Appendix O Preliminary Geotechnical Calculations

Appendix O

Preliminary Geotechnical Calculations

- O1 Final Grades Slope Stability Analyses
- O2 Preliminary Underdrain Groundwater Discharge Estimates
- 03 Subbase vs. Bedrock Figure
- O4 Average Horizontal Hydraulic Gradient and Groundwater Flow Velocity Calculation

O1 Final Grades Slope Stability Analyses

SCS ENGINEERS

February 1, 2024 File No. 2522268.00

TECHNICAL MEMORANDUM

ANALYSIS BY: Niko Villanueva, Brandon Suchomel

REVIEWED BY: Deb Nelson, PE

Phil Gearing, PE

SUBJECT: Final Grades Slope Stability Analyses

Dane County Landfill Site No. 3

PURPOSE

The purpose of the slope stability analysis is to determine the factor of safety against slope failure of the final buildout conditions at the proposed Dane County Landfill Site No. 3 (Landfill).

CONCLUSION

The attached results confirm that the final waste slope of 4H:1V and a peak elevation at approximately 1,135 feet above mean sea level will be stable.

APPROACH

SCS Engineers (SCS) evaluated the waste mass slope stability of the final buildout conditions of the Landfill. Stability of the Landfill was analyzed for two modes of failure – translational (non-circular / block) failure and rotational (circular) failure. SCS used GeoStudio 2023 Slope/W software to evaluate the Landfill at its critical cross section and determine the factors of safety against slope failure. The location of the critical cross-section (A-A') can be found on the attached figure. The critical cross section is oriented from south to north and cuts through the Landfill base liner system, peak waste mass and final cover. The critical cross section is conservative due to its maximum waste grades and longest slope length in the proposed Landfill area. Leachate recirculation wet waste properties were used in the analyses.

RESULTS

SCS recommends a minimum safety factor of 1.5 for the final waste slope. The results indicate that the 4H:1V waste slope with the assumed parameters has an acceptable minimum safety factor of approximately 1.95 for block failure and 2.53 for circular failure, which exceed the minimum recommended safety factor of 1.5. An optimized circular failure was also analyzed and exceeds the safety factor of 1.5, as well.



REFERENCES

- 1. TRC, 2014, Global Slope Stability, Eastern Expansion Plan of Operation, Dane County No. 2 (Rodefeld) Landfill, Appendix F.
- 2. SCS Engineers, 2023, Slope Stability Analyses, Eastern Vertical Expansion Plan of Operation, Dane County Landfill Site No. 2 (Rodefeld), Appendix I.
- 3. Geo-Slope International, Ltd., GeoStudio 2023, Version 1.1, Slope/W slope stability software.

ASSUMPTIONS

- The waste is municipal solid waste (MSW). The waste properties will likely change over time due to the effects of leachate recirculation.
- A final grade slope of 4H:1V is representative of the design final waste slope for the landfill.
- The final cover soil layer is 5-feet thick.
- Circular (Bishop's method) and sliding block (Janbu's method) failure stability analyses are appropriate to evaluate the waste mass stability.
- The geomembrane liner will be smooth on the base and textured on the sidewalls. An interface friction angle for smooth geomembrane was used for the analyses. This approach is conservative. It is inferred that the textured geomembrane along the sidewalls will further increase the slope stability safety factors.
- Low-strength waste materials, if any, will be well mixed with the municipal solid waste to avoid low-strength waste zones. The site will be operated to avoid buildup of liquids or gas that could result in unstable waste slope conditions.
- The uppermost aquifer is assumed to be 1-foot below the base of the clay liner due to the proposed underdrain system to be installed.
- Material properties are as shown in the table below, based on the indicated Dane County Landfill Site No. 2 2014 Eastern Expansion and 2023 Eastern Vertical Expansion Plans of Operation references:

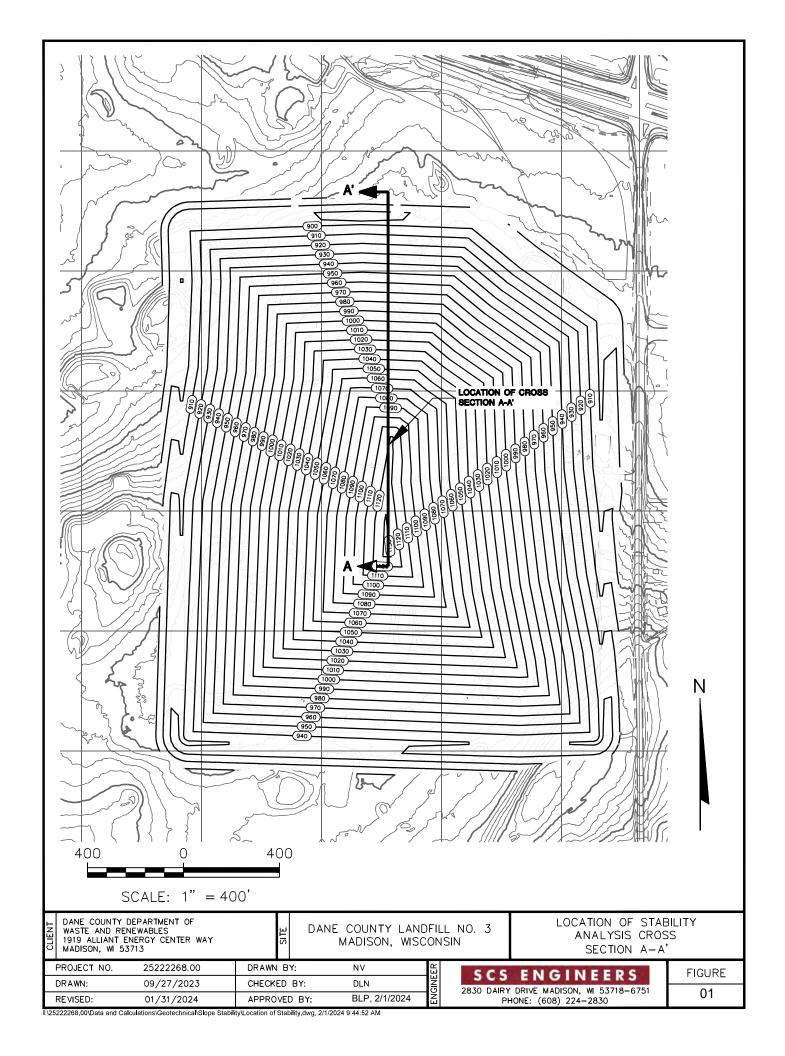
Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Reference
MSW with Leachate Recirculation	119	30	300	1, 2
Geosynthetic Liner Interfaces	115	11	0	1, 2
Cover General Fill	115	30	0	1, 2
Clay Liner	130	30	0	1, 2
Native Sand and Sand Fill	115	32	0	1, 2

TECHNICAL MEMORANDUM February 1, 2024 Page 3

Attachments: Cross Section Location Figure

Slope/W Outputs

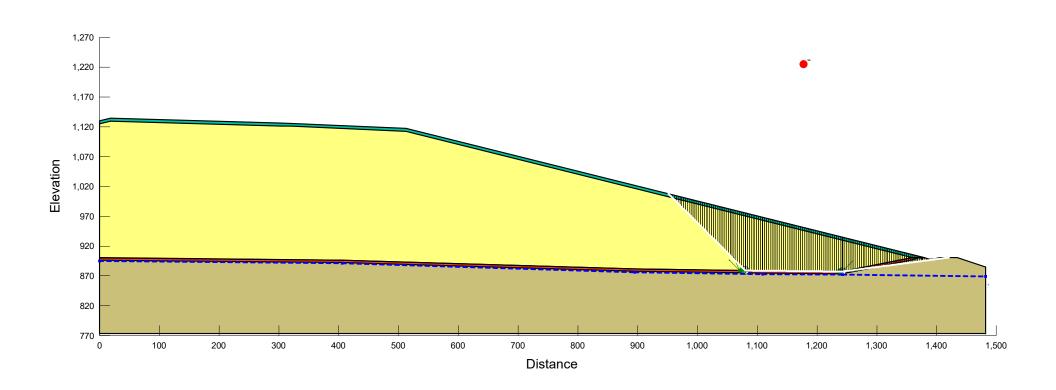
KRG/NV/AJR/DLN/PEG/BLP Slope/W coordinates checked by BSS



Dane Co. Landfill No.3 Block Failure A-A Block Static Conditions 01/30/2024, 03:14:32 PM

Analysis '	Type: Ja	anbu
Factor of	Safety:	1.947

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Clay Liner	130	0	30	
	General Cover Fill	115	0	30	
	Geosynthetic Liner	115	0	11	
	MSW with Leachate Recirculation	119	300	30	
	Native Sand Fill	115	0	32	1



Block Failure A-A

Report generated using GeoStudio 2023.1.1. Copyright © 2023 Bentley Systems, Incorporated.

