TRC
Results you can rely on

10 Maxwell Road
Suite 200
Clifton Park, NY 12065

518.348.1190 PHONE
518.348.1194 FAX

www.TRCsolutions.com

June 14, 2012

Via Email

Mr. Craig D. Rennie, CWS, CWB
Land Resource Specialist
NH Department of Environmental Services
Water Division
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Dear Mr. Rennie:

The attached documents respond to your letter dated May 18, 2012 to TRC's Joshua Brown and to Mr. Rene Pelletier's May 23, 2012 letter to Mr. Thomas S. Burack, Chairman of the NH Energy Facilities Site Evaluation Committee, requesting additional information to support the Antrim Wind Energy's application for an Alteration of Terrain Permit, Wetland Permit, Subsurface System Permit, and the 401 Water Quality Certificate for the Antrim Wind Park.

Please don't hesitate to call if you have any questions. I can be reached at (518) 688-3145.

Sincerely,

Rick Chase

Rick Chase
Senior Project Manager

c: Jack Kenworthy, Antrim Wind Energy
Joshua Brown, TRC
Service List

Antrim Wind Energy, LLC
Site Evaluation Committee No. 2012-001

Request No.:	NHDES-01	Date of Request:	May 18, 2012
Requested By:	Craig D. Rennie	Reply Date:	June 14, 2012
Subject:	Alteration of Terrain Permit Application #120131-015	Witness:	Patrick M. Martin, PE

REQUEST:

1. Please provide a pre and post-development drainage analysis that evaluates the project's effect on the defined study points and watersheds as shown in the pre and post-development watershed plans. The pre and post-development analysis must also include the node listing summaries for the 2, 10 and 50-year storm events which totals of all nodes used in the analysis for total flow, areas, volumes, avg. depths, etc.

2. Please submit a curve number summary for the pre-development and the post-development reports (i.e. for each analysis, summarize the total area used for each curve number). *Please note that HydroCAD 8.0 automatically generates this report for you.*

3. The project narrative and summary should include total flows and volumes for the 2, 10 and 50-year storm at each design point (for the pre and post-development analysis) in order to show that the project meets the Channel Protection Requirements of Rule Env-Wq 1507.05, and the Peak Runoff Control Requirements of Env-Wq 1507.06.

4. Sheet flow lengths in the Time of Concentration (Tc) calculations should be limited to 100'. NRCS made an official investigation back in 2001 and have changed their WinTR55 program to limit sheet flow lengths to 100'. They state in the FAQ:

   Q: Is there any way to increase the sheet flow length beyond 100 feet?
   A: No. After much discussion and research, the development team felt that sheet flow greater than 100' was very unusual in natural watersheds. For more information on the subject read W.H Merkel's "Sheet Flow References" as posted in Technical References and H&H Papers on Various Topics, in the USDA-NRCS National Water and Climate Center website.

5. Please provide Stormwater Treatment BMP worksheets for each of the proposed treatment devices to ensure they meet the applicable design criteria of NH Administrative Rule Env-Wq 1508.03 through 1508.09. BMP worksheets can be found on our website at: http://des.nh.gov/organization/divisions/water/aot/index.htm.

Name of Person
Preparing Response: Patrick M. Martin, PE **Date: June 14, 2012**

6. Please provide the Groundwater Recharge BMP worksheet for the total project to ensure that the recharge requirements of Env-Wq 1507.04.

7. Provide additional documentation from the Natural Heritage Bureau and the NH Fish & Game Dept. to show how the project will minimize potential impacts to exemplary natural communities and species of concern.

8. Please provide rip-rap sizing calculations for the project.

9. In order to meet the program requirements, please include the following construction monitoring notes on the plans:
    a) The permittee shall employ the services of an environmental monitor ("Monitor"). The Monitor shall be a Certified Professional in Erosion and Sediment Control or a Professional Engineer licensed in the State of New Hampshire and shall be employed to inspect the site from the start of alteration of terrain activities until the alteration of terrain activities are completed and the site is considered stable.
    b) During this period, the Monitor shall inspect the subject site at least once a week, and if possible, during any ½ inch or greater rain event (i.e. ½ inch of precipitation or more within a 24 hour period). If unable to be present during such a storm, the Monitor shall inspect the site within 24 hours of this event.
    c) The inspections shall be for the purposes of determining compliance with the permit. The Monitor shall submit a written report to the Department within 24 hours of the inspections. The reports shall describe, at a minimum, whether the project is being constructed in accordance with the approved sequence, shall identify any deviation from the conditions of this permit and the approved plans, and identify any other noted deficiencies.
    d) The Monitor shall provide technical assistance and recommendations to the Contractor on the appropriate Best Management Practices for Erosion and Sediment Controls required to meet the requirements of RSA 485-A:17 and all applicable DES permit conditions.
    e) Within 24 hours of each inspection, the Monitor shall submit a report to DES via email (to Craig Rennie at: craig.rennie@des.nh.gov and to Jennifer Drociak at: jennifer.drociak@des.nh.gov)

<u>RESPONSE:</u>

1. A pre- and post-development drainage analysis is provided as requested. See Attachment A for the HydroCAD reports.

2. A curve number summary for the pre-development and post-development reports is provided as requested. See Attachment A for the HydroCAD reports.

3. Section 4.0 of the Stormwater Management Narrative describes the applicable regulatory requirements for this project. Subsection 4.1.1 explains that the project will result in a relatively small amount of new impervious area compared to the total size of the predominantly undeveloped watersheds. When this issue was discussed during the pre-

application meeting held with NHDES, it was concluded that a runoff curve number comparison between the pre-and post-development conditions would be an acceptable substitute for a formal stormwater runoff analysis. The study demonstrated that the project would result in insignificant changes in the total contributing area of the subcatchments, and that neither the composite curve numbers nor the times of concentration would be altered in any of the subcatchments. Based on these facts, the study concluded that the project would not result in a significant change in the volumes or peak rates of runoff from the site. Therefore, channel protection and peak runoff control requirements would be satisfied and no additional measures would be required.

As requested, pre- and post-development drainage analyses were performed for the watersheds which will be impacted by the project. See Attachment A for the HydroCAD reports. The results are summarized in the following tables:

Table 1: Section 1507.05 – Channel Protection

Stormwater Runoff Summary Table					
Analysis Point	Parameter	2-Year Event			
		Pre	Post	Diff.	%
SP-1	Area (ac)	1664.68	1663.54	-1.14	-0.07%
	Flow (cfs)	279.18	278.99	-0.19	-0.07%
	Vol. (ac-ft)	67.79	67.75	-0.05	-0.07%
SP-2	Area (ac)	595.44	595.43	-0.01	0.00%
	Flow (cfs)	139.11	139.10	-0.01	-0.01%
	Vol. (ac-ft)	26.12	26.12	0.00	0.00%
SP-3	Area (ac)	1997.73	1998.42	0.69	0.03%
	Flow (cfs)	193.34	193.40	0.06	0.03%
	Vol. (ac-ft)	69.54	69.56	0.02	0.03%
SP-4	Area (ac)	715.95	716.41	0.46	0.06%
	Flow (cfs)	140.48	140.57	0.09	0.06%
	Vol. (ac-ft)	29.16	29.18	0.02	0.07%

Table 2: Section 1507.06 – Peak Runoff Control

Stormwater Runoff Summary Table					
Analysis Point	Storm Event	Peak Rate of Runoff (cfs)			
		Pre	Post	Diff.	%
SP-1	Area (ac)	1664.68	1663.54	-1.14	-0.07%
	10-year	877.70	877.10	-0.60	-0.07%
	50-year	1622.52	1621.41	-1.11	-0.07%
SP-2	Area (ac)	595.44	595.43	-0.01	0.00%
	10-year	416.29	416.28	-0.01	0.00%
	50-year	754.35	754.34	-0.01	0.00%
SP-3	Area (ac)	1997.73	1998.42	0.69	0.03%
	10-year	655.39	655.61	0.22	0.03%
	50-year	1263.86	1264.30	0.44	0.03%
SP-4	Area (ac)	715.95	716.41	0.46	0.06%
	10-year	441.76	442.04	0.28	0.06%
	50-year	813.70	814.22	0.52	0.06%

The results of this analysis demonstrate the validity of the curve number comparison study; the project will not result in a significant change in the volumes or peak rates of runoff from the site. Therefore, channel protection and peak runoff control requirements are satisfied and no additional measures are required.

4. Sheet flow lengths for the Time of Concentration calculations have been revised as requested. See Attachment B for the calculation sheets.

5. As requested, Stormwater Treatment BMP worksheets (obtained from the NHDES website) for each of the proposed treatment devices are provided. See Attachment C for the worksheets.

6. Chapter 2, Section 3 of the "New Hampshire Stormwater Manual, Volume 2" states that the Groundwater Recharge Volume (GRV) is calculated by the equation:

   $$GRV = (Ai)*(Rd)$$

   where "Ai" is the Effective Impervious Area and "Rd" is the groundwater recharge depth. In addition, Chapter 5, Section 2 of the "New Hampshire Stormwater Manual, Volume 1" defines Effective Impervious Area as "the portion of the total impervious cover that is directly connected to the storm drain network."

   The stormwater management system proposed for this project is designed to convert concentrated flows to sheet flow and release them overland. No direct connections to a storm drain network are proposed, so the effective impervious area (Ai) and therefore GRV are zero.

7. Project design focused on avoiding or minimizing impacts to natural resources to the extent practical. Consultations with Natural Heritage Bureau (NHB) and NH Fish & Game Dept. (NHFG) have not indicated concerns over impacts to either exemplary natural communities or species of concern to date.

   Initial consultation with NHB did not indicate the presence of known exemplary natural communities or species of concern within the project area. See the attached memos (Attachment D) from NHB. That consultation, however, did identify the potential for certain communities and species to be found in the project area. Subsequent field surveys for natural communities and rare plants did not detect any exemplary natural communities on the site and no rare plants were observed. Survey reports that support this finding were shared with NHB. NHB staff also visited the site on December 13, 2011, and during this site visit concurred with the applicant that no exemplary natural communities or rare plants are found in the project area. To date we have not received written confirmation from NHB.

   Initial consultation with NHFG also did not indicate the presence of species of concern in the project area. Avian and bat study scopes and survey protocols were sent to NHFG on March 17, 2011. An inter-agency meeting to review the proposed study scopes and survey protocols was held April 6, 2011. NHFG was invited, however, they did not attend this meeting and did not offer any comments, written or otherwise. Comments on the survey protocols made by USFWS were addressed and revised protocols were sent to agencies May 23, 2011. No comments were received from NHFG. Surveys were performed during the spring, summer and fall of 2011, and a study results summary report was sent to the agencies, including NHFG, on November 22, 2011. NHFG did not raise any issues regarding species of concern at that time. During a subsequent site visit with NHFG on December 12, 2011, no issues regarding species of concern were raised. To date we have not received written confirmation from NHFG.

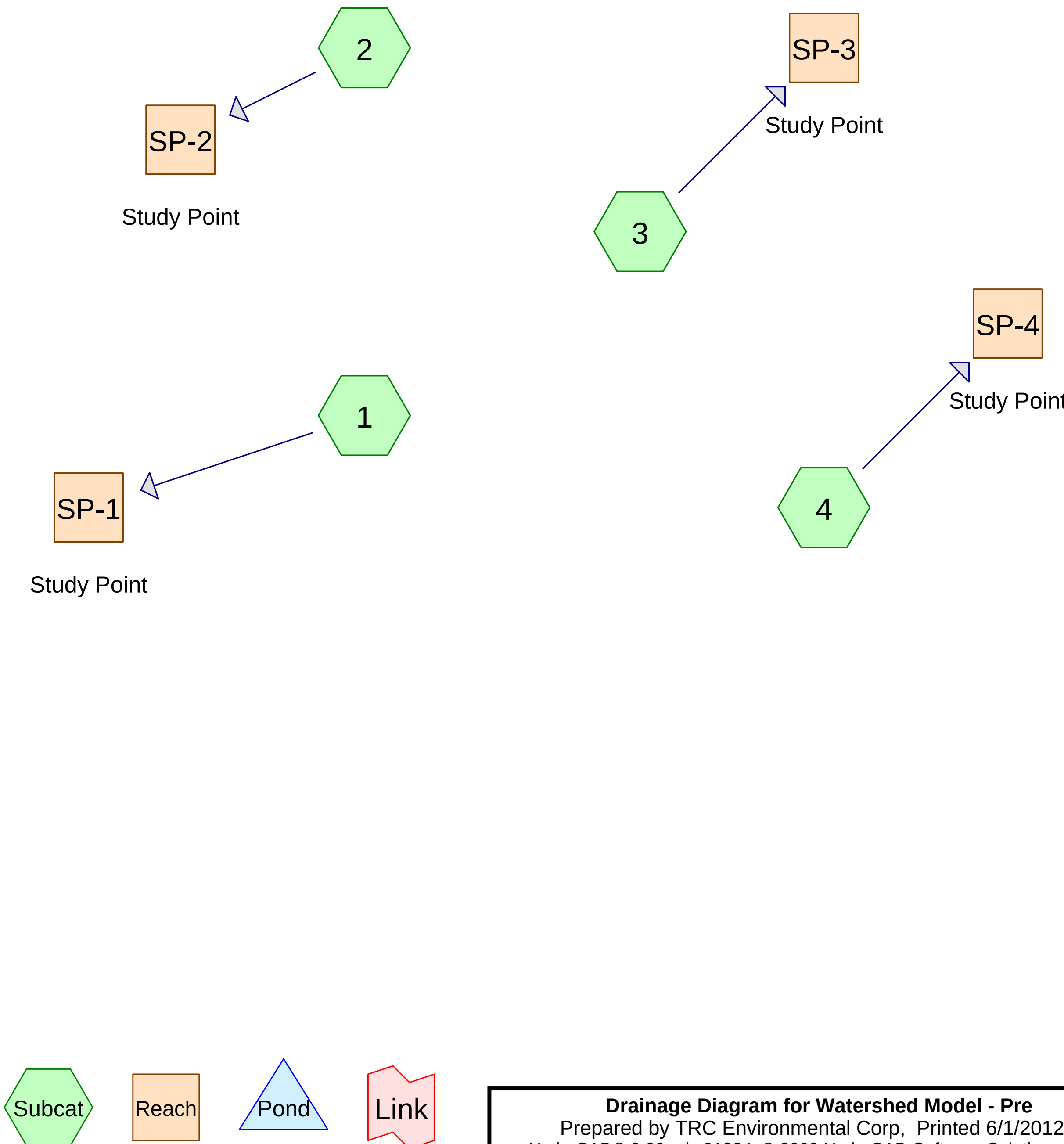
8. Riprap sizing calculations for this project can be found in “APPENDIX C – Conveyance and Stabilization Calculations” of the Stormwater Management Narrative.

9. As requested, the construction monitoring notes have been added to Sheet G-2 “PROJECT NOTES, LEGEND, AND ABBREVIATIONS” of the Permit Plan Set.

Name of Person
Preparing Response: Patrick M. Martin, PE **Date: June 14, 2012**

ATTACHMENT A

HydroCAD Report



Drainage Diagram for Watershed Model - Pre
Prepared by TRC Environmental Corp, Printed 6/1/2012

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
16.165	30	Meadow, non-grazed, HSG A (1, 2, 3, 4)
142.523	30	Woods, Good, HSG A (1, 2, 3, 4)
936.453	55	Woods, Good, HSG B (1, 2, 3, 4)
33.407	58	Meadow, non-grazed, HSG B (1, 2, 3, 4)
3,340.589	70	Woods, Good, HSG C (1, 2, 3, 4)
109.373	71	Meadow, non-grazed, HSG C (1, 2, 3, 4)
3.284	76	Gravel roads, HSG A (1, 2, 3, 4)
225.592	77	Woods, Good, HSG D (1, 2, 3, 4)
139.499	78	Meadow, non-grazed, HSG D (1, 2, 3, 4)
6.847	85	Gravel roads, HSG B (1, 2, 3, 4)
12.892	89	Gravel roads, HSG C (1, 2, 3)
1.950	91	Gravel roads, HSG D (1, 2, 3)
3.281	98	Paved roads (1)
1.946	98	Roofs (1, 2, 3)
4,973.801		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1:	Runoff Area=1,664.684 ac 0.24% Impervious Runoff Depth=0.49" Tc=62.8 min CN=67 Runoff=279.18 cfs 67.794 af
Subcatchment 2:	Runoff Area=595.437 ac 0.04% Impervious Runoff Depth=0.53" Tc=42.9 min CN=68 Runoff=139.11 cfs 26.117 af
Subcatchment 3:	Runoff Area=1,997.728 ac 0.05% Impervious Runoff Depth=0.42" Tc=104.8 min CN=65 Runoff=193.34 cfs 69.540 af
Subcatchment 4:	Runoff Area=715.952 ac 0.00% Impervious Runoff Depth=0.49" Tc=48.3 min CN=67 Runoff=140.48 cfs 29.157 af
Reach SP-1: Study Point	Inflow=279.18 cfs 67.794 af Outflow=279.18 cfs 67.794 af
Reach SP-2: Study Point	Inflow=139.11 cfs 26.117 af Outflow=139.11 cfs 26.117 af
Reach SP-3: Study Point	Inflow=193.34 cfs 69.540 af Outflow=193.34 cfs 69.540 af
Reach SP-4: Study Point	Inflow=140.48 cfs 29.157 af Outflow=140.48 cfs 29.157 af

Total Runoff Area = 4,973.801 ac Runoff Volume = 192.607 af Average Runoff Depth = 0.46"
99.89% Pervious = 4,968.574 ac 0.11% Impervious = 5.227 ac

Summary for Subcatchment 1:

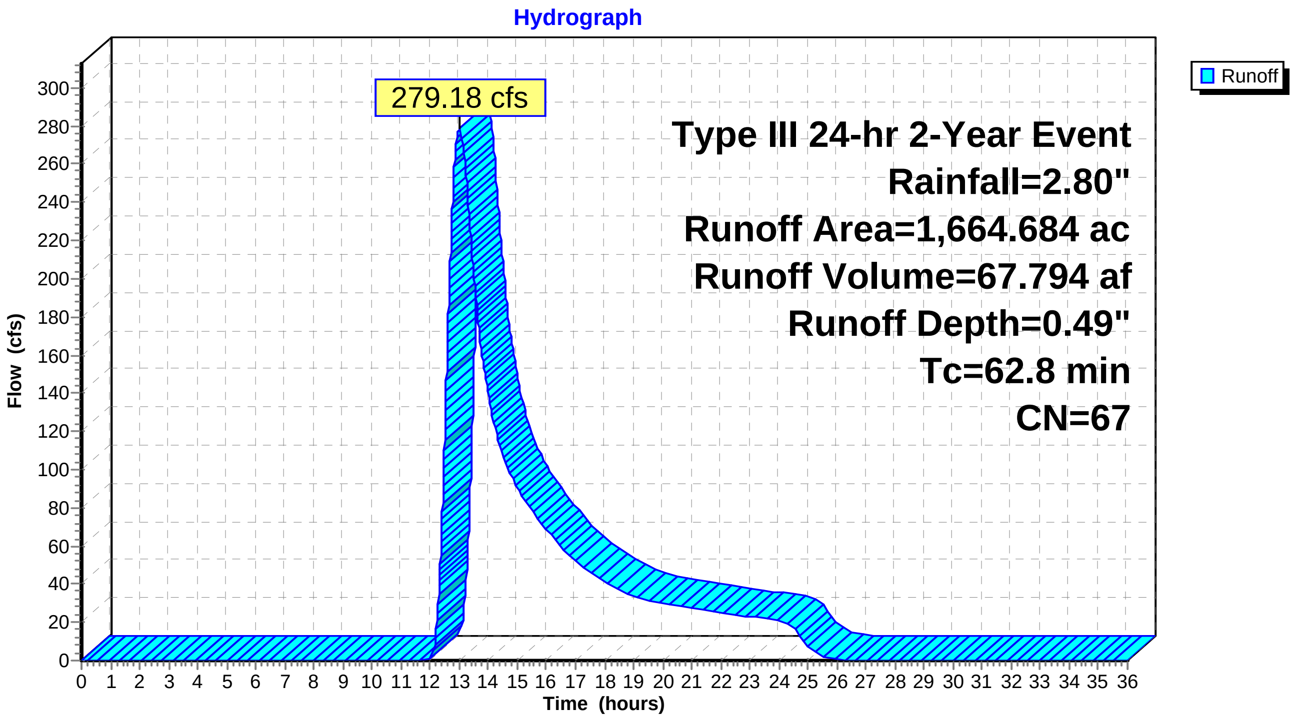
Runoff = 279.18 cfs @ 13.04 hrs, Volume= 67.794 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.788	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	1.753	89	Gravel roads, HSG C
	1.575	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	37.423	71	Meadow, non-grazed, HSG C
	6.536	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,282.411	70	Woods, Good, HSG C
	80.789	77	Woods, Good, HSG D
	1,664.684	67	Weighted Average
	1,660.615		99.76% Pervious Area
	4.069		0.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8					**Direct Entry, See spreadsheet**

Subcatchment 1:



Summary for Subcatchment 2:

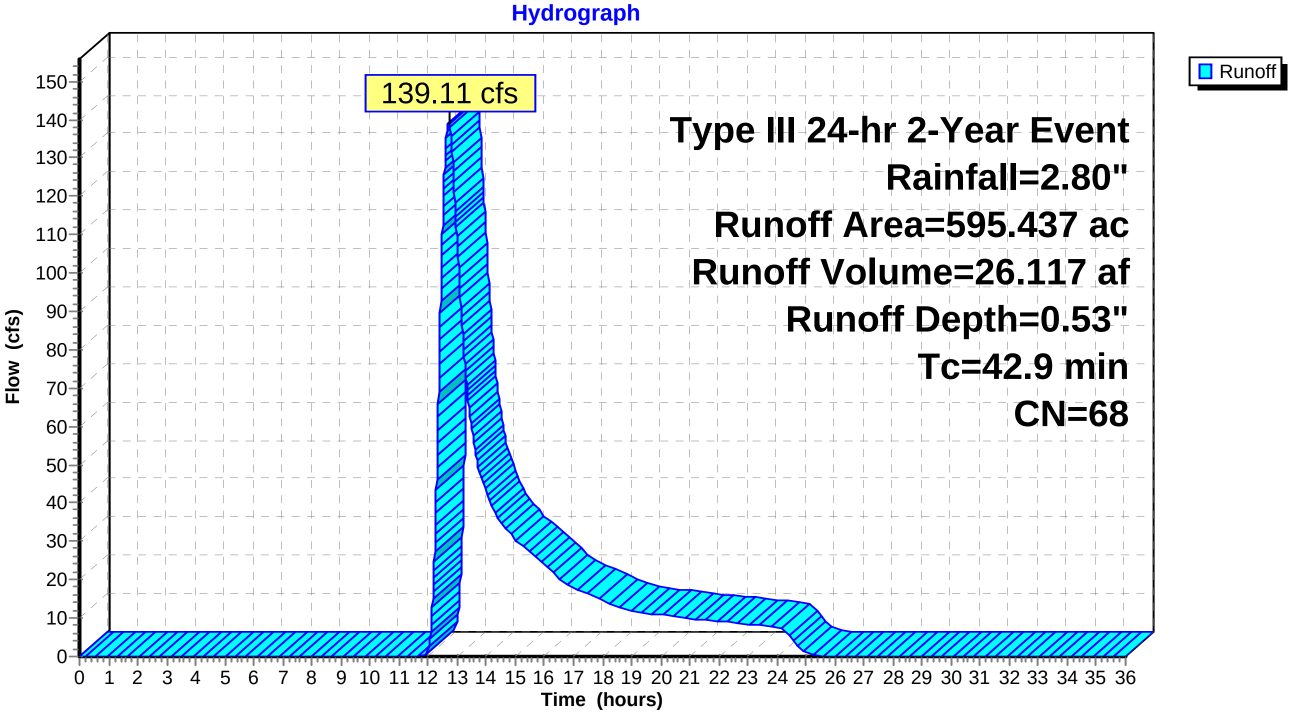
Runoff = 139.11 cfs @ 12.72 hrs, Volume= 26.117 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.068	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	7.926	71	Meadow, non-grazed, HSG C
	44.214	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	430.277	70	Woods, Good, HSG C
	45.093	77	Woods, Good, HSG D
	595.437	68	Weighted Average
	595.195		99.96% Pervious Area
	0.242		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9					**Direct Entry, See spreadsheet**

Subcatchment 2:



Summary for Subcatchment 3:

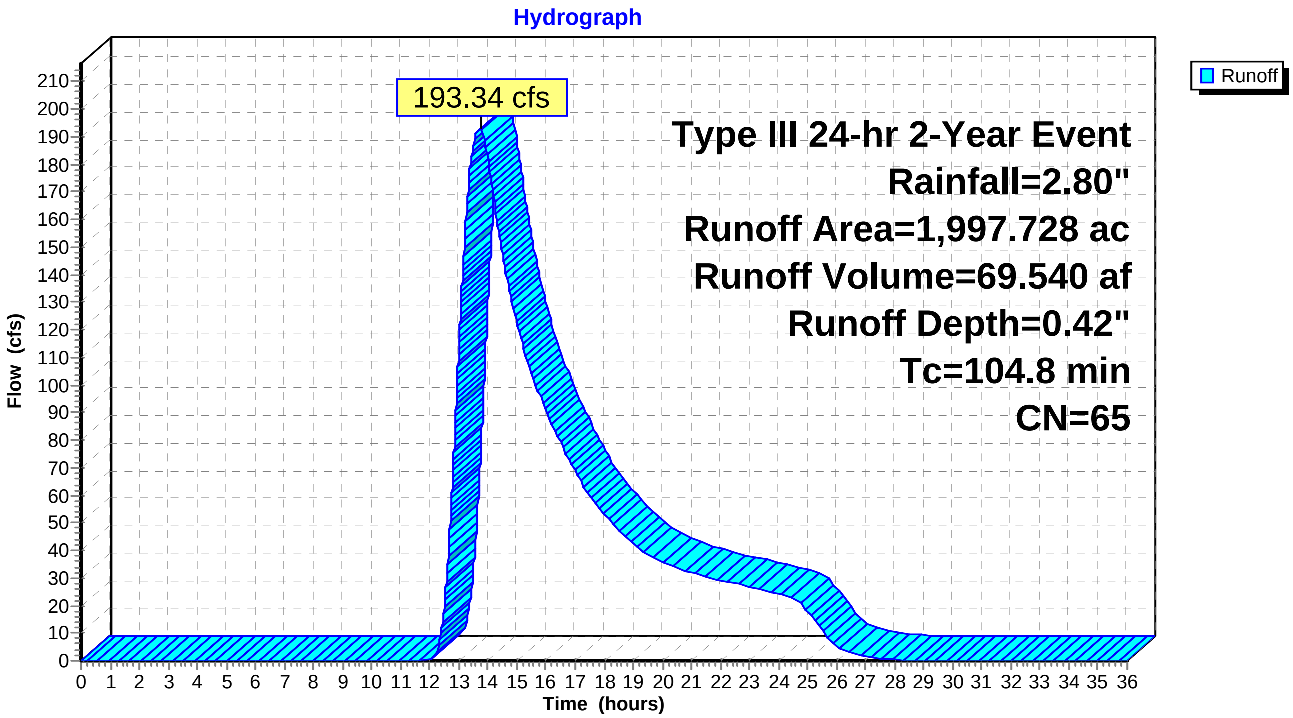
Runoff = 193.34 cfs @ 13.74 hrs, Volume= 69.540 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.071	89	Gravel roads, HSG C
	0.057	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	53.756	71	Meadow, non-grazed, HSG C
	86.160	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,103.235	70	Woods, Good, HSG C
	77.747	77	Woods, Good, HSG D
	1,997.728	65	Weighted Average
	1,996.812		99.95% Pervious Area
	0.916		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
104.8					**Direct Entry, See spreadsheet**

Subcatchment 3:



Summary for Subcatchment 4:

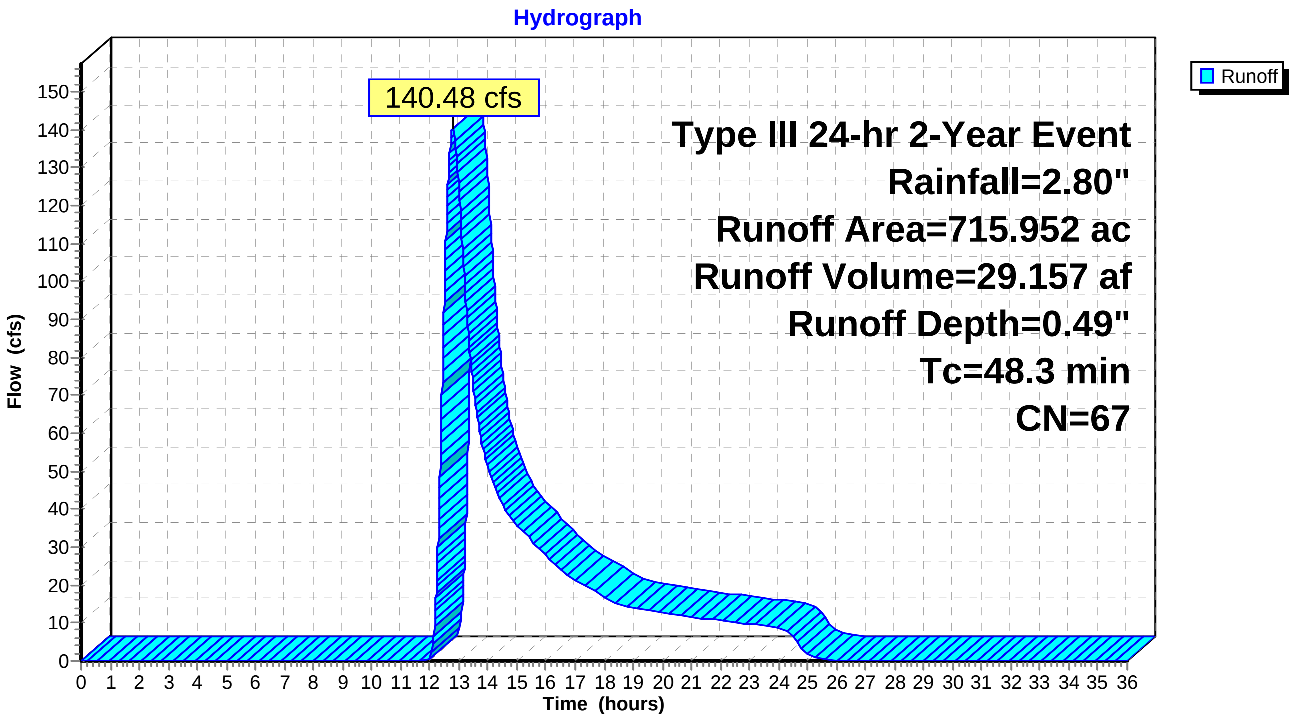
Runoff = 140.48 cfs @ 12.82 hrs, Volume= 29.157 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

Area (ac)	CN	Description
0.249	76	Gravel roads, HSG A
0.266	85	Gravel roads, HSG B
0.175	30	Meadow, non-grazed, HSG A
0.183	58	Meadow, non-grazed, HSG B
10.268	71	Meadow, non-grazed, HSG C
2.589	78	Meadow, non-grazed, HSG D
5.362	30	Woods, Good, HSG A
150.231	55	Woods, Good, HSG B
524.666	70	Woods, Good, HSG C
21.963	77	Woods, Good, HSG D
715.952	67	Weighted Average
715.952		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.3					**Direct Entry, See spreadsheet**

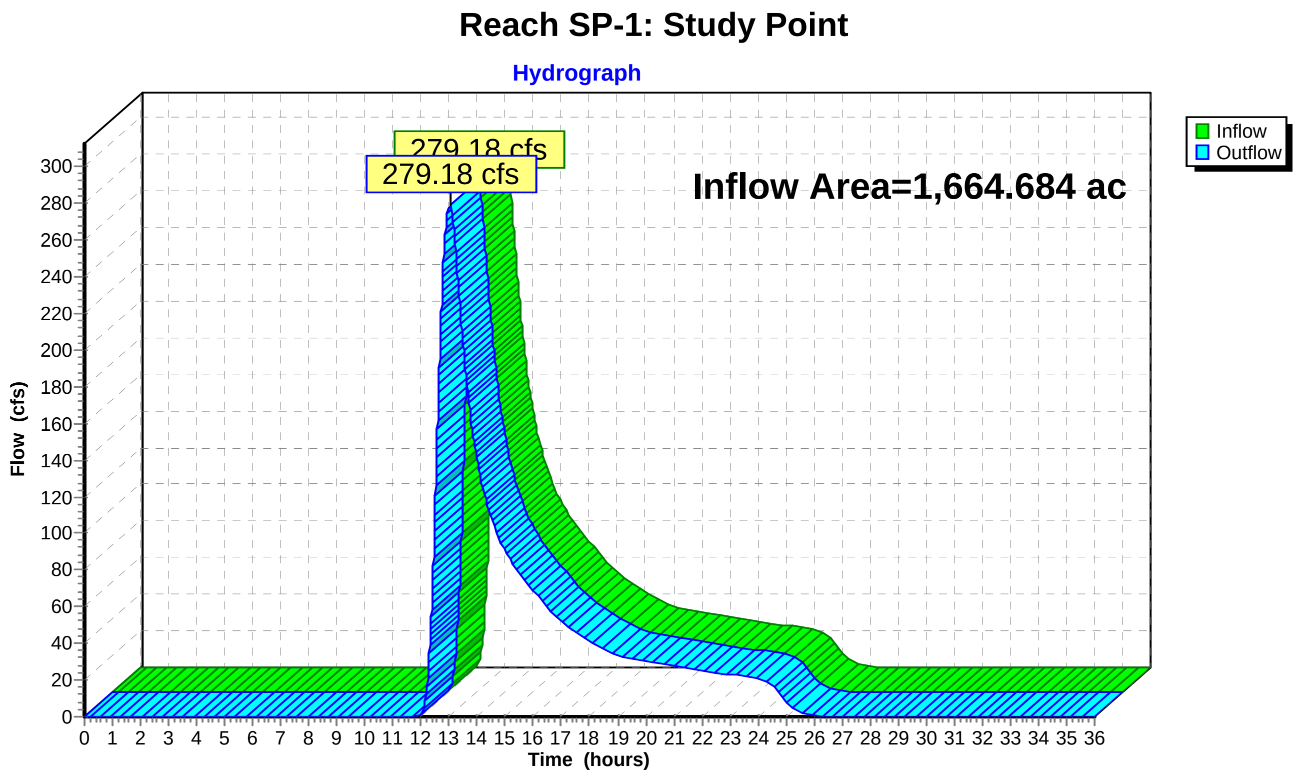
Subcatchment 4:



Summary for Reach SP-1: Study Point

Inflow Area =	1,664.684 ac,	0.24% Impervious,	Inflow Depth =	0.49"	for 2-Year Event event	
Inflow =	279.18 cfs @	13.04 hrs,	Volume=	67.794 af		
Outflow =	279.18 cfs @	13.04 hrs,	Volume=	67.794 af,	Atten= 0%,	Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

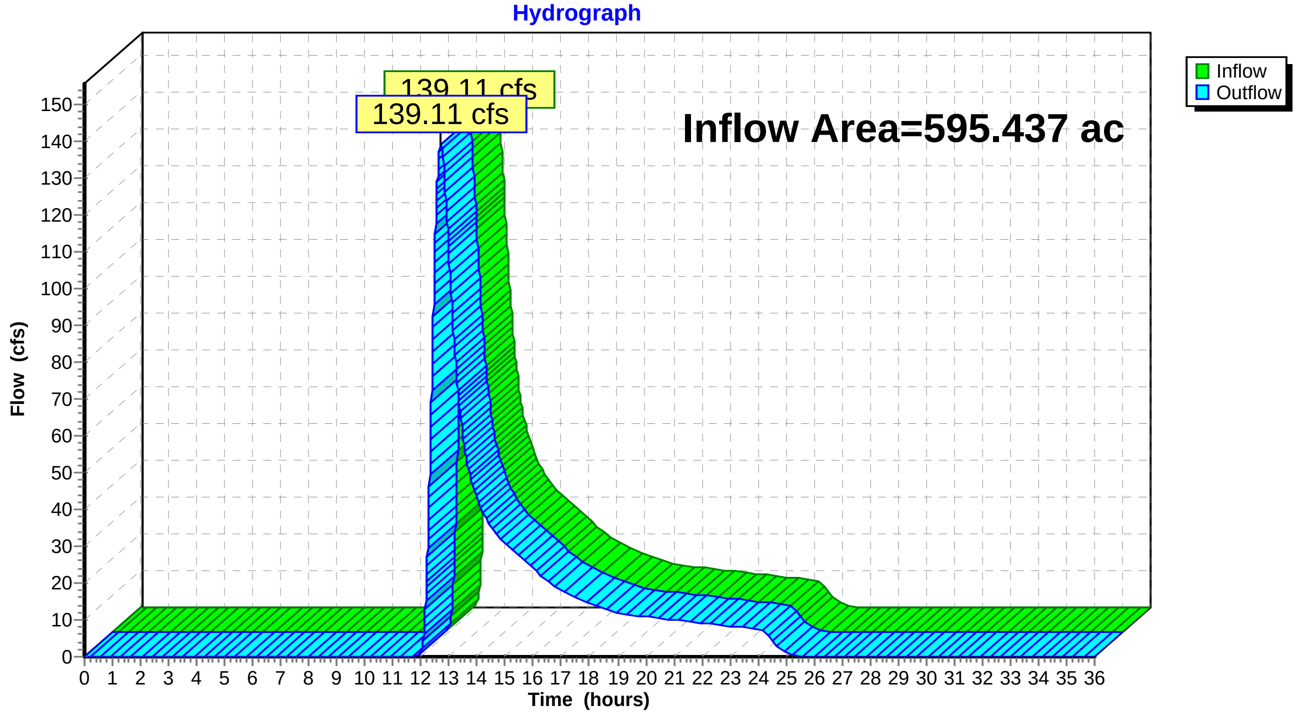


Summary for Reach SP-2: Study Point

Inflow Area = 595.437 ac, 0.04% Impervious, Inflow Depth = 0.53" for 2-Year Event event
Inflow = 139.11 cfs @ 12.72 hrs, Volume= 26.117 af
Outflow = 139.11 cfs @ 12.72 hrs, Volume= 26.117 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

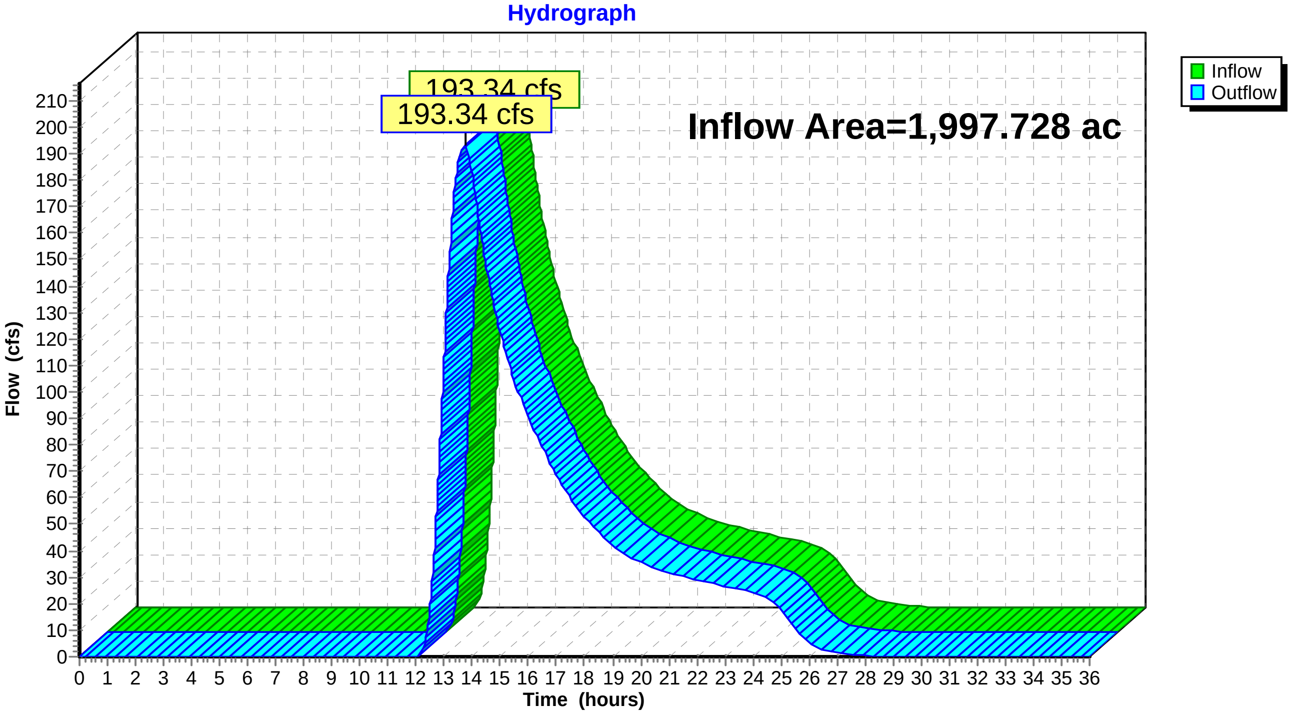


Summary for Reach SP-3: Study Point

Inflow Area = 1,997.728 ac, 0.05% Impervious, Inflow Depth = 0.42" for 2-Year Event event
Inflow = 193.34 cfs @ 13.74 hrs, Volume= 69.540 af
Outflow = 193.34 cfs @ 13.74 hrs, Volume= 69.540 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point

