TRANSALTA CENTRALIA MINE

COAL COMBUSTION RESIDUAL LIMITED PURPOSE LANDFILL RUN-ON AND RUN-OFF CONTROL PLAN

Submitted to:
TRANSALTA CENTRALIA MINING LLC

Date:
October 11, 2016

Norwest Corporation
950 South Cherry St., Suite 800
Denver, Colorado 80246
Tel: (303) 782-0164

www.norwestcorp.com

NORWEST
CORPORATION

NORWEST
CORPORATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NORWEST
CORPORATION

CERTIFICATE OF ENGINEER

I, Paul Kos, certify that all the information presented in this report is true and correct to the best of my knowledge and information, that this plan meets the requirements of the Coal Combustion Residual Rule 40 CFR 257.81, and that I am a duly licensed Professional Engineer under the laws of the State of Washington.

Item	Date of Preparation	Title
Report	October 11, 2016	TransAlta Centralia Mine Coal Combustion Residual Limited Purpose Landfill Run-On and Run-Off Control Plan
Figure 1	October 11, 2016	LPLF/CCR Drainage Plan
Appendix A	October 11, 2016	SEDCAD Model Report for the 25-Year, 24-Hour Storm Event

1 INTRODUCTION

The TransAlta Centralia Mine (TCM) Limited Purpose Landfill (LPLF) is used for industrial waste and coal-combustion byproduct disposal from TransAlta Centralia Generation LLC. The LPLF consists of a solid waste disposal cell and surface impoundments for the management of leachate generated at the disposal cell. It is located northeast of Centralia, Washington on an approximately 40-acre area located within Section 33, Township 15 North, Range 1 West, W.M., Lewis County, WA Latitude 46º 44' 23" North, Longitude 122º 49' 55" West. Additional facilities on the property includes an inactive surface coal mine with associated stormwater management controls. The LPLF discharges to these stormwater management controls.

TCM has applied for and received a Limited Purpose Landfill permit with the Lewis Country Health & Social Services, Environmental Health Division (LCEHD) and a National Pollutant Discharge Elimination System (NPDES) Permit with the State of Washington Department of Ecology to satisfy all regulatory requirements. TCM received its initial NPDES permit (Permit No. WA 0040215) on August 6, 2009. On December 9, 2014 the Washington Department of Ecology re-issued Permit No. WA0040215 for an additional 5-year term (January 1, 2015 through December 31, 2019). The final approval of the initial LPLF permit was granted by the LCEHD on November 13, 2009. The current LPLF permit is approved for a five-year term which expires on October 31, 2020.

Stormwater from the LPLF is routed to Pond 44, which discharges to the Pond 5 System, which discharges to Packwood Creek. These discharges are regulated by an industrial point discharge NPDES permit at the point of discharge from the Pond 5 Outfall 001.

This report documents the stormwater control systems that have been designed and constructed at the LPLF and is supported by the necessary hydrologic calculations (Appendix A). As required by 40 CFR 257.81, the LPLF stormwater management system controls the run-on and run-off peak flows resulting from the 25-year, 24-hour storm event.

2 HYDROLOGIC MODEL

The design flows were determined based on the watershed conditions and the watershed subdivisions shown on Figure 1. SEDCAD 4.0 has been used to estimate runoff rates and to route the flows from the subwatersheds through the designed drainage system. SEDCAD 4.0 is a commercially available software package that uses subroutines from TR-55. SEDCAD calculates the runoff response to a given precipitation event for specific surface topography, soil, and vegetative cover conditions. Application of the SEDCAD 4 program involves subdividing the drainage area into sub-watersheds with relatively uniform surface

characteristics. Information is designated for physical characteristics of channel segments that may affect flow routing within channels. SEDCAD utilities were used to determine surface areas, storage capacities, routing parameters, and storm runoff for the proposed reservoirs. The design features of SEDCAD have also been used to develop designs for the drainage system. The precipitation event used for estimating design flows varies. A 25-year, 24-hour event of 3.5 inches is used for the structure designs (Appendix A). The Type IA rainfall distribution was used for modeling rainfall intensity distribution for the design storm.

