



November 8, 2021

Memorandum to: Russell Broadwell, PE
Project Engineer – Division 4
509 Ward Blvd.
PO Box 3165
Wilson, NC 27895

From: Margaret M. Sweitzer, PE
Senior Project Engineer, Geotechnical

WBS Number: 44989.1.1
TIP Number: I-5972
County: Johnston
Description: I-95 and US-70 Business, (E. Market Street), Exit 95 Interchange from Outlet Center Drive to West of Yelverton Grove Road

Subject: **Geotechnical Report – Roadway Design and Construction Recommendations**

RK&K has completed the subsurface investigation for this project and submits the following recommendations. These recommendations are based on soil borings performed by RK&K, laboratory testing of select soil samples, and roadway plans. This report includes recommendations for the following alignments:

<u>Line</u>	<u>Stations (±)</u>
-L-	27+95 – 82+41
-Y1-	21+70 – 56+50
-Y2-	10+10 – 33+59
-RPA-	10+00 – 22+12
-RPB-	10+00 – 27+09
-RPC-	10+00 – 25+11
-RPD-	10+00 – 30+86

I. SLOPE/ EMBANKMENT STABILITY AND SETTLEMENT

A. Slope Design

It is recommended that all fill and cut slopes be constructed at a ratio of 3:1 (H:V) or flatter as shown on the roadway plans.

Long term settlement due to embankment construction is not anticipated to be significant. Settlement monitoring is not recommended.

It is recommended that embankment preparation and benching be in accordance with Section 235-3(A) of the Standard Specifications where embankment fill will be placed on existing slopes steeper than 4:1 (H:V).



B. Undercut for Embankment Stability

Soils unsuitable for embankment construction should be undercut. Backfill all embankment undercut areas with Select Granular Material, Class II or III. Unsuitable material should be wasted or used in landscape areas.

Any soft or loose alluvial soils encountered within the limits of proposed embankments should be undercut to firm material or to a minimum depth of 3 feet. Backfill to replace undercut material should be Select Material, Class II or III, on top of Geotextile for Soil Stabilization, Type 4.

A contingency quantity of 500 cubic yards of undercut for embankment stability is recommended to be used at the discretion of the Engineer.

C. Geotextile for Soil Stabilization

Geotextile for Soil Stabilization may be needed to establish a working platform for embankment construction due to soft/wet soils in the following areas:

<u>Line</u>	<u>Station</u>	<u>Offset</u>
-L-	33+40 – 45+00	RT
-Y1-	34+30 – 35+30	RT
-Y2-	16+25 – 18+75	LT & RT
-RPA-	19+50 – 22+00	LT & RT

Recommend 11,300 square yards of Geotextile for Soil Stabilization to be used in with section IC. A contingency quantity of 2,000 square yards of Geotextile for Soil Stabilization is recommended to be included in the contract. Geotextile for Soil Stabilization should be Type 4 in accordance with Section 1056 of the Standard Specifications.

D. Rock Embankment

Rock embankment is recommended for the following location where embankments will be constructed in wetlands with standing water:

<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-Y1-	37+75 – 41+55	RT

Class 2 Rip Rap shall be used for rock embankments. Rock embankments are recommended to be installed 2 foot above the existing ground or water level whichever is higher. Recommend 2,400 tons of Rip Rap Class 2, 700 tons of Rip Rap Class A, 1,300 tons of #57 stone, and 2,500 square yards of Geotextile for Rock Embankment. The Rock Embankment Special Provision should be included in the contract.



II. SUBGRADE STABILITY

A. Undercut for Subgrade Stability

Cohesive soils with plasticity indices (PI) greater than 20, greater than 50 percent passing the No. 200 sieve, and soft or wet soils should be undercut. The depth of undercut should be to 3 feet below subgrade or to suitable soils, whichever is less. Unsuitable material should be wasted or used in landscape areas. Backfill all subgrade stability undercut areas with Select Granular Material, Class II or III.