File Information

File Version: 11.05

Title: Dane Co. Landfill No.3 Created By: Villanueva, Niko Last Edited By: Villanueva, Niko

Revision Number: 40 Date: 01/30/2024 Time: 03:07:17 PM Tool Version: 23.1.1.829

File Name: SlopeW DaneCoLF AA'.gsz

Directory: I:\25222268.00\Data and Calculations\Geotechnical\Slope Stability\

Last Solved Date: 01/30/2024 Last Solved Time: 03:14:32 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Block Failure A-A

Description: Block Static Conditions

Kind: SLOPE/W Analysis Type: Janbu

Settings

PWP Conditions from: Piezometric Surfaces

Apply Phreatic Correction: No Use Staged Rapid Drawdown: No Unit Weight of Water: 62.430189 pcf

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No Slip Surface Option: Block Critical slip surfaces saved: 10 Restrict Block Crossing: No

Optimize Critical Slip Surface Location: No

Tension Crack Option: (none)

Distribution

F of S Calculation Option: Constant

Convergence

Geometry Settings

Minimum Slip Surface Depth: 0.1 ft

Minimum Slip Surface Volume: 35.314667 ft³

Number of Columns: 150

Factor of Safety Convergence Settings

Maximum Number of Iterations: 20,000 Tolerable difference in F of S: 0.001

Under-Relaxation Criteria

Initial Rate: 1 Minimum Rate: 0.1

Rate Reduction Factor: 0.65

Reduction Frequency (iterations): 50

Materials

MSW with Leachate Recirculation

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 119 pcf Effective Cohesion: 300 psf Effective Friction Angle: 30 °

Phi-B: 0°

Geosynthetic Liner

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 11 °

Phi-B: 0°

General Cover Fill

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 30 °

Phi-B: 0°

Native Sand Fill

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 32 °

Phi-B: 0°

Pore Water Pressure

Piezometric Surface: 1

Clay Liner

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 130 pcf Effective Cohesion: 0 psf Effective Friction Angle: 30 °

Phi-B: 0°

Slip Surface Limits

Left Coordinate: (0, 1,129.9621) ft

Right Coordinate: (1,482.0689, 773.3598) ft

Slip Surface Block

Left Grid

Upper Left: (1,070.2, 879.2) ft Lower Left: (1,070.2, 879.1) ft Lower Right: (1,082.55, 878.92) ft

X Increments: 15 Y Increments: 10 Starting Angle: 115 ° Ending Angle: 135 ° Angle Increments: 6

Right Grid

Upper Left: (1,234.85, 877.4) ft Lower Left: (1,234.85, 877.25) ft Lower Right: (1,242.25, 877.2) ft

X Increments: 15 Y Increments: 10 Angle Increments: 6

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	Х	Y
Coordinate 1	0 ft	895 ft
Coordinate 2	406 ft	891 ft
Coordinate 3	895 ft	876 ft
Coordinate 4	1,109 ft	873 ft
Coordinate 5	1,243 ft	872 ft
Coordinate 6	1,482.0685 ft	869 ft

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Υ
Point 1	1,482.0684 ft	884.9437 ft
Point 2	1,434.2391 ft	900.8869 ft
Point 3	1,404.2391 ft	900.5869 ft
Point 4	1,396.7391 ft	898.0869 ft
Point 5	1,386.7391 ft	898.0869 ft
Point 6	1,379.2391 ft	900.5869 ft
Point 7	1,376.1831 ft	900.5869 ft
Point 8	1,376.1831 ft	898.5877 ft

1		
Point 9	1,374.0831 ft	898.5877 ft
Point 10	1,374.0831 ft	900.5869 ft
Point 11	1,371.2391 ft	900.5869 ft
Point 12	1,359.2391 ft	896.5869 ft
Point 13	1,242.2249 ft	873.2133 ft
Point 14	1,108.4601 ft	874.551 ft
Point 15	894.4735 ft	877.6211 ft
Point 16	405.7741 ft	892.2821 ft
Point 17	0 ft	896.3398 ft
Point 18	0 ft	773.3598 ft
Point 19	1,482.0689 ft	773.3598 ft
Point 20	0 ft	900.4395 ft
Point 21	0 ft	900.3392 ft
Point 22	405.7741 ft	896.2821 ft
Point 23	894.4735 ft	881.6211 ft
Point 24	1,108.4601 ft	878.551 ft
Point 25	1,242.2249 ft	877.2133 ft
Point 26	1,359.2391 ft	900.5869 ft
Point 27	1,376.1831 ft	898.6877 ft
Point 28	1,374.1831 ft	898.6877 ft
Point 29	1,374.1831 ft	900.6869 ft
Point 30	1,359.2292 ft	900.6869 ft
Point 31	1,305.8088 ft	890.0162 ft
Point 32	1,242.2155 ft	877.3134 ft
Point 33	1,108.4613 ft	878.651 ft
Point 34	894.4757 ft	881.7211 ft
Point 35	405.7761 ft	896.3821 ft
Point 36	512.9414 ft	1,111.992 ft
Point 37	320.4503 ft	1,120.7069 ft
Point 38	304.5738 ft	1,120.8679 ft
Point 39	18.1661 ft	1,129.5 ft
Point 40	0 ft	1,124.9621 ft
Point 41	1,359.0122 ft	900.6435 ft
Point 42	512.9414 ft	1,116.992 ft
Point 43	320.4503 ft	1,125.7069 ft
Point 44	304.5738 ft	1,125.8679 ft
Point 45	18.1661 ft	1,134.5 ft
Point 46	0 ft	1,129.9621 ft

Regions

	Material	Area			
Region 1	Native Sand Fill	ative Sand Fill 1,2,3,4,5,6,7,27,8,9,10,11,12,13,14,15,16,17,18,19			
Region 2	Geosynthetic Liner	20,21,22,23,24,25,26,11,10,9,8,27,28,29,30,41,31,32,33,34,35	138.15 ft²		
Region 3	Clay Liner	21,22,23,24,25,26,11,12,13,14,15,16,17	5,460.8 ft²		
Region 4	MSW with Leachate Recirculation	36,37,38,39,40,20,35,34,33,32,31,41	2.1819e+05 ft²		

Region 5	General Cover Fill	41,30,29,28,27,7,6,42,43,44,45,46,40,39,38,37,36	6,846.8 ft²
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Slip Results

Slip Surfaces Analysed: 1517702 of 1517824 converged

Current Slip Surface

Slip Surface: 111,092 Factor of Safety: 1.947 Volume: 23,036.246 ft³ Weight: 2,735,900.5 lbf

Resisting Moment: 1.6363519e+08 lbf·ft Activating Moment: 94,031,680 lbf·ft

Resisting Force: 964,937.5 lbf Activating Force: 495,714.47 lbf Slip Rank: 1 of 1,517,824 slip surfaces Exit: (1,420.4932, 900.74944) ft Entry: (951.63054, 1,007.4055) ft

Radius: 221.79017 ft

Center: (1,204.2583, 1,034.0695) ft

Slip Columns

	х	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	953.2961 ft	1,005.7399 ft	0 psf	110.81323 psf	63.978046 psf	0 psf	0 psf	General Cover Fill
Column 2	956.6272 ft	1,002.4088 ft	0 psf	332.43968 psf	191.93414 psf	0 psf	0 psf	General Cover Fill
Column 3	959.8528 ft	999.1832 ft	0 psf	431.76064 psf	249.27712 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 4	962.9729 ft	996.0631 ft	0 psf	646.56719 psf	373.29574 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 5	966.0930 ft	992.9430 ft	0 psf	861.37374 psf	497.31436 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 6	969.2131 ft	989.8229 ft	0 psf	1,076.1803 psf	621.33298 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 7	972.3332 ft	986.7028 ft	0 psf	1,290.9868 psf	745.3516 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 8	975.4533 ft	983.5827 ft	0 psf	1,505.7934 psf	869.37021 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 9	978.5734 ft	980.4626 ft	0 psf	1,720.5999 psf	993.38883 psf	300 psf	0 psf	MSW with Leachate Recirculation

