A comprehensive plan for the management of stormwater runoff for a subdivision located on Bailey Road, Holden

Sunshine Ridge
Bailey Road
Holden, MA.

Stormwater Report

Prepared for Bailey Road Development Inc.

December 3, 2020

Job#: 1614-20

New England Environmental Design

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12-10-20

Stormwater Report
Sunshine Ridge
Bailey Road
Holden, MA

Introduction

Project Overview

The applicant, Bailey Road Development, Inc., is proposing to develop a parcel of land fronting on Bailey Road. The existing parcel is 13.23 acres in area and it currently consists of woods and a forested Bordering Vegetated Wetland. 7 single family homes, serviced by public water and sewer, are proposed to be built along a proposed 500 ft long road. The homes in the proposed project will access Bailey Road via driveways connected to the proposed road. This project is subject to the Stormwater Management Standards of 310 CMR 10.05(6)(k)-(q).

Documentation of compliance will adhere to the methods described within Volume 3, Chapter 1, of the Massachusetts Stormwater Handbook.

Compliance Documentation

This Stormwater Report has been prepared in accordance with the requirements of Volume 3, Chapter 1, of the Massachusetts Department of Environmental Protection Stormwater Handbook. This report is separated into sections numbered as to match the Stormwater Management Standard numbering. Stormwater Management Standards 5 and 7 are not applicable to this project and therefore have been omitted from this report. A summary of the Stormwater Management Standards and project compliance begins on the following page.

Stormwater Management Requirements per 310 CMR 10.05(k)

Standard 1 (Untreated discharges)

Statutory Requirement

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Project Compliance

The proposed stormwater discharge has been designed to prevent erosion. Erosion protection is provided by energy dissipation through a rip rap apron.

Standard 2 (Discharge rates)

Statutory Requirement

Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Project Compliance

The post development flow rate is attenuated through the use of grassed qualifying pervious areas, deep sump catch basins, sediment forebays, a detention pond, and an infiltration basin. The post- development runoff rate will not exceed the pre-development rate for the 2, 10, and 100-year storms.

Calculations substantiating compliance for the analysis point are provided in Section 2 – Drainage Analysis.

Standard 3 (Groundwater recharge)

Statutory Requirement

Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices and good operation and maintenance. At a minimum, the annual recharge from the post development site shall approximate the annual recharge from the pre-development conditions based on soil type.

This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Project Compliance

This requirement is met through the infiltration of the water that flows from the roofs and paved surfaces to qualifying pervious areas and/or deep sump catch basins, sediment forebays, and an infiltration basin.

Calculations substantiating compliance with the requirements for Standard 3 are provided in Section 3. This project was designed to exceed the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook. This project provides recharge for the existing impervious areas as well as the proposed impervious areas.

Standard 4 (Water quality and treatment)

Statutory Requirement

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained;

b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with Massachusetts Stormwater Handbook; and

c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Project Compliance

Stormwater Treatment was provided by the proposed stormwater design implemented at the site even though the treatment and water quality requirement could be reduced by Low Impact Development Site Design Credits 2 & 3. This project uses an infiltration basin to provide stormwater treatment for TSS removal and volume attenuation.

Calculations substantiating compliance with the requirements for Standard 4 are provided in Section 4. This project was designed to exceed the required treatment volume as determined in accordance with the Massachusetts Stormwater Handbook. This project provides treatment for the existing impervious areas as well as the proposed impervious areas.

Standard 5 (Land use with higher potential pollutant loads)

Statutory Requirement

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such use as provided in the Massachusetts Stormwater Handbook.

Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

Project Compliance

The proposed use is not considered a Land Use with Higher Potential Pollutant Loads. The requirements of this Standard are not applicable to this project.

Standard 6 (Critical Areas)

Statutory Requirement

Stormwater discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or any other critical area require the use of the specific source control and

pollution prevention measures and the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters or Special Resource Waters shall be set back from the receiving water and receive the highest and best practical method of treatment. A "stormwater discharge," as defined in 314 CMR 3.04(2)(a)1. or (b), to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of the public water supply.

Project Compliance

The proposed project is subject to additional protective measures due to the presence of a Zone A water supply protection area along a small portion of the southern boundary of the project. The plans submitted for this project correctly show the limits of the Zone A water supply protection areas.

This project has been designed in conformance with the additional performance standards for work near to or within critical areas. The following additional treatment requirements have been applied to all stormwater discharges for this project:

- The water quality treatment volume has been increased to the first inch of runoff.
- The infiltration system has been provided with pretreatment exceeding the 44% requirement.
- All structural best management practices are suitable for use within critical areas.

Standard 7 (Redevelopment projects)

Statutory Requirement

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

Project Compliance

The proposed project is entirely of new construction. No portion of the project qualifies as a redevelopment project.

Standard 8 (Construction period erosion, sedimentation and pollution prevention plan)

Statutory Requirement

A plan to control construction related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation and pollution prevention plan) shall be developed and implemented.

Project Compliance

The proposed development is covered by a NPDES Construction General Permit. A NOI is required to be filed with the EPA prior to the start of construction.

A "Construction Period Stormwater Pollution Prevention Plan" has been provided in Section 8. This plan includes all the information required by the Stormwater Checklist.

Standard 9 (Operation and maintenance)

Statutory Requirement

A long-term operation and maintenance plan shall be developed and implemented to ensure that the stormwater management system functions as designed.

Project Compliance

An Operation and Maintenance Plan is included in Section 9.

Standard 10 (Illicit discharge)

Statutory Requirement

All illicit discharges to the stormwater management system are prohibited.

Project Compliance

An illicit discharge statement is provided in Section 10.

Section 1

Supporting calculations for

Stormwater Management

Standard 1

- Riprap sizing calculations

Section 1 – Discharges

Supporting Calculations for Stormwater Management Standard 1

Riprap Outlet Protection

The riprap outlet protection for the proposed pipe discharges have been sized based upon the Connecticut Outlet Protection guidelines. The relevant tables from those guidelines are excerpted and included herein.

Table 11.11 Allowable Outlet Velocities for Type A and B Riprap Aprons

Outlet Velocity - mps (fps)	Riprap Specification
0-2.44 (0-8)	Modified
2.44-3.05 (8-10)	Intermediate
3.05-4.27 (10-14)	Standard

Modified	$d_{50} < 0.13$m (0.42 ft)
Intermediate	0.13m (0.42 ft) $< d_{50} <$ 0.20m (0.67 ft)
Standard	0.20m (0.67 ft) $< d_{50} <$ 0.38m (1.25 ft)
Special Design	0.38m (1.25 ft) $< d_{50}$

Required Riprap Size

Exit velocities at the outlets are below 8 feet/sec with the riprap specification classified as "Modified". The required apron lengths (La) for these outlets is taken from Table 11-12.1 on the following page.

