Big Rivers
ELECTRIC CORPORATION

Your Touchstone Energy® Cooperative

Green Station CCR Landfill

Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule
Run-on and Run-off Control System Plan

October 11, 2016

Prepared By:

ASSOCIATED ENGINEERS, INC.
2740 North Main St. • Madisonville, KY 42431
Phone: (270) 821-7732 • Fax: (270) 821-7789

Project ID: 160029

Big Rivers Electric Corporation
Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule
Run-on and Run-off Control System Plan

CCR Landfill Information

Name:	Green Station CCR Landfill
Operator:	Sebree Generating Station
Address:	9000 Highway 2096 Robards, Kentucky 42452

Qualified Professional Engineer

Name:	David A. Lamb
Company:	Associated Engineers, Inc.
Kentucky P.E. Number:	17822

Regulatory Applicability

As part of the § 257.81 for existing CCR landfill requirements, the owner or operator of an existing or new CCR landfill must design, construct, operate, and maintain a run-on and run-off control system plan as specified below. The owner or operator of the CCR unit must prepare the initial inflow design flood control system plan no later than October 17, 2016.

The owner or operator of an existing CCR landfill must design, construct, operate, and maintain:

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3-3 (Part 257 - Criteria for Classification of Solid Waste Disposal Facilities and Practices Subpart A - Classification of Solid Waste Disposal Facilities and Practices Section 257.3-3 - Surface water):

Run-on and run-off control system plan:

(1) *Content of the plan.* The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit. These plans must document how the run-

on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record.

(2) *Amendment of the plan*. The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record. The owner or operator must amend the written run-on and run- off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

Description of Landfill

An aerial photo of the CCR unit is provided as Attachment A and an excerpt from U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps showing the location of the CCR unit is provided as Attachment B.

The CCR unit is used for the placement of coal combustion residual material; currently fly ash, bottom ash and related material. The approximate total volume of CCR contained in the unit at the time of inspection is 20.3 million cubic yards. This volume was calculated from available flight derived baseline topography compared to December 2015 flight derived topographic contours. The Green CCR landfill is raised above adjacent ground to a maximum elevation of approximately 600 feet AMSL. The original ground surface within the landfill footprint was irregular and the predominant features were small stream valleys draining towards the Green River which is located just east of the landfill; and towards Groves Creek which is located just south of the landfill.

Run-on and Run-off Control System Plan

The initial run-on and run-off control system plan documents that the run-on control system will prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour/25-year storm; and that the run-off control system from the active portion of the CCR unit will collect and control at least the water volume resulting from a 24-hour/25-year storm.

Run-on Control Analysis

An evaluation of the Green CCR landfill configuration and topography resulted in the determination that because of the elevated position of active portions of the landfill, no significant run-on can occur and the only drainage onto active areas is storm water generated from direct precipitation; thus the CCR unit run-on system will prevent flow onto the active portion of the CCR unit during the peak discharge from the design storm event.

Run-off Control Analysis

Analysis of the Green CCR landfill drainage and sedimentation basin configurations and designs via SEDCAD modeling demonstrates that the design flood control system adequately

manages flow out of the CCR unit during and following the specified 24-hour/25-year storm event. SEDCAD by Civil Software Design, LLC is a widely recognized comprehensive hydrology and sedimentology package, useful for runoff and sediment control design calculations. The SEDCAD modeling results for the Green CCR landfill are attached to this report.

The operating facility has verified that discharge from the Green CCR landfill is handled in accordance with the surface water requirements under § 257.3-3 (Part 257 - Criteria for Classification of Solid Waste Disposal Facilities and Practices Subpart A - Classification of Solid Waste Disposal Facilities and Practices Section 257.3-3 - Surface water).

Sources of Information

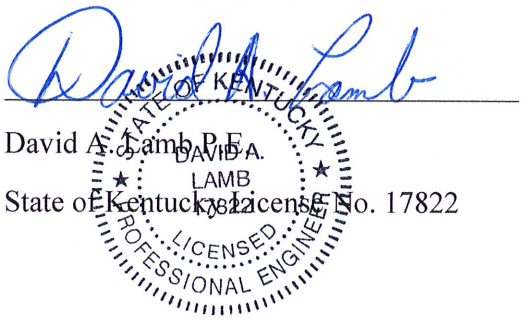
Geotechnical and other information provided by Associated Engineers, Inc.

