



Robinson Adequacy Response 2

Ben Langenfeld <benl@lewicki.biz>

Fri, Dec 14, 2018 at 3:45 PM

To: "Eschberger - DNR, Amy" <amy.eschberger@state.co.us>

Cc: Dan Robinson <robinsonsonsinc@hotmail.com>

Amy

Attached is the adequacy response number 2 for the Robinson Sons Gravel Pit No. 1. I figure you can at least take a brief look at the main items today if you want. Thanks for your help.

Hard copies will arrive Monday. The courier could not get them to you today.

Ben Langenfeld, P.E.

Greg Lewicki and Associates

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4 attachments



AM-01 Adeq Response 2 181212 COMBINED.pdf

3176K



Robinsons Gravel Pit 181112-Map C-1 2018 Conditions.pdf

1994K



Robinsons Gravel Pit 181112-Map C-2 Mining Plan.pdf

2083K



Robinsons Gravel Pit 181112-Map F-1 Reclamation Plan.pdf

2939K



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December 12, 2018

Amy Eschberger
Colorado Division of Reclamation, Mining, and Safety
1313 Sherman St, Rm 215
Denver, CO 80203

**RE: Robinson Sons Gravel Pit No. 1, M-2008-076
AM-01 Adequacy Response 2**

Ms. Eschberger

The following is a response to the Division's December 10, 2018 adequacy review letter.

Exhibit G - Water Information (Rule 6.4.7)

1. The applicant will provide the Division with a copy of any determination(s) made by DWR or USACE for this site.

Exhibit L – Reclamation Costs (Rule 6.4.12)

2. The applicant recognizes that the Division must develop the bond estimate based on costs incurred by the state.

The reclamation regrading in the creek disturbance area has been revised slightly to show a grading plan that will eliminate the necessity to haul sand from other locations onsite. This regrading plan may be revised following consultation with the USACE, but can be used for reclamation cost calculations at this time. Based on that shown on the revised Map F-1, the cut and fill volumes are as follows:

Cut Volume	8,490 CY
Fill Volume	7,800 CY

Note that the volumes shown above are all bank material. It is likely that sand excavated during a regrade will have anywhere from 8-20% swell. Therefore this is conservative enough of a volume estimate to use in bond calculation. The regrade assumes no slopes created greater than 3H:1V and no steeper either. Naturally existing slopes that are steeper, that already exist, will be left in place.

Based on this material balance, it can be assumed that no sand need be hauled from the active mining area. The applicant requests that the Division revise the bond calculation with this assumption.

Exhibit S – Permanent Man-Made Structures (Rule 6.4.19)

3. The revised Map C-1 shows the all surrounding fence owners. Many of these fence locations are not known exactly but are assumed to be between property owners based on observations made during site visits. The applicant is pursuing structure agreements with all of these landowners with regards to these fences out of an abundance of caution.
4. Mail certifications for all neighboring structure owners have been attached.

Geotechnical Stability Exhibit

5. Map C-2 has been revised to show the correct setbacks. Mining will stay 30 feet from gaslines and 10 feet from powerpoles. These setbacks are based on the structure agreements from the original MLRB permit application.
6. Attached to this adequacy is the results of a GALENA software slope stability analysis. This analysis shows the failure slope for a vertical highwall that has a Factor of Safety of 1.5, which is the minimum required by the Division when adjacent to critical structures such as utilities. The failure circle for this Factor of Safety is 11 feet away from the highwall crest. This is less than the 90-foot offset to a gas line, the 25-foot for power poles, and the 50-foot for all other structures. See Figure 1.

Any failure slope with a FOS of 1.5 or lower will be further away from these structures than the required setback. This is shown in the GALENA data results as well.

Additional Geotechnical Stability Analysis

A more detailed geotechnical stability analysis using GALENA was also conducted for the mining slope nearest to an existing structure not owned by the applicant. This is the Pioneer Natural Resources, Inc. gas pipeline that runs along the north side of the current pit in Area 1. The current slope is 1.5H:1V with a maximum depth of 30 feet. Using the same material as the Vertical Highwall Analysis ($\phi = 45^\circ$; unit weight = 110 pcf) the minimum FOS of this slope is 1.5. This is sufficient of factor of safety for slopes near critical infrastructure. If structure agreements cannot be completed prior to the decision date, this analysis should suffice under Rule 6.14.9.

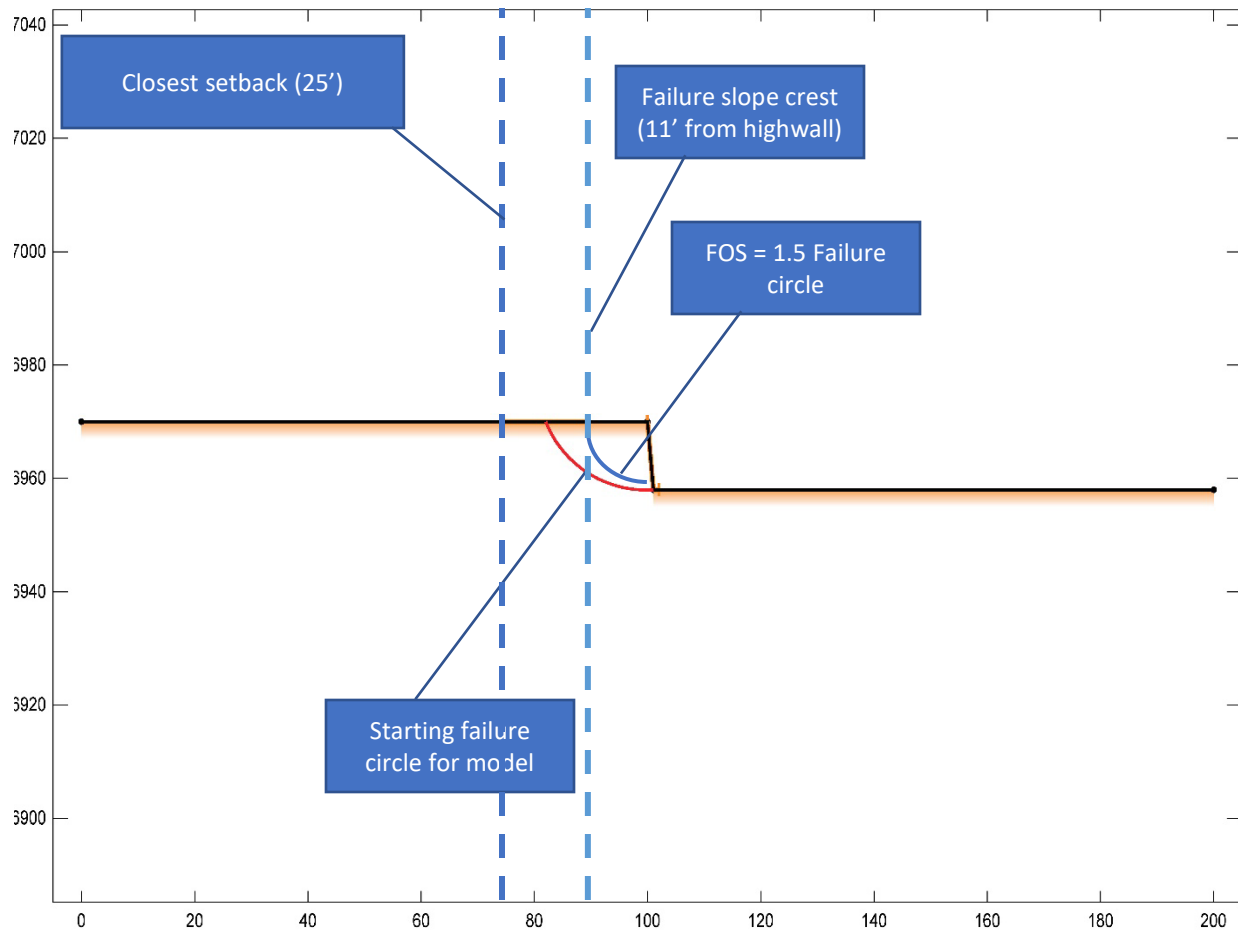


Figure 1 – GALENA Slope Model

Rule 1.6.2(1)(c)

Proof of filing the revised materials for the first adequacy response is attached to this letter. The proof of filing for this adequacy response will be provided as soon as received. The county copy was mailed at the same time as the Division submittal.

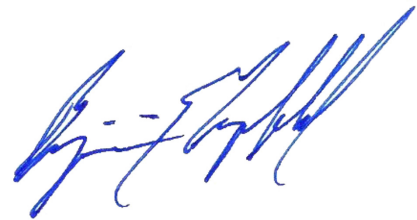
Attachments

These are the documents attached to this response in support of it.

Documents	Maps
Structure Agreement Mail Certifications	C-1, C-2
Proof of filing of first adequacy response with county clerk	F-1
GALENA slope stability analyses	

Please contact me if you have any further questions or concerns.

Sincerely,

A handwritten signature in blue ink, appearing to read "Ben Langenfeld", with a stylized flourish at the end.

Ben Langenfeld, P.E.
Greg Lewicki and Associates

GALENA Slope Stability Analysis – Vertical Highwall

The data shown on the attached GALENA slope stability analysis readout found a variety of failure slopes for a vertical highwall (modeled as near vertical in GALENA). Two rounds of slope stability analysis using Bishop's Method of Slices were conducted under varying failure circles. This process found a variety of Factors of Safety for the modeled slope.

1. Model Inputs

The material used for the analysis was Sand and gravel, mixed grain size, with the following parameters:

Angle of Friction (ϕ)	Cohesion	Unit Weight (lbs/ft ³)
45	0	110

The slope was modelled entirely in this material. The slope was a near vertical highwall (1H:12V).

All GALENA inputs are in Imperial units and the slope is modelled in feet.

2. Factors of Safety

Given the vertical nature of the highwall, and the angle of friction, it is expected that the slope will have a very low minimum Factor of Safety. However, the purpose of this analysis is to determine the failure slope at a FOS of 1.5 in order to show that setbacks are sufficient. A FOS of 1.503 was calculated for a failure circle centered at (106.87, 6976.70) with a radius of 19.00. It intersected the slope surface a X-Left = 89.09. The highwall crest is located at X=100. The failure circle is thus roughly 11 feet from the highwall crest.

Project: Robinson Sons Pit 1
 File: E:\Work\Dropbox (GLA)\Robinsons\DRMS\Vertical High Wall Slope Stability.gmf
 Processed: 12 Dec 2018 08:45:23

DATA: Analysis 1 - Vertical Highwall 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:
 62.400

Material Profiles (1 profile)

 Profile: 1 (4 points) Material beneath: 1 - Sand and gravel, mixed grain size
 0.00 6970.00 100.00 6970.00 101.00 6958.00
 200.00 6958.00

Slope Surface (4 points)

 0.00 6970.00 100.00 6970.00 101.00 6958.00
 200.00 6958.00

Phreatic Surface (2 points)

 0.00 6828.00 200.00 6828.00

Piezometric Surfaces (1 surface)

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R
 Intersects: XL: 82.00 YL: 6970.00 XR: 101.00 YR:

GALENA Results - Vert Highwall.txt

6958.00

Centre: XC: 99.68 YC: 6976.95 Radius: R:
19.00

Variable Restraints

```
-----
Parameter descriptor:      XL      XR      R
Range of variation:      15.00    2.00    1.00
Trial positions within range: 75      75      1
```

```
-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

RESULTS: Analysis 1 - Vertical Highwall 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: 2.841

There were: 4488 successful analyses from a total of 5625 trial surfaces
1137 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      89.50  6970.00  101.00   6958.00   107.59    6975.82
19.00   1.394  <-- Critical Surface
  2      89.50  6970.00  101.03   6958.00   107.58    6975.83
19.00   1.395
  3      89.50  6970.00  100.97   6958.32   107.47    6976.18
19.00   1.417
  4      89.30  6970.00  101.00   6958.00   107.36    6975.91
19.00   1.423
  5      89.30  6970.00  101.03   6958.00   107.35    6975.92
19.00   1.424
  6      89.50  6970.00  100.95   6958.65   107.34    6976.54
19.00   1.441
  7      89.30  6970.00  100.97   6958.32   107.24    6976.26
19.00   1.446
  8      89.09  6970.00  101.00   6958.00   107.13    6975.98
19.00   1.453
  9      89.09  6970.00  101.03   6958.00   107.12    6976.00
```


