

Sunrise Coal
Bulldog Mine - Permit #429
Sediment Pond #1

10 yr-24 hr Storm

Top of Dam Elev = 679.0

Pool Elev = 673.0

Peak Elev = 676.2

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #3, Sta 0+00 to 12+50
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #3, Sta 12+50 to 24+76 (Sediment Pond #1)
Pond	#3	==>	End	0.000	0.000	Sediment Pond #1
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #4, Sta 0+00 to 2+88 (Culvert under Entrance)
Culvert	#5	==>	#6	0.000	0.000	Culvert under Entrance, Collector Ditch #4, Sta 2+88 to 3+38
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #4, Sta 3+38 to 13+50
Channel	#7	==>	#3	0.000	0.000	Collector Ditch #4, Sta 13+50 to 32+70 (Sediment Pond #1)

	#4 Chan'l
	#5 Culvert
	#6 Chan'l
	#7 Chan'l
	#1 Chan'l
	#2 Chan'l
	#3 Pond

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4	2.570	2.570	6.87	0.58
#5	0.000	2.570	6.87	0.58
#6	16.670	19.240	37.15	3.61
#7	20.000	39.240	47.74	6.04
#1	20.000	20.000	37.94	3.65
#2	20.000	40.000	51.16	6.07
#3 In	0.000	79.240	97.39	12.11
Out			16.06	11.97

Structure Detail:

Structure #4 (Vegetated Channel)

Collector Ditch #4, Sta 0+00 to 2+88 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	6.87 cfs		6.87 cfs	
Depth:	1.29 ft	1.79 ft	2.40 ft	2.90 ft
Top Width:	9.16 ft	11.16 ft	13.61 ft	15.61 ft
Velocity:	0.81 fps		0.32 fps	
X-Section Area:	8.50 sq ft		21.16 sq ft	
Hydraulic Radius:	0.869 ft		1.435 ft	
Froude Number:	0.15		0.05	
Roughness Coefficient:	0.0649		0.2259	

Structure #5 (Culvert)

Culvert under Entrance, Collector Ditch #4, Sta 2+88 to 3+38

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.15	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 6.87 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #6 (Vegetated Channel)

Collector Ditch #4, Sta 3+38 to 13+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	37.15 cfs		37.15 cfs	
Depth:	2.19 ft	2.69 ft	3.46 ft	3.96 ft
Top Width:	14.75 ft	16.75 ft	19.85 ft	21.85 ft
Velocity:	1.64 fps		0.83 fps	
X-Section Area:	22.69 sq ft		44.74 sq ft	
Hydraulic Radius:	1.438 ft		2.083 ft	
Froude Number:	0.23		0.10	
Roughness Coefficient:	0.0449		0.1133	

Structure #7 (Vegetated Channel)

Collector Ditch #4, Sta 13+50 to 32+70 (Sediment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	47.74 cfs		47.74 cfs	
Depth:	2.41 ft	2.91 ft	3.71 ft	4.21 ft
Top Width:	15.65 ft	17.65 ft	20.85 ft	22.85 ft
Velocity:	1.83 fps		0.96 fps	
X-Section Area:	26.12 sq ft		49.83 sq ft	
Hydraulic Radius:	1.556 ft		2.205 ft	
Froude Number:	0.25		0.11	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0424		0.1020	

Structure #1 (Vegetated Channel)

Collector Ditch #3, Sta 0+00 to 12+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	37.94 cfs		37.94 cfs	
Depth:	2.03 ft	2.53 ft	3.20 ft	3.70 ft
Top Width:	14.13 ft	16.13 ft	18.80 ft	20.80 ft
Velocity:	1.85 fps		0.96 fps	
X-Section Area:	20.46 sq ft		39.66 sq ft	
Hydraulic Radius:	1.356 ft		1.953 ft	
Froude Number:	0.27		0.12	
Roughness Coefficient:	0.0440		0.1088	

Structure #2 (Vegetated Channel)

Collector Ditch #3, Sta 12+50 to 24+76 (Sediment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	51.16 cfs		51.16 cfs	
Depth:	2.29 ft	2.79 ft	3.48 ft	3.98 ft
Top Width:	15.14 ft	17.14 ft	19.91 ft	21.91 ft
Velocity:	2.12 fps		1.14 fps	
X-Section Area:	24.17 sq ft		45.06 sq ft	
Hydraulic Radius:	1.490 ft		2.091 ft	
Froude Number:	0.30		0.13	
Roughness Coefficient:	0.0411		0.0959	

Structure #3 (Pond)

Sediment Pond #1

Pond Inputs:

Initial Pool Elev:	673.00 ft
Initial Pool:	21.17 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	50.00	1.00	0.0140	673.00	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
676.00	10.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	676.24 ft
Dewater Time:	1.29 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
657.90	0.000	0.000	0.000	
658.00	1.110	0.037	0.000	
658.40	1.125	0.484	0.000	
658.90	1.143	1.051	0.000	
659.40	1.162	1.627	0.000	
659.90	1.181	2.213	0.000	
660.40	1.200	2.808	0.000	
660.90	1.219	3.413	0.000	
661.40	1.239	4.028	0.000	
661.90	1.258	4.652	0.000	
662.40	1.278	5.286	0.000	
662.90	1.297	5.929	0.000	
663.40	1.317	6.583	0.000	
663.90	1.338	7.247	0.000	
664.40	1.358	7.921	0.000	
664.90	1.378	8.605	0.000	
665.40	1.399	9.299	0.000	
665.90	1.419	10.003	0.000	
666.40	1.440	10.718	0.000	
666.90	1.461	11.444	0.000	
667.40	1.483	12.180	0.000	
667.90	1.504	12.926	0.000	
668.40	1.525	13.684	0.000	
668.90	1.547	14.452	0.000	
669.40	1.569	15.231	0.000	
669.90	1.591	16.020	0.000	
670.40	1.613	16.821	0.000	
670.90	1.635	17.633	0.000	
671.40	1.657	18.456	0.000	
671.90	1.680	19.291	0.000	
672.40	1.703	20.136	0.000	
672.90	1.725	20.993	0.000	
673.00	1.730	21.166	0.000	Spillway #1
673.40	1.765	21.865	0.807	10.48*
673.90	1.809	22.758	2.684	6.90
674.40	1.854	23.674	5.211	3.80
674.90	1.899	24.612	7.948	3.05
675.40	1.945	25.573	10.089	2.20
675.90	1.991	26.557	11.854	2.15
676.00	2.000	26.756	12.173	0.60 Spillway #2
676.24	2.022	27.232	16.062	1.70 Peak Stage
676.40	2.038	27.564	18.778	
676.90	2.085	28.595	26.821	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
677.40	2.133	29.649	46.381	
677.90	2.181	30.728	75.230	
678.40	2.230	31.831	114.035	
678.90	2.280	32.958	164.003	
679.00	2.290	33.187	175.395	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
657.90	0.000	0.000	0.000
658.00	0.000	0.000	0.000
658.40	0.000	0.000	0.000
658.90	0.000	0.000	0.000
659.40	0.000	0.000	0.000
659.90	0.000	0.000	0.000
660.40	0.000	0.000	0.000
660.90	0.000	0.000	0.000
661.40	0.000	0.000	0.000
661.90	0.000	0.000	0.000
662.40	0.000	0.000	0.000
662.90	0.000	0.000	0.000
663.40	0.000	0.000	0.000
663.90	0.000	0.000	0.000
664.40	0.000	0.000	0.000
664.90	0.000	0.000	0.000
665.40	0.000	0.000	0.000
665.90	0.000	0.000	0.000
666.40	0.000	0.000	0.000
666.90	0.000	0.000	0.000
667.40	0.000	0.000	0.000
667.90	0.000	0.000	0.000
668.40	0.000	0.000	0.000
668.90	0.000	0.000	0.000
669.40	0.000	0.000	0.000
669.90	0.000	0.000	0.000
670.40	0.000	0.000	0.000
670.90	0.000	0.000	0.000
671.40	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
671.90	0.000	0.000	0.000
672.40	0.000	0.000	0.000
672.90	0.000	0.000	0.000
673.00	0.000	0.000	0.000
673.40	(3)>0.807	0.000	0.807
673.90	(3)>2.684	0.000	2.684
674.40	(3)>5.211	0.000	5.211
674.90	(5)>7.948	0.000	7.948
675.40	(5)>10.089	0.000	10.089
675.90	(5)>11.854	0.000	11.854
676.00	(5)>12.173	0.000	12.173
676.40	(6)>13.334	5.444	18.778
676.90	(6)>14.572	12.249	26.821
677.40	(6)>15.664	30.717	46.381
677.90	(6)>16.735	58.495	75.230
678.40	(6)>17.701	96.334	114.035
678.90	(6)>18.659	145.344	164.003
679.00	(6)>18.833	156.562	175.395

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)
#4	1	2.570	0.078	0.000	0.000	85.000	M	6.87	0.576
	Σ	2.570						6.87	0.576
#5	Σ	2.570						6.87	0.576
#6	1	16.670	0.166	0.000	0.000	85.000	M	31.63	3.038
	Σ	19.240						37.15	3.614
#7	1	20.000	0.416	0.000	0.000	79.000	S	15.54	2.427
	Σ	39.240						47.74	6.041
#1	1	20.000	0.166	0.000	0.000	85.000	M	37.94	3.645
	Σ	20.000						37.94	3.645
#2	1	20.000	0.416	0.000	0.000	79.000	S	15.54	2.427
	Σ	40.000						51.16	6.073
#3	Σ	79.240						97.39	12.114

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.30	2.00	660.00	1.100	0.166
#1	1	Time of Concentration:					0.166
#2	1	3. Short grass pasture	0.30	2.00	660.00	0.440	0.416
#2	1	Time of Concentration:					0.416
#4	1	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#4	1	Time of Concentration:					0.078
#6	1	7. Paved area and small upland gullies	0.30	2.00	660.00	1.100	0.166
#6	1	Time of Concentration:					0.166
#7	1	3. Short grass pasture	0.30	2.00	660.00	0.440	0.416
#7	1	Time of Concentration:					0.416

Sunrise Coal
Bulldog Mine - Permit #429
Sediment Pond #1

25 yr-6 hr Storm

Top of Dam Elev = 679.0

Pool Elev = 673.0

Peak Elev = 676.4

Stephen J. Glodo, P.E.

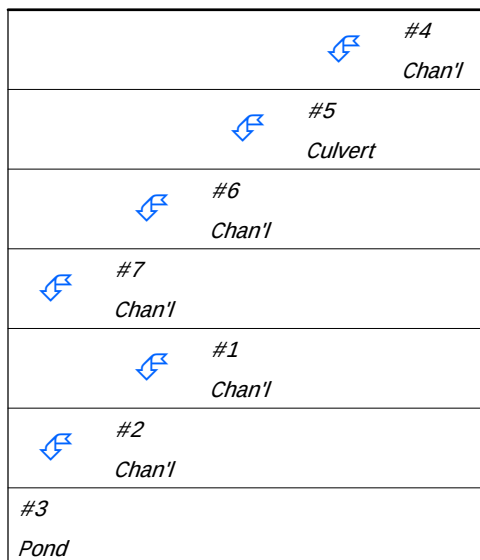
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	3.780 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #3, Sta 0+00 to 12+50
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #3, Sta 12+50 to 24+76 (Sediment Pond #1)
Pond	#3	==>	End	0.000	0.000	Sediment Pond #1
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #4, Sta 0+00 to 2+88 (Culvert under Entrance)
Culvert	#5	==>	#6	0.000	0.000	Culvert under Entrance, Collector Ditch #4, Sta 2+88 to 3+38
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #4, Sta 3+38 to 13+50
Channel	#7	==>	#3	0.000	0.000	Collector Ditch #4, Sta 13+50 to 32+70 (Sediment Pond #1)



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4	2.570	2.570	8.55	0.48
#5	0.000	2.570	8.55	0.48
#6	16.670	19.240	44.10	3.04
#7	20.000	39.240	54.10	5.03
#1	20.000	20.000	45.27	3.06
#2	20.000	40.000	59.23	5.06
#3 In	0.000	79.240	112.56	10.09
Out			17.95	10.04

Structure Detail:

Structure #4 (Vegetated Channel)

Collector Ditch #4, Sta 0+00 to 2+88 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	8.55 cfs		8.55 cfs	
Depth:	1.41 ft	1.91 ft	2.55 ft	3.05 ft
Top Width:	9.63 ft	11.63 ft	14.21 ft	16.21 ft
Velocity:	0.89 fps		0.37 fps	
X-Section Area:	9.59 sq ft		23.23 sq ft	
Hydraulic Radius:	0.932 ft		1.507 ft	
Froude Number:	0.16		0.05	
Roughness Coefficient:	0.0617		0.2062	

Structure #5 (Culvert)

Culvert under Entrance, Collector Ditch #4, Sta 2+88 to 3+38

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.15	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 8.55 cfs

Minimum pipe diameter: 1 - 21 inch pipe(s) required

Structure #6 (Vegetated Channel)

Collector Ditch #4, Sta 3+38 to 13+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	44.10 cfs		44.10 cfs	
Depth:	2.34 ft	2.84 ft	3.63 ft	4.13 ft
Top Width:	15.36 ft	17.36 ft	20.52 ft	22.52 ft
Velocity:	1.77 fps		0.92 fps	
X-Section Area:	24.98 sq ft		48.15 sq ft	
Hydraulic Radius:	1.517 ft		2.165 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0431		0.1054	

Structure #7 (Vegetated Channel)

Collector Ditch #4, Sta 13+50 to 32+70 (Sediment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	54.10 cfs		54.10 cfs	
Depth:	2.53 ft	3.03 ft	3.84 ft	4.34 ft
Top Width:	16.13 ft	18.13 ft	21.37 ft	23.37 ft
Velocity:	1.93 fps		1.03 fps	
X-Section Area:	28.03 sq ft		52.57 sq ft	
Hydraulic Radius:	1.618 ft		2.268 ft	
Froude Number:	0.26		0.12	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0412		0.0968	

Structure #1 (Vegetated Channel)

Collector Ditch #3, Sta 0+00 to 12+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	45.27 cfs		45.27 cfs	
Depth:	2.18 ft	2.68 ft	3.36 ft	3.86 ft
Top Width:	14.72 ft	16.72 ft	19.44 ft	21.44 ft
Velocity:	2.01 fps		1.06 fps	
X-Section Area:	22.57 sq ft		42.76 sq ft	
Hydraulic Radius:	1.434 ft		2.033 ft	
Froude Number:	0.29		0.13	
Roughness Coefficient:	0.0422		0.1010	

Structure #2 (Vegetated Channel)

Collector Ditch #3, Sta 12+50 to 24+76 (Sediment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	59.23 cfs		59.23 cfs	
Depth:	2.42 ft	2.92 ft	3.62 ft	4.12 ft
Top Width:	15.68 ft	17.68 ft	20.49 ft	22.49 ft
Velocity:	2.26 fps		1.23 fps	
X-Section Area:	26.25 sq ft		47.97 sq ft	
Hydraulic Radius:	1.560 ft		2.161 ft	
Froude Number:	0.31		0.14	
Roughness Coefficient:	0.0397		0.0902	

Structure #3 (Pond)

Sediment Pond #1

Pond Inputs:

Initial Pool Elev:	673.00 ft
Initial Pool:	21.17 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	50.00	1.00	0.0140	673.00	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
676.00	10.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	676.35 ft
Dewater Time:	1.12 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
657.90	0.000	0.000	0.000	
658.00	1.110	0.037	0.000	
658.40	1.125	0.484	0.000	
658.90	1.143	1.051	0.000	
659.40	1.162	1.627	0.000	
659.90	1.181	2.213	0.000	
660.40	1.200	2.808	0.000	
660.90	1.219	3.413	0.000	
661.40	1.239	4.028	0.000	
661.90	1.258	4.652	0.000	
662.40	1.278	5.286	0.000	
662.90	1.297	5.929	0.000	
663.40	1.317	6.583	0.000	
663.90	1.338	7.247	0.000	
664.40	1.358	7.921	0.000	
664.90	1.378	8.605	0.000	
665.40	1.399	9.299	0.000	
665.90	1.419	10.003	0.000	
666.40	1.440	10.718	0.000	
666.90	1.461	11.444	0.000	
667.40	1.483	12.180	0.000	
667.90	1.504	12.926	0.000	
668.40	1.525	13.684	0.000	
668.90	1.547	14.452	0.000	
669.40	1.569	15.231	0.000	
669.90	1.591	16.020	0.000	
670.40	1.613	16.821	0.000	
670.90	1.635	17.633	0.000	
671.40	1.657	18.456	0.000	
671.90	1.680	19.291	0.000	
672.40	1.703	20.136	0.000	
672.90	1.725	20.993	0.000	
673.00	1.730	21.166	0.000	Spillway #1
673.40	1.765	21.865	0.807	10.48*
673.90	1.809	22.758	2.684	6.95
674.40	1.854	23.674	5.211	2.90
674.90	1.899	24.612	7.948	1.75
675.40	1.945	25.573	10.089	1.35
675.90	1.991	26.557	11.854	1.20
676.00	2.000	26.756	12.173	0.25 Spillway #2
676.35	2.033	27.463	17.950	2.10 Peak Stage
676.40	2.038	27.564	18.778	
676.90	2.085	28.595	26.821	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
677.40	2.133	29.649	46.381	
677.90	2.181	30.728	75.230	
678.40	2.230	31.831	114.035	
678.90	2.280	32.958	164.003	
679.00	2.290	33.187	175.395	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
657.90	0.000	0.000	0.000
658.00	0.000	0.000	0.000
658.40	0.000	0.000	0.000
658.90	0.000	0.000	0.000
659.40	0.000	0.000	0.000
659.90	0.000	0.000	0.000
660.40	0.000	0.000	0.000
660.90	0.000	0.000	0.000
661.40	0.000	0.000	0.000
661.90	0.000	0.000	0.000
662.40	0.000	0.000	0.000
662.90	0.000	0.000	0.000
663.40	0.000	0.000	0.000
663.90	0.000	0.000	0.000
664.40	0.000	0.000	0.000
664.90	0.000	0.000	0.000
665.40	0.000	0.000	0.000
665.90	0.000	0.000	0.000
666.40	0.000	0.000	0.000
666.90	0.000	0.000	0.000
667.40	0.000	0.000	0.000
667.90	0.000	0.000	0.000
668.40	0.000	0.000	0.000
668.90	0.000	0.000	0.000
669.40	0.000	0.000	0.000
669.90	0.000	0.000	0.000
670.40	0.000	0.000	0.000
670.90	0.000	0.000	0.000
671.40	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
671.90	0.000	0.000	0.000
672.40	0.000	0.000	0.000
672.90	0.000	0.000	0.000
673.00	0.000	0.000	0.000
673.40	(3)>0.807	0.000	0.807
673.90	(3)>2.684	0.000	2.684
674.40	(3)>5.211	0.000	5.211
674.90	(5)>7.948	0.000	7.948
675.40	(5)>10.089	0.000	10.089
675.90	(5)>11.854	0.000	11.854
676.00	(5)>12.173	0.000	12.173
676.40	(6)>13.334	5.444	18.778
676.90	(6)>14.572	12.249	26.821
677.40	(6)>15.664	30.717	46.381
677.90	(6)>16.735	58.495	75.230
678.40	(6)>17.701	96.334	114.035
678.90	(6)>18.659	145.344	164.003
679.00	(6)>18.833	156.562	175.395

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)
#4	1	2.570	0.078	0.000	0.000	85.000	M	8.55	0.483
	Σ	2.570						8.55	0.483
#5	Σ	2.570						8.55	0.483
#6	1	16.670	0.166	0.000	0.000	85.000	M	37.73	2.554
	Σ	19.240						44.10	3.037
#7	1	20.000	0.416	0.000	0.000	79.000	S	16.96	1.992
	Σ	39.240						54.10	5.029
#1	1	20.000	0.166	0.000	0.000	85.000	M	45.27	3.064
	Σ	20.000						45.27	3.064
#2	1	20.000	0.416	0.000	0.000	79.000	S	16.96	1.992
	Σ	40.000						59.23	5.056
#3	Σ	79.240						112.56	10.085

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.30	2.00	660.00	1.100	0.166
#1	1	Time of Concentration:					0.166
#2	1	3. Short grass pasture	0.30	2.00	660.00	0.440	0.416
#2	1	Time of Concentration:					0.416
#4	1	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#4	1	Time of Concentration:					0.078
#6	1	7. Paved area and small upland gullies	0.30	2.00	660.00	1.100	0.166
#6	1	Time of Concentration:					0.166
#7	1	3. Short grass pasture	0.30	2.00	660.00	0.440	0.416
#7	1	Time of Concentration:					0.416

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #3

10 yr-24 hr Storm

Stephen J. Glodo, P.E.

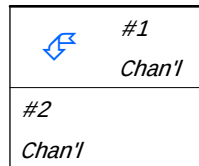
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #3, Sta 0+00 to 12+50
Channel	#2	==>	End	0.000	0.000	Collector Ditch #3, Sta 12+50 to 24+36 (Sediment Pond #1)



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	20.000	20.000	37.94	3.65
#2	20.000	40.000	51.16	6.07

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #3, Sta 0+00 to 12+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	37.94 cfs		37.94 cfs	
Depth:	2.03 ft	2.53 ft	3.20 ft	3.70 ft
Top Width:	14.13 ft	16.13 ft	18.80 ft	20.80 ft
Velocity:	1.85 fps		0.96 fps	
X-Section Area:	20.46 sq ft		39.66 sq ft	
Hydraulic Radius:	1.356 ft		1.953 ft	
Froude Number:	0.27		0.12	
Roughness Coefficient:	0.0440		0.1088	

Structure #2 (Vegetated Channel)

Collector Ditch #3, Sta 12+50 to 24+36 (Sediment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	51.16 cfs		51.16 cfs	
Depth:	2.29 ft	2.79 ft	3.48 ft	3.98 ft
Top Width:	15.14 ft	17.14 ft	19.91 ft	21.91 ft
Velocity:	2.12 fps		1.14 fps	
X-Section Area:	24.17 sq ft		45.06 sq ft	
Hydraulic Radius:	1.490 ft		2.091 ft	
Froude Number:	0.30		0.13	
Roughness Coefficient:	0.0411		0.0959	

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	20.000	0.166	0.000	0.000	85.000	M	37.94	3.645
Σ		20.000						37.94	3.645
#2	1	20.000	0.416	0.000	0.000	79.000	S	15.54	2.427
Σ		40.000						51.16	6.073

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.30	2.00	660.00	1.100	0.166
#1	1	Time of Concentration:					0.166
#2	1	3. Short grass pasture	0.30	2.00	660.00	0.440	0.416
#2	1	Time of Concentration:					0.416

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #4

10 yr-24 hr Storm

Stephen J. Glodo, P.E.