Engineering design drawings and other information provided by Big Rivers Electric Corporation

United States Geological Survey U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps

Professional Engineer Certification [Per 40 CFR § 257.81]
Green CCR Landfill Run-on and Run-off Control System Plan

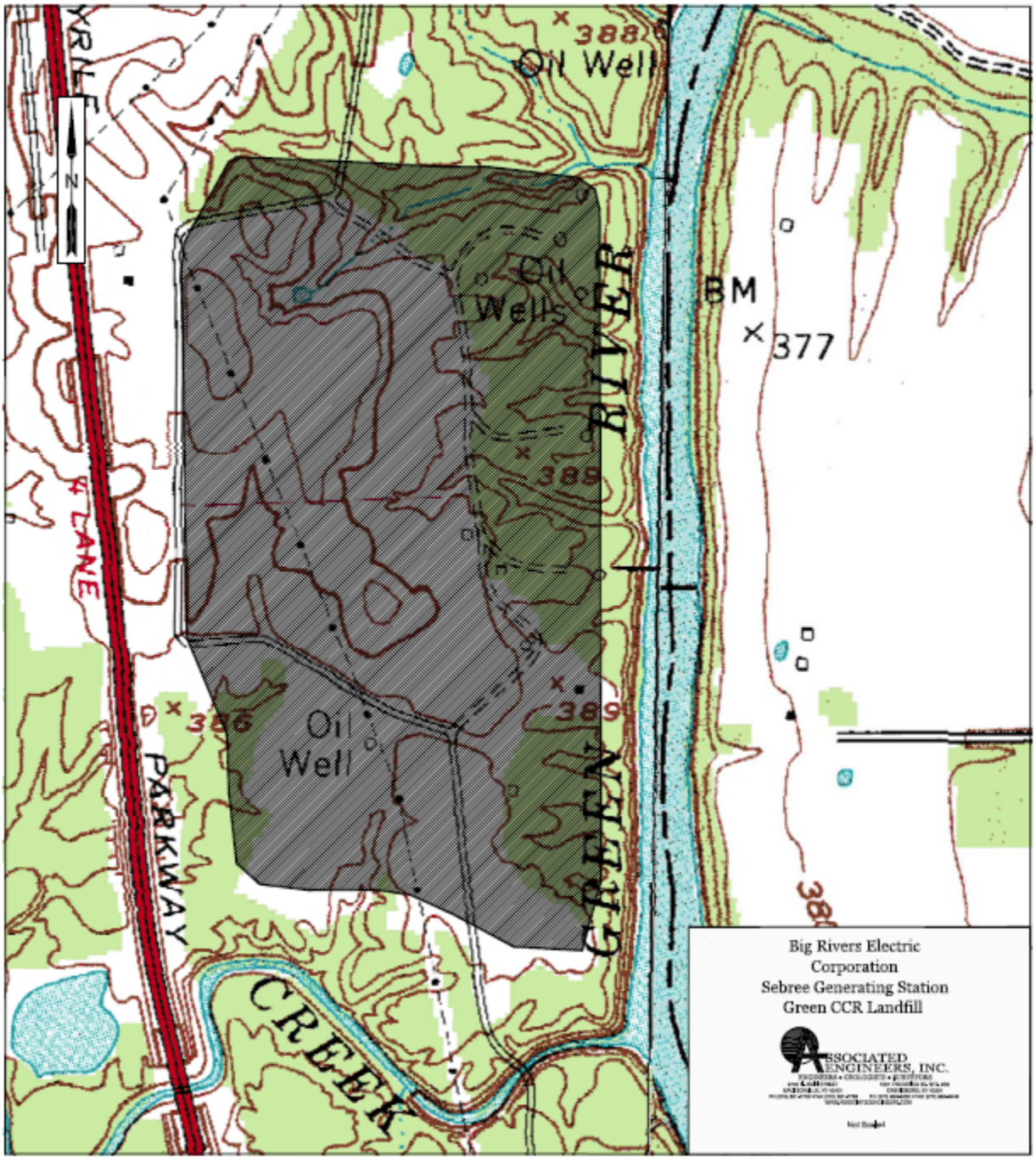
I hereby certify that myself or an agent under my review has prepared this Run-on and Run-off Control System Plan (Plan), and being familiar with the provisions of the final rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under subtitle D of the Resource Conservation and Recovery Act (RCRA), attest that this Plan has been prepared in accordance with good engineering practices and meets the intent of 40 CFR Part 257.81. To the best of my knowledge and belief, the information contained in this Plan is true, complete, and accurate.