GALENA Results - Vert Highwall.txt

19.00	1.454					
10	89.50	6970.00	100.92	6958.97	107.20	6976.90
19.00	1.467					
11	89.30	6970.00	100.95	6958.65	107.11	6976.62
19.00	1.471					
12	89.09	6970.00	100.97	6958.32	107.01	6976.34
19.00	1.477					
13	88.89	6970.00	101.00	6958.00	106.90	6976.06
19.00	1.483					
14	88.89	6970.00	101.03	6958.00	106.90	6976.07
19.00	1.484					
15	89.50	6970.00	100.89	6959.30	107.05	6977.27
19.00	1.496					
16	89.30	6970.00	100.92	6958.97	106.97	6976.98
19.00	1.499					
17	89.09	6970.00	100.95	6958.65	106.87	6976.70
19.00	1.503					
18	88.89	6970.00	100.97	6958.32	106.78	6976.42
19.00	1.508					
19	88.69	6970.00	101.00	6958.00	106.67	6976.13
19.00	1.513					
20	88.69	6970.00	101.03	6958.00	106.67	6976.14
19.00	1.514					
21	89.50	6970.00	100.86	6959.62	106.90	6977.64
19.00	1.527					
22	89.30	6970.00	100.89	6959.30	106.82	6977.35
19.00	1.528					
23	89.09	6970.00	100.92	6958.97	106.73	6977.06
19.00	1.531					
24	88.89	6970.00	100.95	6958.65	106.64	6976.77
19.00	1.534					
25	88.69	6970.00	100.97	6958.32	106.55	6976.49
19.00	1.539					
26	88.49	6970.00	101.00	6958.00	106.45	6976.20
19.00	1.544					
27	88.49	6970.00	101.03	6958.00	106.44	6976.21
19.00	1.545					
28	89.30	6970.00	100.86	6959.62	106.66	6977.72
19.00	1.561					
29	89.50	6970.00	100.84	6959.95	106.73	6978.01
19.00	1.561					
30	89.09	6970.00	100.89	6959.30	106.58	6977.42
19.00	1.561					
31	88.89	6970.00	100.92	6958.97	106.50	6977.13
19.00	1.563					
32	88.69	6970.00	100.95	6958.65	106.41	6976.84
19.00	1.566					
33	88.49	6970.00	100.97	6958.32	106.32	6976.56

GALENA Results - Vert Highwall.txt

19.00	1.570					
34	88.28	6970.00	101.00	6958.00	106.22	6976.27
19.00	1.576					
35	88.28	6970.00	101.03	6958.00	106.22	6976.28
19.00	1.576					
36	89.09	6970.00	100.86	6959.62	106.42	6977.79
19.00	1.595					
37	88.89	6970.00	100.89	6959.30	106.35	6977.50
19.00	1.595					
38	89.30	6970.00	100.84	6959.95	106.49	6978.09
19.00	1.596					
39	88.69	6970.00	100.92	6958.97	106.27	6977.20
19.00	1.596					
40	89.50	6970.00	100.81	6960.27	106.55	6978.38
19.00	1.599					
41	88.49	6970.00	100.95	6958.65	106.18	6976.91
19.00	1.599					
42	88.28	6970.00	100.97	6958.32	106.09	6976.62
19.00	1.602					
43	88.08	6970.00	101.00	6958.00	106.00	6976.33
19.00	1.607					
44	88.08	6970.00	101.03	6958.00	105.99	6976.34
19.00	1.608					
45	88.69	6970.00	100.89	6959.30	106.12	6977.56
19.00	1.629					
46	88.89	6970.00	100.86	6959.62	106.19	6977.86
19.00	1.629					
47	88.49	6970.00	100.92	6958.97	106.04	6977.27
19.00	1.630					
48	89.09	6970.00	100.84	6959.95	106.25	6978.16
19.00	1.631					
49	88.28	6970.00	100.95	6958.65	105.96	6976.98
19.00	1.632					
50	89.30	6970.00	100.81	6960.27	106.31	6978.46
19.00	1.635					
51	88.08	6970.00	100.97	6958.32	105.87	6976.68
19.00	1.635					
52	87.88	6970.00	101.00	6958.00	105.77	6976.39
19.00	1.640					
53	89.50	6970.00	100.78	6960.59	106.36	6978.76
19.00	1.640					
54	87.88	6970.00	101.03	6958.00	105.77	6976.40
19.00	1.640					
55	88.49	6970.00	100.89	6959.30	105.89	6977.63
19.00	1.663					
56	88.28	6970.00	100.92	6958.97	105.81	6977.33
19.00	1.664					
57	88.69	6970.00	100.86	6959.62	105.96	6977.93

GALENA Results - Vert Highwall.txt

19.00	1.664					
58	88.08	6970.00	100.95	6958.65	105.73	6977.04
19.00	1.665					
59	88.89	6970.00	100.84	6959.95	106.02	6978.23
19.00	1.667					
60	87.88	6970.00	100.97	6958.32	105.64	6976.74
19.00	1.668					
61	89.09	6970.00	100.81	6960.27	106.07	6978.53
19.00	1.671					
62	87.68	6970.00	101.00	6958.00	105.55	6976.45
19.00	1.672					
63	87.68	6970.00	101.03	6958.00	105.55	6976.46
19.00	1.673					
64	89.30	6970.00	100.78	6960.59	106.12	6978.83
19.00	1.677					
65	89.50	6970.00	100.76	6960.92	106.16	6979.13
19.00	1.684					
66	88.08	6970.00	100.92	6958.97	105.58	6977.39
19.00	1.698					
67	88.28	6970.00	100.89	6959.30	105.66	6977.69
19.00	1.698					
68	87.88	6970.00	100.95	6958.65	105.50	6977.09
19.00	1.699					
69	88.49	6970.00	100.86	6959.62	105.73	6977.99
19.00	1.700					
70	87.68	6970.00	100.97	6958.32	105.42	6976.80
19.00	1.702					
71	88.69	6970.00	100.84	6959.95	105.79	6978.29
19.00	1.703					
72	87.47	6970.00	101.00	6958.00	105.33	6976.50
19.00	1.705					
73	87.47	6970.00	101.03	6958.00	105.32	6976.51
19.00	1.706					
74	88.89	6970.00	100.81	6960.27	105.84	6978.59
19.00	1.708					
75	89.09	6970.00	100.78	6960.59	105.88	6978.90
19.00	1.714					
76	89.30	6970.00	100.76	6960.92	105.92	6979.20
19.00	1.723					
77	89.50	6970.00	100.73	6961.24	105.95	6979.51
19.00	1.733					
78	87.88	6970.00	100.92	6958.97	105.36	6977.45
19.00	1.733					
79	88.08	6970.00	100.89	6959.30	105.43	6977.75
19.00	1.734					
80	87.68	6970.00	100.95	6958.65	105.28	6977.15
19.00	1.734					
81	87.47	6970.00	100.97	6958.32	105.20	6976.85

GALENA Results - Vert Highwall.txt

19.00	1.736					
82	88.28	6970.00	100.86	6959.62	105.49	6978.05
19.00	1.736					
83	87.27	6970.00	101.00	6958.00	105.11	6976.55
19.00	1.739					
84	88.49	6970.00	100.84	6959.95	105.55	6978.35
19.00	1.739					
85	87.27	6970.00	101.03	6958.00	105.10	6976.56
19.00	1.740					
86	88.69	6970.00	100.81	6960.27	105.60	6978.66
19.00	1.745					
87	88.89	6970.00	100.78	6960.59	105.65	6978.96
19.00	1.752					
88	89.09	6970.00	100.76	6960.92	105.68	6979.27
19.00	1.762					
89	87.68	6970.00	100.92	6958.97	105.13	6977.50
19.00	1.768					
90	87.47	6970.00	100.95	6958.65	105.06	6977.20
19.00	1.769					
91	87.88	6970.00	100.89	6959.30	105.20	6977.80
19.00	1.770					
92	87.27	6970.00	100.97	6958.32	104.97	6976.90
19.00	1.770					
93	88.08	6970.00	100.86	6959.62	105.27	6978.10
19.00	1.772					
94	89.30	6970.00	100.73	6961.24	105.71	6979.58
19.00	1.773					
95	87.07	6970.00	101.00	6958.00	104.88	6976.60
19.00	1.773					
96	87.07	6970.00	101.03	6958.00	104.88	6976.60
19.00	1.774					
97	87.07	6970.00	101.05	6958.00	104.88	6976.61
19.00	1.774					
98	88.28	6970.00	100.84	6959.95	105.32	6978.41
19.00	1.777					
99	88.49	6970.00	100.81	6960.27	105.37	6978.71
19.00	1.783					

Critical Failure Surface (circle 1)

Intersects: XL: 89.50 YL: 6970.00 XR: 101.00 YR: 6958.00

Centre: XC: 107.59 YC: 6975.82 Radius: R: 19.00

Generated failure surface: (20 points)

89.50	6970.00	89.80	6969.15	90.14	6968.31
90.51	6967.48	90.93	6966.68		
91.38	6965.90	91.88	6965.14	92.40	6964.40

GALENA Results - Vert Highwall.txt

92.96	6963.69	93.56	6963.01		
	94.19 6962.35		94.84 6961.73	95.53	6961.14
96.24	6960.58	96.98	6960.06		
	97.74 6959.57		98.53 6959.12	99.33	6958.71
100.16	6958.33	101.00	6958.00		

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

Slice	PoreWater	X-S	Normal	Test	Base			
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi
Weight	Force	Stress	Factor					
1	89.50	0.13	70.8	0.30	0.91	1	0.00	45.0
14.01	0.00	15.38	0.99					
2	89.80	0.43	68.1	0.34	0.91	1	0.00	45.0
47.43	0.00	50.43	0.96					
3	90.14	0.80	65.3	0.38	0.91	1	0.00	45.0
87.53	0.00	90.43	0.94					
4	90.51	0.57	62.6	0.21	0.45	1	0.00	45.0
62.29	0.00	125.45	0.91					
5	90.72	0.65	62.6	0.21	0.45	1	0.00	45.0
71.50	0.00	144.02	0.91					
6	90.93	0.80	59.9	0.23	0.45	1	0.00	45.0
87.90	0.00	173.02	0.89					
7	91.16	0.89	59.8	0.23	0.45	1	0.00	45.0
97.68	0.00	192.40	0.89					
8	91.38	1.05	57.2	0.25	0.45	1	0.00	45.0
116.00	0.00	223.78	0.87					
9	91.63	1.15	57.1	0.25	0.45	1	0.00	45.0
126.28	0.00	243.61	0.87					
10	91.88	1.33	54.4	0.26	0.45	1	0.00	45.0
146.30	0.00	277.56	0.86					
11	92.14	1.43	54.4	0.26	0.45	1	0.00	45.0
156.96	0.00	297.57	0.86					
12	92.40	1.62	51.7	0.28	0.45	1	0.00	45.0
178.40	0.00	333.09	0.85					
13	92.68	1.72	51.7	0.28	0.45	1	0.00	45.0
189.36	0.00	353.78	0.85					
14	92.96	1.93	48.9	0.30	0.45	1	0.00	45.0
211.96	0.00	391.04	0.84					
15	93.26	2.03	48.9	0.30	0.45	1	0.00	45.0
223.11	0.00	411.62	0.84					
16	93.56	2.24	46.2	0.31	0.45	1	0.00	45.0
246.58	0.00	450.12	0.83					
17	93.87	2.34	46.2	0.31	0.45	1	0.00	45.0
257.82	0.00	470.96	0.83					
18	94.19	2.56	43.5	0.33	0.45	1	0.00	45.0
281.88	0.00	510.84	0.82					

