

**APPENDIX 3.6-2**

**SURFACE WATER MANAGEMENT SEDCAD REPORTS**

**SOUTH HEART LIGNITE MINE**

**Appendix 3.6.2**  
**Surface Water Management SEDCAD Reports**

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**Pond 1**  
**10-year, 24-hour storm**

***Great Northern South Heart***  
***Post-Mining Flows***

***Flow to South Branch Heart River***

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***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.100 inches

***Particle Size Distribution:***

Size (mm)	Silt Loam
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#2	==>	#5	0.342	0.272	CC#3
Culvert	#3	==>	#6	0.101	0.265	CC#2
Channel	#5	==>	#6	0.101	0.265	Haul road ditch below CC#3
Channel	#6	==>	#16	0.101	0.265	Haul road ditch below CC#2
Culvert	#7	==>	#16	0.000	0.000	CC#1
Channel	#8	==>	#7	0.000	0.000	Haul road from north
Pond	#9	==>	End	0.000	0.000	Pond 1 - Cell 2
Channel	#12	==>	#2	0.000	0.000	MHR1 north ditch to CC#3
Channel	#13	==>	#3	0.000	0.000	MHR1 north ditch to CC#2
Channel	#14	==>	#17	0.000	0.000	MHR2 north ditch to Pond 1
Channel	#15	==>	#7	0.000	0.000	MHR1 north ditch to CC#1
Pond	#16	==>	#9	0.000	0.000	Pond 1 - Cell 1
Culvert	#17	==>	#16	0.000	0.000	CC#6



**Structure Routing Details:**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	0.46	11.50	2,500.00	2.03	0.342
<b>#2</b>	<b>Muskingum K:</b>					<b>0.342</b>
#3	8. Large gullies, diversions, and low flowing streams	0.41	2.87	700.00	1.92	0.101
<b>#3</b>	<b>Muskingum K:</b>					<b>0.101</b>
#6	8. Large gullies, diversions, and low flowing streams	0.41	2.87	700.00	1.92	0.101
<b>#6</b>	<b>Muskingum K:</b>					<b>0.101</b>

**Structure Summary:**

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#14	8.743	8.743	11.63	0.87	12.6	20,629	8.05	4.10
#17	0.000	8.743	11.63	0.87	12.6	20,629	8.05	4.10
#15	22.224	22.224	16.04	2.23	15.1	14,818	5.71	1.91
#8	150.500	150.500	55.43	12.80	347.7	32,316	1.78	1.09
#7	5.600	178.324	61.15	16.04	560.5	103,423	18.84	4.60
#12	1.579	1.579	1.66	0.12	0.0	434	0.17	0.08
#2	31.580	33.159	24.42	2.58	27.8	17,040	3.66	1.69
#5	3.113	36.272	24.23	3.03	30.7	15,436	2.94	1.41
#13	5.056	5.056	11.00	0.99	13.0	17,387	6.79	3.76
#3	93.100	98.156	80.19	11.37	586.3	87,445	16.73	7.09
#6	2.039	136.467	102.47	14.80	621.7	69,489	13.39	5.84
#16 In	4.170	327.704	154.30	32.79	1,202.3	58,365	11.16	5.18
#16 Out			49.58	0.00	547.3	0	0.00	0.00
#9 In	9.462	337.166	50.82	34.20	557.4	16,144	0.11	0.09
#9 Out			0.00	0.00	557.4	0	0.00	0.00

## ***Particle Size Distribution(s) at Each Structure***

### ***Structure #14 (MHR2 north ditch to Pond 1):***

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

### ***Structure #17 (CC#6):***

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

### ***Structure #15 (MHR1 north ditch to CC#1):***

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	96.061%
0.2500	91.138%
0.1250	87.200%
0.0630	82.277%
0.0160	60.615%



Size (mm)	In/Out
0.0040	33.609%
0.0010	0.000%

***Structure #8 (Haul road from north):***

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	100.000%
0.2500	100.000%
0.1250	100.000%
0.0630	100.000%
0.0160	100.000%
0.0040	77.711%
0.0010	0.000%

***Structure #7 (CC#1):***

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	98.483%
0.2500	96.587%
0.1250	95.071%
0.0630	93.175%
0.0160	84.833%
0.0040	60.756%
0.0010	0.000%

***Structure #12 (MHR1 north ditch to CC#3):***

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

**Structure #2 (CC#3):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	100.000%
0.2500	100.000%
0.1250	100.000%
0.0630	100.000%
0.0160	86.773%
0.0040	47.725%
0.0010	0.000%

**Structure #5 (Haul road ditch below CC#3):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	100.000%
0.2500	100.000%
0.1250	100.000%
0.0630	100.000%
0.0160	90.471%
0.0040	49.759%
0.0010	0.000%

**Structure #13 (MHR1 north ditch to CC#2):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

**Structure #3 (CC#2):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%

Size (mm)	In/Out
0.5000	100.000%
0.2500	99.791%
0.1250	99.698%
0.0630	99.581%
0.0160	90.379%
0.0040	49.710%
0.0010	0.000%

**Structure #6 (Haul road ditch below CC#2):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	100.000%
0.2500	99.740%
0.1250	99.622%
0.0630	99.475%
0.0160	90.159%
0.0040	49.589%
0.0010	0.000%

**Structure #16 (Pond 1 - Cell 1):**

Size (mm)	In	Out
2.0000	100.000%	100.000%
1.0000	100.000%	100.000%
0.5000	99.226%	100.000%
0.2500	98.129%	100.000%
0.1250	97.293%	100.000%
0.0630	96.249%	100.000%
0.0160	87.173%	100.000%
0.0040	54.518%	100.000%
0.0010	0.000%	0.000%

**Structure #9:**

Size (mm)	In	Out
2.0000	100.000%	0.000%
1.0000	100.000%	0.000%
0.5000	100.000%	0.000%
0.2500	99.837%	0.000%
0.1250	99.765%	0.000%
0.0630	99.675%	0.000%

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Size (mm)	In	Out
0.0160	99.278%	0.000%
0.0040	98.790%	0.000%
0.0010	0.000%	0.000%

**Structure Detail:**

**Structure #14 (Erodible Channel)**

*MHR2 north ditch to Pond 1*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.3	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	11.63 cfs	
Depth:	1.29 ft	1.59 ft
Top Width:	7.71 ft	9.51 ft
Velocity:	2.35 fps	
X-Section Area:	4.95 sq ft	
Hydraulic Radius:	0.610 ft	
Froude Number:	0.52	

**Structure #17 (Culvert)**

*CC#6*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	1.50	0.0240	2.00	0.00	0.90

Culvert Results:

Design Discharge = 11.63 cfs

Minimum pipe diameter: 1 - 30 inch pipe(s) required

**Structure #15 (Erodible Channel)**

*MHR1 north ditch to CC#1*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.4	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.04 cfs	
Depth:	1.37 ft	1.67 ft
Top Width:	8.24 ft	10.04 ft
Velocity:	2.83 fps	
X-Section Area:	5.66 sq ft	
Hydraulic Radius:	0.652 ft	
Froude Number:	0.60	

Structure #8 (Erodible Channel)

*Haul road from north*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	4.0:1	3.0:1	0.2	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	55.43 cfs	
Depth:	2.01 ft	2.31 ft
Top Width:	18.08 ft	20.18 ft
Velocity:	2.50 fps	
X-Section Area:	22.21 sq ft	
Hydraulic Radius:	1.191 ft	
Froude Number:	0.40	

Structure #7 (Culvert)

*CC#1*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	1.00	0.0240	3.75	0.00	0.90

Culvert Results:

Design Discharge = 61.15 cfs

Minimum pipe diameter: 1 - 60 inch pipe(s) required

Structure #12 (Erodible Channel)

*MHR1 north ditch to CC#3*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.4	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.66 cfs	
Depth:	0.59 ft	0.89 ft
Top Width:	3.52 ft	5.32 ft
Velocity:	1.61 fps	
X-Section Area:	1.03 sq ft	
Hydraulic Radius:	0.278 ft	
Froude Number:	0.52	

Structure #2 (Culvert)

*CC#3*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	1.00	0.0240	3.00	0.00	0.90

Culvert Results:

Design Discharge = 24.42 cfs

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

Structure #5 (Erodible Channel)

*Haul road ditch below CC#3*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	4.0:1	3.0:1	0.5	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	24.23 cfs	
Depth:	1.12 ft	1.42 ft
Top Width:	11.84 ft	13.94 ft
Velocity:	2.73 fps	
X-Section Area:	8.87 sq ft	
Hydraulic Radius:	0.730 ft	
Froude Number:	0.56	

*Structure #13 (Erodible Channel)*

*MHR1 north ditch to CC#2*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.4	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	11.00 cfs	
Depth:	1.19 ft	1.49 ft
Top Width:	7.15 ft	8.95 ft
Velocity:	2.58 fps	
X-Section Area:	4.27 sq ft	
Hydraulic Radius:	0.566 ft	
Froude Number:	0.59	

*Structure #3 (Culvert)*

*CC#2*

Culvert Inputs:



Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	2.00	0.0240	4.00	0.00	0.90

Culvert Results:

Design Discharge = 80.19 cfs

Minimum pipe diameter: 1 - 60 inch pipe(s) required

Structure #6 (Erodible Channel)

*Haul road ditch below CC#2*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	3.0:1	4.0:1	0.4	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	102.47 cfs	
Depth:	2.26 ft	2.56 ft
Top Width:	19.80 ft	21.90 ft
Velocity:	3.82 fps	
X-Section Area:	26.85 sq ft	
Hydraulic Radius:	1.314 ft	
Froude Number:	0.58	

Structure #16 (Pond)

*Pond 1 - Cell 1*

Pond Inputs:

Initial Pool Elev:	2,499.20 ft
Initial Pool:	8.63 ac-ft
*Sediment Storage:	2.15 ac-ft
Dead Space:	0.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	48.00	2.00	0.0240	2,499.20	0.90	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	48.00	2.00	0.0240	2,499.40	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,502.00	24.00	4.00:1	4.00:1	20.00

Pond Results:

Peak Elevation:	2,502.84 ft
H'graph Detention Time:	7.36 hrs
Pond Model:	CSTRS
Dewater Time:	2.34 days
Trap Efficiency:	0.00 %

*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)
2,496.71	3.121	0.000	0.000	Top of Sed. Storage
2,497.00	3.199	0.919	0.000	
2,497.50	3.336	2.552	0.000	
2,498.00	3.476	4.255	0.000	
2,498.50	3.619	6.029	0.000	
2,499.00	3.765	7.875	0.000	
2,499.20	3.825	8.634	0.000	Spillway #1
2,499.40	3.884	9.405	0.544	17.14* Spillway #2
2,499.50	3.914	9.795	1.054	4.48*
2,500.00	4.066	11.790	3.573	11.70
2,500.50	4.220	13.861	6.757	5.00
2,501.00	4.378	16.011	9.776	3.20
2,501.50	4.538	18.239	12.559	2.45

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
2,502.00	4.701	20.549	14.011	3.45	Spillway #3
2,502.50	4.867	22.941	17.018	5.00	
2,502.84	4.981	24.602	49.577	3.75	Peak Stage
2,503.00	5.036	25.416	65.541		
2,503.50	5.208	27.977	123.834		
2,504.00	5.382	30.624	199.206		
2,504.50	5.560	33.360	295.116		
2,505.00	5.740	36.185	412.431		

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

**Detailed Discharge Table**

Elevation (ft)	Straight Pipe (cfs)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,496.71	0.000	0.000	0.000	0.000
2,497.00	0.000	0.000	0.000	0.000
2,497.50	0.000	0.000	0.000	0.000
2,498.00	0.000	0.000	0.000	0.000
2,498.50	0.000	0.000	0.000	0.000
2,499.00	0.000	0.000	0.000	0.000
2,499.20	0.000	0.000	0.000	0.000
2,499.40	(3)>0.544	0.000	0.000	0.544
2,499.50	(3)>0.587	(2)>0.467	0.000	1.054
2,500.00	(3)>2.251	(1)>1.321	0.000	3.573
2,500.50	(3)>4.630	(1)>2.127	0.000	6.757
2,501.00	(1)>6.667	(6)>3.110	0.000	9.776
2,501.50	(6)>9.027	(6)>3.532	0.000	12.559
2,502.00	(6)>10.103	(6)>3.908	0.000	14.011
2,502.50	(6)>11.075	(6)>4.255	1.688	17.018
2,503.00	(6)>11.969	(6)>4.580	48.992	65.541
2,503.50	(6)>12.803	(6)>4.860	106.170	123.834
2,504.00	(6)>13.589	(6)>5.138	180.479	199.206
2,504.50	(6)>14.320	(6)>5.415	275.381	295.116
2,505.00	(6)>15.007	(6)>5.677	391.747	412.431