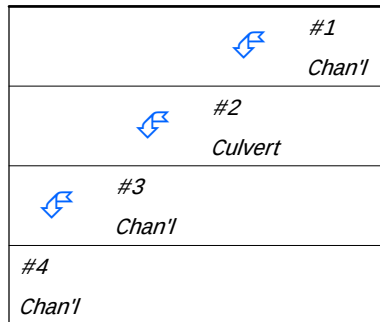
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #4, Sta 0+00 to 2+88 (Culvert under Entrance)
Culvert	#2	==>	#3	0.000	0.000	Culvert under Entrance, Collector Ditch #4, Sta 2+88 to 3+38
Channel	#3	==>	#4	0.000	0.000	Collector Ditch #4, Sta 3+38 to 13+50
Channel	#4	==>	End	0.000	0.000	Collector Ditch #4, Sta 13+50 to 32+49 (Sediment Pond #1)



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.570	2.570	6.87	0.58
#2	0.000	2.570	6.87	0.58
#3	16.670	19.240	37.15	3.61
#4	20.000	39.240	47.74	6.04

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #4, Sta 0+00 to 2+88 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	6.87 cfs		6.87 cfs	
Depth:	1.29 ft	1.79 ft	2.40 ft	2.90 ft
Top Width:	9.16 ft	11.16 ft	13.61 ft	15.61 ft
Velocity:	0.81 fps		0.32 fps	
X-Section Area:	8.50 sq ft		21.16 sq ft	
Hydraulic Radius:	0.869 ft		1.435 ft	
Froude Number:	0.15		0.05	
Roughness Coefficient:	0.0649		0.2259	

Structure #2 (Culvert)

Culvert under Entrance, Collector Ditch #4, Sta 2+88 to 3+38

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.15	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 6.87 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #3 (Vegetated Channel)

Collector Ditch #4, Sta 3+38 to 13+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	37.15 cfs		37.15 cfs	
Depth:	2.19 ft	2.69 ft	3.46 ft	3.96 ft
Top Width:	14.75 ft	16.75 ft	19.85 ft	21.85 ft
Velocity:	1.64 fps		0.83 fps	
X-Section Area:	22.69 sq ft		44.74 sq ft	
Hydraulic Radius:	1.438 ft		2.083 ft	
Froude Number:	0.23		0.10	
Roughness Coefficient:	0.0449		0.1133	

Structure #4 (Vegetated Channel)

Collector Ditch #4, Sta 13+50 to 32+49 (Sediment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	47.74 cfs		47.74 cfs	
Depth:	2.41 ft	2.91 ft	3.71 ft	4.21 ft
Top Width:	15.65 ft	17.65 ft	20.85 ft	22.85 ft
Velocity:	1.83 fps		0.96 fps	
X-Section Area:	26.12 sq ft		49.83 sq ft	
Hydraulic Radius:	1.556 ft		2.205 ft	
Froude Number:	0.25		0.11	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0424		0.1020	

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	2.570	0.078	0.000	0.000	85.000	M	6.87	0.576
	Σ	2.570						6.87	0.576
#2	Σ	2.570						6.87	0.576
#3	1	16.670	0.166	0.000	0.000	85.000	M	31.63	3.038
	Σ	19.240						37.15	3.614
#4	1	20.000	0.416	0.000	0.000	79.000	S	15.54	2.427
	Σ	39.240						47.74	6.041

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#1	1	Time of Concentration:					0.078
#3	1	7. Paved area and small upland gullies	0.30	2.00	660.00	1.100	0.166
#3	1	Time of Concentration:					0.166
#4	1	3. Short grass pasture	0.30	2.00	660.00	0.440	0.416
#4	1	Time of Concentration:					0.416

Sunrise Coal
Bulldog Mine - Permit #429
Treatment #1 to Freshwater #1

10 yr-24 hr Storm

Top of Dam Elev = 678.5

Pool Elev = 670.0

Peak Elev = 675.7

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#4	0.000	0.000	Collector Ditch #1, Sta 0+00 to 21+65 (Freshwater Pond #1)
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #2, Sta 0+00 to 16+50
Channel	#3	==>	#4	0.000	0.000	Collector Ditch #2, Sta 16+50 to 29+50 (Freshwater Pond #1)
Pond	#4	==>	End	0.000	0.000	Freshwater Pond #1
Channel	#5	==>	#6	0.000	0.000	Collector Ditch #6, Sta 0+00 to 7+00
Channel	#6	==>	#16	0.000	0.000	Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)
Channel	#7	==>	#8	0.000	0.000	Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50
Channel	#8	==>	#9	0.000	0.000	Collector Ditch #6, Sta 25+50 to 35+50
Channel	#9	==>	#17	0.000	0.000	Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)
Pond	#10	==>	#11	0.000	0.000	Treatment Pond #1
Channel	#11	==>	#18	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)
Channel	#12	==>	#13	0.000	0.000	Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)
Culvert	#13	==>	#14	0.000	0.000	Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35
Channel	#14	==>	#10	0.000	0.000	Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)
Null	#15	==>	#10	0.000	0.000	Mine Pumpage
Culvert	#16	==>	#7	0.000	0.000	Culvert under Haul Road #2, Collector Ditch #6, Sta 13+68 to 14+00
Channel	#17	==>	#10	0.000	0.000	Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)
Culvert	#18	==>	#4	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+40 (Freshwater Pond #1)

		#5 Chan'l
		#6 Chan'l
		#16 Culvert
		#7 Chan'l

		#8 Chan'l
		#9 Chan'l
		#17 Chan'l
		#15 Null
		#12 Chan'l
		#13 Culvert
		#14 Chan'l
		#10 Pond
		#11 Chan'l
		#18 Culvert
		#2 Chan'l
		#3 Chan'l
		#1 Chan'l
#4 Pond		

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#5	10.930	10.930	25.04	1.98
#6	0.000	10.930	25.04	1.98
#16	0.000	10.930	25.04	1.98
#7	17.670	28.600	39.02	4.12
#8	4.850	33.450	50.13	5.00
#9	8.260	41.710	58.82	6.01
#17	4.130	45.840	61.04	6.51
#15	1.320	1.320	4.29	0.44
#12	4.820	4.820	7.51	0.71
#13	0.000	4.820	7.51	0.71
#14	8.260	13.080	21.35	2.02
#10	In Out	34.780	95.020	103.51
				14.89
#11	0.000	95.020	14.89	13.13
#18	0.000	95.020	14.89	13.13
#2	335.510	335.510	89.13	39.18
#3	156.690	492.200	127.92	57.56
#1	9.800	9.800	10.29	1.19
#4	In Out	0.000	597.020	144.09
				41.53

Structure Detail:

Structure #5 (Vegetated Channel)

Collector Ditch #6, Sta 0+00 to 7+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	25.04 cfs		25.04 cfs	
Depth:	1.75 ft	2.25 ft	2.97 ft	3.47 ft
Top Width:	15.00 ft	17.00 ft	19.90 ft	21.90 ft
Velocity:	1.24 fps		0.60 fps	
X-Section Area:	20.13 sq ft		41.50 sq ft	
Hydraulic Radius:	1.272 ft		1.948 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0507		0.1389	

Structure #6 (Vegetated Channel)

Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	25.04 cfs		25.04 cfs	
Depth:	1.75 ft	2.25 ft	2.97 ft	3.47 ft
Top Width:	15.00 ft	17.00 ft	19.90 ft	21.90 ft
Velocity:	1.24 fps		0.60 fps	
X-Section Area:	20.13 sq ft		41.50 sq ft	
Hydraulic Radius:	1.272 ft		1.948 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0507		0.1389	

Structure #16 (Culvert)

Culvert under Haul Road #2, Collector Ditch #6, Sta 13+68 to 14+00

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
35.00	0.13	0.0140	2.80	0.00	0.90

Culvert Results:

Design Discharge = 25.04 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

Structure #7 (Vegetated Channel)

Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	39.02 cfs		39.02 cfs	
Depth:	1.92 ft	2.42 ft	3.15 ft	3.65 ft
Top Width:	17.69 ft	19.69 ft	22.62 ft	24.62 ft
Velocity:	1.47 fps		0.76 fps	
X-Section Area:	26.61 sq ft		51.43 sq ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Hydraulic Radius:	1.431 ft		2.134 ft	
Froude Number:	0.21		0.09	
Roughness Coefficient:	0.0465		0.1173	

Structure #8 (Vegetated Channel)

Collector Ditch #6, Sta 25+50 to 35+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	50.13 cfs		50.13 cfs	
Depth:	2.13 ft	2.63 ft	3.39 ft	3.89 ft
Top Width:	18.52 ft	20.52 ft	23.58 ft	25.58 ft
Velocity:	1.65 fps		0.88 fps	
X-Section Area:	30.39 sq ft		56.98 sq ft	
Hydraulic Radius:	1.556 ft		2.263 ft	
Froude Number:	0.23		0.10	
Roughness Coefficient:	0.0437		0.1052	

Structure #9 (Vegetated Channel)

Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	58.82 cfs		58.82 cfs	
Depth:	2.28 ft	2.78 ft	3.56 ft	4.06 ft
Top Width:	19.10 ft	21.10 ft	24.22 ft	26.22 ft
Velocity:	1.78 fps		0.97 fps	
X-Section Area:	33.10 sq ft		60.85 sq ft	
Hydraulic Radius:	1.641 ft		2.349 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0421		0.0982	

Structure #17 (Vegetated Channel)

Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	61.04 cfs		61.04 cfs	
Depth:	2.31 ft	2.81 ft	3.59 ft	4.09 ft
Top Width:	19.24 ft	21.24 ft	24.38 ft	26.38 ft
Velocity:	1.81 fps		0.99 fps	
X-Section Area:	33.77 sq ft		61.80 sq ft	
Hydraulic Radius:	1.661 ft		2.370 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0417		0.0966	

Structure #15 (Null)

Mine Pumpage

Structure #12 (Vegetated Channel)

Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.51 cfs		7.51 cfs	
Depth:	1.60 ft	2.10 ft	2.49 ft	2.99 ft
Top Width:	6.40 ft	8.40 ft	9.94 ft	11.94 ft
Velocity:	1.47 fps		0.61 fps	
X-Section Area:	5.12 sq ft		12.35 sq ft	
Hydraulic Radius:	0.716 ft		1.111 ft	
Froude Number:	0.29		0.10	
Roughness Coefficient:	0.0574		0.1858	

Structure #13 (Culvert)

Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
95.00	0.50	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 7.51 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #14 (Vegetated Channel)

Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	21.35 cfs		21.35 cfs	
Depth:	2.18 ft	2.68 ft	3.13 ft	3.63 ft
Top Width:	8.70 ft	10.70 ft	12.53 ft	14.53 ft
Velocity:	2.25 fps		1.09 fps	
X-Section Area:	9.47 sq ft		19.62 sq ft	
Hydraulic Radius:	0.973 ft		1.401 ft	
Froude Number:	0.38		0.15	
Roughness Coefficient:	0.0459		0.1211	

Structure #10 (Pond)

Treatment Pond #1

Pond Inputs:

Initial Pool Elev:	671.00 ft
Initial Pool:	129.99 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
671.00	20.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	672.04 ft
Dewater Time:	0.78 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
644.90	0.000	0.000	0.000	
645.00	3.820	0.127	0.000	
645.40	3.853	1.662	0.000	
645.90	3.895	3.599	0.000	
646.40	3.937	5.557	0.000	
646.90	3.979	7.536	0.000	
647.40	4.021	9.535	0.000	
647.90	4.063	11.556	0.000	
648.40	4.106	13.599	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
648.90	4.149	15.663	0.000	
649.40	4.192	17.748	0.000	
649.90	4.236	19.855	0.000	
650.40	4.279	21.983	0.000	
650.90	4.323	24.134	0.000	
651.40	4.367	26.307	0.000	
651.90	4.411	28.501	0.000	
652.40	4.456	30.718	0.000	
652.90	4.501	32.957	0.000	
653.40	4.546	35.218	0.000	
653.90	4.591	37.503	0.000	
654.40	4.636	39.809	0.000	
654.90	4.682	42.139	0.000	
655.40	4.728	44.491	0.000	
655.90	4.774	46.866	0.000	
656.40	4.820	49.265	0.000	
656.90	4.866	51.686	0.000	
657.40	4.913	54.131	0.000	
657.90	4.960	56.599	0.000	
658.40	5.007	59.091	0.000	
658.90	5.055	61.607	0.000	
659.40	5.102	64.146	0.000	
659.90	5.150	66.709	0.000	
660.40	5.198	69.296	0.000	
660.90	5.247	71.907	0.000	
661.40	5.295	74.543	0.000	
661.90	5.344	77.202	0.000	
662.40	5.393	79.887	0.000	
662.90	5.442	82.595	0.000	
663.40	5.491	85.329	0.000	
663.90	5.541	88.087	0.000	
664.40	5.591	90.870	0.000	
664.90	5.641	93.678	0.000	
665.40	5.691	96.511	0.000	
665.90	5.742	99.369	0.000	
666.40	5.793	102.253	0.000	
666.90	5.844	105.162	0.000	
667.40	5.895	108.096	0.000	
667.90	5.946	111.056	0.000	
668.40	5.998	114.042	0.000	
668.90	6.050	117.054	0.000	
669.40	6.102	120.092	0.000	
669.90	6.154	123.156	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
670.40	6.207	126.246	0.000	
670.90	6.259	129.363	0.000	
671.00	6.270	129.989	0.000	Spillway #1
671.40	6.332	132.510	4.611	6.61*
671.90	6.410	135.695	10.375	9.25
672.04	6.432	136.587	14.885	2.80 Peak Stage
672.40	6.489	138.920	26.689	
672.90	6.567	142.184	52.187	
673.40	6.647	145.487	87.901	
673.90	6.727	148.831	134.607	
674.40	6.807	152.214	193.164	
674.90	6.888	155.638	264.351	
675.40	6.969	159.102	348.885	
675.90	7.051	162.607	447.425	
676.40	7.133	166.154	560.584	
676.90	7.216	169.741	688.939	
677.40	7.299	173.370	833.032	
677.90	7.383	177.041	993.381	
678.00	7.400	177.779	1,027.445	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
644.90	0.000	0.000
645.00	0.000	0.000
645.40	0.000	0.000
645.90	0.000	0.000
646.40	0.000	0.000
646.90	0.000	0.000
647.40	0.000	0.000
647.90	0.000	0.000
648.40	0.000	0.000
648.90	0.000	0.000
649.40	0.000	0.000
649.90	0.000	0.000
650.40	0.000	0.000
650.90	0.000	0.000
651.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
651.90	0.000	0.000
652.40	0.000	0.000
652.90	0.000	0.000
653.40	0.000	0.000
653.90	0.000	0.000
654.40	0.000	0.000
654.90	0.000	0.000
655.40	0.000	0.000
655.90	0.000	0.000
656.40	0.000	0.000
656.90	0.000	0.000
657.40	0.000	0.000
657.90	0.000	0.000
658.40	0.000	0.000
658.90	0.000	0.000
659.40	0.000	0.000
659.90	0.000	0.000
660.40	0.000	0.000
660.90	0.000	0.000
661.40	0.000	0.000
661.90	0.000	0.000
662.40	0.000	0.000
662.90	0.000	0.000
663.40	0.000	0.000
663.90	0.000	0.000
664.40	0.000	0.000
664.90	0.000	0.000
665.40	0.000	0.000
665.90	0.000	0.000
666.40	0.000	0.000
666.90	0.000	0.000
667.40	0.000	0.000
667.90	0.000	0.000
668.40	0.000	0.000
668.90	0.000	0.000
669.40	0.000	0.000
669.90	0.000	0.000
670.40	0.000	0.000
670.90	0.000	0.000
671.00	0.000	0.000
671.40	4.611	4.611

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
671.90	10.375	10.375
672.40	26.689	26.689
672.90	52.187	52.187
673.40	87.901	87.901
673.90	134.607	134.607
674.40	193.164	193.164
674.90	264.351	264.351
675.40	348.885	348.885
675.90	447.425	447.425
676.40	560.584	560.584
676.90	688.939	688.939
677.40	833.032	833.032
677.90	993.381	993.381
678.00	1,027.445	1,027.445

Structure #11 (Vegetated Channel)

Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	3.0:1	3.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.89 cfs		14.89 cfs	
Depth:	1.47 ft	1.97 ft	2.49 ft	2.99 ft
Top Width:	12.81 ft	15.81 ft	18.95 ft	21.95 ft
Velocity:	1.21 fps		0.52 fps	
X-Section Area:	12.34 sq ft		28.58 sq ft	
Hydraulic Radius:	0.929 ft		1.447 ft	
Froude Number:	0.22		0.07	
Roughness Coefficient:	0.0563		0.1755	

Structure #18 (Culvert)

*Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+40
(Freshwater Pond #1)*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.23	0.0140	2.10	0.00	0.90

Culvert Results:

Design Discharge = 14.89 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

Structure #2 (Vegetated Channel)

Collector Ditch #2, Sta 0+00 to 16+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	89.13 cfs		89.13 cfs	
Depth:	2.98 ft	3.48 ft	4.38 ft	4.88 ft
Top Width:	19.93 ft	21.93 ft	25.51 ft	27.51 ft
Velocity:	2.14 fps		1.22 fps	
X-Section Area:	41.66 sq ft		73.35 sq ft	
Hydraulic Radius:	1.952 ft		2.660 ft	
Froude Number:	0.26		0.13	
Roughness Coefficient:	0.0377		0.0815	

Structure #3 (Vegetated Channel)

Collector Ditch #2, Sta 16+50 to 29+50 (Freshwater Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	127.92 cfs		127.92 cfs	
Depth:	3.43 ft	3.93 ft	4.84 ft	5.34 ft
Top Width:	21.74 ft	23.74 ft	27.37 ft	29.37 ft
Velocity:	2.51 fps		1.49 fps	
X-Section Area:	51.06 sq ft		85.62 sq ft	
Hydraulic Radius:	2.186 ft		2.887 ft	
Froude Number:	0.29		0.15	
Roughness Coefficient:	0.0347		0.0701	

Structure #1 (Vegetated Channel)

Collector Ditch #1, Sta 0+00 to 21+65 (Freshwater Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	10.29 cfs		10.29 cfs	
Depth:	2.16 ft	2.66 ft	3.34 ft	3.84 ft
Top Width:	8.62 ft	10.62 ft	13.36 ft	15.36 ft
Velocity:	1.11 fps		0.46 fps	
X-Section Area:	9.29 sq ft		22.31 sq ft	
Hydraulic Radius:	0.964 ft		1.494 ft	
Froude Number:	0.19		0.06	
Roughness Coefficient:	0.0571		0.1839	

Structure #4 (Pond)

Freshwater Pond #1

Pond Inputs:

Initial Pool Elev:	670.00 ft
Initial Pool:	119.87 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
24.00	50.00	0.50	0.0140	670.00	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
675.00	10.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	675.70 ft
Dewater Time:	2.10 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
640.90	0.000	0.000	0.000	
641.00	2.890	0.096	0.000	
641.40	2.920	1.258	0.000	
641.90	2.959	2.728	0.000	
642.40	2.997	4.217	0.000	
642.90	3.036	5.726	0.000	
643.40	3.075	7.253	0.000	
643.90	3.114	8.801	0.000	
644.40	3.154	10.368	0.000	
644.90	3.194	11.954	0.000	
645.40	3.234	13.561	0.000	
645.90	3.274	15.188	0.000	
646.40	3.314	16.835	0.000	
646.90	3.355	18.503	0.000	
647.40	3.396	20.190	0.000	
647.90	3.437	21.899	0.000	
648.40	3.479	23.628	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
648.90	3.521	25.378	0.000	
649.40	3.563	27.149	0.000	
649.90	3.605	28.940	0.000	
650.40	3.647	30.754	0.000	
650.90	3.690	32.588	0.000	
651.40	3.733	34.444	0.000	
651.90	3.776	36.321	0.000	
652.40	3.820	38.220	0.000	
652.90	3.864	40.141	0.000	
653.40	3.908	42.084	0.000	
653.90	3.952	44.049	0.000	
654.40	3.996	46.036	0.000	
654.90	4.041	48.046	0.000	
655.40	4.086	50.077	0.000	
655.90	4.131	52.132	0.000	
656.40	4.177	54.209	0.000	
656.90	4.223	56.309	0.000	
657.40	4.269	58.432	0.000	
657.90	4.315	60.578	0.000	
658.40	4.361	62.747	0.000	
658.90	4.408	64.939	0.000	
659.40	4.455	67.155	0.000	
659.90	4.502	69.394	0.000	
660.40	4.550	71.657	0.000	
660.90	4.598	73.944	0.000	
661.40	4.646	76.255	0.000	
661.90	4.694	78.590	0.000	
662.40	4.742	80.949	0.000	
662.90	4.791	83.332	0.000	
663.40	4.840	85.740	0.000	
663.90	4.889	88.172	0.000	
664.40	4.939	90.629	0.000	
664.90	4.989	93.111	0.000	
665.40	5.039	95.618	0.000	
665.90	5.089	98.150	0.000	
666.40	5.139	100.707	0.000	
666.90	5.190	103.289	0.000	
667.40	5.241	105.897	0.000	
667.90	5.292	108.530	0.000	
668.40	5.344	111.189	0.000	
668.90	5.395	113.874	0.000	
669.40	5.447	116.584	0.000	
669.90	5.500	119.321	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
670.00	5.510	119.871	0.000	Spillway #1
670.40	5.585	122.091	2.483	10.81*
670.90	5.679	124.907	4.791	7.11*
671.40	5.774	127.770	6.674	5.19*
671.90	5.870	130.681	9.311	4.65
672.40	5.967	133.640	13.700	3.45
672.90	6.064	136.648	18.739	2.55
673.40	6.163	139.705	21.717	2.15
673.90	6.262	142.811	24.359	2.00
674.40	6.362	145.967	26.734	2.00
674.90	6.462	149.173	28.907	2.30
675.00	6.482	149.820	29.316	0.60 Spillway #2
675.40	6.564	152.429	36.376	3.55
675.70	6.624	154.386	41.528	4.00 Peak Stage
675.90	6.666	155.736	45.083	
676.00	6.686	156.404	48.087	
676.40	6.769	159.095	65.352	
676.90	6.873	162.505	94.832	
677.40	6.977	165.968	134.296	
677.90	7.083	169.483	184.869	
678.40	7.189	173.050	247.400	
678.50	7.210	173.770	261.406	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
640.90	0.000	0.000	0.000
641.00	0.000	0.000	0.000
641.40	0.000	0.000	0.000
641.90	0.000	0.000	0.000
642.40	0.000	0.000	0.000
642.90	0.000	0.000	0.000
643.40	0.000	0.000	0.000
643.90	0.000	0.000	0.000
644.40	0.000	0.000	0.000
644.90	0.000	0.000	0.000
645.40	0.000	0.000	0.000
645.90	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
646.40	0.000	0.000	0.000
646.90	0.000	0.000	0.000
647.40	0.000	0.000	0.000
647.90	0.000	0.000	0.000
648.40	0.000	0.000	0.000
648.90	0.000	0.000	0.000
649.40	0.000	0.000	0.000
649.90	0.000	0.000	0.000
650.40	0.000	0.000	0.000
650.90	0.000	0.000	0.000
651.40	0.000	0.000	0.000
651.90	0.000	0.000	0.000
652.40	0.000	0.000	0.000
652.90	0.000	0.000	0.000
653.40	0.000	0.000	0.000
653.90	0.000	0.000	0.000
654.40	0.000	0.000	0.000
654.90	0.000	0.000	0.000
655.40	0.000	0.000	0.000
655.90	0.000	0.000	0.000
656.40	0.000	0.000	0.000
656.90	0.000	0.000	0.000
657.40	0.000	0.000	0.000
657.90	0.000	0.000	0.000
658.40	0.000	0.000	0.000
658.90	0.000	0.000	0.000
659.40	0.000	0.000	0.000
659.90	0.000	0.000	0.000
660.40	0.000	0.000	0.000
660.90	0.000	0.000	0.000
661.40	0.000	0.000	0.000
661.90	0.000	0.000	0.000
662.40	0.000	0.000	0.000
662.90	0.000	0.000	0.000
663.40	0.000	0.000	0.000
663.90	0.000	0.000	0.000
664.40	0.000	0.000	0.000
664.90	0.000	0.000	0.000
665.40	0.000	0.000	0.000
665.90	0.000	0.000	0.000
666.40	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
666.90	0.000	0.000	0.000
667.40	0.000	0.000	0.000
667.90	0.000	0.000	0.000
668.40	0.000	0.000	0.000
668.90	0.000	0.000	0.000
669.40	0.000	0.000	0.000
669.90	0.000	0.000	0.000
670.00	0.000	0.000	0.000
670.40	(1)>2.483	0.000	2.483
670.90	(1)>4.791	0.000	4.791
671.40	(1)>6.674	0.000	6.674
671.90	(1)>9.311	0.000	9.311
672.40	(1)>13.700	0.000	13.700
672.90	(6)>18.739	0.000	18.739
673.40	(6)>21.717	0.000	21.717
673.90	(6)>24.359	0.000	24.359
674.40	(6)>26.734	0.000	26.734
674.90	(6)>28.907	0.000	28.907
675.00	(6)>29.316	0.000	29.316
675.40	(6)>30.932	5.444	36.376
675.90	(6)>32.834	12.249	45.083
676.00	(6)>33.195	14.892	48.087
676.40	(6)>34.635	30.717	65.352
676.90	(6)>36.337	58.495	94.832
677.40	(6)>37.963	96.334	134.296
677.90	(6)>39.525	145.344	184.869
678.40	(6)>41.033	206.367	247.400
678.50	(6)>41.324	220.082	261.406

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)
#5	1	10.930	0.118	0.000	0.000	79.000	S	25.04	1.980
	Σ	10.930						25.04	1.980
#6	Σ	10.930						25.04	1.980
#16	Σ	10.930						25.04	1.980
#7	1	17.670	0.285	0.000	0.000	79.000	S	16.82	2.144
	Σ	28.600						39.02	4.125
#8	1	4.850	0.109	0.000	0.000	79.000	S	11.11	0.879
	Σ	33.450						50.13	5.003
#9	1	8.260	0.161	0.000	0.000	79.000	S	9.51	1.010
	Σ	41.710						58.82	6.014
#17	1	4.130	0.396	0.000	0.000	79.000	S	3.30	0.501
	Σ	45.840						61.04	6.515
#15	1	1.320	0.027	0.000	0.000	98.000	M	4.29	0.442
	Σ	1.320						4.29	0.442
#12	1	4.820	0.156	0.000	0.000	79.000	M	7.51	0.710
	Σ	4.820						7.51	0.710
#13	Σ	4.820						7.51	0.710
#14	1	5.510	0.180	0.000	0.000	79.000	M	8.46	0.809
	2	2.750	0.078	0.000	0.000	79.000	M	6.30	0.498
	Σ	13.080						21.35	2.017
#10	1	18.370	0.793	0.000	0.000	79.000	S	9.44	2.226
	2	16.410	0.277	0.000	0.000	79.000	S	15.84	1.993
	Σ	95.020						103.51	13.193
#11	Σ	95.020						14.89	13.126
#18	Σ	95.020						14.89	13.126
#2	1	160.000	1.633	0.000	0.000	78.000	S	46.75	18.672
	2	170.000	2.057	0.000	0.000	78.000	S	41.74	19.838
	3	5.510	0.262	0.000	0.000	79.000	S	5.46	0.670
	Σ	335.510						89.13	39.180
#3	1	136.700	1.967	0.000	0.000	78.000	S	34.72	15.952
	2	19.990	0.462	0.000	0.000	79.000	S	14.58	2.423

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	492.200						127.92	57.556
#1	1	9.800	0.227	0.000	0.000	79.000	S	10.29	1.191
	Σ	9.800						10.29	1.191
#4	Σ	597.020						144.09	71.873

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	0.60	3.00	500.00	0.610	0.227
#1	1	Time of Concentration:					0.227
#2	1	4. Cultivated, straight row	0.33	10.00	3,000.00	0.510	1.633
#2	1	Time of Concentration:					1.633
#2	2	4. Cultivated, straight row	0.38	15.00	4,000.00	0.540	2.057
#2	2	Time of Concentration:					2.057
#2	3	3. Short grass pasture	0.86	6.00	700.00	0.740	0.262
#2	3	Time of Concentration:					0.262
#3	1	4. Cultivated, straight row	0.29	10.00	3,400.00	0.480	1.967
#3	1	Time of Concentration:					1.967
#3	2	3. Short grass pasture	0.29	2.00	700.00	0.420	0.462
#3	2	Time of Concentration:					0.462
#5	1	7. Paved area and small upland gullies	0.88	7.00	800.00	1.880	0.118
#5	1	Time of Concentration:					0.118
#7	1	7. Paved area and small upland gullies	0.13	1.00	750.00	0.730	0.285
#7	1	Time of Concentration:					0.285
#8	1	7. Paved area and small upland gullies	0.40	2.00	500.00	1.270	0.109
#8	1	Time of Concentration:					0.109
#9	1	3. Short grass pasture	1.67	10.00	600.00	1.030	0.161
#9	1	Time of Concentration:					0.161
#10	1	3. Short grass pasture	0.20	2.00	1,000.00	0.350	0.793
#10	1	Time of Concentration:					0.793
#10	2	3. Short grass pasture	0.25	1.00	400.00	0.400	0.277
#10	2	Time of Concentration:					0.277
#12	1	7. Paved area and small upland gullies	0.50	4.00	800.00	1.420	0.156
#12	1	Time of Concentration:					0.156
#14	1	7. Paved area and small upland gullies	0.38	3.00	800.00	1.230	0.180
#14	1	Time of Concentration:					0.180