GALENA Results - Vert Highwall.txt

19	94.51	2.66	43.5	0.33	0.45	1	0.00	45.0
293.14	0.00		531.24	0.82				
20	94.84	2.89	40.7	0.34	0.45	1	0.00	45.0
317.51	0.00		572.38	0.82				
21	95.18	2.99	40.7	0.34	0.45	1	0.00	45.0
328.64	0.00		592.46	0.82				
22	95.53	3.21	38.1	0.36	0.45	1	0.00	45.0
353.03	0.00		633.97	0.81				
23	95.88	3.31	38.0	0.36	0.45	1	0.00	45.0
363.97	0.00		654.02	0.81				
24	96.24	3.53	35.3	0.37	0.45	1	0.00	45.0
388.10	0.00		697.05	0.81				
25	96.61	3.62	35.3	0.37	0.45	1	0.00	45.0
398.72	0.00		715.67	0.81				
26	96.98	3.84	32.6	0.38	0.45	1	0.00	45.0
422.33	0.00		759.30	0.81				
27	97.36	3.93	32.6	0.38	0.45	1	0.00	45.0
432.55	0.00		777.67	0.81				
28	97.74	2.75	29.8	0.26	0.30	1	0.00	45.0
302.48	0.00		819.13	0.82				
29	98.00	2.79	29.9	0.26	0.30	1	0.00	45.0
306.80	0.00		830.04	0.82				
30	98.27	2.83	29.8	0.26	0.30	1	0.00	45.0
311.11	0.00		842.51	0.82				
31	98.53	2.94	27.1	0.27	0.30	1	0.00	45.0
323.52	0.00		880.63	0.82				
32	98.80	2.98	27.1	0.27	0.30	1	0.00	45.0
327.56	0.00		892.51	0.82				
33	99.07	3.01	27.1	0.27	0.30	1	0.00	45.0
331.64	0.00		902.75	0.82				
34	99.33	3.79	24.4	0.33	0.37	1	0.00	45.0
416.47	0.00		943.82	0.83				
35	99.67	3.84	24.4	0.33	0.37	1	0.00	45.0
422.01	0.00		956.36	0.83				
36	100.00	1.69	24.4	0.16	0.17	1	0.00	45.0
186.16	0.00		886.69	0.83				
37	100.16	2.28	21.6	0.28	0.30	1	0.00	45.0
251.08	0.00		696.78	0.84				
38	100.44	1.37	21.6	0.28	0.30	1	0.00	45.0
150.65	0.00		418.07	0.84				
39	100.72	0.46	21.6	0.28	0.30	1	0.00	45.0
50.22	0.00		139.36	0.84				

X-S Area:	84.37	Path Length:	17.20	X-S Weight:
9280.72				

GALENA Results - Vert Highwall.txt

DATA: Analysis 2 - Vertical Highwall 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:	Unit weight of water/medium above ground:
62.400	62.400

Material Profiles (1 profile)

Profile: 1 (4 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00	6970.00	100.00	6970.00	101.00	6958.00
200.00	6958.00				

Slope Surface (4 points)

0.00	6970.00	100.00	6970.00	101.00	6958.00
200.00	6958.00				

Phreatic Surface (2 points)

0.00	6828.00	200.00	6828.00
------	---------	--------	---------

Piezometric Surfaces (1 surface)

Failure Surface (Critical, from previous analysis)

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

Intersects:	XL:	YL:	XR:	YR:
	89.50	6970.00	101.00	6958.00

Centre:	XC:	YC:	Radius:	R:
	107.59	6975.82		19.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	15.00	2.00	1.00

```

GALENA Results - Vert Highwall.txt
Trial positions within range:      75      75      1

```

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

There were: 3140 successful analyses from a total of 5625 trial surfaces
2485 analyses terminated due to unacceptable geometry

Results Summary - Lowest 99 Factor of Safety circles

Circle Radius	X-Left FoS	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre
1	97.00	6970.00	100.97	6958.32	116.00	6969.95
19.00	0.540	<-- Critical Surface				
2	97.00	6970.00	100.95	6958.65	116.00	6970.24
19.00	0.540					
3	97.00	6970.00	101.00	6958.00	116.00	6969.67
19.00	0.540					
4	97.00	6970.00	100.92	6958.97	115.99	6970.54
19.00	0.541					
5	97.00	6970.00	100.89	6959.30	115.98	6970.84
19.00	0.542					
6	97.00	6970.00	100.86	6959.62	115.96	6971.15
19.00	0.543					
7	97.00	6970.00	100.84	6959.95	115.94	6971.47
19.00	0.548					
8	97.00	6970.00	100.81	6960.27	115.91	6971.80
19.00	0.551					
9	97.00	6970.00	100.78	6960.59	115.88	6972.13
19.00	0.555					
10	96.80	6970.00	101.00	6958.00	115.80	6969.92
19.00	0.559					
11	96.80	6970.00	100.97	6958.32	115.80	6970.21
19.00	0.559					
12	97.00	6970.00	100.76	6960.92	115.84	6972.48
19.00	0.559					
13	96.80	6970.00	100.95	6958.65	115.79	6970.51

GALENA Results - Vert Highwall.txt

19.00	0.560					
14	96.80	6970.00	100.92	6958.97	115.78	6970.81
19.00	0.561					
15	96.80	6970.00	100.89	6959.30	115.76	6971.12
19.00	0.563					
16	96.80	6970.00	100.86	6959.62	115.74	6971.44
19.00	0.565					
17	97.00	6970.00	100.73	6961.24	115.79	6972.83
19.00	0.565					
18	96.80	6970.00	100.84	6959.95	115.72	6971.76
19.00	0.568					
19	96.80	6970.00	100.81	6960.27	115.68	6972.10
19.00	0.572					
20	97.00	6970.00	100.70	6961.57	115.73	6973.19
19.00	0.574					
21	96.59	6970.00	101.00	6958.00	115.59	6970.17
19.00	0.577					
22	96.59	6970.00	100.97	6958.32	115.59	6970.46
19.00	0.577					
23	96.80	6970.00	100.78	6960.59	115.64	6972.44
19.00	0.579					
24	96.59	6970.00	100.95	6958.65	115.58	6970.77
19.00	0.580					
25	97.00	6970.00	100.68	6961.89	115.66	6973.57
19.00	0.582					
26	96.59	6970.00	100.92	6958.97	115.56	6971.08
19.00	0.582					
27	96.80	6970.00	100.76	6960.92	115.59	6972.79
19.00	0.584					
28	96.59	6970.00	100.89	6959.30	115.54	6971.39
19.00	0.584					
29	96.59	6970.00	100.86	6959.62	115.52	6971.72
19.00	0.587					
30	96.80	6970.00	100.73	6961.24	115.53	6973.15
19.00	0.591					
31	96.59	6970.00	100.84	6959.95	115.48	6972.05
19.00	0.591					
32	97.00	6970.00	100.65	6962.22	115.58	6973.96
19.00	0.591					
33	96.59	6970.00	100.81	6960.27	115.44	6972.39
19.00	0.596					
34	96.39	6970.00	101.00	6958.00	115.39	6970.41
19.00	0.596					
35	96.39	6970.00	100.97	6958.32	115.38	6970.71
19.00	0.597					
36	96.80	6970.00	100.70	6961.57	115.47	6973.53
19.00	0.599					
37	96.39	6970.00	100.95	6958.65	115.36	6971.02

GALENA Results - Vert Highwall.txt

19.00	0.599					
38	96.59	6970.00	100.78	6960.59	115.40	6972.74
19.00	0.601					
39	96.39	6970.00	100.92	6958.97	115.34	6971.34
19.00	0.601					
40	97.00	6970.00	100.62	6962.54	115.49	6974.37
19.00	0.604					
41	96.39	6970.00	100.89	6959.30	115.32	6971.66
19.00	0.604					
42	96.39	6970.00	100.86	6959.62	115.29	6971.99
19.00	0.608					
43	96.59	6970.00	100.76	6960.92	115.34	6973.10
19.00	0.609					
44	96.80	6970.00	100.68	6961.89	115.39	6973.91
19.00	0.610					
45	96.39	6970.00	100.84	6959.95	115.25	6972.33
19.00	0.614					
46	97.00	6970.00	100.59	6962.86	115.39	6974.79
19.00	0.616					
47	96.19	6970.00	101.00	6958.00	115.18	6970.65
19.00	0.616					
48	96.59	6970.00	100.73	6961.24	115.28	6973.47
19.00	0.617					
49	96.19	6970.00	100.97	6958.32	115.17	6970.96
19.00	0.618					
50	96.39	6970.00	100.81	6960.27	115.20	6972.67
19.00	0.619					
51	96.19	6970.00	100.95	6958.65	115.15	6971.27
19.00	0.620					
52	96.80	6970.00	100.65	6962.22	115.30	6974.31
19.00	0.620					
53	96.19	6970.00	100.92	6958.97	115.12	6971.59
19.00	0.623					
54	96.39	6970.00	100.78	6960.59	115.15	6973.03
19.00	0.626					
55	96.59	6970.00	100.70	6961.57	115.20	6973.85
19.00	0.626					
56	96.19	6970.00	100.89	6959.30	115.09	6971.92
19.00	0.626					
57	96.19	6970.00	100.86	6959.62	115.05	6972.26
19.00	0.631					
58	97.00	6970.00	100.57	6963.19	115.27	6975.23
19.00	0.631					
59	96.80	6970.00	100.62	6962.54	115.20	6974.73
19.00	0.632					
60	96.39	6970.00	100.76	6960.92	115.09	6973.40
19.00	0.633					
61	95.99	6970.00	101.00	6958.00	114.97	6970.88

GALENA Results - Vert Highwall.txt

19.00	0.635					
62	96.19	6970.00	100.84	6959.95	115.01	6972.60
19.00	0.636					
63	96.59	6970.00	100.68	6961.89	115.12	6974.24
19.00	0.636					
64	95.99	6970.00	100.97	6958.32	114.95	6971.20
19.00	0.637					
65	95.99	6970.00	100.95	6958.65	114.93	6971.52
19.00	0.639					
66	96.39	6970.00	100.73	6961.24	115.01	6973.77
19.00	0.642					
67	96.19	6970.00	100.81	6960.27	114.96	6972.95
19.00	0.642					
68	95.99	6970.00	100.92	6958.97	114.90	6971.84
19.00	0.643					
69	95.99	6970.00	100.89	6959.30	114.86	6972.18
19.00	0.647					
70	96.80	6970.00	100.59	6962.86	115.08	6975.15
19.00	0.648					
71	97.00	6970.00	100.54	6963.51	115.13	6975.69
19.00	0.649					
72	96.59	6970.00	100.65	6962.22	115.02	6974.65
19.00	0.650					
73	96.19	6970.00	100.78	6960.59	114.90	6973.31
19.00	0.651					
74	96.39	6970.00	100.70	6961.57	114.93	6974.16
19.00	0.653					
75	95.99	6970.00	100.86	6959.62	114.82	6972.52
19.00	0.654					
76	95.78	6970.00	101.00	6958.00	114.75	6971.11
19.00	0.655					
77	95.78	6970.00	100.97	6958.32	114.73	6971.43
19.00	0.658					
78	96.19	6970.00	100.76	6960.92	114.83	6973.69
19.00	0.659					
79	95.99	6970.00	100.84	6959.95	114.77	6972.87
19.00	0.660					
80	95.78	6970.00	100.95	6958.65	114.70	6971.75
19.00	0.661					
81	96.59	6970.00	100.62	6962.54	114.91	6975.07
19.00	0.663					
82	96.80	6970.00	100.57	6963.19	114.95	6975.60
19.00	0.664					
83	96.39	6970.00	100.68	6961.89	114.84	6974.56
19.00	0.665					
84	95.78	6970.00	100.92	6958.97	114.67	6972.09
19.00	0.665					
85	95.99	6970.00	100.81	6960.27	114.71	6973.22

