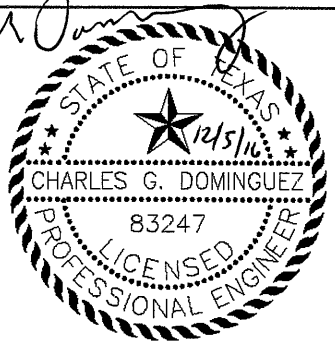
RESPONSE 49

APPENDIX III-3C-1

EXCAVATION STABILITY

EXCAVATION STABILITY

Made By: VK
Checked by: JBF
Reviewed by: CGD



GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

Evaluate the factor of safety against failure of the excavated slopes.

2.0 GIVEN

Based on a review of the design grades, the deepest proposed excavation occurs within Tract 5, Cell 16 and Cell 17. The cross-section in this area consists of a 3H:1V slope from approximate elevation of 593 ft to the toe at an approximate elevation of 541 ft (Section A-A', shown in Figure III 3-4).

SOIL CONDITIONS

For the purposes of this analysis, a conservatively generalized subsurface stratigraphy has been developed based on available laboratory test data and field data from boring logs. The subsurface stratigraphy has been developed using three layers from top to bottom: a residual clay layer, a weathered claystone layer, and an unweathered claystone layer. The analysis is conducted for both total stress and effective stress conditions. The soil strength parameters are obtained from the available laboratory data from testing performed by Jones and Neuse Inc., 1993, except the undrained shear strength of the residual clay for which the Golder 2015 testing data was used, conservatively. Table 1 summarizes the soil parameters used in the analysis.

Table 1 Soil parameters used in the stability analysis

Material	Unit Weight (pcf)		Strength Parameters		Analysis Stress State	Reference
	Moist	Saturated	ϕ (degrees)	c (psf)		
Residual Clay	115	120	0	1700	Total	Golder 2015
			21.6	460	Effective	Jones & Neuse 1993
Weathered Claystone	120	125	16.7	5040	Total	Jones & Neuse 1993
			11	6840	Effective	
Unweathered Claystone	130	130	40.4	5800	Total	Jones & Neuse 1993
			45	7200	Effective	

Note: Jones & Neuse 1993 refers to the previous geotechnical investigation data performed during the MSW-692A permit application, which were based on consolidated undrained triaxial shear testing. Testing results are included in Part III, Attachment 4, Appendix III-4D.

Groundwater level is conservatively assumed to be approximately 10 ft below ground surface, based on the available piezometer data. Within the excavation, the phreatic surface is conservatively assumed to correspond to the excavation grade.

3.0 METHOD

Use SLIDE v.6.0 to analyze excavation stability, based on limit equilibrium methods following Spencer's and GLE/Morgenstern-Price methods of analysis. The results from the method providing the least factor of safety is presented.

4.0 RESULTS

SLIDE output files attached to this appendix.

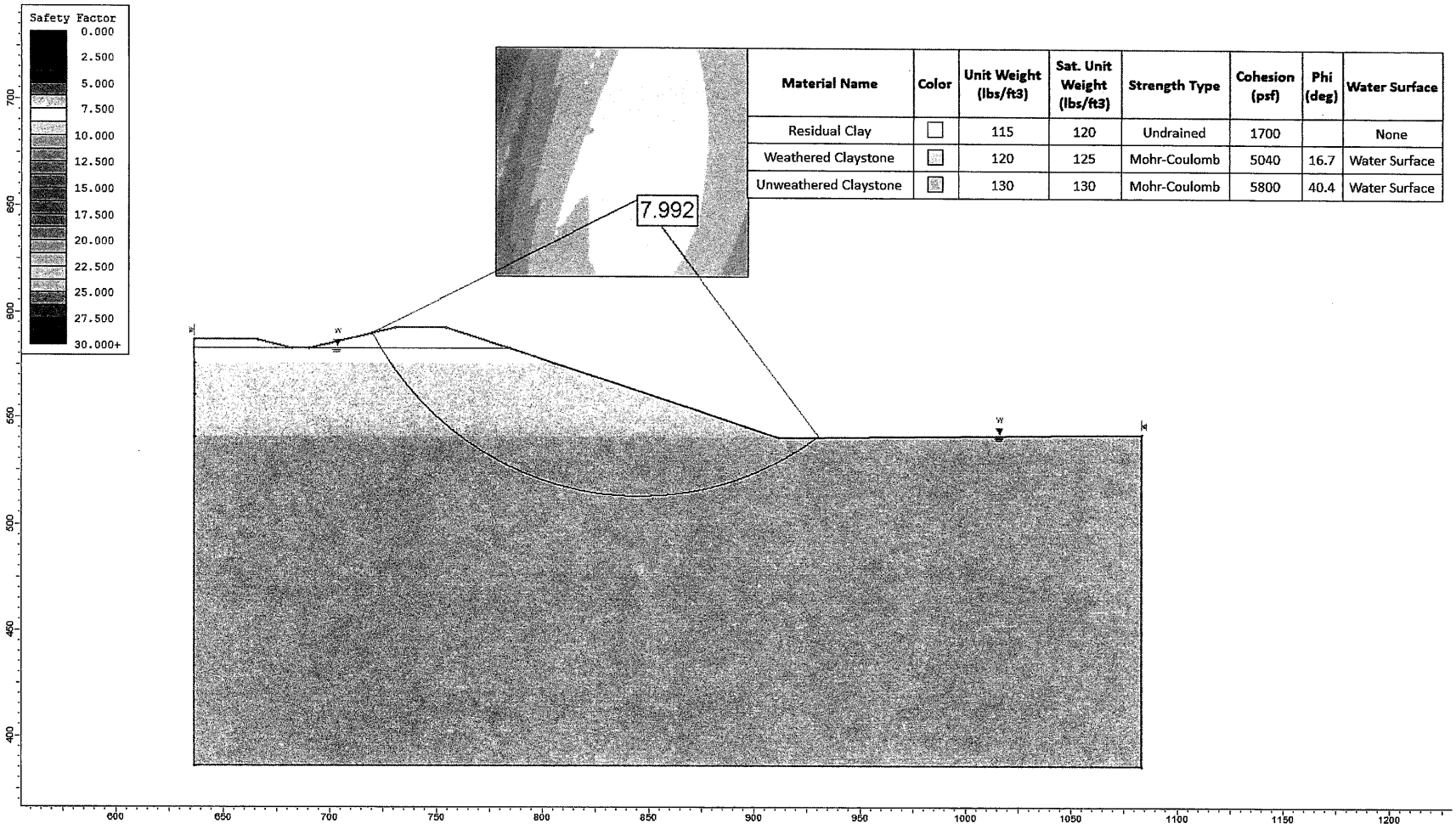
The factor of safety against instability for the slope analyzed is 8.0 for the total stress condition and 4.5 for the effective stress condition. These values are acceptable.
Based on generally accepted industry practice, the minimum allowable factor of safety is 1.5.

5.0 CONCLUSION

Using a generalized cross-section and shear strength parameters from laboratory tests, the analysis indicates that the excavated slopes will be stable.

6.0 REFERENCES

Rocscience 2015, SLIDE - 2D Limit Equilibrium Slope Stability for Soil and Rock Slopes



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Residual Clay		115	120	Undrained	1700		None
Weathered Claystone		120	125	Mohr-Coulomb	5040	16.7	Water Surface
Unweathered Claystone		130	130	Mohr-Coulomb	5800	40.4	Water Surface

FIGURE **3CA.1**

Excavation Stability Analysis - Total Stress Analysis

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Exc Stab_A-A'_Total.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 6/2/2015, 9:53:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
ius Increment: 10
nposite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone
Color			
Strength Type	Undrained	Mohr-Coulomb	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	115	120	130
Saturated Unit Weight [lbs/ft3]	120	125	130
Cohesion [psf]		5040	5800
Friction Angle [deg]		16.7	40.4
Cohesion Type	1700		
Water Surface	None	Water Table	Water Table
Hu Value		1	1
Ru Value	0		

obal Minimums

Method: spencer

FS: 7.991580
Center: 845.775, 654.122
Radius: 141.389
Left Slip Surface Endpoint: 719.642, 590.236
Right Slip Surface Endpoint: 930.567, 540.980
Resisting Moment=2.50398e+008 lb-ft
Driving Moment=3.13327e+007 lb-ft
Resisting Horizontal Force=1.57951e+006 lb
Driving Horizontal Force=197647 lb
Total Slice Area=8256.94 ft2

Method: gle/morgenstern-price

FS: 7.978790
Center: 845.775, 654.122
Radius: 141.389
Left Slip Surface Endpoint: 719.642, 590.236
Right Slip Surface Endpoint: 930.567, 540.980
Resisting Moment=2.49997e+008 lb-ft
Driving Moment=3.13327e+007 lb-ft
Resisting Horizontal Force=1.57789e+006 lb
Driving Horizontal Force=197761 lb
Total Slice Area=8256.94 ft2

Slice Data

oal Minimum Query (spencer) - Safety Factor: 7.99158

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	8.28433	7833.58	Residual Clay	1700	0	212.724	1700	478.682	0	478.682
2	8.32291	22279.4	Weathered Claystone	5040	16.7	659.196	5268.02	1543.03	783.011	760.022
3	8.32291	33099.8	Weathered Claystone	5040	16.7	682.362	5453.15	2803.38	1426.27	1377.11
4	8.32291	42043.6	Weathered Claystone	5040	16.7	703.077	5618.69	3891.44	1962.54	1928.9
5	8.32291	48786.2	Weathered Claystone	5040	16.7	718.663	5743.25	4761.56	2417.49	2344.07
6	8.46745	53749.7	Unweathered Claystone	5800	40.4	983.523	7859.9	5229.92	2809.55	2420.37
7	8.46745	56987.1	Unweathered Claystone	5800	40.4	1001.84	8006.28	5740.49	3148.12	2592.37
8	8.46745	59340.6	Unweathered Claystone	5800	40.4	1015.05	8111.85	6153.16	3436.74	2716.42
9	8.46745	60828.4	Unweathered Claystone	5800	40.4	1035.55	8275.67	6465.14	3556.24	2908.9
10	8.46745	61562.1	Unweathered Claystone	5800	40.4	1056.57	8443.7	6690.68	3584.35	3106.33
11	8.46745	61596.7	Unweathered Claystone	5800	40.4	1073.07	8575.53	6835.98	3574.74	3261.24
12	8.46745	60923.2	Unweathered Claystone	5800	40.4	1084.54	8667.15	6898.5	3529.62	3368.88
13	8.46745	59647.5	Unweathered Claystone	5800	40.4	1091.92	8726.19	6888.82	3450.56	3438.26
14	8.46745	57793.1	Unweathered Claystone	5800	40.4	1095.27	8752.97	6808.43	3338.7	3469.73
15	8.46745	55372.4	Unweathered Claystone	5800	40.4	1094.53	8747.06	6657.51	3194.73	3462.78
16	8.46745	52391.6	Unweathered Claystone	5800	40.4	1089.6	8707.62	6435.46	3019.02	3416.44
17	8.46745	48850.5	Unweathered Claystone	5800	40.4	1080.3	8633.33	6140.7	2811.54	3329.16
18	8.46745	44742.9	Unweathered Claystone	5800	40.4	1066.41	8522.31	5770.65	2571.95	3198.7
19	8.46745	40056.1	Unweathered Claystone	5800	40.4	1047.6	8372	5321.61	2299.52	3022.09
20	8.46745	34770.1	Unweathered Claystone	5800	40.4	1023.45	8178.95	4788.39	1993.13	2795.26
21	8.46745	28856.6	Unweathered Claystone	5800	40.4	993.358	7938.5	4163.9	1651.16	2512.74
22	8.46745	22276.5	Unweathered Claystone	5800	40.4	956.548	7644.33	3438.5	1271.42	2167.08
23	8.46745	15053.7	Unweathered Claystone	5800	40.4	913.042	7296.65	2609.48	850.927	1758.55
24	8.46745	9101.95	Unweathered Claystone	5800	40.4	876.539	7004.93	1931.76	515.968	1415.79

25	8.46745	3190.56	Unweathered Claystone	5800	40.4	838.939	6704.45	1243.59	180.866	1062.72

bal Minimum Query (gle/morgenstern-price) - Safety Factor: 7.97879

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	8.28433	7833.58	Residual Clay	1700	0	213.065	1700	559.483	0	559.483
2	8.32291	22279.4	Weathered Claystone	5040	16.7	665.014	5306.01	1669.65	783.011	886.643
3	8.32291	33099.8	Weathered Claystone	5040	16.7	688.63	5494.44	2940.99	1426.27	1514.72
4	8.32291	42043.6	Weathered Claystone	5040	16.7	706.462	5636.71	3951.48	1962.54	1988.94
5	8.32291	48786.2	Weathered Claystone	5040	16.7	717.981	5728.62	4712.77	2417.49	2295.28
6	8.46745	53749.7	Unweathered Claystone	5800	40.4	968.589	7728.17	5075.14	2809.55	2265.59
7	8.46745	56987.1	Unweathered Claystone	5800	40.4	979.976	7819.02	5520.46	3148.12	2372.34
8	8.46745	59340.6	Unweathered Claystone	5800	40.4	989.487	7894.91	5898.25	3436.74	2461.51
9	8.46745	60828.4	Unweathered Claystone	5800	40.4	1009.81	8057.04	6208.26	3556.24	2652.02
10	8.46745	61562.1	Unweathered Claystone	5800	40.4	1034.05	8250.5	6463.67	3584.35	2879.32
11	8.46745	61596.7	Unweathered Claystone	5800	40.4	1056.7	8431.16	6666.35	3574.74	3091.61
12	8.46745	60923.2	Unweathered Claystone	5800	40.4	1076.54	8589.46	6807.22	3529.62	3277.6
13	8.46745	59647.5	Unweathered Claystone	5800	40.4	1093.63	8725.81	6888.37	3450.56	3437.81
14	8.46745	57793.1	Unweathered Claystone	5800	40.4	1106.97	8832.25	6901.58	3338.7	3562.88
15	8.46745	55372.4	Unweathered Claystone	5800	40.4	1115.39	8899.49	6836.62	3194.73	3641.89
16	8.46745	52391.6	Unweathered Claystone	5800	40.4	1117.69	8917.84	6682.47	3019.02	3663.45
17	8.46745	48850.5	Unweathered Claystone	5800	40.4	1112.71	8878.08	6428.27	2811.54	3616.73
18	8.46745	44742.9	Unweathered Claystone	5800	40.4	1099.46	8772.36	6064.46	2571.95	3492.51
19	8.46745	40056.1	Unweathered Claystone	5800	40.4	1077.25	8595.18	5583.85	2299.52	3284.33
20	8.46745	34770.1	Unweathered Claystone	5800	40.4	1045.81	8344.3	4982.67	1993.13	2989.54
21	8.46745	28856.6	Unweathered Claystone	5800	40.4	1005.35	8021.47	4261.38	1651.16	2610.22
22	8.46745	22276.5	Unweathered Claystone	5800	40.4	956.646	7632.88	3425.05	1271.42	2153.63
23	8.46745	15053.7	Unweathered Claystone	5800	40.4	902.082	7197.52	2493.01	850.927	1642.08
24	8.46745	9101.95	Unweathered Claystone	5800	40.4	855.815	6828.37	1724.3	515.968	1208.33
			Unweathered							

Claystone

terslice Data

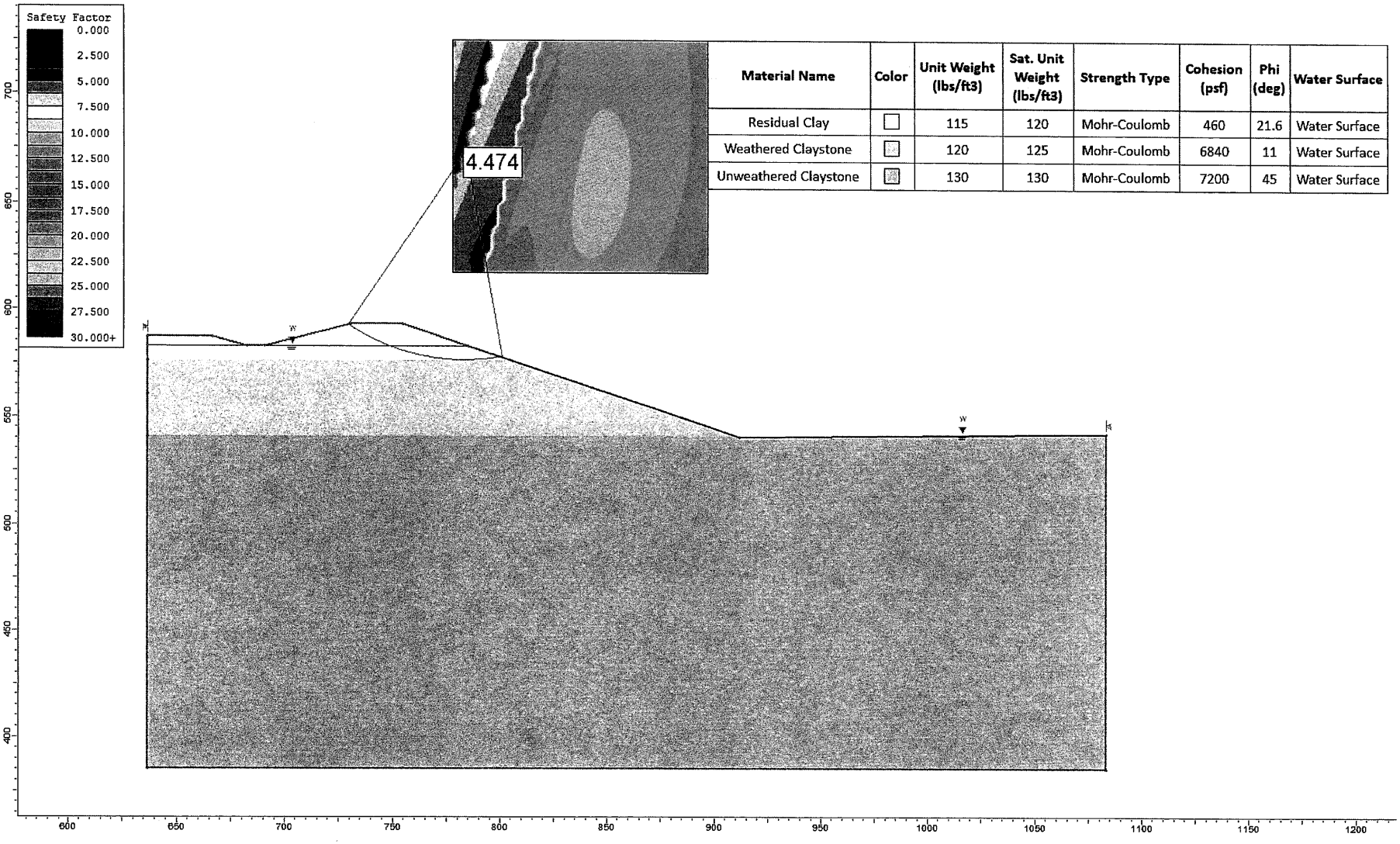
Global Minimum Query (spencer) - Safety Factor: 7.99158

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	719.642	590.236	0	0	0
2	727.926	576.003	5050.96	841.401	9.45762
3	736.249	564.707	16993.9	2830.89	9.45764
4	744.572	555.385	37446.5	6237.92	9.45761
5	752.895	547.519	62207	10362.6	9.45763
6	761.218	540.804	88199.6	14692.5	9.45762
7	769.686	534.953	110471	18402.5	9.45761
8	778.153	529.952	130694	21771.4	9.45766
9	786.62	525.702	148249	24695.7	9.45763
10	795.088	522.131	162571	27081.4	9.4576
11	803.555	519.184	173342	28875.8	9.45765
12	812.023	516.821	180409	30052.9	9.4576
13	820.49	515.012	183701	30601.3	9.45761
14	828.958	513.737	183241	30524.8	9.45765
15	837.425	512.98	179120	29838.3	9.45764
16	845.893	512.733	171494	28567.9	9.45763
17	854.36	512.994	160589	26751.3	9.45762
18	862.827	513.765	146705	24438.5	9.45764
19	871.295	515.055	130230	21694.1	9.45766
20	879.762	516.879	111655	18599.7	9.4576
21	888.23	519.258	91597.8	15258.6	9.45764
22	896.697	522.222	70844.7	11801.5	9.45764
23	905.165	525.811	50401.7	8396.04	9.45763
24	913.632	530.081	31528.5	5252.1	9.45764
25	922.1	535.104	14403.1	2399.3	9.45761
26	930.567	540.98	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 7.97879

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	719.642	590.236	0	0	0
2	727.926	576.003	6197.78	165.151	1.52639
3	736.249	564.707	19521.2	1034.8	3.03435
4	744.572	555.385	41202.9	3236.79	4.49178
5	752.895	547.519	66406.1	6833.22	5.87509
6	761.218	540.804	92075.3	11570.6	7.1625
7	769.686	534.953	113566	16676.2	8.3537
8	778.153	529.952	132872	22015.2	9.40772
9	786.62	525.702	149557	27204.6	10.3095

10	795.088	522.131	163178	31856.4	11.0466
11	803.555	519.184	173469	35638.8	11.6097
12	812.023	516.821	180271	38290.9	11.9918
13	820.49	515.012	183463	39626.9	12.1883
14	828.958	513.737	182986	39552.2	12.1968
15	837.425	512.98	178834	38068.4	12.0172
16	845.893	512.733	171074	35277	11.6516
17	854.36	512.994	159864	31377.1	11.1045
18	862.827	513.765	145481	26655.2	10.3826
19	871.295	515.055	128345	21466.6	9.49523
20	879.762	516.879	109038	16207.1	8.45438
21	888.23	519.258	88327.6	11275.5	7.27477
22	896.697	522.222	67181.8	7030.31	5.97403
23	905.165	525.811	46784.3	3741.56	4.57248
24	913.632	530.081	28499.4	1539.9	3.09284
25	922.1	535.104	12589.7	342.851	1.55993
26	930.567	540.98	0	0	0



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Residual Clay		115	120	Mohr-Coulomb	460	21.6	Water Surface
Weathered Claystone		120	125	Mohr-Coulomb	6840	11	Water Surface
Unweathered Claystone		130	130	Mohr-Coulomb	7200	45	Water Surface

FIGURE **3CA.2**

Excavation Stability Analysis - Effective Stress Analysis

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Exc Stab_A-A'_Effective.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 6/2/2015, 9:53:21 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	115	120	130
Saturated Unit Weight [lbs/ft3]	120	125	130
Cohesion [psf]	460	6840	7200
Friction Angle [deg]	21.6	11	45
Water Surface	Water Table	Water Table	Water Table
Hu Value	0	1	1

Global Minimums

Method: spencer

FS: 4.473560
Center: 783.514, 673.910
Radius: 97.862
Left Slip Surface Endpoint: 729.074, 592.589
Right Slip Surface Endpoint: 800.842, 577.594
Resisting Moment=5.89859e+006 lb-ft
Driving Moment=1.31854e+006 lb-ft
Resisting Horizontal Force=57837.3 lb
Driving Horizontal Force=12928.7 lb
Total Slice Area=558.445 ft2

Method: gle/morgenstern-price

FS: 4.473550
Center: 783.514, 673.910
Radius: 97.862
Left Slip Surface Endpoint: 729.074, 592.589
Right Slip Surface Endpoint: 800.842, 577.594
Resisting Moment=5.89858e+006 lb-ft
Driving Moment=1.31854e+006 lb-ft
Resisting Horizontal Force=57837.5 lb
Driving Horizontal Force=12928.8 lb
Total Slice Area=558.445 ft2

Slice Data

Global Minimum Query (spencer) - Safety Factor: 4.47356

Slice mber	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.87071	392.556	Residual Clay	460	21.6	109.542	490.044	75.8823	0	75.8823
2	2.87071	1009.03	Residual Clay	460	21.6	126.745	567.001	270.254	0	270.254
3	2.87071	1553.49	Residual Clay	460	21.6	142.286	636.526	445.856	0	445.856
4	2.87071	2056.46	Residual Clay	460	21.6	156.942	702.088	611.445	0	611.445
5	2.87071	2520.1	Residual Clay	460	21.6	170.73	763.771	767.237	0	767.237
6	2.87071	2946.24	Residual Clay	460	21.6	183.668	821.648	913.419	0	913.419
7	2.87071	3339.01	Residual Clay	460	21.6	195.84	876.104	1050.96	0	1050.96
8	2.87071	3708.62	Residual Clay	460	21.6	207.515	928.331	1182.87	0	1182.87
9	2.87071	4042.76	Residual Clay	460	21.6	218.319	976.662	1304.94	0	1304.94
10	2.87071	4152.53	Residual Clay	460	21.6	222.724	996.368	1354.71	0	1354.71
11	2.87071	4107.81	Residual Clay	460	21.6	222.629	995.946	1353.65	0	1353.65
12	2.87071	4031.14	Residual Clay	460	21.6	221.561	991.166	1341.57	0	1341.57
13	2.87071	3923.23	Residual Clay	460	21.6	219.52	982.038	1318.52	0	1318.52
14	2.87071	3784.65	Residual Clay	460	21.6	216.508	968.561	1284.48	0	1284.48
15	2.87071	3615.88	Residual Clay	460	21.6	212.52	950.723	1239.42	0	1239.42
16	2.87071	3417.33	Residual Clay	460	21.6	207.553	928.499	1183.29	0	1183.29
17	2.87071	3189.29	Residual Clay	460	21.6	201.595	901.849	1115.98	0	1115.98
18	2.87071	2932	Residual Clay	460	21.6	194.638	870.724	1037.37	0	1037.37
19	2.87071	2645.6	Residual Clay	460	21.6	186.665	835.058	947.287	0	947.287
20	2.87071	2327.92	Residual Clay	460	21.6	177.589	794.454	844.735	0	844.735
21	2.87071	1971.02	Residual Clay	460	21.6	167.135	747.69	726.621	0	726.621
22	2.87071	1583.77	Residual Clay	460	21.6	155.557	695.895	595.802	0	595.802
23	2.87071	1167.26	Residual Clay	460	21.6	142.864	639.111	452.381	0	452.381
24	2.87071	721.244	Residual Clay	460	21.6	129.021	577.184	295.973	0	295.973
25	2.87071	245.413	Residual Clay	460	21.6	113.99	509.939	126.131	0	126.131

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 4.47355

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.87071	392.556	Residual Clay	460	21.6	108.862	486.999	68.1914	0	68.1914
2	2.87071	1009.03	Residual Clay	460	21.6	127.198	569.027	275.371	0	275.371
3	2.87071	1553.49	Residual Clay	460	21.6	143.105	640.187	455.101	0	455.101
4	2.87071	2056.46	Residual Clay	460	21.6	157.654	705.275	619.495	0	619.495
5	2.87071	2520.1	Residual Clay	460	21.6	171.061	765.25	770.972	0	770.972
6	2.87071	2946.24	Residual Clay	460	21.6	183.5	820.896	911.521	0	911.521
7	2.87071	3339.01	Residual Clay	460	21.6	195.183	873.161	1043.53	0	1043.53
8	2.87071	3708.62	Residual Clay	460	21.6	206.47	923.652	1171.05	0	1171.05
9	2.87071	4042.76	Residual Clay	460	21.6	217.048	970.977	1290.58	0	1290.58
10	2.87071	4152.53	Residual Clay	460	21.6	221.454	990.685	1340.36	0	1340.36
11	2.87071	4107.81	Residual Clay	460	21.6	221.596	991.322	1341.97	0	1341.97
12	2.87071	4031.14	Residual Clay	460	21.6	220.942	988.393	1334.57	0	1334.57
13	2.87071	3923.23	Residual Clay	460	21.6	219.424	981.602	1317.42	0	1317.42
14	2.87071	3784.65	Residual Clay	460	21.6	216.968	970.615	1289.66	0	1289.66

15	2.87071	3615.88	Residual Clay	460	21.6	213.495	955.079	1250.43	0	1250.43
16	2.87071	3417.33	Residual Clay	460	21.6	208.929	934.656	1198.85	0	1198.85
17	2.87071	3189.29	Residual Clay	460	21.6	203.204	909.045	1134.16	0	1134.16
18	2.87071	2932	Residual Clay	460	21.6	196.268	878.015	1055.79	0	1055.79
19	2.87071	2645.6	Residual Clay	460	21.6	188.089	841.427	963.376	0	963.376
20	2.87071	2327.92	Residual Clay	460	21.6	178.592	798.939	856.062	0	856.062
21	2.87071	1971.02	Residual Clay	460	21.6	167.548	749.534	731.281	0	731.281
22	2.87071	1583.77	Residual Clay	460	21.6	155.288	694.688	592.756	0	592.756
23	2.87071	1167.26	Residual Clay	460	21.6	141.927	634.919	441.797	0	441.797
24	2.87071	721.244	Residual Clay	460	21.6	127.564	570.665	279.509	0	279.509
25	2.87071	245.413	Residual Clay	460	21.6	112.31	502.423	107.149	0	107.149