**Structure #9 (Pond)**

*Pond 1 - Cell 2*

**Pond Inputs:**

Initial Pool Elev:	2,497.50 ft
Initial Pool:	12.84 ac-ft

*Sediment Storage:	1.00 ac-ft
Dead Space:	0.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

**Emergency Spillway**

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,501.00	100.00	4.00:1	4.00:1	20.00

**Pond Results:**

Peak Elevation:	2,500.99 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

*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)
2,496.11	9.081	0.000	0.000	Top of Sed. Storage
2,496.50	9.168	3.562	0.000	
2,497.00	9.280	8.174	0.000	
2,497.50	9.392	12.842	0.000	
2,498.00	9.505	17.566	0.000	
2,498.50	9.619	22.348	0.000	
2,499.00	9.734	27.186	0.000	
2,499.50	9.849	32.081	0.000	
2,500.00	9.965	37.035	0.000	
2,500.50	10.081	42.046	0.000	
2,500.99	10.196	47.006	0.000	0.00 Peak Stage
2,501.00	10.198	47.116	0.000	Spillway #1
2,501.50	10.316	52.244	16.341	
2,502.00	10.435	57.432	32.682	
2,502.50	10.554	62.679	75.955	
2,503.00	10.674	67.986	136.784	
2,503.50	10.794	73.353	213.354	
2,504.00	10.916	78.780	305.913	
2,504.50	11.037	84.269	428.015	
2,505.00	11.160	89.818	571.042	

**Detailed Discharge Table**

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,496.11	0.000	0.000
2,496.50	0.000	0.000
2,497.00	0.000	0.000
2,497.50	0.000	0.000
2,498.00	0.000	0.000
2,498.50	0.000	0.000
2,499.00	0.000	0.000
2,499.50	0.000	0.000
2,500.00	0.000	0.000
2,500.50	0.000	0.000
2,501.00	0.000	0.000
2,501.50	16.341	16.341
2,502.00	32.682	32.682
2,502.50	75.955	75.955
2,503.00	136.784	136.784
2,503.50	213.354	213.354
2,504.00	305.913	305.913
2,504.50	428.015	428.015
2,505.00	571.042	571.042

### ***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)
#14	1	8.743	0.000	0.000	0.000	78.000	M	11.63	0.874
	<b>Σ</b>	<b>8.743</b>						<b>11.63</b>	<b>0.874</b>
<b>#17</b>	<b>Σ</b>	<b>8.743</b>						<b>11.63</b>	<b>0.874</b>
#15	1	6.464	0.000	0.000	0.000	93.000	M	14.06	1.265
	2	15.760	0.298	0.207	0.265	73.000	M	8.50	0.965
	<b>Σ</b>	<b>22.224</b>						<b>16.04</b>	<b>2.229</b>
#8	1	133.840	1.266	0.204	0.312	81.000	M	54.92	12.350
	2	16.660	0.228	0.023	0.354	61.000	M	3.34	0.451
	<b>Σ</b>	<b>150.500</b>						<b>55.43</b>	<b>12.801</b>
#7	1	5.600	0.064	0.000	0.000	91.000	M	11.62	1.009
	<b>Σ</b>	<b>178.324</b>						<b>61.15</b>	<b>16.039</b>
#12	1	1.579	0.000	0.000	0.000	73.000	M	1.66	0.121
	<b>Σ</b>	<b>1.579</b>						<b>1.66</b>	<b>0.121</b>
#2	1	14.180	0.147	0.114	0.305	82.000	M	14.88	1.400
	2	17.400	0.207	0.000	0.000	73.000	M	10.55	1.064
	<b>Σ</b>	<b>33.159</b>						<b>24.42</b>	<b>2.585</b>
#5	1	3.113	0.209	0.000	0.000	91.000	M	4.46	0.448
	<b>Σ</b>	<b>36.272</b>						<b>24.23</b>	<b>3.033</b>
#13	1	5.056	0.000	0.000	0.000	93.000	M	11.00	0.989
	<b>Σ</b>	<b>5.056</b>						<b>11.00</b>	<b>0.989</b>
#3	1	6.720	0.151	0.291	0.183	61.000	M	1.53	0.184
	2	18.990	0.190	0.042	0.262	73.000	M	11.88	1.171
	3	5.380	0.098	0.000	0.000	82.000	M	8.40	0.653
	4	37.790	0.236	0.361	0.242	94.000	M	58.06	6.200
	5	24.220	0.174	0.161	0.255	80.000	M	22.88	2.171
	<b>Σ</b>	<b>98.156</b>						<b>80.19</b>	<b>11.367</b>
#6	1	2.039	0.072	0.000	0.000	93.000	M	4.44	0.399
	<b>Σ</b>	<b>136.467</b>						<b>102.47</b>	<b>14.798</b>
#16	1	4.170	0.000	0.000	0.000	100.000	F	9.91	1.077
	<b>Σ</b>	<b>327.704</b>						<b>154.30</b>	<b>32.788</b>
#9	1	9.462	0.000	0.000	0.000	100.000	M	22.48	2.443
	<b>Σ</b>	<b>337.166</b>						<b>50.82</b>	<b>34.198</b>

### ***Subwatershed Sedimentology Detail:***

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#14	1	0.370	30.00	1.00	1.0000	1.0000	1	12.6	20,629	8.05	4.10
	<b>Σ</b>							<b>12.6</b>	<b>20,629</b>	<b>8.05</b>	<b>4.10</b>
<b>#17</b>	<b>Σ</b>							<b>12.6</b>	<b>20,629</b>	<b>8.05</b>	<b>4.10</b>
#15	1	0.320	30.00	1.00	1.0000	1.0000	1	14.8	15,499	6.05	3.35
	2	0.240	378.00	0.40	0.0380	1.0000	1	0.4	500	0.11	0.06
	<b>Σ</b>							<b>15.1</b>	<b>14,818</b>	<b>5.71</b>	<b>1.91</b>
#8	1	0.370	300.00	5.00	0.2400	1.0000	1	395.0	37,350	3.20	1.99
	2	0.240	59.00	8.50	0.0380	1.0000	1	1.0	3,384	0.55	0.26
	<b>Σ</b>							<b>347.7</b>	<b>32,316</b>	<b>1.78</b>	<b>1.09</b>
#7	1	0.320	153.00	9.80	1.0000	1.0000	1	197.7	236,583	92.33	51.95
	<b>Σ</b>							<b>560.5</b>	<b>103,423</b>	<b>18.84</b>	<b>4.60</b>
#12	1	0.240	30.00	1.00	0.0380	1.0000	1	0.0	434	0.17	0.08
	<b>Σ</b>							<b>0.0</b>	<b>434</b>	<b>0.17</b>	<b>0.08</b>
#2	1	0.370	275.80	3.60	0.2400	1.0000	1	30.0	29,144	8.52	4.56
	2	0.240	105.00	4.10	0.0380	1.0000	1	2.0	2,702	0.67	0.34
	<b>Σ</b>							<b>27.8</b>	<b>17,040</b>	<b>3.66</b>	<b>1.69</b>
#5	1	0.320	30.00	1.00	1.0000	1.0000	1	5.0	15,138	4.54	2.43
	<b>Σ</b>							<b>30.7</b>	<b>15,436</b>	<b>2.94</b>	<b>1.41</b>
#13	1	0.370	30.00	1.00	1.0000	1.0000	1	13.0	17,387	6.79	3.76
	<b>Σ</b>							<b>13.0</b>	<b>17,387</b>	<b>6.79</b>	<b>3.76</b>
#3	1	0.240	216.00	2.60	0.2400	1.0000	1	1.2	9,357	1.91	0.98
	2	0.240	172.00	1.50	0.0380	1.0000	1	1.0	1,209	0.31	0.16
	3	0.370	144.00	1.00	0.0420	1.0000	1	0.6	1,282	0.50	0.26
	4	0.370	412.00	3.60	1.0000	1.0000	1	698.1	144,882	43.52	23.80
	5	0.370	292.00	2.70	0.0420	1.0000	1	6.7	4,222	1.20	0.64
	<b>Σ</b>							<b>586.3</b>	<b>87,445</b>	<b>16.73</b>	<b>7.09</b>
#6	1	0.370	30.00	1.00	1.0000	1.0000	1	4.7	15,604	6.09	3.38
	<b>Σ</b>							<b>621.7</b>	<b>69,489</b>	<b>13.39</b>	<b>5.84</b>
#16	1	0.370	325.00	0.10	1.0000	1.0000	1	7.7	9,935	3.88	2.04
	<b>Σ</b>							<b>1,202.3</b>	<b>58,365</b>	<b>11.16</b>	<b>5.18</b>
#9	1	0.320	1.00	1.00	1.0000	1.0000	1	10.1	5,749	2.24	1.18
	<b>Σ</b>							<b>557.4</b>	<b>16,144</b>	<b>0.11</b>	<b>0.09</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	7. Paved area and small upland gullies	2.20	8.44	383.90	2.980	0.035
		5. Nearly bare and untilled, and alluvial valley fans	2.20	13.20	600.00	1.480	0.112
<b>#2</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.147</b>
#2	2	3. Short grass pasture	1.77	10.62	600.00	1.060	0.157
		7. Paved area and small upland gullies	1.77	8.64	488.50	2.670	0.050
<b>#2</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.207</b>
#3	1	5. Nearly bare and untilled, and alluvial valley fans	2.60	15.60	600.00	1.610	0.103
		7. Paved area and small upland gullies	2.60	14.79	569.00	3.240	0.048
<b>#3</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.151</b>
#3	2	5. Nearly bare and untilled, and alluvial valley fans	1.50	9.00	600.00	1.220	0.136
		7. Paved area and small upland gullies	1.50	7.26	484.00	2.460	0.054
<b>#3</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.190</b>
#3	3	3. Short grass pasture	1.05	3.00	287.00	0.810	0.098
<b>#3</b>	<b>3</b>	<b>Time of Concentration:</b>					<b>0.098</b>
#3	4	5. Nearly bare and untilled, and alluvial valley fans	2.78	16.68	600.00	1.660	0.100
		7. Paved area and small upland gullies	2.78	18.29	658.00	3.350	0.054
		7. Paved area and small upland gullies	2.24	20.00	891.00	3.010	0.082
<b>#3</b>	<b>4</b>	<b>Time of Concentration:</b>					<b>0.236</b>
#3	5	5. Nearly bare and untilled, and alluvial valley fans	2.70	16.20	600.00	1.640	0.101
		7. Paved area and small upland gullies	2.70	23.46	869.00	3.300	0.073
<b>#3</b>	<b>5</b>	<b>Time of Concentration:</b>					<b>0.174</b>
#5	1	8. Large gullies, diversions, and low flowing streams	0.46	6.90	1,500.00	2.030	0.205
		7. Paved area and small upland gullies	1.00	0.29	30.00	2.010	0.004
<b>#5</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.209</b>
#6	1	7. Paved area and small upland gullies	1.00	0.29	30.00	2.010	0.004
		8. Large gullies, diversions, and low flowing streams	0.46	2.30	500.00	2.030	0.068
<b>#6</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.072</b>
#7	1	5. Nearly bare and untilled, and alluvial valley fans	1.67	3.00	180.00	1.290	0.038
		8. Large gullies, diversions, and low flowing streams	4.82	30.00	623.00	6.580	0.026
<b>#7</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.064</b>



Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	1	5. Nearly bare and untilled, and alluvial valley fans	3.46	10.00	289.00	1.860	0.043
		7. Paved area and small upland gullies	3.52	14.00	398.00	3.770	0.029
		7. Paved area and small upland gullies	2.84	50.00	1,759.00	3.390	0.144
		7. Paved area and small upland gullies	0.85	30.00	3,529.00	1.850	0.529
		7. Paved area and small upland gullies	1.04	40.00	3,847.00	2.050	0.521
<b>#8</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>1.266</b>
#8	2	5. Nearly bare and untilled, and alluvial valley fans	1.18	10.50	890.00	1.080	0.228
<b>#8</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.228</b>
#15	2	5. Nearly bare and untilled, and alluvial valley fans	0.40	2.40	600.00	0.630	0.264
		7. Paved area and small upland gullies	0.40	0.62	156.00	1.270	0.034
<b>#15</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.298</b>