Recommend 2,800 cubic yards of undercut for subgrade stability be used in the following areas. The recommended areas are shown with a double hatching on the included cross section sheets:

<u>Line</u>	<u>Station</u>	<u>Offset</u>
-Y2-	10+10 – 13+25	LT & RT
-Y2-	13+25 – 14+75	LT
-Y2-	14+75 – 16+25	LT & RT
-Y2-	18+75 – 20+75	LT
-Y2-	20+75 – 23+75	LT & RT
-Y2-	23+75 – 28+75	LT
-Y2-	28+75 – 33+25	LT & RT

A contingency quantity of 500 cubic yards of undercut for subgrade stability is recommended to be used at the discretion of the Engineer. It is recommended that Geotextile for Soil Stabilization be placed in the base of undercut sections. Geotextile for Soil Stabilization should be Type 4 in accordance with Section 1056 of the Standard Specifications.

B. Aggregate Subgrade

Aggregate Subgrade is recommended where highly plastic soils exist within 3 feet below subgrade and full depth undercut cannot be performed due to the close proximity of traffic and/or utilities. Aggregate Subgrade should be constructed in accordance with Section 505 of the Standard Specifications. The aggregate subgrade should be extended 1 foot outside the edge of the proposed pavement.

- i. **Shallow Undercut:** Shallow undercut is recommended to a depth of 12 inches below subgrade. Recommend 9,800 cubic yards of Shallow Undercut to be used in the following areas. Undercut materials with $PI > 20$ should be wasted or used in landscape areas at the discretion of the Engineer. Undercut materials with $15 < PI \leq 20$ may be used in fill sections below a depth of 3 feet from subgrade at the discretion of the Engineer. The recommended shallow undercut areas are shown with a shaded pattern on the included cross section sheets.

<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-L-	38+75 – 40+75	RT
-L-	43+25 – 43+75	LT



<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-L-	49+75 – 65+75	LT & RT
-L-	65+75 – 67+75	RT
-L-	69+75 – 71+75	LT
-L-	71+75 – 77+25	LT & RT
-L-	77+25 – 82+40	RT
-Y1-	21+70 – 24+75	LT & RT
-Y1-	24+75 – 25+75	RT
-Y1-	25+75 – 30+25	LT & RT
-Y1-	45+25 – 54+25	LT & RT
-RPA-	10+00 – 11+50	LT & RT
-RPA-	11+50 – 14+00	LT
-RPA-	14+00 – 17+25	LT & RT
-RPB-	10+00 – 12+00	RT
-RPB-	12+00 – 21+25	LT & RT
-RPB-	21+25 – 21+75	LT
-RPC-	10+00 – 11+00	LT
-RPC-	11+00 – 15+25	LT & RT
-RPD-	10+00 – 13+00	RT
-RPD-	15+75 – 20+75	LT & RT

A contingency quantity of 500 cubic yards of Shallow Undercut is recommended to be used at the discretion of the Engineer. Backfill to replace shallow undercut material should be Select Material, Class IV, on top of Geotextile for Soil Stabilization, Type 4.

- ii. **Class IV Aggregate Subgrade Stabilization:** In the following areas, the distance between the proposed subgrade and existing ground is between 6 to 12 inches. Therefore, a combination of Shallow Undercut and Class IV Subgrade Stabilization is recommended. The recommended Class IV Aggregate Subgrade Stabilization areas are shown with a shaded vertical hatch pattern on the included cross section sheets.