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 4.47356

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	729.074	592.589	0	0	0
2	731.944	590.738	-174.045	-28.288	9.23171
3	734.815	589.026	-74.9711	-12.1853	9.23174
4	737.686	587.442	222.68	36.1928	9.23172
5	740.557	585.981	665.805	108.215	9.2317
6	743.427	584.635	1207.92	196.326	9.23169
7	746.298	583.401	1808.18	293.889	9.23173
8	749.169	582.273	2431.35	395.174	9.23171
9	752.039	581.248	3048.42	495.468	9.23171
10	754.91	580.322	3630.13	590.015	9.23171
11	757.781	579.492	4114.8	668.79	9.23172
12	760.652	578.756	4471.9	726.83	9.23171
13	763.522	578.112	4700.24	763.944	9.23173
14	766.393	577.558	4801.2	780.352	9.23171
15	769.264	577.091	4778.56	776.673	9.23172
16	772.134	576.712	4638.56	753.918	9.23172
17	775.005	576.419	4389.81	713.488	9.23172
18	777.876	576.211	4043.34	657.176	9.23173
19	780.747	576.087	3612.68	587.179	9.23172
20	783.617	576.048	3113.9	506.11	9.2317
21	786.488	576.093	2566.01	417.06	9.2317
22	789.359	576.223	1992.17	323.793	9.23172
23	792.229	576.437	1418.05	230.479	9.23169
24	795.1	576.736	872.521	141.813	9.2317
25	797.971	577.122	388.095	63.0781	9.23171
26	800.842	577.594	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 4.47355

X	Y	Interslice	Interslice	Interslice

Number	coordinate [ft]	coordinate - Bottom [ft]	Normal Force [lbs]	Shear Force [lbs]	Force Angle [degrees]
1	729.074	592.589	0	0	0
2	731.944	590.738	-186.273	-4.55736	1.40152
3	734.815	589.026	-79.6817	-3.86825	2.77931
4	737.686	587.442	230.322	16.5511	4.11025
5	740.557	585.981	683.234	64.2528	5.37242
6	743.427	584.635	1229.5	141.073	6.5455
7	746.298	583.401	1827.98	244.271	7.61128
8	749.169	582.273	2444.74	367.714	8.55375
9	752.039	581.248	3052.78	503.157	9.3593
10	754.91	580.322	3624.93	640.269	10.0168
11	757.781	579.492	4101.44	761.447	10.5174
12	760.652	578.756	4453	853.864	10.8547
13	763.522	578.112	4678.71	911.518	11.0244
14	766.393	577.558	4779.42	931.14	11.0244
15	769.264	577.091	4757.98	912.344	10.8547
16	772.134	576.712	4619.45	857.618	10.5174
17	775.005	576.419	4371.4	772.117	10.0168
18	777.876	576.211	4024.18	663.263	9.35931
19	780.747	576.087	3591.19	540.152	8.55376
20	783.617	576.048	3089.03	412.784	7.61129
21	786.488	576.093	2537.83	291.191	6.5455
22	789.359	576.223	1962.28	184.537	5.37242
23	792.229	576.437	1389.65	99.8614	4.11026
24	795.1	576.736	850.042	41.2663	2.77931
25	797.971	577.122	376.198	9.20408	1.40152
26	800.842	577.594	0	0	0

JONES AND NEUSE, INC.
Environmental and Engineering Services

DATE: 3-1-93

REPORT NUMBER: 007819-11-1

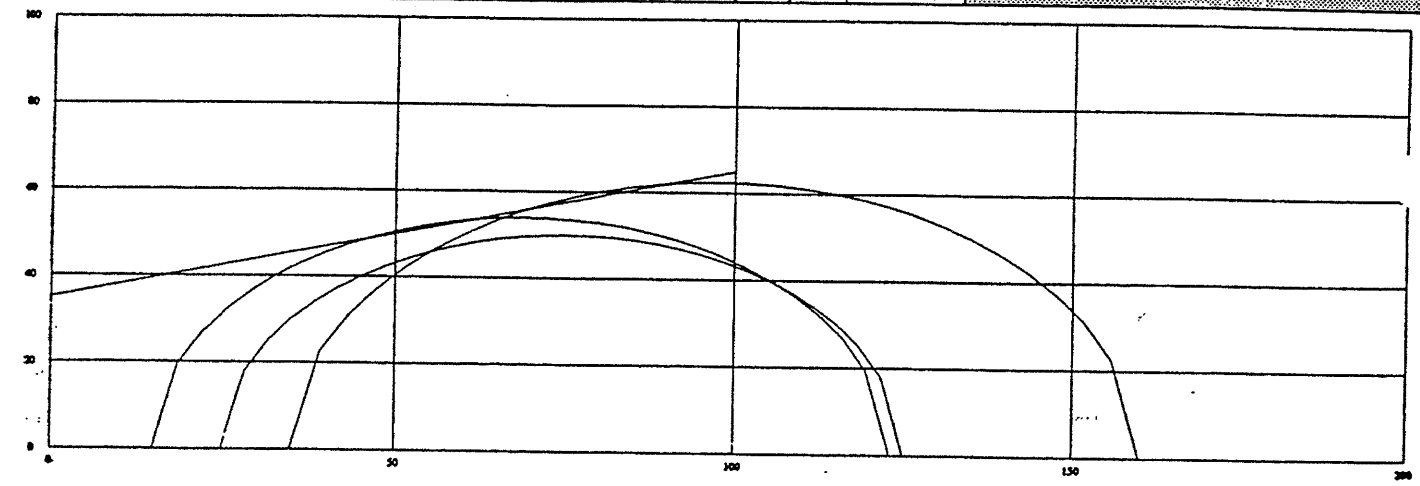
TO: CITY OF TEMPLE
ROMING-PARKER, ASSOCIATES

PROJECT: TEMPLE MUNICIPAL LANDFILL EXPANSION
TEMPLE, TEXAS

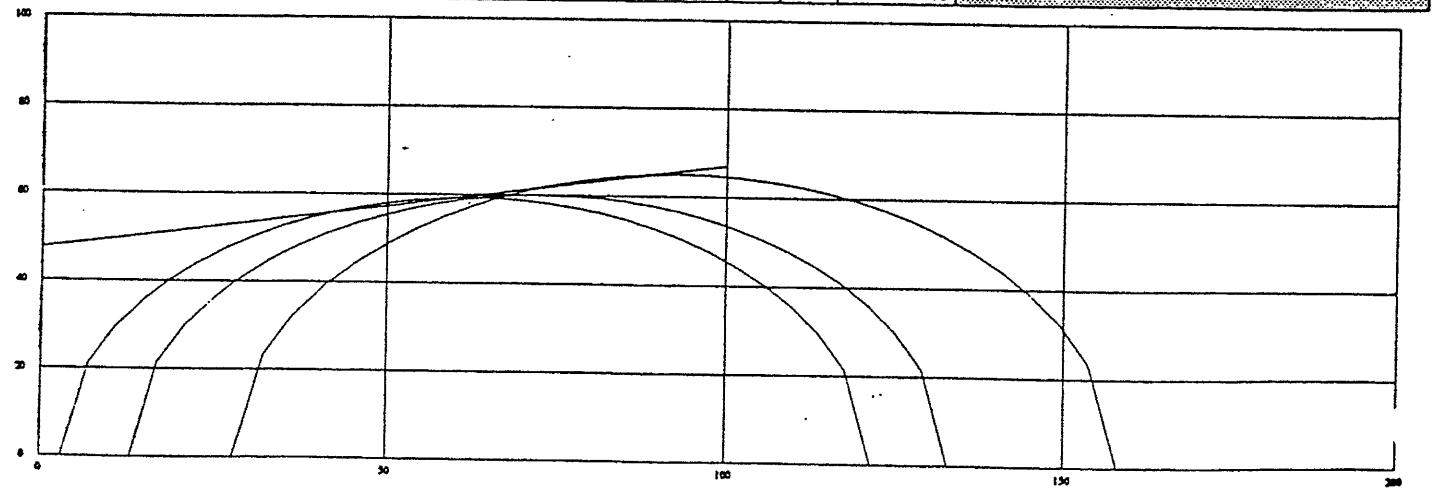
PROJECT NUMBER: 007819.4

TEST STANDARD	ASTM D-4767 CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST		
TEST METHOD	MULTI-STAGE SINGLE SPECIMEN		
SAMPLE TYPE	UNDISTURBED	REMOLDED PARAMETERS	
SAMPLE NUMBER	B1D23	DRY DENSITY(PCF)	-
BORING NUMBER	B-1	MOISTURE CONTENT(%)	-
DEPTH(FT)	23-25	PERCENT COMPACTION	-
		RELATIVE MOISTURE	-

TOTAL STRESS		
TOTAL COHESION(PSI)	35.0	
TOTAL COHESION(PSF)	5040.0	
FRICTION ANGLE(DEG)	16.7	



EFFECTIVE STRESS		
EFFECTIVE COHESION(PSI)	47.5	
EFFECTIVE COHESION(PSF)	6840.0	
FRICTION ANGLE(DEG)	11.0	



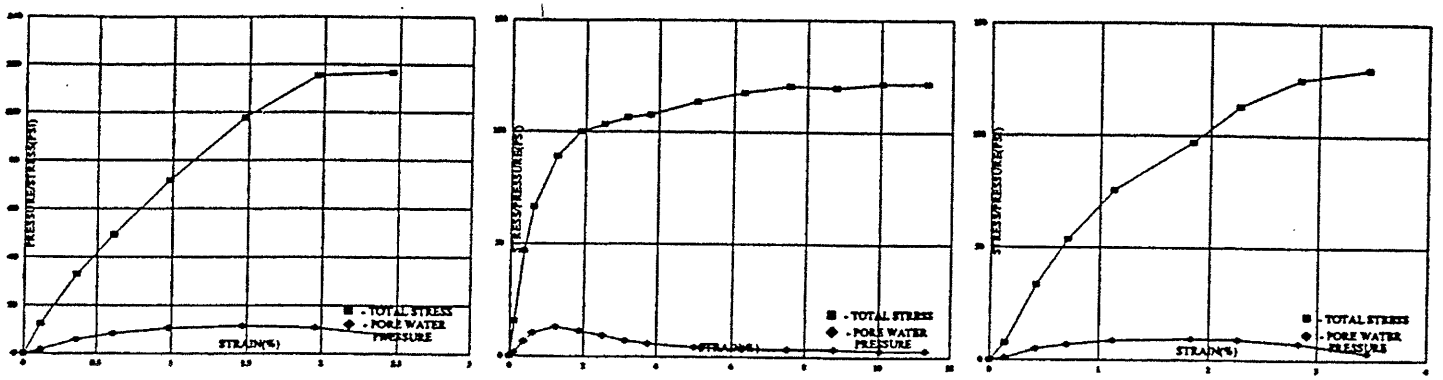
B1D23 PAGE 1/2

TRIAXIAL COMPRESSIVE STRENGTH TEST RESULTS

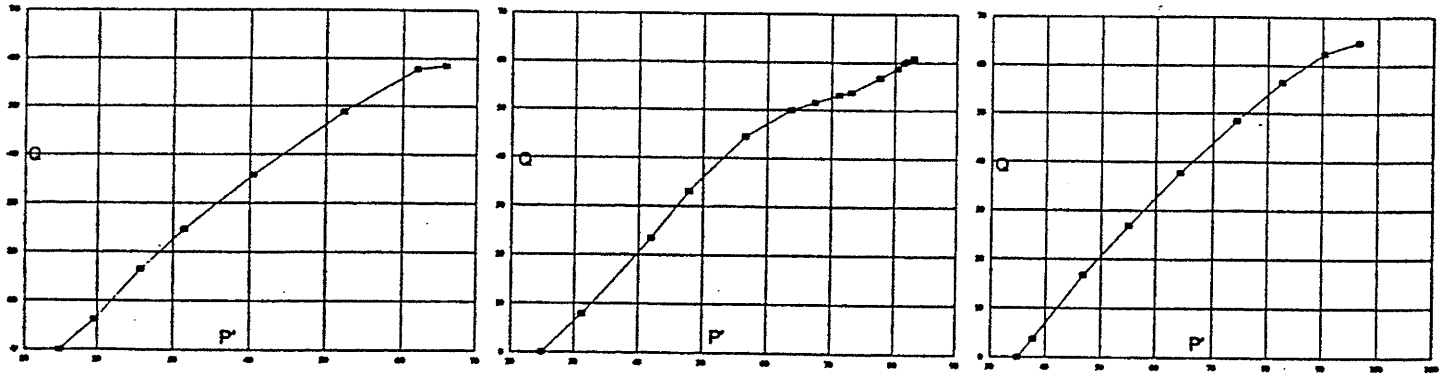
SAMPLE TYPE	UNDISTURBED
SAMPLE NUMBER	B1D23
BORING NUMBER	B-1
SAMPLE DEPTH	23-25

CONDITIONS	INITIAL			FINAL
EFFECTIVE CONFINING PRESSURE(PSI)		15	25	35
HEIGHT(IN)	4.08	4.08	3.98	3.53
DIAMETER(IN)	2.00	2.05	2.11	2.16
VOID RATIO	0.46	0.49	0.51	0.49
SATURATION(%)	100.7			100.1
MOISTURE CONTENT(%)	18.0			18.8
DRY DENSITY(PCF)	110.4			108.6
SPECIFIC GRAVITY	2.59			
CONFINING PRESSURE(PSI)		65	75	85
BACK PRESSURE(PSI)		50	50	50
MAX. DEVIATOR STRESS(PSI)		108	100	125
INDUCED PORE WATER PRESSURE(PSI)		12	12	7

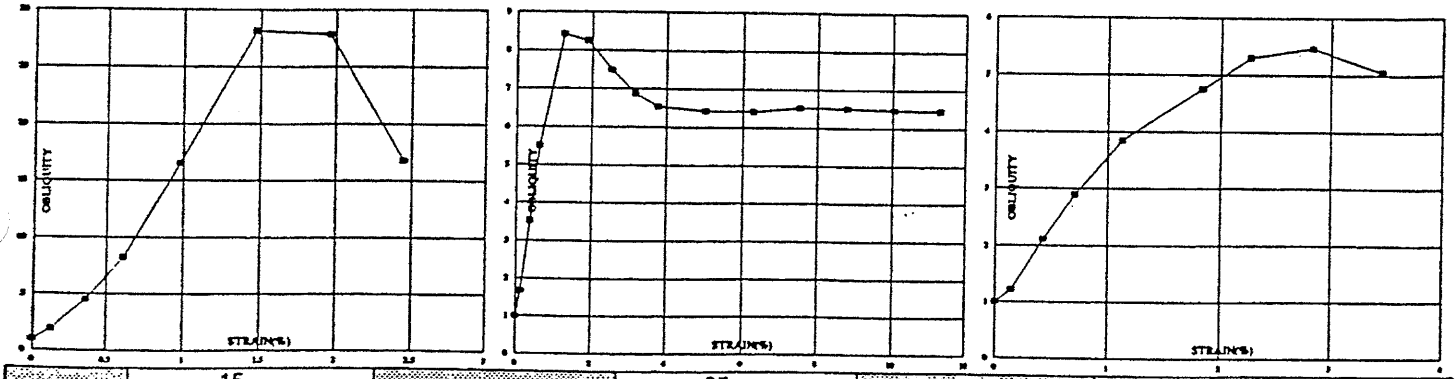
STRESS & INDUCED PORE WATER PRESSURE Vs. STRAIN



P'-Q DIAGRAMS



OBLIQUITY Vs. STRAIN



JONES AND NEUSE, INC.
Environmental and Engineering Services

DATE: 3-1-93

REPORT NUMBER: 007819-11-1

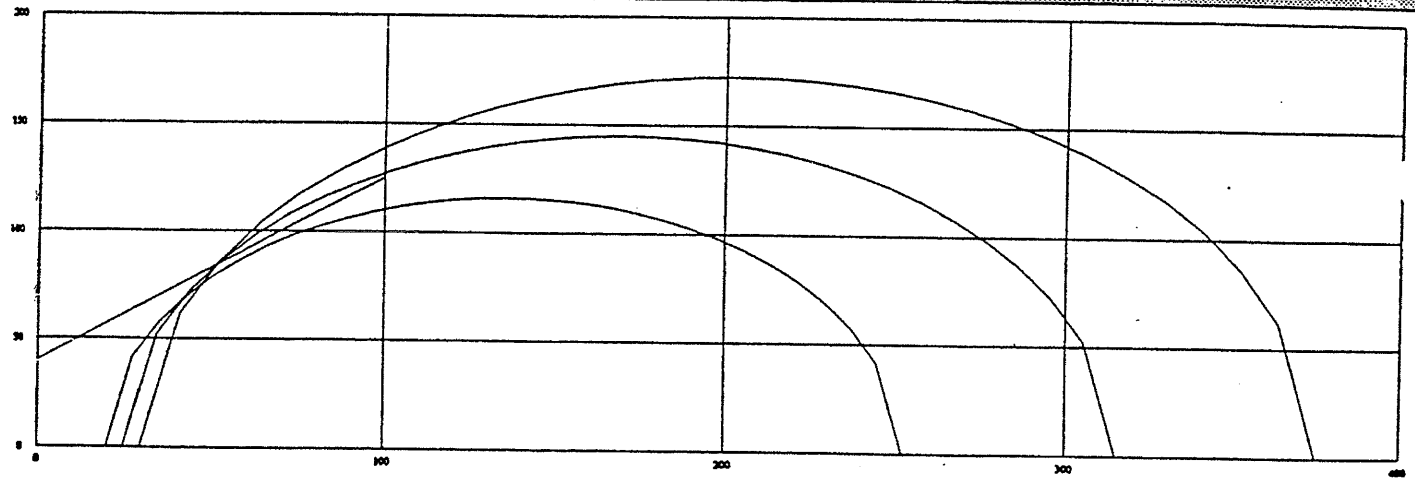
TO: CITY OF TEMPLE
ROMING-PARKER, ASSOCIATES

PROJECT: TEMPLE MUNICIPAL LANDFILL EXPANSION
TEMPLE, TEXAS

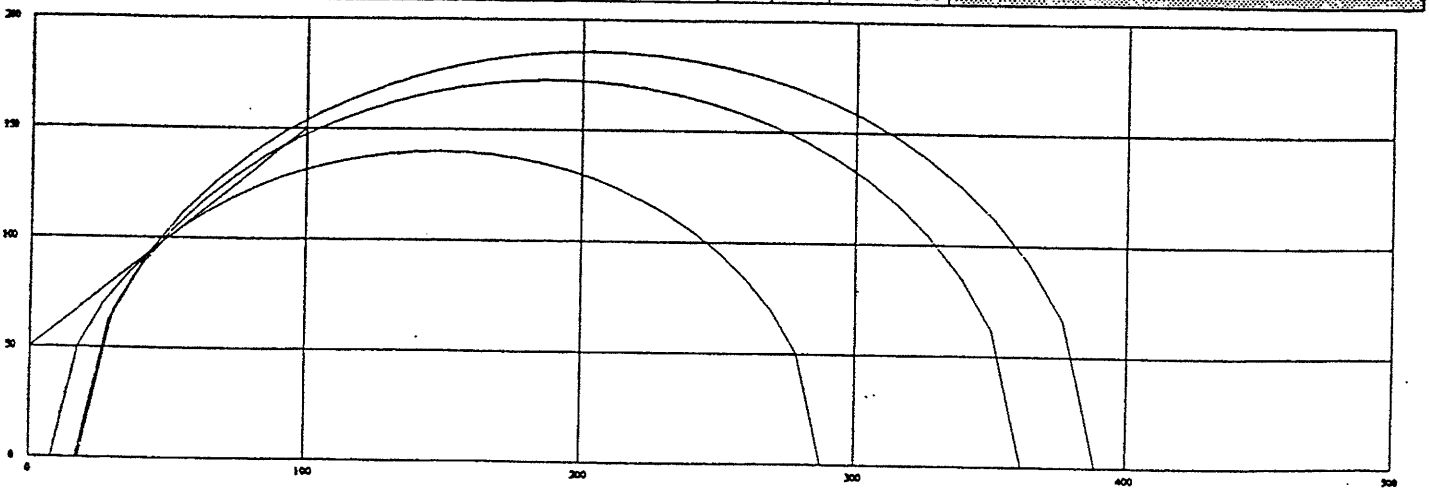
PROJECT NUMBER: 007819.4

TEST STANDARD	ASTM D-4767 CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST		
TEST METHOD	MULTI-STAGE SINGLE SPECIMEN		
SAMPLE TYPE	UNDISTURBED	REMOLDED PARAMETERS	
SAMPLE NUMBER	B20B5860	DRY DENSITY(PCF)	-
BORING NUMBER	B-20	MOISTURE CONTENT(%)	-
DEPTH(FT)	58.5-60	PERCENT COMPACTION	-
		RELATIVE MOISTURE	-

TOTAL STRESS		
TOTAL COHESION(PSI)	40.0	
TOTAL COHESION(PSF)	5760.0	
FRICTION ANGLE(DEG)	40.4	



EFFECTIVE STRESS		
EFFECTIVE COHESION(PSI)	50.0	
EFFECTIVE COHESION(PSF)	7200.0	
FRICTION ANGLE(DEG)	45.0	



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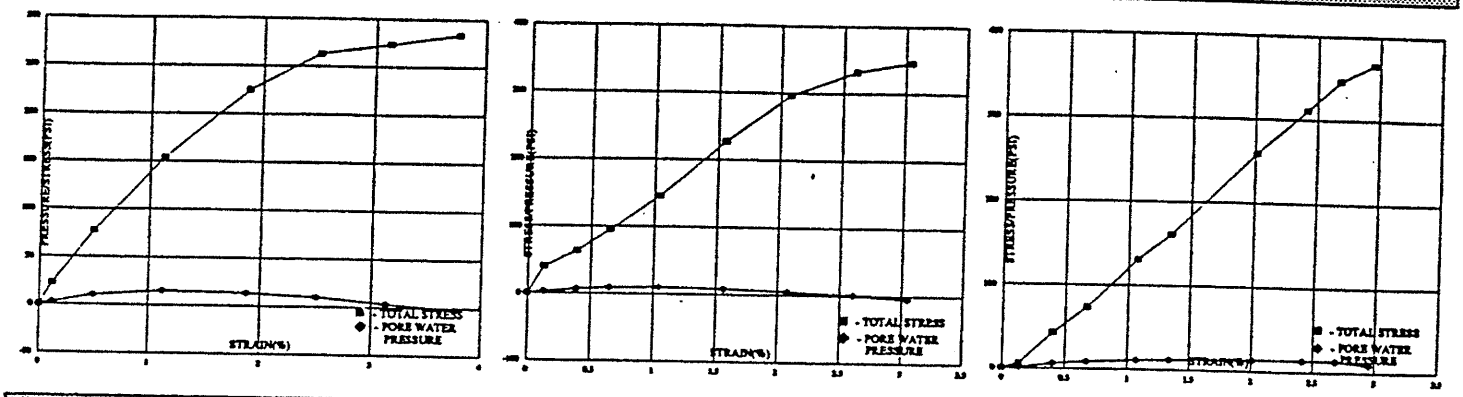
TRIAXIAL COMPRESSIVE STRENGTH TEST RESULTS

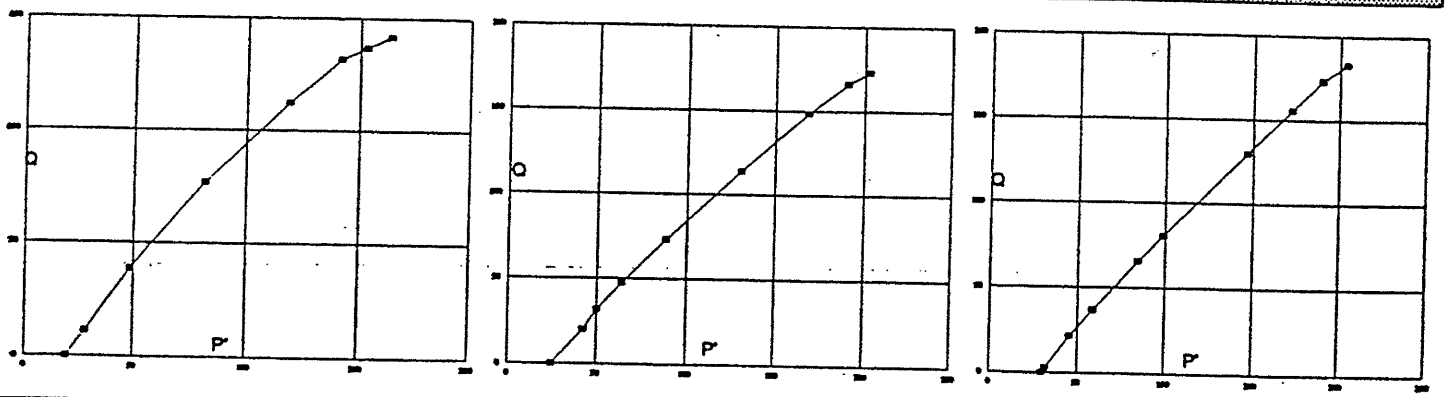
SAMPLE TYPE	UNDISTURBED
SAMPLE NUMBER	B20B5860
BORING NUMBER	B-20
SAMPLE DEPTH	58.5-60

CONDITIONS	INITIAL			FINAL
EFFECTIVE CONFINING PRESSURE(PSI)		20	25	30
HEIGHT(IN)	3.99	3.99	3.84	3.72
DIAMETER(IN)	2.04	2.06	2.09	2.12
VOID RATIO	0.33	0.34	0.33	0.34
SATURATION(%)	97.4			100.2
MOISTURE CONTENT(%)	12.3			13.1
DRY DENSITY(PCF)	121.8			120.8
SPECIFIC GRAVITY	2.59			
CONFINING PRESSURE(PSI)		75	80	85
BACK PRESSURE(PSI)		55	55	55
MAX. DEVIATOR STRESS(PSI)		232	290	345
INDUCED PORE WATER PRESSURE(PSI)		12	8	12

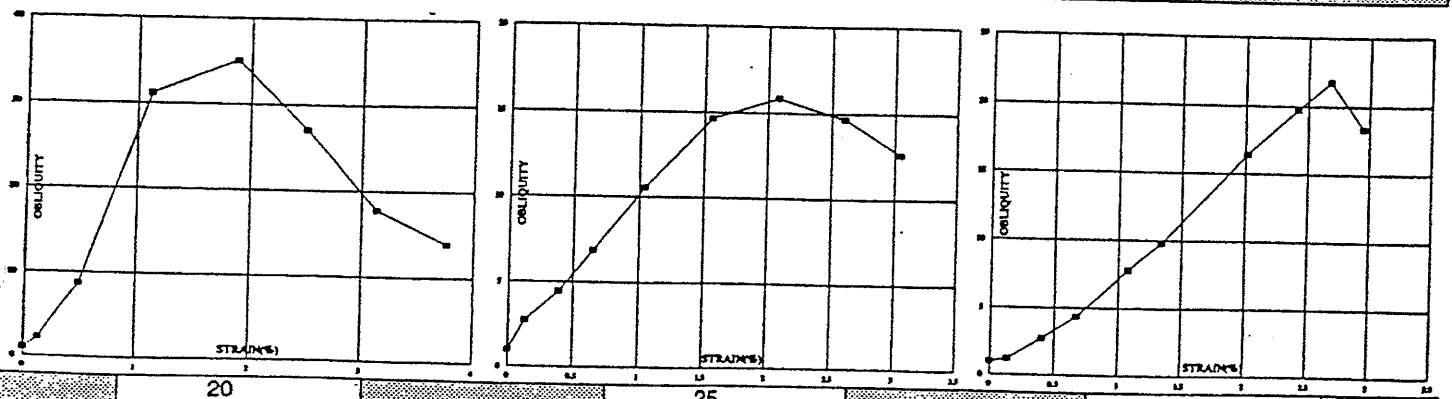
STRESS & INDUCED PORE WATER PRESSURE Vs. STRAIN



P'-Q DIAGRAMS



OBLIQUITY Vs. STRAIN

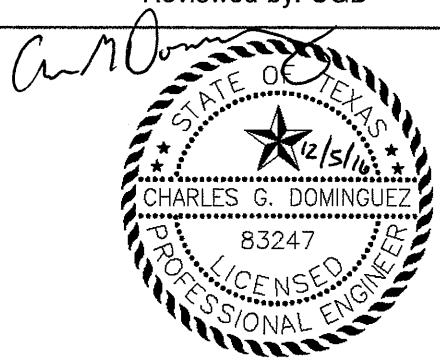


APPENDIX III-3C-2

SIDESLOPE STABILITY

SIDESLOPE STABILITY

Made By: VK
Checked by: JBF / MX
Reviewed by: CGD



Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

Investigate the stability of the lining system along the sideslope.

2.0 SIDESLOPE

Sideslopes are at 3H:1V.
Length of maximum slope is approximately 200 ft.

3.0 ASSUMPTIONS

The maximum head over the geomembrane is less than the thickness of the geocomposite drainage layer (See attached calculations in Appendix III-3D-2).

The failure mechanism will be sliding along one of the liner interfaces.

Proposed slope liner system consists of (from top to bottom):

24 inches of protective cover
Double-sided geocomposite
60-mil textured HDPE geomembrane
24-inch compacted clay liner
Subgrade

Based on a review of available data at low normal stresses, the following parameters were assigned to the materials.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ (°)	c (psf)	Moist	Saturated	
Protective Cover	28	0	115	132	Ref. [1] (1)
Protective Cover/Geocomposite	28	0	N/A	N/A	Golder(2)
Geocomposite/Textured Geomembrane	24	0	N/A	N/A	Golder(2)
Textured Geomembrane/Clay Liner	35	0	N/A	N/A	Golder(2)
Clay Liner	28	0	N/A	N/A	Ref. [1] (1)
Clay Liner/Subgrade	28	0	N/A	N/A	Ref. [1] (1)

(1) The shear strength of the protective cover soils, clay liner and the clay liner/subgrade interface is estimated based on the on-site soil shear strength. This is estimated using the average plasticity index (PI = 40) of the Stratum I and Stratum II soils described in Attachment 4, and Ref. [1].