### ***Subwatershed Muskingum Routing Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	7. Paved area and small upland gullies	1.75	19.00	1,088.51	2.650	0.114
<b>#2</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.114</b>
#2	2	7. Paved area and small upland gullies	1.75	19.00	1,088.00	2.660	0.113
<b>#2</b>	<b>2</b>	<b>Muskingum K:</b>					<b>0.000</b>
#3	1	5. Nearly bare and untilled, and alluvial valley fans	0.97	10.00	1,029.00	0.980	0.291
<b>#3</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.291</b>
#3	2	7. Paved area and small upland gullies	0.87	2.50	287.20	1.870	0.042
<b>#3</b>	<b>2</b>	<b>Muskingum K:</b>					<b>0.042</b>
#3	4	7. Paved area and small upland gullies	0.63	13.00	2,070.00	1.590	0.361
<b>#3</b>	<b>4</b>	<b>Muskingum K:</b>					<b>0.361</b>
#3	5	7. Paved area and small upland gullies	0.78	8.00	1,028.00	1.770	0.161
<b>#3</b>	<b>5</b>	<b>Muskingum K:</b>					<b>0.161</b>
#8	1	7. Paved area and small upland gullies	2.24	22.00	983.85	3.010	0.090
		7. Paved area and small upland gullies	1.75	19.00	1,088.50	2.650	0.114
<b>#8</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.204</b>
#8	2	7. Paved area and small upland gullies	4.23	15.00	355.00	4.130	0.023

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
<b>#8</b>	<b>2</b>	<b>Muskingum K:</b>					<b>0.023</b>
#15	2	7. Paved area and small upland gullies	1.35	8.00	591.00	2.340	0.070
		7. Paved area and small upland gullies	0.63	5.00	790.00	1.600	0.137
<b>#15</b>	<b>2</b>	<b>Muskingum K:</b>					<b>0.207</b>

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**Pond 1**  
**100-year, 6-hour storm**

***Great Northern South Heart***  
***Post-Mining Flows***

***Flow to South Branch Heart River***

CBEGEJ

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***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	3.550 inches

***Particle Size Distribution:***

Size (mm)	Silt Loam
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#2	==>	#5	0.342	0.272	CC#3
Culvert	#3	==>	#6	0.101	0.265	CC#2
Channel	#5	==>	#6	0.101	0.265	Haul road ditch below CC#3
Channel	#6	==>	#16	0.101	0.265	Haul road ditch below CC#2
Culvert	#7	==>	#16	0.000	0.000	CC#1
Channel	#8	==>	#7	0.000	0.000	Haul road from north
Pond	#9	==>	End	0.000	0.000	Pond 1-Cell 2
Channel	#12	==>	#2	0.000	0.000	MHR1 north ditch to CC#3
Channel	#13	==>	#3	0.000	0.000	MHR1 north ditch to CC#2
Channel	#14	==>	#17	0.000	0.000	MHR2 north ditch to Pond 1
Channel	#15	==>	#7	0.000	0.000	MHR1 north ditch to CC#1
Pond	#16	==>	#9	0.000	0.000	Pond 1 - Cell 1
Culvert	#17	==>	#16	0.000	0.000	CC#6



**Structure Routing Details:**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	0.46	11.50	2,500.00	2.03	0.342
<b>#2</b>	<b>Muskingum K:</b>					<b>0.342</b>
#3	8. Large gullies, diversions, and low flowing streams	0.41	2.87	700.00	1.92	0.101
<b>#3</b>	<b>Muskingum K:</b>					<b>0.101</b>
#6	8. Large gullies, diversions, and low flowing streams	0.41	2.87	700.00	1.92	0.101
<b>#6</b>	<b>Muskingum K:</b>					<b>0.101</b>

**Structure Summary:**

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#14	8.743	8.743	21.78	1.11	20.5	21,242	8.29	5.24
#17	0.000	8.743	21.78	1.11	20.5	21,242	8.29	5.24
#15	22.224	22.224	25.89	2.77	22.1	14,720	5.66	2.24
#8	150.500	150.500	94.94	16.20	529.9	33,130	1.46	1.05
#7	5.600	178.324	105.15	20.17	844.7	112,628	19.46	5.21
#12	1.579	1.579	3.28	0.16	0.1	449	0.18	0.11
#2	31.580	33.159	44.63	3.31	44.1	17,024	3.66	2.09
#5	3.113	36.272	43.72	3.85	48.2	15,438	2.92	1.73
#13	5.056	5.056	18.30	1.17	19.1	17,119	6.68	4.65
#3	93.100	98.156	136.48	13.85	839.9	82,517	14.95	7.89
#6	2.039	136.467	175.67	18.18	894.9	64,953	11.90	6.51
#16 In	4.170	327.704	262.57	40.69	1,770.8	59,400	10.81	5.77
#16 Out			139.49	0.00	992.0	0	0.00	0.00
#9 In	9.462	337.166	142.08	43.04	1,006.2	22,200	0.12	0.10
#9 Out			65.50	0.00	353.5	0	0.00	0.00

**Structure Detail:**

**Structure #14 (Erodible Channel)**

*MHR2 north ditch to Pond 1*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.3	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	21.78 cfs	
Depth:	1.63 ft	1.93 ft
Top Width:	9.76 ft	11.56 ft
Velocity:	2.75 fps	
X-Section Area:	7.93 sq ft	
Hydraulic Radius:	0.771 ft	
Froude Number:	0.54	

**Structure #17 (Culvert)**

*CC#6*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	1.50	0.0240	2.00	0.00	0.90

Culvert Results:

Design Discharge = 21.78 cfs

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

**Structure #15 (Erodible Channel)**

*MHR1 north ditch to CC#1*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal



Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.4	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	25.89 cfs	
Depth:	1.64 ft	1.94 ft
Top Width:	9.86 ft	11.66 ft
Velocity:	3.19 fps	
X-Section Area:	8.11 sq ft	
Hydraulic Radius:	0.780 ft	
Froude Number:	0.62	

Structure #8 (Erodible Channel)

*Haul road from north*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	4.0:1	3.0:1	0.2	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	94.94 cfs	
Depth:	2.56 ft	2.86 ft
Top Width:	21.91 ft	24.01 ft
Velocity:	2.86 fps	
X-Section Area:	33.14 sq ft	
Hydraulic Radius:	1.465 ft	
Froude Number:	0.41	

Structure #7 (Culvert)

*CC#1*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	1.00	0.0240	3.75	0.00	0.90

Culvert Results:

Design Discharge = 105.15 cfs

Minimum pipe diameter: 1 - 84 inch pipe(s) required

Structure #12 (Erodible Channel)

MHR1 north ditch to CC#3

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.4	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.28 cfs	
Depth:	0.76 ft	1.06 ft
Top Width:	4.55 ft	6.35 ft
Velocity:	1.91 fps	
X-Section Area:	1.72 sq ft	
Hydraulic Radius:	0.359 ft	
Froude Number:	0.55	

Structure #2 (Culvert)

CC#3

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	1.00	0.0240	3.00	0.00	0.90

Culvert Results:

Design Discharge = 44.63 cfs

Minimum pipe diameter: 1 - 54 inch pipe(s) required

Structure #5 (Erodible Channel)

Haul road ditch below CC#3

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	4.0:1	3.0:1	0.5	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	43.72 cfs	
Depth:	1.49 ft	1.79 ft
Top Width:	14.41 ft	16.51 ft
Velocity:	3.19 fps	
X-Section Area:	13.69 sq ft	
Hydraulic Radius:	0.923 ft	
Froude Number:	0.58	

*Structure #13 (Erodible Channel)*

*MHR1 north ditch to CC#2*

Triangular Erodible Channel Inputs:

Material: Alluvial silts colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.4	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	18.30 cfs	
Depth:	1.44 ft	1.74 ft
Top Width:	8.66 ft	10.46 ft
Velocity:	2.93 fps	
X-Section Area:	6.25 sq ft	
Hydraulic Radius:	0.685 ft	
Froude Number:	0.61	

*Structure #3 (Culvert)*

*CC#2*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	2.00	0.0240	4.00	0.00	0.90

Culvert Results:

Design Discharge = 136.48 cfs

Minimum pipe diameter: 1 - 108 inch pipe(s) required

Structure #6 (Erodible Channel)

*Haul road ditch below CC#2*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	3.0:1	4.0:1	0.4	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	175.67 cfs	
Depth:	2.86 ft	3.16 ft
Top Width:	24.04 ft	26.14 ft
Velocity:	4.38 fps	
X-Section Area:	40.12 sq ft	
Hydraulic Radius:	1.615 ft	
Froude Number:	0.60	

Structure #16 (Pond)

*Pond 1 - Cell 1*

Pond Inputs:

Initial Pool Elev:	2,499.20 ft
Initial Pool:	8.42 ac-ft
*Sediment Storage:	2.37 ac-ft
Dead Space:	0.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	48.00	2.00	0.0240	2,499.20	0.90	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	48.00	2.00	0.0240	2,499.40	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,502.00	24.00	4.00:1	4.00:1	20.00

Pond Results:

Peak Elevation:	2,503.60 ft
H'graph Detention Time:	5.09 hrs
Pond Model:	CSTRS
Dewater Time:	2.22 days
Trap Efficiency:	0.00 %

*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)
2,496.78	3.139	0.000	0.000	Top of Sed. Storage
2,497.00	3.199	0.707	0.000	
2,497.50	3.336	2.341	0.000	
2,498.00	3.476	4.044	0.000	
2,498.50	3.619	5.818	0.000	
2,499.00	3.765	7.664	0.000	
2,499.20	3.825	8.423	0.000	Spillway #1
2,499.40	3.884	9.193	0.544	17.14* Spillway #2
2,499.50	3.914	9.583	1.054	6.10
2,500.00	4.066	11.578	3.573	11.70
2,500.50	4.220	13.650	6.757	5.00
2,501.00	4.378	15.799	9.776	3.20
2,501.50	4.538	18.028	12.559	2.45

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
2,502.00	4.701	20.337	14.011	2.10	Spillway #3
2,502.50	4.867	22.729	17.018	2.20	
2,503.00	5.036	25.205	65.541	1.95	
2,503.50	5.208	27.765	123.834	1.20	
2,503.60	5.245	28.315	139.491	0.35	Peak Stage
2,504.00	5.382	30.413	199.206		
2,504.50	5.560	33.148	295.116		
2,505.00	5.740	35.973	412.431		

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

### Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,496.78	0.000	0.000	0.000	0.000
2,497.00	0.000	0.000	0.000	0.000
2,497.50	0.000	0.000	0.000	0.000
2,498.00	0.000	0.000	0.000	0.000
2,498.50	0.000	0.000	0.000	0.000
2,499.00	0.000	0.000	0.000	0.000
2,499.20	0.000	0.000	0.000	0.000
2,499.40	(3)>0.544	0.000	0.000	0.544
2,499.50	(3)>0.587	(2)>0.467	0.000	1.054
2,500.00	(3)>2.251	(1)>1.321	0.000	3.573
2,500.50	(3)>4.630	(1)>2.127	0.000	6.757
2,501.00	(1)>6.667	(6)>3.110	0.000	9.776
2,501.50	(6)>9.027	(6)>3.532	0.000	12.559
2,502.00	(6)>10.103	(6)>3.908	0.000	14.011
2,502.50	(6)>11.075	(6)>4.255	1.688	17.018
2,503.00	(6)>11.969	(6)>4.580	48.992	65.541
2,503.50	(6)>12.803	(6)>4.860	106.170	123.834
2,504.00	(6)>13.589	(6)>5.138	180.479	199.206
2,504.50	(6)>14.320	(6)>5.415	275.381	295.116
2,505.00	(6)>15.007	(6)>5.677	391.747	412.431

### Structure #9 (Pond)

Pond 1-Cell 2

Pond Inputs:

Initial Pool Elev:	2,501.00 ft
Initial Pool:	46.77 ac-ft

*Sediment Storage:	1.34 ac-ft
Dead Space:	0.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

**Emergency Spillway**

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,501.00	100.00	4.00:1	4.00:1	20.00

**Pond Results:**

Peak Elevation:	2,502.38 ft
H'graph Detention Time:	3.32 hrs
Pond Model:	CSTRS
Dewater Time:	0.52 days
Trap Efficiency:	0.00 %

