M E M O R A N D U M **R-001-2012**

TO: **Bob Farley, PE**
Project Management Coordinator
Division of Highway Design

FROM: **Bart Asher, PE, PLS**
Geotechnical Branch Manager
Division of Structural Design

BY: **Christian Wallover, PG**
Geotechnical Branch

DATE: **March 9, 2012**

SUBJECT: **Jefferson County**
FD52 056 0264 021-023 D
I-264
Station 500+50 to 520+00
Item No. 5-804.00
MARS No. 8556401D
Geotechnical Engineering Roadway Report

An abbreviated geotechnical engineering report has been completed for the subject project. Terracon (formerly H.C. Nutting Co.) completed the drilling and sampling. Testing and analyses were performed by the Geotechnical Branch. The purpose of the investigation was to define the subsurface conditions. Reduced size geotechnical symbol, geotechnical notes, soil profile and cut stability sheets are attached. The CADD input for these sheets, in DGN format, is being e-mailed to the District for incorporation into the roadway plans.

The project is located within the Jeffersonville Quadrangle, East Bound exit ramp for I-264 and US 42 interchange. Geologic mapping indicates bedrock is part of the Beechwood Limestone Member of the Sellersburg Limestone Formation. There were no sinkholes or other karst features found during a field review; however the Beechwood Limestone Member is susceptible to solution, creating shallow sinkholes and caves along fractures. If sinkholes are encountered during construction, please contact this office for mitigation procedures.

Bedrock was encountered below the cut slope. Therefore, select rock quantities were not required and no rock will be available from roadway excavation for construction purposes.

Cut stability analyses were performed at station 511+50 using the maximum slope steepness of 2H:1V. The analyses did not identify any expected stability problems and the required factors of safety for roadway cuts in soil were met. The results of these analyses are shown on the attached cut stability sheet.

Testing indicated that natural moisture contents exceeded optimum moisture in some areas of the project. Subgrade problems may occur in some areas where the template is in a shallow fill or in a cut condition. Therefore, a minimum of one foot working platform consisting of Kentucky Coarse Aggregate # 2's, 3's or 23's wrapped with Geotextile Fabric, will be required in the areas where subgrade problems are encountered. The actual thickness and locations will be determined by the Engineer on construction and may depend on seasonal fluctuations in the water table. The working platform will be required directly beneath the roadway template and extending under the curb and gutter, where applicable. Wrapping the rock with fabric is cost effective because it prevents the soils or DGA from filtrating into these coarse aggregates. The working platform may also serve as a drainage blanket by placing short sections of perforated drain pipe (4 ft.) into the bottom of the granular material. The drainpipe should be located at the drop inlets, where applicable. **For quantity estimating purposes only**, a one-foot working platform shall be calculated for 500 feet of roadway.

GEOTECHNICAL RECOMMENDATIONS:

1.) In accordance with Section 206 of the current Standard Specifications, the moisture content of embankment material shall not vary from the optimum moisture content as determined by the current version of KM 64-511 by more than +2 percent or less than -2 percent. This moisture content requirement shall have equal weight with the density requirement when determining the acceptability of embankment construction. Refer to the Family of Curves for moisture/density correlation.

2.) All soils, whether from roadway or borrow, may require manipulation to obtain proper moisture content prior to compaction. Direct payment shall not be permitted for rehandling, hauling, stockpiling, and/or manipulating soils.

3.) Excavation of surface ditches and channel changes adjacent to embankment areas shall be performed prior to the placement of the adjacent embankments. The material excavated for the channel changes and surface ditches is suitable for embankment construction if dried to proper moisture content in accordance with Section 206 of the current Standard Specifications.

4.) The Contractor is responsible for conducting any operations necessary to excavate the cut areas to the required typical section. These operations shall be incidental to Roadway Excavation or Embankment-in-Place, and no additional compensation shall be made for this work.

5.) The Contractor shall construct foundation embankment benches as indicated on the plans and/or as directed by the Engineer, prior to placement of embankments in areas requiring such benches.

6.) Perforated pipe for subgrade drainage shall be installed or extended in vertical sags in accordance with RDP-005 at the following approximate location and/or where designated by the Engineer.

MAINLINE
Station 508+40
Station 511+85

7.) Borrow material, if required for subgrade, shall meet the minimum CBR value of 4.

