

June 7, 2023

Hunter Ridley
Colorado Division of Reclamation, Mining, and Safety
1313 Sherman St, Rm 215
Denver, CO 80203
(303)866-3567

Delivered Via Email

RE: Hayden Gravel Pit Am-4, M-1987-164 – Rule 6.5 and Notarized Lease

Ms. Ridley,

Attached are the Rule 6.5 Geotechnical Stability Exhibit and notarized lease for the adequacy response previously sent.

Regards,



Ben Langenfeld, P.E.
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RULE 6.5: GEOTECHNICAL STABILITY EXHIBIT

There are no known geologic hazards on the proposed site. Based on a slope stability analysis, buildings or other structures within 200' of the Hayden Gravel Pit mining area will not be affected by mining excavation. Sufficient buffers will be maintained to neighboring property lines. Maps C-2 and F-1 shows these buffers. Map C-3 shows the mining and reclamation slopes of the mine. A standardized mining and reclaimed slope was analyzed for stability based on the anticipated typical thickness of overburden (15') and sand and gravel (23') in the mining pods.

The material properties are derived from Table 2.5 in the SME Mining Reference Handbook⁴, as there is no site-specific sample data of the material available. Therefore, all materials are matched to a classification from this table that best matches the materials in terms of description. The native alluvial material is best classified as sand and gravel with a mixed grain size. From the SME table, sand and gravel with a mixed grain size has an internal angle of friction of 45 degrees and no cohesion. A layer of overburden/topsoil lies atop of the sand and gravel. It is described loose sand with a mixed grain size which has an internal angle of friction of 34 degrees and no cohesion.

The final mining (2H:1V), final reclamation (3H:1V), and active highwall (near vertical) slopes were analyzed. Mining will be conducted at the active highwall angle until the highwall has reached the half-way point of the final mining slope. Then the vertical active highwall slope will be knocked down to the final mining slope of 2H:1V. Then, the mining slope at 2H:1V it will be backfilled with to the final reclamation slope of 3H:1V.

1. Mining and Reclamation Slopes

Factor of Safety is expressed in terms of strength divided by stress as a ratio. It is arrived at by an iterative computer process where a slope failure is assumed, the strength and stress of that slope failure are calculated, and those values are compared to determine a lowest factor of safety. In the case of the Hayden Gravel Pit slope stability analysis, the Bishop's Method of Slices was the iterative calculation used, and the software GALENA was used to model slopes and calculate the factor of safety. Since all three pods onsite will be mining and reclaiming the same deposit a single, standardized slope can be used to evaluate the slope stability at the Hayden Gravel Pit.

Figure GS-1 shows the standardized slopes evaluated in GALENA: the active vertical highwall, the full mining slope, and the permanent reclaimed slope.

The lowest factor of safety for permanent slopes was 2.03 at Final Reclamation. While the Active Highwall has a Factor of Safety below the CDRMS permanent slope minimum (1.5), the

⁴ Original source: Houk and Bray 1977

FoS = 1.5 failure circle was calculated to determine if that failure circle would cause offsite damage. The distance between the closest slope edge or failure circle and the nearest structure is shown Table GS-1.

GALENA data tables and analysis result figures are attached as Appendix GS-1.

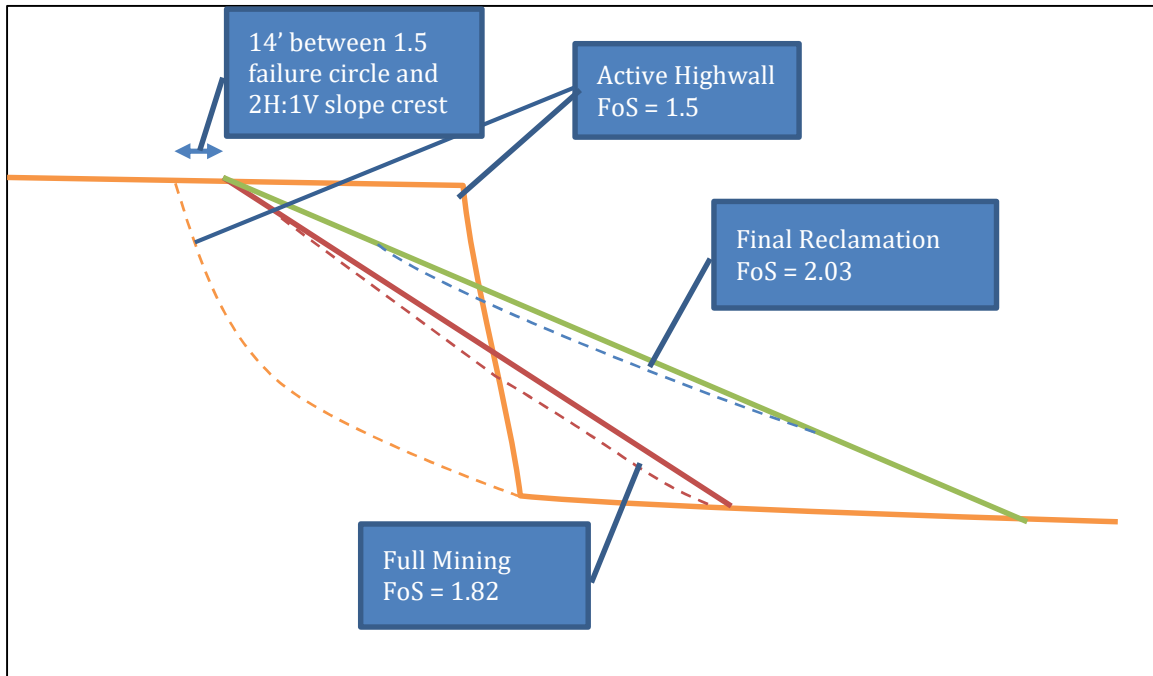


Figure GS-1. Locations of Slope Stability Analysis from Map F-1

Table GS-1. Factors of Safety for Slope Stability

Slope Condition	Lowest Factor of Safety	Distance from Failure Circle to Nearest Structure
Full Mining	1.82	Roughly 50-ft to the property line, where a fence is.
Final Reclamation	2.03	Roughly 50-ft to the property line, where a fence is.
Active Highwall	<1.5	Roughly 50-ft to the property line, where a fence is.

3. Conclusion

The Full Mining and Final Reclamation slopes both have a minimum factor of safety (FoS) of greater than 1.5. The failure circles of these slopes at their lowest FoS are within the disturbance area of the pit. The Active Highwall's lowest FoS are below the minimum of 1.5, this is to be expected from a vertical slope during operations. This slope is not permanent. To ensure that this slope does not risk offsite structures, the FoS = 1.5 failure circle was located to determine its extents. The FoS = 1.5 failure circle is within the disturbance area of the pit. No failure circle reaches the permit boundary or offsite structures.

The slope stability analysis in this permit has been prepared according to appropriate engineering standards and practices.

Ben Langenfeld, P.E.

P.E.# 0047151

APPENDIX GS-1

GALENA INFORMATION

Project: Hayden Gravel Pit

File: E:\Work\GLA Dropbox\Ben Langenfeld\United Companies\Hayden\DRMS\Amendment 2022\Slope Stability\Hayden Gravel Pit.gmf

Processed: 22 Nov 2022 13:31:26

DATA: Analysis 1 - Active Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 45.0 110.00 Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400

Unit weight of water/medium above ground: 0.000

Material Profiles (2 profiles)

Profile: 1 (2 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00 6471.00 200.00 6471.00

Profile: 2 (2 points) Material beneath: 2 - Loose sand, mixed grain size

0.00 6480.00 200.00 6480.00

Slope Surface (4 points)

40.00 6480.00 100.00 6480.00 102.00 6441.00 141.00 6441.00

Phreatic Surface (2 points)

0.00 6430.00 200.00 6430.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 55.00 YL: 6480.00 XR: 102.10 YR: 6441.00

Centre: XC: 172.21 YC: 6573.61 Radius: R: 150.00

Variable Restraints

Parameter descriptor:

XL XR R

Range of variation: 25.10 16.00 25.00

Trial positions within range: 25 10 25

RESULTS: Analysis 1 - Active Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Factor of Safety for initial failure surface approximation: 1.389

There were: 3126 successful analyses from a total of 6251 trial surfaces
3125 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.39

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	55.00	6480.00	102.10	6441.00	172.21	6573.61	150.00	1.389	<-- Critical Surface
2	67.55	6480.00	101.21	6456.38	176.96	6600.15	162.50	1.504	
3	67.55	6480.00	101.21	6456.38	176.36	6599.29	161.46	1.505	
4	67.55	6480.00	101.21	6456.38	175.75	6598.43	160.42	1.506	
5	67.55	6480.00	101.21	6456.38	175.15	6597.57	159.38	1.507	
6	67.55	6480.00	101.21	6456.38	174.55	6596.71	158.33	1.508	
7	67.55	6480.00	101.21	6456.38	173.94	6595.85	157.29	1.509	
8	67.55	6480.00	101.21	6456.38	173.34	6594.99	156.25	1.511	
9	67.55	6480.00	101.21	6456.38	172.74	6594.13	155.21	1.512	
10	67.55	6480.00	101.21	6456.38	172.13	6593.27	154.17	1.513	
11	67.55	6480.00	101.21	6456.38	171.53	6592.41	153.12	1.514	
12	67.55	6480.00	101.21	6456.38	170.93	6591.55	152.08	1.515	
13	67.55	6480.00	101.21	6456.38	170.32	6590.69	151.04	1.517	
14	67.55	6480.00	101.21	6456.38	169.72	6589.83	150.00	1.518	
15	67.55	6480.00	101.21	6456.38	169.11	6588.96	148.96	1.519	
16	67.55	6480.00	101.21	6456.38	168.51	6588.10	147.92	1.521	
17	67.55	6480.00	101.21	6456.38	167.91	6587.24	146.88	1.522	
18	67.55	6480.00	101.21	6456.38	167.30	6586.38	145.83	1.523	
19	67.55	6480.00	101.21	6456.38	166.70	6585.52	144.79	1.525	
20	67.55	6480.00	101.21	6456.38	166.09	6584.66	143.75	1.526	
21	67.55	6480.00	101.21	6456.38	165.49	6583.80	142.71	1.528	
22	67.55	6480.00	101.21	6456.38	164.88	6582.93	141.67	1.529	
23	67.55	6480.00	101.21	6456.38	164.28	6582.07	140.62	1.531	
24	67.55	6480.00	101.21	6456.38	163.67	6581.21	139.58	1.532	
25	67.55	6480.00	101.21	6456.38	163.07	6580.35	138.54	1.534	
26	67.55	6480.00	101.21	6456.38	162.46	6579.49	137.50	1.535	
27	66.50	6480.00	101.21	6456.38	174.51	6601.41	162.50	1.556	
28	66.50	6480.00	101.21	6456.38	173.92	6600.54	161.46	1.557	
29	66.50	6480.00	101.21	6456.38	173.33	6599.68	160.42	1.558	
30	66.50	6480.00	101.21	6456.38	172.74	6598.81	159.38	1.559	
31	66.50	6480.00	101.21	6456.38	172.15	6597.94	158.33	1.561	
32	66.50	6480.00	101.21	6456.38	171.55	6597.07	157.29	1.562	
33	66.50	6480.00	101.21	6456.38	170.96	6596.20	156.25	1.563	
34	66.50	6480.00	101.21	6456.38	170.37	6595.33	155.21	1.564	
35	66.50	6480.00	101.21	6456.38	169.78	6594.46	154.17	1.566	
36	66.50	6480.00	101.21	6456.38	169.19	6593.59	153.12	1.567	
37	66.50	6480.00	101.21	6456.38	168.60	6592.72	152.08	1.568	

