BRIERLEY ASSOCIATES
Creating Space Underground

April 8, 2019
File Number: 514094-000

Mill Iron Mining
801 8th Street
Greeley, CO 80631

Attention: Mr. Kelly Hodge

Cc: Ioana Comaniciu, PE
Colorado Division of Water Resources
The Office of the State Engineer

Subject: 90-Day Performance Leak Test, Final Report
Loloff Pit Slurry Wall
Greeley, Colorado

Mr. Kelly Hodge:

Brierley Associates (Brierley) is pleased to provide Mill Iron Mining with the attached leak test performance report for the Loloff Pit Slurry Wall which was constructed at the Loloff gravel pit in Greeley, Colorado.

Brierley has prepared this document to present a summary of the allowable groundwater flow, water accounting, and measurements affecting the Loloff Slurry wall during the 90-day performance test which started on January 5, 2019 and concluded on April 4, 2019. On March 29, 2019 Derek Magnuson and Ioana Comaniciu visited the site to observe the leak test underway for the Loloff Slurry Wall.

Please feel free to contact this office if you would like to discuss any questions or comments you may have regarding the data presented.

Sincerely,
BRIERLEY ASSOCIATES

Steven C. Kuehr, PE
Principal

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1 EXISTING SITE CONDITIONS

The Loloff Gravel Pit is owned by Loloff Construction inc. and is approximately 58 acres. The mined portion of the site is enclosed by a soil-bentonite backfilled trench (slurry wall), and portions of the slurry wall will be capped with a low-permeability earthen berm to increase water storage capacity above the current top-of-slurry-wall elevation. The slurry wall has been constructed but the low-permeability berm has not yet been constructed; mining operations at the site are ongoing. Prior to the slurry wall construction, a subsurface investigation consisting of thirteen boreholes was performed and encountered bedrock below fine and coarse alluvium at depths ranging from 39 to 105 ft below ground surface (bgs). The bedrock generally consists of highly weathered to fresh, interbedded siltstone, claystone, and silty sandstone. Groundwater was encountered during drilling at depths ranging from 22 to 55 ft bgs, corresponding to elevations ranging from 4603.3 to 4622 ft. Groundwater level measurements obtained during drilling were likely impacted by dewatering operations inside of the active mine.

2 CONSTRUCTION SUMMARY

The slurry wall alignment is approximately 5,574 ft long. The slurry wall was constructed using onsite coarse alluvium, clay borrow material imported from a nearby site, bentonite slurry and dry bentonite powder. The slurry wall was designed to function as a low-permeability groundwater barrier. The slurry wall generally extends 4 ft below the weathered bedrock and into competent bedrock unless excavation refusal conditions were encountered. The top of the slurry wall varies in elevation along the alignment. The perimeter of the site is currently configured such that run-on water from outside of the site during precipitation events will be negligible.

The low-permeability berm construction will occur where the working pad (top of slurry wall) is located below elevation 4634 ft, with a total overall design length of approximately 3,165 ft. The low-permeability berm will have a maximum design height of 12 ft and will be constructed between the top of the slurry wall and elevation 4634 ft.

3 90-DAY PERFORMANCE TEST SUMMARY

The Loloff Pit slurry wall has a perimeter of 5,574 ft with a bottom area of 46.1 acres and an average depth of 54.2 ft. The total, allowable inflow was calculated for both the design and performance standards and is based on a completely dewatered pit. The reservoir perimeter depth used in the calculation is the average depth between the top of the slurry wall and the top of the key. The average depth of the slurry wall is 54.2 ft. As shown in Table I of Appendix A, the design standard for the Loloff Pit slurry wall is 63 gpm and the performance standard for the Loloff Pit slurry wall is 188 gpm.

Table II of the Appendix displays the amount of water on a daily interval that affected the leak test. The site precipitation, evaporation, and dewatering discharge readings were all recorded. Originally, as stated in the Leak Test Work Plan, dated 11/9/2018, the Greeley-Weld County Station was to be utilized. Due to the precipitation history being unavailable for the Greeley-Weld County station toward the end of the leak test period, a different weather station was

utilized. The site precipitation was recorded using a weather station on the University of Northern Colorado campus installed by the Colorado Climate Center – Colorado State University. The weather station is located 2.5 miles southwest of the Loloff slurry wall pit. Brierley conservatively assumed that due to evapotranspiration and other processes, 30 percent of the rain that fell in the area enclosed by the slurry wall contributed to the collected water.