Column 10	981.6935 ft	977.3425 ft	0 psf	1,935.4065 psf	1,117.4074 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 11	984.8136 ft	974.2224 ft	0 psf	2,150.213 psf	1,241.4261 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 12	987.9336 ft	971.1024 ft	0 psf	2,365.0196 psf	1,365.4447 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 13	991.0537 ft	967.9823 ft	0 psf	2,579.8261 psf	1,489.4633 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 14	994.1738 ft	964.8622 ft	0 psf	2,794.6327 psf	1,613.4819 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 15	997.2939 ft	961.7421 ft	0 psf	3,009.4392 psf	1,737.5005 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 16	1,000.4140 ft	958.6220 ft	0 psf	3,224.2458 psf	1,861.5192 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 17	1,003.5341 ft	955.5019 ft	0 psf	3,439.0523 psf	1,985.5378 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 18	1,006.6542 ft	952.3818 ft	0 psf	3,653.8589 psf	2,109.5564 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 19	1,009.7743 ft	949.2617 ft	0 psf	3,868.6654 psf	2,233.575 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 20	1,012.8944 ft	946.1416 ft	0 psf	4,083.472 psf	2,357.5936 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 21	1,016.0145 ft	943.0215 ft	0 psf	4,298.2785 psf	2,481.6123 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 22	1,019.1346 ft	939.9014 ft	0 psf	4,513.0851 psf	2,605.6309 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 23	1,022.2546 ft	936.7814 ft	0 psf	4,727.8916 psf	2,729.6495 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 24	1,025.3747 ft	933.6613 ft	0 psf	4,942.6981 psf	2,853.6681 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 25	1,028.4948 ft	930.5412 ft	0 psf	5,157.5047 psf	2,977.6867 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 26	1,031.6149 ft	927.4211 ft	0 psf	5,372.3112 psf	3,101.7053 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 27	1,034.7350 ft	924.3010 ft	0 psf	5,587.1178 psf	3,225.724 psf	300 psf	0 psf	MSW with Leachate Recirculation

Column 28	1,037.8551 ft	921.1809 ft	0 psf	5,801.9243 psf	3,349.7426 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 29	1,040.9752 ft	918.0608 ft	0 psf	6,016.7309 psf	3,473.7612 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 30	1,044.0953 ft	914.9407 ft	0 psf	6,231.5374 psf	3,597.7798 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 31	1,047.2154 ft	911.8206 ft	0 psf	6,446.344 psf	3,721.7984 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 32	1,050.3355 ft	908.7005 ft	0 psf	6,661.1505 psf	3,845.8171 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 33	1,053.4555 ft	905.5805 ft	0 psf	6,875.9571 psf	3,969.8357 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 34	1,056.5756 ft	902.4604 ft	0 psf	7,090.7636 psf	4,093.8543 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 35	1,059.6957 ft	899.3403 ft	0 psf	7,305.5702 psf	4,217.8729 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 36	1,062.8158 ft	896.2202 ft	0 psf	7,520.3767 psf	4,341.8915 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 37	1,065.9359 ft	893.1001 ft	0 psf	7,735.1833 psf	4,465.9101 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 38	1,069.0560 ft	889.9800 ft	0 psf	7,949.9898 psf	4,589.9288 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 39	1,072.1761 ft	886.8599 ft	0 psf	8,164.7964 psf	4,713.9474 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 40	1,075.2962 ft	883.7398 ft	0 psf	8,379.6029 psf	4,837.966 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 41	1,078.4681 ft	880.5679 ft	0 psf	8,598.0184 psf	4,964.0682 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 42	1,080.3820 ft	878.9528 ft	0 psf	11,401.774 psf	6,582.8175 psf	0 psf	0 psf	Clay Liner
Column 43	1,082.2271 ft	878.9329 ft	0 psf	11,373.442 psf	2,210.7732 psf	0 psf	0 psf	Geosynthetic Liner
Column 44	1,085.3135 ft	878.8998 ft	0 psf	11,285.781 psf	2,193.7335 psf	0 psf	0 psf	Geosynthetic Liner
Column 45	1,088.3999 ft	878.8666 ft	0 psf	11,198.119 psf	2,176.6938 psf	0 psf	0 psf	Geosynthetic Liner
Column 46	1,091.4863 ft	878.8334 ft	0 psf	11,110.457 psf	2,159.6541 psf	0 psf	0 psf	Geosynthetic Liner
Column	1,094.5726	878.8002	0 psf	11,022.795	2,142.6144	0 psf	0 psf	Geosynthetic

47	ft	ft		psf	psf			Liner
Column 48	1,097.6590 ft	878.7671 ft	0 psf	10,935.134 psf	2,125.5747 psf	0 psf	0 psf	Geosynthetic Liner
Column 49	1,100.7454 ft	878.7339 ft	0 psf	10,847.472 psf	2,108.5349 psf	0 psf	0 psf	Geosynthetic Liner
Column 50	1,103.8317 ft	878.7007 ft	0 psf	10,759.81 psf	2,091.4952 psf	0 psf	0 psf	Geosynthetic Liner
Column 51	1,106.9181 ft	878.6676 ft	0 psf	10,672.159 psf	2,074.4575 psf	0 psf	0 psf	Geosynthetic Liner
Column 52	1,108.7306 ft	878.6481 ft	0 psf	10,620.589 psf	2,064.4334 psf	0 psf	0 psf	Geosynthetic Liner
Column 53	1,110.5804 ft	878.6282 ft	0 psf	10,568.091 psf	2,054.2288 psf	0 psf	0 psf	Geosynthetic Liner
Column 54	1,113.7413 ft	878.5942 ft	0 psf	10,478.259 psf	2,036.7671 psf	0 psf	0 psf	Geosynthetic Liner
Column 55	1,116.9022 ft	878.5602 ft	0 psf	10,388.426 psf	2,019.3054 psf	0 psf	0 psf	Geosynthetic Liner
Column 56	1,120.0631 ft	878.5263 ft	0 psf	10,298.593 psf	2,001.8437 psf	0 psf	0 psf	Geosynthetic Liner
Column 57	1,123.2239 ft	878.4923 ft	0 psf	10,208.76 psf	1,984.382 psf	0 psf	0 psf	Geosynthetic Liner
Column 58	1,126.3848 ft	878.4583 ft	0 psf	10,118.928 psf	1,966.9203 psf	0 psf	0 psf	Geosynthetic Liner
Column 59	1,129.5457 ft	878.4244 ft	0 psf	10,029.095 psf	1,949.4586 psf	0 psf	0 psf	Geosynthetic Liner
Column 60	1,132.7065 ft	878.3904 ft	0 psf	9,939.2624 psf	1,931.9969 psf	0 psf	0 psf	Geosynthetic Liner
Column 61	1,135.8674 ft	878.3564 ft	0 psf	9,849.4297 psf	1,914.5352 psf	0 psf	0 psf	Geosynthetic Liner
Column 62	1,139.0283 ft	878.3224 ft	0 psf	9,759.5971 psf	1,897.0735 psf	0 psf	0 psf	Geosynthetic Liner
Column 63	1,142.1892 ft	878.2885 ft	0 psf	9,669.7644 psf	1,879.6118 psf	0 psf	0 psf	Geosynthetic Liner
Column 64	1,145.3500 ft	878.2545 ft	0 psf	9,579.9317 psf	1,862.1501 psf	0 psf	0 psf	Geosynthetic Liner
Column 65	1,148.5109 ft	878.2205 ft	0 psf	9,490.099 psf	1,844.6884 psf	0 psf	0 psf	Geosynthetic Liner
Column 66	1,151.6718 ft	878.1865 ft	0 psf	9,400.2663 psf	1,827.2267 psf	0 psf	0 psf	Geosynthetic Liner
Column 67	1,154.8327 ft	878.1526 ft	0 psf	9,310.4336 psf	1,809.765 psf	0 psf	0 psf	Geosynthetic Liner
Column 68	1,157.9935 ft	878.1186 ft	0 psf	9,220.601 psf	1,792.3033 psf	0 psf	0 psf	Geosynthetic Liner
Column 69	1,161.1544 ft	878.0846 ft	0 psf	9,130.7683 psf	1,774.8416 psf	0 psf	0 psf	Geosynthetic Liner
Column 70	1,164.3153 ft	878.0507 ft	0 psf	9,040.9356 psf	1,757.3799 psf	0 psf	0 psf	Geosynthetic Liner
Column 71	1,167.4762 ft	878.0167 ft	0 psf	8,951.1029 psf	1,739.9182 psf	0 psf	0 psf	Geosynthetic Liner
Column 72	1,170.6370 ft	877.9827 ft	0 psf	8,861.2702 psf	1,722.4564 psf	0 psf	0 psf	Geosynthetic Liner