Sediment and erosion control is implemented on all areas of the LPLF using hydroseeding, mulching, and/or matting. This practice, combined with the site climate provide for a vegetative cover to stabilize slopes and drainage areas. The soils are predominantly clay loams and are classified as a C hydrologic soil type. A curve number (CN) of 86 was used to represent the runoff response from recently reclaimed areas; this value is based on C hydrologic soil type with poor grassland vegetation. For the portions of the watershed that were not disturbed or have been reclaimed with grassland vegetation, a curve number of 76 was assigned based on the C hydrologic soil type. A medium hydrograph response class was designated for all subwatersheds.

3 RUN-ON CONTROL SYSTEM

The LPLF is located and constructed to minimize stormwater run-on. Figure 1 shows the stormwater drainage structures that surround the LPLF area and prevent run-on to the landfill area from adjacent lands. Access roads, berms, and site grading are used to separate runoff from undisturbed/reclaimed areas and disturbed areas. Disturbed areas are limited to areas within active portions of the LPLF, and these areas drain to the south as discussed in the section on Run-Off Control System. The grassed area southwest of the LPLF has not been disturbed. Areas northwest of the active LPLF cells or outside the access road have been reclaimed. Clean waters from these areas are collected in clean water ditches CWD-1 through CWD-7 and culverts CC-1 through CC-4 and routed south to the mine stormwater control system. SEDCAD 4.0 was utilized to design the clean water ditches. The SEDCAD model drainage delineation and layout of ditches are shown in Figure 1. The ditches are designed as triangular ditches with side slopes of 3:1. Armoring is provided by vegetation. Table 3.1, below, specifies the maximum slope, the channel bottom width, the minimum channel depth and the design channel depth, for each down drain segment. The velocities included in Table 3.1 represent the channel stability calculations, and the flow depths represent the channel capacity calculations. The SEDCAD model results for the 25-year, 24-hour event are provided in Appendix A.

TABLE 3.1
CLEAN WATER DITCH DESIGNS

Structure	25-yr, 24-hr Peak Flow (cfs)	Shape	Side Slope	Slope (%)	Flow Velocity (fps)	Flow Depth (ft)	Channel Depth (ft)
CWD-1	0.59	Triangular	3H:1V	0.6%	1.48	0.65	2
CWD-2	0.16	Triangular	3H:1V	1.8%	0.46	0.70	2
CWD-3	0.16	Triangular	3H:1V	0.3%	0.21	1.06	2
CWD-4	3.87	Triangular	3H:1V	1.2%	1.45	1.54	2
CWD-5	0.91	Triangular	3H:1V	0.9%	0.81	1.11	2
CWD-6	5.65	Triangular	3H:1V	1.0%	1.55	1.76	2
CWD-7	2.89	Triangular	3H:1V	2.4%	1.69	1.24	2

SEDCAD 4.0 was utilized to design the culverts. The SEDCAD model drainage delineation and layout of culverts are shown in Figure 1. Table 3.2, below, specifies the culvert length, slope and diameter, and the headwater depth for the peak flow is included. The SEDCAD model results for the 25-year, 24-hour event are provided in Appendix A.

TABLE 3.2
CULVERT DESIGNS

Structure	25-yr, 24-hr Peak Flow (cfs)	Length (ft)	Slope (%)	Diameter (in)	Headwater (ft)
CC-1	0.59	40	2%	6	1
CC -2	0.26	40	2%	4	1
CC -3	4.76	280	2%	18	1.5
CC -4	10.02	100	2%	21	2

4 RUN-OFF CONTROL SYSTEM

The LPLF is graded so that all run-off is routed to the southeast into a diversion ditch, where it is routed to the mine stormwater control system. Run-off flows overland over the LPLF and into diversion ditch DD-

1 as shown on Figure 1. SEDCAD 4.0 was utilized to design the diversion ditch and demonstrate stable conditions for the vegetated channel. The SEDCAD model drainage delineation and layout of ditches are shown in Figure 1. The ditch is designed as a triangular ditch with side slopes of 3:1. Armoring is provided by vegetation. Table 4.1, below, specifies the maximum slope, the channel shape, the minimum channel depth and the design channel depth. The SEDCAD model results for the 25-year, 24-hour event are provided in Appendix A.