The following table presents a summary of the riprap apron requirements for the discharge point:

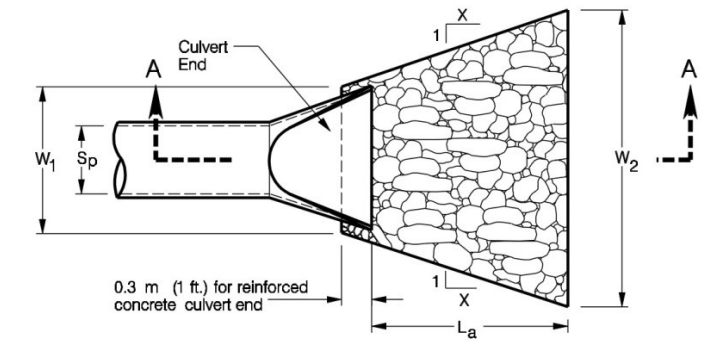
Riprap Apron Requirements								
Outlet	Diameter (in)	Flow (cfs)	Velocity (ft/sec)	La (ft)	W1 (ft)	W2 (ft)	d (in)	Riprap d50 (in)
Infiltration FE-2	12	3.63	4.6	10	3	10	12	5
Detention FE-3	8	2.11	6.0	10	2	9	12	5

OUTLET PROTECTION - OUTLET VELOCITY ≤ 14 feet/sec

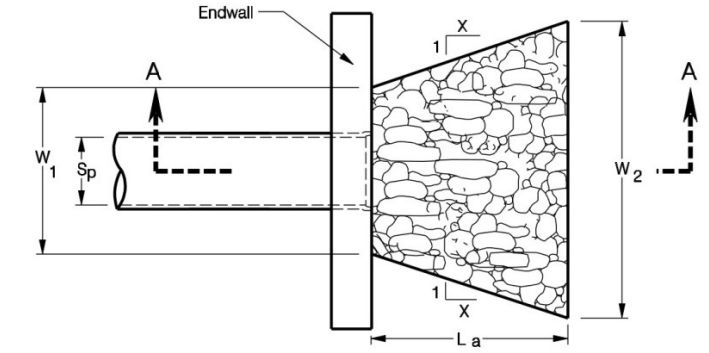
	OUTLET PIPE DIAMETER OR SPAN (in)									
DISCHARGE (cfs)	12	15	18	24	30	36	42	48	54	60
0-5	***10***	***10***		***USE***						
6	12	11								
7		13	***12***							
8		14	13	***12***		***MINIMUM***				
9			14	13						
10			15	13						
11			16	14				***LENGTH***		
12				14						
14				16	***14***					
16				17	15	***14***			***OUTLINED***	
18				18	16	15				
20					17	15	***14***			
22		***USE***			18	16	15			
24						17	15	***14***		
26						17	16	15		
28						18	16	15		
30						19	17	16		
35						20	18	17	***16***	
40			***PREFORMED***				20	18	17	***16***
45							21	19	18	16
50							22	20	18	17
55								21	19	18
60								22	20	19
65								24	21	20
70					***SCOUR***			25	22	20
75								26	23	21
80									24	22
90									26	24
100									28	25
110										27
125							***HOLE***			29
130										30

Table 11-12.1 - Length - L_a (feet)
Type A Riprap Apron

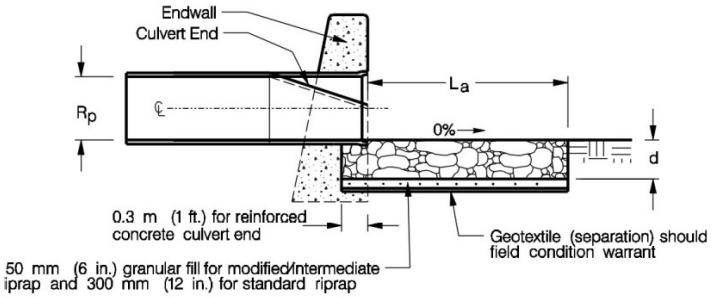
Notes: 1. Bold face outlined boxes indicate minimum L_a to be used for a given pipe diameter or span.
2. Rounding and interpolating are acceptable.



CULVERT END PLAN VIEW



ENDWALL PLAN VIEW



SECTION A–A
CULVERT END AND ENDWALL

LEGEND

S_p = { Max. inside pipe span (non–circular sections) / Inside pipe diameter (circular sections)

R_p = { Max. inside pipe rise (non–circular sections) / Inside pipe diameter (circular sections)

L_a = Length of riprap apron measured from the end of culvert end section or face of endwall

d = { 300 mm (12 in.) Modified Riprap / 450 mm (18 in.) Intermediate Riprap / 900 mm (36 in.) Standard Riprap

	X	W_1	W_2
Type A Riprap Apron	3	$3S_p$	$3S_p+0.7$ La
Type B Riprap Apron	5	$3S_p$	$3S_p+0.4$ La

Figure 11-13 Type A and B Riprap Apron
(to be used where there is no defined channel downstream of the outlet)

Section 2

Drainage Analysis

- Pre & Post development analysis

Existing Conditions

The proposed development is located on Bailey Road, approximately 500 feet north of the Bailey Road/Hubbard Lane intersection. The existing property is a 13.23 acre parcel that consists of woods and a forested Bordering Vegetated Wetland (BVW).

The soil types within the development's limit of work include: Canton, Merrimac, Walpole, and Sudbury. These soils belong to hydrologic soil groups "B", "A", "B/D", and "B". Based upon extensive soil testing and water table observations by NEED, LLC, in the limit of work areas we have determined that the "A" and "B" designations are more appropriate for use on this site.

Proposed Conditions

The proposed development includes the construction of 7 single family homes, serviced by a public water and sewer, along a 500 ft long road with a cul-de-sac. The area impacted by the proposed development is approximately 9.0 acres. A stormwater management system that treats the water that flows from the roofs and paved surfaces to qualifying pervious areas and/or deep sump catch basins, sediment forebays, an infiltration basin, and a detention basin will be constructed to attenuate and treat the increased runoff. This development proposal is in compliance with the Stormwater Management Standards of 310 CMR 10.05(6)(k)-(q).

Analysis Criteria

Stormwater modeling is provided for the 2, 10, and 100 year storms. The 24 hour rainfall depths, as obtained from the NOAA Atlas 14-Volume 10-Version 3, for this analysis are:

Rainfall Event	Rainfall Depth
2 Year	3.17 inches
10 Year	4.88 inches
100 Year	7.59 inches

Methodology

The hydrologic analysis is based upon the NCRS unit hydrograph method and modeled with HydroCAD. A Type III 24 hour rainfall distribution was used for all storms modeled.

Summary of Results

A tabulated summary of the results of the pre-development and post-development analysis is presented as follows:

Summary of Hydrologic Analysis Runoff Rate (CFS)						
Event	2 Year		10 Year		100 Year	
Period	Pre	Post	Pre	Post	Pre	Post
S1 & S2 and S4 & S5 Watersheds	0.09	0.08	1.00	0.60	5.81	5.25
S3 and S6	0.03	0.02	0.94	0.51	6.16	5.77

Discussion of Results

The proposed stormwater management system provides for post-development runoff rates that are similar to the pre-development rates without exceeding them. Compliance with the Stormwater Management Requirements of 310 CMR 10.05(6) has been demonstrated to the maximum extent practicable.

Hydrologic Analysis

Sheet Flow

Shallow Concentrated

Open Channel

Pre-Development Watershed Map

Scale: 1"=100'