Column 73	1,173.7979 ft	877.9487 ft	0 psf	8,771.4376 psf	1,704.9947 psf	0 psf	0 psf	Geosynthetic Liner
Column 74	1,176.9588 ft	877.9148 ft	0 psf	8,681.6049 psf	1,687.533 psf	0 psf	0 psf	Geosynthetic Liner
Column 75	1,180.1196 ft	877.8808 ft	0 psf	8,591.7722 psf	1,670.0713 psf	0 psf	0 psf	Geosynthetic Liner
Column 76	1,183.2805 ft	877.8468 ft	0 psf	8,501.9395 psf	1,652.6096 psf	0 psf	0 psf	Geosynthetic Liner
Column 77	1,186.4414 ft	877.8129 ft	0 psf	8,412.1068 psf	1,635.1479 psf	0 psf	0 psf	Geosynthetic Liner
Column 78	1,189.6023 ft	877.7789 ft	0 psf	8,322.2742 psf	1,617.6862 psf	0 psf	0 psf	Geosynthetic Liner
Column 79	1,192.7631 ft	877.7449 ft	0 psf	8,232.4415 psf	1,600.2245 psf	0 psf	0 psf	Geosynthetic Liner
Column 80	1,195.9240 ft	877.7109 ft	0 psf	8,142.6088 psf	1,582.7628 psf	0 psf	0 psf	Geosynthetic Liner
Column 81	1,199.0849 ft	877.6770 ft	0 psf	8,052.7761 psf	1,565.3011 psf	0 psf	0 psf	Geosynthetic Liner
Column 82	1,202.2458 ft	877.6430 ft	0 psf	7,962.9434 psf	1,547.8394 psf	0 psf	0 psf	Geosynthetic Liner
Column 83	1,205.4066 ft	877.6090 ft	0 psf	7,873.1107 psf	1,530.3777 psf	0 psf	0 psf	Geosynthetic Liner
Column 84	1,208.5675 ft	877.5750 ft	0 psf	7,783.2781 psf	1,512.916 psf	0 psf	0 psf	Geosynthetic Liner
Column 85	1,211.7284 ft	877.5411 ft	0 psf	7,693.4454 psf	1,495.4543 psf	0 psf	0 psf	Geosynthetic Liner
Column 86	1,214.8892 ft	877.5071 ft	0 psf	7,603.6127 psf	1,477.9926 psf	0 psf	0 psf	Geosynthetic Liner
Column 87	1,218.0501 ft	877.4731 ft	0 psf	7,513.78 psf	1,460.5309 psf	0 psf	0 psf	Geosynthetic Liner
Column 88	1,221.2110 ft	877.4392 ft	0 psf	7,423.9473 psf	1,443.0692 psf	0 psf	0 psf	Geosynthetic Liner
Column 89	1,224.3719 ft	877.4052 ft	0 psf	7,334.1147 psf	1,425.6075 psf	0 psf	0 psf	Geosynthetic Liner
Column 90	1,227.5327 ft	877.3712 ft	0 psf	7,244.282 psf	1,408.1458 psf	0 psf	0 psf	Geosynthetic Liner
Column 91	1,230.6936 ft	877.3372 ft	0 psf	7,154.4493 psf	1,390.6841 psf	0 psf	0 psf	Geosynthetic Liner
Column 92	1,233.8545 ft	877.3033 ft	0 psf	7,064.6166 psf	1,373.2224 psf	0 psf	0 psf	Geosynthetic Liner
Column 93	1,237.0154 ft	877.2693 ft	0 psf	6,974.7839 psf	1,355.7607 psf	0 psf	0 psf	Geosynthetic Liner
Column 94	1,240.1762 ft	877.2353 ft	0 psf	6,884.9513 psf	1,338.299 psf	0 psf	0 psf	Geosynthetic Liner
Column 95	1,241.9861 ft	877.2485 ft	0 psf	6,928.2092 psf	1,346.7074 psf	0 psf	0 psf	Geosynthetic Liner
Column 96	1,242.6077 ft	877.3304 ft	0 psf	6,899.637 psf	1,341.1536 psf	0 psf	0 psf	Geosynthetic Liner
Column 97	1,243.1020 ft	877.3955 ft	0 psf	6,876.7649 psf	1,336.7077 psf	0 psf	0 psf	Geosynthetic Liner
Column 98	1,244.7498 ft	877.6124 ft	0 psf	6,985.5265 psf	4,033.0956 psf	0 psf	0 psf	Clay Liner

	I	I			Ī			
Column 99	1,247.8414 ft	878.0194 ft	0 psf	6,841.8965 psf	3,950.1708 psf	0 psf	0 psf	Clay Liner
Column 100	1,250.9329 ft	878.4264 ft	0 psf	6,698.2666 psf	3,867.246 psf	0 psf	0 psf	Clay Liner
Column 101	1,254.0244 ft	878.8334 ft	0 psf	6,554.6366 psf	3,784.3212 psf	0 psf	0 psf	Clay Liner
Column 102	1,257.1160 ft	879.2404 ft	0 psf	6,411.0066 psf	3,701.3964 psf	0 psf	0 psf	Clay Liner
Column 103	1,260.2075 ft	879.6474 ft	0 psf	6,267.3767 psf	3,618.4716 psf	0 psf	0 psf	Clay Liner
Column 104	1,263.2990 ft	880.0544 ft	0 psf	6,123.7467 psf	3,535.5468 psf	0 psf	0 psf	Clay Liner
Column 105	1,266.3906 ft	880.4614 ft	0 psf	5,980.1167 psf	3,452.622 psf	0 psf	0 psf	Clay Liner
Column 106	1,269.4821 ft	880.8685 ft	0 psf	5,836.4867 psf	3,369.6972 psf	0 psf	0 psf	Clay Liner
Column 107	1,272.5736 ft	881.2755 ft	0 psf	5,692.8568 psf	3,286.7724 psf	0 psf	0 psf	Clay Liner
Column 108	1,275.6652 ft	881.6825 ft	0 psf	5,549.2268 psf	3,203.8476 psf	0 psf	0 psf	Clay Liner
Column 109	1,278.7567 ft	882.0895 ft	0 psf	5,405.5968 psf	3,120.9228 psf	0 psf	0 psf	Clay Liner
Column 110	1,281.8483 ft	882.4965 ft	0 psf	5,261.9669 psf	3,037.998 psf	0 psf	0 psf	Clay Liner
Column 111	1,284.9398 ft	882.9035 ft	0 psf	5,118.3369 psf	2,955.0732 psf	0 psf	0 psf	Clay Liner
Column 112	1,288.0313 ft	883.3105 ft	0 psf	4,974.7069 psf	2,872.1484 psf	0 psf	0 psf	Clay Liner
Column 113	1,291.1229 ft	883.7175 ft	0 psf	4,831.0769 psf	2,789.2236 psf	0 psf	0 psf	Clay Liner
Column 114	1,294.2144 ft	884.1245 ft	0 psf	4,687.447 psf	2,706.2988 psf	0 psf	0 psf	Clay Liner
Column 115	1,297.3059 ft	884.5315 ft	0 psf	4,543.817 psf	2,623.374 psf	0 psf	0 psf	Clay Liner
Column 116	1,300.3975 ft	884.9385 ft	0 psf	4,400.187 psf	2,540.4492 psf	0 psf	0 psf	Clay Liner
Column 117	1,303.8760 ft	885.3965 ft	-884.03752 psf	4,250.7443 psf	2,656.1598 psf	0 psf	0 psf	Native Sand Fill
Column 118	1,307.3736 ft	885.8570 ft	-915.52452 psf	4,083.9741 psf	2,551.9502 psf	0 psf	0 psf	Native Sand Fill
Column 119	1,310.5032 ft	886.2690 ft	-943.69888 psf	3,934.7492 psf	2,458.7042 psf	0 psf	0 psf	Native Sand Fill
Column 120	1,313.6328 ft	886.6810 ft	-971.87323 psf	3,785.5244 psf	2,365.4582 psf	0 psf	0 psf	Native Sand Fill
Column 121	1,316.7624 ft	887.0930 ft	-1,000.0476 psf	3,636.2995 psf	2,272.2121 psf	0 psf	0 psf	Native Sand Fill
Column 122	1,319.8921 ft	887.5051 ft	-1,028.2219 psf	3,487.0747 psf	2,178.9661 psf	0 psf	0 psf	Native Sand Fill
Column 123	1,323.0217 ft	887.9171 ft	-1,056.3963 psf	3,337.8498 psf	2,085.7201 psf	0 psf	0 psf	Native Sand Fill
Column 124	1,326.1513 ft	888.3291 ft	-1,084.5707 psf	3,188.625 psf	1,992.474 psf	0 psf	0 psf	Native Sand Fill