38	66.50	6480.00	101.21	6456.38	168.00	6591.85	151.04	1.570
39	66.50	6480.00	101.21	6456.38	167.41	6590.98	150.00	1.571
40	66.50	6480.00	101.21	6456.38	166.82	6590.11	148.96	1.572
41	66.50	6480.00	101.21	6456.38	166.23	6589.24	147.92	1.574
42	66.50	6480.00	101.21	6456.38	165.64	6588.37	146.88	1.575
43	66.50	6480.00	101.21	6456.38	165.04	6587.50	145.83	1.577
44	66.50	6480.00	101.21	6456.38	164.45	6586.63	144.79	1.578
45	66.50	6480.00	101.21	6456.38	163.86	6585.76	143.75	1.580
46	66.50	6480.00	101.21	6456.38	163.27	6584.89	142.71	1.581
47	66.50	6480.00	101.21	6456.38	162.68	6584.02	141.67	1.583
48	66.50	6480.00	101.21	6456.38	162.08	6583.15	140.62	1.585
49	66.50	6480.00	101.21	6456.38	161.49	6582.28	139.58	1.586
50	66.50	6480.00	101.21	6456.38	160.90	6581.41	138.54	1.588
51	66.50	6480.00	101.21	6456.38	160.30	6580.54	137.50	1.589
52	65.46	6480.00	101.21	6456.38	172.12	6602.60	162.50	1.609
53	65.46	6480.00	101.21	6456.38	171.54	6601.72	161.46	1.610
54	65.46	6480.00	101.21	6456.38	170.96	6600.84	160.42	1.611
55	65.46	6480.00	101.21	6456.38	170.38	6599.97	159.38	1.612
56	65.46	6480.00	101.21	6456.38	169.80	6599.09	158.33	1.614
57	65.46	6480.00	101.21	6456.38	169.22	6598.21	157.29	1.615
58	65.46	6480.00	101.21	6456.38	168.64	6597.33	156.25	1.616
59	65.46	6480.00	101.21	6456.38	168.06	6596.46	155.21	1.618
60	65.46	6480.00	101.21	6456.38	167.48	6595.58	154.17	1.619
61	65.46	6480.00	101.21	6456.38	166.90	6594.70	153.12	1.621
62	65.46	6480.00	101.21	6456.38	166.32	6593.82	152.08	1.622
63	65.46	6480.00	101.21	6456.38	165.74	6592.95	151.04	1.623
64	65.46	6480.00	101.21	6456.38	165.16	6592.07	150.00	1.625
65	65.46	6480.00	101.21	6456.38	164.58	6591.19	148.96	1.626
66	65.46	6480.00	101.21	6456.38	164.00	6590.31	147.92	1.628
67	65.46	6480.00	101.21	6456.38	163.42	6589.43	146.88	1.629
68	65.46	6480.00	101.21	6456.38	162.84	6588.55	145.83	1.631
69	65.46	6480.00	101.21	6456.38	162.26	6587.68	144.79	1.632
70	65.46	6480.00	101.21	6456.38	161.68	6586.80	143.75	1.634
71	65.46	6480.00	101.21	6456.38	161.10	6585.92	142.71	1.636
72	65.46	6480.00	101.21	6456.38	160.52	6585.04	141.67	1.637
73	65.46	6480.00	101.21	6456.38	159.94	6584.16	140.62	1.639
74	65.46	6480.00	101.21	6456.38	159.36	6583.28	139.58	1.641
75	65.46	6480.00	101.21	6456.38	158.78	6582.40	138.54	1.642
76	65.46	6480.00	101.21	6456.38	158.19	6581.52	137.50	1.644
77	64.41	6480.00	101.21	6456.38	169.78	6603.71	162.50	1.662
78	64.41	6480.00	101.21	6456.38	169.22	6602.82	161.46	1.663
79	64.41	6480.00	101.21	6456.38	168.65	6601.94	160.42	1.665
80	64.41	6480.00	101.21	6456.38	168.08	6601.05	159.38	1.666
81	64.41	6480.00	101.21	6456.38	167.51	6600.17	158.33	1.667
82	64.41	6480.00	101.21	6456.38	166.94	6599.28	157.29	1.669
83	64.41	6480.00	101.21	6456.38	166.37	6598.40	156.25	1.670
84	64.41	6480.00	101.21	6456.38	165.81	6597.51	155.21	1.672
85	64.41	6480.00	101.21	6456.38	165.24	6596.63	154.17	1.673
86	64.41	6480.00	101.21	6456.38	164.67	6595.74	153.12	1.674
87	64.41	6480.00	101.21	6456.38	164.10	6594.85	152.08	1.676
88	64.41	6480.00	101.21	6456.38	163.53	6593.97	151.04	1.677
89	64.41	6480.00	101.21	6456.38	162.96	6593.08	150.00	1.679
90	64.41	6480.00	101.21	6456.38	162.40	6592.20	148.96	1.681
91	64.41	6480.00	101.21	6456.38	161.83	6591.31	147.92	1.682
92	64.41	6480.00	101.21	6456.38	161.26	6590.42	146.88	1.684

93	64.41	6480.00	101.21	6456.38	160.69	6589.54	145.83	1.686
94	64.41	6480.00	101.21	6456.38	160.12	6588.65	144.79	1.687
95	64.41	6480.00	101.21	6456.38	159.55	6587.76	143.75	1.689
96	64.41	6480.00	101.21	6456.38	158.98	6586.88	142.71	1.691
97	64.41	6480.00	101.21	6456.38	158.41	6585.99	141.67	1.692
98	64.41	6480.00	101.21	6456.38	157.84	6585.10	140.62	1.694
99	64.41	6480.00	101.21	6456.38	157.27	6584.21	139.58	1.696

Critical Failure Surface (circle 1)

Intersects: XL: 55.00 YL: 6480.00 XR: 102.10 YR: 6441.00

Centre: XC: 172.21 YC: 6573.61 Radius: R: 150.00

Generated failure surface: (20 points)

55.00	6480.00	57.05	6477.49	59.15	6475.02	61.31	6472.60	63.52	6470.23
65.78	6467.91	68.09	6465.63	70.44	6463.41	72.85	6461.23	75.30	6459.11
77.80	6457.05	80.34	6455.03	82.92	6453.08	85.54	6451.18	88.21	6449.33
90.91	6447.55	93.66	6445.82	96.44	6444.15	99.25	6442.55	102.10	6441.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	PoreWater	Normal Force	Test Stress	Factor
	X-Left												
1	55.00	0.64	50.8	1.02	1.62	2	0.00	34.0	63.71	0.00	38.98	0.99	
2	56.02	1.93	50.8	1.02	1.62	2	0.00	34.0	191.04	0.00	116.88	0.99	
3	57.05	3.29	49.5	1.05	1.62	2	0.00	34.0	325.61	0.00	197.29	0.98	
4	58.10	4.59	49.5	1.05	1.62	2	0.00	34.0	454.05	0.00	275.10	0.98	
5	59.15	6.02	48.3	1.08	1.62	2	0.00	34.0	595.79	0.00	357.68	0.97	
6	60.23	7.32	48.3	1.08	1.62	2	0.00	34.0	724.90	0.00	435.25	0.97	
7	61.31	12.24	47.1	1.49	2.19	2	0.00	34.0	1211.66	0.00	533.37	0.96	
8	62.80	6.71	47.1	0.72	1.05	1	0.00	45.0	667.58	0.00	526.25	0.83	
9	63.52	11.69	45.8	1.13	1.62	1	0.00	45.0	1174.04	0.00	597.17	0.82	
10	64.65	13.00	45.8	1.13	1.62	1	0.00	45.0	1318.43	0.00	670.61	0.82	
11	65.78	14.62	44.6	1.15	1.62	1	0.00	45.0	1493.41	0.00	756.96	0.82	
12	66.93	15.93	44.6	1.15	1.62	1	0.00	45.0	1637.82	0.00	830.00	0.82	
13	68.09	17.59	43.3	1.18	1.62	1	0.00	45.0	1818.19	0.00	918.59	0.82	
14	69.26	18.90	43.3	1.18	1.62	1	0.00	45.0	1962.32	0.00	991.59	0.82	
15	70.44	20.60	42.1	1.20	1.62	1	0.00	45.0	2147.30	0.00	1081.88	0.82	
16	71.65	21.91	42.1	1.20	1.62	1	0.00	45.0	2290.99	0.00	1154.48	0.82	
17	72.85	23.65	40.9	1.23	1.62	1	0.00	45.0	2479.98	0.00	1247.06	0.81	
18	74.07	24.95	40.9	1.23	1.62	1	0.00	45.0	2622.89	0.00	1318.69	0.81	
19	75.30	26.71	39.6	1.25	1.62	1	0.00	45.0	2815.01	0.00	1413.20	0.81	
20	76.55	28.00	39.6	1.25	1.62	1	0.00	45.0	2956.94	0.00	1484.19	0.81	
21	77.80	29.79	38.4	1.27	1.62	1	0.00	45.0	3151.60	0.00	1580.05	0.81	
22	79.07	31.07	38.4	1.27	1.62	1	0.00	45.0	3292.14	0.00	1650.51	0.81	
23	80.34	32.88	37.1	1.29	1.62	1	0.00	45.0	3488.87	0.00	1747.87	0.81	
24	81.63	34.14	37.1	1.29	1.62	1	0.00	45.0	3627.89	0.00	1817.52	0.81	
25	82.92	35.96	35.9	1.31	1.62	1	0.00	45.0	3825.71	0.00	1915.86	0.81	
26	84.23	37.21	35.9	1.31	1.62	1	0.00	45.0	3962.89	0.00	1984.56	0.81	
27	85.54	39.03	34.7	1.33	1.62	1	0.00	45.0	4161.31	0.00	2084.44	0.81	
28	86.88	40.26	34.7	1.33	1.62	1	0.00	45.0	4296.46	0.00	2152.14	0.81	
29	88.21	42.08	33.4	1.35	1.62	1	0.00	45.0	4494.63	0.00	2252.68	0.81	
30	89.56	43.28	33.4	1.35	1.62	1	0.00	45.0	4627.45	0.00	2319.67	0.81	
31	90.91	45.10	32.2	1.37	1.62	1	0.00	45.0	4824.84	0.00	2421.17	0.81	
32	92.29	46.28	32.2	1.37	1.62	1	0.00	45.0	4955.14	0.00	2486.12	0.81	
33	93.66	48.08	31.0	1.39	1.62	1	0.00	45.0	5151.11	0.00	2588.93	0.81	

34	95.05	49.24	31.0	1.39	1.62	1	0.00	45.0	5278.52	0.00	2652.50	0.81
35	96.44	51.02	29.7	1.41	1.62	1	0.00	45.0	5472.49	0.00	2755.65	0.82
36	97.84	52.15	29.7	1.41	1.62	1	0.00	45.0	5596.84	0.00	2818.76	0.82
37	99.25	28.20	28.5	0.75	0.85	1	0.00	45.0	3027.73	0.00	2907.77	0.82
38	100.00	15.46	28.5	0.46	0.53	1	0.00	45.0	1677.21	0.00	2613.08	0.82
39	100.46	22.25	28.5	1.64	1.86	1	0.00	45.0	2447.63	0.00	1074.39	0.82

X-S Area: 1003.76 Path Length: 61.58 X-S Weight: 106312.11

DATA: Analysis 2 - Active Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 45.0 110.00 Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (2 profiles)

Profile: 1 (2 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00 6471.00 200.00 6471.00

Profile: 2 (2 points) Material beneath: 2 - Loose sand, mixed grain size

0.00 6480.00 200.00 6480.00

Slope Surface (4 points)

40.00	6480.00	100.00	6480.00	102.00	6441.00	141.00	6441.00
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Phreatic Surface (2 points)

0.00	6430.00	200.00	6430.00
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Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 80.10 YL: 6480.00 XR: 101.90 YR: 6442.95

Centre: XC: 218.95 YC: 6536.76 Radius: R: 150.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	25.10	16.00	25.00
Trial positions within range:	25	10	25

RESULTS: Analysis 2 - Active Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Factor of Safety for initial failure surface approximation: 0.659

There were: 2909 successful analyses from a total of 6251 trial surfaces
3342 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 0.66

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	80.10	6480.00	101.90	6442.95	218.95	6536.76	150.00	0.659	<-- Critical Surface
2	70.69	6480.00	101.01	6460.28	172.74	6603.77	160.42	1.576	
3	70.69	6480.00	101.01	6460.28	172.17	6602.89	159.38	1.577	
4	70.69	6480.00	101.01	6460.28	171.59	6602.01	158.33	1.578	
5	70.69	6480.00	101.01	6460.28	171.02	6601.13	157.29	1.579	
6	70.69	6480.00	101.01	6460.28	170.45	6600.26	156.25	1.580	
7	70.69	6480.00	101.01	6460.28	169.88	6599.38	155.21	1.581	
8	70.69	6480.00	101.01	6460.28	169.31	6598.50	154.17	1.583	
9	70.69	6480.00	101.01	6460.28	168.74	6597.62	153.12	1.584	
10	70.69	6480.00	101.01	6460.28	168.16	6596.74	152.08	1.585	
11	70.69	6480.00	101.01	6460.28	167.59	6595.86	151.04	1.586	
12	70.69	6480.00	101.01	6460.28	167.02	6594.98	150.00	1.587	
13	70.69	6480.00	101.01	6460.28	166.45	6594.10	148.96	1.589	
14	70.69	6480.00	101.01	6460.28	165.88	6593.22	147.92	1.590	
15	70.69	6480.00	101.01	6460.28	165.30	6592.34	146.88	1.591	
16	70.69	6480.00	101.01	6460.28	164.73	6591.46	145.83	1.593	
17	70.69	6480.00	101.01	6460.28	164.16	6590.58	144.79	1.594	
18	70.69	6480.00	101.01	6460.28	163.59	6589.70	143.75	1.595	
19	70.69	6480.00	101.01	6460.28	163.01	6588.82	142.71	1.597	
20	70.69	6480.00	101.01	6460.28	162.44	6587.94	141.67	1.598	
21	70.69	6480.00	101.01	6460.28	161.87	6587.06	140.62	1.599	
22	70.69	6480.00	101.01	6460.28	161.30	6586.18	139.58	1.601	
23	70.69	6480.00	101.01	6460.28	160.72	6585.30	138.54	1.602	
24	70.69	6480.00	101.01	6460.28	160.15	6584.42	137.50	1.604	
25	69.64	6480.00	101.01	6460.28	171.24	6606.83	162.50	1.635	
26	69.64	6480.00	101.01	6460.28	170.68	6605.94	161.46	1.636	
27	69.64	6480.00	101.01	6460.28	170.12	6605.05	160.42	1.637	
28	69.64	6480.00	101.01	6460.28	169.56	6604.16	159.38	1.638	
29	69.64	6480.00	101.01	6460.28	169.00	6603.27	158.33	1.639	
30	69.64	6480.00	101.01	6460.28	168.45	6602.39	157.29	1.640	
31	69.64	6480.00	101.01	6460.28	167.89	6601.50	156.25	1.642	
32	69.64	6480.00	101.01	6460.28	167.33	6600.61	155.21	1.643	
33	69.64	6480.00	101.01	6460.28	166.77	6599.72	154.17	1.644	
34	69.64	6480.00	101.01	6460.28	166.21	6598.83	153.12	1.645	
35	69.64	6480.00	101.01	6460.28	165.65	6597.94	152.08	1.647	
36	69.64	6480.00	101.01	6460.28	165.10	6597.06	151.04	1.648	