TABLE 4.1
DIVERSION DITCH DESIGN

Structure	25-yr, 24-hr Peak Flow (cfs)	Shape	Side Slope	Slope (%)	Flow Velocity (fps)	Flow Depth (ft)	Channel Depth (ft)
DD-1	4.65	Triangular	3H:1V	3.4%	2.40	1.26	2

5 NOTIFICATION AND RECORD KEEPING

TransAlta Centralia Mining LLC has performed the necessary notifications, maintains the necessary records, will post this Run-On and Run-Off Control Plan on their website, and will revise this plan at least every five years as required by 40 CFR 257.81.

6 CLOSURE

The purpose of this report is to provide the Run-On and Run-Off Control Plans for the CCR/LPLF at TransAlta's Centralia Mining operation near Centralia, Washington. The report includes hydrologic analysis of the LPLF area.

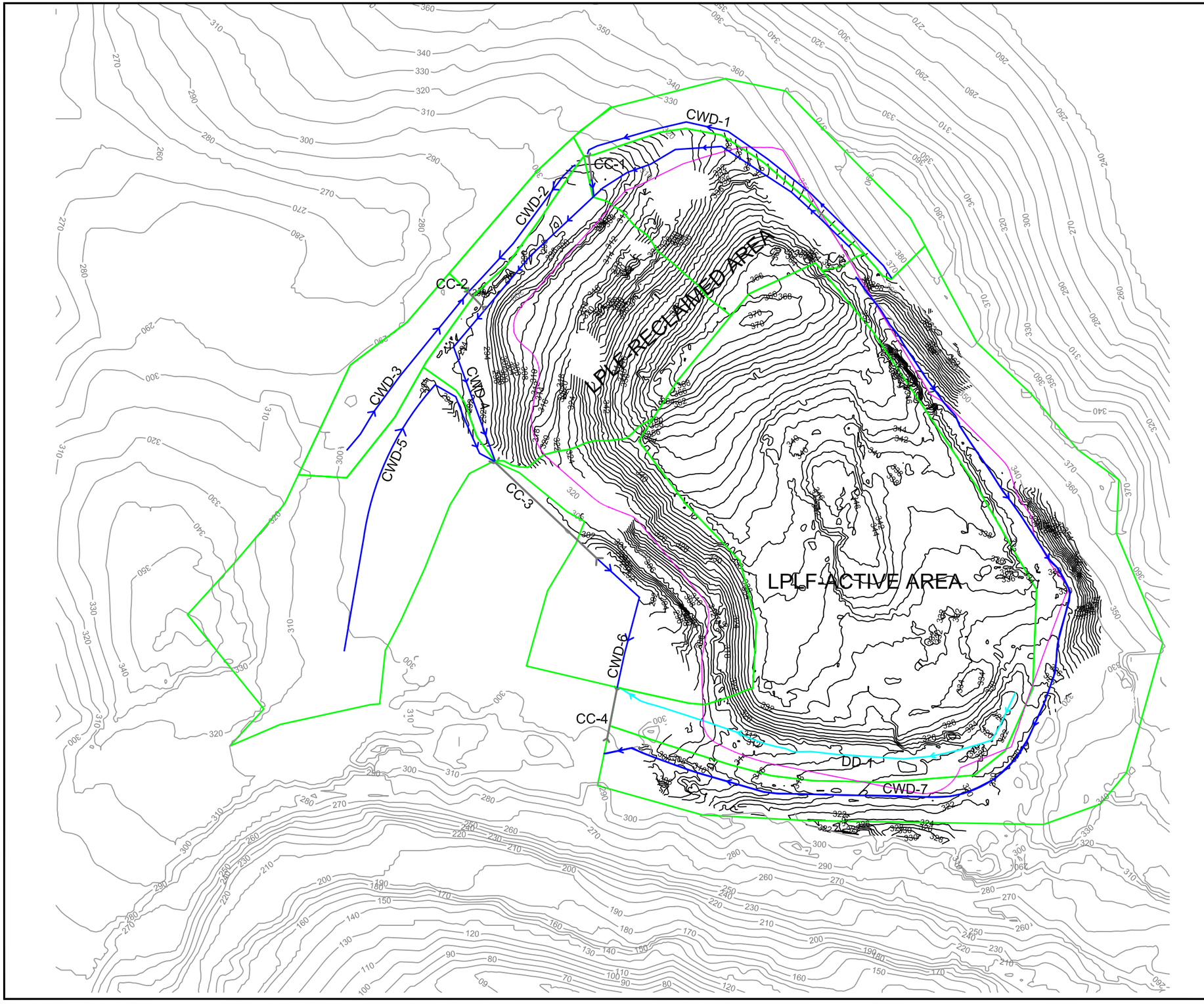
The figures included with the report are intended to provide an overview of the drainage plan and are not meant as construction drawings. All information and design results contained herein have been prepared by the authors who have signed below. The included design was reviewed internally and a draft of this report was reviewed by personnel from TransAlta Centralia Mining LLC.