BAILEY ROAD

S1

S2

S3

Hydrologic Group B

Hydrologic Group A

Hydrologic Group B

Hydrologic Group A

Hydrologic Group B

Hydrologic Group A

Hydrologic Group B

Hydrologic Group A

Hydrologic Group A

Hydrologic Group B/D

LOT AREA
576,309.98 S.F.
13.23 ACRES

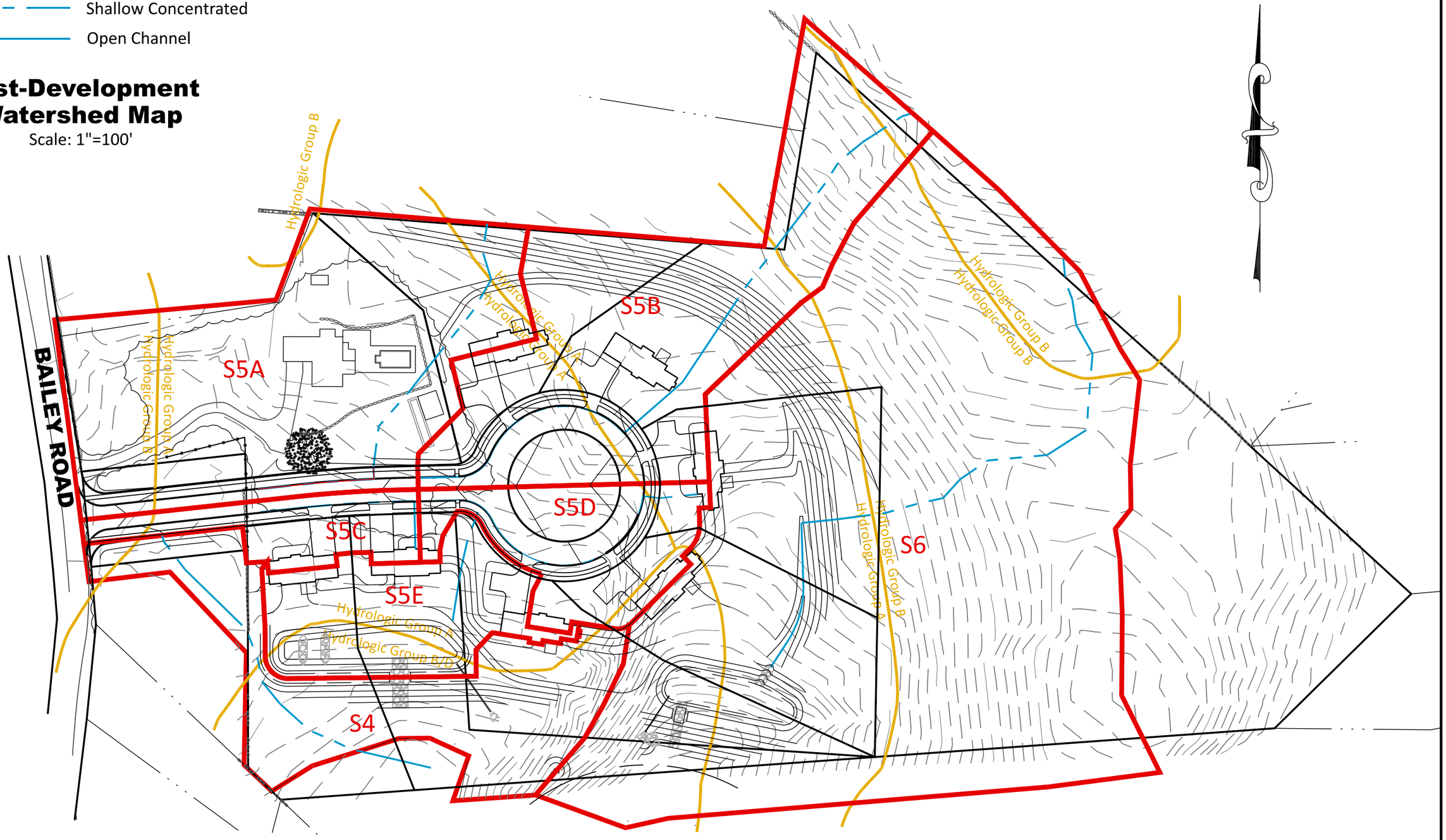
Sheet Flow

Shallow Concentrated

Open Channel

Post-Development Watershed Map

Scale: 1"=100'