37	69.64	6480.00	101.01	6460.28	164.54	6596.17	150.00	1.649
38	69.64	6480.00	101.01	6460.28	163.98	6595.28	148.96	1.651
39	69.64	6480.00	101.01	6460.28	163.42	6594.39	147.92	1.652
40	69.64	6480.00	101.01	6460.28	162.86	6593.50	146.88	1.653
41	69.64	6480.00	101.01	6460.28	162.30	6592.61	145.83	1.655
42	69.64	6480.00	101.01	6460.28	161.74	6591.72	144.79	1.656
43	69.64	6480.00	101.01	6460.28	161.18	6590.83	143.75	1.658
44	69.64	6480.00	101.01	6460.28	160.63	6589.94	142.71	1.659
45	69.64	6480.00	101.01	6460.28	160.07	6589.05	141.67	1.661
46	69.64	6480.00	101.01	6460.28	159.51	6588.16	140.62	1.662
47	69.64	6480.00	101.01	6460.28	158.95	6587.27	139.58	1.664
48	69.64	6480.00	101.01	6460.28	158.39	6586.38	138.54	1.665
49	68.60	6480.00	101.01	6460.28	168.67	6608.03	162.50	1.696
50	68.60	6480.00	101.01	6460.28	168.13	6607.13	161.46	1.697
51	68.60	6480.00	101.01	6460.28	167.58	6606.23	160.42	1.699
52	68.60	6480.00	101.01	6460.28	167.04	6605.34	159.38	1.700
53	68.60	6480.00	101.01	6460.28	166.49	6604.44	158.33	1.701
54	68.60	6480.00	101.01	6460.28	165.95	6603.54	157.29	1.702
55	68.60	6480.00	101.01	6460.28	165.40	6602.65	156.25	1.704
56	68.60	6480.00	101.01	6460.28	164.86	6601.75	155.21	1.705
57	68.60	6480.00	101.01	6460.28	164.31	6600.86	154.17	1.706
58	68.60	6480.00	101.01	6460.28	163.77	6599.96	153.12	1.708
59	68.60	6480.00	101.01	6460.28	163.22	6599.06	152.08	1.709
60	68.60	6480.00	101.01	6460.28	162.67	6598.16	151.04	1.710
61	68.60	6480.00	101.01	6460.28	162.13	6597.27	150.00	1.712
62	68.60	6480.00	101.01	6460.28	161.58	6596.37	148.96	1.713
63	68.60	6480.00	101.01	6460.28	161.04	6595.47	147.92	1.715
64	68.60	6480.00	101.01	6460.28	160.49	6594.58	146.88	1.716
65	68.60	6480.00	101.01	6460.28	159.95	6593.68	145.83	1.718
66	68.60	6480.00	101.01	6460.28	159.40	6592.78	144.79	1.719
67	68.60	6480.00	101.01	6460.28	158.85	6591.88	143.75	1.721
68	68.60	6480.00	101.01	6460.28	158.31	6590.98	142.71	1.723
69	68.60	6480.00	101.01	6460.28	157.76	6590.09	141.67	1.724
70	68.60	6480.00	101.01	6460.28	157.21	6589.19	140.62	1.726
71	68.60	6480.00	101.01	6460.28	156.67	6588.29	139.58	1.727
72	68.60	6480.00	101.01	6460.28	156.12	6587.39	138.54	1.729
73	68.60	6480.00	101.01	6460.28	155.58	6586.49	137.50	1.731
74	67.55	6480.00	101.01	6460.28	166.19	6609.14	162.50	1.758
75	67.55	6480.00	101.01	6460.28	165.65	6608.24	161.46	1.760
76	67.55	6480.00	101.01	6460.28	165.12	6607.33	160.42	1.761
77	67.55	6480.00	101.01	6460.28	164.59	6606.43	159.38	1.762
78	67.55	6480.00	101.01	6460.28	164.05	6605.52	158.33	1.764
79	67.55	6480.00	101.01	6460.28	163.52	6604.62	157.29	1.765
80	67.55	6480.00	101.01	6460.28	162.99	6603.72	156.25	1.766
81	67.55	6480.00	101.01	6460.28	162.46	6602.81	155.21	1.768
82	67.55	6480.00	101.01	6460.28	161.92	6601.91	154.17	1.769
83	67.55	6480.00	101.01	6460.28	161.39	6601.00	153.12	1.771
84	67.55	6480.00	101.01	6460.28	160.86	6600.10	152.08	1.772
85	67.55	6480.00	101.01	6460.28	160.32	6599.19	151.04	1.774
86	67.55	6480.00	101.01	6460.28	159.79	6598.29	150.00	1.775
87	67.55	6480.00	101.01	6460.28	159.26	6597.38	148.96	1.777
88	67.55	6480.00	101.01	6460.28	158.72	6596.48	147.92	1.778
89	67.55	6480.00	101.01	6460.28	158.19	6595.57	146.88	1.780
90	67.55	6480.00	101.01	6460.28	157.66	6594.67	145.83	1.782
91	67.55	6480.00	101.01	6460.28	157.12	6593.76	144.79	1.783

92	67.55	6480.00	101.01	6460.28	156.59	6592.85	143.75	1.784
93	67.55	6480.00	101.01	6460.28	156.05	6591.95	142.71	1.786
94	67.55	6480.00	101.01	6460.28	155.52	6591.04	141.67	1.788
95	67.55	6480.00	101.01	6460.28	154.99	6590.14	140.62	1.790
96	67.55	6480.00	101.01	6460.28	154.45	6589.23	139.58	1.791
97	67.55	6480.00	101.01	6460.28	153.92	6588.32	138.54	1.793
98	67.55	6480.00	101.01	6460.28	153.39	6587.42	137.50	1.795
99	69.64	6480.00	95.68	6480.00	82.66	6634.66	155.21	NaN

Critical Failure Surface (circle 1)

Intersects: XL: 80.10 YL: 6480.00 XR: 101.90 YR: 6442.95
Centre: XC: 218.95 YC: 6536.76 Radius: R: 150.00

Generated failure surface: (20 points)

80.10	6480.00	80.98	6477.90	81.88	6475.82	82.82	6473.76	83.79	6471.70
84.79	6469.67	85.82	6467.64	86.88	6465.64	87.97	6463.64	89.09	6461.67
90.25	6459.71	91.43	6457.77	92.64	6455.85	93.88	6453.95	95.14	6452.07
96.44	6450.20	97.76	6448.36	99.11	6446.54	100.49	6444.73	101.90	6442.95

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Base							PoreWater		Normal	Test	Factor
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight		Force	Stress	
1	80.10	0.23	67.3	0.44	1.14	2	0.00	34.0	22.69	0.00	15.03	0.75	
2	80.54	0.69	67.3	0.44	1.14	2	0.00	34.0	68.06	0.00	45.06	0.75	
3	80.98	1.19	66.5	0.45	1.13	2	0.00	34.0	117.38	0.00	77.29	0.75	
4	81.43	1.66	66.5	0.45	1.13	2	0.00	34.0	164.05	0.00	108.01	0.75	
5	81.88	2.20	65.6	0.47	1.14	2	0.00	34.0	217.90	0.00	142.66	0.74	
6	82.35	2.69	65.6	0.47	1.14	2	0.00	34.0	265.90	0.00	174.02	0.74	
7	82.82	3.27	64.7	0.48	1.14	2	0.00	34.0	324.16	0.00	211.10	0.74	
8	83.30	3.77	64.7	0.48	1.14	2	0.00	34.0	373.39	0.00	243.17	0.74	
9	83.79	2.98	63.9	0.35	0.78	2	0.00	34.0	295.41	0.00	277.38	0.74	
10	84.13	6.33	63.9	0.66	1.49	1	0.00	45.0	631.77	0.00	235.58	0.55	
11	84.79	5.59	63.0	0.52	1.14	1	0.00	45.0	563.59	0.00	274.74	0.55	
12	85.30	6.11	63.0	0.52	1.14	1	0.00	45.0	620.92	0.00	302.80	0.55	
13	85.82	6.82	62.1	0.53	1.14	1	0.00	45.0	698.09	0.00	339.88	0.55	
14	86.35	7.36	62.1	0.53	1.14	1	0.00	45.0	756.69	0.00	368.41	0.55	
15	86.88	8.11	61.3	0.55	1.13	1	0.00	45.0	838.26	0.00	407.61	0.55	
16	87.43	8.66	61.3	0.55	1.14	1	0.00	45.0	898.03	0.00	436.52	0.55	
17	87.97	9.45	60.4	0.56	1.14	1	0.00	45.0	983.84	0.00	477.68	0.55	
18	88.53	10.00	60.4	0.56	1.14	1	0.00	45.0	1044.71	0.00	507.41	0.55	
19	89.09	10.83	59.5	0.58	1.14	1	0.00	45.0	1134.68	0.00	550.50	0.55	
20	89.67	11.40	59.5	0.58	1.13	1	0.00	45.0	1196.62	0.00	580.76	0.55	
21	90.25	12.26	58.7	0.59	1.13	1	0.00	45.0	1290.49	0.00	625.90	0.55	
22	90.84	12.84	58.7	0.59	1.14	1	0.00	45.0	1353.45	0.00	656.20	0.55	
23	91.43	13.74	57.8	0.61	1.14	1	0.00	45.0	1451.14	0.00	703.38	0.55	
24	92.03	14.32	57.8	0.61	1.14	1	0.00	45.0	1515.07	0.00	734.37	0.55	
25	92.64	15.25	56.9	0.62	1.14	1	0.00	45.0	1616.43	0.00	783.35	0.55	
26	93.26	15.84	56.9	0.62	1.14	1	0.00	45.0	1681.24	0.00	814.77	0.55	
27	93.88	16.81	56.1	0.63	1.14	1	0.00	45.0	1786.12	0.00	865.49	0.55	
28	94.51	17.41	56.1	0.63	1.14	1	0.00	45.0	1851.84	0.00	897.33	0.55	
29	95.14	18.40	55.2	0.65	1.14	1	0.00	45.0	1960.02	0.00	950.05	0.55	
30	95.79	19.01	55.2	0.65	1.13	1	0.00	45.0	2026.43	0.00	982.60	0.55	
31	96.44	20.03	54.3	0.66	1.14	1	0.00	45.0	2137.80	0.00	1036.62	0.55	
32	97.10	20.64	54.3	0.66	1.13	1	0.00	45.0	2204.97	0.00	1069.58	0.55	

33	97.76	21.69	53.5	0.68	1.14	1	0.00	45.0	2319.39	0.00	1125.59	0.55
34	98.44	22.31	53.5	0.68	1.14	1	0.00	45.0	2387.20	0.00	1158.50	0.55
35	99.11	14.95	52.6	0.44	0.73	1	0.00	45.0	1600.12	0.00	1210.46	0.55
36	99.56	15.20	52.6	0.44	0.73	1	0.00	45.0	1628.30	0.00	1232.47	0.55
37	100.00	14.04	52.6	0.46	0.76	1	0.00	45.0	1521.75	0.00	1104.52	0.55
38	100.46	14.15	51.8	0.72	1.16	1	0.00	45.0	1556.19	0.00	739.40	0.55
39	101.18	4.72	51.7	0.72	1.16	1	0.00	45.0	518.73	0.00	246.64	0.55

X-S Area: 412.93 Path Length: 43.14 X-S Weight: 43622.82

DATA: Analysis 3 - Active Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 45.0 110.00 Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (2 profiles)

Profile: 1 (2 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00 6471.00 200.00 6471.00

Profile: 2 (2 points) Material beneath: 2 - Loose sand, mixed grain size

0.00 6480.00 200.00 6480.00

Slope Surface (4 points)

40.00	6480.00	100.00	6480.00	102.00	6441.00	141.00	6441.00
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Phreatic Surface (2 points)

0.00	6430.00	200.00	6430.00
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Failure Surface (Critical, from previous analysis)

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 80.10 YL: 6480.00 XR: 101.90 YR: 6442.95

