DOMINION ENERGY

PERIODIC INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

BREMO STATION INACTIVE CCR SURFACE IMPOUNDMENT: WEST POND

APRIL 2023

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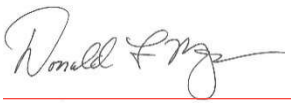
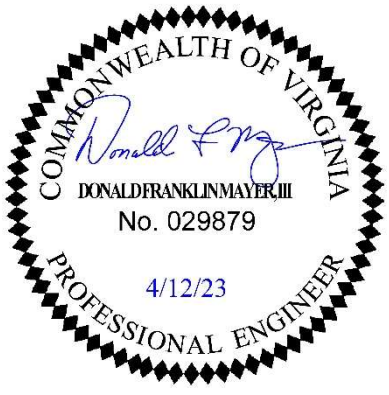
1 CERTIFICATION

This periodic Inflow Design Flood Control System Plan for the Bremo Station's West Pond was prepared by WSP USA Inc. (WSP; formerly d/b/a Golder Associates USA Inc.). The document and Certification/Statement of Professional Opinion are based on and limited to information that WSP has relied on from Dominion Energy and others, but not independently verified, as well as work products previously produced by Golder.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.82 of the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015 (40 CFR §257.82), as well as with the requirements in §257.100 resulting from the EPA's "Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur" published in the Federal Register on August 5, 2016, with an effective date of October 4, 2016 (40 CFR §257.100).

The use of the word "Certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

Donald Mayer, PE	Vice President
Print Name	Title
	4/12/2023
Signature	Date



2 INTRODUCTION

This periodic Inflow Design Flood Control System (PIDFCS) Plan was prepared for the Bremo Station's (Station) Coal Combustion Residuals (CCR) inactive surface impoundment known as the West Pond. This PIDFCS Plan was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.82.

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion Energy), is in Fluvanna County at 1038 Bremo Road, east of Route 15 (James Madison Highway) and north of the James River. The Station includes an inactive CCR surface impoundment, the West Pond, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule and Direct Final Rule (40 CFR §257; the CCR rule). The West Pond is also regulated as an impounding structure by the Virginia Department of Conservation and Recreation (DCR), with Inventory Number 065011 (DCR Dam Permit). Discharge from the West Pond is currently regulated by Virginia Department of Environmental Quality (DEQ) Virginia Pollutant Discharge Elimination System Permit No. VA0004138 (VPDES Permit).

Dominion Energy performed closure by removal activities in the West Pond by removing the stored CCR and over-excavating soil pursuant to its solid waste permit closure plan (SWP 618). The DEQ verified removal activities in April 2020. The Pond remains subject to the CCR Rule requirements due to observed groundwater impacts that prevent full closure of the unit under the rule even though the Pond no longer impounds CCR materials.

3 PURPOSE

This PIDFCS plan is prepared pursuant to 40 CFR §257.82(c) of the CCR Rule [40 CFR §257.82(c)]. The initial IDFCS plan was completed in April 2018 and is required to be reviewed every five (5) years pursuant to 40 CFR §257.82(c)(4). The West Pond remains subject to the CCR rule requirements, including this PIDFCS plan update, even though all CCR materials have been removed.

4 PERIODIC INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

As required by § 257.82(c)(1), this PIDFCS plan includes documentation of how the inflow design flood control system for the West Pond has been designed, constructed, operated, and maintained to:

- Adequately manage flow into the West Pond during and following the peak discharge of the inflow design flood [40 CFR §257.82(a)(1)];
- Adequately manage flow from the West Pond to collect and control the peak discharge resulting from the inflow design flood [40 CFR §257.82(a)(2)]; and
- Adequately handle discharge from the West Pond in accordance with the surface water requirements under 40 CFR §257.3-3 [40 CFR §257.82(b)].

4.1 HAZARD POTENTIAL CLASSIFICATION

As indicated in WSP's Periodic Hazard Potential Classification Assessment (WSP, 2023), the West Pond is assigned a "Low" hazard potential rating per 40 CFR §257.73.

