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MINE ENGINEERING
MINE RECLAMATION

CIVIL ENGINEERING
CONST. MANAGEMENT

August 22, 2019

Rob Zuber
Division of Reclamation, Mining & Safety
1313 Sherman St., Room 215
Denver, CO 80203

Re: Bowie Resources, LLC, Bowie No. 2 Mine
TR-119, Culvert Installation at Curve #11
Adequacy Review #1
Permit C-1996-083

Dear Mr. Zuber:

DRMS' letter dated July 23, 2019 transmitted its adequacy review for the referenced technical revision. On behalf of Bowie Resources, LLC, (BRL), follow are its responses to the DRMS' comments and concerns.

1. **DRMS:** The TR-119 cover page lists revised pages, but this does not appear to match the pages in the submittal. For example, the list includes page Exh 8-58vii but the Division does not have this page. **Can you send this page or explain its absence?** Also, the submittal includes revised pages Exh 8-29, 29i and 31 that are not listed on the cover page. **Please explain.**

   BRL: Page Exh. 8-58vii is not part of the submittal. Pages Exh. 8-29, 29i and 31 were erroneously left off of the cover sheet.

2. **DRMS:** Did the top of page Exh. 8-4 get removed? It appears that is did when compared to the existing page in the PAP. **Please address with an explanation or a revision.**

   BRL: Please see revised **page Exh. 8-4.**

3. DRMS: The table for ditch specifications (page Exh 8-29i) references page 8-17 through 8-19 for information on the design of this ditch. **Please check this page reference;** it appears to be inaccurate.

   BRL: The correct reference should be Exh. 8-14 to Exh. 8-16. Please see revised **page**

Exh. 8-29i.

4. DRMS: - Map 20 should show the change in the drainage basins. That is, the area that drains to C27 should not be included in the B Pond basin. **Please update this map and any other maps, as appropriate.**

   BRL: **Map-20** has been revised. In addition, while re-drawing the drainage basin boundary it was discovered that there is a large section of drainage area B that while accounted for in the pond design, was inadvertently left off the drainage areas for Ditch B-3. Therefore, the PHC for Ponds B & C has been updated, please see revised pages **Exh 8-4, 5 & 8.** And since Ditch B-3 is near the top of the drainage basin, a domino effect was created and many other ditches and culverts were revised. As a side note, a SedCad run is included for reference only for Ditch B-3. The run was conducted to determine the influence of the missed drainage basin, and as it turns out, there is no direct runoff from that area. However, as can be seen on the SedCad run, the influence of the disturbed area is much greater than what was previously shown. The discharge has been updated, and carried through all the other downstream ditches and culverts. Please see revised pages **Exh. 8-29, 29i, 31, 36, 39, 65i, 66, 69, 74 , 74v, and 8-74vii.**

5. **DRMS: On Map 21-2, please add to the legend to include all symbols on the map** (e.g. the green feature at and below the portal bench that appears to be an underdrain). Also, please check the labels and leaders. For example, to the right of the label of "C-C7" there appears to be an orphaned leader.

   BRL: Please see revised **Map 21-2.**

6. **DRMS: On Map No. 22-B, please explain the values for the pond capacities**. The value for the required capacity for water changed, but the value for the total did not change.

   BRL: Please see revised **Map 22-B**. The total has been revised to reflect the total show on page Exh. 8-5.

7. **DRMS: On Map No. 22-C, please explain the values for the pond capacities**. The values for the water changed (both design and required). Should this value have changed? Also, the values for water, mine water, and sediment do not add to the totals.

   BRL: The As-built water requirement was erroneously changed with this revision. It has been changed back to what is currently approved in the PAP. The As-Built total has also been revised.

Please let me know if you have any additional questions.