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	2	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#14	2	Time of Concentration:					0.078
#15	1	5. Nearly bare and untilled, and alluvial valley fans	1.00	1.00	100.00	1.000	0.027
#15	1	Time of Concentration:					0.027
#17	1	3. Short grass pasture	0.20	1.00	500.00	0.350	0.396
#17	1	Time of Concentration:					0.396

Sunrise Coal
Bulldog Mine - Permit #429
Treatment #1 to Freshwater #1

25 yr-6 hr Storm

Top of Dam Elev = 678.5

Pool Elev = 670.0

Peak Elev = 675.8

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	3.780 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#4	0.000	0.000	Collector Ditch #1, Sta 0+00 to 21+65 (Freshwater Pond #1)
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #2, Sta 0+00 to 16+50
Channel	#3	==>	#4	0.000	0.000	Collector Ditch #2, Sta 16+50 to 29+50 (Freshwater Pond #1)
Pond	#4	==>	End	0.000	0.000	Freshwater Pond #1
Channel	#5	==>	#6	0.000	0.000	Collector Ditch #6, Sta 0+00 to 7+00
Channel	#6	==>	#16	0.000	0.000	Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)
Channel	#7	==>	#8	0.000	0.000	Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50
Channel	#8	==>	#9	0.000	0.000	Collector Ditch #6, Sta 25+50 to 35+50
Channel	#9	==>	#17	0.000	0.000	Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)
Pond	#10	==>	#11	0.000	0.000	Treatment Pond #1
Channel	#11	==>	#18	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)
Channel	#12	==>	#13	0.000	0.000	Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)
Culvert	#13	==>	#14	0.000	0.000	Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35
Channel	#14	==>	#10	0.000	0.000	Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)
Null	#15	==>	#10	0.000	0.000	Mine Pumpage
Culvert	#16	==>	#7	0.000	0.000	Culvert under Haul Road #2, Collector Ditch #6, Sta 13+68 to 14+00
Channel	#17	==>	#10	0.000	0.000	Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)
Culvert	#18	==>	#4	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+40 (Freshwater Pond #1)

		#5 Chan'l
		#6 Chan'l
		#16 Culvert
		#7 Chan'l

		#8 Chan'l
		#9 Chan'l
		#17 Chan'l
		#15 Null
		#12 Chan'l
		#13 Culvert
		#14 Chan'l
		#10 Pond
		#11 Chan'l
		#18 Culvert
		#2 Chan'l
		#3 Chan'l
		#1 Chan'l
#4 Pond		

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#5	10.930	10.930	30.94	1.62
#6	0.000	10.930	30.94	1.62
#16	0.000	10.930	30.94	1.62
#7	17.670	28.600	45.30	3.38
#8	4.850	33.450	59.03	4.10
#9	8.260	41.710	68.43	4.93
#17	4.130	45.840	70.52	5.34
#15	1.320	1.320	5.38	0.39
#12	4.820	4.820	8.87	0.58
#13	0.000	4.820	8.87	0.58
#14	8.260	13.080	24.85	1.65
#10	In Out	34.780	95.020	117.08
				16.66
#11			16.66	10.84
#18			16.66	10.84
#2	335.510	335.510	94.23	32.03
#3	156.690	492.200	135.28	47.05
#1	9.800	9.800	11.61	0.98
#4	In Out	0.000	597.020	153.47
				43.71
				56.98

Structure Detail:

Structure #5 (Vegetated Channel)

Collector Ditch #6, Sta 0+00 to 7+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	30.94 cfs		30.94 cfs	
Depth:	1.91 ft	2.41 ft	3.16 ft	3.66 ft
Top Width:	15.64 ft	17.64 ft	20.65 ft	22.65 ft
Velocity:	1.37 fps		0.68 fps	
X-Section Area:	22.56 sq ft		45.31 sq ft	
Hydraulic Radius:	1.364 ft		2.046 ft	
Froude Number:	0.20		0.08	
Roughness Coefficient:	0.0482		0.1268	

Structure #6 (Vegetated Channel)

Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	30.94 cfs		30.94 cfs	
Depth:	1.91 ft	2.41 ft	3.16 ft	3.66 ft
Top Width:	15.64 ft	17.64 ft	20.65 ft	22.65 ft
Velocity:	1.37 fps		0.68 fps	
X-Section Area:	22.56 sq ft		45.31 sq ft	
Hydraulic Radius:	1.364 ft		2.046 ft	
Froude Number:	0.20		0.08	
Roughness Coefficient:	0.0482		0.1268	

Structure #16 (Culvert)

Culvert under Haul Road #2, Collector Ditch #6, Sta 13+68 to 14+00

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
35.00	0.13	0.0140	3.20	0.00	0.90

Culvert Results:

Design Discharge = 30.94 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

Structure #7 (Vegetated Channel)

Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	45.30 cfs		45.30 cfs	
Depth:	2.04 ft	2.54 ft	3.29 ft	3.79 ft
Top Width:	18.18 ft	20.18 ft	23.18 ft	25.18 ft
Velocity:	1.57 fps		0.83 fps	
X-Section Area:	28.80 sq ft		54.66 sq ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Hydraulic Radius:	1.504 ft		2.210 ft	
Froude Number:	0.22		0.10	
Roughness Coefficient:	0.0448		0.1100	

Structure #8 (Vegetated Channel)

Collector Ditch #6, Sta 25+50 to 35+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	59.03 cfs		59.03 cfs	
Depth:	2.28 ft	2.78 ft	3.56 ft	4.06 ft
Top Width:	19.12 ft	21.12 ft	24.24 ft	26.24 ft
Velocity:	1.78 fps		0.97 fps	
X-Section Area:	33.18 sq ft		60.95 sq ft	
Hydraulic Radius:	1.643 ft		2.351 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0420		0.0980	

Structure #9 (Vegetated Channel)

Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	68.43 cfs		68.43 cfs	
Depth:	2.42 ft	2.92 ft	3.72 ft	4.22 ft
Top Width:	19.68 ft	21.68 ft	24.86 ft	26.86 ft
Velocity:	1.91 fps		1.06 fps	
X-Section Area:	35.91 sq ft		64.78 sq ft	
Hydraulic Radius:	1.725 ft		2.434 ft	
Froude Number:	0.25		0.12	
Roughness Coefficient:	0.0405		0.0920	

Structure #17 (Vegetated Channel)

Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	70.52 cfs		70.52 cfs	
Depth:	2.45 ft	2.95 ft	3.75 ft	4.25 ft
Top Width:	19.80 ft	21.80 ft	25.00 ft	27.00 ft
Velocity:	1.93 fps		1.07 fps	
X-Section Area:	36.51 sq ft		65.60 sq ft	
Hydraulic Radius:	1.742 ft		2.451 ft	
Froude Number:	0.25		0.12	
Roughness Coefficient:	0.0402		0.0908	

Structure #15 (Null)

Mine Pumpage

Structure #12 (Vegetated Channel)

Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	8.87 cfs		8.87 cfs	
Depth:	1.68 ft	2.18 ft	2.58 ft	3.08 ft
Top Width:	6.72 ft	8.72 ft	10.31 ft	12.31 ft
Velocity:	1.57 fps		0.67 fps	
X-Section Area:	5.65 sq ft		13.29 sq ft	
Hydraulic Radius:	0.752 ft		1.153 ft	
Froude Number:	0.30		0.10	
Roughness Coefficient:	0.0554		0.1735	

Structure #13 (Culvert)

Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
95.00	0.50	0.0140	2.40	0.00	0.90

Culvert Results:

Design Discharge = 8.87 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #14 (Vegetated Channel)

Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	24.85 cfs		24.85 cfs	
Depth:	2.28 ft	2.78 ft	3.24 ft	3.74 ft
Top Width:	9.10 ft	11.10 ft	12.95 ft	14.95 ft
Velocity:	2.40 fps		1.18 fps	
X-Section Area:	10.35 sq ft		20.97 sq ft	
Hydraulic Radius:	1.017 ft		1.448 ft	
Froude Number:	0.40		0.16	
Roughness Coefficient:	0.0444		0.1138	

Structure #10 (Pond)

Treatment Pond #1

Pond Inputs:

Initial Pool Elev:	671.00 ft
Initial Pool:	129.99 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
671.00	20.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	672.09 ft
Dewater Time:	0.61 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
644.90	0.000	0.000	0.000	
645.00	3.820	0.127	0.000	
645.40	3.853	1.662	0.000	
645.90	3.895	3.599	0.000	
646.40	3.937	5.557	0.000	
646.90	3.979	7.536	0.000	
647.40	4.021	9.535	0.000	
647.90	4.063	11.556	0.000	
648.40	4.106	13.599	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
648.90	4.149	15.663	0.000	
649.40	4.192	17.748	0.000	
649.90	4.236	19.855	0.000	
650.40	4.279	21.983	0.000	
650.90	4.323	24.134	0.000	
651.40	4.367	26.307	0.000	
651.90	4.411	28.501	0.000	
652.40	4.456	30.718	0.000	
652.90	4.501	32.957	0.000	
653.40	4.546	35.218	0.000	
653.90	4.591	37.503	0.000	
654.40	4.636	39.809	0.000	
654.90	4.682	42.139	0.000	
655.40	4.728	44.491	0.000	
655.90	4.774	46.866	0.000	
656.40	4.820	49.265	0.000	
656.90	4.866	51.686	0.000	
657.40	4.913	54.131	0.000	
657.90	4.960	56.599	0.000	
658.40	5.007	59.091	0.000	
658.90	5.055	61.607	0.000	
659.40	5.102	64.146	0.000	
659.90	5.150	66.709	0.000	
660.40	5.198	69.296	0.000	
660.90	5.247	71.907	0.000	
661.40	5.295	74.543	0.000	
661.90	5.344	77.202	0.000	
662.40	5.393	79.887	0.000	
662.90	5.442	82.595	0.000	
663.40	5.491	85.329	0.000	
663.90	5.541	88.087	0.000	
664.40	5.591	90.870	0.000	
664.90	5.641	93.678	0.000	
665.40	5.691	96.511	0.000	
665.90	5.742	99.369	0.000	
666.40	5.793	102.253	0.000	
666.90	5.844	105.162	0.000	
667.40	5.895	108.096	0.000	
667.90	5.946	111.056	0.000	
668.40	5.998	114.042	0.000	
668.90	6.050	117.054	0.000	
669.40	6.102	120.092	0.000	
669.90	6.154	123.156	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
670.40	6.207	126.246	0.000	
670.90	6.259	129.363	0.000	
671.00	6.270	129.989	0.000	Spillway #1
671.40	6.332	132.510	4.611	6.61*
671.90	6.410	135.695	10.375	5.70
672.09	6.440	136.937	16.659	2.35 Peak Stage
672.40	6.489	138.920	26.689	
672.90	6.567	142.184	52.187	
673.40	6.647	145.487	87.901	
673.90	6.727	148.831	134.607	
674.40	6.807	152.214	193.164	
674.90	6.888	155.638	264.351	
675.40	6.969	159.102	348.885	
675.90	7.051	162.607	447.425	
676.40	7.133	166.154	560.584	
676.90	7.216	169.741	688.939	
677.40	7.299	173.370	833.032	
677.90	7.383	177.041	993.381	
678.00	7.400	177.779	1,027.445	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
644.90	0.000	0.000
645.00	0.000	0.000
645.40	0.000	0.000
645.90	0.000	0.000
646.40	0.000	0.000
646.90	0.000	0.000
647.40	0.000	0.000
647.90	0.000	0.000
648.40	0.000	0.000
648.90	0.000	0.000
649.40	0.000	0.000
649.90	0.000	0.000
650.40	0.000	0.000
650.90	0.000	0.000
651.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
651.90	0.000	0.000
652.40	0.000	0.000
652.90	0.000	0.000
653.40	0.000	0.000
653.90	0.000	0.000
654.40	0.000	0.000
654.90	0.000	0.000
655.40	0.000	0.000
655.90	0.000	0.000
656.40	0.000	0.000
656.90	0.000	0.000
657.40	0.000	0.000
657.90	0.000	0.000
658.40	0.000	0.000
658.90	0.000	0.000
659.40	0.000	0.000
659.90	0.000	0.000
660.40	0.000	0.000
660.90	0.000	0.000
661.40	0.000	0.000
661.90	0.000	0.000
662.40	0.000	0.000
662.90	0.000	0.000
663.40	0.000	0.000
663.90	0.000	0.000
664.40	0.000	0.000
664.90	0.000	0.000
665.40	0.000	0.000
665.90	0.000	0.000
666.40	0.000	0.000
666.90	0.000	0.000
667.40	0.000	0.000
667.90	0.000	0.000
668.40	0.000	0.000
668.90	0.000	0.000
669.40	0.000	0.000
669.90	0.000	0.000
670.40	0.000	0.000
670.90	0.000	0.000
671.00	0.000	0.000
671.40	4.611	4.611

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
671.90	10.375	10.375
672.40	26.689	26.689
672.90	52.187	52.187
673.40	87.901	87.901
673.90	134.607	134.607
674.40	193.164	193.164
674.90	264.351	264.351
675.40	348.885	348.885
675.90	447.425	447.425
676.40	560.584	560.584
676.90	688.939	688.939
677.40	833.032	833.032
677.90	993.381	993.381
678.00	1,027.445	1,027.445

Structure #11 (Vegetated Channel)

Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	3.0:1	3.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	16.66 cfs		16.66 cfs	
Depth:	1.53 ft	2.03 ft	2.57 ft	3.07 ft
Top Width:	13.18 ft	16.18 ft	19.40 ft	22.40 ft
Velocity:	1.27 fps		0.55 fps	
X-Section Area:	13.14 sq ft		30.02 sq ft	
Hydraulic Radius:	0.961 ft		1.484 ft	
Froude Number:	0.22		0.08	
Roughness Coefficient:	0.0549		0.1674	

Structure #18 (Culvert)

*Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+40
(Freshwater Pond #1)*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.23	0.0140	2.10	0.00	0.90

Culvert Results:

Design Discharge = 16.66 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

Structure #2 (Vegetated Channel)

Collector Ditch #2, Sta 0+00 to 16+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	94.23 cfs		94.23 cfs	
Depth:	3.05 ft	3.55 ft	4.45 ft	4.95 ft
Top Width:	20.20 ft	22.20 ft	25.79 ft	27.79 ft
Velocity:	2.19 fps		1.25 fps	
X-Section Area:	42.98 sq ft		75.12 sq ft	
Hydraulic Radius:	1.987 ft		2.694 ft	
Froude Number:	0.26		0.13	
Roughness Coefficient:	0.0372		0.0797	

Structure #3 (Vegetated Channel)

Collector Ditch #2, Sta 16+50 to 29+50 (Freshwater Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	135.28 cfs		135.28 cfs	
Depth:	3.51 ft	4.01 ft	4.92 ft	5.42 ft
Top Width:	22.04 ft	24.04 ft	27.67 ft	29.67 ft
Velocity:	2.57 fps		1.54 fps	
X-Section Area:	52.70 sq ft		87.71 sq ft	
Hydraulic Radius:	2.224 ft		2.924 ft	
Froude Number:	0.29		0.15	
Roughness Coefficient:	0.0342		0.0684	

Structure #1 (Vegetated Channel)

Collector Ditch #1, Sta 0+00 to 21+65 (Freshwater Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	11.61 cfs		11.61 cfs	
Depth:	2.23 ft	2.73 ft	3.43 ft	3.93 ft
Top Width:	8.93 ft	10.93 ft	13.72 ft	15.72 ft
Velocity:	1.16 fps		0.49 fps	
X-Section Area:	9.96 sq ft		23.53 sq ft	
Hydraulic Radius:	0.998 ft		1.534 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0557		0.1751	

Structure #4 (Pond)

Freshwater Pond #1

Pond Inputs:

Initial Pool Elev:	670.00 ft
Initial Pool:	119.87 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
24.00	50.00	0.50	0.0140	670.00	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
675.00	10.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	675.82 ft
Dewater Time:	2.13 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
640.90	0.000	0.000	0.000	
641.00	2.890	0.096	0.000	
641.40	2.920	1.258	0.000	
641.90	2.959	2.728	0.000	
642.40	2.997	4.217	0.000	
642.90	3.036	5.726	0.000	
643.40	3.075	7.253	0.000	
643.90	3.114	8.801	0.000	
644.40	3.154	10.368	0.000	
644.90	3.194	11.954	0.000	
645.40	3.234	13.561	0.000	
645.90	3.274	15.188	0.000	
646.40	3.314	16.835	0.000	
646.90	3.355	18.503	0.000	
647.40	3.396	20.190	0.000	
647.90	3.437	21.899	0.000	
648.40	3.479	23.628	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
648.90	3.521	25.378	0.000	
649.40	3.563	27.149	0.000	
649.90	3.605	28.940	0.000	
650.40	3.647	30.754	0.000	
650.90	3.690	32.588	0.000	
651.40	3.733	34.444	0.000	
651.90	3.776	36.321	0.000	
652.40	3.820	38.220	0.000	
652.90	3.864	40.141	0.000	
653.40	3.908	42.084	0.000	
653.90	3.952	44.049	0.000	
654.40	3.996	46.036	0.000	
654.90	4.041	48.046	0.000	
655.40	4.086	50.077	0.000	
655.90	4.131	52.132	0.000	
656.40	4.177	54.209	0.000	
656.90	4.223	56.309	0.000	
657.40	4.269	58.432	0.000	
657.90	4.315	60.578	0.000	
658.40	4.361	62.747	0.000	
658.90	4.408	64.939	0.000	
659.40	4.455	67.155	0.000	
659.90	4.502	69.394	0.000	
660.40	4.550	71.657	0.000	
660.90	4.598	73.944	0.000	
661.40	4.646	76.255	0.000	
661.90	4.694	78.590	0.000	
662.40	4.742	80.949	0.000	
662.90	4.791	83.332	0.000	
663.40	4.840	85.740	0.000	
663.90	4.889	88.172	0.000	
664.40	4.939	90.629	0.000	
664.90	4.989	93.111	0.000	
665.40	5.039	95.618	0.000	
665.90	5.089	98.150	0.000	
666.40	5.139	100.707	0.000	
666.90	5.190	103.289	0.000	
667.40	5.241	105.897	0.000	
667.90	5.292	108.530	0.000	
668.40	5.344	111.189	0.000	
668.90	5.395	113.874	0.000	
669.40	5.447	116.584	0.000	
669.90	5.500	119.321	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
670.00	5.510	119.871	0.000	Spillway #1
670.40	5.585	122.091	2.483	10.81*
670.90	5.679	124.907	4.791	9.85
671.40	5.774	127.770	6.674	6.25
671.90	5.870	130.681	9.311	4.70
672.40	5.967	133.640	13.700	3.40
672.90	6.064	136.648	18.739	2.60
673.40	6.163	139.705	21.717	2.25
673.90	6.262	142.811	24.359	2.25
674.40	6.362	145.967	26.734	2.20
674.90	6.462	149.173	28.907	2.25
675.00	6.482	149.820	29.316	0.50 Spillway #2
675.40	6.564	152.429	36.376	1.75
675.82	6.650	155.214	43.708	2.30 Peak Stage
675.90	6.666	155.736	45.083	
676.00	6.686	156.404	48.087	
676.40	6.769	159.095	65.352	
676.90	6.873	162.505	94.832	
677.40	6.977	165.968	134.296	
677.90	7.083	169.483	184.869	
678.40	7.189	173.050	247.400	
678.50	7.210	173.770	261.406	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
640.90	0.000	0.000	0.000
641.00	0.000	0.000	0.000
641.40	0.000	0.000	0.000
641.90	0.000	0.000	0.000
642.40	0.000	0.000	0.000
642.90	0.000	0.000	0.000
643.40	0.000	0.000	0.000
643.90	0.000	0.000	0.000
644.40	0.000	0.000	0.000
644.90	0.000	0.000	0.000
645.40	0.000	0.000	0.000
645.90	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
646.40	0.000	0.000	0.000
646.90	0.000	0.000	0.000
647.40	0.000	0.000	0.000
647.90	0.000	0.000	0.000
648.40	0.000	0.000	0.000
648.90	0.000	0.000	0.000
649.40	0.000	0.000	0.000
649.90	0.000	0.000	0.000
650.40	0.000	0.000	0.000
650.90	0.000	0.000	0.000
651.40	0.000	0.000	0.000
651.90	0.000	0.000	0.000
652.40	0.000	0.000	0.000
652.90	0.000	0.000	0.000
653.40	0.000	0.000	0.000
653.90	0.000	0.000	0.000
654.40	0.000	0.000	0.000
654.90	0.000	0.000	0.000
655.40	0.000	0.000	0.000
655.90	0.000	0.000	0.000
656.40	0.000	0.000	0.000
656.90	0.000	0.000	0.000
657.40	0.000	0.000	0.000
657.90	0.000	0.000	0.000
658.40	0.000	0.000	0.000
658.90	0.000	0.000	0.000
659.40	0.000	0.000	0.000
659.90	0.000	0.000	0.000
660.40	0.000	0.000	0.000
660.90	0.000	0.000	0.000
661.40	0.000	0.000	0.000
661.90	0.000	0.000	0.000
662.40	0.000	0.000	0.000
662.90	0.000	0.000	0.000
663.40	0.000	0.000	0.000
663.90	0.000	0.000	0.000
664.40	0.000	0.000	0.000
664.90	0.000	0.000	0.000
665.40	0.000	0.000	0.000
665.90	0.000	0.000	0.000
666.40	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
666.90	0.000	0.000	0.000
667.40	0.000	0.000	0.000
667.90	0.000	0.000	0.000
668.40	0.000	0.000	0.000
668.90	0.000	0.000	0.000
669.40	0.000	0.000	0.000
669.90	0.000	0.000	0.000
670.00	0.000	0.000	0.000
670.40	(1)>2.483	0.000	2.483
670.90	(1)>4.791	0.000	4.791
671.40	(1)>6.674	0.000	6.674
671.90	(1)>9.311	0.000	9.311
672.40	(1)>13.700	0.000	13.700
672.90	(6)>18.739	0.000	18.739
673.40	(6)>21.717	0.000	21.717
673.90	(6)>24.359	0.000	24.359
674.40	(6)>26.734	0.000	26.734
674.90	(6)>28.907	0.000	28.907
675.00	(6)>29.316	0.000	29.316
675.40	(6)>30.932	5.444	36.376
675.90	(6)>32.834	12.249	45.083
676.00	(6)>33.195	14.892	48.087
676.40	(6)>34.635	30.717	65.352
676.90	(6)>36.337	58.495	94.832
677.40	(6)>37.963	96.334	134.296
677.90	(6)>39.525	145.344	184.869
678.40	(6)>41.033	206.367	247.400
678.50	(6)>41.324	220.082	261.406

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)
#5	1	10.930	0.118	0.000	0.000	79.000	S	30.94	1.621
	Σ	10.930						30.94	1.621
#6	Σ	10.930						30.94	1.621
#16	Σ	10.930						30.94	1.621
#7	1	17.670	0.285	0.000	0.000	79.000	S	18.72	1.760
	Σ	28.600						45.30	3.381
#8	1	4.850	0.109	0.000	0.000	79.000	S	13.73	0.719
	Σ	33.450						59.03	4.100
#9	1	8.260	0.161	0.000	0.000	79.000	S	10.96	0.829
	Σ	41.710						68.43	4.929
#17	1	4.130	0.396	0.000	0.000	79.000	S	3.61	0.411
	Σ	45.840						70.52	5.341
#15	1	1.320	0.027	0.000	0.000	98.000	M	5.38	0.389
	Σ	1.320						5.38	0.389
#12	1	4.820	0.156	0.000	0.000	79.000	M	8.87	0.583
	Σ	4.820						8.87	0.583
#13	Σ	4.820						8.87	0.583
#14	1	5.510	0.180	0.000	0.000	79.000	M	9.90	0.664
	2	2.750	0.078	0.000	0.000	79.000	M	7.79	0.408
	Σ	13.080						24.85	1.655
#10	1	18.370	0.793	0.000	0.000	79.000	S	10.08	1.827
	2	16.410	0.277	0.000	0.000	79.000	S	17.66	1.636
	Σ	95.020						117.08	10.847
#11	Σ	95.020						16.66	10.838
#18	Σ	95.020						16.66	10.838
#2	1	160.000	1.633	0.000	0.000	78.000	S	49.40	15.261
	2	170.000	2.057	0.000	0.000	78.000	S	44.20	16.214
	3	5.510	0.262	0.000	0.000	79.000	S	6.10	0.550
	Σ	335.510						94.23	32.025
#3	1	136.700	1.967	0.000	0.000	78.000	S	36.75	13.038
	2	19.990	0.462	0.000	0.000	79.000	S	15.86	1.989

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	492.200						135.28	47.052
#1	1	9.800	0.227	0.000	0.000	79.000	S	11.61	0.978
	Σ	9.800						11.61	0.978
#4	Σ	597.020						153.47	58.868

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	0.60	3.00	500.00	0.610	0.227
#1	1	Time of Concentration:					0.227
#2	1	4. Cultivated, straight row	0.33	10.00	3,000.00	0.510	1.633
#2	1	Time of Concentration:					1.633
#2	2	4. Cultivated, straight row	0.38	15.00	4,000.00	0.540	2.057
#2	2	Time of Concentration:					2.057
#2	3	3. Short grass pasture	0.86	6.00	700.00	0.740	0.262
#2	3	Time of Concentration:					0.262
#3	1	4. Cultivated, straight row	0.29	10.00	3,400.00	0.480	1.967
#3	1	Time of Concentration:					1.967
#3	2	3. Short grass pasture	0.29	2.00	700.00	0.420	0.462
#3	2	Time of Concentration:					0.462
#5	1	7. Paved area and small upland gullies	0.88	7.00	800.00	1.880	0.118
#5	1	Time of Concentration:					0.118
#7	1	7. Paved area and small upland gullies	0.13	1.00	750.00	0.730	0.285
#7	1	Time of Concentration:					0.285
#8	1	7. Paved area and small upland gullies	0.40	2.00	500.00	1.270	0.109
#8	1	Time of Concentration:					0.109
#9	1	3. Short grass pasture	1.67	10.00	600.00	1.030	0.161
#9	1	Time of Concentration:					0.161
#10	1	3. Short grass pasture	0.20	2.00	1,000.00	0.350	0.793
#10	1	Time of Concentration:					0.793
#10	2	3. Short grass pasture	0.25	1.00	400.00	0.400	0.277
#10	2	Time of Concentration:					0.277
#12	1	7. Paved area and small upland gullies	0.50	4.00	800.00	1.420	0.156
#12	1	Time of Concentration:					0.156
#14	1	7. Paved area and small upland gullies	0.38	3.00	800.00	1.230	0.180
#14	1	Time of Concentration:					0.180

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	2	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#14	2	Time of Concentration:					0.078
#15	1	5. Nearly bare and untilled, and alluvial valley fans	1.00	1.00	100.00	1.000	0.027
#15	1	Time of Concentration:					0.027
#17	1	3. Short grass pasture	0.20	1.00	500.00	0.350	0.396
#17	1	Time of Concentration:					0.396

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #1

10 yr-24 hr Storm

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Collector Ditch #1, Sta 0+00 to 21+65 (Freshwater Pond #1)

#1 Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	9.800	9.800	10.29	1.19

Structure Detail:**Structure #1 (Vegetated Channel)***Collector Ditch #1, Sta 0+00 to 21+65 (Freshwater Pond #1)*

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.2	D, B	0.30			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	10.29 cfs		10.29 cfs	
Depth:	2.16 ft	2.46 ft	3.34 ft	3.64 ft
Top Width:	8.62 ft	9.82 ft	13.36 ft	14.56 ft
Velocity:	1.11 fps		0.46 fps	
X-Section Area:	9.29 sq ft		22.31 sq ft	
Hydraulic Radius:	0.964 ft		1.494 ft	
Froude Number:	0.19		0.06	
Roughness Coefficient:	0.0571		0.1839	

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	9.800	0.227	0.000	0.000	79.000	S	10.29	1.191
Σ		9.800						10.29	1.191

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	0.60	3.00	500.00	0.610	0.227
#1	1	Time of Concentration:					0.227

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #2

10 yr-24 hr Storm

Stephen J. Glodo, P.E.