Centre: XC: 218.95 YC: 6536.76 Radius: R: 150.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	25.10	16.00	25.00
Trial positions within range:	25	10	25

RESULTS: Analysis 3 - Active Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Factor of Safety for initial failure surface approximation: 0.659

There were: 2909 successful analyses from a total of 6251 trial surfaces
3342 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 0.66

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	80.10	6480.00	101.90	6442.95	218.95	6536.76	150.00	0.659	<-- Critical Surface
2	70.69	6480.00	101.01	6460.28	172.74	6603.77	160.42	1.576	
3	70.69	6480.00	101.01	6460.28	172.17	6602.89	159.38	1.577	
4	70.69	6480.00	101.01	6460.28	171.59	6602.01	158.33	1.578	
5	70.69	6480.00	101.01	6460.28	171.02	6601.13	157.29	1.579	
6	70.69	6480.00	101.01	6460.28	170.45	6600.26	156.25	1.580	
7	70.69	6480.00	101.01	6460.28	169.88	6599.38	155.21	1.581	
8	70.69	6480.00	101.01	6460.28	169.31	6598.50	154.17	1.583	
9	70.69	6480.00	101.01	6460.28	168.74	6597.62	153.12	1.584	
10	70.69	6480.00	101.01	6460.28	168.16	6596.74	152.08	1.585	
11	70.69	6480.00	101.01	6460.28	167.59	6595.86	151.04	1.586	
12	70.69	6480.00	101.01	6460.28	167.02	6594.98	150.00	1.587	
13	70.69	6480.00	101.01	6460.28	166.45	6594.10	148.96	1.589	
14	70.69	6480.00	101.01	6460.28	165.88	6593.22	147.92	1.590	
15	70.69	6480.00	101.01	6460.28	165.30	6592.34	146.88	1.591	
16	70.69	6480.00	101.01	6460.28	164.73	6591.46	145.83	1.593	
17	70.69	6480.00	101.01	6460.28	164.16	6590.58	144.79	1.594	
18	70.69	6480.00	101.01	6460.28	163.59	6589.70	143.75	1.595	
19	70.69	6480.00	101.01	6460.28	163.01	6588.82	142.71	1.597	
20	70.69	6480.00	101.01	6460.28	162.44	6587.94	141.67	1.598	
21	70.69	6480.00	101.01	6460.28	161.87	6587.06	140.62	1.599	
22	70.69	6480.00	101.01	6460.28	161.30	6586.18	139.58	1.601	
23	70.69	6480.00	101.01	6460.28	160.72	6585.30	138.54	1.602	
24	70.69	6480.00	101.01	6460.28	160.15	6584.42	137.50	1.604	
25	69.64	6480.00	101.01	6460.28	171.24	6606.83	162.50	1.635	
26	69.64	6480.00	101.01	6460.28	170.68	6605.94	161.46	1.636	
27	69.64	6480.00	101.01	6460.28	170.12	6605.05	160.42	1.637	
28	69.64	6480.00	101.01	6460.28	169.56	6604.16	159.38	1.638	
29	69.64	6480.00	101.01	6460.28	169.00	6603.27	158.33	1.639	
30	69.64	6480.00	101.01	6460.28	168.45	6602.39	157.29	1.640	
31	69.64	6480.00	101.01	6460.28	167.89	6601.50	156.25	1.642	
32	69.64	6480.00	101.01	6460.28	167.33	6600.61	155.21	1.643	
33	69.64	6480.00	101.01	6460.28	166.77	6599.72	154.17	1.644	
34	69.64	6480.00	101.01	6460.28	166.21	6598.83	153.12	1.645	
35	69.64	6480.00	101.01	6460.28	165.65	6597.94	152.08	1.647	

36	69.64	6480.00	101.01	6460.28	165.10	6597.06	151.04	1.648
37	69.64	6480.00	101.01	6460.28	164.54	6596.17	150.00	1.649
38	69.64	6480.00	101.01	6460.28	163.98	6595.28	148.96	1.651
39	69.64	6480.00	101.01	6460.28	163.42	6594.39	147.92	1.652
40	69.64	6480.00	101.01	6460.28	162.86	6593.50	146.88	1.653
41	69.64	6480.00	101.01	6460.28	162.30	6592.61	145.83	1.655
42	69.64	6480.00	101.01	6460.28	161.74	6591.72	144.79	1.656
43	69.64	6480.00	101.01	6460.28	161.18	6590.83	143.75	1.658
44	69.64	6480.00	101.01	6460.28	160.63	6589.94	142.71	1.659
45	69.64	6480.00	101.01	6460.28	160.07	6589.05	141.67	1.661
46	69.64	6480.00	101.01	6460.28	159.51	6588.16	140.62	1.662
47	69.64	6480.00	101.01	6460.28	158.95	6587.27	139.58	1.664
48	69.64	6480.00	101.01	6460.28	158.39	6586.38	138.54	1.665
49	68.60	6480.00	101.01	6460.28	168.67	6608.03	162.50	1.696
50	68.60	6480.00	101.01	6460.28	168.13	6607.13	161.46	1.697
51	68.60	6480.00	101.01	6460.28	167.58	6606.23	160.42	1.699
52	68.60	6480.00	101.01	6460.28	167.04	6605.34	159.38	1.700
53	68.60	6480.00	101.01	6460.28	166.49	6604.44	158.33	1.701
54	68.60	6480.00	101.01	6460.28	165.95	6603.54	157.29	1.702
55	68.60	6480.00	101.01	6460.28	165.40	6602.65	156.25	1.704
56	68.60	6480.00	101.01	6460.28	164.86	6601.75	155.21	1.705
57	68.60	6480.00	101.01	6460.28	164.31	6600.86	154.17	1.706
58	68.60	6480.00	101.01	6460.28	163.77	6599.96	153.12	1.708
59	68.60	6480.00	101.01	6460.28	163.22	6599.06	152.08	1.709
60	68.60	6480.00	101.01	6460.28	162.67	6598.16	151.04	1.710
61	68.60	6480.00	101.01	6460.28	162.13	6597.27	150.00	1.712
62	68.60	6480.00	101.01	6460.28	161.58	6596.37	148.96	1.713
63	68.60	6480.00	101.01	6460.28	161.04	6595.47	147.92	1.715
64	68.60	6480.00	101.01	6460.28	160.49	6594.58	146.88	1.716
65	68.60	6480.00	101.01	6460.28	159.95	6593.68	145.83	1.718
66	68.60	6480.00	101.01	6460.28	159.40	6592.78	144.79	1.719
67	68.60	6480.00	101.01	6460.28	158.85	6591.88	143.75	1.721
68	68.60	6480.00	101.01	6460.28	158.31	6590.98	142.71	1.723
69	68.60	6480.00	101.01	6460.28	157.76	6590.09	141.67	1.724
70	68.60	6480.00	101.01	6460.28	157.21	6589.19	140.62	1.726
71	68.60	6480.00	101.01	6460.28	156.67	6588.29	139.58	1.727
72	68.60	6480.00	101.01	6460.28	156.12	6587.39	138.54	1.729
73	68.60	6480.00	101.01	6460.28	155.58	6586.49	137.50	1.731
74	67.55	6480.00	101.01	6460.28	166.19	6609.14	162.50	1.758
75	67.55	6480.00	101.01	6460.28	165.65	6608.24	161.46	1.760
76	67.55	6480.00	101.01	6460.28	165.12	6607.33	160.42	1.761
77	67.55	6480.00	101.01	6460.28	164.59	6606.43	159.38	1.762
78	67.55	6480.00	101.01	6460.28	164.05	6605.52	158.33	1.764
79	67.55	6480.00	101.01	6460.28	163.52	6604.62	157.29	1.765
80	67.55	6480.00	101.01	6460.28	162.99	6603.72	156.25	1.766
81	67.55	6480.00	101.01	6460.28	162.46	6602.81	155.21	1.768
82	67.55	6480.00	101.01	6460.28	161.92	6601.91	154.17	1.769
83	67.55	6480.00	101.01	6460.28	161.39	6601.00	153.12	1.771
84	67.55	6480.00	101.01	6460.28	160.86	6600.10	152.08	1.772
85	67.55	6480.00	101.01	6460.28	160.32	6599.19	151.04	1.774
86	67.55	6480.00	101.01	6460.28	159.79	6598.29	150.00	1.775
87	67.55	6480.00	101.01	6460.28	159.26	6597.38	148.96	1.777
88	67.55	6480.00	101.01	6460.28	158.72	6596.48	147.92	1.778
89	67.55	6480.00	101.01	6460.28	158.19	6595.57	146.88	1.780
90	67.55	6480.00	101.01	6460.28	157.66	6594.67	145.83	1.782

91	67.55	6480.00	101.01	6460.28	157.12	6593.76	144.79	1.783
92	67.55	6480.00	101.01	6460.28	156.59	6592.85	143.75	1.784
93	67.55	6480.00	101.01	6460.28	156.05	6591.95	142.71	1.786
94	67.55	6480.00	101.01	6460.28	155.52	6591.04	141.67	1.788
95	67.55	6480.00	101.01	6460.28	154.99	6590.14	140.62	1.790
96	67.55	6480.00	101.01	6460.28	154.45	6589.23	139.58	1.791
97	67.55	6480.00	101.01	6460.28	153.92	6588.32	138.54	1.793
98	67.55	6480.00	101.01	6460.28	153.39	6587.42	137.50	1.795
99	69.64	6480.00	95.68	6480.00	82.66	6634.66	155.21	NaN

Critical Failure Surface (circle 1)

Intersects: XL: 80.10 YL: 6480.00 XR: 101.90 YR: 6442.95

Centre: XC: 218.95 YC: 6536.76 Radius: R: 150.00

Generated failure surface: (20 points)

80.10	6480.00	80.98	6477.90	81.88	6475.82	82.82	6473.76	83.79	6471.70
84.79	6469.67	85.82	6467.64	86.88	6465.64	87.97	6463.64	89.09	6461.67
90.25	6459.71	91.43	6457.77	92.64	6455.85	93.88	6453.95	95.14	6452.07
96.44	6450.20	97.76	6448.36	99.11	6446.54	100.49	6444.73	101.90	6442.95

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	PoreWater	Normal Force	Test Stress	Factor
1	80.10	0.23	67.3	0.44	1.14	2	0.00	34.0	22.69	0.00	15.03	0.75	
2	80.54	0.69	67.3	0.44	1.14	2	0.00	34.0	68.06	0.00	45.06	0.75	
3	80.98	1.19	66.5	0.45	1.13	2	0.00	34.0	117.38	0.00	77.29	0.75	
4	81.43	1.66	66.5	0.45	1.13	2	0.00	34.0	164.05	0.00	108.01	0.75	
5	81.88	2.20	65.6	0.47	1.14	2	0.00	34.0	217.90	0.00	142.66	0.74	
6	82.35	2.69	65.6	0.47	1.14	2	0.00	34.0	265.90	0.00	174.02	0.74	
7	82.82	3.27	64.7	0.48	1.14	2	0.00	34.0	324.16	0.00	211.10	0.74	
8	83.30	3.77	64.7	0.48	1.14	2	0.00	34.0	373.39	0.00	243.17	0.74	
9	83.79	2.98	63.9	0.35	0.78	2	0.00	34.0	295.41	0.00	277.38	0.74	
10	84.13	6.33	63.9	0.66	1.49	1	0.00	45.0	631.77	0.00	235.58	0.55	
11	84.79	5.59	63.0	0.52	1.14	1	0.00	45.0	563.59	0.00	274.74	0.55	
12	85.30	6.11	63.0	0.52	1.14	1	0.00	45.0	620.92	0.00	302.80	0.55	
13	85.82	6.82	62.1	0.53	1.14	1	0.00	45.0	698.09	0.00	339.88	0.55	
14	86.35	7.36	62.1	0.53	1.14	1	0.00	45.0	756.69	0.00	368.41	0.55	
15	86.88	8.11	61.3	0.55	1.13	1	0.00	45.0	838.26	0.00	407.61	0.55	
16	87.43	8.66	61.3	0.55	1.14	1	0.00	45.0	898.03	0.00	436.52	0.55	
17	87.97	9.45	60.4	0.56	1.14	1	0.00	45.0	983.84	0.00	477.68	0.55	
18	88.53	10.00	60.4	0.56	1.14	1	0.00	45.0	1044.71	0.00	507.41	0.55	
19	89.09	10.83	59.5	0.58	1.14	1	0.00	45.0	1134.68	0.00	550.50	0.55	
20	89.67	11.40	59.5	0.58	1.13	1	0.00	45.0	1196.62	0.00	580.76	0.55	
21	90.25	12.26	58.7	0.59	1.13	1	0.00	45.0	1290.49	0.00	625.90	0.55	
22	90.84	12.84	58.7	0.59	1.14	1	0.00	45.0	1353.45	0.00	656.20	0.55	
23	91.43	13.74	57.8	0.61	1.14	1	0.00	45.0	1451.14	0.00	703.38	0.55	
24	92.03	14.32	57.8	0.61	1.14	1	0.00	45.0	1515.07	0.00	734.37	0.55	
25	92.64	15.25	56.9	0.62	1.14	1	0.00	45.0	1616.43	0.00	783.35	0.55	
26	93.26	15.84	56.9	0.62	1.14	1	0.00	45.0	1681.24	0.00	814.77	0.55	
27	93.88	16.81	56.1	0.63	1.14	1	0.00	45.0	1786.12	0.00	865.49	0.55	
28	94.51	17.41	56.1	0.63	1.14	1	0.00	45.0	1851.84	0.00	897.33	0.55	
29	95.14	18.40	55.2	0.65	1.14	1	0.00	45.0	1960.02	0.00	950.05	0.55	
30	95.79	19.01	55.2	0.65	1.13	1	0.00	45.0	2026.43	0.00	982.60	0.55	
31	96.44	20.03	54.3	0.66	1.14	1	0.00	45.0	2137.80	0.00	1036.62	0.55	