Sincerely,

Tamme Bishop

Tamme Bishop, P.E.
Project Engineer

Cc: Basil Bear

Attachments:

Volume II: Maps 20, 21-2, 22-B and 22-C
Volume III: Appendix 8: Pages Exh. 8-4, 5 8, 8-29, 29i, 31, 36, 65i, 66, 69, 74, 74v and 8-74vii

Sagebrush Rangeland

Vegetative Cover %	78.0	Veg Rep. Page 23

Table 2-2d-Runoff curve numbers for arid and semiarid rangelands

Cover Type - Sagebrush with grass understory		
Hydrologic Condition		Good
Soil Type - Absarokee		C
Curve Number		63

Rock Slide Area

Vegetation %	0.0	
Curve Number		89

Rock Slide Transition

Vegetative Cover %	49.0	Veg Rep. Table A23
Litter %	18.0	Veg Rep. Table A23
Ground Cover %	67.0	

Cover Type - Oak-aspen-mountain brush mixture		
Hydrologic Condition		Fair
Soil Type - Absarokee & Boulders		D
Curve Number		63

Pond A

Deleted from design.

RUN-OFF VOLUME - - Pond B

Area	Acres	Curve #	Precip Amount	Direct Run-off	Run-off Vol A-F
Disturbed	41.70	87.6	1.8	0.78	2.73
Previously Disturbed	3.00	74	1.8	0.26	0.07
Mixed Shrub	15.90	41	1.8	0.00	0.00
Dry Mixed Shrub	17.60	57	1.8	0.01	0.02
Juniper Woodland	30.50	61	1.8	0.04	0.10
Wetland	1.70	89	1.8	0.86	0.12
Sagebrush	0.20	63	1.8	0.06	0.00
Upper Meadow	0.00	74	1.8	0.26	0.00
Lower Meadow	0.20	74	1.8	0.26	0.00
TOTAL	110.80				3.04

TOTAL REQUIRED WATER VOLUME - - A-F 3.04

SEDIMENT VOLUME - Pond B

Use the universal soil loss equation.

The Topographic Factor LS is difficult to evaluate for a steep mountainous drainage area. According to the LS factor table, when the length of slope exceeds 400 feet and or percent slope exceeds 24 percent, soil loss estimates are speculative as these values are beyond the range of research data. Therefore, an LS factor using 400 feet and 24 percent will be used for this calculation.

SEDIMENT VOLUME - Pond B

Calculate Weighted Average C-Factor

Area	Acres	% Canopy	% Cover	C-Factor	Extended
Disturbed*	44.70	0.0	0.0	0.1800	8.046
Mixed Shrub	15.90	56.9	92.6	0.0046	0.073
Dry Mixed Shrub	17.60	20.0	40.0	0.1000	1.760
Juniper Woodland	30.50	28.2	85.2	0.0100	0.305
Wetland	1.70	0.0	50.0	0.0710	0.121
Sage	0.20	0.0	78.0	0.0160	0.003
Meadow	0.20	0.0	88.4	0.0074	0.001
TOTAL	110.80			Wt. Ave.	0.093

* One ton mulch per acre.

SEDIMENT VOLUME - Pond B

A = R K L S C P

R = rainfall factor	30.00
K = soil erodibility factor	0.37
LS = combined length slope factor 400' - 24%	11.20
C = cropping management factor	0.0930
P = erosion control practice factor	0.75
A = sediment, tons/acre/year	8.68

ONE YEAR SEDIMENT VOLUME - ACRE FEET 0.384

110.80 ACRES - 115 #/CF

TOTAL REQUIRED SEDIMENT POND CAPACITY -- AF 3.419

RUN-OFF VOLUME - - Pond C

	Area	Acres	Curve #	Precip Amount	Direct Run-off	Run-off Vol A-F
1	Disturbed	34.97	87.6	1.8	0.78	2.29
2	Previously Disturbed	2.02	74	1.8	0.26	0.04
3	Rockfall	11.70	89	1.8	0.86	0.84
4	Rockfall Trans.	7.10	63	1.8	0.06	0.04
5	Mountain Shrub	224.33	41	1.8	0.00	0.00
6	Dry Mountain Shrub	17.90	57	1.8	0.01	0.02
7	Juniper Woodland	11.96	61	1.8	0.04	0.04
8	Wetland	0.00	89	1.8	0.86	0.00
9	Upper Meadow	0.00	74	1.8	0.26	0.00
10	Mixed Shrub	0.40	57	1.8	0.01	0.00
11	Mixed Shrub	36.90	41	1.8	0.00	0.00
	TOTAL	347.28				3.26