<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-L-	54+25 – 54+75	LT
-L-	54+75 – 55+75	LT & RT
-L-	55+75 – 56+75	RT
-L-	56+75 – 58+25	LT
-L-	58+25 – 59+25	LT & RT
-L-	59+25 – 59+75	LT
-L-	72+75 – 75+75	LT
-L-	76+75 – 80+75	RT
-Y1-	23+75 – 24+75	LT
-Y1-	24+75 – 25+75*	LT
-Y1-	25+75 – 26+25	LT
-Y1-	29+25 – 29+75	RT



<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-Y1-	45+25 – 47+25	LT & RT
-Y1-	47+25 – 47+75	RT
-Y1-	48+25 – 51+75	RT
-Y1-	51+75 – 52+75	LT & RT
-Y1-	53+25 – 53+75	LT
-RPA-	10+00 – 10+50	LT
-RPA-	11+75 – 13+75	LT
-RPB-	10+00 – 10+50	RT
-RPB-	14+75 – 15+25	LT
-RPB-	19+25 – 21+75	RT
-RPC-	10+00 – 11+50	LT
-RPC-	12+50 – 13+00	LT & RT
-RPC-	14+00 – 14+50	LT
-RPD-	10+00 – 10+50	RT
-RPD-	16+25 – 17+25	RT

*In these areas, Aggregate Subgrade is recommended, but the undercut is not required because proposed subgrade is more than 1 foot above the existing ground. Therefore, Class IV Aggregate Subgrade Stabilization is recommended.

C. Geotextile for Soil Stabilization

Recommend 33,900 square yards of Geotextile for Soil Stabilization to be used with Items II.A and II.B. A contingency quantity of 2,000 square yards of Geotextile for Soil Stabilization is recommended to be used with contingency Items II.A and II.B, respectively.

D. Special Ditches

Recommend special ditches a minimum of 6-ft below the proposed subgrade, or as deep as outfall will allow, at the following locations. The recommended special ditch locations are all connected to outfall. Existing terrain prevents any further lowering of grade for the addition of deeper ditches.

<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-RPA-	10+00 – 15+50	LT
-RPA-	15+50 – 17+00	LT & RT
-RPB-	10+00 – 15+50	RT
-RPB-	15+50 – 23+50	LT & RT
-RPC-	10+00 – 15+50	LT
-RPC-	15+50 – 19+50	LT & RT
-RPD-	10+00 – 15+50	RT
-RPD-	15+50 – 27+00	LT & RT

It is recommended that the hydraulic engineer evaluate the extension of ditches to outfall.



E. Subsurface Drainage

Groundwater was encountered within 6-ft of the proposed subgrade in the following areas. Recommend 13,800 linear feet of 6-inch perforated subdrain pipe per Roadway Standard Drawing 815.02 – Subsurface Drain.

<u>Line</u>	<u>Stations (±)</u>	<u>Offset</u>
-L-	27+95 – 33+40	LT
-L-	34+50 – 77+12	LT & RT
-L-	77+12 – 82+41	RT
-Y1-	21+70 – 30+25	RT
-Y1-	45+25 – 56+50	RT
-Y2-	10+10 – 17+00	LT
-Y2-	22+00 – 33+60	LT

A contingency quantity of 1,000 linear feet of 6-inch perforated subdrain pipe is recommended. Subsurface drains should be installed at the discretion of the Engineer in any other areas where shallow groundwater is encountered during construction.

F. Grade Point Undercut

A contingency quantity of 150 cubic yards of grade point undercut is recommended to be used at the discretion of the Engineer.

III. BORROW SPECIFICATIONS

A. Borrow Criteria

Common borrow for embankment construction shall meet the borrow criteria outlined in Section 1018-2 (B) of the Standard Specifications.

B. Shrinkage Factor

A shrinkage factor of 25 percent is recommended for calculation of earthwork on this project.

C. Select Granular Material

Select Granular Material for backfill over Geotextile for Soil Stabilization shall be Select Material, Class II or III. Select Granular Material for backfill in water shall be Select Material, Class III. The Select Granular Material should be placed to a height of 3 feet above Geotextile for Soil Stabilization and/or water level whichever is higher.

Recommend 11,300 cubic yards of Select Granular Material, Class II or III, to be used with items I.C and II.A. A contingency quantity of 3,000 cubic yards of Select Granular Material, Class II or III, to be used with contingency items in I.B, I.C, and II.A is recommended.