4.2 INFLOW DESIGN FLOOD

In accordance with 40 CFR §257.82(a)(3)(ii), a CCR impoundment with a Low hazard potential must collect and control the peak discharge resulting from a 100-year flood. Per National Oceanic and Atmospheric Administration (NOAA) Atlas-14, the 100-year, 24-hour precipitation depth is 7.91 inches in Bremo Bluff, Virginia. Evaluation of the West Pond's inflow design flood control system during the 100-year, 24-hour storm event is provided in Appendix A.

4.3 INFLOW CONTROL

As required by §257.82(a)(1), a control system must be in place for the West Pond that is designed, constructed, operated, and maintained to adequately manage flow into the West Pond during and following the peak discharge of the inflow design flood.

Inflow to the West Pond consists of stormwater runoff from the approximately 17 acres of the pond proper. There are no other contributing drainage areas or pumped inflow. The natural conveyance systems adequately manage and control run-on into the West Pond during the inflow design flood.

4.4 OUTFLOW CONTROL

As required by §257.82(a)(2), an inflow design flood control system must be in place for the West Pond that is designed, constructed, operated, and maintained to adequately manage flow from the West Pond to collect and control the peak discharge resulting from the inflow design flood.

The West Pond currently does not discharge to the environment and is designed with sufficient capacity to hold stormwater until the construction of a new water treatment system, anticipated to be operational within the next year. The normal pool in the West Pond is currently kept at or below elevation 222.0 ft above mean sea level (ft amsl). The pond also has a principal spillway (El. 228 ft amsl) and auxiliary spillway (El. 230 ft amsl) that are not expected to see flow during normal operation.

The West Pond stormwater system was modeled in the U.S. Army Corps of Engineers Hydrologic Engineering Center's Hydraulic Modeling System (HEC HMS), and the analysis is included in Appendix A. The West Pond inflow design flood control system is capable of adequately managing the inflow from the design flood event without overtopping the embankment and has adequate spillway capacity to manage resulting outflow.

4.5 SURFACE WATER REQUIREMENTS

As required by §257.82(b), a control system must be in place for the West Pond that is designed, constructed, operated, and maintained to meet the requirements of § 257.3-3.

The West Pond is operated under VPDES No. VA0004138, a Local Land Disturbance Permit, Stormwater Management Plan, and Stormwater Pollution Prevention Plan (SWPPP). The site is routinely inspected and monitored by Dominion Energy personnel in accordance with the before mentioned plans to minimize potential surface water impacts.

5 CONCLUSIONS

The West Pond is subject to a PIDFCS plan update (due every 5 years from the original assessment performed in April 2018). The pond remains subject to the CCR Rule requirements, even though it no longer impounds CCR materials, due to observed groundwater impacts that prevent full closure of the unit under the rule.

Based on known site conditions, information in this PIDFCS Plan, as well as work performed by WSP, it is WSP's opinion that the existing West Pond inflow design flood control system complies with the requirements of 40 CFR §257.82 of the CCR Rule for a low hazard potential impoundment.

REFERENCES

- Golder Associates. Inflow Design Flood Control System Plan, Bremo Power Station Inactive CCR Surface Impoundment: West Ash Pond. April 2018.
- National Oceanic and Atmospheric Administration's National Weather Service. NOAA Atlas 14 Point Precipitation Frequency Estimates: VA. Accessed February 3, 2023. Available online: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va
- Virginia Department of Environmental Quality (VDEQ), Valley Regional Office. Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0004138.
- WSP USA Inc. (WSP). 2023. Periodic Hazard Potential Classification Assessment, Bremo Power Station Inactive CCR Surface Impoundment: West Pond. March 2023.