REQUIRED WATER VOLUME 10-YEAR EVENT - - A-F 3.26
REQUIRED WATER VOLUME MINE DISCHARGE 0.22

TOTAL REQUIRED WATER VOLUME 3.48

SEDIMENT VOLUME - Pond C

The Topographic Factor LS is difficult to evaluate for a steep mountainous drainage area. According to the LS factor table, when the length of slope exceeds 400 feet and or percent slope exceeds 24 percent, soil loss estimates are speculative as these values are beyond the range of research data. Therefore, an LS factor using 400 feet and 24 percent will be used for this calculation.

Calculate Weighted Average C-Factor

Area	Acres	% Canopy	% Cover	C-Factor	Extended
Disturbed*	34.97	0.0	0.0	0.1800	6.295
Previously Disturbed	2.02	0.0	10.0	0.3250	0.657
Rock Fall	18.80	No sediment contribution			
Mixed Shrub	224.33	56.9	92.6	0.0046	1.032
Dry Mixed Shrub	17.90	20.0	40.0	0.1000	1.790
Juniper Woodland	11.96	28.2	85.2	0.0104	0.124
Wetland	0.00	0.0	50.0	0.0710	0.000
Upper Meadow	0.40	0.0	88.4	0.0074	0.003
Mixed Shrub	36.90	56.0	92.0	0.0046	0.170
TOTAL	347.28			Wt. Ave.	0.029

* One tone per acre mulch.

A = R K L S C P

R = rainfall factor 30.00
K = soil erodibility factor 0.37
LS = combined length slope factor 400' - 24% 11.20
C = cropping management factor 0.0290
P = erosion control practice factor 0.75