D. Class IV Subgrade Stabilization

Recommend 21,600 tons of Class IV Subgrade Stabilization to be used with Item II.B. A contingency quantity of 1,000 tons of Class IV Subgrade Stabilization Material to be used with contingency item II.B.



IV. MISCELLANEOUS

A. Reduction of Unclassified Excavation – Clearing and Grubbing

No significant loss of unclassified excavation is anticipated due to clearing and grubbing.

B. Reduction of Unclassified Excavation - Unsuitable Waste

Soils within shallow cut and ditch excavations with plasticity indices (PI) greater than 20 were encountered in the following areas. These materials should be wasted. These areas are represented on the cross sections by a single hatch pattern.

<u>Line</u>	<u>Station</u>	<u>Offset</u>
-L-	35+75 – 40+75	RT
-L-	43+25 – 43+75	LT
-L-	49+75 – 54+25	RT
-L-	58+25 – 62+75	LT
-L-	62+75 – 65+75	LT & RT
-L-	65+75 – 67+75	RT
-L-	74+25 – 77+25	LT & RT
-L-	77+25 – 82+40	RT
-Y1-	32+75 – 36+75	LT
-Y2-	18+75 – 25+25	RT
-RPA-	14+25 – 15+25	RT
-RPB-	12+00 – 13+50	RT
-RPB-	13+50 – 15+25	LT & RT
-RPC-	10+00 – 11+00	LT
-RPC-	11+00 – 15+25	LT & RT
-RPD-	10+00 – 11+00	RT
-RPD-	11+00 – 13+00	LT & RT

The estimated quantity of unsuitable unclassified excavation is 7,600 cubic yards.

C. Acceptable Unclassified Excavation

Soils within excavations with plasticity indices (PI) between 16 and 20 were encountered in the following areas. These soils are acceptable for use as borrow material but should not be placed within the top 3 feet of the embankment or backfill in accordance with Section 1018-2 of the Standard Specifications.

<u>Line</u>	<u>Station</u>	<u>Offset</u>
-L-	43+75 – 45+25	LT
-L-	45+25 – 45+75	LT & RT
-Y1-	47+25 – 54+25	LT & RT
-RPB-	15+25 – 16+75	LT & RT
-RPB-	16+75 – 18+75	RT
-RPC-	16+75 – 20+25	LT
-RPC-	20+25 – 20+75	LT & RT



<u>Line</u>	<u>Station</u>	<u>Offset</u>
-RPD-	13+00 – 14+00	LT & RT
-RPD-	14+00 – 15+25	LT
-RPD-	15+25 – 18+75	RT
-RPD-	24+75 – 28+25	LT
-RPD-	28+25 – 29+25	LT & RT
-RPD-	29+25 – 29+60	RT

These areas are represented on the cross sections by an asterisk hatch pattern. The estimated quantity of acceptable unclassified excavation is 5,100 cubic yards.

D. Culverts

One reinforced concrete box culvert (RCBC) is proposed along the project corridor. The proposed culvert location and recommendations are as follows:

-Y2- STA. 17+35.5 – Double 8'x5' RCBC

The following notes should be included on the culvert plans:

Excavate 1-ft below culvert bearing elevation and replace with foundation conditioning material (Select Material, Class VI).

Undercut any soft/loose alluvial soils that may be encountered beneath the bottom of the foundation conditioning material. Backfill undercut area with foundation conditioning material.

E. Ponds

Ponds were not observed during the subsurface investigation within the footprint of the project. If ponds were encountered in the vicinity of the project, silt studies should be completed at the Contractor’s discretion.

F. Water Wells

The following water well was found within the proposed slope stake limits on the project:

<u>Line</u>	<u>Station</u>	<u>Offset</u>
-Y1-	47+59	LT

Other water wells may be encountered during construction due to the presence of dwellings and businesses near the footprint of the project. Water wells, listed above and any others encountered during construction, should be sealed in accordance with Section 205 of the Standard Specifications.