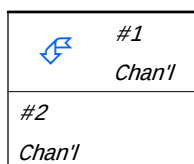
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #2, Sta 0+00 to 16+50
Channel	#2	==>	End	0.000	0.000	Collector Ditch #2, Sta 16+50 to 29+50 (Freshwater Pond #1)



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	335.510	335.510	89.13	39.18
#2	156.690	492.200	127.90	57.56

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #2, Sta 0+00 to 16+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	89.13 cfs		89.13 cfs	
Depth:	2.98 ft	3.48 ft	4.38 ft	4.88 ft
Top Width:	19.93 ft	21.93 ft	25.51 ft	27.51 ft
Velocity:	2.14 fps		1.22 fps	
X-Section Area:	41.66 sq ft		73.35 sq ft	
Hydraulic Radius:	1.952 ft		2.660 ft	
Froude Number:	0.26		0.13	
Roughness Coefficient:	0.0377		0.0815	

Structure #2 (Vegetated Channel)

Collector Ditch #2, Sta 16+50 to 29+50 (Freshwater Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	127.90 cfs		127.90 cfs	
Depth:	3.43 ft	3.93 ft	4.84 ft	5.34 ft
Top Width:	21.74 ft	23.74 ft	27.37 ft	29.37 ft
Velocity:	2.51 fps		1.49 fps	
X-Section Area:	51.06 sq ft		85.62 sq ft	
Hydraulic Radius:	2.186 ft		2.887 ft	
Froude Number:	0.29		0.15	
Roughness Coefficient:	0.0347		0.0701	

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	160.000	1.633	0.000	0.000	78.000	S	46.75	18.672
	2	170.000	2.057	0.000	0.000	78.000	S	41.74	19.838
	3	5.510	0.262	0.000	0.000	79.000	S	5.46	0.670
	Σ	335.510						89.13	39.180
#2	1	136.700	1.968	0.000	0.000	78.000	S	34.71	15.952
	2	19.990	0.462	0.000	0.000	79.000	S	14.58	2.423
	Σ	492.200						127.90	57.556

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	4. Cultivated, straight row	0.33	10.00	3,000.00	0.510	1.633
#1	1	Time of Concentration:					1.633
#1	2	4. Cultivated, straight row	0.38	15.00	4,000.00	0.540	2.057
#1	2	Time of Concentration:					2.057
#1	3	3. Short grass pasture	0.86	6.00	700.00	0.740	0.262
#1	3	Time of Concentration:					0.262
#2	1	4. Cultivated, straight row	0.29	10.00	3,401.36	0.480	1.968
#2	1	Time of Concentration:					1.968
#2	2	3. Short grass pasture	0.29	2.00	700.00	0.420	0.462
#2	2	Time of Concentration:					0.462

Sunrise Coal
Bulldog Mine - Permit #429
Treatment Pond #1

10 yr-24 hr Storm

Top of Dam Elev = 678.0

Pool Elev = 671.0

Peak Elev = 672.0

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #6, Sta 0+00 to 7+00
Channel	#2	==>	#12	0.000	0.000	Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)
Channel	#3	==>	#4	0.000	0.000	Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #6, Sta 25+50 to 35+50
Channel	#5	==>	#13	0.000	0.000	Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)
Culvert	#7	==>	#8	0.000	0.000	Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35
Channel	#8	==>	#9	0.000	0.000	Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)
Pond	#9	==>	#10	0.000	0.000	Treatment Pond #1
Channel	#10	==>	#14	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)
Null	#11	==>	#9	0.000	0.000	Mine Pumpage
Culvert	#12	==>	#3	0.000	0.000	Culvert under Haul Road #2, Collector Ditch #6, Sta 13+65 to 14+00
Channel	#13	==>	#9	0.000	0.000	Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)
Culvert	#14	==>	End	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+30 (Freshwater Pond #1)

		#1 Chan'l
		#2 Chan'l
		#12 Culvert
		#3 Chan'l
		#4 Chan'l
		#5 Chan'l
		#13 Chan'l

	#11 Null	
		 #6 Chan'l
		#7 Culvert
		#8 Chan'l
	#9 Pond	
	#10 Chan'l	
	#14 Culvert	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	10.930	10.930	25.04	1.98
#2	0.000	10.930	25.04	1.98
#12	0.000	10.930	25.04	1.98
#3	17.670	28.600	39.02	4.12
#4	4.850	33.450	50.13	5.00
#5	8.260	41.710	58.82	6.01
#13	4.130	45.840	61.04	6.51
#11	1.320	1.320	4.29	0.44
#6	4.820	4.820	7.51	0.71
#7	0.000	4.820	7.51	0.71
#8	8.260	13.080	21.35	2.02
#9	In Out	34.780	95.020	103.51
			14.89	13.13
#10	0.000	95.020	14.89	13.13
#14	0.000	95.020	14.89	13.13

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #6, Sta 0+00 to 7+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	25.04 cfs		25.04 cfs	
Depth:	1.75 ft	2.25 ft	2.97 ft	3.47 ft
Top Width:	15.00 ft	17.00 ft	19.90 ft	21.90 ft
Velocity:	1.24 fps		0.60 fps	
X-Section Area:	20.13 sq ft		41.50 sq ft	
Hydraulic Radius:	1.272 ft		1.948 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0507		0.1389	

Structure #2 (Vegetated Channel)

Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	25.04 cfs		25.04 cfs	
Depth:	1.75 ft	2.25 ft	2.97 ft	3.47 ft
Top Width:	15.00 ft	17.00 ft	19.90 ft	21.90 ft
Velocity:	1.24 fps		0.60 fps	
X-Section Area:	20.13 sq ft		41.50 sq ft	
Hydraulic Radius:	1.272 ft		1.948 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0507		0.1389	

Structure #12 (Culvert)

Culvert under Haul Road #2, Collector Ditch #6, Sta 13+65 to 14+00

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
35.00	0.13	0.0140	2.80	0.00	0.90

Culvert Results:

Design Discharge = 25.04 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

Structure #3 (Vegetated Channel)

Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	39.02 cfs		39.02 cfs	
Depth:	1.92 ft	2.42 ft	3.15 ft	3.65 ft
Top Width:	17.69 ft	19.69 ft	22.62 ft	24.62 ft
Velocity:	1.47 fps		0.76 fps	
X-Section Area:	26.61 sq ft		51.43 sq ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Hydraulic Radius:	1.431 ft		2.134 ft	
Froude Number:	0.21		0.09	
Roughness Coefficient:	0.0465		0.1173	

Structure #4 (Vegetated Channel)

Collector Ditch #6, Sta 25+50 to 35+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	50.13 cfs		50.13 cfs	
Depth:	2.13 ft	2.63 ft	3.39 ft	3.89 ft
Top Width:	18.52 ft	20.52 ft	23.58 ft	25.58 ft
Velocity:	1.65 fps		0.88 fps	
X-Section Area:	30.39 sq ft		56.98 sq ft	
Hydraulic Radius:	1.556 ft		2.263 ft	
Froude Number:	0.23		0.10	
Roughness Coefficient:	0.0437		0.1052	

Structure #5 (Vegetated Channel)

Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	58.82 cfs		58.82 cfs	
Depth:	2.28 ft	2.78 ft	3.56 ft	4.06 ft
Top Width:	19.10 ft	21.10 ft	24.22 ft	26.22 ft
Velocity:	1.78 fps		0.97 fps	
X-Section Area:	33.10 sq ft		60.85 sq ft	
Hydraulic Radius:	1.641 ft		2.349 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0421		0.0982	

Structure #13 (Vegetated Channel)

Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	61.04 cfs		61.04 cfs	
Depth:	2.31 ft	2.81 ft	3.59 ft	4.09 ft
Top Width:	19.24 ft	21.24 ft	24.38 ft	26.38 ft
Velocity:	1.81 fps		0.99 fps	
X-Section Area:	33.77 sq ft		61.80 sq ft	
Hydraulic Radius:	1.661 ft		2.370 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0417		0.0966	

Structure #11 (Null)

Mine Pumpage

Structure #6 (Vegetated Channel)

Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.51 cfs		7.51 cfs	
Depth:	1.60 ft	2.10 ft	2.49 ft	2.99 ft
Top Width:	6.40 ft	8.40 ft	9.94 ft	11.94 ft
Velocity:	1.47 fps		0.61 fps	
X-Section Area:	5.12 sq ft		12.35 sq ft	
Hydraulic Radius:	0.716 ft		1.111 ft	
Froude Number:	0.29		0.10	
Roughness Coefficient:	0.0574		0.1858	

Structure #7 (Culvert)

Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
95.00	0.50	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 7.51 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #8 (Vegetated Channel)

Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	21.35 cfs		21.35 cfs	
Depth:	2.18 ft	2.68 ft	3.13 ft	3.63 ft
Top Width:	8.70 ft	10.70 ft	12.53 ft	14.53 ft
Velocity:	2.25 fps		1.09 fps	
X-Section Area:	9.47 sq ft		19.62 sq ft	
Hydraulic Radius:	0.973 ft		1.401 ft	
Froude Number:	0.38		0.15	
Roughness Coefficient:	0.0459		0.1211	

Structure #9 (Pond)

Treatment Pond #1

Pond Inputs:

Initial Pool Elev:	671.00 ft
Initial Pool:	129.99 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
671.00	20.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	672.04 ft
Dewater Time:	0.78 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
644.90	0.000	0.000	0.000	
645.00	3.820	0.127	0.000	
645.40	3.853	1.662	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
645.90	3.895	3.599	0.000	
646.40	3.937	5.557	0.000	
646.90	3.979	7.536	0.000	
647.40	4.021	9.535	0.000	
647.90	4.063	11.556	0.000	
648.40	4.106	13.599	0.000	
648.90	4.149	15.663	0.000	
649.40	4.192	17.748	0.000	
649.90	4.236	19.855	0.000	
650.40	4.279	21.983	0.000	
650.90	4.323	24.134	0.000	
651.40	4.367	26.307	0.000	
651.90	4.411	28.501	0.000	
652.40	4.456	30.718	0.000	
652.90	4.501	32.957	0.000	
653.40	4.546	35.218	0.000	
653.90	4.591	37.503	0.000	
654.40	4.636	39.809	0.000	
654.90	4.682	42.139	0.000	
655.40	4.728	44.491	0.000	
655.90	4.774	46.866	0.000	
656.40	4.820	49.265	0.000	
656.90	4.866	51.686	0.000	
657.40	4.913	54.131	0.000	
657.90	4.960	56.599	0.000	
658.40	5.007	59.091	0.000	
658.90	5.055	61.607	0.000	
659.40	5.102	64.146	0.000	
659.90	5.150	66.709	0.000	
660.40	5.198	69.296	0.000	
660.90	5.247	71.907	0.000	
661.40	5.295	74.543	0.000	
661.90	5.344	77.202	0.000	
662.40	5.393	79.887	0.000	
662.90	5.442	82.595	0.000	
663.40	5.491	85.329	0.000	
663.90	5.541	88.087	0.000	
664.40	5.591	90.870	0.000	
664.90	5.641	93.678	0.000	
665.40	5.691	96.511	0.000	
665.90	5.742	99.369	0.000	
666.40	5.793	102.253	0.000	
666.90	5.844	105.162	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
667.40	5.895	108.096	0.000	
667.90	5.946	111.056	0.000	
668.40	5.998	114.042	0.000	
668.90	6.050	117.054	0.000	
669.40	6.102	120.092	0.000	
669.90	6.154	123.156	0.000	
670.40	6.207	126.246	0.000	
670.90	6.259	129.363	0.000	
671.00	6.270	129.989	0.000	Spillway #1
671.40	6.332	132.510	4.611	6.61*
671.90	6.410	135.695	10.375	9.25
672.04	6.432	136.587	14.885	2.80 Peak Stage
672.40	6.489	138.920	26.689	
672.90	6.567	142.184	52.187	
673.40	6.647	145.487	87.901	
673.90	6.727	148.831	134.607	
674.40	6.807	152.214	193.164	
674.90	6.888	155.638	264.351	
675.40	6.969	159.102	348.885	
675.90	7.051	162.607	447.425	
676.40	7.133	166.154	560.584	
676.90	7.216	169.741	688.939	
677.40	7.299	173.370	833.032	
677.90	7.383	177.041	993.381	
678.00	7.400	177.779	1,027.445	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
644.90	0.000	0.000
645.00	0.000	0.000
645.40	0.000	0.000
645.90	0.000	0.000
646.40	0.000	0.000
646.90	0.000	0.000
647.40	0.000	0.000
647.90	0.000	0.000
648.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
648.90	0.000	0.000
649.40	0.000	0.000
649.90	0.000	0.000
650.40	0.000	0.000
650.90	0.000	0.000
651.40	0.000	0.000
651.90	0.000	0.000
652.40	0.000	0.000
652.90	0.000	0.000
653.40	0.000	0.000
653.90	0.000	0.000
654.40	0.000	0.000
654.90	0.000	0.000
655.40	0.000	0.000
655.90	0.000	0.000
656.40	0.000	0.000
656.90	0.000	0.000
657.40	0.000	0.000
657.90	0.000	0.000
658.40	0.000	0.000
658.90	0.000	0.000
659.40	0.000	0.000
659.90	0.000	0.000
660.40	0.000	0.000
660.90	0.000	0.000
661.40	0.000	0.000
661.90	0.000	0.000
662.40	0.000	0.000
662.90	0.000	0.000
663.40	0.000	0.000
663.90	0.000	0.000
664.40	0.000	0.000
664.90	0.000	0.000
665.40	0.000	0.000
665.90	0.000	0.000
666.40	0.000	0.000
666.90	0.000	0.000
667.40	0.000	0.000
667.90	0.000	0.000
668.40	0.000	0.000
668.90	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
669.40	0.000	0.000
669.90	0.000	0.000
670.40	0.000	0.000
670.90	0.000	0.000
671.00	0.000	0.000
671.40	4.611	4.611
671.90	10.375	10.375
672.40	26.689	26.689
672.90	52.187	52.187
673.40	87.901	87.901
673.90	134.607	134.607
674.40	193.164	193.164
674.90	264.351	264.351
675.40	348.885	348.885
675.90	447.425	447.425
676.40	560.584	560.584
676.90	688.939	688.939
677.40	833.032	833.032
677.90	993.381	993.381
678.00	1,027.445	1,027.445

Structure #10 (Vegetated Channel)

Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	3.0:1	3.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.89 cfs		14.89 cfs	
Depth:	1.47 ft	1.97 ft	2.49 ft	2.99 ft
Top Width:	12.81 ft	15.81 ft	18.95 ft	21.95 ft
Velocity:	1.21 fps		0.52 fps	
X-Section Area:	12.34 sq ft		28.58 sq ft	
Hydraulic Radius:	0.929 ft		1.447 ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Froude Number:	0.22		0.07	
Roughness Coefficient:	0.0563		0.1755	

Structure #14 (Culvert)

*Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+30
(Freshwater Pond #1)*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.23	0.0140	2.10	0.00	0.90

Culvert Results:

Design Discharge = 14.89 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

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	10.930	0.118	0.000	0.000	79.000	S	25.04	1.980
	Σ	10.930						25.04	1.980
#2	Σ	10.930						25.04	1.980
#12	Σ	10.930						25.04	1.980
#3	1	17.670	0.285	0.000	0.000	79.000	S	16.82	2.144
	Σ	28.600						39.02	4.125
#4	1	4.850	0.109	0.000	0.000	79.000	S	11.11	0.879
	Σ	33.450						50.13	5.003
#5	1	8.260	0.161	0.000	0.000	79.000	S	9.51	1.010
	Σ	41.710						58.82	6.014
#13	1	4.130	0.396	0.000	0.000	79.000	S	3.30	0.501
	Σ	45.840						61.04	6.515
#11	1	1.320	0.027	0.000	0.000	98.000	M	4.29	0.442
	Σ	1.320						4.29	0.442
#6	1	4.820	0.156	0.000	0.000	79.000	M	7.51	0.710
	Σ	4.820						7.51	0.710
#7	Σ	4.820						7.51	0.710
#8	1	5.510	0.180	0.000	0.000	79.000	M	8.46	0.809
	2	2.750	0.078	0.000	0.000	79.000	M	6.30	0.498
	Σ	13.080						21.35	2.017
#9	1	18.370	0.793	0.000	0.000	79.000	S	9.44	2.226
	2	16.410	0.277	0.000	0.000	79.000	S	15.84	1.993
	Σ	95.020						103.51	13.193
#10	Σ	95.020						14.89	13.126
#14	Σ	95.020						14.89	13.126

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.88	7.00	800.00	1.880	0.118

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	Time of Concentration:					0.118
#3	1	7. Paved area and small upland gullies	0.13	1.00	750.00	0.730	0.285
#3	1	Time of Concentration:					0.285
#4	1	7. Paved area and small upland gullies	0.40	2.00	500.00	1.270	0.109
#4	1	Time of Concentration:					0.109
#5	1	3. Short grass pasture	1.67	10.00	600.00	1.030	0.161
#5	1	Time of Concentration:					0.161
#6	1	7. Paved area and small upland gullies	0.50	4.00	800.00	1.420	0.156
#6	1	Time of Concentration:					0.156
#8	1	7. Paved area and small upland gullies	0.38	3.00	800.00	1.230	0.180
#8	1	Time of Concentration:					0.180
#8	2	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#8	2	Time of Concentration:					0.078
#9	1	3. Short grass pasture	0.20	2.00	1,000.00	0.350	0.793
#9	1	Time of Concentration:					0.793
#9	2	3. Short grass pasture	0.25	1.00	400.00	0.400	0.277
#9	2	Time of Concentration:					0.277
#11	1	5. Nearly bare and untilled, and alluvial valley fans	1.00	1.00	100.00	1.000	0.027
#11	1	Time of Concentration:					0.027
#13	1	3. Short grass pasture	0.20	1.00	500.00	0.350	0.396
#13	1	Time of Concentration:					0.396

Sunrise Coal
Bulldog Mine - Permit #429
Treatment Pond #1

25 yr-6 hr Storm

Top of Dam Elev = 678.0

Pool Elev = 671.0

Peak Elev = 672.1

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	3.780 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #6, Sta 0+00 to 7+00
Channel	#2	==>	#12	0.000	0.000	Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)
Channel	#3	==>	#4	0.000	0.000	Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #6, Sta 25+50 to 35+50
Channel	#5	==>	#13	0.000	0.000	Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)
Culvert	#7	==>	#8	0.000	0.000	Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35
Channel	#8	==>	#9	0.000	0.000	Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)
Pond	#9	==>	#10	0.000	0.000	Treatment Pond #1
Channel	#10	==>	#14	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)
Null	#11	==>	#9	0.000	0.000	Mine Pumpage
Culvert	#12	==>	#3	0.000	0.000	Culvert under Haul Road #2, Collector Ditch #6, Sta 13+65 to 14+00
Channel	#13	==>	#9	0.000	0.000	Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)
Culvert	#14	==>	End	0.000	0.000	Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+30 (Freshwater Pond #1)

		#1 Chan'l
		#2 Chan'l
		#12 Culvert
		#3 Chan'l
		#4 Chan'l
		#5 Chan'l
		#13 Chan'l

	#11 Null	
		 #6 Chan'l
	 #7 Culvert	
	#8 Chan'l	
	#9 Pond	
	#10 Chan'l	
	#14 Culvert	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	10.930	10.930	30.94	1.62
#2	0.000	10.930	30.94	1.62
#12	0.000	10.930	30.94	1.62
#3	17.670	28.600	45.30	3.38
#4	4.850	33.450	59.03	4.10
#5	8.260	41.710	68.43	4.93
#13	4.130	45.840	70.52	5.34
#11	1.320	1.320	5.38	0.39
#6	4.820	4.820	8.87	0.58
#7	0.000	4.820	8.87	0.58
#8	8.260	13.080	24.85	1.65
#9 In Out	34.780	95.020	117.08	10.85
			16.66	10.84
#10	0.000	95.020	16.66	10.84
#14	0.000	95.020	16.66	10.84

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #6, Sta 0+00 to 7+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	30.94 cfs		30.94 cfs	
Depth:	1.91 ft	2.41 ft	3.16 ft	3.66 ft
Top Width:	15.64 ft	17.64 ft	20.65 ft	22.65 ft
Velocity:	1.37 fps		0.68 fps	
X-Section Area:	22.56 sq ft		45.31 sq ft	
Hydraulic Radius:	1.364 ft		2.046 ft	
Froude Number:	0.20		0.08	
Roughness Coefficient:	0.0482		0.1268	

Structure #2 (Vegetated Channel)

Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	30.94 cfs		30.94 cfs	
Depth:	1.91 ft	2.41 ft	3.16 ft	3.66 ft
Top Width:	15.64 ft	17.64 ft	20.65 ft	22.65 ft
Velocity:	1.37 fps		0.68 fps	
X-Section Area:	22.56 sq ft		45.31 sq ft	
Hydraulic Radius:	1.364 ft		2.046 ft	
Froude Number:	0.20		0.08	
Roughness Coefficient:	0.0482		0.1268	

Structure #12 (Culvert)

Culvert under Haul Road #2, Collector Ditch #6, Sta 13+65 to 14+00

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
35.00	0.13	0.0140	2.80	0.00	0.90

Culvert Results:

Design Discharge = 30.94 cfs

Minimum pipe diameter: 1 - 45 inch pipe(s) required

Structure #3 (Vegetated Channel)

Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	45.30 cfs		45.30 cfs	
Depth:	2.04 ft	2.54 ft	3.29 ft	3.79 ft
Top Width:	18.18 ft	20.18 ft	23.18 ft	25.18 ft
Velocity:	1.57 fps		0.83 fps	
X-Section Area:	28.80 sq ft		54.66 sq ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Hydraulic Radius:	1.504 ft		2.210 ft	
Froude Number:	0.22		0.10	
Roughness Coefficient:	0.0448		0.1100	

Structure #4 (Vegetated Channel)

Collector Ditch #6, Sta 25+50 to 35+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	59.03 cfs		59.03 cfs	
Depth:	2.28 ft	2.78 ft	3.56 ft	4.06 ft
Top Width:	19.12 ft	21.12 ft	24.24 ft	26.24 ft
Velocity:	1.78 fps		0.97 fps	
X-Section Area:	33.18 sq ft		60.95 sq ft	
Hydraulic Radius:	1.643 ft		2.351 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0420		0.0980	

Structure #5 (Vegetated Channel)

Collector Ditch #6, Sta 35+50 to 41+10 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	68.43 cfs		68.43 cfs	
Depth:	2.42 ft	2.92 ft	3.72 ft	4.22 ft
Top Width:	19.68 ft	21.68 ft	24.86 ft	26.86 ft
Velocity:	1.91 fps		1.06 fps	
X-Section Area:	35.91 sq ft		64.78 sq ft	
Hydraulic Radius:	1.725 ft		2.434 ft	
Froude Number:	0.25		0.12	
Roughness Coefficient:	0.0405		0.0920	

Structure #13 (Vegetated Channel)

Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	70.52 cfs		70.52 cfs	
Depth:	2.45 ft	2.95 ft	3.75 ft	4.25 ft
Top Width:	19.80 ft	21.80 ft	25.00 ft	27.00 ft
Velocity:	1.93 fps		1.07 fps	
X-Section Area:	36.51 sq ft		65.60 sq ft	
Hydraulic Radius:	1.742 ft		2.451 ft	
Froude Number:	0.25		0.12	
Roughness Coefficient:	0.0402		0.0908	

Structure #11 (Null)

Mine Pumpage

Structure #6 (Vegetated Channel)

Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	8.87 cfs		8.87 cfs	
Depth:	1.68 ft	2.18 ft	2.58 ft	3.08 ft
Top Width:	6.72 ft	8.72 ft	10.31 ft	12.31 ft
Velocity:	1.57 fps		0.67 fps	
X-Section Area:	5.65 sq ft		13.29 sq ft	
Hydraulic Radius:	0.752 ft		1.153 ft	
Froude Number:	0.30		0.10	
Roughness Coefficient:	0.0554		0.1735	