A = sediment, tons/acre/year 2.70

ONE YEAR SEDIMENT VOLUME - ACRE FEET 0.375
347.28 ACRES - 115 #/CF

TOTAL REQUIRED SEDIMENT POND CAPACITY -- AF 3.860

V-Ditch Design

		Ditch Grade		Minimum Grade		Maximum Grade		RipRap	Peak
		Min	Max	Depth	Velocity	Depth	Velocity	D50 Inch	Flow
				Feet	Ft/Sec	Feet	Ft/Sec		cfs
Ditch	B1	7.0%	12.0%	0.52	4.7	0.52	6.2		1.88
	B2	Deleted from Design							
	B3	7.0%	11.0%	0.23	2.7	0.21	3.2		0.43
	B4	10.0%	50.0%	0.28	3.7	0.21	6.9	9	0.44
	B5	Deleted from Design							
	B6	10.0%	50.0%	0.10	1.9	0.08	3.6	15	0.05
	B7	50.0%	50.0%	0.51	12.5	0.51	12.5	18	4.81
	B8	7.0%	11.0%	0.35	3.6	0.33	4.4		0.67
*	B9	27%	27%	0.19	4.8	0.19	4.8		0.24
	B10	7.0%	11.0%	0.44	4.2	0.39	4.9		1.17
*	B11	10%	27%	0.35	4.3	0.29	6.3	9	0.74
	B12	7.0%	11.0%	0.49	4.6	0.45	5.4		1.62
*	B13	27%	27%	0.10	3.1	0.10	3.1		0.78
*	B14	27%	27%	0.18	4.6	0.18	4.6		0.22
	B15	7.0%	11.0%	0.67	5.6	0.61	6.6	12	3.56
	B16	7.0%	11.0%	0.72	5.9	0.66	7.0	6	4.44
	B17	7.0%	14.0%	0.39	3.9	0.34	5.0		0.86
	B18	7.0%	17.0%	0.74	6.0	0.63	8.4	9	4.87
	B19	50.0%	50.0%	0.57	13.5	0.57	13.5	21	6.46
	B20	7.0%	11.0%	0.33	3.5	0.30	4.1		0.55
	B21	2.0%	5.0%	1.10	4.2	0.93	5.9		7.69
	B22	7.0%	11.0%	0.32	3.4	0.29	4.0		0.45
	B23	7.0%	11.0%	0.99	7.3	0.91	8.6	9	10.71
	B24	7%	11%	0.54	4.9	0.50	5.8		2.63
*	B25	27%	27%	0.23	5.4	0.23	5.4		0.64
	B26	5.0%	10.0%	0.28	2.6	0.25	3.5		0.45
	B27	1.0%	2.0%	0.37	1.4	0.33	1.9		0.29
	B28	Deleted from Design							
	B29	2.0%	2.0%	1.36	4.8	1.36	4.8		13.33
	B30	50.0%	50.0%	0.43	11.1	0.43	11.1	15	3.05
	B31	Deleted from Design							
	B32	50.0%	50.0%	0.28	8.4	0.28	8.4	12	0.95
	B33	10.0%	10.0%	1.01	8.8	1.01	8.8	9	13.33
	B34	10.0%	50.0%	1.25	10.2	0.95	18.9	12	22.43
*	B35	27.0%	27.0%	0.10	3.1	0.10	3.1		0.82
*	B36	27.0%	27.0%	0.16	4.2	0.16	4.2		0.16
*	B37	27.0%	27.0%	0.23	5.4	0.23	5.4		0.42
	B38	10.0%	10.0%	0.23	3.6	0.23	3.6		0.36
*	Ditch along downhill conveyor								
Ditch	C1	2.5%	12.0%	0.57	3.0	0.42	5.4		1.42
**	C2	5.0%	50.0%	Trapezoidal Channel C-Gulch					1.46
	C3	7.0%	12.0%	0.67	5.6	0.61	6.90		2.44
**	C4	5.0%	50.0%	Trapezoidal Channel C-Gulch					6.38
	C5	15.0%	15.0%	0.35	5.3	0.35	5.3		0.77
**	C6	5.0%	50.0%	Trapezoidal Channel C-Gulch					18.44
	C7	7.0%	11.0%	1.00	7.3	0.92	8.7	9	12.46
	C7a	No Ditch C7a							
***	C8	7.0%	11.0%	1.50	9.6	1.40	11.5		33.95
	C9	Deleted from design							