32	97.10	20.64	54.3	0.66	1.13	1	0.00	45.0	2204.97	0.00	1069.58	0.55
33	97.76	21.69	53.5	0.68	1.14	1	0.00	45.0	2319.39	0.00	1125.59	0.55
34	98.44	22.31	53.5	0.68	1.14	1	0.00	45.0	2387.20	0.00	1158.50	0.55
35	99.11	14.95	52.6	0.44	0.73	1	0.00	45.0	1600.12	0.00	1210.46	0.55
36	99.56	15.20	52.6	0.44	0.73	1	0.00	45.0	1628.30	0.00	1232.47	0.55
37	100.00	14.04	52.6	0.46	0.76	1	0.00	45.0	1521.75	0.00	1104.52	0.55
38	100.46	14.15	51.8	0.72	1.16	1	0.00	45.0	1556.19	0.00	739.40	0.55
39	101.18	4.72	51.7	0.72	1.16	1	0.00	45.0	518.73	0.00	246.64	0.55

X-S Area: 412.93 Path Length: 43.14 X-S Weight: 43622.82

DATA: Analysis 4 - Final Mining Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion Phi UnitWeight Ru
0.00 45.0 110.00 Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion Phi UnitWeight Ru
0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (2 profiles)

Profile: 1 (2 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00 6471.00 200.00 6471.00

Profile: 2 (2 points) Material beneath: 2 - Loose sand, mixed grain size

0.00 6480.00 200.00 6480.00

Slope Surface (4 points)

20.00	6480.00	80.00	6480.00	160.00	6441.00	200.30	6441.00
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Phreatic Surface (2 points)

0.00	6430.00	200.00	6430.00
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Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 73.90 YL: 6480.00 XR: 155.00 YR: 6443.44

Centre: XC: 257.13 YC: 6778.20 Radius: R: 350.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	47.60	31.60	25.00

Trial positions within range: 15 15 25

RESULTS: Analysis 4 - Final Mining Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Factor of Safety for initial failure surface approximation: 2.048

There were: 3738 successful analyses from a total of 5625 trial surfaces
1887 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.94

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	77.30	6480.00	139.20	6451.14	260.75	6792.65	362.50	1.936	<-- Critical Surface
2	77.30	6480.00	139.20	6451.14	260.31	6791.71	361.46	1.936	
3	77.30	6480.00	139.20	6451.14	259.86	6790.76	360.42	1.936	
4	77.30	6480.00	139.20	6451.14	259.42	6789.81	359.38	1.937	
5	77.30	6480.00	139.20	6451.14	258.98	6788.86	358.33	1.937	
6	77.30	6480.00	139.20	6451.14	258.54	6787.91	357.29	1.937	
7	77.30	6480.00	139.20	6451.14	258.09	6786.96	356.25	1.937	
8	77.30	6480.00	139.20	6451.14	257.65	6786.02	355.21	1.938	
9	77.30	6480.00	139.20	6451.14	257.21	6785.07	354.17	1.938	
10	77.30	6480.00	139.20	6451.14	256.77	6784.12	353.12	1.938	
11	77.30	6480.00	139.20	6451.14	256.33	6783.17	352.08	1.938	
12	77.30	6480.00	139.20	6451.14	255.88	6782.22	351.04	1.939	
13	77.30	6480.00	139.20	6451.14	255.44	6781.27	350.00	1.939	
14	77.30	6480.00	139.20	6451.14	255.00	6780.32	348.96	1.939	
15	77.30	6480.00	139.20	6451.14	254.56	6779.38	347.92	1.939	
16	77.30	6480.00	139.20	6451.14	254.11	6778.43	346.88	1.940	
17	77.30	6480.00	139.20	6451.14	253.67	6777.48	345.83	1.940	
18	77.30	6480.00	139.20	6451.14	253.23	6776.53	344.79	1.940	
19	77.30	6480.00	139.20	6451.14	252.79	6775.58	343.75	1.941	
20	77.30	6480.00	139.20	6451.14	252.35	6774.63	342.71	1.941	
21	77.30	6480.00	139.20	6451.14	251.90	6773.68	341.67	1.941	
22	77.30	6480.00	139.20	6451.14	251.46	6772.73	340.62	1.941	
23	77.30	6480.00	139.20	6451.14	251.02	6771.79	339.58	1.942	
24	77.30	6480.00	139.20	6451.14	250.58	6770.84	338.54	1.942	
25	77.30	6480.00	139.20	6451.14	250.13	6769.89	337.50	1.942	
26	77.30	6480.00	141.46	6450.04	262.03	6791.90	362.50	1.947	
27	77.30	6480.00	141.46	6450.04	261.58	6790.95	361.46	1.947	
28	77.30	6480.00	141.46	6450.04	261.14	6790.00	360.42	1.947	
29	77.30	6480.00	141.46	6450.04	260.70	6789.06	359.38	1.947	
30	77.30	6480.00	141.46	6450.04	260.26	6788.11	358.33	1.948	
31	77.30	6480.00	141.46	6450.04	259.81	6787.16	357.29	1.948	
32	77.30	6480.00	141.46	6450.04	259.37	6786.21	356.25	1.948	
33	77.30	6480.00	141.46	6450.04	258.93	6785.26	355.21	1.948	
34	77.30	6480.00	141.46	6450.04	258.48	6784.31	354.17	1.949	

35	77.30	6480.00	141.46	6450.04	258.04	6783.36	353.12	1.949
36	77.30	6480.00	141.46	6450.04	257.60	6782.42	352.08	1.949
37	77.30	6480.00	141.46	6450.04	257.15	6781.47	351.04	1.949
38	77.30	6480.00	141.46	6450.04	256.71	6780.52	350.00	1.950
39	77.30	6480.00	141.46	6450.04	256.27	6779.57	348.96	1.950
40	77.30	6480.00	141.46	6450.04	255.83	6778.62	347.92	1.950
41	77.30	6480.00	141.46	6450.04	255.38	6777.67	346.88	1.950
42	77.30	6480.00	141.46	6450.04	254.94	6776.72	345.83	1.951
43	77.30	6480.00	141.46	6450.04	254.50	6775.77	344.79	1.951
44	77.30	6480.00	141.46	6450.04	254.05	6774.83	343.75	1.951
45	77.30	6480.00	141.46	6450.04	253.61	6773.88	342.71	1.952
46	77.30	6480.00	141.46	6450.04	253.17	6772.93	341.67	1.952
47	77.30	6480.00	141.46	6450.04	252.72	6771.98	340.62	1.952
48	77.30	6480.00	141.46	6450.04	252.28	6771.03	339.58	1.952
49	77.30	6480.00	141.46	6450.04	251.84	6770.08	338.54	1.953
50	77.30	6480.00	141.46	6450.04	251.39	6769.13	337.50	1.953
51	80.70	6479.66	139.20	6451.14	268.16	6789.93	362.50	1.956
52	80.70	6479.66	139.20	6451.14	267.70	6788.99	361.46	1.956
53	80.70	6479.66	139.20	6451.14	267.24	6788.05	360.42	1.956
54	80.70	6479.66	139.20	6451.14	266.78	6787.11	359.38	1.956
55	80.70	6479.66	139.20	6451.14	266.32	6786.17	358.33	1.956
56	77.30	6480.00	143.71	6448.94	263.29	6791.15	362.50	1.956
57	80.70	6479.66	139.20	6451.14	265.86	6785.23	357.29	1.956
58	77.30	6480.00	143.71	6448.94	262.85	6790.20	361.46	1.957
59	77.30	6480.00	143.71	6448.94	262.40	6789.25	360.42	1.957
60	77.30	6480.00	143.71	6448.94	261.96	6788.30	359.38	1.957
61	77.30	6480.00	143.71	6448.94	261.51	6787.36	358.33	1.957
62	77.30	6480.00	143.71	6448.94	261.07	6786.41	357.29	1.958
63	77.30	6480.00	143.71	6448.94	260.63	6785.46	356.25	1.958
64	77.30	6480.00	143.71	6448.94	260.18	6784.51	355.21	1.958
65	77.30	6480.00	143.71	6448.94	259.74	6783.56	354.17	1.958
66	77.30	6480.00	143.71	6448.94	259.30	6782.61	353.12	1.959
67	77.30	6480.00	143.71	6448.94	258.85	6781.66	352.08	1.959
68	77.30	6480.00	143.71	6448.94	258.41	6780.72	351.04	1.959
69	77.30	6480.00	143.71	6448.94	257.96	6779.77	350.00	1.959
70	80.70	6479.66	139.20	6451.14	265.41	6784.29	356.25	1.959
71	80.70	6479.66	139.20	6451.14	264.95	6783.35	355.21	1.960
72	80.70	6479.66	139.20	6451.14	264.49	6782.41	354.17	1.960
73	77.30	6480.00	143.71	6448.94	257.52	6778.82	348.96	1.960
74	80.70	6479.66	139.20	6451.14	264.03	6781.46	353.12	1.960
75	80.70	6479.66	139.20	6451.14	263.57	6780.52	352.08	1.960
76	80.70	6479.66	139.20	6451.14	263.11	6779.58	351.04	1.960
77	77.30	6480.00	143.71	6448.94	257.08	6777.87	347.92	1.960
78	80.70	6479.66	139.20	6451.14	262.66	6778.64	350.00	1.960
79	80.70	6479.66	139.20	6451.14	262.20	6777.70	348.96	1.960
80	80.70	6479.66	139.20	6451.14	261.74	6776.76	347.92	1.960
81	77.30	6480.00	143.71	6448.94	256.63	6776.92	346.88	1.960
82	80.70	6479.66	139.20	6451.14	261.28	6775.82	346.88	1.960
83	80.70	6479.66	139.20	6451.14	260.82	6774.88	345.83	1.960
84	80.70	6479.66	139.20	6451.14	260.36	6773.94	344.79	1.960
85	77.30	6480.00	143.71	6448.94	256.19	6775.97	345.83	1.961
86	80.70	6479.66	139.20	6451.14	259.90	6773.00	343.75	1.961
87	80.70	6479.66	139.20	6451.14	259.45	6772.06	342.71	1.961
88	80.70	6479.66	139.20	6451.14	258.99	6771.12	341.67	1.961
89	80.70	6479.66	139.20	6451.14	258.53	6770.18	340.62	1.961

90	77.30	6480.00	143.71	6448.94	255.75	6775.02	344.79	1.961
91	80.70	6479.66	139.20	6451.14	258.07	6769.24	339.58	1.961
92	80.70	6479.66	139.20	6451.14	257.61	6768.30	338.54	1.961
93	77.30	6480.00	143.71	6448.94	255.30	6774.07	343.75	1.961
94	80.70	6479.66	139.20	6451.14	257.15	6767.36	337.50	1.961
95	77.30	6480.00	143.71	6448.94	254.86	6773.12	342.71	1.961
96	77.30	6480.00	143.71	6448.94	254.41	6772.18	341.67	1.962
97	77.30	6480.00	143.71	6448.94	253.97	6771.23	340.62	1.962
98	77.30	6480.00	143.71	6448.94	253.53	6770.28	339.58	1.962
99	77.30	6480.00	143.71	6448.94	253.08	6769.33	338.54	1.962

Critical Failure Surface (circle 1)

Intersects: XL: 77.30 YL: 6480.00 XR: 139.20 YR: 6451.14
Centre: XC: 260.75 YC: 6792.65 Radius: R: 362.50

Generated failure surface: (20 points)

77.30	6480.00	80.41	6478.19	83.55	6476.42	86.69	6474.67	89.86	6472.96
93.04	6471.28	96.24	6469.63	99.46	6468.01	102.69	6466.43	105.94	6464.87
109.20	6463.35	112.48	6461.86	115.77	6460.41	119.08	6458.98	122.40	6457.59
125.73	6456.24	129.08	6454.91	132.44	6453.62	135.81	6452.36	139.20	6451.14

Slice Geometry and Properties - Critical Failure Surface (circle 1, 41 slices)