GALENA Results - Vert Highwall.txt

19.00	0.667					
86	96.19	6970.00	100.73	6961.24	114.75	6974.07
19.00	0.669					
87	97.00	6970.00	100.51	6963.84	114.97	6976.16
19.00	0.669					
88	95.78	6970.00	100.89	6959.30	114.63	6972.42
19.00	0.670					
89	95.58	6970.00	101.00	6958.00	114.53	6971.34
19.00	0.674					
90	95.99	6970.00	100.78	6960.59	114.64	6973.59
19.00	0.675					
91	95.78	6970.00	100.86	6959.62	114.58	6972.77
19.00	0.676					
92	95.58	6970.00	100.97	6958.32	114.51	6971.66
19.00	0.677					
93	96.39	6970.00	100.65	6962.22	114.73	6974.97
19.00	0.678					
94	96.59	6970.00	100.59	6962.86	114.78	6975.51
19.00	0.679					
95	96.19	6970.00	100.70	6961.57	114.66	6974.46
19.00	0.680					
96	95.58	6970.00	100.95	6958.65	114.48	6971.99
19.00	0.681					
97	95.78	6970.00	100.84	6959.95	114.53	6973.12
19.00	0.682					
98	95.99	6970.00	100.76	6960.92	114.57	6973.97
19.00	0.684					
99	96.80	6970.00	100.54	6963.51	114.80	6976.07
19.00	0.684					

Critical Failure Surface (circle 1)

Intersects: XL: 97.00 YL: 6970.00 XR: 100.97 YR: 6958.32

Centre: XC: 116.00 YC: 6969.95 Radius: R: 19.00

Generated failure surface: (20 points)

97.00	6970.00	97.01	6969.34	97.04	6968.68
97.10	6968.02	97.18	6967.36		
97.28	6966.71	97.40	6966.06	97.55	6965.42
97.72	6964.78	97.91	6964.14		
98.12	6963.52	98.36	6962.90	98.61	6962.29
98.89	6961.69	99.19	6961.10		
99.51	6960.52	99.84	6959.95	100.20	6959.40
100.58	6958.85	100.97	6958.32		

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

GALENA Results - Vert Highwall.txt

Slice	X-S	----- Base -----						
	PoreWater	Normal	Test					
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi
Weight	Force	Stress		Factor				
1	97.00	0.04	88.2	0.04	1.32	1	0.00	45.0
4.18	0.00	1.68		0.53				
2	97.04	0.09	85.2	0.06	0.66	1	0.00	45.0
10.12	0.00	7.93		0.52				
3	97.10	0.18	83.2	0.08	0.66	1	0.00	45.0
19.96	0.00	15.42		0.51				
4	97.18	0.30	81.2	0.10	0.66	1	0.00	45.0
33.05	0.00	25.20		0.50				
5	97.28	0.45	79.2	0.12	0.66	1	0.00	45.0
49.33	0.00	37.17		0.50				
6	97.40	0.30	77.2	0.07	0.33	1	0.00	45.0
33.05	0.00	49.32		0.49				
7	97.48	0.32	77.2	0.07	0.33	1	0.00	45.0
35.66	0.00	53.20		0.49				
8	97.55	0.40	75.2	0.08	0.33	1	0.00	45.0
44.07	0.00	65.10		0.49				
9	97.63	0.43	75.2	0.08	0.33	1	0.00	45.0
47.04	0.00	69.58		0.49				
10	97.72	0.51	73.2	0.10	0.33	1	0.00	45.0
56.54	0.00	82.95		0.48				
11	97.81	0.54	73.2	0.10	0.33	1	0.00	45.0
59.86	0.00	87.83		0.48				
12	97.91	0.64	71.2	0.11	0.33	1	0.00	45.0
70.41	0.00	102.61		0.48				
13	98.02	0.67	71.2	0.11	0.33	1	0.00	45.0
74.07	0.00	107.94		0.48				
14	98.12	0.78	69.2	0.12	0.33	1	0.00	45.0
85.62	0.00	124.28		0.48				
15	98.24	0.81	69.2	0.12	0.33	1	0.00	45.0
89.60	0.00	129.90		0.48				
16	98.36	0.93	67.2	0.13	0.33	1	0.00	45.0
102.08	0.00	147.25		0.48				
17	98.48	0.97	67.2	0.13	0.33	1	0.00	45.0
106.38	0.00	153.65		0.48				
18	98.61	0.72	65.2	0.09	0.22	1	0.00	45.0
79.31	0.00	171.24		0.48				
19	98.70	0.74	65.2	0.09	0.22	1	0.00	45.0
81.34	0.00	175.97		0.48				
20	98.80	0.76	65.2	0.09	0.22	1	0.00	45.0
83.37	0.00	180.01		0.48				
21	98.89	0.83	63.2	0.10	0.22	1	0.00	45.0
91.78	0.00	197.91		0.48				
22	98.99	0.85	63.2	0.10	0.22	1	0.00	45.0
93.92	0.00	202.53		0.48				

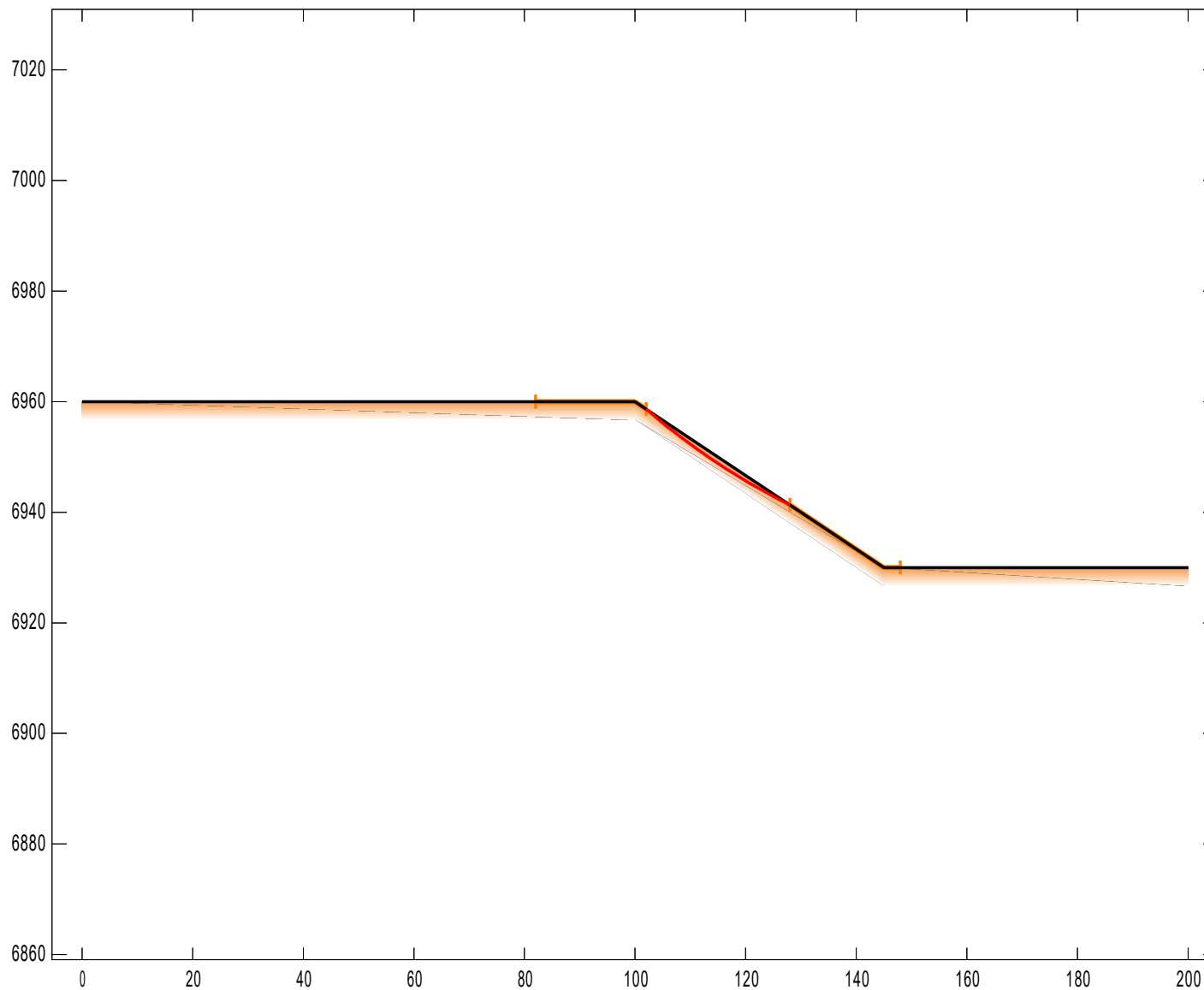
GALENA Results - Vert Highwall.txt

23	99.09	0.87	63.2	0.10	0.22	1	0.00	45.0
96.07	0.00	207.17	0.48					
24	99.19	0.95	61.2	0.11	0.22	1	0.00	45.0
104.91	0.00	226.46	0.48					
25	99.29	0.97	61.3	0.11	0.22	1	0.00	45.0
107.17	0.00	230.88	0.48					
26	99.40	0.99	61.2	0.11	0.22	1	0.00	45.0
109.41	0.00	236.17	0.48					
27	99.51	1.08	59.3	0.11	0.22	1	0.00	45.0
118.65	0.00	255.93	0.48					
28	99.62	1.10	59.3	0.11	0.22	1	0.00	45.0
121.01	0.00	261.01	0.48					
29	99.73	1.12	59.3	0.11	0.22	1	0.00	45.0
123.34	0.00	266.06	0.48					
30	99.84	0.79	57.3	0.08	0.15	1	0.00	45.0
87.16	0.00	286.24	0.48					
31	99.92	0.80	57.2	0.08	0.14	1	0.00	45.0
88.21	0.00	290.56	0.48					
32	100.00	0.98	57.3	0.10	0.19	1	0.00	45.0
107.86	0.00	276.69	0.48					
33	100.10	0.88	57.3	0.10	0.19	1	0.00	45.0
96.28	0.00	246.99	0.48					
34	100.20	0.95	55.3	0.13	0.22	1	0.00	45.0
104.02	0.00	225.57	0.48					
35	100.33	0.78	55.2	0.13	0.22	1	0.00	45.0
85.70	0.00	186.22	0.48					
36	100.45	0.61	55.3	0.13	0.22	1	0.00	45.0
67.39	0.00	146.15	0.48					
37	100.58	0.46	53.3	0.13	0.22	1	0.00	45.0
50.94	0.00	110.93	0.48					
38	100.71	0.28	53.2	0.13	0.22	1	0.00	45.0
30.57	0.00	66.70	0.48					
39	100.84	0.09	53.3	0.13	0.22	1	0.00	45.0
10.19	0.00	22.19	0.48					

X-S Area:	26.00	Path Length:	12.56	X-S Weight:
2859.63				

GALENA Slope Stability Analysis – 1.5H:1V Slope

The GALENA data attached show the minimum FOS of a 1.5H1V slope that is 30 feet tall. This is the slope nearest the gasline north of Area 1.



