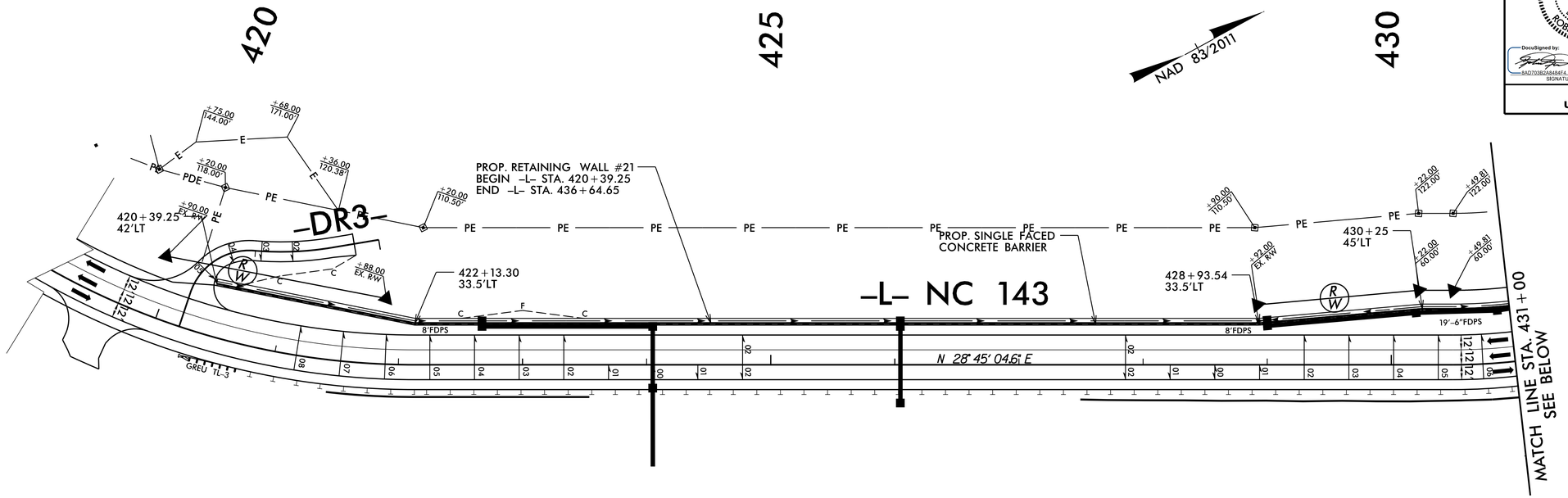
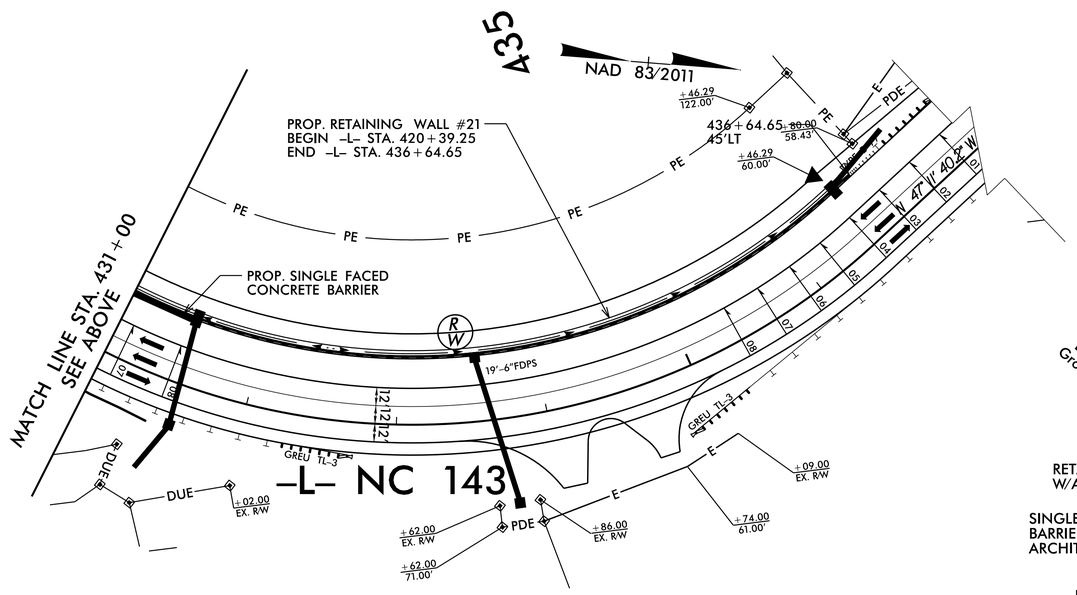
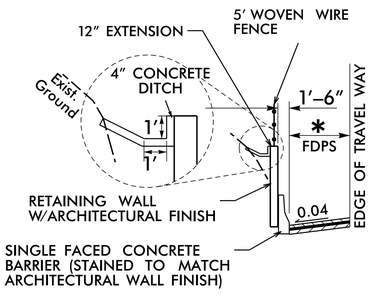
RETAINING WALL #21:







ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
21	26,290*	5	55
FORM LINER ARCHITECTURAL FINISH			26,290* SF
HORIZONTAL DRAINS (CONTIGENCY)			815 LF

*INCLUDES RETAINING WALL EMBEDMENT

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038264484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

DETAIL FOR WALL #21

NOT TO SCALE

–L– STA. 420+39.25 TO –L– STA. 436+64.65, LT

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #21: -L- 420+39, 42' LT TO 436+65, 45' LT

SHEET 1 OF 5

RETAINING WALL #21 – PLAN

NOT TO SCALE

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

RETAINING WALL #21 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

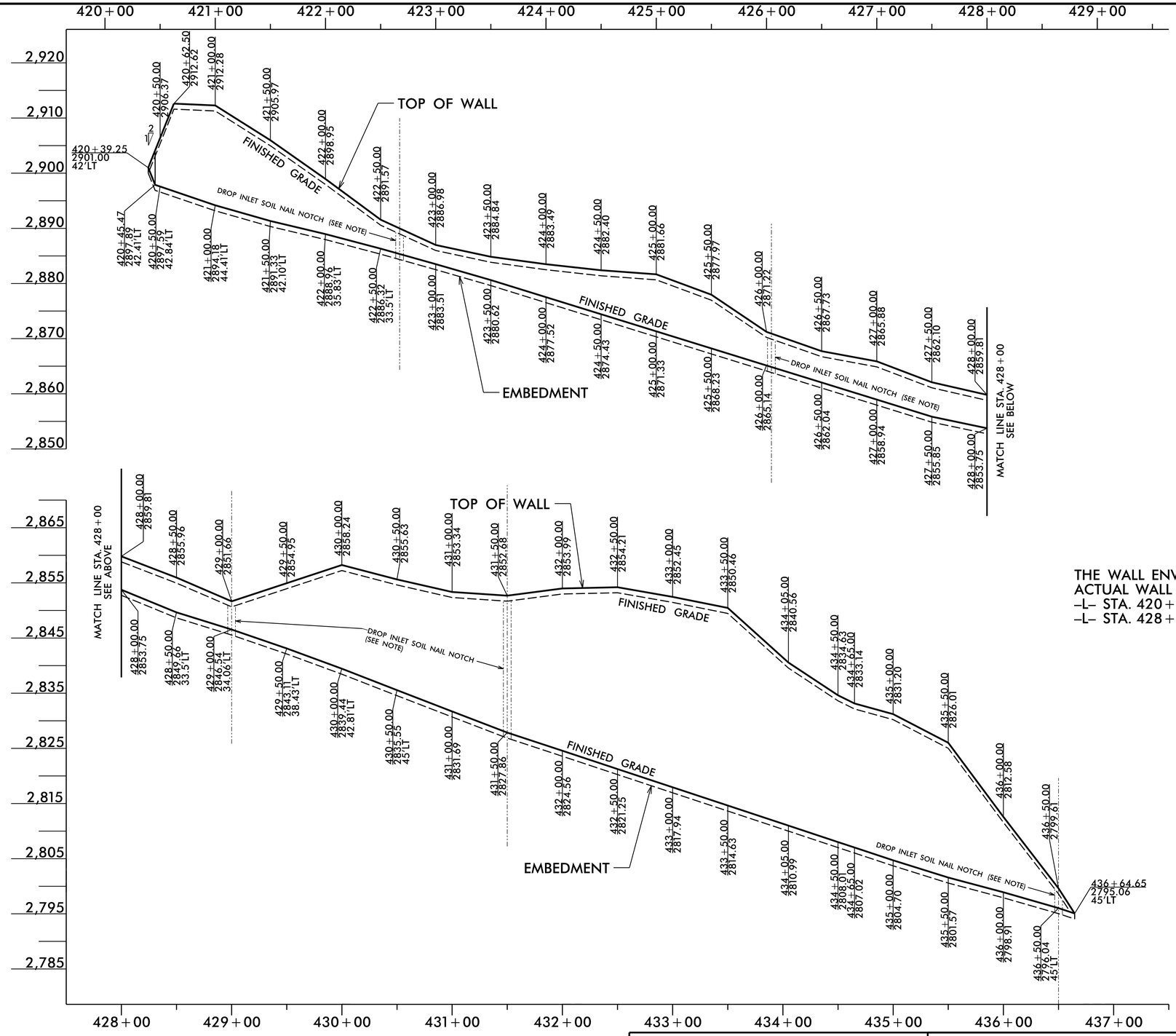
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #21
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W21-1
2			4			



GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038264484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #21 AT THE FOLLOWING LOCATION:
–L– STA. 420+39.25 TO 422+13.30, LT
–L– STA. 428+93.54 TO 436+64.65, LT

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #21: -L- 420+39, 42' LT TO 436+65, 45' LT

SHEET 2 OF 5

RETAINING WALL #21 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

RETAINING WALL #21 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #21
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W21-2
2			4			

SOIL NAIL RETAINING WALL #21

STA. -L-	OFFSET FROM -L- (LT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
420+39.25	42.00	2901.00	2901.00	2900.00	1.00	1.00
420+45.47	42.41	2904.11	2897.89	2896.89	1.00	7.22
420+50.00	42.84	2906.37	2897.59	2896.59	1.00	8.78
420+62.50	43.59	2912.62	2896.74	2895.74	1.00	15.88
421+00.00	44.41	2912.28	2894.18	2893.18	1.00	18.10
421+50.00	42.10	2905.97	2891.33	2890.33	1.00	14.64
422+00.00	35.83	2898.95	2888.96	2887.96	1.00	9.99
422+50.00	35.50	2891.57	2886.32	2885.32	1.00	5.25
423+00.00	35.50	2886.98	2883.51	2882.51	1.00	3.47
423+50.00	35.50	2884.84	2880.62	2879.62	1.00	4.22
424+00.00	35.50	2883.49	2877.52	2876.52	1.00	5.97
424+50.00	35.50	2882.40	2874.43	2873.43	1.00	7.97
425+00.00	35.50	2881.66	2871.33	2870.33	1.00	10.33
425+50.00	35.50	2877.97	2868.23	2867.23	1.00	9.74
426+00.00	35.50	2871.22	2865.14	2864.14	1.00	6.08
426+50.00	35.50	2867.73	2862.04	2861.04	1.00	5.69
427+00.00	35.50	2865.88	2858.94	2857.94	1.00	6.94
427+50.00	35.50	2862.10	2855.85	2854.85	1.00	6.25
428+00.00	35.50	2859.81	2853.75	2852.75	1.00	6.06
428+50.00	35.50	2855.96	2849.66	2848.66	1.00	6.30
429+00.00	34.06	2851.66	2846.54	2845.54	1.00	5.12
429+50.00	38.43	2854.95	2843.11	2842.11	1.00	11.84
430+00.00	42.81	2858.24	2839.44	2838.44	1.00	18.80
430+50.00	45.00	2855.63	2835.55	2834.55	1.00	20.08
431+00.00	45.00	2853.34	2831.69	2830.69	1.00	21.65
431+50.00	45.00	2852.68	2827.86	2826.86	1.00	24.82
432+00.00	45.00	2853.99	2824.56	2823.56	1.00	29.43
432+50.00	45.00	2854.21	2821.25	2820.25	1.00	32.96
433+00.00	45.00	2852.45	2817.94	2816.94	1.00	34.51
433+50.00	45.00	2850.49	2814.63	2813.63	1.00	35.86
434+00.00	45.00	2840.56	2810.99	2809.99	1.00	29.57
434+50.00	45.00	2834.63	2808.01	2807.01	1.00	26.62
434+65.00	45.00	2833.14	2807.02	2806.02	1.00	26.12
435+00.00	45.00	2831.20	2804.70	2803.70	1.00	26.50
435+50.00	45.00	2826.01	2801.57	2800.57	1.00	24.44
436+00.00	45.00	2812.58	2798.91	2797.91	1.00	13.67
436+50.00	45.00	2799.61	2796.04	2795.04	1.00	3.57
436+64.65	45.00	2795.06	2795.06	2794.06	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER (STAINED), SEE ROADWAY PLANS, SECTION 857 OF THE STANDARD SPECIFICATION, AND SIMULATED STONE FORM LINER FINISH SPECIAL PROVISION.

RETAINING WALL #21 HAS SADDLES THAT REQUIRE DRAINAGE STRUCTURES TO BE INSTALLED BEHIND THE WALL. SEE ROADWAY AND HYDRAULIC PLANS FOR STRUCTURE TYPE AND LOCATION.

A FENCE IS REQUIRED ON TOP OF RETAINING WALL #21. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

A FORM LINER ARCHITECTURAL FINISH IS REQUIRED FOR THE CIP REINFORCED CONCRETE FACE FOR RETAINING WALL #21. THE CONTRACTOR SHALL PROVIDE THE REQUESTED FINISH BEFORE BEGINNING CIP REINFORCED CONCRETE FACE CONSTRUCTION. THE APPEARANCE (STONE SIZE AND SHAPE, STONE COLOR, AND STONE TEXTURE, PATTERN, AND RELIEF) SHOULD MATCH NATURAL STONE AND ROCK. FOR FORM LINER ARCHITECHTURAL FINISH, SEE THE SIMULATED STONE FORM LINER FNISH SPECIAL PROVISION.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #21, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #21 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED SOFT TO MEDIUM STIFF COLLUVIAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 120 PCF
   FRICTION ANGLE, ϕ = 26 DEGREES
   COHESION, c = 0 PSF
5) IN-SITU ASSUMED LOOSE TO MEDIUM DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 120 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 0 PSF
6) IN-SITU ASSUMED MEDIUM DENSE TO VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF
7) IN-SITU ASSUMED SOFT TO MEDIUM STIFF RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 120 PCF
   FRICTION ANGLE, ϕ = 30 DEGREES
   COHESION, c = 0 PSF
8) IN-SITU ASSUMED MEDIUM STIFF TO HARD RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 0 PSF
9) IN-SITU ASSUMED WEATHERED ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 135 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 500 PSF
10) IN-SITU ASSUMED CRYSTALLINE ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 170 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 1,000 PSF
11) WHERE ROCK IS ENCOUNTERED IN THE WALL ENVELOPE, DESIGNERS SHOULD REFER TO THE FHWA PRESUMPTIVE STRENGTH PARAMETERS OR OTHER REPRESENTATIVE AND REPEATABLE VALUES AND PROVIDE SOURCE REFERENCES IN THEIR DESIGN SUBMITTAL.

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #21.

THE PROPOSED RIGHT OF WAY (ROW) AND PERMANENT EASEMENT (PE) BOUNDARY VARIES FROM THE FACE OF RETAINING WALL #21. SEE THE ROADWAY PLANS FOR OFFSET DISTANCES FROM THE FACE OF RETAINING WALL #21. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE PE BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #21, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE ROCK IS PRESENT IN THE WALL ENVELOPE, CONTROLLED BLASTING IS RECOMMENDED, BUT NOT REQUIRED, TO MAINTAIN THE NEAT EXCAVATION LINE. VOIDS, RESURTING FROM BLASTING OR EXCAVATING, THAT EXTEND BEYOND THE NEAT LINES ARE TO BE FILLED WITH A COMBINATION OF SHORT SOIL NAILS, WELDED WIRE, AND SHOTCRETE, AT THE DISCRETION OF THE ENGINEER. THE COSTS ASSOCIATED WITH THIS WORK WILL BE CONSIDERED INCIDENTAL TO WALL CONSTRUCTION AND NO ADDITIONAL COMPENSATION WILL BE MADE. FOR BLASTING, SEE THE BLASTING PROVISION.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #21, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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ENGINEER
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #21: -L- 420+39, 42' LT TO 436+65, 45' LT

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

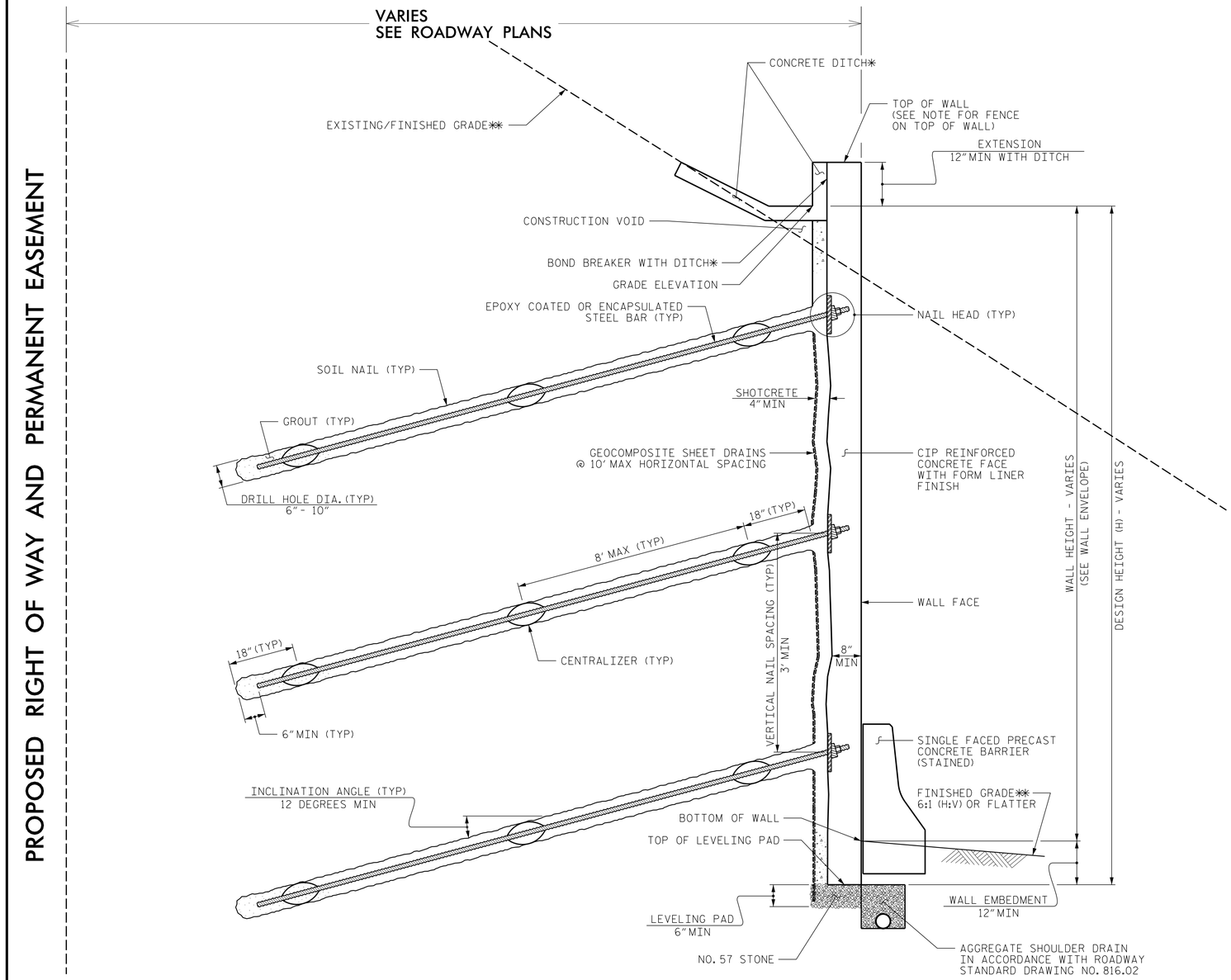
Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

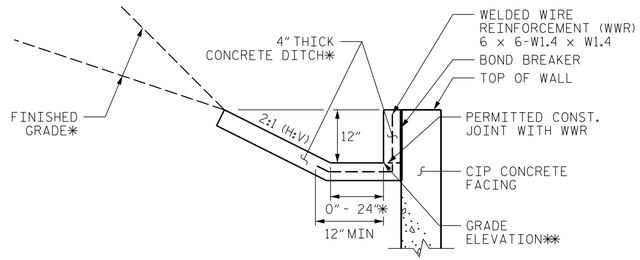
RETAINING WALL #21
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	W21-3
1			3			
2			4			



SOIL NAIL WALL - TYPICAL SECTION

*SEE CONCRETE DITCH BEHIND WALL DETAILS.
**SEE PLANS FOR FINISHED GRADE.



CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
**SEE WALL ENVELOPE FOR GRADE ELEVATIONS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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SIGNATURE DATE

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UNLESS ALL SIGNATURES COMPLETED

PROJECT NO.: A-0009CC
GRAHAM COUNTY
RETAINING WALL #21: -L- 420+39, 42' LT TO 436+65, 45' LT
SHEET 4 OF 5

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #21
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W21-4
2			4			

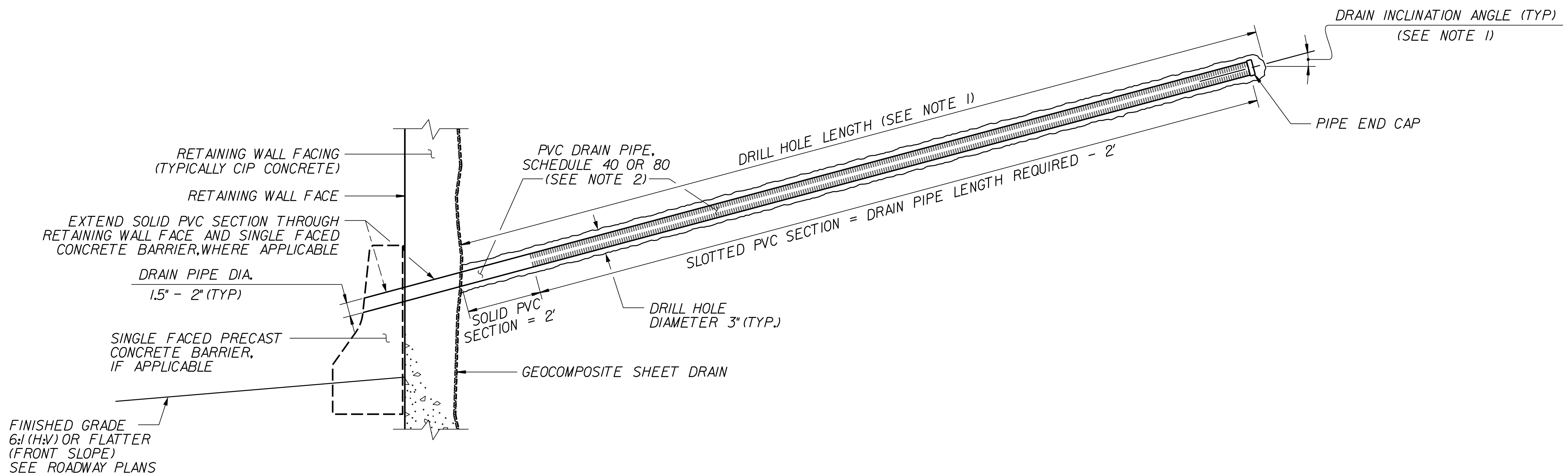
GEOTECHNICAL ENGINEER | ENGINEER

SEAL 042642 NORTH CAROLINA PROFESSIONAL ENGINEER ROBERT E. KRAL

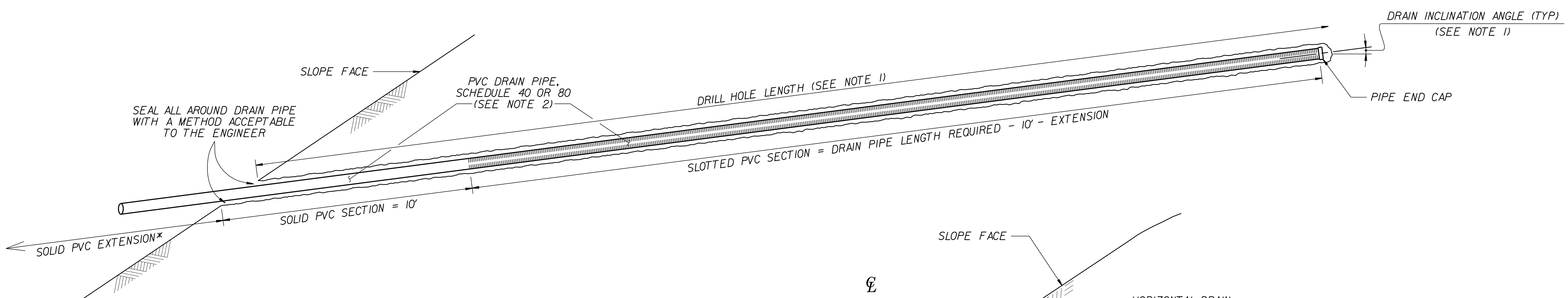
DocuSigned by: 8AD703B2A8484F4... 08/01/2022

SIGNATURE DATE SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

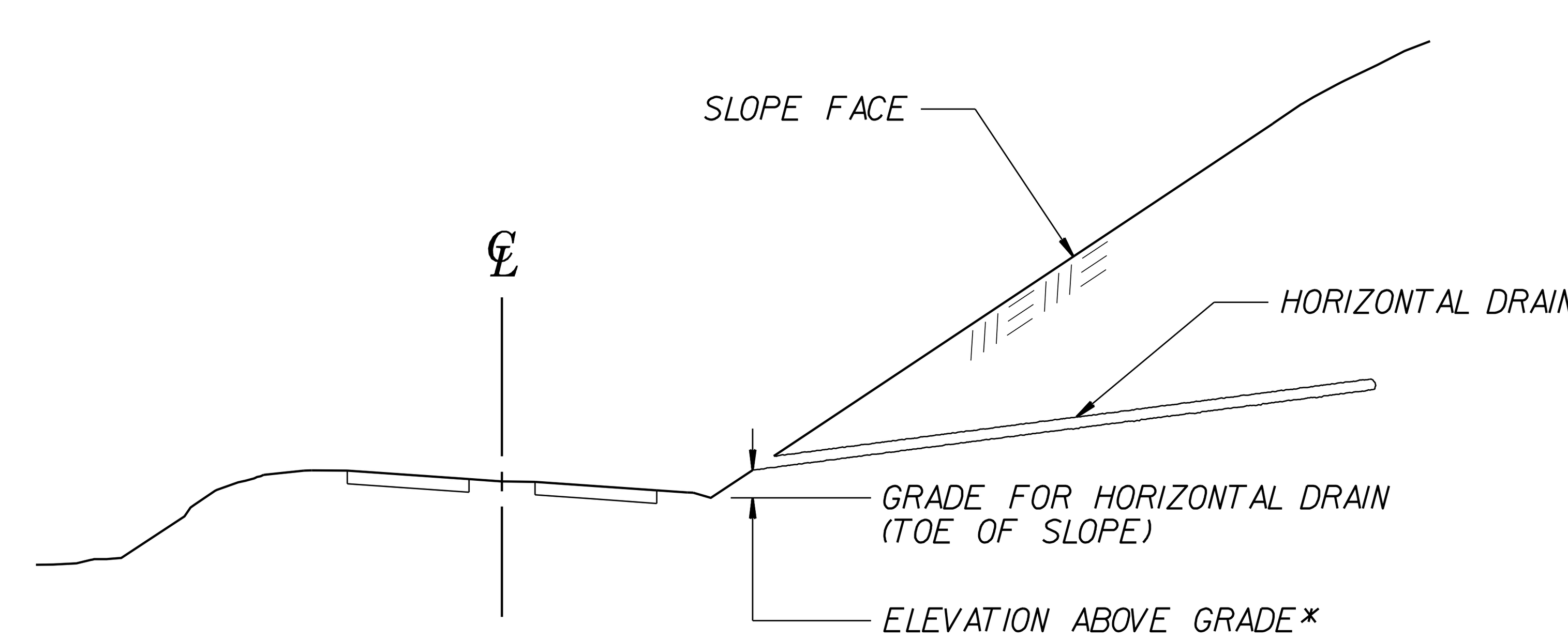


RETAINING WALL HORIZONTAL DRAIN



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS, ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS, SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #21: -L- 420+39, 42' LT TO 436+65, 45' LT

SHEET 5 OF 5

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
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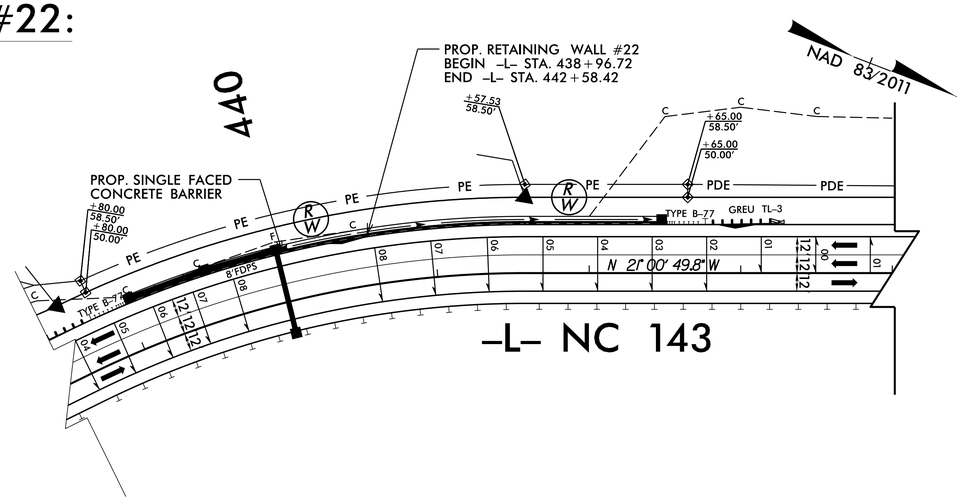
NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #21
SOIL NAIL RETAINING WALL

REVISIONS						
NO.	BY	DATE	NO.	BY	DATE	SHEET NO.
1			3			W21-5
2			4			

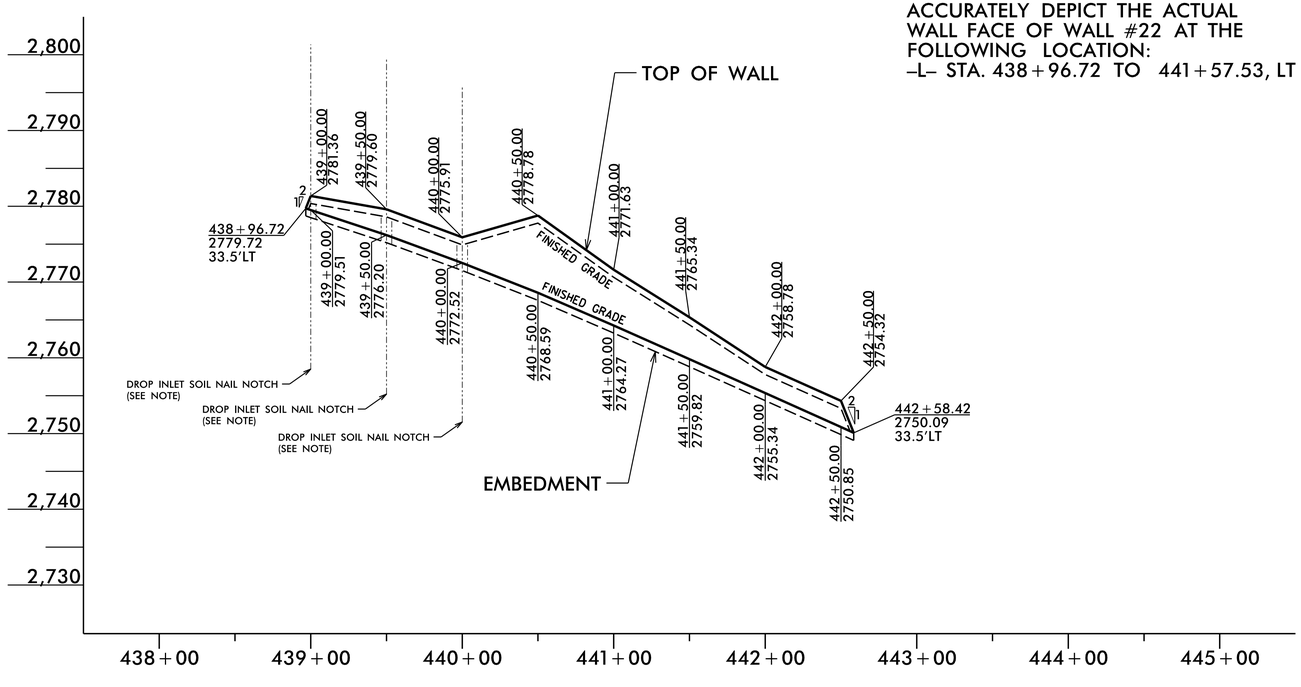
RETAINING WALL #22:



RETAINING WALL #22 – PLAN

NOT TO SCALE

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #22 AT THE FOLLOWING LOCATION:
–L– STA. 438+96.72 TO 441+57.53, LT



RETAINING WALL #22 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

GEOTECHNICAL ENGINEER

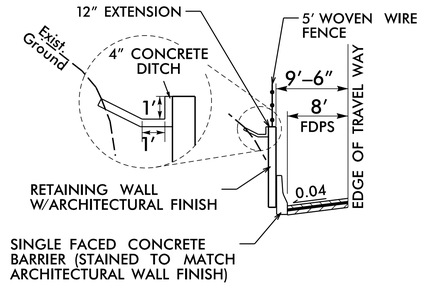
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038224484F4...

08/01/2022
SIGNATURE DATE

ENGINEER
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



DETAIL FOR WALL #22

NOT TO SCALE
–L– STA. 438+96.72 TO –L– STA. 442+58.42, LT

ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
22	2,180 *	2	10
FORM LINER ARCHITECTURAL FINISH			2,180 * SF
HORIZONTAL DRAINS (CONTIGENCY)			185 LF

*INCLUDES RETAINING WALL EMBEDMENT

SOIL NAIL RETAINING WALL #22

STA. -L-	OFFSET FROM -L- (LT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
438+96.72	33.50	2779.72	2779.72	2778.72	1.00	1.00
439+00.00	33.50	2781.36	2779.51	2778.51	1.00	1.85
439+50.00	33.50	2779.60	2776.20	2775.20	1.00	3.40
440+00.00	33.50	2775.91	2772.52	2771.52	1.00	3.39
440+50.00	33.50	2778.78	2768.59	2767.59	1.00	10.19
441+00.00	33.50	2771.63	2764.27	2763.27	1.00	7.36
441+50.00	33.50	2765.34	2759.82	2758.82	1.00	5.52
442+00.00	33.50	2758.78	2755.34	2754.34	1.00	3.44
442+50.00	33.50	2754.32	2750.85	2749.85	1.00	3.47
442+58.42	33.50	2750.09	2750.09	2749.09	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #22: -L- 438+96, 34' LT TO 442+58, 34' LT

SHEET 1 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #22 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

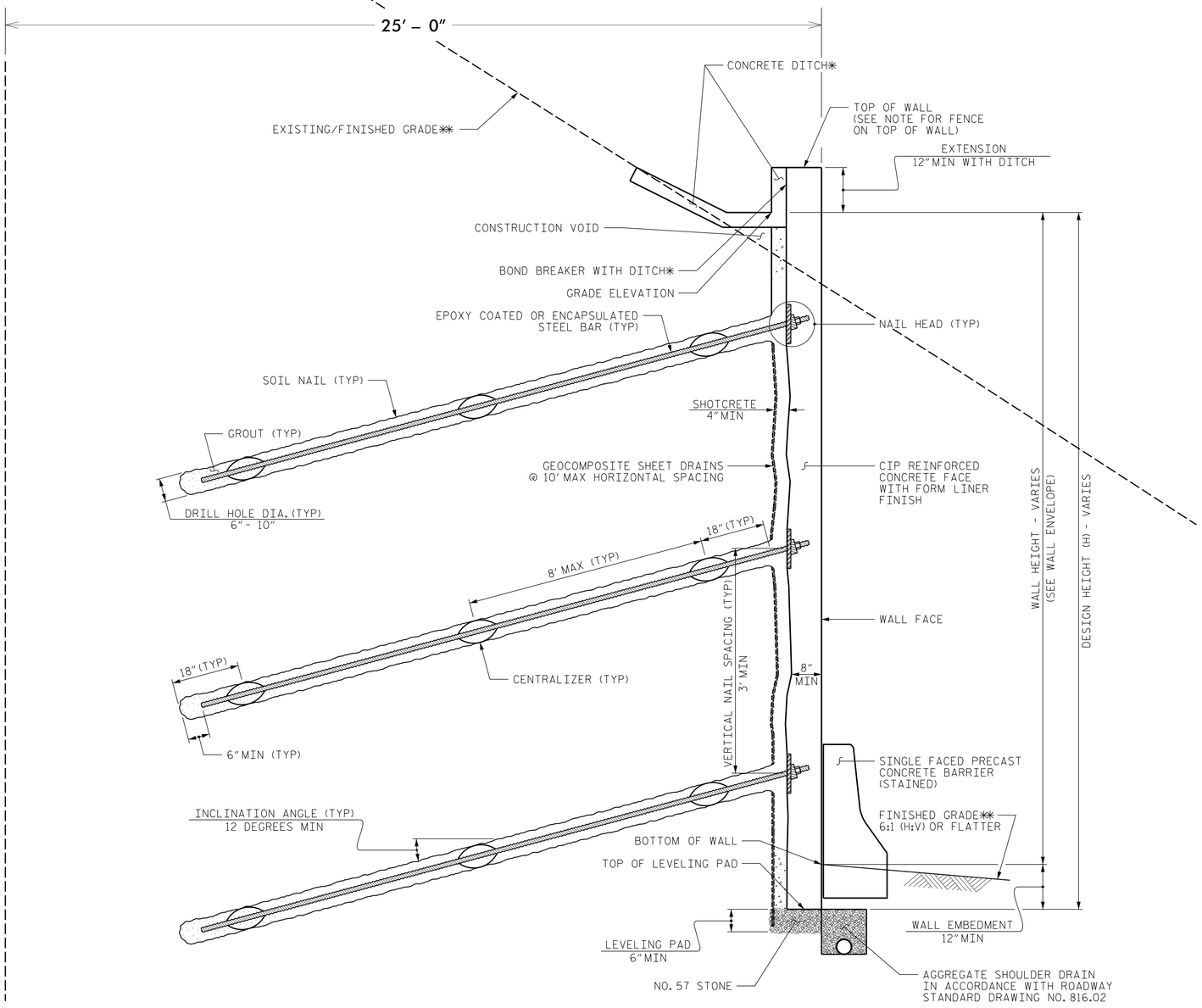
RETAINING WALL #22
SOIL NAIL RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W22-1

PERMANENT EASEMENT



SOIL NAIL WALL - TYPICAL SECTION

*SEE CONCRETE DITCH BEHIND WALL DETAILS.
**SEE PLANS FOR FINISHED GRADE.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038244484F4...
08/01/2022
SIGNATURE DATE

ENGINEER
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER (STAINED), SEE ROADWAY PLANS, SECTION 857 OF THE STANDARD SPECIFICATION, AND SIMULATED STONE FORM LINER FINISH SPECIAL PROVISION.

RETAINING WALL #22 HAS SADDLES THAT REQUIRE DRAINAGE STRUCTURES TO BE INSTALLED BEHIND THE WALL. SEE ROADWAY AND HYDRAULIC PLANS FOR STRUCTURE TYPE AND LOCATION.

A FENCE IS REQUIRED ON TOP OF RETAINING WALL #22. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

A FORM LINER ARCHITECTURAL FINISH IS REQUIRED FOR THE CIP REINFORCED CONCRETE FACE FOR RETAINING WALL #22. THE CONTRACTOR SHALL PROVIDE THE REQUESTED FINISH BEFORE BEGINNING CIP REINFORCED CONCRETE FACE CONSTRUCTION. THE APPEARANCE (STONE SIZE AND SHAPE, STONE COLOR, AND STONE TEXTURE, PATTERN, AND RELIEF) SHOULD MATCH NATURAL STONE AND ROCK. FOR FORM LINER ARCHITECHTURAL FINISH, SEE THE SIMULATED STONE FORM LINER FNISH SPECIAL PROVISION.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #22, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #22 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED MEDIUM DENSE TO VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #22.