Prepared by,

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL ENGINEERING UNIT

Summary of Quantities

WBS Number: 44989.1.1

County: Johnston

Project Engineer: M. Metry

TIP Number: I-5972

Field Office: Raleigh

Project Geologist: P. Cary

Description: I-95 and US-70 Business, (E. Market Street), Exit 95 Interchange from Outlet Center Drive to West of Yelverton Grove Road

Pay Item No.	Pay Item/ Quantity Adjustment	Spec Book Section No. or Special Provision (SP) Reference	Report Section	Alignment	Begin Station	End Station	Quantity	Units / %
0036000000-E	Undercut Excavation	225 - Roadway Excavation	I. B	Contingency	N/A	N/A	500	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	Contingency	N/A	N/A	500	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	Varies	N/A	N/A	2,800	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. F	Contingency	N/A	N/A	150	CY
Total Quantity of Undercut Excavation =							3,950	CY
0195000000-E	Select Granular Material	265 - Select Granular Material	III. C	Varies	N/A	N/A	11,300	CY
0195000000-E	Select Granular Material	265 - Select Granular Material	III. C	Contingency	N/A	N/A	3,000	CY
Total Quantity of Select Granular Material =							14,300	CY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	I. C	Contingency	N/A	N/A	2,000	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	I. C	Varies	N/A	N/A	11,300	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	Varies	N/A	N/A	33,900	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	Contingency	N/A	N/A	2,000	SY
Total Quantity of Geotextile for Soil Stabilization =							49,200	SY
0222000000-E	Geotextile for Rock Embankments	SP - Rock Embankments	I. D	Varies	N/A	N/A	2,500	SY
Total Quantity of Geotextile for Rock Embankments =							2,500	SY
1077000000-E	#57 Stone	SP - Rock Embankments	I. D	Varies	N/A	N/A	1,300	TON
Total Quantity of #57 Stone =							1,300	TON
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	Varies	N/A	N/A	9,800	CY
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	Contingency	N/A	N/A	500	CY
Total Quantity of Shallow Undercut =							10,300	CY
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. D	Varies	N/A	N/A	21,600	TON
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. D	Contingency	N/A	N/A	1,000	TON
Total Quantity of Class IV Subgrade Stabilization =							22,600	TON
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. E	Varies	N/A	N/A	13,800	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. E	Contingency	N/A	N/A	1,000	LF
Total Quantity of 6" Perforated Subdrain Pipe =							14,800	LF



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Description: I-95 and US-70 Business, (E. Market Street), Exit 95 Interchange from Outlet Center Drive to West of Yelverton Grove Road

Pay Item No.	Pay Item/ Quantity Adjustment	Spec Book Section No. or Special Provision (SP) Reference	Report Section	Alignment	Begin Station	End Station	Quantity	Units / %
3635000000-E	Rip Rap, Class 2	SP - Rock Embankments	I. D	Varies	N/A	N/A	2,400	TON
Total Quantity of Rip Rap, Class 2 =							2,400	TON
3642000000-E	Rip Rap, Class A	SP - Rock Embankments	I. D	Varies	N/A	N/A	700	TON
Total Quantity of Rip Rap, Class A =							700	TON
N/A	Unclassified Excavation - Acceptable, but not to be used in top 3 ft of embankment or backfill	225 - Roadway Excavation	IV. C	Varies	N/A	N/A	5,100	CY
Total Quantity of Unclassified Excavation - Acceptable, but not to be used in top 3 ft of embankment or backfill =							5,100	CY

These Items Only Impact Earthwork Totals								
N/A	Shrinkage Factor	235 - Embankments	III. B	N/A	N/A	N/A	25	%
N/A	Unclassified Excavation - Unsuitable Waste	225 - Roadway Excavation	IV. B	N/A	N/A	N/A	7,600	CY