GALENA Version 7.1

Licensed to: Greg Lewicki and Associates

Material Keys

1: Sand and gravel, mixed grain size

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.51

Project Robinson Sons Pit 1
1.5H:1V Highwall Stability

File: E:\Work\Dropbox (GLA)\Robinson\DRMS\1.5 to 1 Slope Stability.gmf

Edited: 12 Dec 2018
Processed: 12 Dec 2018

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GALENA 7.1 Analysis Results
Associates

Version: 7.10.1.02

Licensee: Greg Lewicki and

Project: Robinson Sons Pit 1

File: E:\Work\Dropbox (GLA)\Robinsons\DRMS\1.5 to 1 Slope

Stability.gmf

Processed: 12 Dec 2018 09:26:36

DATA: Analysis 1 - 1.5H:1V Highwall 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: 62.400

Material Profiles (1 profile)

Profile: 1 (4 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00	6960.00	100.00	6960.00	145.00	6930.00	200.00
6930.00						

Slope Surface (4 points)

0.00	6960.00	100.00	6960.00	145.00	6930.00	200.00
6930.00						

Phreatic Surface (2 points)

0.00	6828.00	200.00	6828.00
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Piezometric Surfaces (1 surface)

Failure Surface

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

Intersects:	XL:	92.00	YL:	6960.00	XR:	138.00	YR:	6934.67
Centre:	XC:	161.55	YC:	7031.85	Radius:	R:	100.00	

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	20.00	20.00	50.00
Trial positions within range:	20	20	50

RESULTS: Analysis 1 - 1.5H:1V Highwall 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: 1.787

There were: 17039 successful analyses from a total of 20001 trial surfaces
 2962 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.51

Results Summary - Lowest 99 Factor of Safety circles

Circle FoS	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius
1	102.00	6958.67	128.00	6941.33	183.79	7053.19	125.00
1.513	<-- Critical Surface						
2	102.00	6958.67	128.00	6941.33	183.22	7052.34	123.98
1.513							
3	102.00	6958.67	128.00	6941.33	182.65	7051.48	122.96
1.514							
4	102.00	6958.67	128.00	6941.33	182.08	7050.62	121.94
1.514							
5	102.00	6958.67	128.00	6941.33	181.51	7049.77	120.92
1.514							
6	100.95	6959.37	128.00	6941.33	183.22	7053.47	125.00
1.514							
7	102.00	6958.67	129.05	6940.63	184.28	7052.77	125.00
1.514							
8	102.00	6958.67	128.00	6941.33	180.94	7048.91	119.90
1.514							
9	102.00	6958.67	129.05	6940.63	183.70	7051.92	123.98
1.514							
10	100.95	6959.37	128.00	6941.33	182.65	7052.62	123.98
1.514							
11	102.00	6958.67	128.00	6941.33	180.37	7048.05	118.88
1.515							
12	102.00	6958.67	129.05	6940.63	183.13	7051.06	122.96
1.515							
13	100.95	6959.37	128.00	6941.33	182.08	7051.76	122.96
1.515							
14	102.00	6958.67	128.00	6941.33	179.80	7047.20	117.86
1.515							
15	102.00	6958.67	129.05	6940.63	182.56	7050.20	121.94
1.515							
16	100.95	6959.37	128.00	6941.33	181.51	7050.90	121.94
1.515							
17	102.00	6958.67	128.00	6941.33	179.23	7046.34	116.84
1.515							
18	102.00	6958.67	129.05	6940.63	181.99	7049.35	120.92
1.515							
19	100.95	6959.37	128.00	6941.33	180.94	7050.05	120.92
1.515							
20	102.00	6958.67	128.00	6941.33	178.66	7045.48	115.82
1.515							
21	100.95	6959.37	129.05	6940.63	183.70	7053.05	125.00
1.515							
22	102.00	6958.67	130.11	6939.93	184.75	7052.35	125.00
1.515							
23	100.95	6959.37	128.00	6941.33	180.37	7049.19	119.90
1.516							
24	102.00	6958.67	129.05	6940.63	181.42	7048.49	119.90
1.516							
25	102.00	6958.67	128.00	6941.33	178.08	7044.63	114.80
1.516							
26	100.95	6959.37	129.05	6940.63	183.13	7052.19	123.98
1.516							
27	102.00	6958.67	130.11	6939.93	184.18	7051.49	123.98
1.516							
28	100.95	6959.37	128.00	6941.33	179.80	7048.33	118.88
1.516							

29	102.00	6958.67	129.05	6940.63	180.85	7047.63	118.88
1.516							
30	100.95	6959.37	129.05	6940.63	182.56	7051.34	122.96
1.516							
31	102.00	6958.67	128.00	6941.33	177.51	7043.77	113.78
1.516							
32	99.89	6960.00	128.00	6941.33	182.47	7053.84	125.00
1.516							
33	102.00	6958.67	130.11	6939.93	183.61	7050.64	122.96
1.516							
34	100.95	6959.37	128.00	6941.33	179.22	7047.48	117.86
1.516							
35	102.00	6958.67	129.05	6940.63	180.28	7046.77	117.86
1.516							
36	100.95	6959.37	129.05	6940.63	181.99	7050.48	121.94
1.516							
37	99.89	6960.00	128.00	6941.33	181.90	7052.98	123.98
1.516							
38	102.00	6958.67	130.11	6939.93	183.04	7049.78	121.94
1.516							
39	102.00	6958.67	128.00	6941.33	176.94	7042.91	112.76
1.516							
40	102.00	6958.67	129.05	6940.63	179.71	7045.92	116.84
1.516							
41	100.95	6959.37	128.00	6941.33	178.65	7046.62	116.84
1.516							
42	99.89	6960.00	128.00	6941.33	181.33	7052.12	122.96
1.516							
43	100.95	6959.37	129.05	6940.63	181.42	7049.62	120.92
1.516							
44	102.00	6958.67	130.11	6939.93	182.47	7048.92	120.92
1.516							
45	102.00	6958.67	128.00	6941.33	176.37	7042.06	111.73
1.517							
46	102.00	6958.67	131.16	6939.23	185.23	7051.93	125.00
1.517							
47	100.95	6959.37	130.11	6939.93	184.18	7052.63	125.00
1.517							
48	100.95	6959.37	128.00	6941.33	178.08	7045.76	115.82
1.517							
49	102.00	6958.67	129.05	6940.63	179.13	7045.06	115.82
1.517							
50	99.89	6960.00	128.00	6941.33	180.76	7051.27	121.94
1.517							
51	100.95	6959.37	129.05	6940.63	180.85	7048.77	119.90
1.517							
52	102.00	6958.67	130.11	6939.93	181.90	7048.06	119.90
1.517							
53	102.00	6958.67	128.00	6941.33	175.80	7041.20	110.71
1.517							
54	102.00	6958.67	131.16	6939.23	184.66	7051.07	123.98
1.517							
55	100.95	6959.37	130.11	6939.93	183.61	7051.77	123.98
1.517							
56	102.00	6958.67	129.05	6940.63	178.56	7044.20	114.80
1.517							
57	100.95	6959.37	128.00	6941.33	177.51	7044.90	114.80
1.517							
58	99.89	6960.00	128.00	6941.33	180.19	7050.41	120.92
1.517							
59	100.95	6959.37	129.05	6940.63	180.27	7047.91	118.88
1.517							
60	102.00	6958.67	130.11	6939.93	181.33	7047.21	118.88
1.517							
61	99.89	6960.00	129.05	6940.63	182.96	7053.41	125.00
1.517							

62	102.00	6958.67	128.00	6941.33	175.23	7040.34	109.69
1.517							
63	100.95	6959.37	130.11	6939.93	183.04	7050.91	122.96
1.517							
64	102.00	6958.67	131.16	6939.23	184.09	7050.21	122.96
1.517							
65	102.00	6958.67	129.05	6940.63	177.99	7043.34	113.78
1.517							
66	100.95	6959.37	128.00	6941.33	176.94	7044.05	113.78
1.517							
67	99.89	6960.00	128.00	6941.33	179.62	7049.55	119.90
1.517							
68	100.95	6959.37	129.05	6940.63	179.70	7047.05	117.86
1.517							
69	102.00	6958.67	130.11	6939.93	180.75	7046.35	117.86
1.517							
70	99.89	6960.00	129.05	6940.63	182.39	7052.55	123.98
1.517							
71	100.95	6959.37	130.11	6939.93	182.46	7050.05	121.94
1.517							
72	102.00	6958.67	128.00	6941.33	174.65	7039.48	108.67
1.518							
73	102.00	6958.67	131.16	6939.23	183.52	7049.35	121.94
1.518							
74	102.00	6958.67	129.05	6940.63	177.42	7042.49	112.76
1.518							
75	100.95	6959.37	128.00	6941.33	176.37	7043.19	112.76
1.518							
76	99.89	6960.00	128.00	6941.33	179.05	7048.69	118.88
1.518							
77	100.95	6959.37	129.05	6940.63	179.13	7046.19	116.84
1.518							
78	102.00	6958.67	130.11	6939.93	180.18	7045.49	116.84
1.518							
79	99.89	6960.00	129.05	6940.63	181.82	7051.69	122.96
1.518							
80	100.95	6959.37	130.11	6939.93	181.89	7049.20	120.92
1.518							
81	102.00	6958.67	131.16	6939.23	182.94	7048.50	120.92
1.518							
82	102.00	6958.67	128.00	6941.33	174.08	7038.62	107.65
1.518							
83	102.00	6958.67	132.21	6938.53	185.71	7051.50	125.00
1.518							
84	100.95	6959.37	131.16	6939.23	184.66	7052.20	125.00
1.518							
85	102.00	6958.67	129.05	6940.63	176.85	7041.63	111.73
1.518							
86	100.95	6959.37	128.00	6941.33	175.79	7042.33	111.73
1.518							
87	99.89	6960.00	128.00	6941.33	178.48	7047.83	117.86
1.518							
88	99.89	6960.00	129.05	6940.63	181.25	7050.84	121.94
1.518							
89	100.95	6959.37	129.05	6940.63	178.56	7045.33	115.82
1.518							
90	102.00	6958.67	130.11	6939.93	179.61	7044.63	115.82
1.518							
91	102.00	6958.67	131.16	6939.23	182.37	7047.64	119.90
1.518							
92	100.95	6959.37	130.11	6939.93	181.32	7048.34	119.90
1.518							
93	102.00	6958.67	132.21	6938.53	185.13	7050.64	123.98
1.518							
94	100.95	6959.37	131.16	6939.23	184.08	7051.34	123.98
1.518							

95	102.00	6958.67	128.00	6941.33	173.51	7037.77	106.63
1.518							
96	99.89	6960.00	128.00	6941.33	177.91	7046.97	116.84
1.518							
97	102.00	6958.67	129.05	6940.63	176.27	7040.77	110.71
1.518							
98	100.95	6959.37	128.00	6941.33	175.22	7041.47	110.71
1.518							
99	99.89	6960.00	129.05	6940.63	180.68	7049.98	120.92
1.518							

Critical Failure Surface (circle 1)

Intersects: XL: 102.00 YL: 6958.67 XR: 128.00 YR: 6941.33
 Centre: XC: 183.79 YC: 7053.19 Radius: R: 125.00

Generated failure surface: (20 points)

102.00	6958.67	103.25	6957.60	104.52	6956.54	105.80
6955.50	107.10	6954.48				
108.41	6953.48	109.73	6952.50	111.06	6951.53	112.41
6950.58	113.77	6949.64				
115.14	6948.73	116.53	6947.83	117.92	6946.95	119.33
6946.10	120.75	6945.25				
122.18	6944.43	123.62	6943.63	125.07	6942.84	126.53
6942.08	128.00	6941.33				

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	102.00	0.04	40.5	0.63	0.82	1	0.00	45.0	
4.04	0.00		4.12	0.84					
2	102.63	0.11	40.5	0.63	0.82	1	0.00	45.0	
12.16	0.00		12.40	0.84					
3	103.25	0.18	39.7	0.63	0.82	1	0.00	45.0	
20.02	0.00		20.39	0.84					
4	103.89	0.25	39.7	0.63	0.82	1	0.00	45.0	
27.28	0.00		27.77	0.84					
5	104.52	0.31	39.0	0.64	0.82	1	0.00	45.0	
34.46	0.00		35.03	0.84					
6	105.16	0.37	39.0	0.64	0.82	1	0.00	45.0	
40.93	0.00		41.60	0.84					
7	105.80	0.43	38.2	0.65	0.82	1	0.00	45.0	
47.38	0.00		48.11	0.84					
8	106.45	0.48	38.2	0.65	0.82	1	0.00	45.0	
52.98	0.00		53.81	0.84					
9	107.10	0.53	37.5	0.65	0.82	1	0.00	45.0	
58.70	0.00		59.52	0.84					
10	107.75	0.58	37.5	0.65	0.82	1	0.00	45.0	
63.41	0.00		64.32	0.84					
11	108.41	0.62	36.7	0.66	0.82	1	0.00	45.0	
68.33	0.00		69.27	0.84					
12	109.07	0.66	36.7	0.66	0.82	1	0.00	45.0	
72.10	0.00		73.08	0.84					
13	109.73	0.69	35.9	0.67	0.82	1	0.00	45.0	
76.17	0.00		77.16	0.84					
14	110.40	0.72	36.0	0.67	0.82	1	0.00	45.0	
79.04	0.00		80.04	0.84					
15	111.06	0.75	35.2	0.67	0.82	1	0.00	45.0	
82.21	0.00		83.21	0.83					
16	111.74	0.76	35.2	0.67	0.82	1	0.00	45.0	
84.13	0.00		85.18	0.83					
17	112.41	0.79	34.4	0.68	0.82	1	0.00	45.0	
86.36	0.00		87.41	0.83					
18	113.09	0.79	34.4	0.68	0.82	1	0.00	45.0	