THE PROPOSED RIGHT OF WAY (ROW) AND PERMANENT EASEMENT (PE) BOUNDARY VARIES FROM THE FACE OF RETAINING WALL #22. SEE THE ROADWAY PLANS FOR OFFSET DISTANCES FROM THE FACE OF RETAINING WALL #22. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE PE BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #22, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #22, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

GROUND MAY NOT EXIST ABOVE THE BOTTOM OF THE WALL IN SOME PORTIONS OF THE WALL ENVELOPE. USE CONVENTIONAL GRADING, TEMPORARY WALL, OR OTHER METHOD ACCEPTABLE TO THE ENGINEER TO CREATE GROUND ABOVE EXISTING GRADE IN ORDER TO CONSTRUCT THE SOIL NAIL WALL. THE CONTRACT UNIT PRICE FOR SOIL NAIL RETAINING WALLS WILL BE FULL COMPENSATION FOR THIS WORK, IF REQUIRED.

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #22: -L- 438+96, 34' LT TO 442+58, 34' LT

SHEET 2 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #22
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W22-2
2			4			

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038284484F4...

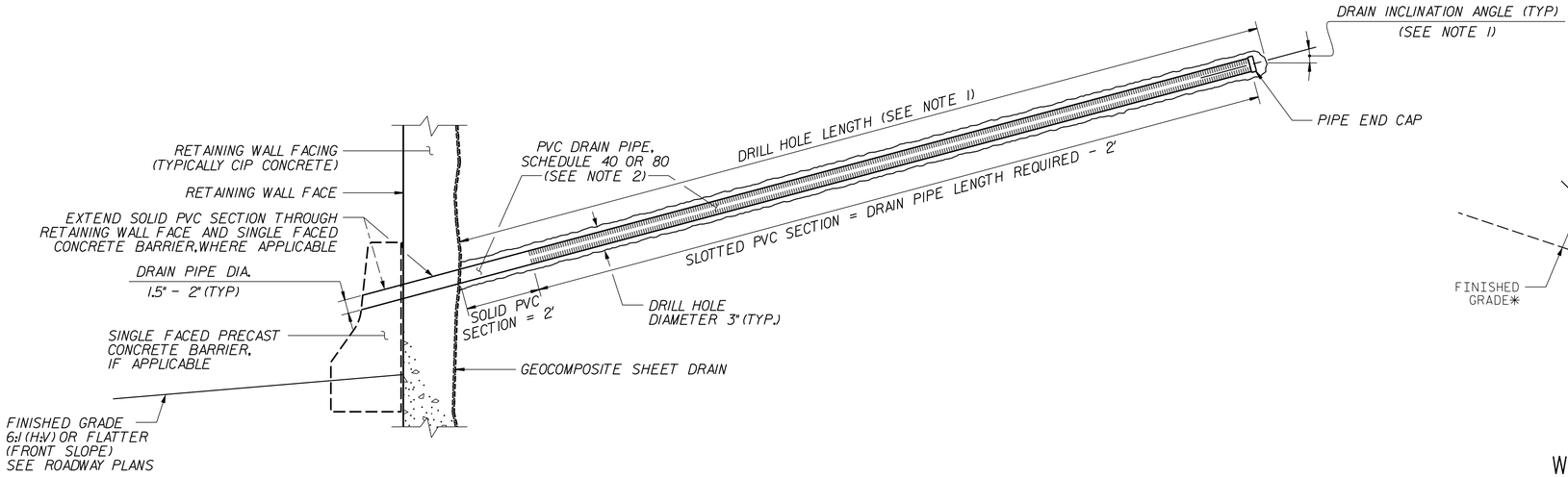
08/01/2022

SIGNATURE DATE

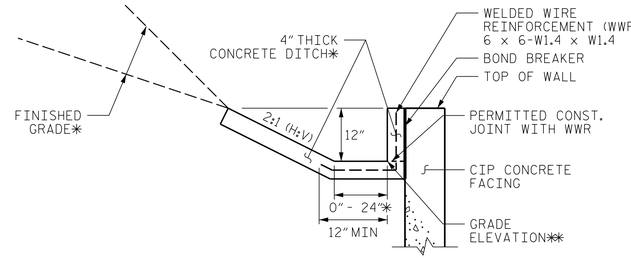
ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

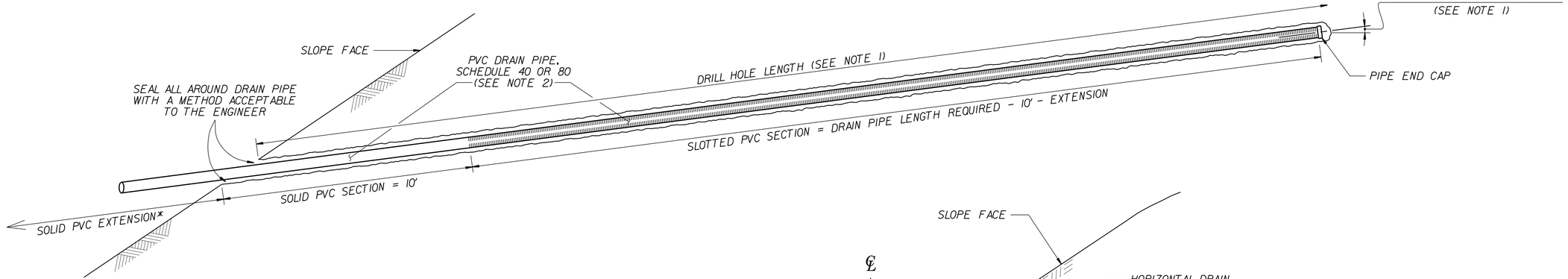


RETAINING WALL HORIZONTAL DRAIN



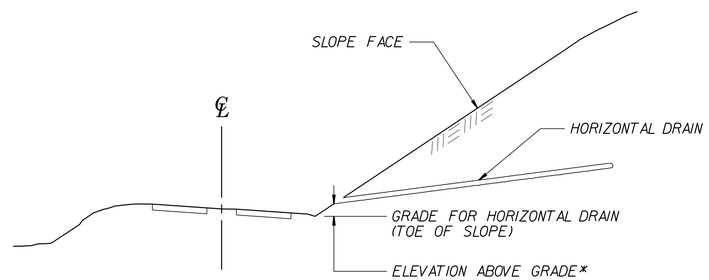
CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
**SEE WALL ENVELOPE FOR GRADE ELEVATIONS.



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #22: -L- 438+96, 34' LT TO 442+58, 34' LT

SHEET 3 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

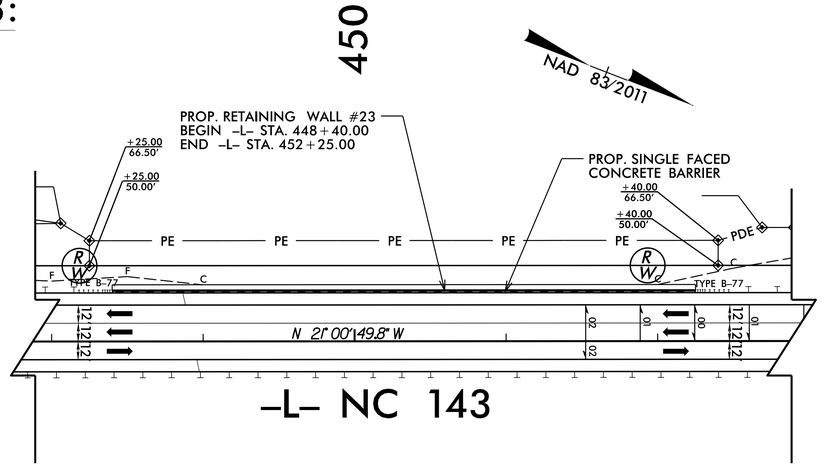
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #22
SOIL NAIL RETAINING WALL

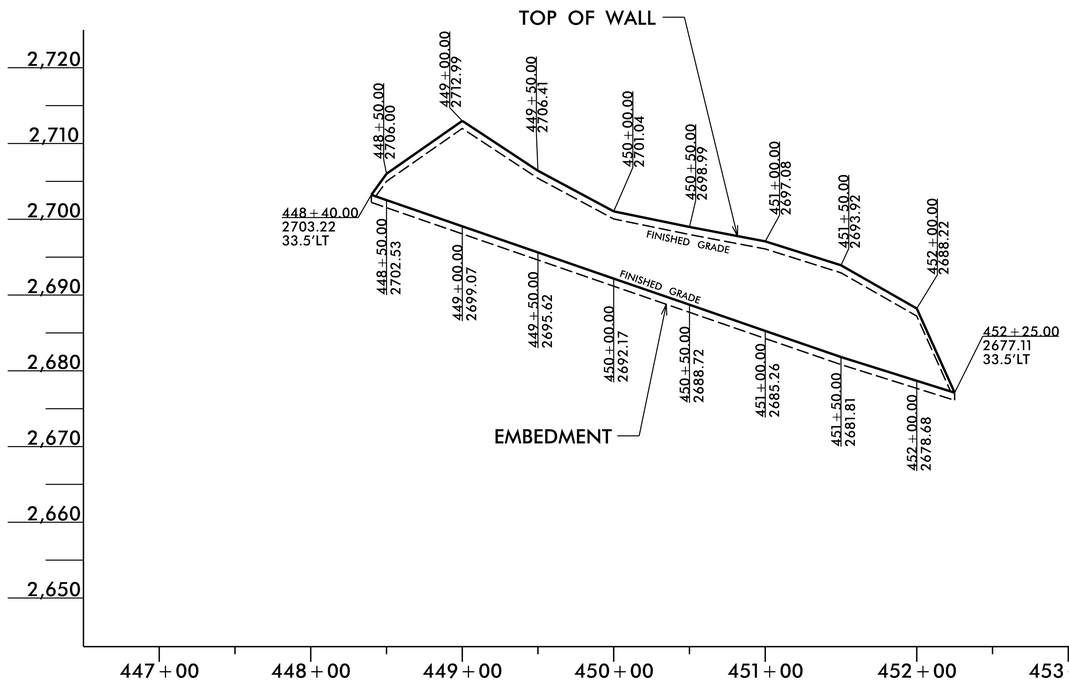
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W22-3
2			4			

RETAINING WALL #23:



RETAINING WALL #23 – PLAN

NOT TO SCALE



RETAINING WALL #23 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #23 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD703B2A4484F4...

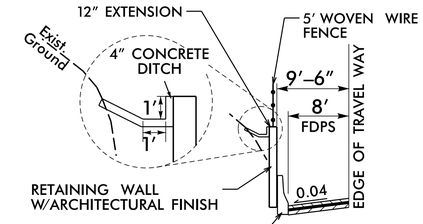
08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



DETAIL FOR WALL #23

NOT TO SCALE
–L– STA. 448+40.00 TO –L– STA. 452+25.00, LT

ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
23	4,240*	3	10
FORM LINER ARCHITECTURAL FINISH			4,240* SF
HORIZONTAL DRAINS (CONTIGENCY)			195 LF

*INCLUDES RETAINING WALL EMBEDMENT

SOIL NAIL RETAINING WALL #23

STA. -L-	OFFSET FROM -L- (LT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
448+40.00	33.50	2703.22	2703.22	2702.22	1.00	1.00
448+50.00	33.50	2706.00	2702.53	2701.53	1.00	3.47
449+00.00	33.50	2712.99	2699.07	2698.07	1.00	13.92
449+50.00	33.50	2706.41	2695.62	2694.62	1.00	10.79
450+00.00	33.50	2701.04	2692.17	2691.17	1.00	8.87
450+50.00	33.50	2698.99	2688.72	2687.72	1.00	10.27
451+00.00	33.50	2697.08	2685.26	2684.26	1.00	11.82
451+50.00	33.50	2693.92	2681.81	2680.81	1.00	12.11
452+00.00	33.50	2688.22	2678.68	2677.68	1.00	9.54
452+25.00	33.50	2677.11	2677.11	2676.11	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #23: -L- 448+40, 34' LT TO 452+25, 34' LT

SHEET 1 OF 3

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

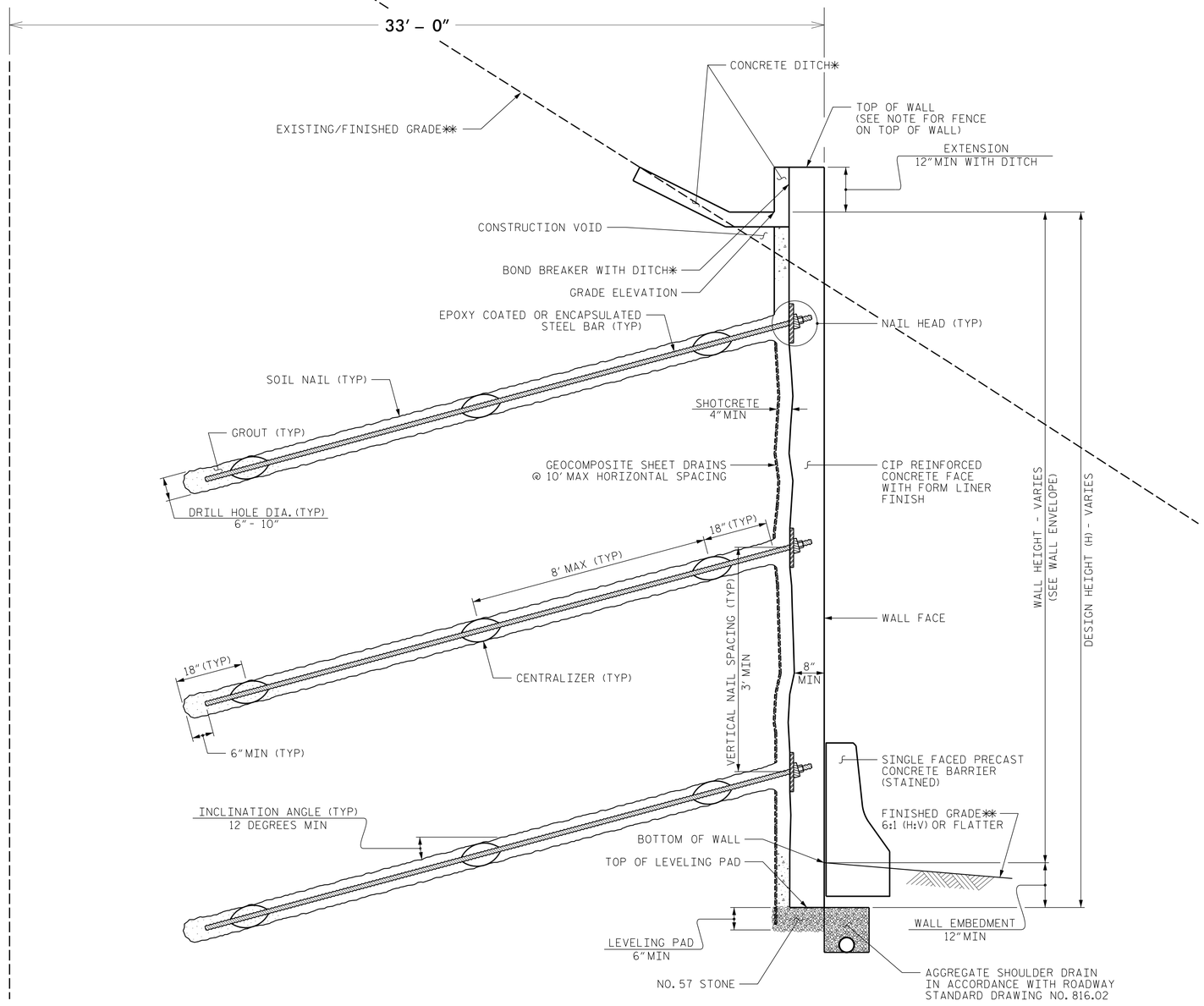
GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #23
SOIL NAIL RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W23-1



SOIL NAIL WALL - TYPICAL SECTION

*SEE CONCRETE DITCH BEHIND WALL DETAILS.
**SEE PLANS FOR FINISHED GRADE.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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08/01/2022

SIGNATURE DATE

ENGINEER

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NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER (STAINED), SEE ROADWAY PLANS, SECTION 857 OF THE STANDARD SPECIFICATION, AND SIMULATED STONE FORM LINER FINISH SPECIAL PROVISION.

A FENCE IS REQUIRED ON TOP OF RETAINING WALL #23. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

A FORM LINER ARCHITECTURAL FINISH IS REQUIRED FOR THE CIP REINFORCED CONCRETE FACE FOR RETAINING WALL #23. THE CONTRACTOR SHALL PROVIDE THE REQUESTED FINISH BEFORE BEGINNING CIP REINFORCED CONCRETE FACE CONSTRUCTION. THE APPEARANCE (STONE SIZE AND SHAPE, STONE COLOR, AND STONE TEXTURE, PATTERN, AND RELIEF) SHOULD MATCH NATURAL STONE AND ROCK. FOR FORM LINER ARCHITECHTURAL FINISH, SEE THE SIMULATED STONE FORM LINER FNISH SPECIAL PROVISION.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #23, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #23 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED DENSE TO VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF
5) IN-SITU ASSUMED VERY STIFF TO HARD RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 0 PSF
6) IN-SITU ASSUMED WEATHERED ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 135 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 500 PSF
7) IN-SITU ASSUMED CRYSTALLINE ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 170 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 1,000 PSF
8) WHERE ROCK IS ENCOUNTERED IN THE WALL ENVELOPE, DESIGNERS SHOULD REFER TO THE FHWA PRESUMPTIVE STRENGTH PARAMETERS OR OTHER REPRESENTATIVE AND REPEATABLE VALUES AND PROVIDE SOURCE REFERENCES IN THEIR DESIGN SUBMITTAL.

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #23.

THE PROPOSED RIGHT OF WAY (ROW) AND PERMANENT EASEMENT (PE) BOUNDARY VARIES FROM THE FACE OF RETAINING WALL #23. SEE THE ROADWAY PLANS FOR OFFSET DISTANCES FROM THE FACE OF RETAINING WALL #23. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE PE BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #23, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE ROCK IS PRESENT IN THE WALL ENVELOPE, CONTROLLED BLASTING IS RECOMMENDED, BUT NOT REQUIRED, TO MAINTAIN THE NEAT EXCAVATION LINE. VOIDS, RESULTING FROM BLASTING OR EXCAVATING, THAT EXTEND BEYOND THE NEAT LINES ARE TO BE FILLED WITH A COMBINATION OF SHORT SOIL NAILS, WELDED WIRE, AND SHOTCRETE, AT THE DISCRETION OF THE ENGINEER. THE COSTS ASSOCIATED WITH THIS WORK WILL BE CONSIDERED INCIDENTAL TO WALL CONSTRUCTION AND NO ADDITIONAL COMPENSATION WILL BE MADE. FOR BLASTING, SEE THE BLASTING PROVISION.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #23, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #23: -L- 448+40, 34' LT TO 452+25, 34' LT

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #23
SOIL NAIL RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W23-2

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL	
DocuSigned by: 8AD7038284484F4... 08/01/2022	
SIGNATURE DATE	SIGNATURE DATE

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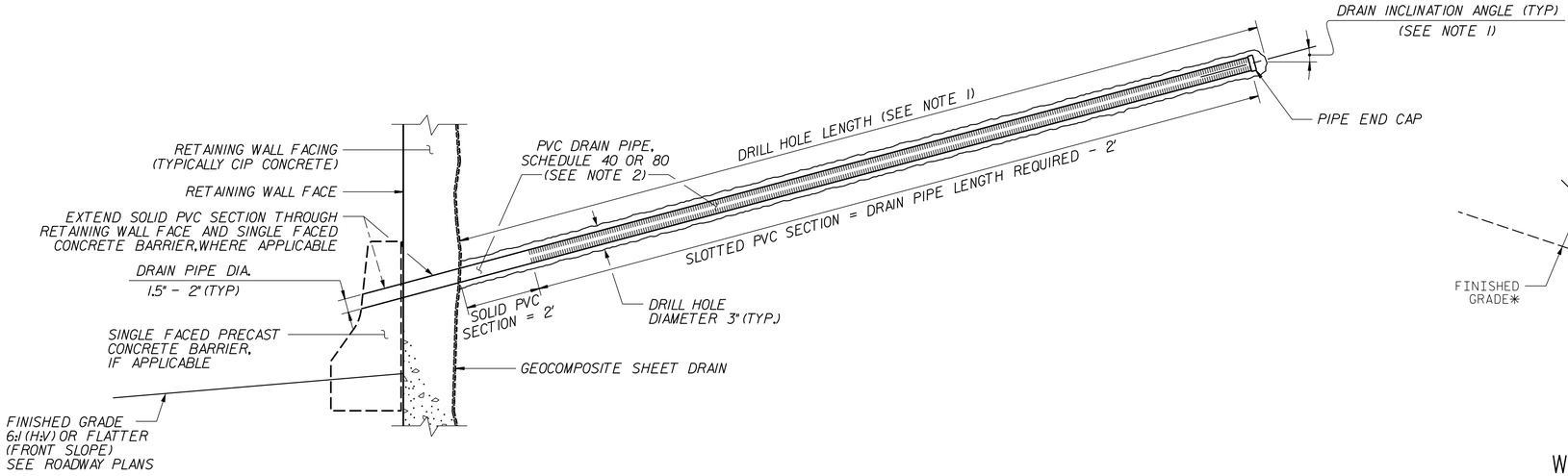
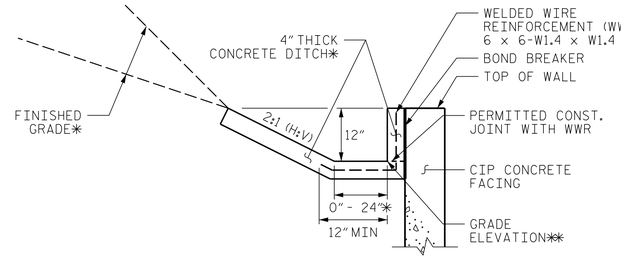
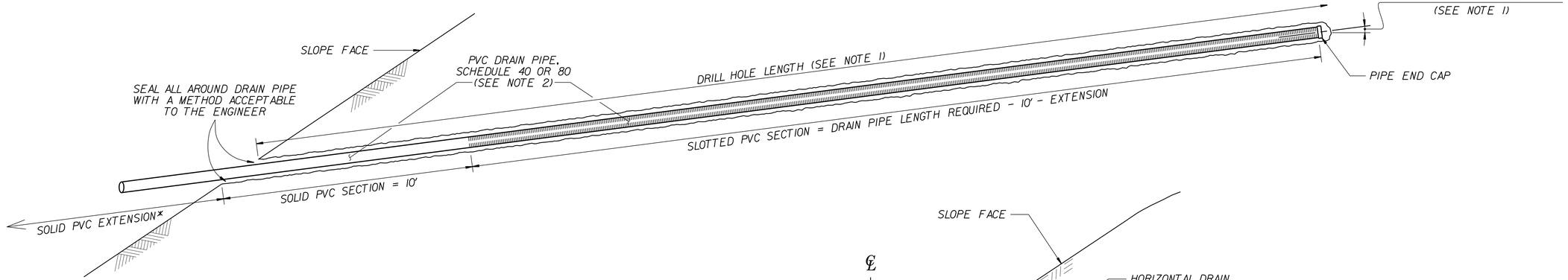


RETAINING WALL HORIZONTAL DRAIN



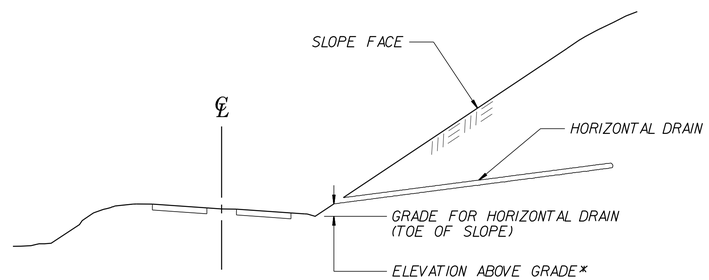
CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
**SEE WALL ENVELOPE FOR GRADE ELEVATIONS.



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #23: -L- 448+40, 34' LT TO 452+25, 34' LT

SHEET 3 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
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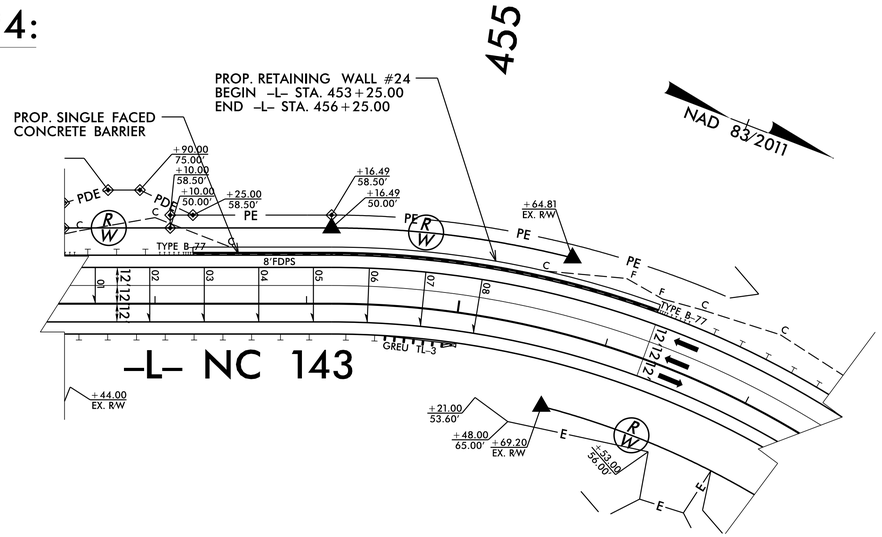
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #23
SOIL NAIL RETAINING WALL

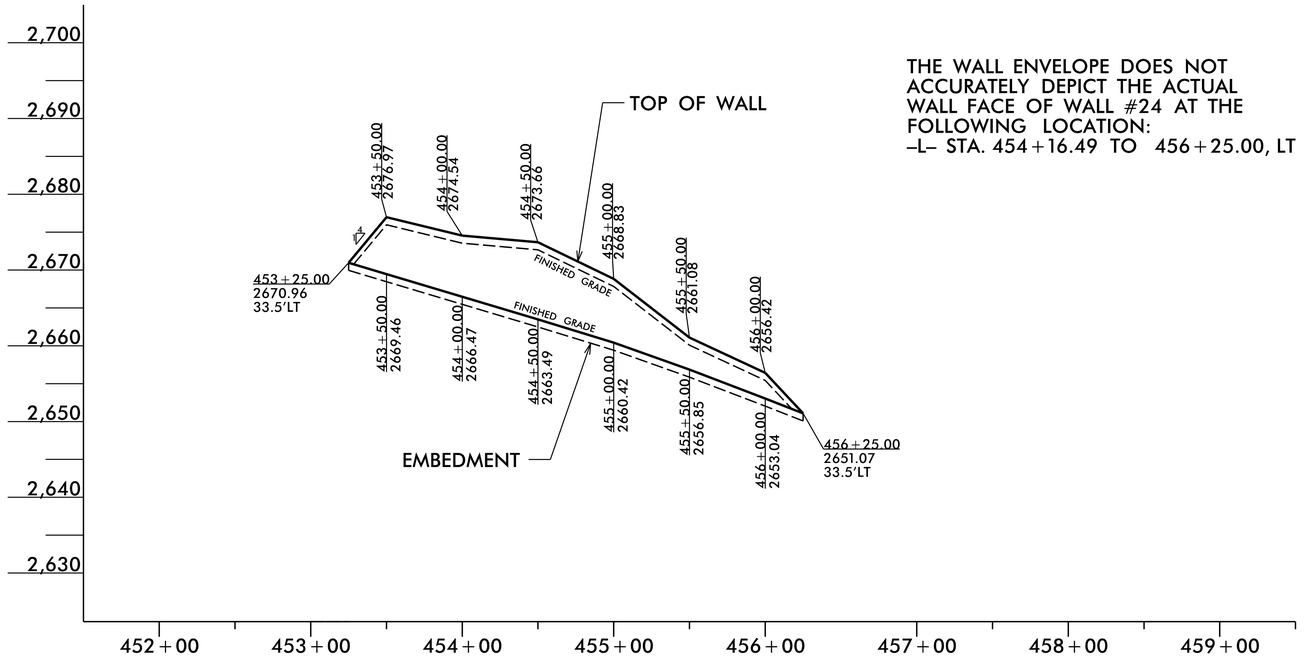
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W23-3
2			4			

RETAINING WALL #24:



RETAINING WALL #24 – PLAN

NOT TO SCALE



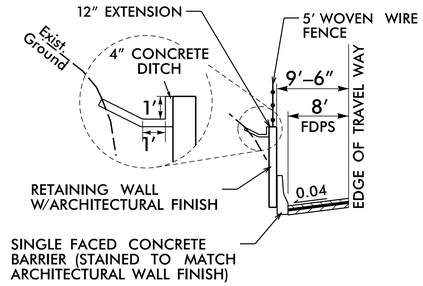
RETAINING WALL #24 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #24 AT THE FOLLOWING LOCATION:
–L– STA. 454+16.49 TO 456+25.00, LT

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL	
DocuSigned by: 8AD703B2A84B4F4... 08/01/2022	
SIGNATURE DATE	SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



DETAIL FOR WALL #24

NOT TO SCALE
–L– STA. 453+25.00 TO –L– STA. 456+25.00, LT

ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
24	2,255*	3	10
FORM LINER ARCHITECTURAL FINISH			2,255* SF
HORIZONTAL DRAINS (CONTIGENCY)			150 LF

*INCLUDES RETAINING WALL EMBEDMENT

SOIL NAIL RETAINING WALL #24

STA. -L-	OFFSET FROM -L- (LT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
453+25.00	33.50	2670.96	2670.96	2669.96	1.00	1.00
453+50.00	33.50	2676.97	2669.46	2668.46	1.00	7.51
454+00.00	33.50	2674.54	2666.47	2665.47	1.00	8.07
454+50.00	33.50	2673.66	2663.49	2662.49	1.00	10.17
455+00.00	33.50	2668.83	2660.42	2659.42	1.00	8.41
455+50.00	33.50	2661.08	2656.85	2655.85	1.00	4.23
456+00.00	33.50	2656.42	2653.04	2652.04	1.00	3.38
456+25.00	33.50	2651.07	2651.07	2650.07	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #24: -L- 453+25, 34' LT TO 456+25, 34' LT

SHEET 1 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #24 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

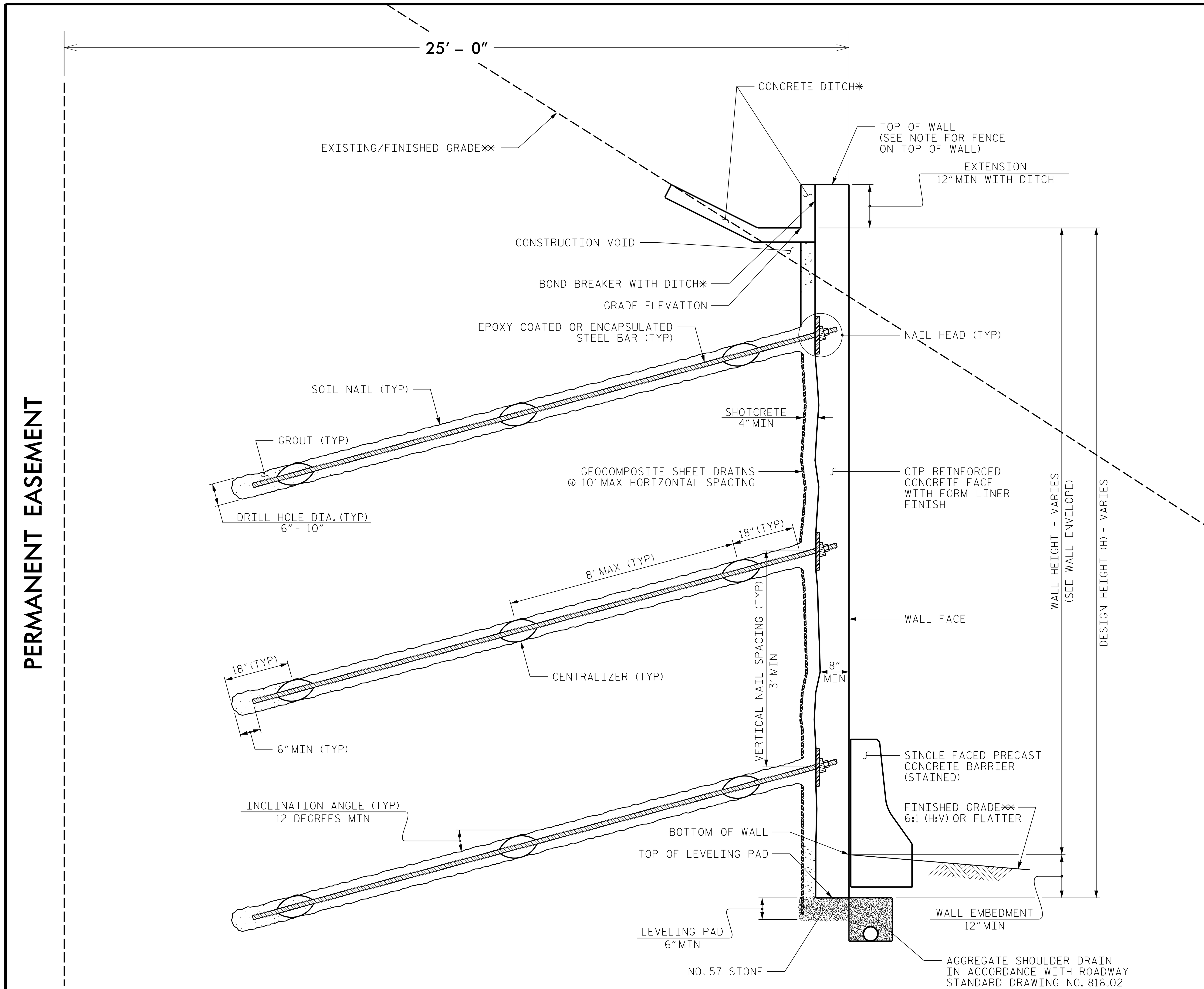
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #24
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W24-1
2			4			



SOIL NAIL WALL - TYPICAL SECTION

*SEE CONCRETE DITCH BEHIND WALL DETAILS.
**SEE PLANS FOR FINISHED GRADE.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by:
8AD703B2A8484F4...

SIGNATURE 08/01/2022 DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER (STAINED), SEE ROADWAY PLANS, SECTION 857 OF THE STANDARD SPECIFICATION, AND SIMULATED STONE FORM LINER FINISH SPECIAL PROVISION.

A FENCE IS REQUIRED ON TOP OF RETAINING WALL #24. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

A FORM LINER ARCHITECTURAL FINISH IS REQUIRED FOR THE CIP REINFORCED CONCRETE FACE FOR RETAINING WALL #24. THE CONTRACTOR SHALL PROVIDE THE REQUESTED FINISH BEFORE BEGINNING CIP REINFORCED CONCRETE FACE CONSTRUCTION. THE APPEARANCE (STONE SIZE AND SHAPE, STONE COLOR, AND STONE TEXTURE, PATTERN, AND RELIEF) SHOULD MATCH NATURAL STONE AND ROCK. FOR FORM LINER ARCHITECHTURAL FINISH, SEE THE SIMULATED STONE FORM LINER FNISH SPECIAL PROVISION.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #24, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #24 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED MEDIUM DENSE TO VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF
5) IN-SITU ASSUMED HARD RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 0 PSF
6) IN-SITU ASSUMED WEATHERED ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 135 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 500 PSF
7) IN-SITU ASSUMED CRYSTALLINE ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 170 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 1,000 PSF
8) WHERE ROCK IS ENCOUNTERED IN THE WALL ENVELOPE, DESIGNERS SHOULD REFER TO THE FHWA PRESUMPTIVE STRENGTH PARAMETERS OR OTHER REPRESENTATIVE AND REPEATABLE VALUES AND PROVIDE SOURCE REFERENCES IN THEIR DESIGN SUBMITTAL.

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #24.

THE PROPOSED RIGHT OF WAY (ROW) AND PERMANENT EASEMENT (PE) BOUNDARY VARIES FROM THE FACE OF RETAINING WALL #24. SEE THE ROADWAY PLANS FOR OFFSET DISTANCES FROM THE FACE OF RETAINING WALL #24. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE PE BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #24, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE ROCK IS PRESENT IN THE WALL ENVELOPE, CONTROLLED BLASTING IS RECOMMENDED, BUT NOT REQUIRED, TO MAINTAIN THE NEAT EXCAVATION LINE. VOIDS, RESULTING FROM BLASTING OR EXCAVATING, THAT EXTEND BEYOND THE NEAT LINES ARE TO BE FILLED WITH A COMBINATION OF SHORT SOIL NAILS, WELDED WIRE, AND SHOTCRETE, AT THE DISCRETION OF THE ENGINEER. THE COSTS ASSOCIATED WITH THIS WORK WILL BE CONSIDERED INCIDENTAL TO WALL CONSTRUCTION AND NO ADDITIONAL COMPENSATION WILL BE MADE. FOR BLASTING, SEE THE BLASTING PROVISION.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #24, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

GROUND MAY NOT EXIST ABOVE THE BOTTOM OF THE WALL IN SOME PORTIONS OF THE WALL ENVELOPE. USE CONVENTIONAL GRADING, TEMPORARY WALL, OR OTHER METHOD ACCEPTABLE TO THE ENGINEER TO CREATE GROUND ABOVE EXISTING GRADE IN ORDER TO CONSTRUCT THE SOIL NAIL WALL. THE CONTRACT UNIT PRICE FOR SOIL NAIL RETAINING WALLS WILL BE FULL COMPENSATION FOR THIS WORK, IF REQUIRED.