*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)
2,496.15	9.090	0.000	0.000	Top of Sed. Storage
2,496.50	9.168	3.218	0.000	
2,497.00	9.280	7.830	0.000	
2,497.50	9.392	12.498	0.000	
2,498.00	9.505	17.223	0.000	
2,498.50	9.619	22.004	0.000	
2,499.00	9.734	26.842	0.000	
2,499.50	9.849	31.738	0.000	
2,500.00	9.965	36.691	0.000	
2,500.50	10.081	41.702	0.000	
2,501.00	10.198	46.772	0.000	Spillway #1
2,501.50	10.316	51.901	16.341	3.80*
2,502.00	10.435	57.088	32.682	6.05
2,502.38	10.525	61.068	65.504	2.60 Peak Stage
2,502.50	10.554	62.335	75.955	
2,503.00	10.674	67.642	136.784	
2,503.50	10.794	73.009	213.354	
2,504.00	10.916	78.437	305.913	
2,504.50	11.037	83.925	428.015	
2,505.00	11.160	89.474	571.042	

*\*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)
2,496.15	0.000	0.000
2,496.50	0.000	0.000
2,497.00	0.000	0.000
2,497.50	0.000	0.000
2,498.00	0.000	0.000
2,498.50	0.000	0.000
2,499.00	0.000	0.000
2,499.50	0.000	0.000
2,500.00	0.000	0.000
2,500.50	0.000	0.000
2,501.00	0.000	0.000
2,501.50	16.341	16.341
2,502.00	32.682	32.682
2,502.50	75.955	75.955
2,503.00	136.784	136.784
2,503.50	213.354	213.354
2,504.00	305.913	305.913
2,504.50	428.015	428.015
2,505.00	571.042	571.042



### ***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)
#14	1	8.743	0.000	0.000	0.000	78.000	M	21.78	1.114
	<b>Σ</b>	<b>8.743</b>						<b>21.78</b>	<b>1.114</b>
<b>#17</b>	<b>Σ</b>	<b>8.743</b>						<b>21.78</b>	<b>1.114</b>
#15	1	6.464	0.000	0.000	0.000	93.000	M	23.40	1.495
	2	15.760	0.298	0.207	0.265	73.000	M	16.25	1.273
	<b>Σ</b>	<b>22.224</b>						<b>25.89</b>	<b>2.768</b>
#8	1	133.840	1.266	0.204	0.312	81.000	M	93.49	15.532
	2	16.660	0.228	0.023	0.354	61.000	M	8.64	0.664
	<b>Σ</b>	<b>150.500</b>						<b>94.94</b>	<b>16.196</b>
#7	1	5.600	0.064	0.000	0.000	91.000	M	19.59	1.204
	<b>Σ</b>	<b>178.324</b>						<b>105.15</b>	<b>20.169</b>
#12	1	1.579	0.000	0.000	0.000	73.000	M	3.28	0.159
	<b>Σ</b>	<b>1.579</b>						<b>3.28</b>	<b>0.159</b>
#2	1	14.180	0.147	0.114	0.305	82.000	M	26.44	1.751
	2	17.400	0.207	0.000	0.000	73.000	M	20.41	1.404
	<b>Σ</b>	<b>33.159</b>						<b>44.63</b>	<b>3.314</b>
#5	1	3.113	0.209	0.000	0.000	91.000	M	7.45	0.536
	<b>Σ</b>	<b>36.272</b>						<b>43.72</b>	<b>3.850</b>
#13	1	5.056	0.000	0.000	0.000	93.000	M	18.30	1.169
	<b>Σ</b>	<b>5.056</b>						<b>18.30</b>	<b>1.169</b>
#3	1	6.720	0.151	0.291	0.183	61.000	M	3.94	0.271
	2	18.990	0.190	0.042	0.262	73.000	M	22.99	1.545
	3	5.380	0.098	0.000	0.000	82.000	M	15.18	0.815
	4	37.790	0.236	0.361	0.242	94.000	M	95.42	7.308
	5	24.220	0.174	0.161	0.255	80.000	M	41.30	2.745
	<b>Σ</b>	<b>98.156</b>						<b>136.48</b>	<b>13.854</b>
#6	1	2.039	0.072	0.000	0.000	93.000	M	7.38	0.472
	<b>Σ</b>	<b>136.467</b>						<b>175.67</b>	<b>18.175</b>
#16	1	4.170	0.000	0.000	0.000	100.000	F	16.05	1.231
	<b>Σ</b>	<b>327.704</b>						<b>262.57</b>	<b>40.690</b>
#9	1	9.462	0.000	0.000	0.000	100.000	M	36.41	2.793
	<b>Σ</b>	<b>337.166</b>						<b>142.08</b>	<b>43.036</b>

# S Heart CC#1 Alternative Culvert Sizing 100-6 Storm 105.15 cfs - (2) 42" Culverts

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	100.00	0.0240	4.00	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 42 inch pipe(s) required

## ***Detailed Performance Curves***

Design Discharge = 52.58 cfs

Maximum Headwater = 4.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) ( 36 in)	<b>Discharge (cfs) ( 42 in)</b>	Discharge (cfs) ( 45 in)
0.40	1.59	<b>1.86</b>	1.99
0.80	4.50	<b>5.24</b>	5.62
1.20	8.26	<b>9.63</b>	10.32
1.60	12.71	<b>14.83</b>	15.89
2.00	17.77	<b>20.73</b>	22.21
2.40	23.36	<b>27.25</b>	29.19
2.80	29.43	<b>34.34</b>	36.79
3.20	35.96	<b>41.95</b>	44.95
3.60	42.27	<b>50.06</b>	53.63
4.00	47.70	<b>58.63</b>	62.82
4.40	52.64	<b>65.63</b>	72.47
4.80	57.14	<b>72.28</b>	79.63
5.20	61.31	<b>78.36</b>	86.89
5.60	65.22	<b>84.01</b>	93.58
6.00	68.92	<b>89.30</b>	99.82

# S Heart CC#1 Alternative Culvert Sizing 100-6 Storm 105.15 cfs - (3) 36" Culverts

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
90.00	1.00	0.0240	3.50	0.00	0.90

Culvert Results:

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

## ***Detailed Performance Curves***

Design Discharge = 35.05 cfs

Maximum Headwater = 3.50 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) ( 30 in)	<b>Discharge (cfs) ( 36 in)</b>	Discharge (cfs) ( 42 in)
0.35	6.01	<b>8.23</b>	10.46
0.70	7.53	<b>10.57</b>	13.78
1.05	8.87	<b>12.67</b>	16.79
1.40	10.09	<b>14.56</b>	19.54
1.75	11.22	<b>16.32</b>	22.07
2.10	13.82	<b>17.94</b>	24.43
2.45	17.92	<b>20.62</b>	26.63
2.80	22.03	<b>26.01</b>	29.03
3.15	25.12	<b>31.56</b>	35.79
3.50	27.31	<b>37.01</b>	42.76
3.85	29.34	<b>41.44</b>	49.86
4.20	31.23	<b>44.61</b>	56.80
4.55	33.02	<b>47.58</b>	63.06
4.90	34.71	<b>50.37</b>	67.38
5.25	36.33	<b>53.01</b>	71.43

# **SHLM Facilities Area Sump & CC#7**

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

***General Information***

***Storm Information:***

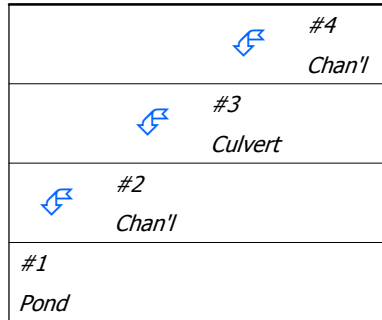
Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.100 inches

***Particle Size Distribution:***

Size (mm)	DustySiltLoam	Sandy Loam	Silt Loam
4.0000	100.000%	100.000%	100.000%
2.0000	100.000%	100.000%	100.000%
1.0000	100.000%	70.000%	100.000%
0.5000	96.000%	67.000%	96.000%
0.2500	91.000%	58.000%	91.000%
0.1250	87.000%	52.000%	87.000%
0.0630	82.000%	38.000%	82.000%
0.0150	45.530%	21.000%	60.000%
0.0123	26.520%	17.000%	58.000%
0.0079	14.500%	13.000%	38.000%
0.0047	8.330%	11.000%	33.000%
0.0025	3.510%	8.000%	0.000%
0.0008	0.000%	0.000%	0.000%

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Sump
Channel	#2	==>	#1	0.000	0.000	Outlet of CC#7 to pond
Culvert	#3	==>	#2	0.000	0.000	CC#7
Channel	#4	==>	#3	0.000	0.000	Ditch along N side of Rd & Fac Area



***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#4	4.160	4.160	8.29	0.73	1.3	2,409	1.52	0.83
#3	0.150	4.310	8.60	0.75	1.3	2,336	1.48	0.81
#2	1.780	6.090	9.81	0.88	1.3	2,239	1.41	0.70
#1 In	0.903	6.993	11.95	1.11	1.4	1,760	1.10	0.56
#1 Out			0.00	0.00	1.4	0	0.00	0.00

**Particle Size Distribution(s) at Each Structure**

**Structure #4 (Ditch along N side of Rd & Fac Area):**

Size (mm)	In/Out
4.0000	100.000%
2.0000	100.000%
1.0000	100.000%
0.5000	96.020%
0.2500	91.045%
0.1250	87.065%
0.0630	82.081%
0.0150	45.575%
0.0123	26.546%
0.0079	14.514%
0.0047	8.338%
0.0025	3.513%
0.0008	0.000%

**Structure #3 (CC#7):**

Size (mm)	In/Out
4.0000	100.000%
2.0000	100.000%
1.0000	100.000%
0.5000	96.020%
0.2500	91.044%
0.1250	87.064%
0.0630	82.080%
0.0150	45.575%
0.0123	26.546%
0.0079	14.514%
0.0047	8.338%
0.0025	3.513%
0.0008	0.000%

**Structure #2 (Outlet of CC#7 to pond):**



Size (mm)	In/Out
4.0000	100.000%
2.0000	100.000%
1.0000	100.000%
0.5000	96.044%
0.2500	91.099%
0.1250	87.142%
0.0630	82.189%
0.0150	45.773%
0.0123	26.844%
0.0079	14.727%
0.0047	8.549%
0.0025	3.492%
0.0008	0.000%

***Structure #1:***

Size (mm)	In	Out
4.0000	100.000%	0.000%
2.0000	100.000%	0.000%
1.0000	100.000%	0.000%
0.5000	96.043%	0.000%
0.2500	91.097%	0.000%
0.1250	87.140%	0.000%
0.0630	82.185%	0.000%
0.0150	46.050%	0.000%
0.0123	27.451%	0.000%
0.0079	15.181%	0.000%
0.0047	9.026%	0.000%
0.0025	3.424%	0.000%
0.0008	0.000%	0.000%

### Structure Detail:

Structure #4 (Erodible Channel)

*Ditch along N side of Rd & Fac Area*

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.2	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.29 cfs	
Depth:	1.31 ft	1.61 ft
Top Width:	7.85 ft	9.65 ft
Velocity:	1.62 fps	
X-Section Area:	5.13 sq ft	
Hydraulic Radius:	0.620 ft	
Froude Number:	0.35	

Structure #3 (Culvert)

CC#7

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	2.00	0.0240	1.75	0.00	0.90

Culvert Results:

Design Discharge = 8.60 cfs

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

Structure #2 (Erodible Channel)

*Outlet of CC#7 to pond*

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.2	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	9.81 cfs	
Depth:	1.39 ft	1.69 ft
Top Width:	8.36 ft	10.16 ft
Velocity:	1.69 fps	
X-Section Area:	5.82 sq ft	
Hydraulic Radius:	0.661 ft	
Froude Number:	0.36	

Structure #1 (Pond)

*Sump*

Pond Inputs:

Initial Pool Elev:	2,495.50 ft
Initial Pool:	0.33 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	20.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,499.00	10.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	2,497.06 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

*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)
2,495.00	0.648	0.000	0.000	Top of Sed. Storage
2,495.50	0.672	0.328	0.000	
2,496.00	0.696	0.669	0.000	
2,496.50	0.720	1.023	0.000	
2,497.00	0.745	1.389	0.000	
2,497.06	0.748	1.435	0.000	0.00 Peak Stage
2,497.50	0.770	1.768	0.000	
2,498.00	0.796	2.160	0.000	
2,498.50	0.822	2.564	0.000	
2,499.00	0.849	2.982	0.000	Spillway #1
2,499.50	0.876	3.413	4.145	
2,500.00	0.903	3.858	55.544	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,495.00	0.000	0.000
2,495.50	0.000	0.000
2,496.00	0.000	0.000
2,496.50	0.000	0.000
2,497.00	0.000	0.000
2,497.50	0.000	0.000
2,498.00	0.000	0.000
2,498.50	0.000	0.000
2,499.00	0.000	0.000
2,499.50	4.145	4.145
2,500.00	55.544	55.544