Structure #7 (Culvert)

Culvert under Haul Road #1, Collector Ditch #5, Sta 4+40 to 5+35

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
95.00	0.50	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 8.87 cfs

Minimum pipe diameter: 1 - 24 inch pipe(s) required

Structure #8 (Vegetated Channel)

Collector Ditch #5, Sta 5+35 (Culvert under Haul Road #1) to 9+44 (Treatment Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	24.85 cfs		24.85 cfs	
Depth:	2.28 ft	2.78 ft	3.24 ft	3.74 ft
Top Width:	9.10 ft	11.10 ft	12.95 ft	14.95 ft
Velocity:	2.40 fps		1.18 fps	
X-Section Area:	10.35 sq ft		20.97 sq ft	
Hydraulic Radius:	1.017 ft		1.448 ft	
Froude Number:	0.40		0.16	
Roughness Coefficient:	0.0444		0.1138	

Structure #9 (Pond)

Treatment Pond #1

Pond Inputs:

Initial Pool Elev:	671.00 ft
Initial Pool:	129.99 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
671.00	20.00	3.00:1	3.00:1	4.00

Pond Results:

Peak Elevation:	672.09 ft
Dewater Time:	0.61 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
644.90	0.000	0.000	0.000	
645.00	3.820	0.127	0.000	
645.40	3.853	1.662	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
645.90	3.895	3.599	0.000	
646.40	3.937	5.557	0.000	
646.90	3.979	7.536	0.000	
647.40	4.021	9.535	0.000	
647.90	4.063	11.556	0.000	
648.40	4.106	13.599	0.000	
648.90	4.149	15.663	0.000	
649.40	4.192	17.748	0.000	
649.90	4.236	19.855	0.000	
650.40	4.279	21.983	0.000	
650.90	4.323	24.134	0.000	
651.40	4.367	26.307	0.000	
651.90	4.411	28.501	0.000	
652.40	4.456	30.718	0.000	
652.90	4.501	32.957	0.000	
653.40	4.546	35.218	0.000	
653.90	4.591	37.503	0.000	
654.40	4.636	39.809	0.000	
654.90	4.682	42.139	0.000	
655.40	4.728	44.491	0.000	
655.90	4.774	46.866	0.000	
656.40	4.820	49.265	0.000	
656.90	4.866	51.686	0.000	
657.40	4.913	54.131	0.000	
657.90	4.960	56.599	0.000	
658.40	5.007	59.091	0.000	
658.90	5.055	61.607	0.000	
659.40	5.102	64.146	0.000	
659.90	5.150	66.709	0.000	
660.40	5.198	69.296	0.000	
660.90	5.247	71.907	0.000	
661.40	5.295	74.543	0.000	
661.90	5.344	77.202	0.000	
662.40	5.393	79.887	0.000	
662.90	5.442	82.595	0.000	
663.40	5.491	85.329	0.000	
663.90	5.541	88.087	0.000	
664.40	5.591	90.870	0.000	
664.90	5.641	93.678	0.000	
665.40	5.691	96.511	0.000	
665.90	5.742	99.369	0.000	
666.40	5.793	102.253	0.000	
666.90	5.844	105.162	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
667.40	5.895	108.096	0.000	
667.90	5.946	111.056	0.000	
668.40	5.998	114.042	0.000	
668.90	6.050	117.054	0.000	
669.40	6.102	120.092	0.000	
669.90	6.154	123.156	0.000	
670.40	6.207	126.246	0.000	
670.90	6.259	129.363	0.000	
671.00	6.270	129.989	0.000	Spillway #1
671.40	6.332	132.510	4.611	6.61*
671.90	6.410	135.695	10.375	5.70
672.09	6.440	136.937	16.659	2.35 Peak Stage
672.40	6.489	138.920	26.689	
672.90	6.567	142.184	52.187	
673.40	6.647	145.487	87.901	
673.90	6.727	148.831	134.607	
674.40	6.807	152.214	193.164	
674.90	6.888	155.638	264.351	
675.40	6.969	159.102	348.885	
675.90	7.051	162.607	447.425	
676.40	7.133	166.154	560.584	
676.90	7.216	169.741	688.939	
677.40	7.299	173.370	833.032	
677.90	7.383	177.041	993.381	
678.00	7.400	177.779	1,027.445	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
644.90	0.000	0.000
645.00	0.000	0.000
645.40	0.000	0.000
645.90	0.000	0.000
646.40	0.000	0.000
646.90	0.000	0.000
647.40	0.000	0.000
647.90	0.000	0.000
648.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
648.90	0.000	0.000
649.40	0.000	0.000
649.90	0.000	0.000
650.40	0.000	0.000
650.90	0.000	0.000
651.40	0.000	0.000
651.90	0.000	0.000
652.40	0.000	0.000
652.90	0.000	0.000
653.40	0.000	0.000
653.90	0.000	0.000
654.40	0.000	0.000
654.90	0.000	0.000
655.40	0.000	0.000
655.90	0.000	0.000
656.40	0.000	0.000
656.90	0.000	0.000
657.40	0.000	0.000
657.90	0.000	0.000
658.40	0.000	0.000
658.90	0.000	0.000
659.40	0.000	0.000
659.90	0.000	0.000
660.40	0.000	0.000
660.90	0.000	0.000
661.40	0.000	0.000
661.90	0.000	0.000
662.40	0.000	0.000
662.90	0.000	0.000
663.40	0.000	0.000
663.90	0.000	0.000
664.40	0.000	0.000
664.90	0.000	0.000
665.40	0.000	0.000
665.90	0.000	0.000
666.40	0.000	0.000
666.90	0.000	0.000
667.40	0.000	0.000
667.90	0.000	0.000
668.40	0.000	0.000
668.90	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
669.40	0.000	0.000
669.90	0.000	0.000
670.40	0.000	0.000
670.90	0.000	0.000
671.00	0.000	0.000
671.40	4.611	4.611
671.90	10.375	10.375
672.40	26.689	26.689
672.90	52.187	52.187
673.40	87.901	87.901
673.90	134.607	134.607
674.40	193.164	193.164
674.90	264.351	264.351
675.40	348.885	348.885
675.90	447.425	447.425
676.40	560.584	560.584
676.90	688.939	688.939
677.40	833.032	833.032
677.90	993.381	993.381
678.00	1,027.445	1,027.445

Structure #10 (Vegetated Channel)

Spillway Ditch to Freshwater Pond #1, Sta 0+00 to 3+90 (Culvert under Haul Road #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	3.0:1	3.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	16.66 cfs		16.66 cfs	
Depth:	1.53 ft	2.03 ft	2.57 ft	3.07 ft
Top Width:	13.18 ft	16.18 ft	19.40 ft	22.40 ft
Velocity:	1.27 fps		0.55 fps	
X-Section Area:	13.14 sq ft		30.02 sq ft	
Hydraulic Radius:	0.961 ft		1.484 ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Froude Number:	0.22		0.08	
Roughness Coefficient:	0.0549		0.1674	

Structure #14 (Culvert)

*Spillway Ditch to Freshwater Pond #1, Culvert under Haul Road #2, Sta 3+90 to 4+30
(Freshwater Pond #1)*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	0.23	0.0140	2.10	0.00	0.90

Culvert Results:

Design Discharge = 16.66 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

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	10.930	0.118	0.000	0.000	79.000	S	30.94	1.621
	Σ	10.930						30.94	1.621
#2	Σ	10.930						30.94	1.621
#12	Σ	10.930						30.94	1.621
#3	1	17.670	0.285	0.000	0.000	79.000	S	18.72	1.760
	Σ	28.600						45.30	3.381
#4	1	4.850	0.109	0.000	0.000	79.000	S	13.73	0.719
	Σ	33.450						59.03	4.100
#5	1	8.260	0.161	0.000	0.000	79.000	S	10.96	0.829
	Σ	41.710						68.43	4.929
#13	1	4.130	0.396	0.000	0.000	79.000	S	3.61	0.411
	Σ	45.840						70.52	5.341
#11	1	1.320	0.027	0.000	0.000	98.000	M	5.38	0.389
	Σ	1.320						5.38	0.389
#6	1	4.820	0.156	0.000	0.000	79.000	M	8.87	0.583
	Σ	4.820						8.87	0.583
#7	Σ	4.820						8.87	0.583
#8	1	5.510	0.180	0.000	0.000	79.000	M	9.90	0.664
	2	2.750	0.078	0.000	0.000	79.000	M	7.79	0.408
	Σ	13.080						24.85	1.655
#9	1	18.370	0.793	0.000	0.000	79.000	S	10.08	1.827
	2	16.410	0.277	0.000	0.000	79.000	S	17.66	1.636
	Σ	95.020						117.08	10.847
#10	Σ	95.020						16.66	10.838
#14	Σ	95.020						16.66	10.838

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.88	7.00	800.00	1.880	0.118

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	Time of Concentration:					0.118
#3	1	7. Paved area and small upland gullies	0.13	1.00	750.00	0.730	0.285
#3	1	Time of Concentration:					0.285
#4	1	7. Paved area and small upland gullies	0.40	2.00	500.00	1.270	0.109
#4	1	Time of Concentration:					0.109
#5	1	3. Short grass pasture	1.67	10.00	600.00	1.030	0.161
#5	1	Time of Concentration:					0.161
#6	1	7. Paved area and small upland gullies	0.50	4.00	800.00	1.420	0.156
#6	1	Time of Concentration:					0.156
#8	1	7. Paved area and small upland gullies	0.38	3.00	800.00	1.230	0.180
#8	1	Time of Concentration:					0.180
#8	2	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#8	2	Time of Concentration:					0.078
#9	1	3. Short grass pasture	0.20	2.00	1,000.00	0.350	0.793
#9	1	Time of Concentration:					0.793
#9	2	3. Short grass pasture	0.25	1.00	400.00	0.400	0.277
#9	2	Time of Concentration:					0.277
#11	1	5. Nearly bare and untilled, and alluvial valley fans	1.00	1.00	100.00	1.000	0.027
#11	1	Time of Concentration:					0.027
#13	1	3. Short grass pasture	0.20	1.00	500.00	0.350	0.396
#13	1	Time of Concentration:					0.396

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #5

10 yr-24 hr Storm

Stephen J. Glodo, P.E.

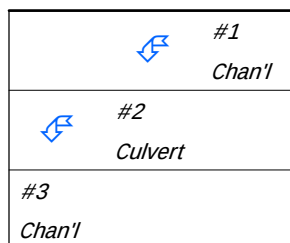
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)
Culvert	#2	==>	#3	0.000	0.000	Culvert under Haul Road #1 (Sta 4+40 to 5+35)
Channel	#3	==>	End	0.000	0.000	Collector Ditch #5, Sta 5+35 (Culvert under Haul #1) to 9+44 (Treatment Pond #1)



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.820	4.820	7.51	0.71
#2	0.000	4.820	7.51	0.71
#3	8.260	13.080	21.35	2.02

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #5, Sta 0+00 to 4+40 (Culvert under Haul Road #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.51 cfs		7.51 cfs	
Depth:	1.60 ft	2.10 ft	2.49 ft	2.99 ft
Top Width:	6.40 ft	8.40 ft	9.94 ft	11.94 ft
Velocity:	1.47 fps		0.61 fps	
X-Section Area:	5.12 sq ft		12.35 sq ft	
Hydraulic Radius:	0.716 ft		1.111 ft	
Froude Number:	0.29		0.10	
Roughness Coefficient:	0.0574		0.1858	

Structure #2 (Culvert)

Culvert under Haul Road #1 (Sta 4+40 to 5+35)

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
95.00	0.50	0.0140	1.90	0.00	0.90

Culvert Results:

Design Discharge = 7.51 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #3 (Vegetated Channel)

Collector Ditch #5, Sta 5+35 (Culvert under Haul #1) to 9+44 (Treatment Pond #1)

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	0.5	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	21.35 cfs		21.35 cfs	
Depth:	2.18 ft	2.68 ft	3.13 ft	3.63 ft
Top Width:	8.70 ft	10.70 ft	12.53 ft	14.53 ft
Velocity:	2.25 fps		1.09 fps	
X-Section Area:	9.47 sq ft		19.62 sq ft	
Hydraulic Radius:	0.973 ft		1.401 ft	
Froude Number:	0.38		0.15	
Roughness Coefficient:	0.0459		0.1211	

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	4.820	0.156	0.000	0.000	79.000	M	7.51	0.710
	Σ	4.820						7.51	0.710
#2	Σ	4.820						7.51	0.710
#3	1	5.510	0.180	0.000	0.000	79.000	M	8.46	0.809
	2	2.750	0.078	0.000	0.000	79.000	M	6.30	0.498
	Σ	13.080						21.35	2.017

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.50	4.00	800.00	1.420	0.156
#1	1	Time of Concentration:					0.156
#3	1	7. Paved area and small upland gullies	0.38	3.00	800.00	1.230	0.180
#3	1	Time of Concentration:					0.180
#3	2	7. Paved area and small upland gullies	0.50	2.00	400.00	1.420	0.078
#3	2	Time of Concentration:					0.078

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #6

10 yr-24 hr Storm

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #6, Sta 0+00 to 7+00
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)
Culvert	#3	==>	#4	0.000	0.000	Culvert under Haul Road #2, Collector Ditch #6, Sta 13+65 to 14+00
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50
Channel	#5	==>	#6	0.000	0.000	Collector Ditch #6, Sta 25+50 to 35+50
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #6, Sta 35+50 to 41+10
Channel	#7	==>	End	0.000	0.000	Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)

	#1 Chan'l
	#2 Chan'l
	#3 Culvert
	#4 Chan'l
	#5 Chan'l
	#6 Chan'l
	#7 Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	10.930	10.930	25.04	1.98
#2	0.000	10.930	25.04	1.98
#3	0.000	10.930	25.04	1.98
#4	17.670	28.600	39.02	4.12
#5	4.850	33.450	50.13	5.00
#6	8.260	41.710	58.82	6.01
#7	4.130	45.840	61.04	6.51

Structure Detail:**Structure #1 (Vegetated Channel)***Collector Ditch #6, Sta 0+00 to 7+00*

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	25.04 cfs		25.04 cfs	
Depth:	1.75 ft	2.25 ft	2.97 ft	3.47 ft
Top Width:	15.00 ft	17.00 ft	19.90 ft	21.90 ft
Velocity:	1.24 fps		0.60 fps	
X-Section Area:	20.13 sq ft		41.50 sq ft	
Hydraulic Radius:	1.272 ft		1.948 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0507		0.1389	

Structure #2 (Vegetated Channel)*Collector Ditch #6, Sta 7+00 to 13+65 (Culvert under Haul Road #2)*

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	25.04 cfs		25.04 cfs	
Depth:	1.75 ft	2.25 ft	2.97 ft	3.47 ft
Top Width:	15.00 ft	17.00 ft	19.90 ft	21.90 ft
Velocity:	1.24 fps		0.60 fps	
X-Section Area:	20.13 sq ft		41.50 sq ft	
Hydraulic Radius:	1.272 ft		1.948 ft	
Froude Number:	0.19		0.07	
Roughness Coefficient:	0.0507		0.1389	

Structure #3 (Culvert)

Culvert under Haul Road #2, Collector Ditch #6, Sta 13+65 to 14+00

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
35.00	0.13	0.0140	2.80	0.00	0.90

Culvert Results:

Design Discharge = 25.04 cfs

Minimum pipe diameter: 1 - 36 inch pipe(s) required

Structure #4 (Vegetated Channel)

Collector Ditch #6, Sta 14+00 (Culvert under Haul Road #2) to 25+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	39.02 cfs		39.02 cfs	
Depth:	1.92 ft	2.42 ft	3.15 ft	3.65 ft
Top Width:	17.69 ft	19.69 ft	22.62 ft	24.62 ft
Velocity:	1.47 fps		0.76 fps	
X-Section Area:	26.61 sq ft		51.43 sq ft	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Hydraulic Radius:	1.431 ft		2.134 ft	
Froude Number:	0.21		0.09	
Roughness Coefficient:	0.0465		0.1173	

Structure #5 (Vegetated Channel)

Collector Ditch #6, Sta 25+50 to 35+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	50.13 cfs		50.13 cfs	
Depth:	2.13 ft	2.63 ft	3.39 ft	3.89 ft
Top Width:	18.52 ft	20.52 ft	23.58 ft	25.58 ft
Velocity:	1.65 fps		0.88 fps	
X-Section Area:	30.39 sq ft		56.98 sq ft	
Hydraulic Radius:	1.556 ft		2.263 ft	
Froude Number:	0.23		0.10	
Roughness Coefficient:	0.0437		0.1052	

Structure #6 (Vegetated Channel)

Collector Ditch #6, Sta 35+50 to 41+10

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	58.82 cfs		58.82 cfs	
Depth:	2.28 ft	2.78 ft	3.56 ft	4.06 ft
Top Width:	19.10 ft	21.10 ft	24.22 ft	26.22 ft
Velocity:	1.78 fps		0.97 fps	
X-Section Area:	33.10 sq ft		60.85 sq ft	
Hydraulic Radius:	1.641 ft		2.349 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0421		0.0982	

Structure #7 (Vegetated Channel)

Collector Ditch #6, Sta 41+10 to 48+00 (Treatment Pond #1)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
10.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	61.04 cfs		61.04 cfs	
Depth:	2.31 ft	2.81 ft	3.59 ft	4.09 ft
Top Width:	19.24 ft	21.24 ft	24.38 ft	26.38 ft
Velocity:	1.81 fps		0.99 fps	
X-Section Area:	33.77 sq ft		61.80 sq ft	
Hydraulic Radius:	1.661 ft		2.370 ft	
Froude Number:	0.24		0.11	
Roughness Coefficient:	0.0417		0.0966	

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	10.930	0.118	0.000	0.000	79.000	S	25.04	1.980
	Σ	10.930						25.04	1.980
#2	Σ	10.930						25.04	1.980
#3	Σ	10.930						25.04	1.980
#4	1	17.670	0.285	0.000	0.000	79.000	S	16.82	2.144
	Σ	28.600						39.02	4.125
#5	1	4.850	0.109	0.000	0.000	79.000	S	11.11	0.879
	Σ	33.450						50.13	5.003
#6	1	8.260	0.161	0.000	0.000	79.000	S	9.51	1.010
	Σ	41.710						58.82	6.014
#7	1	4.130	0.396	0.000	0.000	79.000	S	3.30	0.501
	Σ	45.840						61.04	6.515

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.88	7.00	800.00	1.880	0.118
#1	1	Time of Concentration:					0.118
#4	1	7. Paved area and small upland gullies	0.13	1.00	750.00	0.730	0.285
#4	1	Time of Concentration:					0.285
#5	1	7. Paved area and small upland gullies	0.40	2.00	500.00	1.270	0.109
#5	1	Time of Concentration:					0.109
#6	1	3. Short grass pasture	1.67	10.00	600.00	1.030	0.161
#6	1	Time of Concentration:					0.161
#7	1	3. Short grass pasture	0.20	1.00	500.00	0.350	0.396
#7	1	Time of Concentration:					0.396

Sunrise Coal
Bulldog Mine - Permit #429
Freshwater Pond #2

10 yr-24 hr Storm

Top of Dam Elev = 683.0

Pool Elev = 673.5

Peak Elev = 680.0

Stephen J. Glodo, P.E.

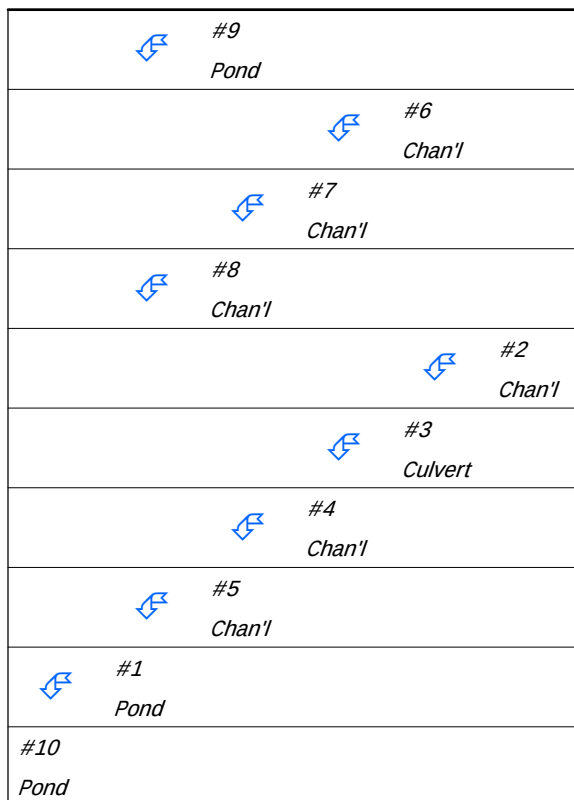
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	#10	0.000	0.000	Treatment Pond #2
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)
Culvert	#3	==>	#4	0.000	0.000	Culvert under Entrance, Sta 0+52 to 1+40
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00
Channel	#5	==>	#1	0.000	0.000	Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #8, Sta 0+00 to 11+50
Channel	#7	==>	#8	0.000	0.000	Collector Ditch #8, Sta 11+50 to 28+00
Channel	#8	==>	#1	0.000	0.000	Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)
Pond	#9	==>	#1	0.000	0.000	Refuse Impoundment
Pond	#10	==>	End	0.000	0.000	Freshwater Pond #2



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#9 In	48.200	48.200	156.51	16.15
Out			9.28	15.03
#6	5.280	5.280	8.57	0.63
#7	6.490	11.770	19.10	1.41
#8	5.150	16.920	27.46	2.03
#2	1.510	1.510	4.04	0.34
#3	0.000	1.510	4.04	0.34
#4	23.520	25.030	66.94	5.61
#5	8.160	33.190	88.76	7.44
#1 In	36.740	135.050	191.43	31.15
Out			38.74	30.65
#10 In	140.000	275.050	77.57	46.99
Out			19.93	44.18

Structure Detail:***Structure #9 (Pond)******Refuse Impoundment***

Pond Inputs:

Initial Pool Elev:	750.00 ft
Initial Pool:	2047.35 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
750.00	20.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	750.26 ft
Dewater Time:	2.10 days

*Dewatering time is calculated from peak stage to lowest spillway***Elevation-Capacity-Discharge Table**

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
662.40	0.000	0.000	0.000	
662.50	8.820	0.294	0.000	
663.40	9.042	8.332	0.000	
664.40	9.292	17.498	0.000	
665.40	9.545	26.917	0.000	
666.40	9.802	36.590	0.000	
667.40	10.062	46.521	0.000	
668.40	10.325	56.714	0.000	
669.40	10.592	67.172	0.000	
670.40	10.862	77.899	0.000	
671.40	11.136	88.898	0.000	
672.40	11.413	100.172	0.000	
673.40	11.693	111.725	0.000	
674.40	11.977	123.560	0.000	
675.40	12.265	135.681	0.000	
676.40	12.555	148.091	0.000	
677.40	12.849	160.793	0.000	
678.40	13.147	173.791	0.000	
679.40	13.448	187.088	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
680.00	13.630	195.211	0.000	
680.40	13.748	200.687	0.000	
681.40	14.043	214.582	0.000	
682.40	14.342	228.775	0.000	
683.40	14.645	243.268	0.000	
684.40	14.950	258.065	0.000	
685.40	15.258	273.169	0.000	
686.40	15.570	288.583	0.000	
687.40	15.885	304.310	0.000	
688.40	16.203	320.354	0.000	
689.40	16.524	336.717	0.000	
690.40	16.848	353.403	0.000	
691.40	17.175	370.414	0.000	
692.40	17.506	387.754	0.000	
693.40	17.840	405.427	0.000	
694.40	18.177	423.435	0.000	
695.40	18.516	441.781	0.000	
696.40	18.860	460.469	0.000	
697.40	19.206	479.501	0.000	
698.40	19.555	498.882	0.000	
699.40	19.908	518.613	0.000	
700.40	20.264	538.699	0.000	
701.40	20.622	559.141	0.000	
702.40	20.984	579.945	0.000	
703.40	21.350	601.112	0.000	
704.40	21.718	622.645	0.000	
705.40	22.090	644.549	0.000	
706.40	22.464	666.825	0.000	
707.40	22.842	689.478	0.000	
708.40	23.223	712.510	0.000	
709.40	23.607	735.925	0.000	
710.40	23.994	759.725	0.000	
711.40	24.385	783.914	0.000	
712.40	24.778	808.495	0.000	
713.40	25.175	833.472	0.000	
714.40	25.575	858.846	0.000	
715.40	25.978	884.622	0.000	
716.40	26.384	910.802	0.000	
717.40	26.793	937.390	0.000	
718.40	27.205	964.389	0.000	
719.40	27.621	991.802	0.000	
720.40	28.040	1,019.633	0.000	
721.40	28.462	1,047.883	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
722.40	28.887	1,076.557	0.000	
723.40	29.315	1,105.658	0.000	
724.40	29.746	1,135.188	0.000	
725.40	30.181	1,165.151	0.000	
726.40	30.618	1,195.550	0.000	
727.40	31.059	1,226.389	0.000	
728.40	31.503	1,257.670	0.000	
729.40	31.950	1,289.396	0.000	
730.40	32.400	1,321.571	0.000	
731.40	32.854	1,354.198	0.000	
732.40	33.310	1,387.279	0.000	
733.40	33.770	1,420.819	0.000	
734.40	34.233	1,454.821	0.000	
735.40	34.699	1,489.286	0.000	
736.40	35.168	1,524.219	0.000	
737.40	35.640	1,559.623	0.000	
738.40	36.116	1,595.501	0.000	
739.40	36.594	1,631.855	0.000	
740.40	37.076	1,668.690	0.000	
741.40	37.561	1,706.009	0.000	
742.40	38.049	1,743.813	0.000	
743.40	38.540	1,782.108	0.000	
744.40	39.034	1,820.895	0.000	
745.40	39.532	1,860.177	0.000	
746.40	40.033	1,899.959	0.000	
747.40	40.536	1,940.244	0.000	
748.40	41.043	1,981.033	0.000	
749.40	41.553	2,022.331	0.000	
750.00	41.861	2,047.354	0.000	Spillway #1
750.26	41.992	2058.057	9.278	36.40 Peak Stage
750.40	42.067	2,064.141	14.552	
751.40	42.583	2,106.465	50.930	
752.40	43.102	2,149.308	147.167	
753.40	43.625	2,192.671	296.405	
754.40	44.151	2,236.559	503.736	
755.40	44.680	2,280.974	774.373	
756.40	45.212	2,325.920	1,113.169	
757.40	45.747	2,371.400	1,524.610	
758.00	46.070	2,398.944	1,808.082	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
662.40	0.000	0.000
662.50	0.000	0.000
663.40	0.000	0.000
664.40	0.000	0.000
665.40	0.000	0.000
666.40	0.000	0.000
667.40	0.000	0.000
668.40	0.000	0.000
669.40	0.000	0.000
670.40	0.000	0.000
671.40	0.000	0.000
672.40	0.000	0.000
673.40	0.000	0.000
674.40	0.000	0.000
675.40	0.000	0.000
676.40	0.000	0.000
677.40	0.000	0.000
678.40	0.000	0.000
679.40	0.000	0.000
680.00	0.000	0.000
680.40	0.000	0.000
681.40	0.000	0.000
682.40	0.000	0.000
683.40	0.000	0.000
684.40	0.000	0.000
685.40	0.000	0.000
686.40	0.000	0.000
687.40	0.000	0.000
688.40	0.000	0.000
689.40	0.000	0.000
690.40	0.000	0.000
691.40	0.000	0.000
692.40	0.000	0.000
693.40	0.000	0.000
694.40	0.000	0.000
695.40	0.000	0.000
696.40	0.000	0.000
697.40	0.000	0.000
698.40	0.000	0.000
699.40	0.000	0.000
700.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
701.40	0.000	0.000
702.40	0.000	0.000
703.40	0.000	0.000
704.40	0.000	0.000
705.40	0.000	0.000
706.40	0.000	0.000
707.40	0.000	0.000
708.40	0.000	0.000
709.40	0.000	0.000
710.40	0.000	0.000
711.40	0.000	0.000
712.40	0.000	0.000
713.40	0.000	0.000
714.40	0.000	0.000
715.40	0.000	0.000
716.40	0.000	0.000
717.40	0.000	0.000
718.40	0.000	0.000
719.40	0.000	0.000
720.40	0.000	0.000
721.40	0.000	0.000
722.40	0.000	0.000
723.40	0.000	0.000
724.40	0.000	0.000
725.40	0.000	0.000
726.40	0.000	0.000
727.40	0.000	0.000
728.40	0.000	0.000
729.40	0.000	0.000
730.40	0.000	0.000
731.40	0.000	0.000
732.40	0.000	0.000
733.40	0.000	0.000
734.40	0.000	0.000
735.40	0.000	0.000
736.40	0.000	0.000
737.40	0.000	0.000
738.40	0.000	0.000
739.40	0.000	0.000
740.40	0.000	0.000
741.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
742.40	0.000	0.000
743.40	0.000	0.000
744.40	0.000	0.000
745.40	0.000	0.000
746.40	0.000	0.000
747.40	0.000	0.000
748.40	0.000	0.000
749.40	0.000	0.000
750.00	0.000	0.000
750.40	14.552	14.552
751.40	50.930	50.930
752.40	147.167	147.167
753.40	296.405	296.405
754.40	503.736	503.736
755.40	774.373	774.373
756.40	1,113.169	1,113.169
757.40	1,524.610	1,524.610
758.00	1,808.082	1,808.082