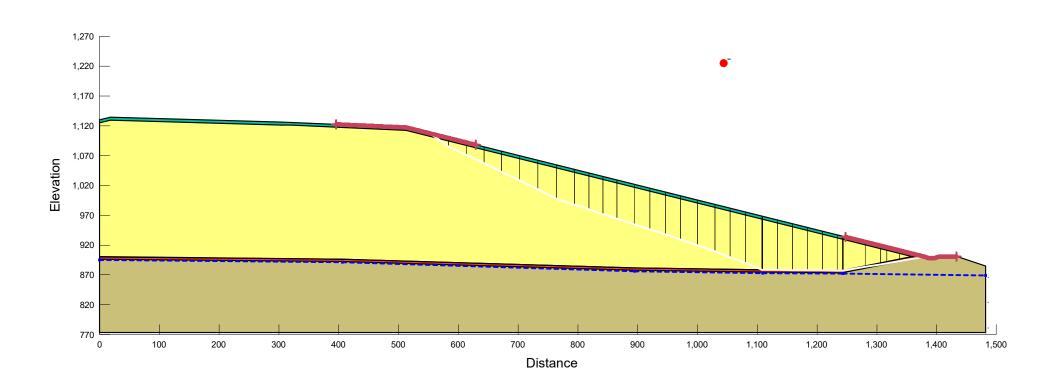
Column 125	1,329.2809 ft	888.7411 ft	-1,112.745 psf	3,039.4001 psf	1,899.228 psf	0 psf	0 psf	Native Sand Fill
Column 126	1,332.4105 ft	889.1531 ft	-1,140.9194 psf	2,890.1753 psf	1,805.9819 psf	0 psf	0 psf	Native Sand Fill
Column 127	1,335.5401 ft	889.5652 ft	-1,169.0937 psf	2,740.9504 psf	1,712.7359 psf	0 psf	0 psf	Native Sand Fill
Column 128	1,338.6697 ft	889.9772 ft	-1,197.2681 psf	2,591.7256 psf	1,619.4899 psf	0 psf	0 psf	Native Sand Fill
Column 129	1,341.7993 ft	890.3892 ft	-1,225.4424 psf	2,442.5007 psf	1,526.2438 psf	0 psf	0 psf	Native Sand Fill
Column 130	1,344.9289 ft	890.8012 ft	-1,253.6168 psf	2,293.2758 psf	1,432.9978 psf	0 psf	0 psf	Native Sand Fill
Column 131	1,348.0586 ft	891.2132 ft	-1,281.7911 psf	2,144.051 psf	1,339.7518 psf	0 psf	0 psf	Native Sand Fill
Column 132	1,351.1882 ft	891.6253 ft	-1,309.9655 psf	1,994.8261 psf	1,246.5057 psf	0 psf	0 psf	Native Sand Fill
Column 133	1,354.3178 ft	892.0373 ft	-1,338.1399 psf	1,845.6013 psf	1,153.2597 psf	0 psf	0 psf	Native Sand Fill
Column 134	1,357.4474 ft	892.4493 ft	-1,366.3142 psf	1,696.3764 psf	1,060.0136 psf	0 psf	0 psf	Native Sand Fill
Column 135	1,359.1256 ft	892.6703 ft	-1,381.4227 psf	1,616.5675 psf	1,010.1435 psf	0 psf	0 psf	Native Sand Fill
Column 136	1,360.7391 ft	892.8827 ft	-1,395.9478 psf	1,534.834 psf	959.07072 psf	0 psf	0 psf	Native Sand Fill
Column 137	1,363.7391 ft	893.2776 ft	-1,422.9553 psf	1,381.7598 psf	863.41935 psf	0 psf	0 psf	Native Sand Fill
Column 138	1,366.7391 ft	893.6726 ft	-1,449.9629 psf	1,228.6856 psf	767.76797 psf	0 psf	0 psf	Native Sand Fill
Column 139	1,369.7391 ft	894.0675 ft	-1,476.9704 psf	1,075.6114 psf	672.1166 psf	0 psf	0 psf	Native Sand Fill
Column 140	1,372.6611 ft	894.4522 ft	-1,503.2757 psf	933.94101 psf	583.59111 psf	0 psf	0 psf	Native Sand Fill
Column 141	1,375.1331 ft	894.7777 ft	-1,525.5299 psf	820.71348 psf	512.8387 psf	0 psf	0 psf	Native Sand Fill
Column 142	1,377.7111 ft	895.1171 ft	-1,548.7384 psf	702.63073 psf	439.05241 psf	0 psf	0 psf	Native Sand Fill
Column 143	1,381.1141 ft	895.5651 ft	-1,579.3739 psf	527.95372 psf	329.9021 psf	0 psf	0 psf	Native Sand Fill
Column 144	1,384.8641 ft	896.0588 ft	-1,613.1333 psf	318.57676 psf	199.06885 psf	0 psf	0 psf	Native Sand Fill
Column 145	1,388.4058 ft	896.5251 ft	-1,645.0172 psf	187.541 psf	117.18862 psf	0 psf	0 psf	Native Sand Fill
Column 146	1,391.7391 ft	896.9639 ft	-1,675.0256 psf	134.84644 psf	84.261409 psf	0 psf	0 psf	Native Sand Fill
Column 147	1,395.0724 ft	897.4027 ft	-1,705.0339 psf	82.151885 psf	51.334195 psf	0 psf	0 psf	Native Sand Fill
Column 148	1,398.6141 ft	897.8690 ft	-1,736.9178 psf	101.21171 psf	63.244096 psf	0 psf	0 psf	Native Sand Fill
Column 149	1,402.3641 ft	898.3627 ft	-1,770.6772 psf	192.02592 psf	119.99111 psf	0 psf	0 psf	Native Sand Fill
Column 150	1,405.8645 ft	898.8235 ft	-1,802.1897 psf	213.68972 psf	133.52816 psf	0 psf	0 psf	Native Sand Fill

Column 151	1,409.1153 ft	899.2515 ft	-1,831.4552 psf	166.20312 psf	103.85523 psf	0 psf	0 psf	Native Sand Fill
Column 152	1,412.3661 ft	899.6795 ft	-1,860.7206 psf	118.71651 psf	74.18231 psf	0 psf	0 psf	Native Sand Fill
Column 153	1,415.6170 ft	900.1075 ft	-1,889.9861 psf	71.229908 psf	44.509386 psf	0 psf	0 psf	Native Sand Fill
Column 154	1,418.8678 ft	900.5355 ft	-1,919.2516 psf	23.743303 psf	14.836462 psf	0 psf	0 psf	Native Sand Fill

Dane Co. Landfill No.3 Circular Optimized Failure A-A Circular Static Conditions 01/29/2024, 04:47:10 PM

Analysis Type: Bishop Factor of Safety: 2.233

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Clay Liner	130	0	30	
	General Cover Fill	115	0	30	
	Geosynthetic Liner	115	0	11	
	MSW with Leachate Recirculation	119	300	30	
	Native Sand Fill	115	0	32	1



Circular Optimized Failure A-A

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File Information

File Version: 11.05

Title: Dane Co. Landfill No.3 Created By: Villanueva, Niko Last Edited By: Villanueva, Niko

Revision Number: 26 Date: 01/29/2024 Time: 04:45:53 PM Tool Version: 23.1.1.829

File Name: SlopeW_DaneCoLF_AA'.gsz

Directory: I:\25222268.00\Data and Calculations\Geotechnical\Slope Stability\

Last Solved Date: 01/29/2024 Last Solved Time: 04:47:10 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Circular Optimized Failure A-A

Description: Circular Static Conditions

Kind: SLOPE/W

Analysis Type: Bishop

Settings

PWP Conditions from: Piezometric Surfaces

Apply Phreatic Correction: No Use Staged Rapid Drawdown: No Unit Weight of Water: 62.430189 pcf

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Entry and Exit Critical slip surfaces saved: 10

Optimize Critical Slip Surface Location: Yes

Optimizations Settings

Maximum Iterations: 2,000

Starting Points: 8 Ending Points: 16

Driving Side Maximum Convex Angle: 5 ° Resisting Side Maximum Convex Angle: 1 °

Tension Crack Option: (none)