APPENDIX

A West Pond Inflow Design Flood Analysis

CALCULATIONS

Date	April 2023	**Made by:**	HNE
Reference No.	21466315	**Checked by:**	BJP
Site Name	Dominion Energy - Bremo West Pond Bremo Bluff, Virginia	**Approved by:**	ELH

BREMO WEST POND INFLOW DESIGN FLOOD ANALYSIS

1.0 OBJECTIVES

The purpose of this evaluation is to determine the hydraulic performance of the West Pond Coal Combustion Residuals (CCR) impoundment at the Bremo Station, resulting from the 100-year, 24-hour design storm event. This evaluation is in support of the Inflow Design Flood Control System Plan and is based on a "Low" hazard potential classification as defined in §257.53 of the *CCR Rule*. The West Pond has been closed by removal of CCR and currently is used for surface water management at the site.

2.0 CALCULATIONS

2.1 Pond Storage Volume

The West Pond storage volume was computed based on the topography of the pond following removal of CCR material, surveyed in 2020. The maximum available storage below the top of embankment (Elevation 234 feet above mean sea level (ft amsl)) is approximately 434 acre-feet. Attachment 1 contains the stage-storage rating table for the West Pond.

2.2 Outlet Design Capacity

Below the top of the embankment, outfall from the pond may occur at the Principal Spillway (Elevation 228 ft amsl) and Auxiliary Spillway (Elevation 230 ft amsl). These spillways are not expected to see flow during current operation of the pond.

This analysis assumes that the starting water level in the West Pond is at elevation 222.0 ft amsl, which was the measured water surface elevation in the pond as of February 2023. This elevation is conservative relative to the long term proposed highwater operation level of 220.0 ft amsl.

2.3 Storm Routing Calculations

The West Pond stormwater system analysis was performed using the US Army Corps of Engineers Hydrologic Engineering Center's Hydraulic Modeling System (HEC-HMS) software package (Ref 1). The drainage area to the pond is 18 acres from direct precipitation into the pond.

Design Storm

Per §257.82(a)(3)(ii), the impoundment is required to adequately manage flow resulting from the 100-year, 24-hour storm event. The 100-year, 24-hour storm event precipitation depth was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server (PFDS, Ref 2) for Bremo Bluff, Virginia, and amounts to 7.9 inches. The design storm is distributed in time as an SCS Type II synthetic distribution.

HMS Model Input

Figure 1 illustrates the connectivity of the stormwater elements and the data inputs as modeled in HEC-HMS. The predominant soil types in the area are Hydrologic Soil Group (HSG) 'B' soils. The acreage, curve number (CN), and lag time for each sub-basin area are provided in the attached worksheet.

The time of concentration for was estimated using the TR-55 time of concentration method (NRCS, Ref 3), which divides the longest hydraulic flow path into sheet flow, shallow concentrated flow, and open channel flow, and considers a minimum time of concentration of 6 minutes. The lag time was estimated as 60% of the time of concentration. The maximum length of sheet flow was assumed to be 100 feet. A minimum lag time of 3.6 minutes was assumed.

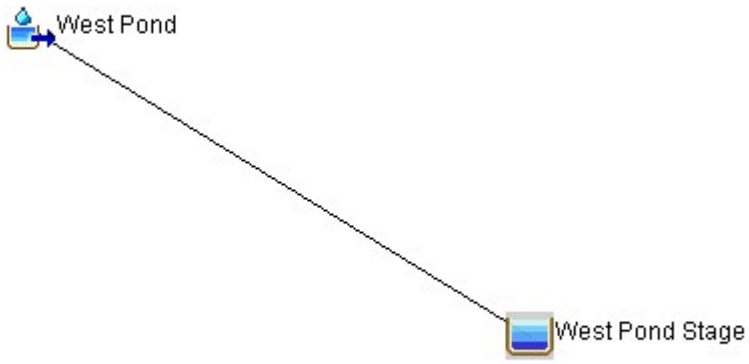


Figure 1: West Pond HEC HMS Model Routing

HMS Model Output

The following table summarizes the results of the HEC-HMS analysis, using a starting water surface elevation of 222.0 ft amsl. Note that the computed high water (Max Hw) elevations are below the level of Primary Spillway (Elevation 228.0 ft amsl). The inflow volume and pool elevation are shown in Attachment 1.