NOAA Atlas 14, Volume 10, Version 3
Location name: Holden, Massachusetts, USA*
Latitude: 42.3396°, Longitude: -71.8553°
Elevation: 785.37 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.346** (0.273-0.431)	**0.403** (0.318-0.503)	**0.496** (0.390-0.621)	**0.574** (0.448-0.722)	**0.681** (0.514-0.895)	**0.762** (0.562-1.02)	**0.846** (0.603-1.18)	**0.936** (0.634-1.35)	**1.06** (0.690-1.58)	**1.16** (0.735-1.77)
10-min	**0.491** (0.387-0.610)	**0.572** (0.451-0.712)	**0.704** (0.553-0.880)	**0.814** (0.636-1.02)	**0.965** (0.728-1.27)	**1.08** (0.796-1.45)	**1.20** (0.854-1.67)	**1.33** (0.898-1.91)	**1.51** (0.978-2.25)	**1.65** (1.04-2.51)
15-min	**0.577** (0.456-0.718)	**0.672** (0.530-0.838)	**0.828** (0.651-1.04)	**0.958** (0.748-1.21)	**1.14** (0.856-1.49)	**1.27** (0.937-1.71)	**1.41** (1.00-1.97)	**1.56** (1.06-2.24)	**1.77** (1.15-2.64)	**1.94** (1.23-2.95)
30-min	**0.777** (0.614-0.968)	**0.907** (0.715-1.13)	**1.12** (0.879-1.40)	**1.30** (1.01-1.63)	**1.54** (1.16-2.02)	**1.72** (1.27-2.31)	**1.91** (1.36-2.66)	**2.12** (1.43-3.04)	**2.40** (1.56-3.58)	**2.62** (1.66-4.00)
60-min	**0.978** (0.772-1.22)	**1.14** (0.900-1.42)	**1.41** (1.11-1.76)	**1.63** (1.27-2.05)	**1.94** (1.46-2.55)	**2.17** (1.60-2.92)	**2.41** (1.72-3.36)	**2.67** (1.81-3.84)	**3.03** (1.97-4.51)	**3.31** (2.10-5.05)
2-hr	**1.23** (0.979-1.52)	**1.45** (1.15-1.80)	**1.82** (1.44-2.26)	**2.12** (1.67-2.65)	**2.54** (1.93-3.32)	**2.85** (2.12-3.82)	**3.18** (2.29-4.45)	**3.56** (2.42-5.09)	**4.13** (2.69-6.13)	**4.61** (2.93-6.98)
3-hr	**1.41** (1.12-1.73)	**1.67** (1.33-2.06)	**2.11** (1.67-2.60)	**2.47** (1.95-3.07)	**2.96** (2.26-3.87)	**3.33** (2.49-4.47)	**3.73** (2.71-5.22)	**4.20** (2.86-5.98)	**4.92** (3.21-7.27)	**5.53** (3.52-8.35)
6-hr	**1.76** (1.42-2.15)	**2.12** (1.70-2.59)	**2.70** (2.16-3.31)	**3.18** (2.53-3.93)	**3.84** (2.96-5.00)	**4.33** (3.26-5.78)	**4.86** (3.56-6.78)	**5.51** (3.76-7.80)	**6.50** (4.25-9.55)	**7.36** (4.69-11.0)
12-hr	**2.19** (1.78-2.66)	**2.65** (2.15-3.22)	**3.41** (2.75-4.15)	**4.03** (3.23-4.95)	**4.90** (3.79-6.32)	**5.54** (4.19-7.33)	**6.23** (4.58-8.62)	**7.06** (4.84-9.92)	**8.33** (5.47-12.1)	**9.41** (6.02-14.0)
24-hr	**2.60** (2.13-3.13)	**3.17** (2.59-3.82)	**4.11** (3.34-4.97)	**4.88** (3.94-5.94)	**5.95** (4.63-7.63)	**6.73** (5.13-8.86)	**7.59** (5.61-10.4)	**8.62** (5.93-12.0)	**10.2** (6.71-14.7)	**11.5** (7.39-17.0)
2-day	**2.96** (2.43-3.53)	**3.62** (2.98-4.34)	**4.71** (3.86-5.66)	**5.62** (4.57-6.79)	**6.86** (5.38-8.75)	**7.78** (5.97-10.2)	**8.78** (6.54-12.0)	**10.0** (6.91-13.9)	**11.9** (7.86-17.1)	**13.5** (8.70-19.8)
3-day	**3.22** (2.66-3.83)	**3.94** (3.25-4.69)	**5.11** (4.20-6.11)	**6.09** (4.97-7.32)	**7.43** (5.86-9.44)	**8.42** (6.49-11.0)	**9.50** (7.11-13.0)	**10.8** (7.51-15.0)	**12.9** (8.54-18.5)	**14.7** (9.46-21.4)
4-day	**3.45** (2.86-4.09)	**4.21** (3.49-5.00)	**5.45** (4.49-6.49)	**6.47** (5.30-7.76)	**7.89** (6.23-9.98)	**8.93** (6.90-11.6)	**10.1** (7.54-13.7)	**11.5** (7.96-15.8)	**13.6** (9.03-19.5)	**15.5** (9.99-22.6)
7-day	**4.12** (3.44-4.86)	**4.95** (4.12-5.84)	**6.30** (5.22-7.46)	**7.42** (6.11-8.84)	**8.96** (7.11-11.2)	**10.1** (7.83-13.0)	**11.3** (8.50-15.3)	**12.8** (8.93-17.5)	**15.1** (10.0-21.4)	**17.0** (11.0-24.7)
10-day	**4.79** (4.01-5.63)	**5.65** (4.73-6.64)	**7.06** (5.88-8.33)	**8.23** (6.80-9.77)	**9.83** (7.82-12.3)	**11.0** (8.56-14.1)	**12.3** (9.23-16.4)	**13.8** (9.66-18.8)	**16.1** (10.7-22.7)	**17.9** (11.6-25.9)
20-day	**6.85** (5.78-7.99)	**7.76** (6.54-9.06)	**9.25** (7.77-10.8)	**10.5** (8.74-12.4)	**12.2** (9.74-15.0)	**13.5** (10.5-17.0)	**14.8** (11.1-19.3)	**16.2** (11.4-21.9)	**18.2** (12.2-25.5)	**19.7** (12.8-28.3)
30-day	**8.59** (7.28-9.96)	**9.53** (8.07-11.1)	**11.1** (9.32-12.9)	**12.3** (10.3-14.5)	**14.1** (11.3-17.2)	**15.5** (12.0-19.2)	**16.8** (12.5-21.6)	**18.1** (12.8-24.3)	**19.8** (13.4-27.7)	**21.1** (13.8-30.2)
45-day	**10.8** (9.16-12.4)	**11.7** (9.98-13.6)	**13.3** (11.3-15.5)	**14.6** (12.3-17.1)	**16.5** (13.2-19.9)	**17.9** (14.0-22.1)	**19.3** (14.3-24.6)	**20.5** (14.6-27.4)	**22.0** (14.9-30.5)	**23.0** (15.0-32.8)
60-day	**12.6** (10.7-14.5)	**13.6** (11.6-15.7)	**15.2** (12.9-17.6)	**16.6** (14.0-19.3)	**18.5** (14.9-22.3)	**20.0** (15.6-24.6)	**21.4** (15.9-27.1)	**22.6** (16.1-30.0)	**23.9** (16.2-33.1)	**24.8** (16.3-35.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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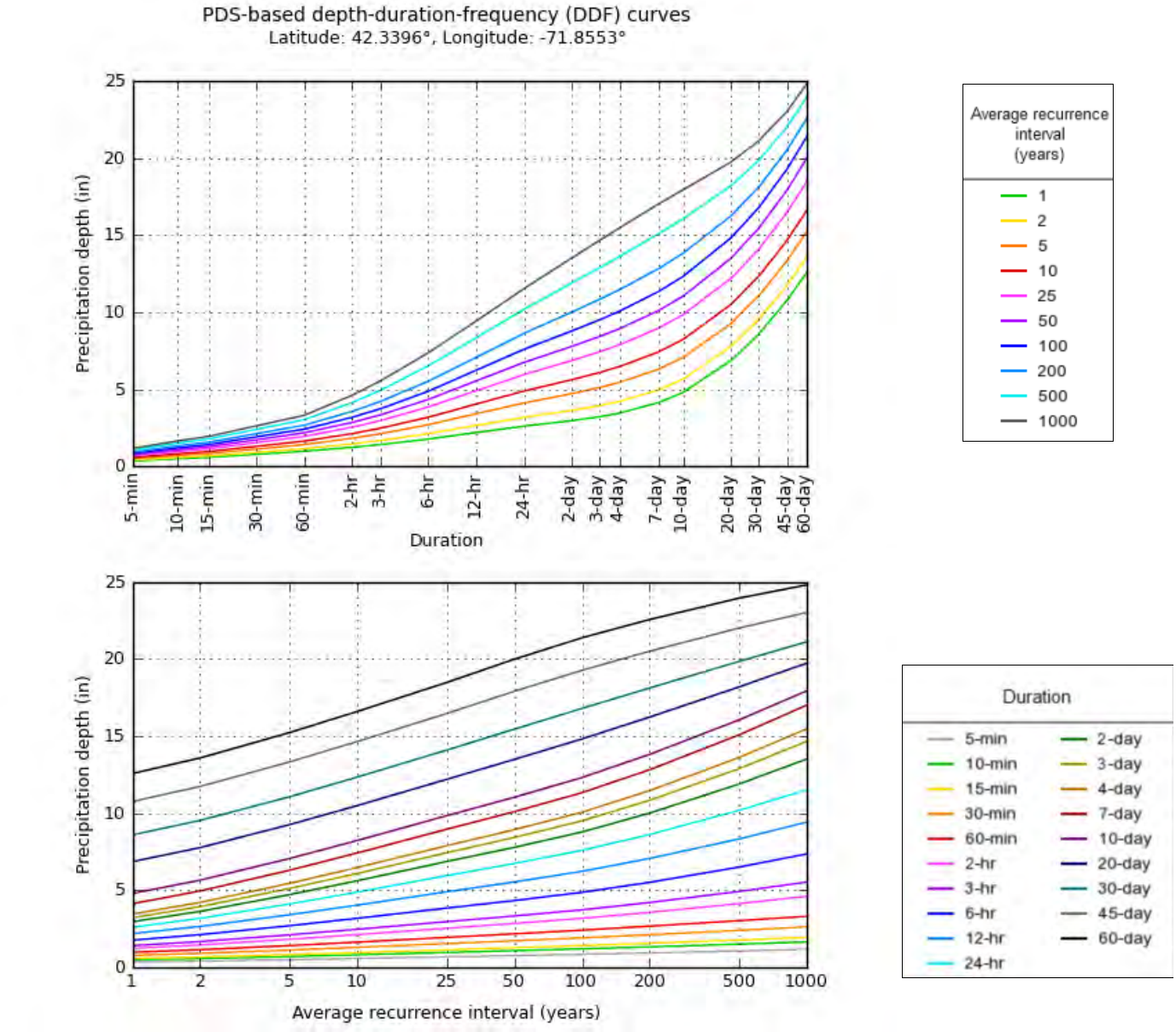
PF graphical