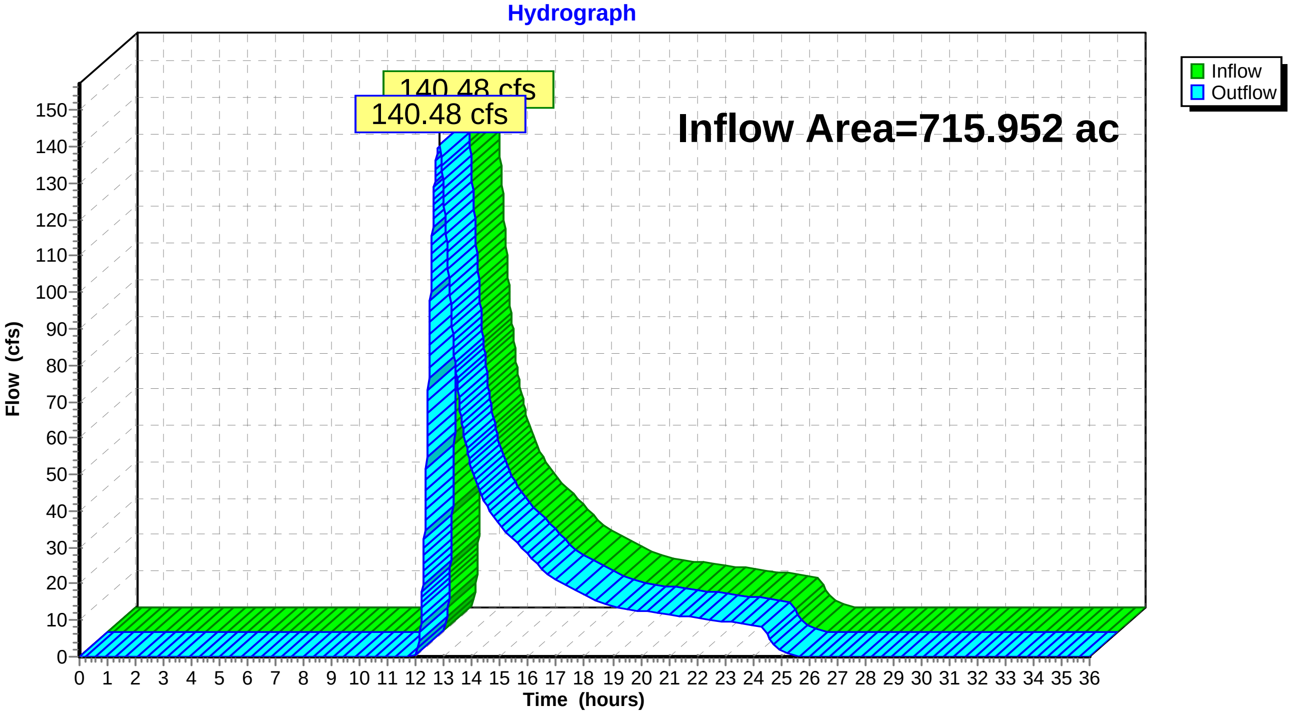


Summary for Reach SP-4: Study Point

Inflow Area = 715.952 ac, 0.00% Impervious, Inflow Depth = 0.49" for 2-Year Event event
Inflow = 140.48 cfs @ 12.82 hrs, Volume= 29.157 af
Outflow = 140.48 cfs @ 12.82 hrs, Volume= 29.157 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-4: Study Point



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff Area=1,664.684 ac 0.24% Impervious Runoff Depth=1.27"
Tc=62.8 min CN=67 Runoff=877.70 cfs 176.138 af

Subcatchment 2: Runoff Area=595.437 ac 0.04% Impervious Runoff Depth=1.33"
Tc=42.9 min CN=68 Runoff=416.29 cfs 66.162 af

Subcatchment 3: Runoff Area=1,997.728 ac 0.05% Impervious Runoff Depth=1.15"
Tc=104.8 min CN=65 Runoff=655.39 cfs 190.857 af

Subcatchment 4: Runoff Area=715.952 ac 0.00% Impervious Runoff Depth=1.27"
Tc=48.3 min CN=67 Runoff=441.76 cfs 75.754 af

Reach SP-1: Study Point Inflow=877.70 cfs 176.138 af
Outflow=877.70 cfs 176.138 af

Reach SP-2: Study Point Inflow=416.29 cfs 66.162 af
Outflow=416.29 cfs 66.162 af

Reach SP-3: Study Point Inflow=655.39 cfs 190.857 af
Outflow=655.39 cfs 190.857 af

Reach SP-4: Study Point Inflow=441.76 cfs 75.754 af
Outflow=441.76 cfs 75.754 af

Total Runoff Area = 4,973.801 ac Runoff Volume = 508.910 af Average Runoff Depth = 1.23"
99.89% Pervious = 4,968.574 ac 0.11% Impervious = 5.227 ac

Summary for Subcatchment 1:

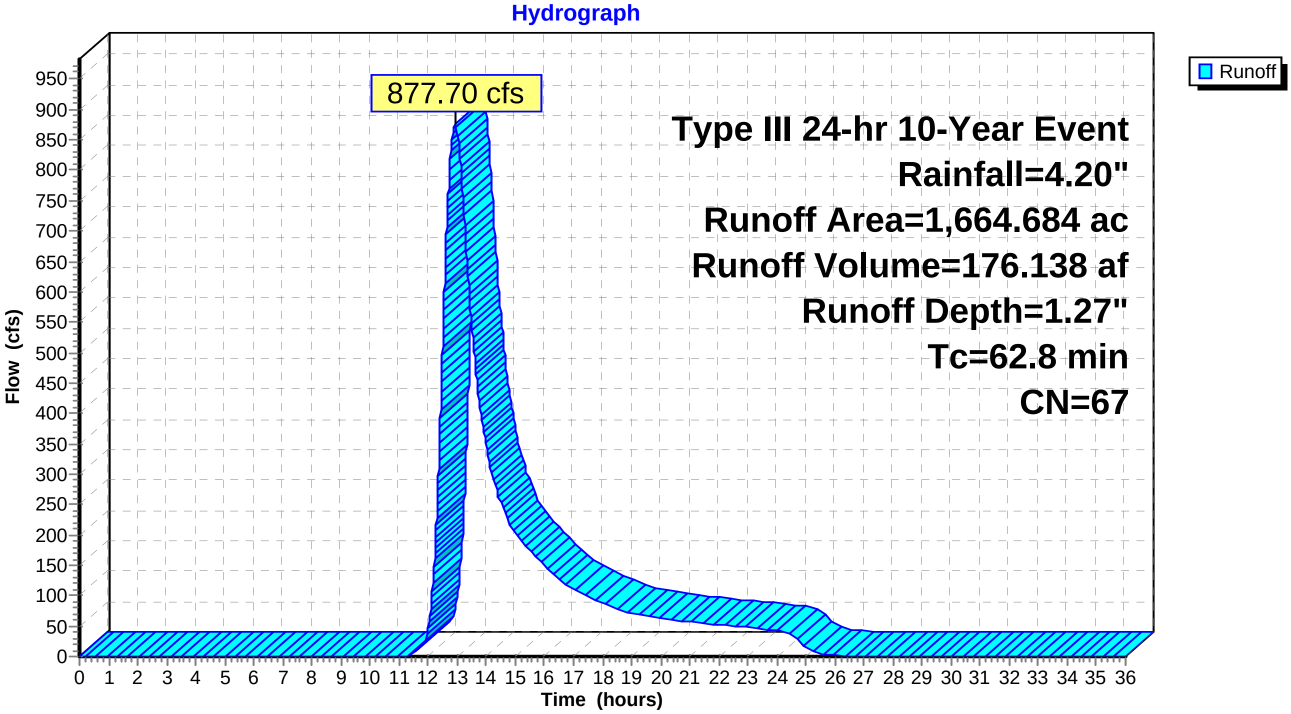
Runoff = 877.70 cfs @ 12.91 hrs, Volume= 176.138 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.788	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	1.753	89	Gravel roads, HSG C
	1.575	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	37.423	71	Meadow, non-grazed, HSG C
	6.536	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,282.411	70	Woods, Good, HSG C
	80.789	77	Woods, Good, HSG D
	1,664.684	67	Weighted Average
	1,660.615		99.76% Pervious Area
	4.069		0.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8					**Direct Entry, See spreadsheet**

Subcatchment 1:



Summary for Subcatchment 2:

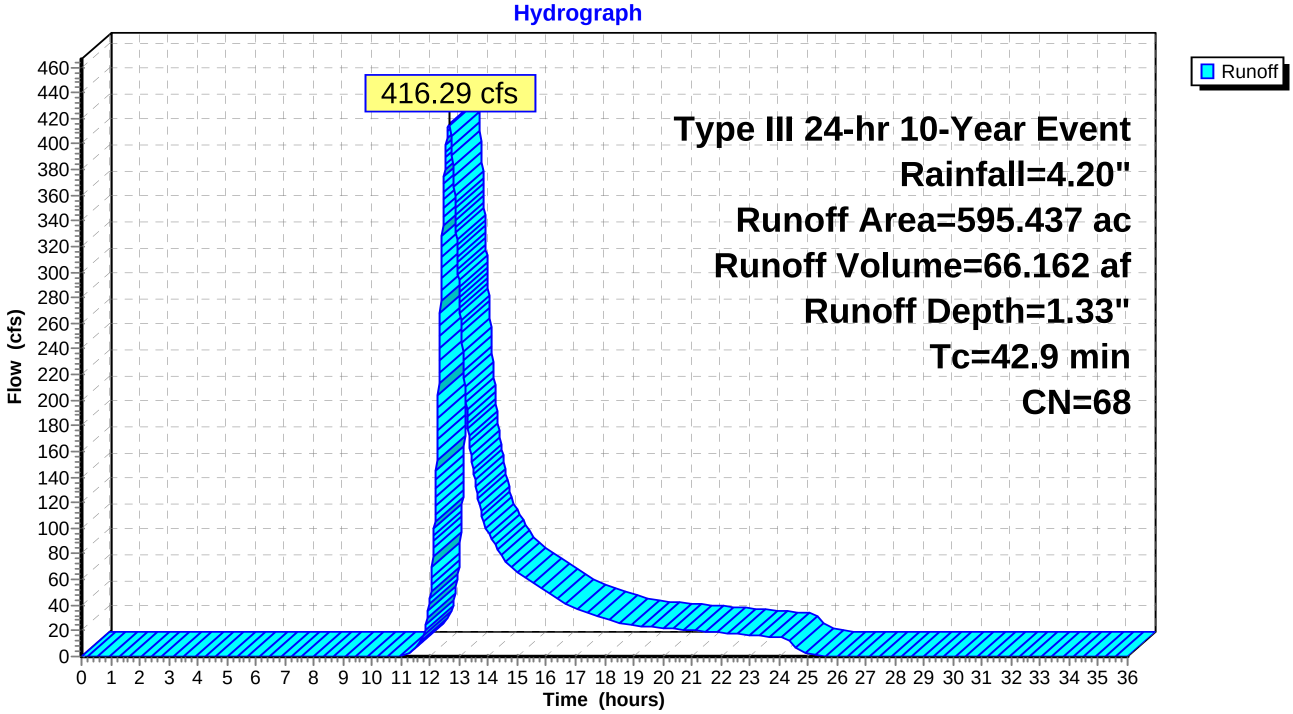
Runoff = 416.29 cfs @ 12.63 hrs, Volume= 66.162 af, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.068	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	7.926	71	Meadow, non-grazed, HSG C
	44.214	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	430.277	70	Woods, Good, HSG C
	45.093	77	Woods, Good, HSG D
	595.437	68	Weighted Average
	595.195		99.96% Pervious Area
	0.242		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9					**Direct Entry, See spreadsheet**

Subcatchment 2:



Summary for Subcatchment 3:

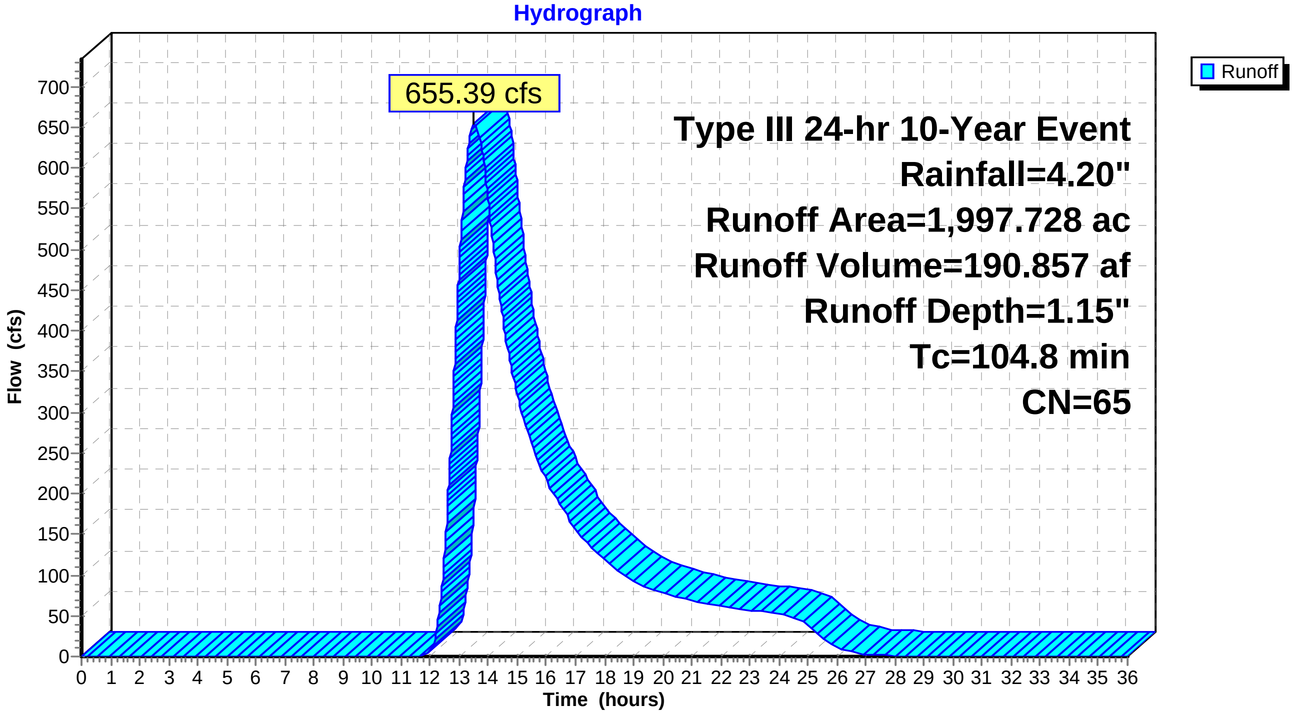
Runoff = 655.39 cfs @ 13.51 hrs, Volume= 190.857 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.071	89	Gravel roads, HSG C
	0.057	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	53.756	71	Meadow, non-grazed, HSG C
	86.160	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,103.235	70	Woods, Good, HSG C
	77.747	77	Woods, Good, HSG D
	1,997.728	65	Weighted Average
	1,996.812		99.95% Pervious Area
	0.916		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
104.8					**Direct Entry, See spreadsheet**

Subcatchment 3:



Summary for Subcatchment 4:

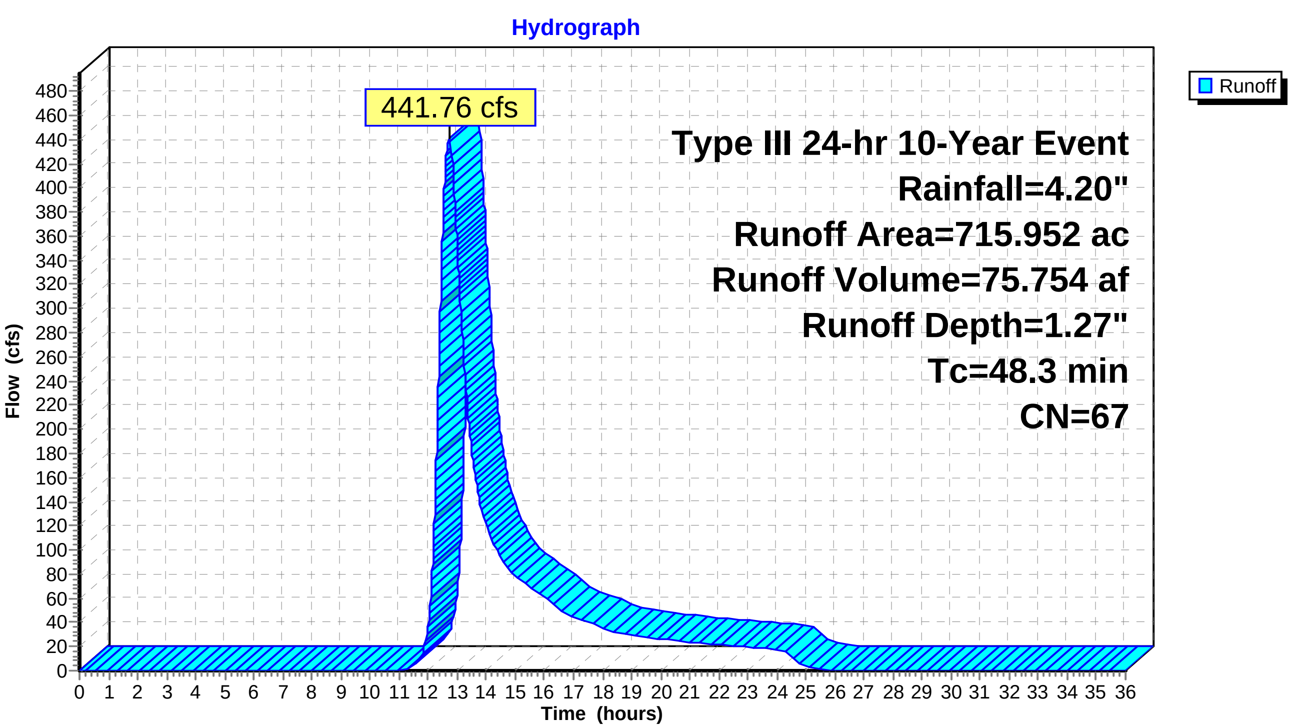
Runoff = 441.76 cfs @ 12.72 hrs, Volume= 75.754 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.249	76	Gravel roads, HSG A
0.266	85	Gravel roads, HSG B
0.175	30	Meadow, non-grazed, HSG A
0.183	58	Meadow, non-grazed, HSG B
10.268	71	Meadow, non-grazed, HSG C
2.589	78	Meadow, non-grazed, HSG D
5.362	30	Woods, Good, HSG A
150.231	55	Woods, Good, HSG B
524.666	70	Woods, Good, HSG C
21.963	77	Woods, Good, HSG D
715.952	67	Weighted Average
715.952		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.3					**Direct Entry, See spreadsheet**

Subcatchment 4:

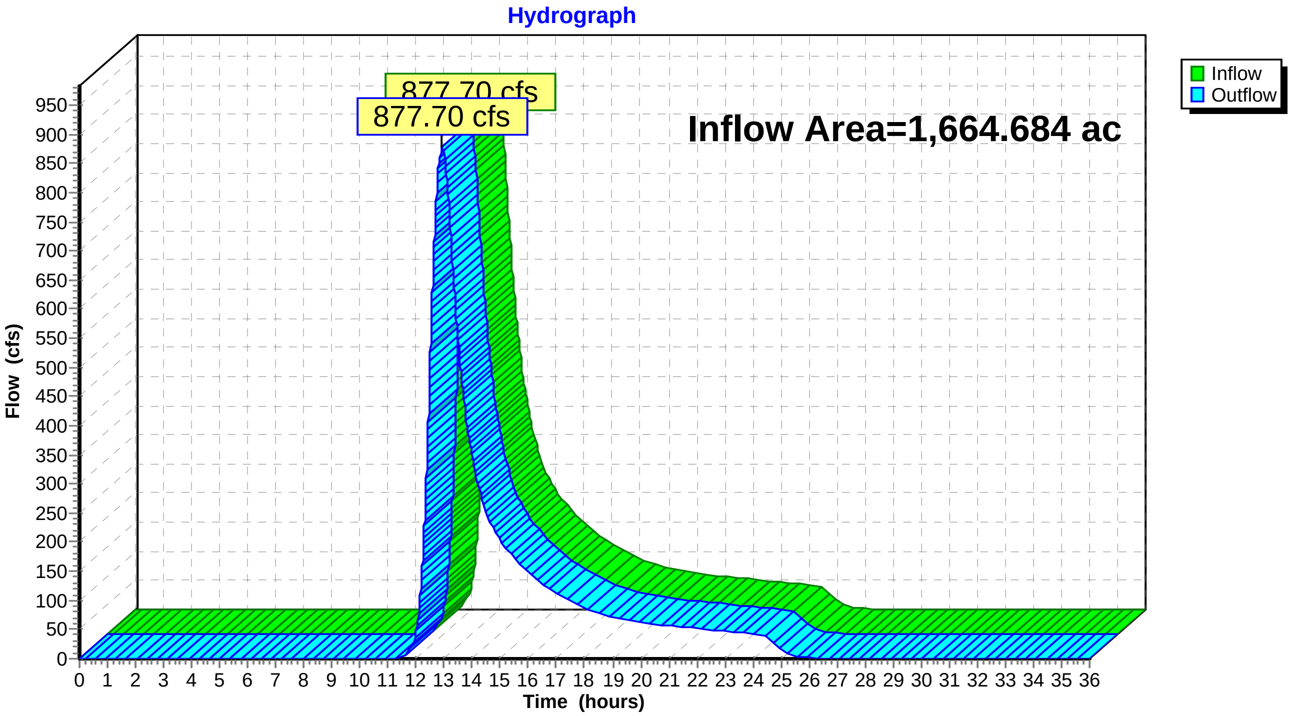


Summary for Reach SP-1: Study Point

Inflow Area = 1,664.684 ac, 0.24% Impervious, Inflow Depth = 1.27" for 10-Year Event event
Inflow = 877.70 cfs @ 12.91 hrs, Volume= 176.138 af
Outflow = 877.70 cfs @ 12.91 hrs, Volume= 176.138 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

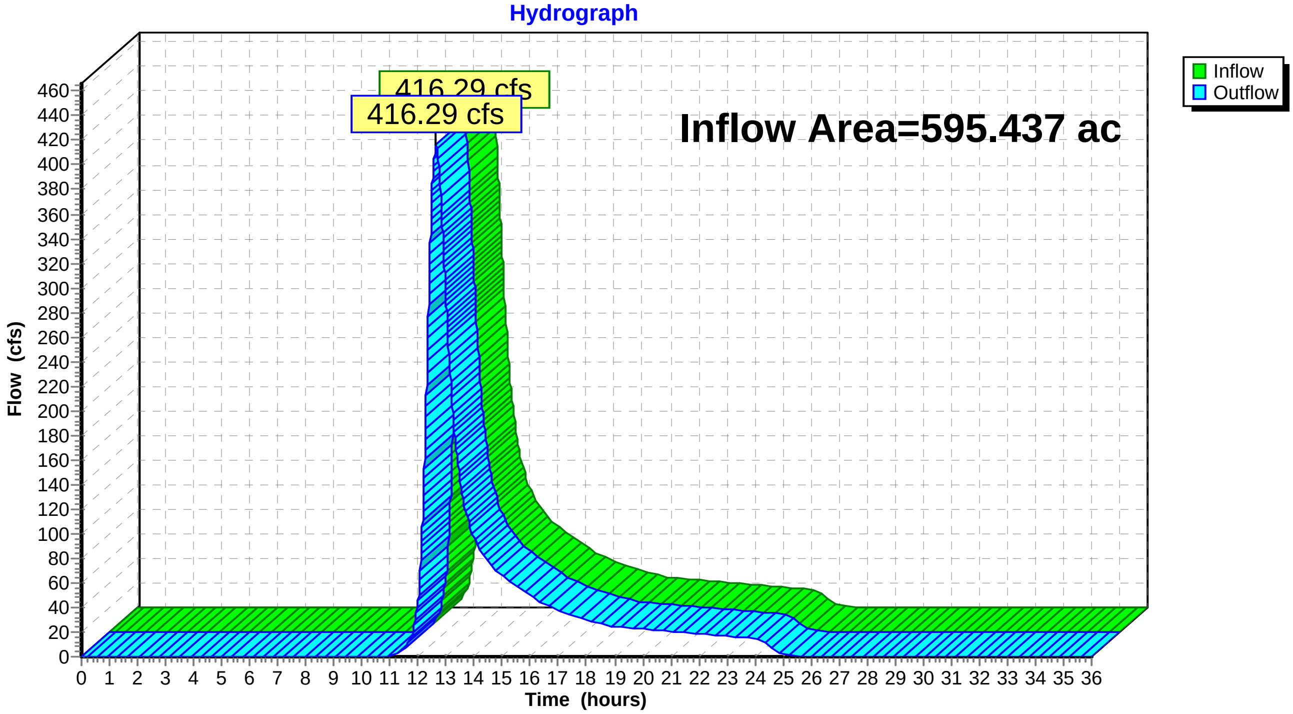


Summary for Reach SP-2: Study Point

Inflow Area = 595.437 ac, 0.04% Impervious, Inflow Depth = 1.33" for 10-Year Event event
Inflow = 416.29 cfs @ 12.63 hrs, Volume= 66.162 af
Outflow = 416.29 cfs @ 12.63 hrs, Volume= 66.162 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

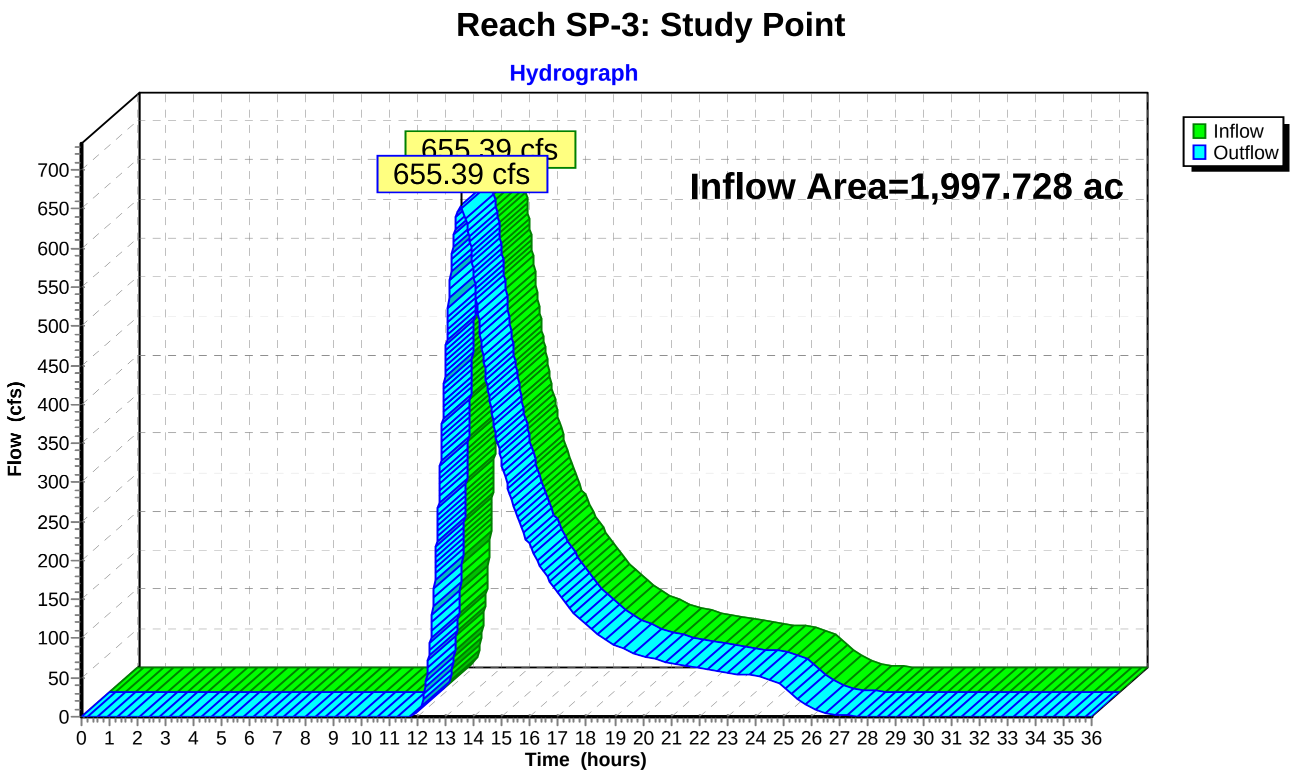
Reach SP-2: Study Point



Summary for Reach SP-3: Study Point

Inflow Area = 1,997.728 ac, 0.05% Impervious, Inflow Depth = 1.15" for 10-Year Event event
Inflow = 655.39 cfs @ 13.51 hrs, Volume= 190.857 af
Outflow = 655.39 cfs @ 13.51 hrs, Volume= 190.857 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

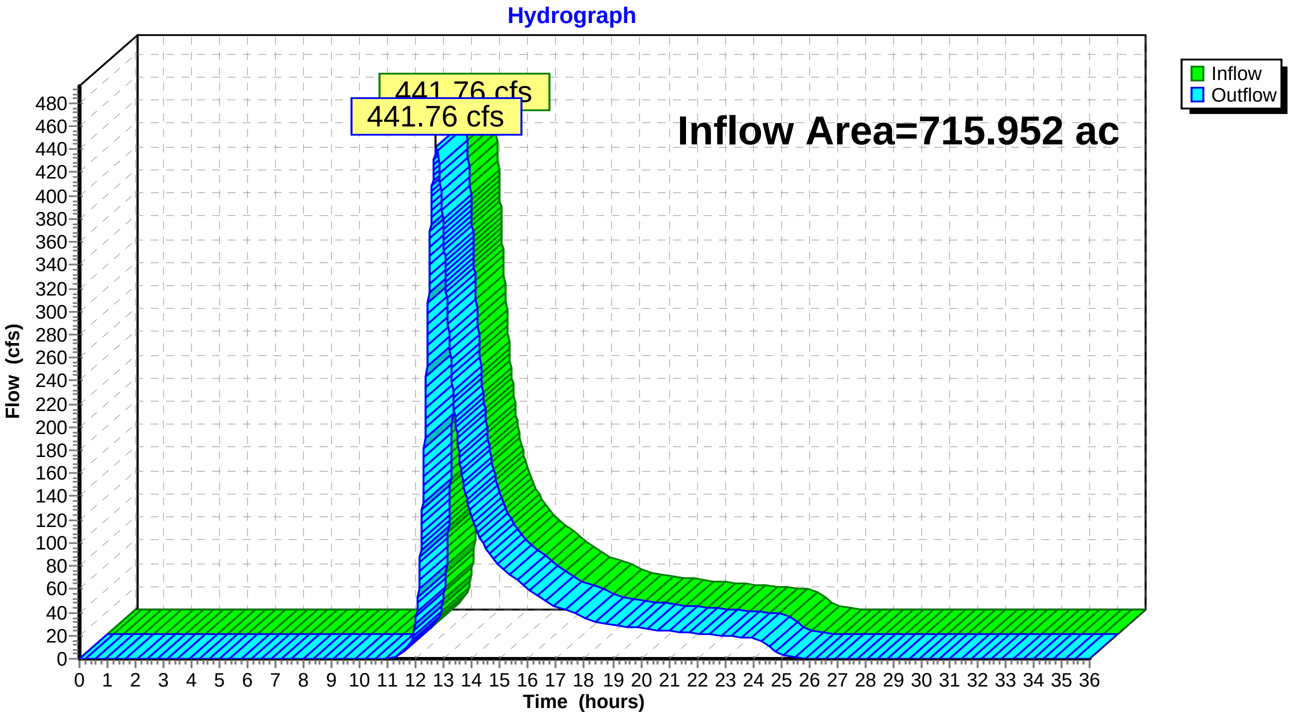


Summary for Reach SP-4: Study Point

Inflow Area =	715.952 ac,	0.00% Impervious, Inflow Depth = 1.27"	for 10-Year Event event	
Inflow =	441.76 cfs @	12.72 hrs, Volume=	75.754 af	
Outflow =	441.76 cfs @	12.72 hrs, Volume=	75.754 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-4: Study Point



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1:	Runoff Area=1,664.684 ac 0.24% Impervious Runoff Depth=2.23" Tc=62.8 min CN=67 Runoff=1,622.52 cfs 309.683 af
Subcatchment 2:	Runoff Area=595.437 ac 0.04% Impervious Runoff Depth=2.32" Tc=42.9 min CN=68 Runoff=754.35 cfs 115.004 af
Subcatchment 3:	Runoff Area=1,997.728 ac 0.05% Impervious Runoff Depth=2.06" Tc=104.8 min CN=65 Runoff=1,263.86 cfs 343.756 af
Subcatchment 4:	Runoff Area=715.952 ac 0.00% Impervious Runoff Depth=2.23" Tc=48.3 min CN=67 Runoff=813.70 cfs 133.190 af
Reach SP-1: Study Point	Inflow=1,622.52 cfs 309.683 af Outflow=1,622.52 cfs 309.683 af
Reach SP-2: Study Point	Inflow=754.35 cfs 115.004 af Outflow=754.35 cfs 115.004 af
Reach SP-3: Study Point	Inflow=1,263.86 cfs 343.756 af Outflow=1,263.86 cfs 343.756 af
Reach SP-4: Study Point	Inflow=813.70 cfs 133.190 af Outflow=813.70 cfs 133.190 af

Total Runoff Area = 4,973.801 ac Runoff Volume = 901.633 af Average Runoff Depth = 2.18"
99.89% Pervious = 4,968.574 ac 0.11% Impervious = 5.227 ac

Summary for Subcatchment 1:

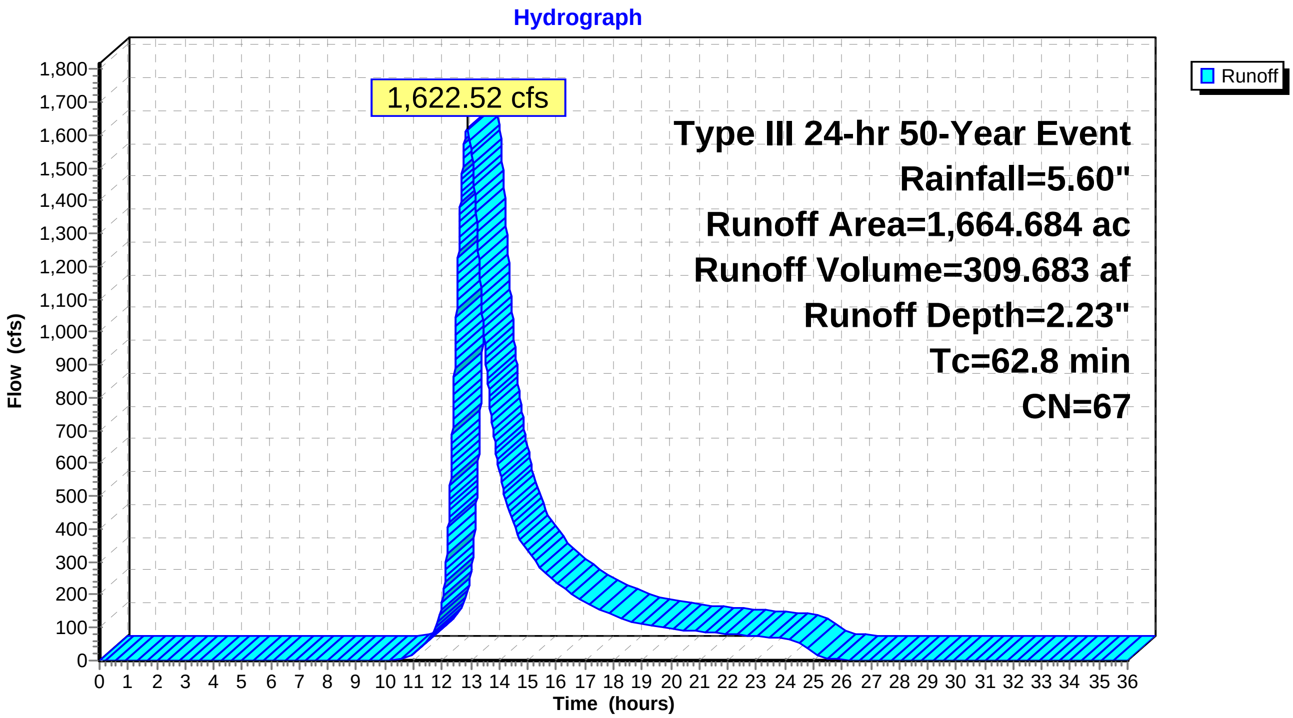
Runoff = 1,622.52 cfs @ 12.91 hrs, Volume= 309.683 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.788	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	1.753	89	Gravel roads, HSG C
	1.575	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	37.423	71	Meadow, non-grazed, HSG C
	6.536	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,282.411	70	Woods, Good, HSG C
	80.789	77	Woods, Good, HSG D
	1,664.684	67	Weighted Average
	1,660.615		99.76% Pervious Area
	4.069		0.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8					**Direct Entry, See spreadsheet**

Subcatchment 1:



Summary for Subcatchment 2:

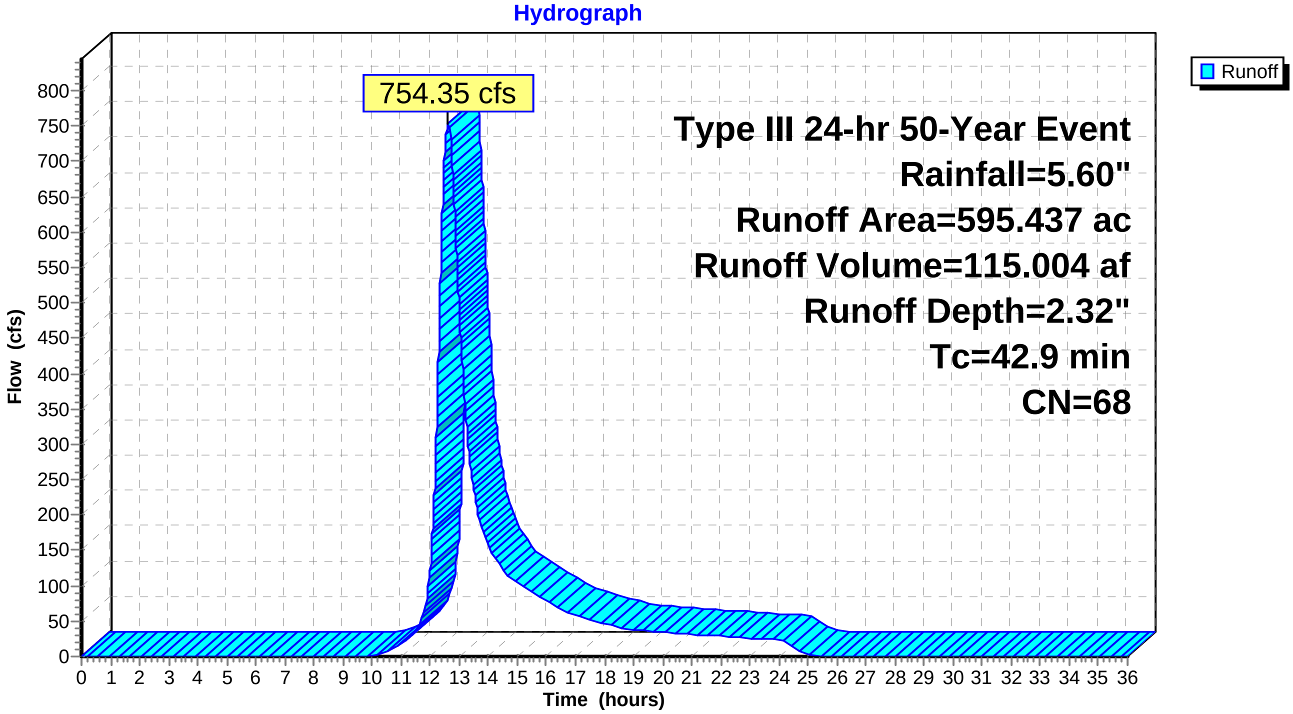
Runoff = 754.35 cfs @ 12.63 hrs, Volume= 115.004 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.068	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	7.926	71	Meadow, non-grazed, HSG C
	44.214	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	430.277	70	Woods, Good, HSG C
	45.093	77	Woods, Good, HSG D
	595.437	68	Weighted Average
	595.195		99.96% Pervious Area
	0.242		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9					**Direct Entry, See spreadsheet**