Table 1: West Pond HEC-HMS Results

Q_{in} (CFS)	V_{in} (acre-ft)	Max Hw (Ft El*)
184.0	11.2	222.7

3.0 CONCLUSIONS

Based on the calculations presented herein, the West Pond at the Bremo Station can accept and store the 100-year, 24-hour storm event without discharging through the Principal Spillway or overtopping the embankment.

4.0 REFERENCES

1) USACE (United States Army Corps of Engineers). 2020. HEC-HMS Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) [computer software]. Version 4.10. September 2020.

2) Precipitation Frequency Data Server (NOAA Atlas 14). https://hdsc.nws.noaa.gov/hdsc/pfds/

3) NRCS. 2010. National Engineering Handbook. Part 630 Hydrology, Chapter 15 Time of Concentration.

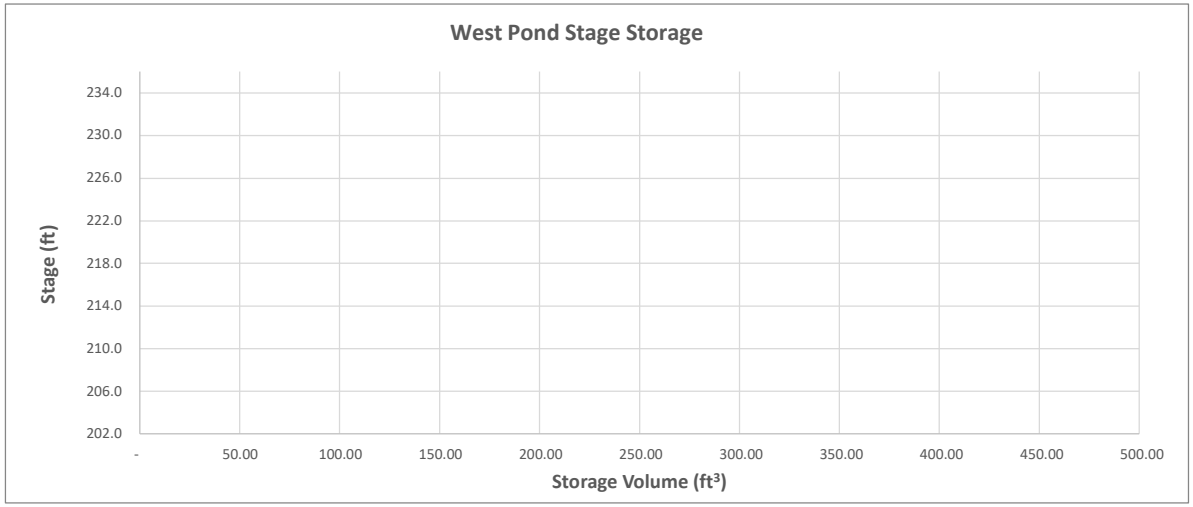
5.0 ATTACHMENTS

1) West Pond H&H Calculations

ATTACHMENT 1

West Pond H&H Calculations

West Pond Stage Storage					
Contour Elevation (ft)	Contour Area (ft^2)	Contour Area (Acre)	Average End Area Volume (ft^3)	Average End Area Cumulative Volume (ft^3)	Average End Area Cumulative Volume (Acre-ft)
204.0	331,131	7.60			
206.0	432,484	9.93	763,615	763,615	17.53
	495,463	11.37	927,947	1,691,562	38.83
2.0	542,573	12.46	1,038,036	2,729,598	62.66
4.0	589,703	13.54	1,132,276	3,861,874	88.66
6.0	627,731	14.41	1,217,434	5,079,308	116.60
8.0	643,284	14.77	1,271,015	6,350,323	145.78
10.0	655,281	15.04	1,298,565	7,648,888	175.59
12.0	666,994	15.31	1,322,275	8,971,163	205.95
14.0	678,750	15.58	1,345,744	10,316,907	236.84
16.0	690,572	15.85	1,369,322	11,686,229	268.28
18.0	702,467	16.13	1,393,039	13,079,268	300.26
20.0	714,434	16.40	1,416,901	14,496,169	332.79
22.0	726,474	16.68	1,440,908	15,937,077	365.86
24.0	738,586	16.96	1,465,060	17,402,137	399.50
26.0	760,000	17.45	1,498,586	18,900,723	433.90