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #24: -L- 453+25, 34' LT TO 456+25, 34' LT

SHEET 2 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

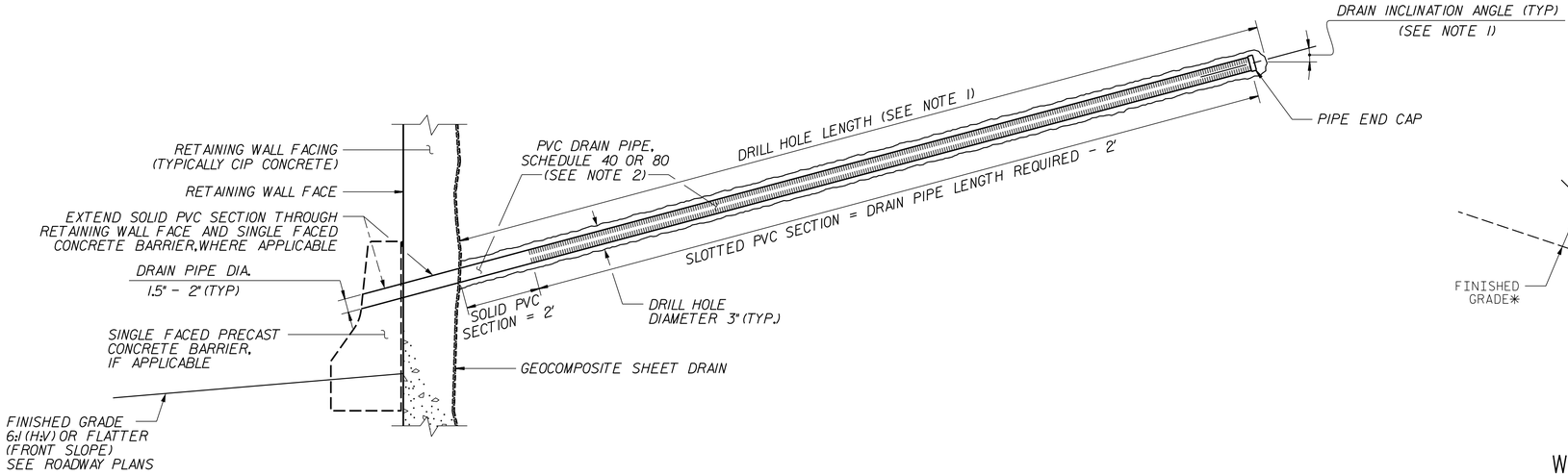
RETAINING WALL #24
SOIL NAIL RETAINING WALL

REVISIONS

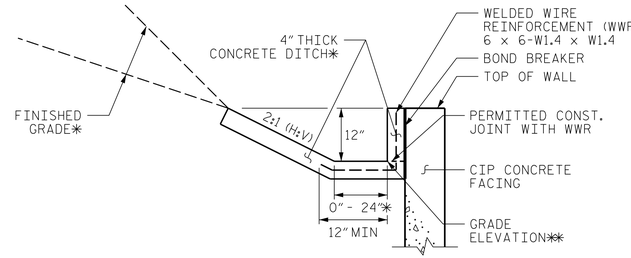
NO.	BY	DATE	NO.	BY	DATE	SHEET NO.
1			3			W24-2
2			4			

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL	
DocuSigned by: 8AD7038284484F4... SIGNATURE	SIGNATURE
08/01/2022 DATE	DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

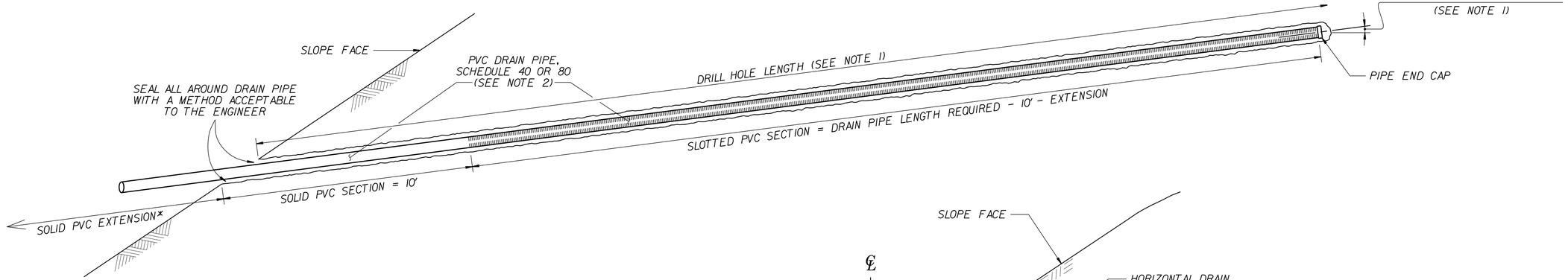


RETAINING WALL HORIZONTAL DRAIN



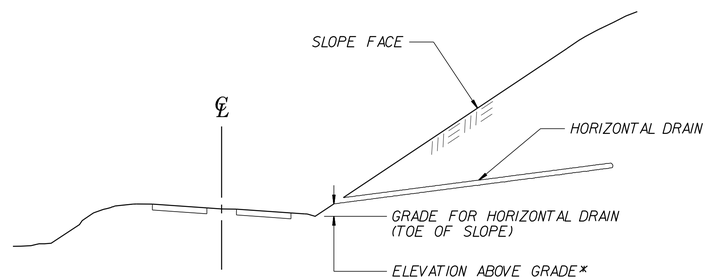
CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
**SEE WALL ENVELOPE FOR GRADE ELEVATIONS.



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #24: -L- 453+25, 34' LT TO 456+25, 34' LT

SHEET 3 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

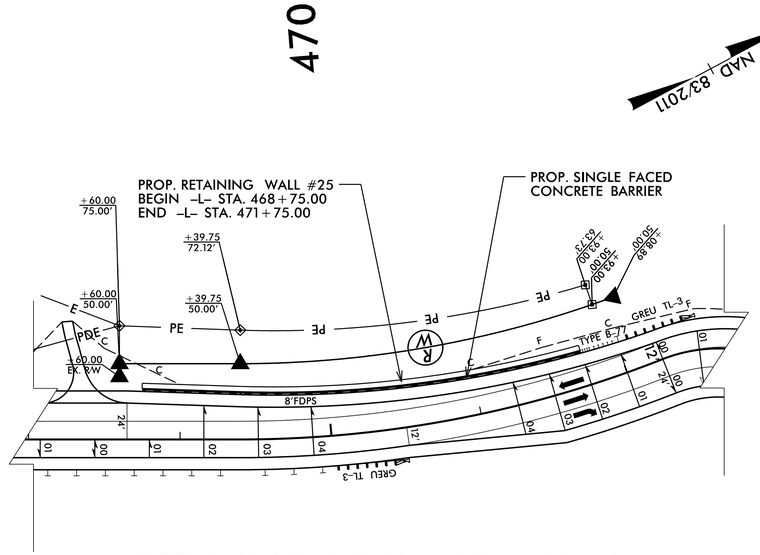
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #24
SOIL NAIL RETAINING WALL

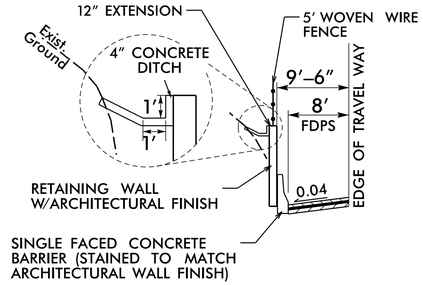
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W24-3
2			4			

RETAINING WALL #25:



RETAINING WALL #25 – PLAN

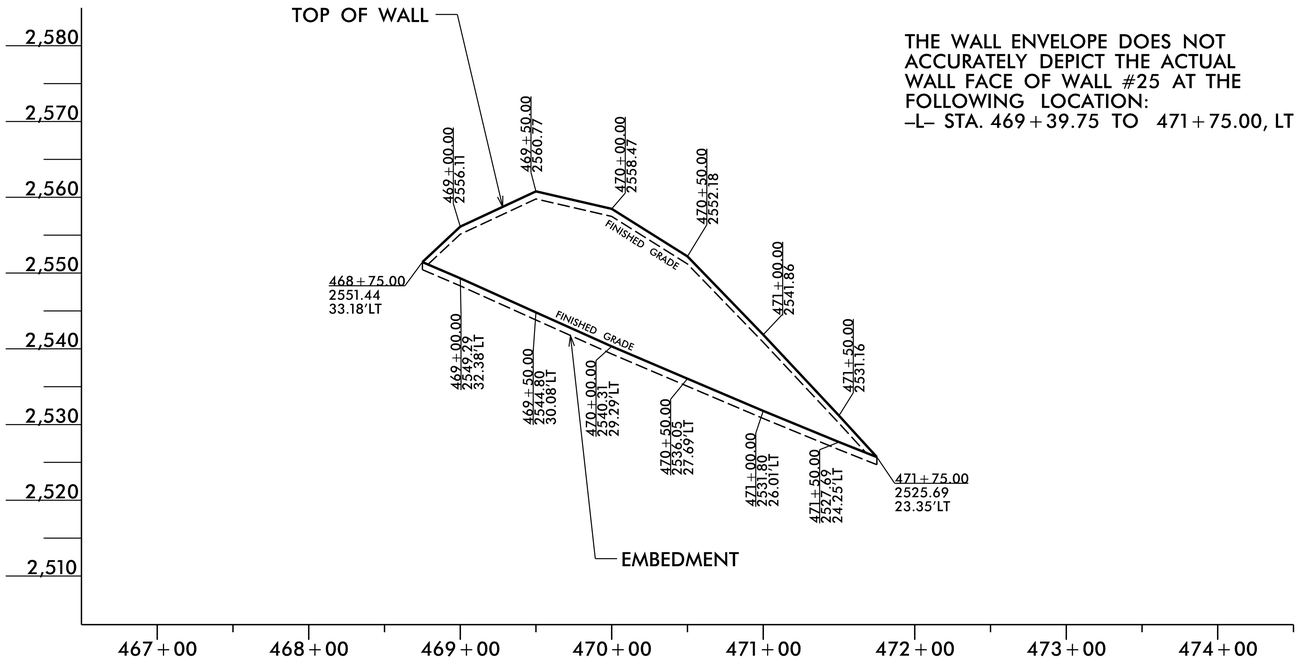
NOT TO SCALE



DETAIL FOR WALL #25

NOT TO SCALE

–L– STA. 468+75.00 TO –L– STA. 471+75.00, LT



RETAINING WALL #25 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #25 AT THE FOLLOWING LOCATION:
–L– STA. 469+39.75 TO 471+75.00, LT

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038248484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
25	3,710 *	3	10
FORM LINER ARCHITECTURAL FINISH			3,710 * SF
HORIZONTAL DRAINS (CONTIGENCY)			150 LF

* INCLUDES RETAINING WALL EMBEDMENT

SOIL NAIL RETAINING WALL #25

STA. -L-	OFFSET FROM -L- (LT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
468+75.00	33.18	2551.44	2551.44	2550.44	1.00	1.00
469+00.00	32.38	2556.11	2549.29	2548.29	1.00	6.82
469+50.00	30.08	2560.77	2544.80	2543.80	1.00	15.97
470+00.00	29.29	2558.47	2540.31	2539.31	1.00	18.16
470+50.00	27.69	2552.18	2536.05	2535.05	1.00	16.13
471+00.00	26.01	2541.86	2531.80	2530.80	1.00	10.06
471+50.00	24.25	2531.16	2527.69	2526.69	1.00	3.47
471+75.00	23.35	2525.69	2525.69	2524.69	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #25: -L- 468+75, 33' LT TO 471+75, 23' LT

SHEET 1 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #25 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

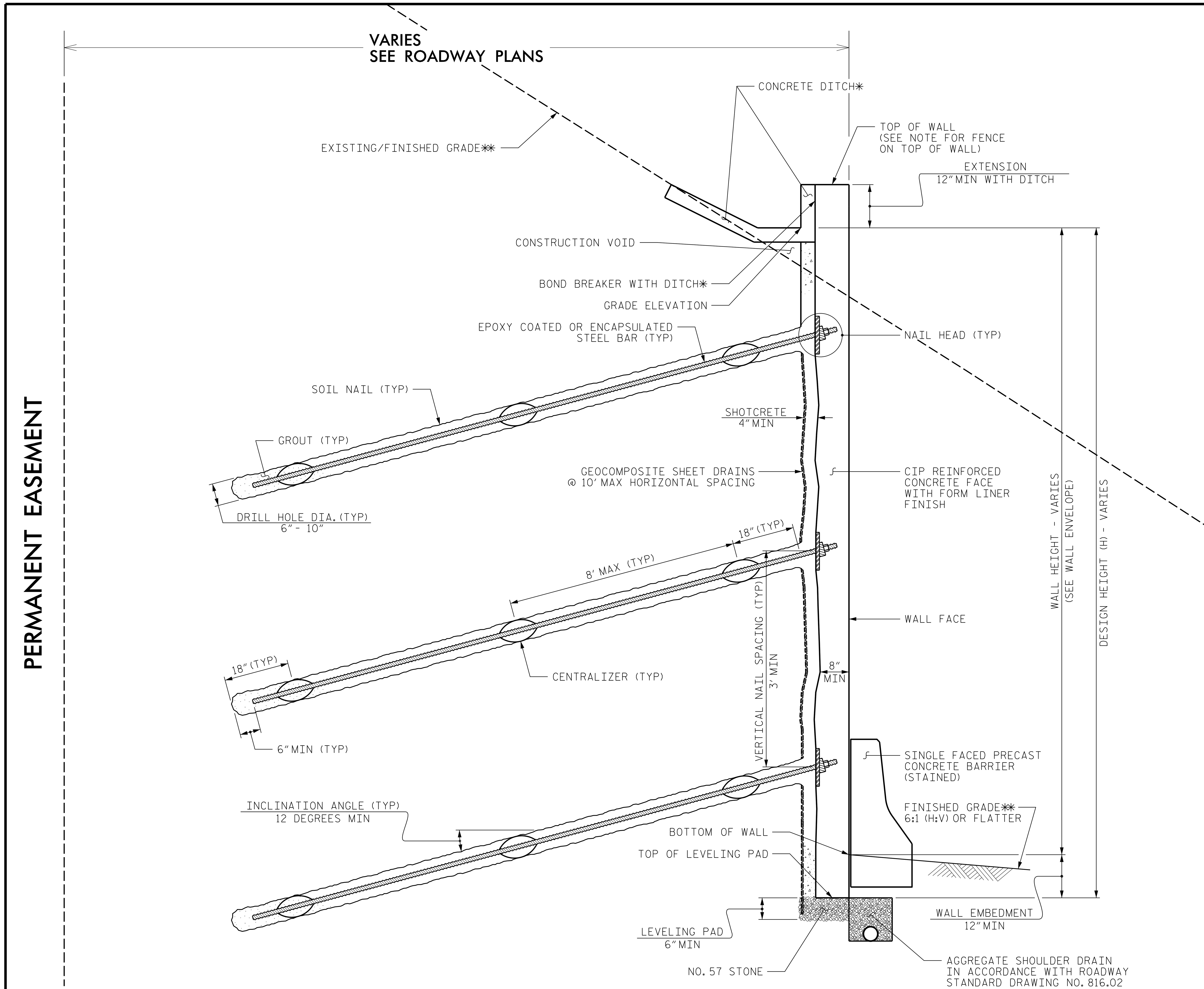
GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #25
SOIL NAIL RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W25-1



SOIL NAIL WALL - TYPICAL SECTION

*SEE CONCRETE DITCH BEHIND WALL DETAILS.
**SEE PLANS FOR FINISHED GRADE.

GEOTECHNICAL ENGINEER | ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 042642 ROBERT E. KRAL

DocuSigned by: 8AD703B2A8484F4... SIGNATURE 08/01/2022 DATE | SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER (STAINED), SEE ROADWAY PLANS, SECTION 857 OF THE STANDARD SPECIFICATION, AND SIMULATED STONE FORM LINER FINISH SPECIAL PROVISION.

A FENCE IS REQUIRED ON TOP OF RETAINING WALL #25. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

A FORM LINER ARCHITECTURAL FINISH IS REQUIRED FOR THE CIP REINFORCED CONCRETE FACE FOR RETAINING WALL #25. THE CONTRACTOR SHALL PROVIDE THE REQUESTED FINISH BEFORE BEGINNING CIP REINFORCED CONCRETE FACE CONSTRUCTION. THE APPEARANCE (STONE SIZE AND SHAPE, STONE COLOR, AND STONE TEXTURE, PATTERN, AND RELIEF) SHOULD MATCH NATURAL STONE AND ROCK. FOR FORM LINER ARCHITECHTURAL FINISH, SEE THE SIMULATED STONE FORM LINER FNISH SPECIAL PROVISION.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #25, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #25 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED MEDIUM DENSE TO VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF
5) IN-SITU ASSUMED MEDIUM STIFF TO VERY STIFF RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 0 PSF
6) IN-SITU ASSUMED WEATHERED ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 135 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 500 PSF
7) IN-SITU ASSUMED CRYSTALLINE ROCK (META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 170 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 1,000 PSF
8) WHERE ROCK IS ENCOUNTERED IN THE WALL ENVELOPE, DESIGNERS SHOULD REFER TO THE FHWA PRESUMPTIVE STRENGTH PARAMETERS OR OTHER REPRESENTATIVE AND REPEATABLE VALUES AND PROVIDE SOURCE REFERENCES IN THEIR DESIGN SUBMITTAL.

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #25.

THE PROPOSED RIGHT OF WAY (ROW) AND PERMANENT EASEMENT (PE) BOUNDARY VARIES FROM THE FACE OF RETAINING WALL #25. SEE THE ROADWAY PLANS FOR OFFSET DISTANCES FROM THE FACE OF RETAINING WALL #25. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE PE BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #25, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE ROCK IS PRESENT IN THE WALL ENVELOPE, CONTROLLED BLASTING IS RECOMMENDED, BUT NOT REQUIRED, TO MAINTAIN THE NEAT EXCAVATION LINE. VOIDS, RESULTING FROM BLASTING OR EXCAVATING, THAT EXTEND BEYOND THE NEAT LINES ARE TO BE FILLED WITH A COMBINATION OF SHORT SOIL NAILS, WELDED WIRE, AND SHOTCRETE, AT THE DISCRETION OF THE ENGINEER. THE COSTS ASSOCIATED WITH THIS WORK WILL BE CONSIDERED INCIDENTAL TO WALL CONSTRUCTION AND NO ADDITIONAL COMPENSATION WILL BE MADE. FOR BLASTING, SEE THE BLASTING PROVISION.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #25, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

GROUND MAY NOT EXIST ABOVE THE BOTTOM OF THE WALL IN SOME PORTIONS OF THE WALL ENVELOPE. USE CONVENTIONAL GRADING, TEMPORARY WALL, OR OTHER METHOD ACCEPTABLE TO THE ENGINEER TO CREATE GROUND ABOVE EXISTING GRADE IN ORDER TO CONSTRUCT THE SOIL NAIL WALL. THE CONTRACT UNIT PRICE FOR SOIL NAIL RETAINING WALLS WILL BE FULL COMPENSATION FOR THIS WORK, IF REQUIRED.

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #25: -L- 468+75, 33' LT TO 471+75, 23' LT

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #25
SOIL NAIL RETAINING WALL

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

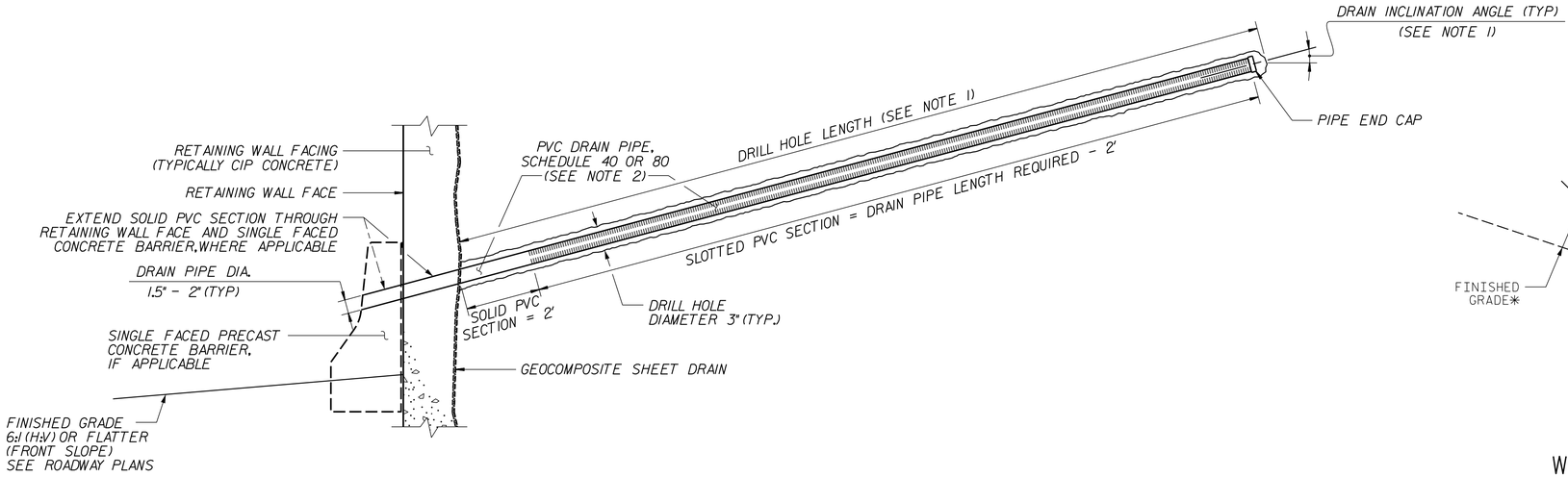
REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

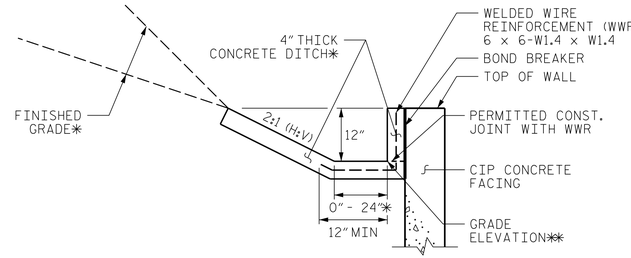
SHEET NO. W25-2

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL	
DocuSigned by: 8AD7038284484F4... SIGNATURE	SIGNATURE
08/01/2022 DATE	DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

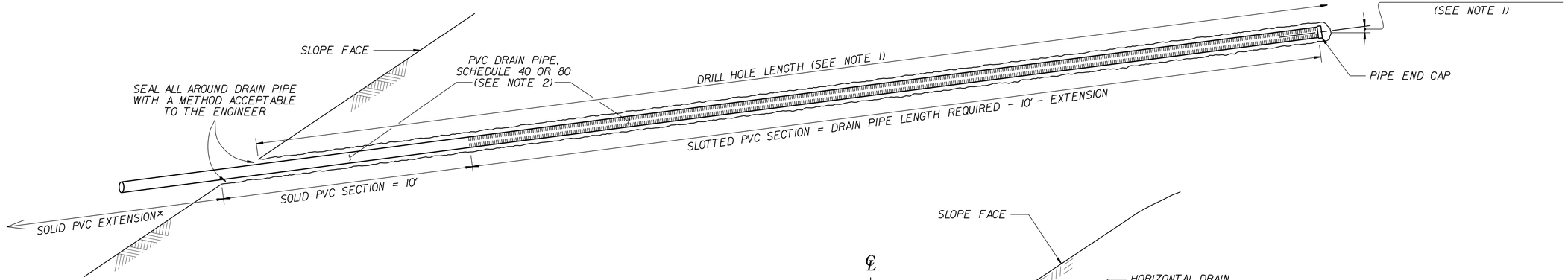


RETAINING WALL HORIZONTAL DRAIN



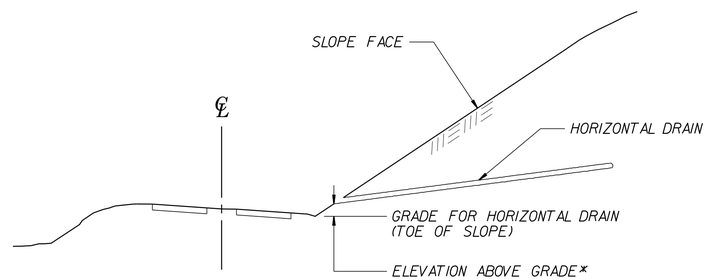
CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
**SEE WALL ENVELOPE FOR GRADE ELEVATIONS.



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #25: -L- 468+75, 33' LT TO 471+75, 23' LT

SHEET 3 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

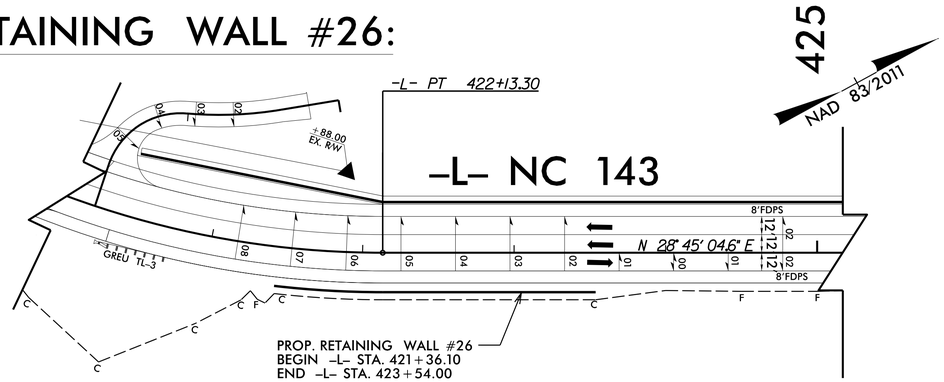
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #25
SOIL NAIL RETAINING WALL

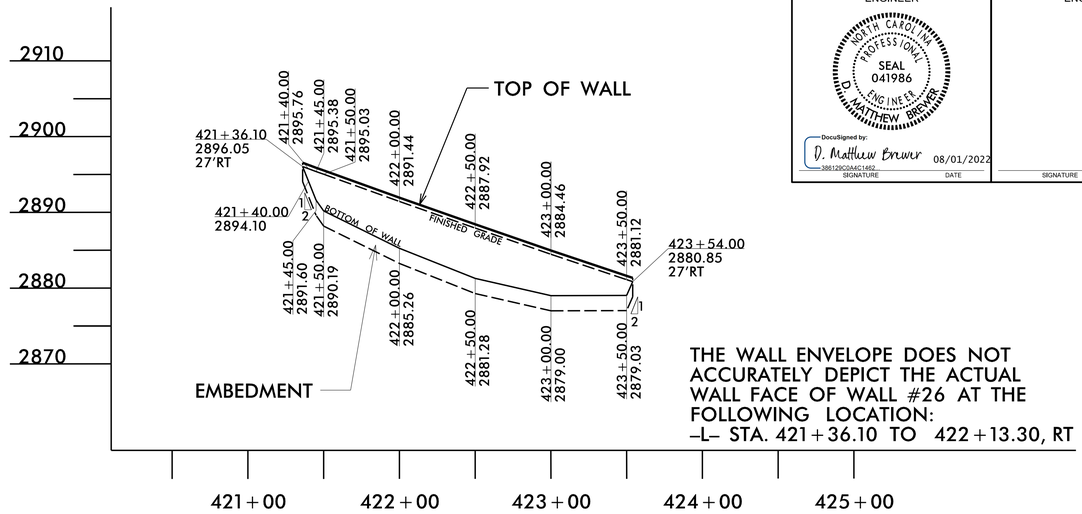
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W25-3
2			4			

RETAINING WALL #26:



RETAINING WALL #26:

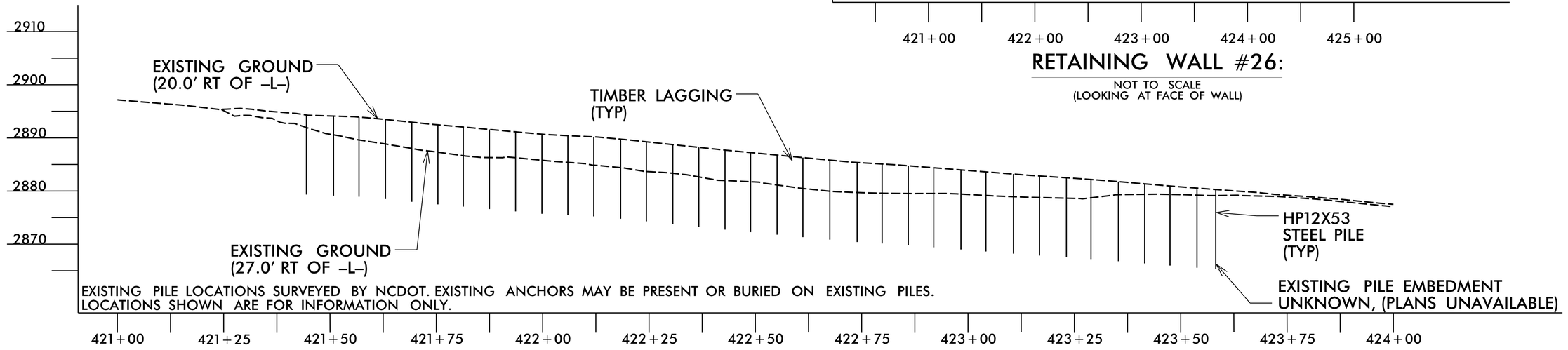
NOT TO SCALE



THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #26 AT THE FOLLOWING LOCATION:
-L- STA. 421+36.10 TO 422+13.30, RT

RETAINING WALL #26:

NOT TO SCALE
(LOOKING AT FACE OF WALL)



EXISTING WALL PROFILE – #26

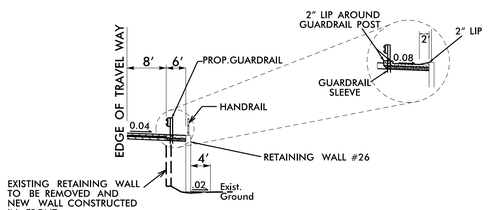
NOT TO SCALE
(LOOKING AT FACE OF WALL)

MSE RETAINING WALL #26						
STA. -L-	OFFSET FROM -L- (FT)	FINISHED GRADE* (FT)	BOTTOM OF WALL (FT)	TOP OF LEVELING PAD (FT)	ESTIMATED MSE WALL EMBEDMENT (FT)	DESIGN MSE WALL HEIGHT "H" (FT)
421+36.10	27.00 RT	2896.05	2896.05	2894.05	2.00	2.00
421+40.00	27.00 RT	2895.76	2894.10	2892.10	2.00	3.66
421+45.00	27.00 RT	2895.38	2891.60	2889.60	2.00	5.78
421+50.00	27.00 RT	2895.03	2890.19	2888.19	2.00	6.84
422+00.00	27.00 RT	2891.44	2885.26	2883.26	2.00	8.18
422+50.00	27.00 RT	2887.92	2881.28	2879.28	2.00	8.64
423+00.00	27.00 RT	2884.46	2879.00	2877.00	2.00	7.46
423+50.00	27.00 RT	2881.12	2879.03	2877.03	2.00	4.09
423+54.00	27.00 RT	2880.85	2880.85	2878.85	2.00	2.00

*FINISHED GRADE ELEVATION ADJACENT TO COPING EXTENSION, SEE TYPICAL DETAIL

ESTIMATED RETAINING WALL QUANTITY (SQUARE FEET)	
MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALL #26	1,680 SF*

*INCLUDES WALL EMBEDMENT



DETAIL FOR WALL #26

NOT TO SCALE
-L- STA. 421+36.10 TO -L- STA. 423+54.00, RT

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #26 STATION: -L- 421+36, 27' RT TO 423+54, 27' RT

SHEET 1 OF 3

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by: D. Matthew Brewer 08/01/2022
3861290C0A4C1462 SIGNATURE DATE

ENGINEER

SIGNATURE DATE

PREPARED BY: DMB DATE: 7/10/2022

REVIEWED BY: REK DATE: 7/10/2022

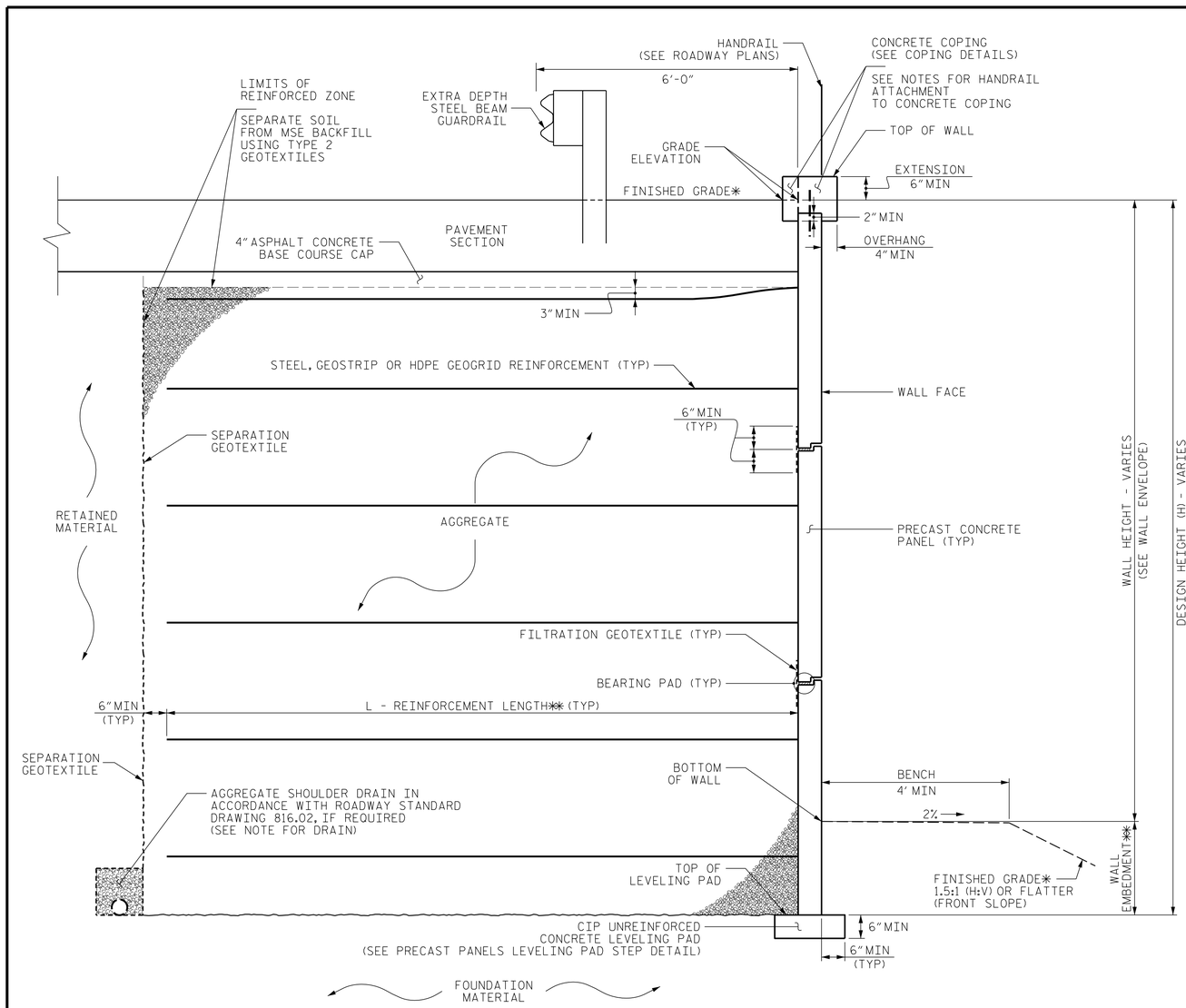
RETAINING WALL #26 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

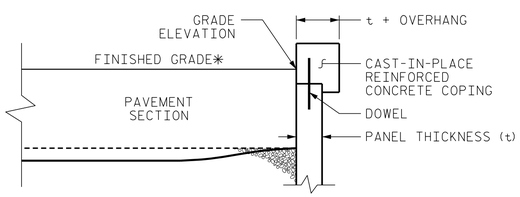
RETAINING WALL #26 MECHANICALLY STABILIZED EARTH (MSE) WALL

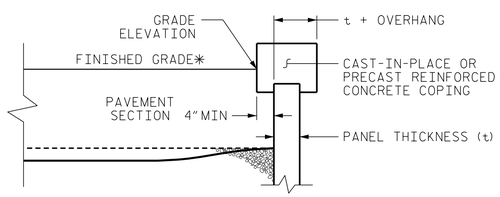
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W26-1
2			4			



MSE WALL WITH PRECAST PANELS - TYPICAL SECTION

*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.
**SEE MSE RETAINING WALLS PROVISION AND IF APPLICABLE, MSE WALL NOTES FOR WALL EMBEDMENT AND REINFORCEMENT LENGTH REQUIREMENTS.





COPING DETAILS

AT THE CONTRACTOR'S OPTION, CONNECT COPING TO PANELS WITH DOWELS OR EXTEND COPING DOWN BACK OF PANELS.
*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

FRONT SLOPE WALL EMBEDMENT

SLOPE IN FRONT OF STRUCTURES		MINIMUM EMBEDMENT DEPTH
HORIZONTAL	FOR WALLS	H/20
	FOR ABUTMENTS	H/10
3.0H:1.0V	WALLS	H/10
2.5H:1.0V	WALLS	H/8.5
2.0H:1.0V	WALLS	H/7
1.5H:1.0V	WALLS	H/5
1.25H:1.0V	WALLS	H/4
1.0H:1.0V	WALLS	H/3

NOTE:
1) MAINTAIN A MINIMUM BENCH WIDTH OF 4.0 FT IN FRONT OF THE WALL.
2) MINIMUM EMBEDMENT DEPTH OF 2 FT. UNLESS LARGER DEPTHS DICTATED BY ABOVE TABLE.
3) MAXIMUM SLOPE OF 1H:1V WILL BE MAINTAINED ON FRONT SLOPES FOR THE ENTIRE LENGTH OF THE WALL.
4) SUBMIT WITH THE WALL DESIGN INTERNAL AND EXTERNAL ANALYSES.
REFERENCE MSE WALL PROVISION.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by: D. Matthew Brewer 08/01/2022
3861290C0A4C1462
SIGNATURE DATE

ENGINEER

SIGNATURE DATE

PROJECT NO.: A-0009CC
GRAHAM COUNTY
RETAINING WALL #26 STATION: -L- 421+36, 27' RT TO 423+54, 27' RT
SHEET 2 OF 3

PREPARED BY: DMB	DATE: 7/10/2022
REVIEWED BY: REK	DATE: 7/10/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #26
MECHANICALLY STABILIZED
EARTH (MSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W26-2
2			4			

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by: D. Matthew Brewer 08/01/2022
3861290C0A4C1462...
SIGNATURE DATE

ENGINEER

SIGNATURE DATE

NOTES:

FOR MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS, SEE MECHANICALLY STABILIZED EARTH RETAINING WALLS PROVISION.

FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.

FOR FENCES OR HANDRAILS ON THE TOP OF THE RETAINING WALL, SEE ROADWAY PLANS FOR FENCE OR HANDRAIL ATTACHMENT DETAILS.

DO NOT USE FINE AGGREGATE IN THE REINFORCED ZONE OF RETAINING WALL #26.

A SEPARATION GEOTEXTILE IS REQUIRED AT THE BACK OF THE REINFORCED ZONE FOR RETAINING WALL #26.

A DRAIN IS REQUIRED FOR RETAINING WALL #26.

A SMOOTH ARCHITECTURAL FINISH IS REQUIRED FOR PRECAST CONCRETE PANELS FOR RETAINING WALL #26.

BEFORE BEGINNING MSE WALL DESIGN FOR RETAINING WALL #26, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #26 FOR THE FOLLOWING:
1) H = DESIGN HEIGHT + EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MAXIMUM FACTORED VERTICAL PRESSURE ON FOUNDATION MATERIAL:
   RETAINING WALL #26: 2,500 PSF
4) MINIMUM REINFORCEMENT
   RETAINING WALL #26: LENGTH (L) = 0.8xH OR 6 FT, WHICHEVER IS LONGER
5) MINIMUM EMBEDMENT DEPTH = 2 FEET, SEE TABLE ON SHEET W26-1 AND MSE WALL PROVISION
6) REINFORCED ZONE AGGREGATE PARAMETERS:

AGGREGATE TYPE*	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (c) PSF
COARSE	110	38	0
FINE	115	34	0
*SEE MSE RETAINING WALLS PROVISION FOR COARSE AND FINE AGGREGATE MATERIAL REQUIREMENTS.			

8) IN-SITU ASSUMED MATERIAL PARAMETERS:

MATERIAL TYPE	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (c) PSF
BACKFILL	120	30	0
FOUNDATION	120	30	0

DESIGN RETAINING WALL #26 FOR A LIVE LOAD (TRAFFIC) SURCHARGE.

FOUNDATIONS FOR SIGNS, LIGHTING OR SIGNALS MAY BE LOCATED BEHIND RETAINING WALL #26 AND MAY INTERFERE WITH REINFORCEMENT. BEFORE BEGINNING MSE WALL CONSTRUCTION, SUBMIT PROPOSED CONSTRUCTION METHODS FOR THESE FOUNDATIONS FOR APPROVAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH REINFORCEMENT FOR RETAINING WALL #26.

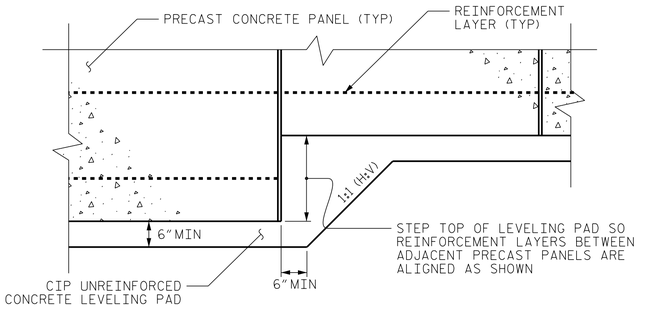
DO NOT PLACE LEVELING PAD CONCRETE, AGGREGATE OR REINFORCEMENT FOR RETAINING WALL #26 UNTIL EXCAVATION DIMENSIONS AND FOUNDATION MATERIAL ARE APPROVED.

AT THE CONTRACTOR'S OPTION, "TEMPORARY SHORING FOR WALL CONSTRUCTION" MAY BE USED TO CONSTRUCT RETAINING WALL #26. SEE MSE RETAINING WALLS PROVISION FOR TEMPORARY SHORING FOR WALL CONSTRUCTION.