87.39	0.00	88.44	0.83					
19	113.77	0.81	33.7	0.69	0.82	1	0.00	45.0
88.62	0.00	89.66	0.83					
20	114.46	0.81	33.7	0.69	0.82	1	0.00	45.0
88.65	0.00	89.72	0.83					
21	115.14	0.81	32.9	0.69	0.82	1	0.00	45.0
88.90	0.00	89.96	0.83					
22	115.84	0.80	32.9	0.69	0.82	1	0.00	45.0
87.90	0.00	88.95	0.83					
23	116.53	0.79	32.2	0.70	0.82	1	0.00	45.0
87.18	0.00	88.22	0.83					
24	117.23	0.77	32.2	0.70	0.82	1	0.00	45.0
85.16	0.00	86.20	0.83					
25	117.92	0.76	31.4	0.70	0.82	1	0.00	45.0
83.33	0.00	84.38	0.83					
26	118.63	0.73	31.4	0.70	0.82	1	0.00	45.0
80.30	0.00	81.31	0.83					
27	119.33	0.70	30.7	0.71	0.82	1	0.00	45.0
77.36	0.00	78.35	0.84					
28	120.04	0.67	30.7	0.71	0.82	1	0.00	45.0
73.28	0.00	74.25	0.84					
29	120.75	0.63	29.9	0.71	0.82	1	0.00	45.0
69.25	0.00	70.20	0.84					
30	121.46	0.58	29.9	0.71	0.82	1	0.00	45.0
64.10	0.00	64.99	0.84					
31	122.18	0.54	29.1	0.72	0.82	1	0.00	45.0
58.90	0.00	59.78	0.84					
32	122.90	0.48	29.2	0.72	0.82	1	0.00	45.0
52.71	0.00	53.48	0.84					
33	123.62	0.42	28.4	0.73	0.82	1	0.00	45.0
46.32	0.00	47.05	0.84					
34	124.34	0.35	28.4	0.73	0.82	1	0.00	45.0
39.03	0.00	39.65	0.84					
35	125.07	0.29	27.6	0.73	0.82	1	0.00	45.0
31.42	0.00	31.96	0.84					
36	125.80	0.21	27.7	0.73	0.82	1	0.00	45.0
23.03	0.00	23.42	0.84					
37	126.53	0.13	26.9	0.73	0.82	1	0.00	45.0
14.21	0.00	14.48	0.84					
38	127.26	0.04	26.9	0.74	0.82	1	0.00	45.0
4.74	0.00	4.83	0.84					

X-S Area: 20.38

Path Length: 31.33

X-S Weight: 2241.46

DATA: Analysis 2 - 1.5H:1V Highwall 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: 62.400

Material Profiles (1 profile)

Profile: 1 (4 points) Material beneath: 1 - Sand and gravel, mixed grain size

0.00	6960.00	100.00	6960.00	145.00	6930.00	200.00
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6930.00

Slope Surface (4 points)

0.00	6960.00	100.00	6960.00	145.00	6930.00	200.00
6930.00						

Phreatic Surface (2 points)

0.00	6828.00	200.00	6828.00
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Piezometric Surfaces (1 surface)

Failure Surface (Critical, from previous analysis)

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

Intersects:	XL:	102.00	YL:	6958.67	XR:	128.00	YR:	6941.33
	Centre:	XC:	183.79	YC:	7053.19		Radius:	R: 125.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	20.00	20.00	20.00
Trial positions within range:	20	20	20

RESULTS: Analysis 2 - 1.5H:1V Highwall 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: 1.513

There were: 8001 successful analyses from a total of 8001 trial surfaces

Critical (minimum) Factor of Safety: 1.50

Results Summary - Lowest 99 Factor of Safety circles

Circle FoS	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius
1	112.00	6952.00	118.00	6948.00	185.77	7056.15	127.63
1.500	<-- Critical Surface						
2	112.00	6952.00	118.00	6948.00	188.69	7060.53	132.89
1.500							
3	112.00	6952.00	118.00	6948.00	189.27	7061.41	133.95
1.500							
4	112.00	6952.00	118.00	6948.00	187.52	7058.78	130.79
1.500							
5	112.00	6952.00	118.00	6948.00	184.60	7054.40	125.53
1.500							
6	112.00	6952.00	118.00	6948.00	188.11	7059.66	131.84
1.500							
7	112.00	6952.00	118.00	6948.00	183.43	7052.65	123.42
1.500							
8	112.00	6952.00	118.00	6948.00	185.18	7055.28	126.58
1.500							
9	112.00	6952.00	118.00	6948.00	182.85	7051.77	122.37
1.500							
10	112.00	6952.00	118.00	6948.00	189.86	7062.29	135.00
1.500							

11	112.00	6952.00	118.00	6948.00	186.94	7057.91	129.74
1.500							
12	112.00	6952.00	118.00	6948.00	186.35	7057.03	128.68
1.500							
13	112.00	6952.00	118.00	6948.00	182.26	7050.90	121.32
1.500							
14	112.00	6952.00	118.00	6948.00	184.02	7053.52	124.47
1.500							
15	112.00	6952.00	118.00	6948.00	179.34	7046.52	116.05
1.500							
16	112.00	6952.00	118.00	6948.00	179.93	7047.39	117.11
1.500							
17	112.00	6952.00	119.05	6947.30	189.79	7061.04	133.95
1.500							
18	112.00	6952.00	118.00	6948.00	181.68	7050.02	120.26
1.500							
19	112.00	6952.00	118.00	6948.00	180.51	7048.27	118.16
1.500							
20	112.00	6952.00	118.00	6948.00	181.10	7049.14	119.21
1.500							
21	112.00	6952.00	119.05	6947.30	190.37	7061.92	135.00
1.500							
22	110.95	6952.70	118.00	6948.00	189.32	7062.62	135.00
1.500							
23	110.95	6952.70	118.00	6948.00	187.57	7059.99	131.84
1.500							
24	112.00	6952.00	119.05	6947.30	188.62	7059.29	131.84
1.500							
25	110.95	6952.70	118.00	6948.00	185.82	7057.37	128.68
1.500							
26	110.95	6952.70	118.00	6948.00	188.74	7061.75	133.95
1.500							
27	112.00	6952.00	119.05	6947.30	188.04	7058.42	130.79
1.500							
28	110.95	6952.70	118.00	6948.00	185.23	7056.49	127.63
1.500							
29	112.00	6952.00	119.05	6947.30	186.87	7056.66	128.68
1.500							
30	112.00	6952.00	118.00	6948.00	178.76	7045.64	115.00
1.500							
31	110.95	6952.70	118.00	6948.00	186.98	7059.12	130.79
1.500							
32	110.95	6952.70	118.00	6948.00	184.06	7054.74	125.53
1.500							
33	110.95	6952.70	118.00	6948.00	184.65	7055.61	126.58
1.500							
34	110.95	6952.70	118.00	6948.00	186.40	7058.24	129.74
1.500							
35	112.00	6952.00	119.05	6947.30	185.12	7054.03	125.53
1.500							
36	110.95	6952.70	118.00	6948.00	188.15	7060.87	132.89
1.500							
37	112.00	6952.00	119.05	6947.30	189.20	7060.17	132.89
1.500							
38	112.00	6952.00	119.05	6947.30	185.70	7054.91	126.58
1.500							
39	110.95	6952.70	118.00	6948.00	181.73	7051.23	121.32
1.500							
40	112.00	6952.00	119.05	6947.30	187.45	7057.54	129.74
1.500							
41	110.95	6952.70	118.00	6948.00	181.14	7050.35	120.26
1.500							
42	112.00	6952.00	119.05	6947.30	183.95	7052.28	123.42
1.500							
43	110.95	6952.70	118.00	6948.00	182.89	7052.98	123.42
1.500							

44	112.00	6952.00	119.05	6947.30	186.28	7055.79	127.63
1.500							
45	112.00	6952.00	119.05	6947.30	184.53	7053.16	124.47
1.500							
46	110.95	6952.70	118.00	6948.00	182.31	7052.11	122.37
1.500							
47	112.00	6952.00	119.05	6947.30	182.78	7050.53	121.32
1.500							
48	112.00	6952.00	119.05	6947.30	183.36	7051.41	122.37
1.500							
49	109.89	6953.40	118.00	6948.00	188.78	7062.96	135.00
1.500							
50	110.95	6952.70	118.00	6948.00	183.48	7053.86	124.47
1.500							
51	110.95	6952.70	118.00	6948.00	180.56	7049.48	119.21
1.500							
52	112.00	6952.00	119.05	6947.30	182.19	7049.65	120.26
1.500							
53	112.00	6952.00	119.05	6947.30	180.44	7047.02	117.11
1.500							
54	112.00	6952.00	119.05	6947.30	181.61	7048.78	119.21
1.500							
55	112.00	6952.00	119.05	6947.30	181.03	7047.90	118.16
1.500							
56	110.95	6952.70	118.00	6948.00	179.97	7048.60	118.16
1.500							
57	110.95	6952.70	119.05	6947.30	188.67	7060.50	132.89
1.500							
58	110.95	6952.70	119.05	6947.30	189.83	7062.25	135.00
1.500							
59	109.89	6953.40	118.00	6948.00	188.20	7062.08	133.95
1.500							
60	110.95	6952.70	119.05	6947.30	189.25	7061.38	133.95
1.501							
61	112.00	6952.00	120.11	6946.60	189.72	7059.80	132.89
1.501							
62	112.00	6952.00	119.05	6947.30	179.27	7045.27	115.00
1.501							
63	112.00	6952.00	119.05	6947.30	179.86	7046.15	116.05
1.501							
64	109.89	6953.40	118.00	6948.00	187.61	7061.20	132.89
1.501							
65	110.95	6952.70	118.00	6948.00	179.39	7047.73	117.11
1.501							
66	112.00	6952.00	120.11	6946.60	190.89	7061.55	135.00
1.501							
67	110.95	6952.70	118.00	6948.00	178.80	7046.85	116.05
1.501							
68	110.95	6952.70	119.05	6947.30	187.50	7058.75	130.79
1.501							
69	110.95	6952.70	119.05	6947.30	188.08	7059.63	131.84
1.501							
70	112.00	6952.00	120.11	6946.60	189.13	7058.92	131.84
1.501							
71	112.00	6952.00	120.11	6946.60	188.55	7058.05	130.79
1.501							
72	112.00	6952.00	120.11	6946.60	190.30	7060.68	133.95
1.501							
73	112.00	6952.00	120.11	6946.60	187.97	7057.17	129.74
1.501							
74	109.89	6953.40	118.00	6948.00	185.86	7058.57	129.74
1.501							
75	109.89	6953.40	118.00	6948.00	187.03	7060.33	131.84
1.501							
76	110.95	6952.70	119.05	6947.30	185.74	7056.12	127.63
1.501							