The totalizer readings were taken daily at the dewatering pump. The pump drains the dewatering trench around the inside perimeter of the pit. A staff gage was installed next to the intake in the sump for the dewatering pump. The staff gage readings over the course of the 90-day performance test varied from 3 ft-8 inches to 5 ft-5 inches.

Table III of the Appendix shows the monthly gross evaporation which takes place for free-standing water. Evaporation losses were determined using the National Oceanic and Atmospheric Administration's (NOAA) Technical Report NWS 33 "Evaporative Atlas for the Contiguous 48 United States". Evaporation rates were applied to the dewatering trenches and surface ponds on the site. The surface areas of the dewatering trenches, ponds, and muddy areas were determined using a combination of a tape measure, wheel roller, GPS unit, and the measurement tool on Google Earth. The area of the Loloff gravel pit site enclosed by the slurry wall and is subject to evaporation is 1.39 acres, or 60,405 sq ft which represents approximately 5 percent of the total area enclosed by the slurry wall. Of the 60,405 sq ft subject to evaporation, 40,960 sq ft comprise the hydraulically connected pond areas and dewatering trenches along the south side, west side, north side, and a portion of the east side of the pit. The remaining 19,445 sq ft comprise several disconnected muddy areas on the north side of the pit.

Table IV of Appendix A displays the groundwater level readings for the monitoring wells located east of the Loloff Pit at the adjacent Derr pit site, as shown on the Monitoring Well Location Plan. The monitoring wells displayed are the five wells closest to the Loloff Pit. The groundwater elevations in the monitoring wells ranged from 4613.08 ft to 4619.17 ft. All groundwater levels in the monitoring wells are below the design height of the slurry wall / low-permeability berm liner of 4634 ft.

During the 90-day performance test period from January 5, 2019 to April 4, 2019, the Loloff slurry wall seepage averaged 11.8 gpm, as shown in Table II of the Appendix. This meets the state requirements for both the design and performance standards. Pending approval from the Office of the State Engineer, Loloff Construction inc. will now be responsible for providing monthly water accounting to the office of the State Engineer, Colorado Division of Water Resources.

APPENDIX A

LOLOFF GRAVEL PIT
SLURRY WALL DESIGN PLANS

GREELEY, COLORADO

LOCATION MAP

NTS

SITE MAP

NTS

DRAWING LIST	
SHEET NUMBER	DESCRIPTION
SH-1	TITLE SHEET
SH-2	SITE PLAN
SH-3	KEY SHEET
SH-4	PLAN STA. 0+00 - 17+00
SH-5	PLAN STA. 17+00 - 33+00
SH-6	PLAN STA. 33+00 - 45+00
SH-7	PLAN STA. 45+00 - 55+74
SH-8	PROFILE STA. 0+00 - 19+00
SH-9	PROFILE STA. 19+00 - 38+00

DRAWING LIST	
SHEET NUMBER	DESCRIPTION
SH-10	PROFILE STA. 38+00 - 55+80
SH-11	CROSS SECTION STA. 1+00
SH-12	CROSS SECTION STA. 14+00
SH-13	CROSS SECTION STA. 20+00
SH-14	CROSS SECTION STA. 29+00
SH-15	CROSS SECTION STA. 38+00
SH-16	CROSS SECTION STA. 43+00
SH-17	CROSS SECTION STA. 48+00
SH-18	GEOTECHNICAL INSTRUMENTATION
SH-19	DETAIL SHEET

NO.	DATE	REVISIONS	BY	CK
--	--	--	--	--

OWNER/GC: LOLOFF CONSTRUCTION

GRAPHIC SCALE: 0, ½", 1", 1½"