As mutual protection to TransAlta Centralia Mining LLC, the public and ourselves, this report and drawings are submitted for exclusive use of TransAlta Centralia Mining LLC. We specifically disclaim any responsibility for losses or damages incurred through the use of our work for a purpose other than as described in the report. Our reports and analysis should not be reproduced in whole or in part without our express written permission, other than as required in relation to this submittal.

NORWEST
CORPORATION

NORWEST CORPORATION

Paul Kos, P.E.
Sr. Geological Engineer



LEGEND:

- LOCAL CONTOUR. CI=10'
- LPLF CONTOUR. CI=2'
- LPLF BOUNDARY
- WATERSHED BOUNDARY
- CLEAN WATER DIVERSION
- DIVERSION DITCH
- CULVERT

N

0 50 100 200 300 400

SCALE: 1" = 200'

TransAlta

FIGURE 1
LPLF/CCR DRAINAGE PLAN

DRAWN BY: PK
DATE: 10/11/16
REV: 00

NORWEST

SCALE AS SHOWN

FILE: S:\TransAlta\Centralia\LPLF Runoff Plan_2016\CAD\Figure 1-LPLF Hydrology_06Oct2016.dwg

NORWEST
CORPORATION

APPENDIX A

SEDCAD MODEL REPORT FOR THE TRANSALTA CENTRALIA MINE
CCR/LPLF HYDROLOGICAL ANALYSIS
25-YEAR, 24-HOUR STORM EVENT

TransAlta Centralia Mine
CCR/LPLF Hydrologic Analysis

25-yr, 24-hr Storm = 3.50"

Angie Welch

Norwest Corporation
950 South Cherry Street
Suite 800
Denver, CO 80246

Phone: 303-782-0164

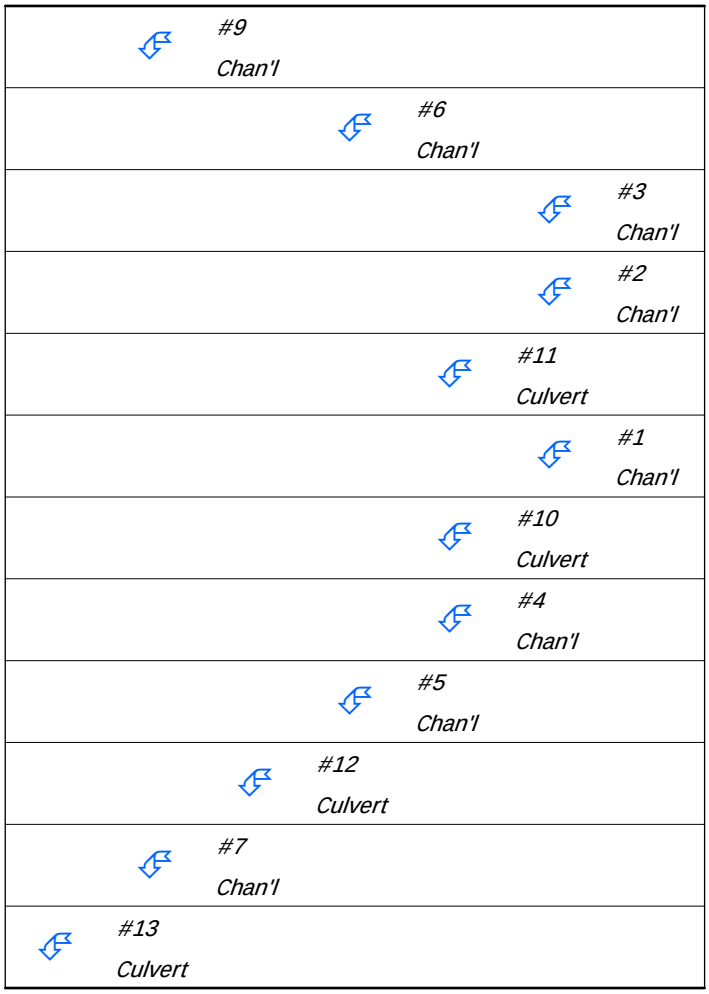
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	3.500 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#10	0.005	0.277	CWD-1
Channel	#2	==>	#11	0.005	0.277	CWD-2
Channel	#3	==>	#11	0.005	0.277	CWD-3
Channel	#4	==>	#5	0.110	0.246	CWD-4 UPPER
Channel	#5	==>	#12	0.036	0.277	CWD-4 LOWER
Channel	#6	==>	#12	0.036	0.277	CWD-5
Channel	#7	==>	#13	0.012	0.277	CWD-6
Channel	#8	==>	#14	0.000	0.000	CWD-7
Channel	#9	==>	#13	0.012	0.277	DD-1
Culvert	#10	==>	#5	0.110	0.246	CC-1
Culvert	#11	==>	#5	0.110	0.246	CC-2
Culvert	#12	==>	#7	0.055	0.234	CC-3
Culvert	#13	==>	#14	0.000	0.000	CC-4
Null	#14	==>	End	0.000	0.000	END