(2) Based on unpublished data from tests performed in Golder's laboratory, on similar geosynthetic materials. Strength parameters were conservatively assigned to be close to the lower bound of data to account for testing material variability. This data is presented in this appendix.

The shear strength parameters indicate that the critical interface above the geomembrane occurs at the geocomposite/geomembrane interface, with a friction angle of 24 degrees.

The critical interface below the geomembrane occurs between the clay liner and the subgrade with a friction angle of 28 degrees.

4.0 METHOD

Create a model representing the sideslope situation and use it in conjunction with limit equilibrium concepts to determine the minimum factor of safety against a sliding block failure along the critical interface.

Infinite Slope Analysis

$$FS = \frac{c + (\gamma b \cos\beta - \gamma_w d \cos\beta)\tan\phi}{\gamma b \sin\beta}$$

Sliding at Interface

ϕ =	24	interface friction angle
β =	18.4	slope angle (degrees)
c =	0	cohesion of soil (psf)
γ =	132	unit weight of soil (pcf)
b =	2.0	soil thickness (ft)
d =	0	water depth in cover (ft)
γ_w =	62.4	unit weight of water (pcf)
FS =	**1.34**	

5.0 RESULTS

By using limit equilibrium analysis for an infinite slope condition, the factor of safety is found to be at least 1.34, and likely to be higher due to the use of conservative parameters in the analysis.

Based on generally accepted industry practice, the minimum allowable factor of safety is 1.3 for a temporary slope.

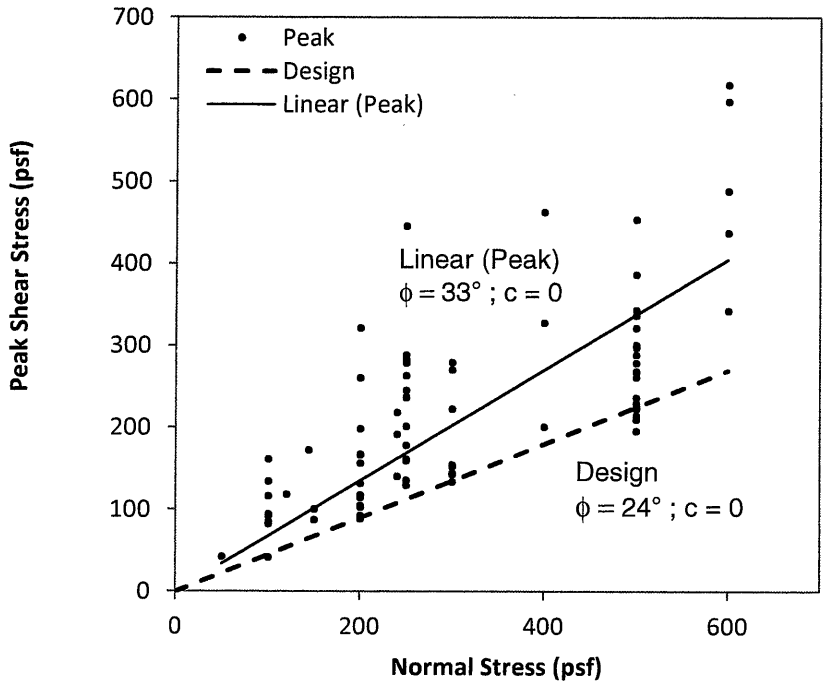
6.0 CONCLUSION

Through analysis of the composite lining system, this temporary condition is found to be stable.

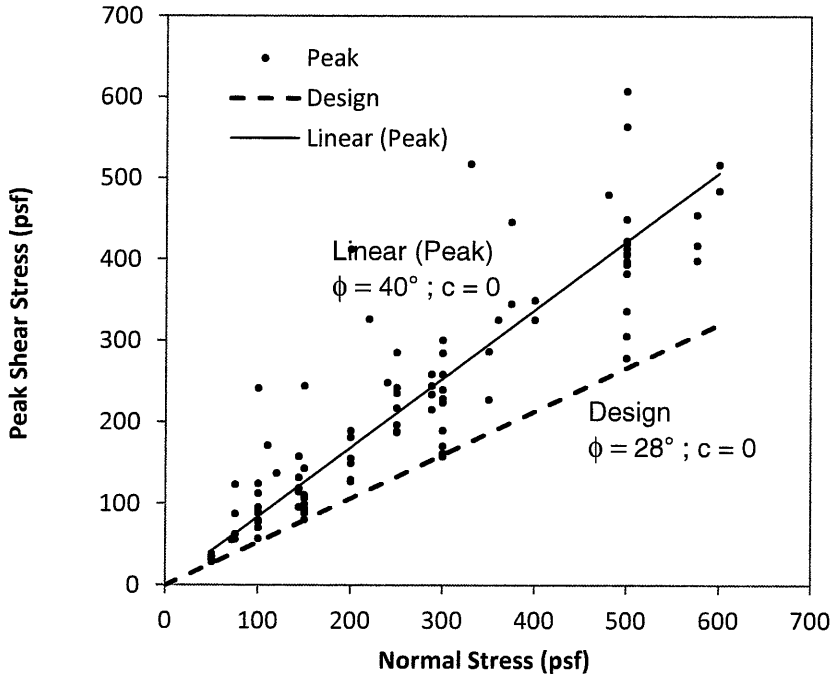
7.0 REFERENCES

[1] Bjerrum, L. and Simons, N. E. (1960). "Comparison of shear strength characteristics of normally consolidated clays." Proceedings of the Research Conference on Shear Strength of Cohesive Soils, ASCE, Boulder, Colorado, 1960, pp. 711–726.

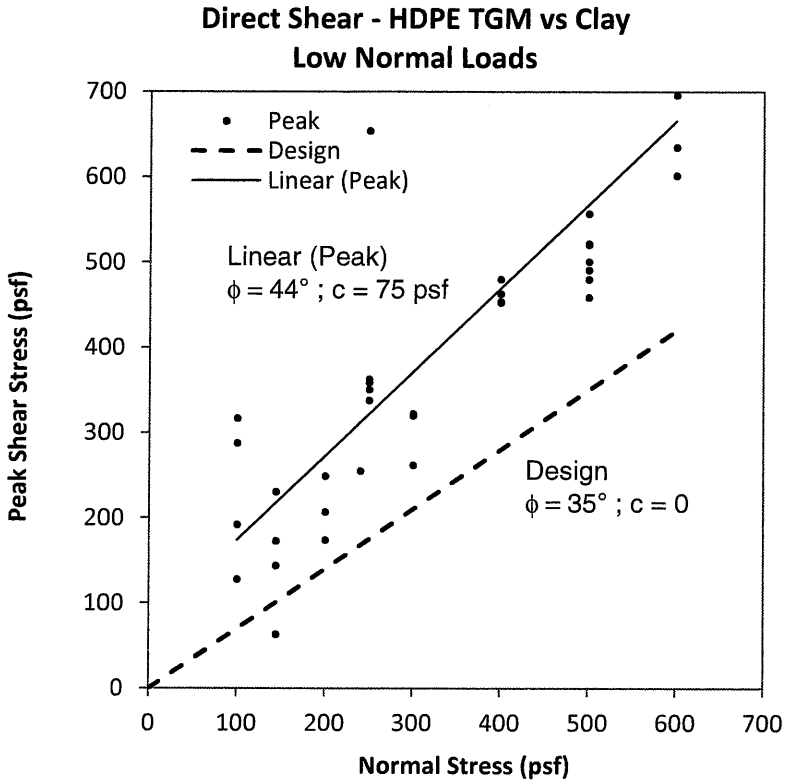
Direct Shear - HDPE TGM vs GC
Low Normal Loads



Direct Shear - Geocomposite vs Protective Cover
Low Normal Loads



P:_2014 Project Folders\1400336 - Temple Expansion\PERMIT APPLICATION\Response to 1st NOD\Part III\Att 3\III-3C - Stability Analysis\III-3C2 - Sideslope Stability\III-3C2_rev1.xlsx
Submitted: June 2016
Revised: December 2016


Direct Shear - HDPE TGM vs Clay
Low Normal Loads
Peak
Design
Linear (Peak)
Linear (Peak)
ϕ = 44° ; c = 75 psf
Design
ϕ = 35° ; c = 0
Peak Shear Stress (psf)
Normal Stress (psf)
0
100
200
300
400
500
600
700

APPENDIX III-3C-3

INTERIOR WASTE SLOPE STABILITY

INTERIOR WASTE SLOPE STABILITY

Made By: VK
Checked by: JBF / MX
Reviewed by: CGD

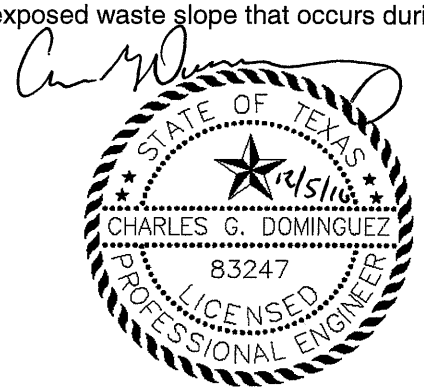
1.0 OBJECTIVE

Investigate the stability of the interior waste slopes against sliding along the interfaces of the proposed liner system.

2.0 GIVEN

Based on a review of the floor grades and filling sequence, it was identified that sliding along the liner of Tract 5 Cell 9 is the most critical case, where the filling and slope occur in the same direction with no buttress effect from existing waste or the floor slope. Along this section, the analysis evaluates temporary interior waste slopes of 3H:1V and 4H:1V.

In addition, the highest exposed waste slope, as part of the operational fill sequence is also analyzed. Section A on detail 4 of Figure III-3-4 shows the analyzed section with the highest exposed waste slope that occurs during operation fill sequence, phase 5 (Fig II-7.5).



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The cell liner system consists of:

FLOOR: 24 inches of protective cover (clay)
Nonwoven geotextile over geonet (floor)
60-mil HDPE smooth geomembrane (floor)
24-inch compacted clay liner
Subgrade

SIDEWALLS: 24 inches of protective cover (clay)
Double-sided geocomposite
60-mil HDPE textured geomembrane
24-inch compacted clay liner
Subgrade

OVERLINER: 24 inches of protective cover (clay)
Double-sided geocomposite
60-mil LLDPE textured Geomembrane
Geosynthetic Clay Liner (GCL)

The following parameters were assigned to the materials based on available data:

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ (deg)	c (psf)	Moist	Saturated	
Waste	Bi-Linear		65	75	Ref. [2]
Protective cover (soil)	28	0	115	132	Ref. [1] (1)
Prot. cover (soil)/Geotextile layer of Geocomposite (F)	28	0	N/A	N/A	Golder(2)
Geonet/Smooth Geomembrane (F)	9	0	N/A	N/A	Golder(2)
Smooth Geomembrane/Clay Liner (F)	15	0	N/A	N/A	Golder(2)
Textured Geomembrane/Clay Liner (S)	35	0	N/A	N/A	Golder(2)
Geocomposite/Text. Geomembrane (S/O)	15	0	N/A	N/A	Golder(2)
Textured Geomembrane/GCL (O)	18	0	N/A	N/A	Golder(2)
Clay Liner	28	0	N/A	N/A	Ref. [1] (1)
Clay Liner/Subgrade	28	0	N/A	N/A	Ref. [1] (1)

(F) = Floor; (S) Slope; (O) Overliner

(1) The shear strength of the protective cover soils, clay liner and the clay liner/subgrade interface is estimated based on the on-site soil shear strength. This is estimated using the average plasticity index (PI = 40) of the Stratum I and Stratum II soils described in Attachment 4, and Ref. [1].

(2) Based on unpublished data from tests performed in Golder's laboratory, on similar geosynthetic materials. Strength parameters were conservatively assigned to be equal to or a percentage of the peak strength (lower bound) to account for testing data variability and to avoid strains that result in residual interface shear strengths. This data is presented in this appendix.

Based on the data listed in the previous table, the weakest interface in the liner system along the floor of the cell is between the geonet and the smooth geomembrane. The weakest interface in the liner system along the sideslopes of the cell is between the textured geomembrane and the geocomposite. The weakest interface in the overliner system is between the textured geomembrane and GCL. These interfaces were used in the analysis. Subsurface profiles are determined based on available adjacent borehole information, and the same soil properties as the excavation stability analysis are used. These are shown in the below table and in Appendix III-3C-1.

Material	Unit Weight (pcf)		Strength Parameters		Analysis Stress State	Reference
	Moist	Saturated	ϕ (degrees)	c (psf)		
Residual Clay	115	120	21.6	460	Effective	Jones & Neuse 1993
Weathered Claystone	120	125	11	6840	Effective	Jones & Neuse 1993
Unweathered Claystone	130	130	45	7200	Effective	Jones & Neuse 1993

Note: Jones & Neuse 1993 refers to the previous geotechnical investigation data performed during the MSW-692A permit application, which were based on consolidated undrained triaxial shear testing. Testing results are included in Part III, Attachment 4, Appendix III-4D.

Based on generally accepted industry practice, the minimum allowable factor of safety for temporary waste slopes is 1.3.

3.0 METHOD

Use limit equilibrium slope stability methods to determine the maximum waste height (limited to 300 ft, corresponding to the design elevation of waste) at which the minimum factor of safety against sliding along the liner is equal to or greater than 1.3. Consider temporary waste slopes of 3H:1V and 4H:1V. In addition, analyze the highest exposed waste slope that occurs during the operational fill sequence. Use SLIDE v.6 (Ref. [3]) to aid analysis, following Spencer's method.

4.0 ASSUMPTIONS

- Use the lowest strength along the floor and sideslope interfaces simultaneously.
- One foot of leachate above the geomembrane

5.0 SCENARIOS

Two possible waste filling slopes are considered for sliding along the liner of Tract 5, Cell 9: (1) continuous 3H:1V temporary waste slopes with no benches; and (2) continuous 4H:1V temporary waste slope with no benches. Section A (detail 4 of Figure III-3-4), containing the highest exposed waste slope that occurs during the operation fill sequence, is also analyzed.

6.0 RESULTS

Minimum factors of safety and maximum waste heights calculated by SLIDE are summarized below:

Case Considered	Minimum Factor of Safety	Total Waste Height (ft)
Scenario 1 (3H:1V)	1.3	160
Scenario 2 (4H:1V)	1.4	300*
Section A**	1.3	275***

* Exceeds maximum elevation of final cover

**Shown on detail 4, Fig. III-3-4

***Contains one bench (~100 ft wide) at ~120 feet height

7.0 CONCLUSIONS

Using the strength parameters that are conservativey chosen from published studies or based on test results for similar conditions, the following conclusions are made:

(i) Considering a minimum factor of safety of 1.3, temporary waste slopes at 3H:1V can be raised to a maximum height of 160 ft. Slopes exceeding this height should be independently evaluated for stability.

(ii) Temporary waste slopes at 4H:1V can be raised to over 300 ft of slope height without reaching the minimum factor of safety of 1.3.

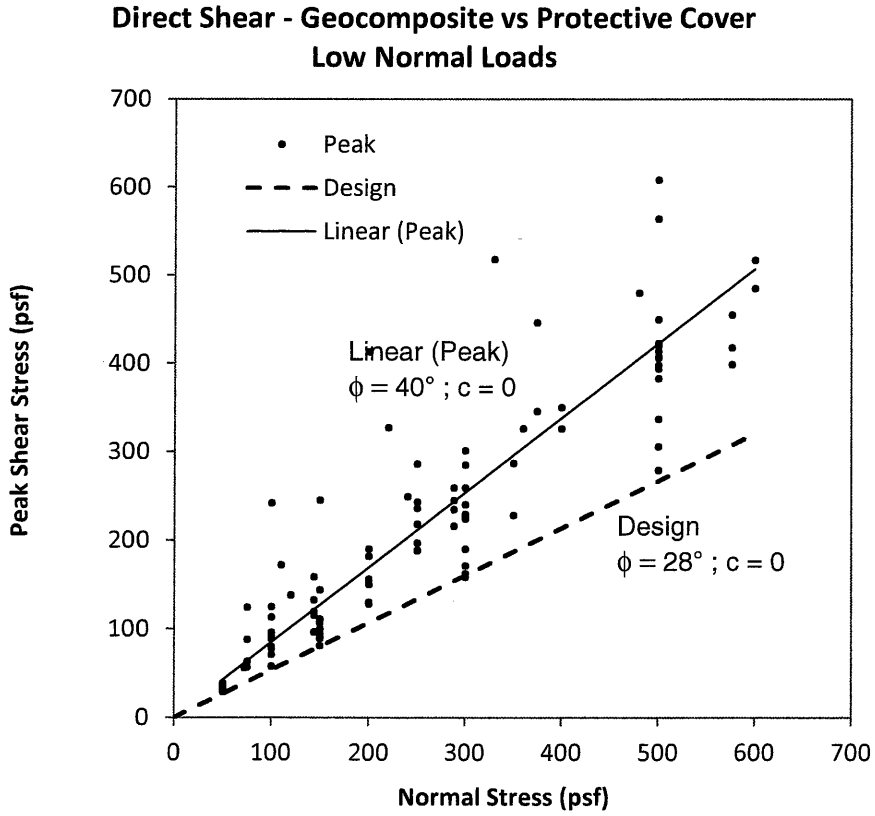
(iii) The most critical slope from the operational fill sequence has a factor of safety of 1.3.

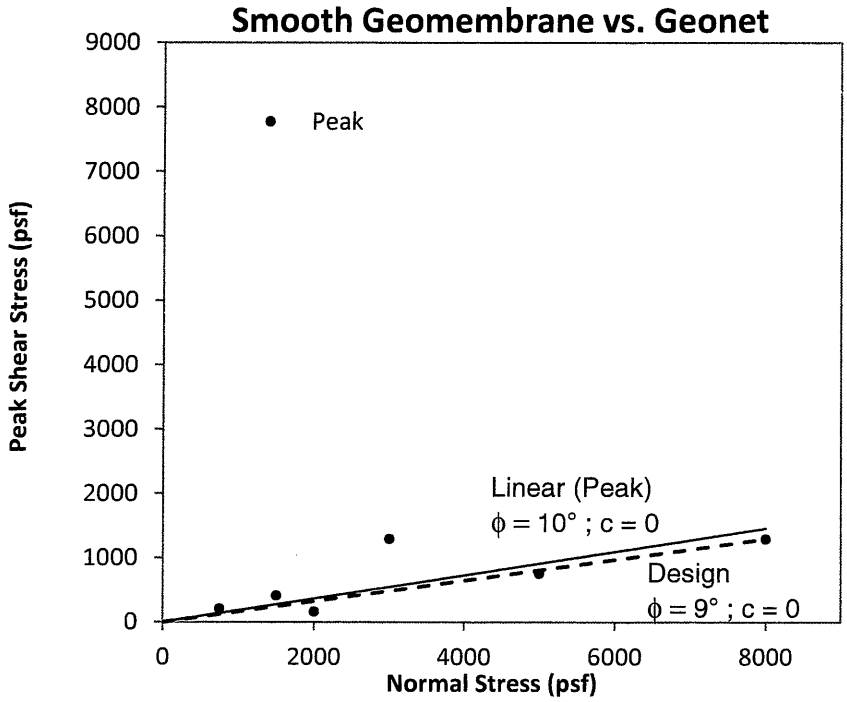
8.0 REFERENCES

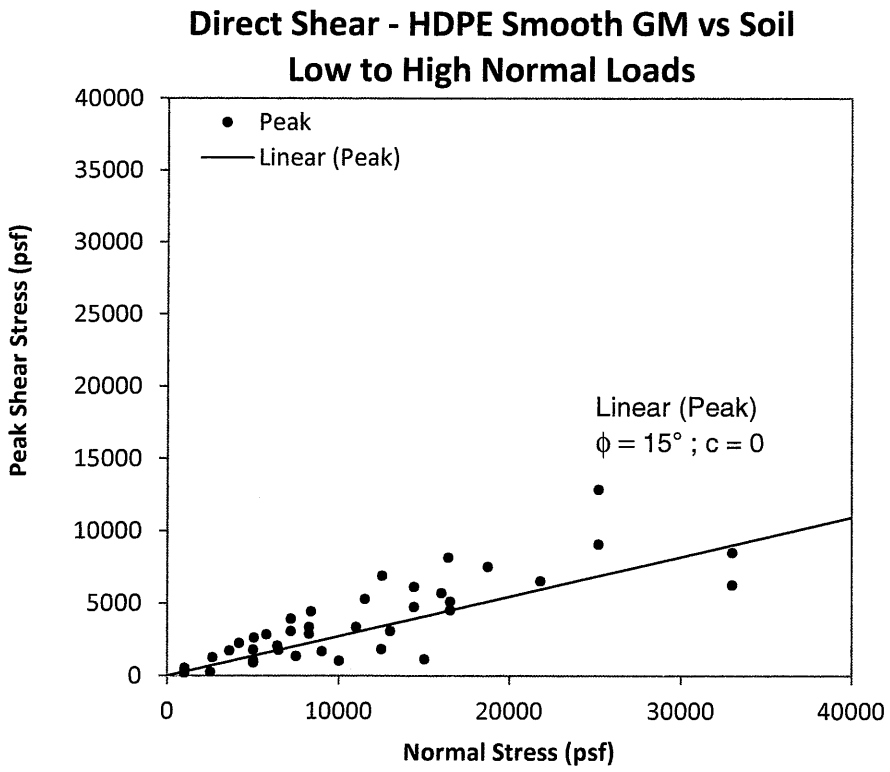
[1] Bjerrum, L. and Simons, N. E. (1960). "Comparison of shear strength characteristics of normally consolidated clays." Proceedings of the Research Conference on Shear Strength of Cohesive Soils, ASCE, Boulder, Colorado, 1960, pp. 711–726.

[2] Bray, J.D., D. Zekkos, E. Kavazanjian, Jr., G.A. Athanasopoulos, and F. Riemer. 2009. Shear strength of

[3] Rocscience 2015, SLIDE - 2D Limit Equilibrium Slope Stability for Soil and Rock Slopes.







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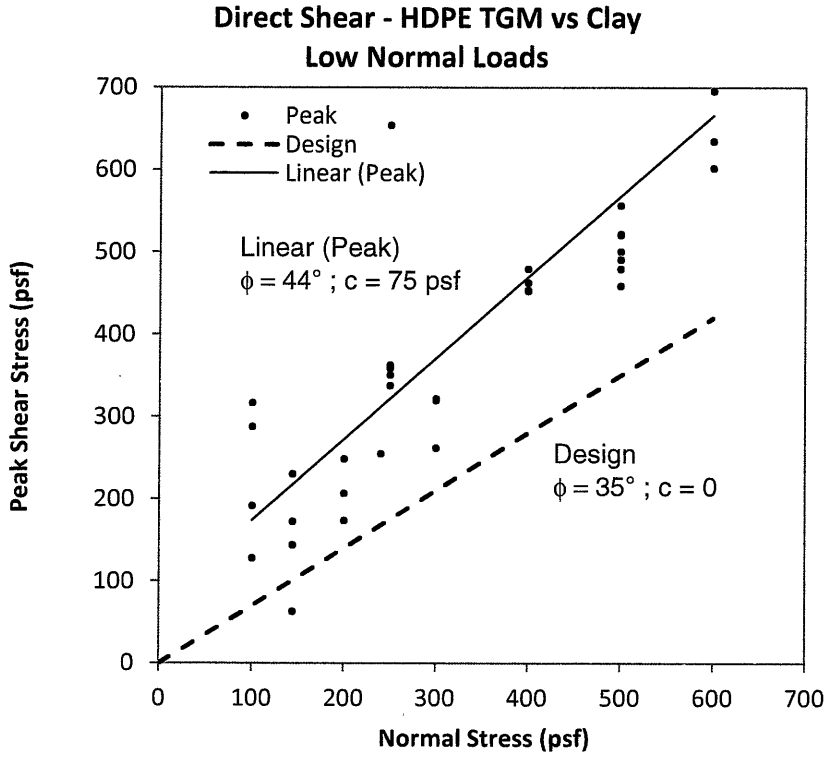
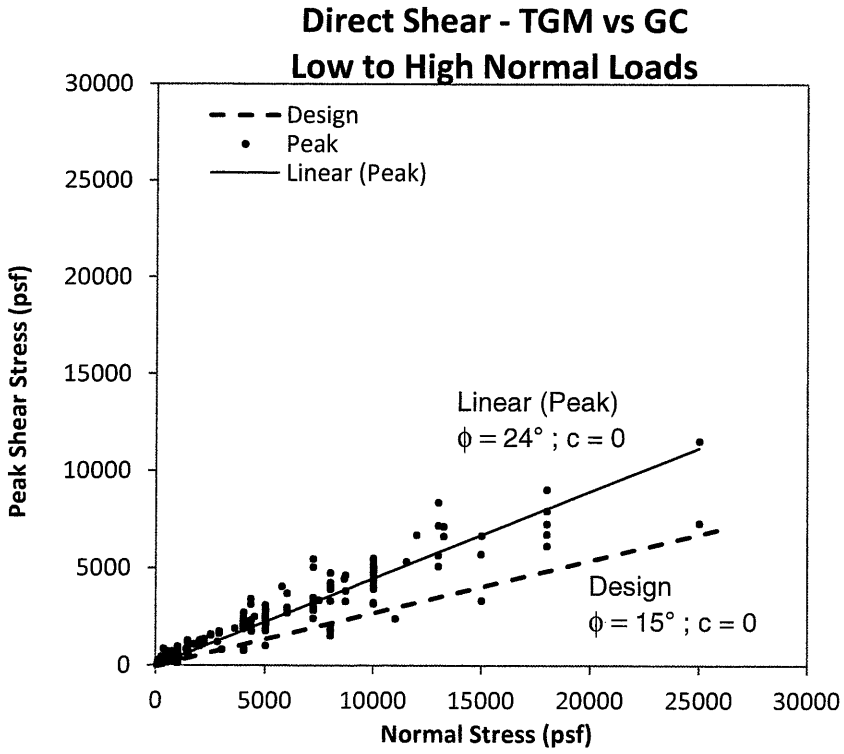
Submitted: June 2016
Revised: December 2016





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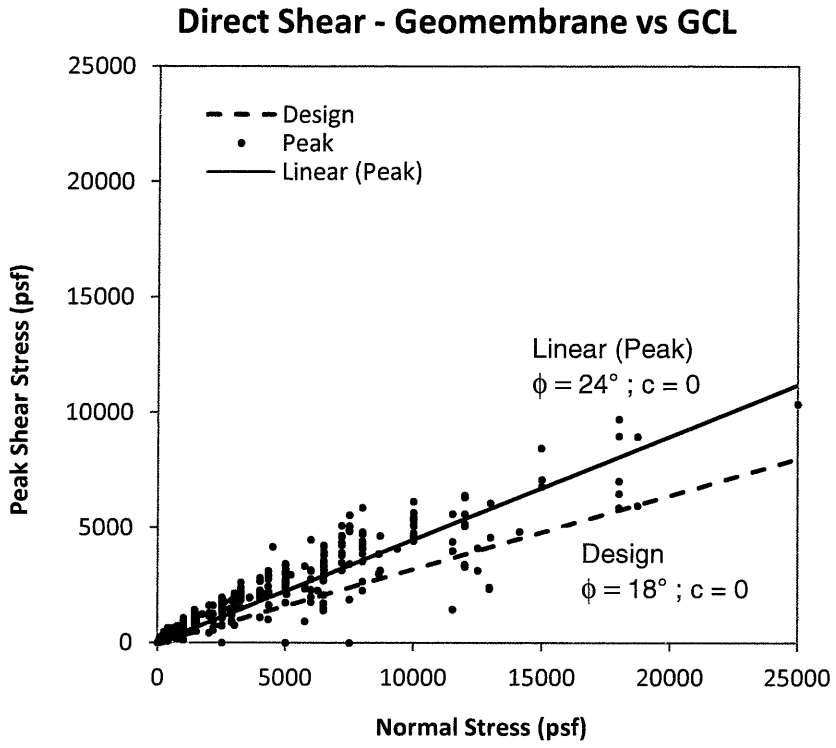
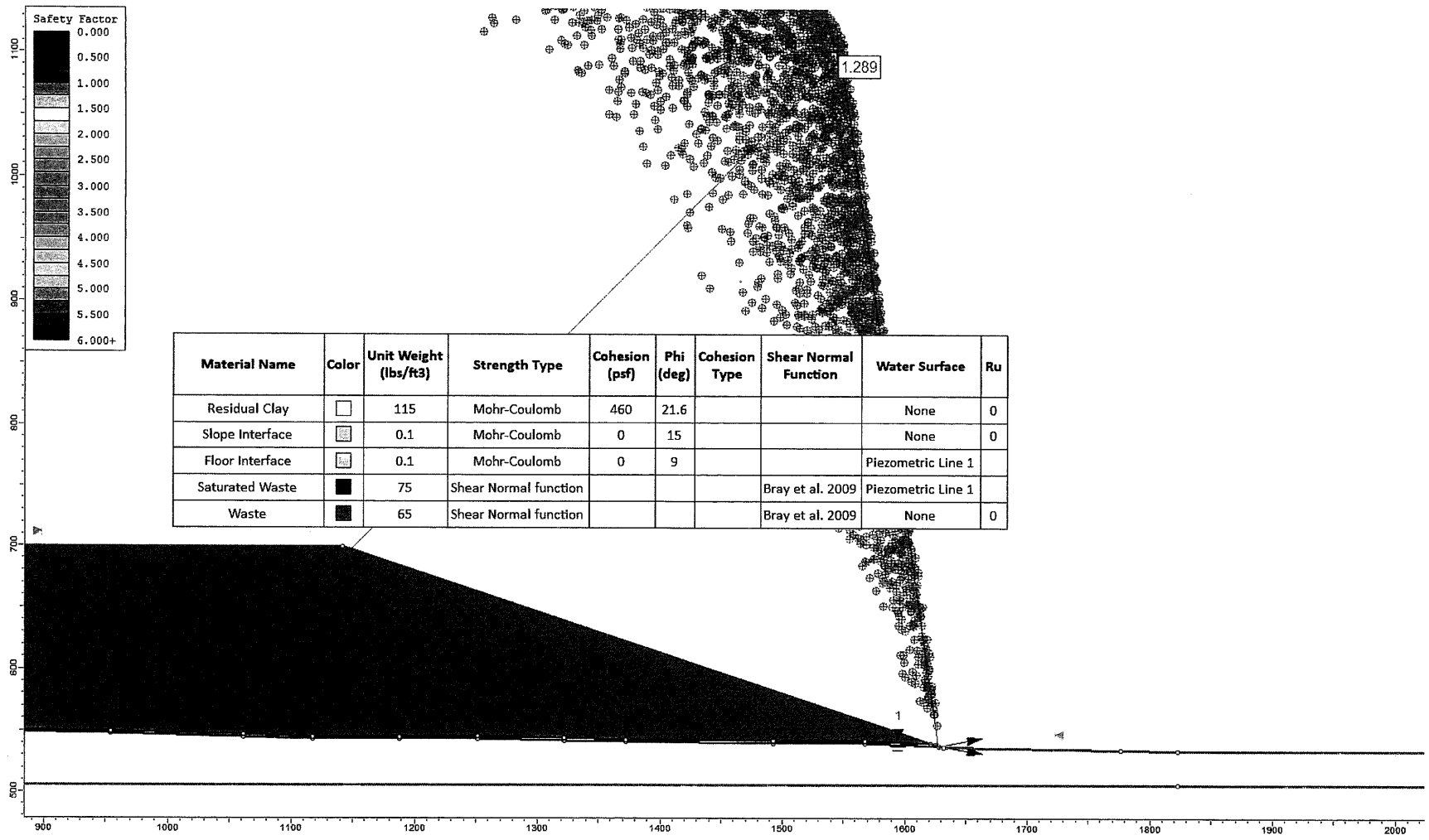
Submitted: June 2016
Revised: December 2016