Slice	X-S			Base					PoreWater		Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	77.30	0.53	30.1	1.35	1.56	2	0.00	34.0	52.34	0.00	32.25	0.96
2	78.65	1.59	30.1	1.35	1.56	2	0.00	34.0	157.01	0.00	96.75	0.96
3	80.00	0.66	30.1	0.41	0.48	2	0.00	34.0	64.96	0.00	130.55	0.96
4	80.41	2.61	29.5	1.57	1.80	2	0.00	34.0	258.42	0.00	137.81	0.96
5	81.98	2.81	29.5	1.57	1.80	2	0.00	34.0	277.73	0.00	148.10	0.96
6	83.55	3.00	29.0	1.57	1.80	2	0.00	34.0	297.07	0.00	158.15	0.96
7	85.12	3.17	29.0	1.57	1.80	2	0.00	34.0	313.36	0.00	166.82	0.96
8	86.69	3.33	28.4	1.58	1.80	2	0.00	34.0	329.93	0.00	175.34	0.96
9	88.28	3.47	28.4	1.58	1.80	2	0.00	34.0	343.09	0.00	182.35	0.96
10	89.86	3.60	27.8	1.59	1.80	2	0.00	34.0	356.67	0.00	189.28	0.96
11	91.45	3.71	27.8	1.59	1.80	2	0.00	34.0	366.83	0.00	194.65	0.96
12	93.04	1.29	27.3	0.54	0.61	2	0.00	34.0	127.44	0.00	198.74	0.95
13	93.59	3.18	27.3	1.33	1.49	1	0.00	45.0	319.85	0.00	190.18	0.89
14	94.92	3.23	27.3	1.33	1.49	1	0.00	45.0	334.80	0.00	199.04	0.89
15	96.24	2.73	26.7	1.11	1.24	1	0.00	45.0	290.01	0.00	207.63	0.89
16	97.35	2.75	26.7	1.11	1.24	1	0.00	45.0	298.68	0.00	213.84	0.89
17	98.46	2.49	26.7	1.00	1.12	1	0.00	45.0	273.83	0.00	217.67	0.89
18	99.46	4.04	26.1	1.62	1.80	1	0.00	45.0	444.91	0.00	219.64	0.89
19	101.08	4.05	26.1	1.62	1.80	1	0.00	45.0	445.78	0.00	220.10	0.89
20	102.69	4.06	25.6	1.62	1.80	1	0.00	45.0	447.04	0.00	220.76	0.89
21	104.32	4.04	25.6	1.62	1.80	1	0.00	45.0	444.51	0.00	219.51	0.89
22	105.94	4.02	25.0	1.63	1.80	1	0.00	45.0	442.15	0.00	218.44	0.89
23	107.57	3.96	25.0	1.63	1.80	1	0.00	45.0	435.84	0.00	215.29	0.89
24	109.20	3.91	24.4	1.64	1.80	1	0.00	45.0	429.72	0.00	212.39	0.89
25	110.84	3.82	24.4	1.64	1.80	1	0.00	45.0	419.95	0.00	207.54	0.89
26	112.48	3.73	23.9	1.65	1.80	1	0.00	45.0	410.08	0.00	202.78	0.89
27	114.13	3.61	23.9	1.65	1.80	1	0.00	45.0	396.73	0.00	196.18	0.89
28	115.77	3.48	23.3	1.65	1.80	1	0.00	45.0	383.08	0.00	189.57	0.89
29	117.43	3.33	23.3	1.65	1.80	1	0.00	45.0	365.85	0.00	181.02	0.89
30	119.08	3.17	22.7	1.66	1.80	1	0.00	45.0	348.42	0.00	172.52	0.89

31	120.74	2.98	22.7	1.66	1.80	1	0.00	45.0	327.55	0.00	162.19	0.89
32	122.40	2.78	22.2	1.67	1.80	1	0.00	45.0	306.14	0.00	151.73	0.89
33	124.07	2.56	22.2	1.67	1.80	1	0.00	45.0	281.60	0.00	139.57	0.89
34	125.73	2.33	21.6	1.67	1.80	1	0.00	45.0	256.22	0.00	127.10	0.89
35	127.41	2.07	21.6	1.67	1.80	1	0.00	45.0	227.90	0.00	113.05	0.89
36	129.08	1.80	21.0	1.68	1.80	1	0.00	45.0	198.54	0.00	98.60	0.89
37	130.76	1.51	21.0	1.68	1.80	1	0.00	45.0	166.41	0.00	82.64	0.89
38	132.44	1.21	20.4	1.69	1.80	1	0.00	45.0	133.08	0.00	66.17	0.89
39	134.13	0.88	20.4	1.69	1.80	1	0.00	45.0	97.11	0.00	48.28	0.89
40	135.81	0.54	19.9	1.69	1.80	1	0.00	45.0	59.64	0.00	29.69	0.90
41	137.51	0.18	19.9	1.69	1.80	1	0.00	45.0	19.82	0.00	9.87	0.90

X-S Area: 112.19 Path Length: 68.40 X-S Weight: 11950.09

DATA: Analysis 5 - Final Mining Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion Phi UnitWeight Ru
0.00 45.0 110.00 Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion Phi UnitWeight Ru
0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (2 profiles)

Profile: 1 (2 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00 6471.00 200.00 6471.00

Profile: 2 (2 points) Material beneath: 2 - Loose sand, mixed grain size

0.00 6480.00 200.00 6480.00

Slope Surface (4 points)

20.00 6480.00 80.00 6480.00 160.00 6441.00 200.30 6441.00

Phreatic Surface (2 points)

0.00 6430.00 200.00 6430.00

Failure Surface (Critical, from previous analysis)

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 77.30 YL: 6480.00 XR: 139.20 YR: 6451.14
Centre: XC: 260.75 YC: 6792.65 Radius: R: 362.50

Variable Restraints

Parameter descriptor: XL XR R
Range of variation: 47.60 31.60 25.00
Trial positions within range: 15 15 25

RESULTS: Analysis 5 - Final Mining Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Factor of Safety for initial failure surface approximation: 1.936

There were: 5613 successful analyses from a total of 5625 trial surfaces
12 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.82

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	77.30	6480.00	123.40	6458.84	256.41	6809.46	375.00	1.823	<-- Critical Surface
2	77.30	6480.00	123.40	6458.84	255.98	6808.51	373.96	1.824	
3	77.30	6480.00	123.40	6458.84	255.54	6807.56	372.92	1.824	
4	77.30	6480.00	123.40	6458.84	255.11	6806.61	371.88	1.824	
5	77.30	6480.00	123.40	6458.84	254.67	6805.66	370.83	1.824	
6	77.30	6480.00	123.40	6458.84	254.23	6804.72	369.79	1.825	
7	77.30	6480.00	123.40	6458.84	253.80	6803.77	368.75	1.825	
8	77.30	6480.00	123.40	6458.84	253.36	6802.82	367.71	1.825	
9	77.30	6480.00	123.40	6458.84	252.93	6801.87	366.67	1.825	
10	77.30	6480.00	123.40	6458.84	252.49	6800.92	365.62	1.825	
11	77.30	6480.00	123.40	6458.84	252.06	6799.97	364.58	1.826	
12	77.30	6480.00	123.40	6458.84	251.62	6799.02	363.54	1.826	
13	77.30	6480.00	123.40	6458.84	251.19	6798.07	362.50	1.826	
14	77.30	6480.00	123.40	6458.84	250.75	6797.12	361.46	1.826	
15	77.30	6480.00	123.40	6458.84	250.31	6796.17	360.42	1.827	
16	77.30	6480.00	123.40	6458.84	249.88	6795.23	359.38	1.827	
17	77.30	6480.00	123.40	6458.84	249.44	6794.28	358.33	1.827	
18	77.30	6480.00	123.40	6458.84	249.01	6793.33	357.29	1.827	
19	77.30	6480.00	123.40	6458.84	248.57	6792.38	356.25	1.828	
20	77.30	6480.00	123.40	6458.84	248.14	6791.43	355.21	1.828	
21	77.30	6480.00	123.40	6458.84	247.70	6790.48	354.17	1.828	
22	77.30	6480.00	123.40	6458.84	247.27	6789.53	353.12	1.828	
23	77.30	6480.00	123.40	6458.84	246.83	6788.58	352.08	1.829	
24	77.30	6480.00	123.40	6458.84	246.39	6787.63	351.04	1.829	
25	77.30	6480.00	123.40	6458.84	245.96	6786.68	350.00	1.829	
26	77.30	6480.00	125.66	6457.74	257.88	6808.66	375.00	1.844	
27	77.30	6480.00	125.66	6457.74	257.44	6807.71	373.96	1.844	
28	77.30	6480.00	125.66	6457.74	257.00	6806.76	372.92	1.844	
29	77.30	6480.00	125.66	6457.74	256.57	6805.81	371.88	1.844	
30	77.30	6480.00	125.66	6457.74	256.13	6804.87	370.83	1.845	
31	77.30	6480.00	125.66	6457.74	255.69	6803.92	369.79	1.845	

32	77.30	6480.00	125.66	6457.74	255.26	6802.97	368.75	1.845
33	77.30	6480.00	125.66	6457.74	254.82	6802.02	367.71	1.845
34	77.30	6480.00	125.66	6457.74	254.38	6801.07	366.67	1.846
35	77.30	6480.00	125.66	6457.74	253.95	6800.12	365.62	1.846
36	77.30	6480.00	125.66	6457.74	253.51	6799.17	364.58	1.846
37	77.30	6480.00	125.66	6457.74	253.07	6798.22	363.54	1.846
38	77.30	6480.00	125.66	6457.74	252.64	6797.27	362.50	1.847
39	77.30	6480.00	125.66	6457.74	252.20	6796.33	361.46	1.847
40	77.30	6480.00	125.66	6457.74	251.76	6795.38	360.42	1.847
41	77.30	6480.00	125.66	6457.74	251.33	6794.43	359.38	1.847
42	77.30	6480.00	125.66	6457.74	250.89	6793.48	358.33	1.848
43	77.30	6480.00	125.66	6457.74	250.45	6792.53	357.29	1.848
44	77.30	6480.00	125.66	6457.74	250.02	6791.58	356.25	1.848
45	77.30	6480.00	125.66	6457.74	249.58	6790.63	355.21	1.848
46	77.30	6480.00	125.66	6457.74	249.14	6789.68	354.17	1.848
47	77.30	6480.00	125.66	6457.74	248.71	6788.74	353.12	1.849
48	77.30	6480.00	125.66	6457.74	248.27	6787.79	352.08	1.849
49	77.30	6480.00	125.66	6457.74	247.83	6786.84	351.04	1.849
50	77.30	6480.00	125.66	6457.74	247.40	6785.89	350.00	1.850
51	80.70	6479.66	123.40	6458.84	266.05	6805.65	375.00	1.850
52	80.70	6479.66	123.40	6458.84	265.59	6804.71	373.96	1.850
53	80.70	6479.66	123.40	6458.84	265.13	6803.78	372.92	1.850
54	80.70	6479.66	123.40	6458.84	264.67	6802.84	371.88	1.850
55	80.70	6479.66	123.40	6458.84	264.22	6801.90	370.83	1.850
56	80.70	6479.66	123.40	6458.84	263.76	6800.96	369.79	1.851
57	80.70	6479.66	123.40	6458.84	263.30	6800.02	368.75	1.851
58	80.70	6479.66	123.40	6458.84	262.85	6799.08	367.71	1.851
59	80.70	6479.66	123.40	6458.84	262.39	6798.15	366.67	1.851
60	80.70	6479.66	123.40	6458.84	261.93	6797.21	365.62	1.851
61	80.70	6479.66	123.40	6458.84	261.47	6796.27	364.58	1.851
62	80.70	6479.66	123.40	6458.84	261.02	6795.33	363.54	1.852
63	80.70	6479.66	123.40	6458.84	260.56	6794.39	362.50	1.852
64	80.70	6479.66	123.40	6458.84	260.10	6793.45	361.46	1.852
65	80.70	6479.66	123.40	6458.84	259.64	6792.52	360.42	1.852
66	80.70	6479.66	123.40	6458.84	259.19	6791.58	359.38	1.852
67	80.70	6479.66	123.40	6458.84	258.73	6790.64	358.33	1.852
68	80.70	6479.66	123.40	6458.84	258.27	6789.70	357.29	1.852
69	80.70	6479.66	123.40	6458.84	257.81	6788.76	356.25	1.852
70	80.70	6479.66	123.40	6458.84	257.36	6787.82	355.21	1.853
71	80.70	6479.66	123.40	6458.84	256.90	6786.89	354.17	1.853
72	80.70	6479.66	123.40	6458.84	256.44	6785.95	353.12	1.853
73	80.70	6479.66	123.40	6458.84	255.98	6785.01	352.08	1.853
74	80.70	6479.66	123.40	6458.84	255.53	6784.07	351.04	1.853
75	80.70	6479.66	123.40	6458.84	255.07	6783.13	350.00	1.853
76	77.30	6480.00	127.91	6456.64	259.31	6807.87	375.00	1.862
77	77.30	6480.00	127.91	6456.64	258.87	6806.92	373.96	1.862
78	77.30	6480.00	127.91	6456.64	258.43	6805.97	372.92	1.862
79	77.30	6480.00	127.91	6456.64	257.99	6805.02	371.88	1.863
80	77.30	6480.00	127.91	6456.64	257.56	6804.08	370.83	1.863
81	77.30	6480.00	127.91	6456.64	257.12	6803.13	369.79	1.863
82	77.30	6480.00	127.91	6456.64	256.68	6802.18	368.75	1.863
83	77.30	6480.00	127.91	6456.64	256.24	6801.23	367.71	1.864
84	77.30	6480.00	127.91	6456.64	255.81	6800.28	366.67	1.864
85	77.30	6480.00	127.91	6456.64	255.37	6799.33	365.62	1.864
86	77.30	6480.00	127.91	6456.64	254.93	6798.38	364.58	1.864