	#8 *Chan'l*
#14 *Null*	

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	6. Grassed waterway	2.00	0.82	41.00	2.12	0.005
#1	**Muskingum K:**					**0.005**
#2	6. Grassed waterway	2.00	0.85	42.50	2.12	0.005
#2	**Muskingum K:**					**0.005**
#3	6. Grassed waterway	2.00	0.85	42.50	2.12	0.005
#3	**Muskingum K:**					**0.005**
#4	6. Grassed waterway	1.22	8.00	654.02	1.65	0.110
#4	**Muskingum K:**					**0.110**
#5	6. Grassed waterway	2.00	5.59	279.50	2.12	0.036
#5	**Muskingum K:**					**0.036**
#6	6. Grassed waterway	2.00	5.59	279.50	2.12	0.036
#6	**Muskingum K:**					**0.036**
#7	6. Grassed waterway	2.00	1.98	99.00	2.12	0.012
#7	**Muskingum K:**					**0.012**
#9	6. Grassed waterway	2.00	1.98	99.00	2.12	0.012
#9	**Muskingum K:**					**0.012**
#10	6. Grassed waterway	1.22	8.00	654.02	1.65	0.110
#10	**Muskingum K:**					**0.110**
#11	6. Grassed waterway	1.22	8.00	654.02	1.65	0.110
#11	**Muskingum K:**					**0.110**
#12	6. Grassed waterway	1.00	3.02	302.00	1.50	0.055
#12	**Muskingum K:**					**0.055**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#9	12.410	12.410	4.65	1.74
#6	4.700	4.700	0.91	0.43
#3	1.070	1.070	0.16	0.10
#2	0.540	0.540	0.16	0.06
#11	0.000	1.610	0.26	0.16
#1	1.940	1.940	0.59	0.22
#10	0.000	1.940	0.59	0.22
#4	2.510	2.510	1.33	0.44
#5	4.590	10.650	3.87	1.47
#12	0.000	15.350	4.76	1.90
#7	3.970	19.320	5.65	2.35
#13	0.000	31.730	10.02	4.08
#8	7.830	7.830	2.89	1.10
#14	0.000	39.560	12.83	5.19

Structure Detail:

Structure #9 (Vegetated Channel)

DD-1

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	3.4	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	4.65 cfs		4.65 cfs	
Depth:	0.80 ft		1.26 ft	
Top Width:	4.82 ft		7.58 ft	
Velocity:	2.40 fps		0.97 fps	
X-Section Area:	1.93 sq ft		4.79 sq ft	
Hydraulic Radius:	0.381 ft		0.600 ft	
Froude Number:	0.67		0.21	
Roughness Coefficient:	0.0599		0.2011	

Structure #6 (Vegetated Channel)

CWD-5

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.3	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	0.91 cfs		0.91 cfs	
Depth:	0.61 ft		1.11 ft	
Top Width:	3.67 ft		6.64 ft	
Velocity:	0.81 fps		0.25 fps	
X-Section Area:	1.12 sq ft		3.68 sq ft	
Hydraulic Radius:	0.290 ft		0.525 ft	
Froude Number:	0.26		0.06	
Roughness Coefficient:	0.0906		0.4415	