### 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	0.490	0.131	0.055	0.308	91.000	M	0.74	0.071
	2	3.670	0.087	0.000	0.000	91.000	M	7.62	0.661
	<b>Σ</b>	<b>4.160</b>						<b>8.29</b>	<b>0.732</b>
#3	1	0.150	0.030	0.000	0.000	91.000	M	0.31	0.022
	<b>Σ</b>	<b>4.310</b>						<b>8.60</b>	<b>0.754</b>
#2	1	0.140	0.003	0.158	0.085	91.000	M	0.29	0.019
	2	1.640	0.158	0.000	0.000	73.000	M	1.07	0.102
	<b>Σ</b>	<b>6.090</b>						<b>9.81</b>	<b>0.875</b>
#1	1	0.903	0.000	0.000	0.000	100.000	F	2.15	0.233
	<b>Σ</b>	<b>6.993</b>						<b>11.95</b>	<b>1.109</b>

### Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#4	1	0.370	10.00	0.50	0.0200	1.0000	1	0.0	124	0.07	0.04
	2	0.370	546.00	3.80	0.0200	1.0000	1	1.3	2,612	1.65	0.91
	<b>Σ</b>							<b>1.3</b>	<b>2,409</b>	<b>1.52</b>	<b>0.83</b>
#3	1	0.370	20.00	2.00	0.0200	1.0000	1	0.0	387	0.24	0.16
	<b>Σ</b>							<b>1.3</b>	<b>2,336</b>	<b>1.48</b>	<b>0.81</b>
#2	1	0.370	20.00	2.00	0.0200	1.0000	1	0.0	401	0.25	0.17
	2	0.340	200.00	0.20	0.0120	1.0000	3	0.0	115	0.04	0.02
	<b>Σ</b>							<b>1.3</b>	<b>2,239</b>	<b>1.41</b>	<b>0.70</b>
#1	1	0.370	276.00	0.10	0.0200	1.0000	3	0.0	158	0.07	0.03
	<b>Σ</b>							<b>1.4</b>	<b>1,760</b>	<b>1.10</b>	<b>0.56</b>

### Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	0.39	19.50	1.410	0.003
<b>#2</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.003</b>
#2	2	3. Short grass pasture	0.20	0.40	200.00	0.350	0.158

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
<b>#2</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.158</b>
#3	1	7. Paved area and small upland gullies	2.00	0.39	19.50	2.840	0.001
		7. Paved area and small upland gullies	1.76	5.00	283.91	2.670	0.029
<b>#3</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.030</b>
#4	1	7. Paved area and small upland gullies	0.20	0.85	425.00	0.900	0.131
<b>#4</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.131</b>
#4	2	5. Nearly bare and untilled, and alluvial valley fans	2.83	15.00	530.00	1.680	0.087
<b>#4</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.087</b>

***Subwatershed Muskingum Routing Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	3. Short grass pasture	0.20	0.40	200.00	0.350	0.158
<b>#2</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.158</b>
#4	1	7. Paved area and small upland gullies	1.83	10.00	546.00	2.720	0.055
<b>#4</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.055</b>

# **SHLM Facilities Area Sump & CC#7**

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

## ***General Information***

### ***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	3.550 inches

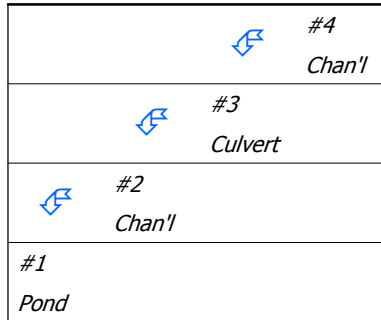
### ***Particle Size Distribution:***

Size (mm)	DustySiltLoam	Sandy Loam	Silt Loam
4.0000	100.000%	100.000%	100.000%
2.0000	100.000%	100.000%	100.000%
1.0000	100.000%	70.000%	100.000%
0.5000	96.000%	67.000%	96.000%
0.2500	91.000%	58.000%	91.000%
0.1250	87.000%	52.000%	87.000%
0.0630	82.000%	38.000%	82.000%
0.0150	45.530%	21.000%	60.000%
0.0123	26.520%	17.000%	58.000%
0.0079	14.500%	13.000%	38.000%
0.0047	8.330%	11.000%	33.000%
0.0025	3.510%	8.000%	0.000%
0.0008	0.000%	0.000%	0.000%



### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Sump
Channel	#2	==>	#1	0.000	0.000	Outlet of CC#7 to pond
Culvert	#3	==>	#2	0.000	0.000	CC#7
Channel	#4	==>	#3	0.000	0.000	Ditch along N side of Rd & Fac Area



***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#4	4.160	4.160	13.96	0.88	1.9	2,394	1.51	1.02
#3	0.150	4.310	14.48	0.91	1.9	2,321	1.47	0.99
#2	1.780	6.090	16.71	1.07	2.0	2,206	1.39	0.85
#1 In	0.903	6.993	20.18	1.34	2.0	1,755	1.10	0.69
#1 Out			0.00	0.00	2.0	0	0.00	0.00

### Structure Detail:

#### Structure #4 (Erodible Channel)

Ditch along N side of Rd & Fac Area

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.2	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.96 cfs	
Depth:	1.59 ft	1.89 ft
Top Width:	9.54 ft	11.34 ft
Velocity:	1.84 fps	
X-Section Area:	7.58 sq ft	
Hydraulic Radius:	0.754 ft	
Froude Number:	0.36	

#### Structure #3 (Culvert)

CC#7

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
50.00	2.00	0.0240	1.75	0.00	0.90

Culvert Results:

Design Discharge = 14.48 cfs

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

#### Structure #2 (Erodible Channel)

Outlet of CC#7 to pond

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.2	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.71 cfs	
Depth:	1.70 ft	2.00 ft
Top Width:	10.20 ft	12.00 ft
Velocity:	1.92 fps	
X-Section Area:	8.68 sq ft	
Hydraulic Radius:	0.807 ft	
Froude Number:	0.37	

Structure #1 (Pond)

*Sump*

Pond Inputs:

Initial Pool Elev:	2,495.50 ft
Initial Pool:	0.33 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	20.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,499.00	10.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	2,497.36 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

*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)
2,495.00	0.648	0.000	0.000	Top of Sed. Storage
2,495.50	0.672	0.327	0.000	
2,496.00	0.696	0.669	0.000	
2,496.50	0.720	1.023	0.000	
2,497.00	0.745	1.389	0.000	
2,497.36	0.763	1.665	0.000	0.00 Peak Stage
2,497.50	0.770	1.768	0.000	
2,498.00	0.796	2.159	0.000	
2,498.50	0.822	2.564	0.000	
2,499.00	0.849	2.982	0.000	Spillway #1
2,499.50	0.876	3.413	4.145	
2,500.00	0.903	3.857	55.544	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,495.00	0.000	0.000
2,495.50	0.000	0.000
2,496.00	0.000	0.000
2,496.50	0.000	0.000
2,497.00	0.000	0.000
2,497.50	0.000	0.000
2,498.00	0.000	0.000
2,498.50	0.000	0.000
2,499.00	0.000	0.000
2,499.50	4.145	4.145
2,500.00	55.544	55.544

# **Pond 2**

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

***General Information***

***Storm Information:***

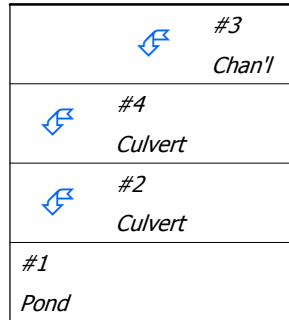
Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.100 inches

***Particle Size Distribution:***

Size (mm)	Silt Loam
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Emergency Spillway
Culvert	#2	==>	#1	0.000	0.000	Northern Ditch and CC #4
Channel	#3	==>	#4	0.000	0.000	Southern Ditch
Culvert	#4	==>	#1	0.000	0.000	CC #5





***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	472.160	472.160	181.90	39.72	597.5	21,201	2.26	1.17
#4	0.000	472.160	181.90	39.72	597.5	21,201	2.26	1.17
#2	67.430	67.430	42.96	5.23	8.2	2,338	0.42	0.21
#1 In	7.500	547.090	186.96	45.41	605.8	20,641	2.22	1.05
#1 Out			0.00	0.00	605.8	0	0.00	0.00

**Particle Size Distribution(s) at Each Structure**

**Structure #3 (Southern Ditch):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	100.000%
0.2500	100.000%
0.1250	100.000%
0.0630	100.000%
0.0160	99.881%
0.0040	61.885%
0.0010	0.000%

**Structure #4 (CC #5):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	100.000%
0.2500	100.000%
0.1250	100.000%
0.0630	100.000%
0.0160	99.881%
0.0040	61.885%
0.0010	0.000%

**Structure #2 (Northern Ditch and CC #4):**

Size (mm)	In/Out
2.0000	100.000%
1.0000	100.000%
0.5000	99.122%
0.2500	98.025%
0.1250	97.147%
0.0630	96.050%
0.0160	91.221%

Size (mm)	In/Out
0.0040	52.114%
0.0010	0.000%

***Structure #1:***

Size (mm)	In	Out
2.0000	100.000%	0.000%
1.0000	100.000%	0.000%
0.5000	100.000%	0.000%
0.2500	100.000%	0.000%
0.1250	100.000%	0.000%
0.0630	100.000%	0.000%
0.0160	99.762%	0.000%
0.0040	61.751%	0.000%
0.0010	0.000%	0.000%

### Structure Detail:

Structure #3 (Erodible Channel)

*Southern Ditch*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	4.0:1	4.0:1	0.5	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	181.90 cfs	
Depth:	2.03 ft	2.33 ft
Top Width:	28.27 ft	30.67 ft
Velocity:	4.44 fps	
X-Section Area:	40.94 sq ft	
Hydraulic Radius:	1.423 ft	
Froude Number:	0.65	

Structure #4 (Culvert)

*CC #5*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
132.00	1.50	0.0240	5.00	0.00	0.90

Culvert Results:

Design Discharge = 181.90 cfs

Minimum pipe diameter: 1 - 96 inch pipe(s) required

Structure #2 (Culvert)

*Northern Ditch and CC #4*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
135.00	1.00	0.0240	3.50	0.00	0.90

Culvert Results:

Design Discharge = 42.96 cfs

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

Structure #1 (Pond)

*Emergency Spillway*

Pond Inputs:

Initial Pool Elev:	2,502.75 ft
Initial Pool:	2.79 ac-ft
*Sediment Storage:	1.09 ac-ft
Dead Space:	0.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,511.80	30.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	2,511.24 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

*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)
2,502.21	5.167	0.000	0.000	Top of Sed. Storage
2,502.35	5.172	0.723	0.000	
2,502.40	5.173	0.981	0.000	
2,502.50	5.177	1.499	0.000	
2,502.75	5.185	2.794	0.000	
2,503.00	5.193	4.091	0.000	
2,503.50	5.210	6.692	0.000	
2,504.00	5.227	9.301	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
2,504.50	5.244	11.919	0.000	
2,505.00	5.260	14.545	0.000	
2,505.50	5.277	17.179	0.000	
2,506.00	5.294	19.822	0.000	
2,506.50	5.311	22.474	0.000	
2,507.00	5.328	25.133	0.000	
2,507.50	5.345	27.802	0.000	
2,508.00	5.362	30.478	0.000	
2,508.50	5.379	33.163	0.000	
2,509.00	5.396	35.857	0.000	
2,509.50	5.413	38.559	0.000	
2,510.00	5.430	41.270	0.000	
2,510.50	5.525	44.009	0.000	
2,511.00	5.621	46.795	0.000	
2,511.24	5.669	48.180	0.000	0.00 Peak Stage
2,511.50	5.718	49.630	0.000	
2,511.80	5.777	51.355	0.000	Spillway #1
2,512.00	5.816	52.514	6.554	
2,512.50	5.915	55.447	22.942	
2,513.00	6.014	58.429	64.824	
2,513.50	6.114	61.461	123.820	
2,514.00	6.215	64.543	195.344	
2,514.50	6.317	67.677	286.475	
2,515.00	6.420	70.861	396.619	

### Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,502.21	0.000	0.000
2,502.35	0.000	0.000
2,502.40	0.000	0.000
2,502.50	0.000	0.000
2,502.75	0.000	0.000
2,503.00	0.000	0.000
2,503.50	0.000	0.000
2,504.00	0.000	0.000
2,504.50	0.000	0.000
2,505.00	0.000	0.000
2,505.50	0.000	0.000
2,506.00	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,506.50	0.000	0.000
2,507.00	0.000	0.000
2,507.50	0.000	0.000
2,508.00	0.000	0.000
2,508.50	0.000	0.000
2,509.00	0.000	0.000
2,509.50	0.000	0.000
2,510.00	0.000	0.000
2,510.50	0.000	0.000
2,511.00	0.000	0.000
2,511.50	0.000	0.000
2,511.80	0.000	0.000
2,512.00	6.554	6.554
2,512.50	22.942	22.942
2,513.00	64.824	64.824
2,513.50	123.820	123.820
2,514.00	195.344	195.344
2,514.50	286.475	286.475
2,515.00	396.619	396.619

# S Heart CC-5 Alternative Culvert Sizing 10-6 Storm 181.9 cfs - (2) 60" Culverts

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
132.00	1.50	0.0240	4.50	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 60 inch pipe(s) required

## ***Detailed Performance Curves***

Design Discharge = 90.81 cfs

Maximum Headwater = 4.50 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) ( 54 in)	<b>Discharge (cfs) ( 60 in)</b>	Discharge (cfs) ( 66 in)
0.45	2.85	<b>3.16</b>	3.48
0.90	8.05	<b>8.94</b>	9.83
1.35	14.78	<b>16.42</b>	18.06
1.80	22.76	<b>25.28</b>	27.81
2.25	31.80	<b>35.34</b>	38.87
2.70	41.80	<b>46.45</b>	51.09
3.15	52.68	<b>58.53</b>	64.38
3.60	64.36	<b>71.51</b>	78.66
4.05	76.80	<b>85.33</b>	93.86
4.50	89.94	<b>99.94</b>	109.93
4.95	98.79	<b>115.30</b>	126.83
5.40	100.99	<b>131.37</b>	144.51
5.85	127.84	<b>135.30</b>	162.94
6.30	138.24	<b>141.68</b>	177.02
6.75	145.05	<b>173.37</b>	179.73



### ***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)
#3	1	82.870	0.450	2.247	0.230	74.000	M	40.47	5.351
	2	78.460	0.265	2.222	0.222	82.000	M	73.38	7.633
	3	91.300	0.160	1.908	0.227	81.000	M	91.53	8.599
	4	96.160	0.337	1.748	0.142	82.000	M	83.53	9.351
	5	71.390	0.711	0.715	0.176	77.000	M	33.18	5.405
	6	38.070	0.402	0.000	0.000	74.000	M	19.56	2.465
	7	13.910	0.168	0.000	0.000	74.000	M	9.64	0.916
	<b>Σ</b>	<b>472.160</b>						<b>181.90</b>	<b>39.719</b>
<b>#4</b>	<b>Σ</b>	<b>472.160</b>						<b>181.90</b>	<b>39.719</b>
#2	1	46.480	0.279	0.124	0.301	77.000	M	32.95	3.536
	2	20.950	0.124	0.000	0.000	74.000	M	23.17	1.695
	<b>Σ</b>	<b>67.430</b>						<b>42.96</b>	<b>5.232</b>
#1	1	7.500	0.311	0.000	0.000	73.000	M	3.98	0.459
	<b>Σ</b>	<b>547.090</b>						<b>186.96</b>	<b>45.411</b>

### ***Subwatershed Sedimentology Detail:***

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#3	1	0.370	188.50	6.10	0.0120	1.0000	1	10.0	2,296	0.37	0.22
	2	0.370	160.00	2.10	0.9500	1.0000	1	393.0	62,351	16.19	9.64
	3	0.370	415.00	6.00	0.0700	1.0000	1	173.1	25,260	7.33	4.26
	4	0.370	409.00	4.90	0.1000	1.0000	1	203.4	26,540	6.30	3.77
	5	0.370	353.00	5.70	0.0420	1.0000	1	40.3	9,230	1.09	0.65
	6	0.370	387.00	5.20	0.0130	1.0000	1	5.7	3,164	0.57	0.31
	7	0.370	78.00	6.40	0.0130	1.0000	1	1.2	1,894	0.52	0.26
	<b>Σ</b>							<b>597.5</b>	<b>21,201</b>	<b>2.26</b>	<b>1.17</b>
<b>#4</b>	<b>Σ</b>							<b>597.5</b>	<b>21,201</b>	<b>2.26</b>	<b>1.17</b>
#2	1	0.370	610.00	1.50	0.0420	1.0000	1	8.0	3,115	0.74	0.40
	2	0.370	343.00	2.90	0.0130	1.0000	1	1.8	1,604	0.63	0.31
	<b>Σ</b>							<b>8.2</b>	<b>2,338</b>	<b>0.42</b>	<b>0.21</b>
#1	1	0.320	224.00	0.60	0.0120	1.0000	1	0.1	215	0.04	0.02
	<b>Σ</b>							<b>605.8</b>	<b>20,641</b>	<b>2.22</b>	<b>1.05</b>

### ***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	0.59	4.00	683.06	0.610	0.311
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.311</b>
#2	1	5. Nearly bare and untilled, and alluvial valley fans	2.38	8.00	335.82	1.540	0.060
		7. Paved area and small upland gullies	1.88	41.00	2,177.00	2.760	0.219
<b>#2</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.279</b>
#2	2	7. Paved area and small upland gullies	1.64	19.00	1,155.68	2.580	0.124
<b>#2</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.124</b>
#3	1	3. Short grass pasture	6.10	23.00	377.00	1.970	0.053
		6. Grassed waterway	1.88	55.00	2,929.90	2.050	0.397
<b>#3</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.450</b>
#3	2	5. Nearly bare and untilled, and alluvial valley fans	16.60	30.00	180.70	4.070	0.012
		7. Paved area and small upland gullies	2.08	55.00	2,645.00	2.900	0.253
<b>#3</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.265</b>
#3	3	5. Nearly bare and untilled, and alluvial valley fans	3.29	20.00	607.00	1.810	0.093
		7. Paved area and small upland gullies	1.02	5.00	490.00	2.030	0.067
<b>#3</b>	<b>3</b>	<b>Time of Concentration:</b>					<b>0.160</b>
#3	4	3. Short grass pasture	3.98	10.00	251.00	1.590	0.043
		5. Nearly bare and untilled, and alluvial valley fans	1.67	15.00	898.04	1.290	0.193
		7. Paved area and small upland gullies	0.26	1.00	378.07	1.030	0.101
<b>#3</b>	<b>4</b>	<b>Time of Concentration:</b>					<b>0.337</b>
#3	5	3. Short grass pasture	0.70	3.50	497.00	0.670	0.206
		7. Paved area and small upland gullies	2.55	37.50	1,471.00	3.210	0.127
		7. Paved area and small upland gullies	0.23	3.00	1,308.00	0.960	0.378
<b>#3</b>	<b>5</b>	<b>Time of Concentration:</b>					<b>0.711</b>
#3	6	3. Short grass pasture	5.17	20.00	387.00	1.810	0.059
		7. Paved area and small upland gullies	2.61	15.00	575.00	3.250	0.049
		7. Paved area and small upland gullies	0.38	5.00	1,316.00	1.240	0.294
<b>#3</b>	<b>6</b>	<b>Time of Concentration:</b>					<b>0.402</b>
#3	7	3. Short grass pasture	3.56	17.00	478.00	1.500	0.088
		7. Paved area and small upland gullies	1.78	13.79	775.00	2.680	0.080
<b>#3</b>	<b>7</b>	<b>Time of Concentration:</b>					<b>0.168</b>

***Subwatershed Muskingum Routing Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	7. Paved area and small upland gullies	1.64	19.00	1,155.68	2.580	0.124
<b>#2</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.124</b>
#3	1	7. Paved area and small upland gullies	3.10	10.00	323.00	3.540	0.025
		7. Paved area and small upland gullies	0.26	3.00	1,156.00	1.020	0.314
		7. Paved area and small upland gullies	7.41	52.00	702.00	5.470	0.035
		7. Paved area and small upland gullies	0.40	7.00	1,731.00	1.270	0.378
		7. Paved area and small upland gullies	0.11	2.00	1,855.00	0.660	0.780
		7. Paved area and small upland gullies	0.21	5.00	2,370.00	0.920	0.715
<b>#3</b>	<b>1</b>	<b>Muskingum K:</b>					<b>2.247</b>
#3	2	7. Paved area and small upland gullies	0.26	3.00	1,156.06	1.020	0.314
		7. Paved area and small upland gullies	7.41	52.00	702.00	5.470	0.035
		7. Paved area and small upland gullies	0.40	7.00	1,731.00	1.270	0.378
		7. Paved area and small upland gullies	0.11	2.00	1,855.00	0.660	0.780
		7. Paved area and small upland gullies	0.21	5.00	2,370.00	0.920	0.715
<b>#3</b>	<b>2</b>	<b>Muskingum K:</b>					<b>2.222</b>
#3	3	7. Paved area and small upland gullies	7.41	52.00	702.00	5.470	0.035
		7. Paved area and small upland gullies	0.40	7.00	1,731.00	1.270	0.378
		7. Paved area and small upland gullies	0.11	2.00	1,855.00	0.660	0.780
		7. Paved area and small upland gullies	0.21	5.00	2,370.00	0.920	0.715
<b>#3</b>	<b>3</b>	<b>Muskingum K:</b>					<b>1.908</b>
#3	4	7. Paved area and small upland gullies	0.11	2.00	1,855.28	0.660	0.780
		6. Grassed waterway	0.21	5.00	2,370.79	0.680	0.968
<b>#3</b>	<b>4</b>	<b>Muskingum K:</b>					<b>1.748</b>
#3	5	7. Paved area and small upland gullies	0.21	5.00	2,370.79	0.920	0.715
<b>#3</b>	<b>5</b>	<b>Muskingum K:</b>					<b>0.715</b>

# **Pond #2 South**

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	3.550 inches

***Particle Size Distribution:***

Size (mm)	Silt Loam
2.0000	100.000%
1.0000	100.000%
0.5000	96.000%
0.2500	91.000%
0.1250	87.000%
0.0630	82.000%
0.0160	60.000%
0.0040	33.000%
0.0010	0.000%

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	472.160	472.160	313.33	50.46	910.6	20,886	2.06	1.30
#4	0.000	472.160	313.33	50.46	910.6	20,886	2.06	1.30
#2	67.430	67.430	76.74	6.77	13.0	2,305	0.40	0.25
#1 In	7.500	547.090	322.92	57.83	923.7	20,289	2.02	1.16
#1 Out			34.42	9.24	0.4	63	0.00	0.00

## ***Structure Detail:***

### *Structure #3 (Erodible Channel)*

#### *Southern Ditch*

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	4.0:1	4.0:1	0.5	0.0300	0.30			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	313.33 cfs	
Depth:	2.67 ft	2.97 ft
Top Width:	33.39 ft	35.79 ft
Velocity:	5.16 fps	
X-Section Area:	60.69 sq ft	
Hydraulic Radius:	1.782 ft	
Froude Number:	0.67	

### *Structure #4 (Culvert)*

#### *CC #5*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
132.00	1.50	0.0240	10.20	0.00	0.90

Culvert Results:

Design Discharge = 313.33 cfs

Minimum pipe diameter: 1 - 72 inch pipe(s) required

### *Structure #2 (Culvert)*

#### *Northern Ditch and CC #4*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
135.00	1.00	0.0240	9.60	0.00	0.90

Culvert Results:

Design Discharge = 76.74 cfs

Minimum pipe diameter: 1 - 42 inch pipe(s) required

Structure #1 (Pond)

*Emergency Spillway*

Pond Inputs:

Initial Pool Elev:	2,502.75 ft
Initial Pool:	2.65 ac-ft
*Sediment Storage:	1.23 ac-ft
Dead Space:	0.00 %

*\*Sediment capacity based on Average Annual R of 50.0 for 3 year(s)*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
2,511.80	30.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	2,512.64 ft
H'graph Detention Time:	4.03 hrs
Pond Model:	CSTRS
Dewater Time:	0.79 days
Trap Efficiency:	99.96 %