8.) The existing subgrade is anticipated to be wet and soft in areas where the roadway template is in a shallow cut or fill. Therefore, a working platform will be required in these areas consisting of Kentucky Coarse Aggregate No. 2, 3 or 23 in accordance with the current edition of Section 805 of the Standard Specifications for Road and Bridge Construction. The working platform shall be wrapped with Geotextile Fabric, Type IV, in accordance with Sections 214 & 843 of the Standard Specifications. The actual locations and thickness shall be determined by the Engineer during construction and may depend on seasonal fluctuations in the water table. For the purpose of calculating quantities, assume 500 linear feet of roadway for this treatment.

DESIGN RECOMMENDATIONS:

1.) The project should be designed for a 2-foot subgrade using a CBR design value of 4.0.

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

cc: **Division of Design (Plan Processing Section)**
TEBM for Pavement Design
Division of Construction
TEBM for Project Delivery & Preservation (District)
TEBM for Project Development (District)
Project Manager (District)
HDR

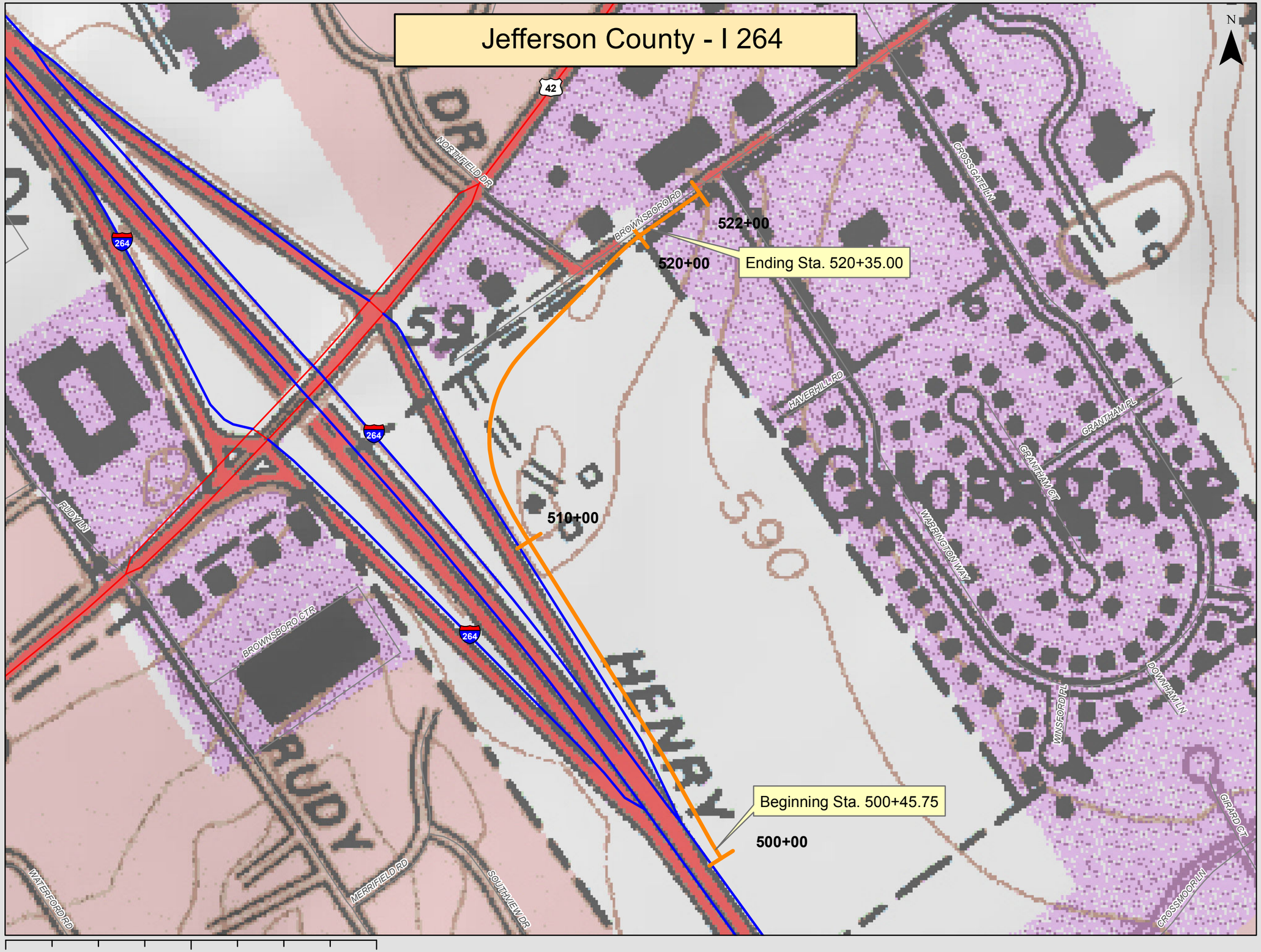
Attachments:

Jefferson County
I-264/US-42 Interchange
Item No. 5-0804.00
Mars No. 8556401D

Improvements to I-264/US-42 Interchange

Kentucky
UNBRIDLED SPIRIT

Jefferson County - I 264



Legend

- 500+00 Stations
- Project Area
- Interstates
- US Highways
- State Roads
- Local Roads

GEOTECHNICAL SYMBOLS

COUNTY OF	ITEM NO.	SHEET NO.
JEFFERSON	5-804.00	

AASHTO Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (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

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 & Rock Core
●	Rock Core
◌	Slope Inclinometer Installation
	typical applications: ⊙ ◕ ◎ ⊙ ●
OW	Observation Well
➡	Approximate Footing Elevation
▼ (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 ROD	Rock Quality Designation (Kentucky Method)
STD ROD	Rock Quality Designation (Standard Method)
SDI(JS)	Slake Durability Index (Jar Slake Test)
REC	Core Recovery
ø	Angle of Internal Friction (Total Stress)
$\bar{ø}$	Angle of Internal Friction (Effective Stress)
c (psf)	Cohesion (Total Stress)
$\bar{c}$ (psf)	Cohesion (Effective Stress)
♂ (pcf)	Total Unit Weight
RDZ	Rock Disintegration Zone
OB	Overburden Bench
IB	Intermediate Bench
R	Refusal
NR	Refusal Not Encountered

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.
		ML-CL		Silty clay-silty clay with sand and or gravel, sandy silty clay, sandy silty clay with gravel, gravelly silty clay, gravelly silty clay with sand
	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.

Unified Soil Classifications - Continued

MAJOR DIVISIONS		SYMBOL		NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GP-GC		Poorly graded gravel with clay (or silty clay), poorly graded gravel with clay and sand (or silty clay & sand)
		GP-GM		Poorly graded gravel with silt, poorly graded gravel with silt and sand
		GW-GC		Well graded gravel with clay (or silty clay), well graded gravel with clay and sand (or silty clay and sand)
		GW-GM		Well graded gravel with silt, well graded gravel with silt and sand
		GC-GM		Silty clayey gravel, silty clayey gravel with sand
	SAND AND SANDY SOILS	SW-SC		Well graded sand with clay (or silty clay), well graded sand with clay and gravel (or silty clay & gravel)
		SP-SC		Poorly graded sand with clay (or silty clay), poorly graded sand with clay and gravel (or silty clay and gravel)
		SP-SM		Poorly graded sand with silt, poorly graded sand with silt and gravel
		SC-SM		Silty clayey sand, silty clayey sand with gravel
		SW-SM		Well graded sand with silt, well graded sand with silt and gravel
UNCLASSIFIED MATERIAL		OH		Organic (High Plasticity)
		OL		Organic (Low Plasticity)

	LIMESTONE
	SANDSTONE
	DURABLE SHALE (SDI ≥ 95)
	NONDURABLE SHALE (SDI < 95)
	GRANULAR EMBANKMENT
	STRUCTURE GRANULAR BACKFILL
	TALUS, MINE WASTE, FILL MATERIAL, BOULDERS, & ETC.
	COAL
	DOLOMITE
	LIMESTONE (ARGILLACEOUS)
	SLOPE PROTECTION

GEOTECHNICAL SYMBOL SHEET

FILE NAME:
USER:
DATE
E-SHEET NAME:
MicroStation v8.11.7.180

COUNTY OF	ITEM NO.	SHEET NO.
JEFFERSON	5-804.00	

GEOTECHNICAL NOTES

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Station 511+85

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Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS
COUNTY OF

JEFFERSON

PROJECT NUMBERS: _____

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Field Drilling and Sampling were performed in Feb. 2012.

Detailed data and interpretation of subsurface conditions encountered in individual borings are shown on the soil profile. Soil and rock strata discriptions 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 Structural Design in Frankfort and are available for inspection request. Contact the Division of Structural Design, Geotechnical Branch for availability information and to schedule an inspection.

