Disintegration Zone (RDZ) Material.

9.2 The recommended rock swell factor is fifteen (15) percent for material excavated below the RDZ.

9.3 The project shall be designed for a soil subgrade utilizing a CBR value of two (2).

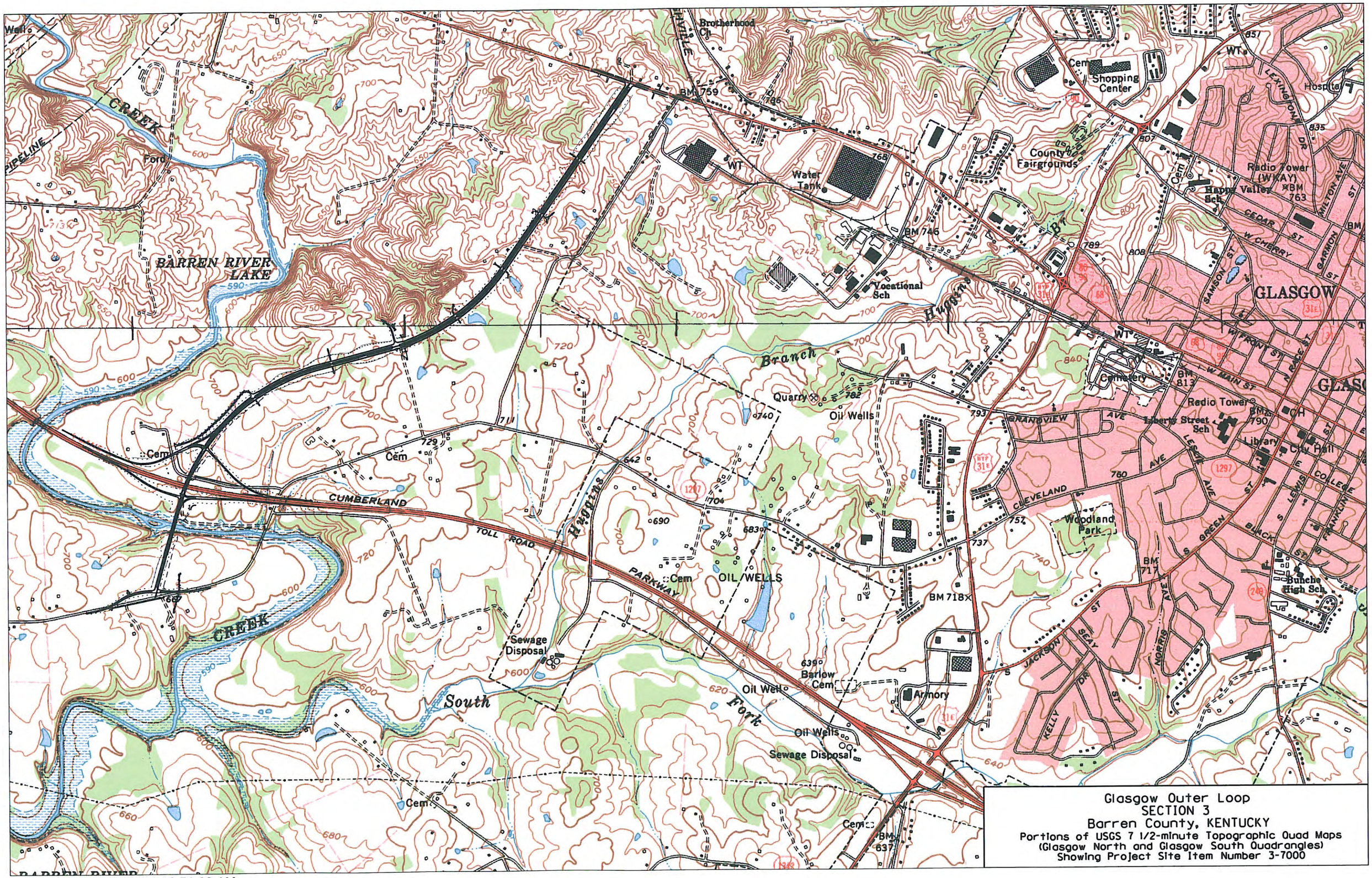
9.4 AEI understands that sufficient rock quantities will not be available to construct a rock subgrade for pavement sections. Therefore a soil subgrade will be used to support the pavement structure. Chemical or mechanical improvement of the subgrade will need to be implemented to reduce problems during construction and extend pavement life. It is recommended that chemical modification of the top eight (8) inches of subgrade material be performed for soil stabilization purposes. AEI's experience gained from past designs indicates lime may be used to treat soil types that were encountered at this project site. It is suggested that six percent by weight (using an average dry density of 103.9 pounds per cubic foot) be utilized to determine plan quantities. The quantities shall be adjusted after the roadbed has been constructed and samples have been submitted to and tested by the KYTC Division of Materials. Approximately three weeks will be required for such testing. The lime shall be applied in accordance with Section 208 entitled "Chemically Stabilized Roadbed" of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

9.5 Where a sinkhole is to be used for drainage purposes, the designer will attempt to provide a minimum length of 150 feet of grass lined ditch or swale with silt checks approximately positioned to filter the flow draining from the highway. Existing grassy areas coupled with innovative meandering of the ditch may constitute all or a portion of the required 150 feet. If this cannot be achieved, a detention area will be utilized to capture pollutants prior to discharging the flow into the sinkhole. The detention area will be sized to pond water at the rate of one acre-inch (3630 cubic feet) per acre of right-of-way disturbed or one half acre-inch (1815 cubic feet) per acre of area draining from the highway right-of-way, whichever is greater. The detention area will require a type IV Geotextile fabric placed in the bottom and covered with approximately 2 feet of soil consisting of an AASHTO Classification of A-6 and/or A-7 (Unified Classification CL and/or CH). The outlet for the detention area shall be constructed with granular material. Type IV Geotextile Fabric shall be placed along the upstream face of the outlet for the detention area. Positive drainage to the detention area must be maintained

to the outlet. Approximately one foot of Granular Embankment is required on the geotextile fabric to prevent sunlight from decaying the geotextile fabric. The Granular embankment shall be in accordance with the current edition of Section 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. The Type IV Geotextile Fabric shall be in accordance with Sections 214 and 843 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

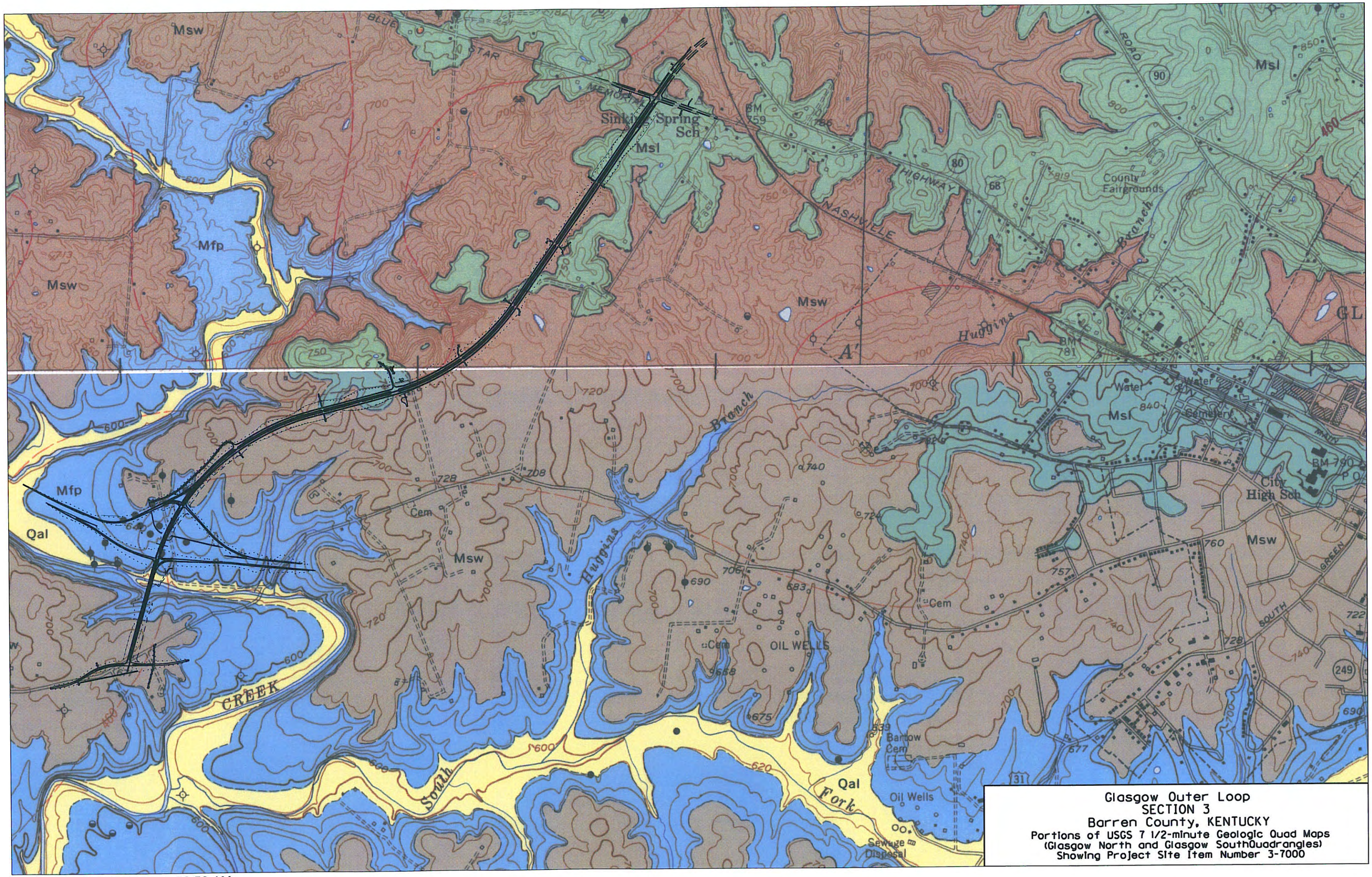
Appendix I

Location Map
Geologic Map



Glasgow Outer Loop
SECTION 3
Barren County, KENTUCKY
Portions of USGS 7 1/2-minute Topographic Quad Maps
(Glasgow North and Glasgow South Quadrangles)
Showing Project Site Item Number 3-7000

topoquad.dgn 10/25/2006 10:51:02 AM



Glasgow Outer Loop
SECTION 3
Barren County, KENTUCKY
Portions of USGS 7 1/2-minute Geologic Quad Maps
(Glasgow North and Glasgow SouthQuadrangles)
Showing Project Site Item Number 3-7000

geoquad.dgn 10/25/2006 10:56:59 AM

Appendix III

Geotechnical Drawings

Symbol Sheet
Geotechnical Notes
Soil Profile Sheets
Cut Stability Sheets
Embankment Stability Sheets

GEOTECHNICAL SYMBOL SHEET

COUNTY OF	ITEM NO.	SHEET NO.
PULASKI	8-59.30	?

AASHTO Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (0.35% or less passing 0.075 mm)							Silt-Clay Materials (More than 35% passing 0.075 mm)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, Percent Passing											
2.00 mm (No. 10)	50 max	----	----	----	----	----	----	----	----	----	----
0.425 mm (No. 40)	30 max	50 max	51 min	----	----	----	----	----	----	----	----
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of Fraction Passing 0.425 mm (No. 40)											
Liquid Limit	----		----	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min

Unified Soil Classifications

MAJOR DIVISIONS		SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well graded sands or gravelly sands, little or no fines.
		SP	Poorly graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS LL IS LESS THAN 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	SILTS AND CLAYS LL IS GREATER THAN 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
UNCLASSIFIED MATERIAL		NONE	Non-Classified material (i.e. overburden, pavement, slag, etc.) Include visual description.

PI	Plasticity Index
AI	Activity Index
LI	Liquidity Index
S+C	Silt + Clay (% finer than No. 200 Sieve)
	Rockline Soundings
	Disturbed Sample Boring
	Undisturbed Sample Boring
	Undisturbed Sample Boring and Rock Core
	Rock Core
	Slope Inclinometer Installation
	typical applications:
OW	Observation Well
(Date)	Water Elevation
VS (psf)	Field Vane Shear Strength
	Thin-walled Tube Sample
<	Standard Penetration Test Sample
N	Penetration Resistance
Qu (psf)	Unconfined Compressive Strength
UU (psf)	Unconsolidated Undrained Triaxial Strength
w%	Moisture Content
KY RQD	Rock Quality Designation (Kentucky Method)
Std RQD	Rock Quality Designation (Standard Method)
SDI (JS)	Slake Durability Index (Jar Slake Test)
REC	Core Recovery
ϕ	Angle of Internal Friction (Total Stress)
$\overline{\phi}$	Angle of Internal Friction (Effective Stress)
C (psf)	Cohesion (Total Stress)
$\overline{C}$ (psf)	Cohesion (Effective Stress)
δ (pcf)	Total Unit Weight
RDZ	Rock Disintegration Zone
OB	Overburden Bench
IB	Intermediate Bench
R	Refusal
NR	Refusal Not Encountered

LIMESTONE

SANDSTONE

DURABLE SHALE (SDI > 95)

NONDURABLE SHALE (SDI < 95)

COAL

TALUS, MINE WASTE, FILL MATERIAL, BOULDERS, & ETC.

GRANULAR EMBANKMENT

STRUCTURE GRANUALR BACKFILL

SLOPE PROTECTION

Geotechnical Notes

1. Clearing and grubbing of embankment areas shall be performed in compliance with Section 202 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

2. Removal of any existing structures and other obstructions shall be performed in accordance with section 203 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

3. Erosion control and water pollution prevention measures shall be performed as necessary to maintain compliance with Sections 212 and 213 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

4. In accordance with Section 206 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction, all channel changes and special ditches shall be constructed prior to placement of any embankment materials adjacent to them. Materials excavated from these areas may be utilized in construction of the embankments, but may require aeration to the proper moisture contents prior to compaction, handling, hauling, stockpiling and/or manipulating these materials.

5. The moisture content of embankment and subgrade materials shall not vary from the optimum moisture, as determined by KM 64-511, by more than plus or minus two (2) percent. This moisture content requirement shall have equal weight with the density requirement when determining the acceptability of embankment or subgrade construction, as is stated in Section 206 and 207 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction.

6. All soils, whether from roadway excavation or borrow, may require manipulation to obtain proper moisture contents prior to compaction. Direct payment shall not be permitted for re-handling, hauling, stockpiling, and/or manipulation of soils.

7. The Contractor shall conduct grading operations in such a manner that soil from roadway excavation can be stockpiled separately or otherwise manipulated so that ample quantities are available for a chemically stabilized roadbed meeting specifications in Section 208 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Remnant layers of limestone and chert were encountered during drilling operations in the soil overburden. These zones may require special handling during construction by the Contractor so that the proposed soil subgrade materials are essentially free of remnants, boulders and large rock fragments, which if included in the subgrade might create less uniform and undesirable conditions. No extra payment shall be permitted for rehandling, hauling, stockpiling, and/or manipulating these materials.

8. The Contractor shall conduct grading operations in such a manner that limestone obtained from roadway excavation can be stockpiled separately or otherwise manipulated so that ample quantities are available for those areas requiring said material. No direct payment will be allowed for such necessary manipulation as stockpiling, double handling the material, and/or hauling. Limestone shall not be wasted unless prior approval is obtained from the Engineer.

9. The Contractor is responsible for conducting any operations necessary to excavate the cut areas to the required typical sections. The cost of these operations shall be incidental to the earthwork.

10. Additional stripping and/or undercutting may be required at the following approximate locations, and other locations, to provide for the removal of any deep organic materials present within pasture fields and other areas and as directed by the Engineer.

Approximate Station Locations	
Mainline	**KY 1297**
32+00	50+00
34+00	**Ramp 1**
40+00	103+00
67+00	106+00
68+00	107+00
83+00	**Ramp 2**
86+00	218+00
146+00	**Ramp 4**
148+00	414+00
	416+00
	418+00

11. As directed by the Engineer, adequate drainage shall be provided for any natural spring outlets encountered within the construction limits, whether shown on the plans or not, by constructing spring box inlets, if there is a defined throat, in accordance with the Kentucky Department of Highways Standard Drawings RDX-010-04 or RDX-011-04. The outlet pipes should extend to the downstream embankment toes for discharging water onto exterior grades. If there is no defined throat then a one (1) foot drainage blanket wrapped with Type IV Geotextile Fabric shall be used.

12. As directed by the Engineer, existing bituminous concrete located at a distance greater than three feet below the proposed subgrade elevation within the limits of new roadway embankments, shall be scarified or broken until all cleavage planes are destroyed, or the pavement shall be removed entirely as conditions demand. This shall be performed in compliance with Section 206 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Subgrade materials remaining after removal of pavements may need to be stabilized prior to placement of new pavement sections, as directed by the Engineer.

Approximate Station Limits
Mainline
52+20 – 52+40

13. As directed by the Engineer, existing bituminous concrete, at the following approximate location, which is positioned less than three feet from proposed subgrade level shall be undercut a minimum of two feet beneath proposed subgrade level and backfilled with suitable subgrade material.

Approximate Station Limits
Ramp 4
411+90 – 412+20

14. Any saturated and soft subgrade soils encountered during subgrade preparations within new cuts shall be drained and stabilized using a twelve (12) inch thick lift of non-erodible Granular Embankment meeting the requirements of Section 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. The coarse aggregate shall be wrapped (top and bottom) with Type IV Geotextile Fabric in accordance with Sections 214 and 843 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. In addition, a four (4) inch diameter pipe underdrain system shall be installed within the coarse aggregate and daylighted on the outslope at the appropriate locations to reduce the possibility of trapping water beneath the pavement subgrade.

Approximate Station Limits	
Mainline	**KY 1297**
31+00 – 37+00	41+00 – 43+00
38+00 – 39+00	45+00 – 49+00
55+00 – 57+00	**Ramp 4**
59+00 – 61+00	419+50 – 421+00
67+00 – 71+00	
74+00 – 81+00	**Bob Lewis Road**
85+00 – 87+00	45+00 – 47+00
93+00 – 99+00	**Frontage Road**
147+00 – 149+00	37+00 – 39+00
151+00 – 153+00	

Geotechnical Notes

15. Any saturated, soft, and unstable areas encountered within embankment foundation limits and/or any other areas as specified by the Engineer shall be drained and stabilized using a twelve (12) inch thick lift of non-erodible Granular Embankment meeting the requirements of Section 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. The coarse aggregate shall be wrapped (top and bottom) with Type III Geotextile Fabric in accordance with Sections 214 and 843 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. A minimum 1-foot thick working platform shall be constructed in such areas.