Direct Shear - Geomembrane vs GCL
Design
Peak
Linear (Peak)
Linear (Peak)
ϕ = 24° ; c = 0
Design
ϕ = 18° ; c = 0
Peak Shear Stress (psf)
Normal Stress (psf)
25000
20000
15000
10000
5000
0
0
5000
10000
15000
20000
25000



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Ru
Residual Clay		115	Mohr-Coulomb	460	21.6			None	0
Slope Interface		0.1	Mohr-Coulomb	0	15			None	0
Floor Interface		0.1	Mohr-Coulomb	0	9			Piezometric Line 1	
Saturated Waste		75	Shear Normal function				Bray et al. 2009	Piezometric Line 1	
Waste		65	Shear Normal function				Bray et al. 2009	None	0

FIGURE **3C3.1**

Interior Waste Slope Stability Analysis - 3H:1V

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section 3H-1V.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 7/20/2015, 11:51:33 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.05
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
dom Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
vex Surfaces Only: Disabled
Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 265
Right Projection Angle (Start Angle): -10
Right Projection Angle (End Angle): 10
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Slope Interface	Floor Interface	Saturated Waste	Waste
Color					
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	115	0.1	0.1	75	65
Cohesion [psf]	460	0	0		
Friction Angle [deg]	21.6	15	9		
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	None
Hu Value			1	1	
Ru Value	0	0			0

ear Normal Functions

Name: Bray et al. 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

Method: spencer

FS: 1.288900
Axis Location: 1547.134, 1096.632
Left Slip Surface Endpoint: 1147.681, 697.179
Right Slip Surface Endpoint: 1627.025, 537.398
Resisting Moment=2.91256e+008 lb-ft
Driving Moment=2.25973e+008 lb-ft
Resisting Horizontal Force=407064 lb
Driving Horizontal Force=315824 lb
Total Slice Area=26861.5 ft2

Slice Data

bal Minimum Query (spencer) - Safety Factor: 1.2889

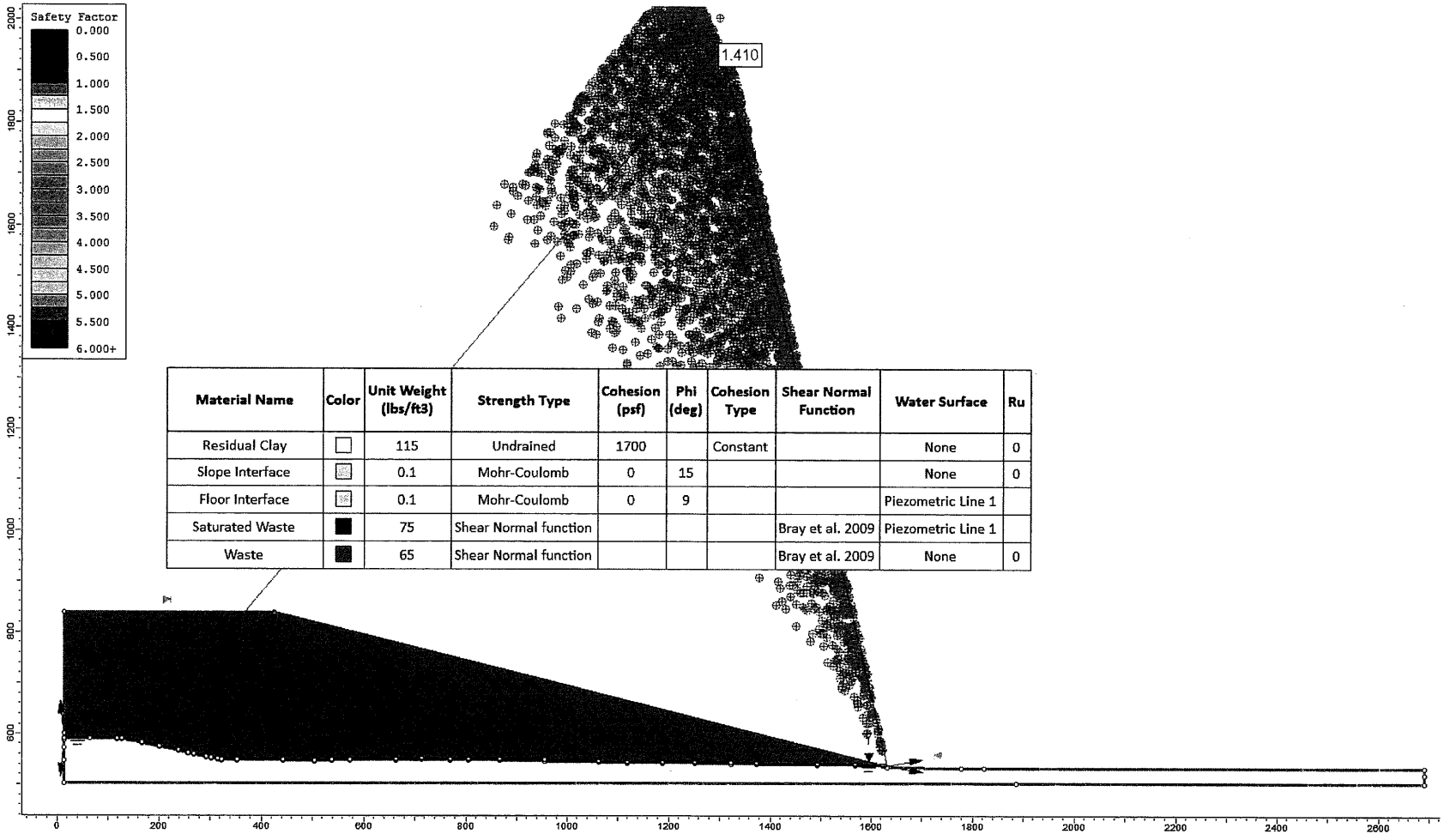
Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	18.0054	9249.61	Waste	310	39.8056	334.488	431.122	145.346	0	145.346
2	18.0054	27748.8	Waste	414.783	33.3727	680.116	876.602	701.11	0	701.11
3	18.0054	46248.1	Waste	414.783	33.3727	981.894	1265.56	1291.62	0	1291.62
4	18.0054	64747.3	Waste	414.783	33.3727	1283.67	1654.52	1882.12	0	1882.12
5	18.0054	83246.5	Waste	414.783	33.3727	1585.45	2043.48	2472.62	0	2472.62
6	18.0054	101746	Waste	414.783	33.3727	1887.22	2432.44	3063.12	0	3063.12
7	18.0054	120245	Waste	414.783	33.3727	2189.01	2821.41	3653.62	0	3653.62
8	0.838688	6056.09	Saturated Waste	414.783	33.3727	2337.12	3012.31	3974.65	31.2	3943.45
9	0.838688	6073.21	Floor Interface	0	9.00002	636.973	820.995	5277.16	93.6	5183.56
10	23.137	161874	Floor Interface	0	9.00002	858.274	1106.23	7109.29	124.8	6984.49
11	23.137	150932	Floor Interface	0	9.00002	799.201	1030.09	6628.54	124.8	6503.74
12	25.01	150972	Floor Interface	0	9.00002	736.992	949.909	6122.29	124.8	5997.49
13	25.01	138442	Floor Interface	0	9.00002	674.529	869.401	5613.98	124.8	5489.18
14	20.1533	102201	Floor Interface	0	9.00002	620.029	799.156	5170.49	124.8	5045.69
15	20.1533	93582.4	Floor Interface	0	9.00002	566.423	730.062	4734.23	124.8	4609.43
16	20.1533	84963.9	Floor Interface	0	9.00002	512.816	660.968	4297.99	124.8	4173.19
17	20.1533	76345.5	Floor Interface	0	9.00002	459.209	591.874	3861.74	124.8	3736.94
18	20.1533	67727	Floor Interface	0	9.00002	405.601	522.779	3425.5	124.8	3300.7
19	20.1533	59108.6	Floor Interface	0	9.00002	351.994	453.685	2989.26	124.8	2864.46
20	22.1902	55043	Floor Interface	0	9.00002	295.677	381.098	2530.96	124.8	2406.16
21	22.1902	44453.5	Floor Interface	0	9.00002	235.778	303.894	2043.51	124.8	1918.71
22	22.1902	33863.9	Floor Interface	0	9.00002	175.879	226.69	1556.06	124.8	1431.26
23	22.6147	23864.1	Floor Interface	0	9.00002	114.394	147.442	1066.95	136.038	930.912
24	22.6147	13967.8	Floor Interface	0	9.00002	61.4648	79.222	623.679	123.492	500.187
25	22.6147	4154.39	Floor Interface	0	9.00002	10.3563	13.3482	195.223	110.946	84.2775

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.2889

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	1147.68	697.179	0	0	0
2	1165.69	675.371	-2782.13	-488.824	9.96523
3	1183.69	653.562	405.966	71.3288	9.96523
4	1201.7	631.754	11102.1	1950.66	9.96526
5	1219.7	609.946	29306.3	5149.16	9.96524
6	1237.71	588.137	55018.5	9666.84	9.96525
7	1255.71	566.329	88238.8	15503.7	9.96525
8	1273.72	544.521	128967	22659.7	9.96524
9	1274.56	543.505	131068	23028.8	9.96522

10	1275.4	542.489	135900	23877.9	9.96527
11	1298.53	542.052	119380	20975.2	9.96522
12	1321.67	541.616	104000	18273	9.96526
13	1346.68	540.986	89636.5	15749.3	9.96526
14	1371.69	540.357	76496.8	13440.6	9.96524
15	1391.84	540.219	64864.6	11396.8	9.96523
16	1412	540.08	54239.6	9529.98	9.96524
17	1432.15	539.941	44621.9	7840.13	9.96523
18	1452.3	539.803	36011.3	6327.24	9.96524
19	1472.46	539.664	28407.9	4991.31	9.96524
20	1492.61	539.525	21811.7	3832.35	9.96524
21	1514.8	539.471	15466.7	2717.52	9.96523
22	1536.99	539.416	10408.4	1828.77	9.96523
23	1559.18	539.361	6636.9	1166.11	9.96521
24	1581.8	538.706	4778.37	839.567	9.96524
25	1604.41	538.052	3812.75	669.905	9.96523
26	1627.02	537.398	0	0	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Ru
Residual Clay		115	Undrained	1700		Constant		None	0
Slope Interface		0.1	Mohr-Coulomb	0	15			None	0
Floor Interface		0.1	Mohr-Coulomb	0	9			Piezometric Line 1	
Saturated Waste		75	Shear Normal function				Bray et al. 2009	Piezometric Line 1	
Waste		65	Shear Normal function				Bray et al. 2009	None	0

FIGURE **3C3.2**

Interior Waste Slope Stability Analysis - 4H:1V Without Benches

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section 4H-1V.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 7/20/2015, 11:51:33 AM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.05
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
dom Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
vex Surfaces Only: Disabled
Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 265
Right Projection Angle (Start Angle): -10
Right Projection Angle (End Angle): 10
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Slope Interface	Floor Interface	Saturated Waste	Waste
Color					
Strength Type	Undrained	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	115	0.1	0.1	75	65
Cohesion [psf]		0	0		
Friction Angle [deg]		15	9		
Cohesion Type	1700				
Water Surface	None	None	Piezometric Line 1	Piezometric Line 1	None
Hu Value			1	1	
Ru Value	0	0			0

Shear Normal Functions

Name: Bray et al. 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

Method: spencer

FS: 1.410110
Axis Location: 1300.935, 1950.943
Left Slip Surface Endpoint: 367.013, 838.162
Right Slip Surface Endpoint: 1630.807, 536.137
Resisting Moment=3.59531e+009 lb-ft
Driving Moment=2.54966e+009 lb-ft
Resisting Horizontal Force=2.09719e+006 lb
Driving Horizontal Force=1.48725e+006 lb
Total Slice Area=155128 ft2

Slice Data

bal Minimum Query (spencer) - Safety Factor: 1.41011

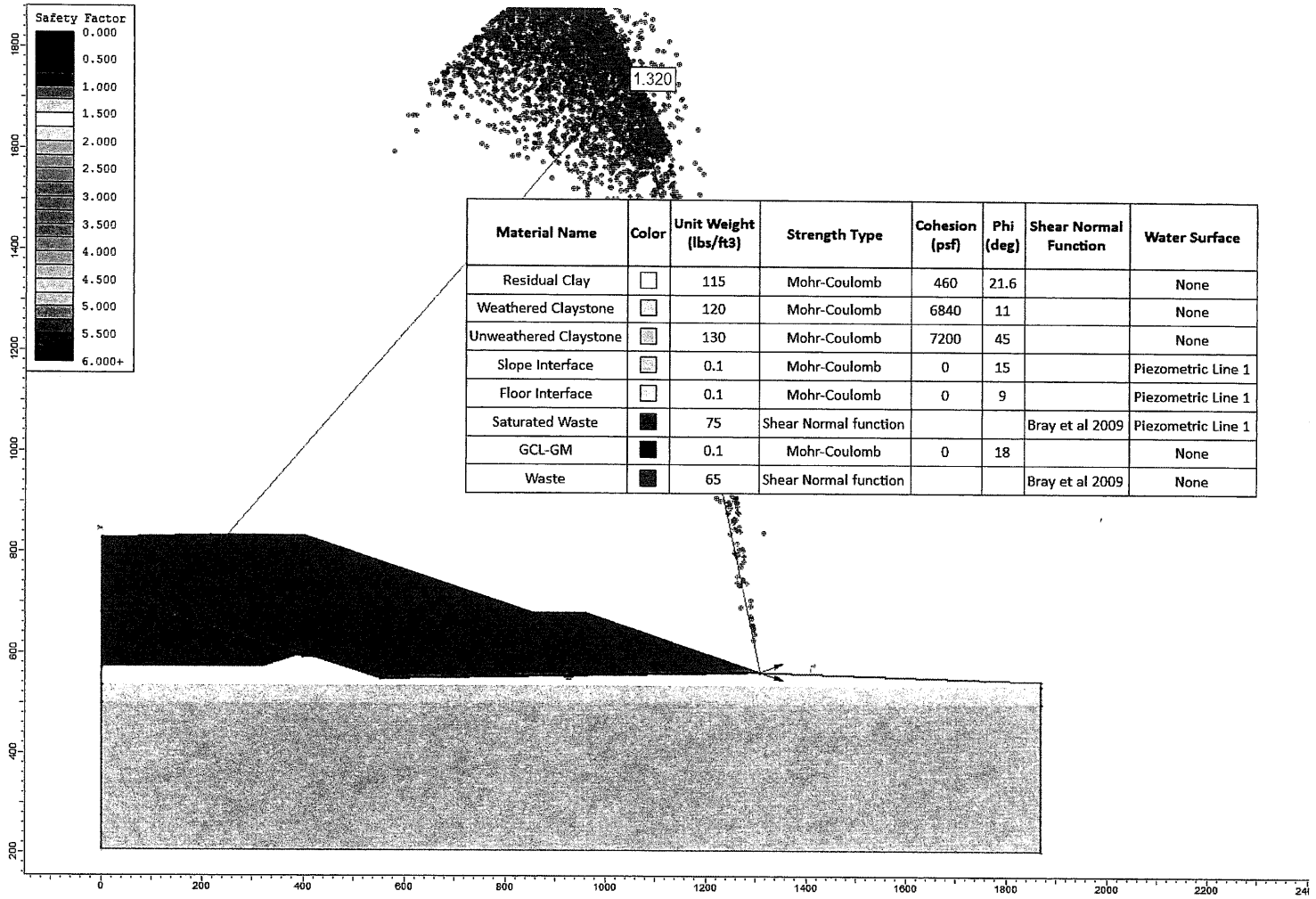
Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	46.2961	86411.9	Waste	414.783	33.3727	728.385	1027.1	929.595	0	929.595
2	46.2961	249364	Waste	414.783	33.3727	1722.75	2429.27	3058.31	0	3058.31
3	46.2961	388451	Waste	414.783	33.3727	2571.5	3626.09	4875.25	0	4875.25
4	46.2961	526478	Waste	448	32.6192	3368.79	4750.36	6722.45	0	6722.45
5	46.2961	664506	Waste	872.048	30.0931	4147.21	5848.03	8586.41	0	8586.41
6	0.806118	12797.2	Saturated Waste	872.048	30.0931	4531.15	6389.42	9551.83	31.2	9520.63
7	0.806118	12816.9	Floor Interface	0	9.00002	1405.05	1981.28	12602.9	93.6	12509.3
8	62.7242	964940	Floor Interface	0	9.00002	1733.54	2444.48	15558.6	124.8	15433.8
9	49.51	715571	Floor Interface	0	9.00002	1632.04	2301.36	14655	124.8	14530.2
10	57.11	778185	Floor Interface	0	9.00002	1523.67	2148.54	13690.1	124.8	13565.3
11	36.1	466934	Floor Interface	0	9.00002	1453.5	2049.59	13065.4	124.8	12940.6
12	60.17	729504	Floor Interface	0	9.00002	1368.5	1929.73	12308.7	124.8	12183.9
13	44.02	495966	Floor Interface	0	9.00002	1261.27	1778.53	11354	124.8	11229.2
14	44.02	466638	Floor Interface	0	9.00002	1185.85	1672.18	10682.5	124.8	10557.7
15	53.49	528249	Floor Interface	0	9.00002	1102.04	1554	9936.38	124.8	9811.58
16	53.49	486333	Floor Interface	0	9.00002	1013.47	1429.11	9147.85	124.8	9023.05
17	55.98	464973	Floor Interface	0	9.00002	922.928	1301.43	8341.73	124.8	8216.93
18	70.89	520035	Floor Interface	0	9.00002	819.269	1155.26	7418.82	124.8	7294.02
19	63.79	397840	Floor Interface	0	9.00002	694.727	979.642	6310.01	124.8	6185.21
20	70.27	364450	Floor Interface	0	9.00002	572.721	807.6	5223.79	124.8	5098.99
21	50.02	214785	Floor Interface	0	9.00002	471.104	664.308	4319.09	124.8	4194.29
22	60.46	208683	Floor Interface	0	9.00002	377.388	532.158	3484.72	124.8	3359.92
23	60.46	150973	Floor Interface	0	9.00002	269.106	379.469	2520.66	124.8	2395.86
24	73.2417	104822	Floor Interface	0	9.00002	148.333	209.166	1445.41	124.8	1320.61
25	64.9553	25514	Floor Interface	0	9.00002	29.3109	41.3316	411.967	151.009	260.958

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.41011

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	367.013	838.162	0	0	0
2	413.309	780.731	19982	1998.2	5.71059
3	459.605	723.3	116614	11661.4	5.71059
4	505.901	665.869	278669	27866.9	5.71059
5	552.198	608.438	510245	51024.5	5.71059
6	598.494	551.007	813169	81316.9	5.71059
7	599.3	550.007	819102	81910.2	5.71059
8	600.106	549.007	830583	83058.3	5.71059

9	662.83	549.007	722867	72286.7	5.71059
10	712.34	549.616	633908	63390.8	5.71059
11	769.45	547.823	572251	57225.1	5.71059
12	805.55	547.616	522977	52297.7	5.71059
13	865.72	548.713	427893	42789.3	5.71059
14	909.74	547.969	381346	38134.6	5.71059
15	953.76	547.224	337589	33758.9	5.71059
16	1007.25	545.92	292153	29215.3	5.71059
17	1060.74	544.616	250381	25038.1	5.71059
18	1116.72	542.762	214661	21466.1	5.71059
19	1187.61	542.782	156978	15697.8	5.71059
20	1251.4	542.942	112069	11206.9	5.71059
21	1321.67	541.616	79129.1	7912.91	5.71059
22	1371.69	540.357	61220.1	6122.01	5.71059
23	1432.15	539.941	40066.2	4006.62	5.71059
24	1492.61	539.525	24996.8	2499.68	5.71059
25	1565.85	539.344	14496.5	1449.65	5.71059
26	1630.81	536.137	0	0	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface
Residual Clay		115	Mohr-Coulomb	460	21.6		None
Weathered Claystone		120	Mohr-Coulomb	6840	11		None
Unweathered Claystone		130	Mohr-Coulomb	7200	45		None
Slope Interface		0.1	Mohr-Coulomb	0	15		Piezometric Line 1
Floor Interface		0.1	Mohr-Coulomb	0	9		Piezometric Line 1
Saturated Waste		75	Shear Normal function			Bray et al 2009	Piezometric Line 1
GCL-GM		0.1	Mohr-Coulomb	0	18		None
Waste		65	Shear Normal function			Bray et al 2009	None

Note: Cross-Section corresponds to Section A shown on Detail 4 of Fig. III-3.4

FIGURE **3C3.3**

Interior Waste Slope Stability Analysis - Section A

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 11/30/2015, 4:19:09 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
dom Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
vex Surfaces Only: Disabled
Projection Angle (Start Angle): 150
Left Projection Angle (End Angle): 180
Right Projection Angle (Start Angle): -20
Right Projection Angle (End Angle): 20
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone	Slope Interface	Floor Interface	Saturated Waste	GCL-GM	Waste
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Mohr-Coulomb	Shear Normal function
Unit Weight [lbs/ft3]	115	120	130	0.1	0.1	75	0.1	65
Cohesion [psf]	460	6840	7200	0	0		0	
Friction gle [deg]	21.6	11	45	15	9		18	
Water Surface	None	None	None	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	None	None
Hu Value				1	1	1		
Ru Value	0	0	0				0	0

Shear Normal Functions

Name: Bray et al 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

thod: spencer

FS: 1.320280
Axis Location: 1051.062, 1758.460

Left Slip Surface Endpoint: 248.357, 834.634
Right Slip Surface Endpoint: 1308.500, 562.000
Resisting Moment=2.82659e+009 lb-ft
Driving Moment=2.14091e+009 lb-ft
Resisting Horizontal Force=1.92199e+006 lb
Driving Horizontal Force=1.45575e+006 lb
Total Slice Area=141031 ft2

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.32028

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	42.4891	82584.7	Waste	414.783	33.3727	724.715	956.827	822.905	0	822.905
2	42.4891	247754	Waste	414.783	33.3727	1745.05	2303.95	2868.05	0	2868.05
3	42.4891	412924	Waste	414.783	33.3727	2765.39	3651.08	4913.2	0	4913.2
4	42.4891	575096	Waste	448	32.6192	3717.01	4907.49	6967.96	0	6967.96
5	1.41031	21486.2	Floor Interface	0	9.00002	1259.84	1663.34	10564.3	62.4037	10501.9
6	43.7586	666647	Slope Interface	0	15	2814.07	3715.36	13973.1	107.156	13865.9
7	43.7586	665642	Slope Interface	0	15	2813.35	3714.41	13951.6	89.2538	13862.4
8	43.7586	664637	Slope Interface	0	15	2812.63	3713.46	13930.2	71.3513	13858.8
9	2.93815	44493.5	Floor Interface	0	9.00002	1669.18	2203.78	14007.7	93.5961	13914.1
10	50.3785	731919	Floor Interface	0	9.00002	1783.57	2354.81	14992.5	124.792	14867.7
11	50.3785	673366	Floor Interface	0	9.00002	1639.65	2164.8	13792.8	124.791	13668
12	50.3785	614813	Floor Interface	0	9.00002	1495.74	1974.79	12593.1	124.791	12468.4
13	50.3785	556260	Floor Interface	0	9.00002	1351.82	1784.78	11393.5	124.79	11268.7
14	50.3785	497707	Floor Interface	0	9.00002	1207.91	1594.78	10193.8	124.789	10069
15	50.3785	439157	Floor Interface	0	9.00002	1064	1404.78	8994.19	124.789	8869.4
16	50.3785	408932	Floor Interface	0	9.00002	989.707	1306.69	8374.94	124.788	8250.15
17	44.0812	355368	Floor Interface	0	9.00002	982.837	1297.62	8317.63	124.788	8192.84
18	44.0812	339921	Floor Interface	0	9.00002	939.445	1240.33	7955.92	124.787	7831.13
19	44.0812	295844	Floor Interface	0	9.00002	815.63	1076.86	6923.84	124.787	6799.05
20	44.0812	250772	Floor Interface	0	9.00002	689.027	909.708	5868.46	124.786	5743.67
21	44.0812	205701	Floor Interface	0	9.00002	562.42	742.552	4813.08	124.785	4688.29
22	44.0812	160629	Floor Interface	0	9.00002	435.814	575.396	3757.7	124.785	3632.91
23	44.0812	115557	Floor Interface	0	9.00002	309.207	408.24	2702.32	124.784	2577.54
24	44.0812	70485.3	Floor Interface	0	9.00002	182.601	241.084	1646.93	124.784	1522.14
25	49.2625	25489.3	Floor Interface	0	9.00002	48.6752	64.2649	530.544	124.792	405.752

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.32028

lice umber	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	248.357	834.634	0	0	0
2	290.846	774.375	18794.4	3950.01	11.8691

3	333.335	714.117	117473	24689.2	11.8691
4	375.825	653.858	296035	62217.5	11.8691
5	418.314	593.6	557980	117270	11.869
6	419.724	591.6	577333	121338	11.8691
7	463.483	577.5	651213	136865	11.8691
8	507.241	563.4	724821	152335	11.8691
9	551	549.3	798159	167749	11.8691
10	553.938	548.353	806516	169505	11.8691
11	604.317	549.264	703002	147750	11.8691
12	654.695	550.176	607832	127748	11.8691
13	705.074	551.087	521004	109499	11.8691
14	755.452	551.998	442520	93004.2	11.8691
15	805.831	552.909	372379	78262.7	11.8691
16	856.209	553.82	310582	65274.7	11.8691
17	906.588	554.731	253091	53191.9	11.8691
18	950.669	555.529	203135	42692.7	11.8691
19	994.75	556.326	155380	32656.1	11.8691
20	1038.83	557.123	113906	23939.5	11.869
21	1082.91	557.92	78853.8	16572.7	11.8691
22	1126.99	558.718	50224.4	10555.6	11.869
23	1171.08	559.515	28017.4	5888.39	11.8691
24	1215.16	560.312	12232.7	2570.94	11.8691
25	1259.24	561.109	2870.41	603.273	11.8691
26	1308.5	562	0	0	0

APPENDIX III-3C-4

FINAL-FILLED CONFIGURATION STABILITY

FINAL-FILLED CONFIGURATION STABILITY

Made By: VK
Checked by: JBF / MX
Reviewed by: CGD

1.0 OBJECTIVE

Estimate the factors of safety against sliding and global stability for the final-filled configuration of lateral expansion cells.

2.0 GIVEN

Based on a review of the design grades, two most-critical cross-sections were selected:

Section C-C' (Figure III-3-4):
Section along Tract 5, Cell 2 and Tract 5, Cell 6, having 3H:1V excavation sideslopes and 4H:1V final cover slopes to a crest elevation of approximately 820 ft, with a maximum fill elevation of about 840 feet-msl.