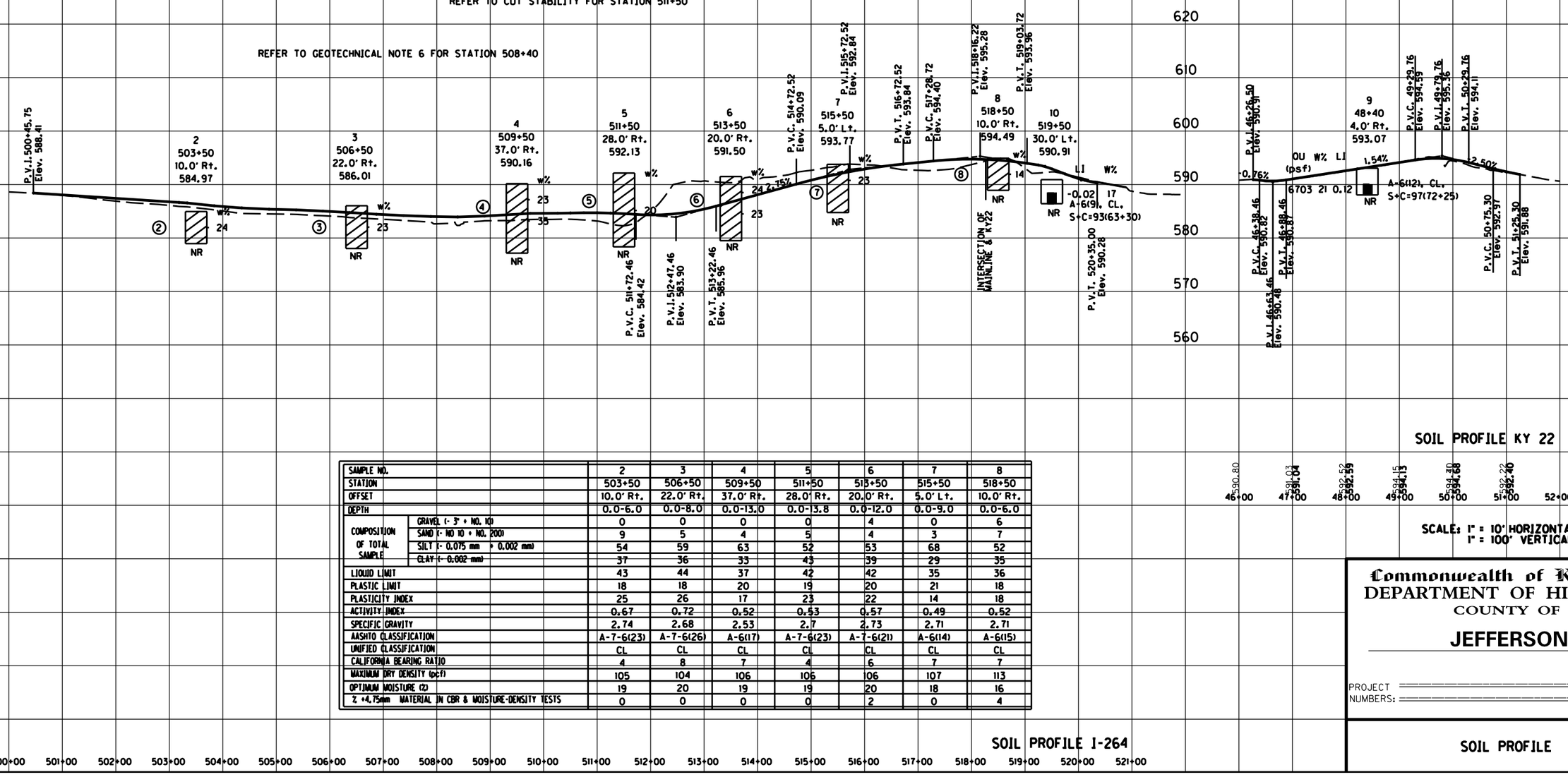
NOTICE - Without regard to the materials encountered, all roadway and drainage excavation shall be unclassified and shall be designated as Roadway Excavation. It shall be distinctly understood that any reference to rock, earth or any other materials on the plans or cross sections whether in numbers, 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