Subcatchment 2:



Summary for Subcatchment 3:

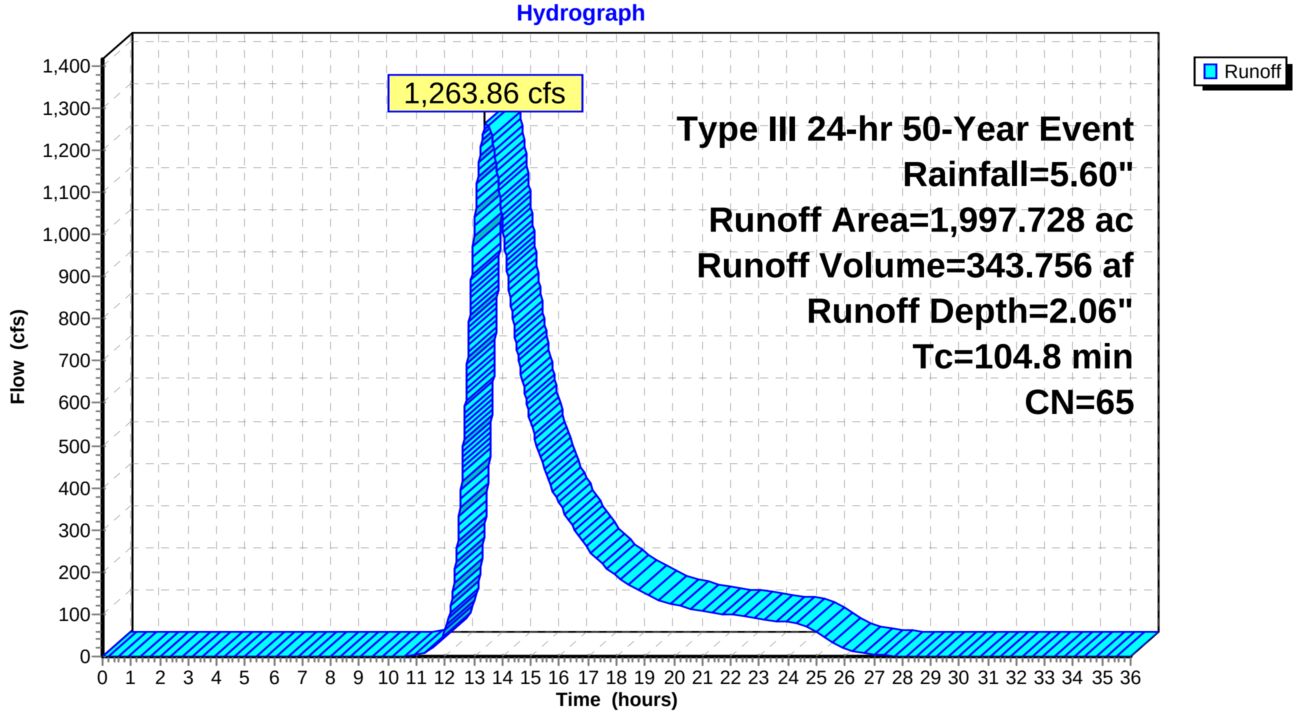
Runoff = 1,263.86 cfs @ 13.40 hrs, Volume= 343.756 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	9.071	89	Gravel roads, HSG C
	0.057	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	53.756	71	Meadow, non-grazed, HSG C
	86.160	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,103.235	70	Woods, Good, HSG C
	77.747	77	Woods, Good, HSG D
	1,997.728	65	Weighted Average
	1,996.812		99.95% Pervious Area
	0.916		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
104.8					**Direct Entry, See spreadsheet**

Subcatchment 3:



Summary for Subcatchment 4:

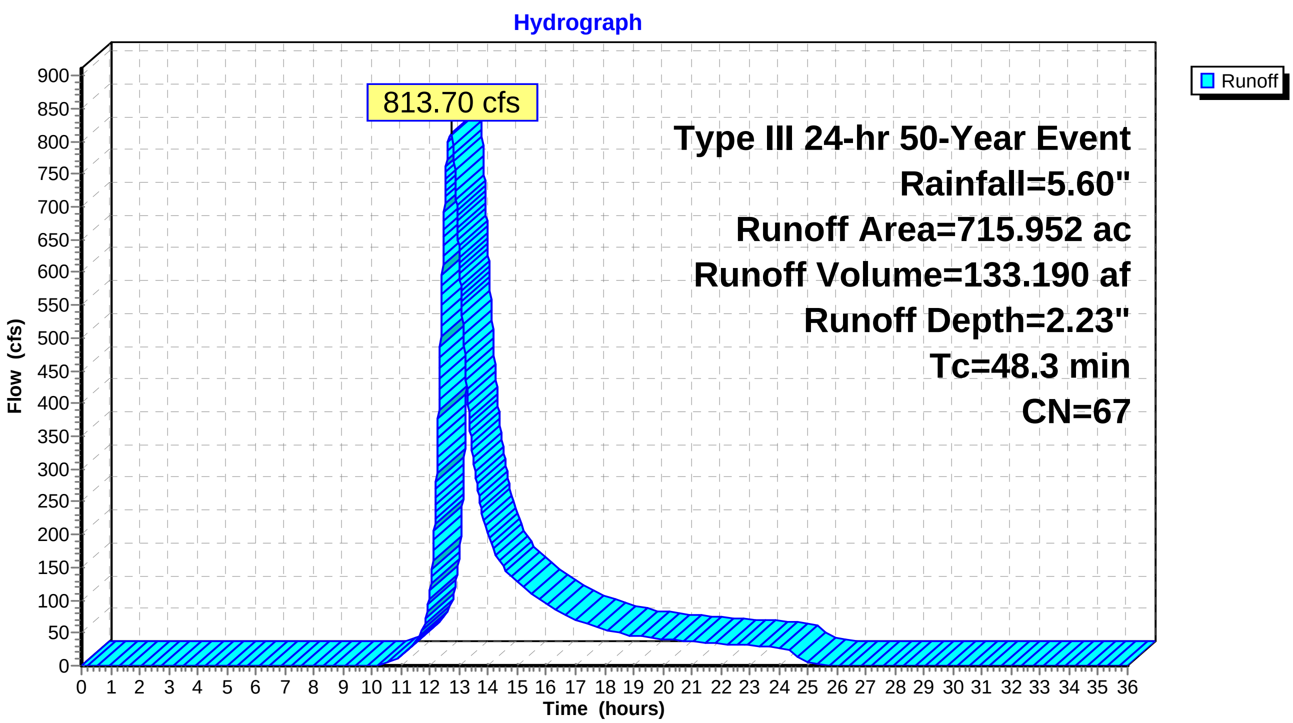
Runoff = 813.70 cfs @ 12.71 hrs, Volume= 133.190 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

Area (ac)	CN	Description
0.249	76	Gravel roads, HSG A
0.266	85	Gravel roads, HSG B
0.175	30	Meadow, non-grazed, HSG A
0.183	58	Meadow, non-grazed, HSG B
10.268	71	Meadow, non-grazed, HSG C
2.589	78	Meadow, non-grazed, HSG D
5.362	30	Woods, Good, HSG A
150.231	55	Woods, Good, HSG B
524.666	70	Woods, Good, HSG C
21.963	77	Woods, Good, HSG D
715.952	67	Weighted Average
715.952		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.3					**Direct Entry, See spreadsheet**

Subcatchment 4:

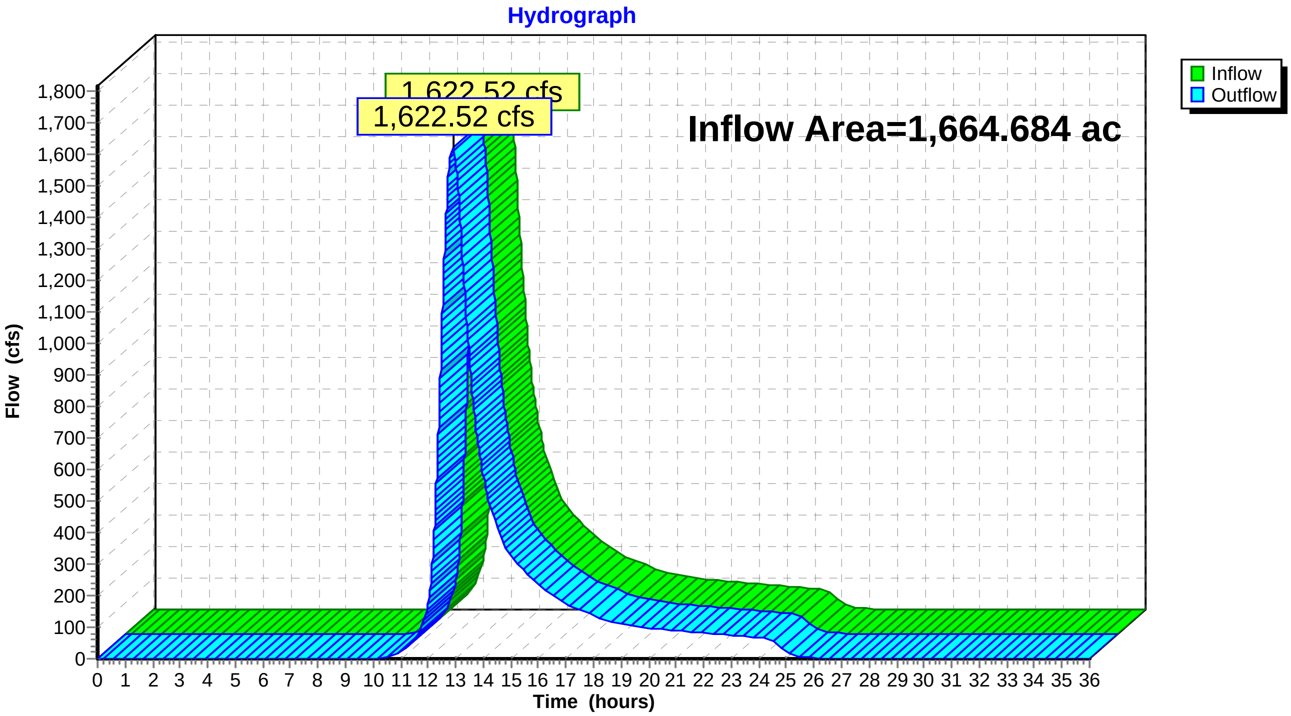


Summary for Reach SP-1: Study Point

Inflow Area = 1,664.684 ac, 0.24% Impervious, Inflow Depth = 2.23" for 50-Year Event event
Inflow = 1,622.52 cfs @ 12.91 hrs, Volume= 309.683 af
Outflow = 1,622.52 cfs @ 12.91 hrs, Volume= 309.683 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

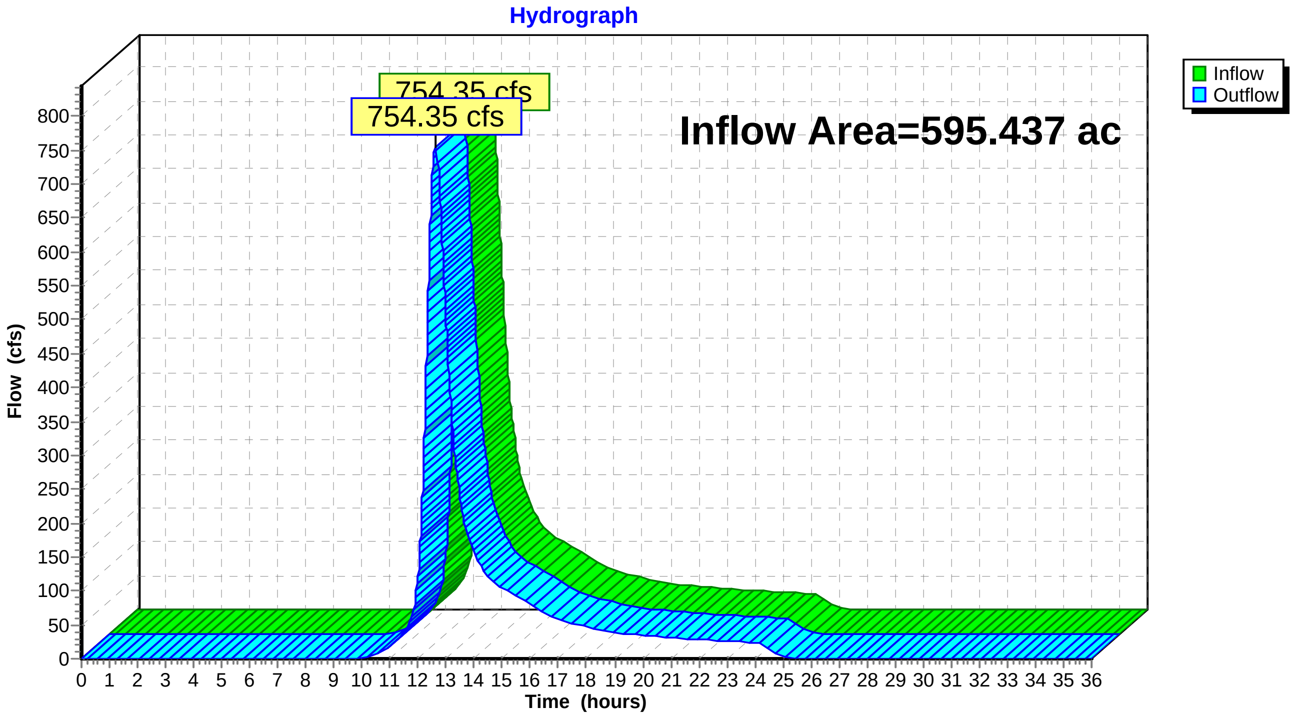


Summary for Reach SP-2: Study Point

Inflow Area = 595.437 ac, 0.04% Impervious, Inflow Depth = 2.32" for 50-Year Event event
Inflow = 754.35 cfs @ 12.63 hrs, Volume= 115.004 af
Outflow = 754.35 cfs @ 12.63 hrs, Volume= 115.004 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

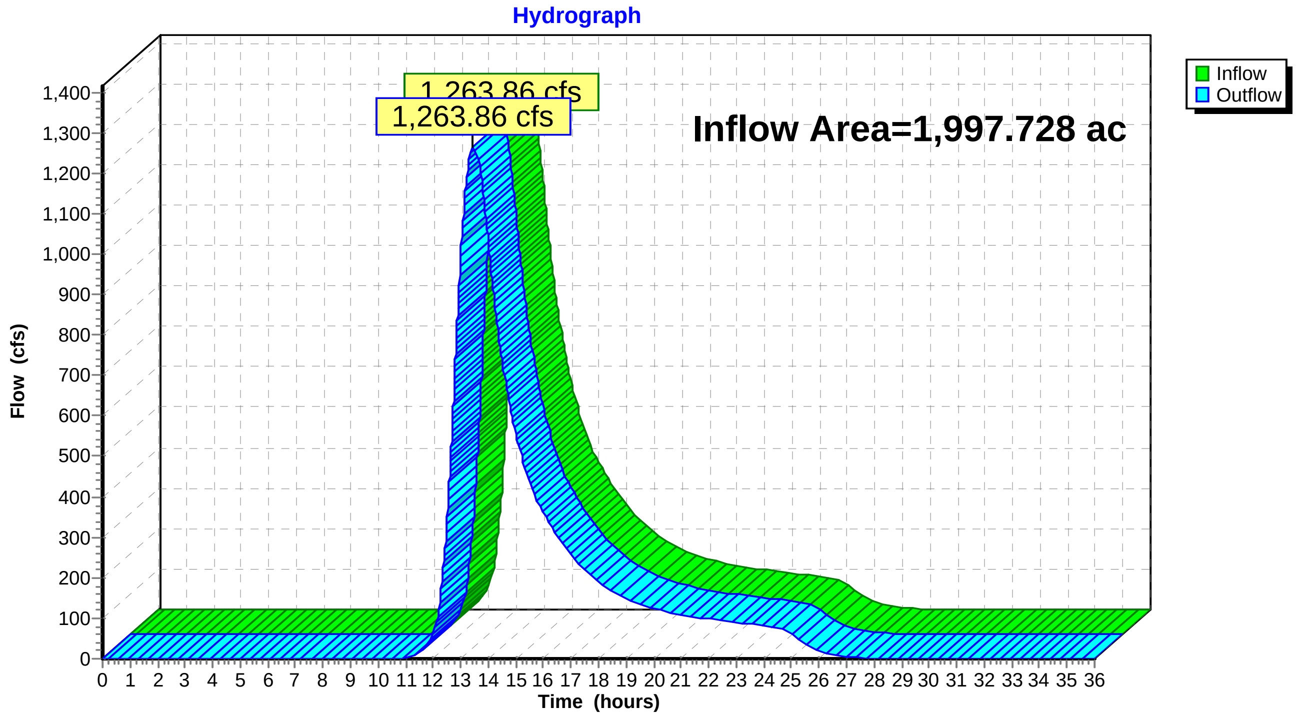


Summary for Reach SP-3: Study Point

Inflow Area = 1,997.728 ac, 0.05% Impervious, Inflow Depth = 2.06" for 50-Year Event event
Inflow = 1,263.86 cfs @ 13.40 hrs, Volume= 343.756 af
Outflow = 1,263.86 cfs @ 13.40 hrs, Volume= 343.756 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point

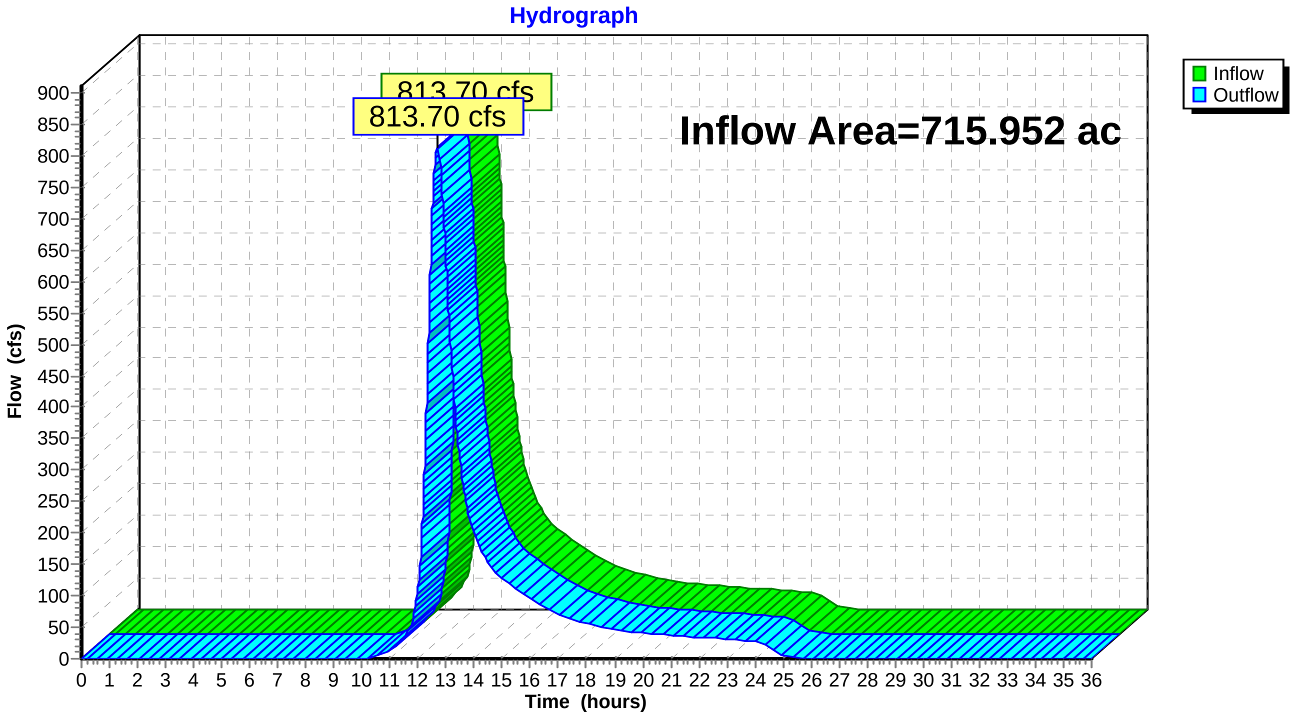


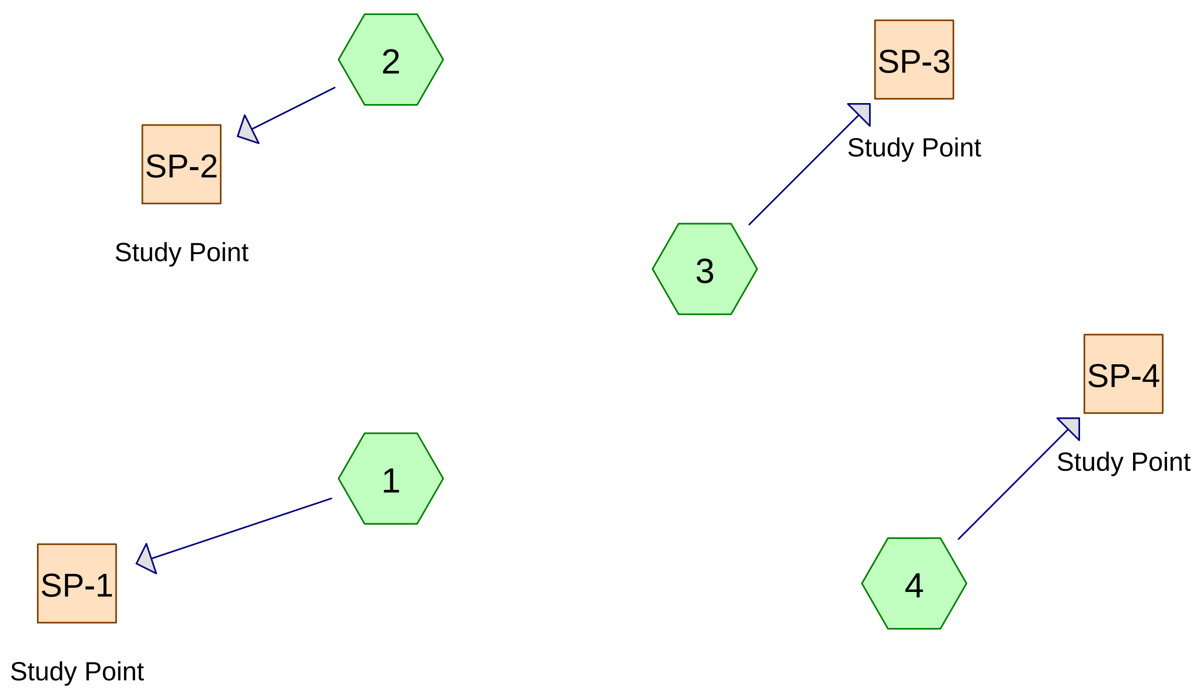
Summary for Reach SP-4: Study Point

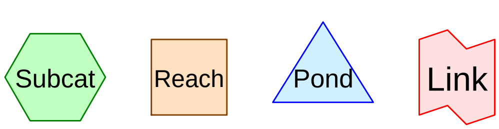
Inflow Area =	715.952 ac,	0.00% Impervious,	Inflow Depth = 2.23"	for 50-Year Event event
Inflow =	813.70 cfs @	12.71 hrs, Volume=	133.190 af	
Outflow =	813.70 cfs @	12.71 hrs, Volume=	133.190 af, Atten= 0%, Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-4: Study Point







Drainage Diagram for Watershed Model - Post
Prepared by TRC Environmental Corp, Printed 6/1/2012
HydroCAD® 9.00 s/n 01824 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
16.165	30	Meadow, non-grazed, HSG A (1, 2, 3, 4)
142.523	30	Woods, Good, HSG A (1, 2, 3, 4)
936.453	55	Woods, Good, HSG B (1, 2, 3, 4)
33.407	58	Meadow, non-grazed, HSG B (1, 2, 3, 4)
3,286.618	70	Woods, Good, HSG C (1, 2, 3, 4)
152.642	71	Meadow, non-grazed, HSG C (1, 2, 3, 4)
3.284	76	Gravel roads, HSG A (1, 2, 3, 4)
221.980	77	Woods, Good, HSG D (1, 2, 3, 4)
142.563	78	Meadow, non-grazed, HSG D (1, 2, 3, 4)
6.847	85	Gravel roads, HSG B (1, 2, 3, 4)
23.507	89	Gravel roads, HSG C (1, 2, 3, 4)
2.496	91	Gravel roads, HSG D (1, 2, 3)
3.281	98	Paved roads (1)
2.032	98	Roofs (1, 2, 3)
4,973.798		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1:	Runoff Area=1,663.541 ac 0.25% Impervious Runoff Depth=0.49" Tc=62.8 min CN=67 Runoff=278.99 cfs 67.747 af
Subcatchment 2:	Runoff Area=595.428 ac 0.04% Impervious Runoff Depth=0.53" Tc=42.9 min CN=68 Runoff=139.10 cfs 26.116 af
Subcatchment 3:	Runoff Area=1,998.418 ac 0.05% Impervious Runoff Depth=0.42" Tc=104.8 min CN=65 Runoff=193.40 cfs 69.564 af
Subcatchment 4:	Runoff Area=716.411 ac 0.00% Impervious Runoff Depth=0.49" Tc=48.3 min CN=67 Runoff=140.57 cfs 29.176 af
Reach SP-1: Study Point	Inflow=278.99 cfs 67.747 af Outflow=278.99 cfs 67.747 af
Reach SP-2: Study Point	Inflow=139.10 cfs 26.116 af Outflow=139.10 cfs 26.116 af
Reach SP-3: Study Point	Inflow=193.40 cfs 69.564 af Outflow=193.40 cfs 69.564 af
Reach SP-4: Study Point	Inflow=140.57 cfs 29.176 af Outflow=140.57 cfs 29.176 af

Total Runoff Area = 4,973.798 ac Runoff Volume = 192.603 af Average Runoff Depth = 0.46"
99.89% Pervious = 4,968.485 ac 0.11% Impervious = 5.313 ac

Summary for Subcatchment 1:

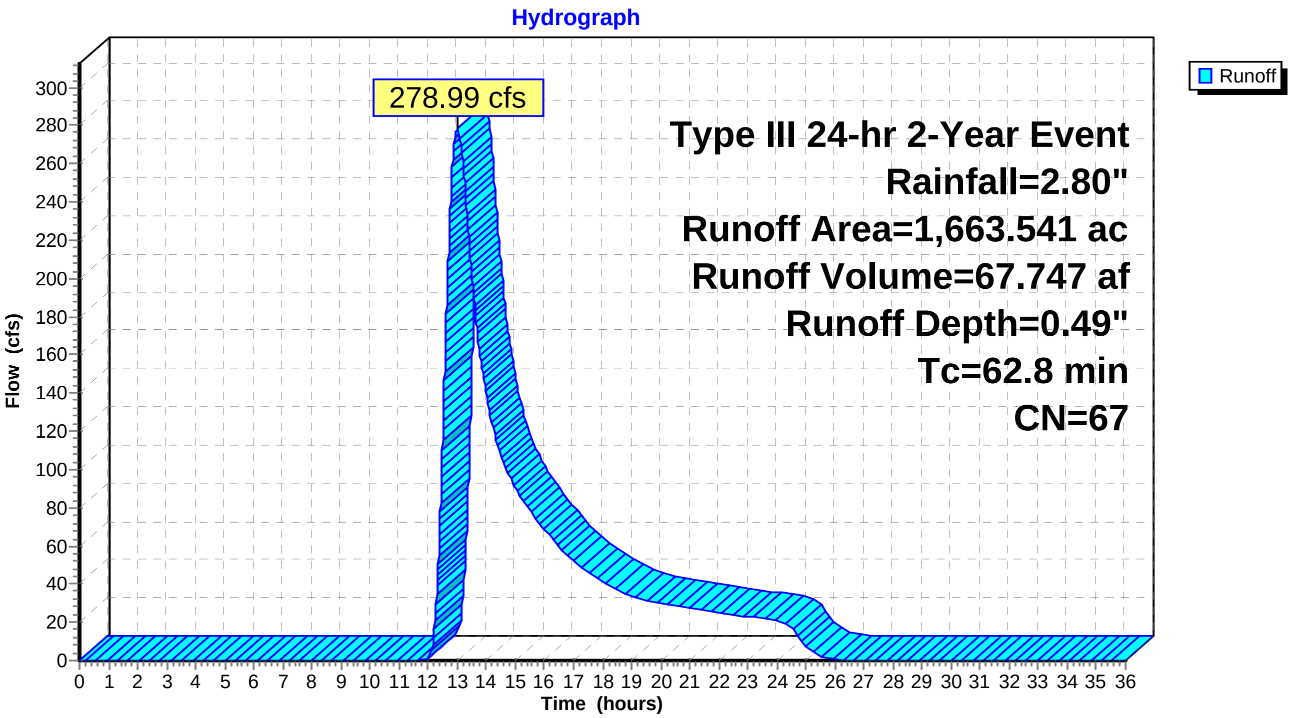
Runoff = 278.99 cfs @ 13.04 hrs, Volume= 67.747 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.874	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	9.844	89	Gravel roads, HSG C
	1.689	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	64.485	71	Meadow, non-grazed, HSG C
	6.747	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,246.019	70	Woods, Good, HSG C
	80.474	77	Woods, Good, HSG D
	1,663.541	67	Weighted Average
	1,659.386		99.75% Pervious Area
	4.155		0.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8					**Direct Entry, See spreadsheet**

Subcatchment 1:



Summary for Subcatchment 2:

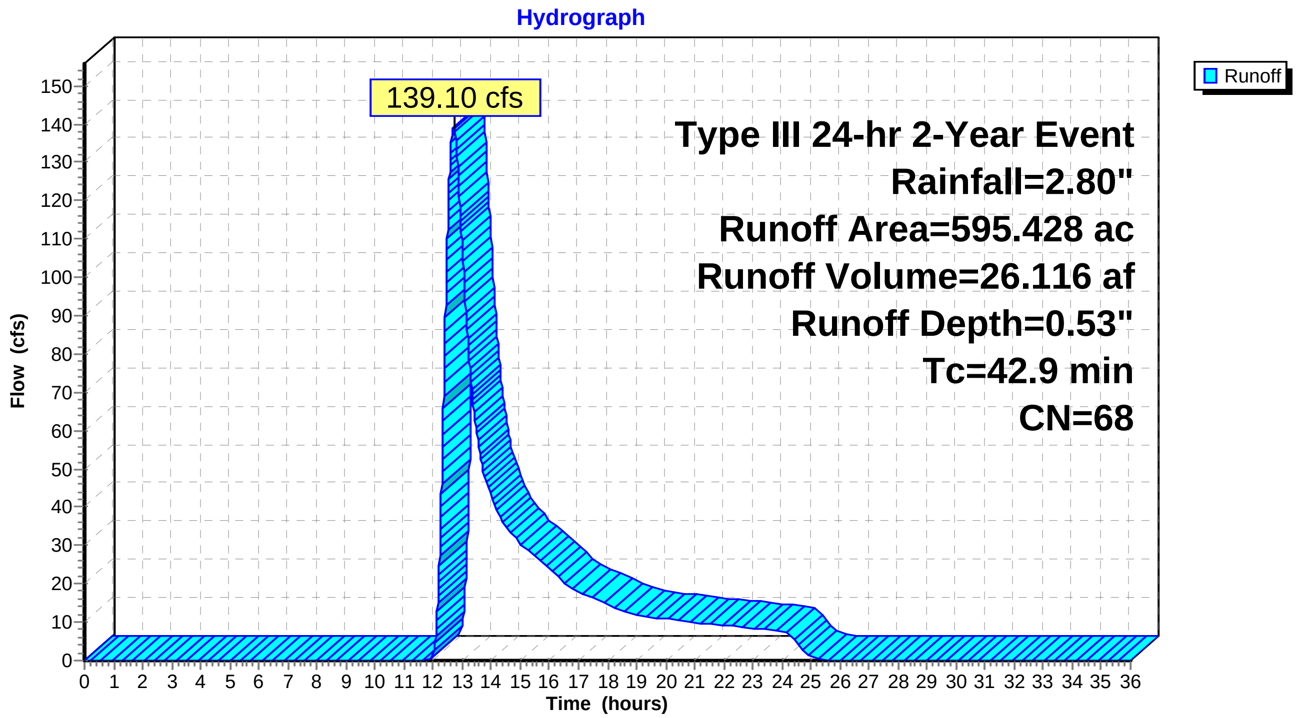
Runoff = 139.10 cfs @ 12.72 hrs, Volume= 26.116 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.281	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	8.692	71	Meadow, non-grazed, HSG C
	44.996	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	429.554	70	Woods, Good, HSG C
	44.046	77	Woods, Good, HSG D
	595.428	68	Weighted Average
	595.186		99.96% Pervious Area
	0.242		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9					**Direct Entry, See spreadsheet**

Subcatchment 2:



Summary for Subcatchment 3:

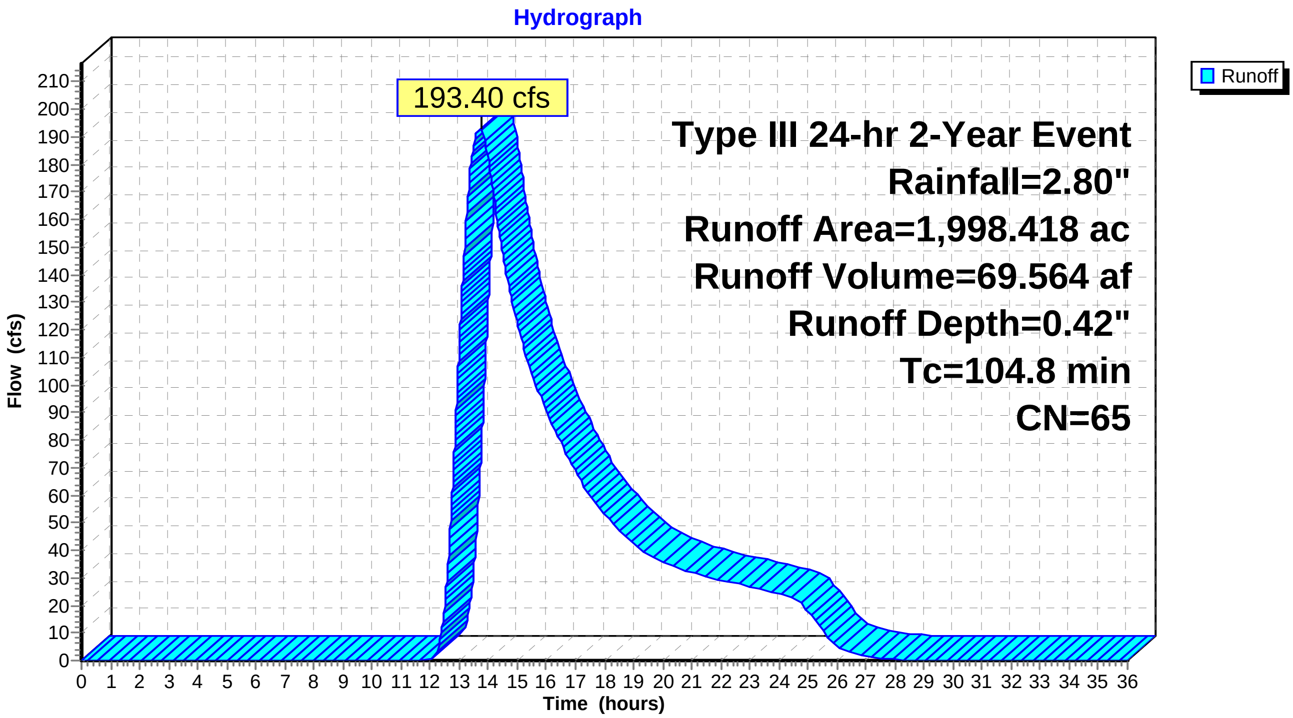
Runoff = 193.40 cfs @ 13.74 hrs, Volume= 69.564 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	11.345	89	Gravel roads, HSG C
	0.489	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	68.410	71	Meadow, non-grazed, HSG C
	88.224	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,086.743	70	Woods, Good, HSG C
	75.505	77	Woods, Good, HSG D
	1,998.418	65	Weighted Average
	1,997.502		99.95% Pervious Area
	0.916		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
104.8					**Direct Entry, See spreadsheet**

Subcatchment 3:



Summary for Subcatchment 4:

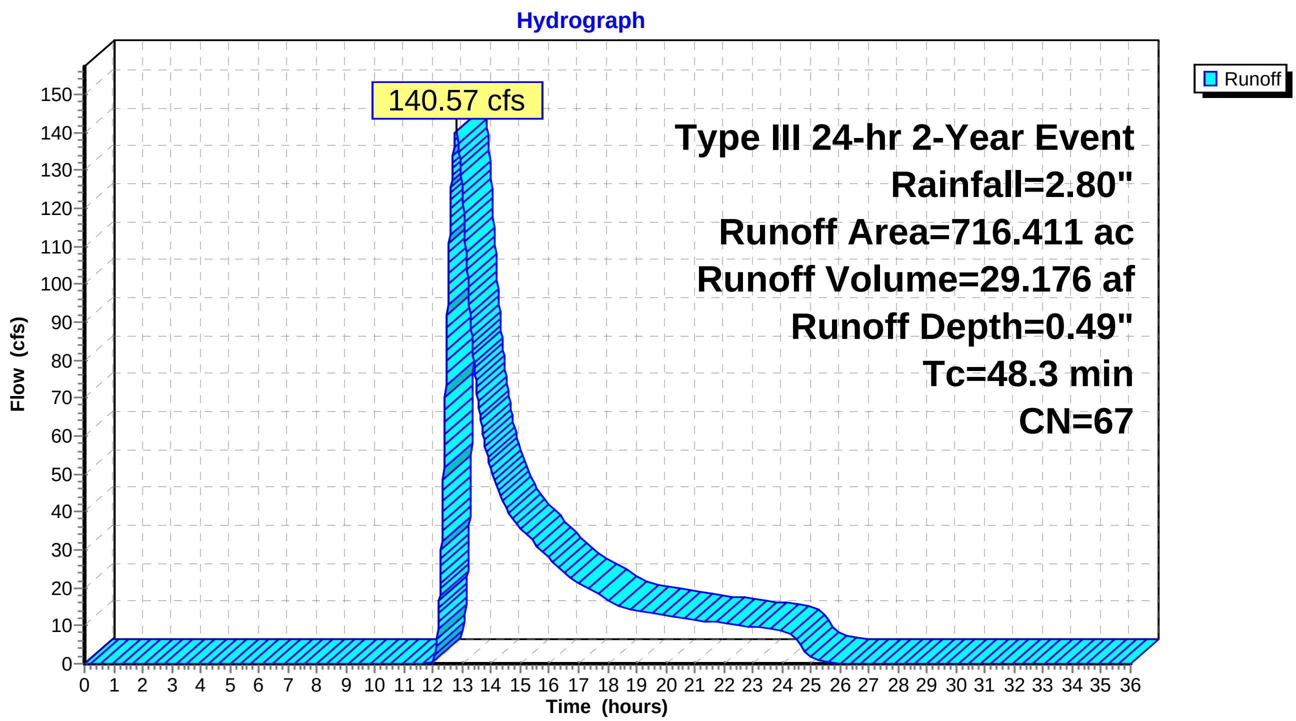
Runoff = 140.57 cfs @ 12.82 hrs, Volume= 29.176 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Event Rainfall=2.80"

Area (ac)	CN	Description
0.249	76	Gravel roads, HSG A
0.266	85	Gravel roads, HSG B
0.037	89	Gravel roads, HSG C
0.175	30	Meadow, non-grazed, HSG A
0.183	58	Meadow, non-grazed, HSG B
11.055	71	Meadow, non-grazed, HSG C
2.596	78	Meadow, non-grazed, HSG D
5.362	30	Woods, Good, HSG A
150.231	55	Woods, Good, HSG B
524.302	70	Woods, Good, HSG C
21.955	77	Woods, Good, HSG D
716.411	67	Weighted Average
716.411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.3					**Direct Entry, See spreadsheet**

Subcatchment 4:

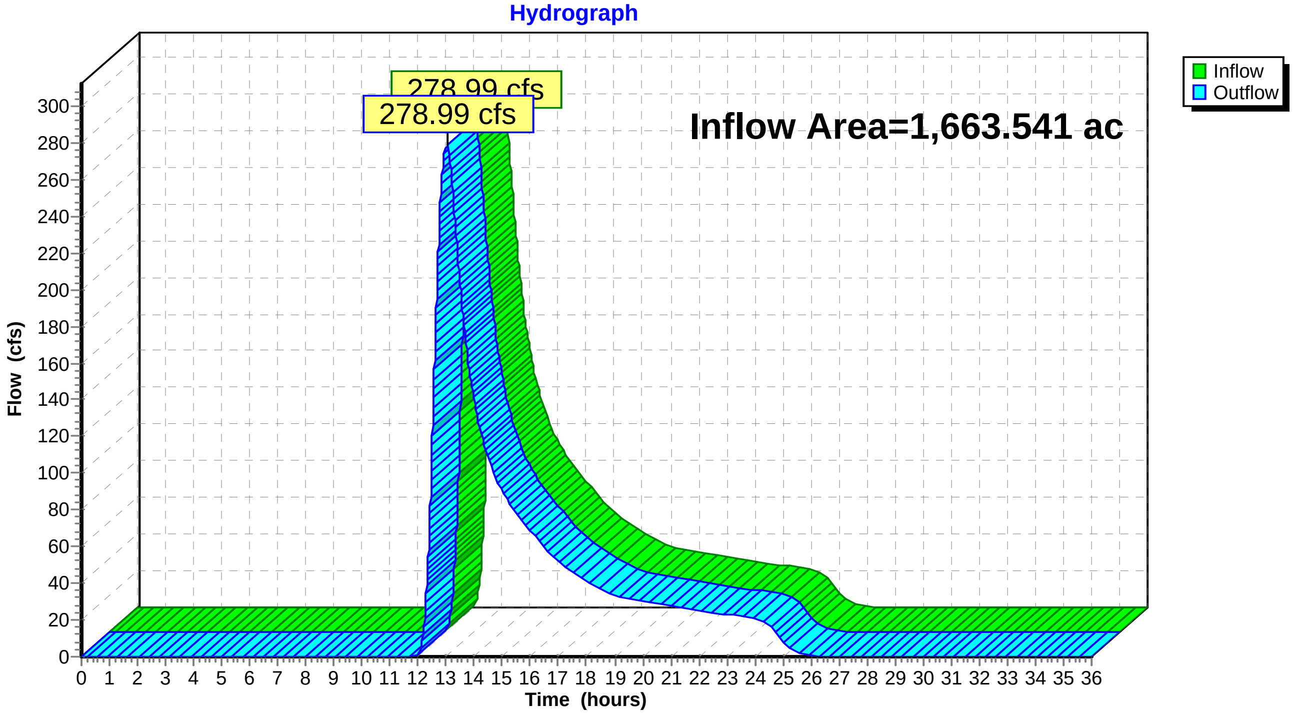


Summary for Reach SP-1: Study Point

Inflow Area = 1,663.541 ac, 0.25% Impervious, Inflow Depth = 0.49" for 2-Year Event event
Inflow = 278.99 cfs @ 13.04 hrs, Volume= 67.747 af
Outflow = 278.99 cfs @ 13.04 hrs, Volume= 67.747 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

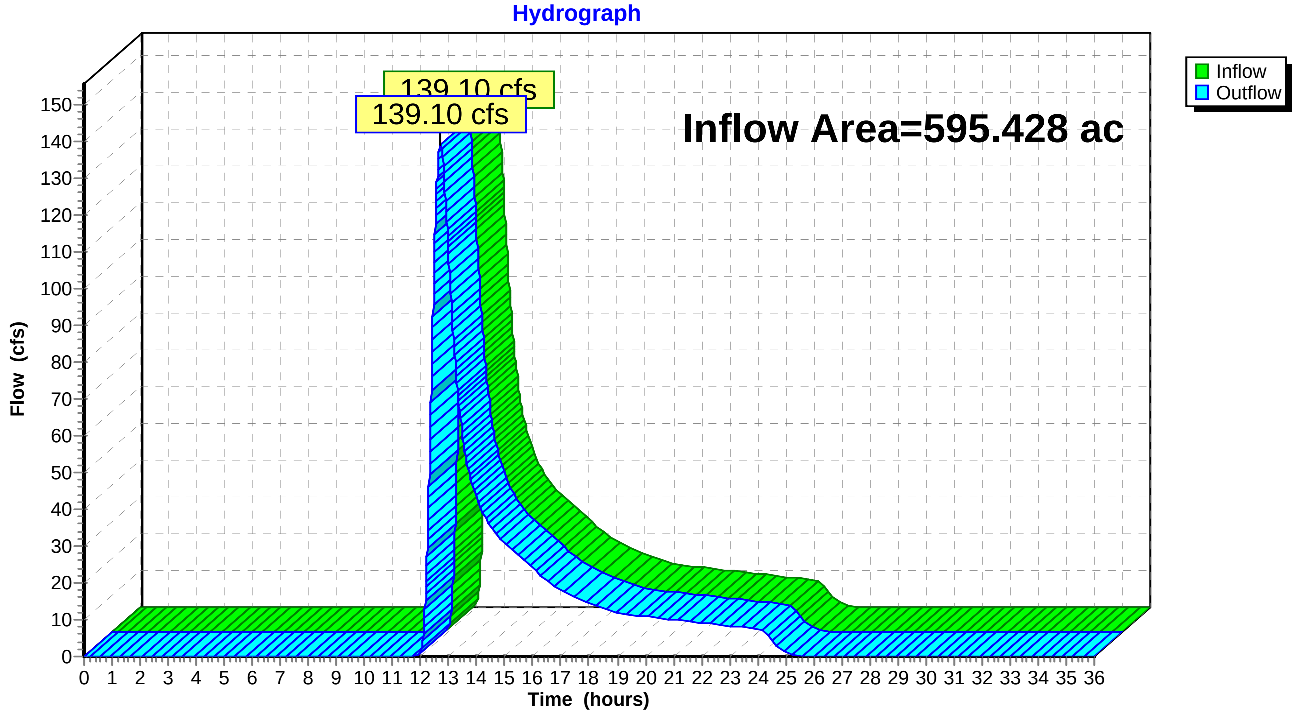


Summary for Reach SP-2: Study Point

Inflow Area =	595.428 ac,	0.04% Impervious,	Inflow Depth = 0.53"	for 2-Year Event event
Inflow =	139.10 cfs @	12.72 hrs, Volume=	26.116 af	
Outflow =	139.10 cfs @	12.72 hrs, Volume=	26.116 af, Atten= 0%, Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

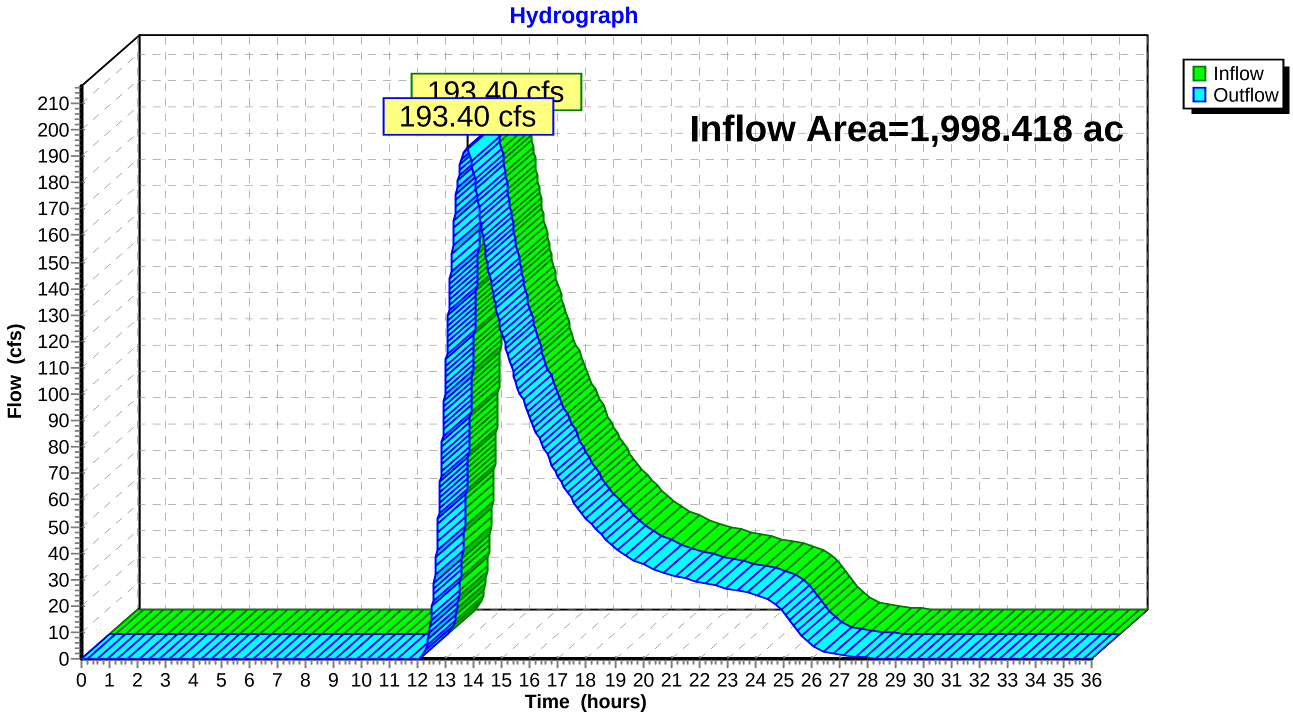


Summary for Reach SP-3: Study Point

Inflow Area = 1,998.418 ac, 0.05% Impervious, Inflow Depth = 0.42" for 2-Year Event event
Inflow = 193.40 cfs @ 13.74 hrs, Volume= 69.564 af
Outflow = 193.40 cfs @ 13.74 hrs, Volume= 69.564 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point

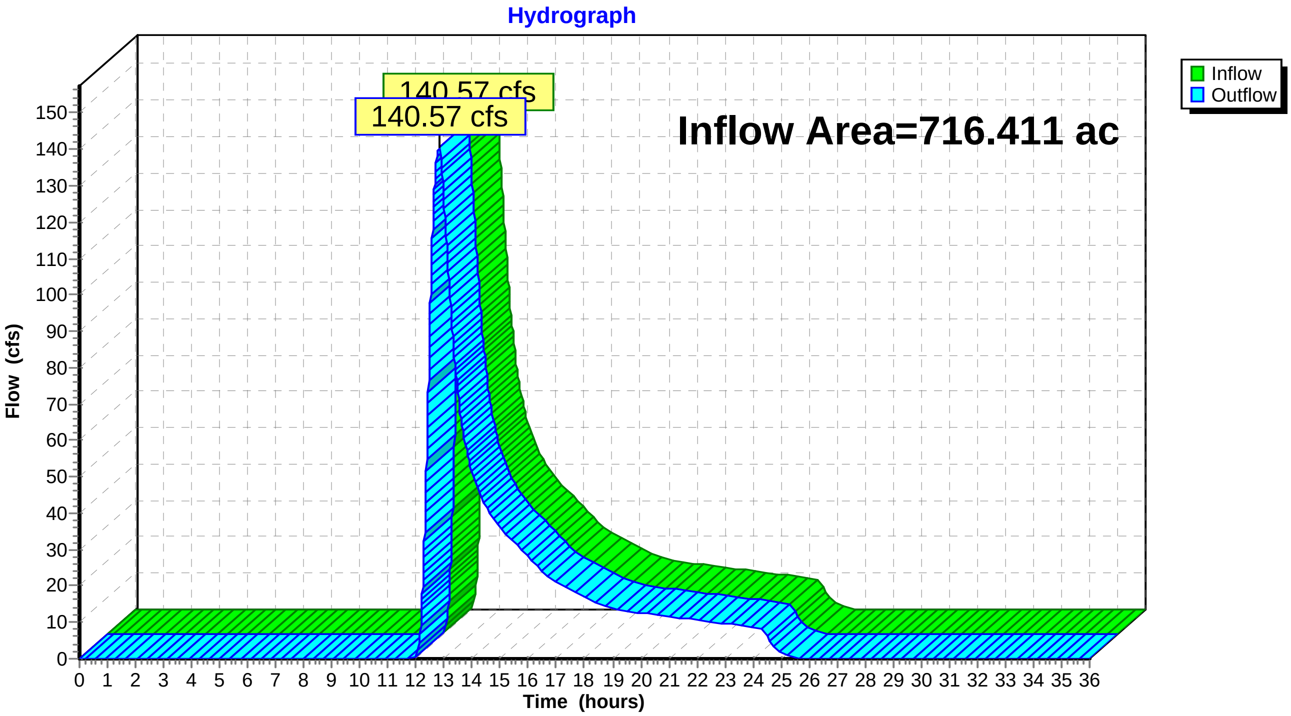


Summary for Reach SP-4: Study Point

Inflow Area = 716.411 ac, 0.00% Impervious, Inflow Depth = 0.49" for 2-Year Event event
Inflow = 140.57 cfs @ 12.82 hrs, Volume= 29.176 af
Outflow = 140.57 cfs @ 12.82 hrs, Volume= 29.176 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-4: Study Point



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Runoff Area=1,663.541 ac 0.25% Impervious Runoff Depth=1.27"
Tc=62.8 min CN=67 Runoff=877.10 cfs 176.017 af

Subcatchment 2: Runoff Area=595.428 ac 0.04% Impervious Runoff Depth=1.33"
Tc=42.9 min CN=68 Runoff=416.28 cfs 66.161 af

Subcatchment 3: Runoff Area=1,998.418 ac 0.05% Impervious Runoff Depth=1.15"
Tc=104.8 min CN=65 Runoff=655.61 cfs 190.923 af

Subcatchment 4: Runoff Area=716.411 ac 0.00% Impervious Runoff Depth=1.27"
Tc=48.3 min CN=67 Runoff=442.04 cfs 75.802 af

Reach SP-1: Study Point Inflow=877.10 cfs 176.017 af
Outflow=877.10 cfs 176.017 af

Reach SP-2: Study Point Inflow=416.28 cfs 66.161 af
Outflow=416.28 cfs 66.161 af

Reach SP-3: Study Point Inflow=655.61 cfs 190.923 af
Outflow=655.61 cfs 190.923 af

Reach SP-4: Study Point Inflow=442.04 cfs 75.802 af
Outflow=442.04 cfs 75.802 af

Total Runoff Area = 4,973.798 ac Runoff Volume = 508.903 af Average Runoff Depth = 1.23"
99.89% Pervious = 4,968.485 ac 0.11% Impervious = 5.313 ac

Summary for Subcatchment 1:

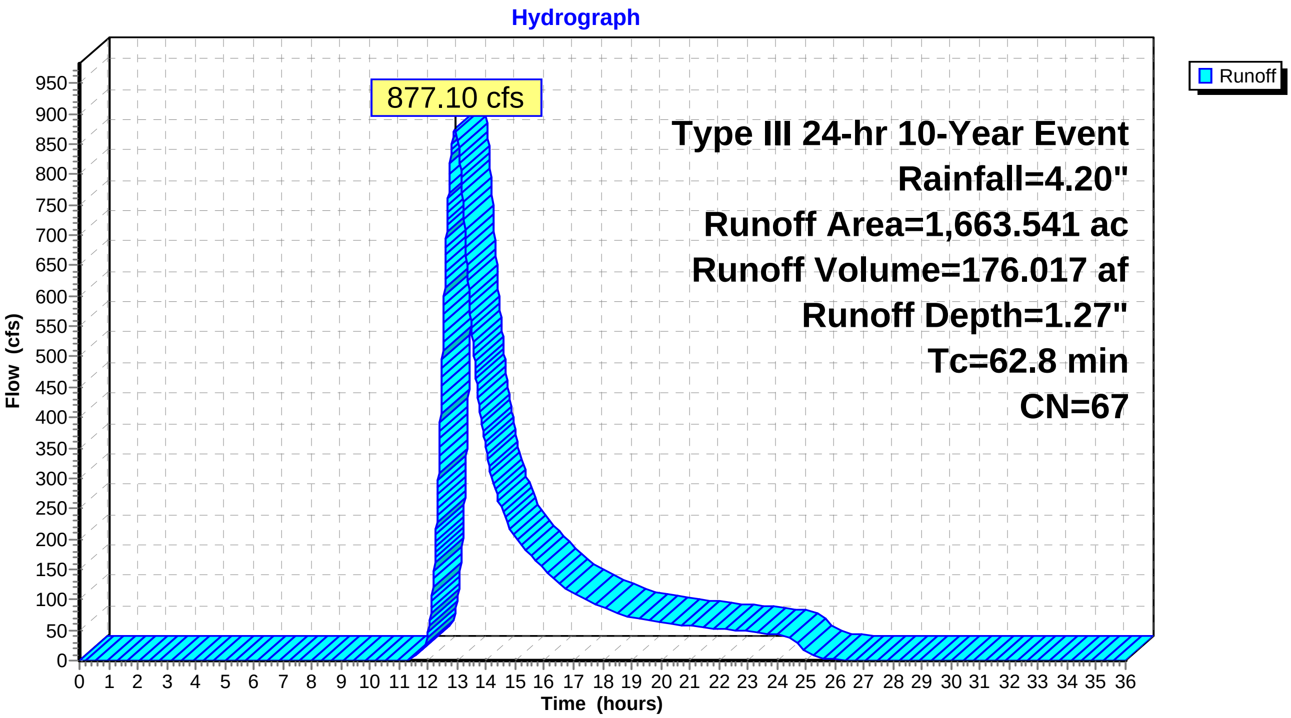
Runoff = 877.10 cfs @ 12.91 hrs, Volume= 176.017 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.874	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	9.844	89	Gravel roads, HSG C
	1.689	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	64.485	71	Meadow, non-grazed, HSG C
	6.747	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,246.019	70	Woods, Good, HSG C
	80.474	77	Woods, Good, HSG D
	1,663.541	67	Weighted Average
	1,659.386		99.75% Pervious Area
	4.155		0.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8					**Direct Entry, See spreadsheet**

Subcatchment 1:



Summary for Subcatchment 2:

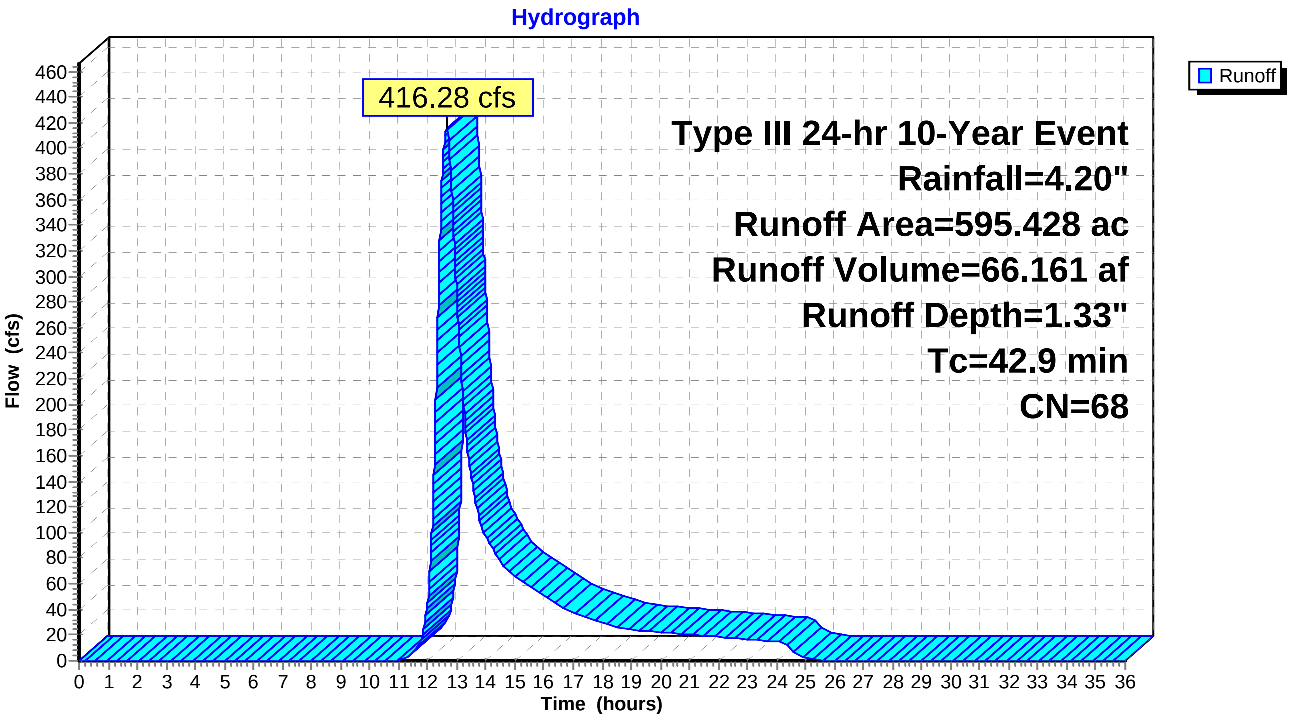
Runoff = 416.28 cfs @ 12.63 hrs, Volume= 66.161 af, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.281	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	8.692	71	Meadow, non-grazed, HSG C
	44.996	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	429.554	70	Woods, Good, HSG C
	44.046	77	Woods, Good, HSG D
	595.428	68	Weighted Average
	595.186		99.96% Pervious Area
	0.242		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9					**Direct Entry, See spreadsheet**

Subcatchment 2:



Summary for Subcatchment 3:

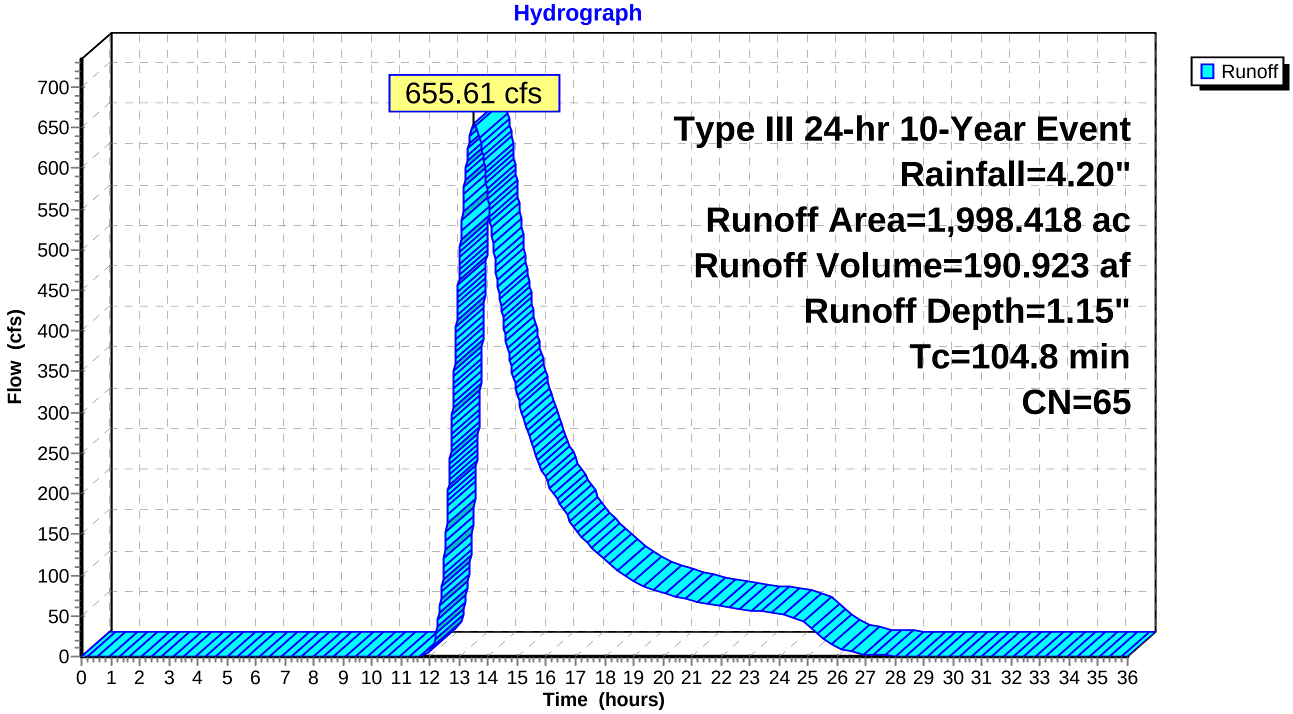
Runoff = 655.61 cfs @ 13.51 hrs, Volume= 190.923 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	11.345	89	Gravel roads, HSG C
	0.489	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	68.410	71	Meadow, non-grazed, HSG C
	88.224	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,086.743	70	Woods, Good, HSG C
	75.505	77	Woods, Good, HSG D
	1,998.418	65	Weighted Average
	1,997.502		99.95% Pervious Area
	0.916		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
104.8					**Direct Entry, See spreadsheet**

Subcatchment 3:



Summary for Subcatchment 4:

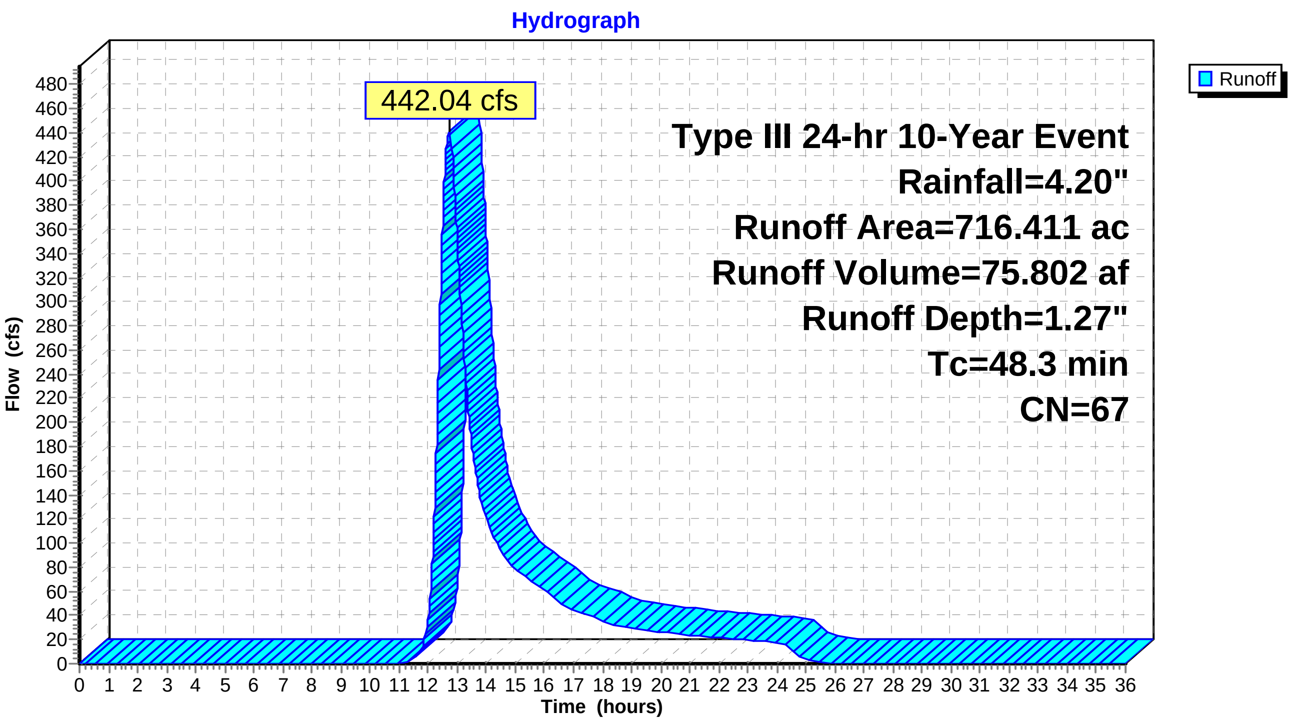
Runoff = 442.04 cfs @ 12.72 hrs, Volume= 75.802 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Event Rainfall=4.20"

Area (ac)	CN	Description
0.249	76	Gravel roads, HSG A
0.266	85	Gravel roads, HSG B
0.037	89	Gravel roads, HSG C
0.175	30	Meadow, non-grazed, HSG A
0.183	58	Meadow, non-grazed, HSG B
11.055	71	Meadow, non-grazed, HSG C
2.596	78	Meadow, non-grazed, HSG D
5.362	30	Woods, Good, HSG A
150.231	55	Woods, Good, HSG B
524.302	70	Woods, Good, HSG C
21.955	77	Woods, Good, HSG D
716.411	67	Weighted Average
716.411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.3					**Direct Entry, See spreadsheet**

Subcatchment 4:

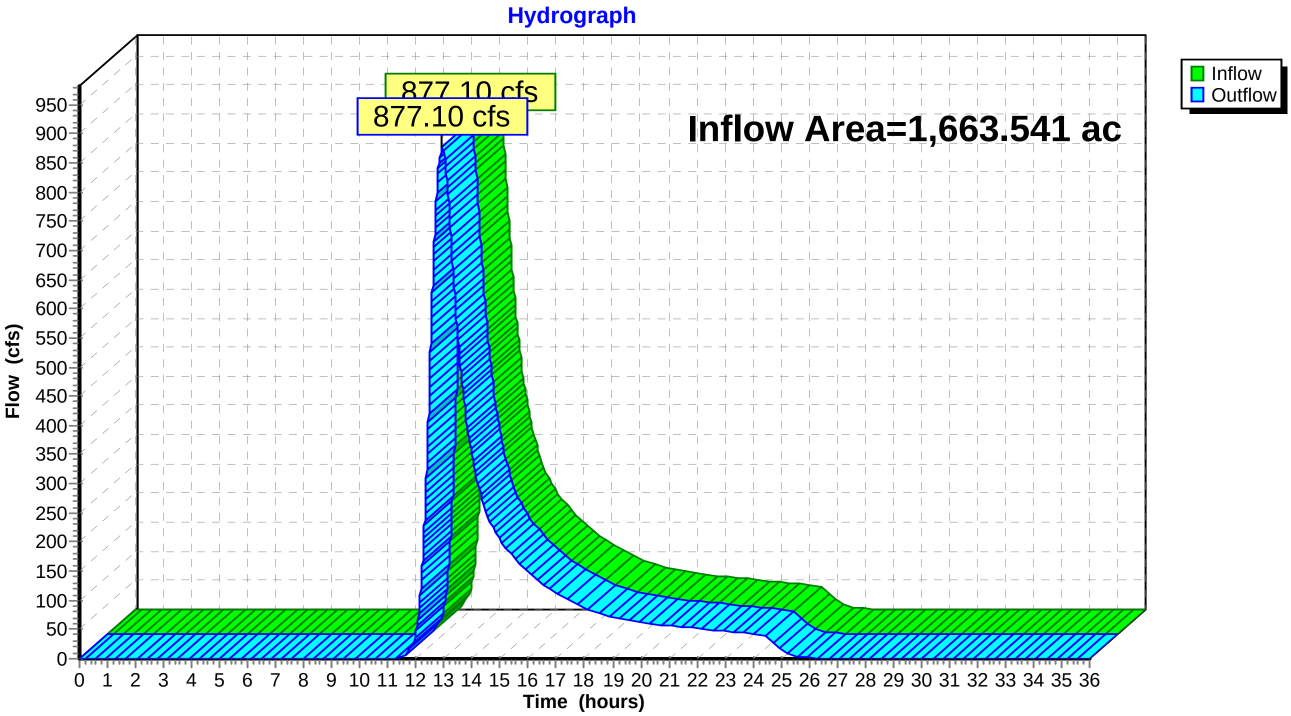


Summary for Reach SP-1: Study Point

Inflow Area = 1,663.541 ac, 0.25% Impervious, Inflow Depth = 1.27" for 10-Year Event event
Inflow = 877.10 cfs @ 12.91 hrs, Volume= 176.017 af
Outflow = 877.10 cfs @ 12.91 hrs, Volume= 176.017 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

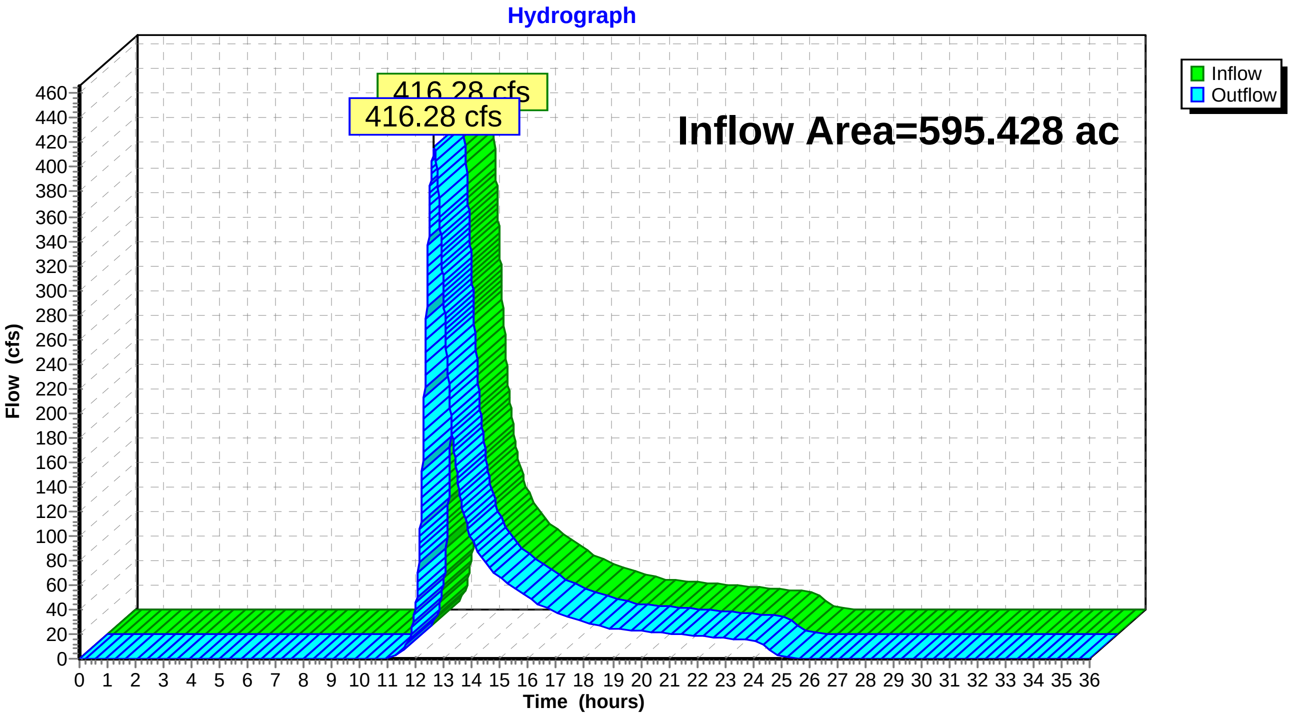


Summary for Reach SP-2: Study Point

Inflow Area = 595.428 ac, 0.04% Impervious, Inflow Depth = 1.33" for 10-Year Event event
Inflow = 416.28 cfs @ 12.63 hrs, Volume= 66.161 af
Outflow = 416.28 cfs @ 12.63 hrs, Volume= 66.161 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

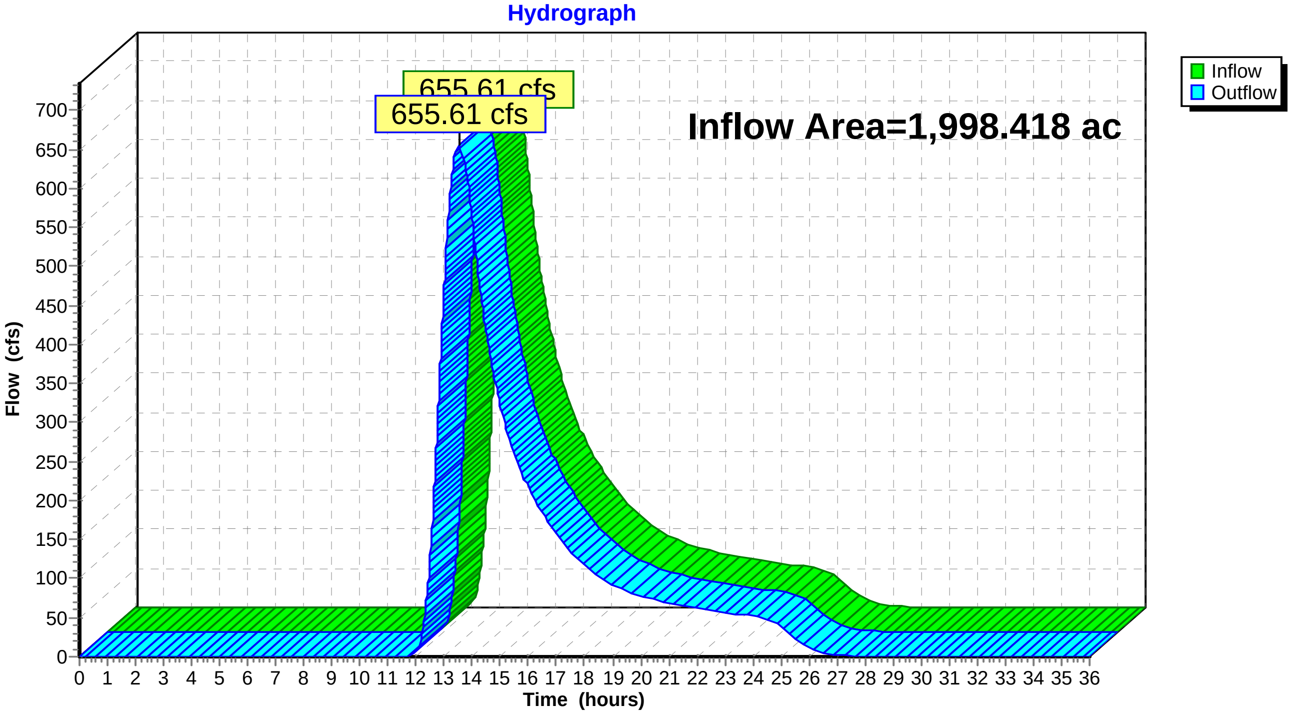


Summary for Reach SP-3: Study Point

Inflow Area = 1,998.418 ac, 0.05% Impervious, Inflow Depth = 1.15" for 10-Year Event event
Inflow = 655.61 cfs @ 13.51 hrs, Volume= 190.923 af
Outflow = 655.61 cfs @ 13.51 hrs, Volume= 190.923 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-3: Study Point

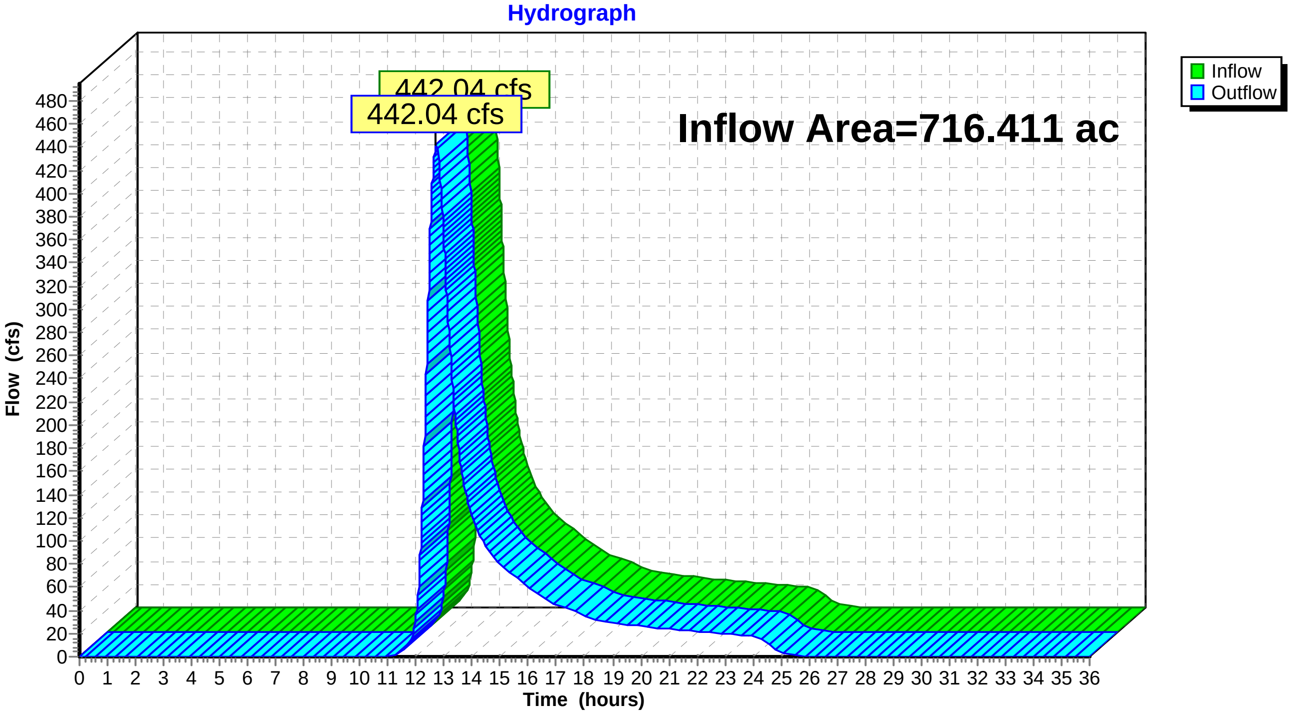


Summary for Reach SP-4: Study Point

Inflow Area = 716.411 ac, 0.00% Impervious, Inflow Depth = 1.27" for 10-Year Event event
Inflow = 442.04 cfs @ 12.72 hrs, Volume= 75.802 af
Outflow = 442.04 cfs @ 12.72 hrs, Volume= 75.802 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-4: Study Point