77	110.95	6952.70	118.00	6948.00	178.22	7045.97	115.00
1.501							
78	109.89	6953.40	118.00	6948.00	185.28	7057.70	128.68
1.501							
79	112.00	6952.00	120.11	6946.60	185.63	7053.67	125.53
1.501							
80	110.95	6952.70	119.05	6947.30	186.91	7057.87	129.74
1.501							
81	112.00	6952.00	120.11	6946.60	187.38	7056.29	128.68
1.501							
82	112.00	6952.00	120.11	6946.60	186.80	7055.42	127.63
1.501							
83	110.95	6952.70	119.05	6947.30	186.33	7057.00	128.68
1.501							
84	109.89	6953.40	118.00	6948.00	184.69	7056.82	127.63
1.501							
85	112.00	6952.00	120.11	6946.60	186.21	7054.54	126.58
1.501							
86	109.89	6953.40	118.00	6948.00	186.44	7059.45	130.79
1.501							
87	109.89	6953.40	118.00	6948.00	184.11	7055.94	126.58
1.501							
88	110.95	6952.70	119.05	6947.30	185.16	7055.24	126.58
1.501							
89	109.89	6953.40	118.00	6948.00	182.35	7053.32	123.42
1.501							
90	109.89	6953.40	118.00	6948.00	183.52	7055.07	125.53
1.501							
91	109.89	6953.40	118.00	6948.00	182.94	7054.19	124.47
1.501							
92	112.00	6952.00	120.11	6946.60	183.88	7051.04	122.37
1.501							
93	112.00	6952.00	120.11	6946.60	184.46	7051.91	123.42
1.501							
94	112.00	6952.00	120.11	6946.60	185.04	7052.79	124.47
1.501							
95	110.95	6952.70	119.05	6947.30	184.58	7054.37	125.53
1.501							
96	110.95	6952.70	119.05	6947.30	183.41	7052.61	123.42
1.501							
97	110.95	6952.70	119.05	6947.30	183.99	7053.49	124.47
1.501							
98	109.89	6953.40	118.00	6948.00	181.77	7052.44	122.37
1.501							
99	110.95	6952.70	119.05	6947.30	182.24	7050.86	121.32
1.501							

Critical Failure Surface (circle 1)

Intersects: XL: 112.00 YL: 6952.00 XR: 118.00 YR: 6948.00
 Centre: XC: 185.77 YC: 7056.15 Radius: R: 127.63

Generated failure surface: (20 points)

112.00	6952.00	112.31	6951.78	112.62	6951.56	112.93
6951.35	113.24	6951.13				
113.56	6950.91	113.87	6950.70	114.18	6950.49	114.50
6950.27	114.81	6950.06				
115.13	6949.85	115.45	6949.64	115.76	6949.43	116.08
6949.23	116.40	6949.02				
116.72	6948.81	117.04	6948.61	117.36	6948.40	117.68
6948.20	118.00	6948.00				

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	112.00	0.00	35.3	0.16	0.19	1	0.00	45.0
0.05	0.00		0.22	0.83				
2	112.16	0.00	35.2	0.16	0.19	1	0.00	45.0
0.17	0.00		0.73	0.83				
3	112.31	0.00	35.0	0.16	0.19	1	0.00	45.0
0.26	0.00		1.13	0.83				
4	112.47	0.00	35.0	0.16	0.19	1	0.00	45.0
0.36	0.00		1.57	0.83				
5	112.62	0.00	35.0	0.16	0.19	1	0.00	45.0
0.43	0.00		1.90	0.83				
6	112.78	0.00	34.8	0.16	0.19	1	0.00	45.0
0.53	0.00		2.31	0.83				
7	112.93	0.01	34.7	0.16	0.19	1	0.00	45.0
0.59	0.00		2.61	0.83				
8	113.09	0.01	34.7	0.16	0.19	1	0.00	45.0
0.66	0.00		2.90	0.83				
9	113.24	0.01	34.5	0.16	0.19	1	0.00	45.0
0.73	0.00		3.20	0.83				
10	113.40	0.01	34.6	0.16	0.19	1	0.00	45.0
0.79	0.00		3.46	0.83				
11	113.56	0.01	34.4	0.16	0.19	1	0.00	45.0
0.84	0.00		3.69	0.83				
12	113.71	0.01	34.3	0.16	0.19	1	0.00	45.0
0.89	0.00		3.91	0.83				
13	113.87	0.01	34.1	0.16	0.19	1	0.00	45.0
0.94	0.00		4.11	0.83				
14	114.03	0.01	34.3	0.16	0.19	1	0.00	45.0
0.97	0.00		4.25	0.83				
15	114.18	0.01	34.0	0.16	0.19	1	0.00	45.0
1.01	0.00		4.41	0.83				
16	114.34	0.01	34.1	0.16	0.19	1	0.00	45.0
1.02	0.00		4.48	0.83				
17	114.50	0.01	33.8	0.16	0.19	1	0.00	45.0
1.04	0.00		4.57	0.83				
18	114.66	0.01	33.9	0.16	0.19	1	0.00	45.0
1.06	0.00		4.64	0.83				
19	114.81	0.01	33.6	0.16	0.19	1	0.00	45.0
1.06	0.00		4.65	0.83				
20	114.97	0.01	33.7	0.16	0.19	1	0.00	45.0
1.06	0.00		4.65	0.83				
21	115.13	0.01	33.6	0.16	0.19	1	0.00	45.0
1.06	0.00		4.65	0.83				
22	115.29	0.01	33.6	0.16	0.19	1	0.00	45.0
1.05	0.00		4.58	0.83				
23	115.45	0.01	33.4	0.16	0.19	1	0.00	45.0
1.04	0.00		4.55	0.83				
24	115.60	0.01	33.3	0.16	0.19	1	0.00	45.0
1.00	0.00		4.41	0.83				
25	115.76	0.01	33.2	0.16	0.19	1	0.00	45.0
0.97	0.00		4.26	0.83				
26	115.92	0.01	33.2	0.16	0.19	1	0.00	45.0
0.95	0.00		4.15	0.83				
27	116.08	0.01	33.0	0.16	0.19	1	0.00	45.0
0.91	0.00		4.01	0.83				
28	116.24	0.01	32.9	0.16	0.19	1	0.00	45.0
0.85	0.00		3.75	0.83				
29	116.40	0.01	32.9	0.16	0.19	1	0.00	45.0
0.81	0.00		3.57	0.83				
30	116.56	0.01	32.9	0.16	0.19	1	0.00	45.0
0.75	0.00		3.27	0.83				
31	116.72	0.01	32.7	0.16	0.19	1	0.00	45.0
0.69	0.00		3.01	0.83				
32	116.88	0.01	32.6	0.16	0.19	1	0.00	45.0
0.61	0.00		2.67	0.83				
33	117.04	0.00	32.5	0.16	0.19	1	0.00	45.0

0.54	0.00	2.37	0.83					
34	117.20	0.00	32.5	0.16	0.19	1	0.00	45.0
0.45	0.00	1.96	0.83					
35	117.36	0.00	32.3	0.16	0.19	1	0.00	45.0
0.36	0.00	1.59	0.83					
36	117.52	0.00	32.3	0.16	0.19	1	0.00	45.0
0.27	0.00	1.17	0.83					
37	117.68	0.00	32.2	0.16	0.19	1	0.00	45.0
0.16	0.00	0.72	0.83					
38	117.84	0.00	32.0	0.16	0.19	1	0.00	45.0
0.06	0.00	0.27	0.83					

X-S Area:

0.25

Path Length:

7.21

X-S Weight:

27.00

U.S. Postal Service
Certified Mail Receipt

ARTICLE NUMBER
9414 7118 9956 0255 3114 89

ARTICLE ADDRESS TO:
Theresa Duran
PO Box 22
Weston CO 81091-0022

FEES
Postage per piece \$0.47
Certified Fee 3.45
Return Receipt Fee 2.75
Total Postage & Fees: \$6.67



U.S. Postal Service
Certified Mail Receipt

ARTICLE NUMBER
9414 7118 9956 0255 3480 03

ARTICLE ADDRESS TO:
Jonathon Brewster
16455 Highway 12
Weston CO 81091

FEES
Postage per piece \$0.47
Certified Fee 3.45
Return Receipt Fee 2.75
Total Postage & Fees: \$6.67



U.S. Postal Service
Certified Mail Receipt

ARTICLE NUMBER
9414 7118 9956 0255 8544 74

ARTICLE ADDRESS TO:
Colorado Interstate Gas
2 North Nevada Ave
Colorado Springs CO 80903-1700

FEES
Postage per piece \$0.47
Certified Fee 3.45
Return Receipt Fee 2.75
Total Postage & Fees: \$6.67



U.S. Postal Service
Certified Mail Receipt

ARTICLE NUMBER
9414 7118 9956 0255 8514 42

ARTICLE ADDRESS TO:
Pioneer Natural Resources USA, Inc.
1401 17th St Suite 1200
Denver CO 80202-5928

FEES
Postage per piece \$0.47
Certified Fee 3.45
Return Receipt Fee 2.75
Total Postage & Fees: \$6.67



U.S. Postal Service
Certified Mail Receipt

ARTICLE NUMBER
9414 7118 9956 0255 8664 77

ARTICLE ADDRESS TO:
David Vigil
7854 S Algonquian Way
Aurora CO 80016-7041

FEES
Postage per piece \$0.47
Certified Fee 3.45
Return Receipt Fee 2.75
Total Postage & Fees: \$6.67

Postmark Here

ARTICLE NUMBER
9414 7118 9956 0255 8874 65

ARTICLE ADDRESS TO:

Reed Evans
9270 County Road 43.6
Trinidad CO 81082-9552

FEES

Postage per piece	\$0.47
Certified Fee	3.45
Return Receipt Fee	2.75
Total Postage & Fees:	\$6.67



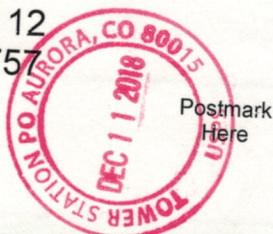
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9414 7118 9956 0255 8011 26

ARTICLE ADDRESS TO:

Parsons Operating LLC
17655 State Highway 12
Weston CO 81091-9757

FEES

Postage per piece	\$0.47
Certified Fee	3.45
Return Receipt Fee	2.75
Total Postage & Fees:	\$6.67



ARTICLE NUMBER
9414 7118 9956 0255 3385 16

ARTICLE ADDRESS TO:

Las Animas County
200 E. 1st Street
Trinidad CO 81082-3003

FEES

Postage per piece	\$0.47
Certified Fee	3.45
Return Receipt Fee	2.75
Total Postage & Fees:	\$6.67



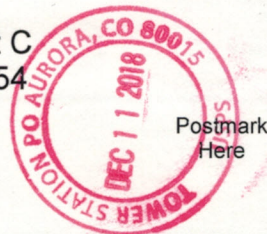
ARTICLE NUMBER
9414 7118 9956 0255 3141 21

ARTICLE ADDRESS TO:

Bob Hill
3794 W Highway 67 Unit C
Glen Rose TX 76043-5854

FEES

Postage per piece	\$0.47
Certified Fee	3.45
Return Receipt Fee	2.75
Total Postage & Fees:	\$6.67



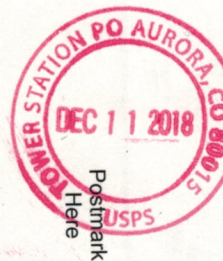
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9414 7118 9956 0255 3992 65

ARTICLE ADDRESS TO:

Allen Beebe
31500 Highway 12
Trinidad CO 81082

FEES

Postage per piece	\$0.47
Certified Fee	3.45
Return Receipt Fee	2.75
Total Postage & Fees:	\$6.67



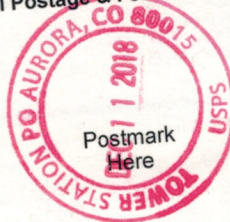
U.S. Postal Service
Certified Mail Receipt

ARTICLE NUMBER
9414 7118 9956 0255 3728 24

ARTICLE ADDRESS TO:
Lawrence Parsons
PO Box 105
Weston CO 81091-0105

FEES

Postage per piece	\$0.47
Certified Fee	3.45
Return Receipt Fee	2.75
Total Postage & Fees:	\$6.67





Adequacy Response 1 County Clerk and
Recorder Copy

December 14,2018

Dear Customer:

The following is the proof-of-delivery for tracking number **773945479742**.

Delivery Information:

Status:	Delivered	Delivered to:	Receptionist/Front Desk
Signed for by:	J.PETERS	Delivery location:	200 E FIRST ST TRINIDAD, CO 81082
Service type:	FedEx Priority Overnight	Delivery date:	Dec 12, 2018 13:38
Special Handling:	Deliver Weekday		

Shipping Information:

Tracking number:	773945479742	Ship date:	Dec 11, 2018
		Weight:	1.0 lbs/0.5 kg

Recipient:
Clerk and Recorder
Las Animas County
200 East 1st Street
Room 205
TRINIDAD, CO 81082 US

Shipper:
Greg Lewicki
11541 Warrington Court
Parker, CO 80138 US

Reference

Robinsons DRMS Ad 1 County

Thank you for choosing FedEx.