Structure #6 (Vegetated Channel)

Collector Ditch #8, Sta 0+00 to 11+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	8.57 cfs		8.57 cfs	
Depth:	1.37 ft	1.87 ft	2.58 ft	3.08 ft
Top Width:	11.46 ft	13.46 ft	16.32 ft	18.32 ft
Velocity:	0.72 fps		0.30 fps	
X-Section Area:	11.92 sq ft		28.81 sq ft	
Hydraulic Radius:	0.984 ft		1.642 ft	
Froude Number:	0.12		0.04	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0648		0.2204	

Structure #7 (Vegetated Channel)

Collector Ditch #8, Sta 11+50 to 28+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.10 cfs		19.10 cfs	
Depth:	1.69 ft	2.19 ft	2.98 ft	3.48 ft
Top Width:	14.77 ft	16.77 ft	19.92 ft	21.92 ft
Velocity:	0.99 fps		0.46 fps	
X-Section Area:	19.28 sq ft		41.62 sq ft	
Hydraulic Radius:	1.238 ft		1.951 ft	
Froude Number:	0.15		0.06	
Roughness Coefficient:	0.0548		0.1602	

Structure #8 (Vegetated Channel)

Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	27.46 cfs		27.46 cfs	
Depth:	1.96 ft	2.46 ft	3.31 ft	3.81 ft
Top Width:	15.86 ft	17.86 ft	21.24 ft	23.24 ft
Velocity:	1.17 fps		0.57 fps	
X-Section Area:	23.43 sq ft		48.39 sq ft	
Hydraulic Radius:	1.396 ft		2.122 ft	
Froude Number:	0.17		0.07	
Roughness Coefficient:	0.0502		0.1371	

Structure #2 (Vegetated Channel)

Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	4.04 cfs		4.04 cfs	
Depth:	1.28 ft	1.78 ft	2.37 ft	2.87 ft
Top Width:	7.11 ft	9.11 ft	11.46 ft	13.46 ft
Velocity:	0.69 fps		0.25 fps	
X-Section Area:	5.82 sq ft		15.93 sq ft	
Hydraulic Radius:	0.754 ft		1.266 ft	
Froude Number:	0.14		0.04	
Roughness Coefficient:	0.0710		0.2749	

Structure #3 (Culvert)

Culvert under Entrance, Sta 0+52 to 1+40

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
88.00	0.16	0.0140	1.40	0.00	0.90

Culvert Results:

Design Discharge = 4.04 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #4 (Vegetated Channel)

Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	66.94 cfs		66.94 cfs	
Depth:	2.45 ft	2.95 ft	3.71 ft	4.21 ft
Top Width:	17.82 ft	19.82 ft	22.82 ft	24.82 ft
Velocity:	2.11 fps		1.17 fps	
X-Section Area:	31.68 sq ft		57.11 sq ft	
Hydraulic Radius:	1.669 ft		2.324 ft	
Froude Number:	0.28		0.13	
Roughness Coefficient:	0.0397		0.0892	

Structure #5 (Vegetated Channel)

Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	88.76 cfs		88.76 cfs	
Depth:	2.74 ft	3.24 ft	4.01 ft	4.51 ft
Top Width:	18.98 ft	20.98 ft	24.06 ft	26.06 ft
Velocity:	2.40 fps		1.38 fps	
X-Section Area:	37.03 sq ft		64.36 sq ft	
Hydraulic Radius:	1.826 ft		2.480 ft	
Froude Number:	0.30		0.15	
Roughness Coefficient:	0.0371		0.0792	

Structure #1 (Pond)

Treatment Pond #2

Pond Inputs:

Initial Pool Elev:	674.00 ft
Initial Pool:	75.24 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
674.00	50.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	675.25 ft
Dewater Time:	0.37 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
660.90	0.000	0.000	0.000	
661.00	5.070	0.169	0.000	
661.90	5.164	4.774	0.000	
662.90	5.269	9.991	0.000	
663.90	5.376	15.313	0.000	
664.90	5.483	20.743	0.000	
665.90	5.592	26.280	0.000	
666.90	5.701	31.926	0.000	
667.90	5.812	37.683	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
668.90	5.924	43.551	0.000	
669.90	6.036	49.531	0.000	
670.90	6.150	55.624	0.000	
671.90	6.265	61.832	0.000	
672.90	6.381	68.155	0.000	
673.90	6.498	74.595	0.000	
674.00	6.510	75.245	0.000	Spillway #1
674.90	6.707	81.193	16.982	4.24*
675.25	6.785	83.553	38.735	4.70 Peak Stage
675.90	6.929	88.010	79.824	
676.90	7.155	95.052	186.713	
677.90	7.384	102.321	352.261	
678.90	7.617	109.821	578.051	
679.90	7.854	117.556	868.644	
680.90	8.094	125.530	1,228.779	
681.90	8.338	133.745	1,662.836	
682.90	8.585	142.206	2,125.495	
683.00	8.610	143.066	2,174.872	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
660.90	0.000	0.000
661.00	0.000	0.000
661.90	0.000	0.000
662.90	0.000	0.000
663.90	0.000	0.000
664.90	0.000	0.000
665.90	0.000	0.000
666.90	0.000	0.000
667.90	0.000	0.000
668.90	0.000	0.000
669.90	0.000	0.000
670.90	0.000	0.000
671.90	0.000	0.000
672.90	0.000	0.000
673.90	0.000	0.000
674.00	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
674.90	16.982	16.982
675.90	79.824	79.824
676.90	186.713	186.713
677.90	352.261	352.261
678.90	578.051	578.051
679.90	868.644	868.644
680.90	1,228.779	1,228.779
681.90	1,662.836	1,662.836
682.90	2,125.495	2,125.495
683.00	2,174.872	2,174.872

Structure #10 (Pond)*Freshwater Pond #2*

Pond Inputs:

Initial Pool Elev:	673.50 ft
Initial Pool:	20.16 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	50.00	0.50	0.0140	673.50	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
680.00	10.00	2.00:1	2.00:1	4.00

Pond Results:

Peak Elevation:	680.03 ft
Dewater Time:	1.49 days

*Dewatering time is calculated from peak stage to lowest spillway*Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
660.40	0.000	0.000	0.000	
660.50	0.940	0.031	0.000	
661.40	1.013	0.910	0.000	
662.40	1.097	1.964	0.000	
663.40	1.184	3.104	0.000	
664.40	1.274	4.333	0.000	
665.40	1.368	5.653	0.000	
666.40	1.465	7.069	0.000	
667.40	1.566	8.584	0.000	
668.40	1.669	10.201	0.000	
669.40	1.776	11.924	0.000	
670.40	1.887	13.755	0.000	
671.40	2.001	15.698	0.000	
672.40	2.118	17.757	0.000	
673.40	2.238	19.935	0.000	
673.50	2.250	20.159	0.000	Spillway #1
674.40	2.416	22.258	2.914	8.72*
675.40	2.608	24.770	7.705	3.94*
676.40	2.806	27.476	11.279	4.80
677.40	3.012	30.384	13.970	3.90
678.40	3.225	33.503	16.208	3.75
679.40	3.446	36.838	18.183	4.10
680.00	3.582	38.946	19.266	4.95 Spillway #2
680.03	3.590	39.062	19.927	1.70 Peak Stage
680.40	3.674	40.397	27.520	
681.40	3.909	44.188	48.052	
682.40	4.151	48.217	101.314	
683.00	4.300	50.752	148.067	

*Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
660.40	0.000	0.000	0.000
660.50	0.000	0.000	0.000
661.40	0.000	0.000	0.000
662.40	0.000	0.000	0.000
663.40	0.000	0.000	0.000
664.40	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
665.40	0.000	0.000	0.000
666.40	0.000	0.000	0.000
667.40	0.000	0.000	0.000
668.40	0.000	0.000	0.000
669.40	0.000	0.000	0.000
670.40	0.000	0.000	0.000
671.40	0.000	0.000	0.000
672.40	0.000	0.000	0.000
673.40	0.000	0.000	0.000
673.50	0.000	0.000	0.000
674.40	(1)>2.914	0.000	2.914
675.40	(6)>7.705	0.000	7.705
676.40	(6)>11.279	0.000	11.279
677.40	(6)>13.970	0.000	13.970
678.40	(6)>16.208	0.000	16.208
679.40	(6)>18.183	0.000	18.183
680.00	(6)>19.266	0.000	19.266
680.40	(6)>19.960	7.560	27.520
681.40	(6)>21.592	26.460	48.052
682.40	(6)>23.117	78.197	101.314
683.00	(6)>23.981	124.086	148.067

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)
#9	1	48.200	0.000	0.000	0.000	98.000	M	156.51	16.155
	Σ	48.200						156.51	16.155
#6	1	5.280	0.022	0.000	0.000	69.000	M	8.57	0.632
	Σ	5.280						8.57	0.632
#7	1	6.490	0.022	0.000	0.000	69.000	M	10.53	0.777
	Σ	11.770						19.10	1.409
#8	1	5.150	0.010	0.000	0.000	69.000	M	8.36	0.617
	Σ	16.920						27.46	2.026
#2	1	1.510	0.071	0.000	0.000	85.000	M	4.04	0.338
	Σ	1.510						4.04	0.338
#3	Σ	1.510						4.04	0.338
#4	1	23.520	0.073	0.000	0.000	85.000	M	62.90	5.271
	Σ	25.030						66.94	5.609
#5	1	8.160	0.014	0.000	0.000	85.000	M	21.82	1.829
	Σ	33.190						88.76	7.437
#1	1	25.530	0.249	0.000	0.000	82.000	M	40.41	4.148
	2	11.210	0.014	0.000	0.000	85.000	M	29.98	2.512
	Σ	135.050						191.43	31.151
#10	1	20.000	1.031	0.000	0.000	78.000	S	8.21	2.334
	2	40.000	1.433	0.000	0.000	78.000	S	12.88	4.668
	3	80.000	1.905	0.000	0.000	78.000	S	20.82	9.336
	Σ	275.050						77.57	46.991

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	2.59	75.00	2,900.00	3.230	0.249
#1	1	Time of Concentration:					0.249
#1	2	7. Paved area and small upland gullies	17.05	75.00	440.00	8.310	0.014
#1	2	Time of Concentration:					0.014
#2	1	7. Paved area and small upland gullies	0.33	1.00	300.00	1.160	0.071

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	Time of Concentration:					0.071
#4	1	7. Paved area and small upland gullies	6.00	78.00	1,300.00	4.930	0.073
#4	1	Time of Concentration:					0.073
#5	1	7. Paved area and small upland gullies	17.73	78.00	440.00	8.470	0.014
#5	1	Time of Concentration:					0.014
#6	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#6	1	Time of Concentration:					0.022
#7	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#7	1	Time of Concentration:					0.022
#8	1	3. Short grass pasture	16.67	20.00	120.00	3.260	0.010
#8	1	Time of Concentration:					0.010
#9	1	9. Small streams flowing bankfull	10.00	1.00	10.00	28.460	0.000
#9	1	Time of Concentration:					0.000
#10	1	4. Cultivated, straight row	0.15	2.00	1,300.00	0.350	1.031
#10	1	Time of Concentration:					1.031
#10	2	4. Cultivated, straight row	0.13	2.00	1,600.00	0.310	1.433
#10	2	Time of Concentration:					1.433
#10	3	4. Cultivated, straight row	0.24	7.00	2,950.00	0.430	1.905
#10	3	Time of Concentration:					1.905

Sunrise Coal
Bulldog Mine - Permit #429
Freshwater Pond #2

25 yr-6 hr Storm

Top of Dam Elev = 683.0

Pool Elev = 673.5

Peak Elev = 679.8

Stephen J. Glodo, P.E.

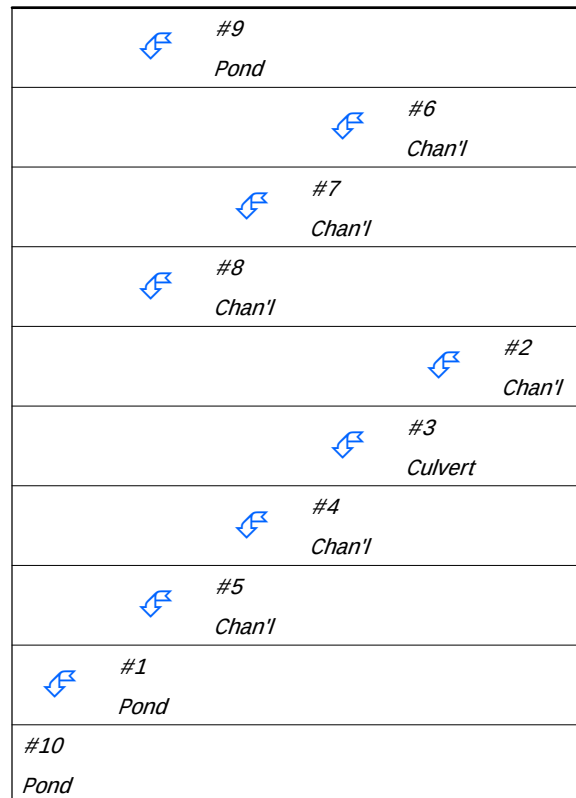
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	3.780 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	#10	0.000	0.000	Treatment Pond #2
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)
Culvert	#3	==>	#4	0.000	0.000	Culvert under Entrance, Sta 0+52 to 1+40
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00
Channel	#5	==>	#1	0.000	0.000	Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #8, Sta 0+00 to 11+50
Channel	#7	==>	#8	0.000	0.000	Collector Ditch #8, Sta 11+50 to 28+00
Channel	#8	==>	#1	0.000	0.000	Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)
Pond	#9	==>	#1	0.000	0.000	Refuse Impoundment
Pond	#10	==>	End	0.000	0.000	Freshwater Pond #2



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#9 In	48.200	48.200	196.42	14.21
Out			10.05	13.72
#6	5.280	5.280	10.46	0.49
#7	6.490	11.770	23.31	1.10
#8	5.150	16.920	33.50	1.58
#2	1.510	1.510	5.02	0.28
#3	0.000	1.510	5.02	0.28
#4	23.520	25.030	83.24	4.70
#5	8.160	33.190	110.37	6.24
#1 In	36.740	135.050	230.94	27.09
Out			40.51	26.88
#10 In	140.000	275.050	82.48	40.23
Out			18.81	39.11

Structure Detail:**Structure #9 (Pond)*****Refuse Impoundment***

Pond Inputs:

Initial Pool Elev:	750.00 ft
Initial Pool:	2047.35 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
750.00	20.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	750.28 ft
Dewater Time:	2.45 days

*Dewatering time is calculated from peak stage to lowest spillway***Elevation-Capacity-Discharge Table**

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
662.40	0.000	0.000	0.000	
662.50	8.820	0.294	0.000	
663.40	9.042	8.332	0.000	
664.40	9.292	17.498	0.000	
665.40	9.545	26.917	0.000	
666.40	9.802	36.590	0.000	
667.40	10.062	46.521	0.000	
668.40	10.325	56.714	0.000	
669.40	10.592	67.172	0.000	
670.40	10.862	77.899	0.000	
671.40	11.136	88.898	0.000	
672.40	11.413	100.172	0.000	
673.40	11.693	111.725	0.000	
674.40	11.977	123.560	0.000	
675.40	12.265	135.681	0.000	
676.40	12.555	148.091	0.000	
677.40	12.849	160.793	0.000	
678.40	13.147	173.791	0.000	
679.40	13.448	187.088	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
680.00	13.630	195.211	0.000	
680.40	13.748	200.687	0.000	
681.40	14.043	214.582	0.000	
682.40	14.342	228.775	0.000	
683.40	14.645	243.268	0.000	
684.40	14.950	258.065	0.000	
685.40	15.258	273.169	0.000	
686.40	15.570	288.583	0.000	
687.40	15.885	304.310	0.000	
688.40	16.203	320.354	0.000	
689.40	16.524	336.717	0.000	
690.40	16.848	353.403	0.000	
691.40	17.175	370.414	0.000	
692.40	17.506	387.754	0.000	
693.40	17.840	405.427	0.000	
694.40	18.177	423.435	0.000	
695.40	18.516	441.781	0.000	
696.40	18.860	460.469	0.000	
697.40	19.206	479.501	0.000	
698.40	19.555	498.882	0.000	
699.40	19.908	518.613	0.000	
700.40	20.264	538.699	0.000	
701.40	20.622	559.141	0.000	
702.40	20.984	579.945	0.000	
703.40	21.350	601.112	0.000	
704.40	21.718	622.645	0.000	
705.40	22.090	644.549	0.000	
706.40	22.464	666.825	0.000	
707.40	22.842	689.478	0.000	
708.40	23.223	712.510	0.000	
709.40	23.607	735.925	0.000	
710.40	23.994	759.725	0.000	
711.40	24.385	783.914	0.000	
712.40	24.778	808.495	0.000	
713.40	25.175	833.472	0.000	
714.40	25.575	858.846	0.000	
715.40	25.978	884.622	0.000	
716.40	26.384	910.802	0.000	
717.40	26.793	937.390	0.000	
718.40	27.205	964.389	0.000	
719.40	27.621	991.802	0.000	
720.40	28.040	1,019.633	0.000	
721.40	28.462	1,047.883	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
722.40	28.887	1,076.557	0.000	
723.40	29.315	1,105.658	0.000	
724.40	29.746	1,135.188	0.000	
725.40	30.181	1,165.151	0.000	
726.40	30.618	1,195.550	0.000	
727.40	31.059	1,226.389	0.000	
728.40	31.503	1,257.670	0.000	
729.40	31.950	1,289.396	0.000	
730.40	32.400	1,321.571	0.000	
731.40	32.854	1,354.198	0.000	
732.40	33.310	1,387.279	0.000	
733.40	33.770	1,420.819	0.000	
734.40	34.233	1,454.821	0.000	
735.40	34.699	1,489.286	0.000	
736.40	35.168	1,524.219	0.000	
737.40	35.640	1,559.623	0.000	
738.40	36.116	1,595.501	0.000	
739.40	36.594	1,631.855	0.000	
740.40	37.076	1,668.690	0.000	
741.40	37.561	1,706.009	0.000	
742.40	38.049	1,743.813	0.000	
743.40	38.540	1,782.108	0.000	
744.40	39.034	1,820.895	0.000	
745.40	39.532	1,860.177	0.000	
746.40	40.033	1,899.959	0.000	
747.40	40.536	1,940.244	0.000	
748.40	41.043	1,981.033	0.000	
749.40	41.553	2,022.331	0.000	
750.00	41.861	2,047.354	0.000	Spillway #1
750.28	42.003	2058.943	10.046	44.90 Peak Stage
750.40	42.067	2,064.141	14.552	
751.40	42.583	2,106.465	50.930	
752.40	43.102	2,149.308	147.167	
753.40	43.625	2,192.671	296.405	
754.40	44.151	2,236.559	503.736	
755.40	44.680	2,280.974	774.373	
756.40	45.212	2,325.920	1,113.169	
757.40	45.747	2,371.400	1,524.610	
758.00	46.070	2,398.944	1,808.082	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
662.40	0.000	0.000
662.50	0.000	0.000
663.40	0.000	0.000
664.40	0.000	0.000
665.40	0.000	0.000
666.40	0.000	0.000
667.40	0.000	0.000
668.40	0.000	0.000
669.40	0.000	0.000
670.40	0.000	0.000
671.40	0.000	0.000
672.40	0.000	0.000
673.40	0.000	0.000
674.40	0.000	0.000
675.40	0.000	0.000
676.40	0.000	0.000
677.40	0.000	0.000
678.40	0.000	0.000
679.40	0.000	0.000
680.00	0.000	0.000
680.40	0.000	0.000
681.40	0.000	0.000
682.40	0.000	0.000
683.40	0.000	0.000
684.40	0.000	0.000
685.40	0.000	0.000
686.40	0.000	0.000
687.40	0.000	0.000
688.40	0.000	0.000
689.40	0.000	0.000
690.40	0.000	0.000
691.40	0.000	0.000
692.40	0.000	0.000
693.40	0.000	0.000
694.40	0.000	0.000
695.40	0.000	0.000
696.40	0.000	0.000
697.40	0.000	0.000
698.40	0.000	0.000
699.40	0.000	0.000
700.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
701.40	0.000	0.000
702.40	0.000	0.000
703.40	0.000	0.000
704.40	0.000	0.000
705.40	0.000	0.000
706.40	0.000	0.000
707.40	0.000	0.000
708.40	0.000	0.000
709.40	0.000	0.000
710.40	0.000	0.000
711.40	0.000	0.000
712.40	0.000	0.000
713.40	0.000	0.000
714.40	0.000	0.000
715.40	0.000	0.000
716.40	0.000	0.000
717.40	0.000	0.000
718.40	0.000	0.000
719.40	0.000	0.000
720.40	0.000	0.000
721.40	0.000	0.000
722.40	0.000	0.000
723.40	0.000	0.000
724.40	0.000	0.000
725.40	0.000	0.000
726.40	0.000	0.000
727.40	0.000	0.000
728.40	0.000	0.000
729.40	0.000	0.000
730.40	0.000	0.000
731.40	0.000	0.000
732.40	0.000	0.000
733.40	0.000	0.000
734.40	0.000	0.000
735.40	0.000	0.000
736.40	0.000	0.000
737.40	0.000	0.000
738.40	0.000	0.000
739.40	0.000	0.000
740.40	0.000	0.000
741.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
742.40	0.000	0.000
743.40	0.000	0.000
744.40	0.000	0.000
745.40	0.000	0.000
746.40	0.000	0.000
747.40	0.000	0.000
748.40	0.000	0.000
749.40	0.000	0.000
750.00	0.000	0.000
750.40	14.552	14.552
751.40	50.930	50.930
752.40	147.167	147.167
753.40	296.405	296.405
754.40	503.736	503.736
755.40	774.373	774.373
756.40	1,113.169	1,113.169
757.40	1,524.610	1,524.610
758.00	1,808.082	1,808.082

Structure #6 (Vegetated Channel)

Collector Ditch #8, Sta 0+00 to 11+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	10.46 cfs		10.46 cfs	
Depth:	1.48 ft	1.98 ft	2.73 ft	3.23 ft
Top Width:	11.92 ft	13.92 ft	16.93 ft	18.93 ft
Velocity:	0.79 fps		0.33 fps	
X-Section Area:	13.26 sq ft		31.32 sq ft	
Hydraulic Radius:	1.051 ft		1.719 ft	
Froude Number:	0.13		0.04	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0618		0.2025	

Structure #7 (Vegetated Channel)

Collector Ditch #8, Sta 11+50 to 28+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	23.31 cfs		23.31 cfs	
Depth:	1.84 ft	2.34 ft	3.16 ft	3.66 ft
Top Width:	15.34 ft	17.34 ft	20.63 ft	22.63 ft
Velocity:	1.09 fps		0.52 fps	
X-Section Area:	21.43 sq ft		45.19 sq ft	
Hydraulic Radius:	1.322 ft		2.043 ft	
Froude Number:	0.16		0.06	
Roughness Coefficient:	0.0522		0.1471	