    For use in establishing bid quantities, it is recommended that the quantities of coarse aggregate and fabric be based on stabilizing the following approximate intervals:

Approximate Station Limits	
Mainline	**Ramp 3**
38+00 – 39+00	303+00 – 305+00
72+00 – 74+00	**Frontage Road**
101+00 – 103+00	33+00 – 35+00

16. As directed by the Engineer, a two-foot thickness of broken limestone excavated from beneath the RDZ, or other suitable materials, shall be utilized to fill full-width and stabilize the existing drainage swales or stream channels located within the limits of the roadway embankment. The broken rock material shall also be placed over all adjacent areas that may be soft and saturated. Positive drainage of these abandoned stream channels shall be maintained to reduce the possibility of trapping water within the roadway embankments.

    For use in establishing bid quantities, it is recommended that the quantities of coarse aggregate be based on stabilizing the following approximate stations:

Approximate Station Limits	
Mainline	**Ramp 3**
72+00 – 74+00	303+75
87+50 – 88+25	**Ramp 4**
104+75	417+00 – 419+00
142+00 – 143+50	**Frontage Road**
Ramp 1	33+50 – 35+00
107+00 – 108+00	

17. Embankment foundation benches/slope serrations and perforated pipe underdrains shall be constructed at the following approximate locations in accordance with Standard Drawings RGX-010 and RDP-006, project cross-sections, and as directed by the Engineer. The benches shall be constructed one at a time beginning with the lowest bench. Each bench shall be backfilled prior to the excavation of the next bench.

Approximate Station Limits	
Mainline	**Ramp 1**
39+00 – 40+50	109+00 – 112+00
103+50 – 104+00	

18. The pond located at the Ramp 2 Station 213+00 80' Right is within a roadway embankment area and shall be entirely or partially drained, as directed by the Engineer. Soft/saturated material shall be removed and/or stabilized prior to construction of the embankments. Stabilization shall be in accordance with Geotechnical Note 16.

19. Conventional transverse benches shall be constructed and perforated pipe underdrains installed at the following approximate locations in accordance with Kentucky Department of Highways Standard Drawings RDP-005 and RDP-006, project cross-sections (as applicable), and as directed by the Engineer. Contrary to Standard Drawing RDP-006, transverse benches and perforated pipe underdrains shall be installed in both uphill and downhill transition areas between cuts and fills.

Approximate Station Limits	
Mainline	**KY 1297**
36+70	40+50
53+90	**Ramp 3**
61+25	301+00
65+65	305+20
71+80	**Ramp 4**
74+00	416+75
87+50	419+60
99+60	**Frontage Road**
123+50	32+80
127+80	36+00
135+00	42+10
145+50	48+90

20. Perforated pipes for subgrade drainage shall be installed at vertical sags and at the upgrade ends of structures, in accordance with Kentucky Department of Highways Standard Drawing RDP-005 and/or as directed by the Engineer. Contrary to Standard Drawing RDP-005, such drains shall be installed even when a rock roadbed is being constructed. These drainage features shall be installed at the following approximate locations:

Approximate Station Locations	
Mainline	**Ramp 2**
39+65	207+75
49+30	**Ramp 3**
52+50	314+00
125+50	**Ramp 4**
KY 1297	403+90
48+00	413+00
Ramp 1	**Bob Lewis Road**
109+00	49+00
118+90	**Frontage Road**
	34+00

21. Subsurface information has not been obtained at the following stations because of denied access to the property by the landowner.

Approximate Station Locations	
Mainline	**Ramp 2**
46+00	208+00 – 214+00

22. Although no obvious surface openings were noted in the surface depressions listed in Section 3, in the course of geotechnical exploration, it is possible that such features may be encountered during roadway construction. Unless otherwise specified, all open sinkholes and/or solution cavities within the limits of construction which are not to accept drainage, whether shown on the plans or not, shall be filled and/or capped in accordance with Section 215 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction, and as directed by the Engineer.

23. The bridge approach embankment sections shall include pile cores at the end bent locations to facilitate installation of the foundation systems. The core material shall be free of rock fragments larger than three (3) inches maximum dimension, and any other obstructions which would interfere with foundation installation. Construction of the pile cores shall be in accordance with KYTC Special Provision No. 69 (current edition), Standard Drawings RGX-100 and RGX-105 and Sections 206 and 805 of the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Erodible materials shall not be used in construction of pile cores.

24. Recommendations for design and construction of the bridges and their approach embankments to be constructed on this project have not been provided since structure layouts are not yet available. AEI will provide recommendations upon completion of the field exploration and subsequent laboratory testing and engineering analyses.

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

Field Drilling and Sampling were performed in the period of July, 2002 to July, 2004.

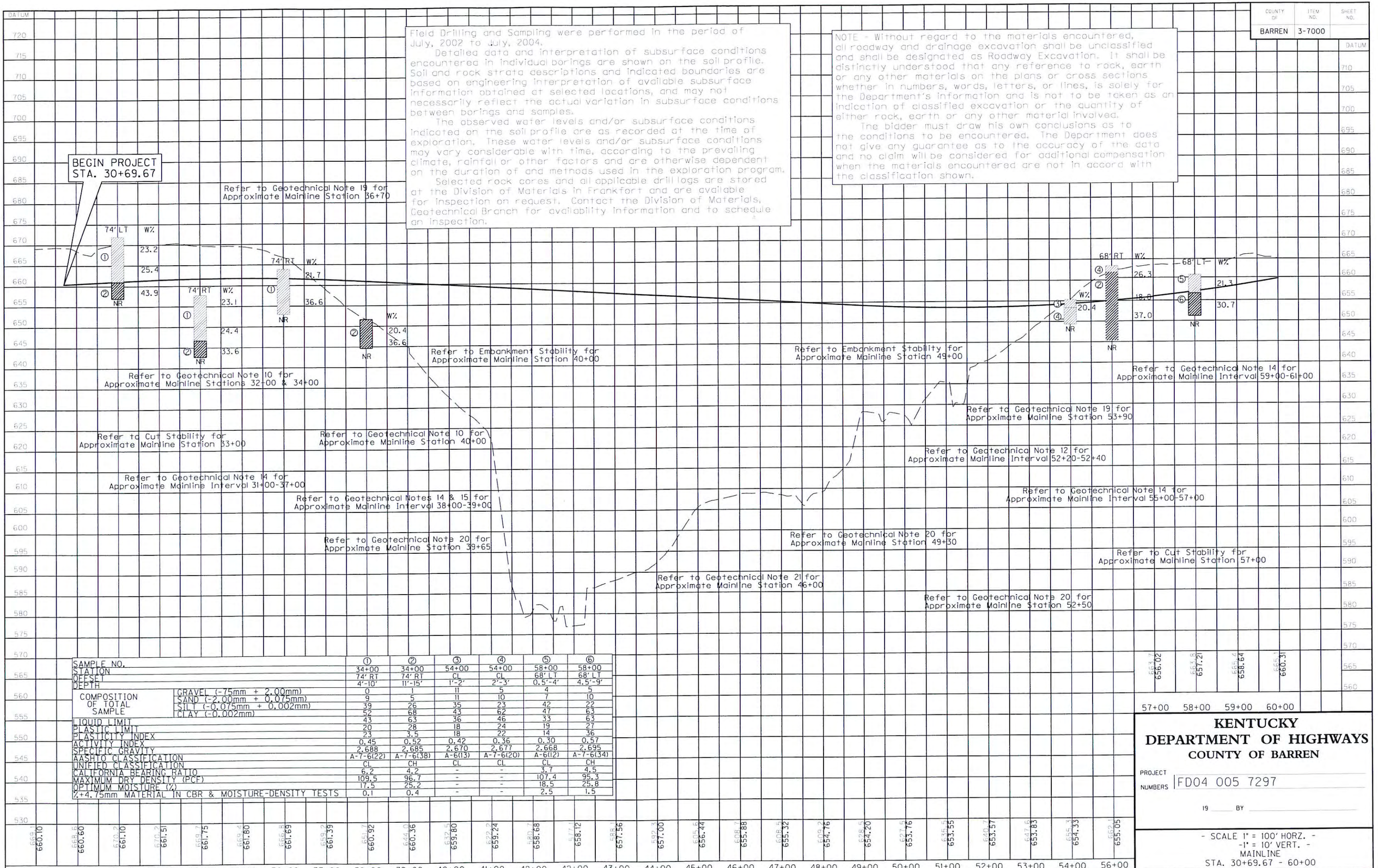
Detailed data and interpretation of subsurface conditions encountered in individual borings are shown on the soil profile. Soil and rock strata descriptions and indicated boundaries are based on engineering interpretation of available subsurface information obtained at selected locations, and may not necessarily reflect the actual variation in subsurface conditions between borings and samples.

The observed water levels and/or subsurface conditions indicated on the soil profile are as recorded at the time of exploration. These water levels and/or subsurface conditions may vary considerable with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent on the duration of and methods used in the exploration program.

Selected rock cores and all applicable drill logs are stored at the Division of Materials in Frankfort and are available for inspection on request. Contact the Division of Materials, Geotechnical Branch for availability information and to schedule an inspection.

NOTE - Without regard to the materials encountered, all roadway and drainage excavation shall be unclassified and shall be designated as Roadway Excavation. It shall be distinctly understood that any reference to rock, earth or any other materials on the plans or cross sections whether in numbers, words, letters, or lines, is solely for the Department's information and is not to be taken as an indication of classified excavation or the quantity of either rock, earth or any other material involved.

The bidder must draw his own conclusions as to the conditions to be encountered. The Department does not give any guarantee as to the accuracy of the data and no claim will be considered for additional compensation when the materials encountered are not in accord with the classification shown.



SAMPLE NO.		①	②	③	④	⑤	⑥
STATION		34+00	34+00	54+00	54+00	58+00	58+00
OFFSET		74' RT	74' RT	CL	CL	68' LT	68' LT
DEPTH		4'-10'	11'-15'	1'-2'	2'-3'	0.5'-4'	4.5'-9'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	0	1	11	5	4	5
	SAND (-2.00mm + 0.075mm)	9	5	11	10	7	10
	SILT (-0.075mm + 0.002mm)	39	26	35	23	42	22
	CLAY (-0.002mm)	52	68	43	62	47	63
LIQUID LIMIT		43	63	36	46	33	63
PLASTIC LIMIT		20	28	18	24	19	27
PLASTICITY INDEX		23	35	18	22	14	36
ACTIVITY INDEX		0.45	0.52	0.42	0.36	0.30	0.57
SPECIFIC GRAVITY		2.688	2.685	2.670	2.677	2.668	2.695
AASHTO CLASSIFICATION		A-7-6(22)	A-7-6(38)	A-6(13)	A-7-6(20)	A-6(12)	A-7-6(34)
UNIFIED CLASSIFICATION		CL	CH	CL	CL	CL	CH
CALIFORNIA BEARING RATIO		6.2	4.2	-	-	3.7	4.5
MAXIMUM DRY DENSITY (PCF)		109.5	96.7	-	-	107.4	95.3
OPTIMUM MOISTURE (%)		17.5	25.2	-	-	18.5	25.8
% +4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		0.1	0.4	-	-	2.5	1.5

KENTUCKY DEPARTMENT OF HIGHWAYS
COUNTY OF BARREN

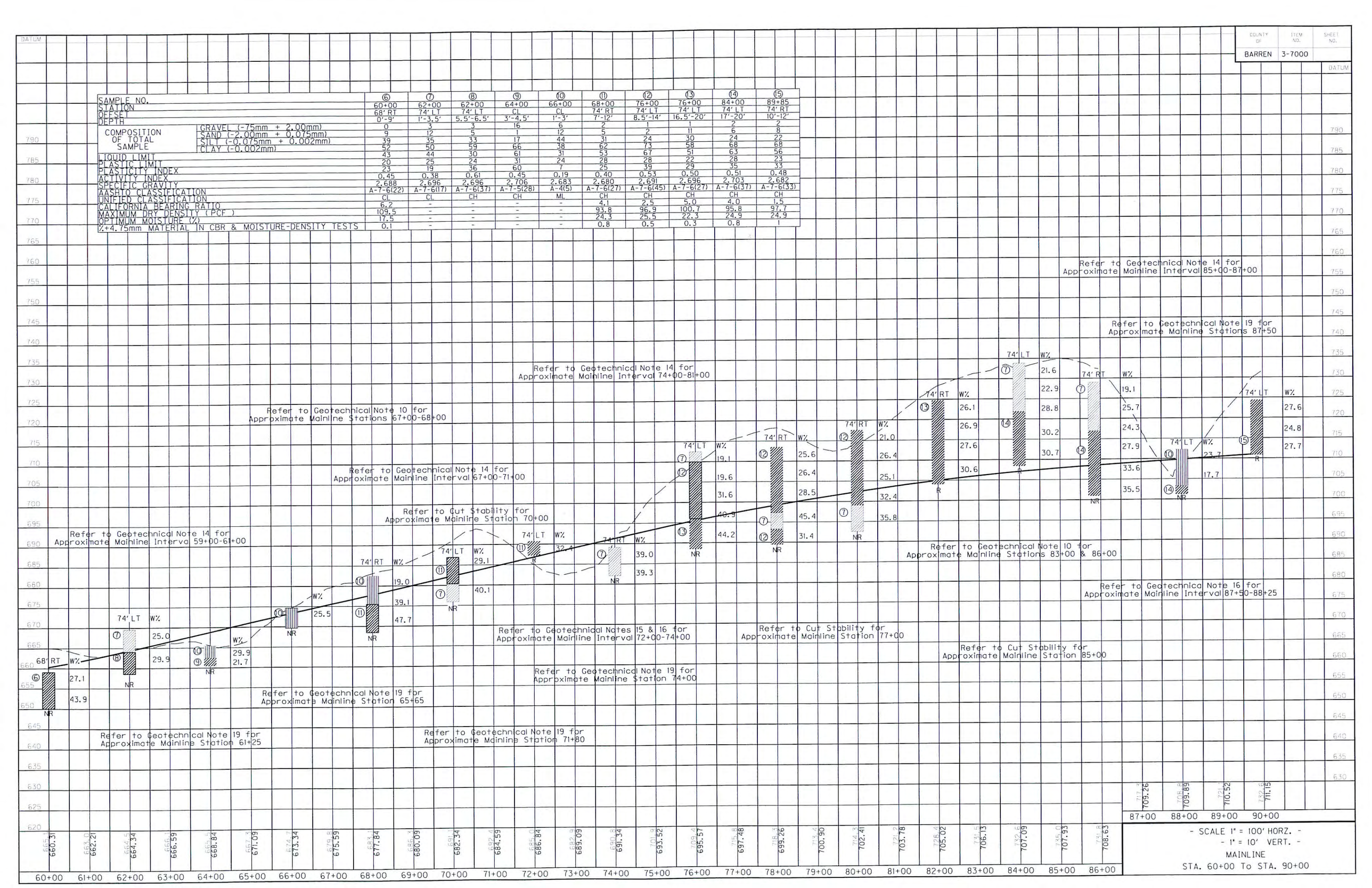
PROJECT NUMBERS FD04 005 7297

19 ____ BY ____

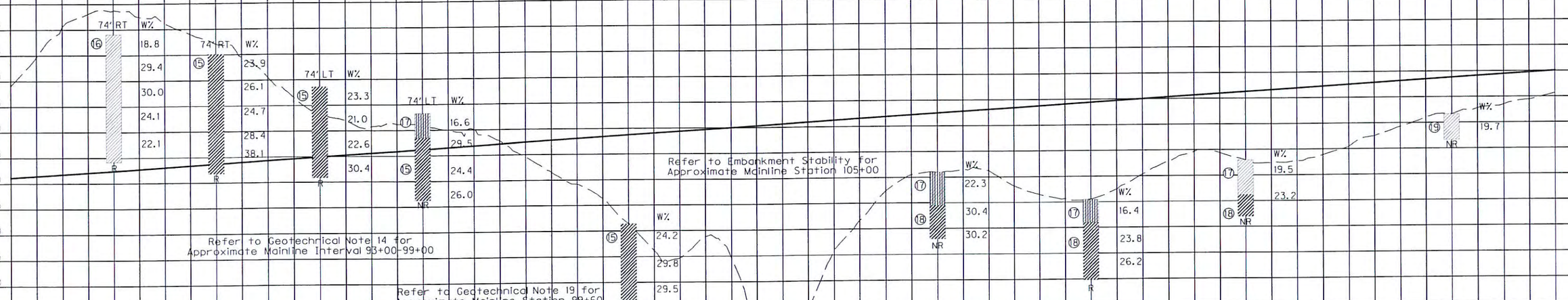
- SCALE 1" = 100' HORZ. -
-1" = 10' VERT. -
MAINLINE
STA. 30+69.67 - 60+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮
STATION		60+00	62+00	62+00	64+00	66+00	68+00	76+00	76+00	84+00	89+85
OFFSET		68' RT	74' LT	74' LT	CL	CL	74' RT	74' LT	74' LT	74' LT	74' RT
DEPTH		0'-9'	1'-3.5'	5.5'-6.5'	3'-4.5'	1'-3'	7'-12'	8.5'-14'	16.5'-20'	17'-20'	10'-12'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	0	3	3	16	6	2	1	1	2	2
	SAND (-2.00mm + 0.075mm)	9	12	5	1	12	5	2	11	6	8
	SILT (-0.075mm + 0.002mm)	39	35	33	17	44	31	24	30	24	22
	CLAY (-0.002mm)	52	50	59	66	38	62	73	58	68	68
LIQUID LIMIT		43	44	30	61	31	53	67	51	63	56
PLASTIC LIMIT		20	25	24	31	24	28	28	22	28	23
PLASTICITY INDEX		23	19	36	60	7	25	39	29	35	33
ACTIVITY INDEX		0.45	0.38	0.61	0.45	0.19	0.40	0.53	0.50	0.51	0.48
SPECIFIC GRAVITY		2.688	2.696	2.696	2.706	2.683	2.680	2.691	2.696	2.703	2.682
AASHTO CLASSIFICATION		A-7-6(22)	A-7-6(17)	A-7-6(37)	A-7-5(28)	A-4(5)	A-7-6(27)	A-7-6(45)	A-7-6(27)	A-7-6(37)	A-7-6(33)
UNIFIED CLASSIFICATION		CL	CL	CH	CH	ML	CH	CH	CH	CH	CH
CALIFORNIA BEARING RATIO		6.2	-	-	-	-	4.1	2.5	5.0	4.0	1.5
MAXIMUM DRY DENSITY (PCF)		109.5	-	-	-	-	93.8	96.9	100.7	95.8	97.7
OPTIMUM MOISTURE (%)		17.5	-	-	-	-	24.3	25.5	22.3	24.9	24.9
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		0.1	-	-	-	-	0.8	0.5	0.3	0.8	1



COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	



SAMPLE NO.		15	16	17	18	19
STATION		76+00	84+00	98+00	108+00	118+00
OFFSET		74' LT	74' LT	74' LT	CL	CL
DEPTH		16.5'-20'	17'-20'	2'-4'	11'-13'	2'-3'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	2	2	3	1	12
	SAND (-2.00mm + 0.075mm)	8	17	12	13	14
	SILT (-0.075mm + 0.002mm)	22	39	50	27	41
	CLAY (-0.002mm)	68	42	35	59	-
LIQUID LIMIT		56	35	26	57	31
PLASTIC LIMIT		23	18	20	27	19
PLASTICITY INDEX		33	17	6	30	12
ACTIVITY INDEX		0.48	0.40	0.17	0.51	0.37
SPECIFIC GRAVITY		2.682	2.690	2.661	2.681	2.695
AASHTO CLASSIFICATION		A-7-6(33)	A-6(13)	A-4(4)	A-7-6(29)	A-6(7)
UNIFIED CLASSIFICATION		CH	CL	CL-ML	CH	CL
CALIFORNIA BEARING RATIO		1.5	10.1	10.0	-	-
MAXIMUM DRY DENSITY (PCF)		97.7	113.4	113.3	-	-
OPTIMUM MOISTURE (%)		24.9	15.3	15.1	-	-
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		1	0.9	0.5	0.3	0.3

90+00	91+00	92+00	93+00	94+00	95+00	96+00	97+00	98+00	99+00	100+00	101+00	102+00	103+00	104+00	105+00	106+00	107+00	108+00	109+00	110+00	111+00	112+00	113+00	114+00	115+00	116+00	117+00	118+00	119+00	120+00
739.6 711.15	740.6 711.78	741.7 712.41	741.2 713.04	737.1 713.68	730.8 714.31	722.9 714.94	720.7 715.57	721.0 716.20	722.1 716.83	714.6 717.46	709.2 718.09	701.4 718.73	694.7 719.36	684.6 719.99	674.1 720.62	669.8 721.25	701.6 721.88	711.0 722.51	711.2 723.14	706.5 723.78	705.5 724.41	710.3 725.04	716.7 725.67	713.0 726.30	712.8 726.93	715.5 727.56	719.3 728.19	722.5 728.82	723.5 729.46	726.7 730.09

- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
MAINLINE
STA. 90+00 To STA. 120+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		(17)	(20)	(21)	(22)	(23)	(25)
STATION		98+00	123+70	130+00	134+35	146+00	152+00
OFFSET		74' LT	74' RT	CL	74' RT	74' LT	74' RT
DEPTH		2'-4'	2'-3'	2'-3'	3'-5'	4'-7'	2'-10'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	3	1	1	1	1	16
	SAND (-2.00mm + 0.075mm)	12	11	8	8	3	19
	SILT (-0.075mm + 0.002mm)	50	26	44	38	15	28
	CLAY (-0.002mm)	35	62	47	53	81	37
LIQUID LIMIT		26	52	38	33	76	33
PLASTIC LIMIT		20	22	19	19	28	17
PLASTICITY INDEX		6	30	19	15	48	16
ACTIVITY INDEX		0.17	0.48	0.41	0.28	0.59	0.43
SPECIFIC GRAVITY		2.661	2.7	2.701	2.69	2.693	2.677
AASHTO CLASSIFICATION		A-4(4)	A-7-6(28)	A-6(17)	A-6(13)	A-7-6(54)	A-6(8)
UNIFIED CLASSIFICATION		CL-ML	CH	CL	CL	CH	CL
CALIFORNIA BEARING RATION		10.0	1.8	-	1.7	4.4	8.1
MAXIMUM DRY DENSITY (PCF)		113.3	100.6	-	105.9	97.5	110.4
OPTIMUM MOISTURE (%)		15.1	21.6	-	20.6	24.1	16.3
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		0.5	0	-	0.8	0.4	7.8

Refer to Geotechnical Note 19 for Approximate Mainline Station 123+50

Refer to Geotechnical Note 19 for Approximate Mainline Station 127+80

Refer to Geotechnical Note 19 for Approximate Mainline Station 135+00

Refer to Geotechnical Note 10 for Approximate Mainline Stations 146+00 & 148+00

Refer to Geotechnical Note 19 for Approximate Mainline Station 145+50

Refer to Embankment Stability for Approximate Mainline Station 142+00

Refer to Geotechnical Note 14 for Approximate Mainline Interval 147+00-149+00

Refer to Geotechnical Note 20 for Approximate Mainline Station 125+50

Refer to Cut Stability for Approximate Mainline Station 125+00

Refer to Geotechnical Note 16 for Approximate Mainline Interval 142+00-143+50

Refer to Cut Stability for Approximate Mainline Station 149+00

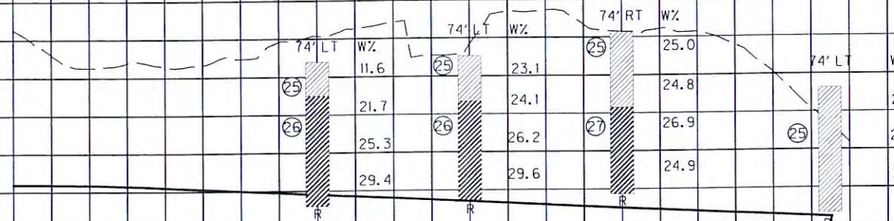
- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
MAINLINE
STA. 120+00 To STA. 150+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

Refer to Geotechnical Note 14 for Approximate Mainline Interval 151+00-153+00

Refer to Cut Stability for Approximate Mainline Station 157+00

Refer to Cut Stability for Approximate Mainline Station 153+00



END PROJECT STA. 160+76.24

SAMPLE NO.		25	26	27
STATION		152+00	154+00	158+00
OFFSET		74' RT	74' LT	74' RT
DEPTH		2'-10'	12'-14'	10'-16'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	16	15	2
	SAND (-2.00mm + 0.075mm)	19	9	4
	SILT (-0.075mm + 0.002mm)	28	10	21
	CLAY (-0.002mm)	37	66	73
LIQUID LIMIT		33	53	69
PLASTIC LIMIT		17	26	25
PLASTICITY INDEX		16	27	44
ACTIVITY INDEX		0.43	0.41	0.60
SPECIFIC GRAVITY		2.677	2.679	2.708
AASHTO CLASSIFICATION		A-6(8)	A-7-6(25)	A-7-6(47)
UNIFIED CLASSIFICATION		CL	CH	CH
CALIFORNIA BEARING RATIO		8.1	-	2.3
MAXIMUM DRY DENSITY (PCF)		110.4	-	93.9
OPTIMUM MOISTURE (%)		16.3	-	27
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		7.8	-	1

- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
MAINLINE
STA. 150+00 To STA. 160+76.24

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		(32)	(33)
STATION		RAMP 1 103+00	RAMP 1 106+00
OFFSET		CL	CL
DEPTH		2'-3'	1'-9.1'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	1	13
	SAND (-2.00mm + 0.075mm)	5	16
	SILT (-0.075mm + 0.002mm)	51	34
	CLAY (-0.002mm)	43	37
LIQUID LIMIT		32	33
PLASTIC LIMIT		23	16
PLASTICITY INDEX		9	17
ACTIVITY INDEX		0.21	0.46
SPECIFIC GRAVITY		2.701	2.681
AASHTO CLASSIFICATION		A-4(8)	A-6(10)
UNIFIED CLASSIFICATION		CL	CL
CALIFORNIA BEARING RATIO		-	-
MAXIMUM DRY DENSITY (PCF)		-	-
OPTIMUM MOISTURE (%)		-	-
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		-	-

BEGIN RAMP 1
STA. 97+57.89

END RAMP 1
STA. 125+40.94

Refer to Geotechnical Note 16 for Approximate Ramp 1 Interval 107+00-108+00

Refer to Geotechnical Note 20 for Approximate Ramp 1 Station 118+90

Refer to Geotechnical Note 20 for Approximate Ramp 1 Station 109+00

Refer to Embankment Stability for Approximate Ramp 1 Station 107+00

	W%
(32)	19.9
	19.2
(33)	14.6
	19.9
45' RT (33)	18.9
	16.1

Refer to Geotechnical Note 17 for Approximate Ramp 1 Interval 106+00-112+00

Refer to Geotechnical Note 10 for Approximate Ramp 1 Stations 103+00, 106+00 & 107+00

96+00	97+00	98+00	99+00	100+00	101+00	102+00	103+00	104+00	105+00	106+00	107+00	108+00	109+00	110+00	111+00	112+00	113+00	114+00	115+00	116+00	117+00	118+00	119+00	120+00	121+00	122+00	123+00	124+00	125+00	126+00
		604.5 656.79	605.8 656.09	604.7 654.70	609.5 651.93	612.9	614.8 645.18	614.1 641.68	613.8 638.28	613.3 635.60	610.7 633.74	610.8 632.70	615.3 632.48	628.4 632.98	627.6 633.59	630.6 634.19	631.8	633.3	635.5	636.8	635.5	613.8	643.9	646.0	649.3	652.2	655.4	659.0	662.0	

- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
RAMP 1
97+57.89 To 125+40.94

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		(34)	(35)
STATION		RAMP 3 304+00	RAMP 3 310+00
OFFSET		42' LT	20' RT
DEPTH		3'-4'	2'-5'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	13	10
	SAND (-2.00mm + 0.075mm)	13	11
	SILT (-0.075mm + 0.002mm)	45	15
	CLAY (-0.002mm)	29	64
LIQUID LIMIT		27	58
PLASTIC LIMIT		19	29
PLASTICITY INDEX		8	29
ACTIVITY INDEX		0.28	0.45
SPECIFIC GRAVITY		2.679	2.709
AASHTO CLASSIFICATION		A-4(4)	A-7-6(25)
UNIFIED CLASSIFICATION		ML	CH
CALIFORNIA BEARING RATIO		-	9.8
MAXIMUM DRY DENSITY (PCF)		-	97
OPTIMUM MOISTURE (%)		-	23.9
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		9.9	6.1

Refer to Geotechnical Note 15 for Approximate Mainline Interval 303+00-305+00

Refer to Geotechnical Note 19 for Approximate Ramp 3 Station 305+20

Refer to Geotechnical Note 20 for Approximate Ramp 3 Station 314+00

42' LT W%
(34) 28.9
36.3
45.6
R

W%
(35) 27.1
32.6
NR

20' RT W%
(35) 27.6
33.5
35.7
NR

20' RT W%
(35) 13.8
16.9
R

20' RT W%
(35) 30.9
24.2
NR

END RAMP
STA. 328+11.13

Refer to Geotechnical Note 16 for Approximate Ramp 3 Station 303+75

Refer to Cut Stability for Approximate Ramp 3 Station 310+00

Refer to Geotechnical Note 20 for Approximate Ramp 3 Station 301+00

Refer to Cut Stability for Approximate Ramp 3 Station 312+50

700 695 690 685 680 675 670 665 660 655 650 645 640 635 630 625 620 615 610 605 600 595 590 585 580

665.8 659.9 653.0 646.1 642.3 654.16 641.2 649.99 650.6 645.82 650.2 641.65 644.2 637.48 645.0 633.32 647.0 629.15 646.1 625.46 642.9 622.74 630.9 620.99 627.6 620.21 618.1 619.91 617.8 619.65 618.4 619.40 618.1 618.88 617.4 618.32 616.6 617.78 616.3 617.23 615.8 616.65 615.5 615.96 615.2 615.48 614.8 614.90 614.4 614.56

300+00 301+00 302+00 303+00 304+00 305+00 306+00 307+00 308+00 309+00 310+00 311+00 312+00 313+00 314+00 315+00 316+00 317+00 318+00 319+00 320+00 321+00 322+00 323+00 324+00 325+00 326+00

614.5 614.62 614.8 614.99

327+00 328+00

- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
RAMP 3
STA. 300+00 To STA. 328+11.13

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		(36)	(37)
STATION		RAMP 4 416+00	RAMP 4 420+00
OFFSET		20' RT	33' LT
DEPTH		2'-7'	4'-9'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	9	7
	SAND (-2.00mm + 0.075mm)	18	9
	SILT (-0.075mm + 0.002mm)	20	20
	CLAY (-0.002mm)	53	64
LIQUID LIMIT		44	60
PLASTIC LIMIT		24	28
PLASTICITY INDEX		20	32
ACTIVITY INDEX		0.38	0.5
SPECIFIC GRAVITY		2.691	2.677
AASHTO CLASSIFICATION		A-7-6(14)	A-7-6(30)
UNIFIED CLASSIFICATION		CL	CH
CALIFORNIA BEARING RATIO		8.3	7.1
MAXIMUM DRY DENSITY (PCF)		97.3	97.4
OPTIMUM MOISTURE (%)		22.2	24.1
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		3.8	1.9

BEGIN RAMP
STA. 400+00.00

Refer to Geotechnical Note 20 for Approximate Ramp 4 Station 403+90

Refer to Geotechnical Note 20 for Approximate Ramp 4 Station 413+00

Refer to Geotechnical Note 10 for Approximate Ramp 4 Stations 414+00, 416+00 & 418+00

Refer to Geotechnical Note 16 for Approximate Ramp 4 Interval 417+00-419+00

Refer to Geotechnical Note 14 for Approximate Ramp 4 Interval 419+50-421+00

Refer to Geotechnical Note 13 for Approximate Ramp 4 Interval 411+90-412+20

Refer to Geotechnical Note 19 for Approximate Ramp 4 Station 419+60

Refer to Geotechnical Note 19 for Approximate Ramp 4 Station 416+75

Refer to Cut Stability for Approximate Ramp 4 Station 415+00

20' RT W% 21.9 16.5 19.3 NR

20' RT W% 30.6 23.8 R

34' RT W% 20.1 22.4 NR

33' LT W% 20.4 39.2 NR

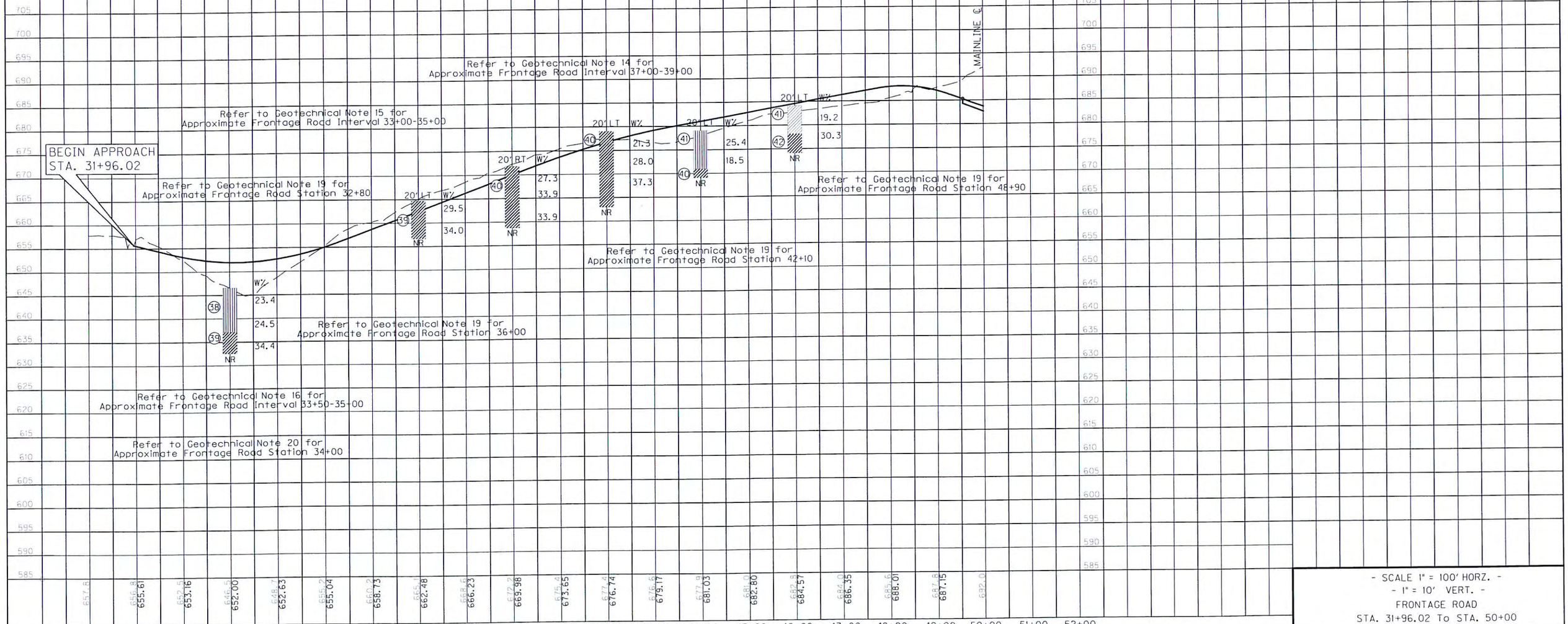
W% 20.5 17.7 NR

400+00	401+00	402+00	403+00	404+00	405+00	406+00	407+00	408+00	409+00	410+00	411+00	412+00	413+00	414+00	415+00	416+00	417+00	418+00	419+00	420+00	421+00	422+00	423+00	424+00
655.8	652.3	648.0	645.7	628.2	624.2	639.0	635.9	628.7	622.6	622.9	626.0	629.4	633.8	639.5	642.0	638.7	635.9	631.8	633.7	650.7	661.2	664.1		
											632.69	631.84	631.40	631.76	632.94	634.92	637.71	641.30	645.30	649.30	653.30			

- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
RAMP 4
STA. 400+00 To STA. 421+96