SPECIAL NOTES:

UNDERCUTTING SOFT AND/OR WET SOILS IN THE VICINITY OF THE REINFORCED ZONE AND LEVELING PAD MAY BE REQUIRED TO IMPROVE BEARING RESISTANCE. IF REQUIRED BY THE ENGINEER, USE UNDERCUT EXCAVATION TO REMOVE SOFT SOILS AS DIRECTED BY THE ENGINEER. UNDERCUT TO SUITABLE FOUNDATION SOILS OR TO A DEPTH NO GREATER THAN 3 FEET BELOW THE TOP OF LEVELING PAD ELEVATION, WHICHEVER OCCURS FIRST. PLACE GEOTEXTILE FOR SOIL STABILIZATION IN THE BOTTOM OF THE EXCAVATION AND BACKFILL WITH SELECT GRANULAR MATERIAL. FOR UNDERCUT EXCAVATION AND SELECT GRANULAR MATERIAL SEE STANDARD SPECIFICATIONS. UNDERCUT EXCAVATION, SELECT GRANULAR MATERIAL, AND GEOTEXTILE FOR SOIL STABILIZATION WILL BE PAID AS SEPARATE ADDITIONAL QUANTITIES.

REMOVAL OF A PORTION OF AN EXISTING SOLDIER PILE RETAINING WALL IS REQUIRED IN THE VICINITY OF RETAINING WALL #26.



PRECAST PANELS
LEVELING PAD STEP DETAIL

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #26 STATION: -L- 421+36, 27' RT TO 423+54, 27' RT

SHEET 3 OF 3

PREPARED BY: DMB	DATE: 7/10/2022
REVIEWED BY: REK	DATE: 7/10/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

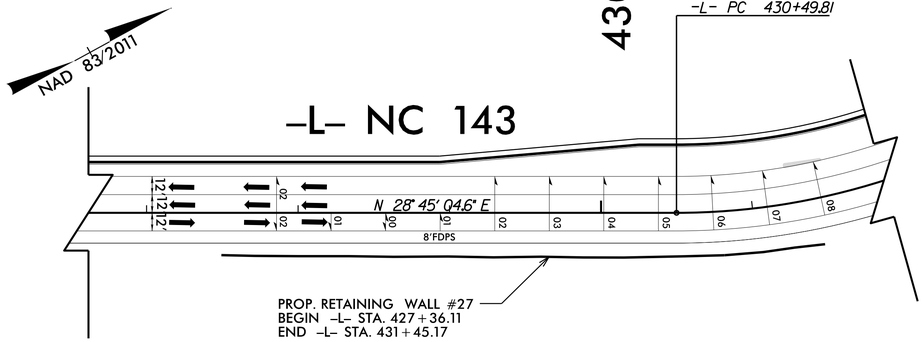
RETAINING WALL #26
MECHANICALLY STABILIZED EARTH (MSE) WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

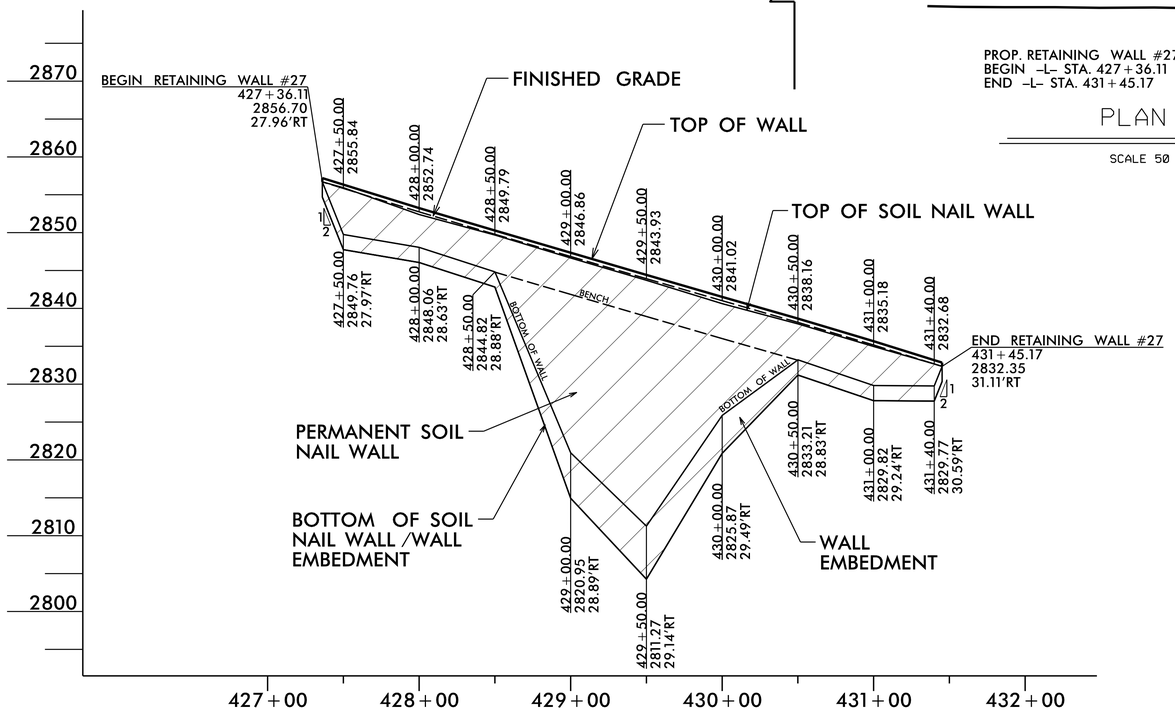
SHEET NO. W26-3

RETAINING WALL #27



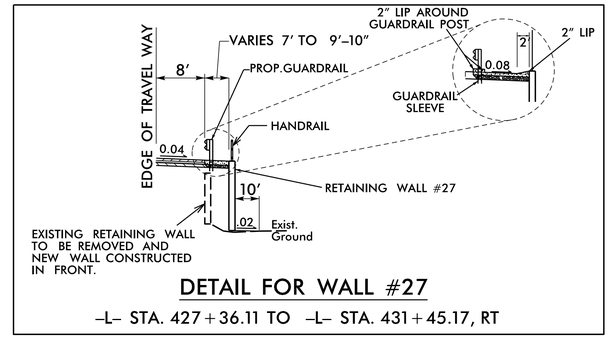
PLAN VIEW

SCALE 50 FT • 1 IN



SMSE WALL ENVELOPE

NOT TO SCALE
(LOOKING AT WALL FACE)



DETAIL FOR WALL #27

-L- STA. 427+36.11 TO -L- STA. 431+45.17, RT

TYPICAL WALL SECTION

NOT TO SCALE

SMSE RETAINING WALL #27 INFORMATION

STA. -L-	OFFSET FROM CL TO WALL FACE	FINISHED GRADE	BOTTOM OF WALL	MINIMUM TOP OF LEVELING PAD	ESTIMATED MINIMUM SMSE WALL EMBEDMENT	* DESIGN SMSE WALL HEIGHT "H"	TOP OF SOIL NAIL WALL	APPROX. SOIL NAIL WALL HEIGHT	WALL REINFORCEMENT (MSE STRAP) LENGTH 'L'
427+36.11	27.96	2856.70	2856.70	2854.70	2.00	2.00	2856.70	2.00	0.5XH OR 6 FT (MIN)
427+50.00	27.97	2855.84	2849.76	2847.76	2.00	8.08	2855.94	8.18	0.5XH OR 6 FT (MIN)
428+00.00	28.63	2852.74	2848.06	2846.06	2.00	6.68	2852.40	6.34	0.5XH OR 6 FT (MIN)
428+50.00	28.88	2849.79	2844.82	2842.82	2.00	6.97	2849.69	6.87	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
429+00.00	28.89	2846.86	2820.95	2814.95	6.00	31.91	2846.66	31.71	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
429+50.00	29.14	2843.93	2811.27	2804.27	7.00	39.66	2843.72	39.45	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
430+00.00	29.49	2841.02	2825.87	2820.87	5.00	20.15	2840.63	19.76	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
430+50.00	28.83	2838.16	2833.21	2831.21	2.00	6.95	2837.96	6.75	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
431+00.00	29.24	2835.18	2829.82	2827.82	2.00	7.36	2834.98	7.16	0.5XH OR 6 FT (MIN)
431+40.00	30.59	2832.68	2829.77	2827.77	2.00	4.91	2832.68	4.91	0.5XH OR 6 FT (MIN)
431+45.17	31.11	2832.35	2832.35	2830.35	2.00	2.00	2832.53	2.00	0.5XH OR 6 FT (MIN)

* FOR DESIGN WALL HEIGHT "H" AND ADDITIONAL CONSTRUCTION DETAILS, SEE SHEETS W27-3 TO W27-5

ALL TABLE DIMENSIONS ARE GIVEN IN FEET

ESTIMATED SMSE WALL #27 QUANTITIES

SHORED MSE RETAINING WALL #27	6,550 SQ. FT.

ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL #	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
27	6,260*	3	18

* INCLUDES RETAINING WALL EMBEDMENT

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by: D. Matthew Brewer 08/01/2022
386129C0A4C1462...
SIGNATURE DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 1 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #27 AT THE FOLLOWING LOCATION: -L- STA. 430+49.81 TO 431+45.17, RT

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #27
SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

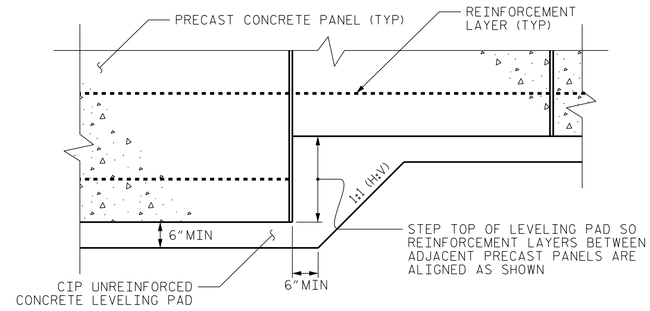
REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W27-1

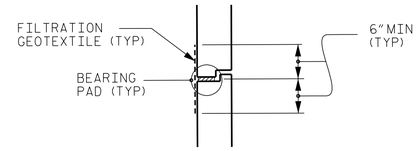
FRONT SLOPE WALL EMBEDMENT		
SLOPE IN FRONT OF STRUCTURES		MINIMUM EMBEDMENT DEPTH
HORIZONTAL	FOR WALLS	H/20
	FOR ABUTMENTS	H/10
3.0H:1.0V	WALLS	H/10
2.5H:1.0V	WALLS	H/8.5
2.0H:1.0V	WALLS	H/7
1.5H:1.0V	WALLS	H/5
1.25H:1.0V	WALLS	H/4
1.0H:1.0V	WALLS	H/3

NOTE:
1) MAINTAIN A MINIMUM BENCH WIDTH OF 10.0 FT IN FRONT OF THE WALL FOR ITS ENTIRE LENGTH.
2) MINIMUM EMBEDMENT DEPTH OF 2 FT, UNLESS LARGER DEPTHS DICTATED BY ABOVE TABLE.
3) MAXIMUM SLOPE OF 1H:1V WILL BE MAINTAINED ON FRONT SLOPES FOR THE ENTIRE LENGTH OF THE WALL.
4) SUBMIT WITH THE WALL DESIGN INTERNAL, EXTERNAL, AND GLOBAL STABILITY ANALYSES.
REFERENCE SPECIAL PROVISION GT-12 FOR SMSE WALL.



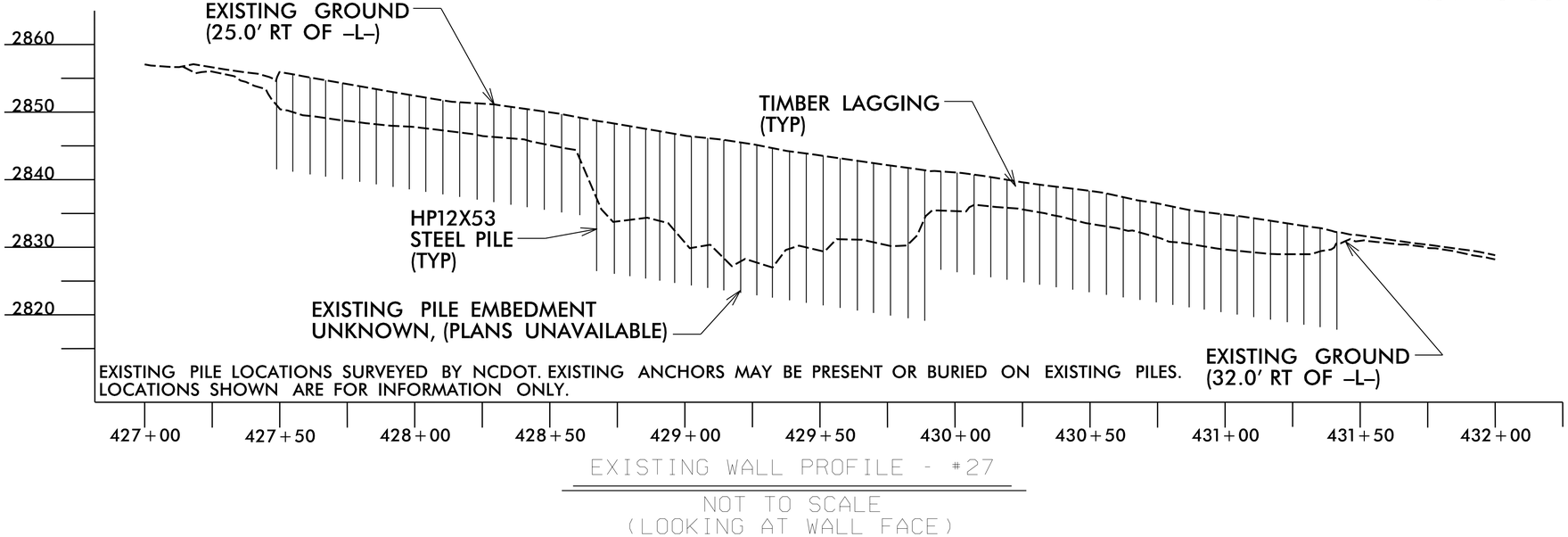
PRECAST PANELS
LEVELING PAD STEP DETAIL

NOT TO SCALE



PRECAST PANEL
JOINT DETAILS

NOT TO SCALE



EXISTING PILE LOCATIONS SURVEYED BY NCDOT. EXISTING ANCHORS MAY BE PRESENT OR BURIED ON EXISTING PILES. LOCATIONS SHOWN ARE FOR INFORMATION ONLY.

EXISTING WALL PROFILE - #27

NOT TO SCALE
(LOOKING AT WALL FACE)

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

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3861290C0A4C1462
SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 2 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

Prepared in the Office of:

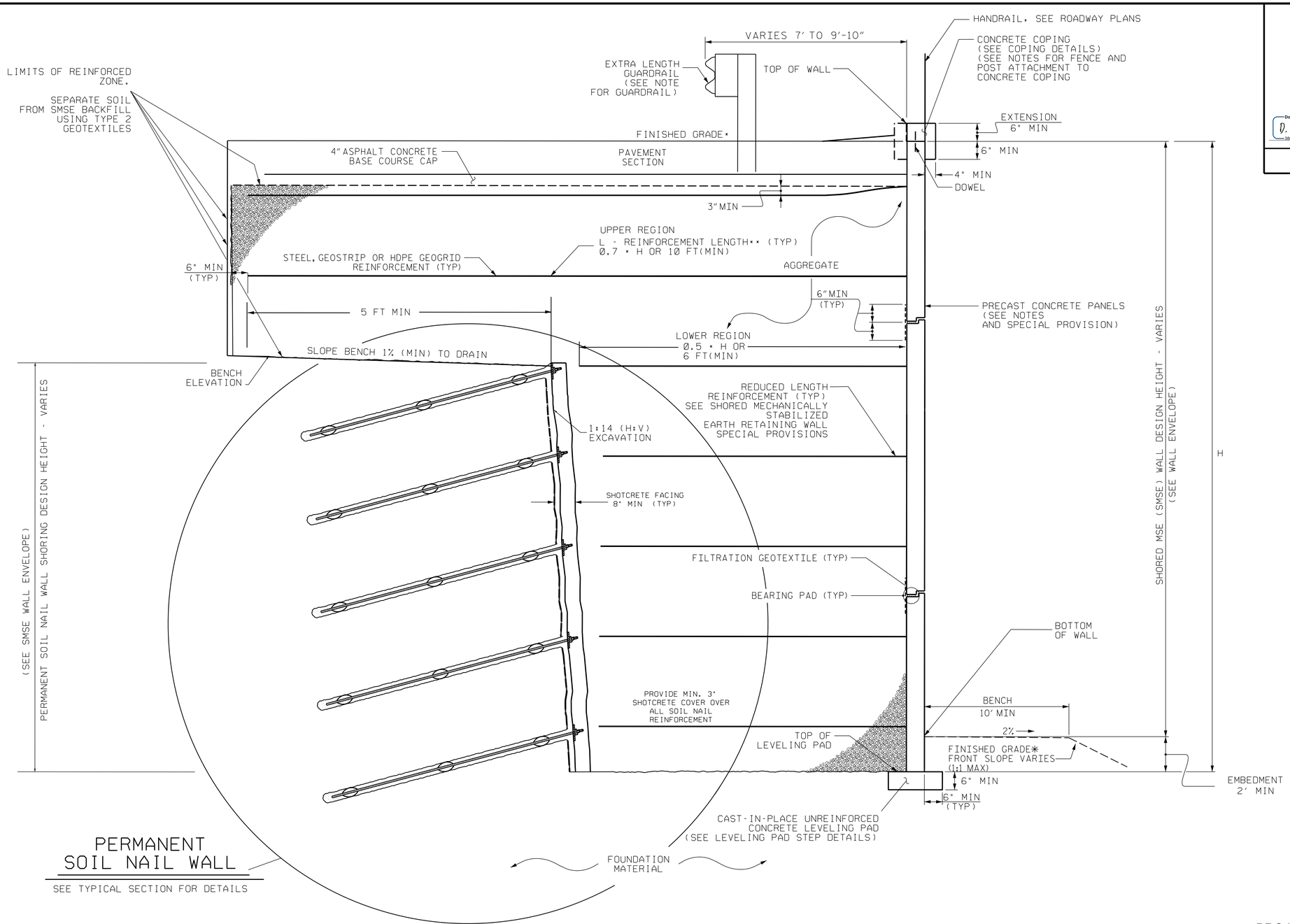
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #27
SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W27-2



PERMANENT
SOIL NAIL WALL

SEE TYPICAL SECTION FOR DETAILS

SMSE WALL WITH SOIL NAIL WALL> 2/3 H

-L- STA. 428+50.00 TO -L- STA. 430+50.00

*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

**SEE SMSE RETAINING WALLS SPECIAL PROVISION REINFORCEMENT LENGTH REQUIREMENTS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 3 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

Prepared in the Office of:

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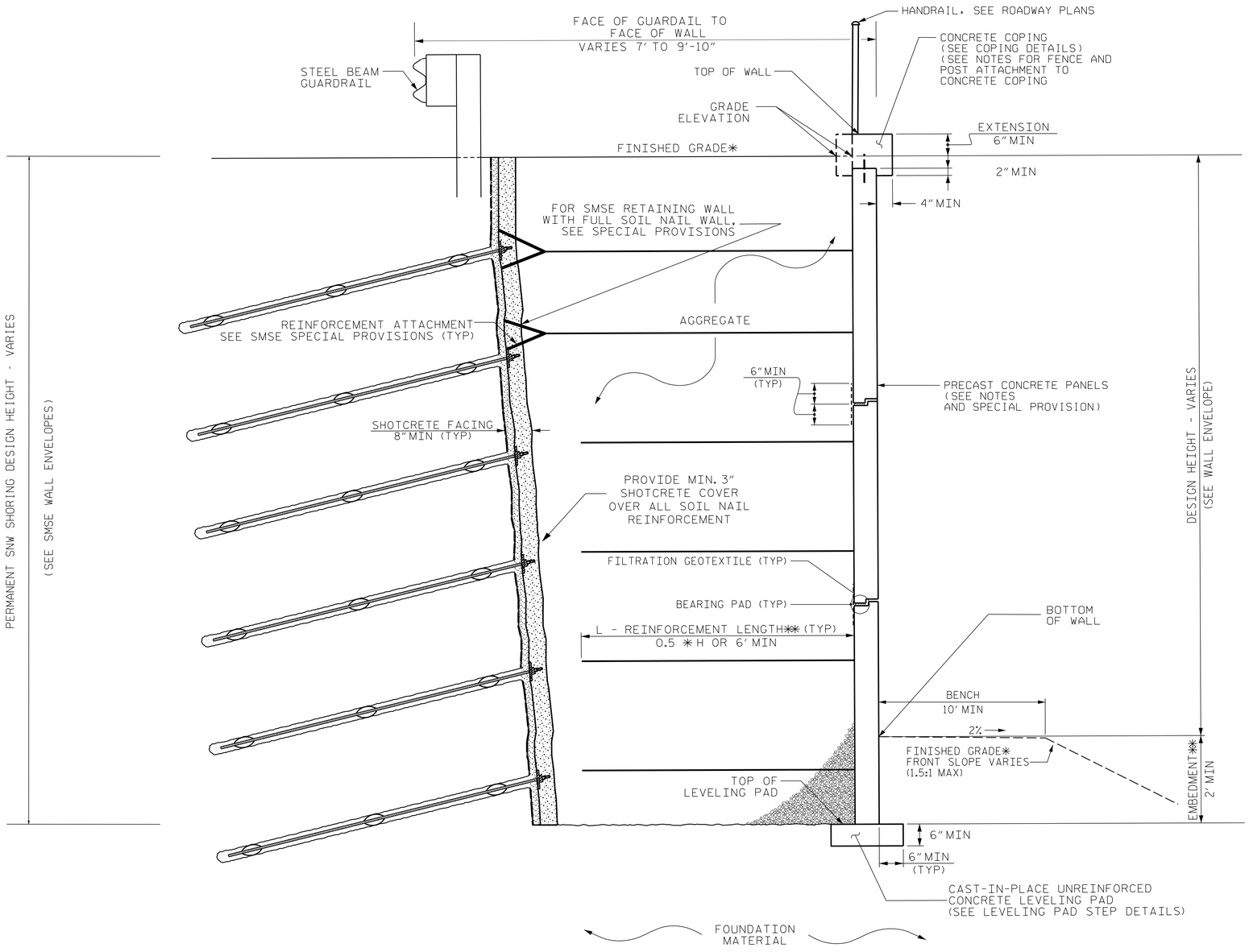
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #27
SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W27-3
2			4			



SMSE WALL WITH FULL HEIGHT SOIL NAIL WALL

-L- STA. 427+36.11 TO 428+50.00 AND STA. 430+50 TO 431+45.17

* SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

** SEE SMSE RETAINING WALLS PROVISION FOR EMBEDMENT AND REINFORCEMENT LENGTH REQUIREMENTS.

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER	
DocuSigned by: D. Matthew Brewer 08/01/2022 386129C0A4C1462...	
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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 4 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

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2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #27
SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	W27-4
1			3			
2			4			

NOTES:

FOR SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL RETAINING WALLS, SEE SHORED MECHANICALLY STABILIZED EARTH RETAINING WALLS SPECIAL PROVISION.

FOR MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS, SEE MECHANICALLY STABILIZED EARTH RETAINING WALLS PROVISION.

FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.

USE AN SMSE WALL SYSTEM WITH PRECAST PANELS FOR THIS RETAINING WALL.

DO NOT USE FINE AGGREGATE IN THE REINFORCED ZONE OF RETAINING WALL *27.

A SMOOTH ARCHITECTURAL FINISH IS REQUIRED FOR PRECAST CONCRETE PANELS FOR RETAINING WALL *27.

A SEPARATION GEOTEXTILE IS REQUIRED AT THE BACK OF THE REINFORCED ZONE FOR RETAINING WALL *27.

BEFORE BEGINNING SMSE WALL DESIGN FOR RETAINING WALL *27. SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL *27 FOR WALL HEIGHTS EQUAL TO THE DESIGN HEIGHT (DIFFERENCE BETWEEN FINISHED GRADE/TOP OF WALL ELEVATION AND BOTTOM OF WALL ELEVATION) PLUS EMBEDMENT (DIFFERENCE BETWEEN BOTTOM OF WALL ELEVATION AND TOP OF LEVELING PAD ELEVATION).

DESIGN RETAINING WALL *27 FOR THE FOLLOWING:
1) H = DESIGN HEIGHT + EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MAXIMUM FACTORED VERTICAL PRESSURE ON FOUNDATION MATERIAL = 6,400 PSF
4) MINIMUM MSE REINFORCEMENT LENGTH (L) = VARIES, SEE TABLE ON SHEET W27-1
5) MINIMUM SOIL NAIL REINFORCEMENT LENGTHS ARE BASED ON SNAIL.
6) MINIMUM EMBEDMENT DEPTH = 2 FT (MIN), SEE TABLE ON SHEET W27-1
7) REINFORCED ZONE AGGREGATE PARAMETERS:

AGGREGATE TYPE*	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (C) PSF
COARSE	110	38	0
FINE	115	34	0
* SEE MSE RETAINING WALLS PROVISION FOR COARSE AND FINE AGGREGATE MATERIAL REQUIREMENTS.			

9) IN-SITU ASSUMED MATERIAL PARAMETERS:

MATERIAL TYPE	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (C) PSF
BACKFILL	120	32	0
FOUNDATION	120	32	0

DESIGN RETAINING WALL *27 FOR A LIVE LOAD (TRAFFIC) SURCHARGE.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH MSE AND SOIL NAIL REINFORCEMENT FOR RETAINING WALL *27.

DO NOT PLACE LEVELING PAD CONCRETE, AGGREGATE OR REINFORCEMENT FOR MSE WALL PORTION OF RETAINING WALL *27 UNTIL EXCAVATION DIMENSIONS AND FOUNDATION MATERIAL ARE APPROVED.

FOR HANDRAILS ON THE TOP OF THE RETAINING WALL, SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

FOR SOIL NAIL RETAINING WALLS, SEE SMSE RETAINING WALL SPECIAL PROVISION.

THE SMSE WALL DESIGNER SHALL CONSULT WITH THE SOIL NAIL WALL DESIGNER TO VERIFY LOCATIONS WHERE "TEMPORARY SHORING" MAY BE REQUIRED FOR THE RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE TRAFFIC CONTROL PLANS. IN LOCATIONS WHERE "PERMANENT SOIL NAIL WALL" IS USED, PAYMENT WILL NOT BE MADE FOR "TEMPORARY SHORING" FOR TRAFFIC CONTROL.

THE PERMANENT SOIL NAIL WALL HEIGHT IS AN ESTIMATE ONLY, THAT IS BASED ON THE ANTICIPATED EXCAVATION PLUS THE MINIMUM EMBEDMENT LISTED.

WHERE APPLICABLE, DESIGN SOIL NAIL WALL REINFORCEMENT INCLINATION TO ACCOUNT FOR EXISTING OR FUTURE UTILITY CONFLICTS BEHIND THE SOIL NAIL WALL. VERIFY UTILITY LOCATION AND ELEVATION BEFORE BEGINNING SOIL NAIL WALL DESIGN OR CONSTRUCTION.

"TOP OF SOIL NAIL WALL" AS SHOWN IN THE WALL ENVELOPE REPRESENTS THE APPROXIMATE GRADE ELEVATION AT A DISTANCE OF 0.5 TIMES THE PROPOSED WALL HEIGHT ("H") AT THAT STATION OR ELEVATION AT THE TOP OF THE EXISTING WALL.

THE ESTIMATED SOIL NAIL WALL QUANTITY IS BASED ON 0.5 TIMES "H" (SMSE DESIGN HEIGHT) INCLUDING THE MINIMUM EMBEDMENT LISTED IN THE DESIGN TABLE ON SHEET W27-2. THESE VALUES ARE PROVIDED AS AN ESTIMATE ONLY AND MAY VARY DUE TO SITE CONDITIONS.

THE SOIL NAIL WALL DESIGNER IS RESPONSIBLE FOR DETERMINING GLOBAL STABILTIY BASED ON THE FINISHED SMSE WALL. A MINIMUM FACTOR OF SAFETY OF 1.35 IS REQUIRED FOR GLOBAL STABILITY. SUBMIT THESE RESULTS WITH THE WALL DESIGN PACKAGE. VERIFY UTILITY LOCATIONS AND ELEVATIONS BEFORE BEGINNING MSE WALL DESIGN OR CONSTRUCTION.

CONTRACTOR SHALL BE MADE AWARE THAT GRAVELLY SOILS AND BOULDER FILL WERE USED IN THE EXISTING ROADWAY EMBANKMENT AND MAY BE ENCOUNTERED DURING SOIL NAIL WALL CONSTRUCTION.

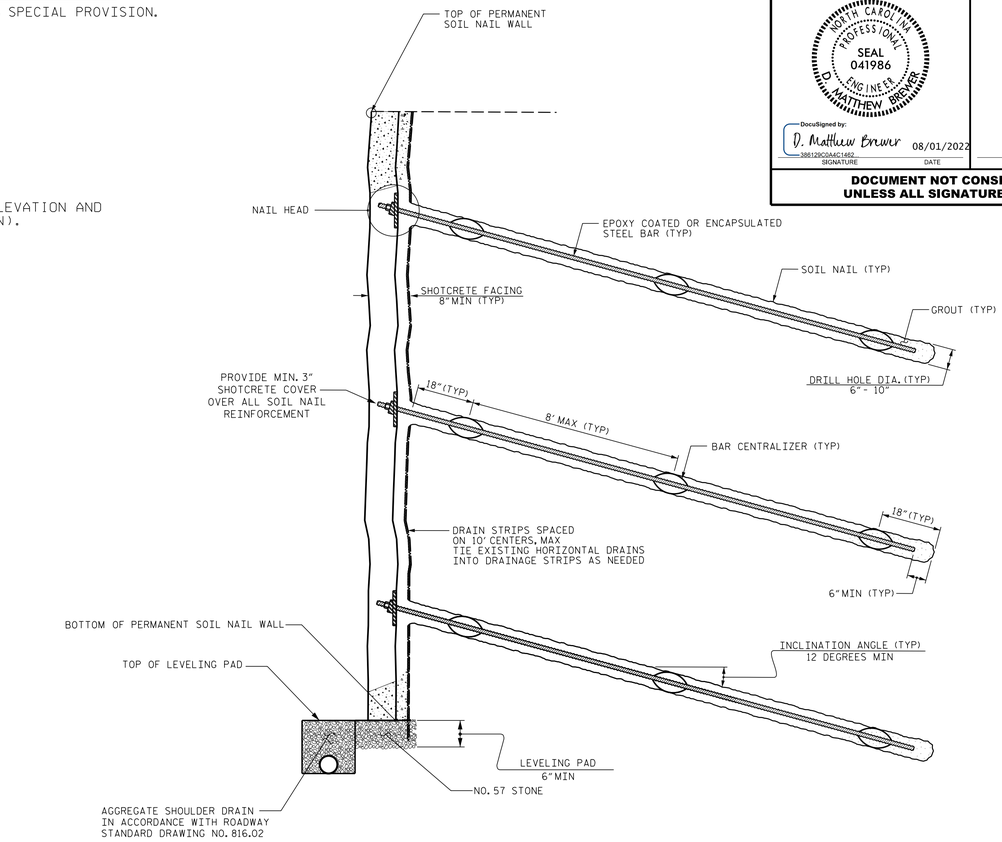
SPECIAL NOTES:

UNDERCUTTING COLLUVIAL SOILS BELOW THE SMSE WALL IS REQUIRED AS SHOWN ON SHEET W27-6. USE UNDERCUT EXCAVATION TO REMOVE SOILS AS DIRECTED BY THE ENGINEER. PLACE GEOTEXTILE FOR SOIL STABILIZATION WHEN NEEDED IN THE BOTTOM OF THE EXCAVATION AND BACKFILL WITH SUITABLE EMBANKMENT MATERIAL. FOR UNDERCUT EXCAVATION SEE STANDARD SPECIFICATIONS. UNDERCUT EXCAVATION AND GEOTEXTILE FOR SOIL STABILIZATION WILL BE PAID AS SEPARATE ADDITIONAL QUANTITIES.

EXTEND SOIL NAIL SHORING TO BOTTOM OF UNDERCUT EXCAVATION. DESIGN SOIL NAIL SHORING FOR THE HEIGHT EQUAL TO THE DIFFERENCE BETWEEN THE EXISTING ROADWAY GRADE AND THE BOTTOM OF THE UNDERCUT EXCAVATION. SOIL NAIL SHORING FOR UNDERCUT EXCAVATION WILL BE PAID IN ACCORDANCE WITH THE TEMPORARY SOIL NAIL SHORING FOR COLLUVIAL UNDERCUT SPECIAL PROVISION.

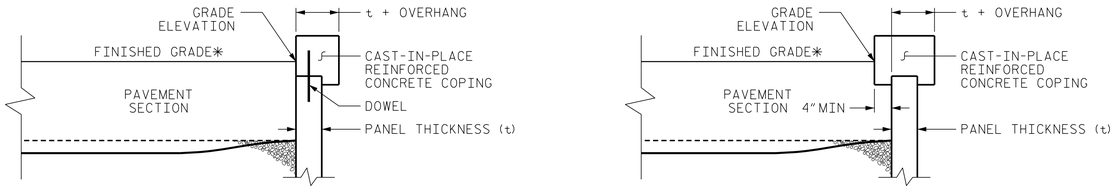
THE COLLUVIAL SOILS ARE SUITABLE FOR USE AS EMBANKMENT BUT WILL REQUIRE SIGNIFICANT DRYING TO ACHIEVE THE REQUIRED DENSITY. DO NOT USE COLLUVIAL SOILS IN THE UPPER 3 FEET OF EMBANKMENT DUE TO THE PRESENCE OF BOULDERS AND COBBLES. NO ADDITIONAL COMPENSATION WILL BE PROVIDED TO DRY COLLUVIAL SOILS OR FOR DOUBLE-HANDLING SOILS.

CONTROL GROUNDWATER DURING AND AT THE BOTTOM OF UNDERCUT EXCAVATION USING DITCHING, SUMPS, AND PERMANENT SHOULDER DRAINS AS DIRECTED BY THE ENGINEER. OUTLET SHOULDER DRAINS EVERY 50 TO 100 FEET AS DIRECTED BY THE ENGINEER.



PERMANENT SOIL NAIL WALL - TYPICAL SECTION

NOT TO SCALE



COPING DETAILS

AT THE CONTRACTOR'S OPTION, CONNECT COPING TO PANELS WITH DOWELS OR EXTEND COPING DOWN BACK OF PANELS.
*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by: D. Matthew Brewer 08/01/2022
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ENGINEER

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 5 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

Prepared in the Office of:

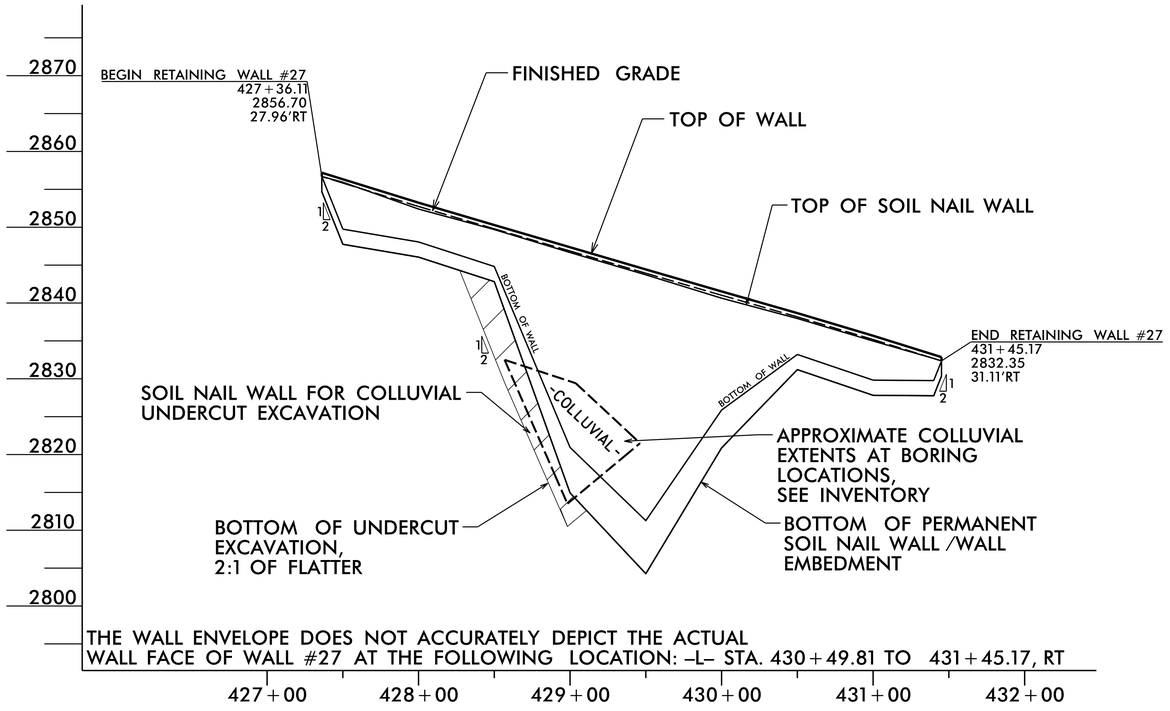
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

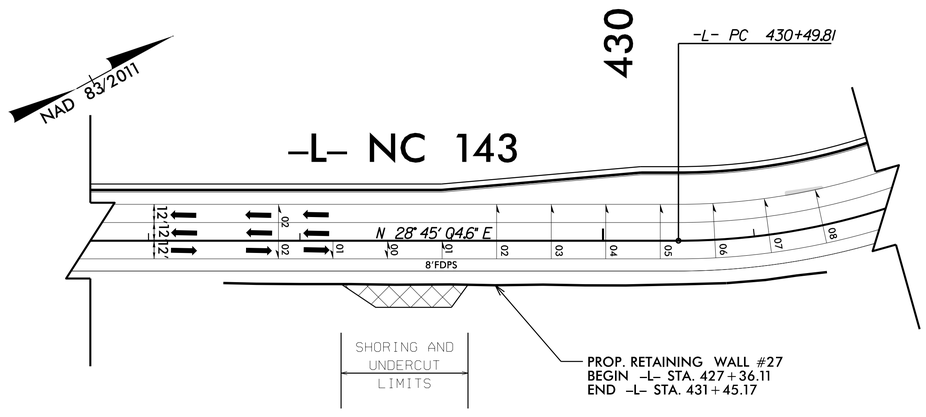
RETAINING WALL #27 SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W27-5
2			4			



APPROXIMATE ENVELOPE SHORING FOR UNDERCUT

NOT TO SCALE
(LOOKING AT WALL FACE)



SHORING AND UNDERCUT LIMITS SKETCH

SCALE: 50' = 1"
-L- STA. 428+27.15 TO -L- STA. 429+10.92, RT

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER	
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ESTIMATED SOIL NAIL SHORING QUANTITIES

RETAINING WALL #	SOIL NAIL SHORING (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
27	530	1	2

ESTIMATED QUANTITIES

UNDERCUT EXCAVATION	560 CY
GEOTEXTILE FOR SOIL STABILIZATION	380 SY
SELECT GRANULAR MATERIAL	380 CY
SHOULDER DRAIN	200 LF
CONCRETE PAD FOR SHOULDER DRAIN PIPE OUTLET	3 EA
HORIZONTAL DRAINS (CONTINGENCY)	210 LF

PROJECT NO.: A-0009CC
GRAHAM COUNTY
STATION: -L- 427+36, 28' RT TO 431+45, 31' RT
SHEET 6 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

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CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
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CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #27 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W27-6

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER	
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3861290C0A4C1462... SIGNATURE DATE	SIGNATURE DATE