Structure #8 (Vegetated Channel)

Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	33.50 cfs		33.50 cfs	
Depth:	2.13 ft	2.63 ft	3.50 ft	4.00 ft
Top Width:	16.52 ft	18.52 ft	22.02 ft	24.02 ft
Velocity:	1.28 fps		0.64 fps	
X-Section Area:	26.10 sq ft		52.61 sq ft	
Hydraulic Radius:	1.489 ft		2.222 ft	
Froude Number:	0.18		0.07	
Roughness Coefficient:	0.0478		0.1259	

Structure #2 (Vegetated Channel)

Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	5.02 cfs		5.02 cfs	
Depth:	1.38 ft	1.88 ft	2.50 ft	3.00 ft
Top Width:	7.53 ft	9.53 ft	12.01 ft	14.01 ft
Velocity:	0.76 fps		0.29 fps	
X-Section Area:	6.59 sq ft		17.52 sq ft	
Hydraulic Radius:	0.805 ft		1.329 ft	
Froude Number:	0.14		0.04	
Roughness Coefficient:	0.0677		0.2513	

Structure #3 (Culvert)

Culvert under Entrance, Sta 0+52 to 1+40

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
88.00	0.16	0.0140	1.40	0.00	0.90

Culvert Results:

Design Discharge = 5.02 cfs

Minimum pipe diameter: 1 - 21 inch pipe(s) required

Structure #4 (Vegetated Channel)

Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	83.24 cfs		83.24 cfs	
Depth:	2.68 ft	3.18 ft	3.94 ft	4.44 ft
Top Width:	18.70 ft	20.70 ft	23.77 ft	25.77 ft
Velocity:	2.33 fps		1.33 fps	
X-Section Area:	35.73 sq ft		62.64 sq ft	
Hydraulic Radius:	1.789 ft		2.444 ft	
Froude Number:	0.30		0.14	
Roughness Coefficient:	0.0377		0.0813	

Structure #5 (Vegetated Channel)

Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	110.37 cfs		110.37 cfs	
Depth:	2.99 ft	3.49 ft	4.27 ft	4.77 ft
Top Width:	19.96 ft	21.96 ft	25.08 ft	27.08 ft
Velocity:	2.64 fps		1.56 fps	
X-Section Area:	41.82 sq ft		70.62 sq ft	
Hydraulic Radius:	1.956 ft		2.606 ft	
Froude Number:	0.32		0.16	
Roughness Coefficient:	0.0353		0.0722	

Structure #1 (Pond)

Treatment Pond #2

Pond Inputs:

Initial Pool Elev:	674.00 ft
Initial Pool:	75.24 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
674.00	50.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	675.27 ft
Dewater Time:	0.32 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
660.90	0.000	0.000	0.000	
661.00	5.070	0.169	0.000	
661.90	5.164	4.774	0.000	
662.90	5.269	9.991	0.000	
663.90	5.376	15.313	0.000	
664.90	5.483	20.743	0.000	
665.90	5.592	26.280	0.000	
666.90	5.701	31.926	0.000	
667.90	5.812	37.683	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
668.90	5.924	43.551	0.000	
669.90	6.036	49.531	0.000	
670.90	6.150	55.624	0.000	
671.90	6.265	61.832	0.000	
672.90	6.381	68.155	0.000	
673.90	6.498	74.595	0.000	
674.00	6.510	75.245	0.000	Spillway #1
674.90	6.707	81.193	16.982	4.24*
675.27	6.791	83.746	40.514	3.40 Peak Stage
675.90	6.929	88.010	79.824	
676.90	7.155	95.052	186.713	
677.90	7.384	102.321	352.261	
678.90	7.617	109.821	578.051	
679.90	7.854	117.556	868.644	
680.90	8.094	125.530	1,228.779	
681.90	8.338	133.745	1,662.836	
682.90	8.585	142.206	2,125.495	
683.00	8.610	143.066	2,174.872	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
660.90	0.000	0.000
661.00	0.000	0.000
661.90	0.000	0.000
662.90	0.000	0.000
663.90	0.000	0.000
664.90	0.000	0.000
665.90	0.000	0.000
666.90	0.000	0.000
667.90	0.000	0.000
668.90	0.000	0.000
669.90	0.000	0.000
670.90	0.000	0.000
671.90	0.000	0.000
672.90	0.000	0.000
673.90	0.000	0.000
674.00	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
674.90	16.982	16.982
675.90	79.824	79.824
676.90	186.713	186.713
677.90	352.261	352.261
678.90	578.051	578.051
679.90	868.644	868.644
680.90	1,228.779	1,228.779
681.90	1,662.836	1,662.836
682.90	2,125.495	2,125.495
683.00	2,174.872	2,174.872

Structure #10 (Pond)*Freshwater Pond #2*

Pond Inputs:

Initial Pool Elev:	673.50 ft
Initial Pool:	20.16 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	50.00	0.50	0.0140	673.50	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
680.00	10.00	2.00:1	2.00:1	4.00

Pond Results:

Peak Elevation:	679.75 ft
Dewater Time:	1.69 days

*Dewatering time is calculated from peak stage to lowest spillway*Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
660.40	0.000	0.000	0.000	
660.50	0.940	0.031	0.000	
661.40	1.013	0.910	0.000	
662.40	1.097	1.964	0.000	
663.40	1.184	3.104	0.000	
664.40	1.274	4.333	0.000	
665.40	1.368	5.653	0.000	
666.40	1.465	7.069	0.000	
667.40	1.566	8.584	0.000	
668.40	1.669	10.201	0.000	
669.40	1.776	11.924	0.000	
670.40	1.887	13.755	0.000	
671.40	2.001	15.698	0.000	
672.40	2.118	17.757	0.000	
673.40	2.238	19.935	0.000	
673.50	2.250	20.159	0.000	Spillway #1
674.40	2.416	22.258	2.914	8.72*
675.40	2.608	24.770	7.705	9.60
676.40	2.806	27.476	11.279	5.05
677.40	3.012	30.384	13.970	4.15
678.40	3.225	33.503	16.208	4.15
679.40	3.446	36.838	18.183	5.15
679.75	3.525	38.052	18.807	3.75 Peak Stage
680.00	3.582	38.946	19.266	Spillway #2
680.40	3.674	40.397	27.520	
681.40	3.909	44.188	48.052	
682.40	4.151	48.217	101.314	
683.00	4.300	50.752	148.067	

*Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
660.40	0.000	0.000	0.000
660.50	0.000	0.000	0.000
661.40	0.000	0.000	0.000
662.40	0.000	0.000	0.000
663.40	0.000	0.000	0.000
664.40	0.000	0.000	0.000

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
665.40	0.000	0.000	0.000
666.40	0.000	0.000	0.000
667.40	0.000	0.000	0.000
668.40	0.000	0.000	0.000
669.40	0.000	0.000	0.000
670.40	0.000	0.000	0.000
671.40	0.000	0.000	0.000
672.40	0.000	0.000	0.000
673.40	0.000	0.000	0.000
673.50	0.000	0.000	0.000
674.40	(1)>2.914	0.000	2.914
675.40	(6)>7.705	0.000	7.705
676.40	(6)>11.279	0.000	11.279
677.40	(6)>13.970	0.000	13.970
678.40	(6)>16.208	0.000	16.208
679.40	(6)>18.183	0.000	18.183
680.00	(6)>19.266	0.000	19.266
680.40	(6)>19.960	7.560	27.520
681.40	(6)>21.592	26.460	48.052
682.40	(6)>23.117	78.197	101.314
683.00	(6)>23.981	124.086	148.067

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)
#9	1	48.200	0.000	0.000	0.000	98.000	M	196.42	14.207
	Σ	48.200						196.42	14.207
#6	1	5.280	0.022	0.000	0.000	69.000	M	10.46	0.493
	Σ	5.280						10.46	0.493
#7	1	6.490	0.022	0.000	0.000	69.000	M	12.85	0.606
	Σ	11.770						23.31	1.099
#8	1	5.150	0.010	0.000	0.000	69.000	M	10.20	0.481
	Σ	16.920						33.50	1.580
#2	1	1.510	0.071	0.000	0.000	85.000	M	5.02	0.284
	Σ	1.510						5.02	0.284
#3	Σ	1.510						5.02	0.284
#4	1	23.520	0.073	0.000	0.000	85.000	M	78.22	4.419
	Σ	25.030						83.24	4.703
#5	1	8.160	0.014	0.000	0.000	85.000	M	27.14	1.533
	Σ	33.190						110.37	6.236
#1	1	25.530	0.249	0.000	0.000	82.000	M	47.32	3.446
	2	11.210	0.014	0.000	0.000	85.000	M	37.28	2.106
	Σ	135.050						230.94	27.093
#10	1	20.000	1.031	0.000	0.000	78.000	S	8.64	1.908
	2	40.000	1.433	0.000	0.000	78.000	S	13.60	3.815
	3	80.000	1.905	0.000	0.000	78.000	S	22.03	7.631
	Σ	275.050						82.48	40.230

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	2.59	75.00	2,900.00	3.230	0.249
#1	1	Time of Concentration:					0.249
#1	2	7. Paved area and small upland gullies	17.05	75.00	440.00	8.310	0.014
#1	2	Time of Concentration:					0.014
#2	1	7. Paved area and small upland gullies	0.33	1.00	300.00	1.160	0.071

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
# 2	1	Time of Concentration:					0.071
#4	1	7. Paved area and small upland gullies	6.00	78.00	1,300.00	4.930	0.073
# 4	1	Time of Concentration:					0.073
#5	1	7. Paved area and small upland gullies	17.73	78.00	440.00	8.470	0.014
# 5	1	Time of Concentration:					0.014
#6	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
# 6	1	Time of Concentration:					0.022
#7	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
# 7	1	Time of Concentration:					0.022
#8	1	3. Short grass pasture	16.67	20.00	120.00	3.260	0.010
# 8	1	Time of Concentration:					0.010
#9	1	9. Small streams flowing bankfull	10.00	1.00	10.00	28.460	0.000
# 9	1	Time of Concentration:					0.000
#10	1	4. Cultivated, straight row	0.15	2.00	1,300.00	0.350	1.031
# 10	1	Time of Concentration:					1.031
#10	2	4. Cultivated, straight row	0.13	2.00	1,600.00	0.310	1.433
# 10	2	Time of Concentration:					1.433
#10	3	4. Cultivated, straight row	0.24	7.00	2,950.00	0.430	1.905
# 10	3	Time of Concentration:					1.905

Sunrise Coal
Bulldog Mine - Permit #429
Treatment Pond #2

10 yr-24 hr Storm

Top of Dam Elev = 683.0

Pool Elev = 674.0

Peak Elev = 675.3

Stephen J. Glodo, P.E.

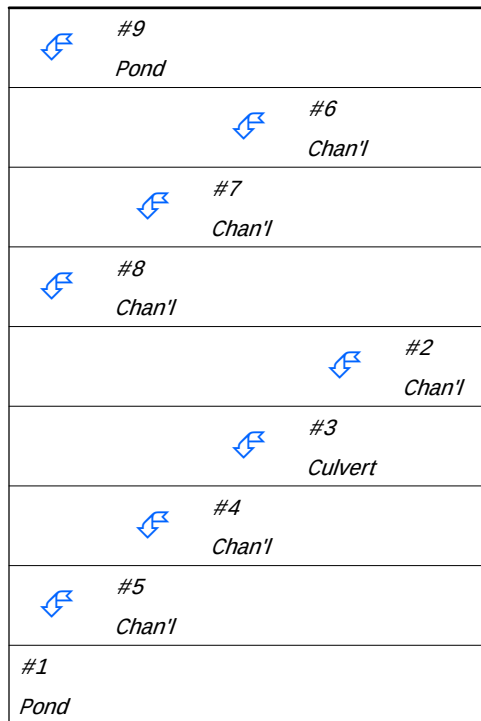
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.260 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Treatment Pond #2
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)
Culvert	#3	==>	#4	0.000	0.000	Culvert under Entrance, Sta 0+52 to 1+40
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00
Channel	#5	==>	#1	0.000	0.000	Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #8, Sta 0+00 to 11+50
Channel	#7	==>	#8	0.000	0.000	Collector Ditch #8, Sta 11+50 to 28+00
Channel	#8	==>	#1	0.000	0.000	Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)
Pond	#9	==>	#1	0.000	0.000	Refuse Impoundment



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#9 In	48.200	48.200	156.51	16.15
Out			9.28	15.03
#6	5.280	5.280	8.57	0.63
#7	6.490	11.770	19.10	1.41
#8	5.150	16.920	27.46	2.03
#2	1.510	1.510	4.04	0.34
#3	0.000	1.510	4.04	0.34
#4	23.520	25.030	66.94	5.61
#5	8.160	33.190	88.76	7.44
#1 In	36.740	135.050	191.43	31.15
Out			38.74	30.65

Structure Detail:***Structure #9 (Pond)******Refuse Impoundment***

Pond Inputs:

Initial Pool Elev:	750.00 ft
Initial Pool:	2047.35 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
750.00	20.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	750.26 ft
Dewater Time:	2.10 days

*Dewatering time is calculated from peak stage to lowest spillway***Elevation-Capacity-Discharge Table**

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
662.40	0.000	0.000	0.000	
662.50	8.820	0.294	0.000	
663.40	9.042	8.332	0.000	
664.40	9.292	17.498	0.000	
665.40	9.545	26.917	0.000	
666.40	9.802	36.590	0.000	
667.40	10.062	46.521	0.000	
668.40	10.325	56.714	0.000	
669.40	10.592	67.172	0.000	
670.40	10.862	77.899	0.000	
671.40	11.136	88.898	0.000	
672.40	11.413	100.172	0.000	
673.40	11.693	111.725	0.000	
674.40	11.977	123.560	0.000	
675.40	12.265	135.681	0.000	
676.40	12.555	148.091	0.000	
677.40	12.849	160.793	0.000	
678.40	13.147	173.791	0.000	
679.40	13.448	187.088	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
680.00	13.630	195.211	0.000	
680.40	13.748	200.687	0.000	
681.40	14.043	214.582	0.000	
682.40	14.342	228.775	0.000	
683.40	14.645	243.268	0.000	
684.40	14.950	258.065	0.000	
685.40	15.258	273.169	0.000	
686.40	15.570	288.583	0.000	
687.40	15.885	304.310	0.000	
688.40	16.203	320.354	0.000	
689.40	16.524	336.717	0.000	
690.40	16.848	353.403	0.000	
691.40	17.175	370.414	0.000	
692.40	17.506	387.754	0.000	
693.40	17.840	405.427	0.000	
694.40	18.177	423.435	0.000	
695.40	18.516	441.781	0.000	
696.40	18.860	460.469	0.000	
697.40	19.206	479.501	0.000	
698.40	19.555	498.882	0.000	
699.40	19.908	518.613	0.000	
700.40	20.264	538.699	0.000	
701.40	20.622	559.141	0.000	
702.40	20.984	579.945	0.000	
703.40	21.350	601.112	0.000	
704.40	21.718	622.645	0.000	
705.40	22.090	644.549	0.000	
706.40	22.464	666.825	0.000	
707.40	22.842	689.478	0.000	
708.40	23.223	712.510	0.000	
709.40	23.607	735.925	0.000	
710.40	23.994	759.725	0.000	
711.40	24.385	783.914	0.000	
712.40	24.778	808.495	0.000	
713.40	25.175	833.472	0.000	
714.40	25.575	858.846	0.000	
715.40	25.978	884.622	0.000	
716.40	26.384	910.802	0.000	
717.40	26.793	937.390	0.000	
718.40	27.205	964.389	0.000	
719.40	27.621	991.802	0.000	
720.40	28.040	1,019.633	0.000	
721.40	28.462	1,047.883	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
722.40	28.887	1,076.557	0.000	
723.40	29.315	1,105.658	0.000	
724.40	29.746	1,135.188	0.000	
725.40	30.181	1,165.151	0.000	
726.40	30.618	1,195.550	0.000	
727.40	31.059	1,226.389	0.000	
728.40	31.503	1,257.670	0.000	
729.40	31.950	1,289.396	0.000	
730.40	32.400	1,321.571	0.000	
731.40	32.854	1,354.198	0.000	
732.40	33.310	1,387.279	0.000	
733.40	33.770	1,420.819	0.000	
734.40	34.233	1,454.821	0.000	
735.40	34.699	1,489.286	0.000	
736.40	35.168	1,524.219	0.000	
737.40	35.640	1,559.623	0.000	
738.40	36.116	1,595.501	0.000	
739.40	36.594	1,631.855	0.000	
740.40	37.076	1,668.690	0.000	
741.40	37.561	1,706.009	0.000	
742.40	38.049	1,743.813	0.000	
743.40	38.540	1,782.108	0.000	
744.40	39.034	1,820.895	0.000	
745.40	39.532	1,860.177	0.000	
746.40	40.033	1,899.959	0.000	
747.40	40.536	1,940.244	0.000	
748.40	41.043	1,981.033	0.000	
749.40	41.553	2,022.331	0.000	
750.00	41.861	2,047.354	0.000	Spillway #1
750.26	41.992	2058.057	9.278	36.40 Peak Stage
750.40	42.067	2,064.141	14.552	
751.40	42.583	2,106.465	50.930	
752.40	43.102	2,149.308	147.167	
753.40	43.625	2,192.671	296.405	
754.40	44.151	2,236.559	503.736	
755.40	44.680	2,280.974	774.373	
756.40	45.212	2,325.920	1,113.169	
757.40	45.747	2,371.400	1,524.610	
758.00	46.070	2,398.944	1,808.082	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
662.40	0.000	0.000
662.50	0.000	0.000
663.40	0.000	0.000
664.40	0.000	0.000
665.40	0.000	0.000
666.40	0.000	0.000
667.40	0.000	0.000
668.40	0.000	0.000
669.40	0.000	0.000
670.40	0.000	0.000
671.40	0.000	0.000
672.40	0.000	0.000
673.40	0.000	0.000
674.40	0.000	0.000
675.40	0.000	0.000
676.40	0.000	0.000
677.40	0.000	0.000
678.40	0.000	0.000
679.40	0.000	0.000
680.00	0.000	0.000
680.40	0.000	0.000
681.40	0.000	0.000
682.40	0.000	0.000
683.40	0.000	0.000
684.40	0.000	0.000
685.40	0.000	0.000
686.40	0.000	0.000
687.40	0.000	0.000
688.40	0.000	0.000
689.40	0.000	0.000
690.40	0.000	0.000
691.40	0.000	0.000
692.40	0.000	0.000
693.40	0.000	0.000
694.40	0.000	0.000
695.40	0.000	0.000
696.40	0.000	0.000
697.40	0.000	0.000
698.40	0.000	0.000
699.40	0.000	0.000
700.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
701.40	0.000	0.000
702.40	0.000	0.000
703.40	0.000	0.000
704.40	0.000	0.000
705.40	0.000	0.000
706.40	0.000	0.000
707.40	0.000	0.000
708.40	0.000	0.000
709.40	0.000	0.000
710.40	0.000	0.000
711.40	0.000	0.000
712.40	0.000	0.000
713.40	0.000	0.000
714.40	0.000	0.000
715.40	0.000	0.000
716.40	0.000	0.000
717.40	0.000	0.000
718.40	0.000	0.000
719.40	0.000	0.000
720.40	0.000	0.000
721.40	0.000	0.000
722.40	0.000	0.000
723.40	0.000	0.000
724.40	0.000	0.000
725.40	0.000	0.000
726.40	0.000	0.000
727.40	0.000	0.000
728.40	0.000	0.000
729.40	0.000	0.000
730.40	0.000	0.000
731.40	0.000	0.000
732.40	0.000	0.000
733.40	0.000	0.000
734.40	0.000	0.000
735.40	0.000	0.000
736.40	0.000	0.000
737.40	0.000	0.000
738.40	0.000	0.000
739.40	0.000	0.000
740.40	0.000	0.000
741.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
742.40	0.000	0.000
743.40	0.000	0.000
744.40	0.000	0.000
745.40	0.000	0.000
746.40	0.000	0.000
747.40	0.000	0.000
748.40	0.000	0.000
749.40	0.000	0.000
750.00	0.000	0.000
750.40	14.552	14.552
751.40	50.930	50.930
752.40	147.167	147.167
753.40	296.405	296.405
754.40	503.736	503.736
755.40	774.373	774.373
756.40	1,113.169	1,113.169
757.40	1,524.610	1,524.610
758.00	1,808.082	1,808.082

Structure #6 (Vegetated Channel)

Collector Ditch #8, Sta 0+00 to 11+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	8.57 cfs		8.57 cfs	
Depth:	1.37 ft	1.87 ft	2.58 ft	3.08 ft
Top Width:	11.46 ft	13.46 ft	16.32 ft	18.32 ft
Velocity:	0.72 fps		0.30 fps	
X-Section Area:	11.92 sq ft		28.81 sq ft	
Hydraulic Radius:	0.984 ft		1.642 ft	
Froude Number:	0.12		0.04	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0648		0.2204	

Structure #7 (Vegetated Channel)

Collector Ditch #8, Sta 11+50 to 28+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.10 cfs		19.10 cfs	
Depth:	1.69 ft	2.19 ft	2.98 ft	3.48 ft
Top Width:	14.77 ft	16.77 ft	19.92 ft	21.92 ft
Velocity:	0.99 fps		0.46 fps	
X-Section Area:	19.28 sq ft		41.62 sq ft	
Hydraulic Radius:	1.238 ft		1.951 ft	
Froude Number:	0.15		0.06	
Roughness Coefficient:	0.0548		0.1602	

Structure #8 (Vegetated Channel)

Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	27.46 cfs		27.46 cfs	
Depth:	1.96 ft	2.46 ft	3.31 ft	3.81 ft
Top Width:	15.86 ft	17.86 ft	21.24 ft	23.24 ft
Velocity:	1.17 fps		0.57 fps	
X-Section Area:	23.43 sq ft		48.39 sq ft	
Hydraulic Radius:	1.396 ft		2.122 ft	
Froude Number:	0.17		0.07	
Roughness Coefficient:	0.0502		0.1371	

Structure #2 (Vegetated Channel)

Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	4.04 cfs		4.04 cfs	
Depth:	1.28 ft	1.78 ft	2.37 ft	2.87 ft
Top Width:	7.11 ft	9.11 ft	11.46 ft	13.46 ft
Velocity:	0.69 fps		0.25 fps	
X-Section Area:	5.82 sq ft		15.93 sq ft	
Hydraulic Radius:	0.754 ft		1.266 ft	
Froude Number:	0.14		0.04	
Roughness Coefficient:	0.0710		0.2749	

Structure #3 (Culvert)

Culvert under Entrance, Sta 0+52 to 1+40

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
88.00	0.16	0.0140	1.40	0.00	0.90

Culvert Results:

Design Discharge = 4.04 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #4 (Vegetated Channel)

Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	66.94 cfs		66.94 cfs	
Depth:	2.45 ft	2.95 ft	3.71 ft	4.21 ft
Top Width:	17.82 ft	19.82 ft	22.82 ft	24.82 ft
Velocity:	2.11 fps		1.17 fps	
X-Section Area:	31.68 sq ft		57.11 sq ft	
Hydraulic Radius:	1.669 ft		2.324 ft	
Froude Number:	0.28		0.13	
Roughness Coefficient:	0.0397		0.0892	

Structure #5 (Vegetated Channel)

Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	88.76 cfs		88.76 cfs	
Depth:	2.74 ft	3.24 ft	4.01 ft	4.51 ft
Top Width:	18.98 ft	20.98 ft	24.06 ft	26.06 ft
Velocity:	2.40 fps		1.38 fps	
X-Section Area:	37.03 sq ft		64.36 sq ft	
Hydraulic Radius:	1.826 ft		2.480 ft	
Froude Number:	0.30		0.15	
Roughness Coefficient:	0.0371		0.0792	

Structure #1 (Pond)

Treatment Pond #2

Pond Inputs:

Initial Pool Elev:	674.00 ft
Initial Pool:	75.24 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
674.00	50.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	675.25 ft
Dewater Time:	0.37 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
660.90	0.000	0.000	0.000	
661.00	5.070	0.169	0.000	
661.90	5.164	4.774	0.000	
662.90	5.269	9.991	0.000	
663.90	5.376	15.313	0.000	
664.90	5.483	20.743	0.000	
665.90	5.592	26.280	0.000	
666.90	5.701	31.926	0.000	
667.90	5.812	37.683	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
668.90	5.924	43.551	0.000	
669.90	6.036	49.531	0.000	
670.90	6.150	55.624	0.000	
671.90	6.265	61.832	0.000	
672.90	6.381	68.155	0.000	
673.90	6.498	74.595	0.000	
674.00	6.510	75.245	0.000	Spillway #1
674.90	6.707	81.193	16.982	4.24*
675.25	6.785	83.553	38.735	4.70 Peak Stage
675.90	6.929	88.010	79.824	
676.90	7.155	95.052	186.713	
677.90	7.384	102.321	352.261	
678.90	7.617	109.821	578.051	
679.90	7.854	117.556	868.644	
680.90	8.094	125.530	1,228.779	
681.90	8.338	133.745	1,662.836	
682.90	8.585	142.206	2,125.495	
683.00	8.610	143.066	2,174.872	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
660.90	0.000	0.000
661.00	0.000	0.000
661.90	0.000	0.000
662.90	0.000	0.000
663.90	0.000	0.000
664.90	0.000	0.000
665.90	0.000	0.000
666.90	0.000	0.000
667.90	0.000	0.000
668.90	0.000	0.000
669.90	0.000	0.000
670.90	0.000	0.000
671.90	0.000	0.000
672.90	0.000	0.000
673.90	0.000	0.000
674.00	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
674.90	16.982	16.982
675.90	79.824	79.824
676.90	186.713	186.713
677.90	352.261	352.261
678.90	578.051	578.051
679.90	868.644	868.644
680.90	1,228.779	1,228.779
681.90	1,662.836	1,662.836
682.90	2,125.495	2,125.495
683.00	2,174.872	2,174.872