87	77.30	6480.00	127.91	6456.64	254.49	6797.44	363.54	1.865
88	77.30	6480.00	127.91	6456.64	254.06	6796.49	362.50	1.865
89	77.30	6480.00	127.91	6456.64	253.62	6795.54	361.46	1.865
90	77.30	6480.00	127.91	6456.64	253.18	6794.59	360.42	1.865
91	77.30	6480.00	127.91	6456.64	252.74	6793.64	359.38	1.866
92	77.30	6480.00	127.91	6456.64	252.30	6792.69	358.33	1.866
93	77.30	6480.00	127.91	6456.64	251.87	6791.74	357.29	1.866
94	77.30	6480.00	127.91	6456.64	251.43	6790.79	356.25	1.866
95	77.30	6480.00	127.91	6456.64	250.99	6789.85	355.21	1.867
96	77.30	6480.00	127.91	6456.64	250.55	6788.90	354.17	1.867
97	77.30	6480.00	127.91	6456.64	250.11	6787.95	353.12	1.867
98	77.30	6480.00	127.91	6456.64	249.68	6787.00	352.08	1.867
99	77.30	6480.00	127.91	6456.64	249.24	6786.05	351.04	1.868

Critical Failure Surface (circle 1)

Intersects: XL: 77.30 YL: 6480.00 XR: 123.40 YR: 6458.84

Centre: XC: 256.41 YC: 6809.46 Radius: R: 375.00

Generated failure surface: (20 points)

77.30	6480.00	79.65	6478.73	82.01	6477.48	84.38	6476.25	86.76	6475.03
89.15	6473.83	91.54	6472.65	93.95	6471.48	96.36	6470.33	98.78	6469.20
101.21	6468.09	103.64	6466.99	106.09	6465.91	108.54	6464.85	111.00	6463.80
113.46	6462.77	115.94	6461.76	118.42	6460.77	120.91	6459.80	123.40	6458.84

Slice Geometry and Properties - Critical Failure Surface (circle 1, 40 slices)

Slice	X-S			Base				PoreWater		Normal	Test	
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	77.30	0.37	28.3	1.18	1.34	2	0.00	34.0	36.89	0.00	26.16	0.95
2	78.48	1.12	28.3	1.18	1.34	2	0.00	34.0	110.73	0.00	78.50	0.95
3	79.65	0.47	27.9	0.35	0.39	2	0.00	34.0	46.90	0.00	112.60	0.95
4	80.00	1.48	27.9	1.01	1.14	2	0.00	34.0	146.85	0.00	122.04	0.95
5	81.01	1.53	27.9	1.01	1.14	2	0.00	34.0	151.03	0.00	125.50	0.95
6	82.01	1.84	27.5	1.18	1.34	2	0.00	34.0	182.65	0.00	129.25	0.95
7	83.20	1.89	27.5	1.18	1.34	2	0.00	34.0	187.29	0.00	132.53	0.95
8	84.38	1.94	27.1	1.19	1.34	2	0.00	34.0	191.99	0.00	135.76	0.94
9	85.57	1.97	27.1	1.19	1.34	2	0.00	34.0	195.44	0.00	138.18	0.94
10	86.76	2.01	26.7	1.19	1.34	2	0.00	34.0	198.92	0.00	140.54	0.94
11	87.95	2.03	26.7	1.19	1.34	2	0.00	34.0	201.11	0.00	142.08	0.94
12	89.15	2.05	26.3	1.20	1.34	2	0.00	34.0	203.33	0.00	143.55	0.94
13	90.35	2.06	26.3	1.20	1.34	2	0.00	34.0	204.26	0.00	144.19	0.94
14	91.54	2.07	25.9	1.20	1.34	2	0.00	34.0	205.26	0.00	144.80	0.94
15	92.74	2.07	25.9	1.20	1.34	2	0.00	34.0	204.91	0.00	144.56	0.94
16	93.95	1.73	25.5	1.01	1.12	2	0.00	34.0	171.25	0.00	144.34	0.94
17	94.96	2.39	25.5	1.40	1.55	1	0.00	45.0	241.59	0.00	136.49	0.88
18	96.36	1.77	25.1	1.05	1.16	1	0.00	45.0	185.76	0.00	140.62	0.88
19	97.41	1.75	25.0	1.05	1.16	1	0.00	45.0	189.27	0.00	143.30	0.88
20	98.46	0.52	25.1	0.32	0.35	1	0.00	45.0	57.54	0.00	144.31	0.88
21	98.78	1.98	24.7	1.21	1.34	1	0.00	45.0	217.41	0.00	143.04	0.88
22	99.99	1.93	24.7	1.21	1.34	1	0.00	45.0	212.78	0.00	140.02	0.88
23	101.21	1.89	24.2	1.22	1.34	1	0.00	45.0	208.17	0.00	137.07	0.88
24	102.43	1.84	24.3	1.22	1.34	1	0.00	45.0	202.08	0.00	133.04	0.88
25	103.64	1.78	23.8	1.22	1.34	1	0.00	45.0	195.98	0.00	129.09	0.88
26	104.86	1.71	23.8	1.22	1.34	1	0.00	45.0	188.43	0.00	124.14	0.88
27	106.09	1.64	23.4	1.23	1.34	1	0.00	45.0	180.78	0.00	119.19	0.88

28	107.31	1.56	23.4	1.23	1.34	1	0.00	45.0	171.76	0.00	113.22	0.88
29	108.54	1.48	23.0	1.23	1.34	1	0.00	45.0	162.64	0.00	107.29	0.88
30	109.77	1.38	23.0	1.23	1.34	1	0.00	45.0	152.21	0.00	100.40	0.88
31	111.00	1.29	22.6	1.23	1.34	1	0.00	45.0	141.54	0.00	93.44	0.88
32	112.23	1.18	22.6	1.23	1.34	1	0.00	45.0	129.68	0.00	85.61	0.88
33	113.46	1.07	22.2	1.24	1.34	1	0.00	45.0	117.44	0.00	77.59	0.88
34	114.70	0.95	22.2	1.24	1.34	1	0.00	45.0	104.09	0.00	68.77	0.88
35	115.94	0.82	21.8	1.24	1.34	1	0.00	45.0	90.28	0.00	59.69	0.88
36	117.18	0.69	21.8	1.24	1.34	1	0.00	45.0	75.42	0.00	49.87	0.88
37	118.42	0.55	21.4	1.24	1.34	1	0.00	45.0	60.06	0.00	39.75	0.88
38	119.66	0.40	21.4	1.24	1.34	1	0.00	45.0	43.69	0.00	28.91	0.88
39	120.91	0.24	21.0	1.25	1.34	1	0.00	45.0	26.73	0.00	17.71	0.88
40	122.15	0.08	21.0	1.25	1.34	1	0.00	45.0	8.91	0.00	5.90	0.88

X-S Area: 57.54 Path Length: 50.76 X-S Weight: 6003.08

DATA: Analysis 6 - Reclaimed Highwall Slope Stability

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and gravel, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 45.0 110.00 Auto

Material: 2 (Mohr-Coulomb Isotropic) - Loose sand, mixed grain size

Cohesion Phi UnitWeight Ru

0.00 34.0 99.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (2 profiles)

Profile: 1 (2 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00 6471.00 200.00 6471.00

Profile: 2 (2 points) Material beneath: 2 - Loose sand, mixed grain size

0.00 6480.00 200.00 6480.00

Slope Surface (4 points)

20.00 6480.00 80.00 6480.00 197.00 6441.00 200.30 6441.00

Phreatic Surface (2 points)

0.00 6430.00 200.00 6430.00

Failure Surface (Critical, from previous analysis)

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: 77.30 YL: 6480.00 XR: 123.40 YR: 6465.53

Centre: XC: 212.40 YC: 6829.82 Radius: R: 375.00

Variable Restraints

 Parameter descriptor: XL XR R
 Range of variation: 47.60 31.60 25.00
 Trial positions within range: 15 15 25

RESULTS: Analysis 6 - Reclaimed Highwall Slope Stability

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Factor of Safety for initial failure surface approximation: 2.431

There were: 5563 successful analyses from a total of 5625 trial surfaces
 62 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.03

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	80.70	6479.77	107.60	6470.80	216.61	6842.65	387.50	2.026	<-- Critical Surface
2	80.70	6479.77	107.60	6470.80	216.28	6841.66	386.46	2.026	
3	80.70	6479.77	107.60	6470.80	215.29	6838.70	383.33	2.027	
4	80.70	6479.77	107.60	6470.80	215.62	6839.68	384.38	2.027	
5	80.70	6479.77	107.60	6470.80	214.96	6837.71	382.29	2.027	
6	80.70	6479.77	107.60	6470.80	214.30	6835.73	380.21	2.027	
7	80.70	6479.77	107.60	6470.80	213.64	6833.75	378.12	2.027	
8	80.70	6479.77	107.60	6470.80	215.95	6840.67	385.42	2.027	
9	80.70	6479.77	107.60	6470.80	210.67	6824.85	368.75	2.027	
10	80.70	6479.77	107.60	6470.80	211.00	6825.84	369.79	2.027	
11	80.70	6479.77	107.60	6470.80	213.31	6832.76	377.08	2.027	
12	80.70	6479.77	107.60	6470.80	213.97	6834.74	379.17	2.027	
13	80.70	6479.77	107.60	6470.80	211.99	6828.81	372.92	2.027	
14	80.70	6479.77	107.60	6470.80	211.66	6827.82	371.88	2.027	
15	80.70	6479.77	107.60	6470.80	214.63	6836.72	381.25	2.027	
16	80.70	6479.77	107.60	6470.80	211.33	6826.83	370.83	2.027	
17	80.70	6479.77	107.60	6470.80	212.32	6829.80	373.96	2.027	
18	80.70	6479.77	107.60	6470.80	212.98	6831.77	376.04	2.027	
19	80.70	6479.77	107.60	6470.80	210.34	6823.86	367.71	2.027	
20	80.70	6479.77	107.60	6470.80	209.69	6821.88	365.62	2.027	
21	80.70	6479.77	107.60	6470.80	212.65	6830.78	375.00	2.027	
22	84.10	6478.63	107.60	6470.80	217.34	6839.18	384.38	2.027	
23	80.70	6479.77	107.60	6470.80	210.02	6822.87	366.67	2.027	
24	80.70	6479.77	107.60	6470.80	209.03	6819.91	363.54	2.027	
25	84.10	6478.63	107.60	6470.80	217.01	6838.19	383.33	2.027	
26	84.10	6478.63	107.60	6470.80	217.67	6840.17	385.42	2.027	
27	80.70	6479.77	107.60	6470.80	209.36	6820.90	364.58	2.027	
28	80.70	6479.77	107.60	6470.80	208.70	6818.92	362.50	2.027	
29	84.10	6478.63	107.60	6470.80	218.00	6841.15	386.46	2.027	