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1:	Runoff Area=1,663.541 ac 0.25% Impervious Runoff Depth=2.23" Tc=62.8 min CN=67 Runoff=1,621.41 cfs 309.471 af
Subcatchment 2:	Runoff Area=595.428 ac 0.04% Impervious Runoff Depth=2.32" Tc=42.9 min CN=68 Runoff=754.34 cfs 115.002 af
Subcatchment 3:	Runoff Area=1,998.418 ac 0.05% Impervious Runoff Depth=2.06" Tc=104.8 min CN=65 Runoff=1,264.30 cfs 343.875 af
Subcatchment 4:	Runoff Area=716.411 ac 0.00% Impervious Runoff Depth=2.23" Tc=48.3 min CN=67 Runoff=814.22 cfs 133.275 af
Reach SP-1: Study Point	Inflow=1,621.41 cfs 309.471 af Outflow=1,621.41 cfs 309.471 af
Reach SP-2: Study Point	Inflow=754.34 cfs 115.002 af Outflow=754.34 cfs 115.002 af
Reach SP-3: Study Point	Inflow=1,264.30 cfs 343.875 af Outflow=1,264.30 cfs 343.875 af
Reach SP-4: Study Point	Inflow=814.22 cfs 133.275 af Outflow=814.22 cfs 133.275 af

Total Runoff Area = 4,973.798 ac Runoff Volume = 901.623 af Average Runoff Depth = 2.18"
99.89% Pervious = 4,968.485 ac 0.11% Impervious = 5.313 ac

Summary for Subcatchment 1:

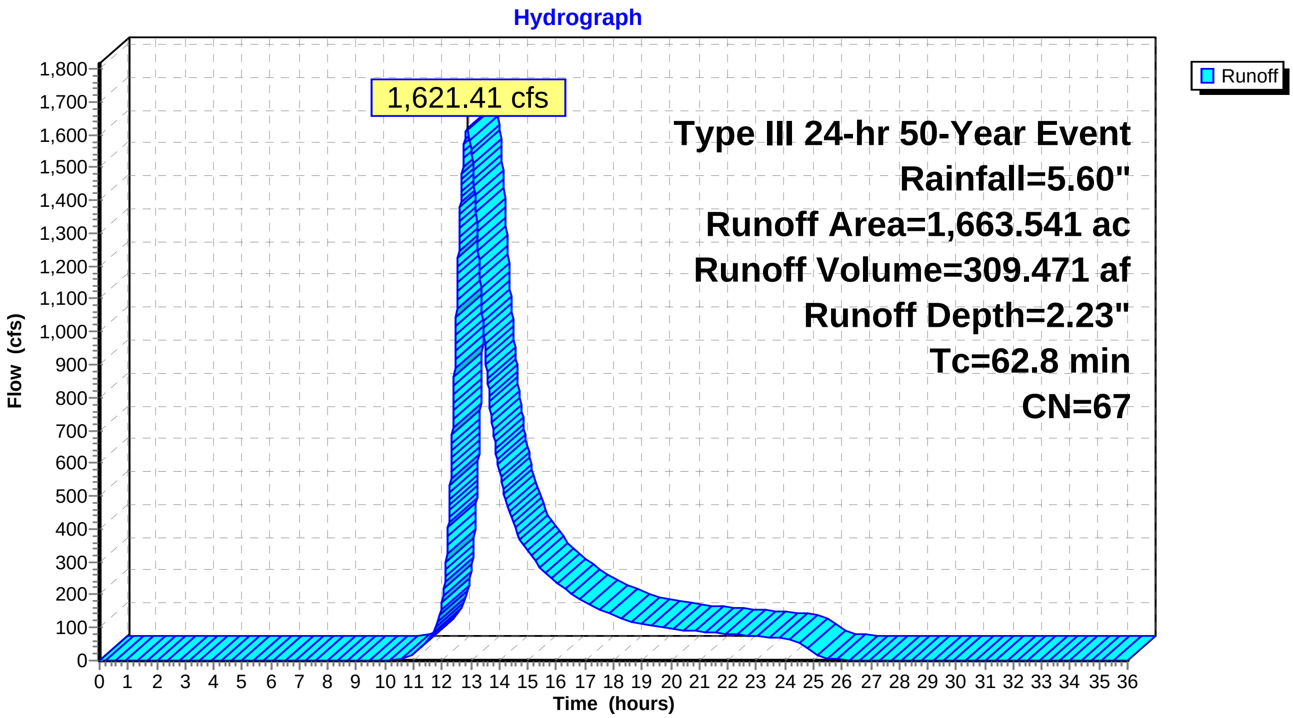
Runoff = 1,621.41 cfs @ 12.91 hrs, Volume= 309.471 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.874	98	Roofs
	1.837	76	Gravel roads, HSG A
	2.685	85	Gravel roads, HSG B
	9.844	89	Gravel roads, HSG C
	1.689	91	Gravel roads, HSG D
*	3.281	98	Paved roads
	12.831	30	Meadow, non-grazed, HSG A
	13.799	58	Meadow, non-grazed, HSG B
	64.485	71	Meadow, non-grazed, HSG C
	6.747	78	Meadow, non-grazed, HSG D
	66.513	30	Woods, Good, HSG A
	152.463	55	Woods, Good, HSG B
	1,246.019	70	Woods, Good, HSG C
	80.474	77	Woods, Good, HSG D
	1,663.541	67	Weighted Average
	1,659.386		99.75% Pervious Area
	4.155		0.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8					**Direct Entry, See spreadsheet**

Subcatchment 1:



Summary for Subcatchment 2:

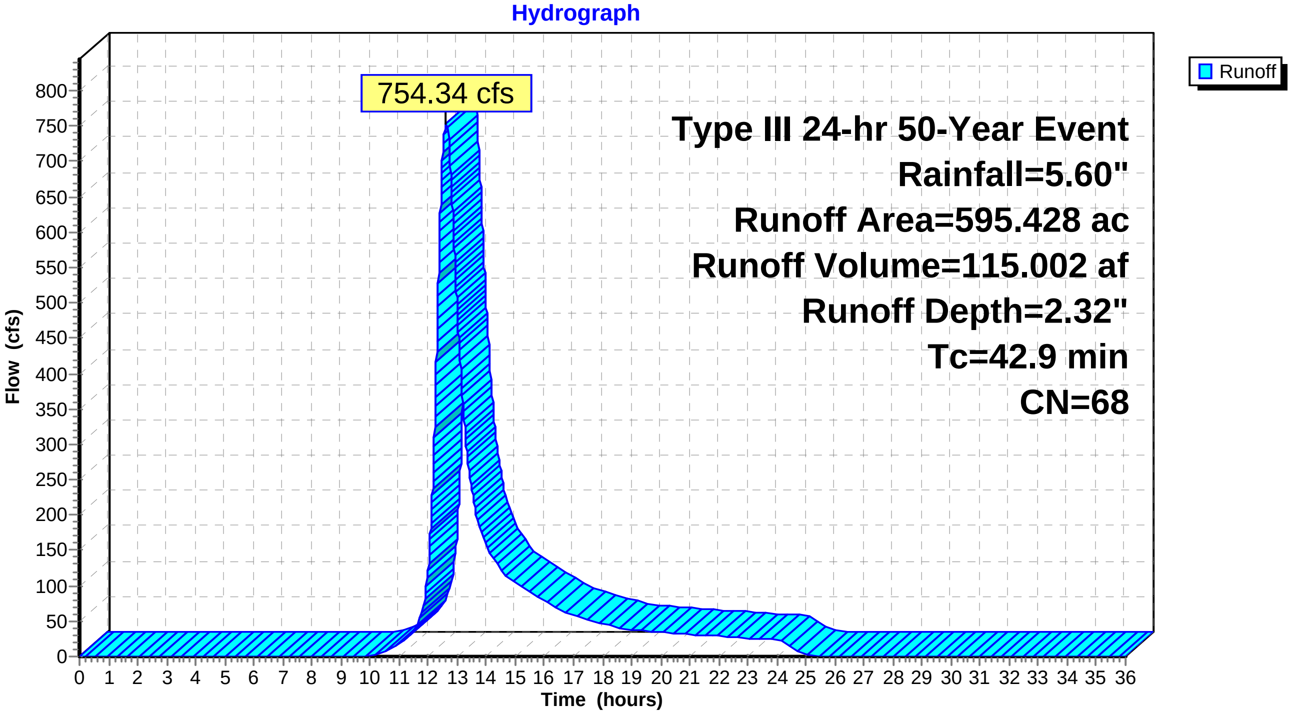
Runoff = 754.34 cfs @ 12.63 hrs, Volume= 115.002 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.242	98	Roofs
	0.894	76	Gravel roads, HSG A
	0.614	85	Gravel roads, HSG B
	2.281	89	Gravel roads, HSG C
	0.318	91	Gravel roads, HSG D
	1.770	30	Meadow, non-grazed, HSG A
	6.372	58	Meadow, non-grazed, HSG B
	8.692	71	Meadow, non-grazed, HSG C
	44.996	78	Meadow, non-grazed, HSG D
	28.548	30	Woods, Good, HSG A
	27.101	55	Woods, Good, HSG B
	429.554	70	Woods, Good, HSG C
	44.046	77	Woods, Good, HSG D
	595.428	68	Weighted Average
	595.186		99.96% Pervious Area
	0.242		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9					**Direct Entry, See spreadsheet**

Subcatchment 2:



Summary for Subcatchment 3:

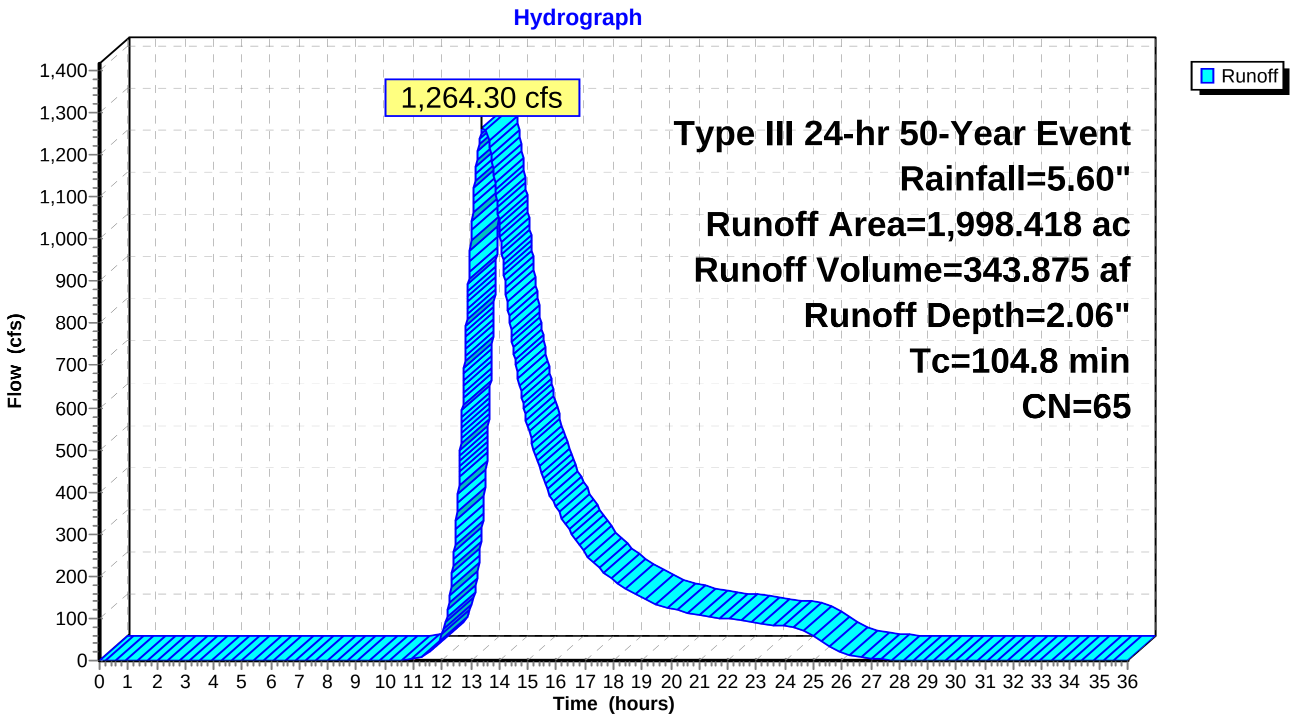
Runoff = 1,264.30 cfs @ 13.40 hrs, Volume= 343.875 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

	Area (ac)	CN	Description
*	0.916	98	Roofs
	0.304	76	Gravel roads, HSG A
	3.282	85	Gravel roads, HSG B
	11.345	89	Gravel roads, HSG C
	0.489	91	Gravel roads, HSG D
	1.389	30	Meadow, non-grazed, HSG A
	13.053	58	Meadow, non-grazed, HSG B
	68.410	71	Meadow, non-grazed, HSG C
	88.224	78	Meadow, non-grazed, HSG D
	42.100	30	Woods, Good, HSG A
	606.658	55	Woods, Good, HSG B
	1,086.743	70	Woods, Good, HSG C
	75.505	77	Woods, Good, HSG D
	1,998.418	65	Weighted Average
	1,997.502		99.95% Pervious Area
	0.916		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
104.8					**Direct Entry, See spreadsheet**

Subcatchment 3:



Summary for Subcatchment 4:

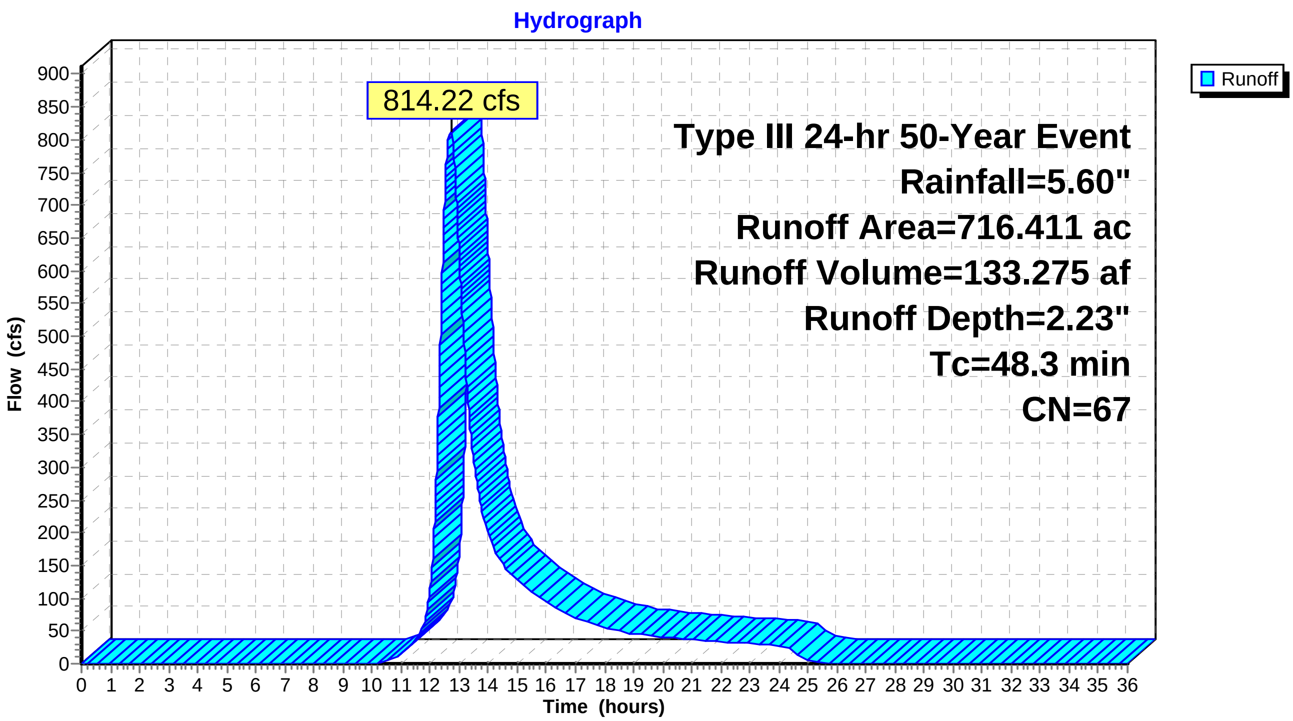
Runoff = 814.22 cfs @ 12.71 hrs, Volume= 133.275 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Event Rainfall=5.60"

Area (ac)	CN	Description
0.249	76	Gravel roads, HSG A
0.266	85	Gravel roads, HSG B
0.037	89	Gravel roads, HSG C
0.175	30	Meadow, non-grazed, HSG A
0.183	58	Meadow, non-grazed, HSG B
11.055	71	Meadow, non-grazed, HSG C
2.596	78	Meadow, non-grazed, HSG D
5.362	30	Woods, Good, HSG A
150.231	55	Woods, Good, HSG B
524.302	70	Woods, Good, HSG C
21.955	77	Woods, Good, HSG D
716.411	67	Weighted Average
716.411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.3					**Direct Entry, See spreadsheet**

Subcatchment 4:

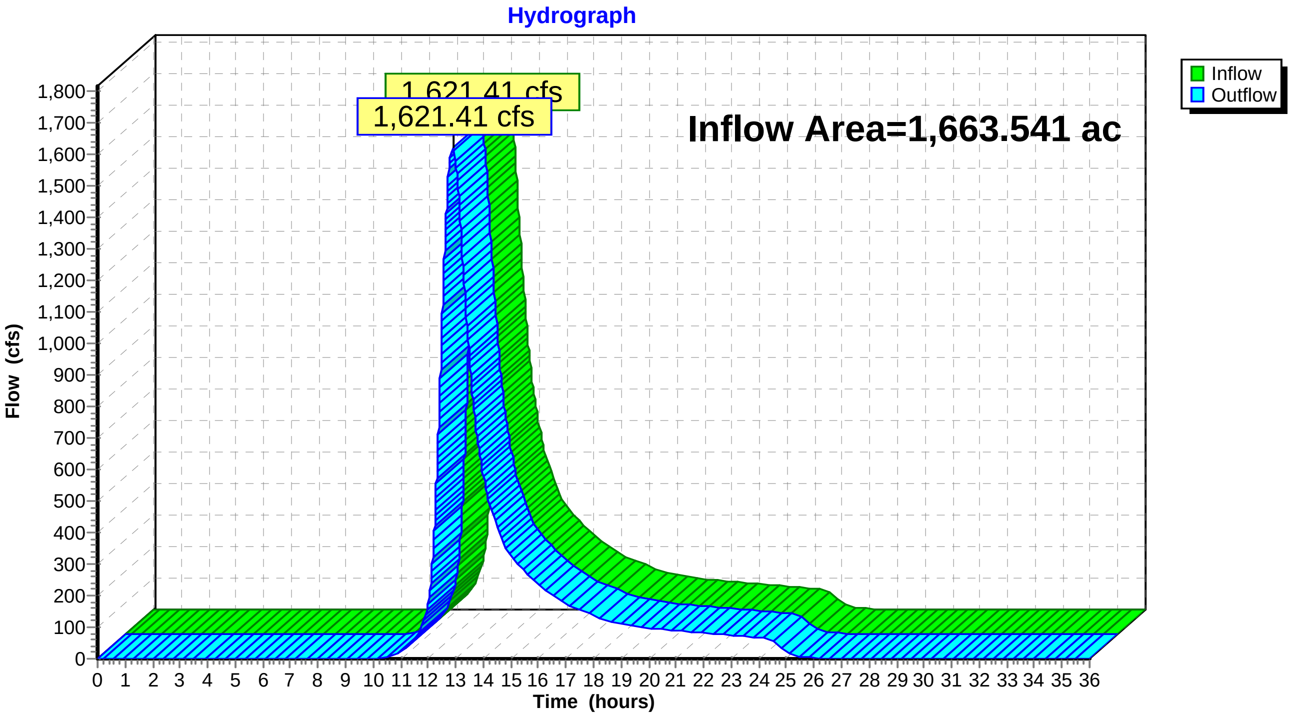


Summary for Reach SP-1: Study Point

Inflow Area = 1,663.541 ac, 0.25% Impervious, Inflow Depth = 2.23" for 50-Year Event event
Inflow = 1,621.41 cfs @ 12.91 hrs, Volume= 309.471 af
Outflow = 1,621.41 cfs @ 12.91 hrs, Volume= 309.471 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-1: Study Point

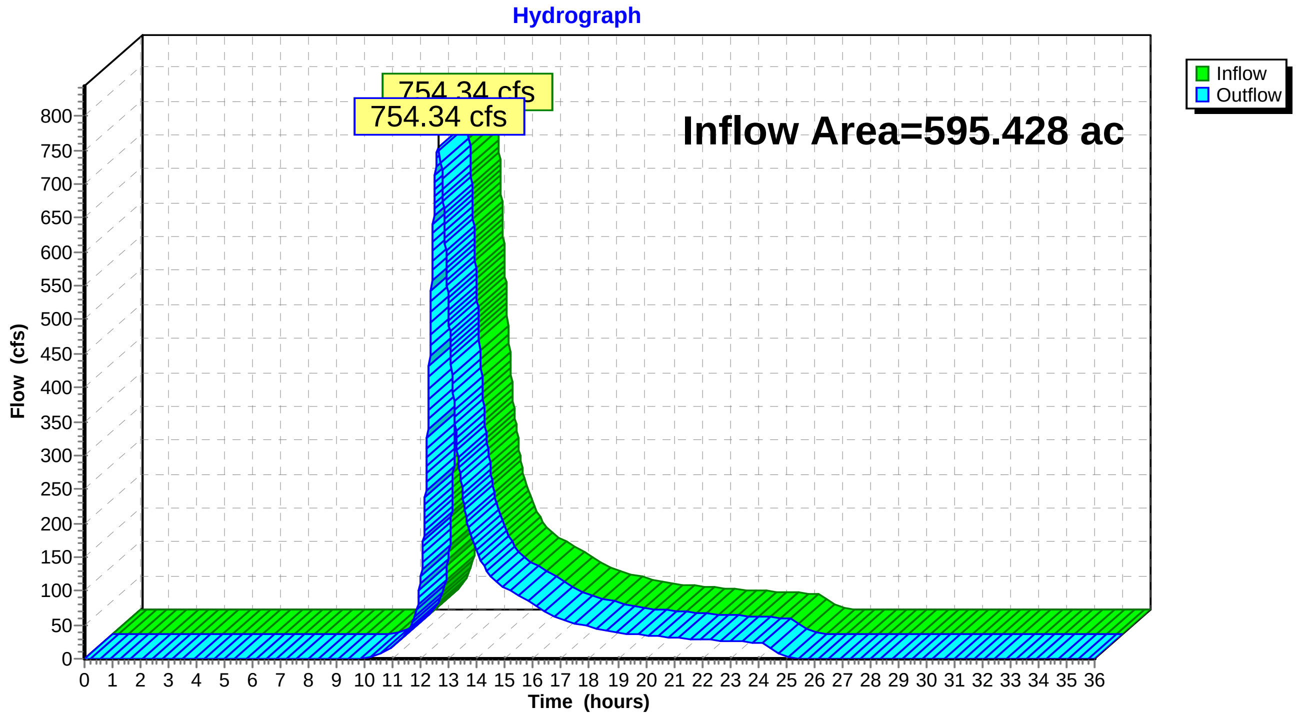


Summary for Reach SP-2: Study Point

Inflow Area = 595.428 ac, 0.04% Impervious, Inflow Depth = 2.32" for 50-Year Event event
Inflow = 754.34 cfs @ 12.63 hrs, Volume= 115.002 af
Outflow = 754.34 cfs @ 12.63 hrs, Volume= 115.002 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

Reach SP-2: Study Point

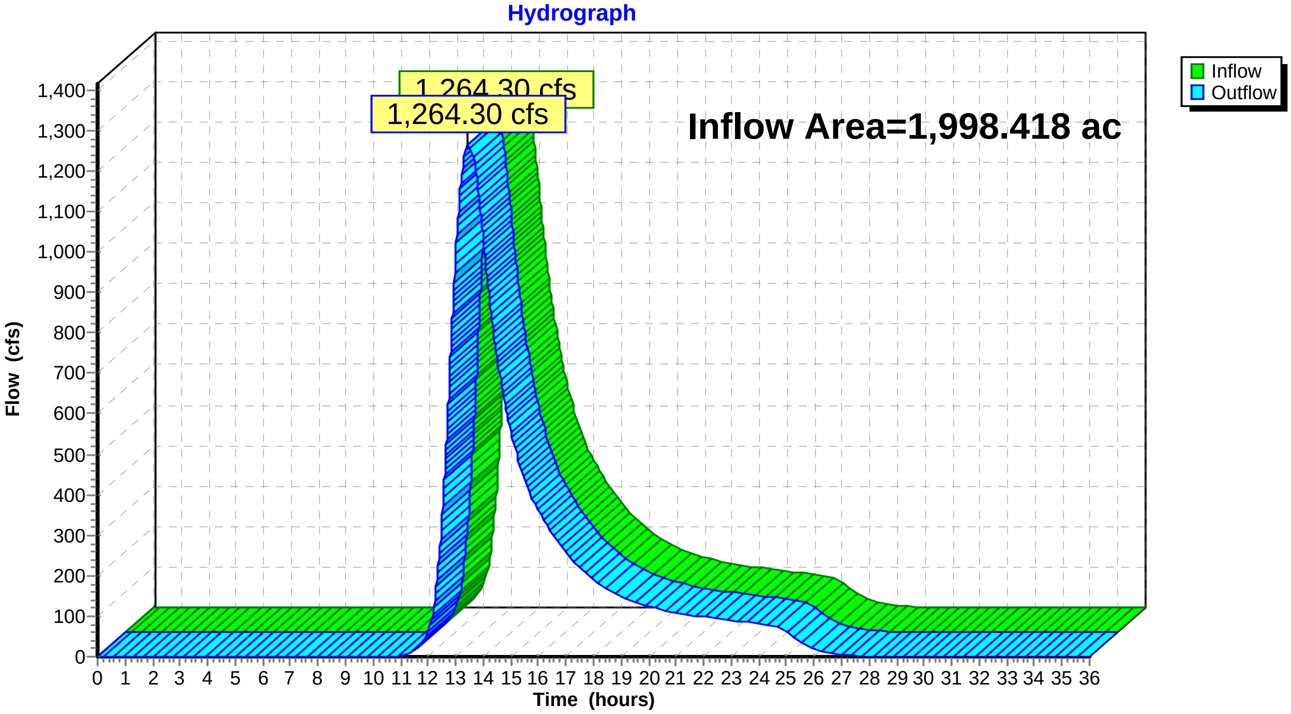


Summary for Reach SP-3: Study Point

Inflow Area = 1,998.418 ac, 0.05% Impervious, Inflow Depth = 2.06" for 50-Year Event event
Inflow = 1,264.30 cfs @ 13.40 hrs, Volume= 343.875 af
Outflow = 1,264.30 cfs @ 13.40 hrs, Volume= 343.875 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3

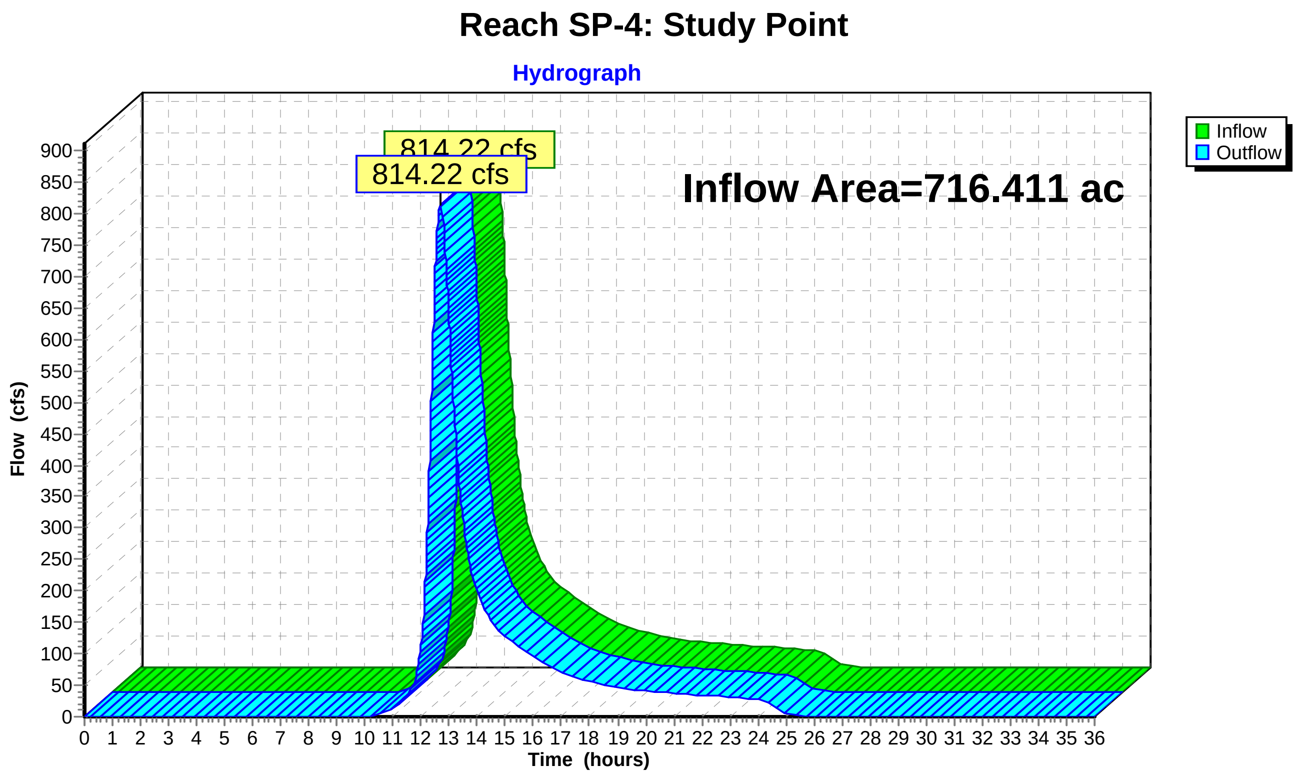
Reach SP-3: Study Point



Summary for Reach SP-4: Study Point

Inflow Area =	716.411 ac,	0.00% Impervious, Inflow Depth = 2.23"	for 50-Year Event event	
Inflow =	814.22 cfs @	12.71 hrs, Volume=	133.275 af	
Outflow =	814.22 cfs @	12.71 hrs, Volume=	133.275 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3



ATTACHMENT B

Time of Concentration Calculations

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	PGT
Proj. No.:	**186317.0000.0000**	**Date:**	
	Time of Concentration Summary		

Time of Concentration Equations:

1. Where $T_t := \frac{0.007 \cdot (N \cdot L)^{0.8}}{P_2^{0.5} \cdot S^{0.4}}$	from SCS TR-55.	For Sheet Flow (300 feet or less)
2. Where $V := 20.3282 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Shallow Concentrated Flow (Paved surfaces)
3. Where $T_t := \frac{L}{3600 \cdot V}$	from the SCS Upland Method *Channel Flow Chart*	Travel time equation
4. Where $V := 16.1345 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Shallow Concentrated Flow (Unpaved surfaces)
5. Where: $v = 7 \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Shallow Concentrated Flow (Short Grass Pasture)
6. Where: $v = 5 \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Shallow Concentrated Flow (Woodland)
7. Where $V := 12 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Channel Flow - Waterways and Swamps, No Channels
8. Where $V := 15 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Channel Flow - Grassed Waterways and Roadside Ditches
9. Where $V := 21 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Channel Flow - Small Tributary & Swamp w/Channels
10. Where $V := 35 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Channel Flow - Large Tributary
11. Where $V := 60 \cdot \sqrt{S}$	from the SCS Upland Method *Channel Flow Chart*	For Channel Flow - Main River
12. Where $V := \frac{1.49 \cdot R^{.667} \cdot \sqrt{S}}{N}$		For Channel Flow - Culvert Flow

13. Where P_2 = 2-Year, 24 Hour Rainfall (in) (Antrim, NH: P2= 2.8 inches)

Mannings Roughness Coefficients Table

Surface Description	n - value
Smooth surfaces	0.011
Crush Stone/Substation Yards	0.025
Fallow	0.050
Cultivated: Residue<=20%	0.060
Cultivated: Residue>=20%	0.170
Grass: Short	0.150
Grass: Dense	0.240
Grass: Bermuda	0.410
Range	0.130
Woods: Light underbrush	0.400
Woods: Dense underbrush	0.800

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	PGT
Proj. No.:	**186317.0000.0000**	**Date:**	November 10, 2011
Watershed:	**1W - Pre and Post**	**Revised:**	June 1, 2012

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.05								
T_t[1], hr	0.265								0.2652
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft		60	1545						
Slope, ft/ft		0.083	0.291						
Velocity[5], ft/sec		1.4431	2.6972						
T_t[3], hr		0.012	0.159						0.1707
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft				1930	1245				
Slope, ft/ft				0.036	0.072				
Velocity[8], ft/sec				3.984	5.635				
T_t, hr				0.135	0.061				0.1959
Large Tributary									
Length, ft						8425			
Slope, ft/ft						0.026			
Velocity[8], ft/sec						5.644			
T_t, hr						0.415			0.4147
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	1.046
Min	**62.79**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	PGT
Proj. No.:	**186317.0000.0000**	**Date:**	November 10, 2011
Watershed:	**2W - Pre and Post**	**Revised:**	June 1, 2012

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.1								
T_t[1], hr	0.201								0.2010
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft			2810						
Slope, ft/ft			0.093						
Velocity[5], ft/sec			1.5207						
T_t[3], hr			0.513						0.5133
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000
								HR	0.714
								Min	**42.86**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	PGT
Proj. No.:	**186317.0000.0000**	**Date:**	November 10, 2011
Watershed:	**3W - Pre and Post**	**Revised:**	June 1, 2012

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.02								
T_t^1, hr	0.383								0.3826
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity^2, ft/sec									
T_t^3, hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity^4, ft/sec									
T_t^3, hr									0.0000
Woodland									
Length, ft		865	630						
Slope, ft/ft		0.050	0.087						
Velocity^5, ft/sec		1.1180	1.4748						
T_t^3, hr		0.215	0.119						0.3336
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity^6, ft/sec									
T_t^3, hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity^7, ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft				4925					
Slope, ft/ft				0.004					
Velocity^8, ft/sec				1.328					
T_t, hr				1.030					1.0300
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity^8, ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity^{11}, ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	1.746
Min	**104.77**

PROJECT:	**Eolian Renewable Energy LLC**	**Calculated By:**	PMM
	Antrim Wind Project	**Checked By:**	PGT
Proj. No.:	**186317.0000.0000**	**Date:**	November 10, 2011
Watershed:	**4W - Pre and Post**	**Revised:**	June 1, 2012

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	
SHEET FLOW									
Manning's No.	0.4								
Length, ft	100								
P2 , in	2.8								
Slope, ft/ft	0.03								
T_t[1], hr	0.325								0.3253
SHALLOW CONCENTRATED FLOW									
Paved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Unpaved									
Length, ft									
Slope, ft/ft									
Velocity[2], ft/sec									
T_t[3], hr									0.0000
Short Grass Pasture									
Length, ft									
Slope, ft/ft									
Velocity[4], ft/sec									
T_t[3], hr									0.0000
Woodland									
Length, ft		930	525						
Slope, ft/ft		0.070	0.21						
Velocity[5], ft/sec		1.3229	2.2913						
T_t[3], hr		0.195	0.064						0.2589
CHANNEL FLOW									
Waterways & Swamps, No Channels									
Length, ft									
Slope, ft/ft									
Velocity[6], ft/sec									
T_t[3], hr									0.0000
Grassed Waterways/Roadside Ditches									
Length, ft									
Slope, ft/ft									
Velocity[7], ft/sec									
T_t, hr									0.0000
Small Tributary & Swamp w/Channels									
Length, ft				3700	1250				
Slope, ft/ft				0.114	0.048				
Velocity[8], ft/sec				7.090	4.601				
T_t, hr				0.145	0.075				0.2204
Large Tributary									
Length, ft									
Slope, ft/ft									
Velocity[8], ft/sec									
T_t, hr									0.0000
Culvert									
Diameter, ft									
Area, ft^2									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity[11], ft/sec									
Length, L, ft									
T_t, hr									0.0000

HR	0.805
Min	**48.28**

ATTACHMENT C

Stormwater Treatment BMP Worksheets

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-1 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
11.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
82	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← **yes**
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
10,063	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
151	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
173	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 173' is not available for a 20' level spreader.

For a 30' level spreader and an equivalent buffer area: Buffer length = (20' * 173') / 30' = 115'

As designed: Level spreader length = 30 feet

Buffer length = 115 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-2 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
10.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
80	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
15.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-3 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
10.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
80	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
15.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-4 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
15.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← **yes**
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
11,920	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
179	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
209	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 209' is not available for a 20' level spreader.
For a 35' level spreader and an equivalent buffer area: Buffer length = (20' * 209') / 35' = 120'

As designed: Level spreader length = 35 feet
Buffer length = 120 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-5 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
12.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
84	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **≥ L_{MIN}**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site restrictions require that part of the work area at WTG-1 is graded to this buffer. Threfore the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-6 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
11.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
82	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← **yes**
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
16,850	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
253	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
275	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.
Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 275' is not available for a 20' level spreader.
For a 30' level spreader and an equivalent buffer area: Buffer length = (20' * 275') / 30' = 185'

As designed: Level spreader length = 30 feet
Buffer length = 185 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-7 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
22.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
44	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
104	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Too Steep		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Too Steep		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
44	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-8 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
-	%C		
100.0	%D		
16.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
142	feet	Buffer base length due to soil type (weighted based on HSG)	
32	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
174	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Too Steep		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
32	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-9 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
9.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
78	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← **yes**
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
16,823	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
252	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
270	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 270' is not available for a 20' level spreader.

For a 40' level spreader and an equivalent buffer area: Buffer length = (20' * 270') / 40' = 135'

As designed: Level spreader length = 40 feet

Buffer length = 135 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-10 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
8.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
16	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
76	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
16	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site restrictions require that part of the work area at WTG-4 is graded to this buffer. Threfore the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-11 - Ditch Turnout Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

No	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
Yes	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
11.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
Yes		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
82	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

Yes		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

Yes	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

Yes		Level Spreader proposed?	← **yes**
20.0	feet	Level Spreader Length [7]	
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
9,650	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
145	feet	Buffer base length due to soil type (weighted based on HSG)	
22	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
167	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Due to site restrictions, a buffer length of 167' is not available for a 20' level spreader.
For a 25' level spreader and an equivalent buffer area: Buffer length = (20' * 167') / 25' = 135'

As designed: Level spreader length = 25 feet
Buffer length = 135 feet

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-12 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
15.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-5A - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
3.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.19	ac	A = area draining to the buffer	
0.08	ac	A_{IMP} = impervious area draining to the buffer	
40.9	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
96	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **≥ L_{MIN}**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
6	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 120 feet is provided.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-5B - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
6.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.08	ac	A = area draining to the buffer	
0.07	ac	A_{IMP} = impervious area draining to the buffer	
82.9	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
12	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
102	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
12	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 110 feet is provided.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-13 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Too Steep		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Too Steep		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-14 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
12.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
84	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
-	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-15 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
15.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-16 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Too Steep		Natural slope check [5]	← **$\leq$ 20%**
15.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Too Steep		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-17 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Too Steep		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Too Steep		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.

2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.

3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

The uphill swale discharges under the road and into this buffer, and the buffer slope exceeds 20%.
Therefore, the buffer length has been increased to 75'.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-18 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
20.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
100	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
15.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Too Steep		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-19 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
20.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
100	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
10.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **≥ L_{MIN}**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Too Steep		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-20 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
64.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
36.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
9.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.67	ac	A = area draining to the buffer	
0.14	ac	A_{IMP} = impervious area draining to the buffer	
21.4	%	I = percent impervious area draining to the buffer	← **≤ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
11	feet	Buffer length adjustment due to percent of meadow in buffer	
89	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
18	feet	Buffer length adjustment due to steepness of buffer	
11	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site constraints limit the length of this buffer to 50 feet.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-8 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
12.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.56	ac	A = area draining to the buffer	
0.14	ac	A_{IMP} = impervious area draining to the buffer	
25.6	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
114	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
24	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
54	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Site constraints limit the length of this buffer to 50 feet.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-21 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
30.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I ≤ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
60	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
150	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
No	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Too Steep		Natural slope check [5]	← **$\leq$ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
75.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Too Steep		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
60	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
90	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 75 feet is provided due to the steepness of the slope.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-9 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
2.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.26	ac	A = area draining to the buffer	
0.13	ac	A_{IMP} = impervious area draining to the buffer	
51.1	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
4	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
94	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
4	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 120 feet is provided.