David A. Lamb, P.E.
State of Kentucky License No. 17822

Date: 10/11/16

Attachment A. Aerial Photo of the Green CCR Landfill



Attachment B. Topographic Map showing the Green CCR Landfill

Big Rivers Electric Corporation
Reid/Green/HMPL Stations
Sebree, Kentucky

Stormwater Evaluation

Green Landfill

Pond 012

25 Year - 24 Hour Event

AEI Project #16-0029

Matthew T. Lile

Associated Engineers, Inc.
2740 N. Main St.
Madisonville, KY 42431

Phone: (270) 821-7732
Email: mlile@associatedengineers.com

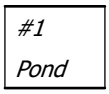
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.680 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 012



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	74.700	74.700	233.63	23.98
	Out			4.46	14.93

Structure Detail:

Structure #1 (Pond)

Pond 012

Pond Inputs:

Initial Pool Elev:	382.50 ft
Initial Pool:	2.49 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
386.85	18.00	8.00:1	8.00:1	28.00

Pond Results:

Peak Elevation:	385.34 ft
Dewater Time:	0.00 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
382.00	4.740	0.000	0.000		
382.01	4.750	0.047	0.000		
382.50	5.223	2.490	0.000		
383.00	5.728	5.227	4.460		
383.50	6.258	8.222	4.460		
384.00	6.810	11.488	4.460		
384.50	7.063	14.956	4.460		
385.00	7.321	18.552	4.460		
385.34	7.498	21.052	4.460	0.00	Peak Stage
385.50	7.583	22.278	4.460		
386.00	7.850	26.136	4.460		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
382.00	0.000	0.000	0.000
382.01	0.000	0.000	0.000
382.50	0.000	0.000	0.000
383.00	0.000	4.460	4.460
383.50	0.000	4.460	4.460
384.00	0.000	4.460	4.460
384.50	0.000	4.460	4.460
385.00	0.000	4.460	4.460
385.50	0.000	4.460	4.460
386.00	0.000	4.460	4.460

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	19.200	0.201	0.071	0.315	91.000	F	72.61	7.025
	2	20.400	0.085	0.000	0.000	91.000	F	84.37	7.890
	3	30.360	0.282	0.000	0.000	79.000	M	64.76	6.872
	4	4.740	0.000	0.000	0.000	99.000	F	20.62	2.195
	Σ	**74.700**						**233.63**	**23.982**

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	38.16	29.00	76.00	6.170	0.003
		8. Large gullies, diversions, and low flowing streams	0.62	10.00	1,624.00	2.350	0.191
		7. Paved area and small upland gullies	19.75	48.00	243.00	8.940	0.007
#1	**1**	**Time of Concentration:**					**0.201**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	34.29	24.00	70.00	5.850	0.003
		8. Large gullies, diversions, and low flowing streams	1.89	20.00	1,057.00	4.120	0.071
		7. Paved area and small upland gullies	21.09	81.00	384.00	9.240	0.011
#1	**2**	**Time of Concentration:**					**0.085**
#1	3	3. Short grass pasture	37.14	26.00	70.00	4.870	0.003
		6. Grassed waterway	0.76	10.00	1,309.00	1.310	0.277
		7. Paved area and small upland gullies	23.08	24.00	104.00	9.670	0.002
#1	**3**	**Time of Concentration:**					**0.282**

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	0.93	7.00	749.00	2.900	0.071
#1	**1**	**Muskingum K:**					**0.071**

Big Rivers Electric Corporation
Reid/Green/HMPL Stations
Sebree, Kentucky

Stormwater Evaluation

Green Landfill

Pond 014

25 Year - 24 Hour Event

AEI Project #16-0029

Matthew T. Lile

Associated Engineers, Inc.
2740 N. Main St.
Madisonville, KY 42431

Phone: (270) 821-7732
Email: mlile@associatedengineers.com

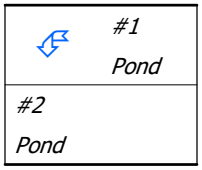
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.680 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	#2	0.000	0.000	Pond 014A
Pond	#2	==>	End	0.000	0.000	Pond 014B