Section D-D' (Figure III-3-4):
Section along Tract 5-Cell 1 and existing Tract 2A, Cell 1A, 1B and 1C. The section has 3H:1V excavation sideslopes and 4H:1V final cover slopes until Tract 2A, and approximately 3H:1V in Tract 2A. The crest elevation is approximately 820 ft, with a maximum fill elevation of about 836 feet-msl.

One feet of leachate is assumed over the liner interface (conservative since LCRS is designed to maintain < 1 foot of leachate).

The cell liner system consists of:

FLOOR: 24 inches of protective cover (clay)
6-oz nonwoven geotextile over geonet
60-mil HDPE smooth geomembrane
24-inch compacted clay liner
Subgrade

SIDEWALLS: 24 inches of protective cover (lean clay)
Double-sided geocomposite
60-mil HDPE textured geomembrane
24-inch compacted clay liner
Subgrade

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

P:_2014 Project Folders\1400336 - Temple Expansion\PERMIT APPLICATION\Response to 1st NOD\Part III\Att 3\III-3C - Stability Analysis\III-3C4 - Final Configuration Stability\III-3C4_rev1.xlsx
Submitted: June 2016
Revised: December 2016

The following parameters were assigned to the materials based on available high load condition data.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ	c	Moist	Saturated	
Waste	Bi-Linear Function		65	75	Ref. [3]
Protective cover (soil)	>28	0	115	132	Ref. [2](1)
Prot. cover (soil)/Geotextile layer of Geocomposite (F)	28	0	N/A	N/A	Golder(2)
Geotextile/Geonet (F)	11.8	0	N/A	N/A	Ref. [1]
Geocomposite/Text. Geomembrane (S)	15	0	N/A	N/A	Golder(2)
Geonet/Smooth Geomembrane (F)	9	0	N/A	N/A	Golder(2)
Textured Geomembrane/Clay Liner (S)	35	0	N/A	N/A	Golder(2)
Smooth Geomembrane/Clay Liner (F)	15	0	N/A	N/A	Golder(2)
Clay Liner	28	0	N/A	N/A	Ref. [2](1)
Clay Liner/Subgrade	28	0	N/A	N/A	Ref. [2](1)

(F) = Floor; (S) = Slope

(1) The shear strength of the protective cover soils, clay liner and the clay liner/subgrade interface is estimated based on the on-site soil shear strength. This is estimated using the average plasticity index (PI = 40) of the Stratum I and Stratum II soils described in Attachment 4, and Ref. [2].

(2) Based on unpublished data from tests performed in Golder's laboratory, on similar geosynthetic materials. Strength parameters were conservatively assigned to be equal to or a percentage of the peak strength (lower bound) to account for testing data variability and to avoid strains that result in residual interface shear strengths. This data is presented in this appendix.

Based on the data listed in the previous table, the weakest interface in the liner system along the floor of the cell is between the geonet and the smooth geomembrane. The weakest interface in the liner system along the sideslopes of the cell is between the textured geomembrane and the geocomposite. These interfaces were used in the analysis.

Subsurface profiles are determined based on available adjacent borehole information, and the same soil properties as the excavation stability analysis are used. These are shown in the below table and in Appendix III-3C-1.

Material	Unit Weight (pcf)		Strength Parameters		Analysis Stress State	Reference
	Moist	Saturated	ϕ (degrees)	c (psf)		
Residual Clay	115	120	21.6	460	Effective	Golder 2015
Weathered Claystone	120	125	11	6840	Effective	Jones & Neuse 1993
Unweathered	130	130	45	7200	Effective	Jones & Neuse 1993

Note: Jones & Neuse 1993 refers to the previous geotechnical investigation data performed during the MSW-692A permit application, which were based on consolidated undrained triaxial shear testing. Testing results are included in Part III, Attachment 4, Appendix III-4D.

P:_2014 Project Folders\1400336 - Temple Expansion\PERMIT APPLICATION\Response to 1st NOD\Part III\Att 3\III-3C - Stability Analysis\III-3C4 - Final Configuration Stability\III-3C4_rev1.xlsx
Submitted: June 2016
Revised: December 2016

3.0 METHOD

Use SLIDE v.6.0 (Ref. [4]) to analyze the final-filled configuration stability, based on limit equilibrium methods following Spencer's method of analyses.

4.0 RESULTS

Section	FS - Block Failure	FS - Circular Failure	Minimum Allowable FS[(1)]
C-C'	1.52	2.82	1.5
D-D'	1.50	2.87	1.5

(1) Based on generally accepted industry practice, the minimum allowable factor of safety is 1.5.

5.0 CONCLUSION

Using strength parameters that are conservatively estimated or based on test results for similar conditions, and the reasonable worst possible case configuration, the analysis indicates that the final-filled configuration will be stable.

6.0 REFERENCES

[1] Bergado D. T., Youwai S., and Voottipreux P., (2004) "Interface shear strength of different Geosynthetics in landfill liner syatem: A case of Sakaew landfill, Thailand" Geoasia-204, 507-514.

[2] Bjerrum, L. and Simons, N. E. (1960). "Comparison of shear strength characteristics of normally consolidated clays." Proceedings of the Research Conference on Shear Strength of Cohesive Soils, ASCE, Boulder, Colorado, 1960, pp. 711–726.

[3] Bray, J.D., D. Zekkos, E. Kavazanjian, Jr., G.A. Athanasopoulos, and F. Riemer. 2009. Shear strength of municipal solid waste. J. Geotech. Geoenviron. Eng. (ASCE) 135(6): 709–22.

[4] Rocscience 2015, SLIDE - 2D Limit Equilibrium Slope Stability for Soil and Rock Slopes.

Smooth Geomembrane vs. Geonet

Date	Interface	Condition (Dry/Wet)	Shear Rate (in/min)	Normal Stress (psf)	Peak Shear Stress (psf)
Jun-03	Solmax 460 Smooth HDPE GM vs SKAPS Transnet 220 GN	Wet	0.2	2000	161
				5000	755
				8000	1295
Jul-10	Agru 40 mil Smooth HDPE GM vs SKAPS GN	Hydrated	0.2	750	206
				1500	408
				3000	1295

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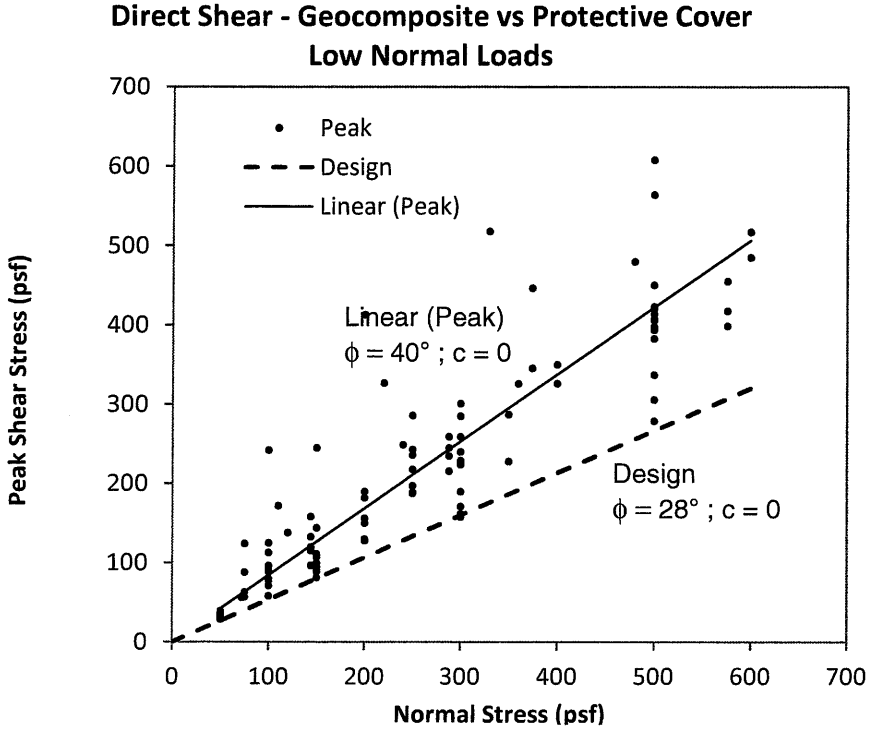
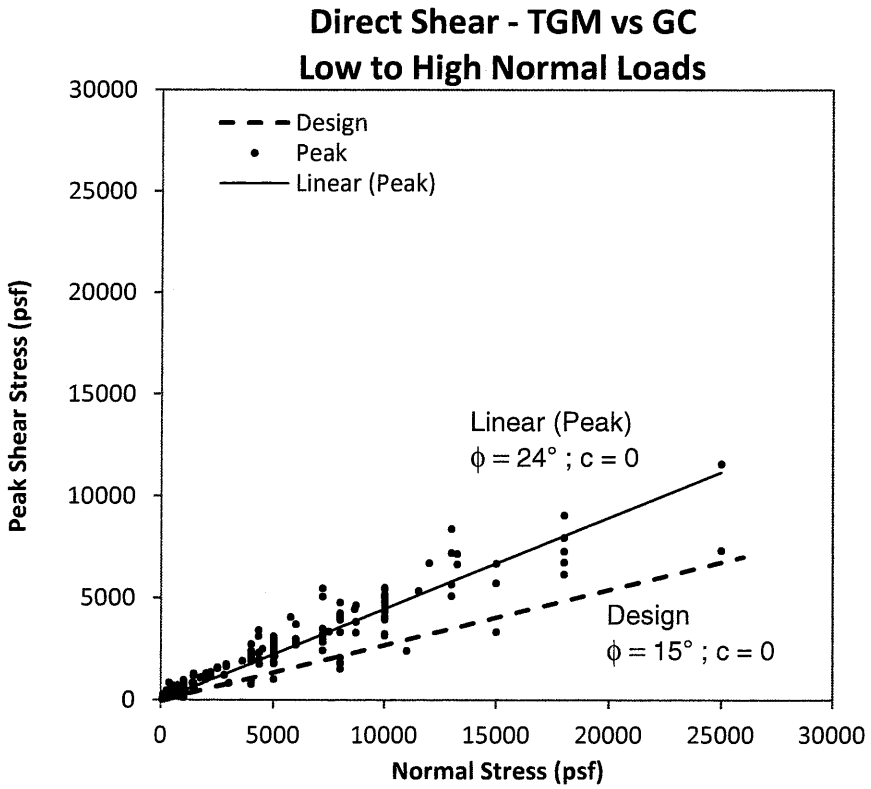
Submitted: June 2016
Revised: December 2016





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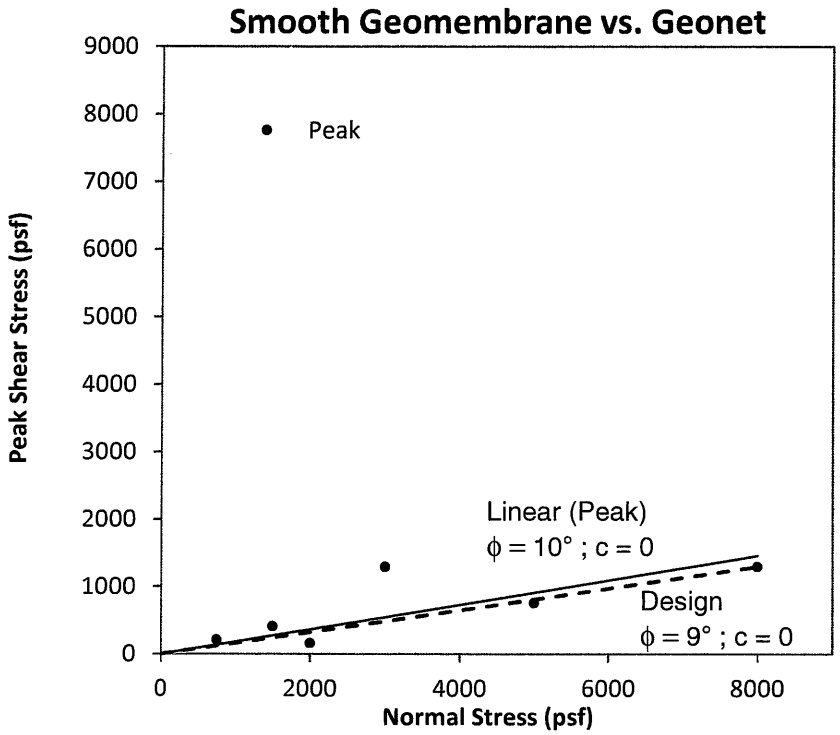
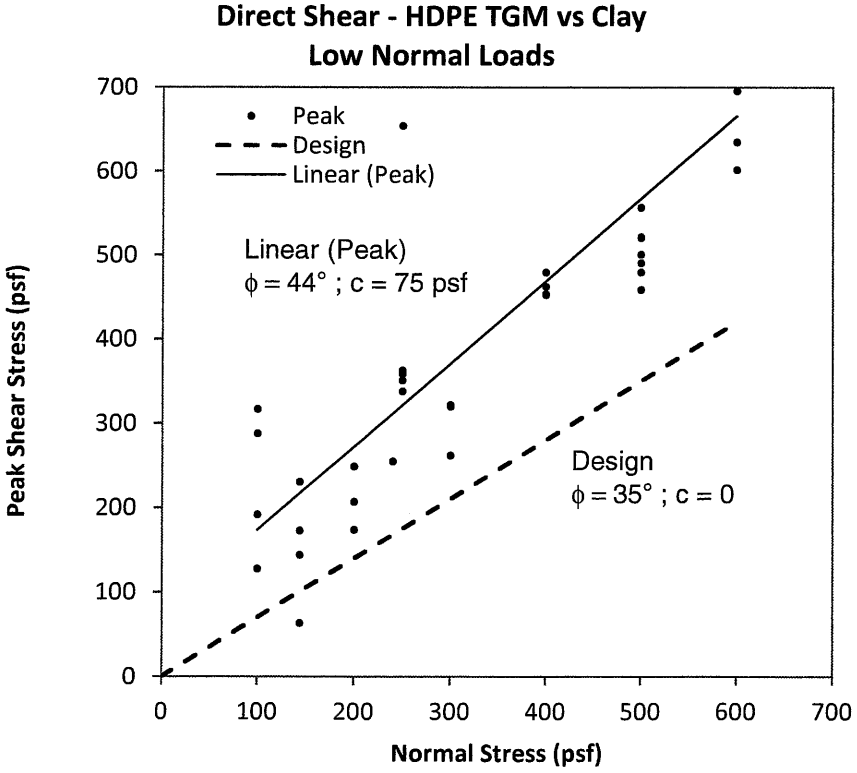
Submitted: June 2016
Revised: December 2016





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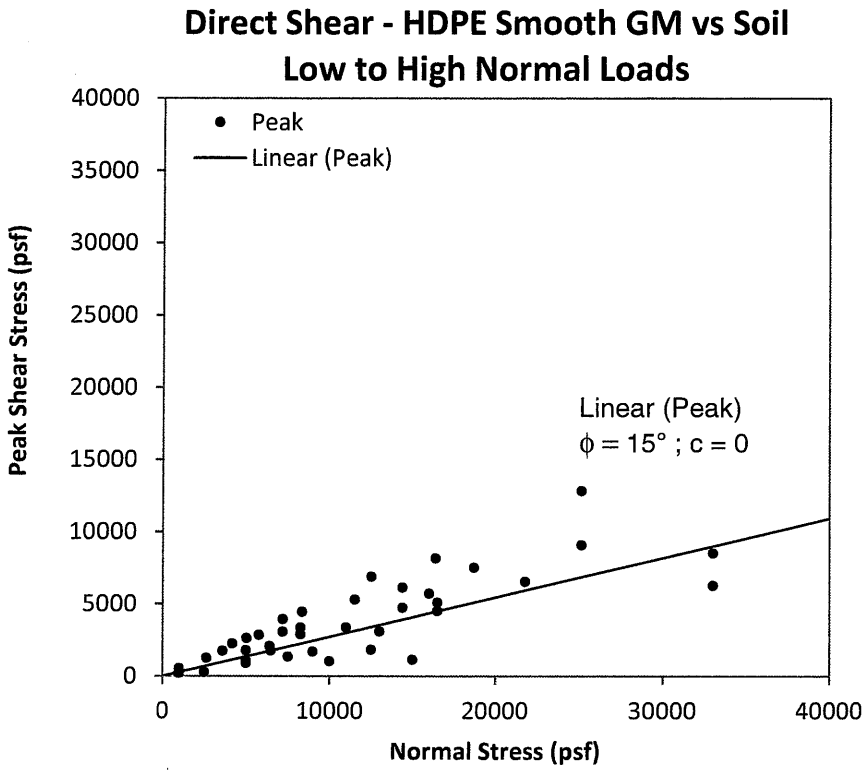
Submitted: June 2016
Revised: December 2016



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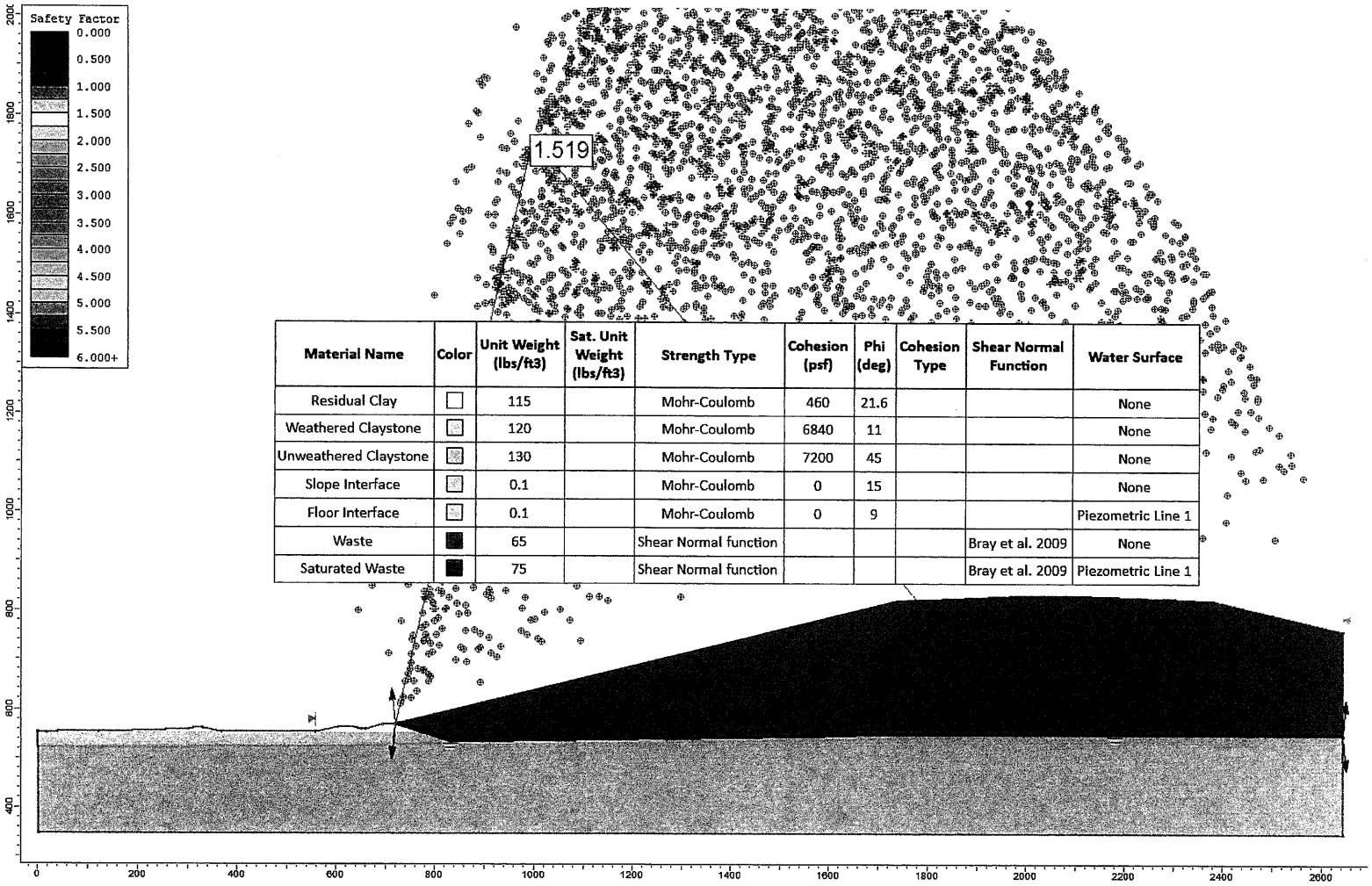
Submitted: June 2016
Revised: December 2016



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface
Residual Clay		115		Mohr-Coulomb	460	21.6			None
Weathered Claystone		120		Mohr-Coulomb	6840	11			None
Unweathered Claystone		130		Mohr-Coulomb	7200	45			None
Slope Interface		0.1		Mohr-Coulomb	0	15			None
Floor Interface		0.1		Mohr-Coulomb	0	9			Piezometric Line 1
Waste		65		Shear Normal function				Bray et al. 2009	None
Saturated Waste		75		Shear Normal function				Bray et al. 2009	Piezometric Line 1

FIGURE **3C4.1**

Final Configuration Stability Analysis - Section C-C' - Block Failure

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: FinalConfig_D-D'_Block.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 6/2/2015, 3:44:21 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
dom Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 95
Left Projection Angle (End Angle): 265
Right Projection Angle (Start Angle): -85
Right Projection Angle (End Angle): 85
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone	Slope Interface	Floor Interface	Waste	Saturated Waste
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	115	120	130	0.1	0.1	65	75
Cohesion [psf]	460	6840	7200	0	0		
Friction Angle [deg]	21.6	11	45	15	9		
Water Surface	None	None	None	None	Piezometric Line 1	None	Piezometric Line 1
Ru Value					1		1
Ru Value	0	0	0	0		0	

Shear Normal Functions

Name: Bray et al. 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

Method: spencer

FS: 1.519100
Axis Location: 997.238, 1755.875
Left Slip Surface Endpoint: 719.653, 569.556
Right Slip Surface Endpoint: 1779.742, 822.016
Resisting Moment=2.85347e+009 lb-ft

Driving Moment=1.87839e+009 lb-ft
Resisting Horizontal Force=1.94479e+006 lb
Driving Horizontal Force=1.28022e+006 lb
Total Slice Area=132006 ft2

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.5191

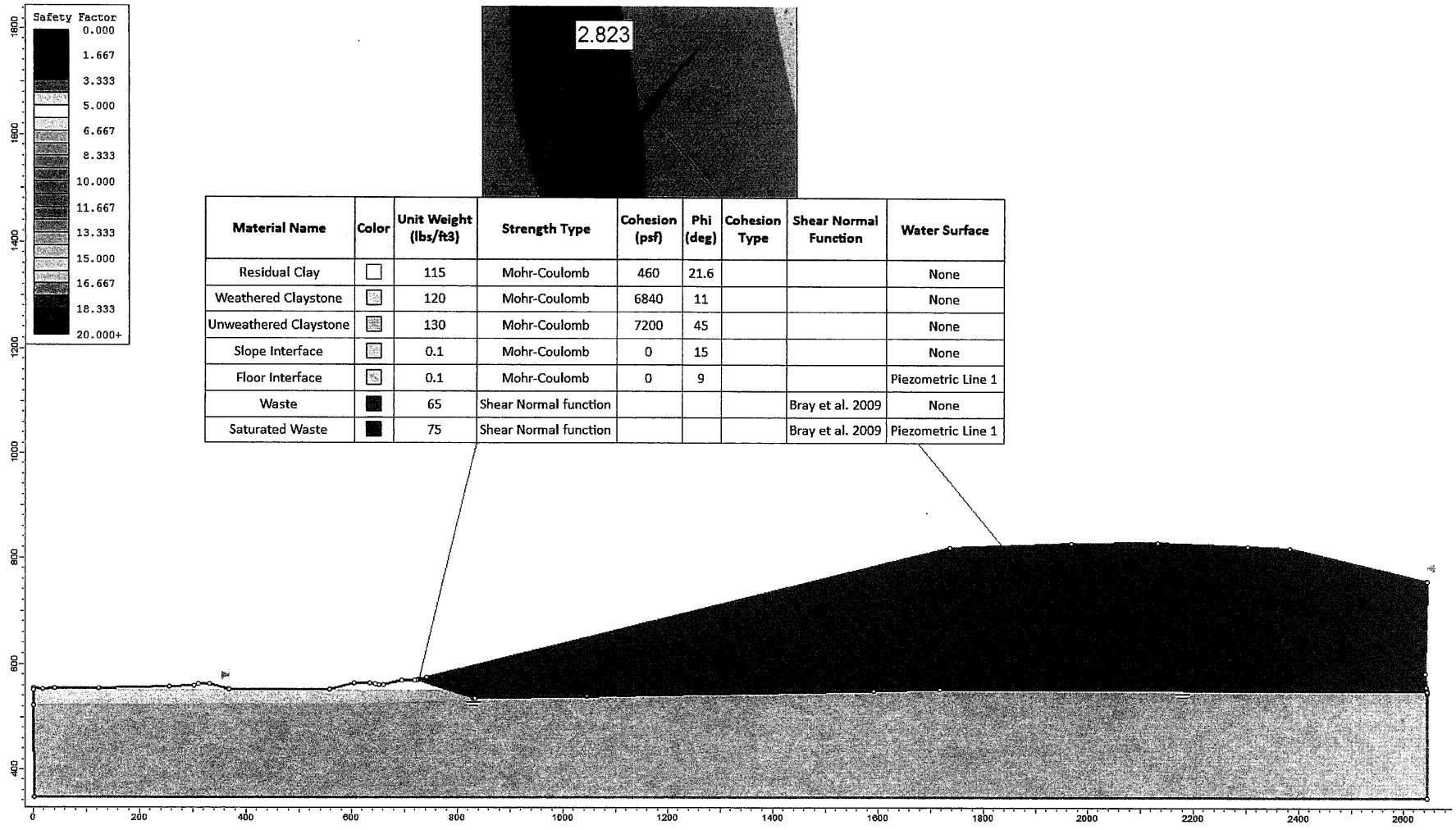
Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.32327	0.0856154	Slope Interface	0	15	0.00694418	0.0105489	0.039369	0	0.039369
2	55.2336	56871.9	Slope Interface	0	15	216.707	329.2	1228.59	0	1228.59
3	55.2336	170802	Slope Interface	0	15	650.831	988.677	3689.78	0	3689.78
4	46.0746	205857	Floor Interface	0	9.00002	461.172	700.566	4539.31	116.111	4423.2
5	46.0746	237585	Floor Interface	0	9.00002	534.484	811.934	5239.35	112.998	5126.35
6	46.0746	269312	Floor Interface	0	9.00002	607.796	923.303	5939.39	109.885	5829.51
7	46.0746	301039	Floor Interface	0	9.00002	681.107	1034.67	6639.43	106.771	6532.66
8	46.0746	332751	Floor Interface	0	9.00002	754.381	1145.98	7339.12	103.658	7235.47
9	46.0746	364288	Floor Interface	0	9.00002	826.805	1256	8034.89	104.837	7930.05
10	46.0746	395777	Floor Interface	0	9.00002	899.032	1365.72	8729.55	106.712	8622.83
11	46.0746	427265	Floor Interface	0	9.00002	971.266	1475.45	9424.21	108.586	9315.62
12	46.0746	458754	Floor Interface	0	9.00002	1043.5	1585.18	10118.9	110.461	10008.4
13	46.0746	490242	Floor Interface	0	9.00002	1115.73	1694.9	10813.5	112.336	10701.2
14	46.0746	521730	Floor Interface	0	9.00002	1187.96	1804.63	11508.2	114.21	11394
15	46.0746	553219	Floor Interface	0	9.00002	1260.19	1914.36	12202.9	116.085	12086.8
16	46.0746	584707	Floor Interface	0	9.00002	1332.43	2024.09	12897.5	117.96	12779.6
17	46.0746	616195	Floor Interface	0	9.00002	1404.65	2133.81	13592.2	119.834	13472.4
18	46.0746	647684	Floor Interface	0	9.00002	1476.89	2243.54	14286.9	121.709	14165.1
19	0.909233	13098.1	Floor Interface	0	9.00002	1138.76	1729.89	11014.6	92.5232	10922.1
20	0.941736	13543.9	Saturated Waste	872.048	30.0931	3966.28	6025.18	8923.27	31.2	8892.07
21	50.8659	659893	Waste	1005.45	29.4072	3633.65	5519.88	8009.48	0	8009.48
22	50.8659	519689	Waste	814.545	30.1916	2932.43	4454.65	6256.45	0	6256.45
23	50.8659	379485	Waste	414.783	33.3727	2227.26	3383.43	4506.86	0	4506.86
24	50.8659	239281	Waste	414.783	33.3727	1481.39	2250.38	2786.72	0	2786.72
25	50.8659	87017.6	Waste	414.783	33.3727	671.995	1020.83	920.068	0	920.068

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.5191

Slice mber	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	719.653	569.556	0	0	0
2	721.977	569.391	0.0225933	0.00471099	11.7781
3	777.21	551.285	34201.9	7131.54	11.7782

