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# Retaining Wall Foundation Recommendation and Structure Subsurface Investigation Report

**April 29, 2013**

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# RETAINING WALL FOUNDATION RECOMMENDATION AND SUBSURFACE INVESTIGATION REPORT

**PROPOSED RETAINING WALL NO. 1 ON NCRR/NS MAINLINE (-M1G-)**
**FROM STA 10689+00 TO STA 10698+00**
**WBS NO. 50000.1.STR11T1B**
**TIP NO. P-5208G**
**F.A. NO. N/A**
**MECKLENBURG COUNTY, NORTH CAROLINA**

**Prepared for:**

AECOM
701 Corporate Center Drive, Suite 475
Raleigh, North Carolina 27607

**Prepared By:**

Kleinfelder Southeast, Inc.
313 Gallimore Dairy Road
Greensboro, North Carolina 27616

April 29, 2013

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Bright People. Right Solutions.

April 29, 2013
File: 127855 | GSO13R0174

Mr. Len Hill, P.E.
AECOM
701 Corporate Center Drive, Suite 475
Raleigh, North Carolina 27607

Reference: **Retaining Wall Foundation Recommendations and Structure Subsurface Investigation Report**
**Proposed Retaining Wall on NCRR/NS Mainline (-M1G-)**
**from STA 10689+00 to STA 10698+00**
**Mecklenburg County, North Carolina**
**WBS NO. 50000.1.STR11T1B**
**TIP NO. P-5208G**

Dear Mr. Hill:

Kleinfelder Southeast, Inc. has completed the authorized retaining wall foundation recommendation report for the above referenced project. Attached are the design calculations (Appendix).

## RETAINING WALL RECOMMENDATIONS

Based on the subsurface conditions encountered along the wall length, the following parameters were used in the analysis:

| Parameter | Foundation Soils | Retained Soils |
|---|---|---|
| Cohesion, C (psf) | 0 | 0 |
| Angle of Internal Friction, $\phi$ | 30 | 33 |
| Soil Moist Unit Weight (pcf) | 110 | 120 |

The analysis was performed on a wall with a 2(H):1(V) slope at the bottom of the wall and a level surface above the wall. An external stability analysis was performed to assess the global stability, the stability of the toe slope, and settlement of the wall. A summary of the factors of safety are summarized in the following table.

| Parameter | Calculated F.S. | Required F.S. |
|---|---|---|
| Global Stability | 2.23 | 1.5 |
| Toe Slope Stability (2:1) | 1.87 | 1.5 |
| Settlement | <1.0 inch | N/A |

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## FOUNDATION RECOMMENDATIONS

Since the foundation will experience horizontal loads and lateral deflections are not limited, a passive state can develop. As such, a passive earth pressure coefficient can be used to calculate the lateral resistance of the drilled in place soldier pile foundation. Depending upon the soil conditions, an active earth pressure coefficient (Ka) and a passive earth pressure coefficient ($K_p$) of 0.33 and 1.12, respectively, can be used for the soils below the wall. Moist soil unit weights will likely range between 120 pounds per cubic foot (pcf) for compacted fill and 110 pcf for foundation soils. An active earth pressure coefficient ($K_a$) of 0.29 is estimated for the retained soils. Lateral loads will control the depth of embedment as opposed to end bearing conditions. The minimum embedment depth of the drilled in place soldier piles for 5, 10 feet and 14 feet wall heights should be 13, 23 and 30 feet, respectively for piles spacings of 6 and 8 feet.

The soldier pile section should be sized to limit the wall deflection to below the maximum allowable value.

## CONSTRUCTION CONSIDERATIONS

See Soldier Pile Wall Standard provisions for materials and construction methods.

## CLOSURE

Kleinfelder appreciates the opportunity to continue our services to you on this project. If you have any questions or require additional information, please call.

Respectfully submitted,

**KLEINFELDER SOUTHEAST, INC.**

Joshua D. Fregosi, P.E.
Project Professional

NORTH CAROLINA PROFESSIONAL SEAL 15741 ENGINEER XAVIER C. BARRETT

4/29/13

Xavier C. Barrett, P.E.
North Carolina License No. 15741

JDF/XCB: cas
Attachments


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# APPENDIX

# RETAINING WALL RECOMMENDATION NOTES AND COMMENTS

**WBS NO.:** 50000.1.STR11T1B **T.I.P. NO.:** P-5208G

**DESCRIPTION:** Proposed Retaining Wall on NCRR/NS (-M1G-) from STA 10689+00 to STA 10698+00

**COUNTY**: Mecklenburg **ALIGNMENT**: -M1G-

## FOUNDATION RECOMMENDATION NOTES ON PLANS:

For Soldier Pile Retaining Walls, see Soldier Pile Retaining Walls Provision

Drilled-in H-Piles are required for Retaining Wall No. 1.

Design Retaining Wall No. 1 for the following:

1) H = Design Height + Embedment

2) Design Life = 100 Years

3) Minimum Embedment Elevation = 715.0 FT

4) In-Situ Assumed Material Parameters (Above elevation 742.0 ft.):
   Unit Weight, gamma = 120 pcf
   Friction Angle, phi = 33 Degrees
   Cohesion, c = 0 psf

5) In-Situ Assumed Material Parameters (Below elevation 742.0 ft.):
   Unit Weight, gamma = 110 pcf
   Friction Angle, phi = 30 Degrees
   Cohesion, c = 0 psf

Design Retaining Wall No. 1 for a Live Load (Traffic) Surcharge.

## FOUNDATION RECOMMENDATION COMMENTS:

Foundation Design was performed using ASD and AREMA Methods.

Minimum Embedment Elevation for heights above 10 feet is 715.0 ft.

Leveling pad subgrade should be observed to confirm the presence of suitable materials.


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**PILE EXCAVATION DEPTH CHARTS FOR PLANS:**

| PILE EXCAVATION | | | |
|---|---|---|---|
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10689+50 |
| | To: | Sta. | 10690+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 6' - 0" | 3' - 0" | | 13’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10690+00 |
| | To: | Sta. | 10692+40 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 6' - 0" | 3' - 0" | | 23’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10692+40 |
| | To: | Sta. | 10695+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 6' - 0" | 3' - 0" | | 30’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10695+00 |
| | To: | Sta. | 10697+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 6' - 0" | 3' - 0" | | 23’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10697+00 |
| | To: | Sta. | 10698+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 6' - 0" | 3' - 0" | | 13’ |


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| PILE EXCAVATION | | | |
|---|---|---|---|
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10689+50 |
| | To: | Sta. | 10690+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 8' - 0" | 3' - 0" | | 13’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10690+00 |
| | To: | Sta. | 10692+40 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 8' - 0" | 3' - 0" | | 23’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10692+40 |
| | To: | Sta. | 10695+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 8' - 0" | 3' - 0" | | 30’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10695+00 |
| | To: | Sta. | 10697+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 8' - 0" | 3' - 0" | | 23’ |
| Wall # RW-1 | Wall Stations | | |
| | From: | Sta. | 10697+00 |
| | To: | Sta. | 10698+00 |
| Pile Spacing | Hole Ø | | Depth "D" |
| 8' - 0" | 3' - 0" | | 13’ |


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| | | | |
|---|---|---|---|
| Project Name: | RW STA 10690+00 & STA 10697+00 | Date: | 3/20/2013 |
| TIP No.: | P-5208G | Setup by: | TRW |
| Subject: | Cantilevered Solder Pile Wall | Computed By: | TRW |
| Work: | 5-foot Wall Height | Checked By: | XCB |

References:

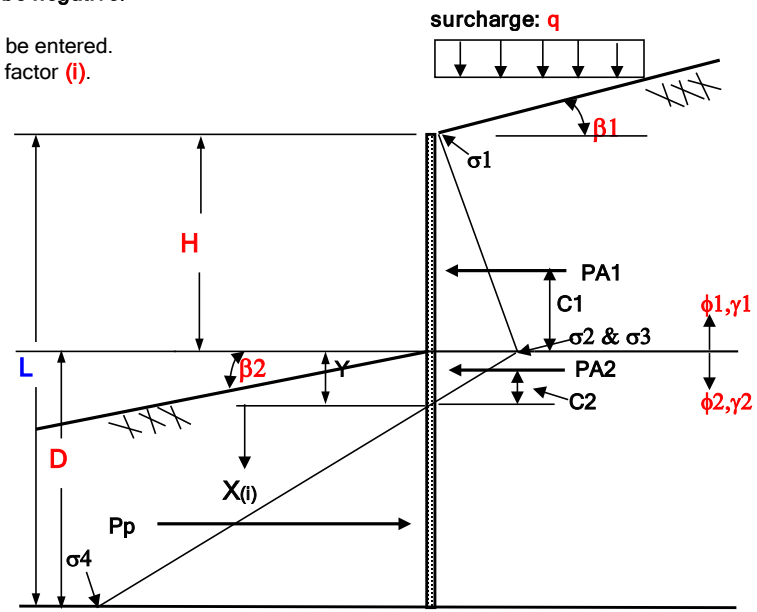
1 Lateral Support Systems and Underpinning, Vol I - Design and Construction. FHWA Report No. FHWA-RD-75-128
2 Kleinfelder Borings RW-1 through RW-8
3 Provided Drawings and Documents Provided by AECOM

**Soldier Pile Retaining Wall Program -** Simplified analysis that assumes the pile rotates about its tip.

* $\gamma_2$ is the effective unit weight below grade. If the water table is somewhere between grade and the pile tip, use a weighted average.
* If you enter a backslope, use zero for surcharge or vise-versa. **Front slope must be negative**.
* The pile diameter equals the shaft diameter if the piles are drilled in.
* The passive influence factor (i) is normally 3 for piles in sand, but other values may be entered.
* For sheet pile analysis, enter 1 for **Pile Diam., Pile Spacing** and passive influence factor **(i)**.

| UNITS= | kips,feet | |
|---|---|---|
| $\gamma_1$= | 0.120 | kcf |
| $\gamma_2$= | 0.110 | kcf |
| $\phi_1$= | 33 | degrees |
| $\phi_2$= | 30 | degrees |
| $\beta_1$= | 0.0 | degrees |
| $\beta_2$= | -26.6 | degrees |
| q= | 0.25 | ksf |
| Pile Dia.= | 3.0 | feet |
| i= | 3.0 | |
| Trial D = | 10.00 | feet |
| Pile Spacing | 6.00 | feet |
| H = | 5.00 | feet |
| X2 | 9.15 | feet |
| b | 2.00 | |

| | | |
|---|---|---|
| Ka1 | 0.295 | |
| Ka2 | 0.333 | |
| Kp | 1.121 | |
| iKp-Ka2 | 3.030 | |
| $\sigma_1$ | 0.074 | ksf |
| $\sigma_2$ | 0.251 | ksf |
| $\sigma_3$ | 0.283 | ksf |
| $\sigma_4$ | 3.333 | ksf |
| Y | 0.850 | feet |
| C1 | 2.045 | feet |
| C2 | 0.567 | feet |
| Pa1 | 4.864 | kips |
| Pa2 | 0.241 | kips |
| X1 | 3.914 | Zero Shear |
| Pp | 5.105 | Zero Shear |




**Max Moment** = $P_{A1}(Y+C_1+X_1)+P_{A2}(C_2+X_1)-P_p(X_1)/3$

= **27.54** kip-feet

**Safety Factor** = $\gamma_2(X_2)^3(IK_p-K_{A2})(b)/(6(C_1+Y+X_1)+P_{A2}(C_2+X_1))$

= **1.40**

**Pile Embedment (ft)** = (Trial D for FS $\geq$1.3)(1.3)

= **13** feet



File: RW_Embed_5 ft Height (6' spacing).xls

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| | | | |
|---|---|---|---|
| Project Name: | RW STA 10692+40 & STA 10695+00 | Date: | 3/20/2013 |
| TIP No.: | P-5208G | Setup by: | TRW |
| Subject: | Cantilevered Solder Pile Wall | Computed By: | TRW |
| Work: | 10-foot Wall Height | Checked By: | XCB |

References:

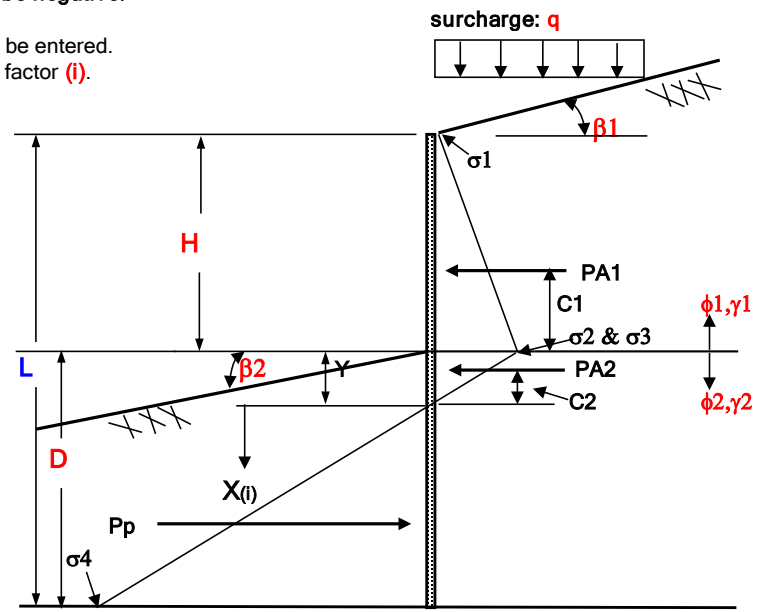
1 Lateral Support Systems and Underpinning, Vol I - Design and Construction. FHWA Report No. FHWA-RD-75-128
2 Kleinfelder Borings RW-1 through RW-8
3 Provided Drawings and Documents Provided by AECOM

**Soldier Pile Retaining Wall Program -** Simplified analysis that assumes the pile rotates about its tip.

* $\gamma_2$ is the effective unit weight below grade. If the water table is somewhere between grade and the pile tip, use a weighted average.
* If you enter a backslope, use zero for surcharge or vise-versa. **Front slope must be negative**.
* The pile diameter equals the shaft diameter if the piles are drilled in.
* The passive influence factor (i) is normally 3 for piles in sand, but other values may be entered.
* For sheet pile analysis, enter 1 for **Pile Diam., Pile Spacing** and passive influence factor **(i)**.

| UNITS= | kips,feet | |
|---|---|---|
| $\gamma_1$= | 0.120 | kcf |
| $\gamma_2$= | 0.110 | kcf |
| $\phi_1$= | 33 | degrees |
| $\phi_2$= | 30 | degrees |
| $\beta_1$= | 0.0 | degrees |
| $\beta_2$= | -26.6 | degrees |
| q= | 0.25 | ksf |
| Pile Dia.= | 3.0 | feet |
| i= | 3.0 | |
| Trial D = | 17.50 | feet |
| Pile Spacing | 6.00 | feet |
| H = | 10.00 | feet |
| X2 | 16.05 | feet |
| b | 2.00 | |

| | | |
|---|---|---|
| Ka1 | 0.295 | |
| Ka2 | 0.333 | |
| Kp | 1.121 | |
| iKp-Ka2 | 3.030 | |
| $\sigma_1$ | 0.074 | ksf |
| $\sigma_2$ | 0.427 | ksf |
| $\sigma_3$ | 0.483 | ksf |
| $\sigma_4$ | 5.833 | ksf |
| Y | 1.450 | feet |
| C1 | 3.824 | feet |
| C2 | 0.967 | feet |
| Pa1 | 15.035 | kips |
| Pa2 | 0.701 | kips |
| X1 | 6.871 | Zero Shear |
| Pp | 15.736 | Zero Shear |




**Max Moment** = $P_{A1}(Y+C_1+X_1)+P_{A2}(C_2+X_1)-P_p(X_1)/3$

= **152.04** kip-feet

**Safety Factor** = $\gamma_2(X_2)^3(IK_p-K_{A2})(b)/(6(C_1+Y+X_1)+P_{A2}(C_2+X_1))$

= **1.38**

**Pile Embedment (ft)** = (Trial D for FS $\geq$1.3)(1.3)

= **23** feet

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| | | | |
|---|---|---|---|
| Project Name: | RW STA 10694+00 | Date: | 3/20/2013 |
| TIP No.: | P-5208G | Setup by: | TRW |
| Subject: | Cantilevered Solder Pile Wall | Computed By: | TRW |
| Work: | 14-foot Wall Height | Checked By: | XCB |

References:

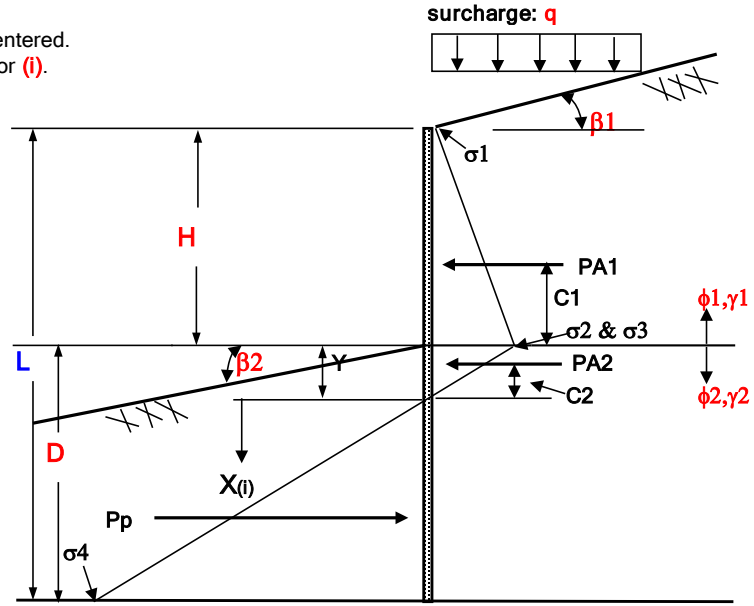
1 Lateral Support Systems and Underpinning, Vol I - Design and Construction. FHWA Report No. FHWA-RD-75-128
2 Kleinfelder Borings RW-1 through RW-8
3 Provided Drawings and Documents Provided by AECOM

**Soldier Pile Retaining Wall Program -** Simplified analysis that assumes the pile rotates about its tip.

* $\gamma_2$ is the effective unit weight below grade. If the water table is somewhere between grade and the pile tip, use a weighted average.
* If you enter a backslope, use zero for surcharge or vise-versa. **Front slope must be negative**.
* The pile diameter equals the shaft diameter if the piles are drilled in.
* The passive influence factor (i) is normally 3 for piles in sand, but other values may be entered.
* For sheet pile analysis, enter 1 for **Pile Diam., Pile Spacing** and passive influence factor **(i)**.

| UNITS= | kips,feet | |
|---|---|---|
| $\gamma_1$= | 0.120 | kcf |
| $\gamma_2$= | 0.110 | kcf |
| $\phi_1$= | 33 | degrees |
| $\phi_2$= | 30 | degrees |
| $\beta_1$= | 0.0 | degrees |
| $\beta_2$= | -26.6 | degrees |
| q= | 0.25 | ksf |
| Pile Dia.= | 3.0 | feet |
| i= | 3.0 | |
| Trial D = | 23.00 | feet |
| Pile Spacing | 6.00 | feet |
| H = | 14.00 | feet |
| X2 | 21.07 | feet |
| b | 2.00 | |

| | | |
|---|---|---|
| Ka1 | 0.295 | |
| Ka2 | 0.333 | |
| Kp | 1.121 | |
| iKp-Ka2 | 3.030 | |
| $\sigma_1$ | 0.074 | ksf |
| $\sigma_2$ | 0.569 | ksf |
| $\sigma_3$ | 0.643 | ksf |
| $\sigma_4$ | 7.666 | ksf |
| Y | 1.930 | feet |
| C1 | 5.202 | feet |
| C2 | 1.287 | feet |
| Pa1 | 26.992 | kips |
| Pa2 | 1.242 | kips |
| X1 | 9.204 | Zero Shear |
| Pp | 28.234 | Zero Shear |




**Max Moment** = $P_{A1}(Y+C_1+X_1)+P_{A2}(C_2+X_1)-P_p(X_1)/3$

= 367.34 kip-feet

**Safety Factor** = $\gamma_2(X_2)^3(IK_p-K_{A2})(b)/(6(C_1+Y+X_1)+P_{A2}(C_2+X_1))$

= 1.32

**Pile Embedment (ft)** = (Trial D for FS ≥1.3)(1.3)

= 30 feet

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| | | | |
|---|---|---|---|
| Project Name: | RW STA 10690+00 & STA 10697+00 | Date: | 3/20/2013 |
| TIP No.: | P-5208G | Setup by: | TRW |
| Subject: | Cantilevered Solder Pile Wall | Computed By: | TRW |
| Work: | 5-foot Wall Height | Checked By: | XCB |

References:

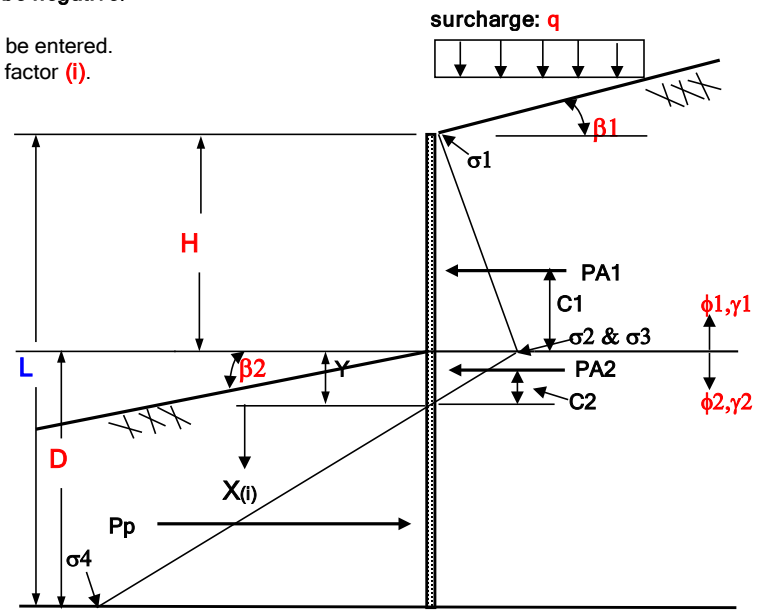
1 Lateral Support Systems and Underpinning, Vol I - Design and Construction. FHWA Report No. FHWA-RD-75-128
2 Kleinfelder Borings RW-1 through RW-8
3 Provided Drawings and Documents Provided by AECOM

**Soldier Pile Retaining Wall Program -** Simplified analysis that assumes the pile rotates about its tip.

* $\gamma_2$ is the effective unit weight below grade. If the water table is somewhere between grade and the pile tip, use a weighted average.
* If you enter a backslope, use zero for surcharge or vise-versa. **Front slope must be negative**.
* The pile diameter equals the shaft diameter if the piles are drilled in.
* The passive influence factor (i) is normally 3 for piles in sand, but other values may be entered.
* For sheet pile analysis, enter 1 for **Pile Diam., Pile Spacing** and passive influence factor **(i)**.

| UNITS= | kips,feet | |
|---|---|---|
| $\gamma_1$= | 0.120 | kcf |
| $\gamma_2$= | 0.110 | kcf |
| $\phi_1$= | 33 | degrees |
| $\phi_2$= | 30 | degrees |
| $\beta_1$= | 0.0 | degrees |
| $\beta_2$= | -26.6 | degrees |
| q= | 0.25 | ksf |
| Pile Dia.= | 3.0 | feet |
| i= | 3.0 | |
| Trial D = | 10.00 | feet |
| Pile Spacing | 8.00 | feet |
| H = | 5.00 | feet |
| X2 | 9.15 | feet |
| b | 2.67 | |

| | | |
|---|---|---|
| Ka1 | 0.295 | |
| Ka2 | 0.333 | |
| Kp | 1.121 | |
| iKp-Ka2 | 3.030 | |
| $\sigma_1$ | 0.074 | ksf |
| $\sigma_2$ | 0.251 | ksf |
| $\sigma_3$ | 0.283 | ksf |
| $\sigma_4$ | 3.333 | ksf |
| Y | 0.850 | feet |
| C1 | 2.045 | feet |
| C2 | 0.567 | feet |
| Pa1 | 6.486 | kips |
| Pa2 | 0.321 | kips |
| X1 | 3.914 | Zero Shear |
| Pp | 6.807 | Zero Shear |




**Max Moment** = $P_{A1}(Y+C_1+X_1)+P_{A2}(C_2+X_1)-P_p(X_1)/3$

= **36.72** kip-feet

**Safety Factor** = $\gamma_2(X_2)^3(IK_p-K_{A2})(b)/(6(C_1+Y+X_1)+P_{A2}(C_2+X_1))$

= **1.40**

**Pile Embedment (ft)** = (Trial D for FS $\geq$1.3)(1.3)

= **13** feet

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| | | | |
|---|---|---|---|
| Project Name: | RW STA 10692+40 & STA 10695+00 | Date: | 3/20/2013 |
| TIP No.: | P-5208G | Setup by: | TRW |
| Subject: | Cantilevered Solder Pile Wall | Computed By: | TRW |
| Work: | 10-foot Wall Height | Checked By: | XCB |