Flow depth in feet does not include 0.3 feet freeboard.									
	C10	15.0%	15.0%	0.45	6.3	0.45	6.3		1.88
***	C11	7.0%	11.0%	1.55	9.8	1.45	11.8	12	37.54

V-Ditch Design

		Ditch Grade		Minimum Grade		Maximum Grade		RipRap	Peak
		Min	Max	Depth	Velocity	Depth	Velocity	D_{50} Inch	Flow
	C12	7.0%	12.0%	0.84	6.5	0.76	8.0	9	6.84
	C13	7.0%	11.0%	0.39	3.9	0.36	4.6		0.86
**	C14	5.0%	50%	Trapezoidal Channel C-Gulch					39.61
	C15	7.0%	11.0%	0.38	3.8	0.35	4.6		0.75
	C16	2.0%	5.0%	1.98	6.2	1.68	8.7	9	37.59
	C17	7.0%	11.0%	0.46	4.4	0.42	5.1		1.33
***	C18	33%	33%	0.68	12.3	0.68	12.3	9	8.50
	C19	25%	25%	0.21	4.9	0.21	4.9		0.29
	C-20	7.0%	11.0%	0.40	4.0	0.37	4.7		0.93
	C-21	7.0%	11.0%	0.38	3.8	0.35	4.6		1.02
	C-22	7.0%	11.0%	0.91	6.9	0.84	8.2	9	8.87
	C-23	7.0%	11.0%	0.97	7.2	0.89	8.5	9	10.31
	C-24	40.0%	40.0%	0.61	12.6	0.61	15.5	21	6.84
	C-25	10.0%	20.0%	0.18	2.8	0.16	3.5		0.16
	C-26	7%	7%	1.00	7.3	1.00	7.3		10.74
**	Riprap lined trapezoidal channel in C-Gulch - See pages 8-14 - 8-16								
***	Line with gunnite, concrete or other material to prevent infiltration.								
Ditch	D1	Trapezoidal Channel - See page 8-11							
	D2	2%	10%	1.48	5.1	0.84	7.8	12	9.7
	D3	20%	50%	0.10	8.5	0.30	4.2	6	0.60
	D4	2%	10%	0.44	2.3	0.33	4.2		0.78
	D5	2%	2%	0.38	2.6	0.38	2.58		0.74
	D6	2%	2%	0.36	2.4	0.36	2.39		0.47
Ditch	E1	2%	2%	0.64	2.9	0.64	2.9		1.79
	G1	Renamed Ditch D-4							
	G2	Deleted from Design							
Ditch	SAE1	Deleted from Design							
	SAE2	Deleted from Design							
Ditch	FG1	30%	30%	0.21	5.4	0.21	5.4		0.33
Ditch	GVB1	28%	28%	0.16	4.3	0.16	4.3		0.16
	GVB2	17%	17%	0.15	3.2	0.15	3.2		0.11
	GVB3	10%	10%	0.17	2.7	0.17	2.7		0.11
	GVB4	47%	47%	0.20	6.5	0.20	6.5	6	0.35
	GVB5	35%	35%	0.18	5.2	0.18	5.2		0.25
	GVB6	15%	15%	0.20	3.7	0.20	3.7		0.20
	GVB7	10%	2%	0.30	3.9	0.43	2.2		0.60
Berm along coal stockpile pad - flow in ditches B 30, 31, 32									
				Height	Velocity	Height	Velocity		
		1%	2%	1.00	2.8	0.87	3.6		4.00
Berms Freeman Gulch									
		2%	4%	0.34	1.9	0.30	2.5		0.33
			Provide riprap, gunnite or concrete lined V-Ditch as						
			necessary for erosion protection.						
			Ditches cut in rock will not require erosion protection.						
Flow depth in feet does not include 0.3 feet freeboard.									