CADD FILE NAME: SH-1.DWG

CLIENT: HALL-IRWIN

APPROVED: -

DATE: MAY 2016

BRIERLEY ASSOCIATES

Creating Space Underground

990 SOUTH BROADWAY, SUITE 2222, DENVER, CO 80209

303.703.1405 FAX 303.703.1404

DESIGNED: HES | CHECKED: SK | DRAWN: CDK

LOLOFF SLURRY WALL

TITLE SHEET

CONTRACT: -

DATE: MAY 13, 2016

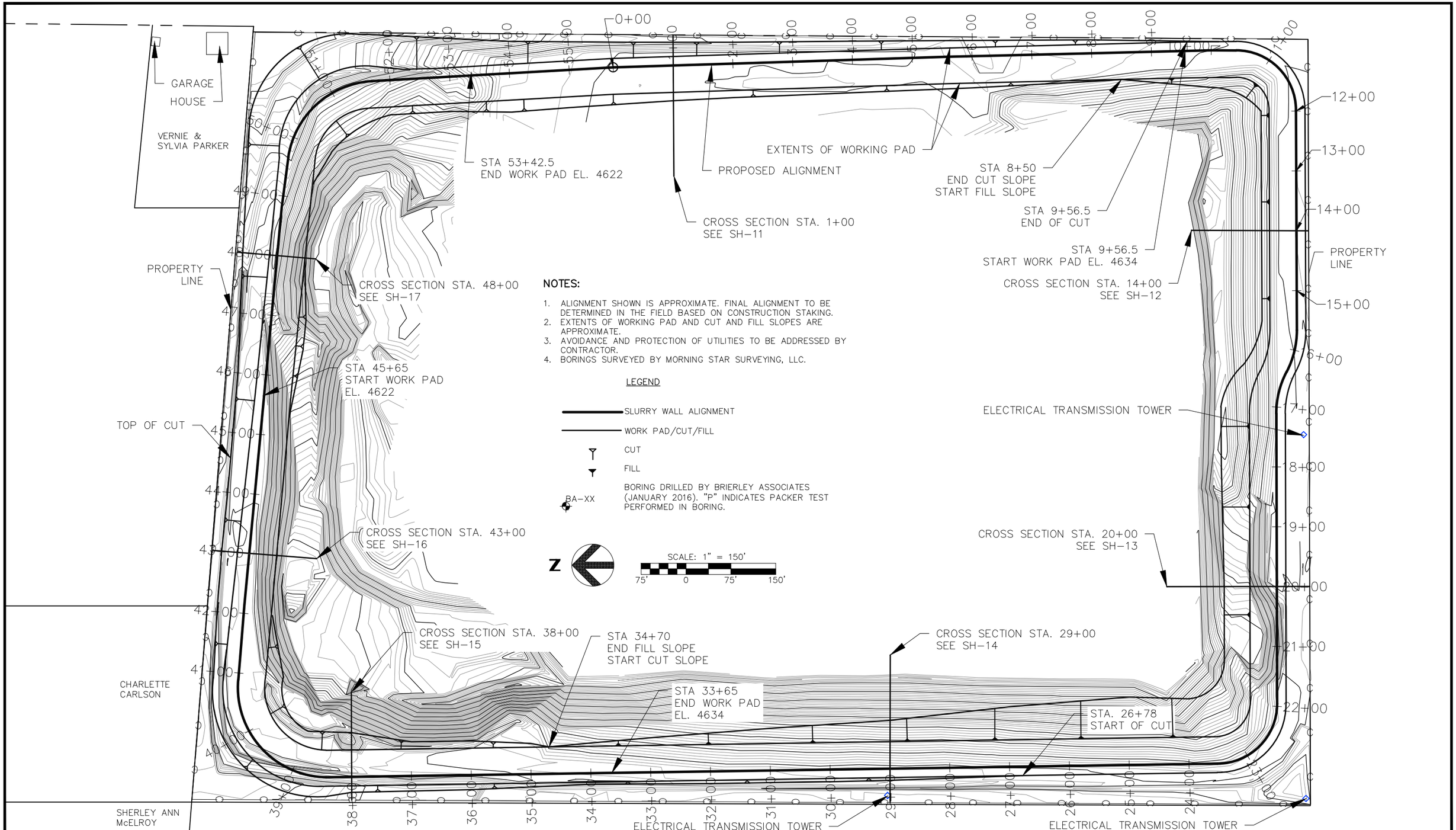
PROJECT: 514094-000

SHEET: SH-1

DRAWING NO.: 1 OF 19

REVISION: 0

SCALE: NTS



NOTES:

1. ALIGNMENT SHOWN IS APPROXIMATE. FINAL ALIGNMENT TO BE DETERMINED IN THE FIELD BASED ON CONSTRUCTION STAKING.
2. EXTENTS OF WORKING PAD AND CUT AND FILL SLOPES ARE APPROXIMATE.
3. AVOIDANCE AND PROTECTION OF UTILITIES TO BE ADDRESSED BY CONTRACTOR.
4. BORINGS SURVEYED BY MORNING STAR SURVEYING, LLC.