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)
#9	1	48.200	0.000	0.000	0.000	98.000	M	156.51	16.155
	Σ	48.200						156.51	16.155
#6	1	5.280	0.022	0.000	0.000	69.000	M	8.57	0.632
	Σ	5.280						8.57	0.632
#7	1	6.490	0.022	0.000	0.000	69.000	M	10.53	0.777
	Σ	11.770						19.10	1.409
#8	1	5.150	0.010	0.000	0.000	69.000	M	8.36	0.617
	Σ	16.920						27.46	2.026
#2	1	1.510	0.071	0.000	0.000	85.000	M	4.04	0.338
	Σ	1.510						4.04	0.338
#3	Σ	1.510						4.04	0.338
#4	1	23.520	0.073	0.000	0.000	85.000	M	62.90	5.271
	Σ	25.030						66.94	5.609
#5	1	8.160	0.014	0.000	0.000	85.000	M	21.82	1.829
	Σ	33.190						88.76	7.437
#1	1	25.530	0.249	0.000	0.000	82.000	M	40.41	4.148
	2	11.210	0.014	0.000	0.000	85.000	M	29.98	2.512
	Σ	135.050						191.43	31.151

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	2.59	75.00	2,900.00	3.230	0.249
#1	1	Time of Concentration:					0.249
#1	2	7. Paved area and small upland gullies	17.05	75.00	440.00	8.310	0.014
#1	2	Time of Concentration:					0.014
#2	1	7. Paved area and small upland gullies	0.33	1.00	300.00	1.160	0.071
#2	1	Time of Concentration:					0.071
#4	1	7. Paved area and small upland gullies	6.00	78.00	1,300.00	4.930	0.073
#4	1	Time of Concentration:					0.073

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	1	7. Paved area and small upland gullies	17.73	78.00	440.00	8.470	0.014
#5	1	Time of Concentration:					0.014
#6	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#6	1	Time of Concentration:					0.022
#7	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#7	1	Time of Concentration:					0.022
#8	1	3. Short grass pasture	16.67	20.00	120.00	3.260	0.010
#8	1	Time of Concentration:					0.010
#9	1	9. Small streams flowing bankfull	10.00	1.00	10.00	28.460	0.000
#9	1	Time of Concentration:					0.000

Sunrise Coal
Bulldog Mine - Permit #429
Treatment Pond #2

25 yr-6 hr Storm

Top of Dam Elev = 683.0

Pool Elev = 674.0

Peak Elev = 675.3

Stephen J. Glodo, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	3.780 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Treatment Pond #2
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)
Culvert	#3	==>	#4	0.000	0.000	Culvert under Entrance, Sta 0+52 to 1+40
Channel	#4	==>	#5	0.000	0.000	Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00
Channel	#5	==>	#1	0.000	0.000	Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)
Channel	#6	==>	#7	0.000	0.000	Collector Ditch #8, Sta 0+00 to 11+50
Channel	#7	==>	#8	0.000	0.000	Collector Ditch #8, Sta 11+50 to 28+00
Channel	#8	==>	#1	0.000	0.000	Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)
Pond	#9	==>	#1	0.000	0.000	Refuse Impoundment



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#9 In	48.200	48.200	196.42	14.21
Out			10.05	13.72
#6	5.280	5.280	10.46	0.49
#7	6.490	11.770	23.31	1.10
#8	5.150	16.920	33.50	1.58
#2	1.510	1.510	5.02	0.28
#3	0.000	1.510	5.02	0.28
#4	23.520	25.030	83.24	4.70
#5	8.160	33.190	110.37	6.24
#1 In	36.740	135.050	230.94	27.09
Out			40.51	26.88

Structure Detail:**Structure #9 (Pond)*****Refuse Impoundment***

Pond Inputs:

Initial Pool Elev:	750.00 ft
Initial Pool:	2047.35 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
750.00	20.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	750.28 ft
Dewater Time:	2.45 days

*Dewatering time is calculated from peak stage to lowest spillway***Elevation-Capacity-Discharge Table**

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
662.40	0.000	0.000	0.000	
662.50	8.820	0.294	0.000	
663.40	9.042	8.332	0.000	
664.40	9.292	17.498	0.000	
665.40	9.545	26.917	0.000	
666.40	9.802	36.590	0.000	
667.40	10.062	46.521	0.000	
668.40	10.325	56.714	0.000	
669.40	10.592	67.172	0.000	
670.40	10.862	77.899	0.000	
671.40	11.136	88.898	0.000	
672.40	11.413	100.172	0.000	
673.40	11.693	111.725	0.000	
674.40	11.977	123.560	0.000	
675.40	12.265	135.681	0.000	
676.40	12.555	148.091	0.000	
677.40	12.849	160.793	0.000	
678.40	13.147	173.791	0.000	
679.40	13.448	187.088	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
680.00	13.630	195.211	0.000	
680.40	13.748	200.687	0.000	
681.40	14.043	214.582	0.000	
682.40	14.342	228.775	0.000	
683.40	14.645	243.268	0.000	
684.40	14.950	258.065	0.000	
685.40	15.258	273.169	0.000	
686.40	15.570	288.583	0.000	
687.40	15.885	304.310	0.000	
688.40	16.203	320.354	0.000	
689.40	16.524	336.717	0.000	
690.40	16.848	353.403	0.000	
691.40	17.175	370.414	0.000	
692.40	17.506	387.754	0.000	
693.40	17.840	405.427	0.000	
694.40	18.177	423.435	0.000	
695.40	18.516	441.781	0.000	
696.40	18.860	460.469	0.000	
697.40	19.206	479.501	0.000	
698.40	19.555	498.882	0.000	
699.40	19.908	518.613	0.000	
700.40	20.264	538.699	0.000	
701.40	20.622	559.141	0.000	
702.40	20.984	579.945	0.000	
703.40	21.350	601.112	0.000	
704.40	21.718	622.645	0.000	
705.40	22.090	644.549	0.000	
706.40	22.464	666.825	0.000	
707.40	22.842	689.478	0.000	
708.40	23.223	712.510	0.000	
709.40	23.607	735.925	0.000	
710.40	23.994	759.725	0.000	
711.40	24.385	783.914	0.000	
712.40	24.778	808.495	0.000	
713.40	25.175	833.472	0.000	
714.40	25.575	858.846	0.000	
715.40	25.978	884.622	0.000	
716.40	26.384	910.802	0.000	
717.40	26.793	937.390	0.000	
718.40	27.205	964.389	0.000	
719.40	27.621	991.802	0.000	
720.40	28.040	1,019.633	0.000	
721.40	28.462	1,047.883	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
722.40	28.887	1,076.557	0.000	
723.40	29.315	1,105.658	0.000	
724.40	29.746	1,135.188	0.000	
725.40	30.181	1,165.151	0.000	
726.40	30.618	1,195.550	0.000	
727.40	31.059	1,226.389	0.000	
728.40	31.503	1,257.670	0.000	
729.40	31.950	1,289.396	0.000	
730.40	32.400	1,321.571	0.000	
731.40	32.854	1,354.198	0.000	
732.40	33.310	1,387.279	0.000	
733.40	33.770	1,420.819	0.000	
734.40	34.233	1,454.821	0.000	
735.40	34.699	1,489.286	0.000	
736.40	35.168	1,524.219	0.000	
737.40	35.640	1,559.623	0.000	
738.40	36.116	1,595.501	0.000	
739.40	36.594	1,631.855	0.000	
740.40	37.076	1,668.690	0.000	
741.40	37.561	1,706.009	0.000	
742.40	38.049	1,743.813	0.000	
743.40	38.540	1,782.108	0.000	
744.40	39.034	1,820.895	0.000	
745.40	39.532	1,860.177	0.000	
746.40	40.033	1,899.959	0.000	
747.40	40.536	1,940.244	0.000	
748.40	41.043	1,981.033	0.000	
749.40	41.553	2,022.331	0.000	
750.00	41.861	2,047.354	0.000	Spillway #1
750.28	42.003	2058.943	10.046	44.90 Peak Stage
750.40	42.067	2,064.141	14.552	
751.40	42.583	2,106.465	50.930	
752.40	43.102	2,149.308	147.167	
753.40	43.625	2,192.671	296.405	
754.40	44.151	2,236.559	503.736	
755.40	44.680	2,280.974	774.373	
756.40	45.212	2,325.920	1,113.169	
757.40	45.747	2,371.400	1,524.610	
758.00	46.070	2,398.944	1,808.082	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
662.40	0.000	0.000
662.50	0.000	0.000
663.40	0.000	0.000
664.40	0.000	0.000
665.40	0.000	0.000
666.40	0.000	0.000
667.40	0.000	0.000
668.40	0.000	0.000
669.40	0.000	0.000
670.40	0.000	0.000
671.40	0.000	0.000
672.40	0.000	0.000
673.40	0.000	0.000
674.40	0.000	0.000
675.40	0.000	0.000
676.40	0.000	0.000
677.40	0.000	0.000
678.40	0.000	0.000
679.40	0.000	0.000
680.00	0.000	0.000
680.40	0.000	0.000
681.40	0.000	0.000
682.40	0.000	0.000
683.40	0.000	0.000
684.40	0.000	0.000
685.40	0.000	0.000
686.40	0.000	0.000
687.40	0.000	0.000
688.40	0.000	0.000
689.40	0.000	0.000
690.40	0.000	0.000
691.40	0.000	0.000
692.40	0.000	0.000
693.40	0.000	0.000
694.40	0.000	0.000
695.40	0.000	0.000
696.40	0.000	0.000
697.40	0.000	0.000
698.40	0.000	0.000
699.40	0.000	0.000
700.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
701.40	0.000	0.000
702.40	0.000	0.000
703.40	0.000	0.000
704.40	0.000	0.000
705.40	0.000	0.000
706.40	0.000	0.000
707.40	0.000	0.000
708.40	0.000	0.000
709.40	0.000	0.000
710.40	0.000	0.000
711.40	0.000	0.000
712.40	0.000	0.000
713.40	0.000	0.000
714.40	0.000	0.000
715.40	0.000	0.000
716.40	0.000	0.000
717.40	0.000	0.000
718.40	0.000	0.000
719.40	0.000	0.000
720.40	0.000	0.000
721.40	0.000	0.000
722.40	0.000	0.000
723.40	0.000	0.000
724.40	0.000	0.000
725.40	0.000	0.000
726.40	0.000	0.000
727.40	0.000	0.000
728.40	0.000	0.000
729.40	0.000	0.000
730.40	0.000	0.000
731.40	0.000	0.000
732.40	0.000	0.000
733.40	0.000	0.000
734.40	0.000	0.000
735.40	0.000	0.000
736.40	0.000	0.000
737.40	0.000	0.000
738.40	0.000	0.000
739.40	0.000	0.000
740.40	0.000	0.000
741.40	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
742.40	0.000	0.000
743.40	0.000	0.000
744.40	0.000	0.000
745.40	0.000	0.000
746.40	0.000	0.000
747.40	0.000	0.000
748.40	0.000	0.000
749.40	0.000	0.000
750.00	0.000	0.000
750.40	14.552	14.552
751.40	50.930	50.930
752.40	147.167	147.167
753.40	296.405	296.405
754.40	503.736	503.736
755.40	774.373	774.373
756.40	1,113.169	1,113.169
757.40	1,524.610	1,524.610
758.00	1,808.082	1,808.082

Structure #6 (Vegetated Channel)

Collector Ditch #8, Sta 0+00 to 11+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	10.46 cfs		10.46 cfs	
Depth:	1.48 ft	1.98 ft	2.73 ft	3.23 ft
Top Width:	11.92 ft	13.92 ft	16.93 ft	18.93 ft
Velocity:	0.79 fps		0.33 fps	
X-Section Area:	13.26 sq ft		31.32 sq ft	
Hydraulic Radius:	1.051 ft		1.719 ft	
Froude Number:	0.13		0.04	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0618		0.2025	

Structure #7 (Vegetated Channel)

Collector Ditch #8, Sta 11+50 to 28+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	23.31 cfs		23.31 cfs	
Depth:	1.84 ft	2.34 ft	3.16 ft	3.66 ft
Top Width:	15.34 ft	17.34 ft	20.63 ft	22.63 ft
Velocity:	1.09 fps		0.52 fps	
X-Section Area:	21.43 sq ft		45.19 sq ft	
Hydraulic Radius:	1.322 ft		2.043 ft	
Froude Number:	0.16		0.06	
Roughness Coefficient:	0.0522		0.1471	

Structure #8 (Vegetated Channel)

Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	33.50 cfs		33.50 cfs	
Depth:	2.13 ft	2.63 ft	3.50 ft	4.00 ft
Top Width:	16.52 ft	18.52 ft	22.02 ft	24.02 ft
Velocity:	1.28 fps		0.64 fps	
X-Section Area:	26.10 sq ft		52.61 sq ft	
Hydraulic Radius:	1.489 ft		2.222 ft	
Froude Number:	0.18		0.07	
Roughness Coefficient:	0.0478		0.1259	

Structure #2 (Vegetated Channel)

Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	5.02 cfs		5.02 cfs	
Depth:	1.38 ft	1.88 ft	2.50 ft	3.00 ft
Top Width:	7.53 ft	9.53 ft	12.01 ft	14.01 ft
Velocity:	0.76 fps		0.29 fps	
X-Section Area:	6.59 sq ft		17.52 sq ft	
Hydraulic Radius:	0.805 ft		1.329 ft	
Froude Number:	0.14		0.04	
Roughness Coefficient:	0.0677		0.2513	

Structure #3 (Culvert)

Culvert under Entrance, Sta 0+52 to 1+40

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
88.00	0.16	0.0140	1.40	0.00	0.90

Culvert Results:

Design Discharge = 5.02 cfs

Minimum pipe diameter: 1 - 21 inch pipe(s) required

Structure #4 (Vegetated Channel)

Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	83.24 cfs		83.24 cfs	
Depth:	2.68 ft	3.18 ft	3.94 ft	4.44 ft
Top Width:	18.70 ft	20.70 ft	23.77 ft	25.77 ft
Velocity:	2.33 fps		1.33 fps	
X-Section Area:	35.73 sq ft		62.64 sq ft	
Hydraulic Radius:	1.789 ft		2.444 ft	
Froude Number:	0.30		0.14	
Roughness Coefficient:	0.0377		0.0813	

Structure #5 (Vegetated Channel)

Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	110.37 cfs		110.37 cfs	
Depth:	2.99 ft	3.49 ft	4.27 ft	4.77 ft
Top Width:	19.96 ft	21.96 ft	25.08 ft	27.08 ft
Velocity:	2.64 fps		1.56 fps	
X-Section Area:	41.82 sq ft		70.62 sq ft	
Hydraulic Radius:	1.956 ft		2.606 ft	
Froude Number:	0.32		0.16	
Roughness Coefficient:	0.0353		0.0722	

Structure #1 (Pond)

Treatment Pond #2

Pond Inputs:

Initial Pool Elev:	674.00 ft
Initial Pool:	75.24 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
674.00	50.00	3.00:1	3.00:1	10.00

Pond Results:

Peak Elevation:	675.27 ft
Dewater Time:	0.32 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
660.90	0.000	0.000	0.000	
661.00	5.070	0.169	0.000	
661.90	5.164	4.774	0.000	
662.90	5.269	9.991	0.000	
663.90	5.376	15.313	0.000	
664.90	5.483	20.743	0.000	
665.90	5.592	26.280	0.000	
666.90	5.701	31.926	0.000	
667.90	5.812	37.683	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
668.90	5.924	43.551	0.000	
669.90	6.036	49.531	0.000	
670.90	6.150	55.624	0.000	
671.90	6.265	61.832	0.000	
672.90	6.381	68.155	0.000	
673.90	6.498	74.595	0.000	
674.00	6.510	75.245	0.000	Spillway #1
674.90	6.707	81.193	16.982	4.24*
675.27	6.791	83.746	40.514	3.40 Peak Stage
675.90	6.929	88.010	79.824	
676.90	7.155	95.052	186.713	
677.90	7.384	102.321	352.261	
678.90	7.617	109.821	578.051	
679.90	7.854	117.556	868.644	
680.90	8.094	125.530	1,228.779	
681.90	8.338	133.745	1,662.836	
682.90	8.585	142.206	2,125.495	
683.00	8.610	143.066	2,174.872	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
660.90	0.000	0.000
661.00	0.000	0.000
661.90	0.000	0.000
662.90	0.000	0.000
663.90	0.000	0.000
664.90	0.000	0.000
665.90	0.000	0.000
666.90	0.000	0.000
667.90	0.000	0.000
668.90	0.000	0.000
669.90	0.000	0.000
670.90	0.000	0.000
671.90	0.000	0.000
672.90	0.000	0.000
673.90	0.000	0.000
674.00	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
674.90	16.982	16.982
675.90	79.824	79.824
676.90	186.713	186.713
677.90	352.261	352.261
678.90	578.051	578.051
679.90	868.644	868.644
680.90	1,228.779	1,228.779
681.90	1,662.836	1,662.836
682.90	2,125.495	2,125.495
683.00	2,174.872	2,174.872

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)
#9	1	48.200	0.000	0.000	0.000	98.000	M	196.42	14.207
	Σ	48.200						196.42	14.207
#6	1	5.280	0.022	0.000	0.000	69.000	M	10.46	0.493
	Σ	5.280						10.46	0.493
#7	1	6.490	0.022	0.000	0.000	69.000	M	12.85	0.606
	Σ	11.770						23.31	1.099
#8	1	5.150	0.010	0.000	0.000	69.000	M	10.20	0.481
	Σ	16.920						33.50	1.580
#2	1	1.510	0.071	0.000	0.000	85.000	M	5.02	0.284
	Σ	1.510						5.02	0.284
#3	Σ	1.510						5.02	0.284
#4	1	23.520	0.073	0.000	0.000	85.000	M	78.22	4.419
	Σ	25.030						83.24	4.703
#5	1	8.160	0.014	0.000	0.000	85.000	M	27.14	1.533
	Σ	33.190						110.37	6.236
#1	1	25.530	0.249	0.000	0.000	82.000	M	47.32	3.446
	2	11.210	0.014	0.000	0.000	85.000	M	37.28	2.106
	Σ	135.050						230.94	27.093

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	2.59	75.00	2,900.00	3.230	0.249
#1	1	Time of Concentration:					0.249
#1	2	7. Paved area and small upland gullies	17.05	75.00	440.00	8.310	0.014
#1	2	Time of Concentration:					0.014
#2	1	7. Paved area and small upland gullies	0.33	1.00	300.00	1.160	0.071
#2	1	Time of Concentration:					0.071
#4	1	7. Paved area and small upland gullies	6.00	78.00	1,300.00	4.930	0.073
#4	1	Time of Concentration:					0.073

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	1	7. Paved area and small upland gullies	17.73	78.00	440.00	8.470	0.014
#5	1	Time of Concentration:					0.014
#6	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#6	1	Time of Concentration:					0.022
#7	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#7	1	Time of Concentration:					0.022
#8	1	3. Short grass pasture	16.67	20.00	120.00	3.260	0.010
#8	1	Time of Concentration:					0.010
#9	1	9. Small streams flowing bankfull	10.00	1.00	10.00	28.460	0.000
#9	1	Time of Concentration:					0.000

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #7

100 yr-6 hr Storm

Stephen J. Glodo, P.E.

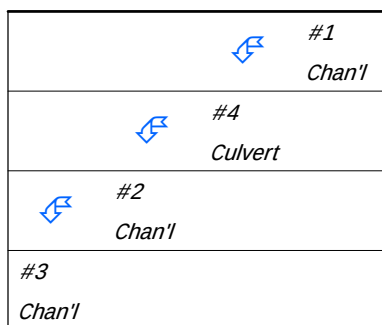
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	4.960 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#4	0.000	0.000	Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00
Channel	#3	==>	End	0.000	0.000	Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)
Culvert	#4	==>	#2	0.000	0.000	Culvert under Entrance, Sta 0+52 to 1+40



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.510	1.510	7.06	0.42
#4	0.000	1.510	7.06	0.42
#2	23.520	25.030	117.07	6.93
#3	8.160	33.190	155.23	9.18

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #7, Sta 0+00 to 0+52 (Culvert under Entrance)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.06 cfs		7.06 cfs	
Depth:	1.57 ft	2.07 ft	2.73 ft	3.23 ft
Top Width:	8.26 ft	10.26 ft	12.92 ft	14.92 ft
Velocity:	0.88 fps		0.35 fps	
X-Section Area:	8.03 sq ft		20.37 sq ft	
Hydraulic Radius:	0.892 ft		1.433 ft	
Froude Number:	0.16		0.05	
Roughness Coefficient:	0.0628		0.2184	

Structure #4 (Culvert)

Culvert under Entrance, Sta 0+52 to 1+40

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
88.00	0.16	0.0140	2.10	0.00	0.90

Culvert Results:

Design Discharge = 7.06 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #2 (Vegetated Channel)

Collector Ditch #7, Sta 1+40 (Culvert under Entrance) to 21+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	117.07 cfs		117.07 cfs	
Depth:	3.06 ft	3.56 ft	4.34 ft	4.84 ft
Top Width:	20.24 ft	22.24 ft	25.36 ft	27.36 ft
Velocity:	2.71 fps		1.62 fps	
X-Section Area:	43.23 sq ft		72.41 sq ft	
Hydraulic Radius:	1.993 ft		2.642 ft	
Froude Number:	0.33		0.17	
Roughness Coefficient:	0.0348		0.0704	

Structure #3 (Vegetated Channel)

Collector Ditch #7, Sta 21+00 to 30+98 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.2	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	155.23 cfs		155.23 cfs	
Depth:	3.42 ft	3.92 ft	4.70 ft	5.20 ft
Top Width:	21.66 ft	23.66 ft	26.79 ft	28.79 ft
Velocity:	3.06 fps		1.90 fps	
X-Section Area:	50.66 sq ft		81.70 sq ft	
Hydraulic Radius:	2.177 ft		2.817 ft	
Froude Number:	0.35		0.19	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Roughness Coefficient:	0.0327		0.0625	

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	1.510	0.071	0.000	0.000	85.000	M	7.06	0.418
	Σ	1.510						7.06	0.418
#4	Σ	1.510						7.06	0.418
#2	1	23.520	0.073	0.000	0.000	85.000	M	110.01	6.509
	Σ	25.030						117.07	6.927
#3	1	8.160	0.014	0.000	0.000	85.000	M	38.17	2.258
	Σ	33.190						155.23	9.185

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	0.33	1.00	300.00	1.160	0.071
#1	1	Time of Concentration:					0.071
#2	1	7. Paved area and small upland gullies	6.00	78.00	1,300.00	4.930	0.073
#2	1	Time of Concentration:					0.073
#3	1	7. Paved area and small upland gullies	17.73	78.00	440.00	8.470	0.014
#3	1	Time of Concentration:					0.014

Sunrise Coal
Bulldog Mine - Permit #429
Collector Ditch #8

100 yr-6 hr Storm

Stephen J. Glodo, P.E.

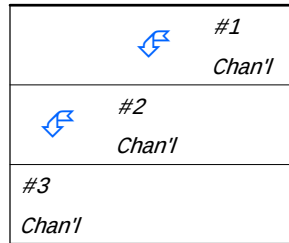
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	4.960 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.000	0.000	Collector Ditch #8, Sta 0+00 to 11+50
Channel	#2	==>	#3	0.000	0.000	Collector Ditch #8, Sta 11+50 to 28+00
Channel	#3	==>	End	0.000	0.000	Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.280	5.280	16.95	0.84
#2	6.490	11.770	37.79	1.88
#3	5.150	16.920	54.32	2.71

Structure Detail:

Structure #1 (Vegetated Channel)

Collector Ditch #8, Sta 0+00 to 11+50

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
6.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	16.95 cfs		16.95 cfs	
Depth:	1.80 ft	2.30 ft	3.13 ft	3.63 ft
Top Width:	13.20 ft	15.20 ft	18.53 ft	20.53 ft
Velocity:	0.98 fps		0.44 fps	
X-Section Area:	17.27 sq ft		38.43 sq ft	
Hydraulic Radius:	1.229 ft		1.920 ft	
Froude Number:	0.15		0.05	
Roughness Coefficient:	0.0551		0.1650	

Structure #2 (Vegetated Channel)

Collector Ditch #8, Sta 11+50 to 28+00

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	37.79 cfs		37.79 cfs	
Depth:	2.24 ft	2.74 ft	3.63 ft	4.13 ft
Top Width:	16.94 ft	18.94 ft	22.51 ft	24.51 ft
Velocity:	1.36 fps		0.68 fps	
X-Section Area:	27.87 sq ft		55.32 sq ft	
Hydraulic Radius:	1.549 ft		2.284 ft	
Froude Number:	0.19		0.08	
Roughness Coefficient:	0.0465		0.1196	

Structure #3 (Vegetated Channel)

Collector Ditch #8, Sta 28+00 to 49+12 (Treatment Pond #2)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
8.00	2.0:1	2.0:1	0.1	D, B	0.50			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	54.32 cfs		54.32 cfs	
Depth:	2.58 ft	3.08 ft	4.02 ft	4.52 ft
Top Width:	18.34 ft	20.34 ft	24.08 ft	26.08 ft
Velocity:	1.60 fps		0.84 fps	
X-Section Area:	34.03 sq ft		64.50 sq ft	
Hydraulic Radius:	1.740 ft		2.483 ft	
Froude Number:	0.21		0.09	
Roughness Coefficient:	0.0427		0.1026	

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	5.280	0.022	0.000	0.000	69.000	M	16.95	0.845
	Σ	5.280						16.95	0.845
#2	1	6.490	0.022	0.000	0.000	69.000	M	20.84	1.039
	Σ	11.770						37.79	1.883
#3	1	5.150	0.010	0.000	0.000	69.000	M	16.53	0.824
	Σ	16.920						54.32	2.708

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#1	1	Time of Concentration:					0.022
#2	1	3. Short grass pasture	10.00	20.00	200.00	2.520	0.022
#2	1	Time of Concentration:					0.022
#3	1	3. Short grass pasture	16.67	20.00	120.00	3.260	0.010
#3	1	Time of Concentration:					0.010