4	832.444	533.179	136919	28549.5	11.7782
5	878.518	533.988	154471	32209.2	11.7782
6	924.593	534.797	174830	36454.3	11.7781
7	970.667	535.607	197996	41284.9	11.7782
8	1016.74	536.416	223971	46700.8	11.7781
9	1062.82	537.226	252751	52701.9	11.7782
10	1108.89	538.035	284302	59280.6	11.7781
11	1154.97	538.844	318614	66435.2	11.7782
12	1201.04	539.654	355689	74165.8	11.7782
13	1247.11	540.463	395526	82472.3	11.7782
14	1293.19	541.272	438125	91354.8	11.7782
15	1339.26	542.082	483487	100813	11.7781
16	1385.34	542.891	531610	110848	11.7782
17	1431.41	543.7	582496	121458	11.7782
18	1477.49	544.51	636144	132644	11.7781
19	1523.56	545.319	692555	144407	11.7782
20	1524.47	546.301	682772	142367	11.7782
21	1525.41	547.318	677427	141252	11.7781
22	1576.28	602.258	422019	87996.6	11.7782
23	1627.14	657.197	227293	47393.6	11.7782
24	1678.01	712.137	92857.4	19362	11.7782
25	1728.88	767.077	15027.6	3133.44	11.7781
26	1779.74	822.016	0	0	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface
Residual Clay		115	Mohr-Coulomb	460	21.6			None
Weathered Claystone		120	Mohr-Coulomb	6840	11			None
Unweathered Claystone		130	Mohr-Coulomb	7200	45			None
Slope Interface		0.1	Mohr-Coulomb	0	15			None
Floor Interface		0.1	Mohr-Coulomb	0	9			Piezometric Line 1
Waste		65	Shear Normal function				Bray et al. 2009	None
Saturated Waste		75	Shear Normal function				Bray et al. 2009	Piezometric Line 1

FIGURE **3C4.2**

Final Configuration Stability Analysis – Section C-C' - Circular Failure

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: FinalConfig_D-D'_Circular.slim
Slide Modeler Version: 6.03
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 6/2/2015, 3:44:21 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
dom Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
nposite Surfaces: Disabled
erse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone	Slope Interface	Floor Interface	Waste	Saturated Waste
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	115	120	130	0.1	0.1	65	75
Cohesion [psf]	460	6840	7200	0	0		
Friction Angle [deg]	21.6	11	45	15	9		
Water Surface	None	None	None	None	Piezometric Line 1	None	Piezometric Line 1
Hu Value					1		1
Ru Value	0	0	0	0		0	

Shear Normal Functions

Name: Bray et al. 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

Method: spencer

FS: 2.823050
Center: 1027.996, 1812.477
Radius: 1277.321
Left Slip Surface Endpoint: 726.510, 571.245
Right Slip Surface Endpoint: 1837.336, 824.288
Resisting Moment=5.78883e+009 lb-ft
Driving Moment=2.05056e+009 lb-ft
Resisting Horizontal Force=4.29506e+006 lb

Driving Horizontal Force=1.52142e+006 lb
Total Slice Area=113200 ft2

ce Data

Global Minimum Query (spencer) - Safety Factor: 2.82305

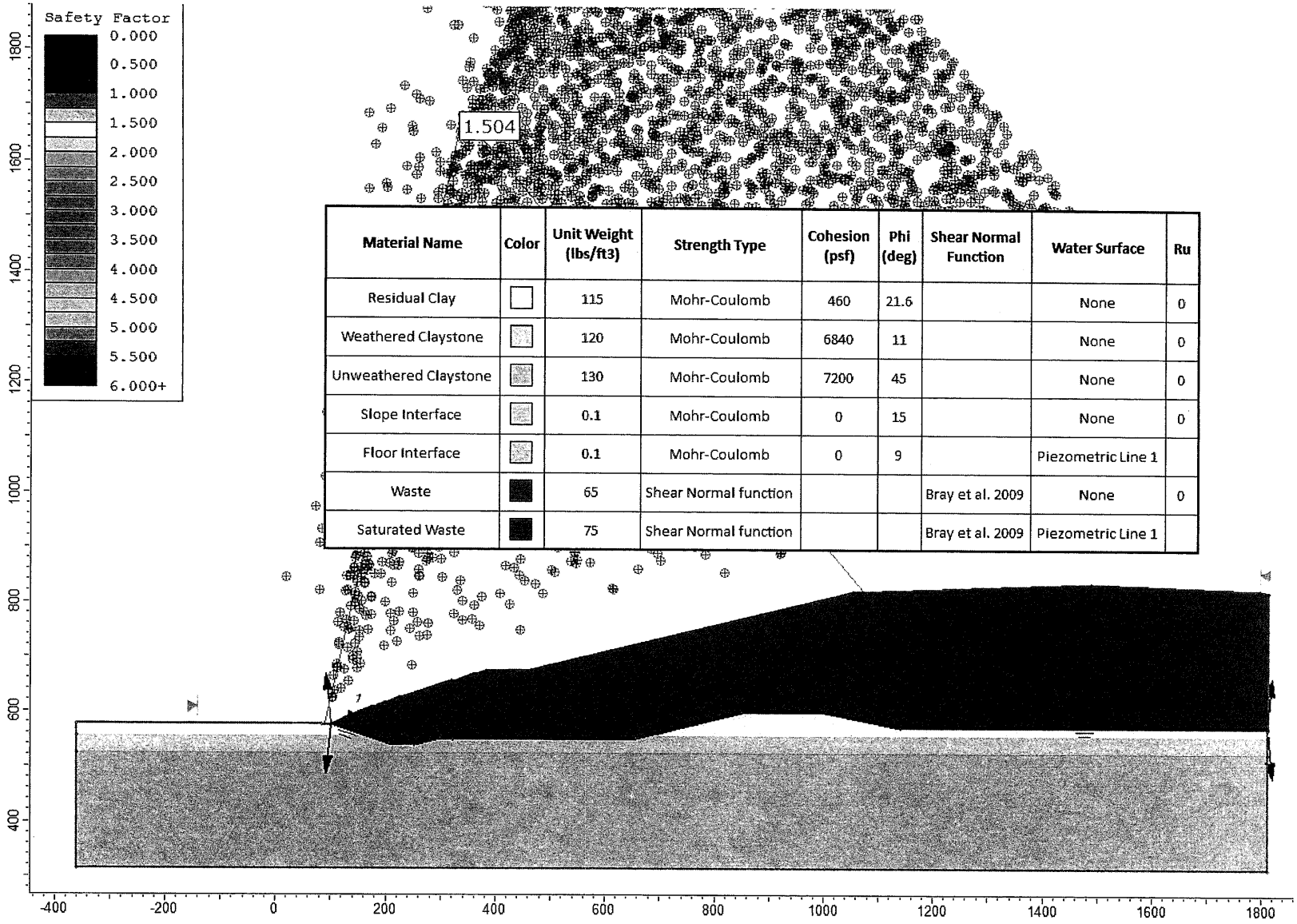
Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	46.133	32495.2	Waste	414.783	33.3727	357.409	1008.98	902.086	0	902.086
2	46.133	94828.6	Waste	414.783	33.3727	714.781	2017.86	2433.73	0	2433.73
3	46.133	151902	Waste	414.783	33.3727	1028.79	2904.32	3779.5	0	3779.5
4	46.133	203811	Waste	414.783	33.3727	1302.58	3677.24	4952.9	0	4952.9
5	46.133	250628	Waste	814.545	30.1916	1516.69	4281.7	5959.16	0	5959.16
6	15.1365	91777.3	Saturated Waste	448	32.6192	1639.06	4627.16	6561.14	31.2	6529.94
7	48.79	320971	Floor Interface	0	9.00002	368.945	1041.55	6700.92	124.8	6576.12
8	58.408	430977	Floor Interface	0	9.00002	406.45	1147.43	7430.41	185.841	7244.57
9	48.5211	396527	Floor Interface	0	9.00002	449.592	1269.22	8138.32	124.8	8013.52
10	15.0823	129804	Saturated Waste	872.048	30.0931	2092.05	5905.97	8717.56	31.2	8686.36
11	46.2816	411332	Waste	872.048	30.0931	2136.51	6031.49	8902.98	0	8902.98
12	46.2816	427894	Waste	872.048	30.0931	2178.53	6150.11	9107.69	0	9107.69
13	46.2816	439244	Waste	872.048	30.0931	2196.4	6200.56	9194.72	0	9194.72
14	46.2816	445286	Waste	872.048	30.0931	2190.66	6184.35	9166.76	0	9166.76
15	46.2816	445900	Waste	872.048	30.0931	2161.73	6102.66	9025.8	0	9025.8
16	46.2816	440935	Waste	872.048	30.0931	2109.93	5956.43	8773.46	0	8773.46
17	46.2816	430210	Waste	872.048	30.0931	2035.49	5746.3	8410.87	0	8410.87
18	46.2816	413509	Waste	1005.45	29.4072	1941.08	5479.76	7938.28	0	7938.28
19	46.2816	390570	Waste	1005.45	29.4072	1824.83	5151.6	7356.07	0	7356.07
20	46.2816	361084	Waste	448	32.6192	1670.35	4715.49	6667.96	0	6667.96
21	46.2816	324679	Waste	814.545	30.1916	1498.25	4229.63	5869.68	0	5869.68
22	46.2816	280913	Waste	414.783	33.3727	1304.39	3682.35	4960.67	0	4960.67
23	46.2816	228882	Waste	414.783	33.3727	1066.57	3010.99	3941.44	0	3941.44
24	46.2816	150033	Waste	414.783	33.3727	730.477	2062.17	2500.99	0	2500.99
25	46.2816	51644.5	Waste	414.783	33.3727	332.507	938.683	795.36	0	795.36

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.82305

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	726.51	571.245	0	0	0
2	772.643	560.94	25791.4	5475.17	11.9852
3	818.776	552.407	79547.8	16886.9	11.9852
4	864.909	545.61	152718	32419.9	11.9852
5	911.041	540.521	238038	50532.3	11.9852
6	957.174	537.12	328302	69694.1	11.9852

7	972.311	536.37	358046	76008.4	11.9852
8	1021.1	535.174	384068	81532.3	11.9852
9	1079.51	536.195	400234	84964.3	11.9852
10	1128.03	539.079	398587	84614.6	11.9852
11	1143.11	540.353	419040	88956.5	11.9852
12	1189.39	545.393	473092	100431	11.9852
13	1235.68	552.152	512406	108777	11.9852
14	1281.96	560.657	535901	113764	11.9851
15	1328.24	570.944	543031	115278	11.9852
16	1374.52	583.058	533781	113314	11.9851
17	1420.8	597.054	508681	107986	11.9852
18	1467.08	612.997	468829	99526.1	11.9852
19	1513.37	630.967	416055	88322.9	11.9852
20	1559.65	651.056	352764	74887	11.9852
21	1605.93	673.379	281257	59707.1	11.9852
22	1652.21	698.068	205710	43669.4	11.9852
23	1698.49	725.285	131089	27828.4	11.9852
24	1744.77	755.226	62464.3	13260.3	11.9852
25	1791.05	788.128	13997.9	2971.56	11.9852
26	1837.34	824.288	0	0	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Residual Clay		115	Mohr-Coulomb	460	21.6		None	0
Weathered Claystone		120	Mohr-Coulomb	6840	11		None	0
Unweathered Claystone		130	Mohr-Coulomb	7200	45		None	0
Slope Interface		0.1	Mohr-Coulomb	0	15		None	0
Floor Interface		0.1	Mohr-Coulomb	0	9		Piezometric Line 1	
Waste		65	Shear Normal function			Bray et al. 2009	None	0
Saturated Waste		75	Shear Normal function			Bray et al. 2009	Piezometric Line 1	

FIGURE **3C4.3**

Final Configuration Stability Analysis – Section D-D' - Block Failure

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name:	Final Config_Block.slim
Slide Modeler Version:	6.03
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	11/2/2016, 4:04:21 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Left Projection Angle (Start Angle):	95
Left Projection Angle (End Angle):	265
Right Projection Angle (Start Angle):	-85
Right Projection Angle (End Angle):	85
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone	Slope Interface	Floor Interface	Waste	Saturated Waste
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	115	120	130	0.1	0.1	65	75
Cohesion [psf]	460	6840	7200	0	0		
Friction Angle [deg]	21.6	11	45	15	9		
Water Surface	None	None	None	None	Piezometric Line 1	None	Piezometric Line 1
Hu Value					1		1
Ru Value	0	0	0	0		0	

Shear Normal Functions

Name: Bray et al. 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

Method: spencer

FS	1.504160
Axis Location:	338.392, 1682.436
Left Slip Surface Endpoint:	89.970, 576.722
Right Slip Surface Endpoint:	1073.910, 820.270
Resisting Moment:	2.4393e+009 lb-ft
Driving Moment:	1.62171e+009 lb-ft
Resisting Horizontal Force:	1.86911e+006 lb
Driving Horizontal Force:	1.24263e+006 lb
Total Slice Area:	112268 ft2
Surface Horizontal Width:	983.94 ft
Surface Average Height:	114.1 ft

Method: gle/morgenstern-price

FS	1.485250
Axis Location:	307.222, 1577.288
Left Slip Surface Endpoint:	86.892, 577.000
Right Slip Surface Endpoint:	975.254, 800.852
Resisting Moment:	1.84127e+009 lb-ft
Driving Moment:	1.2397e+009 lb-ft
Resisting Horizontal Force:	1.51881e+006 lb
Driving Horizontal Force:	1.0226e+006 lb
Total Slice Area:	103748 ft2
Surface Horizontal Width:	888.362 ft
Surface Average Height:	116.786 ft

Global Minimum Coordinates

Method: spencer

X	Y
89.9702	576.722
112.76	572.589
206.721	541.239
251.328	540.909
297.518	551.011
321.096	550.025
655.424	552.312
834.995	595.839
1073.91	820.27

Method: gle/morgenstern-price

X	Y
86.8923	577
105.875	574.886
206.721	541.239
251.328	540.909
297.518	551.011
321.096	550.025
655.424	552.312
839.841	597.013
975.254	800.852

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.50416

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	15.7151	1152.71	-10.279	Residual Clay	460	21.6	361.73	544.101	212.413	0	212.413
2	7.07499	2695.17	-10.279	Slope Interface	0	15	75.2599	113.203	422.479	0	422.479
3	18.7921	20047.9	-18.4512	Slope Interface	0	15	224.364	337.48	1259.49	0	1259.49
4	18.7921	37536.9	-18.4512	Slope Interface	0	15	420.091	631.884	2358.22	0	2358.22
5	18.7921	54572.4	-18.4512	Slope Interface	0	15	610.743	918.655	3428.47	0	3428.47
6	18.7921	70382.2	-18.4512	Slope Interface	0	15	787.676	1184.79	4421.71	0	4421.71
7	18.7921	85826.7	-18.4512	Slope Interface	0	15	960.523	1444.78	5391.98	0	5391.98
8	22.3035	117084	-0.423863	Floor Interface	0	9.00002	551.236	829.147	5362.51	127.501	5235.01
9	22.3035	126509	-0.423863	Floor Interface	0	9.00002	596.498	897.228	5794.4	129.525	5664.88
10	23.095	139327	12.3366	Slope Interface	0	15	1026.97	1544.73	5765.01	0	5765.01
11	23.095	144013	12.3366	Slope Interface	0	15	1061.52	1596.69	5958.96	0	5958.96
12	23.578	156511	-2.39464	Floor Interface	0	9.00002	708.236	1065.3	6850.83	124.821	6726.01
13	20.8955	146841	0.391931	Floor Interface	0	9.00002	739.662	1112.57	7149.65	125.175	7024.47
14	20.8955	156636	0.391931	Floor Interface	0	9.00002	789.909	1188.15	7626.73	125.062	7501.66
15	20.8955	163353	0.391931	Floor Interface	0	9.00002	824.367	1239.98	7953.87	124.95	7828.92
16	20.8955	167696	0.391931	Floor Interface	0	9.00002	846.652	1273.5	8165.39	124.838	8040.56
17	20.8955	168519	0.391931	Floor Interface	0	9.00002	850.887	1279.87	8205.5	124.725	8080.77
18	20.8955	169343	0.391931	Floor Interface	0	9.00002	855.122	1286.24	8245.65	124.613	8121.04
19	20.8955	170204	0.391931	Floor Interface	0	9.00002	859.556	1292.91	8287.57	124.501	8163.07
20	20.8955	174579	0.391931	Floor Interface	0	9.00002	882.001	1326.67	8500.67	124.388	8376.29
21	20.8955	181256	0.391931	Floor Interface	0	9.00002	916.252	1378.19	8825.86	124.276	8701.58
22	20.8955	187932	0.391931	Floor Interface	0	9.00002	950.504	1429.71	9151.04	124.163	9026.88
23	20.8955	194608	0.391931	Floor Interface	0	9.00002	984.756	1481.23	9476.22	124.051	9352.17
24	20.8955	201284	0.391931	Floor Interface	0	9.00002	1019.01	1532.76	9801.35	123.939	9677.42
25	20.8955	207961	0.391931	Floor Interface	0	9.00002	1053.27	1584.28	10126.5	123.826	10002.7
26	20.8955	214637	0.391931	Floor Interface	0	9.00002	1087.52	1635.8	10451.7	123.714	10328
27	20.8955	221313	0.391931	Floor Interface	0	9.00002	1121.77	1687.32	10776.9	123.602	10653.3
28	20.8955	227990	0.391931	Floor Interface	0	9.00002	1156.02	1738.84	11102.1	123.489	10978.6
29	19.9523	220877	13.6253	Slope Interface	0	15	1869.19	2811.56	10492.8	0	10492.8
30	19.9523	220869	13.6253	Slope Interface	0	15	1869.12	2811.45	10492.5	0	10492.5
31	19.9523	220860	13.6253	Slope Interface	0	15	1869.04	2811.34	10492.1	0	10492.1
32	19.9523	220852	13.6253	Slope Interface	0	15	1868.97	2811.23	10491.7	0	10491.7
33	19.9523	220843	13.6253	Slope Interface	0	15	1868.9	2811.12	10491.2	0	10491.2
34	19.9523	220835	13.6253	Slope Interface	0	15	1868.82	2811.01	10490.9	0	10490.9
35	19.9523	220826	13.6253	Slope Interface	0	15	1868.76	2810.91	10490.5	0	10490.5
36	19.9523	220818	13.6253	Slope Interface	0	15	1868.68	2810.8	10490	0	10490
37	19.9523	220809	13.6253	Slope Interface	0	15	1868.61	2810.69	10489.6	0	10489.6
38	1.3908	15391.4	43.2096	Slope Interface	0	15	1509.97	2271.23	8476.32	0	8476.32
39	1.43462	15822.4	43.2096	Saturated Waste	448	32.6192	3363.55	5059.32	7236.39	31.2	7205.19
40	21.4627	225467	43.2096	Waste	448	32.6192	3224.7	4850.47	6878.86	0	6878.86
41	21.4627	204586	43.2096	Waste	814.545	30.1916	2949.96	4437.22	6226.47	0	6226.47
42	21.4627	183705	43.2096	Waste	814.545	30.1916	2693.13	4050.91	5562.5	0	5562.5
43	21.4627	162824	43.2096	Waste	414.783	33.3727	2424.15	3646.31	4905.97	0	4905.97
44	21.4627	141943	43.2096	Waste	414.783	33.3727	2140.84	3220.16	4258.98	0	4258.98
45	21.4627	121062	43.2096	Waste	414.783	33.3727	1857.52	2794.01	3612.03	0	3612.03
46	21.4627	100181	43.2096	Waste	414.783	33.3727	1574.21	2367.86	2965.07	0	2965.07
47	21.4627	79299.6	43.2096	Waste	414.783	33.3727	1290.9	1941.71	2318.11	0	2318.11
48	21.4627	58418.6	43.2096	Waste	414.783	33.3727	1007.57	1515.55	1671.14	0	1671.14
49	21.4627	37537.5	43.2096	Waste	414.783	33.3727	724.26	1089.4	1024.18	0	1024.18
50	21.4627	13532.4	43.2096	Waste	310	39.8056	370.758	557.68	297.215	0	297.215

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.48525

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	14.1135	220.146	-6.35406	Residual Clay	460	21.6	324.562	482.055	55.7047	0	55.7047
2	4.86962	383.138	-6.35406	Slope Interface	0	15	15.2926	22.7134	84.7675	0	84.7675
3	20.1691	14888.9	-18.4512	Slope Interface	0	15	145.132	215.557	804.468	0	804.468
4	20.1691	35759.9	-18.4512	Slope Interface	0	15	352.153	523.035	1951.99	0	1951.99
5	20.1691	55022.4	-18.4512	Slope Interface	0	15	549.098	815.548	3043.67	0	3043.67
6	20.1691	73859.2	-18.4512	Slope Interface	0	15	747.093	1109.62	4141.16	0	4141.16
7	20.1691	91492.8	-18.4512	Slope Interface	0	15	937.97	1393.12	5199.2	0	5199.2
8	22.3035	117084	-0.423863	Floor Interface	0	9.00002	567.367	842.682	5448.01	127.501	5320.51
9	22.3035	126509	-0.423863	Floor Interface	0	9.00002	614.525	912.723	5892.23	129.525	5762.71
10	23.095	139327	12.3366	Slope Interface	0	15	1064.07	1580.41	5898.17	0	5898.17
11	23.095	144013	12.3366	Slope Interface	0	15	1096.5	1628.57	6077.9	0	6077.9
12	23.578	156511	-2.39464	Floor Interface	0	9.00002	728.685	1082.28	6958.08	124.821	6833.26
13	17.5962	123010	0.391931	Floor Interface	0	9.00002	757.852	1125.6	7231.96	125.184	7106.77
14	17.5962	130051	0.391931	Floor Interface	0	9.00002	801.852	1190.95	7644.42	125.089	7519.33
15	17.5962	135236	0.391931	Floor Interface	0	9.00002	834.257	1239.08	7948.23	124.994	7823.24
16	17.5962	140221	0.391931	Floor Interface	0	9.00002	865.268	1285.14	8238.97	124.9	8114.07
17	17.5962	141418	0.391931	Floor Interface	0	9.00002	872.634	1296.08	8307.96	124.805	8183.15
18	17.5962	142002	0.391931	Floor Interface	0	9.00002	875.954	1301.01	8338.99	124.71	8214.28
19	17.5962	142586	0.391931	Floor Interface	0	9.00002	879.01	1305.55	8367.57	124.616	8242.96
20	17.5962	143171	0.391931	Floor Interface	0	9.00002	881.804	1309.7	8393.6	124.521	8269.08
21	17.5962	145157	0.391931	Floor Interface	0	9.00002	893.015	1326.35	8498.68	124.427	8374.25
22	17.5962	149825	0.391931	Floor Interface	0	9.00002	920.613	1367.34	8757.36	124.332	8633.03
23	17.5962	154560	0.391931	Floor Interface	0	9.00002	948.359	1408.55	9017.47	124.237	8893.23
24	17.5962	159294	0.391931	Floor Interface	0	9.00002	975.829	1449.35	9275.02	124.143	9150.88
25	17.5962	164029	0.391931	Floor Interface	0	9.00002	1003.03	1489.75	9529.95	124.048	9405.91
26	17.5962	168763	0.391931	Floor Interface	0	9.00002	1029.93	1529.71	9782.16	123.954	9658.21
27	17.5962	173497	0.391931	Floor Interface	0	9.00002	1056.55	1569.24	10031.6	123.859	9907.78
28	17.5962	178232	0.391931	Floor Interface	0	9.00002	1082.87	1608.34	10278.4	123.764	10154.6
29	17.5962	182966	0.391931	Floor Interface	0	9.00002	1108.9	1646.99	10522.4	123.67	10398.7
30	17.5962	187701	0.391931	Floor Interface	0	9.00002	1134.63	1685.21	10763.6	123.575	10640
31	17.5962	192435	0.391931	Floor Interface	0	9.00002	1160.08	1723.01	11002.1	123.48	10878.6
32	18.4417	204155	13.6253	Slope Interface	0	15	1856.46	2757.3	10290.4	0	10290.4
33	18.4417	204148	13.6253	Slope Interface	0	15	1853.98	2753.63	10276.7	0	10276.7
34	18.4417	204140	13.6253	Slope Interface	0	15	1851.95	2750.61	10265.4	0	10265.4
35	18.4417	204133	13.6253	Slope Interface	0	15	1850.36	2748.25	10256.6	0	10256.6
36	18.4417	204126	13.6253	Slope Interface	0	15	1849.21	2746.54	10250.2	0	10250.2
37	18.4417	204119	13.6253	Slope Interface	0	15	1848.49	2745.47	10246.3	0	10246.3
38	18.4417	204111	13.6253	Slope Interface	0	15	1848.2	2745.04	10244.6	0	10244.6
39	18.4417	204104	13.6253	Slope Interface	0	15	1848.33	2745.23	10245.4	0	10245.4
40	18.4417	204097	13.6253	Slope Interface	0	15	1848.86	2746.02	10248.3	0	10248.3
41	18.4417	204089	13.6253	Slope Interface	0	15	1849.79	2747.4	10253.4	0	10253.4
42	0.767341	8491.78	56.4032	Slope Interface	0	15	1373.17	2039.5	7611.49	0	7611.49
43	0.79178	8732.48	56.4032	Saturated Waste	814.545	30.1916	2824.3	4194.78	5840.99	31.2	5809.79
44	19.122	195165	56.4032	Waste	814.545	30.1916	2662.25	3954.11	5396.1	0	5396.1
45	19.122	165140	56.4032	Waste	414.783	33.3727	2310.74	3432.03	4580.64	0	4580.64
46	19.122	135115	56.4032	Waste	414.783	33.3727	1944.61	2888.23	3755.08	0	3755.08
47	19.122	105089	56.4032	Waste	414.783	33.3727	1569.13	2330.54	2908.4	0	2908.4
48	19.122	75063.6	56.4032	Waste	414.783	33.3727	1183.19	1757.33	2038.2	0	2038.2
49	19.122	45038.2	56.4032	Waste	414.783	33.3727	785.846	1167.18	1142.25	0	1142.25
50	19.122	15012.7	56.4032	Waste	310	39.8056	351.931	522.706	255.247	0	255.247

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.50416

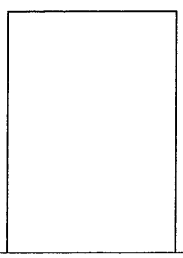
Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	89.9702	576.722	0	0	0
2	105.685	573.872	6294.64	1158.77	10.4307
3	112.76	572.589	7369.61	1356.66	10.4307
4	131.552	566.319	19486.4	3587.21	10.4307
5	150.345	560.049	42173.3	7763.6	10.4307
6	169.137	553.779	75156.3	13835.4	10.4307
7	187.929	547.509	117695	21666.2	10.4307
8	206.721	541.239	169567	31215.4	10.4307
9	229.024	541.074	182757	33643.4	10.4307
10	251.328	540.909	197028	36270.5	10.4307
11	274.423	545.96	191646	35279.8	10.4307
12	297.518	551.011	186083	34255.7	10.4307
13	321.096	550.025	209551	38575.8	10.4307
14	341.991	550.168	223997	41235.2	10.4307
15	362.887	550.311	239426	44075.5	10.4307
16	383.783	550.454	255529	47039.8	10.4307
17	404.678	550.597	272067	50084.3	10.4307
18	425.574	550.74	288688	53144.1	10.4307
19	446.469	550.883	305393	56219.2	10.4307
20	467.365	551.026	322184	59310.2	10.4307
21	488.26	551.168	339413	62482	10.4307
22	509.156	551.311	357313	65777.2	10.4307
23	530.051	551.454	375883	69195.6	10.4307
24	550.947	551.597	395122	72737.3	10.4307
25	571.842	551.74	415031	76402.4	10.4307
26	592.737	551.883	435610	80190.7	10.4307
27	613.633	552.026	456859	84102.4	10.4307
28	634.528	552.169	478778	88137.4	10.4307
29	655.424	552.312	501366	92295.6	10.4307
30	675.376	557.148	487945	89824.9	10.4307
31	695.329	561.985	474524	87354.2	10.4307
32	715.281	566.821	461103	84883.6	10.4307
33	735.233	571.657	447683	82413.2	10.4307
34	755.185	576.494	434263	79942.8	10.4307
35	775.138	581.33	420844	77472.5	10.4307
36	795.09	586.166	407426	75002.3	10.4307
37	815.042	591.002	394008	72532.2	10.4307
38	834.995	595.839	380590	70062.2	10.4307
39	836.385	597.145	371618	68410.5	10.4307
40	837.82	598.493	366695	67504.3	10.4307
41	859.283	618.654	297274	54724.7	10.4307
42	880.746	638.816	235105	43280	10.4307
43	902.208	658.978	180805	33284.1	10.4307
44	923.671	679.139	133965	24661.3	10.4307
45	945.134	699.301	94082.5	17319.5	10.4307
46	966.596	719.462	61158.3	11258.5	10.4307
47	988.059	739.624	35192.3	6478.48	10.4307
48	1009.52	759.786	16184.3	2979.34	10.4307
49	1030.98	779.947	4134.46	761.106	10.4307
50	1052.45	800.109	-957.238	-176.216	10.4307
51	1073.91	820.27	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.48525