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-22 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
25.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **≤ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
110	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
Yes	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Too Steep		Natural slope check [5]	← **$\leq$ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Too Steep		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
50	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-23 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
10.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
80	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
10.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
20	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **B-24 - Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
100.0	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
-	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) <u>in buffer</u> (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
20.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Too Steep		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
100	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Too Steep		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = <u>total</u> length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
No	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
Yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
50.0	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Too Steep		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
40	feet	Buffer length adjustment due to steepness of buffer	
-	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

BUFFER DESIGN CRITERIA (Env-Wq 1508.08)

Type **WTG-10 - Small Pervious Area Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

Yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
Yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
N	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
-	%B		
100.0	%C		
-	%D		
2.0	%	Buffer Slope	← **$\leq$ 15%**

If a Residential or Small Pervious Area buffer is proposed:

No	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
70.0		L_{FP} = maximum flow path to the buffer	
0.22	ac	A = area draining to the buffer	
0.14	ac	A_{IMP} = impervious area draining to the buffer	
65.5	%	I = percent impervious area draining to the buffer	← **$\leq$ 10%**
TRUE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: I $\leq$ 10% & $L_{FP} \leq 150'$	**A or B**
N		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **$\leq$ 15%**
60	feet	Buffer base length due to soil type (weighted based on HSG)	
4	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
94	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

N		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **$\leq$ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **$\geq A_{MIN}$**

If a Roadway Buffer is proposed:

N	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **$\leq$ 20%**
	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
	Lane(s)	Number of travel lanes draining to the buffer	
20.0		Minimum buffer flow path (L_{MIN})	
	feet	Buffer flow path	← **$\geq L_{MIN}$**

If a Ditch Turn Out Buffer is proposed:

N		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **$\leq$ 6000 sf**
Good		Slope check	← **$\leq$ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
4	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
50	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

A buffer length of 120 feet is provided.

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-1**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?
No	Yes/No	Is the system lined?
0.41	ac	A = Area draining to the practice
0.16	ac	A_I = Impervious area draining to the practice
6.0	minutes	T_c = Time of Concentration
0.38	decimal	I = percent impervious area draining to the practice, in decimal form
0.39	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.16	ac-in	WQV= 1" x Rv x A
584	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")
1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.39	inches	Q = water quality depth. Q = WQV/A
92	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$
0.90	inches	S = potential maximum retention. S = (1000/CN) - 10
0.180	inches	Ia = initial abstraction. Ia = 0.2S
630	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.16	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$
150.00	feet	L = swale length [1] ← **≥ 100'**
3.00	feet	w = bottom of the swale width[2] ← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit
1,206.50	feet	E_{BTM} = elevation of the bottom of the practice ← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope ← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope ← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3] ← **0.005 - .05**
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4] ← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)
4.14	feet	Check wetted perimeter
0.16	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**
-1%		Percent difference between WQF_{check} and WQF [5] ← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF ← **≥ 10 min**
1,206.92	ft	Peak elevation of the 10-year storm event
1,208.00	ft	Elevation of the top of the swale
YES	Yes/No	10 peak elevation ≤ the top of swale ← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-1: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,206.50	0.00	0.00
1,206.51	0.04	0.00
1,206.52	0.07	0.00
1,206.53	0.09	0.01
1,206.54	0.11	0.01
1,206.55	0.13	0.02
1,206.56	0.15	0.03
1,206.57	0.16	0.04
1,206.58	0.17	0.05
1,206.59	0.19	0.06
1,206.60	0.20	0.07
1,206.61	0.21	0.08
1,206.62	0.22	0.09
1,206.63	0.23	0.10
1,206.64	0.25	0.12
1,206.65	0.26	0.13
1,206.66	0.27	0.15
1,206.67	0.28	0.16
1,206.68	0.29	0.18
1,206.69	0.29	0.20
1,206.70	0.30	0.22
1,206.71	0.31	0.24
1,206.72	0.32	0.26
1,206.73	0.33	0.28
1,206.74	0.34	0.30
1,206.75	0.34	0.32
1,206.76	0.35	0.35
1,206.77	0.36	0.37
1,206.78	0.37	0.40
1,206.79	0.37	0.42
1,206.80	0.38	0.45
1,206.81	0.39	0.47
1,206.82	0.40	0.50
1,206.83	0.40	0.53
1,206.84	0.41	0.56
1,206.85	0.42	0.59
1,206.86	0.42	0.62
1,206.87	0.43	0.65
1,206.88	0.44	0.69
1,206.89	0.44	0.72
1,206.90	0.45	0.75
1,206.91	0.45	0.79
1,206.92	0.46	0.82
1,206.93	0.47	0.86
1,206.94	0.47	0.90
1,206.95	0.48	0.94
1,206.96	0.48	0.98
1,206.97	0.49	1.02
1,206.98	0.50	1.06
1,206.99	0.50	1.10
1,207.00	0.51	1.14
1,207.01	0.51	1.18
1,207.02	0.52	1.23
1,207.03	0.52	1.27
1,207.04	0.53	1.32
1,207.05	0.53	1.37
1,207.06	0.54	1.41
1,207.07	0.54	1.46
1,207.08	0.55	1.51
1,207.09	0.55	1.56
1,207.10	0.56	1.61
1,207.11	0.56	1.66
1,207.12	0.57	1.72
1,207.13	0.57	1.77
1,207.14	0.58	1.83
1,207.15	0.58	1.88
1,207.16	0.59	1.94
1,207.17	0.59	2.00
1,207.18	0.60	2.05
1,207.19	0.60	2.11
1,207.20	0.61	2.17
1,207.21	0.61	2.23
1,207.22	0.62	2.30
1,207.23	0.62	2.36
1,207.24	0.63	2.42
1,207.25	0.63	2.49
1,207.26	0.64	2.55
1,207.27	0.64	2.62
1,207.28	0.65	2.69
1,207.29	0.65	2.76
1,207.30	0.65	2.83
1,207.31	0.66	2.90
1,207.32	0.66	2.97
1,207.33	0.67	3.04
1,207.34	0.67	3.12
1,207.35	0.68	3.19
1,207.36	0.68	3.27
1,207.37	0.69	3.34
1,207.38	0.69	3.42
1,207.39	0.69	3.50
1,207.40	0.70	3.58
1,207.41	0.70	3.66
1,207.42	0.71	3.74
1,207.43	0.71	3.83
1,207.44	0.71	3.91
1,207.45	0.72	4.00
1,207.46	0.72	4.08
1,207.47	0.73	4.17
1,207.48	0.73	4.26
1,207.49	0.74	4.35
1,207.50	0.74	4.44
1,207.51	0.74	4.53
1,207.52	0.75	4.62
1,207.53	0.75	4.71
1,207.54	0.76	4.81
1,207.55	0.76	4.90
1,207.56	0.76	5.00
1,207.57	0.77	5.10
1,207.58	0.77	5.20
1,207.59	0.78	5.30
1,207.60	0.78	5.40
1,207.61	0.78	5.50
1,207.62	0.79	5.61
1,207.63	0.79	5.71
1,207.64	0.79	5.82
1,207.65	0.80	5.92
1,207.66	0.80	6.03
1,207.67	0.81	6.14
1,207.68	0.81	6.25
1,207.69	0.81	6.36
1,207.70	0.82	6.47
1,207.71	0.82	6.59
1,207.72	0.82	6.70
1,207.73	0.83	6.82
1,207.74	0.83	6.94
1,207.75	0.84	7.06
1,207.76	0.84	7.17
1,207.77	0.84	7.30
1,207.78	0.85	7.42
1,207.79	0.85	7.54
1,207.80	0.85	7.67
1,207.81	0.86	7.79
1,207.82	0.86	7.92
1,207.83	0.87	8.05
1,207.84	0.87	8.18
1,207.85	0.87	8.31
1,207.86	0.88	8.44
1,207.87	0.88	8.57
1,207.88	0.88	8.70
1,207.89	0.89	8.84
1,207.90	0.89	8.98
1,207.91	0.89	9.11
1,207.92	0.90	9.25
1,207.93	0.90	9.39
1,207.94	0.90	9.54
1,207.95	0.91	9.68
1,207.96	0.91	9.82
1,207.97	0.92	9.97
1,207.98	0.92	10.11
1,207.99	0.92	10.26
1,208.00	**0.93**	**10.41**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-2**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.27	ac	A = Area draining to the practice	
0.13	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.49	decimal	I = percent impervious area draining to the practice, in decimal form	
0.49	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
473	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.49	inches	Q = water quality depth. Q = WQV/A	
94	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
0.67	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.135	inches	Ia = initial abstraction. Ia = 0.2S	
640	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.13	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
130.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,354.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.005	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.14	feet	Check wetted perimeter	
0.13	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-1%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
11	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,354.38	ft	Peak elevation of the 10-year storm event	
1,355.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-2: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,354.00	0.00	0.00
1,354.01	0.03	0.00
1,354.02	0.06	0.00
1,354.03	0.08	0.01
1,354.04	0.09	0.01
1,354.05	0.11	0.02
1,354.06	0.12	0.02
1,354.07	0.13	0.03
1,354.08	0.14	0.04
1,354.09	0.15	0.05
1,354.10	0.16	0.05
1,354.11	0.17	0.06
1,354.12	0.18	0.07
1,354.13	0.19	0.08
1,354.14	0.20	0.10
1,354.15	0.21	0.11
1,354.16	0.22	0.12
1,354.17	0.22	0.13
1,354.18	0.23	0.15
1,354.19	0.24	0.16
1,354.20	0.25	0.18
1,354.21	0.25	0.19
1,354.22	0.26	0.21
1,354.23	0.27	0.23
1,354.24	0.27	0.24
1,354.25	0.28	0.26
1,354.26	0.29	0.28
1,354.27	0.29	0.30
1,354.28	0.30	0.32
1,354.29	0.31	0.34
1,354.30	0.31	0.36
1,354.31	0.32	0.39
1,354.32	0.32	0.41
1,354.33	0.33	0.43
1,354.34	0.33	0.46
1,354.35	0.34	0.48
1,354.36	0.34	0.51
1,354.37	0.35	0.53
1,354.38	0.36	0.56
1,354.39	0.36	0.59
1,354.40	0.37	0.61
1,354.41	0.37	0.64
1,354.42	0.38	0.67
1,354.43	0.38	0.70
1,354.44	0.38	0.73
1,354.45	0.39	0.76
1,354.46	0.39	0.79
1,354.47	0.40	0.83
1,354.48	0.40	0.86
1,354.49	0.41	0.89
1,354.50	0.41	0.93
1,354.51	0.42	0.96
1,354.52	0.42	1.00
1,354.53	0.43	1.04
1,354.54	0.43	1.07
1,354.55	0.43	1.11
1,354.56	0.44	1.15
1,354.57	0.44	1.19
1,354.58	0.45	1.23
1,354.59	0.45	1.27
1,354.60	0.46	1.31
1,354.61	0.46	1.36
1,354.62	0.46	1.40
1,354.63	0.47	1.44
1,354.64	0.47	1.49
1,354.65	0.48	1.53
1,354.66	0.48	1.58
1,354.67	0.48	1.63
1,354.68	0.49	1.67
1,354.69	0.49	1.72
1,354.70	0.50	1.77
1,354.71	0.50	1.82
1,354.72	0.50	1.87
1,354.73	0.51	1.92
1,354.74	0.51	1.97
1,354.75	0.51	2.03
1,354.76	0.52	2.08
1,354.77	0.52	2.14
1,354.78	0.53	2.19
1,354.79	0.53	2.25
1,354.80	0.53	2.30
1,354.81	0.54	2.36
1,354.82	0.54	2.42
1,354.83	0.54	2.48
1,354.84	0.55	2.54
1,354.85	0.55	2.60
1,354.86	0.55	2.66
1,354.87	0.56	2.72
1,354.88	0.56	2.79
1,354.89	0.57	2.85
1,354.90	0.57	2.92
1,354.91	0.57	2.98
1,354.92	0.58	3.05
1,354.93	0.58	3.12
1,354.94	0.58	3.19
1,354.95	0.59	3.26
1,354.96	0.59	3.33
1,354.97	0.59	3.40
1,354.98	0.60	3.47
1,354.99	0.60	3.54
1,355.00	0.60	3.61
1,355.01	0.61	3.69
1,355.02	0.61	3.76
1,355.03	0.61	3.84
1,355.04	0.62	3.92
1,355.05	0.62	4.00
1,355.06	0.62	4.07
1,355.07	0.63	4.15
1,355.08	0.63	4.24
1,355.09	0.63	4.32
1,355.10	0.63	4.40
1,355.11	0.64	4.48
1,355.12	0.64	4.57
1,355.13	0.64	4.65
1,355.14	0.65	4.74
1,355.15	0.65	4.83
1,355.16	0.65	4.91
1,355.17	0.66	5.00
1,355.18	0.66	5.09
1,355.19	0.66	5.18
1,355.20	0.67	5.27
1,355.21	0.67	5.37
1,355.22	0.67	5.46
1,355.23	0.68	5.56
1,355.24	0.68	5.65
1,355.25	0.68	5.75
1,355.26	0.68	5.84
1,355.27	0.69	5.94
1,355.28	0.69	6.04
1,355.29	0.69	6.14
1,355.30	0.70	6.24
1,355.31	0.70	6.35
1,355.32	0.70	6.45
1,355.33	0.71	6.55
1,355.34	0.71	6.66
1,355.35	0.71	6.77
1,355.36	0.71	6.87
1,355.37	0.72	6.98
1,355.38	0.72	7.09
1,355.39	0.72	7.20
1,355.40	0.73	7.31
1,355.41	0.73	7.42
1,355.42	0.73	7.54
1,355.43	0.73	7.65
1,355.44	0.74	7.77
1,355.45	0.74	7.88
1,355.46	0.74	8.00
1,355.47	0.75	8.12
1,355.48	0.75	8.24
1,355.49	0.75	8.36
1,355.50	**0.75**	**8.48**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-3**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?
No	Yes/No	Is the system lined?
0.31	ac	A = Area draining to the practice
0.07	ac	A_I = Impervious area draining to the practice
6.0	minutes	T_c = Time of Concentration
0.24	decimal	I = percent impervious area draining to the practice, in decimal form
0.26	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.08	ac-in	WQV= 1" x Rv x A
294	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")
1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.26	inches	Q = water quality depth. Q = WQV/A
88	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$
1.32	inches	S = potential maximum retention. S = (1000/CN) - 10
0.264	inches	Ia = initial abstraction. Ia = 0.2S
620	cfs/mi²/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.08	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi²/in * ac-in" to "cfs" multiply by 1mi²/640ac
130.00	feet	L = swale length [1] ← **≥ 100'**
3.00	feet	w = bottom of the swale width[2] ← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit
1,758.00	feet	E_{BTM} = elevation of the bottom of the practice ← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope ← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope ← **≥3:1**
0.010	ft/ft	S = slope of swale in decimal form[3] ← **0.005 - .05**
1.3	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4] ← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15
0.37	ft²	Cross-sectional area check (assume trapezoidal channel)
3.70	feet	Check wetted perimeter
0.08	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**
-1%		Percent difference between WQF_{check} and WQF [5] ← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF ← **≥ 10 min**
1,758.34	ft	Peak elevation of the 10-year storm event
1,759.50	ft	Elevation of the top of the swale
YES	Yes/No	10 peak elevation ≤ the top of swale ← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-3: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,758.00	0.00	0.00	1,758.52	0.52	1.23	1,759.04	0.75	4.80
1,758.01	0.04	0.00	1,758.53	0.52	1.27	1,759.05	0.76	4.90
1,758.02	0.07	0.00	1,758.54	0.53	1.32	1,759.06	0.76	4.99
1,758.03	0.09	0.01	1,758.55	0.53	1.36	1,759.07	0.77	5.09
1,758.04	0.11	0.01	1,758.56	0.54	1.41	1,759.08	0.77	5.19
1,758.05	0.13	0.02	1,758.57	0.54	1.46	1,759.09	0.77	5.29
1,758.06	0.15	0.03	1,758.58	0.55	1.51	1,759.10	0.78	5.39
1,758.07	0.16	0.04	1,758.59	0.55	1.56	1,759.11	0.78	5.49
1,758.08	0.17	0.05	1,758.60	0.56	1.61	1,759.12	0.79	5.60
1,758.09	0.19	0.06	1,758.61	0.56	1.66	1,759.13	0.79	5.70
1,758.10	0.20	0.07	1,758.62	0.57	1.71	1,759.14	0.79	5.81
1,758.11	0.21	0.08	1,758.63	0.57	1.77	1,759.15	0.80	5.91
1,758.12	0.22	0.09	1,758.64	0.58	1.82	1,759.16	0.80	6.02
1,758.13	0.23	0.10	1,758.65	0.58	1.88	1,759.17	0.80	6.13
1,758.14	0.25	0.12	1,758.66	0.59	1.94	1,759.18	0.81	6.24
1,758.15	0.26	0.13	1,758.67	0.59	1.99	1,759.19	0.81	6.35
1,758.16	0.27	0.15	1,758.68	0.60	2.05	1,759.20	0.82	6.46
1,758.17	0.28	0.16	1,758.69	0.60	2.11	1,759.21	0.82	6.58
1,758.18	0.28	0.18	1,758.70	0.61	2.17	1,759.22	0.82	6.69
1,758.19	0.29	0.20	1,758.71	0.61	2.23	1,759.23	0.83	6.81
1,758.20	0.30	0.22	1,758.72	0.62	2.29	1,759.24	0.83	6.93
1,758.21	0.31	0.24	1,758.73	0.62	2.36	1,759.25	0.83	7.04
1,758.22	0.32	0.26	1,758.74	0.63	2.42	1,759.26	0.84	7.16
1,758.23	0.33	0.28	1,758.75	0.63	2.49	1,759.27	0.84	7.28
1,758.24	0.34	0.30	1,758.76	0.64	2.55	1,759.28	0.85	7.41
1,758.25	0.34	0.32	1,758.77	0.64	2.62	1,759.29	0.85	7.53
1,758.26	0.35	0.35	1,758.78	0.64	2.69	1,759.30	0.85	7.65
1,758.27	0.36	0.37	1,758.79	0.65	2.75	1,759.31	0.86	7.78
1,758.28	0.37	0.39	1,758.80	0.65	2.82	1,759.32	0.86	7.91
1,758.29	0.37	0.42	1,758.81	0.66	2.89	1,759.33	0.86	8.03
1,758.30	0.38	0.45	1,758.82	0.66	2.97	1,759.34	0.87	8.16
1,758.31	0.39	0.47	1,758.83	0.67	3.04	1,759.35	0.87	8.29
1,758.32	0.40	0.50	1,758.84	0.67	3.11	1,759.36	0.87	8.42
1,758.33	0.40	0.53	1,758.85	0.68	3.19	1,759.37	0.88	8.56
1,758.34	0.41	0.56	1,758.86	0.68	3.26	1,759.38	0.88	8.69
1,758.35	0.42	0.59	1,758.87	0.68	3.34	1,759.39	0.89	8.83
1,758.36	0.42	0.62	1,758.88	0.69	3.42	1,759.40	0.89	8.96
1,758.37	0.43	0.65	1,758.89	0.69	3.50	1,759.41	0.89	9.10
1,758.38	0.44	0.68	1,758.90	0.70	3.58	1,759.42	0.90	9.24
1,758.39	0.44	0.72	1,758.91	0.70	3.66	1,759.43	0.90	9.38
1,758.40	0.45	0.75	1,758.92	0.71	3.74	1,759.44	0.90	9.52
1,758.41	0.45	0.79	1,758.93	0.71	3.82	1,759.45	0.91	9.66
1,758.42	0.46	0.82	1,758.94	0.71	3.91	1,759.46	0.91	9.81
1,758.43	0.47	0.86	1,758.95	0.72	3.99	1,759.47	0.91	9.95
1,758.44	0.47	0.90	1,758.96	0.72	4.08	1,759.48	0.92	10.10
1,758.45	0.48	0.94	1,758.97	0.73	4.16	1,759.49	0.92	10.25
1,758.46	0.48	0.97	1,758.98	0.73	4.25	1,759.50	**0.92**	**10.40**
1,758.47	0.49	1.01	1,758.99	0.73	4.34			
1,758.48	0.49	1.05	1,759.00	0.74	4.43			
1,758.49	0.50	1.10	1,759.01	0.74	4.52			
1,758.50	0.51	1.14	1,759.02	0.75	4.61			
1,758.51	0.51	1.18	1,759.03	0.75	4.71			

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-4**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.25	ac	A = Area draining to the practice	
0.09	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.34	decimal	I = percent impervious area draining to the practice, in decimal form	
0.36	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.09	ac-in	WQV= 1" x Rv x A	
326	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.36	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
0.99	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.198	inches	Ia = initial abstraction. Ia = 0.2S	
625	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.09	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
130.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,628.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.6	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.44	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.82	feet	Check wetted perimeter	
0.09	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
2%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
11	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,628.37	ft	Peak elevation of the 10-year storm event	
1,629.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-4: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,628.00	0.00	0.00	1,628.52	0.47	1.11	1,629.04	0.69	4.37
1,628.01	0.04	0.00	1,628.53	0.47	1.16	1,629.05	0.69	4.45
1,628.02	0.06	0.00	1,628.54	0.48	1.20	1,629.06	0.69	4.54
1,628.03	0.09	0.01	1,628.55	0.48	1.24	1,629.07	0.70	4.63
1,628.04	0.10	0.01	1,628.56	0.49	1.28	1,629.08	0.70	4.72
1,628.05	0.12	0.02	1,628.57	0.49	1.33	1,629.09	0.70	4.81
1,628.06	0.13	0.03	1,628.58	0.50	1.37	1,629.10	0.71	4.90
1,628.07	0.15	0.03	1,628.59	0.50	1.42	1,629.11	0.71	4.99
1,628.08	0.16	0.04	1,628.60	0.51	1.46	1,629.12	0.71	5.09
1,628.09	0.17	0.05	1,628.61	0.51	1.51	1,629.13	0.72	5.18
1,628.10	0.18	0.06	1,628.62	0.52	1.56	1,629.14	0.72	5.28
1,628.11	0.19	0.07	1,628.63	0.52	1.61	1,629.15	0.72	5.38
1,628.12	0.20	0.08	1,628.64	0.53	1.66	1,629.16	0.73	5.47
1,628.13	0.21	0.09	1,628.65	0.53	1.71	1,629.17	0.73	5.57
1,628.14	0.22	0.11	1,628.66	0.54	1.76	1,629.18	0.74	5.67
1,628.15	0.23	0.12	1,628.67	0.54	1.81	1,629.19	0.74	5.78
1,628.16	0.24	0.13	1,628.68	0.54	1.86	1,629.20	0.74	5.88
1,628.17	0.25	0.15	1,628.69	0.55	1.92	1,629.21	0.75	5.98
1,628.18	0.26	0.16	1,628.70	0.55	1.97	1,629.22	0.75	6.09
1,628.19	0.27	0.18	1,628.71	0.56	2.03	1,629.23	0.75	6.19
1,628.20	0.28	0.20	1,628.72	0.56	2.08	1,629.24	0.76	6.30
1,628.21	0.28	0.22	1,628.73	0.57	2.14	1,629.25	0.76	6.40
1,628.22	0.29	0.23	1,628.74	0.57	2.20	1,629.26	0.76	6.51
1,628.23	0.30	0.25	1,628.75	0.57	2.26	1,629.27	0.77	6.62
1,628.24	0.31	0.27	1,628.76	0.58	2.32	1,629.28	0.77	6.73
1,628.25	0.31	0.29	1,628.77	0.58	2.38	1,629.29	0.77	6.85
1,628.26	0.32	0.31	1,628.78	0.59	2.44	1,629.30	0.78	6.96
1,628.27	0.33	0.34	1,628.79	0.59	2.50	1,629.31	0.78	7.07
1,628.28	0.33	0.36	1,628.80	0.59	2.57	1,629.32	0.78	7.19
1,628.29	0.34	0.38	1,628.81	0.60	2.63	1,629.33	0.79	7.30
1,628.30	0.35	0.41	1,628.82	0.60	2.70	1,629.34	0.79	7.42
1,628.31	0.35	0.43	1,628.83	0.61	2.76	1,629.35	0.79	7.54
1,628.32	0.36	0.46	1,628.84	0.61	2.83	1,629.36	0.80	7.66
1,628.33	0.37	0.48	1,628.85	0.61	2.90	1,629.37	0.80	7.78
1,628.34	0.37	0.51	1,628.86	0.62	2.97	1,629.38	0.80	7.90
1,628.35	0.38	0.54	1,628.87	0.62	3.04	1,629.39	0.81	8.02
1,628.36	0.38	0.56	1,628.88	0.63	3.11	1,629.40	0.81	8.15
1,628.37	0.39	0.59	1,628.89	0.63	3.18	1,629.41	0.81	8.27
1,628.38	0.40	0.62	1,628.90	0.63	3.25	1,629.42	0.81	8.40
1,628.39	0.40	0.65	1,628.91	0.64	3.32	1,629.43	0.82	8.53
1,628.40	0.41	0.68	1,628.92	0.64	3.40	1,629.44	0.82	8.66
1,628.41	0.41	0.72	1,628.93	0.65	3.47	1,629.45	0.82	8.79
1,628.42	0.42	0.75	1,628.94	0.65	3.55	1,629.46	0.83	8.92
1,628.43	0.42	0.78	1,628.95	0.65	3.63	1,629.47	0.83	9.05
1,628.44	0.43	0.82	1,628.96	0.66	3.71	1,629.48	0.83	9.18
1,628.45	0.43	0.85	1,628.97	0.66	3.78	1,629.49	0.84	9.32
1,628.46	0.44	0.89	1,628.98	0.66	3.86	1,629.50	**0.84**	**9.45**
1,628.47	0.44	0.92	1,628.99	0.67	3.95			
1,628.48	0.45	0.96	1,629.00	0.67	4.03			
1,628.49	0.46	1.00	1,629.01	0.67	4.11			
1,628.50	0.46	1.04	1,629.02	0.68	4.19			
1,628.51	0.47	1.07	1,629.03	0.68	4.28			

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-5**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.40	ac	A = Area draining to the practice	
0.12	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.30	decimal	I = percent impervious area draining to the practice, in decimal form	
0.32	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
461	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.32	inches	Q = water quality depth. Q = WQV/A	
90	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.11	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.222	inches	Ia = initial abstraction. Ia = 0.2S	
625	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.12	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
120.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,682.50	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.005	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
2.0	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.60	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.08	feet	Check wetted perimeter	
0.12	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-6%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,682.94	ft	Peak elevation of the 10-year storm event	
1,684.00	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-5: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,682.50	0.00	0.00
1,682.51	0.03	0.00
1,682.52	0.06	0.00
1,682.53	0.08	0.01
1,682.54	0.09	0.01
1,682.55	0.11	0.02
1,682.56	0.12	0.02
1,682.57	0.13	0.03
1,682.58	0.14	0.04
1,682.59	0.15	0.05
1,682.60	0.16	0.05
1,682.61	0.17	0.06
1,682.62	0.18	0.07
1,682.63	0.19	0.08
1,682.64	0.20	0.10
1,682.65	0.21	0.11
1,682.66	0.22	0.12
1,682.67	0.22	0.13
1,682.68	0.23	0.15
1,682.69	0.24	0.16
1,682.70	0.25	0.18
1,682.71	0.25	0.19
1,682.72	0.26	0.21
1,682.73	0.27	0.23
1,682.74	0.27	0.24
1,682.75	0.28	0.26
1,682.76	0.29	0.28
1,682.77	0.29	0.30
1,682.78	0.30	0.32
1,682.79	0.31	0.34
1,682.80	0.31	0.36
1,682.81	0.32	0.39
1,682.82	0.32	0.41
1,682.83	0.33	0.43
1,682.84	0.33	0.46
1,682.85	0.34	0.48
1,682.86	0.34	0.51
1,682.87	0.35	0.53
1,682.88	0.36	0.56
1,682.89	0.36	0.59
1,682.90	0.37	0.61
1,682.91	0.37	0.64
1,682.92	0.38	0.67
1,682.93	0.38	0.70
1,682.94	0.38	0.73
1,682.95	0.39	0.76
1,682.96	0.39	0.79
1,682.97	0.40	0.83
1,682.98	0.40	0.86
1,682.99	0.41	0.89
1,683.00	0.41	0.93
1,683.01	0.42	0.96
1,683.02	0.42	1.00
1,683.03	0.43	1.04
1,683.04	0.43	1.07
1,683.05	0.43	1.11
1,683.06	0.44	1.15
1,683.07	0.44	1.19
1,683.08	0.45	1.23
1,683.09	0.45	1.27
1,683.10	0.46	1.31
1,683.11	0.46	1.36
1,683.12	0.46	1.40
1,683.13	0.47	1.44
1,683.14	0.47	1.49
1,683.15	0.48	1.53
1,683.16	0.48	1.58
1,683.17	0.48	1.63
1,683.18	0.49	1.67
1,683.19	0.49	1.72
1,683.20	0.50	1.77
1,683.21	0.50	1.82
1,683.22	0.50	1.87
1,683.23	0.51	1.92
1,683.24	0.51	1.97
1,683.25	0.51	2.03
1,683.26	0.52	2.08
1,683.27	0.52	2.14
1,683.28	0.53	2.19
1,683.29	0.53	2.25
1,683.30	0.53	2.30
1,683.31	0.54	2.36
1,683.32	0.54	2.42
1,683.33	0.54	2.48
1,683.34	0.55	2.54
1,683.35	0.55	2.60
1,683.36	0.55	2.66
1,683.37	0.56	2.72
1,683.38	0.56	2.79
1,683.39	0.57	2.85
1,683.40	0.57	2.92
1,683.41	0.57	2.98
1,683.42	0.58	3.05
1,683.43	0.58	3.12
1,683.44	0.58	3.19
1,683.45	0.59	3.26
1,683.46	0.59	3.33
1,683.47	0.59	3.40
1,683.48	0.60	3.47
1,683.49	0.60	3.54
1,683.50	0.60	3.61
1,683.51	0.61	3.69
1,683.52	0.61	3.76
1,683.53	0.61	3.84
1,683.54	0.62	3.92
1,683.55	0.62	4.00
1,683.56	0.62	4.07
1,683.57	0.63	4.15
1,683.58	0.63	4.24
1,683.59	0.63	4.32
1,683.60	0.63	4.40
1,683.61	0.64	4.48
1,683.62	0.64	4.57
1,683.63	0.64	4.65
1,683.64	0.65	4.74
1,683.65	0.65	4.83
1,683.66	0.65	4.91
1,683.67	0.66	5.00
1,683.68	0.66	5.09
1,683.69	0.66	5.18
1,683.70	0.67	5.27
1,683.71	0.67	5.37
1,683.72	0.67	5.46
1,683.73	0.68	5.56
1,683.74	0.68	5.65
1,683.75	0.68	5.75
1,683.76	0.68	5.84
1,683.77	0.69	5.94
1,683.78	0.69	6.04
1,683.79	0.69	6.14
1,683.80	0.70	6.24
1,683.81	0.70	6.35
1,683.82	0.70	6.45
1,683.83	0.71	6.55
1,683.84	0.71	6.66
1,683.85	0.71	6.77
1,683.86	0.71	6.87
1,683.87	0.72	6.98
1,683.88	0.72	7.09
1,683.89	0.72	7.20
1,683.90	0.73	7.31
1,683.91	0.73	7.42
1,683.92	0.73	7.54
1,683.93	0.73	7.65
1,683.94	0.74	7.77
1,683.95	0.74	7.88
1,683.96	0.74	8.00
1,683.97	0.75	8.12
1,683.98	0.75	8.24
1,683.99	0.75	8.36
1,684.00	**0.75**	**8.48**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-6**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.59	ac	A = Area draining to the practice	
0.09	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.16	decimal	I = percent impervious area draining to the practice, in decimal form	
0.19	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.11	ac-in	WQV= 1" x Rv x A	
408	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.19	inches	Q = water quality depth. Q = WQV/A	
86	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.67	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.334	inches	Ia = initial abstraction. Ia = 0.2S	
610	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.11	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
120.00	feet	L = swale length [1]	← **≥ 100'**
4.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,579.50	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.4	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.52	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.76	feet	Check wetted perimeter	
0.10	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-4%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,579.92	ft	Peak elevation of the 10-year storm event	
1,581.00	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-6: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,579.50	0.00	0.00
1,579.51	0.04	0.00
1,579.52	0.07	0.01
1,579.53	0.09	0.01
1,579.54	0.11	0.02
1,579.55	0.13	0.03
1,579.56	0.15	0.04
1,579.57	0.16	0.05
1,579.58	0.18	0.06
1,579.59	0.19	0.07
1,579.60	0.20	0.09
1,579.61	0.22	0.10
1,579.62	0.23	0.12
1,579.63	0.24	0.14
1,579.64	0.25	0.15
1,579.65	0.26	0.17
1,579.66	0.27	0.19
1,579.67	0.28	0.22
1,579.68	0.29	0.24
1,579.69	0.30	0.26
1,579.70	0.31	0.28
1,579.71	0.32	0.31
1,579.72	0.33	0.34
1,579.73	0.34	0.36
1,579.74	0.34	0.39
1,579.75	0.35	0.42
1,579.76	0.36	0.45
1,579.77	0.37	0.48
1,579.78	0.38	0.51
1,579.79	0.38	0.54
1,579.80	0.39	0.58
1,579.81	0.40	0.61
1,579.82	0.41	0.65
1,579.83	0.41	0.68
1,579.84	0.42	0.72
1,579.85	0.43	0.76
1,579.86	0.44	0.80
1,579.87	0.44	0.84
1,579.88	0.45	0.88
1,579.89	0.46	0.92
1,579.90	0.46	0.96
1,579.91	0.47	1.00
1,579.92	0.47	1.05
1,579.93	0.48	1.09
1,579.94	0.49	1.14
1,579.95	0.49	1.19
1,579.96	0.50	1.24
1,579.97	0.51	1.29
1,579.98	0.51	1.33
1,579.99	0.52	1.39
1,580.00	0.52	1.44
1,580.01	0.53	1.49
1,580.02	0.53	1.55
1,580.03	0.54	1.60
1,580.04	0.55	1.66
1,580.05	0.55	1.71
1,580.06	0.56	1.77
1,580.07	0.56	1.83
1,580.08	0.57	1.89
1,580.09	0.57	1.95
1,580.10	0.58	2.01
1,580.11	0.58	2.08
1,580.12	0.59	2.14
1,580.13	0.59	2.20
1,580.14	0.60	2.27
1,580.15	0.60	2.34
1,580.16	0.61	2.40
1,580.17	0.61	2.47
1,580.18	0.62	2.54
1,580.19	0.62	2.61
1,580.20	0.63	2.69
1,580.21	0.63	2.76
1,580.22	0.64	2.83
1,580.23	0.64	2.91
1,580.24	0.65	2.99
1,580.25	0.65	3.06
1,580.26	0.66	3.14
1,580.27	0.66	3.22
1,580.28	0.67	3.30
1,580.29	0.67	3.38
1,580.30	0.68	3.46
1,580.31	0.68	3.55
1,580.32	0.69	3.63
1,580.33	0.69	3.72
1,580.34	0.69	3.81
1,580.35	0.70	3.89
1,580.36	0.70	3.98
1,580.37	0.71	4.07
1,580.38	0.71	4.16
1,580.39	0.72	4.26
1,580.40	0.72	4.35
1,580.41	0.73	4.45
1,580.42	0.73	4.54
1,580.43	0.73	4.64
1,580.44	0.74	4.74
1,580.45	0.74	4.84
1,580.46	0.75	4.94
1,580.47	0.75	5.04
1,580.48	0.76	5.14
1,580.49	0.76	5.24
1,580.50	0.76	5.35
1,580.51	0.77	5.45
1,580.52	0.77	5.56
1,580.53	0.78	5.67
1,580.54	0.78	5.78
1,580.55	0.78	5.89
1,580.56	0.79	6.00
1,580.57	0.79	6.12
1,580.58	0.80	6.23
1,580.59	0.80	6.35
1,580.60	0.80	6.46
1,580.61	0.81	6.58
1,580.62	0.81	6.70
1,580.63	0.82	6.82
1,580.64	0.82	6.94
1,580.65	0.82	7.06
1,580.66	0.83	7.19
1,580.67	0.83	7.31
1,580.68	0.84	7.44
1,580.69	0.84	7.57
1,580.70	0.84	7.70
1,580.71	0.85	7.83
1,580.72	0.85	7.96
1,580.73	0.86	8.09
1,580.74	0.86	8.22
1,580.75	0.86	8.36
1,580.76	0.87	8.49
1,580.77	0.87	8.63
1,580.78	0.87	8.77
1,580.79	0.88	8.91
1,580.80	0.88	9.05
1,580.81	0.89	9.20
1,580.82	0.89	9.34
1,580.83	0.89	9.49
1,580.84	0.90	9.63
1,580.85	0.90	9.78
1,580.86	0.90	9.93
1,580.87	0.91	10.08
1,580.88	0.91	10.23
1,580.89	0.91	10.39
1,580.90	0.92	10.54
1,580.91	0.92	10.70
1,580.92	0.93	10.85
1,580.93	0.93	11.01
1,580.94	0.93	11.17
1,580.95	0.94	11.33
1,580.96	0.94	11.49
1,580.97	0.94	11.66
1,580.98	0.95	11.82
1,580.99	0.95	11.99
1,581.00	**0.95**	**12.16**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-7**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.25	ac	A = Area draining to the practice	
0.06	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.25	decimal	I = percent impervious area draining to the practice, in decimal form	
0.28	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.07	ac-in	WQV= 1" x Rv x A	
255	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.28	inches	Q = water quality depth. Q = WQV/A	
89	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.27	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.253	inches	Ia = initial abstraction. Ia = 0.2S	
615	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.07	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
120.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,503.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.3	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.37	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.70	feet	Check wetted perimeter	
0.07	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
0%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
11	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,503.33	ft	Peak elevation of the 10-year storm event	
1,540.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-7: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,503.00	0.00	0.00
1,503.01	0.03	0.00
1,503.02	0.06	0.00
1,503.03	0.08	0.01
1,503.04	0.10	0.01
1,503.05	0.11	0.02
1,503.06	0.13	0.02
1,503.07	0.14	0.03
1,503.08	0.15	0.04
1,503.09	0.16	0.05
1,503.10	0.17	0.06
1,503.11	0.18	0.07
1,503.12	0.19	0.08
1,503.13	0.20	0.09
1,503.14	0.21	0.10
1,503.15	0.22	0.11
1,503.16	0.23	0.13
1,503.17	0.24	0.14
1,503.18	0.25	0.16
1,503.19	0.25	0.17
1,503.20	0.26	0.19
1,503.21	0.27	0.21
1,503.22	0.28	0.22
1,503.23	0.28	0.24
1,503.24	0.29	0.26
1,503.25	0.30	0.28
1,503.26	0.30	0.30
1,503.27	0.31	0.32
1,503.28	0.32	0.34
1,503.29	0.32	0.36
1,503.30	0.33	0.39
1,503.31	0.34	0.41
1,503.32	0.34	0.43
1,503.33	0.35	0.46
1,503.34	0.35	0.48
1,503.35	0.36	0.51
1,503.36	0.37	0.54
1,503.37	0.37	0.56
1,503.38	0.38	0.59
1,503.39	0.38	0.62
1,503.40	0.39	0.65
1,503.41	0.39	0.68
1,503.42	0.40	0.71
1,503.43	0.40	0.74
1,503.44	0.41	0.78
1,503.45	0.41	0.81
1,503.46	0.42	0.84
1,503.47	0.42	0.88
1,503.48	0.43	0.91
1,503.49	0.43	0.95
1,503.50	0.44	0.99
1,503.51	0.44	1.02
1,503.52	0.45	1.06
1,503.53	0.45	1.10
1,503.54	0.46	1.14
1,503.55	0.46	1.18
1,503.56	0.47	1.22
1,503.57	0.47	1.26
1,503.58	0.48	1.31
1,503.59	0.48	1.35
1,503.60	0.48	1.39
1,503.61	0.49	1.44
1,503.62	0.49	1.49
1,503.63	0.50	1.53
1,503.64	0.50	1.58
1,503.65	0.51	1.63
1,503.66	0.51	1.68
1,503.67	0.51	1.73
1,503.68	0.52	1.78
1,503.69	0.52	1.83
1,503.70	0.53	1.88
1,503.71	0.53	1.93
1,503.72	0.53	1.99
1,503.73	0.54	2.04
1,503.74	0.54	2.10
1,503.75	0.55	2.15
1,503.76	0.55	2.21
1,503.77	0.55	2.27
1,503.78	0.56	2.33
1,503.79	0.56	2.39
1,503.80	0.57	2.45
1,503.81	0.57	2.51
1,503.82	0.57	2.57
1,503.83	0.58	2.63
1,503.84	0.58	2.70
1,503.85	0.59	2.76
1,503.86	0.59	2.83
1,503.87	0.59	2.89
1,503.88	0.60	2.96
1,503.89	0.60	3.03
1,503.90	0.60	3.10
1,503.91	0.61	3.17
1,503.92	0.61	3.24
1,503.93	0.61	3.31
1,503.94	0.62	3.38
1,503.95	0.62	3.46
1,503.96	0.63	3.53
1,503.97	0.63	3.61
1,503.98	0.63	3.68
1,503.99	0.64	3.76
1,504.00	0.64	3.84
1,504.01	0.64	3.92
1,504.02	0.65	4.00
1,504.03	0.65	4.08
1,504.04	0.65	4.16
1,504.05	0.66	4.24
1,504.06	0.66	4.33
1,504.07	0.66	4.41
1,504.08	0.67	4.50
1,504.09	0.67	4.58
1,504.10	0.67	4.67
1,504.11	0.68	4.76
1,504.12	0.68	4.85
1,504.13	0.68	4.94
1,504.14	0.69	5.03
1,504.15	0.69	5.12
1,504.16	0.69	5.22
1,504.17	0.70	5.31
1,504.18	0.70	5.41
1,504.19	0.70	5.50
1,504.20	0.71	5.60
1,504.21	0.71	5.70
1,504.22	0.71	5.80
1,504.23	0.72	5.90
1,504.24	0.72	6.00
1,504.25	0.72	6.10
1,504.26	0.73	6.20
1,504.27	0.73	6.31
1,504.28	0.73	6.41
1,504.29	0.74	6.52
1,504.30	0.74	6.63
1,504.31	0.74	6.74
1,504.32	0.75	6.85
1,504.33	0.75	6.96
1,504.34	0.75	7.07
1,504.35	0.75	7.18
1,504.36	0.76	7.30
1,504.37	0.76	7.41
1,504.38	0.76	7.53
1,504.39	0.77	7.64
1,504.40	0.77	7.76
1,504.41	0.77	7.88
1,504.42	0.78	8.00
1,504.43	0.78	8.12
1,504.44	0.78	8.25
1,504.45	0.79	8.37
1,504.46	0.79	8.49
1,504.47	0.79	8.62
1,504.48	0.79	8.75
1,504.49	0.80	8.87
1,504.50	**0.80**	**9.00**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-8**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.37	ac	A = Area draining to the practice	
0.12	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.32	decimal	I = percent impervious area draining to the practice, in decimal form	
0.34	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
455	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.34	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.04	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.208	inches	Ia = initial abstraction. Ia = 0.2S	
625	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.12	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
135.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,471.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.8	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.52	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.95	feet	Check wetted perimeter	
0.11	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-7%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,471.40	ft	Peak elevation of the 10-year storm event	
1,472.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-8: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,471.00	0.00	0.00	1,471.52	0.48	1.13	1,472.04	0.70	4.43
1,471.01	0.04	0.00	1,471.53	0.48	1.17	1,472.05	0.70	4.52
1,471.02	0.07	0.00	1,471.54	0.49	1.21	1,472.06	0.70	4.61
1,471.03	0.09	0.01	1,471.55	0.49	1.26	1,472.07	0.71	4.70
1,471.04	0.10	0.01	1,471.56	0.50	1.30	1,472.08	0.71	4.79
1,471.05	0.12	0.02	1,471.57	0.50	1.35	1,472.09	0.71	4.88
1,471.06	0.13	0.03	1,471.58	0.51	1.39	1,472.10	0.72	4.97
1,471.07	0.15	0.03	1,471.59	0.51	1.44	1,472.11	0.72	5.07
1,471.08	0.16	0.04	1,471.60	0.52	1.48	1,472.12	0.72	5.16
1,471.09	0.17	0.05	1,471.61	0.52	1.53	1,472.13	0.73	5.26
1,471.10	0.18	0.06	1,471.62	0.52	1.58	1,472.14	0.73	5.36
1,471.11	0.20	0.07	1,471.63	0.53	1.63	1,472.15	0.74	5.45
1,471.12	0.21	0.08	1,471.64	0.53	1.68	1,472.16	0.74	5.55
1,471.13	0.22	0.10	1,471.65	0.54	1.73	1,472.17	0.74	5.65
1,471.14	0.23	0.11	1,471.66	0.54	1.78	1,472.18	0.75	5.76
1,471.15	0.24	0.12	1,471.67	0.55	1.84	1,472.19	0.75	5.86
1,471.16	0.24	0.14	1,471.68	0.55	1.89	1,472.20	0.75	5.96
1,471.17	0.25	0.15	1,471.69	0.56	1.95	1,472.21	0.76	6.07
1,471.18	0.26	0.17	1,471.70	0.56	2.00	1,472.22	0.76	6.17
1,471.19	0.27	0.18	1,471.71	0.56	2.06	1,472.23	0.76	6.28
1,471.20	0.28	0.20	1,471.72	0.57	2.11	1,472.24	0.77	6.39
1,471.21	0.29	0.22	1,471.73	0.57	2.17	1,472.25	0.77	6.50
1,471.22	0.29	0.24	1,471.74	0.58	2.23	1,472.26	0.77	6.61
1,471.23	0.30	0.26	1,471.75	0.58	2.29	1,472.27	0.78	6.72
1,471.24	0.31	0.28	1,471.76	0.59	2.35	1,472.28	0.78	6.83
1,471.25	0.32	0.30	1,471.77	0.59	2.41	1,472.29	0.78	6.94
1,471.26	0.32	0.32	1,471.78	0.59	2.48	1,472.30	0.79	7.06
1,471.27	0.33	0.34	1,471.79	0.60	2.54	1,472.31	0.79	7.17
1,471.28	0.34	0.36	1,471.80	0.60	2.60	1,472.32	0.79	7.29
1,471.29	0.35	0.39	1,471.81	0.61	2.67	1,472.33	0.80	7.41
1,471.30	0.35	0.41	1,471.82	0.61	2.74	1,472.34	0.80	7.53
1,471.31	0.36	0.44	1,471.83	0.61	2.80	1,472.35	0.80	7.65
1,471.32	0.36	0.46	1,471.84	0.62	2.87	1,472.36	0.81	7.77
1,471.33	0.37	0.49	1,471.85	0.62	2.94	1,472.37	0.81	7.89
1,471.34	0.38	0.52	1,471.86	0.63	3.01	1,472.38	0.81	8.01
1,471.35	0.38	0.54	1,471.87	0.63	3.08	1,472.39	0.82	8.14
1,471.36	0.39	0.57	1,471.88	0.63	3.15	1,472.40	0.82	8.27
1,471.37	0.40	0.60	1,471.89	0.64	3.22	1,472.41	0.82	8.39
1,471.38	0.40	0.63	1,471.90	0.64	3.30	1,472.42	0.83	8.52
1,471.39	0.41	0.66	1,471.91	0.65	3.37	1,472.43	0.83	8.65
1,471.40	0.41	0.69	1,471.92	0.65	3.45	1,472.44	0.83	8.78
1,471.41	0.42	0.73	1,471.93	0.65	3.52	1,472.45	0.84	8.91
1,471.42	0.42	0.76	1,471.94	0.66	3.60	1,472.46	0.84	9.04
1,471.43	0.43	0.79	1,471.95	0.66	3.68	1,472.47	0.84	9.18
1,471.44	0.44	0.83	1,471.96	0.67	3.76	1,472.48	0.85	9.31
1,471.45	0.44	0.86	1,471.97	0.67	3.84	1,472.49	0.85	9.45
1,471.46	0.45	0.90	1,471.98	0.67	3.92	1,472.50	**0.85**	**9.59**
1,471.47	0.45	0.94	1,471.99	0.68	4.00			
1,471.48	0.46	0.97	1,472.00	0.68	4.09			
1,471.49	0.46	1.01	1,472.01	0.68	4.17			
1,471.50	0.47	1.05	1,472.02	0.69	4.25			
1,471.51	0.47	1.09	1,472.03	0.69	4.34			