LEGEND

- SLURRY WALL ALIGNMENT
- WORK PAD/CUT/FILL
- CUT
- FILL
- BA-XX — BORING DRILLED BY BRIERLEY ASSOCIATES (JANUARY 2016). "P" INDICATES PACKER TEST PERFORMED IN BORING.

SCALE: 1" = 150'
75' 0 75' 150'

NO.	DATE	REVISIONS	BY	CK
–	–	–	–	–

OWNER/GC: LOLOFF CONSTRUCTION

GRAPHIC SCALE: 0 ½" 1" 1½"

CADD FILE NAME: SH-2.DWG

CLIENT: HALL-IRWIN

APPROVED: –

DATE: –

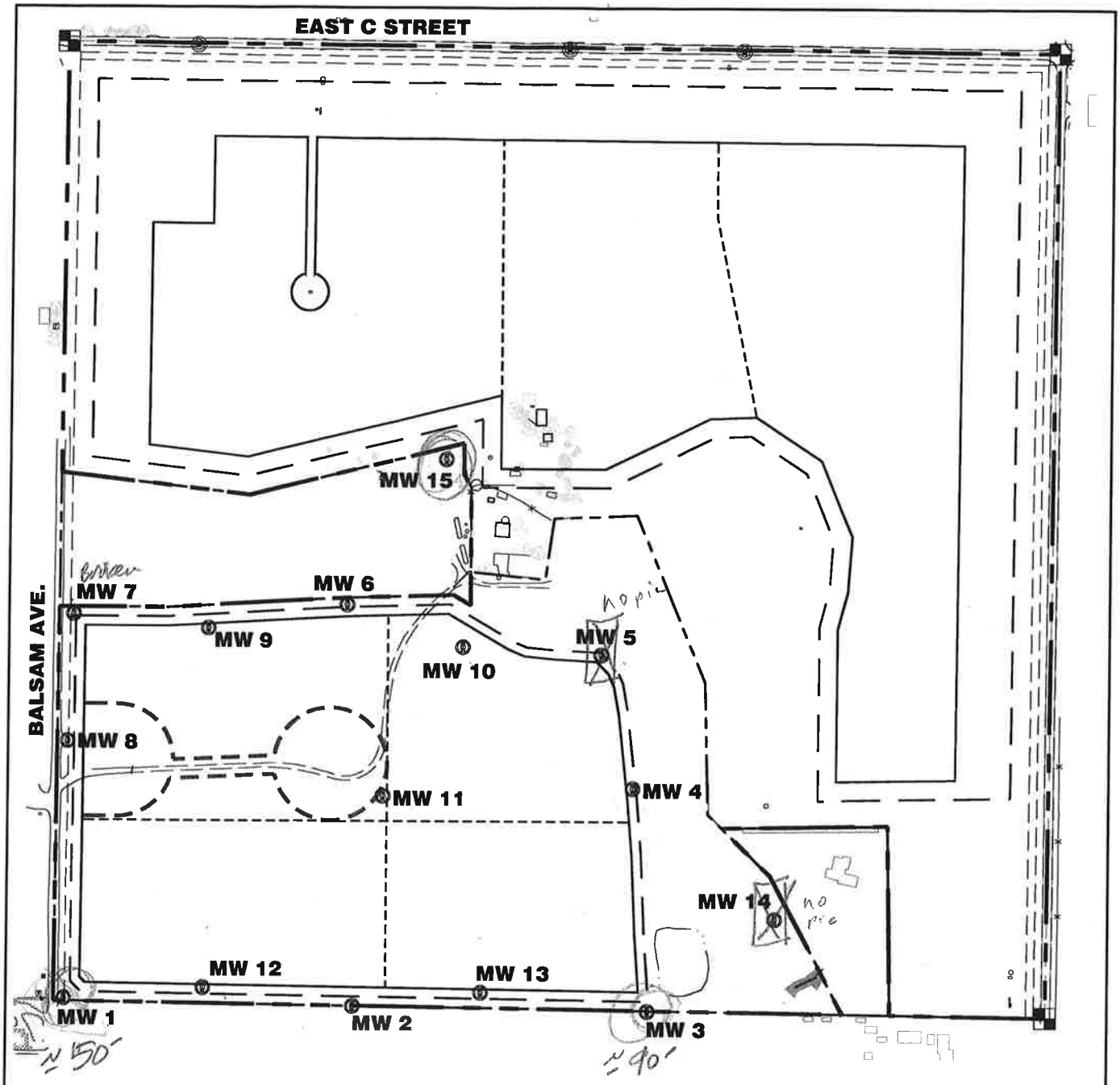
BRIERLEY ASSOCIATES
Creating Space Underground
990 SOUTH BROADWAY, SUITE 2222, DENVER, CO 80209
303.703.1405 FAX 303.703.1404