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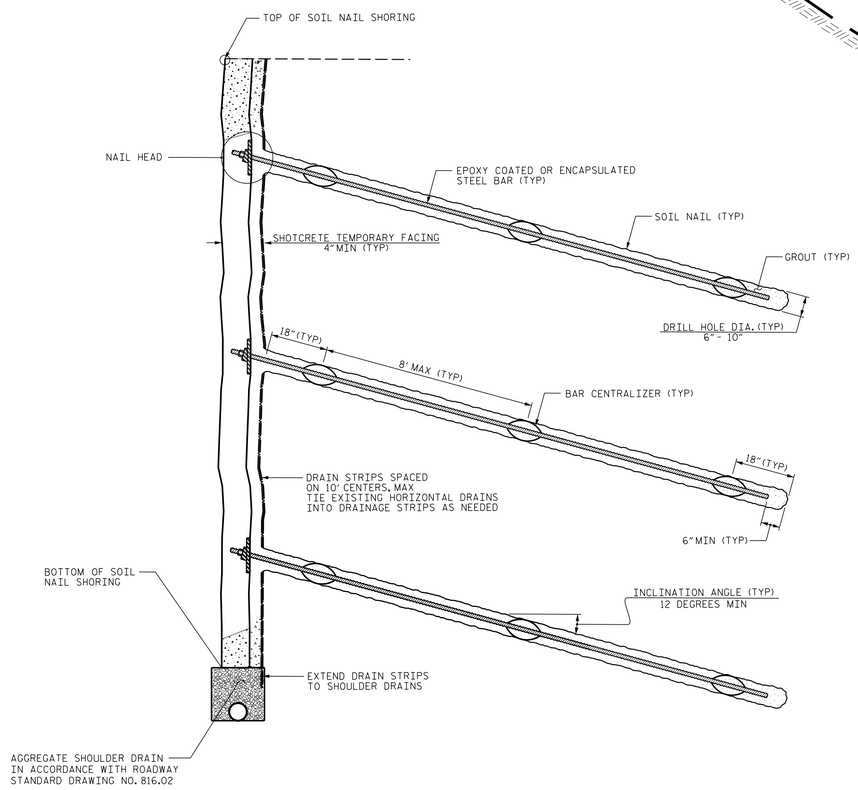
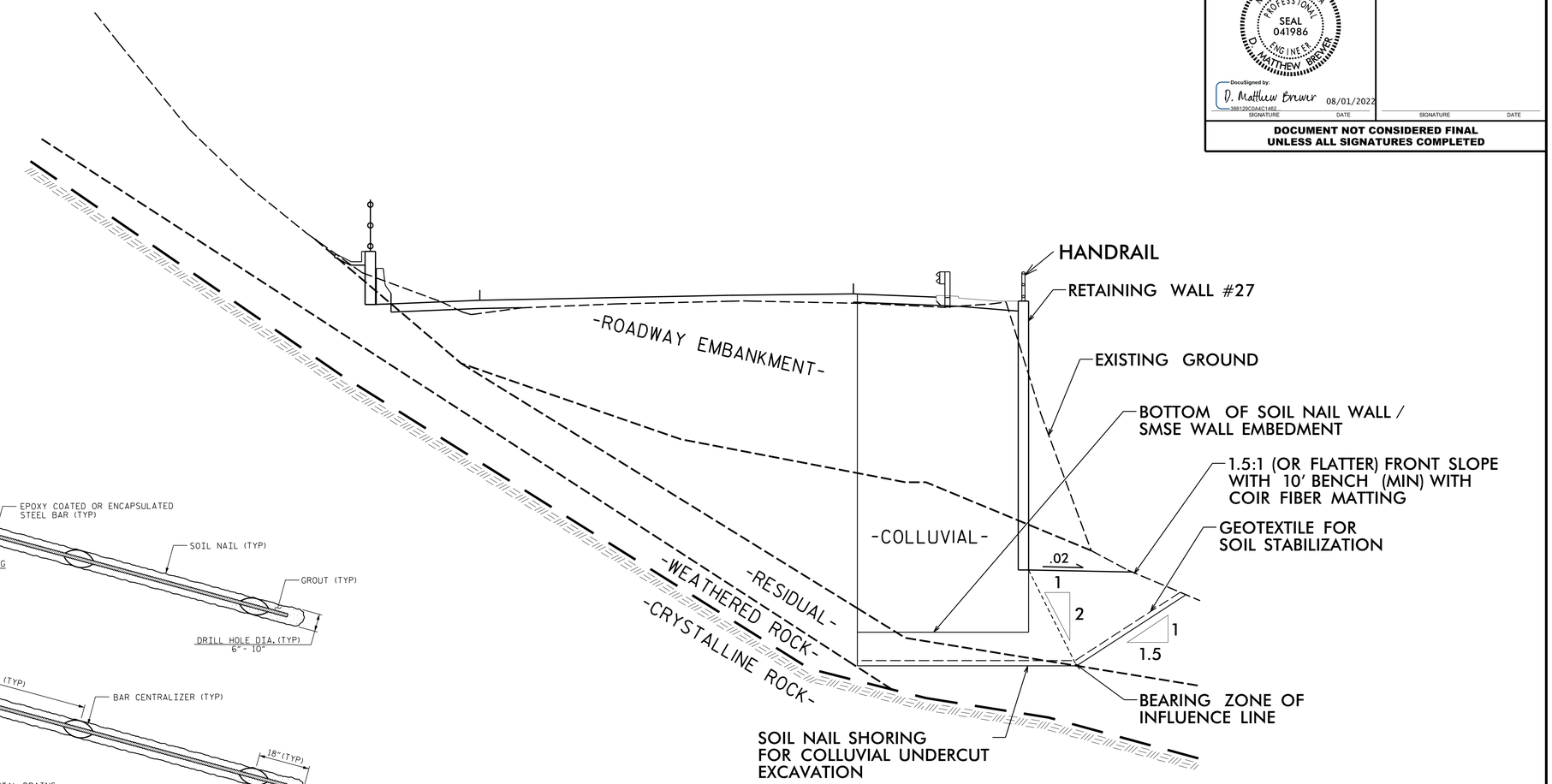


SOIL NAIL SHORING - TYPICAL SECTION

NOT TO SCALE



UNDERCUT EXCAVATION - TYPICAL SECTION - RETAINING WALL #27

NOT TO SCALE

-L-STA. 428+27.15 TO -L-STA. 429+10.92, RT

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 7 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

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CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #27 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W27-7
2			4			

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER MATTHEW BREWER

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386129C0A4C1462...
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ENGINEER

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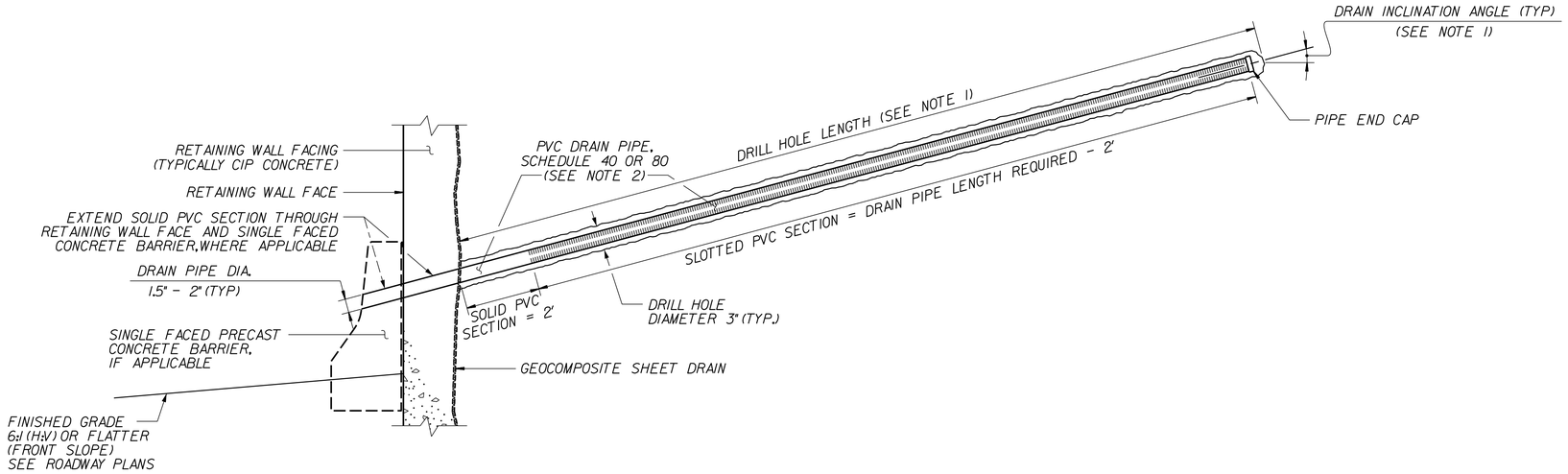
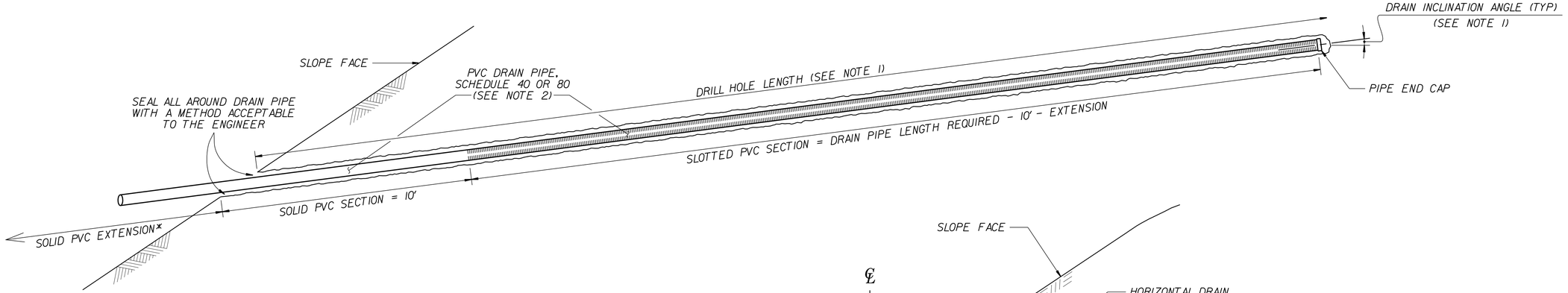
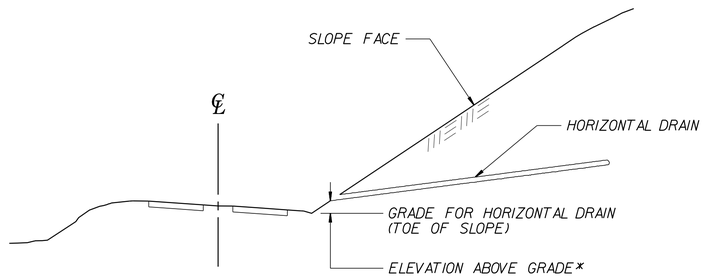


RETAINING WALL HORIZONTAL DRAIN



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS, ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS, SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -L- 427+36, 28' RT TO 431+45, 31' RT

SHEET 8 OF 8

PREPARED BY: M. BREWER	DATE: 7/10/2022
REVIEWED BY: R. KRAL	DATE: 7/10/2022

Prepared in the Office of:
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SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

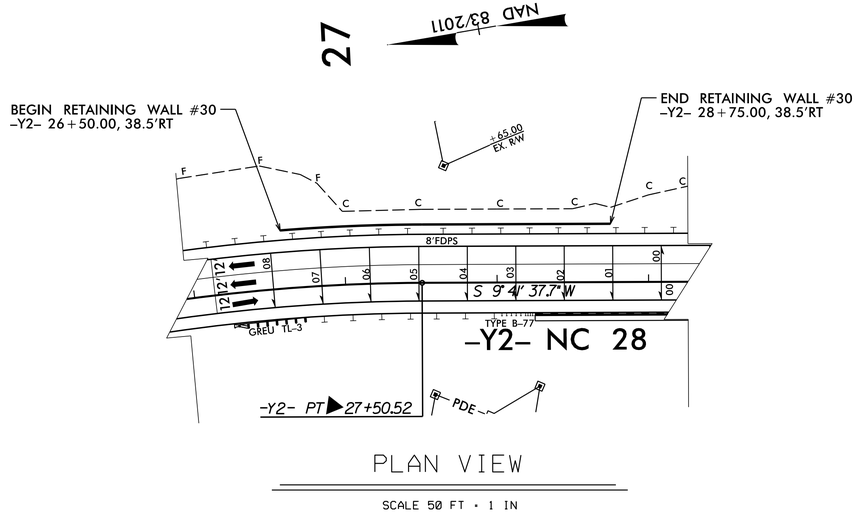
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #27
SOIL NAIL SHORING FOR
UNDERCUT EXCAVATION

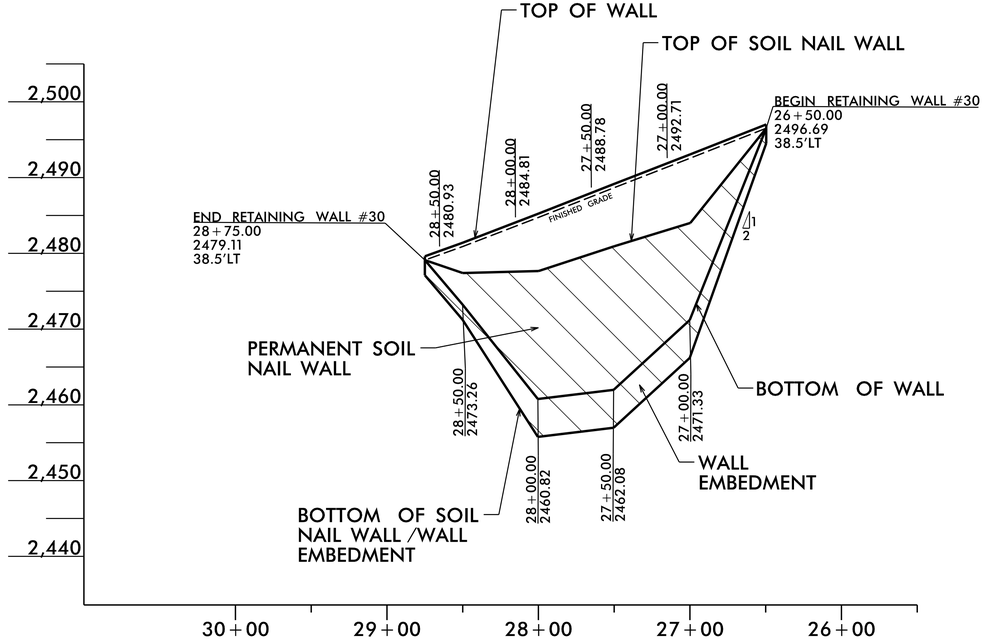
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W27-8
2			4			

RETAINING WALL #30



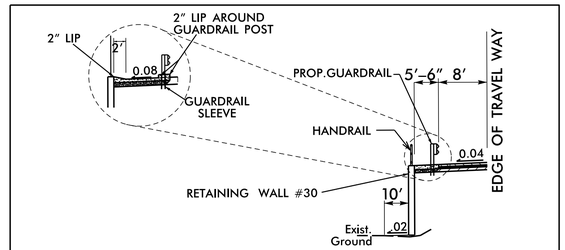
PLAN VIEW

SCALE 50 FT • 1 IN



SMSE WALL ENVELOPE

NOT TO SCALE
(LOOKING AT WALL FACE)



DETAIL FOR WALL #30

–Y2– STA. 26+50.00 TO –Y2– STA. 28+75.00, LT

TYPICAL WALL SECTION

NOT TO SCALE

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 1 OF 7

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #30 AT THE FOLLOWING LOCATION: –Y2– STA. 26+50.00 TO 27+50.52, LT

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #30
SHORED MECHANICALLY
STABILIZED EARTH (SMSE) WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W30-1

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL	
DocuSigned by: 8AD703B2A8484F4... 08/01/2022	
SIGNATURE DATE	SIGNATURE DATE

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SMSE RETAINING WALL #30 INFORMATION

STA. -Y2-	OFFSET FROM CL TO WALL FACE	FINISHED GRADE	BOTTOM OF WALL	MINIMUM TOP OF LEVELING PAD	ESTIMATED MINIMUM SMSE WALL EMBEDMENT	* DESIGN SMSE WALL HEIGHT "H"	TOP OF SOIL NAIL WALL	APPROX. SOIL NAIL WALL HEIGHT	WALL REINFORCEMENT (MSE STRAP) LENGTH 'L'
26+50.00	38.50	2496.69	2496.69	2494.69	2.00	2.00	2496.69	2.00	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
27+00.00	31.84	2492.71	2471.33	2466.33	5.00	26.38	2484.15	17.82	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
27+50.00	31.82	2488.78	2462.08	2457.08	5.00	31.70	2481.05	23.97	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
28+00.00	31.79	2484.81	2460.82	2455.82	5.00	28.99	2477.73	21.91	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
28+50.00	31.47	2480.93	2473.26	2471.26	2.00	9.67	2477.42	6.16	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)
28+75.00	30.56	2479.11	2479.61	2477.11	2.00	2.00	2479.11	2.00	LOWER: 0.5XH OR 6 FT (MIN) UPPER: 0.7XH OR 10 FT (MIN)

* FOR DESIGN WALL HEIGHT "H" AND ADDITIONAL CONSTRUCTION DETAILS, SEE SHEETS 3 AND 4

ALL TABLE DIMENSIONS ARE GIVEN IN FEET

FRONT SLOPE WALL EMBEDMENT

SLOPE IN FRONT OF STRUCTURES		MINIMUM EMBEDMENT DEPTH
HORIZONTAL	FOR WALLS	H/20
	FOR ABUTMENTS	H/10
3.0H:1.0V	WALLS	H/10
2.5H:1.0V	WALLS	H/8.5
2.0H:1.0V	WALLS	H/7
1.5H:1.0V	WALLS	H/5
1.25H:1.0V	WALLS	H/4
1.0H:1.0V	WALLS	H/3

NOTE:
1) MAINTAIN A MINIMUM BENCH WIDTH OF 10.0 FT IN FRONT OF THE WALL FOR ITS ENTIRE LENGTH.
2) MINIMUM EMBEDMENT DEPTH OF 2 FT, UNLESS LARGER DEPTHS DICTATED BY ABOVE TABLE.
3) MAXIMUM SLOPE OF 1H:1V WILL BE MAINTAINED ON FRONT SLOPES FOR THE ENTIRE LENGTH OF THE WALL.
4) SUBMIT WITH THE WALL DESIGN INTERNAL, EXTERNAL, AND GLOBAL STABILITY ANALYSES.
REFERENCE SPECIAL PROVISION GT-12 FOR SMSE WALL.

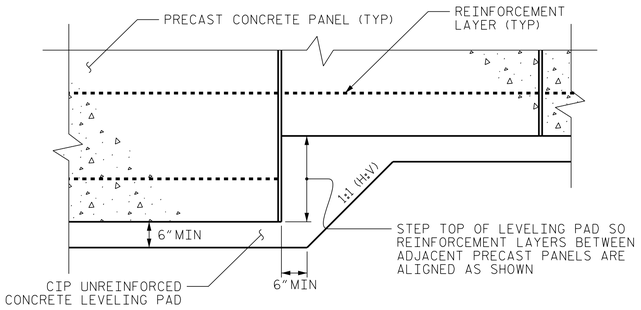
ESTIMATED SMSE WALL #30 QUANTITIES

SHORED MSE RETAINING WALL #30	3,900 SQ. FT.

ESTIMATED SOIL NAIL WALL QUANTITIES

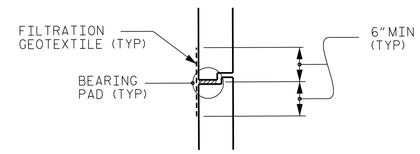
RETAINING WALL #	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
30	3,500*	2	10

* INCLUDES RETAINING WALL EMBEDMENT



PRECAST PANELS LEVELING PAD STEP DETAIL

NOT TO SCALE



PRECAST PANEL JOINT DETAILS

NOT TO SCALE

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 2 OF 7

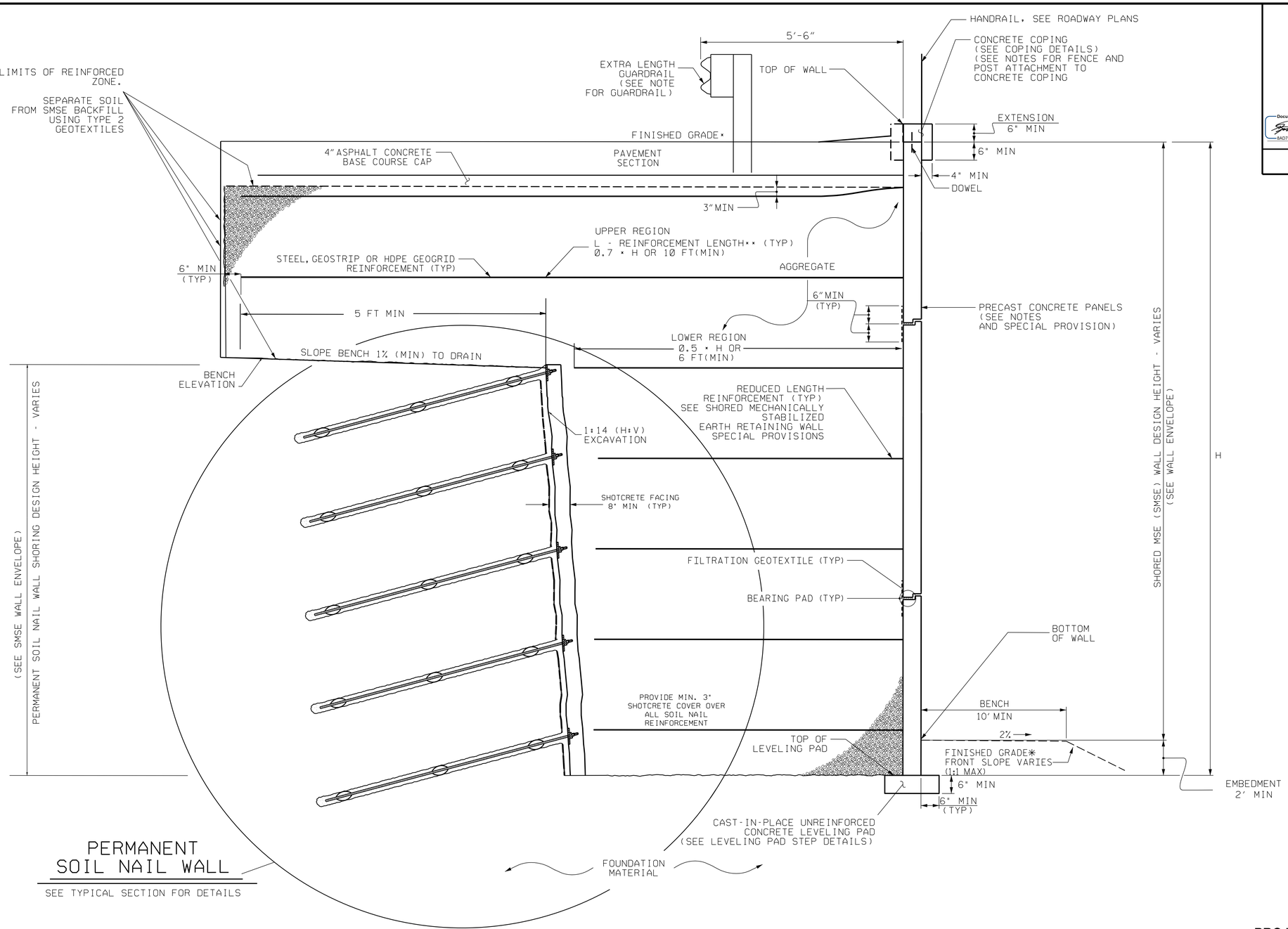
PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #30 SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W30-2
2			4			



PERMANENT
SOIL NAIL WALL

SEE TYPICAL SECTION FOR DETAILS

SMSE WALL WITH SOIL NAIL WALL> ⅔ H

-Y2- STA. 26+50.00 TO -Y2- STA. 28+75.00, LT
*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.
**SEE SMSE RETAINING WALLS SPECIAL PROVISION REINFORCEMENT LENGTH REQUIREMENTS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD703B2A8484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 3 OF 7

PREPARED BY: R. KRAL	DATE: 8/1/2022
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CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #30 SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W30-3
2			4			

NOTES:

FOR SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL RETAINING WALLS, SEE SHORED MECHANICALLY STABILIZED EARTH RETAINING WALLS SPECIAL PROVISION.

FOR MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS, SEE MECHANICALLY STABILIZED EARTH RETAINING WALLS PROVISION.

FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.

USE AN SMSE WALL SYSTEM WITH PRECAST PANELS FOR THIS RETAINING WALL.

DO NOT USE FINE AGGREGATE IN THE REINFORCED ZONE OF RETAINING WALL #30.

A SMOOTH ARCHITECTURAL FINISH IS REQUIRED FOR PRECAST CONCRETE PANELS FOR RETAINING WALL #30.

A SEPARATION GEOTEXTILE IS REQUIRED AT THE BACK OF THE REINFORCED ZONE FOR RETAINING WALL #30.

BEFORE BEGINNING SMSE WALL DESIGN FOR RETAINING WALL #30, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #30 FOR WALL HEIGHTS EQUAL TO THE DESIGN HEIGHT (DIFFERENCE BETWEEN FINISHED GRADE/TOP OF WALL ELEVATION AND BOTTOM OF WALL ELEVATION) PLUS EMBEDMENT (DIFFERENCE BETWEEN BOTTOM OF WALL ELEVATION AND TOP OF LEVELING PAD ELEVATION).

DESIGN RETAINING WALL #30 FOR THE FOLLOWING:
1) H = DESIGN HEIGHT + EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MAXIMUM FACTORED VERTICAL PRESSURE ON FOUNDATION MATERIAL = 5,200 PSF
4) MINIMUM MSE REINFORCEMENT LENGTH (L) = VARIES, SEE TABLE ON SHEET W30-2
5) MINIMUM SOIL NAIL REINFORCEMENT LENGTHS ARE BASED ON SNAIL.
6) MINIMUM EMBEDMENT DEPTH = 2 FT (MIN), SEE TABLE ON SHEET W30-2
7) REINFORCED ZONE AGGREGATE PARAMETERS:

AGGREGATE TYPE*	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (C) PSF
COARSE	110	38	0
FINE	115	34	0
* SEE MSE RETAINING WALLS PROVISION FOR COARSE AND FINE AGGREGATE MATERIAL REQUIREMENTS.			

9) IN-SITU ASSUMED MATERIAL PARAMETERS:

MATERIAL TYPE	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (C) PSF
BACKFILL	120	32	0
FOUNDATION	120	32	0

DESIGN RETAINING WALL #30 FOR A LIVE LOAD (TRAFFIC) SURCHARGE.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH MSE AND SOIL NAIL REINFORCEMENT FOR RETAINING WALL #30.

DO NOT PLACE LEVELING PAD CONCRETE, AGGREGATE OR REINFORCEMENT FOR MSE WALL PORTION OF RETAINING WALL #30 UNTIL EXCAVATION DIMENSIONS AND FOUNDATION MATERIAL ARE APPROVED.

FOR HANDRAILS ON THE TOP OF THE RETAINING WALL, SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

FOR SOIL NAIL RETAINING WALLS, SEE SMSE RETAINING WALL SPECIAL PROVISION.

THE SMSE WALL DESIGNER SHALL CONSULT WITH THE SOIL NAIL WALL DESIGNER TO VERIFY LOCATIONS WHERE "TEMPORARY SHORING" MAY BE REQUIRED FOR THE RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE TRAFFIC CONTROL PLANS. IN LOCATIONS WHERE "PERMANENT SOIL NAIL WALL" IS USED, PAYMENT WILL NOT BE MADE FOR "TEMPORARY SHORING" FOR TRAFFIC CONTROL.

THE PERMANENT SOIL NAIL WALL HEIGHT IS AN ESTIMATE ONLY, THAT IS BASED ON THE ANTICIPATED EXCAVATION PLUS THE MINIMUM EMBEDMENT LISTED.

WHERE APPLICABLE, DESIGN SOIL NAIL WALL REINFORCEMENT INCLINATION TO ACCOUNT FOR EXISTING OR FUTURE UTILITY CONFLICTS BEHIND THE SOIL NAIL WALL. VERIFY UTILITY LOCATION AND ELEVATION BEFORE BEGINNING SOIL NAIL WALL DESIGN OR CONSTRUCTION.

"TOP OF SOIL NAIL WALL" AS SHOWN IN THE WALL ENVELOPE REPRESENTS THE APPROXIMATE GRADE ELEVATION AT A DISTANCE OF 0.5 TIMES THE PROPOSED WALL HEIGHT ("H") AT THAT STATION OR ELEVATION AT THE TOP OF THE EXISTING WALL.

THE ESTIMATED SOIL NAIL WALL QUANTITY IS BASED ON 0.5 TIMES "H" (SMSE DESIGN HEIGHT) INCLUDING THE MINIMUM EMBEDMENT LISTED IN THE DESIGN TABLE ON SHEET W30-2. THESE VALUES ARE PROVIDED AS AN ESTIMATE ONLY AND MAY VARY DUE TO SITE CONDITIONS.

THE SOIL NAIL WALL DESIGNER IS RESPONSIBLE FOR DETERMINING GLOBAL STABILTIY BASED ON THE FINISHED SMSE WALL. A MINIMUM FACTOR OF SAFETY OF 1.35 IS REQUIRED FOR GLOBAL STABILITY. SUBMIT THESE RESULTS WITH THE WALL DESIGN PACKAGE. VERIFY UTILITY LOCATIONS AND ELEVATIONS BEFORE BEGINNING MSE WALL DESIGN OR CONSTRUCTION.

CONTRACTOR SHALL BE MADE AWARE THAT GRAVELLY SOILS AND BOULDER FILL WERE USED IN THE EXISTING ROADWAY EMBANKMENT AND MAY BE ENCOUNTERED DURING SOIL NAIL WALL CONSTRUCTION.

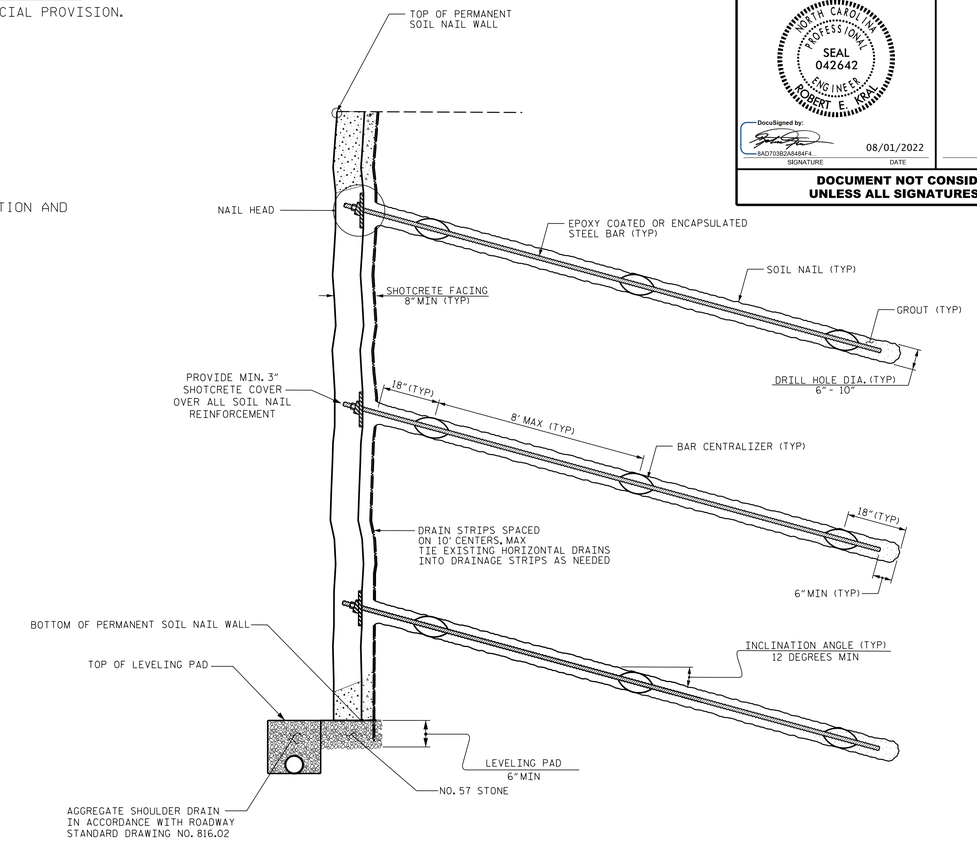
SPECIAL NOTES:

UNDERCUTTING COLLUVIAL SOILS BELOW THE SMSE WALL IS REQUIRED AS SHOWN ON SHEET W30-6. USE UNDERCUT EXCAVATION TO REMOVE SOILS AS DIRECTED BY THE ENGINEER. PLACE GEOTEXTILE FOR SOIL STABILIZATION WHEN NEEDED IN THE BOTTOM OF THE EXCAVATION AND BACKFILL WITH SUITABLE EMBANKMENT MATERIAL. FOR UNDERCUT EXCAVATION SEE STANDARD SPECIFICATIONS. UNDERCUT EXCAVATION AND GEOTEXTILE FOR SOIL STABILIZATION WILL BE PAID AS SEPARATE ADDITIONAL QUANTITIES.

EXTEND SOIL NAIL SHORING TO BOTTOM OF UNDERCUT EXCAVATION. DESIGN SOIL NAIL SHORING FOR THE HEIGHT EQUAL TO THE DIFFERENCE BETWEEN THE EXISTING ROADWAY GRADE AND THE BOTTOM OF THE UNDERCUT EXCAVATION. SOIL NAIL SHORING FOR UNDERCUT EXCAVATION WILL BE PAID IN ACCORDANCE WITH THE TEMPORARY SOIL NAIL SHORING FOR COLLUVIAL UNDERCUT SPECIAL PROVISION.

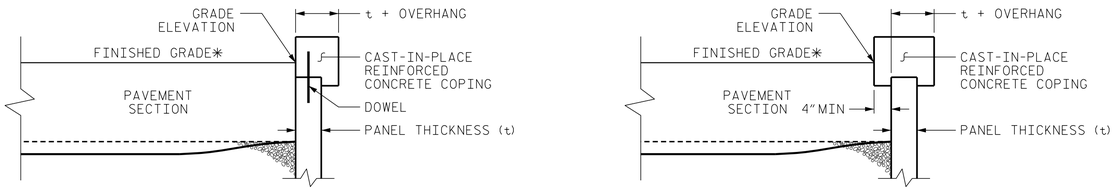
THE COLLUVIAL SOILS ARE SUITABLE FOR USE AS EMBANKMENT BUT WILL REQUIRE SIGNIFICANT DRYING TO ACHIEVE THE REQUIRED DENSITY. DO NOT USE COLLUVIAL SOILS IN THE UPPER 3 FEET OF EMBANKMENT DUE TO THE PRESENCE OF BOULDERS AND COBBLES. NO ADDITIONAL COMPENSATION WILL BE PROVIDED TO DRY COLLUVIAL SOILS OR FOR DOUBLE-HANDLING SOILS.

CONTROL GROUNDWATER DURING AND AT THE BOTTOM OF UNDERCUT EXCAVATION USING DITCHING, SUMPS, AND PERMANENT SHOULDER DRAINS AS DIRECTED BY THE ENGINEER. OUTLET SHOULDER DRAINS EVERY 50 TO 100 FEET AS DIRECTED BY THE ENGINEER.