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-9**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Value	Unit	Description	Criteria
Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.18	ac	A = Area draining to the practice	
0.06	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.35	decimal	I = percent impervious area draining to the practice, in decimal form	
0.36	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.07	ac-in	WQV= 1" x Rv x A	
242	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.36	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$	
0.97	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.195	inches	Ia = initial abstraction. Ia = 0.2S	
625	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.07	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
120.00	feet	L = swale length[1]	← ≥ 100'
3.00	feet	w = bottom of the swale width[2]	← 0 - 8 feet[2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,521.00	feet	E_{BTM} = elevation of the bottom of the practice	← ≥ E_{SHWT}
3.0	:1	SS_{RIGHT} = right Side slope	← ≥3:1
3.0	:1	SS_{LEFT} = left Side slope	← ≥3:1
0.008	ft/ft	S = slope of swale in decimal form[3]	← 0.005 - .05
1.3	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← ≤ 4"
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.37	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.70	feet	Check wetted perimeter	
0.07	cfs	WQF_{check}.[5] ← WQF_{check} = WQF	
3%		Percent difference between WQF_{check} and WQF[5]	← +/- 10%
11	minutes	HRT = hydraulic residence time during the WQF	← ≥ 10 min
1,521.28	ft	Peak elevation of the 10-year storm event	
1,522.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← yes

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-9: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,521.00	0.00	0.00
1,521.01	0.03	0.00
1,521.02	0.06	0.00
1,521.03	0.08	0.01
1,521.04	0.10	0.01
1,521.05	0.11	0.02
1,521.06	0.13	0.02
1,521.07	0.14	0.03
1,521.08	0.15	0.04
1,521.09	0.16	0.05
1,521.10	0.17	0.06
1,521.11	0.18	0.07
1,521.12	0.19	0.08
1,521.13	0.20	0.09
1,521.14	0.21	0.10
1,521.15	0.22	0.11
1,521.16	0.23	0.13
1,521.17	0.24	0.14
1,521.18	0.25	0.16
1,521.19	0.25	0.17
1,521.20	0.26	0.19
1,521.21	0.27	0.21
1,521.22	0.28	0.22
1,521.23	0.28	0.24
1,521.24	0.29	0.26
1,521.25	0.30	0.28
1,521.26	0.30	0.30
1,521.27	0.31	0.32
1,521.28	0.32	0.34
1,521.29	0.32	0.36
1,521.30	0.33	0.39
1,521.31	0.34	0.41
1,521.32	0.34	0.43
1,521.33	0.35	0.46
1,521.34	0.35	0.48
1,521.35	0.36	0.51
1,521.36	0.37	0.54
1,521.37	0.37	0.56
1,521.38	0.38	0.59
1,521.39	0.38	0.62
1,521.40	0.39	0.65
1,521.41	0.39	0.68
1,521.42	0.40	0.71
1,521.43	0.40	0.74
1,521.44	0.41	0.78
1,521.45	0.41	0.81
1,521.46	0.42	0.84
1,521.47	0.42	0.88
1,521.48	0.43	0.91
1,521.49	0.43	0.95
1,521.50	0.44	0.99
1,521.51	0.44	1.02
1,521.52	0.45	1.06
1,521.53	0.45	1.10
1,521.54	0.46	1.14
1,521.55	0.46	1.18
1,521.56	0.47	1.22
1,521.57	0.47	1.26
1,521.58	0.48	1.31
1,521.59	0.48	1.35
1,521.60	0.48	1.39
1,521.61	0.49	1.44
1,521.62	0.49	1.49
1,521.63	0.50	1.53
1,521.64	0.50	1.58
1,521.65	0.51	1.63
1,521.66	0.51	1.68
1,521.67	0.51	1.73
1,521.68	0.52	1.78
1,521.69	0.52	1.83
1,521.70	0.53	1.88
1,521.71	0.53	1.93
1,521.72	0.53	1.99
1,521.73	0.54	2.04
1,521.74	0.54	2.10
1,521.75	0.55	2.15
1,521.76	0.55	2.21
1,521.77	0.55	2.27
1,521.78	0.56	2.33
1,521.79	0.56	2.39
1,521.80	0.57	2.45
1,521.81	0.57	2.51
1,521.82	0.57	2.57
1,521.83	0.58	2.63
1,521.84	0.58	2.70
1,521.85	0.59	2.76
1,521.86	0.59	2.83
1,521.87	0.59	2.89
1,521.88	0.60	2.96
1,521.89	0.60	3.03
1,521.90	0.60	3.10
1,521.91	0.61	3.17
1,521.92	0.61	3.24
1,521.93	0.61	3.31
1,521.94	0.62	3.38
1,521.95	0.62	3.46
1,521.96	0.63	3.53
1,521.97	0.63	3.61
1,521.98	0.63	3.68
1,521.99	0.64	3.76
1,522.00	0.64	3.84
1,522.01	0.64	3.92
1,522.02	0.65	4.00
1,522.03	0.65	4.08
1,522.04	0.65	4.16
1,522.05	0.66	4.24
1,522.06	0.66	4.33
1,522.07	0.66	4.41
1,522.08	0.67	4.50
1,522.09	0.67	4.58
1,522.10	0.67	4.67
1,522.11	0.68	4.76
1,522.12	0.68	4.85
1,522.13	0.68	4.94
1,522.14	0.69	5.03
1,522.15	0.69	5.12
1,522.16	0.69	5.22
1,522.17	0.70	5.31
1,522.18	0.70	5.41
1,522.19	0.70	5.50
1,522.20	0.71	5.60
1,522.21	0.71	5.70
1,522.22	0.71	5.80
1,522.23	0.72	5.90
1,522.24	0.72	6.00
1,522.25	0.72	6.10
1,522.26	0.73	6.20
1,522.27	0.73	6.31
1,522.28	0.73	6.41
1,522.29	0.74	6.52
1,522.30	0.74	6.63
1,522.31	0.74	6.74
1,522.32	0.75	6.85
1,522.33	0.75	6.96
1,522.34	0.75	7.07
1,522.35	0.75	7.18
1,522.36	0.76	7.30
1,522.37	0.76	7.41
1,522.38	0.76	7.53
1,522.39	0.77	7.64
1,522.40	0.77	7.76
1,522.41	0.77	7.88
1,522.42	0.78	8.00
1,522.43	0.78	8.12
1,522.44	0.78	8.25
1,522.45	0.79	8.37
1,522.46	0.79	8.49
1,522.47	0.79	8.62
1,522.48	0.79	8.75
1,522.49	0.80	8.87
1,522.50	**0.80**	**9.00**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-10**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Value	Unit	Description	Criteria
Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.29	ac	A = Area draining to the practice	
0.11	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.37	decimal	I = percent impervious area draining to the practice, in decimal form	
0.39	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.11	ac-in	WQV= 1" x Rv x A	
413	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.39	inches	Q = water quality depth. Q = WQV/A	
92	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$	
0.91	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.182	inches	Ia = initial abstraction. Ia = 0.2S	
625	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.11	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
135.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,571.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.8	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.52	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.95	feet	Check wetted perimeter	
0.11	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
3%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,571.36	ft	Peak elevation of the 10-year storm event	
1,572.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-10: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,571.00	0.00	0.00
1,571.01	0.04	0.00
1,571.02	0.07	0.00
1,571.03	0.09	0.01
1,571.04	0.10	0.01
1,571.05	0.12	0.02
1,571.06	0.13	0.03
1,571.07	0.15	0.03
1,571.08	0.16	0.04
1,571.09	0.17	0.05
1,571.10	0.18	0.06
1,571.11	0.20	0.07
1,571.12	0.21	0.08
1,571.13	0.22	0.10
1,571.14	0.23	0.11
1,571.15	0.24	0.12
1,571.16	0.24	0.14
1,571.17	0.25	0.15
1,571.18	0.26	0.17
1,571.19	0.27	0.18
1,571.20	0.28	0.20
1,571.21	0.29	0.22
1,571.22	0.29	0.24
1,571.23	0.30	0.26
1,571.24	0.31	0.28
1,571.25	0.32	0.30
1,571.26	0.32	0.32
1,571.27	0.33	0.34
1,571.28	0.34	0.36
1,571.29	0.35	0.39
1,571.30	0.35	0.41
1,571.31	0.36	0.44
1,571.32	0.36	0.46
1,571.33	0.37	0.49
1,571.34	0.38	0.52
1,571.35	0.38	0.54
1,571.36	0.39	0.57
1,571.37	0.40	0.60
1,571.38	0.40	0.63
1,571.39	0.41	0.66
1,571.40	0.41	0.69
1,571.41	0.42	0.73
1,571.42	0.42	0.76
1,571.43	0.43	0.79
1,571.44	0.44	0.83
1,571.45	0.44	0.86
1,571.46	0.45	0.90
1,571.47	0.45	0.94
1,571.48	0.46	0.97
1,571.49	0.46	1.01
1,571.50	0.47	1.05
1,571.51	0.47	1.09
1,571.52	0.48	1.13
1,571.53	0.48	1.17
1,571.54	0.49	1.21
1,571.55	0.49	1.26
1,571.56	0.50	1.30
1,571.57	0.50	1.35
1,571.58	0.51	1.39
1,571.59	0.51	1.44
1,571.60	0.52	1.48
1,571.61	0.52	1.53
1,571.62	0.52	1.58
1,571.63	0.53	1.63
1,571.64	0.53	1.68
1,571.65	0.54	1.73
1,571.66	0.54	1.78
1,571.67	0.55	1.84
1,571.68	0.55	1.89
1,571.69	0.56	1.95
1,571.70	0.56	2.00
1,571.71	0.56	2.06
1,571.72	0.57	2.11
1,571.73	0.57	2.17
1,571.74	0.58	2.23
1,571.75	0.58	2.29
1,571.76	0.59	2.35
1,571.77	0.59	2.41
1,571.78	0.59	2.48
1,571.79	0.60	2.54
1,571.80	0.60	2.60
1,571.81	0.61	2.67
1,571.82	0.61	2.74
1,571.83	0.61	2.80
1,571.84	0.62	2.87
1,571.85	0.62	2.94
1,571.86	0.63	3.01
1,571.87	0.63	3.08
1,571.88	0.63	3.15
1,571.89	0.64	3.22
1,571.90	0.64	3.30
1,571.91	0.65	3.37
1,571.92	0.65	3.45
1,571.93	0.65	3.52
1,571.94	0.66	3.60
1,571.95	0.66	3.68
1,571.96	0.67	3.76
1,571.97	0.67	3.84
1,571.98	0.67	3.92
1,571.99	0.68	4.00
1,572.00	0.68	4.09
1,572.01	0.68	4.17
1,572.02	0.69	4.25
1,572.03	0.69	4.34
1,572.04	0.70	4.43
1,572.05	0.70	4.52
1,572.06	0.70	4.61
1,572.07	0.71	4.70
1,572.08	0.71	4.79
1,572.09	0.71	4.88
1,572.10	0.72	4.97
1,572.11	0.72	5.07
1,572.12	0.72	5.16
1,572.13	0.73	5.26
1,572.14	0.73	5.36
1,572.15	0.74	5.45
1,572.16	0.74	5.55
1,572.17	0.74	5.65
1,572.18	0.75	5.76
1,572.19	0.75	5.86
1,572.20	0.75	5.96
1,572.21	0.76	6.07
1,572.22	0.76	6.17
1,572.23	0.76	6.28
1,572.24	0.77	6.39
1,572.25	0.77	6.50
1,572.26	0.77	6.61
1,572.27	0.78	6.72
1,572.28	0.78	6.83
1,572.29	0.78	6.94
1,572.30	0.79	7.06
1,572.31	0.79	7.17
1,572.32	0.79	7.29
1,572.33	0.80	7.41
1,572.34	0.80	7.53
1,572.35	0.80	7.65
1,572.36	0.81	7.77
1,572.37	0.81	7.89
1,572.38	0.81	8.01
1,572.39	0.82	8.14
1,572.40	0.82	8.27
1,572.41	0.82	8.39
1,572.42	0.83	8.52
1,572.43	0.83	8.65
1,572.44	0.83	8.78
1,572.45	0.84	8.91
1,572.46	0.84	9.04
1,572.47	0.84	9.18
1,572.48	0.85	9.31
1,572.49	0.85	9.45
1,572.50	**0.85**	**9.59**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-11**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.18	ac	A = Area draining to the practice	
0.13	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.73	decimal	I = percent impervious area draining to the practice, in decimal form	
0.70	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.13	ac-in	WQV= 1" x Rv x A	
468	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.70	inches	Q = water quality depth. Q = WQV/A	
97	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
0.31	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.062	inches	Ia = initial abstraction. Ia = 0.2S	
650	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.13	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
125.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,688.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.005	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.14	feet	Check wetted perimeter	
0.13	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-2%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,688.36	ft	Peak elevation of the 10-year storm event	
1,689.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-11: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,688.00	0.00	0.00	1,688.52	0.37	0.87	1,689.04	0.54	3.41
1,688.01	0.03	0.00	1,688.53	0.37	0.90	1,689.05	0.54	3.48
1,688.02	0.05	0.00	1,688.54	0.37	0.93	1,689.06	0.54	3.55
1,688.03	0.07	0.01	1,688.55	0.38	0.97	1,689.07	0.54	3.62
1,688.04	0.08	0.01	1,688.56	0.38	1.00	1,689.08	0.55	3.69
1,688.05	0.09	0.01	1,688.57	0.39	1.04	1,689.09	0.55	3.76
1,688.06	0.10	0.02	1,688.58	0.39	1.07	1,689.10	0.55	3.83
1,688.07	0.11	0.03	1,688.59	0.39	1.11	1,689.11	0.56	3.90
1,688.08	0.12	0.03	1,688.60	0.40	1.14	1,689.12	0.56	3.97
1,688.09	0.13	0.04	1,688.61	0.40	1.18	1,689.13	0.56	4.05
1,688.10	0.14	0.05	1,688.62	0.40	1.22	1,689.14	0.56	4.12
1,688.11	0.15	0.06	1,688.63	0.41	1.26	1,689.15	0.57	4.20
1,688.12	0.16	0.06	1,688.64	0.41	1.29	1,689.16	0.57	4.28
1,688.13	0.17	0.07	1,688.65	0.41	1.33	1,689.17	0.57	4.35
1,688.14	0.17	0.08	1,688.66	0.42	1.37	1,689.18	0.57	4.43
1,688.15	0.18	0.09	1,688.67	0.42	1.41	1,689.19	0.58	4.51
1,688.16	0.19	0.11	1,688.68	0.42	1.46	1,689.20	0.58	4.59
1,688.17	0.20	0.12	1,688.69	0.43	1.50	1,689.21	0.58	4.67
1,688.18	0.20	0.13	1,688.70	0.43	1.54	1,689.22	0.58	4.75
1,688.19	0.21	0.14	1,688.71	0.43	1.58	1,689.23	0.59	4.83
1,688.20	0.21	0.15	1,688.72	0.44	1.63	1,689.24	0.59	4.92
1,688.21	0.22	0.17	1,688.73	0.44	1.67	1,689.25	0.59	5.00
1,688.22	0.23	0.18	1,688.74	0.44	1.72	1,689.26	0.60	5.09
1,688.23	0.23	0.20	1,688.75	0.45	1.76	1,689.27	0.60	5.17
1,688.24	0.24	0.21	1,688.76	0.45	1.81	1,689.28	0.60	5.26
1,688.25	0.24	0.23	1,688.77	0.45	1.86	1,689.29	0.60	5.35
1,688.26	0.25	0.25	1,688.78	0.46	1.91	1,689.30	0.61	5.43
1,688.27	0.26	0.26	1,688.79	0.46	1.96	1,689.31	0.61	5.52
1,688.28	0.26	0.28	1,688.80	0.46	2.00	1,689.32	0.61	5.61
1,688.29	0.27	0.30	1,688.81	0.47	2.05	1,689.33	0.61	5.70
1,688.30	0.27	0.32	1,688.82	0.47	2.11	1,689.34	0.62	5.80
1,688.31	0.28	0.34	1,688.83	0.47	2.16	1,689.35	0.62	5.89
1,688.32	0.28	0.36	1,688.84	0.48	2.21	1,689.36	0.62	5.98
1,688.33	0.29	0.38	1,688.85	0.48	2.26	1,689.37	0.62	6.08
1,688.34	0.29	0.40	1,688.86	0.48	2.32	1,689.38	0.63	6.17
1,688.35	0.30	0.42	1,688.87	0.49	2.37	1,689.39	0.63	6.27
1,688.36	0.30	0.44	1,688.88	0.49	2.43	1,689.40	0.63	6.36
1,688.37	0.30	0.46	1,688.89	0.49	2.48	1,689.41	0.63	6.46
1,688.38	0.31	0.49	1,688.90	0.49	2.54	1,689.42	0.64	6.56
1,688.39	0.31	0.51	1,688.91	0.50	2.60	1,689.43	0.64	6.66
1,688.40	0.32	0.53	1,688.92	0.50	2.65	1,689.44	0.64	6.76
1,688.41	0.32	0.56	1,688.93	0.50	2.71	1,689.45	0.64	6.86
1,688.42	0.33	0.58	1,688.94	0.51	2.77	1,689.46	0.65	6.96
1,688.43	0.33	0.61	1,688.95	0.51	2.83	1,689.47	0.65	7.07
1,688.44	0.33	0.64	1,688.96	0.51	2.89	1,689.48	0.65	7.17
1,688.45	0.34	0.66	1,688.97	0.52	2.96	1,689.49	0.65	7.28
1,688.46	0.34	0.69	1,688.98	0.52	3.02	1,689.50	**0.66**	**7.38**
1,688.47	0.35	0.72	1,688.99	0.52	3.08			
1,688.48	0.35	0.75	1,689.00	0.52	3.15			
1,688.49	0.36	0.78	1,689.01	0.53	3.21			
1,688.50	0.36	0.81	1,689.02	0.53	3.28			
1,688.51	0.36	0.84	1,689.03	0.53	3.34			

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-12**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.51	ac	A = Area draining to the practice	
0.16	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.30	decimal	I = percent impervious area draining to the practice, in decimal form	
0.32	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.17	ac-in	WQV= 1" x Rv x A	
603	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.32	inches	Q = water quality depth. Q = WQV/A	
90	unitless	CN = unit peak discharge curve number. CN =1000/(10+5P+10Q–10*[Q^2 + 1.25*Q*P]$^{0.5}$)	
1.10	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.220	inches	Ia = initial abstraction. Ia = 0.2S	
625	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.16	cfs	WQF = q_u x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
150.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,787.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
2.2	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.64	ft^2	Cross-sectional area check (assume trapezoidal channel)	
4.14	feet	Check wetted perimeter	
0.16	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-3%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,787.46	ft	Peak elevation of the 10-year storm event	
1,788.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-12: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,787.00	0.00	0.00
1,787.01	0.04	0.00
1,787.02	0.07	0.00
1,787.03	0.09	0.01
1,787.04	0.11	0.01
1,787.05	0.13	0.02
1,787.06	0.15	0.03
1,787.07	0.16	0.04
1,787.08	0.17	0.05
1,787.09	0.19	0.06
1,787.10	0.20	0.07
1,787.11	0.21	0.08
1,787.12	0.22	0.09
1,787.13	0.23	0.10
1,787.14	0.25	0.12
1,787.15	0.26	0.13
1,787.16	0.27	0.15
1,787.17	0.28	0.16
1,787.18	0.29	0.18
1,787.19	0.29	0.20
1,787.20	0.30	0.22
1,787.21	0.31	0.24
1,787.22	0.32	0.26
1,787.23	0.33	0.28
1,787.24	0.34	0.30
1,787.25	0.34	0.32
1,787.26	0.35	0.35
1,787.27	0.36	0.37
1,787.28	0.37	0.40
1,787.29	0.37	0.42
1,787.30	0.38	0.45
1,787.31	0.39	0.47
1,787.32	0.40	0.50
1,787.33	0.40	0.53
1,787.34	0.41	0.56
1,787.35	0.42	0.59
1,787.36	0.42	0.62
1,787.37	0.43	0.65
1,787.38	0.44	0.69
1,787.39	0.44	0.72
1,787.40	0.45	0.75
1,787.41	0.45	0.79
1,787.42	0.46	0.82
1,787.43	0.47	0.86
1,787.44	0.47	0.90
1,787.45	0.48	0.94
1,787.46	0.48	0.98
1,787.47	0.49	1.02
1,787.48	0.50	1.06
1,787.49	0.50	1.10
1,787.50	0.51	1.14
1,787.51	0.51	1.18
1,787.52	0.52	1.23
1,787.53	0.52	1.27
1,787.54	0.53	1.32
1,787.55	0.53	1.37
1,787.56	0.54	1.41
1,787.57	0.54	1.46
1,787.58	0.55	1.51
1,787.59	0.55	1.56
1,787.60	0.56	1.61
1,787.61	0.56	1.66
1,787.62	0.57	1.72
1,787.63	0.57	1.77
1,787.64	0.58	1.83
1,787.65	0.58	1.88
1,787.66	0.59	1.94
1,787.67	0.59	2.00
1,787.68	0.60	2.05
1,787.69	0.60	2.11
1,787.70	0.61	2.17
1,787.71	0.61	2.23
1,787.72	0.62	2.30
1,787.73	0.62	2.36
1,787.74	0.63	2.42
1,787.75	0.63	2.49
1,787.76	0.64	2.55
1,787.77	0.64	2.62
1,787.78	0.65	2.69
1,787.79	0.65	2.76
1,787.80	0.65	2.83
1,787.81	0.66	2.90
1,787.82	0.66	2.97
1,787.83	0.67	3.04
1,787.84	0.67	3.12
1,787.85	0.68	3.19
1,787.86	0.68	3.27
1,787.87	0.69	3.34
1,787.88	0.69	3.42
1,787.89	0.69	3.50
1,787.90	0.70	3.58
1,787.91	0.70	3.66
1,787.92	0.71	3.74
1,787.93	0.71	3.83
1,787.94	0.71	3.91
1,787.95	0.72	4.00
1,787.96	0.72	4.08
1,787.97	0.73	4.17
1,787.98	0.73	4.26
1,787.99	0.74	4.35
1,788.00	0.74	4.44
1,788.01	0.74	4.53
1,788.02	0.75	4.62
1,788.03	0.75	4.71
1,788.04	0.76	4.81
1,788.05	0.76	4.90
1,788.06	0.76	5.00
1,788.07	0.77	5.10
1,788.08	0.77	5.20
1,788.09	0.78	5.30
1,788.10	0.78	5.40
1,788.11	0.78	5.50
1,788.12	0.79	5.61
1,788.13	0.79	5.71
1,788.14	0.79	5.82
1,788.15	0.80	5.92
1,788.16	0.80	6.03
1,788.17	0.81	6.14
1,788.18	0.81	6.25
1,788.19	0.81	6.36
1,788.20	0.82	6.47
1,788.21	0.82	6.59
1,788.22	0.82	6.70
1,788.23	0.83	6.82
1,788.24	0.83	6.94
1,788.25	0.84	7.06
1,788.26	0.84	7.17
1,788.27	0.84	7.30
1,788.28	0.85	7.42
1,788.29	0.85	7.54
1,788.30	0.85	7.67
1,788.31	0.86	7.79
1,788.32	0.86	7.92
1,788.33	0.87	8.05
1,788.34	0.87	8.18
1,788.35	0.87	8.31
1,788.36	0.88	8.44
1,788.37	0.88	8.57
1,788.38	0.88	8.70
1,788.39	0.89	8.84
1,788.40	0.89	8.98
1,788.41	0.89	9.11
1,788.42	0.90	9.25
1,788.43	0.90	9.39
1,788.44	0.90	9.54
1,788.45	0.91	9.68
1,788.46	0.91	9.82
1,788.47	0.92	9.97
1,788.48	0.92	10.11
1,788.49	0.92	10.26
1,788.50	**0.93**	**10.41**

TREATMENT SWALE DESIGN CRITERIA (Env-Wq 1508.07)

Node Name: **SW-13**

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable

Value	Unit	Description	Criteria
Yes	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.07(b)?	
No	Yes/No	Is the system lined?	
0.27	ac	A = Area draining to the practice	
0.09	ac	A_I = Impervious area draining to the practice	
6.0	minutes	T_c = Time of Concentration	
0.34	decimal	I = percent impervious area draining to the practice, in decimal form	
0.35	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.10	ac-in	WQV= 1" x Rv x A	
350	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.35	inches	Q = water quality depth. Q = WQV/A	
91	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$	
1.01	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.202	inches	Ia = initial abstraction. Ia = 0.2S	
625	$cfs/mi^2/in$	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.09	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
125.00	feet	L = swale length [1]	← **≥ 100'**
3.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet** [2]
	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
1,849.00	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.008	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
1.6	inches	d = flow depth in swale at WQF (attach stage-discharge table)[4]	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.44	ft^2	Cross-sectional area check (assume trapezoidal channel)	
3.82	feet	Check wetted perimeter	
0.09	cfs	WQF_{check}.[5] ← **WQF_{check} = WQF**	
-5%		Percent difference between WQF_{check} and WQF [5]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
1,849.35	ft	Peak elevation of the 10-year storm event	
1,850.50	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. If a detention structure is used immediately upstream of the swale, the flow depth in the swale shall be no greater than 4" during the peak of the 2-yr storm, 24-hour storm event.
5. The WQF_{check} & WQF should be near equal (within 10%) to confirm that you have selected the correct depth off the stage-discharge table. If the depth is not accurate the HRT will be incorrect.

Designer's Notes:

Stage-Discharge for Reach SW-13: Swale

Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)	Elevation (feet)	Velocity (ft/sec)	Discharge (cfs)
1,849.00	0.00	0.00	1,849.52	0.46	1.10	1,850.04	0.67	4.30
1,849.01	0.04	0.00	1,849.53	0.47	1.14	1,850.05	0.68	4.38
1,849.02	0.06	0.00	1,849.54	0.47	1.18	1,850.06	0.68	4.47
1,849.03	0.08	0.01	1,849.55	0.48	1.22	1,850.07	0.69	4.55
1,849.04	0.10	0.01	1,849.56	0.48	1.26	1,850.08	0.69	4.64
1,849.05	0.12	0.02	1,849.57	0.49	1.31	1,850.09	0.69	4.73
1,849.06	0.13	0.02	1,849.58	0.49	1.35	1,850.10	0.70	4.82
1,849.07	0.14	0.03	1,849.59	0.50	1.39	1,850.11	0.70	4.91
1,849.08	0.16	0.04	1,849.60	0.50	1.44	1,850.12	0.70	5.01
1,849.09	0.17	0.05	1,849.61	0.50	1.49	1,850.13	0.71	5.10
1,849.10	0.18	0.06	1,849.62	0.51	1.53	1,850.14	0.71	5.19
1,849.11	0.19	0.07	1,849.63	0.51	1.58	1,850.15	0.71	5.29
1,849.12	0.20	0.08	1,849.64	0.52	1.63	1,850.16	0.72	5.39
1,849.13	0.21	0.09	1,849.65	0.52	1.68	1,850.17	0.72	5.48
1,849.14	0.22	0.11	1,849.66	0.53	1.73	1,850.18	0.72	5.58
1,849.15	0.23	0.12	1,849.67	0.53	1.78	1,850.19	0.73	5.68
1,849.16	0.24	0.13	1,849.68	0.54	1.83	1,850.20	0.73	5.78
1,849.17	0.25	0.15	1,849.69	0.54	1.89	1,850.21	0.73	5.88
1,849.18	0.25	0.16	1,849.70	0.54	1.94	1,850.22	0.74	5.99
1,849.19	0.26	0.18	1,849.71	0.55	2.00	1,850.23	0.74	6.09
1,849.20	0.27	0.20	1,849.72	0.55	2.05	1,850.24	0.74	6.20
1,849.21	0.28	0.21	1,849.73	0.56	2.11	1,850.25	0.75	6.30
1,849.22	0.29	0.23	1,849.74	0.56	2.16	1,850.26	0.75	6.41
1,849.23	0.29	0.25	1,849.75	0.56	2.22	1,850.27	0.75	6.52
1,849.24	0.30	0.27	1,849.76	0.57	2.28	1,850.28	0.76	6.62
1,849.25	0.31	0.29	1,849.77	0.57	2.34	1,850.29	0.76	6.73
1,849.26	0.31	0.31	1,849.78	0.58	2.40	1,850.30	0.76	6.85
1,849.27	0.32	0.33	1,849.79	0.58	2.46	1,850.31	0.77	6.96
1,849.28	0.33	0.35	1,849.80	0.58	2.53	1,850.32	0.77	7.07
1,849.29	0.33	0.38	1,849.81	0.59	2.59	1,850.33	0.77	7.19
1,849.30	0.34	0.40	1,849.82	0.59	2.65	1,850.34	0.78	7.30
1,849.31	0.35	0.42	1,849.83	0.60	2.72	1,850.35	0.78	7.42
1,849.32	0.35	0.45	1,849.84	0.60	2.78	1,850.36	0.78	7.54
1,849.33	0.36	0.47	1,849.85	0.60	2.85	1,850.37	0.79	7.65
1,849.34	0.37	0.50	1,849.86	0.61	2.92	1,850.38	0.79	7.77
1,849.35	0.37	0.53	1,849.87	0.61	2.99	1,850.39	0.79	7.89
1,849.36	0.38	0.55	1,849.88	0.62	3.06	1,850.40	0.80	8.02
1,849.37	0.38	0.58	1,849.89	0.62	3.13	1,850.41	0.80	8.14
1,849.38	0.39	0.61	1,849.90	0.62	3.20	1,850.42	0.80	8.26
1,849.39	0.39	0.64	1,849.91	0.63	3.27	1,850.43	0.80	8.39
1,849.40	0.40	0.67	1,849.92	0.63	3.34	1,850.44	0.81	8.52
1,849.41	0.41	0.70	1,849.93	0.63	3.42	1,850.45	0.81	8.64
1,849.42	0.41	0.74	1,849.94	0.64	3.49	1,850.46	0.81	8.77
1,849.43	0.42	0.77	1,849.95	0.64	3.57	1,850.47	0.82	8.90
1,849.44	0.42	0.80	1,849.96	0.65	3.65	1,850.48	0.82	9.03
1,849.45	0.43	0.84	1,849.97	0.65	3.72	1,850.49	0.82	9.17
1,849.46	0.43	0.87	1,849.98	0.65	3.80	1,850.50	**0.83**	**9.30**
1,849.47	0.44	0.91	1,849.99	0.66	3.88			
1,849.48	0.44	0.94	1,850.00	0.66	3.96			
1,849.49	0.45	0.98	1,850.01	0.66	4.04			
1,849.50	0.45	1.02	1,850.02	0.67	4.13			
1,849.51	0.46	1.06	1,850.03	0.67	4.21			

FILTRATION PRACTICE DESIGN CRITERIA (Env-Wq 1508.06)

Type/Node Name: **Bio-Retention Area #1**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.06(b)?	
1.01	ac	A = Area draining to the practice[1]	
0.90	ac	A_I = Impervious area draining to the practice	
0.89	decimal	I = percent impervious area draining to the practice, in decimal form	
0.85	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.86	ac-in	WQV= 1" x Rv x A	
3,107	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
777	cf	25% x WQV (check calc for sediment forebay volume)	
2,330	cf	75% x WQV (check calc for surface sand filter volume)	
None		Method of Pretreatment? (not required for clean or roof runoff)	
-	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
2,735	sf	A_{SA} = surface area of the practice	
2.0	iph	I_{DESIGN} = design infiltration rate[2]	
Yes	Yes/No	If I_{DESIGN} is < 0.50 iph, has an underdrain been provided?	
-	hours	T_{DRAIN} = drain time = V_{PP} / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
1,115.75	feet	E_{FC} = elevation of the bottom of the filter course material	
1,114.92	feet	E_{UD} = invert elevation of the underdrain (UD), if applicable	
1,114.33	feet	E_{BTM} = elevation of the bottom of the practice (i.e., bottom of the stone reservoir).	
1,114.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
1,114.00	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
0.83	feet	$D_{FC\ to\ UD}$ = depth to UD from the bottom of the filter course[3]	← **≥ 1'**
1.75	feet	$D_{FC\ to\ ROCK}$ = depth to bedrock from the bottom of the filter course[3]	← **≥ 1'**
1.75	feet	$D_{FC\ to\ SHWT}$ = depth to SHWT from the bottom of the filter course[3]	← **≥ 1'**
0.33	feet	$D_{BTM\ to\ SHWT}$ = depth to SHWT from the bottom of the practice[3]	← **≥ 2'**
	ft	Peak elevation of the 10-year storm event (infiltration can be used in analysis)	
1,118.00	ft	Elevation of the top of the practice	
-		10 peak elevation ≤ Elevation of the top of the practice	← **yes**

If a surface sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **18"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**
		The filter shall not be covered in grass. What is covering the filter?	