NOAA Atlas 14, Volume 10, Version 3

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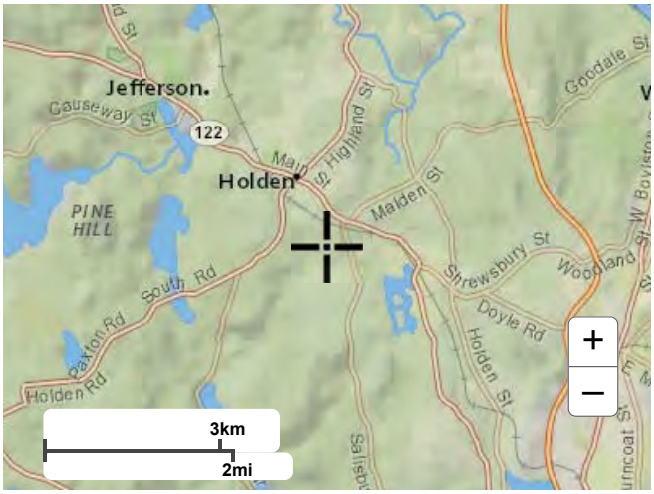
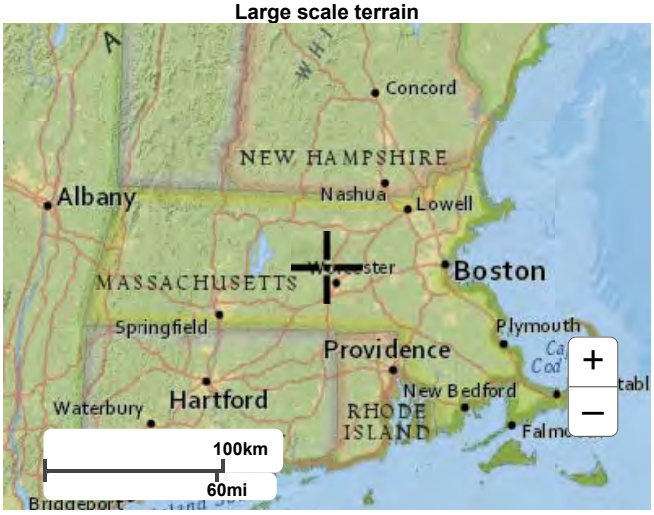
Maps & aerials

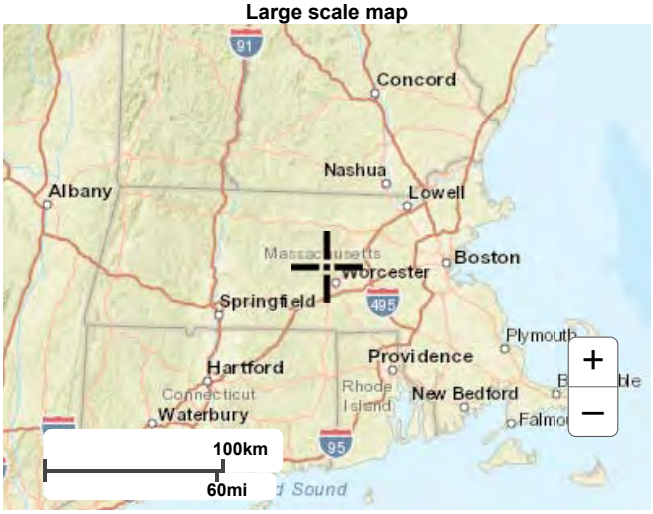
Small scale terrain



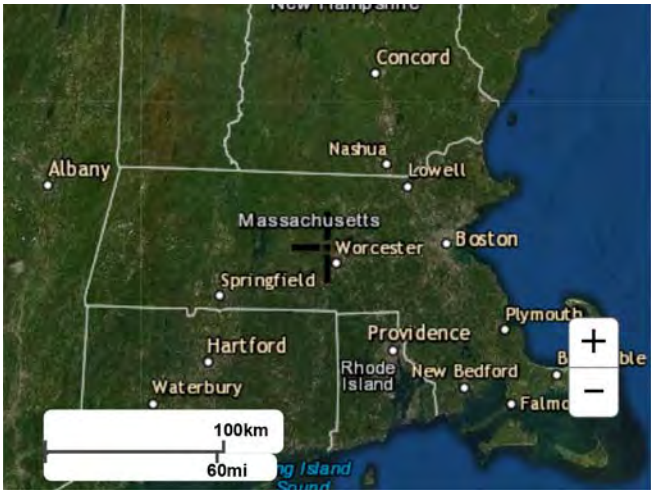
Large scale terrain



Large scale map



Large scale aerial



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National Weather Service
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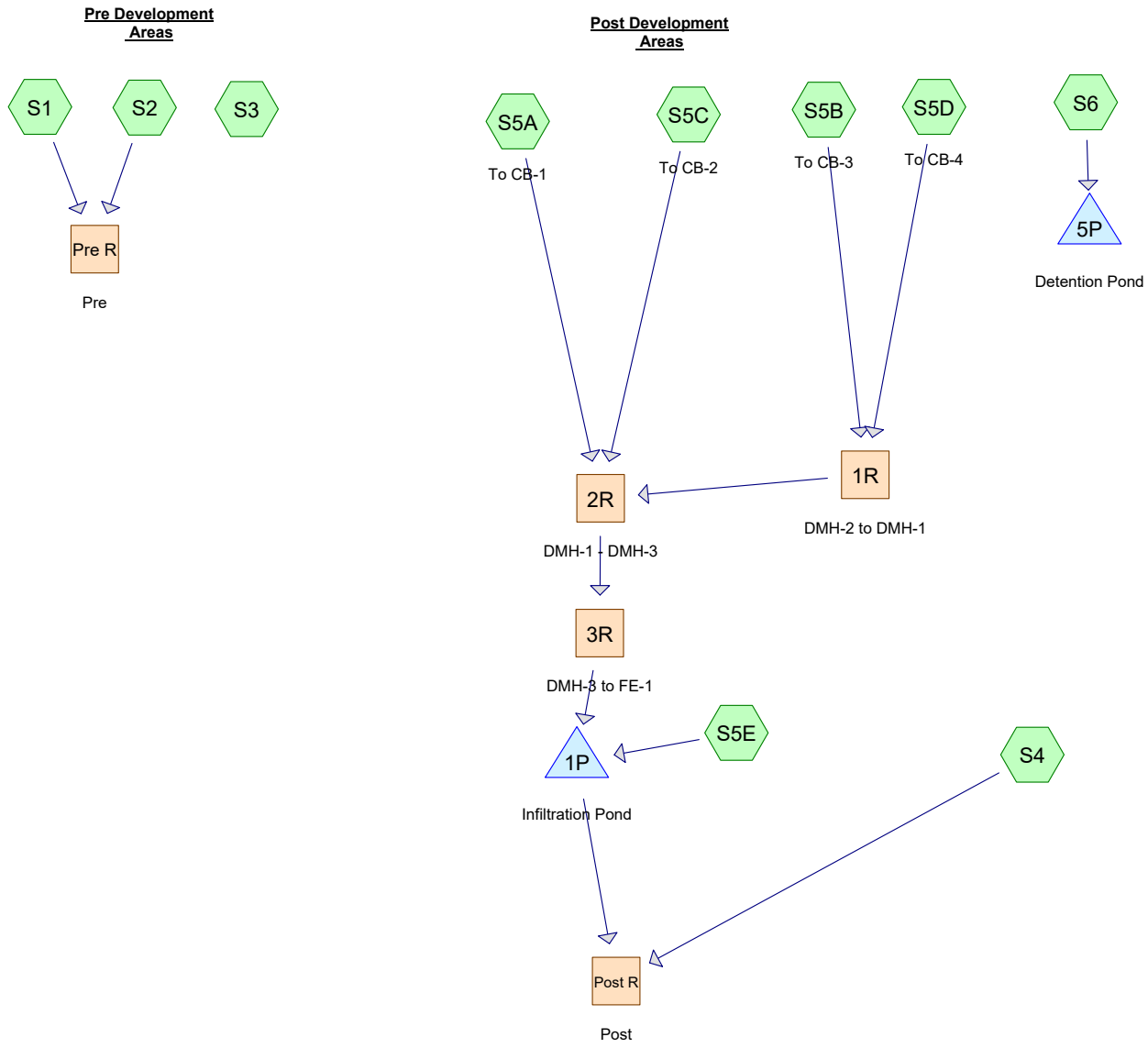