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	52.290	52.290	190.00	18.66
	Out			73.35	18.66
#2	In	42.010	94.300	176.55	31.06
	Out			34.64	29.87

Structure Detail:

Structure #1 (Pond)

Pond 014A

Pond Inputs:

Initial Pool Elev:	382.74 ft
Initial Pool:	0.67 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
24.00	141.00	0.99	0.0120	382.74	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)
36.00	130.00	1.00	0.0120	386.00	0.90	0.00

Pond Results:

Peak Elevation:	389.38 ft
Dewater Time:	0.91 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
382.00	0.880	0.000	0.000		
382.50	0.912	0.448	0.000		
382.74	0.927	0.669	0.000		Spillway #1
383.00	0.944	0.912	0.564	5.22*	
383.50	0.977	1.392	2.778	4.15	
384.00	1.010	1.889	5.929	5.40	
384.01	1.010	1.899	6.000	0.05	
384.50	1.032	2.399	9.780	2.10	
385.00	1.055	2.921	14.230	1.15	
385.50	1.077	3.454	17.934	0.75	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
386.00	1.100	3.998	21.070	0.65	Spillway #2
386.50	1.134	4.556	26.012	0.50	
387.00	1.169	5.132	32.525	0.40	
387.50	1.204	5.726	40.017	0.30	
388.00	1.240	6.337	48.202	0.30	
388.50	1.289	6.969	56.781	0.25	
389.00	1.338	7.625	66.020	0.25	
389.38	1.376	8.139	73.352	0.30	Peak Stage
389.50	1.389	8.307	75.747		
390.00	1.440	9.014	83.775		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
382.00	0.000	0.000	0.000
382.50	0.000	0.000	0.000
382.74	0.000	0.000	0.000
383.00	(3)>0.564	0.000	0.564
383.50	(3)>2.778	0.000	2.778
384.00	(3)>5.929	0.000	5.929
384.01	(3)>6.000	0.000	6.000
384.50	(3)>9.780	0.000	9.780
385.00	(3)>14.230	0.000	14.230
385.50	(5)>17.934	0.000	17.934
386.00	(5)>21.070	0.000	21.070
386.50	(5)>23.788	(3)>2.224	26.012
387.00	(5)>26.238	(3)>6.287	32.525
387.50	(5)>28.477	(3)>11.541	40.017
388.00	(6)>30.426	(3)>17.776	48.202
388.50	(6)>31.948	(3)>24.832	56.781
389.00	(6)>33.380	(3)>32.640	66.020
389.50	(6)>34.764	(3)>40.983	75.747
390.00	(6)>36.079	(5)>47.696	83.775

Structure #2 (Pond)

Pond 014B

Pond Inputs:

Initial Pool Elev:	378.00 ft
Initial Pool:	0.01 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
27.00	41.00	2.02	0.0130	384.55	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)
27.00	41.00	2.56	0.0130	384.82	0.90	0.00

Pond Results:

Peak Elevation:	386.85 ft
Dewater Time:	1.58 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
376.50	0.005	0.000	0.000	
376.51	0.005	0.000	0.000	
377.00	0.006	0.003	0.000	
377.50	0.008	0.006	0.000	
378.00	0.010	0.011	0.000	
378.50	0.017	0.018	4.460	0.02*
379.00	0.026	0.028	4.460	0.03*
379.50	0.037	0.044	4.460	0.04*
380.00	0.050	0.066	4.460	0.06*
380.01	0.100	0.067	4.460	0.00*
380.50	1.422	0.377	4.460	0.84*
380.60	1.860	0.540	4.460	0.44*
380.61	1.861	0.559	4.460	0.05*
381.00	1.919	1.296	4.460	2.00*
381.50	1.994	2.274	4.460	2.65*