If an underground sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **24"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**

If a bioretention area is proposed:

YES	ac	Drainage Area no larger than 5 ac?	← **yes**
3,172	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ WQV**
18.0	inches	D_{FC} = filter course thickness	← **18"**
Sheet	C-23	Note what sheet in the plan set contains the filter course specification	
3.0	:1	Pond side slopes	← **≥2:1**
Sheet	C-23	Note what sheet in the plan set contains the planting plans and surface cover	

If porous pavement is proposed:

		Type of pavement proposed (concrete? Asphalt? Pavers? Etc)	
	sf	A_{SA} = surface area of the pervious pavement	
-	:1	ratio of the contributing area to the pervious surface area	← **5:1**
	inches	D_{FC} = filter course thickness	← **12"**
Sheet		Note what sheet in the plan set contains the filter course spec.	← **304.1 sand**

1. If the practice is a tree box filter, the drainage area shall be < 0.1 acre

2. Rate of the limiting layer (either the filter course or the underlying soil). See Vol. 2 of the NH Stormwater Manual, Ch. 2-4, for guidance on determining the infiltration rate.

3. If not within a GPA or WSIPA: SHWT/Bedrock must be at least 1 foot below the filter course material (or an underdrain must drain the SHWT to at least one foot below the filter course material). If within a GPA or WSIPA: SHWT must be at least two feet below the bottom of the practice OR the filter course material must be at least twice as thick as required and the SHWT must be at least one foot below the filter course material.

4. Volume without depending on infiltration. The storage above the filter media shall not include the volume above the outlet structure, if any.

5. The volume includes the storage above the filter but below the invert of the outlet structure (if any), the filter media voids, and the pretreatment area.

Designer's Notes:

Due to site (space) constraints, the bio-retention basin was not designed to detain the 10-year event.

FILTRATION PRACTICE DESIGN CRITERIA (Env-Wq 1508.06)

Type/Node Name: **Bio-Retention Area #2**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.06(b)?	
0.99	ac	A = Area draining to the practice[1]	
0.72	ac	A_I = Impervious area draining to the practice	
0.73	decimal	I = percent impervious area draining to the practice, in decimal form	
0.70	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.69	ac-in	WQV= 1" x Rv x A	
2,515	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
629	cf	25% x WQV (check calc for sediment forebay volume)	
1,886	cf	75% x WQV (check calc for surface sand filter volume)	
None		Method of Pretreatment? (not required for clean or roof runoff)	
-	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
2,050	sf	A_{SA} = surface area of the practice	
2.0	iph	I_{DESIGN} = design infiltration rate[2]	
Yes	Yes/No	If I_{DESIGN} is < 0.50 iph, has an underdrain been provided?	
-	hours	T_{DRAIN} = drain time = V_{PP} / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
1,110.75	feet	E_{FC} = elevation of the bottom of the filter course material	
1,109.92	feet	E_{UD} = invert elevation of the underdrain (UD), if applicable	
1,109.33	feet	E_{BTM} = elevation of the bottom of the practice (i.e., bottom of the stone reservoir).	
1,108.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
1,108.00	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
0.83	feet	$D_{FC\ to\ UD}$ = depth to UD from the bottom of the filter course[3]	← **≥ 1'**
2.75	feet	$D_{FC\ to\ ROCK}$ = depth to bedrock from the bottom of the filter course[3]	← **≥ 1'**
2.75	feet	$D_{FC\ to\ SHWT}$ = depth to SHWT from the bottom of the filter course[3]	← **≥ 1'**
1.33	feet	$D_{BTM\ to\ SHWT}$ = depth to SHWT from the bottom of the practice[3]	← **≥ 2'**
	ft	Peak elevation of the 10-year storm event (infiltration can be used in analysis)	
1,113.00	ft	Elevation of the top of the practice	
-		10 peak elevation ≤ Elevation of the top of the practice	← **yes**

If a surface sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **18"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**
		The filter shall not be covered in grass. What is covering the filter?	

If an underground sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **24"**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**

If a bioretention area is proposed:

YES	ac	Drainage Area no larger than 5 ac?	← **yes**
2,523	cf	V = volume of storage[4, 5] (attach a stage-storage table)	← **≥ WQV**
18.0	inches	D_{FC} = filter course thickness	← **18"**
Sheet	C-23	Note what sheet in the plan set contains the filter course specification	
3.0	:1	Pond side slopes	← **≥2:1**
Sheet	C-23	Note what sheet in the plan set contains the planting plans and surface cover	

If porous pavement is proposed:

		Type of pavement proposed (concrete? Asphalt? Pavers? Etc)	
	sf	A_{SA} = surface area of the pervious pavement	
-	:1	ratio of the contributing area to the pervious surface area	← **5:1**
	inches	D_{FC} = filter course thickness	← **12"**
Sheet		Note what sheet in the plan set contains the filter course spec.	← **304.1 sand**

1. If the practice is a tree box filter, the drainage area shall be < 0.1 acre

2. Rate of the limiting layer (either the filter course or the underlying soil). See Vol. 2 of the NH Stormwater Manual, Ch. 2-4, for guidance on determining the infiltration rate.

3. If not within a GPA or WSIPA: SHWT/Bedrock must be at least 1 foot below the filter course material (or an underdrain must drain the SHWT to at least one foot below the filter course material). If within a GPA or WSIPA: SHWT must be at least two feet below the bottom of the practice OR the filter course material must be at least twice as thick as required and the SHWT must be at least one foot below the filter course material.

4. Volume without depending on infiltration. The storage above the filter media shall not include the volume above the outlet structure, if any.

5. The volume includes the storage above the filter but below the invert of the outlet structure (if any), the filter media voids, and the pretreatment area.

Designer's Notes:

Due to site (space) constraints, the bio-retention basin was not designed to detain the 10-year event.

Groundwater Recharge Volume (GRV) Calculation

	ac	Area of HSG A soil that was replaced by impervious cover	0.40"
	ac	Area of HSG B soil that was replaced by impervious cover	0.25"
	ac	Area of HSG C soil that was replaced by impervious cover	0.10"
	ac	Area of HSG D soil or impervious cover that was replaced by impervious cover	0.0"
-	inches	Rd = weighted groundwater recharge depth	
-	ac-in	GRV = AI * Rd	
-	cf	GRV conversion (ac-in x 43,560 sf/ac x 1ft/12”)	

Provide calculations below showing that the project meets the groundwater recharge requirements (Env-Wq 1507.04):

Chapter 2 Section 3 of the "New Hampshire Stormwater Manual, Volume 2" states that the Groundwater Recharge Volume (GRV) is calculated by the equation: GRV = (Ai)(Rd) where Ai is the Effective Impervious Area and Rd is the groundwater recharge depth. In addition, Chapter 5 Section 2 of the "New Hampshire Stormwater Manual, Volume 1" defines Effective Impervious Area as "the portion of the total impervious cover that is directly connected to the storm drain network."

The stormwater management system proposed for this project is designed to convert concentrated flows to sheet flow and release it overland. No direct connections to a storm drain network are proposed, therefore the effective impervious area and GRV are zero.

ATTACHMENT D

Natural Heritage Bureau Memoranda

Memo

NH Natural Heritage Bureau

To: James Kenworthy, Eolian Renewable Energy, LLC
55 Fleet St.
Portsmouth, NH 03801

From: Melissa Coppola, NH Natural Heritage Bureau
Date: 3/22/2010 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau

NHB File ID:	NHB10-0644	Town:	Antrim
Project type:	Roads, Driveways, Bridges: Road construction, etc.	Location:	Tax Maps: 212-030, 212-027, 212-034, 211-004, 235-014

cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: NHB has concerns about potential impacts to the exemplary natural community. Please send detailed site plans to mcoppola@dred.state.nh.us for further review.

Natural Community	State[1]	Federal	Notes
Inland Atlantic white cedar swamp	--	--	Changes to the hydrology of the wetland are the greatest threat facing the cedar swamp. Damming which causes pooling for extended periods can flood and drown existing trees, and drainage that results in lower water levels can lead to invasion by other species that can out compete -- and eventually eliminate -- Atlantic white cedar trees. Increased nutrient input from stormwater runoff could also deleteriously impact this acidic, low-nutrient plant community.

Vertebrate species	State[1]	Federal	Notes
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. For some purposes, including legal requirements for state wetland permits, the fact that no species of concern are known to be present is sufficient. However, an on-site survey would provide better information on what species and communities are indeed present.

New Hampshire Natural Heritage Bureau
DRED - Division of Forests & Lands
PO Box 1856 -- 172 Pembroke Road, Concord, NH 03302-1856
(603) 271-2214

To: Josh Brown, TRC Solutions

From: Melissa Coppola, NHB-Environmental Information Specialist

Date: August 3, 2011

Subject: Antrim Rare Plant Surveys

Thanks for sending the natural community mapping for the proposed Antrim Wind Site. We recommend that you reconsider the classification of the area currently mapped as ***high elevation spruce fir forest***. This community is known to occur from 2500 to 4000 feet elevation, well above the elevation of this site.

Based on the information provided we suggest targeting the following rare plant species in the communities listed below.

- ***rich red oak rocky woods***
  sickle-pod (*Boechera canadensis*)
  smooth rock cress (*Boechera laevigata*)
  Carolina cranesbill (*Geranium carolinianum*)
  climbing fumitory (*Adlumia fungosa*)

- ***hemlock - beech - oak - pine forest***
  small whorled pogonia (*Isotria medeoloides*)

- ***red oak - pine rocky ridge***
  Douglas' knotweed (*Polygonum douglasii*)
  Smooth sandwort (*Minuartia glabra*)

- ***red spruce swamp***
  green adder's mouth (*Malaxis unifolia*)

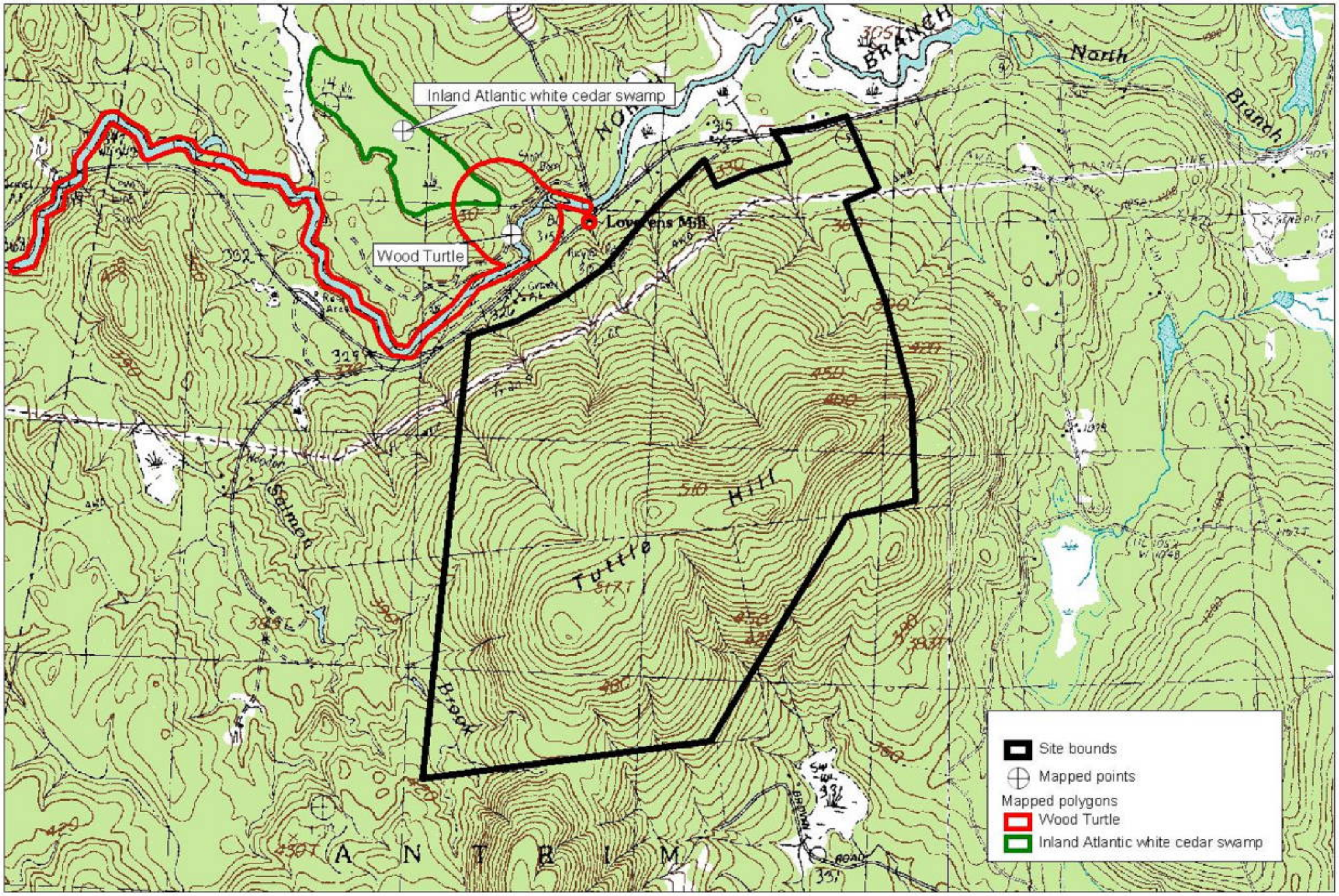
Should you have any further questions, contact me at 603-271-2215 ext. 323 or at Melissa.Coppola@dred.state.nh.us.

NHB10-0644

NH NATURAL HERITAGE BUREAU

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



*Historical record

0.25 0 0.25 0.5 0.75 1 Miles

1:24000

Valid for one year from this date: 22 Mar 2010

New Hampshire Natural Heritage Bureau - Community Record

Inland Atlantic white cedar swamp

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).

Comments on Rank: This site is probably the best, largest and most viable remaining cedar swamp in the western part of the state. It should remain among the highest conservation priorities in the state.

Detailed Description: 2006: Community observed and photographed. 2004: Community observed and photographed. 1993: *Chamaecyparis thyoides* (Atlantic white cedar) is the dominant tree with both *Acer rubrum* (red maple) and *Picea rubens* (red spruce) present in abundance. *Picea mariana* (black spruce) is scattered and less abundant. Occasionally, *Pinus strobus* (white pine) and *Betula alleghaniensis* (yellow birch) are also found. Dominant shrub species are *Gaylussacia baccata* (black huckleberry), *Nemopanthus mucronatus* (mountain holly), *Ilex laevigata* (smooth winterberry), and *Kalmia angustifolia* (sheep laurel). Common boreal components present are *Chamaedaphne calyculata* (leather-leaf), *Gaultheria hispidula* (creeping snowberry), and *Ledum groenlandicum* (Labrador-tea). The herbaceous layer is fairly abundant, although richness is somewhat limited. *Osmunda cinnamomea* (cinnamon fern), *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada mayflower), *Sarracenia purpurea* (pitcher-plant) and *Carex trisperma* (three-seeded sedge) are commonly present. Sphagnum species are abundant. 1990: Has *Chamaecyparis thyoides*(Atlantic white cedar) to 14 inches dbh and a few larger individuals, abundant in areas away from streams. *Picea mariana* (black spruce), *Picea rubens* (red spruce), *Abies balsamea* (balsam fir), and *Acer rubrum* (red maple) also occur. Lesser amounts of *Pinus strobus* (white pine).

General Area: 1993: Soil type is a mucky peat, with the peat deposits averaging <1 meter. The soil is permanently saturated with a couple of obvious watercourses present. The pH of the groundwater is quite acidic with a range of 3.8-4.0. 1990: Purest and largest cedar around open black spruce bog (90 percent, 10-14 inches average range). Other areas 50-80 percent. Basin is surrounded by gradually sloping uplands which are punctuated by a number of small cliffs. 1961 (Baldwin): a fairly large boggy swamp with *Chamaecyparis thyoides* (Atlantic white cedar). Contains 6 stands of cedar.

General Comments: 1997: New community boundaries mapped based on 1993 field work. 1990: Encroaching urban development.

Management Comments:

Location

Survey Site Name: Loverens Mill Cedar Swamp
Managed By: Loverens Mill Preserve

County:	Hillsborough	USGS quad(s):	Stoddard (4307211)
Town(s):	Antrim	Lat, Long:	430433N, 0720142W
Size:	51.3 acres	Elevation:	1080 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From Hillsboro, take Rte. 9 south ca. 5 miles south to Holmes Hill Road. Turn right (north) onto Holmes Hill. Park on the right immediately after crossing the bridge over the river, at the TNC preserve sign kiosk. After ca. 900 feet there will be a gravel road on the left. This is the trailhead. Take the marked trail on this road, up past the old mill, and look for a turnoff to the right. Proceed down this trail (N-NW). The cedar swamp is at the bottom of the basin, to the north.

Dates documented

First reported:	1961	Last reported:	2006-06-13

Kimball, Ben, et al. 2006. Field visit to Loverens Mill Cedar Swamp Preserve on June 13.

Sperduto, D. & N. Ritter. 1994. Altantic White Cedar Wetlands of New Hampshire. Environmental Protection Agency, Boston, MA.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	SC	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 11603: 1 adult seen.2006: Area 11693: 1 adult seen.2005: Area 12135: 1 adult seen.2002: Area 12069: 1 observed.
General Area: 2005: Area 12135: Crossing highway towards North Branch of Contoocook River.2002: Area 12069: Near cedar swamp.
General Comments:
Management Comments:

Location

Survey Site Name: Loverens Mill
Managed By: The Nature Conservancy #2

County:	Hillsborough	USGS quad(s):	Stoddard (4307211)
Town(s):	Antrim	Lat, Long:	
Size:	84.4 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Area 11603: TNC property at Loverens Mill Road.2002: Area 12069: Loverens Mill property near trail to cedar swamp.

Dates documented

First reported:	2002-07-28	Last reported:	2008-06-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

ATTACHMENT E

Revised Sheet G-2

GENERAL NOTES

1. 2 FOOT CONTOURS DEVELOPED FROM AERIAL SURVEY BY JAMES W SEWALL CO, 2011.
2. PLANIMETRIC AND TOPOGRAPHIC INFORMATION ARE SHOWN IN NEW HAMPSHIRE STATE PLANE, US–FEET, NAD 83. VERTICAL DATUM IS NAVD 1988 US–FEET. SEE DRAWING G–3 FOR PROJECT BENCHMARKS. HORIZONTAL AND VERTICAL LOCATION COORDINATES FOR ALL IMPROVEMENTS WILL BE PROVIDED TO THE CONTRACTOR BY THE ENGINEER IN ELECTRONIC FORMAT AFTER NH DES APPROVALS.
3. NATURAL RESOURCE DATA, INCLUDING WETLAND DELINEATION BOUNDARIES AND OTHER SENSITIVE RESOURCES PERFORMED BY TRC, 2011.

CLEARING AND STOCKPILING OPERATIONS

1. INSTALL PERIMETER EROSION CONTROL MEASURES PRIOR TO SOIL DISTURBANCE.
2. EQUIPMENT LAYDOWN AREA AND THE SUBSTATION AREA: CLEAR TIMBER AND BRUSH WITHIN LIMIT OF DISTURBANCE. GRUBBING SHALL BE PERFORMED AFTER ESTABLISHMENT AND STABILIZATION OF TEMPORARY OR PERMANENT DRAINAGE COURSES BUT JUST PRIOR TO PRELIMINARY GRADING; STUMPS SHALL BE GROUND TO GRADE OR REMOVED AND GROUND ON–SITE TO GENERATE EROSION CONTROL MIX (ECM).
3. ALL DISTURBED AREAS SHALL BE TEMPORARILY STABILIZED AS SOON AS PRACTICABLE, BUT NO LATER THAN 45 DAYS OF INITIAL DISTURBANCE. WHERE FEASIBLE, CONTRACTOR OPERATIONS SHALL MAINTAIN THE NATURAL COVER MATERIAL OR USE NATURAL VEGETATIVE BUFFER STRIPS TO AID IN SEDIMENT RETENTION, AND TO REDUCE THE POTENTIAL OF SOIL EROSION
4. THE CONTRACTOR SHALL MINIMIZE THE AMOUNT OF DISTURBANCE AT ANY ONE TIME BY STAGING CONSTRUCTION AS MUCH AS PRACTICAL FOR EFFICIENT CONSTRUCTION OF THE PROJECT. THE UNSTABILIZED DISTURBED AREA SHALL NOT EXCEED 5 ACRES UNLESS THE FOLLOWING CONDITIONS ARE MET:
   - SUBMIT DOCUMENTATION THAT THE REQUIRED AREAS OF CUTS AND FILLS ARE SUCH THAT AN AREA OF DISTURBANCE OF 5 ACRES OR LESS WOULD UNREASONABLY LIMIT THE CONSTRUCTION SCHEDULE;
   - SUBMIT A CONSTRUCTION SEQUENCE PLAN, DEVELOPED BY A QUALIFIED ENGINEER OR A CPESC SPECIALIST; AND
   - EMPLOY AN ENVIRONMENTAL MONITOR DURING CONSTRUCTION
5. AN AREA SHALL BE CONSIDERED STABLE IF ONE OF THE FOLLOWING HAS OCCURRED:
   - BASE COURSE GRAVELS HAVE BEEN INSTALLED.
   - A MINIMUM OF 85% VEGETATED GROWTH HAS BEEN ESTABLISHED.
   - A MINIMUM OF 3 INCHES OF NON–EROSIVE MATERIAL SUCH AS STONE OR RIPRAP HAS BEEN INSTALLED.
   - OR, EROSION CONTROL BLANKETS OR EROSION CONTROL MIX HAS BEEN PROPERLY INSTALLED.
   - EXPOSED LEDGE SHALL BE CONSIDERED STABLE.
6. ACCESS ROADS, WTG ASSEMBLY AREAS, AND RIDGE ROADS: IN FILL AREAS LESS THAN 5 FEET, CLEAR TIMBER AND BRUSH AND GRUB AS DESCRIBED IN 2 ABOVE. IN FILL AREAS EXCEEDING 5 FEET, GRUBBING AND STUMP REMOVAL IS NOT REQUIRED.
7. STRIPPED TOPSOIL SHALL BE STOCKPILED ON–SITE WITHIN DISTURBED AREAS FOR USE IN STABILIZING ACCESS ROAD DITCHES AND FOR FINAL STABILIZATION OF ROAD SHOULDERS, WTG ASSEMBLY AREAS, LAYDOWN AREAS AND SLOPES. AN EROSION CONTROL BARRIER SHALL BE INSTALLED AROUND SOIL STOCKPILES THAT ARE EXPECTED TO REMAIN UNDISTURBED FOR MORE THAN 48 HOURS, OR PRIOR TO A STORM EVENT. THAT BARRIERS SHALL BE ADEQUATELY LOCATED AND REINFORCED TO PREVENT COLLAPSE DURING A STORM EVENT AND THE POTENTIAL SLUMPING OF THE PILE. IF NO ACTIVITY IS SCHEDULED WITHIN 30 DAYS, APPLY HAY AND/OR STRAW MULCH AS SPECIFIED HEREIN, UNLESS DIRECTED OTHERWISE. 4 INCHES OF ECM MAY ALSO BE USED. HAY/STRAW MULCH MAY ALSO BE SUPPLEMENTED BY TEMPORARY SEEDING WITH ANNUAL RYEGRASS AS SPECIFIED HEREIN FOR AREAS WHERE ADDITIONAL ACTIVITY IS NOT EXPECTED FOR SEVERAL MORE WEEKS. APPLY ANCHORED MULCH OR SUPPLEMENTAL SEEDING DURING WINTER CONSTRUCTION.
8. STOCKPILE GENERATED ECM ON–SITE WITHIN DISTURBED AREAS.
9. REMOVE EXCESS SPOILS FROM SITE THAT WILL NOT BE USED FOR THE FINAL DESIGN AND STABILIZATION.

CONSTRUCTION OF ACCESS ROADS, ASSEMBLY AREAS, RIDGE ROADS & SUBSTATION

1. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL USE SURVEY CREWS TO ACCURATELY LOCATE ALL IMPROVEMENTS INCLUDING ROADWAY CENTERLINES AND LIMITS OF DISTURBANCE. PROVIDE ADDITIONAL STAKING AND MARKING AT LOCATIONS WHERE STORMWATER CONTROL MEASURES ARE TO BE INSTALLED.
2. DUE TO DIFFERING SITE CONDITIONS, MINOR HORIZONTAL AND VERTICAL ADJUSTMENTS, WITHIN PERMIT CONSTRAINTS, MAY BE NECESSARY FOR PROPER CONSTRUCTION AND INTERPRETATION OF THE CONTRACT DRAWINGS. ALL ADJUSTMENTS SHALL BE APPROVED BY THE ENGINEER PRIOR TO IMPLEMENTATION.

CONSTRUCTION OF PERMANENT STORMWATER MANAGEMENT SYSTEMS

1. GRADING TO BE CONDUCTED IN ACCORDANCE WITH PERMITTED PERMANENT STORMWATER MANAGEMENT DESIGN.
2. ONCE FINAL GRADES ARE ACHIEVED, EXPOSED SOIL SURROUNDING THE STORMWATER MANAGEMENT STRUCTURES SHALL BE PERMANENTLY STABILIZED AS DESCRIBED HEREIN.

CRANE PAD CONSTRUCTION

1. FOLLOWING CONSTRUCTION OF THE WTG ASSEMBLY AREA SUBGRADES, BRING CRANE PADS TO FINISH GRADE WITH 4–INCH MINUS CRUSHED STONE. AREAS TO BE REVEGETATED (ASSEMBLY AREAS, ETC.) MAY BE BROUGHT TO FINISH GRADE WITH SUBGRADE MATERIAL. SPREAD AND COMPACT MATERIAL AS NECESSARY TO THE LIMITS DEPICTED ON CONTRACT DOCUMENTS. MINOR VERTICAL AND HORIZONTAL ADJUSTMENTS, WITHIN PERMIT CONSTRAINTS, MAY BE NECESSARY TO ACCOMMODATE SPECIFIC SITE CONDITIONS. ALL ADJUSTMENTS SHALL BE APPROVED BY THE ENGINEER PRIOR TO IMPLEMENTATION.
2. PORTIONS OF THE WTG ASSEMBLY AREA WITHIN A 50–FOOT RADIUS OF THE TURBINE GENERATOR AND THE CRANE PAD SHALL REMAIN AS A PERMANENT DISTURBANCE. ALL OTHER AREAS WITHIN THE WTG ASSEMBLY AREA SHALL BE PERMANENTLY STABILIZED AS DESCRIBED HEREIN. PRIOR TO PERMANENT STABILIZATION, THE CONTRACTOR SHALL PERMANENTLY PIN THE FOUR CORNERS OF THE WTG LAYDOWN AREA.

CLEAN–UP & FINAL STABILIZATION

1. AT STREAM CROSSINGS, COMPLETE FINAL RESTORATION (FINISH GRADE, SEED AND MULCH) OF ALL AREAS WITHIN 100 FEET OF THE WATERBODY WITHIN 48 HOURS OF FINAL GRADING, UNLESS DIRECTED OTHERWISE. ALL OTHER AREAS OF EXPOSED SOIL SHALL BE PERMANENTLY RE–VEGETATED OR OTHERWISE PERMANENTLY STABILIZED WITHIN 7 DAYS OF FINAL GRADING.
2. UPON COMPLETION OF CONSTRUCTION ACTIVITIES, ALL WORK AREAS SHALL BE CLEARED OF CONSTRUCTION DEBRIS AND OTHER MATERIALS.
3. SPECIFIC CLEAN–UP REQUIREMENTS TO INVOLVE: REMOVAL OF ALL TEMPORARY WORK TRAILERS; REMOVAL OF MATERIAL & EQUIPMENT; DISPOSAL OF ALL RUBBISH RESULTING FROM CLEARING, CONSTRUCTION, & INSTALLATION; ROUGH GRADING & STABILIZATION OF EMBANKMENTS MADE FOR CONSTRUCTION PURPOSES; FILLING OF ANY EXCAVATIONS; & REPAIRING RUTS IN ACCESS ROADS.

CONSTRUCTION MONITORING

1. THE PERMITTEE SHALL EMPLOY THE SERVICES OF AN ENVIRONMENTAL MONITTOR ("MONITOR"). THE MONITOR SHALL BE A CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL OR A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NEW HAMPSHIRE AND SHALL BE EMPLOYED TO INSPECT THE SITE FROM THE START OF ALTERATION OF TERRAIN ACTIVITIES UNTIL THE ALTERATION OF TERRAIN ACTIVITIES ARE COMPLETED AND THE SITE IS CONSIDERED STABLE.
2. DURING THIS PERIOD, THE MONITOR SHALL INSPECT THE SUBJECT SITE AT LEAST ONCE A WEEK, AND IF POSSIBLE, DURING ANY 1/2–INCH OR GREATER RAIN EVENT (I.E. 1/2–INCH OF PRECIPITATION OR MORE WITHIN A 24 HOUR PERIOD). IF UNABLE TO BE PRESENT DURING SUCH A STORM, THE MONITOR SHALL INSPECT THE SITE WITHIN 24 HOURS OF THIS EVENT.
3. THE INSPECTIONS SHALL BE FOR THE PURPOSES OF DETERMINING COMPLIANCE WITH THE PERMIT. THE MONITOR SHALL SUBMIT A WRITTEN REPORT TO THE DEPARTMENT WITHIN 24 HOURS OF THE INSPECTIONS. THE REPORTS SHALL, AT A MINIMUM, DESCRIBE WHETHER THE PROJECT IS BEING CONSTRUCTED IN ACCORDANCE WITH THE APPROVED SEQUENCE, IDENTIFY ANY DEVIATION FROM THE CONDITIONS OF THIS PERMIT AND THE APPROVED PLANS, AND IDENTIFY ANY OTHER NOTED DEFICIENCIES.
4. THE MONITOR SHALL PROVIDE TECHNICAL ASSISTANCE AND RECOMMENDATIONS TO THE CONTRACTOR ON THE APPROPRIATE BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROLS REQUIRED TO MEET THE REQUIREMENTS OF RSA 485–A:17 AND ALL APPLICABLE DES PERMIT CONDITIONS.
5. WITHIN 24 HOURS OF EACH INSPECTION, THE MONITOR SHALL SUBMIT A REPORT TO DES VIA EMAIL (TO CRAIG RENNIE AT: craig.rennie@des.nh.gov AND TO JENNIFER DROCIAK AT: jennifer.drociak@des.nh.gov).

WINTER CONSTRUCTION NOTES

FOR WORK PROPOSED DURING THE WINTER SEASON (TYPICALLY NOVEMBER 1 – APRIL 15), THE CONTRACTOR SHALL ADHERE TO THE FOLLOWING PRACTICES:

1. A PLAN AND SCHEDULE OF ACTIVITIES SHALL BE SUBMITTED TO THE PERMITTEE FOR APPROVAL PRIOR TO ANY WORK BEING DONE.
2. LIMIT THE TOTAL AREA OF EXPOSED SOIL TO THAT IN WHICH EARTH WORK CAN BE COMPLETED WITHIN 15 DAYS AND MULCHED WITHIN ONE DAY PRIOR TO A SNOW EVENT.
3. EXPOSED SOIL MAY BE LEFT BARE FOR NO MORE THAN 15 DAYS.
4. MULCH ALL EXPOSED SOIL WHERE NO ACTIVITY IS SCHEDULED WITHIN 7 DAYS AND PRIOR TO A FORECASTED SNOW EVENT OF MORE THAN 1 INCH.
5. WHERE PRACTICABLE, MULCH SHOULD BE APPLIED AT THE END OF EACH DAY'S WORK FOR AREAS THAT ARE FINAL GRADED. OTHERWISE, MULCH THE FOLLOWING DAY.
6. DO NOT APPLY MULCH OVER MORE THAN 1 INCH OF SNOW.
7. HAY OR STRAW MULCH SHALL BE APPLIED AT 140 LBS/1000 S.F. (APPROX.. 4 BALES) AND SO THAT THE GROUND SURFACE IS NOT VISIBLE THROUGH THE MULCH.
8. ECM IS THE PREFERRED MULCHING MATERIAL AND SHALL BE APPLIED AT A MINIMUM 4 INCH THICKNESS, WITH HIGHER AMOUNTS AS DESCRIBED HEREIN.
9. ECM IS THE PREFERRED EROSION CONTROL BARRIER. IF ECM IS NOT AVAILABLE, INSTALLATION OF SILT FENCE ON FROZEN GROUND MAY BE MODIFIED FROM ILLUSTRATIONS AND DETAIL DRAWINGS TO SUBSTITUTE SIX INCHES OF SUITABLE NON–ORGANIC MATERIAL OVER THE BOTTOM OF THE SILT FENCE IN LIEU OF TRENCHING AND BACKFILLING FABRIC.
10. A DOUBLE ROW OF EROSION CONTROL BARRIER WILL BE USED WHERE REQUIRED WITHIN 100 FEET OF WETLANDS AND WATER BODIES.
11. INSPECTION OF EROSION CONTROL MEASURES AND ANY NEEDED REPAIR/REPLACEMENT OF WHICH SHALL OCCUR EACH DAY.
12. ALL PROPOSED VEGETATED AREAS THAT DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15, OR WHICH ARE DISTURBED AFTER OCTOBER 15, SHALL BE STABILIZED BY SEEDING AND INSTALLING EROSION CONTROL BLANKETS ON SLOPES GREATER THAN 3:1, AND SEEDING AND PLACING 3 TO 4 TONS/ACRE OF MULCH, SECURED WITH ANCHOR NETTING, ELSEWHERE. THE INSTALLATION OF EROSION CONTROL BLANKETS OR MULCH AND NETTING SHALL NOT OCCUR OVER ACCUMULATED SNOW OR ON FROZEN GROUND AND SHALL BE COMPLETED IN ADVANCE OF THAW OR SPRING MELT EVENTS.
13. ALL DITCHES OR SWALES WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15, OR WHICH ARE DISTURBED AFTER OCTOBER 15, SHALL BE STABILIZED TEMPORARILY WITH STONE OR EROSION CONTROL BLANKETS APPROPRIATE FOR THE DESIGN FLOW CONDITIONS.
14. AFTER NOVEMBER 15, INCOMPLETE ROAD, SUBSTATION, OR TURBINE PAD AREAS, WHERE WORK HAS STOPPED FOR THE WINTER SEASON, SHALL BE PROTECTED WITH A MINIMUM OF 3 INCHES OF CRUSHED GRAVEL PER NHDOT ITEM 304.3.
15. PERMANENT SEEDING IS NOT REQUIRED DURING THE WINTER SEASON; HOWEVER, IF DONE, THE CONTRACTOR SHALL FOLLOW PROCEDURES FOR DORMANT SEEDING. THE PERMANENT SEED MIX SHALL BE APPLIED AT THREE TIMES THE STANDARD RATE AND MULCHED. RE–VEGETATION SUCCESS MUST BE INSPECTED BY THE CONTRACTOR IN THE FOLLOWING SPRING (AFTER APRIL 15) AND RE–SEEDED AS NECESSARY IF VEGETATIVE COVER IS LESS THAN 75 PERCENT. ACCEPTANCE OF DORMANT SEEDING AS SUCCESSFUL WILL NOT OCCUR UNTIL AFTER JUNE 1 OF THE FOLLOWING SPRING.

CIVIL ABBREVIATIONS

&	AND
ø, DIA	DIAMETER
#, NO	NUMBER
APP'D	APPROVED
AR	TANGENT RIGID STRUCTURE
BLDG	BUILDING
CB	CATCH BASIN
CEN	CENTER
CFS	CUBIC FEET PER SECOND
CI	CAST IRON
CL, ℄	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
CONC	CONCRETE
COR	CORNER
CY	CUBIC YARD
DEMO	DEMOLITION
DER	DEAD END RIGID STRUCTURE
DMH	DRAIN MANHOLE
DI	DUCTILE IRON
DR	DRAIN
DWG	DRAWING
ECB	EROSION CONTROL BERM
ECM	EROSION CONTROL MIX
EL	ELEVATION
EMH	ELECTRIC MANHOLE
FM	FORCE MAIN
FT	FEET
G	GAS
HDPE	HIGH DENSITY POLYETHYLENE
HYD	HYDRANT
IN	INCH
INF	INFLUENT
INV	INVERT
LF	LINEAR FEET
LBS	POUNDS
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MW	MONITORING WELL
N	NORTH
NAD83	NORTH AMERICAN DATUM 1983
NAVD88	NORTH AMERICAN VERTICAL DATUM 1988
N/A	NOT AVAILABLE/APPLICABLE
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
PC	PERFORATED CLAY
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PS	PRIMARY SLUDGE
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
R, RAD	RADIUS
RCP	REINFORCED CONCRETE PIPE
RD	ROOF DRAIN
REQ'D	REQUIRED
S	SLOPE, SEWER
SD	STORM DRAIN
SF	SQUARE FEET
SMH	SANITARY SEWER MANHOLE
SQ	SQUARE
STA	STATION
T, XFMR	TRANSFORMER
T/FNDN	TOP OF FOUNDATION
TBM	TEMPORARY BENCH MARK
THK	THICKNESS
TOS	TOP OF STRUCTURE
TYP	TYPICAL
UD	UNDERDRAIN
UG	UNDERGROUND
UGE	UNDERGROUND ELECTRIC
UTM	UNIVERSAL TRANSVERSE MERCATOR
VC	VITRIFIED CLAY
W/	WITH
W	POTABLE WATER
WTG	WIND TURBINE GENERATOR

LEGEND

EXISTING		PROPOSED
	LEASE AREA	
	PROPERTY LINE	
	CENTERLINE	
	EDGE OF PAVEMENT	
	EDGE OF GRAVEL	
1050	CONTOUR	1050
	BUILDING	
	STONEWALL	
	TREELINE	
	CHAIN LINK FENCE	
	CULVERT	
	UNDERGROUND FIBER	UGF
	UNDERGROUND 34kV COLLECTOR	UGE
	OVERHEAD 34kV COLLECTOR	OHE OHE
	OVERHEAD TRANSMISSION	
	UTILITY POLE	
	SURVEY CONTROL POINT	
1225.5	SPOT ELEVATION	1112.50
	STREAM	
AN–31	WETLANDS	
	VERNAL POOL	
	DRAINAGE FLOW	
	SIGN	
	PLUNGE POOL	
	PERMANENT CHECK DAM	
	EROSION CONTROL BARRIER	ECB
	LIMIT OF DISTURBANCE	
	RIPRAP	
	MATCHLINE	
	PERMEABLE BASE ROAD CONSTRUCTION	
	STORMWATER BUFFER	
	TURBINE LOCATION	WTG-3

NOT FOR CONSTRUCTION

NO.	REVISION	DATE	BY	CK	P.E. STAMPED BY	P.E. No.
C	REVISED PER DES REVIEW COMMENTS	6/5/12	PMM		DTB	8105
B	ISSUED FOR PERMITTING	1/20/12	PMM	PGT	DTB	8105
A	ISSUED FOR CLIENT REVIEW	12/19/11	PMM	PGT		

STATE OF NEW HAMPSHIRE
DANIEL T. BUTLER No. 8105
LICENSED PROFESSIONAL ENGINEER
6/11/12

CLIENT APPROVAL
APPROVED BY
COMPANY
DATE

TRC/PMM DESIGNED
TRC/KAV DRAWN
TRC/DTB CHECKED
APPROVED
REVIEWED

PROJECT NOTES, LEGEND AND ABBREVIATIONS

ANTRIM WIND ENERGY, LLC
ANTRIM WINDPARK
ANTRIM NEW HAMPSHIRE

TRC
249 WESTERN AVENUE
AUGUSTA, ME 04330
PROJECT NO: 186317
SCALE: AS NOTED DATE: 11-8-11

G–2

REV. B

Antrim Wind Energy, LLC
Site Evaluation Committee No. 2012-001

Request No.:	NHDES-02	Date of Request:	May 23, 2012
Requested By:	Rene Pelletier, PG	Reply Date:	June 14, 2012
Subject:	Subsurface Systems Bureau Individual Sewage Disposal System (ISDS) Application	Witness:	David Pettit

REQUEST:

1. Please address section c (depth and types of cover) in the enviro-septic manual (2003 edition) to address vehicular traffic requirements for the proposed field.

RESPONSE:

1. Section (c) (depths and types of cover) of the 2003 Enviro-septic Manual requires a minimum of 18 inches of cover, and appropriate venting for the proposed field (detailed in section J of the manual). The plans for the proposed septic design address these requirements. Full-size plans were sent to the Subsurface Systems Bureau on June 4, 2012 containing the following information.

   - Detail D-2 on the proposed plan shows a cover of 34" over the field, and Note 6 of Detail D-2 specifies "Final cover thickness shall exceed 18 inches".
   - Detail D-1 indicates a 3-foot vent on the end of the proposed field, and this is also shown in the plan view.

Name of Person
Preparing Response: David Pettit **Date: June 14, 2012**