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	86.8923	577	0	0	0
2	101.006	575.428	4665.05	56.3053	0.691504
3	105.875	574.886	4785.43	77.6607	0.929747
4	126.045	568.157	13124.2	438.205	1.91234
5	146.214	561.427	33357.6	1680.56	2.88413
6	166.383	554.698	64906.7	4356.19	3.83963
7	186.552	547.968	107832	9004.83	4.77358
8	206.721	541.239	161724	16087.8	5.68092
9	229.024	541.074	175269	20426.4	6.64744
10	251.328	540.909	189937	25239.8	7.56941
11	274.423	545.96	184703	27508.7	8.47107
12	297.518	551.011	179309	29405.2	9.31314
13	321.096	550.025	203339	36242	10.106
14	338.692	550.145	215795	40582.8	10.6507
15	356.288	550.266	228974	45144.9	11.1535
16	373.885	550.386	242687	49871.8	11.6125
17	391.481	550.506	256910	54732	12.0265
18	409.077	550.627	271254	59609.7	12.3941
19	426.673	550.747	285653	64449.5	12.7143
20	444.269	550.868	300102	69207.8	12.9862
21	461.866	550.988	314598	73840.4	13.209
22	479.462	551.108	329277	78336.7	13.3822
23	497.058	551.229	344411	82719	13.5052
24	514.654	551.349	360002	86946	13.5778
25	532.251	551.469	376044	90973	13.5998
26	549.847	551.59	392534	94753.9	13.571
27	567.443	551.71	409467	98241.3	13.4917
28	585.039	551.831	426838	101387	13.3619
29	602.635	551.951	444641	104143	13.1821
30	620.232	552.071	462874	106460	12.9526
31	637.828	552.192	481529	108290	12.6743
32	655.424	552.312	500604	109585	12.3476
33	673.866	556.782	488816	103496	11.9546
34	692.307	561.252	477045	97150.7	11.5109
35	710.749	565.722	465286	90594.8	11.0181
36	729.191	570.193	453537	83875.6	10.4777
37	747.632	574.663	441796	77039.9	9.89171
38	766.074	579.133	430059	70134	9.26226
39	784.516	583.603	418324	63203.6	8.5917
40	802.957	588.073	406589	56293.3	7.88264
41	821.399	592.543	394850	49446.7	7.13794
42	839.841	597.013	383105	42706	6.36069
43	840.608	598.169	375366	41624.4	6.32769
44	841.4	599.36	370639	40876.9	6.29358
45	860.522	628.145	266186	25417.1	5.45442
46	879.644	656.929	178490	14323.5	4.58805
47	898.766	685.714	107561	6953.09	3.69864
48	917.888	714.498	53827.9	2623.72	2.79055
49	937.01	743.283	17768.6	579.603	1.8683
50	956.132	772.067	-93.9757	-1.53623	0.936536
51	975.254	800.852	0	0	0

List Of Coordinates

Piezoline



X	Y
103.457	577.613
162.429	558
206.73	543.266
251.32	543.001
297.52	553.004
321.11	552.032
655.41	554.29
670.72	558
849.14	601.236
1003.58	601
1140.6	573.052
1811.45	573.052

Block Search Polyline

X	Y
101.107	576.477
206.721	541.239
251.328	540.909
297.518	551.011
321.096	550.025
655.424	552.312
849.105	599.259
1003.58	598.998
1140.6	571.023
1811.44	571.356

External Boundary

X	Y
-360.438	577.337
-360.438	555
-360.438	525
-360.438	313.863
1811.44	313.863
1811.44	525
1811.44	555
1811.44	570.101
1811.45	572.545
1811.45	573.052
1812.11	819.481
1797.44	822.689
1488.7	834.984
1052.34	819.505
465	677.371
381.66	674.389
364.86	668.55
358.92	668.959
324.03	656.142
320.69	657.492
228.76	625.161
224.6	626.084
201.4	615.787
196.41	616.3
179.63	608.247
173.4	608.775
149.93	597.848
133.63	592.197
103.457	577.613
102.231	577.021
99.78	575.836
83.16	577.337

Material Boundary

X	Y
99.78	575.836
162.429	555
206.73	540.266
251.32	540.001
297.52	550.004
321.11	549.032
655.41	551.29
670.72	555
849.14	598.236
1003.58	598
1140.6	570.052
1811.44	570.101

Material Boundary

X	Y
670.72	555
1811.44	555

Material Boundary

X	Y
-360.438	555
162.429	555

Material Boundary

X	Y
-360.438	525
1811.44	525

Material Boundary

X	Y
102.231	577.021
162.429	557
206.73	542.266
251.32	542.001
297.52	552.004
321.11	551.032
655.41	553.29
670.72	557
849.14	600.236
1003.58	600
1140.6	572.052
1811.45	572.545

Material Boundary

X	Y
103.457	577.613
162.429	558
206.73	543.266
251.32	543.001
297.52	553.004
321.11	552.032
655.41	554.29
670.72	558
849.14	601.236
1003.58	601
1140.6	573.052
1811.45	573.052

Material Boundary

X	Y
1003.58	598
1003.58	600

Material Boundary

X	Y
1140.6	570.052
1140.6	572.052

Material Boundary

X	Y
849.14	598.236
849.14	600.236

Material Boundary

X	Y
655.41	551.29
655.41	553.29

Material Boundary

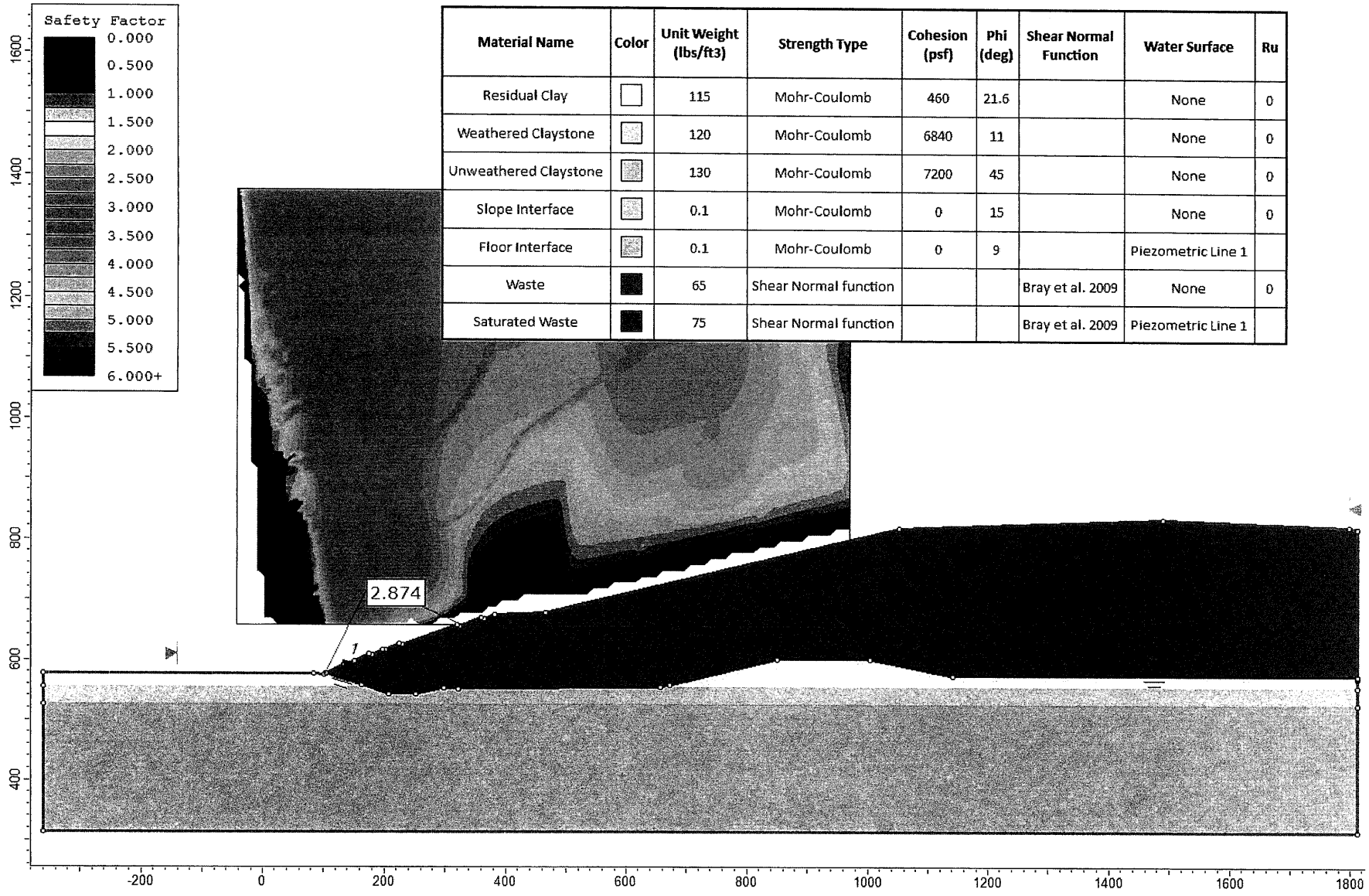
X	Y
251.32	540.001
251.32	542.001

Material Boundary

X	Y
297.52	550.004
297.52	552.004

Material Boundary

X	Y
206.73	540.266
206.73	542.266



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Residual Clay		115	Mohr-Coulomb	460	21.6		None	0
Weathered Claystone		120	Mohr-Coulomb	6840	11		None	0
Unweathered Claystone		130	Mohr-Coulomb	7200	45		None	0
Slope Interface		0.1	Mohr-Coulomb	0	15		None	0
Floor Interface		0.1	Mohr-Coulomb	0	9		Piezometric Line 1	
Waste		65	Shear Normal function			Bray et al. 2009	None	0
Saturated Waste		75	Shear Normal function			Bray et al. 2009	Piezometric Line 1	

FIGURE **3C4.4**

Final Configuration Stability Analysis – Section D-D' - Circular Failure

Permit Amendment Application MSW 692B Temple Recycling and Disposal Facility, Bell County, Texas

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name:	Final Config_Circular.slim
Slide Modeler Version:	6.03
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	11/2/2016, 4:04:21 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Residual Clay	Weathered Claystone	Unweathered Claystone	Slope Interface	Floor Interface	Waste	Saturated Waste
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Shear Normal function	Shear Normal function
Unit Weight [lbs/ft3]	115	120	130	0.1	0.1	65	75
Cohesion [psf]	460	6840	7200	0	0		
Friction Angle [deg]	21.6	11	45	15	9		
Water Surface	None	None	None	None	Piezometric Line 1	None	Piezometric Line 1
Hu Value					1		1
Ru Value	0	0	0	0		0	

Shear Normal Functions

Name: Bray et al. 2009

Normal (psf)	Shear (psf)
0	310
600	810
5200	3840
6300	4480
7300	5120
8400	5740
16700	10550

Global Minimums

Method: spencer

FS	2.874380
Center:	175.470, 727.010
Radius:	166.917
Left Slip Surface Endpoint:	102.231, 577.021
Right Slip Surface Endpoint:	327.124, 657.278
Resisting Moment:	7.61705e+007 lb-ft
Driving Moment:	2.64998e+007 lb-ft
Resisting Horizontal Force:	407143 lb
Driving Horizontal Force:	141646 lb
Total Slice Area:	9027.15 ft2
Surface Horizontal Width:	224.892 ft
Surface Average Height:	40.1399 ft

Method: gle/morgenstern-price

FS	2.884540
Center:	163.953, 866.871
Radius:	303.435
Left Slip Surface Endpoint:	73.165, 577.337
Right Slip Surface Endpoint:	399.032, 675.011
Resisting Moment:	1.9889e+008 lb-ft
Driving Moment:	6.89503e+007 lb-ft
Resisting Horizontal Force:	604757 lb
Driving Horizontal Force:	209655 lb
Total Slice Area:	12363.2 ft2
Surface Horizontal Width:	325.867 ft
Surface Average Height:	37.9393 ft

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.87438

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.67411	620.098	-25.1549	Slope Interface	0	15	15.8082	45.4387	169.58	0	169.58
2	4.67411	1785.16	-23.3793	Slope Interface	0	15	44.6611	128.373	479.095	0	479.095
3	4.67411	2944.01	-21.6422	Slope Interface	0	15	72.3655	208.006	776.29	0	776.29
4	4.67411	4102.78	-19.9258	Slope Interface	0	15	99.1727	285.06	1063.86	0	1063.86
5	4.67411	5261.48	-18.2279	Slope Interface	0	15	125.164	359.768	1342.67	0	1342.67
6	4.67411	6420.11	-16.5463	Slope Interface	0	15	150.405	432.322	1613.45	0	1613.45
7	4.67411	7570.93	-14.8794	Slope Interface	0	15	174.776	502.372	1874.88	0	1874.88
8	4.67411	8585.33	-13.2252	Slope Interface	0	15	195.402	561.659	2096.14	0	2096.14
9	4.67411	9549.7	-11.5822	Slope Interface	0	15	214.39	616.238	2299.83	0	2299.83
10	6.17761	13870.8	-9.6876	Saturated Waste	414.783	33.3727	770.129	2213.64	2762.14	31.2	2730.94
11	4.41619	10752.7	-7.8468	Waste	414.783	33.3727	814.653	2341.62	2925.23	0	2925.23
12	4.41619	11500.5	-6.31906	Waste	414.783	33.3727	847.029	2434.68	3066.51	0	3066.51
13	4.41619	12214	-4.79582	Waste	414.783	33.3727	876.44	2519.22	3194.86	0	3194.86
14	4.41619	12893.7	-3.27598	Waste	414.783	33.3727	903.027	2595.64	3310.88	0	3310.88
15	4.41619	13539.6	-1.75844	Waste	414.783	33.3727	926.914	2664.3	3415.11	0	3415.11
16	4.41619	13923.6	-0.242129	Waste	414.783	33.3727	935.424	2688.76	3452.24	0	3452.24
17	4.41619	13874.3	1.27401	Waste	414.783	33.3727	919.772	2643.77	3383.96	0	3383.96
18	4.41619	14308.1	2.79104	Waste	414.783	33.3727	930.817	2675.52	3432.14	0	3432.14
19	4.41619	14837.8	4.31003	Waste	414.783	33.3727	946.619	2720.94	3501.1	0	3501.1
20	4.41619	15333.7	5.83207	Waste	414.783	33.3727	960.097	2759.68	3559.92	0	3559.92
21	4.41619	15663.1	7.35825	Waste	414.783	33.3727	964.428	2772.13	3578.82	0	3578.82
22	4.41619	15487.4	8.8897	Waste	414.783	33.3727	942.629	2709.47	3483.69	0	3483.69
23	4.41619	15736.5	10.4276	Waste	414.783	33.3727	942.747	2709.81	3484.2	0	3484.2
24	4.41619	16048.1	11.9731	Waste	414.783	33.3727	945.788	2718.55	3497.47	0	3497.47
25	4.41619	16323.8	13.5275	Waste	414.783	33.3727	946.772	2721.38	3501.76	0	3501.76
26	4.41619	16563	15.0922	Waste	414.783	33.3727	945.718	2718.35	3497.17	0	3497.17
27	4.41619	16745.4	16.6685	Waste	414.783	33.3727	941.71	2706.83	3479.69	0	3479.69
28	4.41619	16352.2	18.2578	Waste	414.783	33.3727	910.521	2617.18	3343.59	0	3343.59
29	4.41619	16168	19.8619	Waste	414.783	33.3727	889.574	2556.97	3252.17	0	3252.17
30	4.41619	16135.4	21.4824	Waste	414.783	33.3727	875.783	2517.33	3191.98	0	3191.98
31	4.41619	16061.1	23.1211	Waste	414.783	33.3727	860.141	2472.37	3123.72	0	3123.72
32	4.41619	15943.7	24.7802	Waste	414.783	33.3727	842.635	2422.05	3047.35	0	3047.35
33	4.41619	15781.4	26.4617	Waste	414.783	33.3727	823.257	2366.35	2962.77	0	2962.77
34	4.41619	15572.4	28.1682	Waste	414.783	33.3727	801.979	2305.19	2869.93	0	2869.93
35	4.41619	15314.3	29.9024	Waste	414.783	33.3727	778.778	2238.5	2768.7	0	2768.7
36	4.41619	15004.7	31.6673	Waste	414.783	33.3727	753.624	2166.2	2658.91	0	2658.91
37	4.41619	14640.5	33.4665	Waste	414.783	33.3727	726.471	2088.15	2540.45	0	2540.45
38	4.41619	14218.5	35.3039	Waste	414.783	33.3727	697.282	2004.25	2413.06	0	2413.06
39	4.41619	13734.7	37.1841	Waste	414.783	33.3727	666.002	1914.34	2276.55	0	2276.55
40	4.41619	13184.3	39.1124	Waste	414.783	33.3727	632.565	1818.23	2130.65	0	2130.65
41	4.41619	12562	41.0951	Waste	414.783	33.3727	596.909	1715.74	1975.06	0	1975.06
42	4.41619	11861	43.1397	Waste	414.783	33.3727	558.956	1606.65	1809.44	0	1809.44
43	4.41619	11073.4	45.2553	Waste	414.783	33.3727	518.614	1490.69	1633.39	0	1633.39
44	4.41619	10189.1	47.453	Waste	414.783	33.3727	475.792	1367.61	1446.53	0	1446.53
45	4.41619	9195.71	49.7471	Waste	414.783	33.3727	430.386	1237.09	1248.39	0	1248.39
46	4.41619	8077.06	52.1557	Waste	414.783	33.3727	382.293	1098.85	1038.52	0	1038.52
47	4.41619	6811.75	54.7031	Waste	414.783	33.3727	331.42	952.628	816.53	0	816.53
48	4.41619	5370.3	57.4228	Waste	310	39.8056	276.975	796.13	583.356	0	583.356
49	4.41619	3610.07	60.3635	Waste	310	39.8056	205.316	590.155	336.186	0	336.186
50	4.41619	1087.97	63.6015	Waste	310	39.8056	115.027	330.632	24.7586	0	24.7586

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.88454

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	6.53539	739.854	-16.7652	Residual Clay	460	21.6	183.28	528.679	173.464	0	173.464
2	6.53539	2110.75	-15.4806	Residual Clay	460	21.6	214.576	618.952	401.465	0	401.465
3	6.53539	3031.09	-14.2038	Residual Clay	460	21.6	236.323	681.683	559.907	0	559.907
4	6.53539	3773.12	-12.9342	Residual Clay	460	21.6	254.289	733.507	690.801	0	690.801
5	6.53539	4265.61	-11.6711	Residual Clay	460	21.6	266.703	769.315	781.241	0	781.241
6	6.53539	5667.91	-10.4136	Residual Clay	460	21.6	299.472	863.84	1019.98	0	1019.98
7	6.53539	7146.93	-9.16127	Residual Clay	460	21.6	333.935	963.248	1271.06	0	1271.06
8	6.53539	8515.96	-7.9133	Residual Clay	460	21.6	365.74	1054.99	1502.78	0	1502.78
9	6.53539	9776.08	-6.6691	Residual Clay	460	21.6	394.752	1138.68	1714.14	0	1714.14
10	8.31493	14840.2	-5.25949	Slope Interface	0	15	180.776	521.457	1946.1	0	1946.1
11	3.83492	7734.41	-4.10812	Saturated Waste	414.783	33.3727	666.405	1922.27	2319.8	31.2	2288.6
12	6.53586	14049.3	-3.12713	Waste	414.783	33.3727	706.349	2037.49	2463.51	0	2463.51
13	6.53586	15333.9	-1.89172	Waste	414.783	33.3727	752.96	2171.94	2667.63	0	2667.63
14	6.53586	16688.4	-0.65719	Waste	414.783	33.3727	800.482	2309.02	2875.74	0	2875.74
15	6.53586	17983.1	0.577035	Waste	414.783	33.3727	843.917	2434.31	3065.96	0	3065.96
16	6.53586	19009.6	1.81153	Waste	414.783	33.3727	875.562	2525.59	3204.52	0	3204.52
17	6.53586	19084.7	3.04686	Waste	414.783	33.3727	870.75	2511.71	3183.44	0	3183.44
18	6.53586	20093.7	4.28362	Waste	414.783	33.3727	898.425	2591.54	3304.66	0	3304.66
19	6.53586	21188.1	5.52238	Waste	414.783	33.3727	927.435	2675.22	3431.68	0	3431.68
20	6.53586	21453.1	6.76373	Waste	414.783	33.3727	925.504	2669.65	3423.24	0	3423.24
21	6.53586	21885	8.00829	Waste	414.783	33.3727	928.426	2678.08	3436.03	0	3436.03
22	6.53586	22695.8	9.25666	Waste	414.783	33.3727	943.444	2721.4	3501.81	0	3501.81
23	6.53586	23444.4	10.5095	Waste	414.783	33.3727	955.238	2755.42	3553.45	0	3553.45
24	6.53586	23694.1	11.7674	Waste	414.783	33.3727	949.369	2738.49	3527.76	0	3527.76
25	6.53586	23434.1	13.0311	Waste	414.783	33.3727	926.274	2671.87	3426.6	0	3426.6
26	6.53586	23735.4	14.3013	Waste	414.783	33.3727	921.801	2658.97	3407.01	0	3407.01
27	6.53586	23970.9	15.5787	Waste	414.783	33.3727	915.128	2639.72	3377.8	0	3377.8
28	6.53586	24139.5	16.8642	Waste	414.783	33.3727	906.44	2614.66	3339.74	0	3339.74
29	6.53586	24239.9	18.1584	Waste	414.783	33.3727	895.901	2584.26	3293.61	0	3293.61
30	6.53586	24270.4	19.4623	Waste	414.783	33.3727	883.664	2548.96	3240.01	0	3240.01
31	6.53586	24229.6	20.7768	Waste	414.783	33.3727	869.849	2509.11	3179.51	0	3179.51
32	6.53586	24115.6	22.1028	Waste	414.783	33.3727	854.56	2465.01	3112.57	0	3112.57
33	6.53586	23926.3	23.4414	Waste	414.783	33.3727	837.875	2416.88	3039.48	0	3039.48
34	6.53586	23659.6	24.7937	Waste	414.783	33.3727	819.841	2364.86	2960.52	0	2960.52
35	6.53586	23312.8	26.161	Waste	414.783	33.3727	800.482	2309.02	2875.74	0	2875.74
36	6.53586	22883.3	27.5444	Waste	414.783	33.3727	779.8	2249.36	2785.17	0	2785.17
37	6.53586	22367.9	28.9456	Waste	414.783	33.3727	757.758	2185.78	2688.65	0	2688.65
38	6.53586	21763.2	30.3659	Waste	414.783	33.3727	734.302	2118.12	2585.94	0	2585.94
39	6.53586	20286.1	31.8073	Waste	414.783	33.3727	687.161	1982.14	2379.49	0	2379.49
40	6.53586	19239.6	33.2714	Waste	414.783	33.3727	653.516	1885.09	2232.15	0	2232.15
41	6.53586	18385.2	34.7606	Waste	414.783	33.3727	626.371	1806.79	2113.28	0	2113.28
42	6.53586	17422.7	36.2772	Waste	414.783	33.3727	597.195	1722.63	1985.52	0	1985.52
43	6.53586	16346	37.8239	Waste	414.783	33.3727	565.752	1631.93	1847.82	0	1847.82
44	6.53586	15136.2	39.4037	Waste	414.783	33.3727	531.441	1532.96	1697.56	0	1697.56
45	6.53586	13077.7	41.0202	Waste	414.783	33.3727	474.399	1368.42	1447.77	0	1447.77
46	6.53586	11210.8	42.6775	Waste	414.783	33.3727	423.036	1220.26	1222.84	0	1222.84
47	6.53586	9537.14	44.3803	Waste	414.783	33.3727	377.157	1087.93	1021.93	0	1021.93
48	6.53586	7511.78	46.1342	Waste	414.783	33.3727	321.588	927.633	778.584	0	778.584
49	6.53586	4678.4	47.9459	Waste	310	39.8056	235.791	680.149	444.179	0	444.179
50	6.53586	1594.56	49.8237	Waste	310	39.8056	132.753	382.932	87.5185	0	87.5185

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.87438

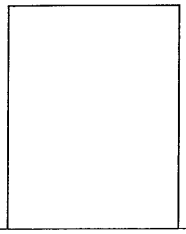
Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	102.231	577.021	0	0	0
2	106.905	574.826	446.087	138.403	17.237
3	111.579	572.805	1622.86	503.508	17.237
4	116.254	570.951	3400.69	1055.1	17.2371
5	120.928	569.256	5666.67	1758.14	17.237
6	125.602	567.717	8318.26	2580.82	17.237
7	130.276	566.328	11261.5	3494	17.2371
8	134.95	565.086	14406.6	4469.78	17.237
9	139.624	563.988	17622.1	5467.44	17.237
10	144.298	563.03	20827	6461.78	17.237
11	150.476	561.975	28495.8	8841.12	17.2371
12	154.892	561.367	33872.6	10509.3	17.237
13	159.308	560.878	39111.7	12134.8	17.237
14	163.724	560.507	44164.6	13702.5	17.237
15	168.141	560.254	48988.1	15199.1	17.2371
16	172.557	560.119	53543.2	16612.3	17.237
17	176.973	560.1	57737.2	17913.5	17.237
18	181.389	560.198	61465.4	19070.2	17.237
19	185.805	560.414	64835.7	20115.9	17.237
20	190.222	560.746	67849.5	21051	17.237
21	194.638	561.198	70482.2	21867.8	17.237
22	199.054	561.768	72698.9	22555.6	17.2371
23	203.47	562.459	74454	23100.1	17.237
24	207.886	563.271	75784.2	23512.8	17.237
25	212.302	564.208	76684.1	23792	17.237
26	216.719	565.27	77143.3	23934.5	17.237
27	221.135	566.461	77153.4	23937.6	17.237
28	225.551	567.784	76709.7	23799.9	17.237
29	229.967	569.24	75858.1	23535.7	17.237
30	234.383	570.836	74597	23144.5	17.2371
31	238.8	572.574	72915.6	22622.8	17.237
32	243.216	574.459	70822.8	21973.5	17.237
33	247.632	576.498	68330.1	21200.1	17.237
34	252.048	578.696	65451.9	20307.1	17.237
35	256.464	581.061	62205.6	19299.9	17.237
36	260.881	583.601	58612.2	18185	17.237
37	265.297	586.325	54696.2	16970	17.237
38	269.713	589.244	50487.1	15664.1	17.237
39	274.129	592.371	46019	14277.9	17.2371
40	278.545	595.721	41332.4	12823.8	17.237
41	282.962	599.312	36474.8	11316.7	17.2371
42	287.378	603.164	31502.4	9773.93	17.237
43	291.794	607.302	26481.9	8216.29	17.2371
44	296.21	611.758	21493.5	6668.57	17.237
45	300.626	616.569	16634	5160.86	17.237
46	305.043	621.785	12022.3	3730.04	17.237
47	309.459	627.47	7806.81	2422.14	17.237
48	313.875	633.708	4176.48	1295.79	17.237
49	318.291	640.619	1367.4	424.248	17.237
50	322.707	648.381	-335.804	-104.187	17.2371
51	327.124	657.278	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.88454

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	73.1654	577.337	0	0	0
2	79.7007	575.368	1538.4	33.2238	1.23719
3	86.2361	573.558	3666.31	158.044	2.46833
4	92.7715	571.904	6135.75	395.428	3.68742
5	99.3069	570.403	8833.17	755.505	4.88864
6	105.842	569.053	11629.5	1235.92	6.06631
7	112.378	567.852	14810.2	1874.93	7.2151
8	118.913	566.798	18330.6	2683.92	8.32991
9	125.448	565.89	22084.1	3658.38	9.40601
10	131.984	565.125	25971.8	4785.02	10.4391
11	140.299	564.36	28963.4	5990.04	11.6848
12	144.134	564.085	32156	6971	12.2317
13	150.67	563.728	37648.6	8775.66	13.121
14	157.205	563.512	43141.9	10719.7	13.954
15	163.741	563.437	48585.3	12771.7	14.7282
16	170.277	563.503	53894.9	14887	15.4414
17	176.813	563.709	58950.6	17006	16.0917
18	183.349	564.057	63529.8	19032.8	16.6776
19	189.885	564.547	67779.4	20978.5	17.1979
20	196.421	565.179	71667.7	22805	17.6513
21	202.956	565.954	75058.5	24441.6	18.037
22	209.492	566.873	77962.3	25865.8	18.3545
23	216.028	567.938	80393.6	27060	18.6029
24	222.564	569.151	82323.6	27996.5	18.7821
25	229.1	570.512	83720.6	28650.4	18.8917
26	235.636	572.025	84586.6	29012.4	18.9315
27	242.172	573.691	84930.1	29080.7	18.9016
28	248.707	575.514	84751.5	28854.8	18.8018
29	255.243	577.495	84054.3	28340.5	18.6325
30	261.779	579.638	82845	27548.9	18.3938
31	268.315	581.948	81132.7	26496.6	18.0862
32	274.851	584.428	78929.3	25204.9	17.7101
33	281.387	587.082	76248.5	23699.5	17.2662
34	287.923	589.916	73106.8	22010.2	16.7554
35	294.458	592.935	69522.9	20170.2	16.1787
36	300.994	596.146	65518	18215.8	15.5374
37	307.53	599.554	61116.6	16185.4	14.833
38	314.066	603.169	56346.5	14119.1	14.0673
39	320.602	606.999	51239.7	12058.3	13.2425
40	327.138	611.052	46082	10098.9	12.361
41	333.674	615.341	40777.2	8241.16	11.4257
42	340.21	619.877	35282.3	6500.78	10.4397
43	346.745	624.674	29657.8	4913.34	9.40662
44	353.281	629.748	23976.5	3510.83	8.3305
45	359.817	635.117	18332.5	2321.01	7.21562
46	366.353	640.803	13199.2	1402.85	6.06679
47	372.889	646.829	8592.7	734.99	4.88898
48	379.425	653.225	4519.58	291.292	3.68768
49	385.961	660.025	1325.52	57.1433	2.4685
50	392.496	667.27	-352.675	-7.61704	1.23728
51	399.032	675.011	0	0	0

List Of Coordinates

Piezoline



X	Y
103.457	577.613
162.429	558
206.73	543.266
251.32	543.001
297.52	553.004
321.11	552.032
655.41	554.29
670.72	558
849.14	601.236
1003.58	601
1140.6	573.052
1811.45	573.052

External Boundary

X	Y
-360.438	577.337
-360.438	555
-360.438	525
-360.438	313.863
1811.44	313.863
1811.44	525
1811.44	555
1811.44	570.101
1811.45	572.545
1811.45	573.052
1812.11	819.481
1797.44	822.689
1488.7	834.984
1052.34	819.505
465	677.371
381.66	674.389
364.86	668.55
358.92	668.959
324.03	656.142
320.69	657.492
228.76	625.161
224.6	626.084
201.4	615.787
196.41	616.3
179.63	608.247
173.4	608.775
149.93	597.848
133.63	592.197
103.457	577.613
102.231	577.021
99.78	575.836
83.16	577.337

Material Boundary

X	Y
99.78	575.836
162.429	555
206.73	540.266
251.32	540.001
297.52	550.004
321.11	549.032
655.41	551.29
670.72	555
849.14	598.236
1003.58	598
1140.6	570.052
1811.44	570.101

Material Boundary

X	Y
670.72	555
1811.44	555

Material Boundary

X	Y
-360.438	555
162.429	555

Material Boundary

X	Y
-360.438	525
1811.44	525

Material Boundary

X	Y
102.231	577.021
162.429	557
206.73	542.266
251.32	542.001
297.52	552.004
321.11	551.032
655.41	553.29
670.72	557
849.14	600.236
1003.58	600
1140.6	572.052
1811.45	572.545

Material Boundary

X	Y
103.457	577.613
162.429	558
206.73	543.266
251.32	543.001
297.52	553.004
321.11	552.032
655.41	554.29
670.72	558
849.14	601.236
1003.58	601
1140.6	573.052
1811.45	573.052

Material Boundary

X	Y
1003.58	598
1003.58	600

Material Boundary

X	Y
1140.6	570.052
1140.6	572.052

Material Boundary

X	Y
849.14	598.236
849.14	600.236

Material Boundary

X	Y
655.41	551.29
655.41	553.29

Material Boundary

X	Y
251.32	540.001
251.32	542.001

Material Boundary

X	Y
297.52	550.004
297.52	552.004

Material Boundary

X	Y
206.73	540.266
206.73	542.266

APPENDIX III-3C-5

FINAL COVER STABILITY

FINAL COVER STABILITY

Made By: VK
Checked by: JBF / MX
Reviewed by: CGD

1.0 OBJECTIVE

To investigate the stability of the final cover lining system.