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
382.00	2.070	3.290	4.460	2.76*	
382.50	2.112	4.336	4.460	2.84*	
383.00	2.154	5.402	4.460	2.89*	
383.50	2.197	6.490	4.460	2.95*	
384.00	2.240	7.599	4.460	3.01*	
384.50	2.299	8.734	4.460	3.08*	
384.55	2.305	8.849	4.460	0.31*	Spillway #1
384.82	2.337	9.476	5.127	1.48*	Spillway #2
385.00	2.359	9.898	6.282	1.30	
385.50	2.419	11.093	11.467	4.60	
386.00	2.480	12.317	18.736	2.70	
386.50	2.564	13.578	27.553	1.95	
386.85	2.624	14.488	34.642	1.80	Peak Stage
387.00	2.650	14.882	37.706		

**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)	User-input discharge (cfs)	Combined Total Discharge (cfs)
376.50	0.000	0.000	0.000	0.000
376.51	0.000	0.000	0.000	0.000
377.00	0.000	0.000	0.000	0.000
377.50	0.000	0.000	0.000	0.000
378.00	0.000	0.000	0.000	0.000
378.50	0.000	0.000	4.460	4.460
379.00	0.000	0.000	4.460	4.460
379.50	0.000	0.000	4.460	4.460
380.00	0.000	0.000	4.460	4.460
380.01	0.000	0.000	4.460	4.460
380.50	0.000	0.000	4.460	4.460
380.60	0.000	0.000	4.460	4.460
380.61	0.000	0.000	4.460	4.460
381.00	0.000	0.000	4.460	4.460
381.50	0.000	0.000	4.460	4.460
382.00	0.000	0.000	4.460	4.460
382.50	0.000	0.000	4.460	4.460
383.00	0.000	0.000	4.460	4.460
383.50	0.000	0.000	4.460	4.460
384.00	0.000	0.000	4.460	4.460

Elevation (ft)	Straight Pipe (cfs)	Straight Pipe (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
384.50	0.000	0.000	4.460	4.460
384.55	0.000	0.000	4.460	4.460
384.82	(3)>0.667	0.000	4.460	5.127
385.00	(3)>1.429	(3)>0.393	4.460	6.282
385.50	(3)>4.365	(3)>2.643	4.460	11.467
386.00	(3)>8.231	(3)>6.045	4.460	18.736
386.50	(3)>12.831	(3)>10.262	4.460	27.553
387.00	(3)>18.074	(3)>15.172	4.460	37.706

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	51.280	0.209	0.000	0.000	90.000	F	189.16	18.195
	2	1.010	0.000	0.000	0.000	99.000	F	4.39	0.468
	Σ	**52.290**						**190.00**	**18.663**
#2	1	11.400	0.154	0.090	0.327	79.000	M	27.44	2.621
	2	28.750	0.187	0.000	0.000	84.000	F	97.64	8.917
	3	1.860	0.000	0.000	0.000	99.000	F	8.09	0.861
	Σ	**94.300**						**176.55**	**31.057**

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	25.49	26.00	102.00	4.030	0.007
		5. Nearly bare and untilled, and alluvial valley fans	1.15	4.00	349.00	1.070	0.090
		8. Large gullies, diversions, and low flowing streams	48.82	62.00	127.00	20.960	0.001
		8. Large gullies, diversions, and low flowing streams	1.85	16.00	866.03	4.070	0.059
		8. Large gullies, diversions, and low flowing streams	2.12	10.00	472.03	4.360	0.030
		8. Large gullies, diversions, and low flowing streams	13.09	116.00	886.00	10.850	0.022
#1	**1**	**Time of Concentration:**					**0.209**
#2	1	3. Short grass pasture	4.76	2.00	42.00	1.740	0.006
		3. Short grass pasture	37.14	26.00	70.00	4.870	0.003
		6. Grassed waterway	0.70	4.00	571.00	1.250	0.126
		7. Paved area and small upland gullies	24.89	176.00	707.00	10.040	0.019
#2	**1**	**Time of Concentration:**					**0.154**
#2	2	3. Short grass pasture	40.00	26.00	65.00	5.050	0.003
		6. Grassed waterway	0.68	5.00	739.09	1.230	0.166
		7. Paved area and small upland gullies	24.11	27.00	112.00	9.880	0.003
		8. Large gullies, diversions, and low flowing streams	2.81	8.00	285.00	5.020	0.015
#2	**2**	**Time of Concentration:**					**0.187**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	8. Large gullies, diversions, and low flowing streams	1.14	12.00	1,048.00	3.210	0.090
#2	**1**	**Muskingum K:**					**0.090**