REFER TO GEOTECHNICAL NOTE 6 FOR STATION 511+85

REFER TO CUT STABILITY FOR STATION 511+50

REFER TO GEOTECHNICAL NOTE 6 FOR STATION 508+40



SAMPLE NO.		2	3	4	5	6	7	8
STATION		503+50	506+50	509+50	511+50	513+50	515+50	518+50
OFFSET		10.0' Rt.	22.0' Rt.	37.0' Rt.	28.0' Rt.	20.0' Rt.	5.0' Lt.	10.0' Rt.
DEPTH		0.0-6.0	0.0-8.0	0.0-13.0	0.0-13.8	0.0-12.0	0.0-9.0	0.0-6.0
COMPOSITION OF TOTAL SAMPLE	GRAVEL (- 3" + NO. 10)	0	0	0	0	4	0	6
	SAND (- NO 10 + NO. 200)	9	5	4	5	4	3	7
	SILT (- 0.075 mm + 0.002 mm)	54	59	63	52	53	68	52
	CLAY (- 0.002 mm)	37	36	33	43	39	29	35
LIQUID LIMIT		43	44	37	42	42	35	36
PLASTIC LIMIT		18	18	20	19	20	21	18
PLASTICITY INDEX		25	26	17	23	22	14	18
ACTIVITY INDEX		0.67	0.72	0.52	0.53	0.57	0.49	0.52
SPECIFIC GRAVITY		2.74	2.68	2.53	2.7	2.73	2.71	2.71
AASHTO CLASSIFICATION		A-7-6(23)	A-7-6(26)	A-6(17)	A-7-6(23)	A-7-6(21)	A-6(14)	A-6(15)
UNIFIED CLASSIFICATION		CL	CL	CL	CL	CL	CL	CL
CALIFORNIA BEARING RATIO		4	8	7	4	6	7	7
MAXIMUM DRY DENSITY (pcf)		105	104	106	106	106	107	113
OPTIMUM MOISTURE (%)		19	20	19	19	20	18	16
% +4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		0	0	0	0	2	0	4

SOIL PROFILE I-264

SOIL PROFILE KY 22

SCALE: 1" = 10' HORIZONTAL
1" = 100' VERTICAL

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS
COUNTY OF

JEFFERSON

PROJECT NUMBERS:

SOIL PROFILE

FILE NAME:
USER:
PLOTTED:
E-SHEET NAME:
MicroStation v8.11.7.180

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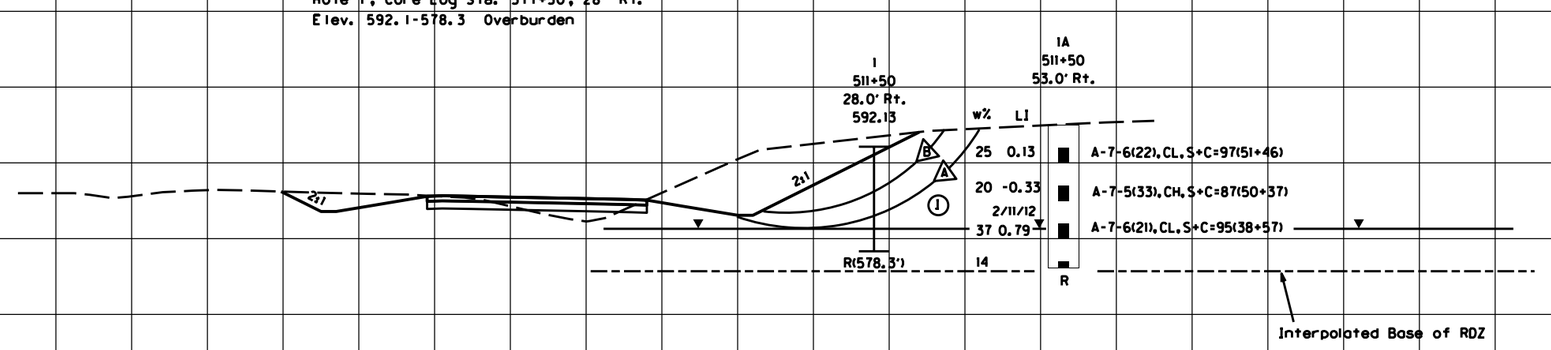
FACTORS OF SAFETY		
INTERMEDIATE TERM	A	2.7
LONG TERM	B	1.5

ASSUMED SOIL STRENGTH PARAMETERS	
SOIL	1
INTERMEDIATE TERM	γ = 125 pcf c = 230 psf ϕ = 25°
LONG TERM	γ = 125 pcf $\bar{c}$ = 46 psf $\bar{\phi}$ = 25°

Cut Limits from Sta. 503+00 to Sta. 516+50
Hole 1, Core Log Sta. 511+50, 28' Rt.
Elev. 592.1-578.3 Overburden



511+50

SCALE: 1" = 10' HORIZONTAL
1" = 100' VERTICAL

CUT STABILITY SECTION, MAINLINE
STA. 511+50

600 590 580 570

150 100 50 0 50 100 150

FILE NAME:
USER:
DATE
E-SHEET NAME:
MicroStation v8.11.7.180