Adequacy Response 2 County Clerk and
Recorder Copy

December 14,2018

Dear Customer:

The following is the proof-of-delivery for tracking number **773955245496**.

Delivery Information:

Status:	Delivered	Delivered to:	Receptionist/Front Desk
Signed for by:	J.PETERS	Delivery location:	200 EAST 1ST STREET TRINIDAD, CO 81082
Service type:	FedEx Priority Overnight	Delivery date:	Dec 13, 2018 12:45
Special Handling:	Deliver Weekday		

Shipping Information:

Tracking number:	773955245496	Ship date:	Dec 12, 2018
		Weight:	1.0 lbs/0.5 kg

Recipient:

Las Animas County
200 East 1st Street
TRINIDAD, CO 81082 US

Shipper:

Ben Langenfeld
Greg Lewicki and Associates
4654 South Espana St
Centennial, CO 80015 US

Reference

Robinson Adeq 2 County

Thank you for choosing FedEx.

LEGEND

BOUNDARIES

DRMS Permit Boundary

200' Offset of DRMS Permit Boundary

BUILDINGS AND RELATED STRUCTURES

Building

Well (other than water)

Airport, paved landing strip, runway, taxiway, or apron

Unpaved landing strip

Tanks

Located or landmark object

Retaining wall, jetty, or wart

Fence

BASELINE CONTOURS

Index

Approximate of indefinite

Intermediate

Approximate of indefinite

Supplementary

LAND SURVEYS

Public Land Survey System

Range or Township line

Range or Township labels

Section line

Section numbers

Mining claim or property boundary

Mining claim or property monument

Estimated Easement & Setback

BASELINE MINES AND CAVES

Quarry and open pit mine

Gravel, sand, clay, or borrow pit

Mine adit or cave entrance

Mine shaft

Prospect

Mine Dump

ROADS AND RELATED FEATURES

Highway

Light duty road, paved

Light duty road, gravel

Unimproved road

Trail

Road block, berm, or barrier

Gate on road

Cattle crossing guard

Railroad

RIVERS, LAKES, SHORELINES, AND CANALS

Perennial stream/ditch

Perennial river

Intermittent stream/ditch

Intermittent river

Dam

Perennial lake/pond

Intermittent lake/pond

Dry lake/pond

Elevated aqueduct, flume, or conduit

Buried aqueduct, flume, or conduit

Waterwell

Spring or seep

Drainage Basin

Flood Plain

VEGETATION & SOILS

Woodland

Soils

WETLANDS (USFWS National Wetland Inventory)

Freshwater Emergent

TRANSMISSION LINES AND PIPELINES

Power transmission line, pole, tower

Power transmission line, buried

Telephone/data line, above ground

Telephone/data line, buried

Pipeline (non-water), above ground

Pipeline (non-water), buried

Map C-1 2018 Conditions

Robinson Sons Gravel Pit No. 1

Robinson Sons Inc.

DRMS Permit Number: M-2008-076

Mine Entry Location: Latitude: 37.14026 Longitude: -104.85376

State: CO County: Las Animas Nearest Town: Weston

Section: 26 Township: 33S Range: 67W PM: 6th

Major Watershed: Purgatoire River

Map Scale: 1"=200'

Map Georeferencing Information:

Datum: NAD83 Projection: CO Central

Survey Source: Google/Drone Survey Date: 08/16/18

Imagery Source: Google/Drone Imagery Date: 08/16/18

Drawn by: BEL Date: 08/20/18

Checked by: BEL Date: ----

Approved by: BEL Date: ----

File Name: E:\Work\Dropbox\Robinsons\AutoCAD\Robinsons Gravel Pit 181112.dwg

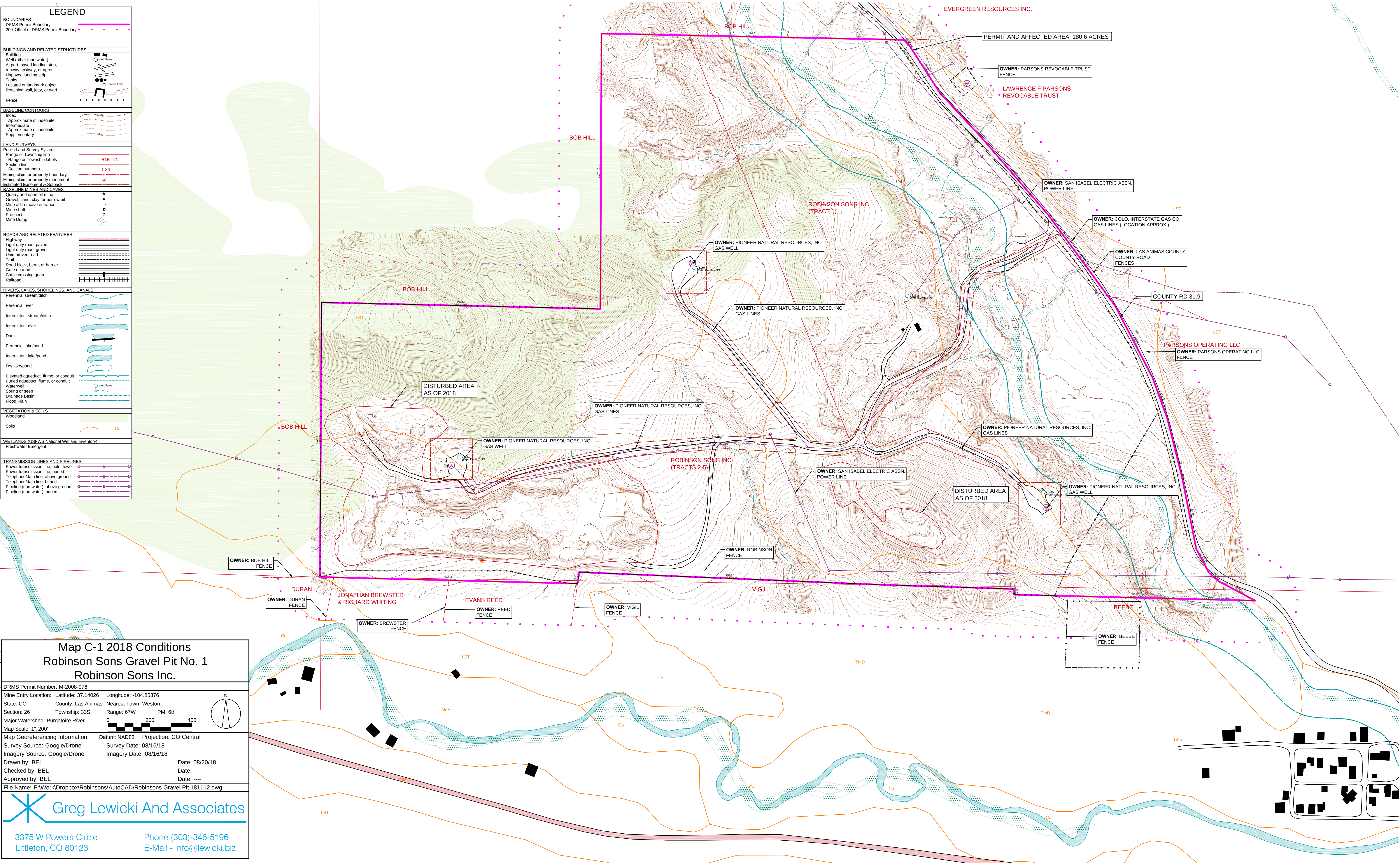
Greg Lewicki And Associates

3375 W Powers Circle

Littleton, CO 80123

Phone (303)-346-5196

E-Mail - info@lewicki.biz



LEGEND

BOUNDARIES

DRMS Permit Boundary

Easement

BUILDINGS AND RELATED STRUCTURES

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Pipeline (non-water), buried

MINING CONTOURS

Index

Approximate of indefinite

Intermediate

Approximate of indefinite

Supplementary

MINING FEATURES

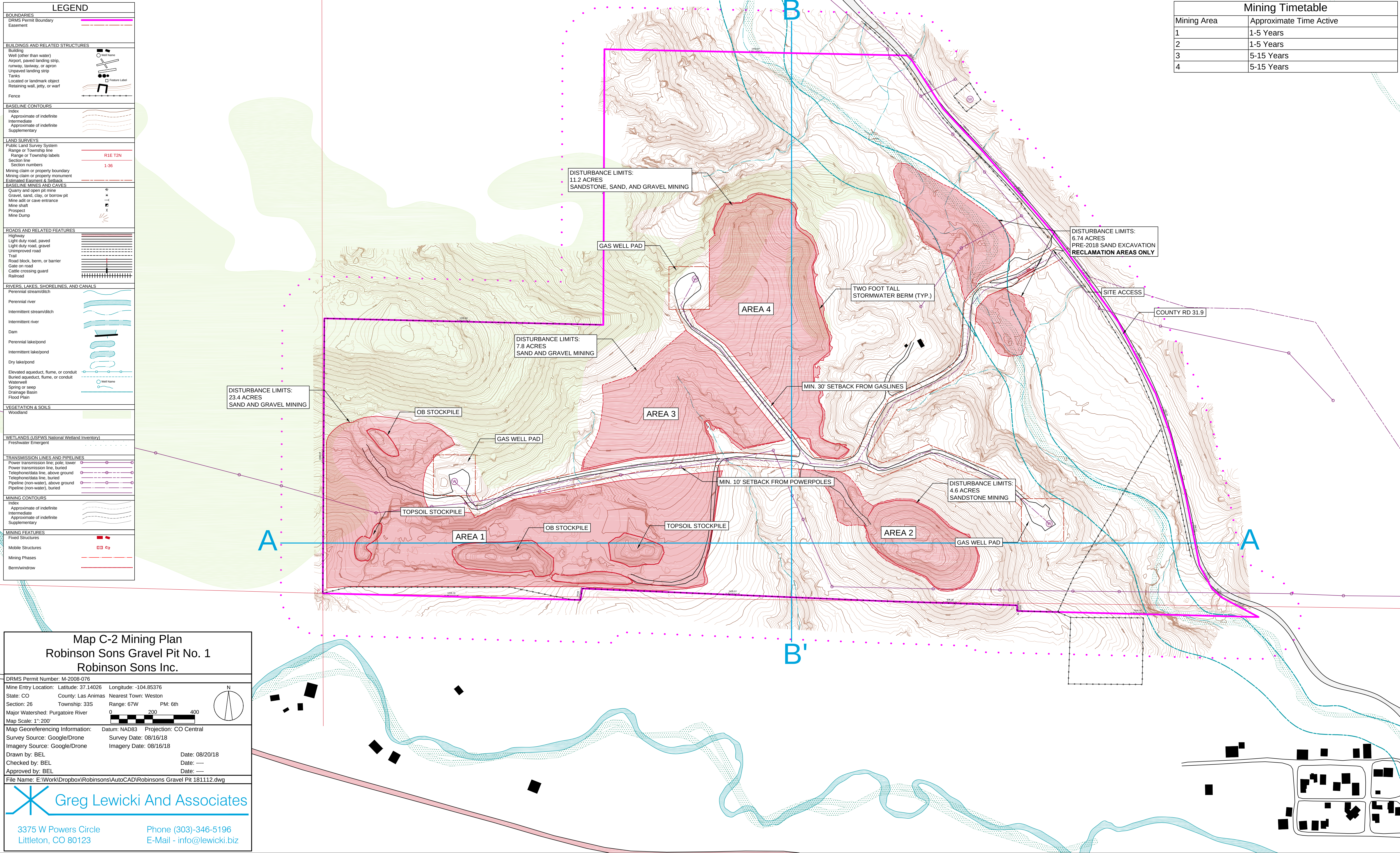
Fixed Structures

Mobile Structures

Mining Phases

Berm/Window

Mining Timetable	
Mining Area	Approximate Time Active
1	1-5 Years
2	1-5 Years
3	5-15 Years
4	5-15 Years



Map C-2 Mining Plan

Robinson Sons Gravel Pit No. 1

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