DESIGNED: HES | CHECKED: SK | DRAWN: CDK

LOLOFF SLURRY WALL
SITE PLAN

CONTRACT: – | DATE: MAY 13, 2016 | PROJECT: 514094-000 | SCALE: AS SHOWN

SHEET: SH-2
DRAWING NO.: 2 OF 19
REVISION: 0



LEGEND:

◎	MONITORING WELL
MW 12	MONITORING WELL NUMBER

400 200 0 400

SCALE IN FEET

J&T Consulting, Inc.

1400 W 122nd Avenue - Suite 120
Westminster, CO 80234
303-457-0735

BROKEN ARROW INVESTMENTS, LLC
DERR PIT
MONITORING WELL LOCATION MAP

Date:	6/7/18
Job No:	07123
Drawn:	WSS
Scale:	1" = 400'
Sheet: 1	Of: 1

P:\07123 Derr ...el Pit\Drawings\2018 Monitoring Well Location.dwg, Layout1, 6/7/2018 12:41:04 PM

TABLE I
ALLOWABLE GROUNDWATER FLOW INTO PIT
LOLOFF SLURRY WALL RESERVOIR
GREELEY, COLORADO

	Design Standard	Performance Standard
Pit Perimeter	= 5,574 ft x 54.2 ft x 0.03 $ft^3/day/ft^2$ = 9,063 ft^3/day (47 gpm)	141 gpm
Pit Bottom	= 46.1 acre x 43560 ft^2/acre x 0.0015 $ft^3/day/ft^2$ = 3,015 ft^3/day (16 gpm)	47 gpm
TOTAL	63 gpm	188 gpm

TABLE II
WATER ACCOUNTING SUMMARY
LOLOFF SLURRY WALL RESERVOIR
GREELEY, COLORADO

		OUTFLOW VOLUMES			INFLOW VOLUMES		
Date	Slurry Wall Test Day	Water Pumped Out		Daily Evaporation	Weather Data Precipitation		
		Acre-ft	Gallons/day	Gallons/day	Snow (in)	Water (in)	Gallons/day
1/5/2019	1	619.46	0.0	1676.14			0
1/6/2019	2	619.46	0.0	1676.14			0
1/7/2019	3	619.51	16292.5	1676.14			0
1/8/2019	4	619.52	3258.5	1676.14			0
1/9/2019	5	619.59	22809.6	1676.14			0
1/10/2019	6	619.66	22809.6	1676.14			0
1/11/2019	7	619.70	13034.0	1676.14		0.08	100144.874
1/12/2019	8	619.74	13034.0	1676.14			0
1/13/2019	9	619.92	58653.2	1676.14			0
1/14/2019	10	620.06	45619.1	1676.14			0
1/15/2019	11	620.16	32585.1	1676.14			0
1/16/2019	12	620.28	39102.1	1676.14			0
1/17/2019	13	620.40	39102.1	1676.14			0
1/18/2019	14	620.50	32585.1	1676.14			0
1/19/2019	15	620.59	29326.6	1676.14			0
1/20/2019	16	620.69	32585.1	1676.14			0
1/21/2019	17	620.82	42360.6	1676.14			0
1/22/2019	18	620.90	26068.1	1676.14			0
1/23/2019	19	620.90	0.0	1676.14			0
1/24/2019	20	620.99	29326.6	1676.14	2.4	0.03	37554.3278
1/25/2019	21	621.15	52136.2	1676.14			0
1/26/2019	22	621.15	0.0	1676.14			0
1/27/2019	23	621.22	22809.6	1676.14			0
1/28/2019	24	621.38	52136.2	1676.14			0
1/29/2019	25	621.38	0.0	1676.14			0
1/30/2019	26	621.45	22809.6	1676.14			0
1/31/2019	27	621.57	39102.1	1676.14			0
2/1/2019	28	621.64	22809.6	2165.01			0
2/2/2019	29	621.64	0.0	2165.01			0
2/3/2019	30	621.76	39102.1	2165.01			0
2/4/2019	31	621.89	42360.6	2165.01			0
2/5/2019	32	622.02	42360.6	2165.01			0
2/6/2019	33	622.13	35843.6	2165.01	2.1	0.15	187771.639
2/7/2019	34	622.13	0.0	2165.01		0.1	125181.093
2/8/2019	35	622.13	0.0	2165.01	T	0.01	12518.1093
2/9/2019	36	622.13	0.0	2165.01			0
2/10/2019	37	622.13	0.0	2165.01			0
2/11/2019	38	622.25	39102.1	2165.01	2.4	0.18	225325.967
2/12/2019	39	622.50	81462.8	2165.01			0
2/13/2019	40	622.60	32585.1	2165.01			0
2/14/2019	41	622.71	35843.6	2165.01			0
2/15/2019	42	622.82	35843.6	2165.01			0
2/16/2019	43	622.91	29326.6	2165.01			0
2/17/2019	44	622.91	0.0	2165.01			0
2/18/2019	45	623.12	68428.7	2165.01	T	T	0