PERMANENT SOIL NAIL WALL - TYPICAL SECTION

NOT TO SCALE



COPING DETAILS

AT THE CONTRACTOR'S OPTION, CONNECT COPING TO PANELS WITH DOWELS OR EXTEND COPING DOWN BACK OF PANELS.
*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 4 OF 7

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

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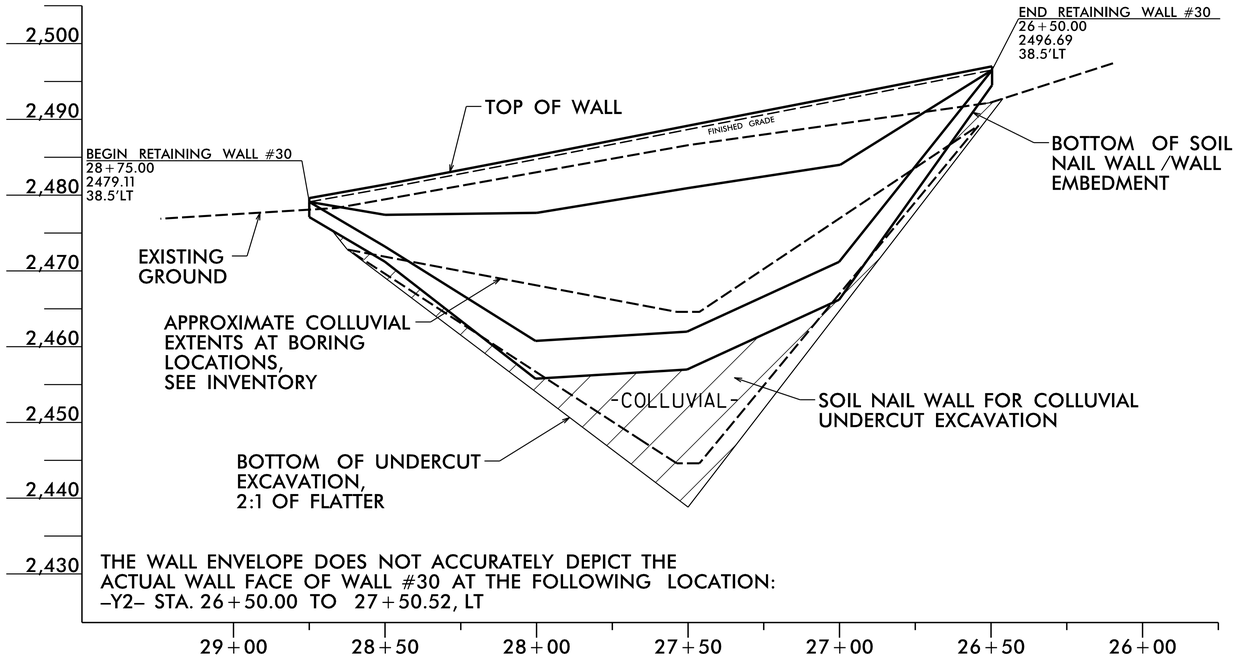
GEOTECHNICAL ENGINEERING UNIT

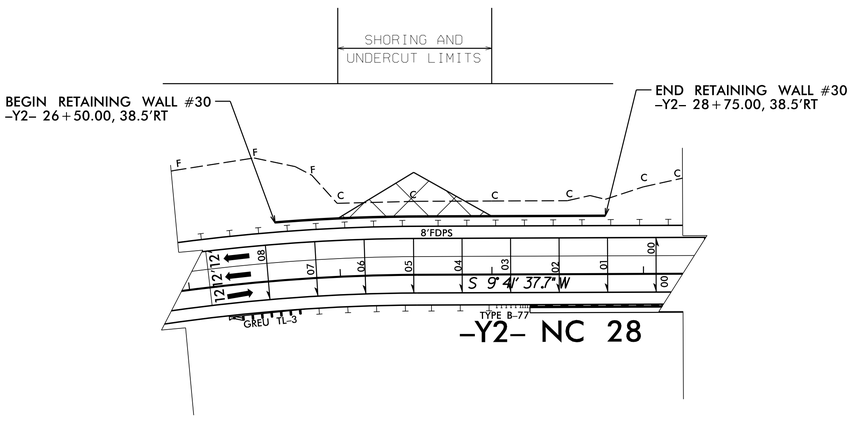
RETAINING WALL #30 SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W30-4
2			4			



APPROXIMATE ENVELOPE SHORING FOR UNDERCUT

NOT TO SCALE
(LOOKING AT WALL FACE)



SHORING AND UNDERCUT LIMITS SKETCH

SCALE: 50' = 1"
-Y2- STA. 26+50.00 TO -Y2- STA. 28+50.00, LT

ESTIMATED SOIL NAIL SHORING QUANTITIES			
RETAINING WALL #	SOIL NAIL SHORING (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
30	1,830	1	5

ESTIMATED QUANTITIES	
UNDERCUT EXCAVATION	2,850 CY
GEOTEXTILE FOR SOIL STABILIZATION	550 SY
SELECT GRANULAR MATERIAL	550 CY
SHOULDER DRAIN	600 LF
CONCRETE PAD FOR SHOULDER DRAIN PIPE OUTLET	5 EA
HORIZONTAL DRAINS (CONTINGENCY)	115 LF

GEOTECHNICAL ENGINEER

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 5 OF 7

PREPARED BY: R. KRAL	DATE: 8/1/2022
REVIEWED BY: M. BREWER	DATE: 8/1/2022

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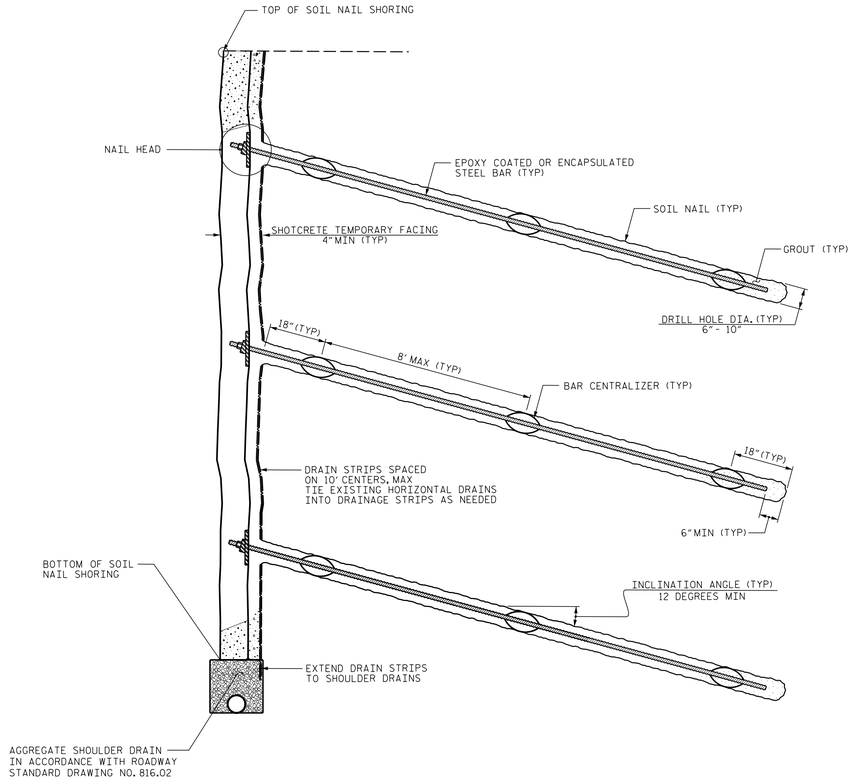
RETAINING WALL #30 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

REVISIONS

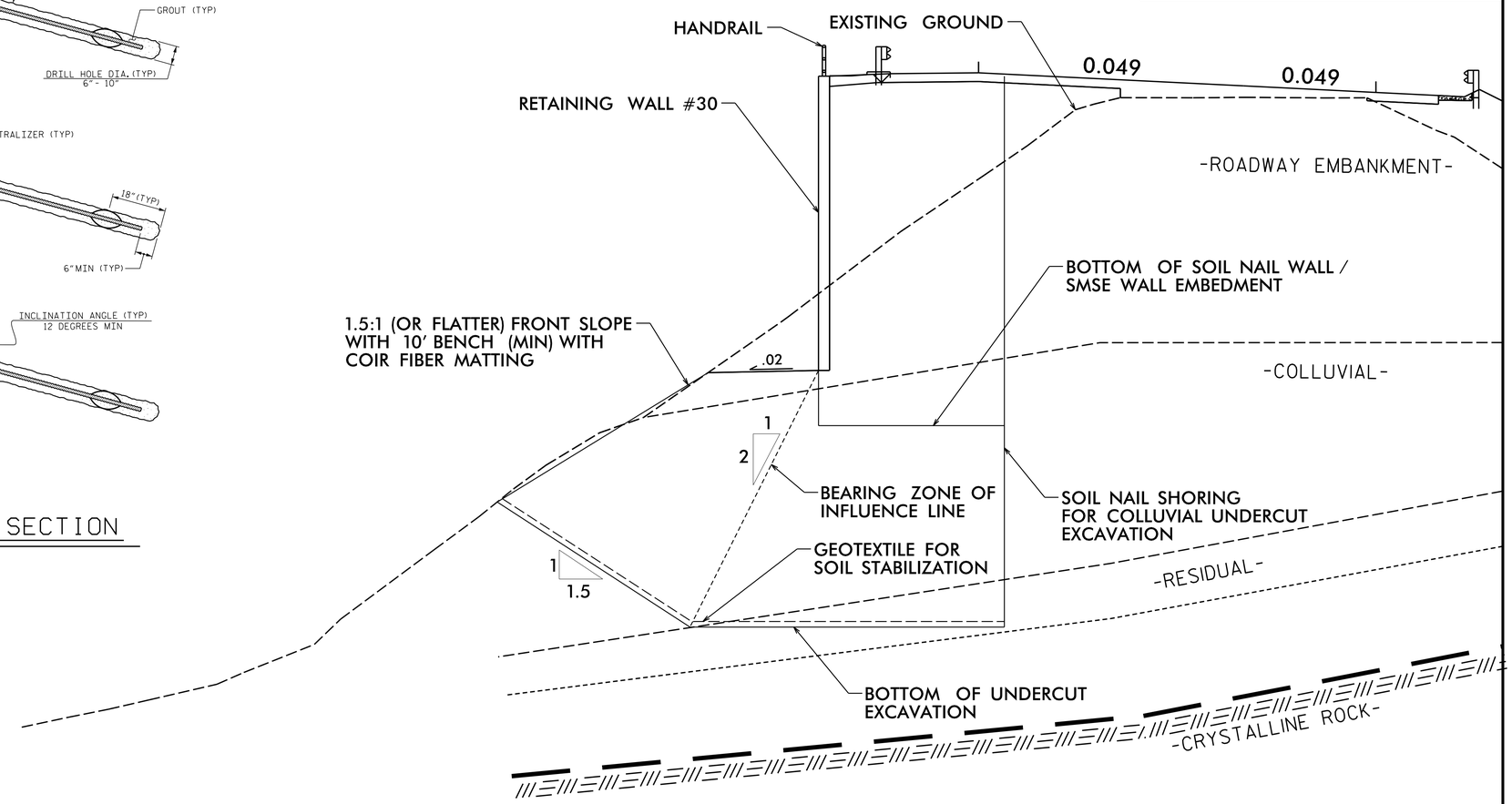
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W30-5



SOIL NAIL SHORING - TYPICAL SECTION

NOT TO SCALE



UNDERCUT EXCAVATION - TYPICAL SECTION - RETAINING WALL #30

NOT TO SCALE

-Y2- STA. 26+50.00 TO -Y2- STA. 28+50.00, LT

GEOTECHNICAL ENGINEER

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 6 OF 7

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RETAINING WALL #30 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W30-6

GEOTECHNICAL ENGINEER

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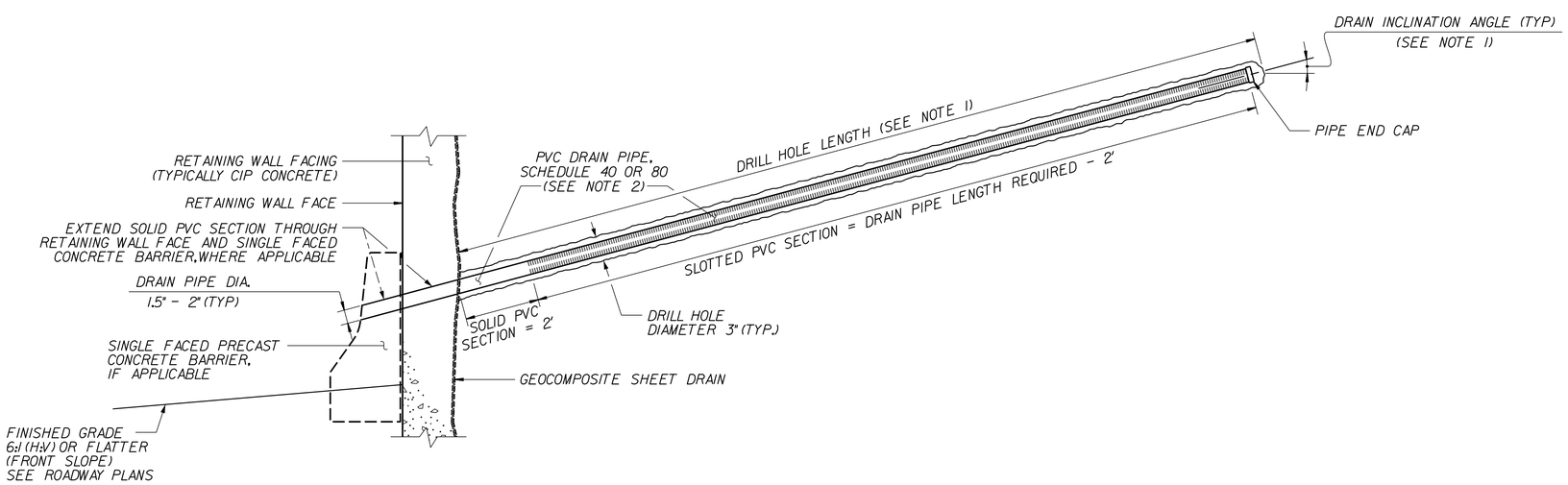
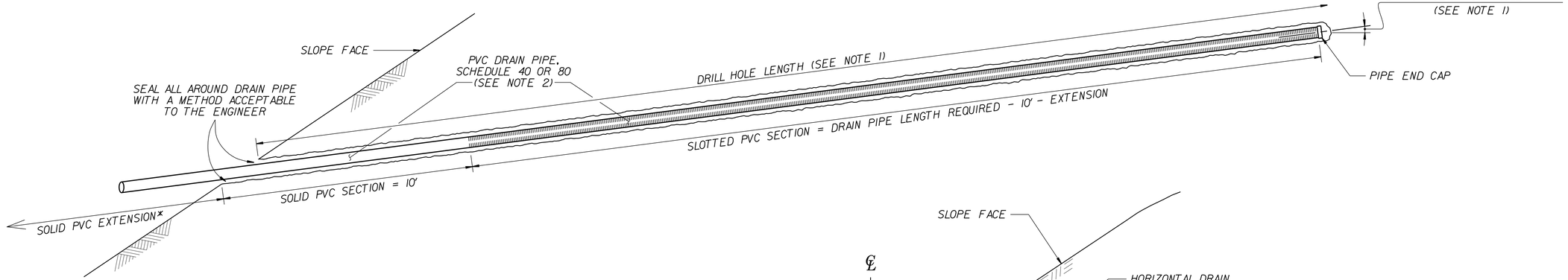
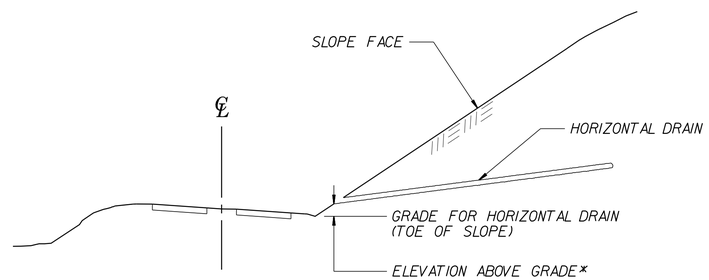


RETAINING WALL HORIZONTAL DRAIN



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 26+50, 39' LT TO 28+75, 39' LT

SHEET 7 OF 7

PREPARED BY: R. KRAL	DATE: 8/1/2022
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

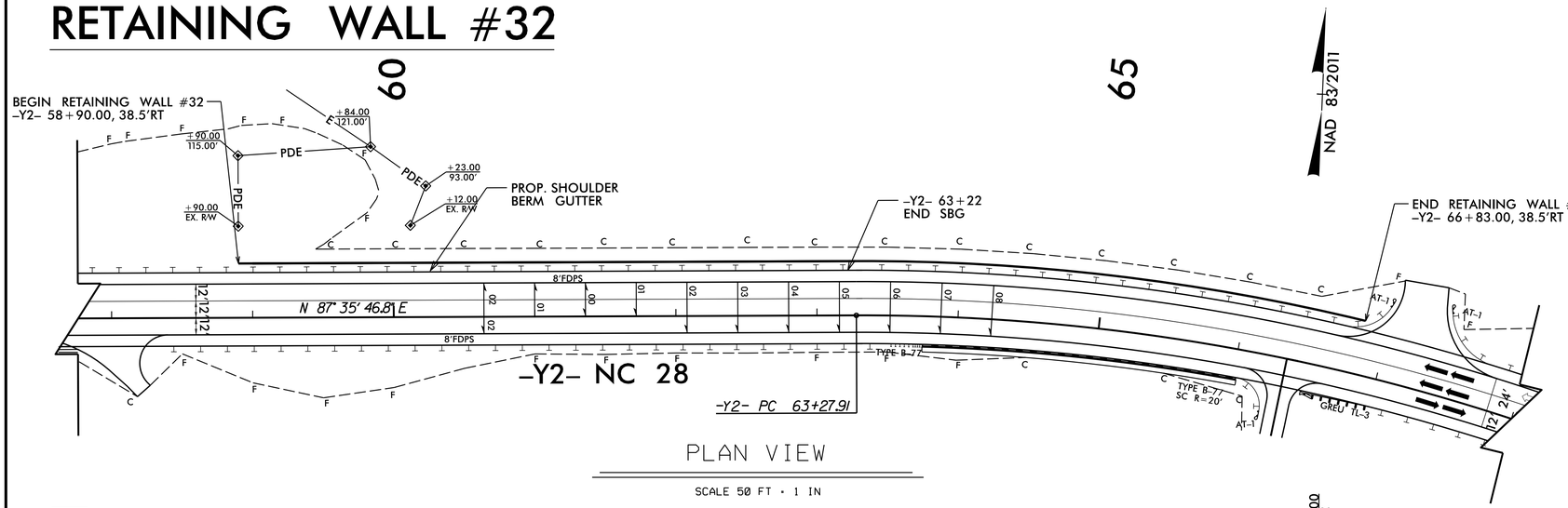
RETAINING WALL #30
SOIL NAIL SHORING FOR
UNDERCUT EXCAVATION

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

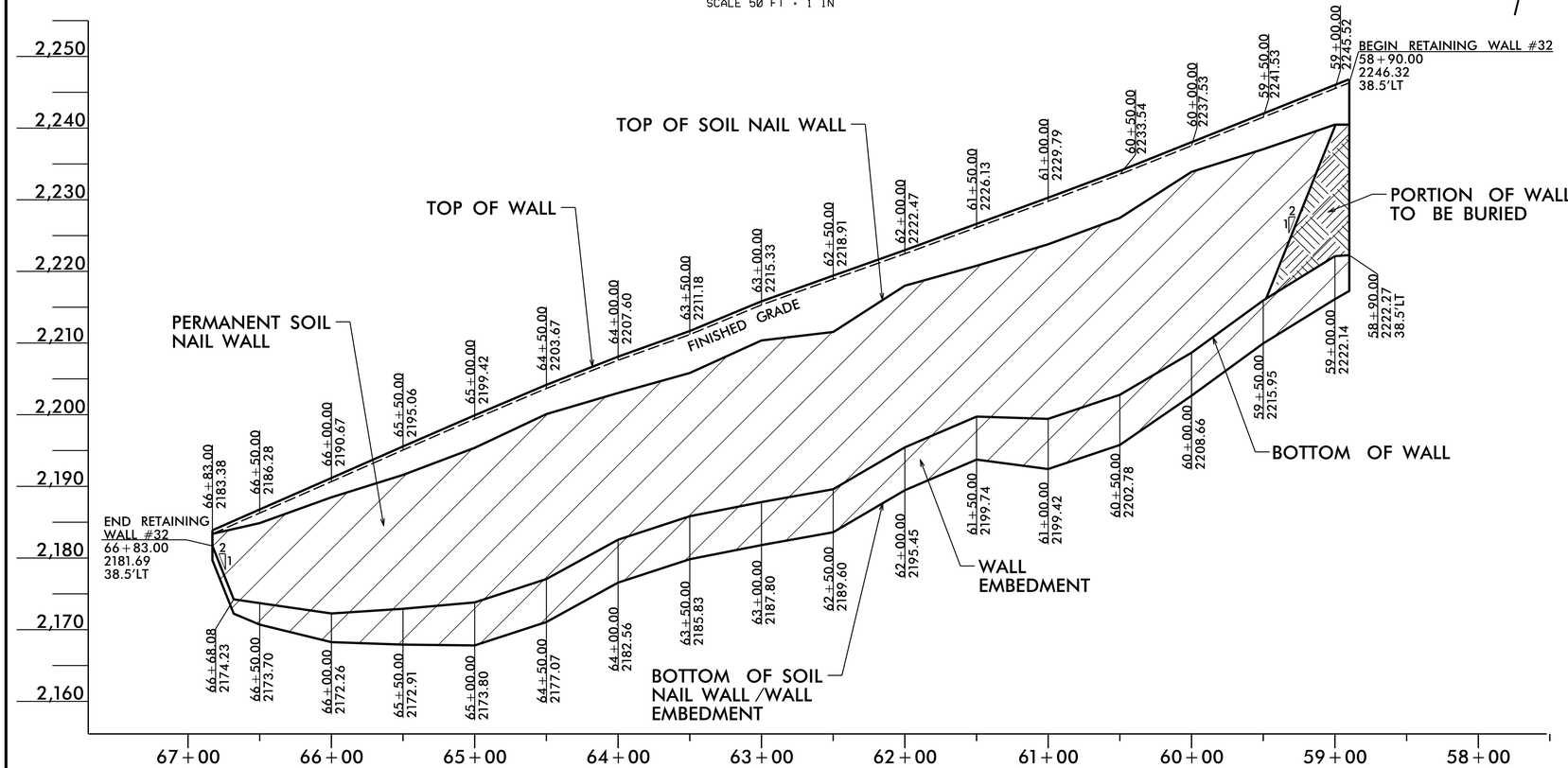
SHEET NO. W30-7

RETAINING WALL #32



PLAN VIEW

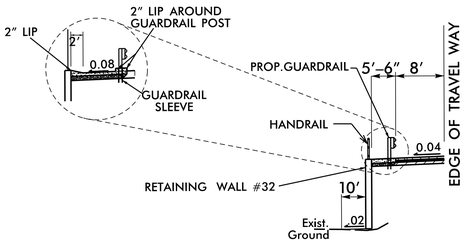
SCALE 50 FT • 1 IN



SMSE WALL ENVELOPE

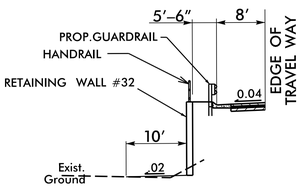
NOT TO SCALE
(LOOKING AT WALL FACE)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #32 AT THE FOLLOWING LOCATION:
–Y2– STA. 63+27.91 TO 66+83.00, LT



DETAIL FOR WALL #32

–Y2– STA. 63+22.00 TO –Y2– STA. 66+83.00, LT



DETAIL FOR WALL #32

–Y2– STA. 58+90.00 TO –Y2– STA. 63+22.00, LT

TYPICAL WALL SECTIONS

NOT TO SCALE

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT

SHEET 1 OF 7

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #32
SHORED MECHANICALLY
STABILIZED EARTH (SMSE) WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W32-1

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038224484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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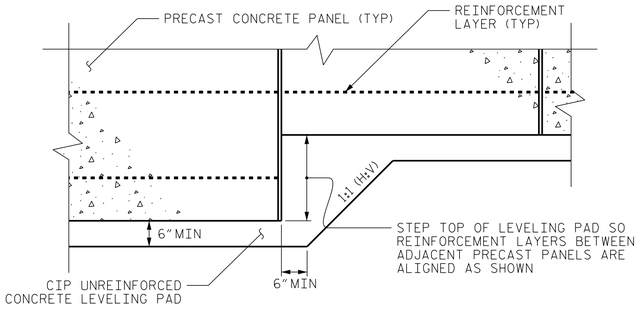
SMSE RETAINING WALL #32 INFORMATION

STA. -Y2-	OFFSET FROM CL TO WALL FACE	FINISHED GRADE	BOTTOM OF WALL	MINIMUM TOP OF LEVELING PAD	ESTIMATED MINIMUM SMSE WALL EMBEDMENT	* DESIGN SMSE WALL HEIGHT "H"	TOP OF SOIL NAIL WALL	APPROX. SOIL NAIL WALL HEIGHT	WALL REINFORCEMENT (MSE STRAP) LENGTH 'L'
58+90.00	38.50	2246.32	2222.27	2217.27	5.00	29.05	2246.32	29.05	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
59+00.00	38.50	2245.52	2222.14	2217.14	5.00	28.38	2240.48	23.34	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
59+50.00	38.50	2241.53	2215.95	2209.95	6.00	31.58	2237.05	27.10	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
60+00.00	38.50	2237.53	2208.66	2202.66	6.00	34.87	2233.89	31.23	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
60+50.00	38.50	2233.54	2202.78	2195.78	7.00	37.76	2227.47	31.69	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
61+00.00	38.50	2229.79	2199.42	2192.42	7.00	37.37	2223.79	31.37	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
61+50.00	38.50	2226.13	2199.74	2193.74	6.00	32.39	2220.79	27.05	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
62+00.00	38.50	2222.47	2195.45	2189.45	6.00	33.02	2218.01	28.56	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
62+50.00	38.50	2218.91	2189.60	2183.60	6.00	35.31	2211.54	27.94	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
63+00.00	38.50	2215.33	2187.80	2181.80	6.00	33.53	2210.37	28.57	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
63+50.00	38.50	2211.18	2185.83	2179.83	6.00	31.35	2205.82	25.99	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
64+00.00	38.50	2207.60	2182.56	2176.56	6.00	31.04	2203.04	26.48	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
64+50.00	38.50	2203.67	2177.07	2171.07	6.00	32.60	2200.08	29.01	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
65+00.00	38.50	2199.42	2173.80	2167.80	6.00	31.62	2195.38	27.58	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
65+50.00	38.50	2195.06	2172.91	2167.91	5.00	27.15	2191.60	23.69	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
66+00.00	38.50	2190.67	2171.52	2167.52	4.00	22.41	2188.47	20.21	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
66+50.00	38.50	2186.28	2173.70	2170.70	3.00	15.58	2184.87	14.17	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
66+68.08	38.50	2185.19	2174.23	2172.23	2.00	12.96	2185.19	12.96	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)
66+83.00	38.50	2183.38	2181.69	2179.69	2.00	3.96	2183.38	3.69	LOWER: 0.6XH OR 6 FT (MIN) UPPER: 0.8XH OR 10 FT (MIN)

* FOR DESIGN WALL HEIGHT "H" AND ADDITIONAL CONSTRUCTION DETAILS, SEE SHEETS 3 AND 4

ALL TABLE DIMENSIONS ARE GIVEN IN FEET



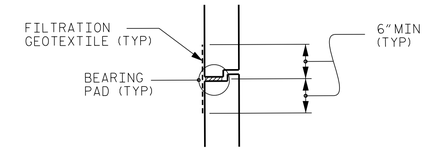
PRECAST PANELS LEVELING PAD STEP DETAIL

NOT TO SCALE

FRONT SLOPE WALL EMBEDMENT

SLOPE IN FRONT OF STRUCTURES		MINIMUM EMBEDMENT DEPTH
HORIZONTAL	FOR WALLS	H/20
	FOR ABUTMENTS	H/10
3.0H:1.0V	WALLS	H/10
2.5H:1.0V	WALLS	H/8.5
2.0H:1.0V	WALLS	H/7
1.5H:1.0V	WALLS	H/5
1.25H:1.0V	WALLS	H/4
1.0H:1.0V	WALLS	H/3

NOTE:
1) MAINTAIN A MINIMUM BENCH WIDTH OF 10.0 FT IN FRONT OF THE WALL FOR ITS ENTIRE LENGTH.
2) MINIMUM EMBEDMENT DEPTH OF 2 FT, UNLESS LARGER DEPTHS DICTATED BY ABOVE TABLE.
3) MAXIMUM SLOPE OF 1H:1V WILL BE MAINTAINED ON FRONT SLOPES FOR THE ENTIRE LENGTH OF THE WALL.
4) SUBMIT WITH THE WALL DESIGN INTERNAL, EXTERNAL, AND GLOBAL STABILITY ANALYSES.
REFERENCE SPECIAL PROVISION GT-12 FOR SMSE WALL.



PRECAST PANEL JOINT DETAILS

NOT TO SCALE

ESTIMATED SMSE WALL #32 QUANTITIES

SHORED MSE RETAINING WALL #32	24,390 SQ. FT.

ESTIMATED SOIL NAIL WALL QUANTITIES

RETAINING WALL #	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
32	20,880*	2	45

* INCLUDES RETAINING WALL EMBEDMENT

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT

SHEET 2 OF 7

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

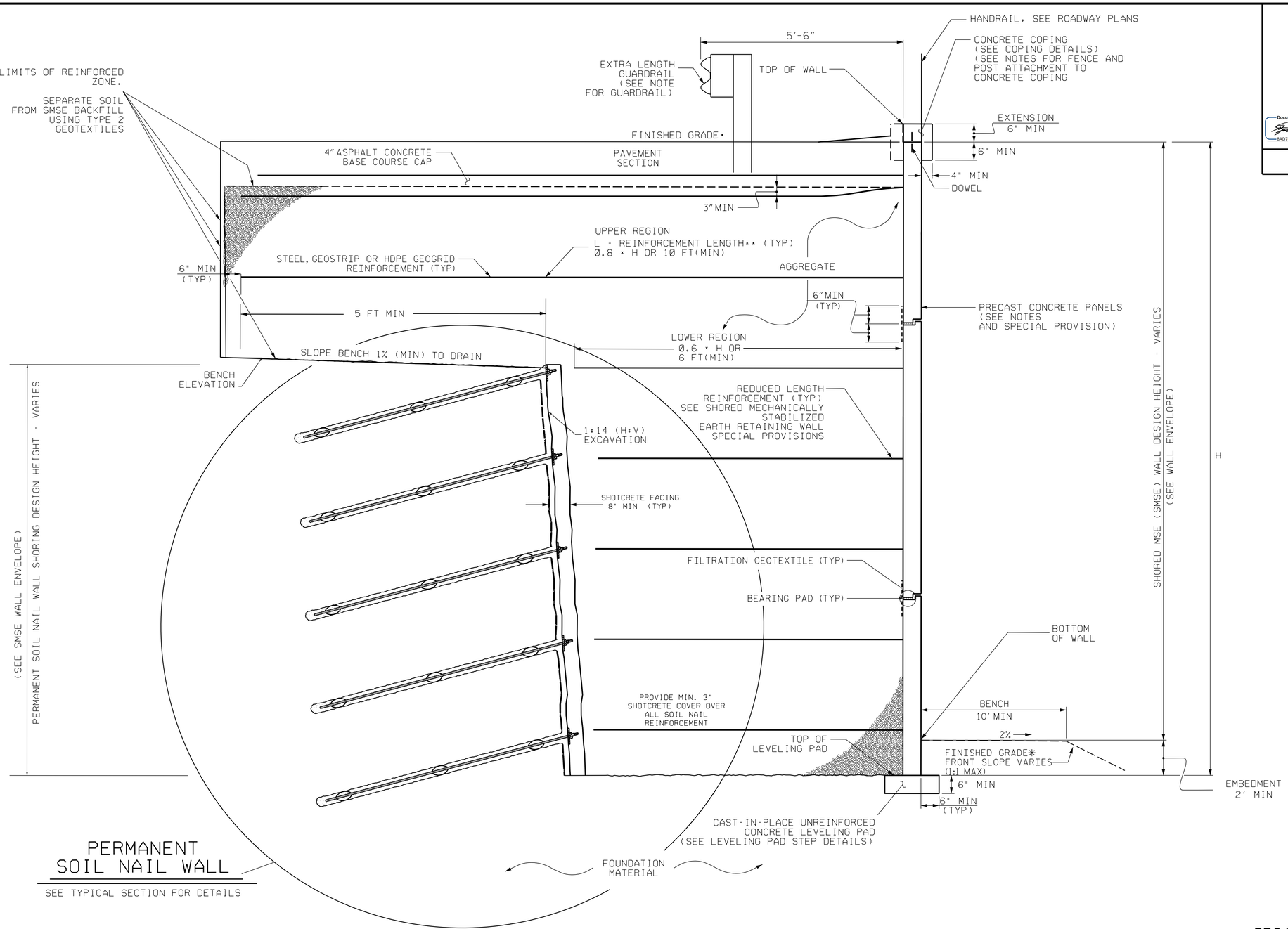
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #32 SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W32-2



PERMANENT
SOIL NAIL WALL

SEE TYPICAL SECTION FOR DETAILS

SMSE WALL WITH SOIL NAIL WALL> 2/3 H

-Y2- STA. 58+90.00 TO -Y2- STA. 66+83.00, LT

*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

**SEE SMSE RETAINING WALLS SPECIAL PROVISION REINFORCEMENT LENGTH REQUIREMENTS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038248484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT

SHEET 3 OF 7

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #32
SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W32-3
2			4			

NOTES:

FOR SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL RETAINING WALLS, SEE SHORED MECHANICALLY STABILIZED EARTH RETAINING WALLS SPECIAL PROVISION.

FOR MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS, SEE MECHANICALLY STABILIZED EARTH RETAINING WALLS PROVISION.

FOR STEEL BEAM GUARDRAIL, SEE ROADWAY PLANS AND SECTION 862 OF THE STANDARD SPECIFICATIONS.

USE AN SMSE WALL SYSTEM WITH PRECAST PANELS FOR THIS RETAINING WALL.

DO NOT USE FINE AGGREGATE IN THE REINFORCED ZONE OF RETAINING WALL #32.

A SMOOTH ARCHITECTURAL FINISH IS REQUIRED FOR PRECAST CONCRETE PANELS FOR RETAINING WALL #32.

A SEPARATION GEOTEXTILE IS REQUIRED AT THE BACK OF THE REINFORCED ZONE FOR RETAINING WALL #32.

BEFORE BEGINNING SMSE WALL DESIGN FOR RETAINING WALL #32, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #32 FOR WALL HEIGHTS EQUAL TO THE DESIGN HEIGHT (DIFFERENCE BETWEEN FINISHED GRADE/TOP OF WALL ELEVATION AND BOTTOM OF WALL ELEVATION) PLUS EMBEDMENT (DIFFERENCE BETWEEN BOTTOM OF WALL ELEVATION AND TOP OF LEVELING PAD ELEVATION).

DESIGN RETAINING WALL #32 FOR THE FOLLOWING:
1) H = DESIGN HEIGHT + EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MAXIMUM FACTORED VERTICAL PRESSURE ON FOUNDATION MATERIAL = 6,100 PSF
4) MINIMUM MSE REINFORCEMENT LENGTH (L) = VARIES, SEE TABLE ON SHEET W32-2
5) MINIMUM SOIL NAIL REINFORCEMENT LENGTHS ARE BASED ON SNAIL.
6) MINIMUM EMBEDMENT DEPTH = 2 FT (MIN), SEE TABLE ON SHEET W32-2
7) REINFORCED ZONE AGGREGATE PARAMETERS:

AGGREGATE TYPE*	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (C) PSF
COARSE	110	38	Ø
FINE	115	34	Ø
* SEE MSE RETAINING WALLS PROVISION FOR COARSE AND FINE AGGREGATE MATERIAL REQUIREMENTS.			

9) IN-SITU ASSUMED MATERIAL PARAMETERS:

MATERIAL TYPE	UNIT WEIGHT (γ) PCF	FRICTION ANGLE (ϕ) DEGREES	COHESION (C) PSF
BACKFILL	120	32	0
FOUNDATION	120	32	0

DESIGN RETAINING WALL #32 FOR A LIVE LOAD (TRAFFIC) SURCHARGE.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH MSE AND SOIL NAIL REINFORCEMENT FOR RETAINING WALL #32.

DO NOT PLACE LEVELING PAD CONCRETE, AGGREGATE OR REINFORCEMENT FOR MSE WALL PORTION OF RETAINING WALL #32 UNTIL EXCAVATION DIMENSIONS AND FOUNDATION MATERIAL ARE APPROVED.

FOR HANDRAILS ON THE TOP OF THE RETAINING WALL, SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

FOR SOIL NAIL RETAINING WALLS, SEE SMSE RETAINING WALL SPECIAL PROVISION.

THE SMSE WALL DESIGNER SHALL CONSULT WITH THE SOIL NAIL WALL DESIGNER TO VERIFY LOCATIONS WHERE "TEMPORARY SHORING" MAY BE REQUIRED FOR THE RETAINING WALL IN ACCORDANCE WITH THE TEMPORARY SHORING PROVISION. SEE TRAFFIC CONTROL PLANS. IN LOCATIONS WHERE "PERMANENT SOIL NAIL WALL" IS USED, PAYMENT WILL NOT BE MADE FOR "TEMPORARY SHORING" FOR TRAFFIC CONTROL.

THE PERMANENT SOIL NAIL WALL HEIGHT IS AN ESTIMATE ONLY, THAT IS BASED ON THE ANTICIPATED EXCAVATION PLUS THE MINIMUM EMBEDMENT LISTED.

WHERE APPLICABLE, DESIGN SOIL NAIL WALL REINFORCEMENT INCLINATION TO ACCOUNT FOR EXISTING OR FUTURE UTILITY CONFLICTS BEHIND THE SOIL NAIL WALL. VERIFY UTILITY LOCATION AND ELEVATION BEFORE BEGINNING SOIL NAIL WALL DESIGN OR CONSTRUCTION.

"TOP OF SOIL NAIL WALL" AS SHOWN IN THE WALL ENVELOPE REPRESENTS THE APPROXIMATE GRADE ELEVATION AT A DISTANCE OF Ø.5 TIMES THE PROPOSED WALL HEIGHT ("H") AT THAT STATION OR ELEVATION AT THE TOP OF THE EXISTING WALL.

THE ESTIMATED SOIL NAIL WALL QUANTITY IS BASED ON Ø.6 TIMES "H" (SMSE DESIGN HEIGHT) INCLUDING THE MINIMUM EMBEDMENT LISTED IN THE DESIGN TABLE ON SHEET W32-2. THESE VALUES ARE PROVIDED AS AN ESTIMATE ONLY AND MAY VARY DUE TO SITE CONDITIONS.

THE SOIL NAIL WALL DESIGNER IS RESPONSIBLE FOR DETERMINING GLOBAL STABLITIY BASED ON THE FINISHED SMSE WALL. A MINIMUM FACTOR OF SAFETY OF 1.35 IS REQUIRED FOR GLOBAL STABILITY. SUBMIT THESE RESULTS WITH THE WALL DESIGN PACKAGE. VERIFY UTILITY LOCATIONS AND ELEVATIONS BEFORE BEGINNING MSE WALL DESIGN OR CONSTRUCTION.

CONTRACTOR SHALL BE MADE AWARE THAT GRAVELLY SOILS AND BOULDER FILL WERE USED IN THE EXISTING ROADWAY EMBANKMENT AND MAY BE ENCOUNTERED DURING SOIL NAIL WALL CONSTRUCTION.

SPECIAL NOTES:

UNDERCUTTING COLLUVIAL AND ALLUVIAL SOILS BELOW THE SMSE WALL IS REQUIRED AS SHOWN ON SHEET W32-6. USE UNDERCUT EXCAVATION TO REMOVE SOILS AS DIRECTED BY THE ENGINEER. PLACE GEOTEXTILE FOR SOIL STABILIZATION WHEN NEEDED IN THE BOTTOM OF THE EXCAVATION AND BACKFILL WITH SUITABLE EMBANKMENT MATERIAL. FOR UNDERCUT EXCAVATION SEE STANDARD SPECIFICATIONS. UNDERCUT EXCAVATION AND GEOTEXTILE FOR SOIL STABILIZATION WILL BE PAID AS SEPARATE ADDITIONAL QUANTITIES.

EXTEND SOIL NAIL SHORING TO BOTTOM OF UNDERCUT EXCAVATION. DESIGN SOIL NAIL SHORING FOR THE HEIGHT EQUAL TO THE DIFFERENCE BETWEEN THE EXISTING ROADWAY GRADE AND THE BOTTOM OF THE UNDERCUT EXCAVATION. SOIL NAIL SHORING FOR UNDERCUT EXCAVATION WILL BE PAID IN ACCORDANCE WITH THE TEMPORARY SOIL NAIL SHORING FOR COLLUVIAL UNDERCUT SPECIAL PROVISION.

THE COLLUVIAL SOILS ARE SUITABLE FOR USE AS EMBANKMENT BUT WILL REQUIRE SIGNIFICANT DRYING TO ACHIEVE THE REQUIRED DENSITY. DO NOT USE COLLUVIAL SOILS IN THE UPPER 3 FEET OF EMBANKMENT DUE TO THE PRESENCE OF BOULDERS AND COBBLES. NO ADDITIONAL COMPENSATION WILL BE PROVIDED TO DRY COLLUVIAL SOILS OR FOR DOUBLE-HANDLING SOILS.

CONTROL GROUNDWATER DURING AND AT THE BOTTOM OF UNDERCUT EXCAVATION USING DITCHING, SUMPS, AND PERMANENT SHOULDER DRAINS AS DIRECTED BY THE ENGINEER. OUTLET SHOULDER DRAINS EVERY 50 TO 100 FEET AS DIRECTED BY THE ENGINEER.

GEOTECHNICAL ENGINEER | ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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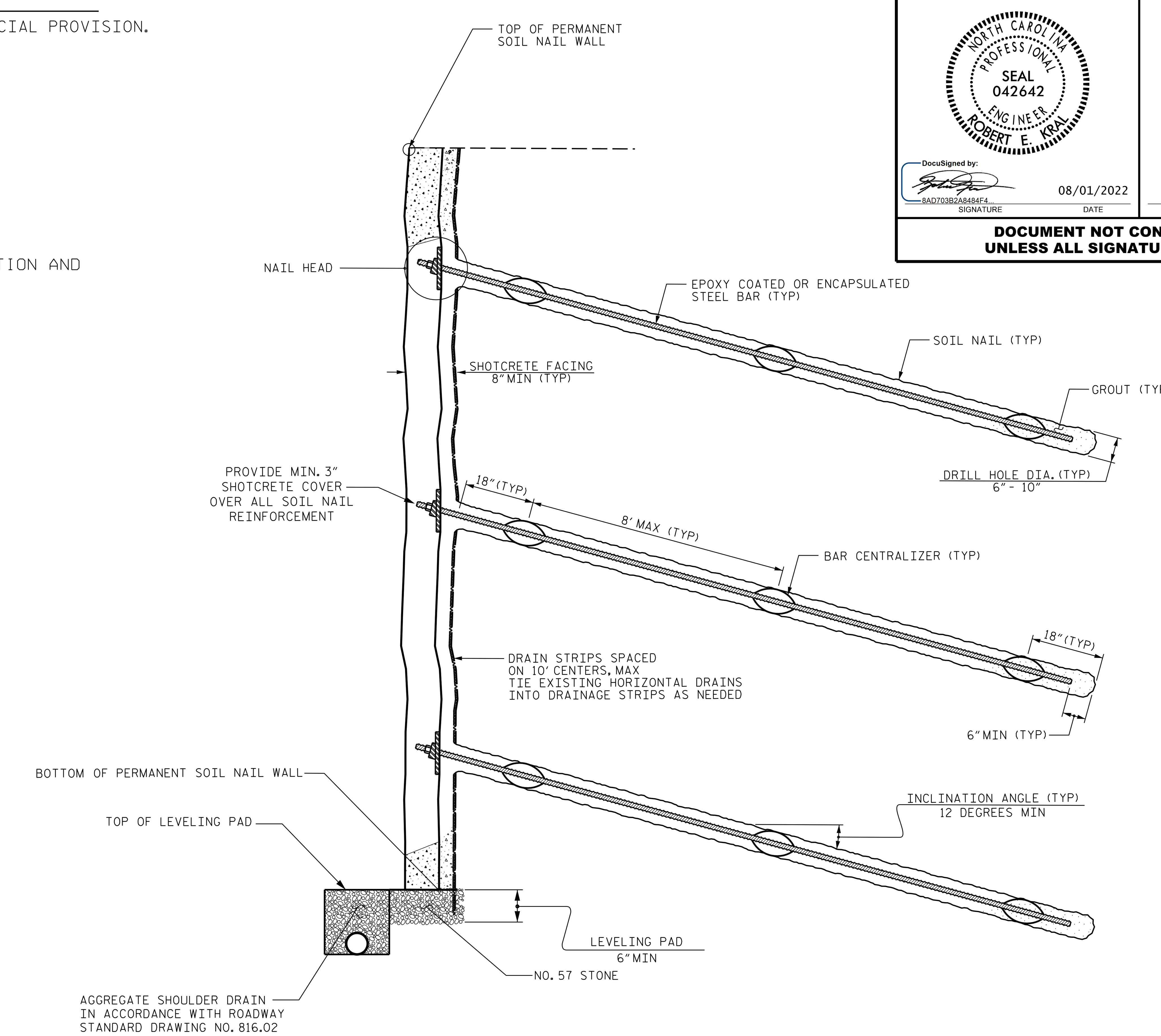
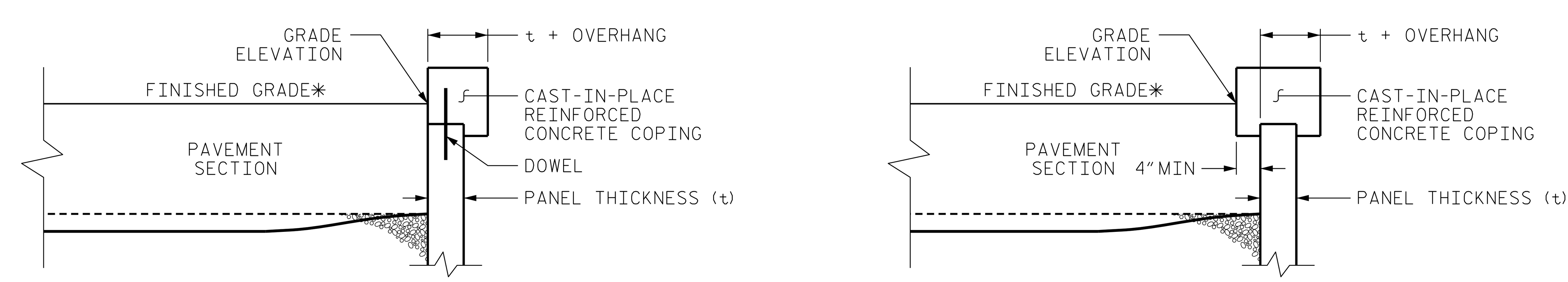


PERMANENT SOIL NAIL WALL - TYPICAL SECTION

NOT TO SCALE



COPING DETAILS

AT THE CONTRACTOR'S OPTION, CONNECT COPING TO PANELS WITH DOWELS OR EXTEND COPING DOWN BACK OF PANELS.
*SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.