*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)
2,502.24	5.168	0.000	0.000	Top of Sed. Storage
2,502.35	5.172	0.574	0.000	
2,502.40	5.173	0.832	0.000	
2,502.50	5.177	1.350	0.000	
2,502.75	5.185	2.645	0.000	
2,503.00	5.193	3.942	0.000	
2,503.50	5.210	6.543	0.000	
2,504.00	5.227	9.153	0.000	



Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
2,504.50	5.244	11.770	0.000	
2,505.00	5.260	14.396	0.000	
2,505.50	5.277	17.031	0.000	
2,506.00	5.294	19.673	0.000	
2,506.50	5.311	22.325	0.000	
2,507.00	5.328	24.984	0.000	
2,507.50	5.345	27.653	0.000	
2,508.00	5.362	30.329	0.000	
2,508.50	5.379	33.015	0.000	
2,509.00	5.396	35.708	0.000	
2,509.50	5.413	38.410	0.000	
2,510.00	5.430	41.121	0.000	
2,510.50	5.525	43.860	0.000	
2,511.00	5.621	46.647	0.000	
2,511.50	5.718	49.482	0.000	
2,511.80	5.777	51.206	0.000	Spillway #1
2,512.00	5.816	52.365	6.554	15.35
2,512.50	5.915	55.298	22.942	2.80
2,512.64	5.942	56.115	34.417	0.85 Peak Stage
2,513.00	6.014	58.280	64.824	
2,513.50	6.114	61.312	123.820	
2,514.00	6.215	64.395	195.344	
2,514.50	6.317	67.528	286.475	
2,515.00	6.420	70.712	396.619	

### Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,502.24	0.000	0.000
2,502.35	0.000	0.000
2,502.40	0.000	0.000
2,502.50	0.000	0.000
2,502.75	0.000	0.000
2,503.00	0.000	0.000
2,503.50	0.000	0.000
2,504.00	0.000	0.000
2,504.50	0.000	0.000
2,505.00	0.000	0.000
2,505.50	0.000	0.000
2,506.00	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
2,506.50	0.000	0.000
2,507.00	0.000	0.000
2,507.50	0.000	0.000
2,508.00	0.000	0.000
2,508.50	0.000	0.000
2,509.00	0.000	0.000
2,509.50	0.000	0.000
2,510.00	0.000	0.000
2,510.50	0.000	0.000
2,511.00	0.000	0.000
2,511.50	0.000	0.000
2,511.80	0.000	0.000
2,512.00	6.554	6.554
2,512.50	22.942	22.942
2,513.00	64.824	64.824
2,513.50	123.820	123.820
2,514.00	195.344	195.344
2,514.50	286.475	286.475
2,515.00	396.619	396.619

# S Heart CC#5 Alternative Culvert Sizing 100-6 Storm 313.33 cfs - (2) 60" Culverts

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
132.00	1.50	0.0240	6.50	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 60 inch pipe(s) required

## ***Detailed Performance Curves***

Design Discharge = 156.67 cfs

Maximum Headwater = 6.50 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) ( 54 in)	<b>Discharge (cfs) ( 60 in)</b>	Discharge (cfs) ( 66 in)
0.65	4.94	<b>5.49</b>	6.04
1.30	13.97	<b>15.52</b>	17.07
1.95	25.66	<b>28.51</b>	31.36
2.60	39.50	<b>43.89</b>	48.28
3.25	55.21	<b>61.34</b>	67.47
3.90	72.57	<b>80.63</b>	88.70
4.55	91.45	<b>101.61</b>	111.77
5.20	99.53	<b>124.14</b>	136.56
5.85	127.82	<b>136.58</b>	162.95
6.50	141.29	<b>166.35</b>	180.73
7.15	150.83	<b>184.07</b>	188.14
7.80	159.82	<b>196.67</b>	231.63
8.45	168.31	<b>207.91</b>	249.79
9.10	176.39	<b>218.58</b>	263.52
9.75	184.14	<b>228.75</b>	276.56

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# Explosives Storage Area

## *Bermed Small Area Exemption*

C BEGEJ

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950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

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***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	4.500 inches

***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	berm

#1 Chan'l
--------------

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.420	5.420	17.82	1.67

### Structure Detail:

Structure #1 (Erodible Channel)

berm

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	5.0	0.0250	0.50			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.82 cfs	
Depth:	0.26 ft	0.76 ft
Top Width:	13.59 ft	16.59 ft
Velocity:	5.26 fps	
X-Section Area:	3.39 sq ft	
Hydraulic Radius:	0.248 ft	
Froude Number:	1.86	



***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	5.420	0.100	0.000	0.000	93.000	M	17.82	1.673
	<b>Σ</b>	<b>5.420</b>						<b>17.82</b>	<b>1.673</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	33.00	28.05	85.00	5.740	0.004
		7. Paved area and small upland gullies	2.14	22.00	1,026.00	2.940	0.096
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.100</b>

# OVB-1

## *Bermed Small Area Exemption*

*2014-2015*

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

## ***General Information***

### ***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	4.500 inches

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Null
Channel	#2	==>	#1	0.000	0.000	N Side of OBD Pile
Channel	#3	==>	#4	0.000	0.000	SW
Culvert	#4	==>	#5	0.000	0.000	Culvert below ramp
Channel	#5	==>	#1	0.000	0.000	SWS above ramp & SE



***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	4.350	4.350	9.47	1.11
#4	0.000	4.350	9.47	1.11
#5	4.310	8.660	20.01	2.25
#2	17.890	17.890	29.05	4.53
#1	0.000	26.550	45.82	6.78

### Structure Detail:

Structure #3 (Erodible Channel)

SW

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	0.2	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	9.47 cfs	
Depth:	0.47 ft	0.77 ft
Top Width:	14.83 ft	16.63 ft
Velocity:	1.50 fps	
X-Section Area:	6.32 sq ft	
Hydraulic Radius:	0.422 ft	
Froude Number:	0.40	

Structure #4 (Culvert)

*Culvert below ramp*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	0.20	0.0240	2.00	1.00	0.90

Culvert Results:

Design Discharge = 9.47 cfs

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

Structure #5 (Erodible Channel)

*SWS above ramp & SE*

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
14.00	3.0:1	3.0:1	5.7	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.01 cfs	
Depth:	0.25 ft	0.55 ft
Top Width:	15.50 ft	17.30 ft
Velocity:	5.44 fps	
X-Section Area:	3.68 sq ft	
Hydraulic Radius:	0.236 ft	
Froude Number:	1.97	

Structure #2 (Erodible Channel)

*N Side of OBD Pile*

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	0.2	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	29.05 cfs	
Depth:	0.90 ft	1.20 ft
Top Width:	17.40 ft	19.20 ft
Velocity:	2.20 fps	
X-Section Area:	13.23 sq ft	
Hydraulic Radius:	0.748 ft	
Froude Number:	0.44	

Structure #1 (Erodible Channel)

*Null*

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	0.2	0.0250	0.30			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	45.82 cfs	
Depth:	1.16 ft	1.46 ft
Top Width:	18.98 ft	20.78 ft
Velocity:	2.54 fps	
X-Section Area:	18.03 sq ft	
Hydraulic Radius:	0.931 ft	
Froude Number:	0.46	



### *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)
#3	1	4.350	0.337	0.000	0.000	94.000	M	9.47	1.107
	<b>Σ</b>	<b>4.350</b>						<b>9.47</b>	<b>1.107</b>
<b>#4</b>	<b>Σ</b>	<b>4.350</b>						<b>9.47</b>	<b>1.107</b>
#5	1	0.660	0.011	0.241	0.245	94.000	M	2.20	0.209
	2	3.650	0.249	0.000	0.000	94.000	M	8.40	0.932
	<b>Σ</b>	<b>8.660</b>						<b>20.01</b>	<b>2.248</b>
#2	1	17.890	0.689	0.000	0.000	94.000	M	29.05	4.530
	<b>Σ</b>	<b>17.890</b>						<b>29.05</b>	<b>4.530</b>
<b>#1</b>	<b>Σ</b>	<b>26.550</b>						<b>45.82</b>	<b>6.778</b>

### *Subwatershed Time of Concentration Details:*

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	50.00	89.00	178.00	7.070	0.006
		7. Paved area and small upland gullies	0.20	4.43	2,215.80	0.900	0.683
<b>#2</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.689</b>
#3	1	5. Nearly bare and untilled, and alluvial valley fans	50.00	89.00	178.00	7.070	0.006
		7. Paved area and small upland gullies	0.20	2.14	1,074.00	0.900	0.331
<b>#3</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.337</b>
#5	1	7. Paved area and small upland gullies	22.70	89.00	392.00	9.590	0.011
<b>#5</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.011</b>
#5	2	5. Nearly bare and untilled, and alluvial valley fans	43.63	89.00	204.00	6.600	0.008
		7. Paved area and small upland gullies	0.20	0.99	498.00	0.900	0.153
		7. Paved area and small upland gullies	5.85	10.00	171.00	4.860	0.009
		7. Paved area and small upland gullies	0.20	0.51	256.00	0.900	0.079
<b>#5</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.249</b>

### *Subwatershed Muskingum Routing Details:*

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	0.20	0.99	498.00	0.900	0.153
		7. Paved area and small upland gullies	5.85	10.00	171.00	4.860	0.009
		7. Paved area and small upland gullies	0.20	0.51	256.00	0.900	0.079
<b>#5</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.241</b>

# **SOVB 10**

*Bermed Small Area Exemption*

*2019-2022*

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

## ***General Information***

### ***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	4.500 inches

***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	berm

#1 Chan'l
--------------

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.420	5.420	17.82	1.67

## *Structure Detail:*

### Structure #1 (Erodible Channel)

*berm*

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	5.0	0.0250	0.50			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.82 cfs	
Depth:	0.26 ft	0.76 ft
Top Width:	13.59 ft	16.59 ft
Velocity:	5.26 fps	
X-Section Area:	3.39 sq ft	
Hydraulic Radius:	0.248 ft	
Froude Number:	1.86	

***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	5.420	0.100	0.000	0.000	93.000	M	17.82	1.673
	<b>Σ</b>	<b>5.420</b>						<b>17.82</b>	<b>1.673</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	33.00	28.05	85.00	5.740	0.004
		7. Paved area and small upland gullies	2.14	22.00	1,026.00	2.940	0.096
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.100</b>



# **SPGM 9 &10**

## ***Bermed Small Area Exemption***

***2014-2016***

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

## ***General Information***

### ***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	4.500 inches

***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	berm

#1  
Chan'

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.329	6.329	21.05	2.01

## **Structure Detail:**

### Structure #1 (Erodible Channel)

*berm*

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	3.8	0.0250	0.50			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	21.05 cfs	
Depth:	0.32 ft	0.82 ft
Top Width:	13.90 ft	16.90 ft
Velocity:	5.13 fps	
X-Section Area:	4.11 sq ft	
Hydraulic Radius:	0.293 ft	
Froude Number:	1.66	

***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	6.329	0.122	0.000	0.000	94.000	M	21.05	2.011
	<b>Σ</b>	<b>6.329</b>						<b>21.05</b>	<b>2.011</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	50.00	32.00	64.00	7.070	0.002
		7. Paved area and small upland gullies	3.80	64.60	1,700.00	3.920	0.120
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.122</b>

# **SPGM 13**

*Bermed Small Area Exemption*

*2018-2020*

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

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***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	4.500 inches



***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	berm

#1 Chan'l
--------------

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.570	2.570	8.22	0.75

### Structure Detail:

Structure #1 (Erodible Channel)

berm

Trapezoidal Erodible Channel Inputs:

Material: Alluvial silts colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	5.0	0.0250	0.50			5.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.22 cfs	
Depth:	0.17 ft	0.67 ft
Top Width:	13.00 ft	16.00 ft
Velocity:	3.93 fps	
X-Section Area:	2.09 sq ft	
Hydraulic Radius:	0.160 ft	
Froude Number:	1.73	

***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	0.072	0.000	0.000	91.000	M	8.22	0.748
	<b>Σ</b>	<b>2.570</b>						<b>8.22</b>	<b>0.748</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	33.00	27.72	84.00	5.740	0.004
		7. Paved area and small upland gullies	1.59	10.00	627.00	2.540	0.068
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.072</b>

# **CC#8**

## ***Explosives Storage Access Road East Culvert***

### ***10-year 24-hour Storm***

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

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***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.100 inches