Distribution

F of S Calculation Option: Constant

Convergence

Geometry Settings

Minimum Slip Surface Depth: 0.1 ft

Minimum Slip Surface Volume: 35.314667 ft³

Number of Columns: 30

Factor of Safety Convergence Settings

Maximum Number of Iterations: 20,000 Tolerable difference in F of S: 0.001

Under-Relaxation Criteria

Initial Rate: 1 Minimum Rate: 0.1

Rate Reduction Factor: 0.65

Reduction Frequency (iterations): 50

Materials

MSW with Leachate Recirculation

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 119 pcf Effective Cohesion: 300 psf Effective Friction Angle: 30 °

Phi-B: 0°

Geosynthetic Liner

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 11 °

Phi-B: 0°

General Cover Fill

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 30 °

Phi-B: 0°

Native Sand Fill

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 32 °

Phi-B: 0°

Pore Water Pressure

Piezometric Surface: 1

Clay Liner

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 130 pcf Effective Cohesion: 0 psf Effective Friction Angle: 30 °

Phi-B: 0°

Slip Surface Entry and Exit

Left Type: Range

Left-Zone Left Coordinate: (395.5223, 1,122.3081) ft

Left-Zone Right Coordinate: (629, 1,088) ft

Left-Zone Increment: 200

Right Type: Range

Right-Zone Left Coordinate: (1,247.8049, 933.4198) ft Right-Zone Right Coordinate: (1,433, 900.8745) ft

Right-Zone Increment: 200

Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 1,129.9621) ft

Right Coordinate: (1,482.0689, 773.3598) ft

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	X	Υ
Coordinate 1	0.0237 ft	895 ft
Coordinate 2	406.0237 ft	891 ft
Coordinate 3	895.0237 ft	876 ft
Coordinate 4	1,109.0237 ft	873 ft
Coordinate 5	1,243.0237 ft	872 ft
Coordinate 6	1,482.0922 ft	869 ft

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Υ
Point 1	1,482.0684 ft	884.9437 ft
Point 2	1,434.2391 ft	900.8869 ft
Point 3	1,404.2391 ft	900.5869 ft
Point 4	1,396.7391 ft	898.0869 ft
Point 5	1,386.7391 ft	898.0869 ft
Point 6	1,379.2391 ft	900.5869 ft
Point 7	1,376.1831 ft	900.5869 ft
Point 8	1,376.1831 ft	898.5877 ft
Point 9	1,374.0831 ft	898.5877 ft

Point 10	1,374.0831 ft	900.5869 ft
Point 11	1,371.2391 ft	900.5869 ft
Point 12	1,359.2391 ft	896.5869 ft
Point 13	1,242.2249 ft	873.2133 ft
Point 14	1,108.4601 ft	874.551 ft
Point 15	894.4735 ft	877.6211 ft
Point 16	405.7741 ft	892.2821 ft
Point 17	0 ft	896.3398 ft
Point 18	0 ft	773.3598 ft
Point 19	1,482.0689 ft	773.3598 ft
Point 20	0 ft	900.4395 ft
Point 21	0 ft	900.3392 ft
Point 22	405.7741 ft	896.2821 ft
Point 23	894.4735 ft	881.6211 ft
Point 24	1,108.4601 ft	878.551 ft
Point 25	1,242.2249 ft	877.2133 ft
Point 26	1,359.2391 ft	900.5869 ft
Point 27	1,376.1831 ft	898.6877 ft
Point 28	1,374.1831 ft	898.6877 ft
Point 29	1,374.1831 ft	900.6869 ft
Point 30	1,359.2292 ft	900.6869 ft
Point 31	1,305.8088 ft	890.0162 ft
Point 32	1,242.2155 ft	877.3134 ft
Point 33	1,108.4613 ft	878.651 ft
Point 34	894.4757 ft	881.7211 ft
Point 35	405.7761 ft	896.3821 ft
Point 36	512.9414 ft	1,111.992 ft
Point 37	320.4503 ft	1,120.7069 ft
Point 38	304.5738 ft	1,120.8679 ft
Point 39	18.1661 ft	1,129.5 ft
Point 40	0 ft	1,124.9621 ft
Point 41	1,359.0122 ft	900.6435 ft
Point 42	512.9414 ft	1,116.992 ft
Point 43	320.4503 ft	1,125.7069 ft
Point 44	304.5738 ft	1,125.8679 ft
Point 45	18.1661 ft	1,134.5 ft
Point 46	0 ft	1,129.9621 ft

Regions

	Material	Points	Area
Region 1	Native Sand Fill	1,2,3,4,5,6,7,27,8,9,10,11,12,13,14,15,16,17,18,19	1.6729e+05 ft²
Region 2	Geosynthetic Liner	20,21,22,23,24,25,26,11,10,9,8,27,28,29,30,41,31,32,33,34,35	138.15 ft²
Region 3	Clay Liner	21,22,23,24,25,26,11,12,13,14,15,16,17	5,460.8 ft ²
Region 4	MSW with Leachate Recirculation	36,37,38,39,40,20,35,34,33,32,31,41	2.1819e+05 ft²

Region 5	General Cover Fill	41,30,29,28,27,7,6,42,43,44,45,46,40,39,38,37,36	6,846.8 ft ²
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Slip Results

Slip Surfaces Analysed: 202006 of 202006 converged

Current Slip Surface

Slip Surface: 202,006 Factor of Safety: 2.233 Volume: 44,858.957 ft³ Weight: 5,324,872 lbf

Resisting Moment: 3.0707513e+09 lbf·ft Activating Moment: 1.3752614e+09 lbf·ft

Resisting Force: 2,590,112 lbf Activating Force: 1,183,306.1 lbf Slip Rank: 1 of 202,006 slip surfaces Exit: (1,380.2828, 900.239) ft Entry: (550.15003, 1,107.6971) ft

Radius: 381.6896 ft

Center: (1,198.5682, 2,027.3946) ft

Slip Columns

	х	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	556.5023 ft	1,103.8739 ft	0 psf	222.56073 psf	128.4955 psf	0 psf	0 psf	General Cover Fill
Column 2	563.4125 ft	1,099.6478 ft	0 psf	459.0082 psf	265.00851 psf	0 psf	0 psf	General Cover Fill
Column 3	573.8526 ft	1,092.1105 ft	0 psf	870.71541 psf	502.70778 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 4	598.5182 ft	1,077.9441 ft	0 psf	1,797.8133 psf	1,037.968 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 5	628.0852 ft	1,063.8800 ft	0 psf	2,505.4887 psf	1,446.5446 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 6	657.6521 ft	1,049.8158 ft	0 psf	3,213.1642 psf	1,855.1212 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 7	687.2191 ft	1,035.7517 ft	0 psf	3,920.8396 psf	2,263.6978 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 8	717.5221 ft	1,020.9407 ft	0 psf	4,657.7063 psf	2,689.128 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 9	748.5612 ft	1,005.3828 ft	0 psf	5,479.8709 psf	3,163.805 psf	300 psf	0 psf	MSW with Leachate Recirculation