Bremo West Pond H and H Calculations

Client: Dominion Energy West Pond Stage Storage
Project: Bremo West Pond CCR Inflow Design
Project Number: 21466315

Date:	3/9/23
By:	HNE
Chkd:	
Apprvd:	

Design Storm **100 -Year Reccurence Interval**

Storm Duration (hours)	2-Year Depth (inches)	100 -Year Depth (inches)	Storm Distribution
24	3.2	7.9	II

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 Pond Area (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
West Pond	764,267	17.55	0.0274	17.55	CN = 98	0.20	7.66	11.20	487,874
Total:	764,267	17.55	0.03					11.20	487,874

Bremo West Pond H and H Calculations

Client: Dominion Energy
Project: Bremo West Pond CCR Inflow Design
Project Number: 21466315

Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)
West Pond	0.0274	98	3.6	6.0

Bremo West Pond H and H Calculations

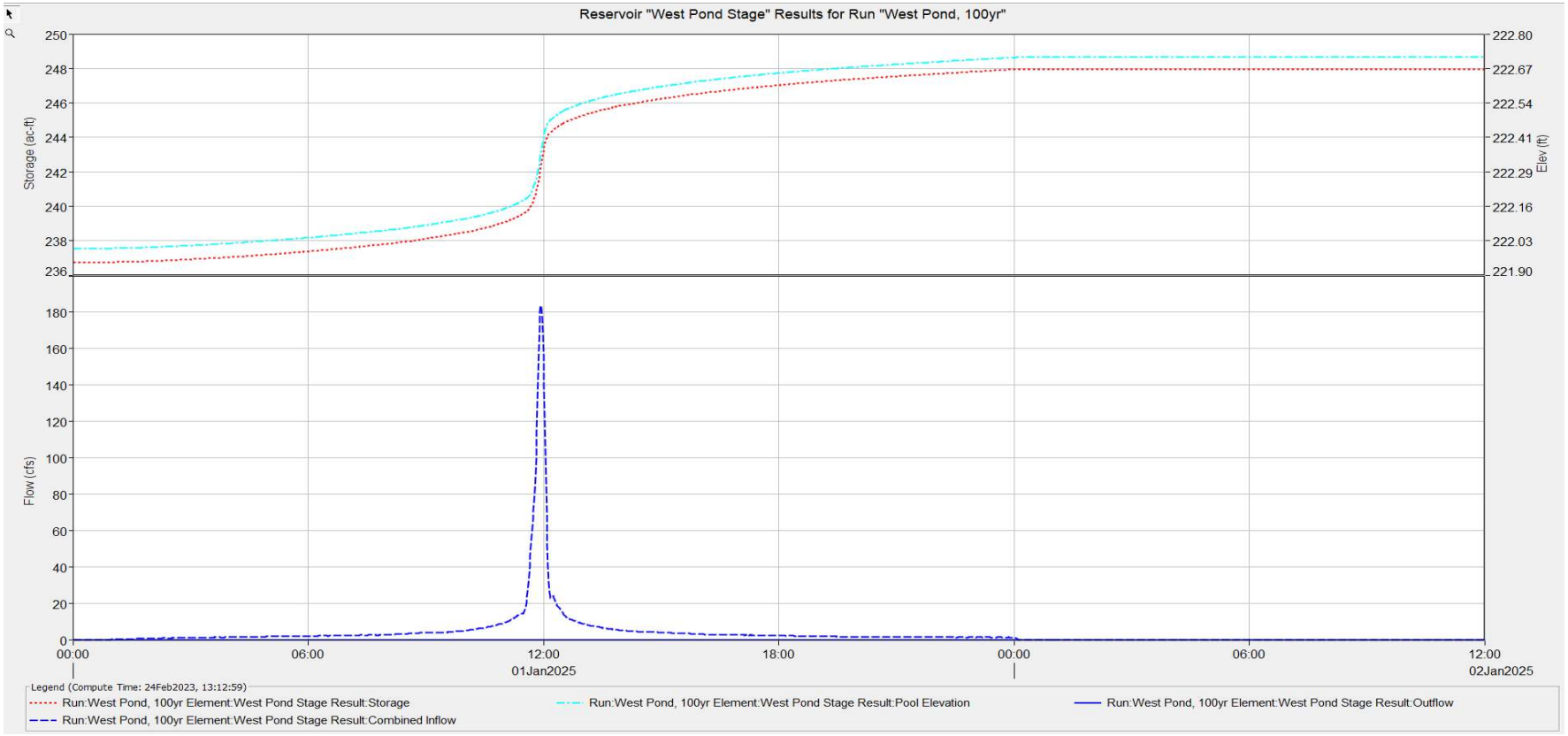
Client: Dominion Energy
Project: Bremo West Pond CCR Inflow Design
Project Number: 21466315