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		(38)	(39)	(40)	(41)	(42)
STATION		FRONTAGE 34+00	FRONTAGE 34+00	FRONTAGE 40+00	FRONTAGE 46+00	FRONTAGE 46+00
OFFSET		CL	CL	20' RT	20' LT	20' LT
DEPTH		1.5'-2.5'	10'-11'	4.5'-8.5'	1'-5.5'	6'-9'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	5	4	5	5	3
	SAND (-2.00mm + 0.075mm)	13	10	7	13	8
	SILT (-0.075mm + 0.002mm)	47	20	27	41	24
	CLAY (-0.002mm)	35	66	61	41	65
LIQUID LIMIT		29	56	65	29	54
PLASTIC LIMIT		24	27	31	20	26
PLASTICITY INDEX		5	29	34	9	28
ACTIVITY INDEX		0.14	0.44	0.56	0.22	0.43
SPECIFIC GRAVITY		2.72	2.693	2.688	2.701	2.678
AASHTO CLASSIFICATION		A-4(3)	A-7-6(28)	A-7-5(35)	A-4(6)	A-7-6(28)
UNIFIED CLASSIFICATION		ML	CH	CH	CL	CH
CALIFORNIA BEARING RATIO		-	-	4.1	5.3	5.6
MAXIMUM DRY DENSITY (PCF)		-	-	96	111.5	9.6
OPTIMUM MOISTURE (%)		-	-	25.3	15.3	22.4
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		-	-	2.5	2.1	1.5



- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
FRONTAGE ROAD
STA. 31+96.02 To STA. 50+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000	

SAMPLE NO.		(28)	(29)	(30)	(31)	(41)	(43)
STATION		RT 1297 42+00	RT 1297 44+00	RT 1297 46+00	RT 1297 52+00	FRONTAGE 46+00	BOB LEWIS 46+00
OFFSET		24' LT	28' RT	29' LT	26' LT	20' LT	15' RT
DEPTH		2'-7'	2'-6'	3.5'-6.5'	1'-3'	1.0'-5.5'	4.5'-7.5'
COMPOSITION OF TOTAL SAMPLE	GRAVEL (-75mm + 2.00mm)	0	7	1	2	5	2
	SAND (-2.00mm + 0.075mm)	4	12	4	8	13	19
	SILT (-0.075mm + 0.002mm)	21	43	20	45	41	20
	CLAY (-0.002mm)	75	38	75	45	41	59
LIQUID LIMIT		55	33	53	32	29	54
PLASTIC LIMIT		27	19	25	17	20	23
PLASTICITY INDEX		28	14	28	15	9	31
ACTIVITY INDEX		0.37	0.37	0.37	0.33	0.22	0.53
SPECIFIC GRAVITY		2.688	2.704	2.688	2.674	2.701	2.688
AASHTO CLASSIFICATION		A-7-6(31)	A-6(10)	A-7-6(30)	A-6(13)	A-4(6)	A-7-6(25)
UNIFIED CLASSIFICATION		CH	CL	CH	CL	CL	CH
CALIFORNIA BEARING RATIO		3.5	10.1	5.3	3.1	5.3	5.6
MAXIMUM DRY DENSITY (PCF)		98.4	109.2	95.5	108.9	111.5	96.6
OPTIMUM MOISTURE (%)		24.2	17.3	25.8	17.6	15.3	24.4
%+4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		0.2	3.4	0.7	0.4	2.1	0.6

Refer to Geotechnical Note 20 for Approximate Bob Lewis Road Station 49+00

15' RT W% 31.7 29.3 30.7 NR

15' LT W% 21.9 NR

Refer to Geotechnical Note 14 for Approximate Bob Lewis Road Interval 45+00-47+00

BOB LEWIS ROAD

BEGIN APPROACH STA. 36+50.00

Refer to Geotechnical Note 14 for Approximate Hwy 1297 Interval 41+00-43+00

Refer to Geotechnical Note 10 for Approximate Hwy 1297 Station 50+00

24' LT W% 21.6 36.6 NR

28' RT W% 22.0 25.6 32.6 NR

29' LT W% 19.0 33.3 40.1 39.4 NR

29' RT W% 21.9 23.0 34.0 33.8 NR

28' RT W% 23.5 24.5 25.0 NR

26' LT W% 20.4 23.6 22.4 NR

22' RT W% 20.8 26.0 25.6 NR

22' LT W% 22.7 25.3 26.8 NR

Refer to Geotechnical Note 19 for Approximate Hwy 1297 Station 40+50

Refer to Geotechnical Note 14 for Approximate Hwy 1297 Interval 45+00-49+00

Refer to Geotechnical Note 20 for Approximate Hwy 1297 Station 48+00

Refer to Cut Stability for Approximate Hwy 1297 Station 47+00

END APPROACH STA. 59+70.00

- SCALE 1" = 100' HORZ. -
- 1" = 10' VERT. -
KY. 1297 & BOB LEWIS ROAD
STA. 36+50 To STA. 59+70

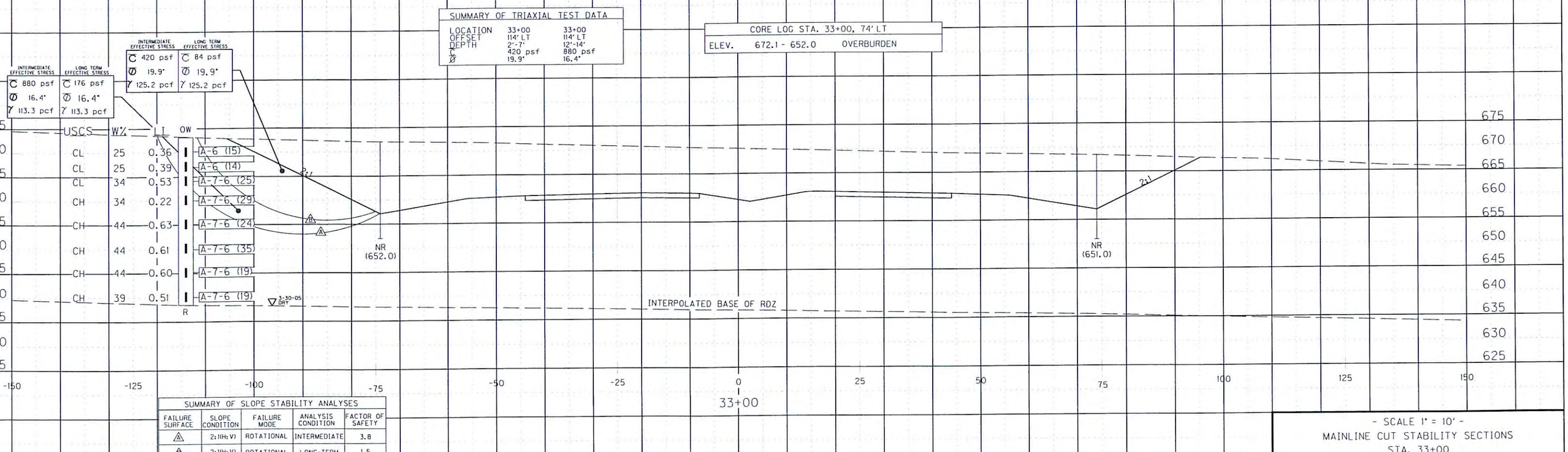
COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
31+00	74 LT	20	-	651.1
31+00	74 RT	17	-	650.4
32+00	74 RT	14	-	651.7
33+00	74 LT	20.1	-	652.0
33+00	74 RT	17	-	651.0
34+00	74 LT	16	-	654.4
35+00	74 LT	18	-	651.9
35+00	74 RT	15	-	652.3
36+00	74 RT	14	-	651.4
37+00	74 RT	12	-	651.7

CUT LIMITS FROM STATION 30+00 TO STATION 37+00

SUMMARY OF TRIAXIAL TEST DATA		
LOCATION	33+00	33+00
OFFSET	114' LT	114' LT
DEPTH	2'-7'	12'-14'
C	420 psf	880 psf
Ø	19.9°	16.4°

CORE LOG STA. 33+00, 74' LT		
ELEV.	672.1 - 652.0	OVERBURDEN



SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	3.8
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.5

- SCALE 1" = 10' -
MAINLINE CUT STABILITY SECTIONS
STA. 33+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
55+00	68 RT	13	-	643.8
56+00	68 LT	11	-	648.4
57+00	68 LT	10	-	649.5
57+00	68 RT	20.4	-	645.0
58+00	68 RT	13.3	649.7	-
59+00	68 LT	13	-	652.4
59+00	68 RT	13	-	648.5
60+00	68 LT	13	-	654.2
61+00	74 LT	11	-	656.7

CUT LIMITS FROM STATION 55+00 TO STATION 61+00

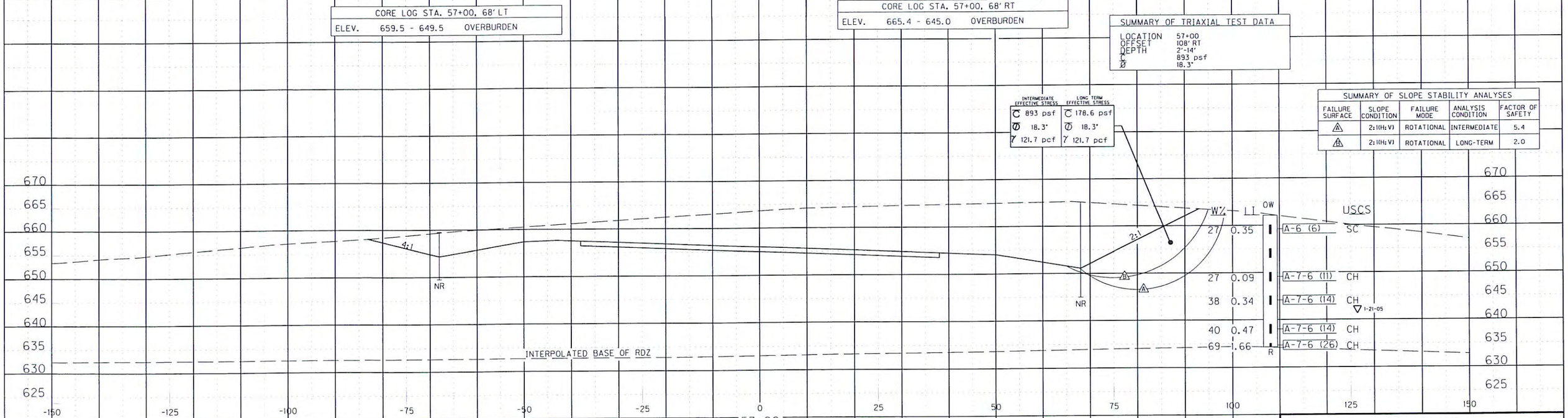
CORE LOG STA. 57+00, 68' LT		
ELEV.	659.5 - 649.5	OVERBURDEN

CORE LOG STA. 57+00, 68' RT		
ELEV.	665.4 - 645.0	OVERBURDEN

SUMMARY OF TRIAXIAL TEST DATA	
LOCATION	57+00
OFFSET	108' RT
DEPTH	2'-14'
C	893 psf
Ø	18.3°

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 893 psf	C 178.6 psf
Ø 18.3°	Ø 18.3°
γ 121.7 pcf	γ 121.7 pcf

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	5.4
B	2:1(H:V)	ROTATIONAL	LONG-TERM	2.0



- SCALE 1" = 10' -
MAINLINE CUT STABILITY SECTIONS
STA. 57+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	GT3

ROCKLINE DATA

STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
67+00	74 LT	1.8	676.6	-
67+00	74 RT	12	665.4	-
68+00	74 LT	10	-	671.4
69+00	74 LT	10	-	673.2
69+00	74 RT	16	-	670.3
71+00	74 LT	12	-	677.5
71+00	74 RT	16	-	675.4

CUT LIMITS FROM STATION 66+00 TO STATION 72+00

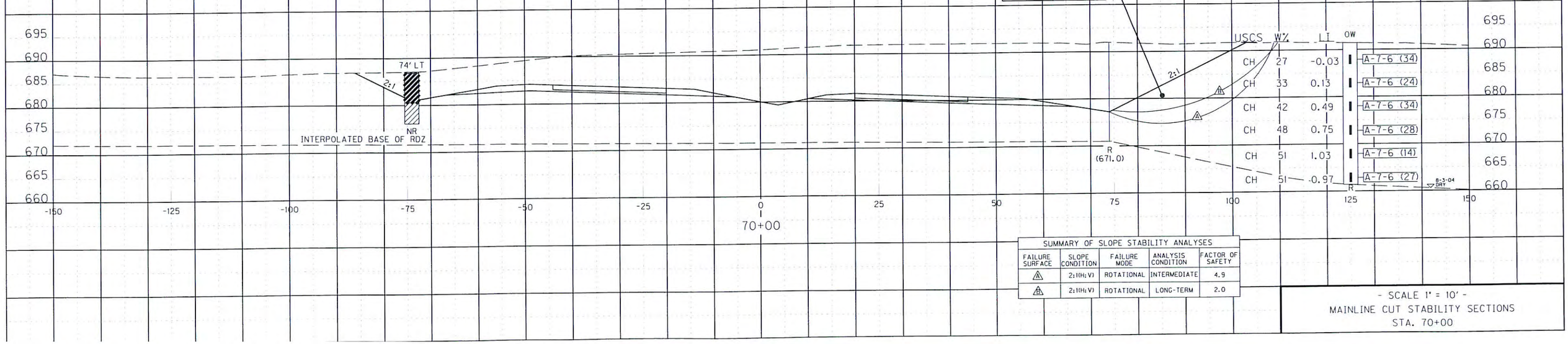
CORE LOG STA. 70+00, 74' RT

ELEV. 697.9 - 671.0 OVERBURDEN

SUMMARY OF TRIAXIAL TEST DATA

LOCATION	70+00
OFFSET	125' RT
DEPTH	22.5'-29.5'
γ	731 psf
ϕ	22.7°

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 731 psf	C 146.2 psf
ϕ 22.7°	ϕ 22.7°
γ 112.3 pcf	γ 112.3 pcf



SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	4.9
B	2:1(H:V)	ROTATIONAL	LONG-TERM	2.0

- SCALE 1" = 10' -

MAINLINE CUT STABILITY SECTIONS
STA. 70+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

CUT LIMITS FROM STATION 74+00 TO STATION 99+00

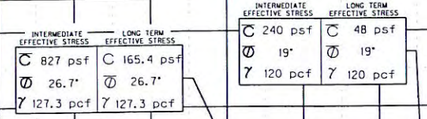
ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
81+00	64 LT	15	-	698.2
81+00	74 RT	27	-	694.8
82+00	74 LT	18.9	-	703.9
83+00	74 LT	32	-	698.8
83+00	74 RT	18	708.2	-
84+00	74 RT	19.8	709.4	-
86+00	74 LT	23.6	709.0	-
87+00	74 LT	14.1	705.2	-
89+00	74 LT	19	-	701.9
89+00	74 RT	12	-	702.2

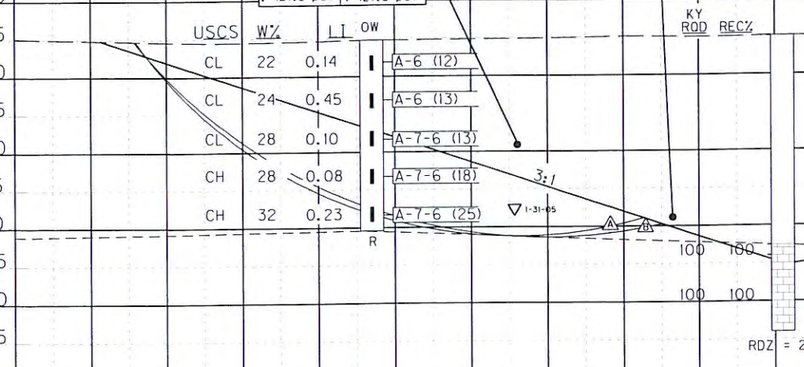
SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	3:1(H:V)	ROTATIONAL	INTERMEDIATE	2.7
B	3:1(H:V)	ROTATIONAL	LONG-TERM	1.5

SUMMARY OF TRIAXIAL TEST DATA	
LOCATION	85+00
OFFSET	128' LT
DEPTH	2'-9'
C	827 psf
Ø	26.7°

CORE LOG STATION 85+00, 74' LT		
ELEV.	735.0 - 707.3	Overburden
	707.3 - 695.9	Limestone- dark gray

NOTE: UPPER SOIL CHARACTERISTICS c AND ϕ ASSUMED FROM NAVFAC





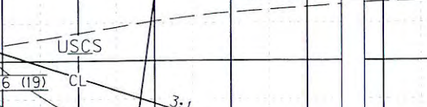
SUMMARY OF TRIAXIAL TEST DATA		
LOCATION	77+00	77+00
OFFSET	128' LT	128' LT
DEPTH	17'-24'	27'-33'
C	241 psf	714 psf
Ø	31.4°	19°

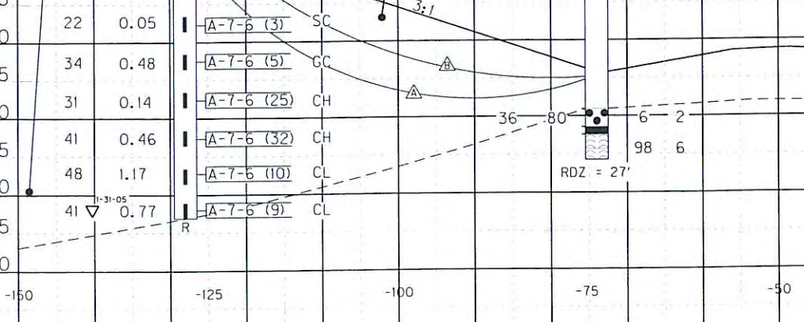
CORE LOG STATION 77+00, 74' LT		
ELEV.	718.2 - 691.9	Overburden
	691.9 - 689.3	Sandstone and mudstone, weathered
	689.3 - 688.3	Mud-filled void
	688.3 - 685.0	Shale- dark gray to brown

ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
75+00	74 LT	16	-	687.2
75+00	74 RT	14	-	684.8
76+00	74 RT	20	-	685.7
77+00	74 RT	21	-	687.7
78+00	74 LT	20	-	692.2
79+00	74 LT	9	-	694.0
79+00	74 RT	24	-	692.0

USING 3:1 SLOPE TO MAINTAIN CONSISTENCY IN CUT INTERVAL

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
NOT SHOWN	2:1(H:V)	ROTATIONAL	INTERMEDIATE	2.4
NOT SHOWN	2:1(H:V)	ROTATIONAL	LONG-TERM	1.5
A	3.1(H:V)	ROTATIONAL	INTERMEDIATE	3.3
B	3:1(H:V)	ROTATIONAL	LONG-TERM	2.2