Subcat Reach Pond Link

Routing Diagram for Bailey Road HydroCAD 12-3-2020
Prepared by New England Environmental Design LLC, Printed 12/7/2020
HydroCAD® 10.00-26 s/n 02960 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
37,787	49	50-75% Grass cover, Fair, HSG A (S1, S2)
22,101	69	50-75% Grass cover, Fair, HSG B (S1)
175,675	39	>75% Grass cover, Good, HSG A (S4, S5A, S5B, S5C, S5D, S5E, S6)
7,386	61	>75% Grass cover, Good, HSG B (S4, S5A)
69,066	61	>75% Grass cover, Good, HSG B/D (S4, S5D, S5E, S6)
3,448	98	Driveway/Sidewalks (S5C)
1,730	98	Paved Driveway, HSG A (S5E)
18,706	98	Paved driveways, HSG A (S5A, S5B)
976	98	Paved driveways, HSG B (S5A)
5,365	98	Paved parking, HSG A (S1, S2)
965	98	Paved parking, HSG B (S1)
21,595	98	Paved roads w/curbs & sewers, HSG A (S5A, S5B, S5C)
1,186	98	Paved roads w/curbs & sewers, HSG B (S5A)
9,111	98	Pavement (S5D)
16,741	98	Roofs, HSG A (S1, S2, S5A, S5B, S5C, S5D, S5E, S6)
1,892	98	Roofs, HSG B/D (S5D, S6)
16,774	35	Stabilized Slope (S5A, S5B)
16,306	35	Stabilized Slope, HSG A (S6)
862	56	Stabilized Slope, HSG B (S6)
360,776	30	Woods, Good, HSG A (S1, S2, S3, S4, S5A, S5B, S6)
389,385	55	Woods, Good, HSG B (S1, S2, S3, S4, S5A, S5B, S6)
58,605	55	Woods, Good, HSG B/D (S1, S2, S6)
1,236,438	**48**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
654,681	HSG A	S1, S2, S3, S4, S5A, S5B, S5C, S5D, S5E, S6
552,424	HSG B	S1, S2, S3, S4, S5A, S5B, S5D, S5E, S6
0	HSG C	
0	HSG D	
29,333	Other	S5A, S5B, S5C, S5D
1,236,438		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
37,787	22,101	0	0	0	59,888	50-75% Grass cover, Fair
175,675	76,452	0	0	0	252,127	>75% Grass cover, Good
0	0	0	0	3,448	3,448	Driveway/Sidewalks
1,730	0	0	0	0	1,730	Paved Driveway
18,706	976	0	0	0	19,682	Paved driveways
5,365	965	0	0	0	6,330	Paved parking
21,595	1,186	0	0	0	22,781	Paved roads w/curbs & sewers
0	0	0	0	9,111	9,111	Pavement
16,741	1,892	0	0	0	18,633	Roofs
16,306	862	0	0	16,774	33,942	Stabilized Slope
360,776	447,990	0	0	0	808,766	Woods, Good
654,681	**552,424**	**0**	**0**	**29,333**	**1,236,438**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1R	777.16	774.61	169.7	0.0150	0.012	15.0	0.0	0.0
2	2R	773.50	771.00	125.4	0.0199	0.012	18.0	0.0	0.0
3	3R	770.90	770.25	28.7	0.0226	0.012	18.0	0.0	0.0
4	1P	768.50	766.00	60.0	0.0417	0.012	12.0	0.0	0.0
5	5P	769.00	768.00	43.0	0.0233	0.012	8.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Runoff Area=107,735 sf 6.87% Impervious Runoff Depth>0.16"
Flow Length=874' Tc=21.4 min CN=52 Runoff=0.09 cfs 1,472 cf

Subcatchment S2: Runoff Area=228,823 sf 0.96% Impervious Runoff Depth=0.00"
Flow Length=898' Tc=16.0 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment S3: Runoff Area=281,661 sf 0.00% Impervious Runoff Depth>0.04"
Flow Length=813' Tc=21.1 min CN=45 Runoff=0.03 cfs 932 cf

Subcatchment S4: Runoff Area=54,593 sf 0.00% Impervious Runoff Depth>0.21"
Flow Length=399' Tc=24.8 min CN=54 Runoff=0.08 cfs 967 cf

Subcatchment S5A: To CB-1 Runoff Area=106,072 sf 20.98% Impervious Runoff Depth>0.21"
Flow Length=430' Tc=8.7 min CN=54 Runoff=0.19 cfs 1,895 cf

Subcatchment S5B: To CB-3 Runoff Area=98,158 sf 23.03% Impervious Runoff Depth>0.27"
Flow Length=677' Tc=11.1 min CN=56 Runoff=0.26 cfs 2,199 cf

Subcatchment S5C: To CB-2 Runoff Area=17,240 sf 57.01% Impervious Runoff Depth>0.96"
Flow Length=210' Slope=0.0200 '/' Tc=6.8 min CN=73 Runoff=0.41 cfs 1,382 cf

Subcatchment S5D: To CB-4 Runoff Area=30,006 sf 35.64% Impervious Runoff Depth>0.43"
Flow Length=308' Tc=8.9 min CN=61 Runoff=0.19 cfs 1,076 cf

Subcatchment S5E: Runoff Area=33,823 sf 14.39% Impervious Runoff Depth>0.21"
Flow Length=118' Tc=3.7 min CN=54 Runoff=0.06 cfs 606 cf

Subcatchment S6: Runoff Area=278,327 sf 0.67% Impervious Runoff Depth>0.12"
Flow Length=668' Tc=17.4 min CN=50 Runoff=0.11 cfs 2,809 cf

Reach 1R: DMH-2 to DMH-1 Avg. Flow Depth=0.19' Max Vel=3.59 fps Inflow=0.41 cfs 3,275 cf
15.0" Round Pipe n=0.012 L=169.7' S=0.0150 '/' Capacity=8.58 cfs Outflow=0.41 cfs 3,271 cf

Reach 2R: DMH-1 - DMH-3 Avg. Flow Depth=0.23' Max Vel=4.71 fps Inflow=0.79 cfs 6,548 cf
18.0" Round Pipe n=0.012 L=125.4' S=0.0199 '/' Capacity=16.07 cfs Outflow=0.78 cfs 6,543 cf

Reach 3R: DMH-3 to FE-1 Avg. Flow Depth=0.22' Max Vel=4.92 fps Inflow=0.78 cfs 6,543 cf
18.0" Round Pipe n=0.012 L=28.7' S=0.0226 '/' Capacity=17.13 cfs Outflow=0.78 cfs 6,542 cf

Reach Post R: Post Inflow=0.08 cfs 967 cf
Outflow=0.08 cfs 967 cf

Reach Pre R: Pre Inflow=0.09 cfs 1,472 cf
Outflow=0.09 cfs 1,472 cf

Pond 1P: Infiltration Pond Peak Elev=770.61' Storage=2,789 cf Inflow=0.85 cfs 7,148 cf
Discarded=0.13 cfs 5,497 cf Primary=0.00 cfs 0 cf Outflow=0.13 cfs 5,497 cf

Pond 5P: Detention Pond Peak Elev=771.50' Storage=2,246 cf Inflow=0.11 cfs 2,809 cf
Outflow=0.02 cfs 563 cf

Total Runoff Area = 1,236,438 sf Runoff Volume = 13,337 cf Average Runoff Depth = 0.13"
93.39% Pervious = 1,154,723 sf 6.61% Impervious = 81,715 sf

Summary for Subcatchment S1:

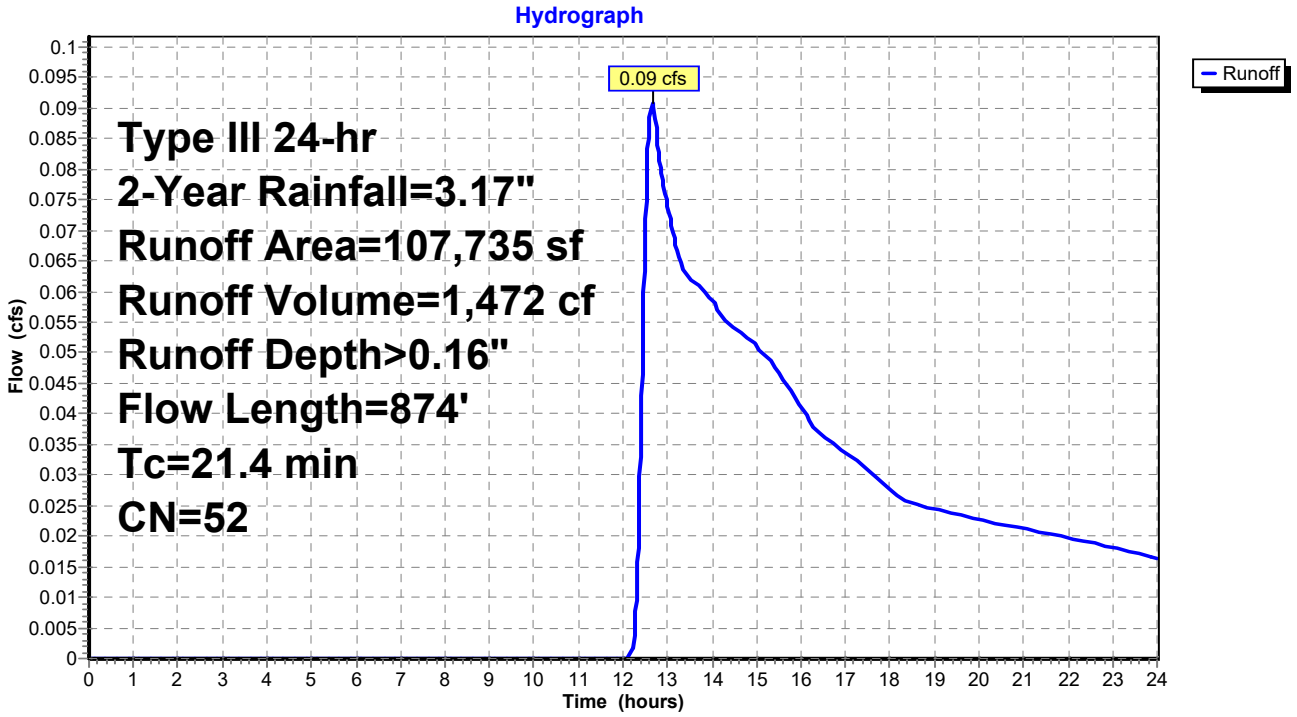
Runoff = 0.09 cfs @ 12.65 hrs, Volume= 1,472 cf, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
	35,273	30	Woods, Good, HSG A
	17,691	55	Woods, Good, HSG B
	3,254	98	Paved parking, HSG A
	965	98	Paved parking, HSG B
	3,183	98	Roofs, HSG A
	9,374	49	50-75% Grass cover, Fair, HSG A
	22,101	69	50-75% Grass cover, Fair, HSG B
*	15,894	55	Woods, Good, HSG B/D
	107,735	52	Weighted Average
	100,333		93.13% Pervious Area
	7,402		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1300	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.2	11	0.0370	0.96		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.2	96	0.0370	1.35		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	23	0.0860	2.05		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.6	49	0.0400	1.40		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	31	0.1290	2.51		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.6	47	0.0320	1.25		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.1	11	0.0280	3.40		**Shallow Concentrated Flow, Driveway** Paved Kv= 20.3 fps
3.2	161	0.0280	0.84		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
5.4	162	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	43	0.0900	1.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.2	83	0.0500	1.12		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.8	67	0.0800	1.41		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.3	40	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
21.4	874	Total			

Subcatchment S1:



Summary for Subcatchment S2:

[45] Hint: Runoff=Zero

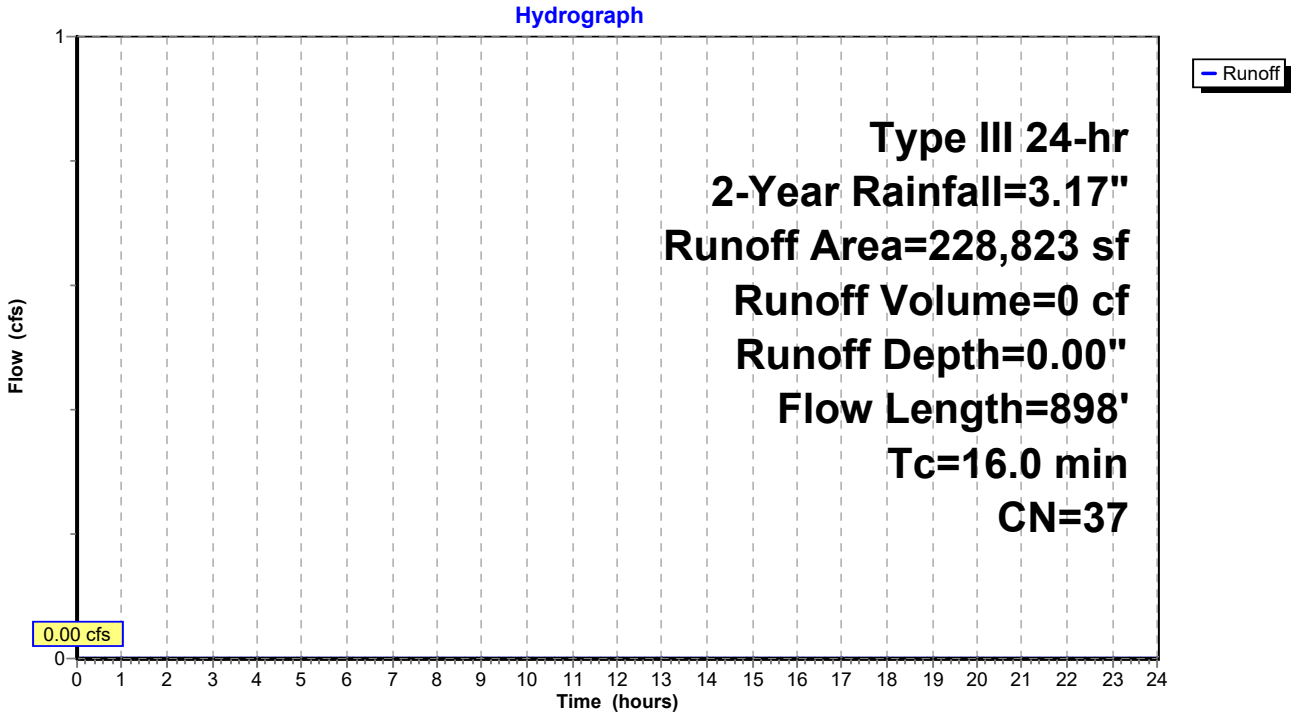
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
*	2,111	98	Paved parking, HSG A
	75	98	Roofs, HSG A
	28,413	49	50-75% Grass cover, Fair, HSG A
	3,550	55	Woods, Good, HSG B
	161,498	30	Woods, Good, HSG A
*	33,176	55	Woods, Good, HSG B/D
	228,823	37	Weighted Average
	226,637		99.04% Pervious Area
	2,186		0.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.1200	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.8	78	0.1150	1.70		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.0	110	0.1460	1.91		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.5	253	0.0570	1.19		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	71	0.1530	1.96		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.5	132	0.0920	1.52		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.5	204	0.0740	1.36		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
16.0	898	Total			