Date:	3/9/23
By:	HNE
Chkd:	
Apprvd:	

HEC-HMS Basin Model:	West Pond
HEC-HMS Met. Model:	100yr, 24-hr
HEC-HMS Control Specs:	36 hr, 1-min

Hydrologic Element	Drainage Area (sq mile)	Peak Discharge (cfs)	Time of Peak	Total Volume (ac-ft)
West Pond	0.027	184	01Jan2025, 11:56	11.2
West Pond Stage	0.027	0	01Jan2025, 00:00	0

West Pond Storage Analysis



Attachment A
Time of Concentration and Mannings Flow Coefficients

TR-55 (1986)

Sheet Flow Travel time (SCS Upland Method)

$$T_t = \frac{0.007\ (n'\ L)^{0.8}}{(P_2)^{0.5}\ S^{0.4}}$$

Where: T_t = travel time (hr); n' = roughness coefficient; L = flow length (ft);

P_2 = 2-yr storm depth (inches); s = slope (ft/ft)

flow velocity = $L/(60T_t)$

Flow Type	Surface Type	roughness n	Surface Description	Short Description
Sheet/Overland Flow	A	0.011	Smooth surfaces (concrete, asphalt, gravel, bare soil)	Smooth
	B	0.05	Fallow (no residue)	Fallow
	C	0.06	Cultivated soils: Residue cover <= 20%	Cover<20%
	D	0.17	Cultivated soils: Residue cover > 20%	Cover>20%
	E	0.15	Grass: Short grass prairie	Short Grass
	F	0.24	Grass: Dense grasses	Dense Grass
	G	0.41	Grass: Bermuda grass	Bermuda Grass
	H	0.13	Range (natural)	Range
	I	0.40	Woods: Light underbrush	Light woods
	J	0.80	Woods: Heavy underbrush	Heavy Woods

Shallow Concentrated Flow Velocity (SCS Upland Method)

$v = mS^{0.5}$

Where: v = velocity (fps); m = roughness coeffient; S = slope (ft/ft)

Flow Type	Surface Type	Roughness m	Surface Description	Short Description
Shallow Conc. Flow	P	20.3282	Paved Surfaces	Paved
	U	16.1345	Unpaved Surfaces	Unpaved

Channel Flow Velocity (Mannings Velocity)

$v = 1.49/n\ Rh^{2/3}S^{1/2}$ Where: v = velocity (fps); n = roughness coeffient; Rh = Hydraulic Radius (ft), S = slope (ft/ft)

Lining Type	Mannings n for Depth	Mannings n for Velocity	Material	Maximum Velocity	Maximum Shear Stress
A	0.026	0.026	ACB	25	
C	0.024	0.022	CSP	50	
E	0.025	0.022	Earth-lined	3	
G	0.035	0.030	Grass-lined	5	
I	0.017	0.013	Ductile Iron	50	
P	0.012	0.009	Plastic	25	
R	0.040	0.035	Riprap	16	
T	0.035	0.030	Turf Reinf.	10	1.5
Z	0.060	0.005	Other	25	