References:

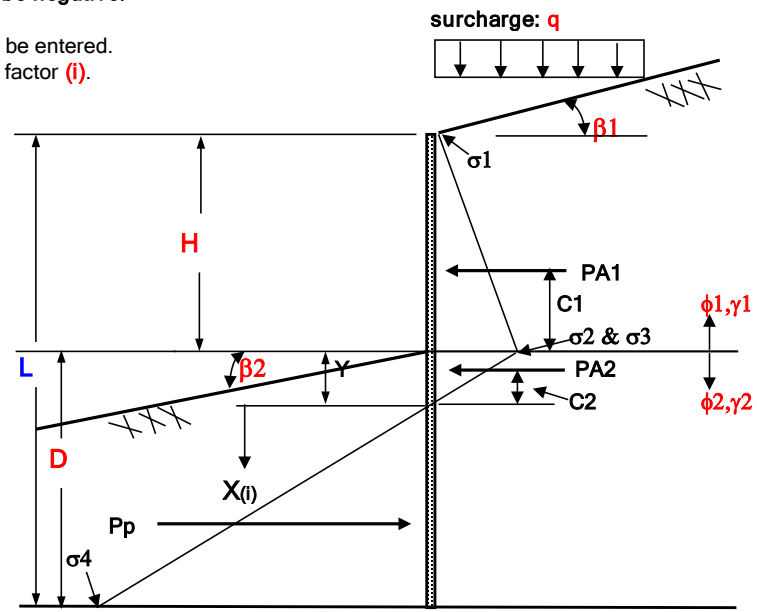
1 Lateral Support Systems and Underpinning, Vol I - Design and Construction. FHWA Report No. FHWA-RD-75-128
2 Kleinfelder Borings RW-1 through RW-8
3 Provided Drawings and Documents Provided by AECOM

**Soldier Pile Retaining Wall Program -** Simplified analysis that assumes the pile rotates about its tip.

* $\gamma_2$ is the effective unit weight below grade. If the water table is somewhere between grade and the pile tip, use a weighted average.
* If you enter a backslope, use zero for surcharge or vise-versa. **Front slope must be negative**.
* The pile diameter equals the shaft diameter if the piles are drilled in.
* The passive influence factor (i) is normally 3 for piles in sand, but other values may be entered.
* For sheet pile analysis, enter 1 for **Pile Diam., Pile Spacing** and passive influence factor **(i)**.

| UNITS= | kips,feet | |
|---|---|---|
| $\gamma_1$= | 0.120 | kcf |
| $\gamma_2$= | 0.110 | kcf |
| $\phi_1$= | 33 | degrees |
| $\phi_2$= | 30 | degrees |
| $\beta_1$= | 0.0 | degrees |
| $\beta_2$= | -26.6 | degrees |
| q= | 0.25 | ksf |
| Pile Dia.= | 3.0 | feet |
| i= | 3.0 | |
| Trial D = | 17.50 | feet |
| Pile Spacing | 8.00 | feet |
| H = | 10.00 | feet |
| X2 | 16.05 | feet |
| b | 2.67 | |

| | | |
|---|---|---|
| Ka1 | 0.295 | |
| Ka2 | 0.333 | |
| Kp | 1.121 | |
| iKp-Ka2 | 3.030 | |
| $\sigma_1$ | 0.074 | ksf |
| $\sigma_2$ | 0.427 | ksf |
| $\sigma_3$ | 0.483 | ksf |
| $\sigma_4$ | 5.833 | ksf |
| Y | 1.450 | feet |
| C1 | 3.824 | feet |
| C2 | 0.967 | feet |
| Pa1 | 20.046 | kips |
| Pa2 | 0.934 | kips |
| X1 | 6.871 | Zero Shear |
| Pp | 20.981 | Zero Shear |




**Max Moment** = $P_{A1}(Y+C_1+X_1)+P_{A2}(C_2+X_1)-P_p(X_1)/3$

= **202.73** kip-feet

**Safety Factor** = $\gamma_2(X_2)^3(IK_p-K_{A2})(b)/(6(C_1+Y+X_1)+P_{A2}(C_2+X_1))$

= **1.38**

**Pile Embedment (ft)** = (Trial D for FS $\geq$1.3)(1.3)

= **23** feet

0041DEL_P10a1
0001ADD_P10a1

| | | | |
|---|---|---|---|
| Project Name: | RW STA 10694+00 | Date: | 3/20/2013 |
| TIP No.: | P-5208G | Setup by: | TRW |
| Subject: | Cantilevered Solder Pile Wall | Computed By: | TRW |
| Work: | 14-foot Wall Height | Checked By: | XCB |

References:

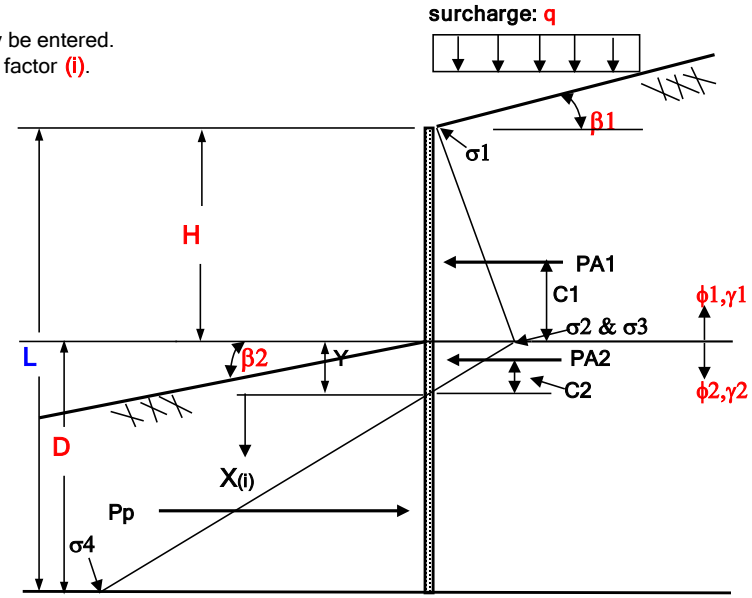
1 Lateral Support Systems and Underpinning, Vol I - Design and Construction. FHWA Report No. FHWA-RD-75-128
2 Kleinfelder Borings RW-1 through RW-8
3 Provided Drawings and Documents Provided by AECOM

**Soldier Pile Retaining Wall Program -** Simplified analysis that assumes the pile rotates about its tip.

* $\gamma 2$ is the effective unit weight below grade. If the water table is somewhere between grade and the pile tip, use a weighted average.
* If you enter a backslope, use zero for surcharge or vise-versa. **Front slope must be negative**.
* The pile diameter equals the shaft diameter if the piles are drilled in.
* The passive influence factor (i) is normally 3 for piles in sand, but other values may be entered.
* For sheet pile analysis, enter 1 for Pile Diam., Pile Spacing and passive influence factor (i).

| UNITS= | kips,feet | |
|---|---|---|
| $\gamma 1$= | 0.120 | kcf |
| $\gamma 2$= | 0.110 | kcf |
| $\phi 1$= | 33 | degrees |
| $\phi 2$= | 30 | degrees |
| $\beta 1$= | 0.0 | degrees |
| $\beta 2$= | -26.6 | degrees |
| q= | 0.25 | ksf |
| Pile Dia.= | 3.0 | feet |
| i= | 3.0 | |
| Trial D = | 23.00 | feet |
| Pile Spacing | 8.00 | feet |
| H = | 14.00 | feet |
| X2 | 21.07 | feet |
| b | 2.67 | |

| | | | |
|---|---|---|---|
| Ka1 | 0.295 | | |
| Ka2 | 0.333 | | |
| Kp | 1.121 | | |
| iKp-Ka2 | 3.030 | | |
| $\sigma 1$ | 0.074 | ksf | |
| $\sigma 2$ | 0.569 | ksf | |
| $\sigma 3$ | 0.643 | ksf | |
| $\sigma 4$ | 7.666 | ksf | |
| Y | 1.930 | feet | |
| C1 | 5.202 | feet | |
| C2 | 1.287 | feet | |
| Pa1 | 35.989 | kips | |
| Pa2 | 1.656 | kips | |
| $X_1$ | 9.204 | | Zero Shear |
| Pp | 37.645 | | Zero Shear |




**Max Moment** = $P_{A1}(Y+C_1+X_1)+P_{A2}(C_2+X_1)-P_p(X_1)/3$

= 489.78 kip-feet

**Safety Factor** = $\gamma_2(X_2)^3(IK_p-K_{A2})(b)/(6(C_1+Y+X_1)+P_{A2}(C_2+X_1))$

= 1.32

**Pile Embedment (ft)** = (Trial D for FS $\geq$1.3)(1.3)

= 30 feet

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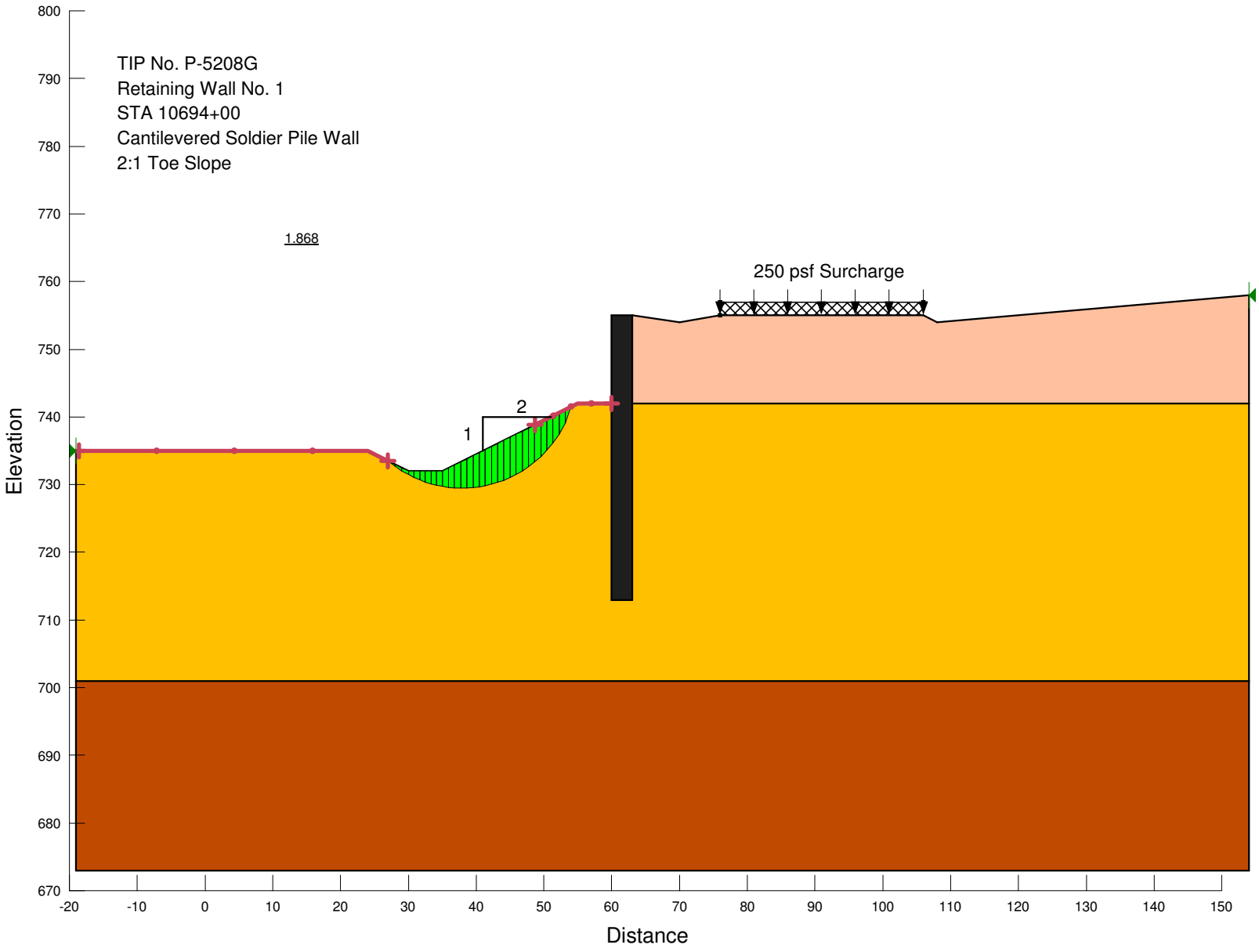
0001ADD_P10a1