***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#1	==>	End	0.000	0.000	

#1 Culvert
---------------

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	40.590	40.590	56.33	5.88



## ***Structure Detail:***

### *Structure #1 (Culvert)*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
25.00	2.00	0.0240	3.70	0.00	0.90

Culvert Results:

Design Discharge = 56.33 cfs

Minimum pipe diameter: 1 - 48 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	40.590	0.194	0.247	0.339	91.000	M	59.11	5.875
	<b>Σ</b>	<b>40.590</b>						<b>56.33</b>	<b>5.875</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.61	20.00	434.00	2.140	0.056
		7. Paved area and small upland gullies	2.52	40.00	1,590.00	3.190	0.138
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.194</b>

***Subwatershed Muskingum Routing 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	11.11	52.00	468.00	6.700	0.019
		7. Paved area and small upland gullies	2.22	55.00	2,472.00	3.000	0.228
<b>#1</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.247</b>

# **CC#9**

## ***Explosives Storage Access Road West Culvert***

### ***10-year 24-hour Storm***

C BEGEJ

Norwest Corporation  
950 S. Cherry Suite 800  
Denver, CO 80246

Phone: 303-782-0164  
Email: cbegej@norwestcorp.com

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***General Information***

***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.100 inches

***Structure Networking:***

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#1	==>	End	0.000	0.000	

#1 Culvert
---------------

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	113.443	113.443	148.49	15.69

## ***Structure Detail:***

### *Structure #1 (Culvert)*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
25.00	2.00	0.0240	5.50	0.00	0.90

Culvert Results:

Design Discharge = 148.49 cfs

Minimum pipe diameter: 1 - 66 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	10.933	0.060	0.247	0.339	74.000	M	12.09	0.885
	2	102.510	0.267	0.000	0.000	91.000	M	138.71	14.804
	<b>Σ</b>	<b>113.443</b>						<b>148.49</b>	<b>15.689</b>

***Subwatershed Time of Concentration Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	6. Grassed waterway	8.89	57.00	641.00	4.470	0.039
		7. Paved area and small upland gullies	10.19	50.00	490.60	6.420	0.021
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.060</b>
#1	2	5. Nearly bare and untilled, and alluvial valley fans	11.11	52.00	468.00	3.330	0.039
		7. Paved area and small upland gullies	2.22	55.00	2,472.00	3.000	0.228
<b>#1</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.267</b>

***Subwatershed Muskingum Routing 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	11.11	52.00	468.00	6.700	0.019
		7. Paved area and small upland gullies	2.22	55.00	2,472.00	3.000	0.228
<b>#1</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.247</b>



# **Culvert 70+51 DD-2 and DD-3**

C Begej

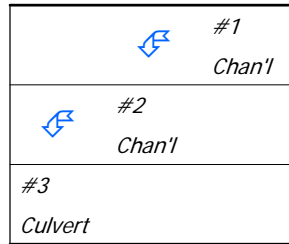
## ***General Information***

### ***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	4.500 inches

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#2	0.188	0.317	SW1 & DD3
Channel	#2	==>	#3	0.000	0.000	SW2 & DD2
Culvert	#3	==>	End	0.000	0.000	Culvert CVT70+51



### Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.97	19.44	2,005.00	2.95	0.188
#1	<b>Muskingum K:</b>					<b>0.188</b>

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	796.440	796.440	406.93	125.54
#2	158.540	954.980	449.05	146.28
#3	0.000	954.980	449.05	146.28

## Structure Detail:

### Structure #1 (Erodible Channel)

SW1 & DD3

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	0.3	0.0300				5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	406.93 cfs	
Depth:	3.56 ft	
Top Width:	33.39 ft	
Velocity:	5.03 fps	
X-Section Area:	80.88 sq ft	
Hydraulic Radius:	2.342 ft	
Froude Number:	0.57	

### Structure #2 (Riprap Channel)

SW2 & DD2

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	3.0:1	3.0:1	0.9			

Riprap Channel Results:

PADER Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	449.05 cfs	
Depth:	3.18 ft	
Top Width:	31.10 ft	
Velocity:	6.55 fps	
X-Section Area:	68.60 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	2.135 ft	
Froude Number:	0.78	
Manning's n:	0.0360	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Structure #3 (Culvert)

*Culvert CVT70+51*

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
132.00	0.30	0.0240	11.50	2.00	0.90

Culvert Results:

Design Discharge = 449.05 cfs

Minimum pipe diameter: 1 - 96 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	782.040	2.905	0.311	0.251	79.000	M	406.54	123.256
	2	14.400	0.354	0.000	0.000	79.000	M	28.03	2.281
	<b>Σ</b>	<b>796.440</b>						<b>406.93</b>	<b>125.537</b>
#2	1	144.240	1.306	0.188	0.317	74.000	M	109.43	18.871
	2	14.300	0.373	0.000	0.000	74.000	M	22.44	1.873
	<b>Σ</b>	<b>954.980</b>						<b>449.05</b>	<b>146.281</b>
#3	<b>Σ</b>	<b>954.980</b>						<b>449.05</b>	<b>146.281</b>

### 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	2.34	75.10	3,205.70	1.220	0.729
		6. Grassed waterway	0.58	44.90	7,690.99	1.140	1.874
		8. Large gullies, diversions, and low flowing streams	0.33	6.17	1,872.00	1.720	0.302
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>2.905</b>
#1	2	3. Short grass pasture	2.61	12.60	483.30	1.290	0.104
		8. Large gullies, diversions, and low flowing streams	0.33	5.11	1,550.00	1.720	0.250
<b>#1</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.354</b>
#2	1	3. Short grass pasture	9.01	78.19	868.00	2.400	0.100
		6. Grassed waterway	2.78	82.10	2,951.00	2.500	0.327
		8. Large gullies, diversions, and low flowing streams	0.28	10.00	3,598.41	1.580	0.632
		8. Large gullies, diversions, and low flowing streams	0.20	2.39	1,195.00	1.340	0.247
<b>#2</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>1.306</b>
#2	2	3. Short grass pasture	1.98	4.00	202.00	1.120	0.050
		8. Large gullies, diversions, and low flowing streams	0.33	6.61	2,005.00	1.720	0.323
<b>#2</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>0.373</b>

### Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.33	6.36	1,930.00	1.720	0.311

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
<b>#1</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.311</b>
#2	1	8. Large gullies, diversions, and low flowing streams	0.97	19.44	2,005.00	2.950	0.188
<b>#2</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.188</b>



# Culvert 55+75 and West Tributary Diversion DD-1

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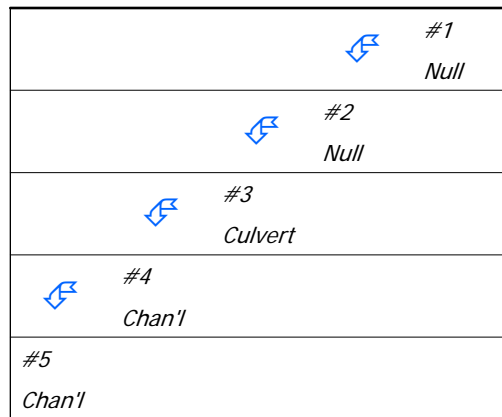
## ***General Information***

### ***Storm Information:***

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	4.500 inches

### Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.370	0.285	Western Block W & E
Null	#2	==>	#3	0.139	0.254	Central Pit Area
Culvert	#3	==>	#4	0.336	0.220	Area above culvert
Channel	#4	==>	#5	0.780	0.279	DD-1B
Channel	#5	==>	End	0.000	0.000	DD-1A



### Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.57	17.00	3,000.00	2.25	0.370
<b>#1</b>	<b>Muskingum K:</b>					<b>0.370</b>
#2	8. Large gullies, diversions, and low flowing streams	0.34	3.00	876.00	1.75	0.139
<b>#2</b>	<b>Muskingum K:</b>					<b>0.139</b>
#3	8. Large gullies, diversions, and low flowing streams	0.20	3.25	1,625.00	1.34	0.336
<b>#3</b>	<b>Muskingum K:</b>					<b>0.336</b>
#4	8. Large gullies, diversions, and low flowing streams	0.51	30.65	6,011.00	2.14	0.780
<b>#4</b>	<b>Muskingum K:</b>					<b>0.780</b>

***Structure Summary:***

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1,041.020	1,041.020	649.89	165.28
#2	229.600	1,270.620	712.91	196.57
#3	56.500	1,327.120	721.22	203.97
#4	0.000	1,327.120	697.99	203.97
#5	28.200	1,355.320	672.12	207.82

### Structure Detail:

Structure #1 (Null)

Western Block W & E

Structure #2 (Null)

Central Pit Area

Structure #3 (Culvert)

Area above culvert

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
132.00	0.30	0.0240	11.50	2.00	0.90

Culvert Results:

Design Discharge = 721.22 cfs

Minimum pipe diameter: 1 - 120 inch pipe(s) required

Structure #4 (Erodible Channel)

DD-1B

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	3.0:1	3.0:1	0.2	0.0300				5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	697.99 cfs	
Depth:	5.22 ft	
Top Width:	43.33 ft	
Velocity:	4.83 fps	
X-Section Area:	144.46 sq ft	
Hydraulic Radius:	3.208 ft	
Froude Number:	0.47	

Structure #5 (Riprap Channel)

DD-1A

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	3.0:1	3.0:1	0.5			

Riprap Channel Results:

PADER Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	672.12 cfs	
Depth:	4.23 ft	
Top Width:	37.37 ft	
Velocity:	6.44 fps	
X-Section Area:	104.39 sq ft	
Hydraulic Radius:	2.694 ft	
Froude Number:	0.68	
Manning's n:	0.0320	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

### 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	325.000	0.421	0.727	0.287	79.550	M	602.88	52.436
	2	716.020	4.034	0.000	0.000	79.000	M	288.85	112.843
	<b>Σ</b>	<b>1,041.020</b>						<b>649.89</b>	<b>165.280</b>
#2	1	229.600	0.515	0.000	0.000	75.000	M	323.52	31.290
	<b>Σ</b>	<b>1,270.620</b>						<b>712.91</b>	<b>196.570</b>
#3	1	56.500	0.842	0.000	0.000	74.000	M	57.30	7.398
	<b>Σ</b>	<b>1,327.120</b>						<b>721.22</b>	<b>203.968</b>
<b>#4</b>	<b>Σ</b>	<b>1,327.120</b>						<b>697.99</b>	<b>203.968</b>
#5	1	28.200	0.211	0.000	0.000	75.000	M	55.53	3.850
	<b>Σ</b>	<b>1,355.320</b>						<b>672.12</b>	<b>207.818</b>

### 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	3.98	10.00	251.00	1.590	0.043
		5. Nearly bare and untilled, and alluvial valley fans	5.79	35.00	604.00	2.400	0.069
		7. Paved area and small upland gullies	1.91	35.00	1,831.00	2.780	0.182
		8. Large gullies, diversions, and low flowing streams	1.36	22.00	1,612.00	3.500	0.127
<b>#1</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.421</b>
#1	2	3. Short grass pasture	2.53	20.00	792.00	1.270	0.173
		5. Nearly bare and untilled, and alluvial valley fans	3.11	50.00	1,609.55	1.760	0.254
		7. Paved area and small upland gullies	2.13	40.00	1,876.00	2.930	0.177
		8. Large gullies, diversions, and low flowing streams	0.13	18.00	13,461.00	1.090	3.430
<b>#1</b>	<b>2</b>	<b>Time of Concentration:</b>					<b>4.034</b>
#2	1	3. Short grass pasture	6.20	40.00	645.65	1.990	0.090
		5. Nearly bare and untilled, and alluvial valley fans	8.14	25.00	307.20	2.850	0.029
		7. Paved area and small upland gullies	1.81	40.00	2,210.00	2.700	0.227
		8. Large gullies, diversions, and low flowing streams	0.88	15.00	1,711.00	2.800	0.169

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
<b>#2</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.515</b>
#3	1	3. Short grass pasture	2.55	18.00	704.60	1.270	0.154
		5. Nearly bare and untilled, and alluvial valley fans	0.92	22.00	2,380.00	0.960	0.688
<b>#3</b>	<b>1</b>	<b>Time of Concentration:</b>					<b>0.842</b>

***Subwatershed Muskingum Routing Details:***

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.58	35.00	6,000.00	2.290	0.727
<b>#1</b>	<b>1</b>	<b>Muskingum K:</b>					<b>0.727</b>