- SCALE 1" = 10' -

MAINLINE CUT STABILITY SECTIONS
STA. 77+00 & 85+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

CUT LIMITS FROM STATION 74+00 TO STATION 99+00

CORE LOG STATION 95+00, 74' LT		
ELEV.	732.1 - 711.4	Overburden
	711.4 - 705.0	Limestone- dark gray

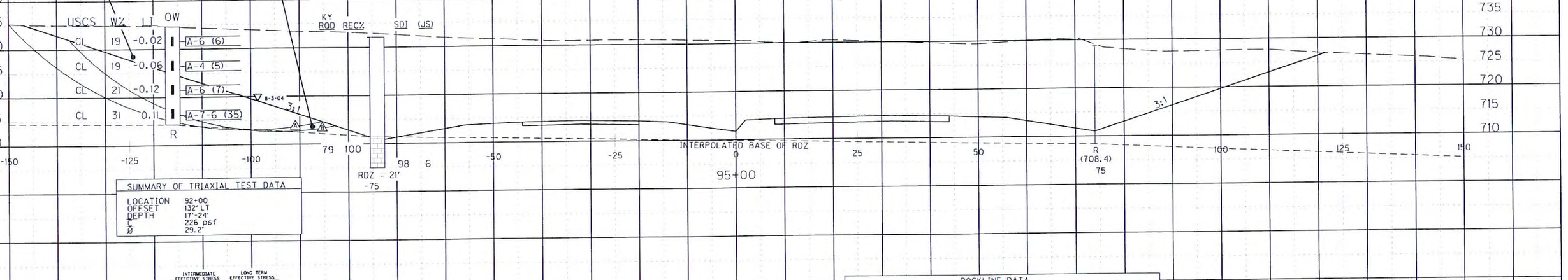
ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
94+00	74 LT	24.1	714.1	-
96+00	74 RT	16.0	-	706.5
97+00	74 LT	13.2	709.8	-
97+00	74 RT	11.0	-	707.7
99+00	74 LT	0.9	722.1	-

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
NOT SHOWN	2:1(H:V)	ROTATIONAL	INTERMEDIATE	1.6
NOT SHOWN	2:1(H:V)	ROTATIONAL	LONG-TERM	1.1
A	3:1(H:V)	ROTATIONAL	INTERMEDIATE	2.2
B	3:1(H:V)	ROTATIONAL	LONG-TERM	1.4

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 270 psf	C 54 psf
Ø 28°	Ø 28°
γ 120 pcf	γ 120 pcf

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 240 psf	C 48 psf
Ø 19°	Ø 19°
γ 125 pcf	γ 125 pcf

NOTE: SOIL CHARACTERISTICS C AND ϕ ASSUMED FROM NAVFAC



SUMMARY OF TRIAXIAL TEST DATA	
LOCATION	92+00
OFFSET	132' LT
DEPTH	17'-24'
C	226 psf
Ø	29.2°

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 226 psf	C 45.2 psf
Ø 29.2°	Ø 29.2°
γ 122.1 pcf	γ 122.1 pcf

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 270 psf	C 54 psf
Ø 28°	Ø 28°
γ 120 pcf	γ 120 pcf

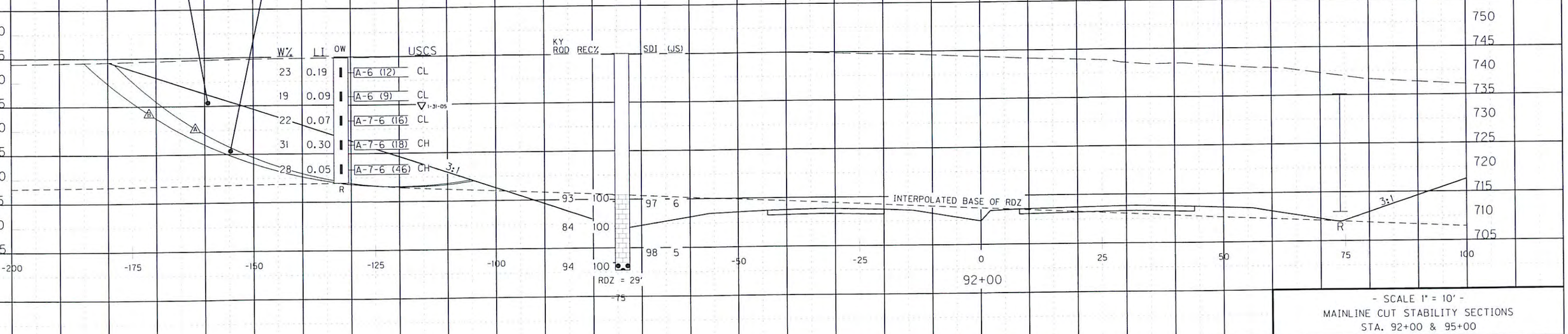
CORE LOG STATION 92+00, 74' LT		
ELEV.	745.1 - 715.9	Overburden
	715.9 - 701.1	Limestone- dark gray
	701.1 - 700.4	Sandstone

NOTE: SOIL CHARACTERISTICS FOR UPPER SOIL LAYTER C AND ϕ ASSUMED FROM NAVFAC

ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
90+00	74 LT	22.1	710.4	-
91+00	74 LT	26.5	713.8	-
91+00	74 RT	24.2	711.0	-
93+00	74 LT	31.0	712.6	-
93+00	74 RT	24.1	714.7	-

USING 3:1 SLOPE TO MAINTAIN CONSISTENCY IN CUT INTERVAL

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
NOT SHOWN	2.5:1(H:V)	ROTATIONAL	INTERMEDIATE	1.8
NOT SHOWN	2.5:1(H:V)	ROTATIONAL	LONG-TERM	1.5
A	3:1(H:V)	ROTATIONAL	INTERMEDIATE	2.6
B	3:1(H:V)	ROTATIONAL	LONG-TERM	2.0



- SCALE 1" = 10' -

MAINLINE CUT STABILITY SECTIONS
STA. 92+00 & 95+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
124+00	74 LT	19.3	-	723.81
126+00	74 RT	16.2	728.6	-
127+00	74 RT	19.2	-	-
131+00	74 RT	6.0	734.0	-
135+00	74 RT	14.5	738.2	-

CORE LOG STATION 124+60, CL		
ELEV.	745.2 - 725.1	Overburden

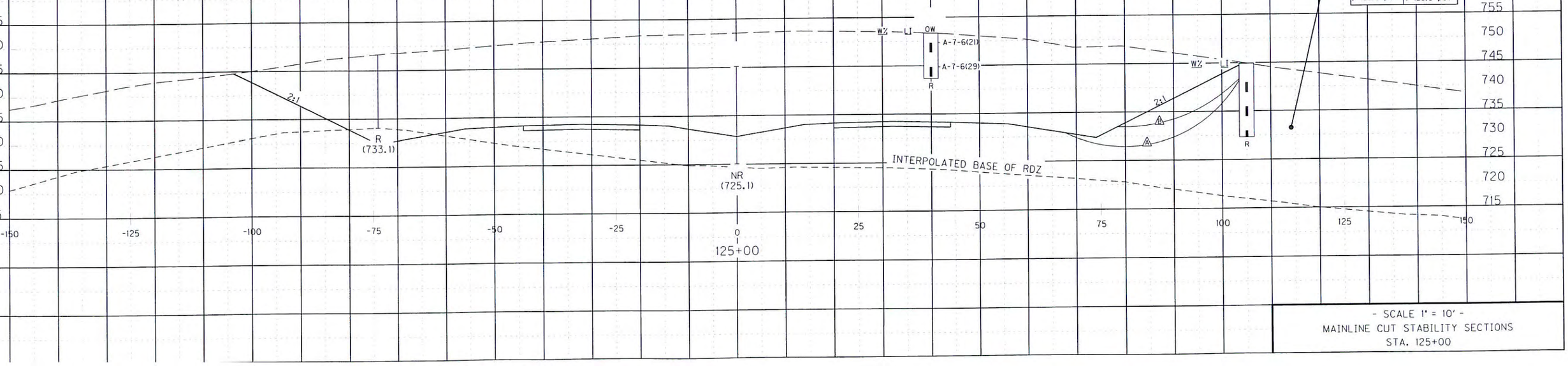
CORE LOG STATION 125+00, 74' LT		
ELEV.	748.3 - 733.1	Overburden

CUT LIMITS FROM STATION 123+50 TO STATION 128+00

SUMMARY OF TRIAXIAL TEST DATA	
LOCATION	125+00
OFFSET	105' RT
DEPTH	4.0'-11.0'
C	880 psf
Ø	25.2°

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	INTERMEDIATE	ROTATIONAL	4.9
B	2:1(H:V)	LONG-TERM	ROTATIONAL	2.1

	INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C	880 psf	176 psf
Ø	25.2°	25.2°
γ	128.5 pcf	128.5 pcf



- SCALE 1" = 10' -

MAINLINE CUT STABILITY SECTIONS
STA. 125+00

CUT LIMITS FROM STATION 145+50 TO STATION 160+76

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

CORE LOG STATION 153+00, 74' LT

ELEV.	785.6 - 764.7	Overburden
	764.7 - 762.6	Limestone- gray to dark gray, microcrystalline
	762.6 - 757.2	Shale- dark gray, with interbedded limestone (<20%)

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 573 psf	C 114.6 psf
Ø 32°	Ø 32°
γ 126.2 pcf	γ 126.2 pcf

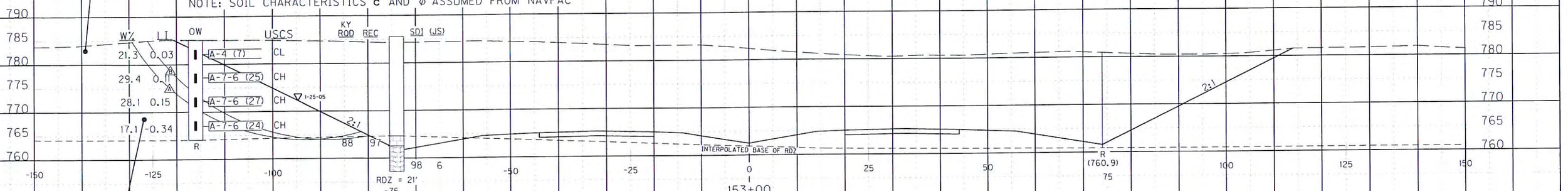
SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	2.7
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.4

ROCKLINE DATA

STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
152+00	74 LT	25.2	760.30	-

NOTE: SOIL CHARACTERISTICS C AND Ø ASSUMED FROM NAVFAC



CORE LOG STATION 149+00, 74' LT

ELEV.	789.9 - 758.3	Overburden
	758.3 - 752.2	Shale- dark gray, argillaceous
	752.2 - 749.4	Mudstone- brown, argillaceous, thin bedded
	749.4 - 746.9	Limestone- light gray to gray, mod. crystalline

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 553 psf	C 110.6 psf
Ø 23.6°	Ø 23.6°
γ 121.3 pcf	γ 121.3 pcf

SUMMARY OF TRIAXIAL TEST DATA

LOCATION	149+00
OFFSET	134' LT
DEPTH	2'-10'
C	1650 psf
Ø	19°

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 270 psf	C 54 psf
Ø 28°	Ø 28°
γ 120 pcf	γ 120 pcf

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 1650 psf	C 330 psf
Ø 19°	Ø 19°
γ 125.4 pcf	γ 125.4 pcf

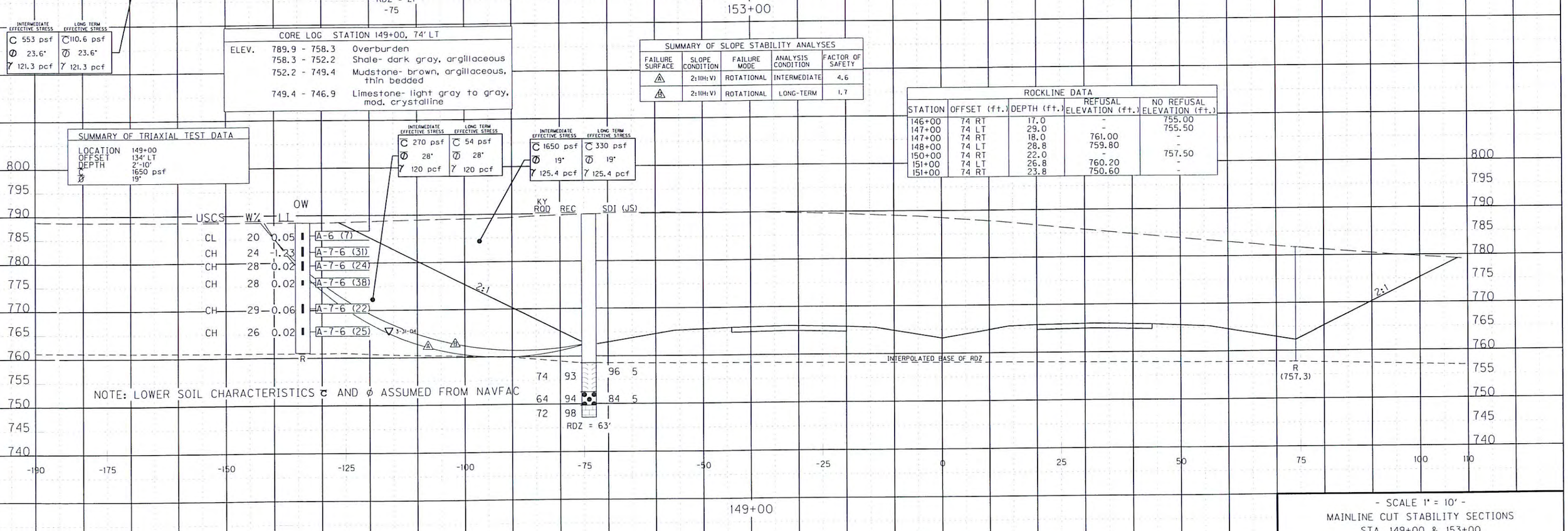
SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	4.6
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.7

ROCKLINE DATA

STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
146+00	74 RT	17.0	-	755.00
147+00	74 LT	29.0	-	755.50
147+00	74 RT	18.0	761.00	-
148+00	74 LT	28.8	759.80	-
150+00	74 RT	22.0	-	757.50
151+00	74 LT	26.8	760.20	-
151+00	74 RT	23.8	750.60	-

NOTE: LOWER SOIL CHARACTERISTICS C AND Ø ASSUMED FROM NAVFAC



- SCALE 1" = 10' -

MAINLINE CUT STABILITY SECTIONS
STA. 149+00 & 153+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

CUT LIMITS FROM STATION 145+50 TO STATION 160+76

ROCKLINE DATA

STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
154+00	74 RT	24.7	761.4	-
155+00	74 LT	19.3	762.6	-
155+00	74 RT	25.7	764.0	-
156+00	80 RT	22.2	766.5	-
158+00	74 LT	16.9	765.2	-
159+00	74 LT	23.1	759.6	-
159+00	74 RT	22.2	763.0	-
160+00	74 RT	22.1	759.0	-

SUMMARY OF SLOPE STABILITY ANALYSES

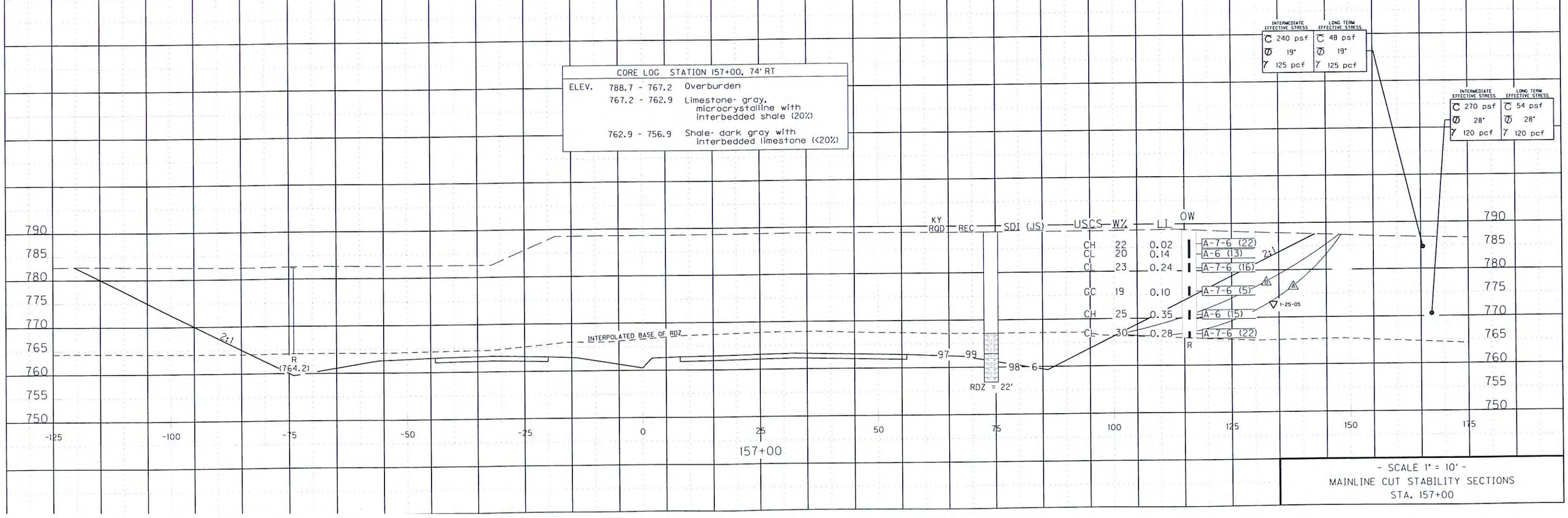
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	2.1
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.5

CORE LOG STATION 157+00, 74' RT

ELEV. 788.7 - 767.2 Overburden

767.2 - 762.9 Limestone- gray, microcrystalline with interbedded shale (20%)

762.9 - 756.9 Shale- dark gray with interbedded limestone (<20%)



- SCALE 1" = 10' -

MAINLINE CUT STABILITY SECTIONS

STA. 157+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

NOTE: DUE TO A CEMETERY LOCATED APPROXIMATELY 90' RIGHT OF CENTERLINE, IT IS DESIRABLE TO USE A 2:1(H:V) SLOPE STARTING AT STATION 309+00 THROUGH STATION 310+50. AT STATION 310+50 THE SLOPE SHOULD START TRANSITIONING TO A 2.5:1(H:V) SLOPE, WHICH IS THE GOVERNING SLOPE FOR THIS CUT INTERVAL.