0041DEL_P10a1
0001ADD_P10a1

# SLOPE/W Analysis

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## File Information

Created By: Joshua Fregosi
Last Edited By: Joshua Fregosi
Revision Number: 36
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 3/20/2013
Time: 2:55:45 PM
File Name: P-5208G_RW_STA_10694+00.gsz
Directory: C:\Users\JFregosi\Desktop\P-5208G Retaining Wall\
Last Solved Date: 3/20/2013
Last Solved Time: 2:55:46 PM

## Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

## Analysis Settings

### SLOPE/W Analysis

Description: P-5208G Retaining Wall STA 10694+00 (2:1 Toe Slope)
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda

| | |
|---|---|
| Lambda 1: -1 | Lambda 7: 0.2 |
| Lambda 2: -0.8 | Lambda 8: 0.4 |
| Lambda 3: -0.6 | Lambda 9: 0.6 |
| Lambda 4: -0.4 | Lambda 10: 0.8 |
| Lambda 5: -0.2 | Lambda 11: 1 |
| Lambda 6: 0 | |

# Analysis Settings (cont'd)

## SLOPE/W Analysis (cont'd)

PWP Conditions Source: Ru

Slip Surface

Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30
F of S Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

# Materials

## Pile

Model: High Strength
Unit Weight: 1,500 pcf
Pore Water Pressure

Ru: 0

## Residual Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °
Pore Water Pressure

Ru: 0

# Materials (cont'd)

## Residual Soil (2)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Ru: 0

## Deep Soil

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °
Pore Water Pressure
Ru: 0

# Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-18.62559, 735) ft
Left-Zone Right Coordinate: (27, 733.5) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (48.64662, 738.82331) ft
Right-Zone Right Coordinate: (60, 742) ft
Right-Zone Increment: 4
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (-19, 735) ft
Right Coordinate: (154, 758) ft

# Surcharge Loads

## Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

### Coordinates

| | X (ft) | Y (ft) |
|---|---|---|
| | 76 | 755 |
| | 76 | 757 |
| | 106 | 757 |

## Points

| | X (ft) | Y (ft) |
|---|---|---|
| Point 1 | 60 | 755 |
| Point 2 | 63 | 755 |
| Point 3 | 63 | 713 |
| Point 4 | 60 | 713 |
| Point 5 | 70 | 754 |
| Point 6 | 76 | 755 |
| Point 7 | 106 | 755 |
| Point 8 | 108 | 754 |
| Point 9 | 154 | 758 |
| Point 10 | 154 | 742 |
| Point 11 | 63 | 742 |
| Point 12 | 60 | 742 |
| Point 13 | 55 | 742 |
| Point 14 | 35 | 732 |
| Point 15 | 30 | 732 |
| Point 16 | 24 | 735 |
| Point 17 | -19 | 735 |
| Point 18 | -19 | 701 |
| Point 19 | 154 | 701 |
| Point 20 | -19 | 673 |
| Point 21 | 154 | 673 |
| | | |

## Regions

| | Material | Points | Area ($ft^2$) |
|---|---|---|---|
| Region 1 | Pile | 1,2,11,3,4,12 | 126 |
| Region 2 | Residual Soil | 2,5,6,7,8,9,10,11 | 1,221.5 |
| Region 3 | Residual Soil (2) | 11,3,4,12,13,14,15,16,17,18,19,10 | 6,504 |
| Region 4 | Deep Soil | 18,20,21,19 | 4,844 |

## Current Slip Surface

Slip Surface: 114
F of S: 1.868
Volume: 95.342979 $ft^3$
Weight: 10,487.728 lbs
Resisting Moment: 106,189.34 lbs-ft
Activating Moment: 56,861.129 lbs-ft
Resisting Force: 5,527.6653 lbs
Activating Force: 2,960.2004 lbs
F of S Rank: 1
Exit: (27, 733.5) ft
Entry: (54.059378, 741.52969) ft
Radius: 16.858934 ft
Center: (37.906087, 746.35616) ft

## Slip Slices

| | X (ft) | Y (ft) | PWP (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| Slice 1 | 27.5 | 733.10728 | 0 | 22.235041 | 12.837407 | 0 |
| Slice 2 | 28.5 | 732.37811 | 0 | 59.892123 | 34.578733 | 0 |
| Slice 3 | 29.5 | 731.75382 | 0 | 83.047813 | 47.947677 | 0 |
| Slice 4 | 30.416667 | 731.25928 | 0 | 124.42221 | 71.835199 | 0 |
| Slice 5 | 31.25 | 730.87345 | 0 | 186.88694 | 107.89922 | 0 |
| Slice 6 | 32.083333 | 730.54092 | 0 | 240.00219 | 138.56533 | 0 |
| Slice 7 | 32.916667 | 730.25837 | 0 | 282.94911 | 163.36074 | 0 |
| Slice 8 | 33.75 | 730.0232 | 0 | 315.31522 | 182.04733 | 0 |
| Slice 9 | 34.583333 | 729.83338 | 0 | 337.12304 | 194.63808 | 0 |
| Slice 10 | 35.453795 | 729.68284 | 0 | 380.1918 | 219.50384 | 0 |
| Slice 11 | 36.361384 | 729.57433 | 0 | 441.52061 | 254.91204 | 0 |
| Slice 12 | 37.268974 | 729.51539 | 0 | 488.92298 | 282.27981 | 0 |
| Slice 13 | 38.176563 | 729.50551 | 0 | 523.37511 | 302.17076 | 0 |
| Slice 14 | 39.084152 | 729.54459 | 0 | 546.21839 | 315.35934 | 0 |
| Slice 15 | 39.991742 | 729.63299 | 0 | 558.97697 | 322.72551 | 0 |
| Slice 16 | 40.899331 | 729.77149 | 0 | 563.20255 | 325.16514 | 0 |
| Slice 17 | 41.806921 | 729.96136 | 0 | 560.35585 | 323.5216 | 0 |
| Slice 18 | 42.71451 | 730.20443 | 0 | 551.72502 | 318.53859 | 0 |
| Slice 19 | 43.6221 | 730.50315 | 0 | 538.37457 | 310.8307 | 0 |
| Slice 20 | 44.529689 | 730.86074 | 0 | 521.11624 | 300.8666 | 0 |
| Slice 21 | 45.437278 | 731.28143 | 0 | 500.49236 | 288.9594 | 0 |
| Slice 22 | 46.344868 | 731.7707 | 0 | 476.76239 | 275.25889 | 0 |
| Slice 23 | 47.252457 | 732.33576 | 0 | 449.88344 | 259.74033 | 0 |
| Slice 24 | 48.160047 | 732.98631 | 0 | 419.47356 | 242.18317 | 0 |
| Slice 25 | 49.067636 | 733.73568 | 0 | 384.74193 | 222.13086 | 0 |
| Slice 26 | 49.975226 | 734.60302 | 0 | 344.35798 | 198.81517 | 0 |
| Slice 27 | 50.882815 | 735.61738 | 0 | 296.20162 | 171.01208 | 0 |
| Slice 28 | 51.790404 | 736.82693 | 0 | 236.85702 | 136.74947 | 0 |
| Slice 29 | 52.697994 | 738.3238 | 0 | 160.45804 | 92.640493 | 0 |
| Slice 30 | 53.605583 | 740.34458 | 0 | 55.301918 | 31.928577 | 0 |

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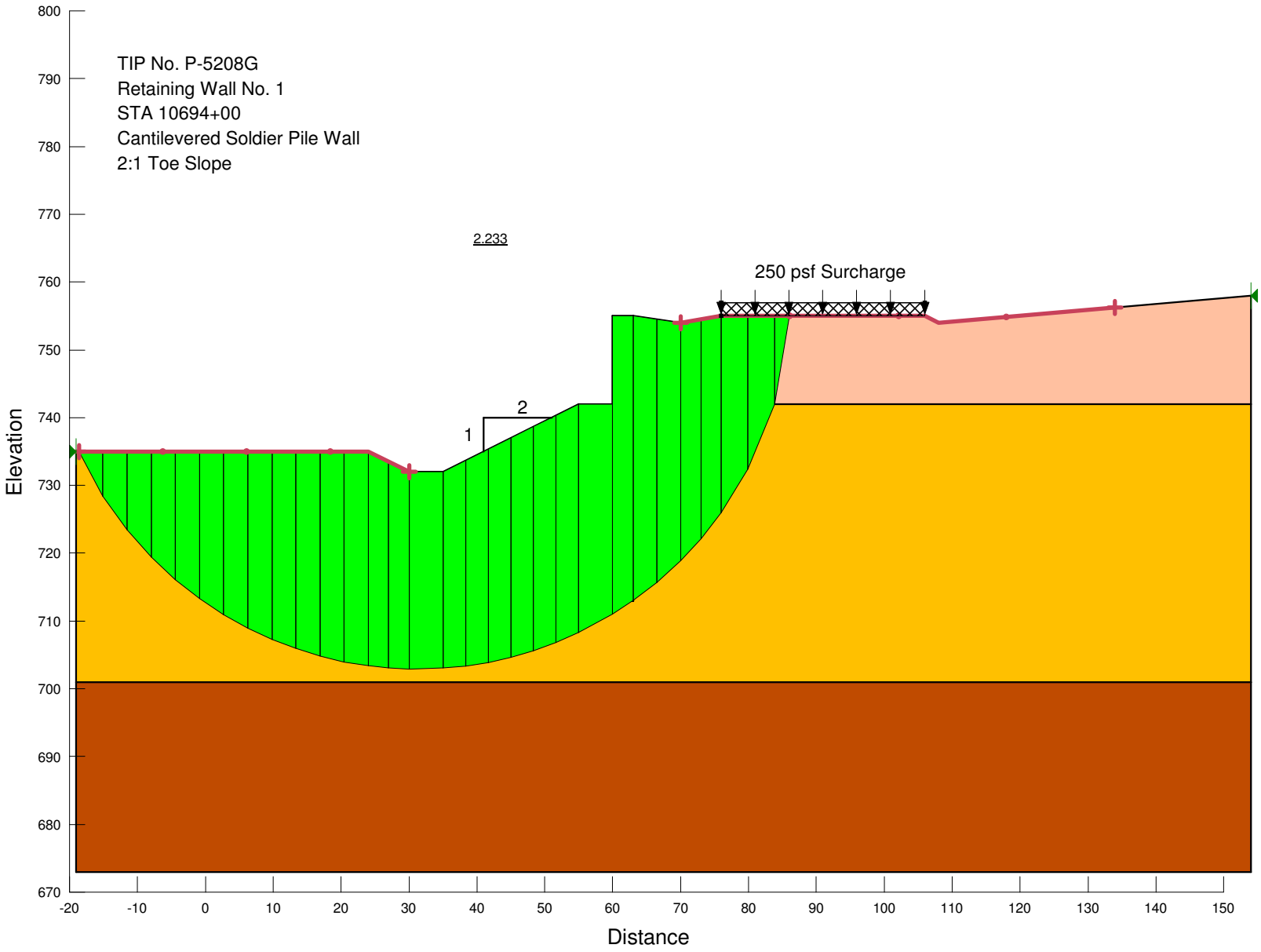

0041DEL_P10a1
0001ADD_P10a1

# SLOPE/W Analysis

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## File Information

Created By: Joshua Fregosi
Last Edited By: Joshua Fregosi
Revision Number: 32
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 3/20/2013
Time: 2:44:41 PM
File Name: P-5208G_RW_STA_10694+00.gsz
Directory: C:\Users\JFregosi\Desktop\P-5208G Retaining Wall\
Last Solved Date: 3/20/2013
Last Solved Time: 2:44:43 PM

## Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

## Analysis Settings

### SLOPE/W Analysis

Description: P-5208G Retaining Wall STA 10694+00 (Global Stability)
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda

| | |
|---|---|
| Lambda 1: -1 | Lambda 7: 0.2 |
| Lambda 2: -0.8 | Lambda 8: 0.4 |
| Lambda 3: -0.6 | Lambda 9: 0.6 |
| Lambda 4: -0.4 | Lambda 10: 0.8 |
| Lambda 5: -0.2 | Lambda 11: 1 |
| Lambda 6: 0 | |

# Analysis Settings (cont'd)

## SLOPE/W Analysis (cont'd)

PWP Conditions Source: Ru

Slip Surface

Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30
F of S Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

# Materials

## Pile

Model: High Strength
Unit Weight: 1,500 pcf
Pore Water Pressure

Ru: 0

## Residual Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °
Pore Water Pressure

Ru: 0

# Materials (cont'd)

## Residual Soil (2)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Ru: 0

## Deep Soil

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °
Pore Water Pressure
Ru: 0

# Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-18.80294, 735) ft
Left-Zone Right Coordinate: (30, 732) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (70.02556, 754.00426) ft
Right-Zone Right Coordinate: (135, 756.34783) ft
Right-Zone Increment: 4
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (-19, 735) ft
Right Coordinate: (154, 758) ft