Structure #3 (Vegetated Channel)

CWD-3

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.3	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	0.16 cfs		0.16 cfs	
Depth:	0.50 ft		1.06 ft	
Top Width:	2.99 ft		6.34 ft	
Velocity:	0.21 fps		0.05 fps	
X-Section Area:	0.75 sq ft		3.35 sq ft	
Hydraulic Radius:	0.237 ft		0.501 ft	
Froude Number:	0.08		0.01	
Roughness Coefficient:	0.1448		1.0764	

Structure #2 (Vegetated Channel)

CWD-2

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.8	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	0.16 cfs		0.16 cfs	
Depth:	0.34 ft		0.70 ft	
Top Width:	2.06 ft		4.20 ft	
Velocity:	0.46 fps		0.11 fps	
X-Section Area:	0.36 sq ft		1.47 sq ft	
Hydraulic Radius:	0.163 ft		0.332 ft	
Froude Number:	0.20		0.03	
Roughness Coefficient:	0.1284		0.8557	

Structure #11 (Culvert)

CC-2

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
42.93	2.00	0.0140	1.00	0.00	0.90

Culvert Results:

Design Discharge = 0.26 cfs

Minimum pipe diameter: 1 - 4 inch pipe(s) required

Structure #1 (Vegetated Channel)

CWD-1

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	8.1	D, B				4.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	0.59 cfs		0.59 cfs	
Depth:	0.36 ft		0.65 ft	
Top Width:	2.18 ft		3.92 ft	
Velocity:	1.48 fps		0.46 fps	
X-Section Area:	0.40 sq ft		1.28 sq ft	
Hydraulic Radius:	0.173 ft		0.310 ft	
Froude Number:	0.61		0.14	
Roughness Coefficient:	0.0884		0.4212	

Structure #10 (Culvert)

CC-1

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
41.25	2.00	0.0140	1.00	0.00	0.90

Culvert Results:

Design Discharge = 0.59 cfs

Minimum pipe diameter: 1 - 6 inch pipe(s) required

Structure #4 (Vegetated Channel)

CWD-4 UPPER

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	9.1	D, B				4.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	1.33 cfs		1.33 cfs	
Depth:	0.45 ft		0.76 ft	
Top Width:	2.71 ft		4.57 ft	
Velocity:	2.19 fps		0.77 fps	

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
X-Section Area:	0.61 sq ft		1.74 sq ft	
Hydraulic Radius:	0.214 ft		0.361 ft	
Froude Number:	0.81		0.22	
Roughness Coefficient:	0.0735		0.2973	

Structure #5 (Vegetated Channel)

CWD-4 LOWER

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.2	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	3.87 cfs		3.87 cfs	
Depth:	0.94 ft		1.54 ft	
Top Width:	5.67 ft		9.25 ft	
Velocity:	1.45 fps		0.54 fps	
X-Section Area:	2.68 sq ft		7.13 sq ft	
Hydraulic Radius:	0.448 ft		0.731 ft	
Froude Number:	0.37		0.11	
Roughness Coefficient:	0.0666		0.2457	

Structure #12 (Culvert)

CC-3

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
279.67	2.00	0.0140	1.50	0.00	0.90

Culvert Results:

Design Discharge = 4.76 cfs

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

Structure #7 (Vegetated Channel)

CWD-6

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.0	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	5.65 cfs		5.65 cfs	
Depth:	1.10 ft		1.76 ft	
Top Width:	6.61 ft		10.53 ft	
Velocity:	1.55 fps		0.61 fps	
X-Section Area:	3.64 sq ft		9.24 sq ft	
Hydraulic Radius:	0.522 ft		0.832 ft	
Froude Number:	0.37		0.11	
Roughness Coefficient:	0.0622		0.2157	

Structure #13 (Culvert)

CC-4

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
99.28	2.00	0.0140	2.00	0.00	0.90

Culvert Results:

Design Discharge = 10.02 cfs

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

Structure #8 (Vegetated Channel)

CWD-7

Triangular Vegetated Channel Inputs:

Material: Grass mixture

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	2.3	D, B				5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	2.89 cfs		2.89 cfs	
Depth:	0.75 ft		1.24 ft	
Top Width:	4.53 ft		7.44 ft	
Velocity:	1.69 fps		0.63 fps	
X-Section Area:	1.71 sq ft		4.61 sq ft	
Hydraulic Radius:	0.358 ft		0.588 ft	
Froude Number:	0.48		0.14	
Roughness Coefficient:	0.0680		0.2557	

Structure #14 (Null)

END

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#9	1	12.410	0.215	0.000	0.000	86.000	M	4.65	1.737
	Σ	**12.410**						**4.65**	**1.737**
#6	1	4.700	0.254	0.000	0.000	76.000	M	0.91	0.429
	Σ	**4.700**						**0.91**	**0.429**
#3	1	1.070	0.667	0.000	0.000	76.000	M	0.16	0.097
	Σ	**1.070**						**0.16**	**0.097**
#2	1	0.540	0.078	0.000	0.000	76.000	M	0.16	0.061
	Σ	**0.540**						**0.16**	**0.061**
#11	Σ	**1.610**						**0.26**	**0.158**
#1	1	1.940	0.078	0.000	0.000	76.000	M	0.59	0.220
	Σ	**1.940**						**0.59**	**0.220**
#10	Σ	**1.940**						**0.59**	**0.220**
#4	1	2.510	0.059	0.000	0.000	86.000	M	1.33	0.438
	Σ	**2.510**						**1.33**	**0.438**
#5	1	4.590	0.140	0.000	0.000	86.000	M	1.79	0.652
	Σ	**10.650**						**3.87**	**1.468**
#12	Σ	**15.350**						**4.76**	**1.897**
#7	1	3.970	0.049	0.000	0.000	76.000	M	1.21	0.451
	Σ	**19.320**						**5.65**	**2.348**
#13	Σ	**31.730**						**10.02**	**4.085**
#8	1	7.830	0.240	0.000	0.000	86.000	M	2.89	1.101
	Σ	**7.830**						**2.89**	**1.101**
#14	Σ	**39.560**						**12.83**	**5.186**

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	26.68	25.00	93.70	4.130	0.006
		5. Nearly bare and untilled, and alluvial valley fans	8.10	60.00	740.67	2.840	0.072

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	**1**	**Time of Concentration:**					**0.078**
#2	1	3. Short grass pasture	4.82	3.00	62.22	1.750	0.009
		5. Nearly bare and untilled, and alluvial valley fans	1.80	6.00	333.44	1.340	0.069
#2	**1**	**Time of Concentration:**					**0.078**
#3	1	3. Short grass pasture	9.30	10.00	107.50	2.430	0.012
		5. Nearly bare and untilled, and alluvial valley fans	0.30	3.82	1,274.00	0.540	0.655
#3	**1**	**Time of Concentration:**					**0.667**
#4	1	3. Short grass pasture	6.77	2.00	29.55	2.080	0.003
		5. Nearly bare and untilled, and alluvial valley fans	9.13	56.00	613.60	3.020	0.056
#4	**1**	**Time of Concentration:**					**0.059**
#5	1	3. Short grass pasture	18.32	68.00	371.28	3.420	0.030
		6. Grassed waterway	1.22	8.00	654.02	1.650	0.110
#5	**1**	**Time of Concentration:**					**0.140**
#6	1	3. Short grass pasture	2.69	8.00	297.88	1.310	0.063
		5. Nearly bare and untilled, and alluvial valley fans	1.28	10.00	778.63	1.130	0.191
#6	**1**	**Time of Concentration:**					**0.254**
#7	1	3. Short grass pasture	19.40	34.00	175.28	3.520	0.013
		5. Nearly bare and untilled, and alluvial valley fans	21.53	34.00	157.92	4.640	0.009
		8. Large gullies, diversions, and low flowing streams	1.00	3.02	302.00	3.000	0.027
#7	**1**	**Time of Concentration:**					**0.049**
#8	1	3. Short grass pasture	28.41	45.00	158.39	4.260	0.010
		6. Grassed waterway	2.35	45.00	1,911.55	2.300	0.230
#8	**1**	**Time of Concentration:**					**0.240**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	7.58	21.00	276.92	2.750	0.027
		5. Nearly bare and untilled, and alluvial valley fans	3.82	27.00	706.01	1.950	0.100
		6. Grassed waterway	3.40	30.00	881.98	2.760	0.088
#9	**1**	**Time of Concentration:**					**0.215**