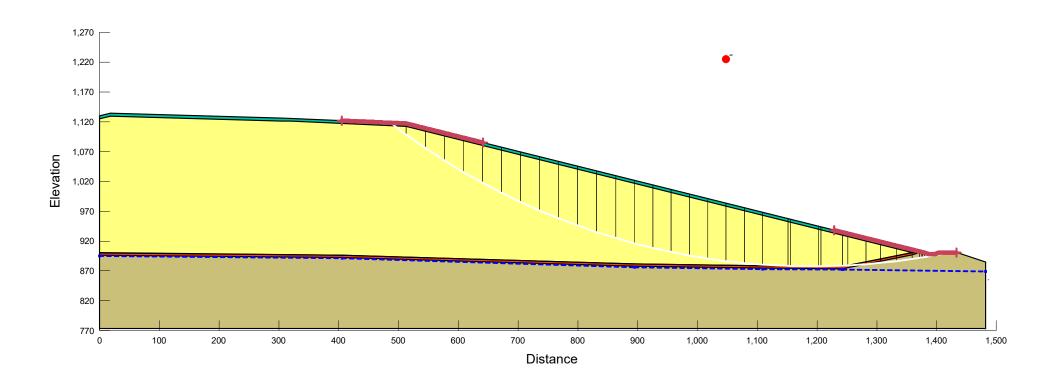
Column	779.3339	992.4845	0 psf	6,286.8414	3,629.7096	300 psf	0 psf	MSW with Leachate
10	ft	ft	о ро.	psf	psf	000 001	о ро.	Recirculation
Column 11	806.3911 ft	983.5014 ft	0 psf	6,544.3214 psf	3,778.3657 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 12	829.9992 ft	975.7737 ft	0 psf	6,745.1304 psf	3,894.3028 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 13	853.6073 ft	968.0460 ft	0 psf	6,945.9394 psf	4,010.24 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 14	880.2175 ft	959.3476 ft	0 psf	7,172.4527 psf	4,141.0175 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 15	907.8059 ft	950.3392 ft	0 psf	7,404.7292 psf	4,275.1224 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 16	933.3705 ft	941.9917 ft	0 psf	7,619.9654 psf	4,399.3891 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 17	958.9350 ft	933.6442 ft	0 psf	7,835.2015 psf	4,523.6557 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 18	986.0792 ft	924.5121 ft	0 psf	8,054.977 psf	4,650.5431 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 19	1,014.8030 ft	914.5953 ft	0 psf	8,354.4667 psf	4,823.4536 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 20	1,042.0568 ft	904.6863 ft	0 psf	8,609.2265 psf	4,970.5392 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 21	1,067.8405 ft	894.7848 ft	0 psf	8,983.8445 psf	5,186.825 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 22	1,094.1271 ft	884.2222 ft	0 psf	9,335.5132 psf	5,389.861 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 23	1,107.9915 ft	878.6058 ft	0 psf	10,649.95 psf	2,070.1405 psf	0 psf	0 psf	Geosynthetic Liner
Column 24	1,108.7425 ft	878.5986 ft	0 psf	10,628.513 psf	2,065.9736 psf	0 psf	0 psf	Geosynthetic Liner
Column 25	1,121.5128 ft	878.4758 ft	0 psf	10,263.829 psf	1,995.0863 psf	0 psf	0 psf	Geosynthetic Liner
Column 26	1,146.4909 ft	878.2357 ft	0 psf	9,550.5222 psf	1,856.4335 psf	0 psf	0 psf	Geosynthetic Liner
Column 27	1,171.4690 ft	877.9955 ft	0 psf	8,837.2152 psf	1,717.7806 psf	0 psf	0 psf	Geosynthetic Liner
Column 28	1,196.4472 ft	877.7554 ft	0 psf	8,123.9082 psf	1,579.1278 psf	0 psf	0 psf	Geosynthetic Liner
Column 29	1,221.4253 ft	877.5153 ft	0 psf	7,410.6012 psf	1,440.475 psf	0 psf	0 psf	Geosynthetic Liner

Column 30	1,238.1741 ft	877.3251 ft	0 psf	6,931.6327 psf	1,347.3729 psf	0 psf	0 psf	Geosynthetic Liner
Column 31	1,242.7287 ft	877.2502 ft	0 psf	6,786.5179 psf	3,918.198 psf	0 psf	0 psf	Clay Liner
Column 32	1,243.3974 ft	877.2392 ft	0 psf	6,769.6102 psf	3,908.4363 psf	0 psf	0 psf	Clay Liner
Column 33	1,262.2858 ft	880.3553 ft	0 psf	6,141.0546 psf	3,545.5395 psf	0 psf	0 psf	Clay Liner
Column 34	1,293.3046 ft	885.5017 ft	0 psf	4,540.3647 psf	2,621.3808 psf	0 psf	0 psf	Clay Liner
Column 35	1,311.3982 ft	888.4305 ft	0 psf	3,623.1228 psf	2,091.8109 psf	0 psf	0 psf	Clay Liner
Column 36	1,327.4938 ft	891.1452 ft	0 psf	2,800.2067 psf	1,616.7001 psf	0 psf	0 psf	Clay Liner
Column 37	1,348.6195 ft	894.7844 ft	0 psf	1,696.218 psf	979.31192 psf	0 psf	0 psf	Clay Liner
Column 38	1,365.2391 ft	897.6475 ft	-1,696.9217 psf	808.78579 psf	505.38545 psf	0 psf	0 psf	Native Sand Fill
Column 39	1,372.6611 ft	898.9260 ft	-1,782.5575 psf	399.21155 psf	249.45506 psf	0 psf	0 psf	Native Sand Fill
Column 40	1,375.1331 ft	899.3519 ft	0 psf	272.10078 psf	157.09746 psf	0 psf	0 psf	General Cover Fill
Column 41	1,377.7111 ft	899.7960 ft	-1,840.825 psf	141.68017 psf	88.531594 psf	0 psf	0 psf	Native Sand Fill
Column 42	1,379.7609 ft	900.1491 ft	-1,864.4763 psf	31.878901 psf	19.920148 psf	0 psf	0 psf	Native Sand Fill

Dane Co. Landfill No.3 Circular Failure A-A Circular Static Conditions 01/29/2024, 04:46:38 PM

Analysis Type: Bishop Factor of Safety: 2.533

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Clay Liner	130	0	30	
	General Cover Fill	115	0	30	
	Geosynthetic Liner	115	0	11	
	MSW with Leachate Recirculation	119	300	30	
	Native Sand Fill	115	0	32	1



Circular Failure A-A

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File Information

File Version: 11.05

Title: Dane Co. Landfill No.3 Created By: Villanueva, Niko Last Edited By: Villanueva, Niko

Revision Number: 26 Date: 01/29/2024 Time: 04:45:53 PM Tool Version: 23.1.1.829

File Name: SlopeW_DaneCoLF_AA'.gsz

Directory: I:\25222268.00\Data and Calculations\Geotechnical\Slope Stability\

Last Solved Date: 01/29/2024 Last Solved Time: 04:46:38 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Circular Failure A-A

Description: Circular Static Conditions

Kind: SLOPE/W

Analysis Type: Bishop

Settings

PWP Conditions from: Piezometric Surfaces

Apply Phreatic Correction: No Use Staged Rapid Drawdown: No Unit Weight of Water: 62.430189 pcf

Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Entry and Exit Critical slip surfaces saved: 10

Optimize Critical Slip Surface Location: No

Tension Crack Option: (none)

Distribution

F of S Calculation Option: Constant

Convergence

Geometry Settings

Minimum Slip Surface Depth: 0.1 ft

Minimum Slip Surface Volume: 35.314667 ft³

Number of Columns: 30

Factor of Safety Convergence Settings

Maximum Number of Iterations: 20,000

Tolerable difference in F of S: 0.001

Under-Relaxation Criteria

Initial Rate: 1 Minimum Rate: 0.1

Rate Reduction Factor: 0.65

Reduction Frequency (iterations): 50

Materials

MSW with Leachate Recirculation

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 119 pcf

Effective Cohesion: 300 psf Effective Friction Angle: 30 °

Phi-B: 0°

Geosynthetic Liner

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 11 °

Phi-B: 0°

General Cover Fill

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 30 °

Phi-B: 0°

Native Sand Fill

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 115 pcf Effective Cohesion: 0 psf Effective Friction Angle: 32 °

Phi-B: 0°

Pore Water Pressure

Piezometric Surface: 1

Clay Liner

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 130 pcf Effective Cohesion: 0 psf Effective Friction Angle: 30 °

Phi-B: 0°

Slip Surface Entry and Exit

Left Type: Range

Left-Zone Left Coordinate: (404.9446, 1,121.8815) ft Left-Zone Right Coordinate: (641.0095, 1,085) ft

Left-Zone Increment: 200

Right Type: Range

Right-Zone Left Coordinate: (1,229.0412, 938.107) ft Right-Zone Right Coordinate: (1,433, 900.8745) ft

Right-Zone Increment: 200

Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 1,129.9621) ft

Right Coordinate: (1,482.0689, 773.3598) ft

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	Х	Y
Coordinate 1	0 ft	895 ft
Coordinate 2	406 ft	891 ft
Coordinate 3	895 ft	876 ft
Coordinate 4	1,109 ft	873 ft
Coordinate 5	1,243 ft	872 ft
Coordinate 6	1,482.0685 ft	869 ft

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	Х	Υ
Point 1	1,482.0684 ft	884.9437 ft
Point 2	1,434.2391 ft	900.8869 ft
Point 3	1,404.2391 ft	900.5869 ft
Point 4	1,396.7391 ft	898.0869 ft
Point 5	1,386.7391 ft	898.0869 ft
Point 6	1,379.2391 ft	900.5869 ft
Point 7	1,376.1831 ft	900.5869 ft
Point 8	1,376.1831 ft	898.5877 ft
Point 9	1,374.0831 ft	898.5877 ft
Point 10	1,374.0831 ft	900.5869 ft
Point 11	1,371.2391 ft	900.5869 ft
Point 12	1,359.2391 ft	896.5869 ft
Point 13	1,242.2249 ft	873.2133 ft
Point 14	1,108.4601 ft	874.551 ft