PROJECT NO.: A-0009CC
GRAHAM COUNTY
STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT
SHEET 4 OF 7

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

Prepared in the Office of:

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

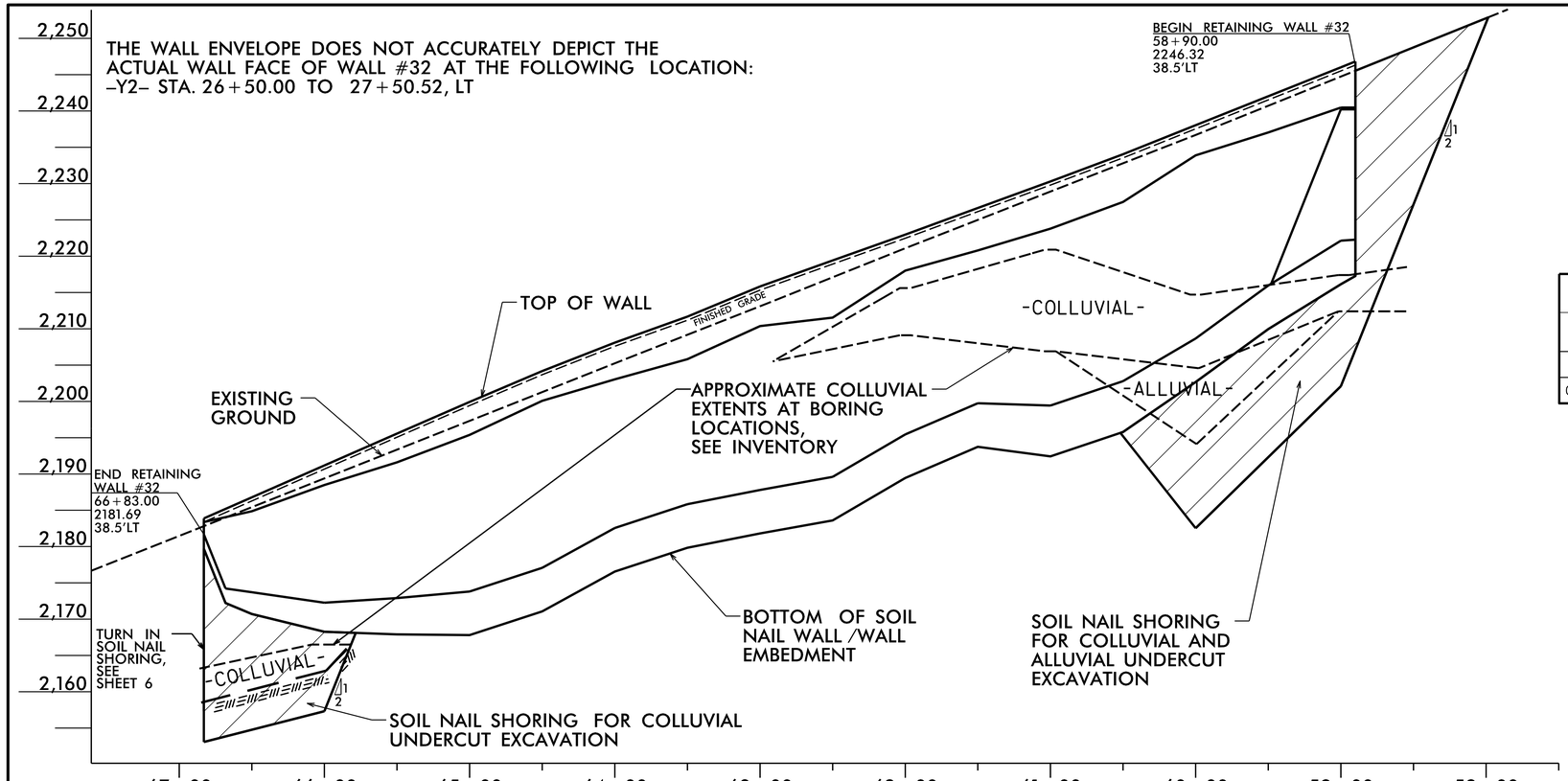
GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #32
SHORED MECHANICALLY STABILIZED EARTH (SMSE) WALL

REVISIONS

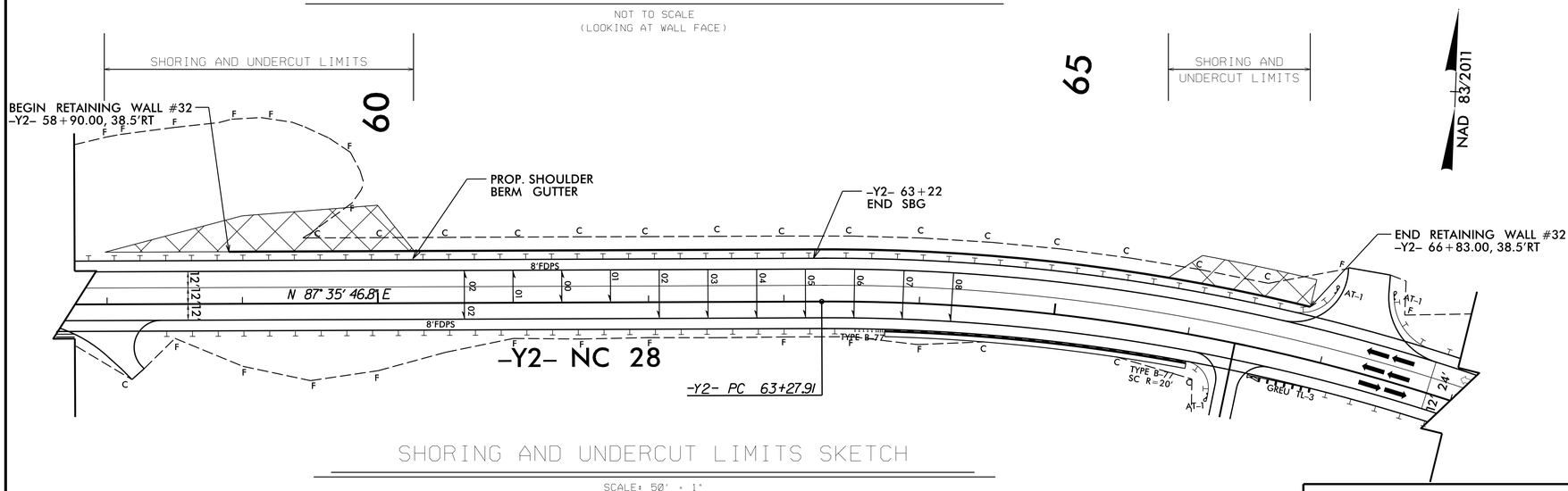
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W32-4



APPROXIMATE ENVELOPE SHORING FOR UNDERCUT

NOT TO SCALE
(LOOKING AT WALL FACE)



SHORING AND UNDERCUT LIMITS SKETCH

SCALE: 50' = 1'
-Y2- STA. 57+98.53 TO -Y2- STA. 59+73.06, LT
-Y2- STA. 65+78.42 TO -Y2- STA. 66+83.00 LT

GEOTECHNICAL ENGINEER	ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL	
DocuSigned by: 8AD7038224484F4... 08/01/2022	
SIGNATURE DATE	SIGNATURE DATE

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ESTIMATED SOIL NAIL SHORING QUANTITIES

RETAINING WALL #	SOIL NAIL SHORING (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
32	6,120	2	15
CONTINGENCY	3,000	2	10

ESTIMATED QUANTITIES

UNDERCUT EXCAVATION	4,150 CY
UNDERCUT EXCAVATION (CONTINGENCY)	4,000 CY
GEOTEXTILE FOR SOIL STABILIZATION	1,190 SY
GEOTEXTILE FOR SOIL STABILIZATION (CONTINGENCY)	1,500 SY
SELECT GRANULAR MATERIAL	1,190 CY
SELECT GRANULAR MATERIAL (CONTINGENCY)	1,500 CY
SHOULDER DRAIN	1,600 LF
CONCRETE PAD FOR SHOULDER DRAIN PIPE OUTLET	8 EA
HORIZONTAL DRAINS (CONTINGENCY)	400 LF

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

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2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT

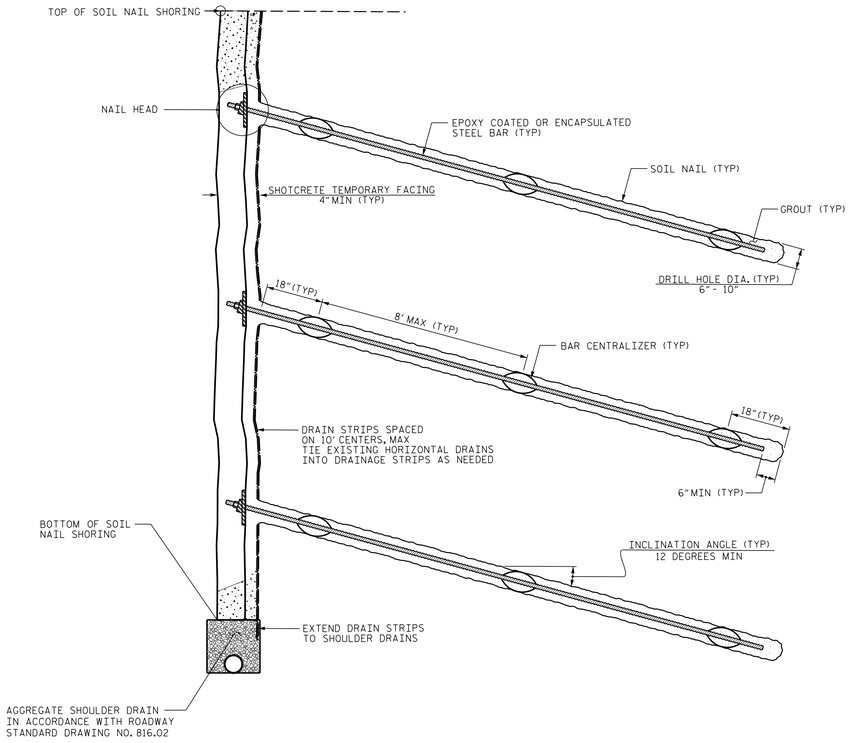
SHEET 5 OF 7

RETAINING WALL #32 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

REVISIONS

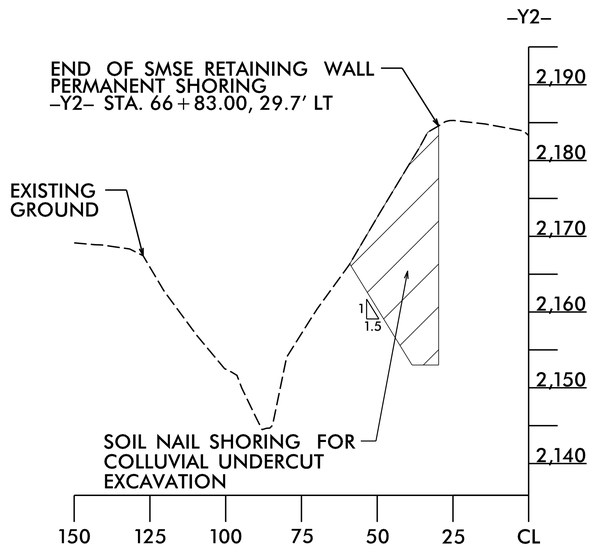
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W32-5



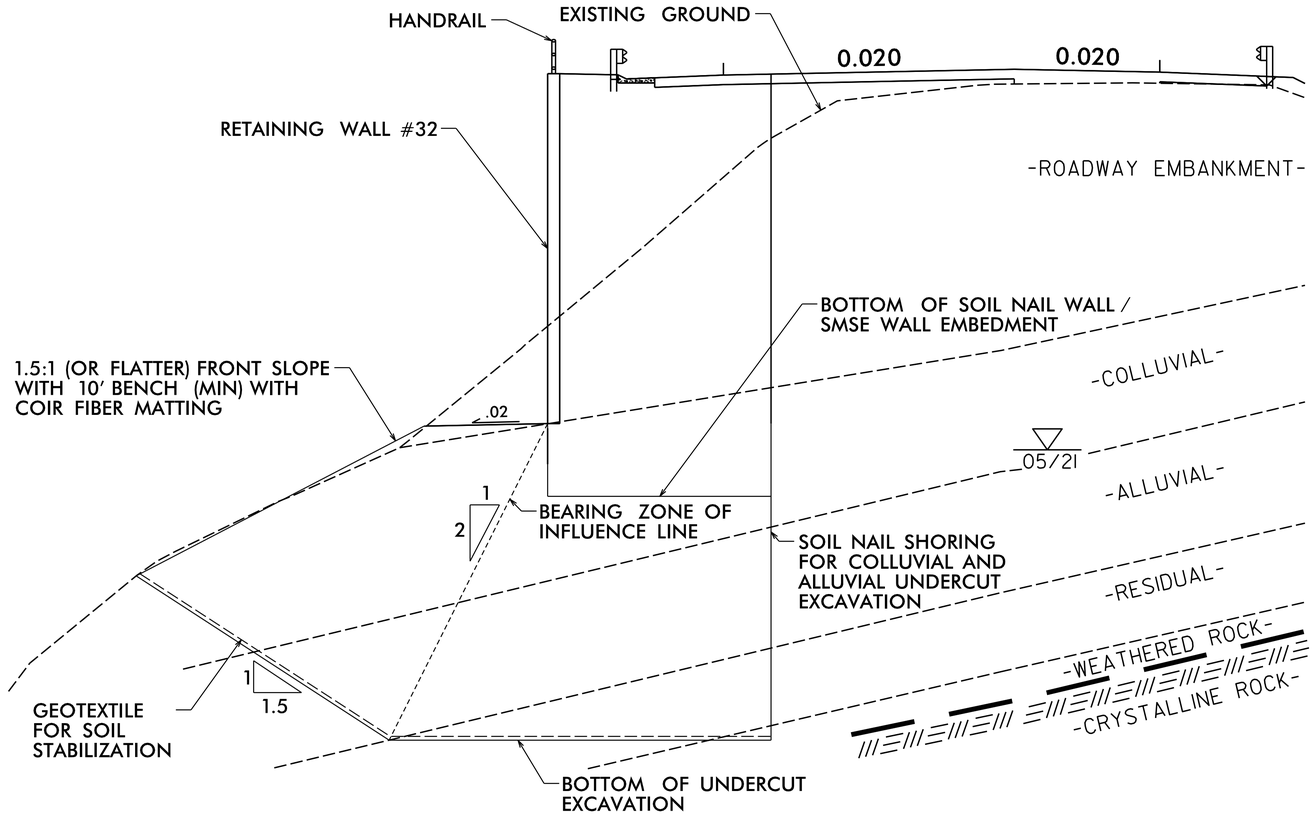
SOIL NAIL SHORING - TYPICAL SECTION

NOT TO SCALE



APPROXIMATE CROSS SECTION SHORING FOR UNDERCUT AT SHORING WALL TURN

NOT TO SCALE
(LOOKING AT SHORING WALL FACE)



UNDERCUT EXCAVATION - TYPICAL SECTION - RETAINING WALL #32

NOT TO SCALE
-Y2- STA. 57+98.53 TO -Y2- STA. 59+73.06, LT
-Y2- STA. 65+78.42 TO -Y2- STA. 66+83.00 LT

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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SIGNATURE DATE

ENGINEER
SIGNATURE DATE

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT

SHEET 6 OF 7

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

RETAINING WALL #32 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W32-6
2			4			

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 08/01/2022
8AD703B2A8484F4... SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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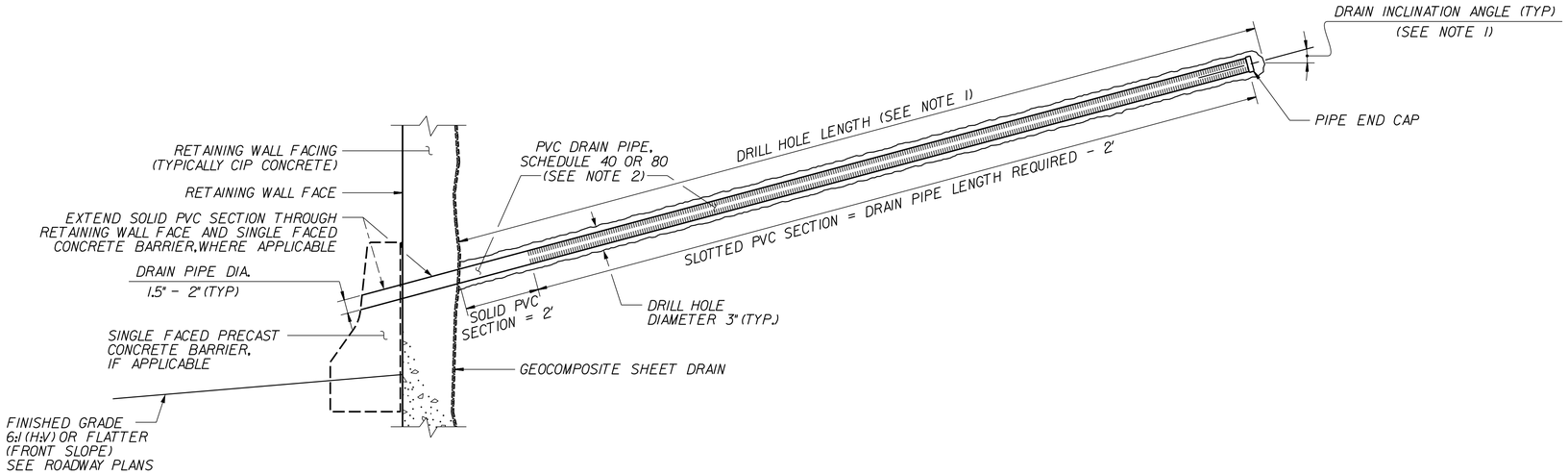
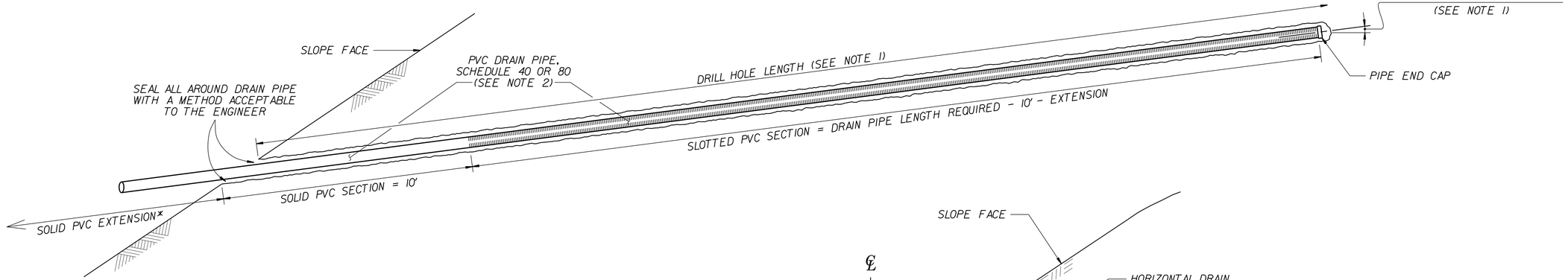
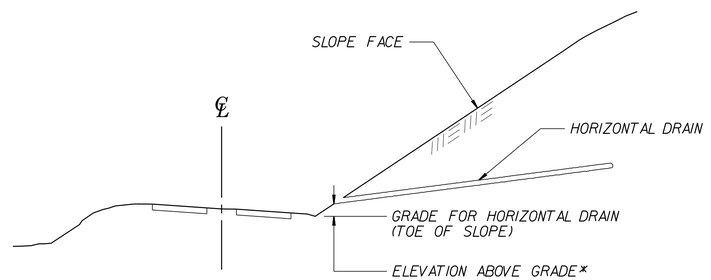


RETAINING WALL HORIZONTAL DRAIN



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PREPARED BY: R. KRAL	DATE: 7/10/2022
REVIEWED BY: M. BREWER	DATE: 7/10/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

PROJECT NO.: A-0009CC

GRAHAM COUNTY

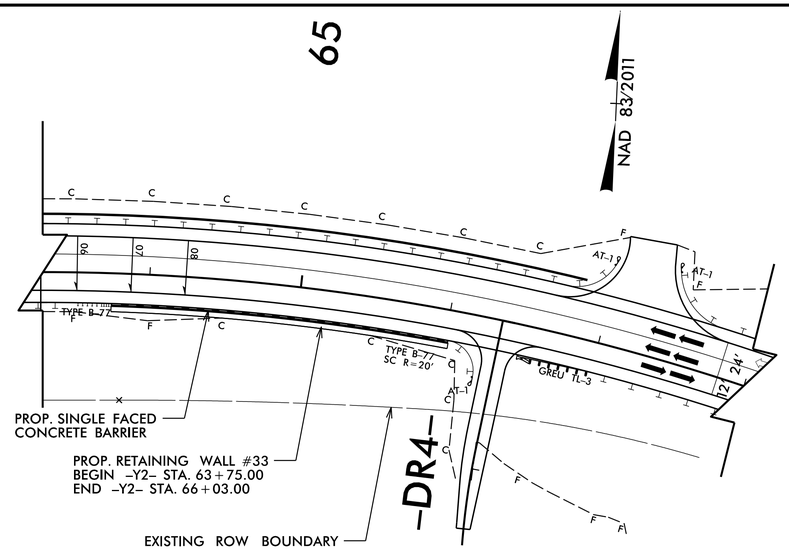
STATION: -Y2- 58+90, 39' LT TO 66+83, 39' LT

SHEET 7 OF 7

RETAINING WALL #32 SOIL NAIL SHORING FOR UNDERCUT EXCAVATION

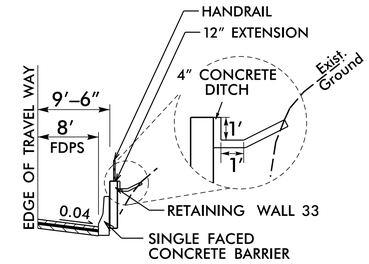
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W32-7
2			4			

RETAINING WALL #33:



RETAINING WALL #33 – PLAN

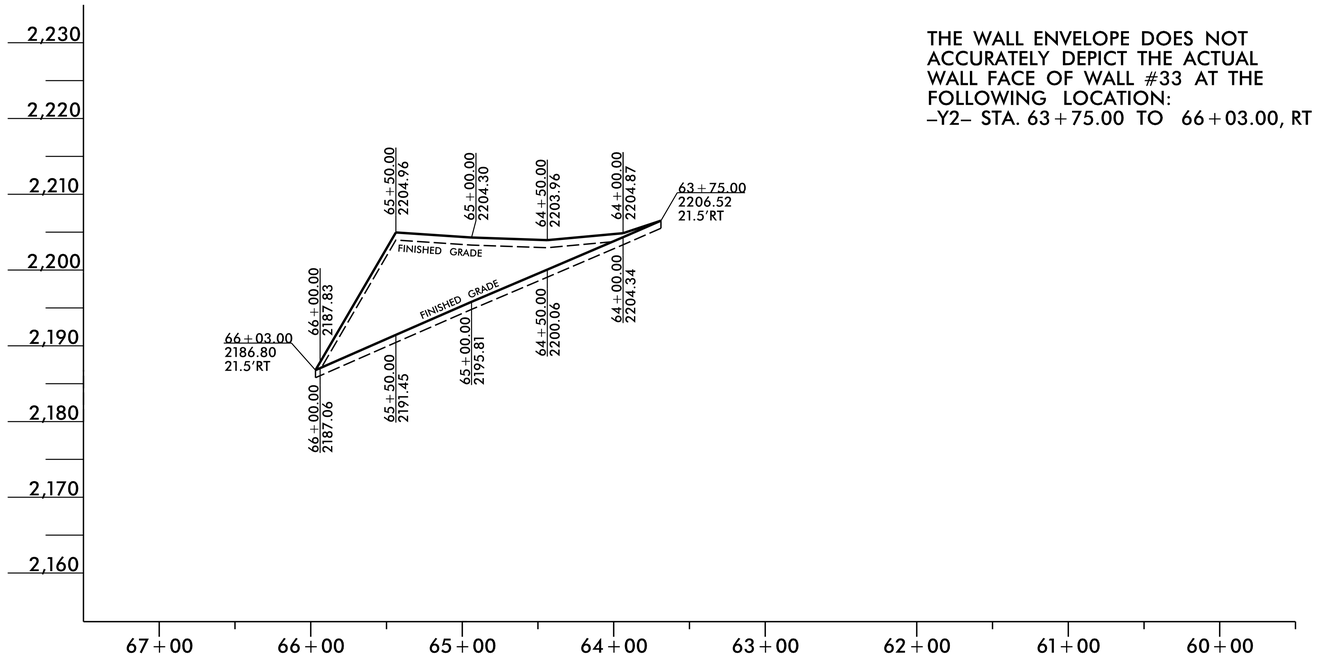
NOT TO SCALE



DETAIL FOR WALL #33

NOT TO SCALE

–Y2– STA. 63+75.00 TO –Y2– STA. 66+03.00, RT



RETAINING WALL #33 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #33 AT THE FOLLOWING LOCATION:
–Y2– STA. 63+75.00 TO 66+03.00, RT

ESTIMATED SOIL NAIL WALL QUANTITIES			
RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
33	1,570 *	1	5
HORIZONTAL DRAINS (CONTIGENCY)			115 LF

* INCLUDES RETAINING WALL EMBEDMENT

SOIL NAIL RETAINING WALL #33						
STA. -Y2-	OFFSET FROM -Y2- (RT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
63+75.00	21.50	2206.52	2206.52	2205.52	1.00	1.00
64+00.00	21.50	2204.87	2204.34	2203.34	1.00	1.00
64+50.00	21.50	2203.96	2200.06	2199.06	1.00	3.90
65+00.00	21.50	2204.30	2195.81	2194.81	1.00	8.49
65+50.00	21.50	2204.96	2191.45	2190.45	1.00	13.51
66+00.00	21.50	2187.83	2187.06	2186.06	1.00	1.00
66+03.00	21.50	2186.80	2186.80	2185.80	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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08/01/2022
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PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #33: -Y2- 63+75, 22' RT TO 66+03, 22' RT

SHEET 1 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #33 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

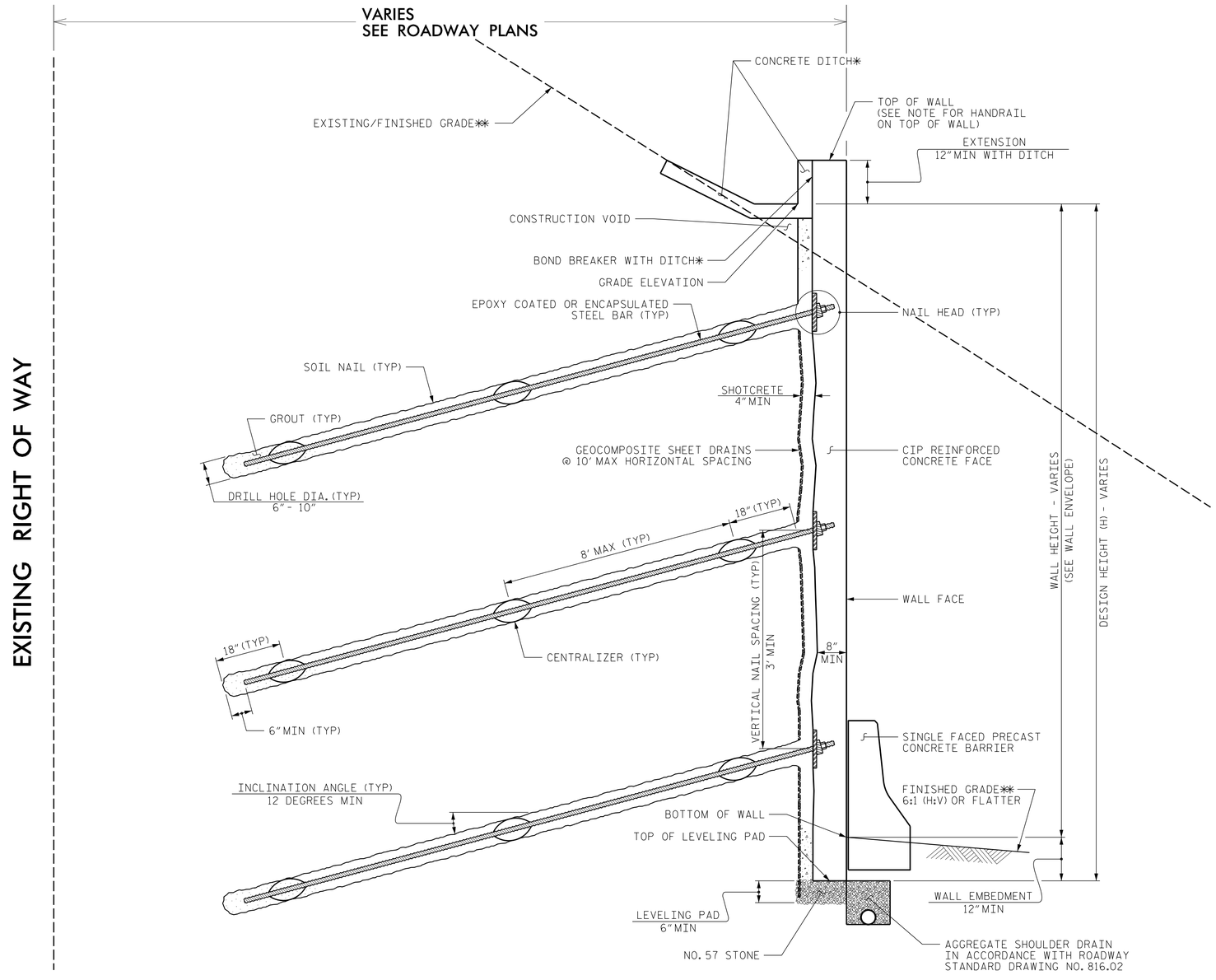
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #33
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W33-1
2			4			



SOIL NAIL WALL - TYPICAL SECTION

*SEE CONCRETE DITCH BEHIND WALL DETAILS.
**SEE PLANS FOR FINISHED GRADE.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038284484F4...
08/01/2022
SIGNATURE DATE

ENGINEER
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER, SEE ROADWAY PLANS AND SECTION 857 OF THE STANDARD SPECIFICATIONS.

A HANDRAIL IS REQUIRED ON TOP OF RETAINING WALL #33. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #33, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #33 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF
5) IN-SITU ASSUMED WEATHERED ROCK (META-GRAYWACKE & META-SILTSTONE) PARAMETERS:
   UNIT WEIGHT, γ = 135 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 500 PSF
6) IN-SITU ASSUMED CRYSTALLINE ROCK (META-GRAYWACKE) PARAMETERS:
   UNIT WEIGHT, γ = 170 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 1,000 PSF
7) WHERE ROCK IS ENCOUNTERED IN THE WALL ENVELOPE, DESIGNERS SHOULD REFER TO THE FHWA PRESUMPTIVE STRENGTH PARAMETERS OR OTHER REPRESENTATIVE AND REPEATABLE VALUES AND PROVIDE SOURCE REFERENCES IN THEIR DESIGN SUBMITTAL.

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #33.

THE EXISTING RIGHT OF WAY (ROW) BOUNDARY VARIES FROM THE FACE OF RETAINING WALL #33. SEE THE ROADWAY PLANS FOR OFFSET DISTANCES FROM THE FACE OF RETAINING WALL #33. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE EXISTING ROW BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #33, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE ROCK IS PRESENT IN THE WALL ENVELOPE, CONTROLLED BLASTING IS RECOMMENDED, BUT NOT REQUIRED, TO MAINTAIN THE NEAT EXCAVATION LINE. VOIDS, RESURTING FROM BLASTING OR EXCAVATING, THAT EXTEND BEYOND THE NEAT LINES ARE TO BE FILLED WITH A COMBINATION OF SHORT SOIL NAILS, WELDED WIRE, AND SHOTCRETE, AT THE DISCRETION OF THE ENGINEER. THE COSTS ASSOCIATED WITH THIS WORK WILL BE CONSIDERED INCIDENTAL TO WALL CONSTRUCTION AND NO ADDITIONAL COMPENSATION WILL BE MADE. FOR BLASTING, SEE THE BLASTING PROVISION.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #33, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

GROUND MAY NOT EXIST ABOVE THE BOTTOM OF THE WALL IN SOME PORTIONS OF THE WALL ENVELOPE. USE CONVENTIONAL GRADING, TEMPORARY WALL, OR OTHER METHOD ACCEPTABLE TO THE ENGINEER TO CREATE GROUND ABOVE EXISTING GRADE IN ORDER TO CONSTRUCT THE SOIL NAIL WALL. THE CONTRACT UNIT PRICE FOR SOIL NAIL RETAINING WALLS WILL BE FULL COMPENSATION FOR THIS WORK, IF REQUIRED.

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #33: -Y2- 63+75, 22' RT TO 66+03, 22' RT

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #33
SOIL NAIL RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W33-2

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038284484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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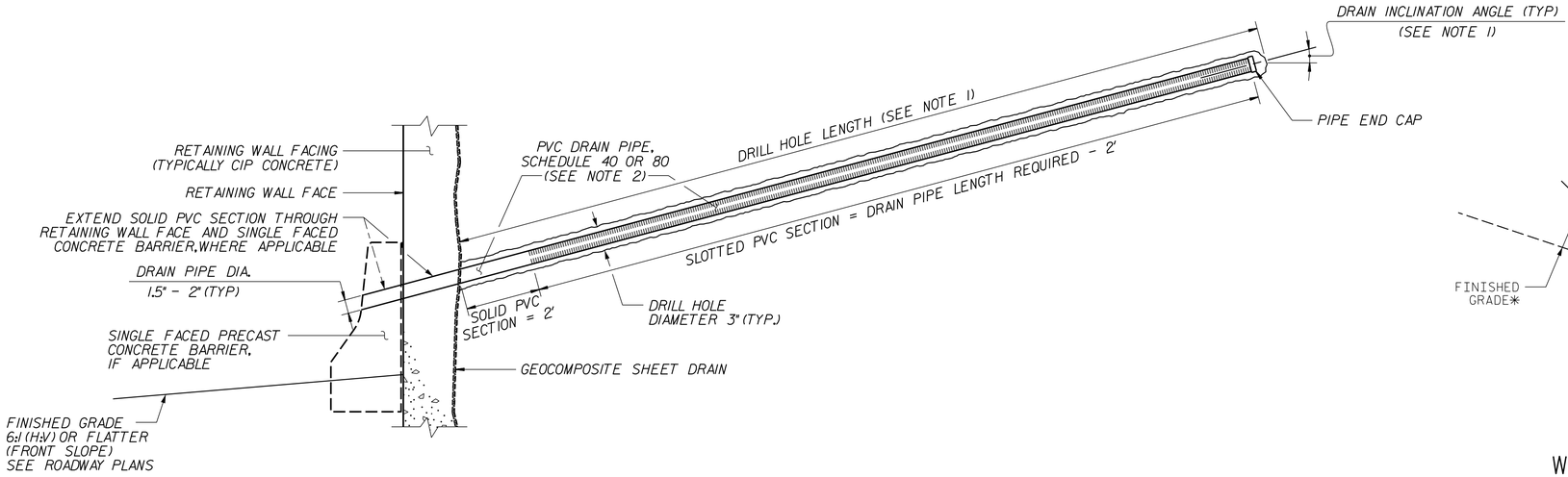
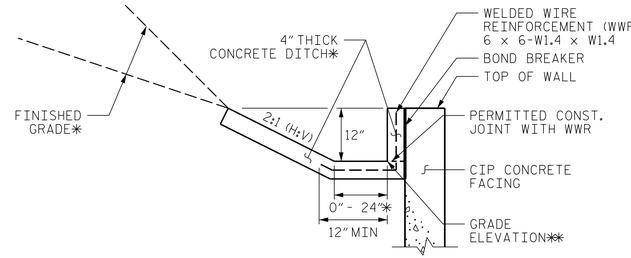
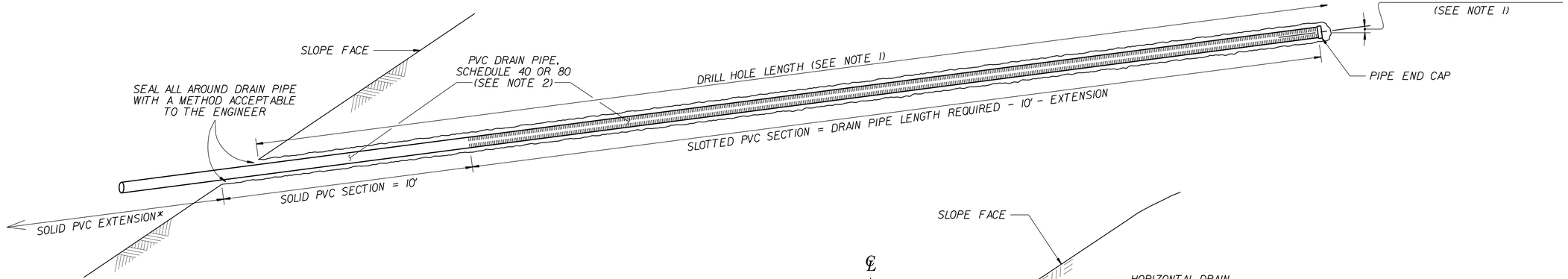


RETAINING WALL HORIZONTAL DRAIN



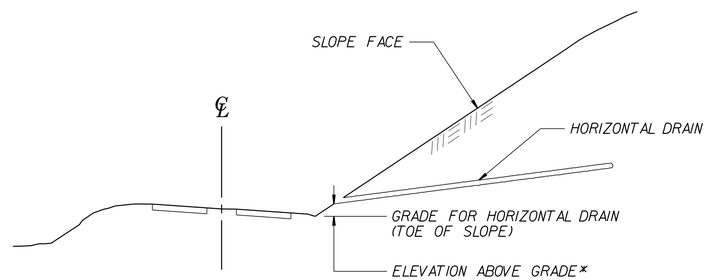
CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

*SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
**SEE WALL ENVELOPE FOR GRADE ELEVATIONS.