		OUTFLOW VOLUMES			INFLOW VOLUMES		
Date	Slurry Wall Test Day	Water Pumped Out		Daily Evaporation	Weather Data Precipitation		
		Acre-ft	Gallons/day	Gallons/day	Snow (in)	Water (in)	Gallons/day
2/19/2019	46	623.12	0.0	2165.01			0
2/20/2019	47	623.12	0.0	2165.01			0
2/21/2019	48	623.12	0.0	2165.01			0
2/22/2019	49	623.25	42360.6	2165.01			0
2/23/2019	50	623.25	0.0	2165.01			0
2/24/2019	51	623.25	0.0	2165.01			0
2/25/2019	52	623.25	0.0	2165.01			0
2/26/2019	53	623.68	140115.9	2165.01			0
2/27/2019	54	623.68	0.0	2165.01			0
2/28/2019	55	623.87	61911.7	2165.01			0
3/1/2019	56	624.06	61911.7	3072.92			0
3/2/2019	57	624.17	35843.6	3072.92	2.5	0.15	187771.639
3/3/2019	58	624.17	0.0	3072.92			0
3/4/2019	59	624.17	0.0	3072.92			0
3/5/2019	60	624.17	0.0	3072.92			0
3/6/2019	61	624.26	29326.6	3072.92			0
3/7/2019	62	624.70	143374.4	3072.92			0
3/8/2019	63	624.98	91238.3	3072.92			0
3/9/2019	64	625.19	68428.7	3072.92			0
3/10/2019	65	625.27	26068.1	3072.92			0
3/11/2019	66	625.27	0.0	3072.92			0
3/12/2019	67	625.39	39102.1	3072.92			0
3/13/2019	68	625.56	55394.7	3072.92	4.1	1.68	2103042.35
3/14/2019	69	625.78	71687.2	3072.92			0
3/15/2019	70	625.92	45619.1	3072.92			0
3/16/2019	71	626.05	42360.6	3072.92			0
3/17/2019	72	626.05	0.0	3072.92			0
3/18/2019	73	626.05	0.0	3072.92			0
3/19/2019	74	626.15	32585.1	3072.92			0
3/20/2019	75	626.15	0.0	3072.92			0
3/21/2019	76	626.15	0.0	3072.92	M		0
3/22/2019	77	626.25	32585.1	3072.92	M		0
3/23/2019	78	626.25	0.0	3072.92	M	0.84	1051521.18
3/24/2019	79	626.38	42360.6	3072.92	M	M	0
3/25/2019	80	626.56	58653.2	3072.92			0
3/26/2019	81	626.73	0.0	3072.92			0
3/27/2019	82	626.81	26068.1	3072.92			0
3/28/2019	83	626.90	29326.6	3072.92	M		0
3/29/2019	84	627.03	42360.6	3072.92	M	M	0
3/30/2019	85	627.03	0.0	3072.92	M		0
3/31/2019	86	627.03	0.0	3072.92	M	M	0
4/1/2019	87	627.12	29326.6	5196.03			0
4/2/2019	88	627.13	3258.5	5196.03			0
4/3/2019	89	627.21	26068.1	5196.03			0
4/4/2019	90	627.33	39102.1	5196.03	M	0.12	150217.311