Point 15	894.4735 ft	877.6211 ft
Point 16	405.7741 ft	892.2821 ft
Point 17	0 ft	896.3398 ft
Point 18	0 ft	773.3598 ft
Point 19	1,482.0689 ft	773.3598 ft
Point 20	0 ft	900.4395 ft
Point 21	0 ft	900.3392 ft
Point 22	405.7741 ft	896.2821 ft
Point 23	894.4735 ft	881.6211 ft
Point 24	1,108.4601 ft	878.551 ft
Point 25	1,242.2249 ft	877.2133 ft
Point 26	1,359.2391 ft	900.5869 ft
Point 27	1,376.1831 ft	898.6877 ft
Point 28	1,374.1831 ft	898.6877 ft
Point 29	1,374.1831 ft	900.6869 ft
Point 30	1,359.2292 ft	900.6869 ft
Point 31	1,305.8088 ft	890.0162 ft
Point 32	1,242.2155 ft	877.3134 ft
Point 33	1,108.4613 ft	878.651 ft
Point 34	894.4757 ft	881.7211 ft
Point 35	405.7761 ft	896.3821 ft
Point 36	512.9414 ft	1,111.992 ft
Point 37	320.4503 ft	1,120.7069 ft
Point 38	304.5738 ft	1,120.8679 ft
Point 39	18.1661 ft	1,129.5 ft
Point 40	0 ft	1,124.9621 ft
Point 41	1,359.0122 ft	900.6435 ft
Point 42	512.9414 ft	1,116.992 ft
Point 43	320.4503 ft	1,125.7069 ft
Point 44	304.5738 ft	1,125.8679 ft
Point 45	18.1661 ft	1,134.5 ft
Point 46	0 ft	1,129.9621 ft

Regions

	Material	Points	Area
Region 1	Native Sand Fill	1,2,3,4,5,6,7,27,8,9,10,11,12,13,14,15,16,17,18,19	1.6729e+05 ft²
Region 2	Geosynthetic Liner	20,21,22,23,24,25,26,11,10,9,8,27,28,29,30,41,31,32,33,34,35	138.15 ft²
Region 3	Clay Liner	21,22,23,24,25,26,11,12,13,14,15,16,17	5,460.8 ft²
Region 4	MSW with Leachate Recirculation	36,37,38,39,40,20,35,34,33,32,31,41	2.1819e+05 ft²
Region 5	General Cover Fill	41,30,29,28,27,7,6,42,43,44,45,46,40,39,38,37,36	6,846.8 ft²

Slip Results

Slip Surfaces Analysed: 202005 of 202005 converged

Current Slip Surface

Slip Surface: 69,282 Factor of Safety: 2.533 Volume: 65,217.08 ft³ Weight: 7,745,301.7 lbf

Resisting Moment: 5.1553295e+09 lbf·ft Activating Moment: 2.0355834e+09 lbf·ft

Resisting Force: 4,261,067.4 lbf Activating Force: 1,742,356.7 lbf Slip Rank: 1 of 202,005 slip surfaces Exit: (1,420.4374, 900.74888) ft Entry: (486.49878, 1,118.1892) ft

Radius: 1,150.3572 ft

Center: (1,190.5818, 2,027.9081) ft

Slip Columns

	х	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	489.9583 ft	1,115.5325 ft	0 psf	244.67891 psf	141.26543 psf	0 psf	0 psf	General Cover Fill
Column 2	503.1796 ft	1,105.6004 ft	0 psf	1,111.1879 psf	641.54461 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 3	528.8605 ft	1,087.1278 ft	0 psf	2,565.9903 psf	1,481.4752 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 4	560.6987 ft	1,065.5117 ft	0 psf	4,010.7311 psf	2,315.5967 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 5	592.5369 ft	1,045.4029 ft	0 psf	5,322.5454 psf	3,072.973 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 6	624.3752 ft	1,026.7103 ft	0 psf	6,505.5199 psf	3,755.9636 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 7	656.2134 ft	1,009.3559 ft	0 psf	7,563.2572 psf	4,366.6486 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 8	688.0516 ft	993.2721 ft	0 psf	8,498.9158 psf	4,906.8513 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 9	719.8898 ft	978.4005 ft	0 psf	9,315.2451 psf	5,378.1593 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 10	751.7280 ft	964.6902 ft	0 psf	10,014.618 psf	5,781.9424 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 11	783.5662 ft	952.0967 ft	0 psf	10,599.057 psf	6,119.3685 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 12	815.4045 ft	940.5812 ft	0 psf	11,070.259 psf	6,391.4172 psf	300 psf	0 psf	MSW with Leachate

								Recirculation
Column 13	847.2427 ft	930.1096 ft	0 psf	11,429.613 psf	6,598.8903 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 14	879.0809 ft	920.6524 ft	0 psf	11,678.217 psf	6,742.4215 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 15	910.2857 ft	912.3333 ft	0 psf	11,816.262 psf	6,822.122 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 16	940.8571 ft	905.0930 ft	0 psf	11,848.539 psf	6,840.7571 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 17	971.4286 ft	898.7266 ft	0 psf	11,780.219 psf	6,801.3124 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 18	1,002.0000 ft	893.2195 ft	0 psf	11,611.339 psf	6,703.8095 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 19	1,032.5714 ft	888.5591 ft	0 psf	11,341.715 psf	6,548.1419 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 20	1,063.1429 ft	884.7352 ft	0 psf	10,970.939 psf	6,334.0743 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 21	1,093.7143 ft	881.7393 ft	0 psf	10,498.374 psf	6,061.2393 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 22	1,130.1352 ft	879.3352 ft	0 psf	9,790.3559 psf	5,652.4646 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 23	1,153.5193 ft	878.1504 ft	0 psf	9,336.5776 psf	1,814.8468 psf	0 psf	0 psf	Geosynthetic Liner
Column 24	1,179.0808 ft	877.8448 ft	0 psf	8,629.3593 psf	1,677.3775 psf	0 psf	0 psf	Geosynthetic Liner
Column 25	1,204.6432 ft	877.6391 ft	0 psf	7,908.1807 psf	1,537.1946 psf	0 psf	0 psf	Geosynthetic Liner
Column 26	1,224.9466 ft	878.2063 ft	0 psf	7,283.0758 psf	4,204.8858 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 27	1,247.2402 ft	878.9550 ft	0 psf	6,557.6476 psf	3,786.0596 psf	300 psf	0 psf	MSW with Leachate Recirculation
Column 28	1,266.8688 ft	880.1869 ft	0 psf	5,858.2061 psf	3,382.2369 psf	0 psf	0 psf	Clay Liner
Column 29	1,294.0330 ft	882.2731 ft	-681.33207 psf	4,838.4622 psf	3,023.4068 psf	0 psf	0 psf	Native Sand Fill
Column 30	1,319.1097 ft	884.8320 ft	-860.73092 psf	3,775.6503 psf	2,359.2882 psf	0 psf	0 psf	Native Sand Fill
Column 31	1,345.8199 ft	888.1540 ft	-1,089.0459 psf	2,559.7549 psf	1,599.5124 psf	0 psf	0 psf	Native Sand Fill
Column 32	1,365.2341 ft	890.9028 ft	-1,275.8634 psf	1,606.8866 psf	1,004.0942 psf	0 psf	0 psf	Native Sand Fill

Column 33	1,372.6611 ft	892.0531 ft	-1,353.4985 psf	1,218.536 psf	761.42581 psf	0 psf	0 psf	Native Sand Fill
Column 34	1,375.1331 ft	892.4517 ft	-1,380.3205 psf	1,097.5002 psf	685.79426 psf	0 psf	0 psf	Native Sand Fill
Column 35	1,377.7111 ft	892.8743 ft	-1,408.7217 psf	970.30284 psf	606.3125 psf	0 psf	0 psf	Native Sand Fill
Column 36	1,382.9891 ft	893.7624 ft	-1,468.301 psf	669.06459 psf	418.07796 psf	0 psf	0 psf	Native Sand Fill
Column 37	1,391.7391 ft	895.2866 ft	-1,570.3121 psf	336.7877 psf	210.44831 psf	0 psf	0 psf	Native Sand Fill
Column 38	1,400.4891 ft	896.8706 ft	-1,676.0547 psf	297.23357 psf	185.73215 psf	0 psf	0 psf	Native Sand Fill
Column 39	1,412.3383 ft	899.1577 ft	-1,828.1235 psf	182.51565 psf	114.04843 psf	0 psf	0 psf	Native Sand Fill