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #33: -Y2- 63+75, 22' RT TO 66+03, 22' RT

SHEET 3 OF 3

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

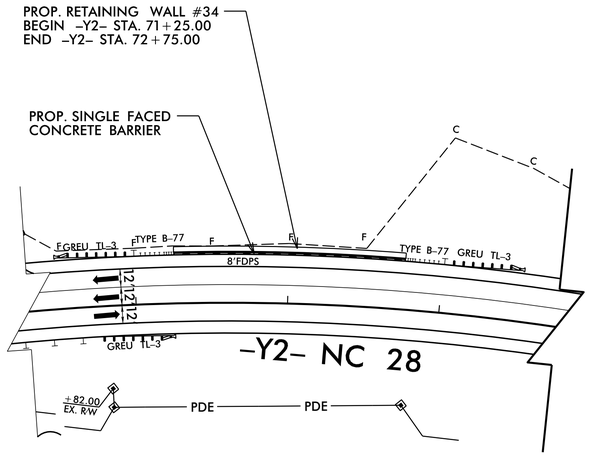
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #33
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W33-3
2			4			

RETAINING WALL #34:



RETAINING WALL #34:

NOT TO SCALE

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

DocuSigned by: 8AD7038248484F4...

08/01/2022

SIGNATURE DATE

ENGINEER

SIGNATURE DATE

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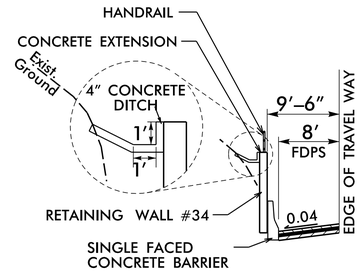
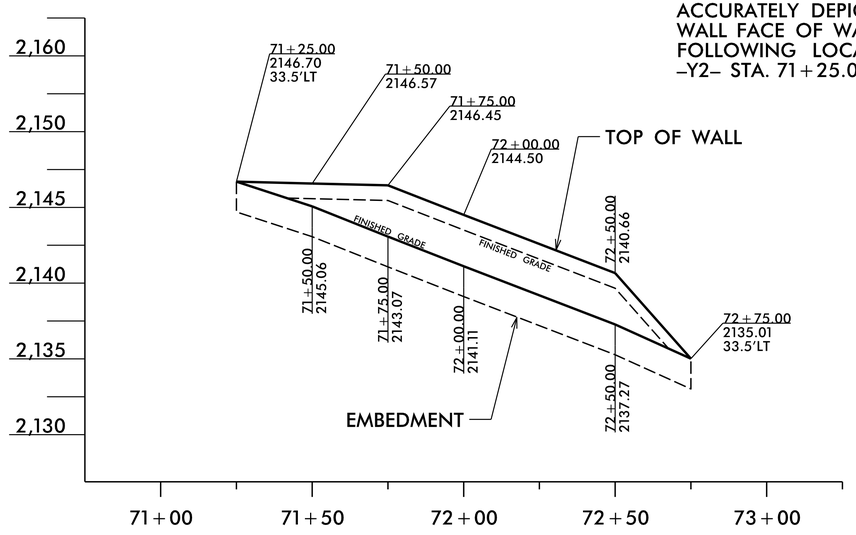


DETAIL FOR WALL #34

NOT TO SCALE

–Y2– STA. 71+25.00 TO –Y2– STA. 72+75.00, LT

THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #34 AT THE FOLLOWING LOCATION:
–Y2– STA. 71+25.00 TO 72+75.00, LT



RETAINING WALL #34:

NOT TO SCALE
(LOOKING AT FACE OF WALL)

ESTIMATED RETAINING WALL QUANTITY (SQUARE FEET)	
NON-STANDARD CIP GRAVITY RETAINING WALL #34	1,060 SF

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #38: -Y2- 71+25, 34' LT TO 72+75, 34' LT

SHEET 1 OF 2

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #34 ENVELOPES AND WALL LAYOUTS PROVIDED BY TGS ENGINEERS, INC.

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #34
NON-STANDARD
CIP GRAVITY
RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W34-1
2			4			

NOTES:

FOR NON-STANDARD CIP GRAVITY RETAINING WALLS, SEE NON-STANDARD CIP GRAVITY RETAINING WALLS SPECIAL PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER, SEE ROADWAY PLANS AND SECTION 857 OF THE STANDARD SPECIFICATIONS.

FOR HANDRAILS ON TOP OF WALLS, SEE ROADWAY PLANS FOR HANDRAIL ATTACHMENT DETAILS.

FOR SUBSURFACE DRAINAGE AT WEEP HOLES, SEE ARTICLE 414-8 OF THE STANDARD SPECIFICATIONS.

NON-STANDARD CIP GRAVITY WALLS ARE BASED ON THE FOLLOWING:

IN-SITU ASSUMED RETAINED SOIL PARAMETERS:
UNIT WEIGHT, γ = 125 PCF
FRICTION ANGLE, ϕ = 37 DEGREES
COHESION, c = 0 PSF

IN-SITU ASSUMED FOUNDATION SOIL PARAMETERS:
UNIT WEIGHT, γ = 120 PCF
FRICTION ANGLE, ϕ = 30 DEGREES
COHESION, c = 0 PSF

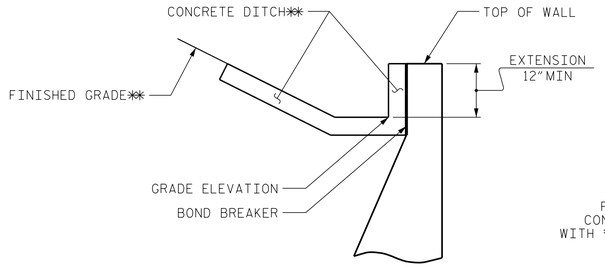
A MINIMUM BEARING RESISTANCE OF 1.0 TSF IS REQUIRED FOR RETAINING WALL #34.

UNDERCUTTING SOFT AND/OR WET SOILS IN THE VICINITY OF THE WALL FOUNDATION MAY BE REQUIRED TO IMPROVE BEARING RESISTANCE. THE ENGINEER WILL DETERMINE THE SOILS BEARING RESISTANCE AFTER THE WALL FOOTING IS EXCAVATED TO BEARING GRADE. IF REQUIRED BY THE ENGINEER, USE UNDERCUT EXCAVATION TO REMOVE SOFT AND/OR WET SOILS. UNDERCUT TO SUITABLE FOUNDATION SOILS OR TO A DEPTH NO GREATER THAN 3 FEET BELOW THE BOTTOM OF FOOTING ELEVATION, WHICHEVER OCCURS FIRST. PLACE GEOTEXTILE FOR SOIL STABILIZATION IN THE BOTTOM OF THE EXCAVATION AND BACKFILL WITH SELECT GRANULAR MATERIAL. FOR UNDERCUT EXCAVATION AND SELECT GRANULAR MATERIAL SEE STANDARD SPECIFICATIONS. UNDERCUT EXCAVATION, SELECT GRANULAR MATERIAL, AND GEOTEXTILE FOR SOIL STABILIZATION WILL BE PAID AS SEPARATE ADDITIONAL QUANTITIES.

BEFORE BEGINNING NON-STANDARD CIP GRAVITY WALL CONSTRUCTION, SURVEY WALL LOCATIONS AND SUBMIT WALL PROFILE VIEWS (WALL ENVELOPES) FOR REVIEW. FOR WALL ENVELOPES, INCLUDE BOTTOM OF WALL, EXISTING GROUND AND GRADE ELEVATIONS, AND SLOPE ELEVATIONS BEHIND THE WALL AT INTERVALS OF 25' OR LESS ALONG WALLS. DO NOT START WALL CONSTRUCTION UNTIL WALL ENVELOPES ARE ACCEPTED.

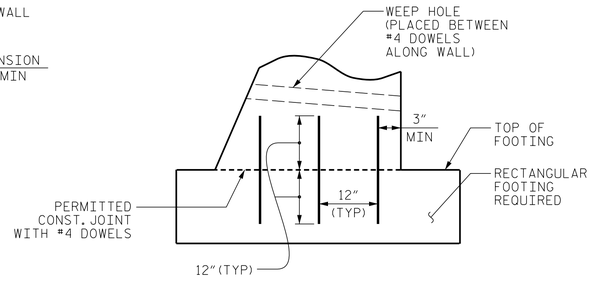
DO NOT PLACE CONCRETE FOR FOOTINGS UNTIL EXCAVATION DIMENSIONS AND FOUNDATION MATERIAL ARE APPROVED.

WHEN CONSTRUCTING NON-STANDARD CIP GRAVITY WALLS WITH A CONSTRUCTION JOINT AS SHOWN IN DETAIL "A", PROVIDE A MINIMUM OF 3 EQUALLY SPACED #4 DOWELS AT INTERVALS OF 1'-6" ALONG WALLS.

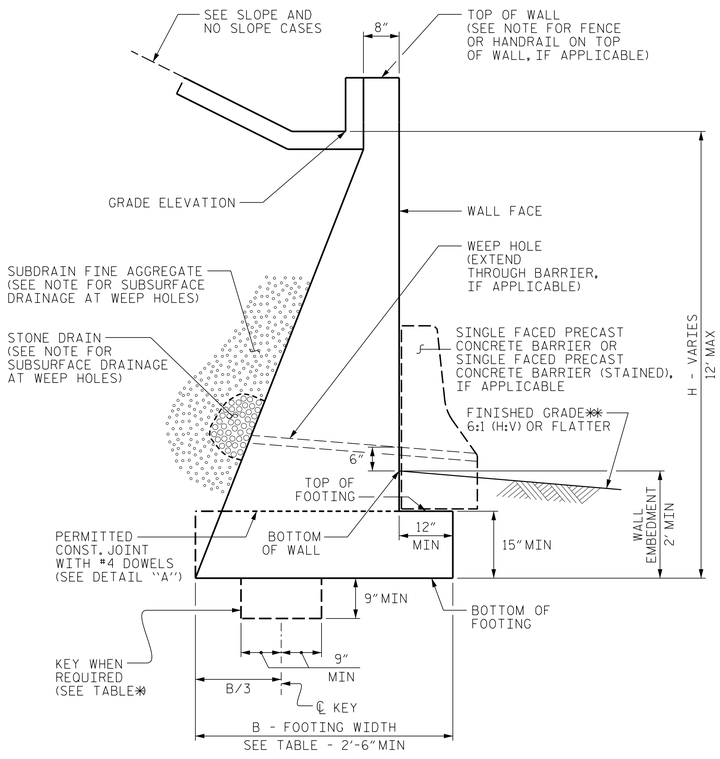


SLOPE CASE

**SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.

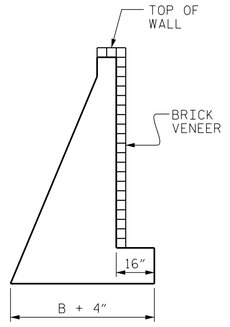


DETAIL "A"



NON-STANDARD CIP GRAVITY WALL

**SEE ROADWAY PLANS FOR FINISHED GRADE DETAILS.



BRICK VENEER DETAIL

(WHEN APPLICABLE)

H (FT)	3 - < 6	6 - 9	> 9 - 12
SLOPE CASE	.70	-	-
NO SLOPE CASE WITH TRAFFIC SURCHARGE	-	-	-
NO SLOPE CASE WITHOUT TRAFFIC SURCHARGE	-	-	-

B/H RATIO (B = 2'-6" MIN)

KEY IS REQUIRED FOR "SLOPE CASE" OR "NO SLOPE CASE WITH TRAFFIC SURCHARGE" WHEN H IS 6' OR GREATER.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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08/01/2022

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #38: -Y2- 71+25, 34' LT TO 72+75, 34' LT

SHEET 2 OF 2

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

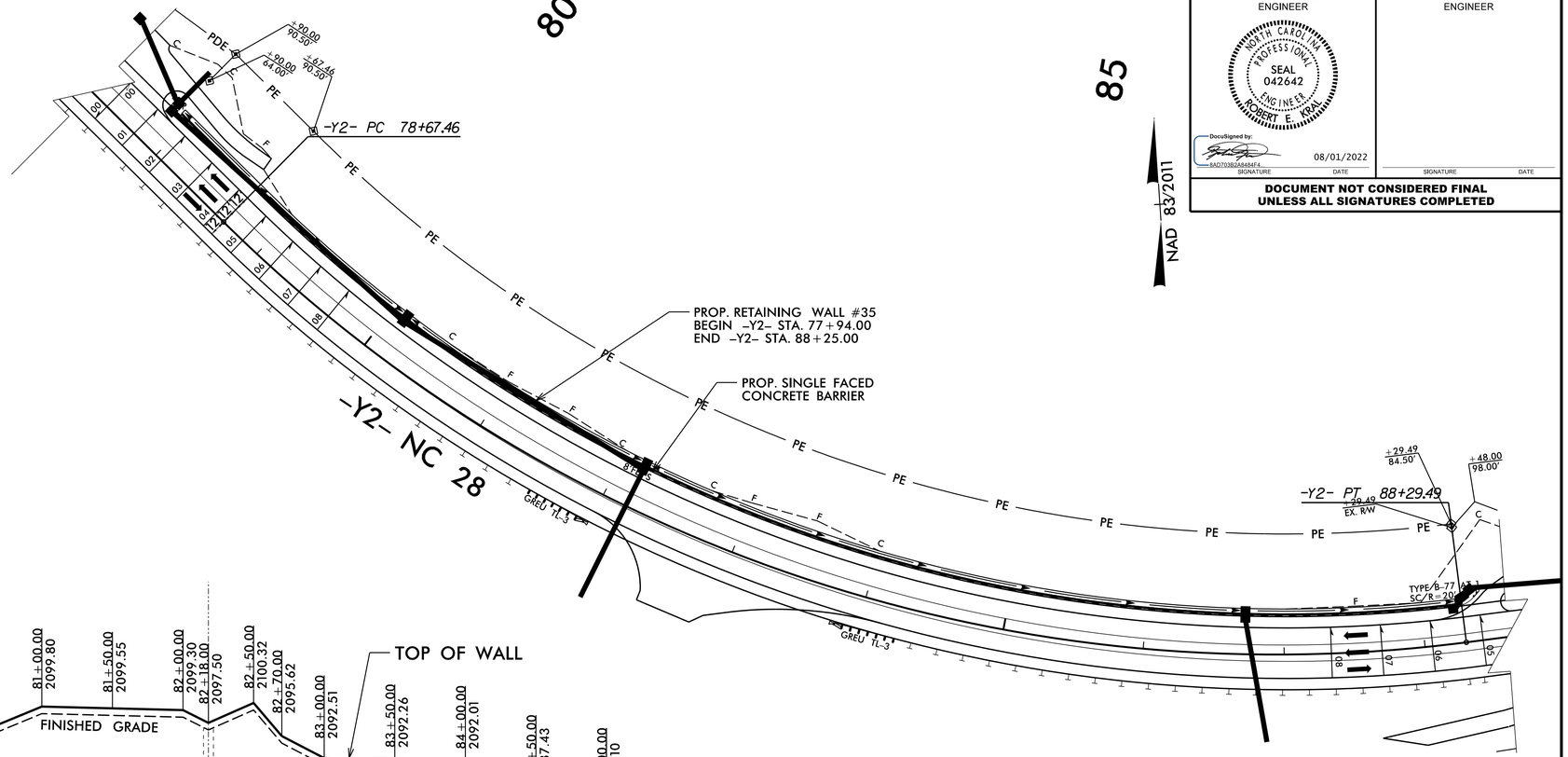
RETAINING WALL #34
NON-STANDARD
CIP GRAVITY
RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

SHEET NO. W34-2

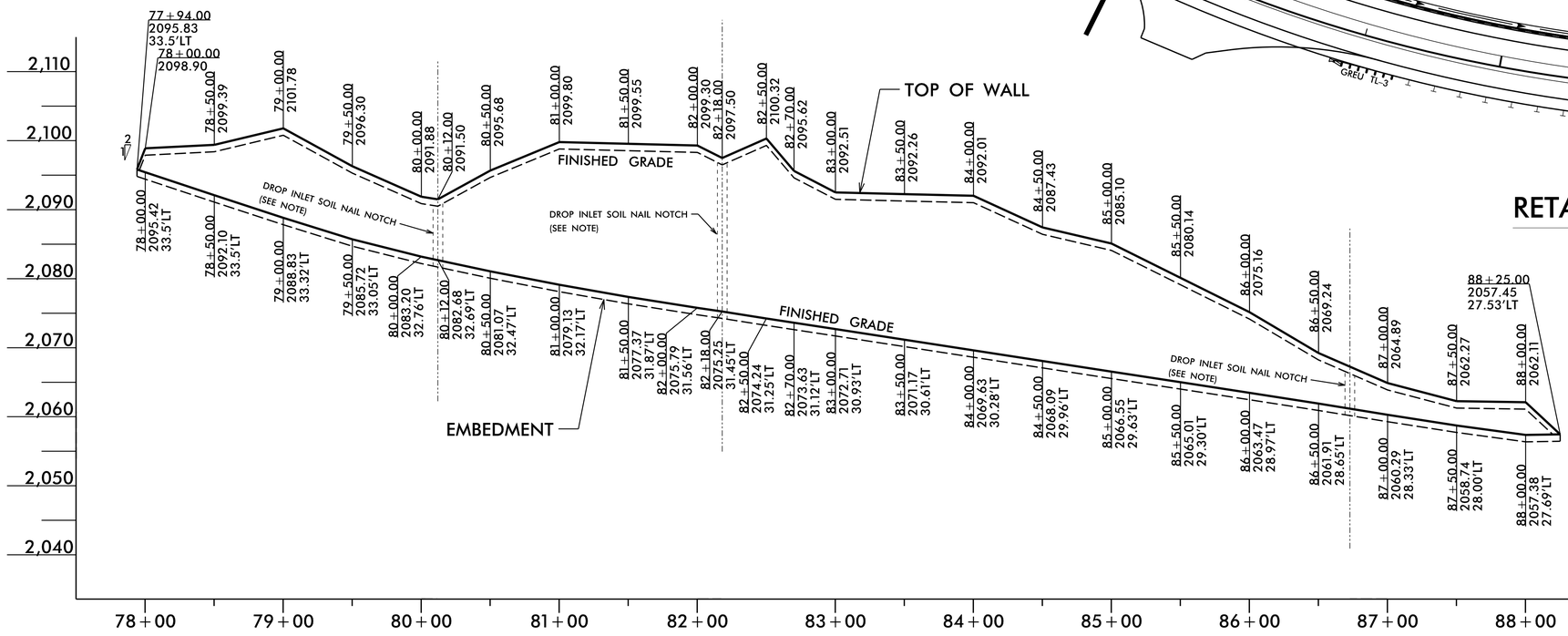
RETAINING WALL #35:



THE WALL ENVELOPE DOES NOT ACCURATELY DEPICT THE ACTUAL WALL FACE OF WALL #35 AT THE FOLLOWING LOCATION:
-Y2- STA. 78+50.00 TO 88+25.00, LT

RETAINING WALL #35 – PLAN

NOT TO SCALE



RETAINING WALL #35 – ENVELOPE

NOT TO SCALE
(LOOKING AT FACE OF WALL)

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

RETAINING WALL #35 ENVELOPE AND WALL LAYOUT PROVIDED BY TGS ENGINEERS, INC.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #35
SOIL NAIL RETAINING WALL

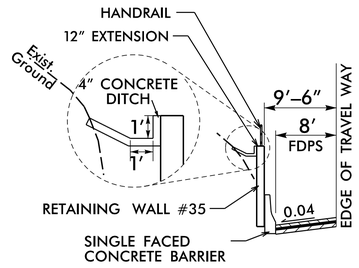
REVISIONS							SHEET NO.
NO.	BY	DATE	NO.	BY	DATE		
1			3				W35-1
2			4				

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #35: -Y2- 77+94, 34' LT TO 88+25, 28' LT

SHEET 1 OF 4



DETAIL FOR WALL #35

NOT TO SCALE

-Y2- STA. 77+94.00 TO -Y2- STA. 88+25.00, LT

ESTIMATED SOIL NAIL WALL QUANTITIES			
RETAINING WALL NO.	SOIL NAIL RETAINING WALLS (SQUARE FEET)	SOIL NAIL VERIFICATION TESTS	SOIL NAIL PROOF TESTS
35	15,690*	5	35
HORIZONTAL DRAINS (CONTIGENCY)			520 LF

* INCLUDES RETAINING WALL EMBEDMENT

SOIL NAIL RETAINING WALL #35						
STA. -Y2-	OFFSET FROM -Y2- (LT) FT.	ELEV. @ TOP OF WALL	BOW FINISHED GRADE	TOP OF LEVELING PAD	ESTIMATED WALL EMBEDMENT FT.	WALL DESIGN HEIGHT "H"
77+94.00	33.50	2095.83	2095.83	2094.83	1.00	1.00
78+00.00	33.50	2098.90	2095.42	2094.42	1.00	3.48
78+50.00	33.50	2099.39	2092.10	2091.10	1.00	7.29
79+00.00	33.32	2101.78	2088.83	2087.83	1.00	12.95
79+50.00	33.05	2096.30	2085.72	2084.72	1.00	10.58
80+00.00	32.76	2091.88	2083.20	2082.20	1.00	8.68
80+12.00	32.69	2091.50	2082.68	2081.68	1.00	8.82
80+50.00	32.47	2095.68	2081.07	2080.07	1.00	14.61
81+00.00	32.17	2099.80	2079.13	2078.13	1.00	20.67
81+50.00	31.87	2099.55	2077.37	2076.37	1.00	22.18
82+00.00	31.56	2099.30	2075.79	2074.79	1.00	23.51
82+18.00	31.45	2097.50	2075.25	2074.25	1.00	22.25
82+50.00	31.25	2100.32	2074.24	2073.24	1.00	26.08
82+70.00	31.12	2095.62	2073.63	2072.63	1.00	21.99
83+00.00	30.93	2092.51	2072.71	2071.71	1.00	19.80
83+50.00	30.61	2092.26	2071.17	2070.17	1.00	21.09
84+00.00	30.28	2092.01	2069.63	2068.63	1.00	22.38
84+50.00	29.96	2087.43	2068.09	2067.09	1.00	19.34
85+00.00	29.63	2085.10	2066.55	2065.55	1.00	18.55
85+50.00	29.30	2080.14	2065.01	2064.01	1.00	15.13
86+00.00	28.97	2075.16	2063.47	2062.47	1.00	11.69
86+50.00	28.65	2069.24	2061.91	2060.91	1.00	7.33
87+00.00	28.33	2064.89	2060.29	2059.29	1.00	4.60
87+50.00	28.00	2062.27	2058.74	2057.74	1.00	3.53
88+00.00	27.69	2062.11	2057.38	2056.38	1.00	4.73
88+25.00	27.53	2057.45	2057.45	2056.45	1.00	1.00

BOW = BOTTOM OF WALL
ALL MEASUREMENTS ARE IN FEET

NOTES:

FOR SOIL NAIL RETAINING WALLS, SEE SOIL NAIL RETAINING WALLS PROVISION.

FOR SINGLE FACED PRECAST CONCRETE BARRIER, SEE ROADWAY PLANS AND SECTION 857 OF THE STANDARD SPECIFICATIONS.

RETAINING WALL #35 HAS SADDLES THAT REQUIRE DRAINAGE STRUCTURES TO BE INSTALLED BEHIND THE WALL. SEE ROADWAY AND HYDRAULIC PLANS FOR STRUCTURE TYPE AND LOCATION.

A HANDRAIL IS REQUIRED ON TOP OF RETAINING WALL #35. SEE ROADWAY PLANS FOR FENCE ATTACHMENT DETAILS.

BEFORE BEGINNING SOIL NAIL WALL DESIGN FOR RETAINING WALL #35, SURVEY WALL LOCATION AND SUBMIT A REVISED WALL PROFILE VIEW (WALL ENVELOPE) FOR REVIEW. DO NOT START WALL DESIGN OR CONSTRUCTION UNTIL THE REVISED WALL ENVELOPE IS ACCEPTED.

DESIGN RETAINING WALL #35 FOR THE FOLLOWING:
1) DESIGN HEIGHT (H) = WALL HEIGHT + WALL EMBEDMENT
2) DESIGN LIFE = 75 YEARS
3) MINIMUM WALL EMBEDMENT ELEVATION = VARIES (MIN. 1 FT BELOW PROPOSED FINISHED GRADE ELEVATION)
4) IN-SITU ASSUMED LOOSE TO MEDIUM DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 120 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 0 PSF
5) IN-SITU ASSUMED MEDIUM DENSE TO VERY DENSE RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 36 DEGREES
   COHESION, c = 0 PSF
6) IN-SITU ASSUMED SOFT TO MEDIUM STIFF RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 120 PCF
   FRICTION ANGLE, ϕ = 30 DEGREES
   COHESION, c = 0 PSF
7) IN-SITU ASSUMED MEDIUM STIFF TO VERY STIFF RESIDUAL SOIL PARAMETERS:
   UNIT WEIGHT, γ = 125 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 0 PSF
8) IN-SITU ASSUMED WEATHERED ROCK PARAMETERS:
   UNIT WEIGHT, γ = 135 PCF
   FRICTION ANGLE, ϕ = 32 DEGREES
   COHESION, c = 500 PSF
9) IN-SITU ASSUMED CRYSTALLINE ROCK PARAMETERS:
   UNIT WEIGHT, γ = 170 PCF
   FRICTION ANGLE, ϕ = 34 DEGREES
   COHESION, c = 1,000 PSF
10) WHERE ROCK IS ENCOUNTERED IN THE WALL ENVELOPE, DESIGNERS SHOULD REFER TO THE FHWA PRESUMPTIVE STRENGTH PARAMETERS OR OTHER REPRESENTATIVE AND REPEATABLE VALUES AND PROVIDE SOURCE REFERENCES IN THEIR DESIGN SUBMITTAL.

WHEN ANALYZING FOR INFINITE SLOPE CONDITIONS, DESIGNERS SHOULD ANALYZE UP TO TWO (2) TIMES THE WALL HEIGHT BEHIND THE WALL FACE FOR FAILURE PLANE SEARCHES. THIS INFORMATION SHOULD BE INCLUDED WITH THE DESIGN SUBMITTAL.

EXISTING OR FUTURE OBSTRUCTIONS SUCH AS FOUNDATIONS, GUARDRAIL, FENCE OR HANDRAIL POSTS, PAVEMENTS, PIPES, INLETS OR UTILITIES MAY INTERFERE WITH SOIL NAILS FOR RETAINING WALL #35.

THE PROPOSED PERMANENT EASEMENT (PE) BOUNDARY IS 57 FT FROM THE FACE OF RETAINING WALL #35. SOIL NAILS MAY NOT BE INSTALLED BEYOND THE PROPOSED PE BOUNDARY. SEE "SOIL NAIL WALL - TYPICAL SECTION" DETAIL.

IF GROUNDWATER IS ENCOUNTERED BEHIND THE FACE OF RETAINING WALL #35, HORIZONTAL DRAINS MAY BE REQUIRED AS DIRECTED BY THE ENGINEER. FOR HORIZONTAL DRAINS, SEE THE RETAINING WALL HORIZONTAL DRAIN DETAIL.

WHERE ROCK IS PRESENT IN THE WALL ENVELOPE, CONTROLLED BLASTING IS RECOMMENDED, BUT NOT REQUIRED, TO MAINTAIN THE NEAT EXCAVATION LINE. VOIDS, RESURTING FROM BLASTING OR EXCAVATING, THAT EXTEND BEYOND THE NEAT LINES ARE TO BE FILLED WITH A COMBINATION OF SHORT SOIL NAILS, WELDED WIRE, AND SHOTCRETE, AT THE DISCRETION OF THE ENGINEER. THE COSTS ASSOCIATED WITH THIS WORK WILL BE CONSIDERED INCIDENTAL TO WALL CONSTRUCTION AND NO ADDITIONAL COMPENSATION WILL BE MADE. FOR BLASTING, SEE THE BLASTING PROVISION.

WHERE CONSTRUCTION VOIDS EXIST ALONG THE TOP OF RETAINING WALL #35, THE CONTRACTOR SHOULD BE PREPARED TO FORM THE CANTILEVERED SECTION OF THE CIP REINFORCED CONCRETE FACE TO THE TOP OF WALL ELEVATION. THE CONSTRUCTION VOID SHOULD BE FILLED WITH CONCRETE OR SHOTCRETE PRIOR TO CONSTRUCTION OF THE CONCRETE DITCH. ADDITIONAL WALL FACE REINFORCEMENT OR SOIL NAILS MAY BE REQUIRED FOR TALLER THAN TYPICAL CANTILEVER FACE HEIGHTS.

GROUND MAY NOT EXIST ABOVE THE BOTTOM OF THE WALL IN SOME PORTIONS OF THE WALL ENVELOPE. USE CONVENTIONAL GRADING, TEMPORARY WALL, OR OTHER METHOD ACCEPTABLE TO THE ENGINEER TO CREATE GROUND ABOVE EXISTING GRADE IN ORDER TO CONSTRUCT THE SOIL NAIL WALL. THE CONTRACT UNIT PRICE FOR SOIL NAIL RETAINING WALLS WILL BE FULL COMPENSATION FOR THIS WORK, IF REQUIRED.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #35: -Y2- 77+94, 34' LT TO 88+25, 28' LT

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

Prepared in the Office of:
CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

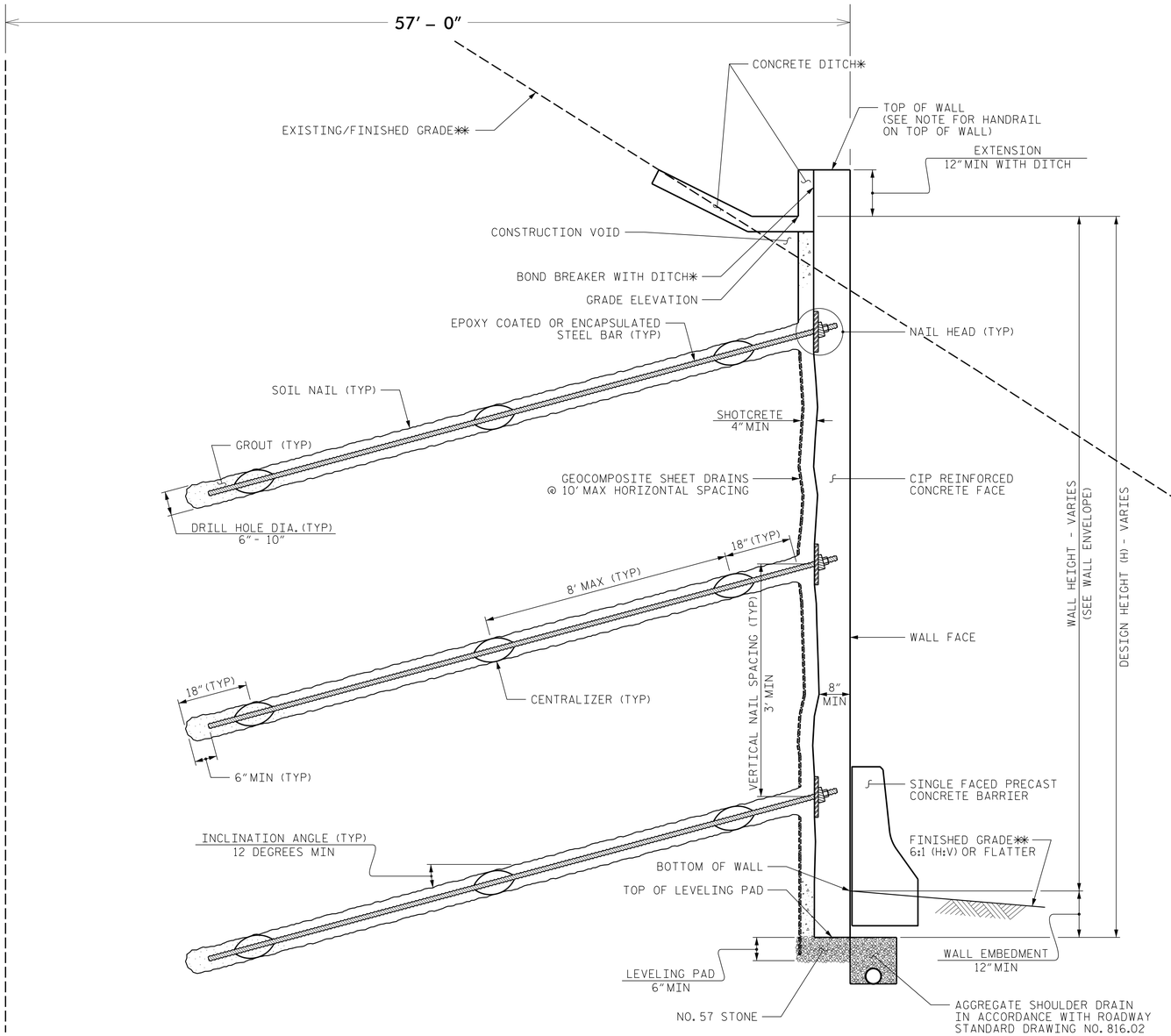
RETAINING WALL #35
SOIL NAIL RETAINING WALL

REVISIONS

NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

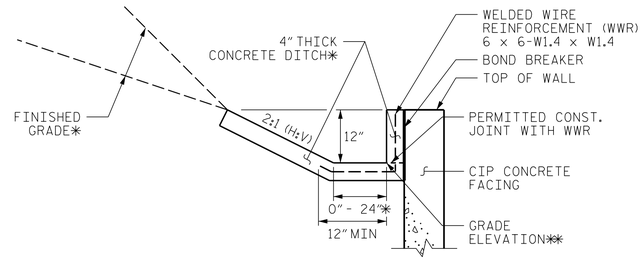
SHEET NO. W35-2

PROPOSED PERMANENT EASEMENT



SOIL NAIL WALL - TYPICAL SECTION

✳SEE CONCRETE DITCH BEHIND WALL DETAILS.
✳✳SEE PLANS FOR FINISHED GRADE.



CONCRETE DITCH BEHIND WALL WITH CONCRETE FACING

✳SEE ROADWAY PLANS FOR CONCRETE DITCH AND FINISHED GRADE DETAILS.
✳✳SEE WALL ENVELOPE FOR GRADE ELEVATIONS.

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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PROJECT NO.: A-0009CC
GRAHAM COUNTY
RETAINING WALL #35: -Y2- 77+94, 34' LT TO 88+25, 28' LT
SHEET 3 OF 4

PREPARED BY: R. KRAL	DATE: 7/9/2022
REVIEWED BY: M. BREWER	DATE: 7/9/2022

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CAROLINAS GEOTECHNICAL GROUP
2400 CROWNPOINT EXECUTIVE DRIVE
SUITE 800
CHARLOTTE, NC 28227
(980) 339-8684

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #35
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W35-3
2			4			

GEOTECHNICAL ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

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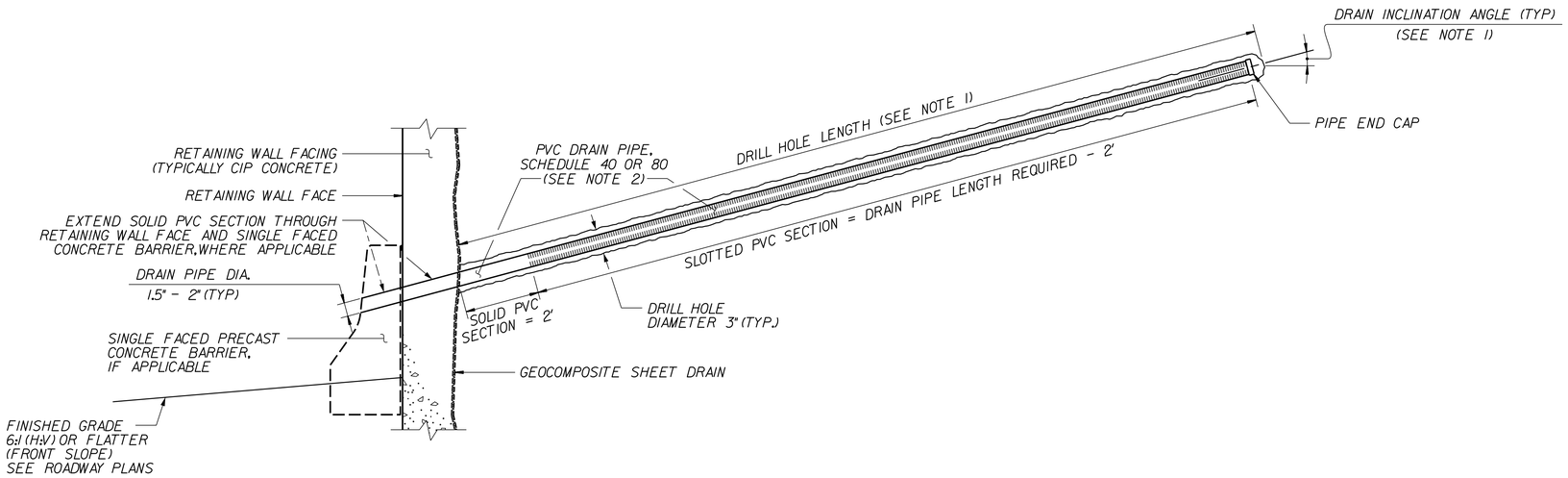
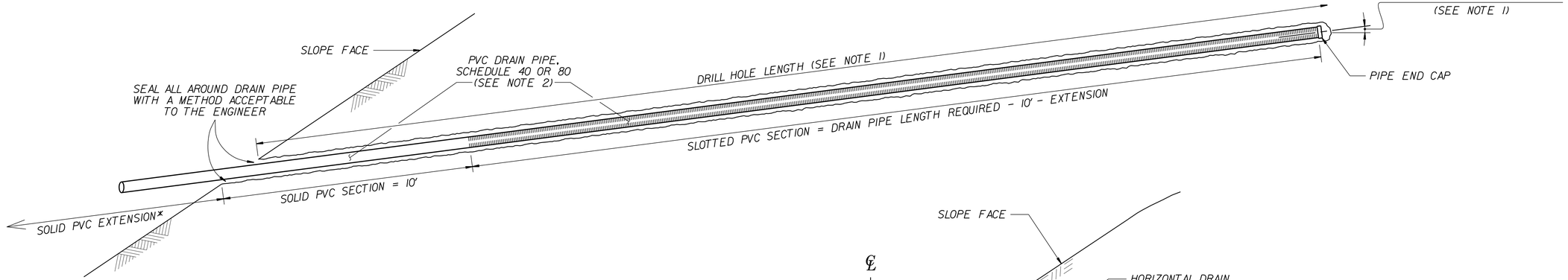
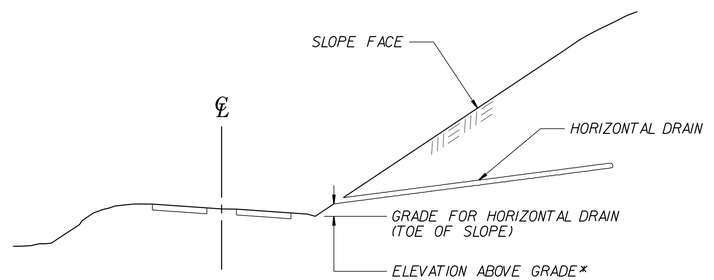


RETAINING WALL HORIZONTAL DRAIN



SLOPE HORIZONTAL DRAIN

*EXTEND SOLID PVC SECTION TO CONNECT PIPE TO A DRAINAGE SYSTEM OR DISCHARGE WATER AS DIRECTED



EXAMPLE CROSS-SECTION WITH SLOPE HORIZONTAL DRAIN

*SEE NOTE 1 FOR DRAIN ELEVATIONS ABOVE (OR BELOW) GRADE

NOTES:

1. SEE ROADWAY SUMMARY SHEETS FOR APPROXIMATE KNOWN HORIZONTAL DRAIN LOCATIONS,ELEVATIONS, INCLINATION AND LENGTHS. ADDITIONAL DRAINS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER.
2. DRAIN PIPES MAY BE OMITTED FOR SOME HORIZONTAL DRAINS. SEE ROADWAY SUMMARY SHEETS FOR DRAIN PIPE REQUIREMENTS INCLUDING THOSE DRAINS WITHOUT PIPES.
3. FOR HORIZONTAL DRAINS,SEE HORIZONTAL DRAINS SPECIAL PROVISION (GT-6).

PROJECT NO.: A-0009CC

GRAHAM COUNTY

RETAINING WALL #35: -Y2- 77+94, 34' LT TO 88+25, 28' LT

SHEET 4 OF 4

PREPARED BY: R. KRAL	DATE: 7/9/2022
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CHARLOTTE, NC 28227
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

RETAINING WALL #35
SOIL NAIL RETAINING WALL

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			W35-4
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