# Surcharge Loads

## Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

### Coordinates

| | X (ft) | Y (ft) |
|---|---|---|
| | 76 | 755 |
| | 76 | 757 |
| | 106 | 757 |

## Points

| | X (ft) | Y (ft) |
|---|---|---|
| Point 1 | 60 | 755 |
| Point 2 | 63 | 755 |
| Point 3 | 63 | 713 |
| Point 4 | 60 | 713 |
| Point 5 | 70 | 754 |
| Point 6 | 76 | 755 |
| Point 7 | 106 | 755 |
| Point 8 | 108 | 754 |
| Point 9 | 154 | 758 |
| Point 10 | 154 | 742 |
| Point 11 | 63 | 742 |
| Point 12 | 60 | 742 |
| Point 13 | 55 | 742 |
| Point 14 | 35 | 732 |
| Point 15 | 30 | 732 |
| Point 16 | 24 | 735 |
| Point 17 | -19 | 735 |
| Point 18 | -19 | 701 |
| Point 19 | 154 | 701 |
| Point 20 | -19 | 673 |
| Point 21 | 154 | 673 |
| | | |

## Regions

| | Material | Points | Area ($ft^2$) |
|---|---|---|---|
| Region 1 | Pile | 1,2,11,3,4,12 | 126 |
| Region 2 | Residual Soil | 2,5,6,7,8,9,10,11 | 1,221.5 |
| Region 3 | Residual Soil (2) | 11,3,4,12,13,14,15,16,17,18,19,10 | 6,504 |
| Region 4 | Deep Soil | 18,20,21,19 | 4,844 |

## Current Slip Surface

Slip Surface: 10
F of S: 2.249
Volume: 2,852.6023 $ft^3$
Weight: 491,743.94 lbs
Resisting Moment: 18,035,642 lbs-ft
Activating Moment: 8,018,795.5 lbs-ft
Resisting Force: 268,767.44 lbs
Activating Force: 120,858.75 lbs
F of S Rank: 1
Exit: (-18.80294, 735) ft
Entry: (86.291851, 755) ft
Radius: 55.044452 ft
Center: (31.31654, 757.75806) ft

## Slip Slices

| | X (ft) | Y (ft) | PWP (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| Slice 1 | -17.019484 | 731.69273 | 0 | 732.24676 | 422.76287 | 0 |
| Slice 2 | -13.452573 | 725.88074 | 0 | 1,712.2628 | 988.57541 | 0 |
| Slice 3 | -9.8856608 | 721.35731 | 0 | 2,366.08 | 1,366.0569 | 0 |
| Slice 4 | -6.3187492 | 717.66451 | 0 | 2,854.9586 | 1,648.3111 | 0 |
| Slice 5 | -2.7518375 | 714.58311 | 0 | 3,231.0095 | 1,865.4242 | 0 |
| Slice 6 | 0.81507417 | 711.98734 | 0 | 3,518.4836 | 2,031.3975 | 0 |
| Slice 7 | 4.3819858 | 709.79727 | 0 | 3,731.432 | 2,154.3433 | 0 |
| Slice 8 | 7.9488975 | 707.95883 | 0 | 3,879.4673 | 2,239.8115 | 0 |
| Slice 9 | 11.515809 | 706.43391 | 0 | 3,970.0765 | 2,292.1247 | 0 |
| Slice 10 | 15.082721 | 705.19505 | 0 | 4,009.649 | 2,314.972 | 0 |
| Slice 11 | 18.649632 | 704.22226 | 0 | 4,003.9407 | 2,311.6762 | 0 |
| Slice 12 | 22.216544 | 703.50116 | 0 | 3,958.2642 | 2,285.3049 | 0 |
| Slice 13 | 25.5 | 703.04258 | 0 | 3,797.5517 | 2,192.5175 | 0 |
| Slice 14 | 28.5 | 702.80624 | 0 | 3,535.8945 | 2,041.4496 | 0 |
| Slice 15 | 32.5 | 702.78318 | 0 | 3,304.882 | 1,908.0745 | 0 |
| Slice 16 | 36.666667 | 702.99983 | 0 | 3,222.8363 | 1,860.7054 | 0 |
| Slice 17 | 40 | 703.42906 | 0 | 3,237.4466 | 1,869.1407 | 0 |
| Slice 18 | 43.333333 | 704.06848 | 0 | 3,228.3471 | 1,863.8871 | 0 |
| Slice 19 | 46.666667 | 704.92575 | 0 | 3,197.2055 | 1,845.9075 | 0 |
| Slice 20 | 50 | 706.01176 | 0 | 3,145.1562 | 1,815.8568 | 0 |
| Slice 21 | 53.333333 | 707.34135 | 0 | 3,072.7088 | 1,774.0292 | 0 |
| Slice 22 | 57.5 | 709.42346 | 0 | 2,830.3931 | 1,634.1282 | 0 |
| Slice 23 | 61.5 | 711.76207 | 0 | 52,404.216 | 30,255.588 | 0 |
| Slice 24 | 64.75 | 714.08613 | 0 | 3,601.5603 | 2,079.3618 | 0 |
| Slice 25 | 68.25 | 717.01211 | 0 | 3,196.5071 | 1,845.5042 | 0 |
| Slice 26 | 71.5 | 720.20337 | 0 | 2,834.4977 | 1,636.498 | 0 |
| Slice 27 | 74.5 | 723.71088 | 0 | 2,503.8973 | 1,445.6258 | 0 |
| Slice 28 | 78.014295 | 728.86945 | 0 | 2,348.9736 | 1,356.1805 | 0 |
| Slice 29 | 82.042886 | 737.06275 | 0 | 1,539.6868 | 888.93857 | 0 |
| Slice 30 | 85.174516 | 748.5 | 0 | 469.98668 | 305.21292 | 0 |

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0001ADD_P10a1

# STRUCTURE SUBSURFACE INVESTIGATION


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0041DEL_P10a1
0001ADD_P10a1

PROJECT: 50000.1.STR11T1B ID: P-5208G

| STATE | STATE PROJECT REFERENCE NO. | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|
| N.C. | 50000.1.STR11T1B (P-5208G) | 1 | 16 |

# STATE OF NORTH CAROLINA
## DEPARTMENT OF TRANSPORTATION
## DIVISION OF HIGHWAYS
## GEOTECHNICAL ENGINEERING UNIT

# STRUCTURE SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. 50000.1.STR11T1B (P-5208G) F.A. PROJ. N/A

COUNTY MECKLENBERG

PROJECT DESCRIPTION MILLBROOK (MP 365.5) TO JUNKER (MP 372.2) ON THE NCRR/NS MAINLINE

SITE DESCRIPTION RETAINING WALL (-RW1-) FROM STATION 10689+85 TO 10697+93

## CONTENTS


| SHEET | DESCRIPTION |
|---|---|
| 1 | TITLE SHEET |
| 2 | LEGEND |
| 3 | SITE PLAN |
| 4-5 | PROFILES |
| 6-15 | BORING LOG REPORTS |
| 16 | SITE PHOTOGRAPHS |


## CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N.C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION, AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THIS PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

PERSONNEL

R. TOOTHMAN
G. LOWDERMILK
J. FREGOSI
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DATE APRIL 2013

NORTH CAROLINA PROFESSIONAL SEAL 37998 ENGINEER THOMAS R. WELLS 04/22/13

DRAWN BY: W. FELDER

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| PROJECT REFERENCE NO. | SHEET NO. |
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| 50000.1.STRI1TIB (P-5208G) | 2 OF 15 |

# NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
## DIVISION OF HIGHWAYS
## GEOTECHNICAL ENGINEERING UNIT

# SUBSURFACE INVESTIGATION

## SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

### SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

*VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6*

### SOIL LEGEND AND AASHTO CLASSIFICATION

| GENERAL CLASS. | GRANULAR MATERIALS (≤ 35% PASSING #200) | | | | | | | SILT-CLAY MATERIALS (> 35% PASSING #200) | | | | ORGANIC MATERIALS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GROUP CLASS. | A-1 | | A-3 | A-2 | | | | A-4 | A-5 | A-6 | A-7 | A-1, A-2 A-3 | A-4, A-5 A-6, A-7 | |
| | A-1-a | A-1-b | | A-2-4 | A-2-5 | A-2-6 | A-2-7 | | | | A-7-5 A-7-6 | | | |
| SYMBOL | | | | | | | | | | | | | | |
| % PASSING # 10 | 50 MX | | | | | | | | | | | GRANULAR SOILS | SILT-CLAY SOILS | MUCK, PEAT |
| # 40 | 30 MX | 50 MX | 51 MN | | | | | | | | | | | |
| # 200 | 15 MX | 25 MX | 10 MX | 35 MX | 35 MX | 35 MX | 35 MX | 36 MN | 36 MN | 36 MN | 36 MN | | | |
| LIQUID LIMIT | 6 MX | | NP | 40 MX | 41 MN | 40 MX | 41 MN | 40 MX | 41 MN | 40 MX | 41 MN | SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER | | HIGHLY ORGANIC SOILS |
| PLASTIC INDEX | | | | 10 MX | 10 MX | 11 MN | 11 MN | 10 MX | 10 MX | 11 MN | 11 MN | | | |
| GROUP INDEX | 0 | | 0 | 0 | | 4 MX | | 8 MX | 12 MX | 16 MX | No MX | | | |
| USUAL TYPES OF MAJOR MATERIALS | STONE FRAGS. GRAVEL, AND SAND | | FINE SAND | SILTY OR CLAYEY GRAVEL AND SAND | | | | SILTY SOILS | | CLAYEY SOILS | | | | |
| GEN. RATING AS A SUBGRADE | EXCELLENT TO GOOD | | | | | | | FAIR TO POOR | | | | FAIR TO POOR | POOR | UNSUITABLE |

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

### CONSISTENCY OR DENSENESS

| PRIMARY SOIL TYPE | COMPACTNESS OR CONSISTENCY | RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE) | RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT$^2$) |
|---|---|---|---|
| GENERALLY GRANULAR MATERIAL (NON-COHESIVE) | VERY LOOSE<br>LOOSE<br>MEDIUM DENSE<br>DENSE<br>VERY DENSE | <4<br>4 TO 10<br>10 TO 30<br>30 TO 50<br>>50 | N/A |
| GENERALLY SILT-CLAY MATERIAL (COHESIVE) | VERY SOFT<br>SOFT<br>MEDIUM STIFF<br>STIFF<br>VERY STIFF<br>HARD | <2<br>2 TO 4<br>4 TO 8<br>8 TO 15<br>15 TO 30<br>>30 | <0.25<br>0.25 TO 0.50<br>0.5 TO 1.0<br>1 TO 2<br>2 TO 4<br>>4 |

### TEXTURE OR GRAIN SIZE

| U.S. STD. SIEVE SIZE | 4 | 10 | 40 | 60 | 200 | 270 |
|---|---|---|---|---|---|---|
| OPENING (MM) | 4.76 | 2.00 | 0.42 | 0.25 | 0.075 | 0.053 |

| BOULDER (BLDR.) | COBBLE (COB.) | GRAVEL (GR.) | COARSE SAND (CSE. SD.) | FINE SAND (F SD.) | SILT (SL.) | CLAY (CL.) |
|---|---|---|---|---|---|---|

GRAIN SIZE MM: 305 | 75 | 2.0 | 0.25 | 0.05 | 0.005
GRAIN SIZE IN.: 12 | 3

### SOIL MOISTURE - CORRELATION OF TERMS

| SOIL MOISTURE SCALE (ATTERBERG LIMITS) | FIELD MOISTURE DESCRIPTION | GUIDE FOR FIELD MOISTURE DESCRIPTION |
|---|---|---|
| | - SATURATED - (SAT.) | USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE |
| LL — LIQUID LIMIT<br>PLASTIC RANGE (PI)<br>PL — PLASTIC LIMIT | - WET - (W) | SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE |
| OM — OPTIMUM MOISTURE<br>SL — SHRINKAGE LIMIT | - MOIST - (M) | SOLID; AT OR NEAR OPTIMUM MOISTURE |
| | - DRY - (D) | REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE |

### PLASTICITY

| | PLASTICITY INDEX (PI) | DRY STRENGTH |
|---|---|---|
| NONPLASTIC | 0-5 | VERY LOW |
| LOW PLASTICITY | 6-15 | SLIGHT |
| MED. PLASTICITY | 16-25 | MEDIUM |
| HIGH PLASTICITY | 26 OR MORE | HIGH |

### COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

### GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORM (POORLY GRADED) - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

### ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

### MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

### COMPRESSIBILITY

| | |
|---|---|
| SLIGHTLY COMPRESSIBLE | LIQUID LIMIT LESS THAN 31 |
| MODERATELY COMPRESSIBLE | LIQUID LIMIT EQUAL TO 31-50 |
| HIGHLY COMPRESSIBLE | LIQUID LIMIT GREATER THAN 50 |

### PERCENTAGE OF MATERIAL

| ORGANIC MATERIAL | GRANULAR SOILS | SILT - CLAY SOILS |
|---|---|---|
| TRACE OF ORGANIC MATTER | 2 - 3% | 3 - 5% |
| LITTLE ORGANIC MATTER | 3 - 5% | 5 - 12% |
| MODERATELY ORGANIC | 5 - 10% | 12 - 20% |
| HIGHLY ORGANIC | >10% | >20% |

| OTHER MATERIAL | |
|---|---|
| TRACE | 1 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| HIGHLY | 35% AND ABOVE |

### GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

### MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT DPT DMT VST PMT TEST BORING
- AUGER BORING
- CORE BORING
- MW MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING W/ CORE
- SPT N-VALUE
- REF SPT REFUSAL

### ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
$w$ - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
$\gamma$ - UNIT WEIGHT
$\gamma_d$ - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS
S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

### EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] MOBILE B-___
- [ ] BK-51
- [ ] CME-45C
- [ ] CME-550
- [ ] PORTABLE HOIST
- [x] CME-55
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [x] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [ ] TRICONE ____" STEEL TEETH
- [ ] TRICONE ____" TUNG.-CARB.
- [ ] CORE BIT
- [ ] _____

HAMMER TYPE:
- [x] AUTOMATIC
- [ ] MANUAL

CORE SIZE:
- [ ] -B_____
- [ ] -N_____
- [ ] -H_____

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

### ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

| | |
|---|---|
| WEATHERED ROCK (WR) | NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED. |
| CRYSTALLINE ROCK (CR) | FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC. |
| NON-CRYSTALLINE ROCK (NCR) | FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC. |
| COASTAL PLAIN SEDIMENTARY ROCK (CP) | COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC. |

### WEATHERING

| | |
|---|---|
| FRESH | ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE. |
| VERY SLIGHT (V SLI.) | ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE. |
| SLIGHT (SLI.) | ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS. |
| MODERATE (MOD.) | SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK. |
| MODERATELY SEVERE (MOD. SEV.) | ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL* |
| SEVERE (SEV.) | ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF* |
| VERY SEVERE (V SEV.) | ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF* |
| COMPLETE | ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE. |

### ROCK HARDNESS

| | |
|---|---|
| VERY HARD | CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK. |
| HARD | CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN. |
| MODERATELY HARD | CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS. |
| MEDIUM HARD | CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK. |
| SOFT | CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE. |
| VERY SOFT | CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL. |

### FRACTURE SPACING

| TERM | SPACING |
|---|---|
| VERY WIDE | MORE THAN 10 FEET |
| WIDE | 3 TO 10 FEET |
| MODERATELY CLOSE | 1 TO 3 FEET |
| CLOSE | 0.16 TO 1 FEET |
| VERY CLOSE | LESS THAN 0.16 FEET |

### BEDDING

| TERM | THICKNESS |
|---|---|
| VERY THICKLY BEDDED | > 4 FEET |
| THICKLY BEDDED | 1.5 - 4 FEET |
| THINLY BEDDED | 0.16 - 1.5 FEET |
| VERY THINLY BEDDED | 0.03 - 0.16 FEET |
| THICKLY LAMINATED | 0.008 - 0.03 FEET |
| THINLY LAMINATED | < 0.008 FEET |

### INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

| | |
|---|---|
| FRIABLE | RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE. |
| MODERATELY INDURATED | GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER. |
| INDURATED | GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER. |
| EXTREMELY INDURATED | SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS. |

### TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION. AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: BM-108 (567371FT N, 1485018 FT E)

ELEVATION: 747.49

NOTES: FIAD - FILLED IN AFTER DRILLING

REVISED 09/23/09

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# SITE PLAN

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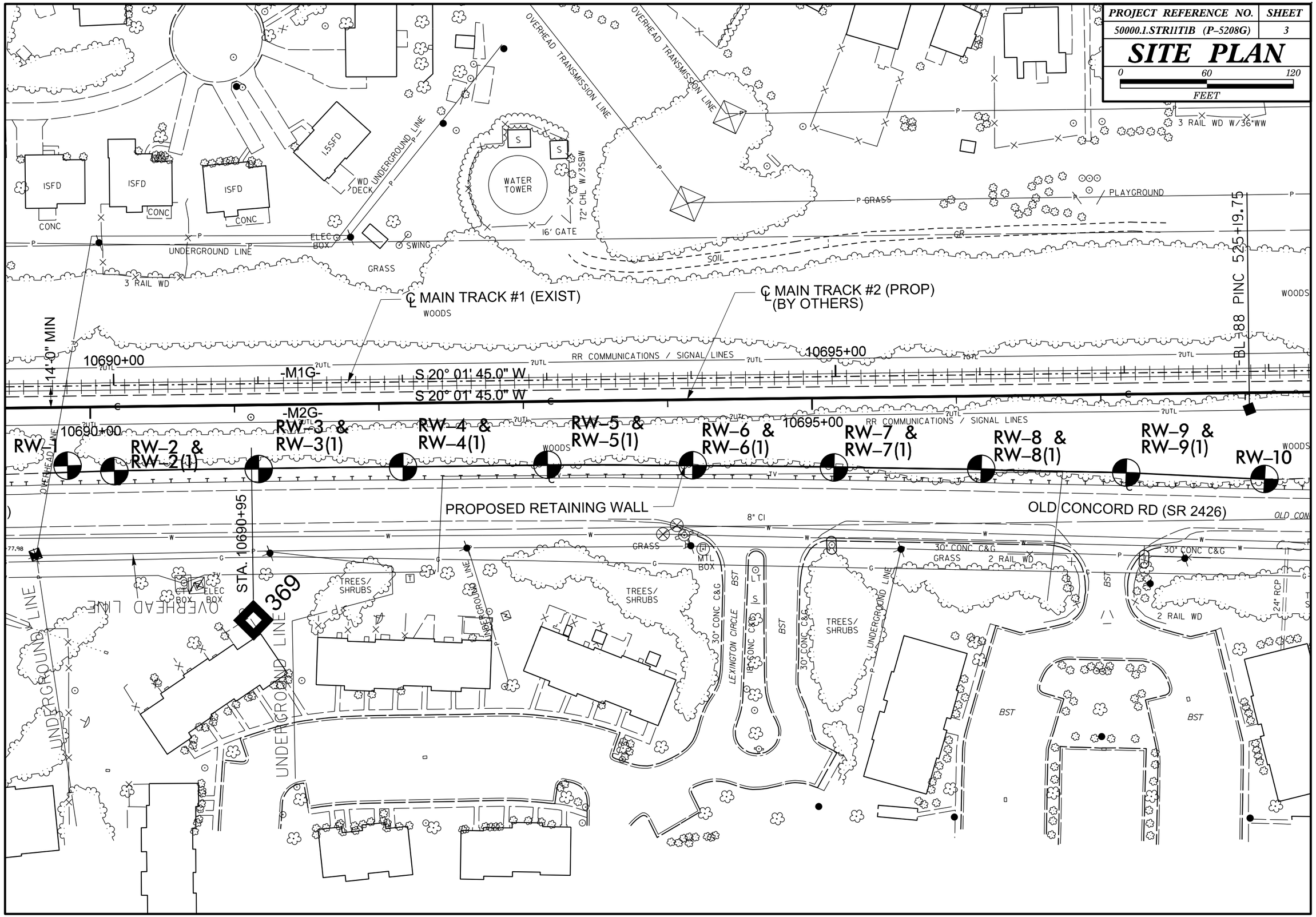

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| PROFILE ALONG -RW1- | |

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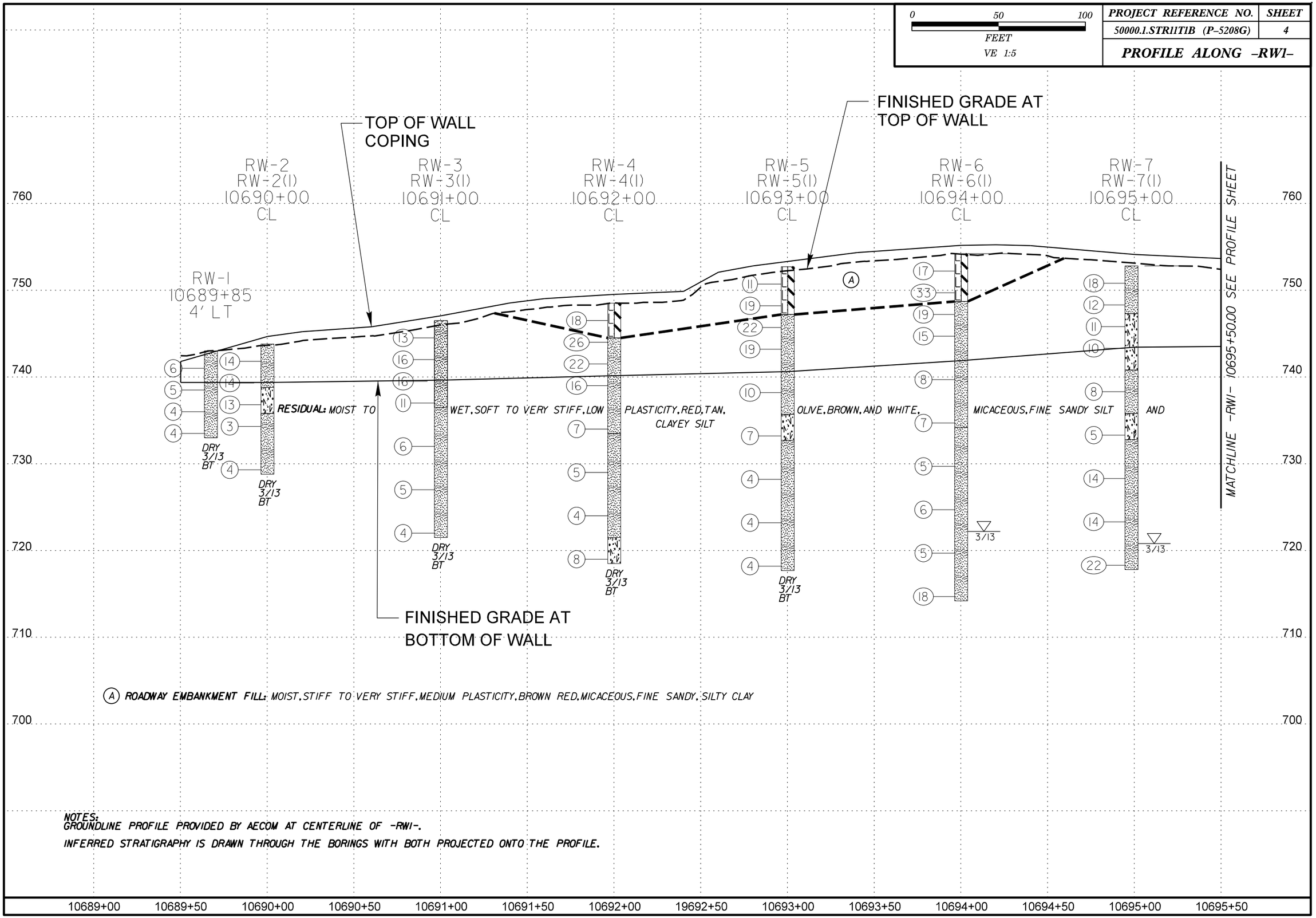


(A) ROADWAY EMBANKMENT FILL: MOIST, STIFF TO VERY STIFF, MEDIUM PLASTICITY, BROWN RED, MICACEOUS, FINE SANDY, SILTY CLAY

NOTES:
GROUNDLINE PROFILE PROVIDED BY AECOM AT CENTERLINE OF -RW1-.
INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