Culvert Summary and Minimum Size Requirements

		Drainage or Culvert Contributing Flow				Maximum Flow CFS	Minimum Culvert Inches	
Culverts	C-B1	Ditch B1	1.88			1.88	12	
	C-B2	Deleted from Design						
	C-B3	Drainage Area	0.67			0.67	12	
	C-B4	Deleted from Design						
	C-B5	Deleted from Design						
	C-B6	Deleted from Design						
	C-B7	Ditch B9	0.24	Ditch B8	0.67	0.91	12	
	C-B8	Ditch B10	1.17			1.17	12	
	C-B9	Ditch B12	1.62	Ditch B36	0.16	1.78	12	
	C-B10	Deleted from Design						
	C-B11	Ditch B15	3.56			3.56	18	
	C-B12	Drainage Area	1.76	Ditch B20	0.55	2.31	18	
	C-B13	Ditch B37	0.42			0.42	12	
	C-B14	Ditch B16	4.44			4.44	18	
	C-B15	Ditch B21	7.69	Ditch B24	2.63	10.32	24	Note 2
	C-B16	Ditch B23	10.71			10.71	24	Note 2
	C-B17	Ditch B-19	6.46	Ditch B-26	0.45	6.91	24	
	C-B18	Ditch B27 & 32	1.24	Ditch B22	0.45	1.69	12	
	C-B19	Culvert B18	1.69	Culvert B16	10.71	12.40	24	
	C-B20	Deleted from Design				0.00		
	C-B21	Drainage Area B - 25 Year Event				22.43	36	
	C-B22	Ditch B15	3.56			3.56	18	
	C-B23	Ditch B16	4.44			4.44	18	
	C-B24	Ditch B13	0.78			0.78	12	
	C-B25	Ditch B35	0.82			0.82	12	
	C-B26	Ditch B25	0.64			0.64	12	
	C-B27	Culvert B19	12.40			12.40	24	
	C-B28	Ditch B29	13.33			13.33	30	
	C-B29	Pond B/C Diversion Structure				0.00	18	Note 4
Culverts	C-C1	Ditch C1	1.42			1.42	12	
	C-C2	Deleted from Design - Plugged with TR-119				0.00	12	
	C-C3	Ditch C2	1.46			1.46	12	
	C-C4	Ditch C4	6.38			6.38	24	
	C-C5	Culvert C13	11.57	Culvert C4	6.38	17.95	30	
	C-C6	Deleted from Design						
	C-C7	Ditch C8	33.95			33.95	36	
	C-C8	Drainage Area	0.09			0.09	12	
	C-C9	Deleted from Design						
	C-C10	Ditch C15	0.75			0.75	12	
	C-C11	Ditch C12	6.84			6.84	24	Note 2
	C-C12	Ditch C17	1.33	Ditch C24	6.84	8.17	24	Note 2
	C-C13	Drainage Area D-C5 renamed C-C13 (page 63)				11.57	24	
	C-C14	Ditch C12	6.84			6.84	24	Note 2
	C-C15	Ditch C21	1.02	Ditch C22	8.87	9.89	24	Note 2
	C-C16	Ditch C18	8.50			8.50	24	Note 2
	C-C17	Ditch C19	0.29			0.29	12	
	C-C18	Deleted from Design						
	C-C19	Ditch C17	1.33			1.33	12	
	C-C20	Ditch C11	37.54			37.54	36	
	C-C21	Ditch C-C20	0.93			0.93	12	
	C-C22	Drainage Area	0.25			0.25	12	
	C-C23	Drainage Area	0.21			0.21	12	
	C-C24	Ditch C1	1.42			1.42	12	
	C-C25	Mine Water	0.50			0.50	12	
	C-C26	Drainage Area	1.66			1.66	36*	
	C-C27	Ditch B3	0.43			0.43	12	
Culverts	C-D1	Ditch D-1	9.70	Ditch D-1		9.70	24	
	C-D2	Ditch D-2	9.70	Ditch D-2		9.70	24	
	C-E1	Ditch E-1	1.79			1.79	12	
	C-G1	Deleted from design						
	C-G2	Ditch D-D4	0.42			0.42	12	
	C-G3	Ditch D-D3 & D6	1.07			1.07	24	
	C-G4	Ditch D-5	0.86				12	
	C-G5	Culvert D-1	9.70			9.70	36	
	C-G6	Pond C Primary Discharge				0.72	12	
	C-H1	Ditch H1	2.57			23.73	36**	
		CW Ditch	8.79	Ponds C& D Discharge		12.37		
	"J" Culvert designs located in Volume XI, Appendix B							
	** 36" in-place, design of C-26 requries a minimum of 10" be installed							
	** 42" in-place, design of C-H1 requries a minimum of 36" be installed							
	C-K1	Ditch K1	0.46	Ditch K2	0.97	1.43	12	
	C-K2	Ditch K3	1.70			1.70	12	
	C-K3	Wash down water	1.00			1.00	24	
	C-L1	Deleted from design.						
Culverts	SAE1	Deleted from design.						
	SAE2	Deleted from design.						

Note 1 End sections must conform to fill slopes.

Note 2 An 18-inch culvert will handle 11 cfs with a HW/D ratio of 2.0. If an 18-inch culvert is to be used, assure rock headwall or road will provide 1.5' of head over top of culvert.

Note 3 Culverts C-B19, B20,B21 & SAE2 are located under old State Highway 133. Maintenance and repair of these culverts is the responsibility of the operator.

Note 4 Culvert B29 is the Pond B/C diversion structure. Water will be diverted to C-B29 only during times when maintenance or clean out of Pond C is necessary.

DITCH - B3			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	0.5	Acres
	Hydraulic length	200	Feet
	Elevation change	60	Feet
	Concentration time	0.01	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#2	Mixed Shrub
	Curve number	41	
	Area	36.9	Acres
	Hydraulic length	2197	Feet
	Elevation change	990	Feet
	Concentration time	0.36	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Watershed data for watershed		#3	Dry Mixed Shrub
	Curve number	57	
	Area	0.3	Acres
	Hydraulic length	520	Feet
	Elevation change	230	Feet
	Concentration time	0.05	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Total Area		37.7	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	0.43	cfs
Flow from other ditches or culverts		0	
Peak discharge		0.43	cfs

Bowie No. 2

TR-119

Ditch B3

FOR REFERENCE ONLY

J.E. Stover & Associates, Inc.
2352 N. 7th Street, Unit B
Grand Junction, CO 81501

Phone: 970-245-4101
Email: tamme.jestover@bresnan.net

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	37.700	37.700	0.43	0.03
#2	0.000	37.700	0.43	0.03