30	84.10	6478.63	107.60	6470.80	218.33	6842.14	387.50	2.027
31	84.10	6478.63	107.60	6470.80	215.36	6833.24	378.12	2.027
32	84.10	6478.63	107.60	6470.80	213.71	6828.30	372.92	2.027
33	84.10	6478.63	107.60	6470.80	215.03	6832.26	377.08	2.027
34	84.10	6478.63	107.60	6470.80	213.38	6827.31	371.88	2.027
35	84.10	6478.63	107.60	6470.80	214.70	6831.27	376.04	2.027
36	84.10	6478.63	107.60	6470.80	213.05	6826.32	370.83	2.027
37	84.10	6478.63	107.60	6470.80	215.69	6834.23	379.17	2.027
38	84.10	6478.63	107.60	6470.80	214.37	6830.28	375.00	2.027
39	84.10	6478.63	107.60	6470.80	214.04	6829.29	373.96	2.027
40	84.10	6478.63	107.60	6470.80	216.68	6837.20	382.29	2.027
41	84.10	6478.63	107.60	6470.80	216.35	6836.21	381.25	2.027
42	84.10	6478.63	107.60	6470.80	216.02	6835.22	380.21	2.027
43	84.10	6478.63	107.60	6470.80	212.73	6825.33	369.79	2.027
44	84.10	6478.63	107.60	6470.80	210.42	6818.41	362.50	2.027
45	84.10	6478.63	107.60	6470.80	211.08	6820.39	364.58	2.027
46	84.10	6478.63	107.60	6470.80	212.40	6824.35	368.75	2.027
47	84.10	6478.63	107.60	6470.80	212.07	6823.36	367.71	2.027
48	84.10	6478.63	107.60	6470.80	211.41	6821.38	365.62	2.027
49	84.10	6478.63	107.60	6470.80	211.74	6822.37	366.67	2.027
50	84.10	6478.63	107.60	6470.80	210.75	6819.40	363.54	2.027
51	87.50	6477.50	107.60	6470.80	215.43	6827.79	372.92	2.027
52	87.50	6477.50	107.60	6470.80	215.76	6828.77	373.96	2.027
53	87.50	6477.50	107.60	6470.80	217.41	6833.72	379.17	2.027
54	87.50	6477.50	107.60	6470.80	216.75	6831.74	377.08	2.027
55	87.50	6477.50	107.60	6470.80	218.07	6835.69	381.25	2.027
56	87.50	6477.50	107.60	6470.80	217.08	6832.73	378.12	2.027
57	87.50	6477.50	107.60	6470.80	215.10	6826.80	371.88	2.027
58	87.50	6477.50	107.60	6470.80	219.72	6840.64	386.46	2.027
59	87.50	6477.50	107.60	6470.80	220.05	6841.63	387.50	2.027
60	87.50	6477.50	107.60	6470.80	214.44	6824.82	369.79	2.027
61	87.50	6477.50	107.60	6470.80	217.74	6834.71	380.21	2.027
62	87.50	6477.50	107.60	6470.80	216.42	6830.75	376.04	2.027
63	87.50	6477.50	107.60	6470.80	218.73	6837.67	383.33	2.027
64	87.50	6477.50	107.60	6470.80	216.09	6829.76	375.00	2.027
65	87.50	6477.50	107.60	6470.80	219.06	6838.66	384.38	2.027
66	87.50	6477.50	107.60	6470.80	218.40	6836.68	382.29	2.027
67	87.50	6477.50	107.60	6470.80	219.39	6839.65	385.42	2.027
68	87.50	6477.50	107.60	6470.80	212.47	6818.89	363.54	2.027
69	87.50	6477.50	107.60	6470.80	212.14	6817.90	362.50	2.027
70	87.50	6477.50	107.60	6470.80	212.80	6819.88	364.58	2.027
71	87.50	6477.50	107.60	6470.80	213.45	6821.85	366.67	2.027
72	87.50	6477.50	107.60	6470.80	213.78	6822.84	367.71	2.027
73	87.50	6477.50	107.60	6470.80	213.13	6820.87	365.62	2.027
74	87.50	6477.50	107.60	6470.80	214.77	6825.81	370.83	2.027
75	87.50	6477.50	107.60	6470.80	214.11	6823.83	368.75	2.028
76	90.90	6476.37	107.60	6470.80	214.18	6818.37	363.54	2.028
77	90.90	6476.37	107.60	6470.80	218.14	6830.23	376.04	2.028
78	90.90	6476.37	107.60	6470.80	216.49	6825.29	370.83	2.028
79	90.90	6476.37	107.60	6470.80	217.81	6829.24	375.00	2.028
80	90.90	6476.37	107.60	6470.80	214.84	6820.34	365.62	2.028
81	90.90	6476.37	107.60	6470.80	216.16	6824.30	369.79	2.028
82	90.90	6476.37	107.60	6470.80	216.82	6826.27	371.88	2.028
83	90.90	6476.37	107.60	6470.80	219.45	6834.18	380.21	2.028
84	90.90	6476.37	107.60	6470.80	217.15	6827.26	372.92	2.028

85	90.90	6476.37	107.60	6470.80	221.10	6839.12	385.42	2.028
86	90.90	6476.37	107.60	6470.80	215.50	6822.32	367.71	2.028
87	90.90	6476.37	107.60	6470.80	220.44	6837.15	383.33	2.028
88	90.90	6476.37	107.60	6470.80	215.83	6823.31	368.75	2.028
89	90.90	6476.37	107.60	6470.80	218.80	6832.21	378.12	2.029
90	90.90	6476.37	107.60	6470.80	219.78	6835.17	381.25	2.029
91	90.90	6476.37	107.60	6470.80	220.77	6838.14	384.38	2.029
92	90.90	6476.37	107.60	6470.80	217.48	6828.25	373.96	2.029
93	90.90	6476.37	107.60	6470.80	218.47	6831.22	377.08	2.029
94	90.90	6476.37	107.60	6470.80	215.17	6821.33	366.67	2.029
95	90.90	6476.37	107.60	6470.80	213.85	6817.38	362.50	2.029
96	90.90	6476.37	107.60	6470.80	220.11	6836.16	382.29	2.029
97	90.90	6476.37	107.60	6470.80	219.13	6833.19	379.17	2.029
98	90.90	6476.37	107.60	6470.80	214.51	6819.35	364.58	2.029
99	90.90	6476.37	107.60	6470.80	221.76	6841.10	387.50	2.029

Critical Failure Surface (circle 1)

Intersects: XL: 80.70 YL: 6479.77 XR: 107.60 YR: 6470.80
Centre: XC: 216.61 YC: 6842.65 Radius: R: 387.50

Generated failure surface: (20 points)

80.70	6479.77	82.10	6479.25	83.50	6478.73	84.90	6478.22	86.31	6477.72
87.71	6477.22	89.12	6476.72	90.53	6476.23	91.95	6475.75	93.36	6475.27
94.78	6474.80	96.19	6474.33	97.61	6473.87	99.04	6473.42	100.46	6472.97
101.88	6472.52	103.31	6472.08	104.74	6471.65	106.17	6471.22	107.60	6470.80

Slice Geometry and Properties - Critical Failure Surface (circle 1, 38 slices)

Slice	X-S	----- Base -----				PoreWater		Normal		Test	
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor
1	80.70	0.01	20.4	0.70	0.75	2	0.00	34.0	0.95	0.00	1.20 0.95
2	81.40	0.03	20.4	0.70	0.75	2	0.00	34.0	2.84	0.00	3.61 0.95
3	82.10	0.05	20.2	0.70	0.75	2	0.00	34.0	4.64	0.00	5.90 0.95
4	82.80	0.06	20.2	0.70	0.75	2	0.00	34.0	6.30	0.00	8.01 0.95
5	83.50	0.08	20.0	0.70	0.75	2	0.00	34.0	7.87	0.00	10.00 0.95
6	84.20	0.09	20.0	0.70	0.75	2	0.00	34.0	9.36	0.00	11.90 0.95
7	84.90	0.11	19.8	0.70	0.75	2	0.00	34.0	10.73	0.00	13.64 0.95
8	85.61	0.12	19.7	0.70	0.75	2	0.00	34.0	12.02	0.00	15.29 0.95
9	86.31	0.13	19.5	0.70	0.75	2	0.00	34.0	13.19	0.00	16.78 0.95
10	87.01	0.14	19.6	0.70	0.75	2	0.00	34.0	14.25	0.00	18.11 0.95
11	87.71	0.15	19.3	0.70	0.75	2	0.00	34.0	15.22	0.00	19.35 0.95
12	88.42	0.16	19.3	0.70	0.75	2	0.00	34.0	16.04	0.00	20.39 0.95
13	89.12	0.17	19.1	0.71	0.75	2	0.00	34.0	16.81	0.00	21.37 0.95
14	89.83	0.18	19.1	0.71	0.75	2	0.00	34.0	17.46	0.00	22.19 0.95
15	90.53	0.18	18.9	0.71	0.75	2	0.00	34.0	17.99	0.00	22.87 0.95
16	91.24	0.19	18.9	0.71	0.75	2	0.00	34.0	18.43	0.00	23.43 0.95
17	91.95	0.19	18.7	0.71	0.75	2	0.00	34.0	18.73	0.00	23.81 0.95
18	92.65	0.19	18.7	0.71	0.75	2	0.00	34.0	18.97	0.00	24.12 0.95
19	93.36	0.19	18.5	0.71	0.75	2	0.00	34.0	19.13	0.00	24.32 0.95
20	94.07	0.19	18.4	0.71	0.75	2	0.00	34.0	19.10	0.00	24.28 0.95
21	94.78	0.19	18.2	0.71	0.75	2	0.00	34.0	19.06	0.00	24.22 0.95
22	95.49	0.19	18.2	0.71	0.75	2	0.00	34.0	18.85	0.00	23.96 0.95
23	96.19	0.19	18.0	0.71	0.75	2	0.00	34.0	18.53	0.00	23.56 0.95
24	96.90	0.18	18.0	0.71	0.75	2	0.00	34.0	18.12	0.00	23.03 0.95
25	97.61	0.18	17.8	0.71	0.75	2	0.00	34.0	17.59	0.00	22.37 0.95

26	98.32	0.17	17.8	0.71	0.75	2	0.00	34.0	16.97	0.00	21.58	0.95
27	99.04	0.16	17.6	0.71	0.75	2	0.00	34.0	16.24	0.00	20.64	0.95
28	99.75	0.15	17.6	0.71	0.75	2	0.00	34.0	15.34	0.00	19.51	0.95
29	100.46	0.15	17.3	0.71	0.75	2	0.00	34.0	14.43	0.00	18.35	0.95
30	101.17	0.13	17.4	0.71	0.75	2	0.00	34.0	13.36	0.00	16.99	0.95
31	101.88	0.12	17.1	0.71	0.75	2	0.00	34.0	12.21	0.00	15.52	0.95
32	102.60	0.11	17.1	0.71	0.75	2	0.00	34.0	10.90	0.00	13.86	0.95
33	103.31	0.10	16.9	0.71	0.75	2	0.00	34.0	9.53	0.00	12.12	0.95
34	104.02	0.08	16.9	0.71	0.75	2	0.00	34.0	8.04	0.00	10.23	0.95
35	104.74	0.06	16.7	0.71	0.75	2	0.00	34.0	6.43	0.00	8.18	0.95
36	105.45	0.05	16.7	0.71	0.75	2	0.00	34.0	4.73	0.00	6.02	0.95
37	106.17	0.03	16.5	0.75	0.79	2	0.00	34.0	2.99	0.00	3.61	0.95
38	106.92	0.01	16.5	0.68	0.71	1	0.00	45.0	0.98	0.00	1.27	0.91

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X-S Area: 4.89	Path Length: 28.36	X-S Weight: 484.31

MEMORANDUM OF LEASE AGREEMENT

Under the terms of the Lease Agreement ("Lease") between CWH Properties LLC, a Colorado limited liability company ("Landlord"), and Oldcastle SW Group, Inc., a Colorado corporation ("Tenant"), having the same effective date ("Effective Date") as this Memorandum, Landlord has leased to Tenant portions of the following two parcels of real property:

PARCEL A:

THE NORTH ONE HALF OF SECTION 12, TOWNSHIP 6 NORTH, RANGE 88 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF ROUTT, STATE OF COLORADO, EXCEPT THOSE PORTIONS DESCRIBED IN THE DEEDS RECORDED IN BOOK 289 AT PAGE 570 AND IN BOOK 258 AT PAGE 189 ALSO EXCEPTING THOSE PORTIONS LYING WITHIN US HIGHWAY 40 AND COUNTY ROAD 51.

PARCEL B:

THE SOUTHEAST 1/4, SECTION 12, TOWNSHIP 6 NORTH, RANGE 88 WEST, OF THE 6TH P.M., COUNTY OF ROUTT, STATE OF COLORADO EXCEPT THOSE PORTIONS LYING WITHIN COUNTY ROAD 51.

Such portions are generally depicted as Mining Pods #1 through #4 on **Exhibit A**, attached and incorporated by reference. The Lease permits Tenant to engage in mining and processing sand, gravel and other aggregate materials, and related activities. The Lease has an initial term beginning on the Effective Date and ending on the 15th anniversary of the Effective Date, with two successive five-year renewal terms. Other terms and conditions of the Lease are incorporated into this Memorandum by this reference.

Effective: February 24, 2017.

[Signature pages follow]

LANDLORD:

CWH Properties LLC, a Colorado limited liability company

By: *Sheri C. Welch*
Sheri C. Welch, Authorized Agent

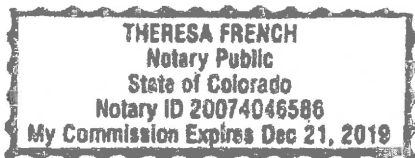
STATE OF COLORADO)
) ss.
COUNTY OF LARIMER)

Acknowledged before me this 24th day of February, 2017, by Sheri C. Welch as Authorized Agent of CWH Properties LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires: 12-21-2019

Theresa French
Notary Public



TENANT:

Oldcastle SW Group, Inc., a Colorado corporation

By: 
Richard Umbel, President

STATE OF Colorado)
) ss.
COUNTY OF Mesa)

Acknowledged before me this 24th day of February, 2017, by Richard Umbel ss
President of Oldcastle SW Group, Inc., a Colorado corporation.

Witness my hand and official seal.

My commission expires: April 10, 2018


Notary Public

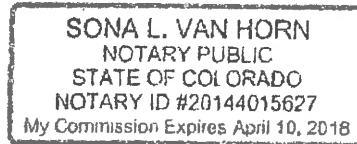


EXHIBIT A
PROPERTY LAYOUT