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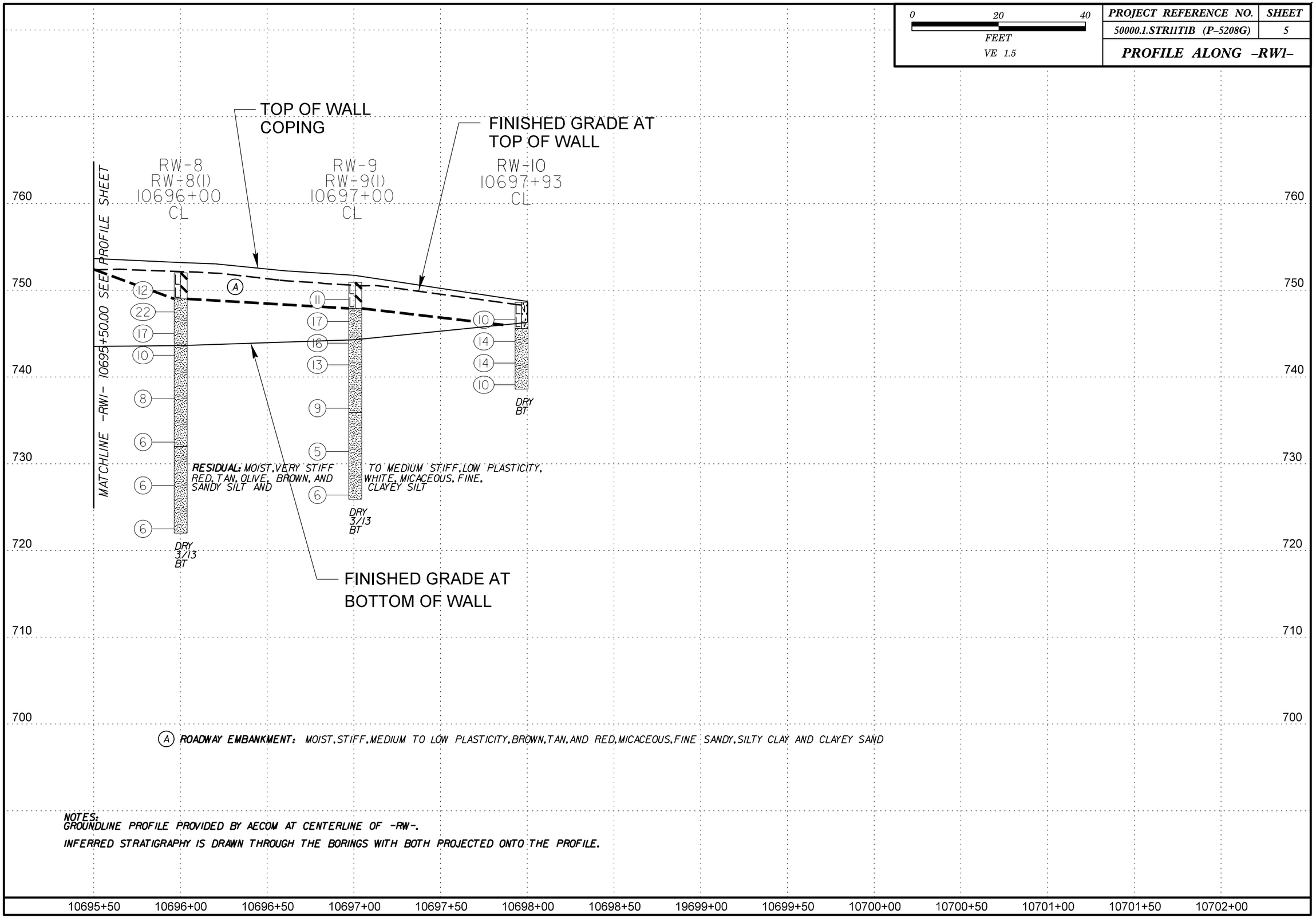
## PROFILE ALONG -RW1-




NOTES:
GROUNDLINE PROFILE PROVIDED BY AECOM AT CENTERLINE OF -RW-.
INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | |
|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-1 | **STATION** 10689+85 | **OFFSET** 4 ft LT | **ALIGNMENT** RET1 — **0 HR.** Dry |
| **COLLAR ELEV.** 743.0 ft | **TOTAL DEPTH** 10.0 ft | **NORTHING** 567,329 | **EASTING** 1,485,068 — **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT (0 25 50 75 100) | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION — ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 745 | | | | | | | | | | | |
| | | | | | | | | | | 743.0 GROUND SURFACE | 0.0 |
| | 742.0 | 1.0 | | | | | | | | **RESIDUAL** Red, Tan, Micaceous, Fine Sandy SILT | |
| 740 | | | 2 | 3 | 3 | 6 | | M | | | |
| | 739.5 | 3.5 | | | | | | | | | |
| | | | 2 | 2 | 3 | 5 | | M | | | |
| | 737.0 | 6.0 | | | | | | | | | |
| | | | 2 | 2 | 2 | 4 | | M | | | |
| 735 | 734.5 | 8.5 | | | | | | | | | |
| | | | 2 | 2 | 2 | 4 | | M | | 733.0 | 10.0 |
| | | | | | | | | | | Boring Terminated at Elevation 733.0 ft in Sandy SILT | |

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# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-2 | **STATION** 10690+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 743.8 ft | **TOTAL DEPTH** 5.0 ft | **NORTHING** 567,300 | **EASTING** 1,485,053 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 745 | | | | | | | | | | 743.8 GROUND SURFACE | 0.0 |
| | 742.8 | 1.0 | 4 | 7 | 7 | 14 | | M | | **RESIDUAL** Red Tan, Fine Sandy SILT | |
| 740 | 740.3 | 3.5 | 4 | 6 | 8 | 14 | | M | | 738.8 | 5.0 |
| | | | | | | | | | | Boring Terminated at Elevation 738.8 ft in Sandy SILT | |

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-2(1) | **STATION** 10690+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 743.8 ft | **TOTAL DEPTH** 15.0 ft | **NORTHING** 567,300 | **EASTING** 1,485,053 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 745 | | | | | | | | | | 743.8 GROUND SURFACE | 0.0 |
| | | | | | | | | | | **RESIDUAL** Red Tan, Fine Sandy SILT | |
| 740 | | | | | | | | | | 738.8 | 5.0 |
| | 737.8 | 6.0 | 3 | 5 | 8 | 13 | | M | | Red and Tan, Clayey, Fine Sandy SILT | |
| 735 | 735.3 | 8.5 | 2 | 1 | 2 | 3 | | M | | 735.8 | 8.0 |
| | | | | | | | | | | Red, Olive, and Brown, Micaceous, Fine Sandy SILT | |
| 730 | 730.3 | 13.5 | 2 | 2 | 2 | 4 | | M | | 728.8 | 15.0 |
| | | | | | | | | | | Boring Terminated at Elevation 728.8 ft in Sandy SILT | |

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# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | |
|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-3 | **STATION** 10691+00 | **OFFSET** CL | **ALIGNMENT** RET1 — **0 HR.** Dry |
| **COLLAR ELEV.** 746.5 ft | **TOTAL DEPTH** 10.0 ft | **NORTHING** 567,206 | **EASTING** 1,485,019 — **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION (ELEV. (ft) / DEPTH (ft)) |
|---|---|---|---|---|---|---|---|---|---|---|
| 750 | | | | | | | | | | |
| | | | | | | | | | | 746.5 GROUND SURFACE 0.0 |
| 745 | 745.5 | 1.0 | 4 | 6 | 7 | 13 | | M | | **RESIDUAL** Olive Tan to Brown Red, Micaceous, Fine Sandy SILT |
| | 743.0 | 3.5 | 3 | 6 | 10 | 16 | | M | | |
| 740 | 740.5 | 6.0 | 4 | 7 | 9 | 16 | | M | | |
| | 738.0 | 8.5 | 3 | 5 | 6 | 11 | | M | | 736.5 10.0 |
| | | | | | | | | | | Boring Terminated at Elevation 736.5 ft in Sandy SILT |

| | | | |
|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-3(1) | **STATION** 10691+00 | **OFFSET** CL | **ALIGNMENT** RET1 — **0 HR.** Dry |
| **COLLAR ELEV.** 746.5 ft | **TOTAL DEPTH** 25.0 ft | **NORTHING** 567,206 | **EASTING** 1,485,019 — **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| 750 | | | | | | | | | | |
| | | | | | | | | | | 746.5 GROUND SURFACE 0.0 |
| 745 | | | | | | | | | | **RESIDUAL** Olive, Tan, Brown Red, and White, Micaceous, Fine Sandy SILT |
| 740 | | | | | | | | | | |
| 735 | 733.0 | 13.5 | 2 | 3 | 3 | 6 | | M | | |
| 730 | 728.0 | 18.5 | 2 | 2 | 3 | 5 | | M | | |
| 725 | 723.0 | 23.5 | 2 | 2 | 2 | 4 | | M | | 721.5 25.0 |
| | | | | | | | | | | Boring Terminated at Elevation 721.5 ft in Sandy SILT |

# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

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|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-4 | **STATION** 10692+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 748.5 ft | **TOTAL DEPTH** 15.0 ft | **NORTHING** 567,112 | **EASTING** 1,484,985 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 750 | | | | | | | | | | 748.5 GROUND SURFACE | 0.0 |
| | 747.5 | 1.0 | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Fine Sandy, Silty CLAY | |
| | | | 5 | 8 | 10 | 18 | | M | | | |
| 745 | 745.0 | 3.5 | | | | | | | | 744.5 **RESIDUAL** Tan, Brown, and Red, Micaceous, Fine Sandy SILT | 4.0 |
| | | | 7 | 11 | 15 | 26 | | M | | | |
| | 742.5 | 6.0 | | | | | | | | | |
| | | | 6 | 10 | 12 | 22 | | M | | | |
| 740 | 740.0 | 8.5 | | | | | | | | | |
| | | | 5 | 7 | 9 | 16 | | M | | | |
| 735 | 735.0 | 13.5 | | | | | | | | | |
| | | | 2 | 3 | 4 | 7 | | M | | 733.5 Boring Terminated at Elevation 733.5 ft in Sandy SILT | 15.0 |

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-4(1) | **STATION** 10692+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 748.5 ft | **TOTAL DEPTH** 30.0 ft | **NORTHING** 567,112 | **EASTING** 1,484,985 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 750 | | | | | | | | | | 748.5 GROUND SURFACE | 0.0 |
| | | | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Fine Sandy, Silty CLAY | |
| 745 | | | | | | | | | | 744.5 **RESIDUAL** Tan, Brown, Red, and Olive, Micaceous, Fine Sandy SILT | 4.0 |
| 740 | | | | | | | | | | | |
| 735 | | | | | | | | | | | |
| 730 | 730.0 | 18.5 | 2 | 2 | 3 | 5 | | M | | | |
| 725 | 725.0 | 23.5 | 2 | 2 | 2 | 4 | | W | | 721.5 Tan, Clayey, Fine Sandy SILT | 27.0 |
| 720 | 720.0 | 28.5 | 2 | 3 | 5 | 8 | | W | | 718.5 Boring Terminated at Elevation 718.5 ft in Sandy SILT | 30.0 |

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# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | |
|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-5 | **STATION** 10693+00 | **OFFSET** CL | **ALIGNMENT** RET1 — **0 HR.** Dry |
| **COLLAR ELEV.** 752.7 ft | **TOTAL DEPTH** 20.0 ft | **NORTHING** 567,018 | **EASTING** 1,484,951 — **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | | |
| | | | | | | | | | | 752.7 GROUND SURFACE | 0.0 |
| | 751.7 | 1.0 | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| 750 | | | 4 | 5 | 6 | 11 | | M | | | |
| | 749.2 | 3.5 | 6 | 8 | 11 | 19 | | M | | | |
| | 746.7 | 6.0 | 7 | 10 | 12 | 22 | | M | | 747.2 — **RESIDUAL** Tan, Brown, and Red, Micaceous, Fine Sandy SILT | 5.5 |
| 745 | 744.2 | 8.5 | 6 | 8 | 11 | 19 | | M | | | |
| 740 | 739.2 | 13.5 | 3 | 4 | 6 | 10 | | M | | | |
| 735 | 734.2 | 18.5 | 2 | 3 | 4 | 7 | | W | | 735.7 — Red, Tan, and Olive, Clayey, Fine Sandy SILT | 17.0 |
| | | | | | | | | | | 732.7 Boring Terminated at Elevation 732.7 ft in Sandy SILT | 20.0 |

| | | | |
|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-5(1) | **STATION** 10693+00 | **OFFSET** CL | **ALIGNMENT** RET1 — **0 HR.** Dry |
| **COLLAR ELEV.** 752.7 ft | **TOTAL DEPTH** 35.0 ft | **NORTHING** 567,018 | **EASTING** 1,484,951 — **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | | |
| | | | | | | | | | | 752.7 GROUND SURFACE | 0.0 |
| 750 | | | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| | | | | | | | | | | 747.2 — **RESIDUAL** Tan, Brown, and Red, Micaceous, Fine Sandy SILT | 5.5 |
| 745 | | | | | | | | | | | |
| 740 | | | | | | | | | | | |
| 735 | | | | | | | | | | 735.7 — Red, Tan, and Olive, Clayey, Fine Sandy SILT | 17.0 |
| | | | | | | | | | | 732.7 — Red, Olive, and Brown to White, Micaceous, Fine Sandy SILT | 20.0 |
| 730 | 729.2 | 23.5 | 1 | 2 | 2 | 4 | | W | | | |
| 725 | 724.2 | 28.5 | 1 | 2 | 2 | 4 | | W | | | |
| 720 | 719.2 | 33.5 | 1 | 2 | 2 | 4 | | W | | 717.7 Boring Terminated at Elevation 717.7 ft in Sandy SILT | 35.0 |