Structure Detail:

Structure #1 (Erodible Channel)

ditch b3

Trapezoidal Erodible Channel Inputs:

Material: Shales and hardpans

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
0.00	1.5:1	1.5:1	10.0	0.0250	0.30			6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.43 cfs	
Depth:	0.26 ft	0.56 ft
Top Width:	0.77 ft	1.67 ft
Velocity:	4.22 fps	
X-Section Area:	0.10 sq ft	
Hydraulic Radius:	0.106 ft	
Froude Number:	2.08	

Structure #2 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	36.900	0.361	0.000	0.000	41.000	TR55	0.00	0.000
	2	0.500	0.010	0.000	0.000	87.600	TR55	0.43	0.029
	3	0.300	0.085	0.000	0.000	57.000	TR55	0.00	0.000
	Σ	**37.700**						**0.43**	**0.029**
#2	Σ	**37.700**						**0.43**	**0.029**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	45.06	990.00	2,197.00	1.690	0.361
#1	**1**	**Time of Concentration:**					**0.361**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	30.00	60.00	199.99	5.470	0.010
#1	**2**	**Time of Concentration:**					**0.010**
#1	3	1. Forest with heavy ground litter	44.23	230.00	520.00	1.680	0.085
#1	**3**	**Time of Concentration:**					**0.085**

DITCH - C7			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	2.5	Acres
	Hydraulic length	400	Feet
	Elevation change	170	Feet
	Concentration time	0.02	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#2	Mixed Shrub
	Curve number	41	
	Area	0.7	Acres
	Hydraulic length	800	Feet
	Elevation change	160	Feet
	Concentration time	0.2	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Total Area		3.2	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	1.43	cfs
Flow from other ditches or culverts		10.74	Ditch C26
		0.29	Culvert C17
Peak discharge		12.46	cfs

DITCH - C8				
Watershed data for watershed		#1	Disturbed	
	Curve number	87.6		
	Area	2.7	Acres	
	Concentration time	0.1	Hours	
	Concentration time type	SCS Upland Curves		
Watershed data for watershed		#2	Mixed Shrub	
	Curve number	41		
	Area	1.1	Acres	
	Concentration time	0.1	Hours	
	Concentration time type	SCS Upland Curves		
Total Area		3.8	Acres	
Storm data				
	Total precipitation	1.8	Inches	
	Storm Type	SCS Type 2 storm, 24 hour storm		
	Peak discharge	2.28	cfs	
Flow from other ditches or culverts				
		18.44	D-C6	
		0.77	D-C5	
		12.46	D-C7	
Peak discharge		33.95	cfs	
SEDCAD used for peak flow calculation, 0.1 hour concentration time assumed.				

DITCH - C11				
Watershed data for watershed		#1	Disturbed	
	Curve number	87.6		
	Area	1.0	Acres	
	Concentration time	0.1	Hours	
	Concentration time type	SCS Upland Curves		
Total Area		1.0	Acres	
Storm data				
	Total precipitation	1.8	Inches	
	Storm Type	SCS Type 2 storm, 24 hour storm		
	Peak discharge	0.85	cfs	
Flow from other ditches or culverts		33.95	C-C7	
		1.88	D-C10	
		0.77	D-C5	
		0.09	C-C8	
Peak discharge		37.54	cfs	
SEDCAD used for peak flow calculation, 0.1 hour concentration time assumed.				

DITCH - C16			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	0.1	Acres
	Hydraulic length	80	Feet
	Elevation change	30	Feet
	Concentration time	0.00	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#2	Mixed Shrub
	Curve number	41	
	Area	0.3	Acres
	Hydraulic length	355	Feet
	Elevation change	210	Feet
	Concentration time	0.01	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Watershed data for watershed		#3	Prev Dist
	Curve number	74	
	Area	0.1	Acres
	Hydraulic length	90	Feet
	Elevation change	40	Feet
	Concentration time	0	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Total Area		0.5	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	0.05	cfs
Flow from other ditches or culverts		37.54	Culvert C-20
Peak discharge		37.59	cfs