2.0 GIVEN

Final cover slopes are as follows:

(i) Future final cover area: 4H:1V (S = 25%) with a maximum length of slope conservatively assumed to be 1300 ft.

(ii) Existing final cover areas: The as-constructed slope of the final cover in Tract 2A is 3.16H:1V (S = 31.7%) with a maximum length of slope 300 ft. The area in Tract 3 that currently has final cover has flatter slopes (~4H:1V), and hence, the steeper slope in Tract 2A represents the critical case and is considered in the analysis.

Based on generally accepted industry practice, the minimum allowable factor of safety is 1.5 for long-term conditions.

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

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3.0 ASSUMPTIONS

Proposed final cover liner system consists of (from top to bottom):

18-inch Soil Cover consisting of on-site soils
Double-sided geocomposite
40-mil LLDPE textured Geomembrane
18-inch Clay Liner

The geocomposite drainage layer is adequate to prevent the buildup of excess pore water pressures at the geocomposite/geomembrane interface if the geocomposite is daylighted at the appropriate interval (see calculations in Appendix III-3D-2).

Based on a review of available data, the following parameters were assigned to the materials.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ	c	Moist	Saturated	
Soil cover	28	0	115	132	Ref. [1][(1)]
Soil cover/Geocomposite	28	0	N/A	N/A	Golder[(2)]
Geocomposite/Textured Geomembrane[(3)]	21	0	N/A	N/A	Golder[(2)]
Textured Geomembrane/Clay Liner	35	0	N/A	N/A	Golder[(2)]
Clay Liner	28	0	115	132	Ref. [1][(1)]
Clay Liner/Subgrade	28	0	N/A	N/A	Ref. [1][(1)]

(1) The shear strength of the protective cover soils, clay liner and clay liner/subgrade interface is estimated based on the on-site soil shear strength. This is estimated using the average plasticity index (PI = 40) of the Stratum I and Stratum II soils described in Attachment 4, and Ref. [1].

(2) Based on unpublished data from tests performed in Golder's laboratory, on similar geosynthetic materials. Strength parameters were conservatively assigned to be equal to or a percentage of the peak strength (lower bound) to account for testing data variability and to avoid strains that result in residual interface shear strengths. This data is presented in this appendix.

(3) The data indicates a lower-bound angle of 24°, but since the final cover pertains to a long-term condition a conservative angle of 21° is assumed for the calculation.

Based on the shear strength parameters, the critical interface occurs along the geocomposite/ textured geomembrane interface; this interface has a friction angle of 21 degrees.

4.0 METHOD

A model was created representing the final cover slopes. A limit equilibrium analysis was performed to determine the minimum factor of safety against a sliding block failure along the critical interface.

Case (i) 4H:1V (S = 25%)
Infinite Slope Analysis

$$FS = \frac{c + (\gamma b \cos\beta - \gamma_w d \cos\beta)\tan\phi}{\gamma b \sin\beta}$$

Sliding at Geocomposite-Textured Geomembrane Interface

ϕ =	21	interface friction angle
c =	0	interface adhesion (psf)
β =	14.0	slope angle (degrees)
γ =	132	saturated unit weight of soil (pcf)
b =	1.5	soil thickness (ft)
d =	0	water depth in cover (ft)
γ_w =	62.4	unit weight of water (pcf)
FS =	**1.54**	**> 1.5**

Case (ii) 3.16H:1V (S = 31.7%)

The existing final cover consists of (top to bottom):

6" top soil consisting of on-site soils

36" clay liner consisting of on-site soils ($k = 1 \times 10^{-7}$ cm/s)

Based on a review of available data, the following parameters were assigned to the materials.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ	c	Moist	Saturated	
Top Soil	28	0	115	132	Ref. [1](1)
Top Soil/Soil Cover	28	0	N/A	N/A	Ref. [1](1)
Clay Liner	28	0	115	132	Ref. [1](1)
Clay Liner/Subgrade	28	0	N/A	N/A	Ref. [1](1)

(1) The shear strength of the protective cover soils, clay liner and clay liner/subgrade interface is estimated based on the on-site soil shear strength. This is estimated using the average plasticity index (PI = 40) of the Stratum I and Stratum II soils described in Attachment 4, and Ref. [1].

ϕ =	28	interface friction angle
c =	0	interface adhesion (psf)
β =	17.6	slope angle (degrees)
γ =	132	saturated unit weight of soil (pcf)
b =	3.5	soil thickness (ft)
d =	0.5	water depth in cover (ft) (assuming the top soil is fully saturated)
γ_w =	62.4	unit weight of water (pcf)

Factor of safety against sliding of the entire final cover = **1.57** **> 1.5**

5.0 RESULTS

The future 4H:1V final cover slope will have a minimum factor of safety of 1.54.
The existing 3.16H:1V final cover slope has a minimum factor of safety of 1.57.

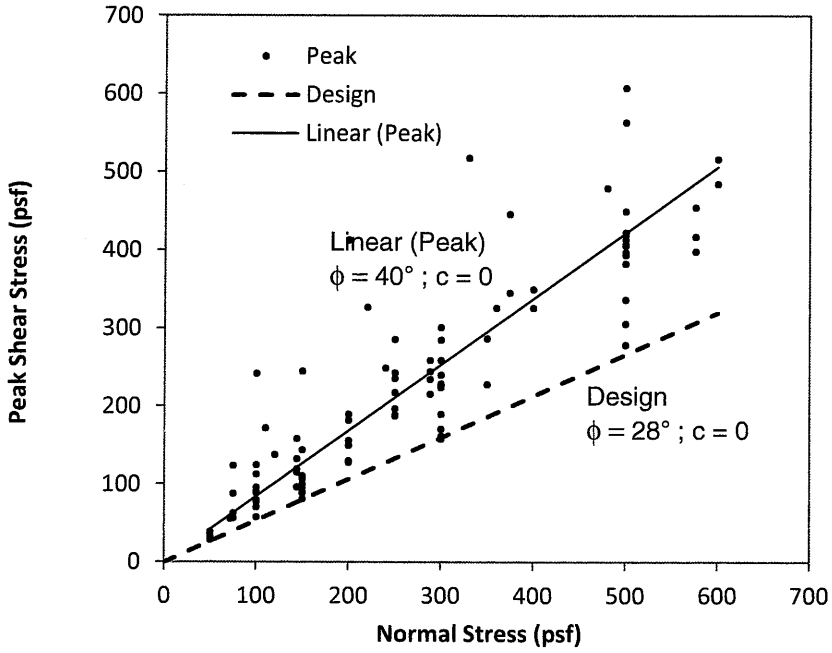
6.0 CONCLUSION

Through analysis of the lining system, the final cover slope is found to be stable.

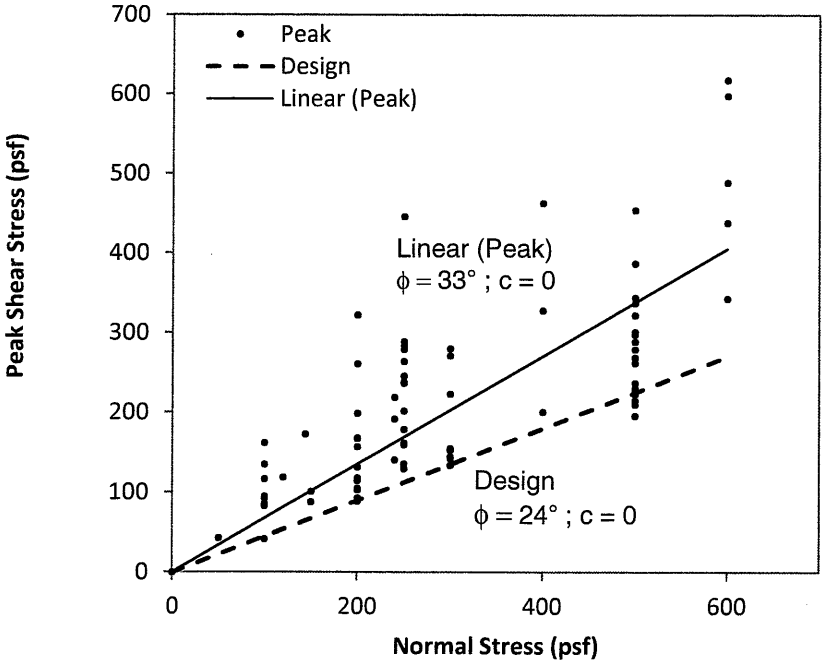
7.0 REFERENCES

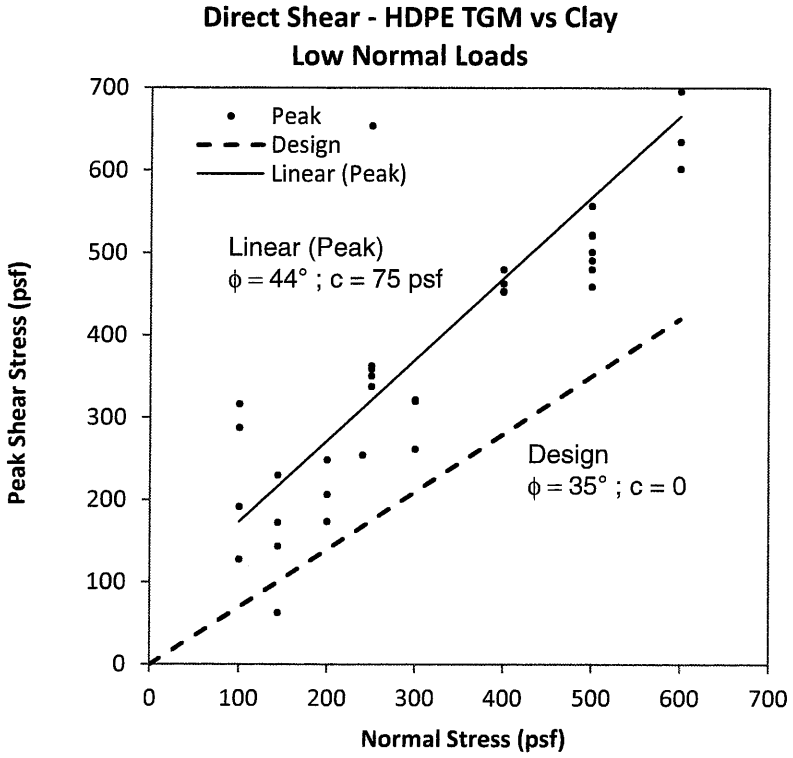
[1] Bjerrum, L. and Simons, N. E. (1960). "Comparison of shear strength characteristics of normally consolidated clays." Proceedings of the Research Conference on Shear Strength of Cohesive Soils, ASCE, Boulder, Colorado, 1960, pp. 711–726.

Direct Shear - Geocomposite vs Protective Cover
Low Normal Loads



Direct Shear - HDPE TGM vs GC
Low Normal Loads




Direct Shear - HDPE TGM vs Clay
Low Normal Loads
Peak
Design
Linear (Peak)
Linear (Peak)
ϕ = 44° ; c = 75 psf
Design
ϕ = 35° ; c = 0
Peak Shear Stress (psf)
Normal Stress (psf)
0
100
200
300
400
500
600
700

7.0 DOCUMENTATION AND REPORTING

7.1 Liner Evaluation Reports

Upon completion of all required liner construction and evaluation, the POR shall prepare and submit in triplicate the SLER and the GLER to the TCEQ for review and approval. Multiple submittals of the reports or documentation during the project may be made, if they may facilitate TCEQ's review of the project.

The SLER and the GLER shall be signed and sealed by the POR performing the evaluation and counter-signed by the site operator or his/her authorized representative. The area covered by this LQCP shall not be used for the receipt of solid waste until written acceptance of the SLER or GLER document(s) is received from the TCEQ. If no response, either written or verbal, is received within 14 days, the SLER or GLER shall be considered accepted and the owner or operator may continue facility construction or operations.

The construction documentation provided in the SLER or GLER will contain a narrative describing the conduct of work and testing programs required by the LQCP, "as-built" or record drawings, and appendices of field and laboratory data. Because the volume of data for these projects can be quite large, the documents may be divided for ease of review. The preferred document format for larger reports will include the SLER, its narrative, as-built drawings, and summaries of test results in a single volume; the GLER, its narrative, as-built drawings, and summaries of test results in a second volume.

The construction documentation report will contain or discuss the following information at a minimum:

For soil liners:

- Pre-construction soil test results
- Summary of construction material conformance tests results
- Summary of field moisture-density control test methods and results
- Summary of hydraulic conductivity test results
- Soil liner construction practices for floor and sidewall sections
- Placement and processing methods
- Observations of soil conditions prior to and after compaction, including soil structure, clod size, and presence of inclusions
- Compaction methods, equipment type, compactor weight and foot length, and number of passes
- Lift tie-in and bonding observations
- Repair of failed and damaged lifts
- Any and all deviations from the permitted design
- Liner thickness verification
- Post-construction care of soil liner
- Laboratory worksheets for hydraulic conductivity tests

- Sample calculations for hydraulic conductivity tests

For geomembrane liners:

- Roll shipment and receipt information
- Manufacturer's quality control certificates and results
- Storage and handling information
- Conformance test sampling and test results
- Seamer's names and resumes of experience and qualifications
- Subgrade acceptance
- Anchor trench preparation and backfilling
- Panel deployment, identification, and placement
- Seam preparation, orientation, and identification
- Equipment placed or operated on geomembrane
- 100 percent visual inspection for defects, damage, etc.
- Trial seam tests for each combination of seaming equipment and personnel
- Seaming methods, times, temperature, and equipment shutdowns and startups
- Continuous 100 percent non-destructive seam testing, methods, criteria, and results
- Destructive testing methods, criteria, and results
- Repairs, including preparation and procedures, failure delineation, patch size and shape, and retesting
- Material properties and placement of drainage materials and protective cover
- Confirmation of the interface friction angle for the geomembrane/adjoin material interface and a recalculation of the factor of safety, if needed.
-

The report shall also include pertinent record drawings including:

- Phase layout plan
- Location of the subject cell with SLER/GLER markers
- Previous filled and active areas
- As-built geomembrane panel layout drawings showing location of destructive test samples, patches, and repairs
- As-built drawings showing elevations of protective cover to confirm its thickness

7.2 Interim Status Report

An Interim Status Report (ISR) should be provided to the TCEQ for portions of a liner system that remain uncovered with waste for more than six months from the date that the protective cover was applied, and the area shall be reevaluated by a POR.

7.0 DOCUMENTATION AND REPORTING

7.1 Liner Evaluation Reports

Upon completion of all required liner construction and evaluation, the POR shall prepare and submit the GCLER and the GLER to the TCEQ for review and approval. Multiple submittals of the reports or documentation during the project may be made, if they may facilitate TCEQ's review of the project.

The GCLER and the GLER shall be signed and sealed by the POR performing the evaluation and counter-signed by the site operator or his/her authorized representative. The overliner area covered by this OQCP shall not be used for the receipt of solid waste until written acceptance of the GCLER or GLER document(s) is received from the TCEQ. If no response, either written or verbal, is received within 14 days, the GCLER or GLER shall be considered accepted and the owner or operator may continue facility construction or operations.

The construction documentation provided in the GCLER or GLER will contain a narrative describing the conduct of work and testing programs required by the OQCP, "as-built" or record drawings, and appendices of field and laboratory data. Because the volume of data for these projects can be quite large, the documents may be divided for ease of review. The preferred document format for larger reports will include the GCLER, its narrative, as-built drawings, and summaries of test results in a single volume; the GLER, its narrative, as-built drawings, and summaries of test results in a second volume, and the supporting appendices placed in separate accompanying volumes, as needed.

The construction documentation report will contain or discuss the following information at a minimum:

For GCLs:

- Roll shipment and receipt information
- Manufacturer's quality control certificates and results
- Storage and handling information
- Conformance test sampling and test results
- Subgrade acceptance
- Anchor trench preparation and backfilling
- Panel deployment, identification, and placement
- Equipment placed or operated on GCL
- 100 percent visual inspection for defects, damage, etc.
- Seaming methods
- Repairs, including patch size and shape

For geomembrane liners:

- Roll shipment and receipt information
- Manufacturer's quality control certificates and results
- Storage and handling information
- Conformance test sampling and test results
- Seamer's names and resumes of experience and qualifications
- Subgrade acceptance
- Anchor trench preparation and backfilling
- Panel deployment, identification, and placement
- Seam preparation, orientation, and identification
- Equipment placed or operated on geomembrane
- 100 percent visual inspection for defects, damage, etc.
- Trial seam tests for each combination of seaming equipment and personnel
- Seaming methods, times, temperature, and equipment shutdowns and startups
- Continuous 100 percent non-destructive seam testing, methods, criteria, and results
- Destructive testing methods, criteria, and results
- Repairs, including preparation and procedures, failure delineation, patch size and shape, and retesting
- Material properties and placement of drainage materials and protective cover
- Confirmation of the interface friction angle for the geomembrane/adjoin material interface and a recalculation of the factor of safety, if needed.
-

The report shall also include pertinent record drawings including:

- Phase layout plan
- Location of the subject cell with GCLER/GLER markers
- Previous filled and active areas
- As-built GCL panel layout drawings, showing locations of patches and repairs
- As-built geomembrane panel layout drawings, showing location of destructive test samples, patches, and repairs
- As-built drawings showing elevations of protective cover to confirm its thickness

7.2 Interim Status Report

An Interim Status Report (ISR) should be provided to the TCEQ for portions of a liner system that remain uncovered with waste for more than six months from the date that the protective cover was applied, and the area shall be reevaluated by a POR.

5.0 DOCUMENTATION AND REPORTING

5.1 Final Cover System Evaluation Reports

Upon completion of all required final cover construction and evaluation, the POR shall prepare and submit in triplicate the FCSER, prepared in accordance with this plan, to the TCEQ for review and approval.

Each FCSER will include a discussion of the construction of the final cover elements and a cover placement map, which not only shows the covered area being submitted for approval, but also the areas covered by all previous FCSER submittals with the dates of acceptance by the TCEQ. The map should depict the site grid system, graphic scale, and north arrow. It may be a print from a master drawing that is annotated and updated with each new submittal. The FCSER shall be signed and/or sealed by the POR performing the evaluation and counter-signed by the site operator or his/her authorized representative.

The construction documentation will contain a narrative describing the conduct of work and testing programs required by the FCQCP, "as-built" or record drawings, and appendices of field and laboratory testing. Constructed cover details ("as-builts"), where applicable, will be depicted and will show slopes, widths, and thickness for compaction lifts as determined from the field documentation.

The construction documentation report will contain or discuss the following information at a minimum.

For cohesive soil covers:

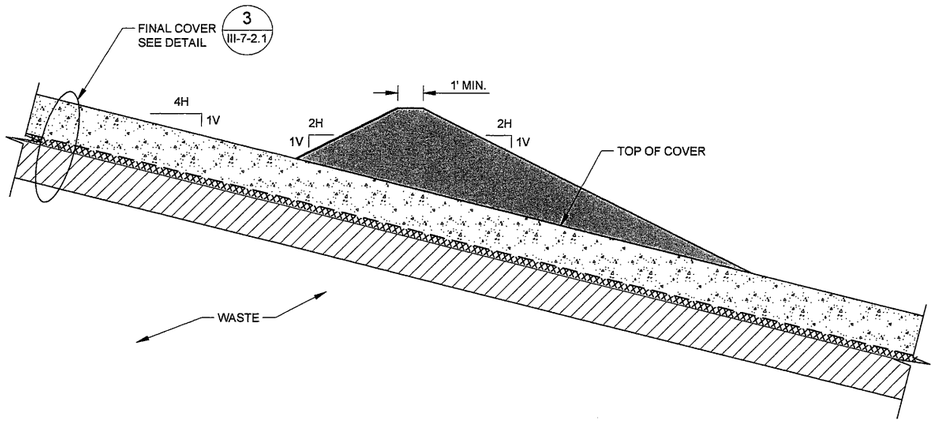
- Pre-construction soil test results
- Summary of construction material conformance tests results
- Summary of field moisture-density control test methods and results
- Summary of hydraulic conductivity test results
- Cohesive soil cover construction practices
- Placement and processing methods
- Observations of soil conditions prior to and after compaction, including soil structure, clod size, and presence of inclusions
- Compaction methods, equipment type, compactor weight and foot length, and number of passes
- Lift tie-in and bonding observations
- Repair of failed and damaged lifts
- Any and all deviations from the permitted design
- Thickness verification
- Post-construction care of cohesive soil cover

For geomembrane:

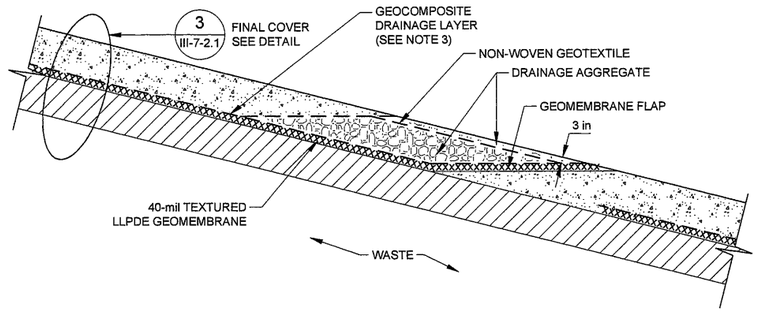
- Roll shipment and receipt information
- Manufacturer's quality control certificates and results
- Storage and handling information
- Conformance test sampling and test results
- Seamer's names and resumes of experience and qualifications
- Subgrade acceptance
- Panel deployment, identification, and placement
- Seam preparation, orientation, and identification
- Equipment placed or operated on geomembrane
- 100 percent visual inspection for defects, damage, etc.
- Trial seam tests for each combination of seaming equipment and personnel
- Seaming methods, times, temperature, and equipment shutdowns and startups
- Continuous 100 percent non-destructive seam testing, methods, criteria, and results
- Destructive testing methods, criteria, and results
- Repairs, including preparation and procedures, failure delineation, patch size and shape, and retesting
- Material properties and placement of drainage materials and soil cover
- Confirmation of the interface friction angle for the geomembrane/adjoin material interface and a recalculation of the factor of safety, if needed.
-

The report shall also include pertinent record drawings including:

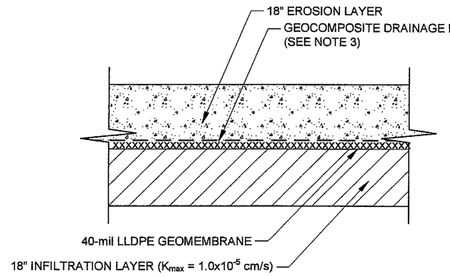
- Layout plan
- Previous covered areas
- As-built cohesive soil cover drawings, showing sample and test locations, and thickness
- As-built geomembrane panel layout drawings, showing location of destructive test samples, patches, and repairs
- As-built drawings showing elevations of soil cover to confirm its thickness



SCALE 1" = 6' 1 III-7-2.1 DETAIL
ADD-ON BERM



SCALE 1" = 6' 2 III-7-2.1 DETAIL
GEOCOMPOSITE DAYLIGHT DRAINAGE



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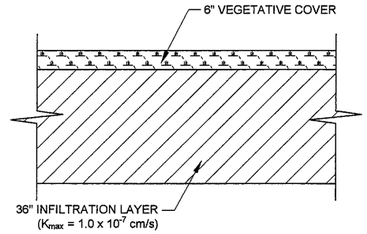
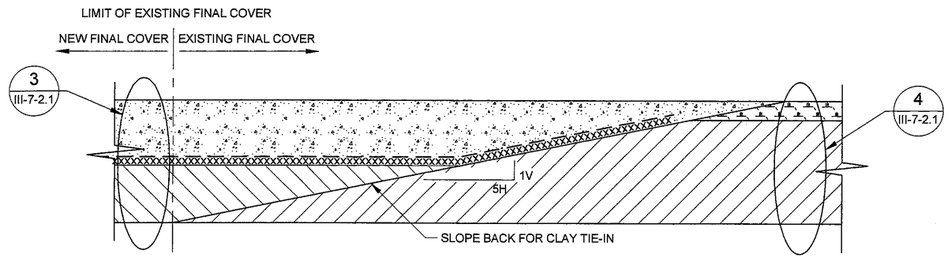
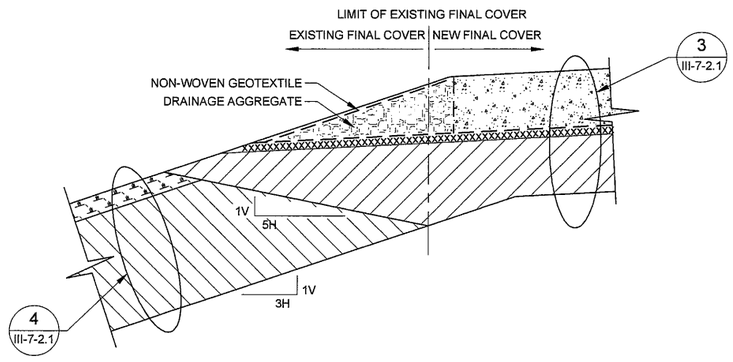
PROPOSED FINAL COVER



SCALE 1" = 4' 4 III-7-2.1 DETAIL
EXISTING FINAL COVER - TRACT 2A & 3



SCALE 1" = 4' A III-7-2.1 DETAIL
TIE-IN BETWEEN EXISTING AND PROPOSED FINAL COVER



SCALE 1" = 4' B III-7-2.1 DETAIL
TIE-IN BETWEEN EXISTING AND PROPOSED FINAL COVER

NOTES

1. GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY.
2. SEE ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.
3. SEE ATTACHMENT 3, APPENDIX III-3D-2 FOR DESIGN AND LOCATIONS OF THE GEOCOMPOSITE DRAINAGE LAYER.

INTENDED FOR PERMITTING PURPOSES ONLY

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

0 2 4
1" = 4' FEET

0 3 6
1" = 6' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
1	2016-12	RESPONSE TO 1ST NOD	MX	TNB	MX	CGD
0	2015-12-03	INITIAL SUBMITTAL	VJE	TNB	PRM	CGD

CLIENT
CITY OF TEMPLE

CONSULTANT
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USA
(281) 821-6868
www.golder.com

PROJECT
PERMIT AMENDMENT APPLICATION MSW 692B
TEMPLE RECYCLING AND DISPOSAL FACILITY
BELL COUNTY, TEXAS

TITLE
FINAL COVER DETAILS I

APPLICATION SECTION
III Attachment 7

PROJECT NO.
1400336

REV. 0 | 2 of 8 | FIGURE III-7-2.1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

0

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