CUT LIMITS FROM STATION 309+00 TO STATION 314+00

ROCKLINE DATA

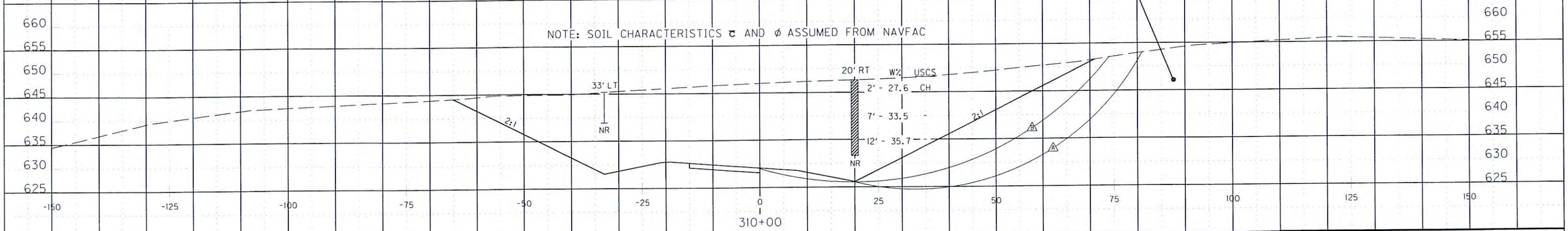
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
309+00	20 RT	12.0	-	634.50
310+00	33 LT	13.0	-	632.90
311+00	33 LT	5.3	639.50	-
312+00	20 RT	19.0	-	628.30
313+00	20 LT	10.0	-	627.70
	20 RT	1.1	638.2	-

SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	INTERMEDIATE	ROTATIONAL	2.0
B	2:1(H:V)	LONG-TERM	ROTATIONAL	1.4

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
τ 270 psf	τ 54 psf
ϕ 28°	ϕ 28°
γ 125 pcf	γ 125 pcf

NOTE: SOIL CHARACTERISTICS τ AND ϕ ASSUMED FROM NAVFAC



- SCALE 1" = 10' -
RAMP 3 CUT STABILITY SECTIONS
STA. 310+00

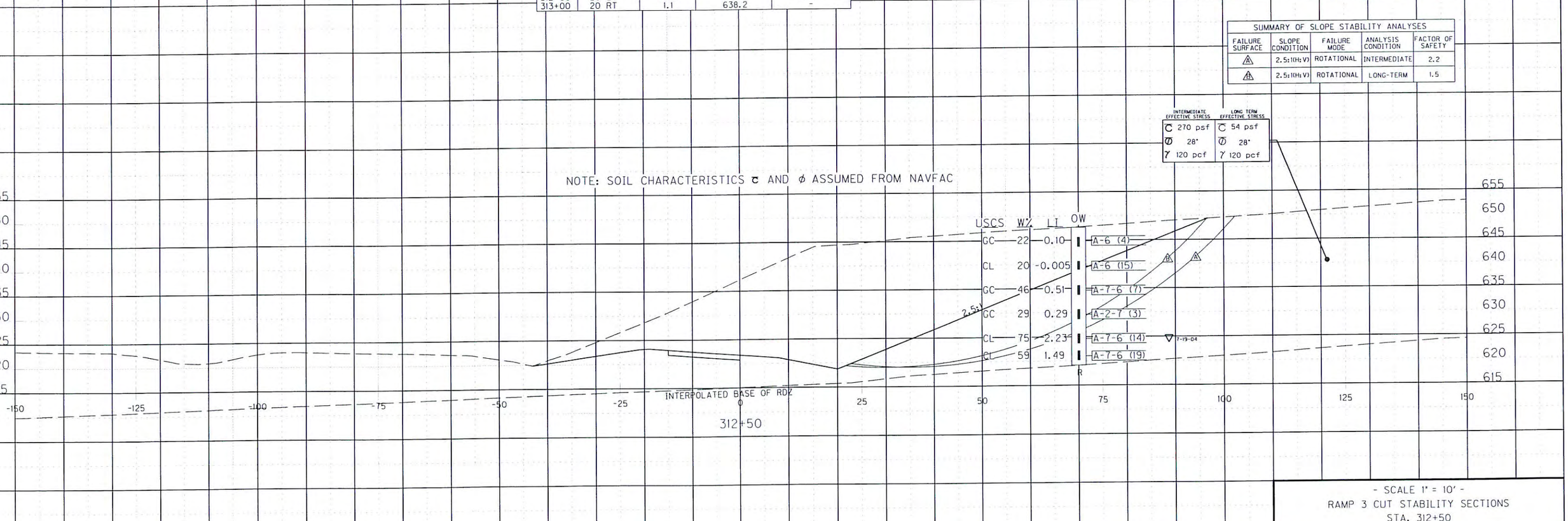
COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

CUT LIMITS FROM STATION 309+00 TO STATION 314+00

ROCKLINE DATA				
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
309+00	20 RT	12.0	-	634.5
310+00	33 LT	13.0	-	632.9
311+00	33 LT	5.3	639.5	-
311+00	20 RT	19.0	-	628.3
312+00	20 LT	10.0	-	627.7
313+00	20 RT	1.1	638.2	-

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2.5:1(H:V)	ROTATIONAL	INTERMEDIATE	2.2
B	2.5:1(H:V)	ROTATIONAL	LONG-TERM	1.5

NOTE: SOIL CHARACTERISTICS τ AND ϕ ASSUMED FROM NAVFAC



- SCALE 1" = 10' -
RAMP 3 CUT STABILITY SECTIONS
STA. 312+50

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	

NOTES:
1. THIS SHEET PRESENTS GEOTECHNICAL DATA AND RECOMMENDATIONS. REFER TO PROJECT PLANS, PROFILES AND CROSS SECTIONS FOR FINAL ALIGNMENT AND GRADE.
2. AUGER REFUSAL INDICATES THE BEGINNING OF ROCK-LIKE RESISTANCE TO THE ADVANCEMENT OF THE AUGERS. THIS MAY INDICATE THE BEGINNING OF WEATHERED BEDROCK, BOULDERS OR ROCK REMNANTS. AN EXACT DETERMINATION CANNOT BE MADE WITHOUT PERFORMING ROCK CORING.

ROCKLINE DATA

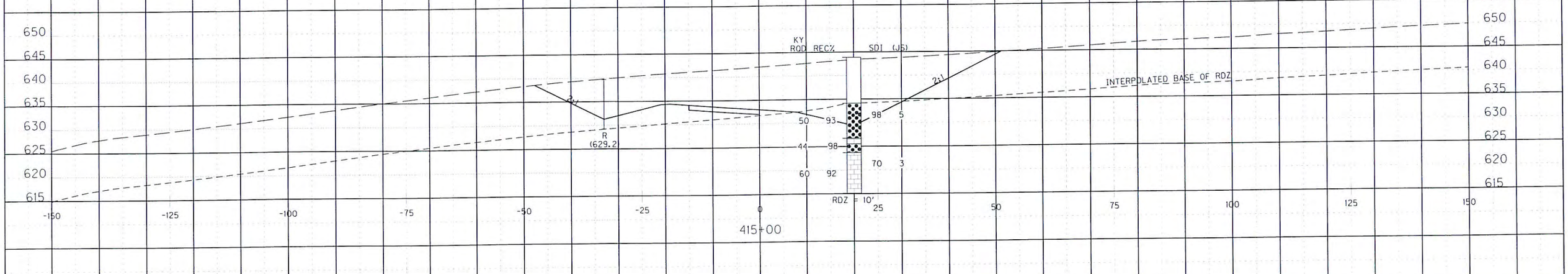
STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
414+00	33 LT	13.0	-	625.6
420+00	20 RT	10.0	-	640.0

CUT LIMITS FROM STATION 413+00 TO STATION 417+00

NOTE: NO ANALYSES DEEMED NECESSARY DUE TO SLOPE CONFIGURATION AND SUBSURFACE CONDITIONS.

CORE LOG STATION 415+00, 25' RT

ELEV.	643.9 - 634.1	Overburden
	634.1 - 626.7	Sandstone- brown to dark gray
	626.7 - 625.5	Limestone- Light gray
	625.5 - 623.7	Sandstone- Light brown
	623.7 - 615.1	Limestone- Light gray



- SCALE 1" = 10' -
RAMP 4 CUT STABILITY SECTIONS
STA. 415+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.00	GT9

ROCKLINE DATA

STATION	OFFSET (ft.)	DEPTH (ft.)	REFUSAL ELEVATION (ft.)	NO REFUSAL ELEVATION (ft.)
43+00	28 LT	15.0	-	663.4
43+00	28 RT	15.0	-	678.9
44+00	28 LT	12.0	-	662.6
45+00	29 LT	14.0	-	659.3
45+00	29 RT	13.0	-	658.2
46+00	29 RT	19.0	-	656.8
48+00	29 LT	22.0	-	654.1
49+00	29 RT	19.0	-	652.9
51+00	28 RT	16.0	-	650.6
52+00	26 RT	12.0	-	650.3
53+00	24 LT	12.0	-	649.1
53+00	24 RT	12.0	-	649.1
54+00	22 LT	14.0	-	648.3
55+00	22 LT	14.0	-	646.2

CUT LIMITS FROM STATION 41+00 TO STATION 56+00

SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	INTERMEDIATE	3.2
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.5

CORE LOG STA. 47+00, 29' LT

ELEV. 676.7 - 654.7 OVERBURDEN

CORE LOG STA. 47+00, 29' RT

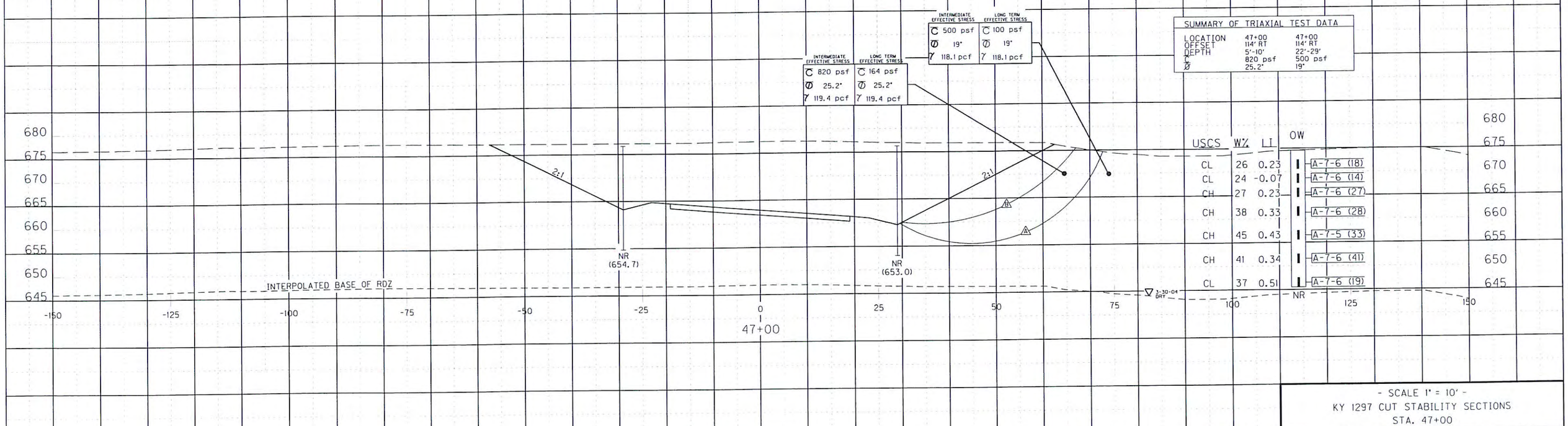
ELEV. 676.3 - 653.0 OVERBURDEN

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 820 psf	C 164 psf
Ø 25.2°	Ø 25.2°
γ 119.4 pcf	γ 119.4 pcf

INTERMEDIATE EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 500 psf	C 100 psf
Ø 19°	Ø 19°
γ 118.1 pcf	γ 118.1 pcf

SUMMARY OF TRIAXIAL TEST DATA

LOCATION	47+00	47+00
OFFSET	114' RT	114' RT
DEPTH	5'-10'	22'-29'
C	820 psf	500 psf
Ø	25.2°	19°



- SCALE 1" = 10' -

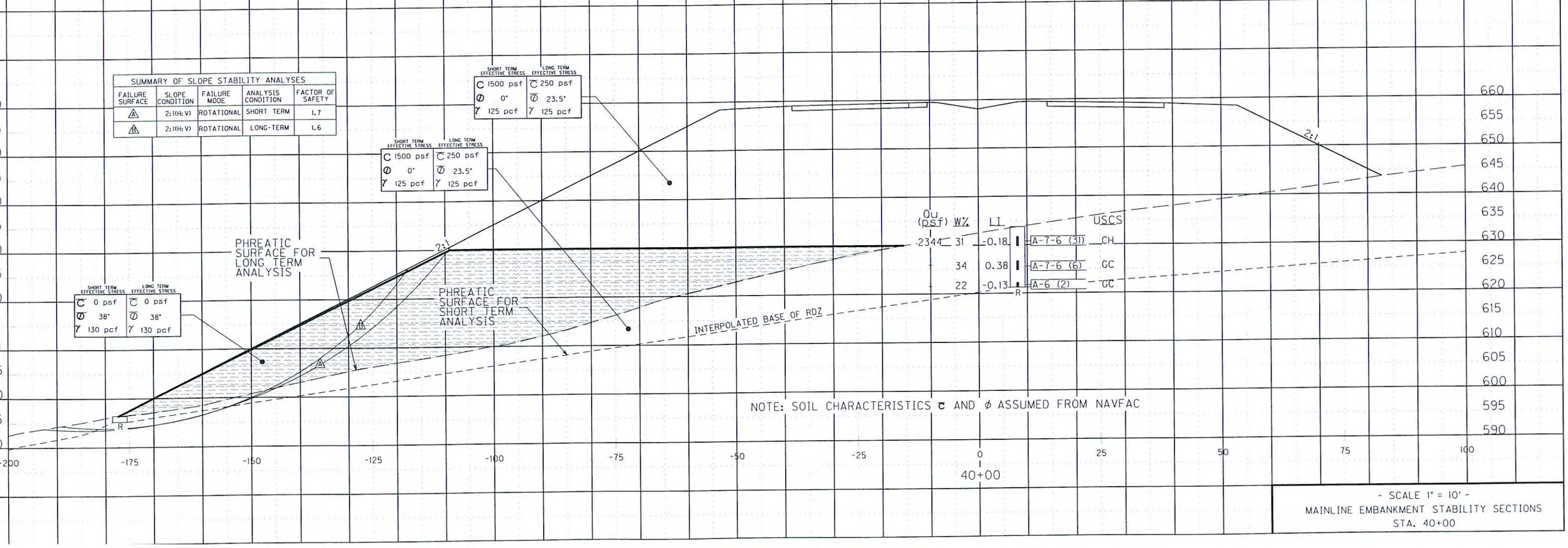
KY 1297 CUT STABILITY SECTIONS

STA. 47+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.0	GT12

NOTE: DUE TO A STRUCTURE AT THIS STATION THE MINIMUM LONG TERM FACTOR OF SAFETY IS 1.6

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	SHORT TERM	1.7
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.6



NOTE: SOIL CHARACTERISTICS c AND ϕ ASSUMED FROM NAVFAC

- SCALE 1" = 10' -

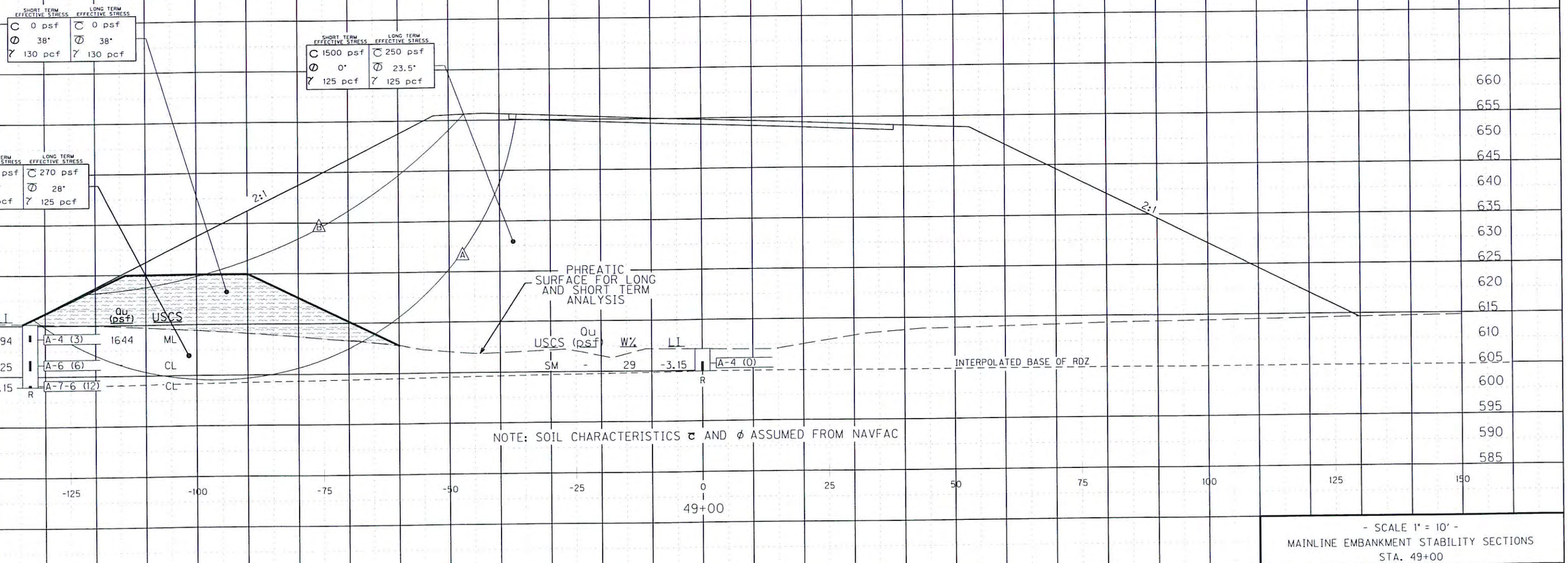
MAINLINE EMBANKMENT STABILITY SECTIONS
STA. 40+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.0	GT13