DITCH - C21			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	0.9	Acres
	Hydraulic length	400	Feet
	Elevation change	100	Feet
	Concentration time	0.02	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#2	Mixed Shrub
	Curve number	41	
	Area	0.4	Acres
	Hydraulic length	280	Feet
	Elevation change	90	Feet
	Concentration time	0.05	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Total Area		1.3	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	0.59	cfs
Flow from other ditches or culverts		0.43	Culvert C-27
Peak discharge		1.02	cfs

DITCH - C23			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	0.5	Acres
	Hydraulic length	85	Feet
	Elevation change	42	Feet
	Concentration time	0	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Total Area		0.5	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	0.17	cfs
Flow from other ditches or culverts		9.89	Culvert C15
		0.25	Culvert C22
Peak discharge		10.31	cfs

J. E. STOVER & ASSOCIATES, INC.
2352 NORTH 7TH STREET, UNIT B
GRAND JUNCTION, COLORADO 81501
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MINE ENGINEERING
MINE RECLAMATION

CIVIL ENGINEERING
CONST. MANAGEMENT

August 22, 2019

Rob Zuber
Division of Reclamation, Mining & Safety
1313 Sherman St., Room 215
Denver, CO 80203

Re: Bowie Resources, LLC, Bowie No. 2 Mine
Permit C-1996-083

Dear Mr. Zuber:

Bowie Resources, LLC submitted a Technical Revision application (TR-119) for installation of a culvert (C-27) at curve #11. Currently, the revision is in the adequacy response phase of the process.

Since TR-119 is a hydrologic revision, Bowie would also like to include into the revision, the plugging of Culvert C-2 and re-routing the flow of Ditch C-25 to Ditch C3. Other than an increased flow in a Ditches C-3, there is no additional hydrologic impact. There is no new disturbed area, and no additional bond required for inclusion of this change. All of the maps under review as part of TR-119 would be the same maps that need revised for this proposed change.

Attached are **pages Exh. 8-32** (Culvert C-2), **& 61** (Ditch C-3).

Please let me know if you have any questions.

Sincerely,

Tamme Bishop

Tamme Bishop, P.E.
Project Engineer

Cc: Basil Bear

CULVERT - C2 - PLUGGED*			
**Flow directed/added to Ditch C-C3*			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	0.7	Acres
	Hydraulic length	12	Feet
	Elevation change	5	Feet
	Concentration time	0.00	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#2	Mixed Shrub
	Curve number	41	
	Area	66.6	Acres
	Hydraulic length	2530	Feet
	Elevation change	1015	Feet
	Concentration time	0.32	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Watershed data for watershed		#3	Rock Slide
	Curve number	89	
	Area	0.2	Acres
	Hydraulic length	444	Feet
	Elevation change	180	Feet
	Concentration time	0.08	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#4	Rock Transition
	Curve number	63	
	Area	0.2	Acres
	Hydraulic length	390	Feet
	Elevation change	140	Feet
	Concentration time	0.07	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Total Area		67.7	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	0.35	cfs
Flow from other ditches or culverts		0.00	
Peak discharge		0.35	cfs

DITCH - C3			
Watershed data for watershed		#1	Disturbed
	Curve number	87.6	
	Area	2.4	Acres
	Hydraulic length	1100	Feet
	Elevation change	630	Feet
	Concentration time	0.06	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Disturbed	
Watershed data for watershed		#2	Rock Transition
	Curve number	63	
	Area	0.3	Acres
	Hydraulic length	400	Feet
	Elevation change	130	Feet
	Concentration time	0.04	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Watershed data for watershed		#3	Mixed Shrub
	Curve number	41	
	Area	0.3	Acres
	Hydraulic length	160	Feet
	Elevation change	40	Feet
	Concentration time	0.04	Hours
	Concentration time type	SCS Upland Curves	
	Unit hydrograph	Forested	
Total Area		3.0	Acres
Storm data			
	Total precipitation	1.8	Inches
	Storm Type	SCS Type 2 storm, 24 hour storm	
	Peak discharge	1.93	cfs
Flow from other ditches or culverts		0.16	Ditch C25
		0.35	Old Culvert C-2
Peak discharge		2.44	cfs