Total Gallons Pumped	2564447.37
Total Gallons Evaporation	221920.70
Total Gallons Precipitation	4181048.49
Credited Precipitation (30% of Total)	1254314.55

Total Seepage= Volume Water Pumped + Volume Evaporation - Volume Credited Precipitation

Total Seepage (Gallons)	1532053.52
Average Seepage Rate (GPM)	11.82

Notes:
1. M = Minimal
2. T = Trace

TABLE III
MONTHLY EVAPORATION PERCENTAGES
LOLOFF SLURRY WALL RESERVOIR
GREELEY, COLORADO

Slurry Wall

Month	Percent of Total Evaporation	Monthly Evaporation (CF/SF)	Daily Evaporation (CF/SF)	Daily Evaporation (CF)	Daily Evaporation (GALLONS)	Evaporation (GPM)
January	3.0%	0.12	0.0037	224	1676.141323	1.16398703
February	3.5%	0.13	0.0048	289	2165.015875	1.503483247
March	5.5%	0.21	0.0068	411	3072.925758	2.133976221
April	9.0%	0.35	0.0115	695	5196.0381	3.608359792
May	12.0%	0.46	0.0148	896	6704.56529	4.655948118
June	14.5%	0.56	0.0185	1,119	8371.394717	5.813468553
July	15.0%	0.58	0.0185	1,120	8380.706613	5.819935148
August	13.5%	0.52	0.0167	1,008	7542.635952	5.237941633
September	10.0%	0.38	0.0128	772	5773.375667	4.009288657
October	7.0%	0.27	0.0087	523	3910.996419	2.715969736
November	4.0%	0.15	0.0051	309	2309.350267	1.603715463
December	3.0%	0.12	0.0037	224	1676.141323	1.16398703
	100.0%	3.83				

46	Annual Free Water Surface Evaporation (Shallow Lake) (inches)
3.83	Annual Free Water Surface Evaporation (Shallow Lake) (feet)
60,405 sf	Water Surface exposed

TABLE IV
GROUNDWATER MONITORING WELL READINGS
DERR PIT
GREELEY, COLORADO

Date	MW-1	MW-7	MW-8	MW-9	MW-12
9/26/2018	4614.65	-	4617.17	4618.28	4614.62
10/26/2018	4614.32	4619.03	4617.45	4618.7	4614.69
11/20/2018	4614.24	4619.17	4617.53	4618.81	4614.71
12/18/2018	4614	4619.04	4617.42	4618.71	4614.56
1/17/2019	4613.66	4618.85	4617.15	4618.46	4614.25
2/12/2019	4613.28	4618.49	4616.8	4618.1	4613.87
3/7/2019	4613.08	4618.26	4616.59	4617.89	4613.66

Note:
1. Design top of slurry wall/low permeability berm elevation is 4634 feet
2. 90 Day performance test period from 1/5/2019 to 4/4/2019

Photo 1: View eastward along southern drainage ditch. Note minimal moisture.

Photo 2: View northwestward of southwest corner of site. Note relatively dry soil conditions at time of photo.

BRIERLEY ASSOCIATES
Creating Space Underground

Site Photographs
Loloff Slurry Wall
Greeley, CO
February 27, 2019

Photo 3: View southwestward from top of pit, with ponded (frozen) area in southeast corner of pit.

Photo 4: View westward along southern drainage ditch. Note minimal moisture and frozen water.

Photo 5: View northward of western drainage ditch. Note minimal water in ditch.

Photo 6: View northeastward of southwest corner of site. Note relatively dry soil conditions at time of photo.

Photo 7: View along eastern side of site looking southward. Note frozen ponded area is on the right side of photo, former slurry wall work pad in center, slurry wall covered by soil and vegetation left.