NOTE: DUE TO A STRUCTURE AT THIS STATION, THE MINIMUM LONG TERM FACTOR OF SAFETY IS 1.6

SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	SHORT TERM	1.6
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.5



NOTE: SOIL CHARACTERISTICS C AND Ø ASSUMED FROM NAVFAC

- SCALE 1" = 10' -
MAINLINE EMBANKMENT STABILITY SECTIONS
STA. 49+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.0	GT14

SUMMARY OF SLOPE STABILITY ANALYSES

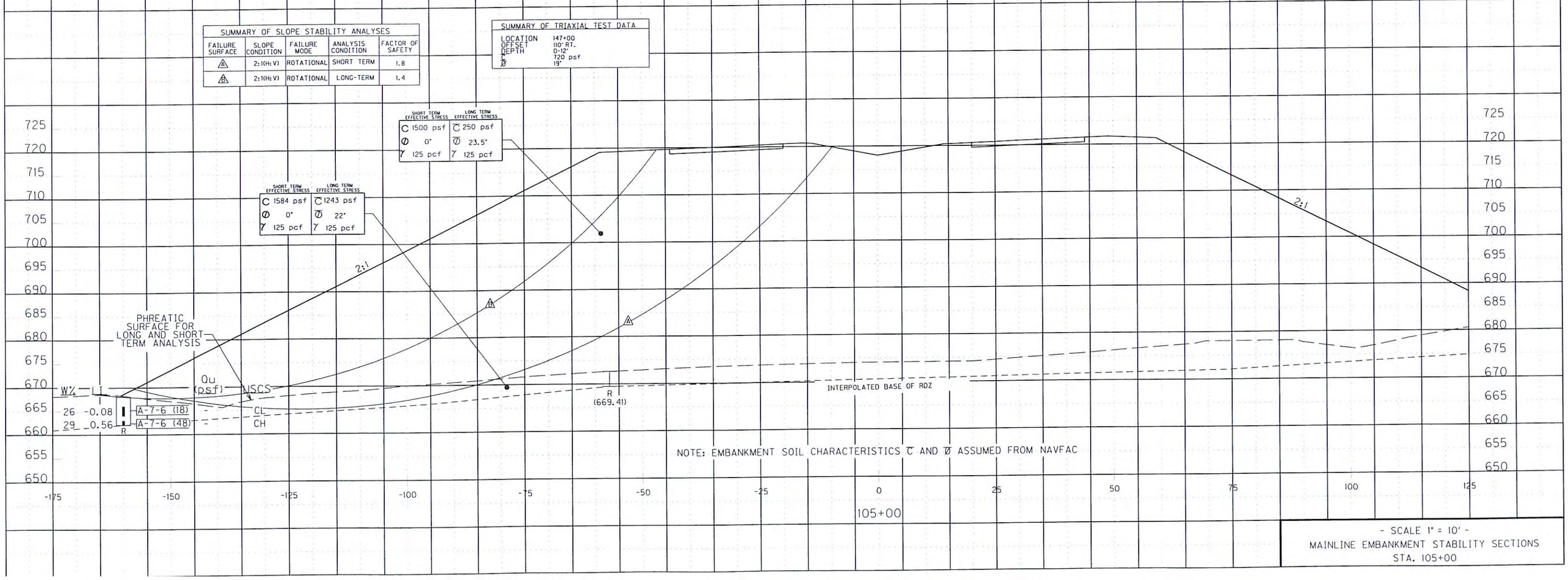
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	SHORT TERM	1.8
A	2:1(H:V)	ROTATIONAL	LONG-TERM	1.4

SUMMARY OF TRIAXIAL TEST DATA

LOCATION	147+00
OFFSET	110' RT.
DEPTH	0-12'
C	720 psf
Ø	19°

SHORT TERM EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 1500 psf	C̄ 250 psf
Ø 0°	Ø̄ 23.5°
γ 125 pcf	γ 125 pcf

SHORT TERM EFFECTIVE STRESS	LONG TERM EFFECTIVE STRESS
C 1584 psf	C̄ 1243 psf
Ø 0°	Ø̄ 22°
γ 125 pcf	γ 125 pcf



NOTE: EMBANKMENT SOIL CHARACTERISTICS C̄ AND Ø̄ ASSUMED FROM NAVFAC

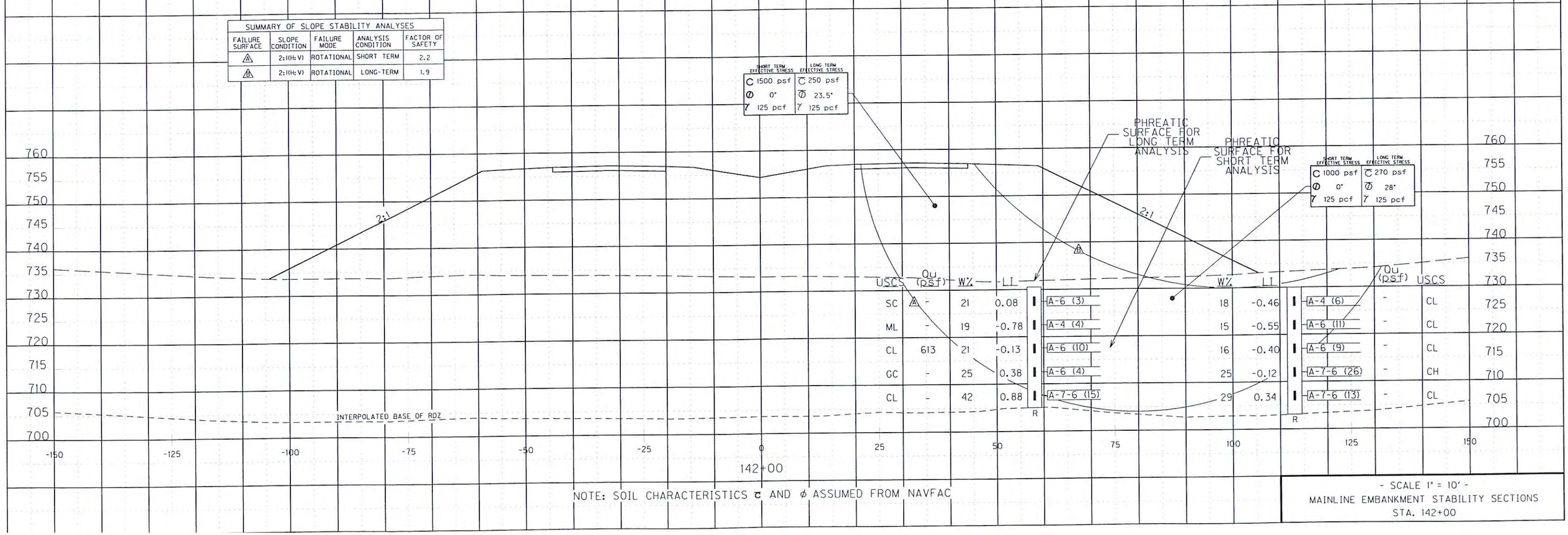
- SCALE 1" = 10' -

MAINLINE EMBANKMENT STABILITY SECTIONS
STA. 105+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.0	GT15

SUMMARY OF SLOPE STABILITY ANALYSES

FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
A	2:1(H:V)	ROTATIONAL	SHORT TERM	2.2
B	2:1(H:V)	ROTATIONAL	LONG-TERM	1.9



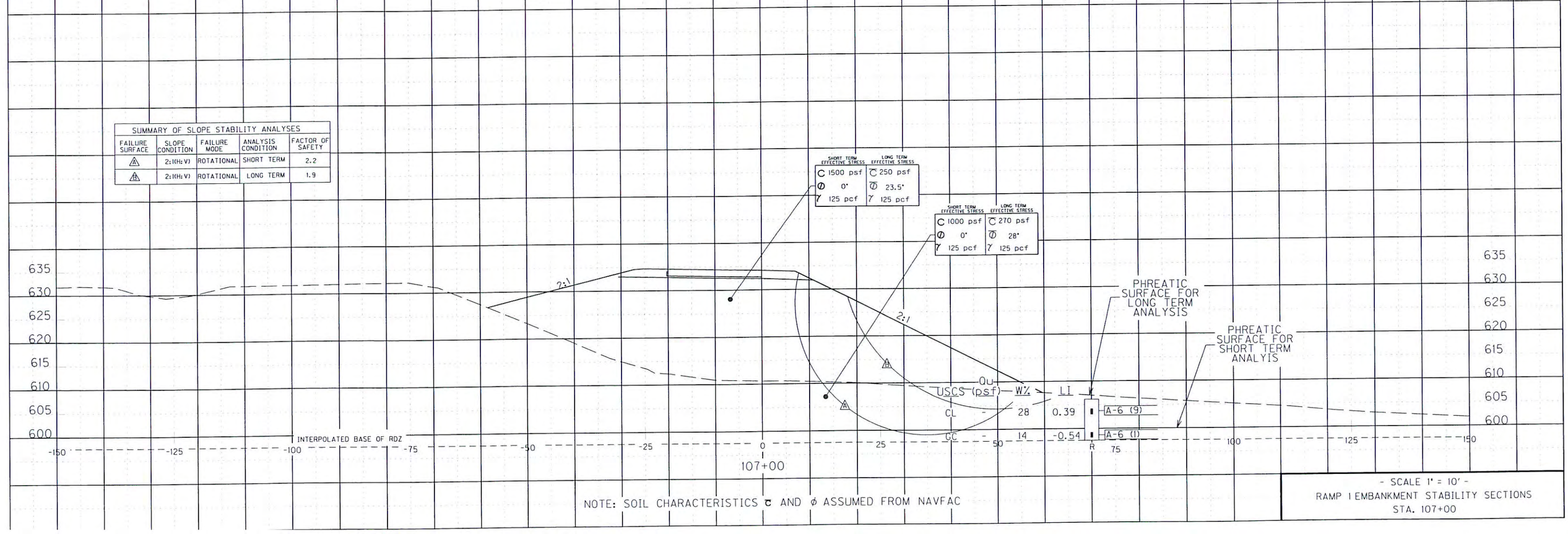
NOTE: SOIL CHARACTERISTICS c AND ϕ ASSUMED FROM NAVFAC

- SCALE 1" = 10' -

MAINLINE EMBANKMENT STABILITY SECTIONS
STA. 142+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.0	GT16

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
①	2:1(H:V)	ROTATIONAL	SHORT TERM	2.2
②	2:1(H:V)	ROTATIONAL	LONG TERM	1.9



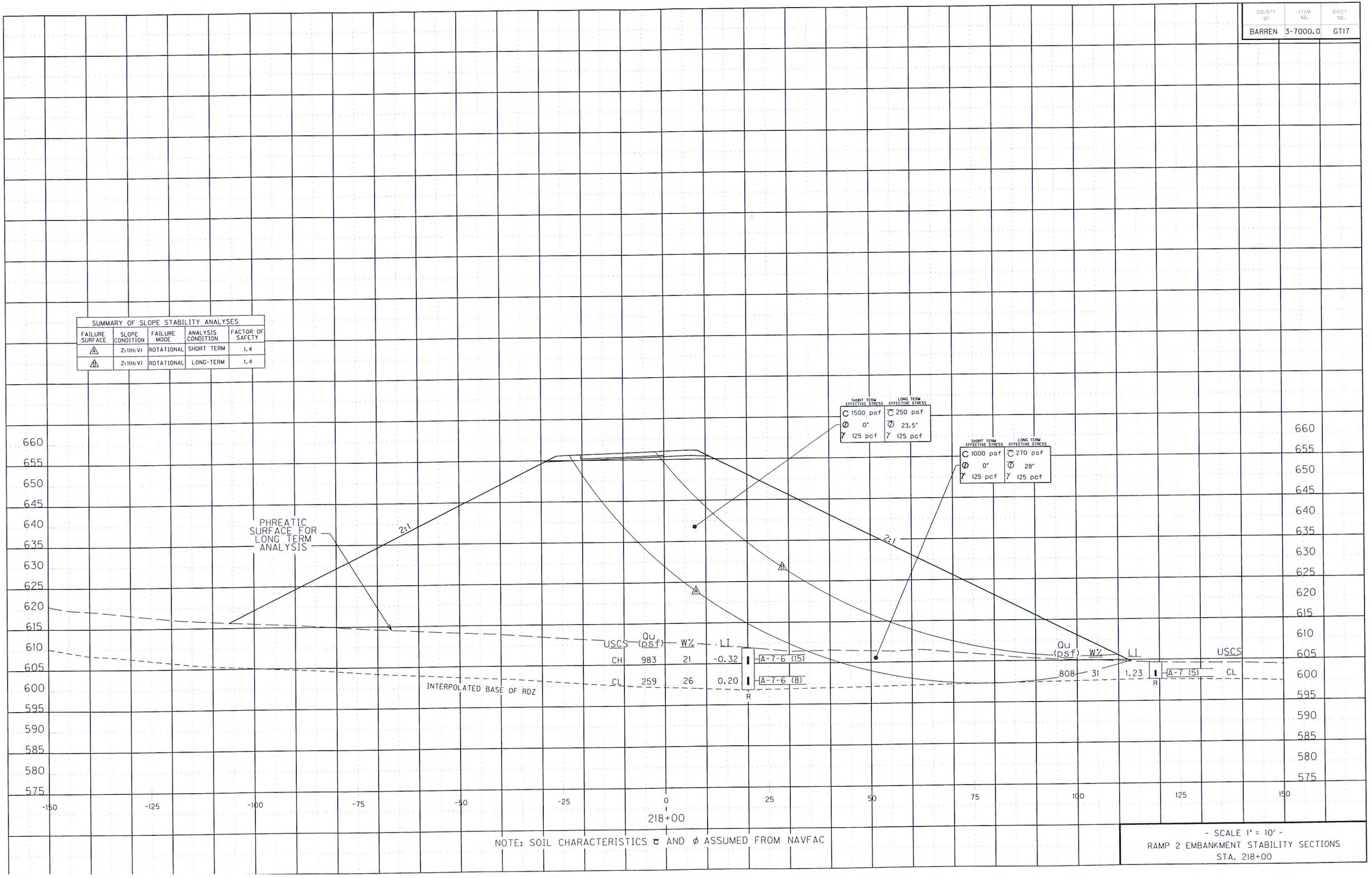
NOTE: SOIL CHARACTERISTICS C AND Ø ASSUMED FROM NAVFAC

- SCALE 1" = 10' -

RAMP 1 EMBANKMENT STABILITY SECTIONS
STA. 107+00

COUNTY OF	ITEM NO.	SHEET NO.
BARREN	3-7000.0	GT17

SUMMARY OF SLOPE STABILITY ANALYSES				
FAILURE SURFACE	SLOPE CONDITION	FAILURE MODE	ANALYSIS CONDITION	FACTOR OF SAFETY
⚠	2:1(H:V)	ROTATIONAL	SHORT TERM	1.4
⚠	2:1(H:V)	ROTATIONAL	LONG-TERM	1.4



NOTE: SOIL CHARACTERISTICS c AND ϕ ASSUMED FROM NAVFAC

- SCALE 1" = 10' -

RAMP 2 EMBANKMENT STABILITY SECTIONS
STA. 218+00

Appendix IV

Laboratory Summary Sheets

American Engineers, Inc

SUMMARY OF CONSOLIDATED-UNDRAINED TRIAXIAL TESTING

PROJECT NAME: Glasgow Outer Loop Section 3 AEI PROJECT NO 199-158 DATE: 6/2/2005
COUNTY: Barren
ITEM NO: 3-7000.00

Individual Samples Tested				Average	Average		Effective-Stress Parameters	
Alignment	Station	Offset	Specimen Interval	Moisture Content	Dry Unit Weight	USCS Classification	Internal Angle of Friction (f)	cohesion (c)
			(ft)	(%)	(pcf)		(degrees)	(psf)
Mainline	33+00	114' lt	2-7'	23.1	101.7	CL	19.9	420
Mainline	33+00	114' lt	12-14'	42	80.3	CL	16.4	880
Mainline	57+00	108' rt	2-14'	22.6	102	CL	18.3	893
Mainline	70+00	125' rt	22.5-29.5'	45.1	77.5	CL	22.7	731
Mainline	77+00	128' lt	22-24'	40	82.5	CH	31.4	241
Mainline	77+00	128' lt	27-33'	36.7	85.8	CL	19	714
Mainline	85+00	128' lt	2-9'	29.5	99.3	CL	26.7	827
Mainline	92+00	132' lt	17-24'	32.2	89.7	CH	29.2	226
Mainline	95+00	116' lt	2-12'	23.5	99.8	CL	28	120
Mainline	105+00	160' lt	3.0-6.0'	28.4	97	CH	22	1243
Mainline	125+00	105' rt	4-11'	21.2	108.2	CL	25.2	880
Mainline	142+00	113' rt	12-19'	24.2	103.5	CL	30.5	130
Mainline	149+00	134' lt	2-10'	23.5	101.6	CH	19	1650
Mainline	153+00	116' lt	2-17'	18.8	103.9	CL	28	270
KY 1297	47+00	114' rt	5-10'	29.2	92.6	CL	25.2	820
KY 1297	47+00	114' rt	22-29'	36.1	86.8	CL	19	500

AMERICAN ENGINEERS, INC.

UNCONFINED COMPRESSIVE STRENGTH SUMMARY

Project: Outer Loop Section 3 **Date:** 6/2/2005
County: Barren
Item No.: 3-7000.00

Station	Offset	Sample Interval	Unit Weight		Moisture Content	Unconfined Compressive Strength	Visual Description
			wet density	dry density			
		(depth ft.)	(pcf)	(pcf)	(%)	(psf)	
Mainline							
40+00	8' rt	2.0-4.0'	117.1	90.9	28.9	2344	red lean clay
49+00	CL	2.5-4.4'	113.9	87.9	29.6	610	grayish brown clayey silt with gravel
49+00	133' lt	2.0-3.3/R	132.9	113.3	17.3	2550	brown clayey silt with gravel
49+00	133' lt	7.0-9.0'	125.9	107.2	17.4	1644	gray to brown silt
142+00	58' rt	22.0-24.0'	117.9	85.9	37.3	613	yellowish brown fat clay
Ramp 2							
218+00	20' rt	2.0-4.0'	114	85.1	34	983	yellowish brown clayey sand
218+00	20' rt	7.0-9.0'	113.3	81.5	39.1	259	brown clayey sand with gravel
218+00	119' rt	2.0-3.5/R	128.4	104.3	23.1	808	brown clayey silt with gravel

AMERICAN ENGINEERS, INC.