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# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-6 | **STATION** 10694+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 754.2 ft | **TOTAL DEPTH** 20.0 ft | **NORTHING** 566,924 | **EASTING** 1,484,915 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | 754.2 GROUND SURFACE | 0.0 |
| | 753.2 | 1.0 | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| | | | 5 | 8 | 9 | 17 | | M | | | |
| 750 | 750.7 | 3.5 | 9 | 14 | 19 | 33 | | M | | | |
| | 748.2 | 6.0 | 8 | 8 | 11 | 19 | | M | | 748.7 **RESIDUAL** Tan, Brown, and Red, Micaceous, Fine Sandy SILT | 5.5 |
| 745 | 745.7 | 8.5 | 5 | 7 | 8 | 15 | | M | | | |
| 740 | 740.7 | 13.5 | 3 | 4 | 4 | 8 | | M | | | |
| 735 | 735.7 | 18.5 | 2 | 3 | 4 | 7 | | M | | 734.2 Boring Terminated at Elevation 734.2 ft in Sandy SILT | 20.0 |

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-6(1) | **STATION** 10694+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** 32.0 |
| **COLLAR ELEV.** 754.2 ft | **TOTAL DEPTH** 40.0 ft | **NORTHING** 566,924 | **EASTING** 1,484,915 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | 754.2 GROUND SURFACE | 0.0 |
| | | | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| 750 | | | | | | | | | | 748.7 **RESIDUAL** Tan, Brown, Red, Olive, and White, Micaceous, Fine Sandy SILT | 5.5 |
| 745 | | | | | | | | | | | |
| 740 | | | | | | | | | | | |
| 735 | | | | | | | | | | | |
| 730 | 730.7 | 23.5 | 2 | 2 | 3 | 5 | | M | | | |
| 725 | 725.7 | 28.5 | 2 | 3 | 3 | 6 | | M | | | |
| 720 | 720.7 | 33.5 | 2 | 2 | 3 | 5 | | W | | | |
| 715 | 715.7 | 38.5 | 11 | 9 | 9 | 18 | | W | | 714.2 Boring Terminated at Elevation 714.2 ft in Sandy SILT | 40.0 |

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# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-7 | **STATION** 10695+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 752.8 ft | **TOTAL DEPTH** 20.0 ft | **NORTHING** 566,833 | **EASTING** 1,484,879 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | 752.8 GROUND SURFACE | 0.0 |
| | 751.8 | 1.0 | | | | | | | | **RESIDUAL** Tan Red, Micaceous, Fine Sandy SILT | |
| 750 | | | 5 | 8 | 10 | 18 | | M | | | |
| | 749.3 | 3.5 | 5 | 6 | 6 | 12 | | M | | 747.3 Olive and Tan, Clayey, Fine Sandy SILT | 5.5 |
| | 746.8 | 6.0 | 4 | 4 | 7 | 11 | | M | | | |
| 745 | 744.3 | 8.5 | 3 | 4 | 6 | 10 | | M | | | |
| 740 | 739.3 | 13.5 | | | | | | | | 740.8 Olive, Red, and Tan, Fine Sandy SILT | 12.0 |
| | | | 2 | 3 | 5 | 8 | | M | | | |
| 735 | 734.3 | 18.5 | | | | | | | | 735.8 Olive, Clayey, Fine Sandy SILT | 17.0 |
| | | | 2 | 2 | 3 | 5 | | W | | 732.8 Boring Terminated at Elevation 732.8 ft in Sandy SILT | 20.0 |

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-7(1) | **STATION** 10695+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** 32.0 |
| **COLLAR ELEV.** 752.8 ft | **TOTAL DEPTH** 35.0 ft | **NORTHING** 566,833 | **EASTING** 1,484,879 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | 752.8 GROUND SURFACE | 0.0 |
| | | | | | | | | | | **RESIDUAL** Tan Red, Micaceous, Clayey, Fine Sandy SILT | |
| 750 | | | | | | | | | | | |
| | | | | | | | | | | 747.3 Olive and Tan, Clayey, Fine Sandy SILT | 5.5 |
| 745 | | | | | | | | | | | |
| 740 | | | | | | | | | | 740.8 Olive, Red, and Tan, Fine Sandy SILT | 12.0 |
| 735 | | | | | | | | | | 735.8 Olive, Clayey, Fine Sandy SILT | 17.0 |
| | | | | | | | | | | 732.8 **RESIDUAL** Olive, and Brown, Micaceous, Fine Sandy SILT | 20.0 |
| 730 | 729.3 | 23.5 | 4 | 6 | 8 | 14 | | M | | | |
| 725 | 724.3 | 28.5 | 5 | 7 | 7 | 14 | | M | | | |
| 720 | 719.3 | 33.5 | 5 | 10 | 12 | 22 | | M | | 717.8 Boring Terminated at Elevation 717.8 ft in Sandy SILT | 35.0 |

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NCDOT BORE DOUBLE 127855.GPJ NC_DOT.GDT 4/29/13

# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-8 | **STATION** 10696+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 752.0 ft | **TOTAL DEPTH** 20.0 ft | **NORTHING** 566,738 | **EASTING** 1,484,842 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | | |
| | | | | | | | | | | 752.0 GROUND SURFACE | 0.0 |
| 750 | 751.0 | 1.0 | 6 | 6 | 6 | 12 | | M | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| | 748.5 | 3.5 | 6 | 9 | 13 | 22 | | M | | 749.0 | 3.0 |
| 745 | 746.0 | 6.0 | 6 | 7 | 10 | 17 | | M | | **RESIDUAL** Tan, Brown, and Red, Micaceous, Fine Sandy SILT | |
| | 743.5 | 8.5 | 4 | 4 | 6 | 10 | | M | | | |
| 740 | 738.5 | 13.5 | 3 | 4 | 4 | 8 | | M | | | |
| 735 | 733.5 | 18.5 | 3 | 3 | 3 | 6 | | M | | 732.0 | 20.0 |
| | | | | | | | | | | Boring Terminated at Elevation 732.0 ft in Sandy SILT | |

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-8(1) | **STATION** 10696+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 752.0 ft | **TOTAL DEPTH** 30.0 ft | **NORTHING** 566,738 | **EASTING** 1,484,842 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | |
| | | | | | | | | | | 752.0 GROUND SURFACE 0.0 |
| 750 | | | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY |
| | | | | | | | | | | 749.0 3.0 |
| 745 | | | | | | | | | | **RESIDUAL** Tan, Brown, Red, Olive, and White, Micaceous, Fine Sandy SILT |
| 740 | | | | | | | | | | |
| 735 | | | | | | | | | | |
| 730 | 728.5 | 23.5 | 2 | 3 | 3 | 6 | | M | | |
| 725 | 723.5 | 28.5 | 2 | 3 | 3 | 6 | | M | | 722.0 30.0 |
| | | | | | | | | | | Boring Terminated at Elevation 722.0 ft in Sandy SILT |

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# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-9 | **STATION** 10697+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 750.9 ft | **TOTAL DEPTH** 15.0 ft | **NORTHING** 566,645 | **EASTING** 1,484,804 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** TRI0055 CME-55 74% 02/15/2013 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** Toothman, R. E. | **START DATE** 11/30/12 | **COMP. DATE** 11/30/12 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | | |
| 750 | | | | | | | | | | 750.9 GROUND SURFACE | 0.0 |
| | 749.9 | 1.0 | 4 | 5 | 6 | 11 | | M | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| | 747.4 | 3.5 | 5 | 7 | 10 | 17 | | M | | 747.9 **RESIDUAL** Tan, Red, and Olive, Micaceous, Fine Sandy SILT | 3.0 |
| 745 | 744.9 | 6.0 | 6 | 7 | 9 | 16 | | M | | | |
| | 742.4 | 8.5 | 4 | 6 | 7 | 13 | | M | | | |
| 740 | | | | | | | | | | | |
| | 737.4 | 13.5 | 3 | 4 | 5 | 9 | | M | | 735.9 Boring Terminated at Elevation 735.9 ft in Sandy SILT | 15.0 |

| | | | | |
|---|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. | |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-9(1) | **STATION** 10697+00 | **OFFSET** CL | **ALIGNMENT** RET1 | **0 HR.** Dry |
| **COLLAR ELEV.** 750.9 ft | **TOTAL DEPTH** 25.0 ft | **NORTHING** 566,645 | **EASTING** 1,484,804 | **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic | |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A | |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 755 | | | | | | | | | | | |
| 750 | | | | | | | | | | 750.9 GROUND SURFACE | 0.0 |
| | | | | | | | | | | **ROADWAY EMBANKMENT** Brown Red, Micaceous, Fine Sandy, Silty CLAY | |
| | | | | | | | | | | 747.9 **RESIDUAL** Tan, Red, Olive, Brown, and White, Micaceous, Fine Sandy SILT | 3.0 |
| 745 | | | | | | | | | | | |
| 740 | | | | | | | | | | | |
| 735 | | | | | | | | | | | |
| | 732.4 | 18.5 | 2 | 3 | 2 | 5 | | M | | | |
| 730 | | | | | | | | | | | |
| | 727.4 | 23.5 | 2 | 2 | 4 | 6 | | M | | 725.9 Boring Terminated at Elevation 725.9 ft in Sandy SILT | 25.0 |

# NCDOT GEOTECHNICAL ENGINEERING UNIT
# BORELOG REPORT

| | | | |
|---|---|---|---|
| **WBS** 50000.1.STR11T1B | **TIP** P-5208G | **COUNTY** MECKLENBURG | **GEOLOGIST** Fregosi, J. D. |
| **SITE DESCRIPTION** Millbrook to Junker on the NCRR/NS Mainline: Retaining Wall 1 | | | **GROUND WTR (ft)** |
| **BORING NO.** RW-10 | **STATION** 10697+93 | **OFFSET** CL | **ALIGNMENT** RET1 — **0 HR.** Dry |
| **COLLAR ELEV.** 748.6 ft | **TOTAL DEPTH** 10.0 ft | **NORTHING** 566,557 | **EASTING** 1,484,766 — **24 HR.** FIAD |
| **DRILL RIG/HAMMER EFF./DATE** AME6515 CME-55 93% 05/04/2012 | | **DRILL METHOD** H.S. Augers | **HAMMER TYPE** Automatic |
| **DRILLER** D. Harris | **START DATE** 03/13/13 | **COMP. DATE** 03/13/13 | **SURFACE WATER DEPTH** N/A |

| ELEV (ft) | DRIVE ELEV (ft) | DEPTH (ft) | BLOW COUNT 0.5ft | 0.5ft | 0.5ft | BLOWS PER FOOT 0 25 50 75 100 | SAMP. NO. | MOI | LOG | SOIL AND ROCK DESCRIPTION — ELEV. (ft) | DEPTH (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 750 | | | | | | | | | | 748.6 GROUND SURFACE | 0.0 |
| | 747.6 | 1.0 | | | | | | | | **ROADWAY EMBANKMENT** Tan and Red, Micaceous, Clayey, Fine Sandy SILT | |
| | | | 3 | 4 | 6 | 10 | | M | | | |
| 745 | 745.1 | 3.5 | | | | | | | | 745.6 | 3.0 |
| | | | 4 | 6 | 8 | 14 | | M | | **RESIDUAL** Tan and Red, Micaceous, Fine Sandy SILT | |
| | 742.6 | 6.0 | | | | | | | | | |
| | | | 5 | 6 | 8 | 14 | | M | | | |
| 740 | 740.1 | 8.5 | | | | | | | | | |
| | | | 3 | 4 | 6 | 10 | | M | | 738.6 | 10.0 |
| | | | | | | | | | | Boring Terminated at Elevation 738.6 ft in Sandy SILT | |

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# SITE PHOTOGRAPHS

View Looking Upstation along -RW1- from Boring RW-1

View Looking Downstation along -RW1- from Boring RW-10