BULK SAMPLE LAB DATA SUMMARY

PROJECT NAME: Glasgow Outer Loop Section 3
COUNTY: Barren
ITEM No: 3-7000.00

AEI PROJECT NO. 199-158
DATE: 6/2/05

Sample Location							Classification Testing						Standard Proctor		
Mainline/ Approach	Station	Offset	Sample Depth (FT)	Sample No.	Sample Type	Natural Moisture (%)	Plastic Limit (PL)	Liquid Limit (LL)	Plasticity Index (PI)	USCS	Visual Description	AASHTO	Maximum Dry Density (pcf)	Optimum Moisture (%)	KY CBR
Mainline	34+00	74' rt	4-10'	1	bulk	28.1	20	43	23	CL	reddish brown lean clay	A-7-6 (22)	109.5	17.5	6.2
Mainline	34+00	74' rt	11-15'	2	bulk	34	28	63	35	CH	red fat clay	A-7-6 (38)	96.7	25.2	4.2
Mainline	54+00	CL	1.0-2.0'	3	bulk	24.5	18	36	18	CL	brown lean clay	A-6 (13)	n/a	n/a	n/a
Mainline	54+00	CL	2.0-3.0'	4	bulk	28.2	24	46	22	CL	reddish brown lean clay	A-7-6 (20)	n/a	n/a	n/a
Mainline	58+00	68' lt	0.5-4.0'	5	bulk	22.1	19	33	14	CL	yellowish brown lean clay	A-6 (12)	107.4	18.5	3.7
Mainline	58+00	68' lt	4.5-9.0'	6	bulk	27.4	27	63	36	CH	yellow to red fat clay	A-7-6 (34)	95.3	25.8	4.5
Mainline	62+00	74' lt	1.0-3.5'	7	bulk	25.6	25	44	19	CL	yellowish brown lean clay	A-7-6 (17)	n/a	n/a	n/a
Mainline	62+00	74'lt	5.5-6.5'	8	bulk	32.4	24	60	36	CH	red fat clay	A-7-6 (37)	n/a	n/a	n/a
Mainline	64+00	CL	3.0-4.5'	9	bulk	36.8	31	61	30	CH	red fat clay with gravel	A-7-5 (28)	n/a	n/a	n/a
Mainline	66+00	CL	1.0-3.0'	10	bulk	25.5	24	31	7	ML	yellowish brown clayey silt	A-4 (5)	n/a	n/a	n/a
Mainline	68+00	74' rt	7.0-12.0'	11	bulk	19	28	53	25	CH	brown fat clay	A-7-6 (27)	93.8	24.3	4.1
Mainline	76+00	74'lt	8.5-14.0'	12	bulk	28.7	28	67	39	CH	reddish brown fat clay	A-7-6 (45)	96.9	25.5	2.5
Mainline	76+00	74'lt	16.5-20.0'	13	bulk	30.1	22	51	29	CH	yellowish brown fat clay	A-7-6 (27)	100.7	22.3	5
Mainline	84+00	74'lt	17.0-20.0'	14	bulk	27.7	28	63	35	CH	reddish brown fat clay	A-7-6 (37)	95.8	24.9	4
Mainline	89+85	74' rt	10.0-12.0'	15	bulk	30.7	23	56	33	CH	yellowish brown fat clay	A-7-6 (330	97.7	24.9	1.5
Mainline	92+00	74' rt	10.0-14.0'	16	bulk	30.4	18	35	17	CL	red lean clay with sand	A-6 (13)	113.4	15.3	10.1
Mainline	98+00	74'lt	2.0-4.0'	17	bulk	14.7	20	26	6	ML	reddish brown clayey silt	A-4 (4)	113.3	15.1	10
Mainline	108+00	CL	11.0-13.0'	18	bulk	30.2	27	57	30	CH	reddish brown fat clay	A-7-6 (29)	n/a	n/a	n/a
Mainline	118+00	CL	2.0-3.0'	19	bulk	19.8	19	31	12	CL	brown lean clay with sand	A-6 (7)	n/a	n/a	n/a
Mainline	123+70	74' rt	2.0-3.0'	20	bulk	26.1	22	52	30	CH	yellowish brown fat clay	A-7-6 (28)	100.6	21.6	1.8
Mainline	130+00	CL	2.0-3.0'	21	bulk	17.1	19	38	19	CL	brown silty clay	A-6 (17)	n/a	n/a	n/a
Mainline	134+35	74' rt	3.0-5.0'	22	bulk	21.3	18	33	15	CL	yellow to brown lean clay	A-6 (13)	105.9	20.6	1.7
Mainline	146+00	74' lt	4.0-7.0'	23	bulk	22.6	28	76	48	CH	reddish brown fat clay	A-7-6 (54)	97.5	24.1	4.4
Mainline	148+00	74' rt	4.5-12.0'	24	bulk	20.4	17	26	9	CL	yellow to brown lean clay with sand	A-4 (5)	115	13.1	13
Mainline	152+00	74' rt	2.0-10.0'	25	bulk	26.9	17	33	16	CL	reddish brown lean clay with sand	A-6 (8)	110.4	16.3	8.1
Mainline	154+00	74' lt	12.0-14.0'	26	bulk	21.7	26	53	27	CH	red fat clay	A-7-6 (23)	98.3	23.4	3.5
Mainline	158+00	74' rt	10.0-16.0'	27	bulk	26.7	25	69	44	CH	red fat clay with yellow mottle	A-7-6 (47)	93.9	27	2.3
KY 1297	42+00	24' lt	2.0-7.0'	28	bulk	33.9	27	55	28	CH	yellowish brown fat clay	A-7-6 (31)	98.4	24.2	3.5
KY 1297	44+00	28' rt	2.0-6.0'	29	bulk	25.4	19	33	14	CL	reddish brown lean clay with sand	A-6 (10)	109.2	17.3	10.1
KY 1297	46+00	29' lt	3.5-6.5'	30	bulk	30.3	25	53	28	CH	reddish brown fat clay	A-7-6 (30)	95.5	25.8	5.3
KY 1297	52+00	26' lt	1.0-3.0'	31	bulk	24.7	17	32	15	CL	brown lean clay	A-6 (13)	108.9	17.6	3.1
ramp 1	103+00	CL	2.0-3.0'	32	bulk	19.7	23	32	9	CL	yellowish brown clayey silt	A-4 (8)	n/a	n/a	n/a
ramp 1	106+00	CL	7.0-8.0'	33	bulk	23.8	16	33	17	CL	yellowish brown lean clay with sand	A-6 (10)	n/a	n/a	n/a
ramp 3	304+00	42' lt	3.0-4.0'	34	bulk	24.2	19	27	8	ML	brown lean clayey silt	A-4 (4)	n/a	n/a	n/a
ramp 3	310+00	20' rt	2.0-5.0'	35	bulk	29.4	29	58	29	CH	reddish brown fat clay	A-7-6 (25)	97	23.9	5.5
ramp 4	416+00	20' rt	2.0-7.0'	36	bulk	25.6	24	44	20	CL	brown lean clay with sand	A-7-6 (14)	97.3	22.2	8.3
ramp 4	420+00	33' lt	4.0-9.0'	37	bulk	27	28	60	32	CH	reddish brown fat clay	A-7-6 (30)	97.4	24.1	7.1
Frontage Rd.	34+00	CL	1.5-2.5'	38	bulk	23.1	24	29	5	ML	yellow to brown clayey silt	A-4 (3)	n/a	n/a	n/a
Frontage Rd.	34+00	CL	10.0-11.0'	39	bulk	24.4	27	56	29	CH	yellowish brown fat clay	A-7-6 (28)	n/a	n/a	n/a
Frontage Rd	40+00	20' rt	4.5-8.5'	40	bulk	36.3	31	65	34	CH	yellow to reddish brown fat clay	A-7-5 (35)	96	25.3	4.1
Frontage Rd	46+00	20' lt	1.0-5.5'	41	bulk	27.9	20	29	9	CL	lean brown clay	A-4 (6)	111.5	15.3	5.3
Frontage Rd	46+00	20' lt	6.0-9.0'	42	bulk	32.1	26	54	28	CH	reddish brown fat clay	A-7-6 (28)	98.4	22.4	5.4
Bob Lewis Rd	46+00	15' rt	4.5-7.5'	43	bulk	21.9	23	54	31	CH	reddish brown fat clay	A-7-6 (25)	96.6	24.4	5.6

Appendix V

Boring Coordinates

COORDINATE DATA SUBMISSION FORM
KYTC DIVISION OF STRUCTURAL DESIGN -- GEOTECHNICAL BRANCH

County Barren

Date 3/21/2006

Road Number Glasgow Outer Loop Section 3

Survey Crew / Consultant American Engineers, Inc.

Contact Person Dennis Mitchell

Item # 3-7000.00

MARS # 6565801D

Project # 1100 C35 D625 03 FD04 1550 C005 E143

Notes:

All coordinates should be NAD-83 Latitude and Longitude in Decimal Degrees.

Soil Profile Borings - 11000 series
Cut Stability Borings - 12000 series
Embankment Stability Borings - 13000 series

Elevation Datum (circle one) **Sea Level** **Assumed**

HOLE NUMBER	STATION	OFFSET	ELEVATION (ft)	LATITUDE	LONGITUDE
11000	ML 32+00	74' LT	672.0	36.98755089	85.98230995
11001	ML 34+00	74' RT	667.7	36.98797039	85.98163756
11002	ML 36+00	74' RT	665.8	36.98849938	85.98145313
11003	ML 38+00	CL	651.7	36.98908310	85.98151268
11004	ML 54+00	CL	647.6	36.99324602	85.97979495
11005	ML 56+00	38' RT	662.3	36.99367266	85.97935029
11006	ML 58+00	68' LT	661.3	36.99429431	85.97928871
11007	ML 60+00	68' RT	659.0	36.99452318	85.97851151
11008	ML 62+00	74' LT	669.6	36.99519576	85.97845931
11009	ML 64+00	CL	665.5	36.99547062	85.97780701
11010	ML 66+00	CL	674.7	36.99585587	85.97731902
11011	ML 68+00	74' RT	682.5	36.99606161	85.97664277
11012	ML 70+00	74' LT	687.1	36.99671989	85.97641501
11013	ML 72+00	74' LT	690.7	36.99703932	85.97584033
11014	ML 74+00	74' RT	689.1	36.99697922	85.97499192
11015	ML 76+00	74' LT	712.5	36.99759669	85.97462748
11016	ML 78+00	74' RT	713.4	36.99745936	85.97379314
11017	ML 80+00	74' RT	717.6	36.99765747	85.97317007
11018	ML 82+00	74' RT	724.8	36.99782671	85.97253390
11019	ML 84+00	74' LT	733.8	36.99836363	85.97201070
11020	ML 85+85	74' RT	729.0	36.99809912	85.97126954
11021	ML 88+00	74' LT	712.3	36.99864189	85.97068573
11022	ML 89+85	74' RT	724.4	36.99837737	85.96994457
11023	ML 92+00	74' RT	739.1	36.99852692	85.96923240
11024	ML 94+00	74' RT	735.1	36.99866604	85.96856991
11025	ML 96+00	74' LT	728.6	36.99919837	85.96803576
11026	ML 98+00	74' LT	723.3	36.99934202	85.96738413
11027	ML 102+00	CL	701.4	36.99952245	85.96602476
11028	ML 108+00	CL	711.0	37.00029916	85.96421566
11029	ML 111+00	CL	705.5	37.00077776	85.96337988
11030	ML 114+00	CL	713.0	37.00131199	85.96259823
11031	ML 118+00	CL	721.6	37.00210400	85.96165012
11032	ML 122+00	CL	729.8	37.00297699	85.96081978
11033	ML 123+70	74' RT	732.4	37.00324653	85.96028110
11034	ML 126+00	74' LT	742.0	37.00399733	85.96025249
11035	ML 128+00	74' RT	738.9	37.00421966	85.95944686
11036	ML 130+00	CL	734.1	37.00478742	85.95926764
11037	ML 132+00	74' RT	741.0	37.00512489	85.95867080
11038	ML 134+35	74' RT	752.1	37.00565671	85.95821486
11039	ML 136+00	74' RT	749.6	37.00603012	85.95789473
11040	ML 140+00	CL	736.9	37.00705049	85.95732745
11041	ML 146+00	74' LT	774.6	37.00852347	85.95637209
11042	ML 148+00	74' RT	778.7	37.00874577	85.95556640
11043	ML 150+00	74' LT	789.0	37.00942868	85.95559596
11044	ML 152+00	74' RT	776.4	37.00965097	85.95479025
11045	ML 154+00	74' LT	782.0	37.01033388	85.95481980
11046	ML 156+00	74' LT	782.7	37.01072207	85.98868055
11047	ML 158+00	74'RT	785.8	37.01100877	85.95362600
11048	ML 160+25	74' LT	775.6	37.01174826	85.95360703
11049	R1 103+00	CL	614.8	36.99165950	85.97956748
11050	R1 106+00	CL	613.3	36.99162455	85.97854127
11051	R1 112+00	CL	630.4	36.99153885	85.97649019
11052	R3 304+00	42' LT	640.1	36.99409906	85.98032828
11053	R3 307+00	CL	650.5	36.99383942	85.98131366
11054	R3 310+00	20' RT	647.6	36.99355600	85.98226944

11055	R3 312+00	20' RT	645.5	36.99347264	85.98292610
11056	R3 314+00	20' RT	629.6	36.99352918	85.98358718
11057	R4 410+00	CL	622.9	36.99197357	85.97612907
11058	R4 414+00	20' RT	640.1	36.99260338	85.97723380
11059	R4 416+00	20' RT	641.7	36.99299084	85.97770533
11060	R4 418+00	34' RT	636.5	36.99343059	85.97811844
11061	R4 420+00	33' LT	652.8	36.99372438	85.97874084
11062	KY 1297 42+00	24' LT	678.2	36.98656796	85.98482689
11063	KY 1297 44+00	28' RT	673.3	36.98672624	85.98415249
11064	KY 1297 46+00	29' LT	676.8	36.98707369	85.98358871
11065	KY 1297 48+00	29' RT	674.9	36.98701505	85.98288092
11066	KY 1297 50+00	28' RT	669.0	36.98702252	85.98220533
11067	KY 1297 52+00	26' LT	662.3	36.98716482	85.98151864
11068	KY 1297 54+00	22' RT	662.8	36.98702700	85.98083576
11069	KY 1297 56+00	22' LT	656.1	36.98716622	85.98015720
11070	Frontage Rd 34+00	CL	646.5	36.99444075	85.98034854
11071	Frontage Rd 38+00	20' LT	664.7	36.99502246	85.97921162
11072	Frontage Rd 40+00	20' RT	671.8	36.99531334	85.97861681
11073	Frontage Rd 42+00	20' LT	678.9	36.99576732	85.97820770
11074	Frontage Rd 44+00	20' LT	679.1	36.99615481	85.97773202
11075	Frontage Rd 46+00	20' LT	684.1	36.99657608	85.97729798
12000	ML 33+00	74' LT	672.1	36.98781538	85.98221774
12001	ML 33+00	74' RT	668.4	36.98770590	85.98172977
12002	ML 33+00	114' LT	673.2	36.98784497	85.98234962
12003	ML 57+00	68' LT	659.4	36.99405999	85.97947971
12004	ML 57+00	68' RT	665.1	36.99386008	85.97908637
12005	ML 57+00	108' RT	662.3	36.99380128	85.97897068
12006	ML 70+00	74' LT	687.1	36.99671989	85.97641501
12007	ML 70+00	74' RT	691.9	36.99639255	85.97611459
12008	ML 70+00	125' RT	691.4	36.99627975	85.97601107
12009	ML 77+00	74' LT	717.5	36.99771837	85.97431247
12010	ML 77+00	128' LT	710.7	36.99785290	85.97439032
12011	ML 77+00	74' RT	708.5	36.99734968	85.97409913
12012	ML 85+00	74' LT	735.1	36.99843320	85.97167946
12013	ML 85+00	128' LT	734.8	36.99857667	85.97172629
12014	ML 85+00	74' RT	730.1	36.99803999	85.97155109
12015	ML 125+00	40' RT	751.7	37.00359364	85.96012482
12016	ML 125+00	104' RT	744.9	37.00349250	85.95994141
12017	ML 125+00	74' LT	748.5	37.00354073	85.96002889
12018	ML 149+00	74' LT	789.9	37.00920237	85.95578999
12019	ML 149+00	134' LT	788.4	37.00929574	85.95595930
12020	ML 149+00	74' RT	781.7	37.00897207	85.95537236
12021	ML 153+00	74' LT	784.4	37.01010758	85.95501385
12022	ML 153+00	116' LT	785.1	37.01017294	85.95513236
12023	ML 153+00	74' RT	780.9	37.00981282	85.98884463
12024	ML 157+00	74' LT	782.6	37.01101278	85.95423768
12025	ML 157+00	74' RT	788.6	37.01078247	85.95382004
12026	ML 157+00	116' RT	788.7	37.01071712	85.95370153
12027	R3 310+00	20' RT	647.6	36.99355600	85.98226944
12028	R3 310+00	33' LT	645.3	36.99341645	85.98221780
12029	R3 312+50	70' RT	647.7	36.99361086	85.98308583
12030	R4 415+00	20' RT	643.4	36.99278967	85.97747804
12031	R4 415+00	33' LT	639.8	36.99268513	85.97914888
12032	KY 1297 47+00	29' LT	677.3	36.98713767	85.98324572
12033	KY 1297 47+00	29' RT	677.0	36.98698091	85.98321048
12034	KY 1297 47+00	124' RT	674.9	36.98672414	85.98315275
13000	ML 105+00	160' LT	668.2	37.00026711	85.96535800
13001	ML 105+00	57' LT	672.6	37.00001771	85.96519156
13002	ML 142+00	58' RT	731.9	37.00741285	85.95677573
13003	ML 142+00	113' RT	733.4	37.00732726	85.95662054
13004	ML 40+00	8' RT	633.7	36.98960616	85.98130187
13005	ML 40+00	177' LT	596.4	36.98974301	85.98191184
13006	ML 49+00	128' LT	615.2	36.99210235	85.98088672
13007	ML 49+00	CL	609.2	36.99198639	85.98047301
13008	R1 107+00	70' RT	607.1	36.99142083	85.97820937
13009	R2 218+00	20' RT	608.9	36.99183593	85.98138416
13010	R2 218+00	119' RT	604.4	36.99157652	85.98148568