Subcatchment S2:



Summary for Subcatchment S3:

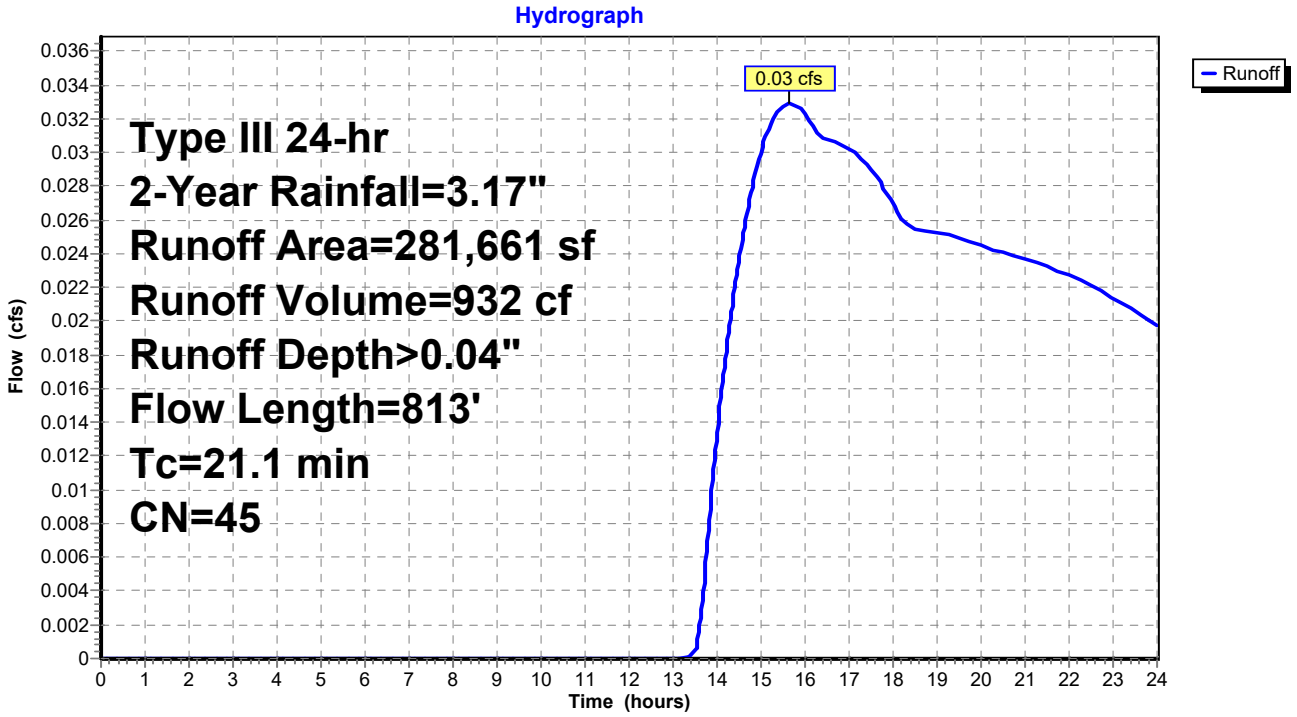
Runoff = 0.03 cfs @ 15.64 hrs, Volume= 932 cf, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

Area (sf)	CN	Description
166,040	55	Woods, Good, HSG B
115,621	30	Woods, Good, HSG A
281,661	45	Weighted Average
281,661		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.09		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.9	139	0.0570	1.19		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.0	112	0.0350	0.94		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.9	123	0.0110	0.52		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.1	266	0.0820	1.43		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	62	0.1940	2.20		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.7	61	0.0960	1.55		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
21.1	813	Total			

Subcatchment S3:



Summary for Subcatchment S4:

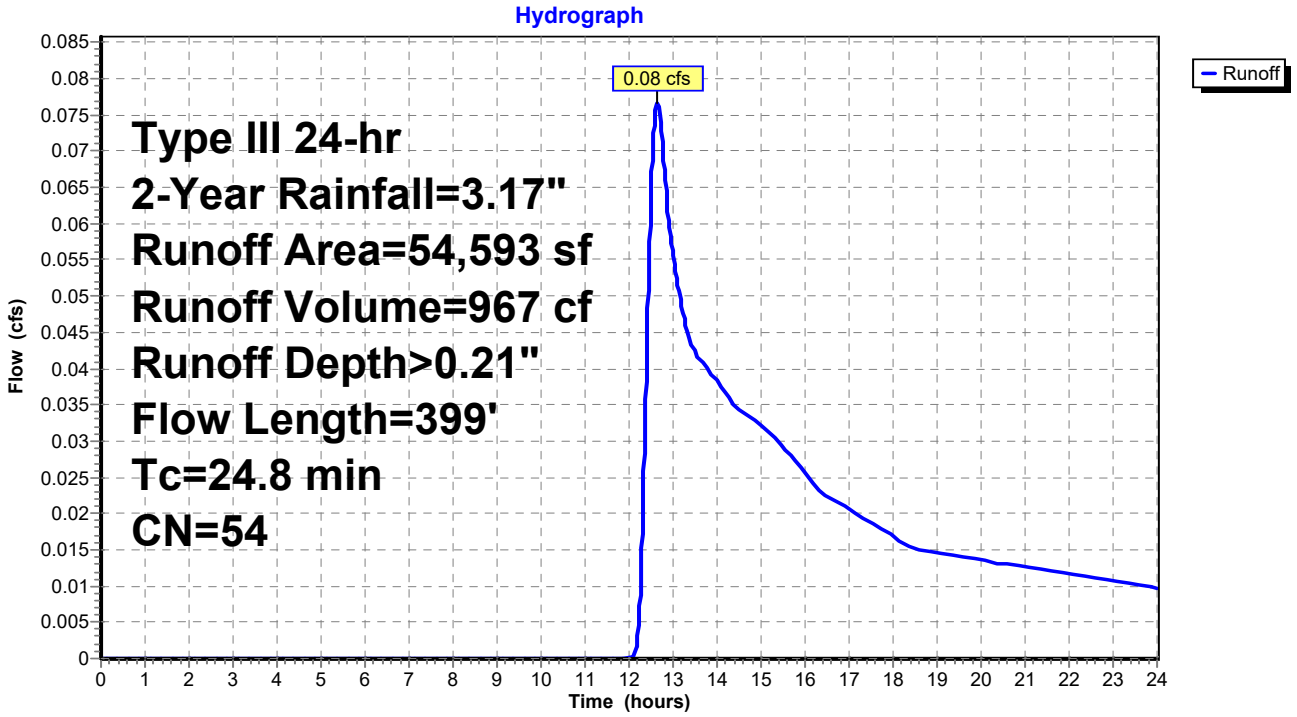
Runoff = 0.08 cfs @ 12.65 hrs, Volume= 967 cf, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG A
	0	98	Roofs, HSG A
	5,517	39	>75% Grass cover, Good, HSG A
*	38,812	61	>75% Grass cover, Good, HSG B/D
	1,862	39	>75% Grass cover, Good, HSG A
	804	61	>75% Grass cover, Good, HSG B
	3,792	30	Woods, Good, HSG A
	660	55	Woods, Good, HSG B
	3,146	30	Woods, Good, HSG A
	54,593	54	Weighted Average
	54,593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	13	0.0330	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
16.3	37	0.0220	0.04		**Sheet Flow, Woodland** Woods: Dense underbrush n= 0.800 P2= 3.17"
2.0	87	0.0220	0.74		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.1	87	0.0700	1.32		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	42	0.0500	1.12		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	56	0.1000	1.58		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.6	77	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
24.8	399	Total			

Subcatchment S4:



Summary for Subcatchment S5A: To CB-1

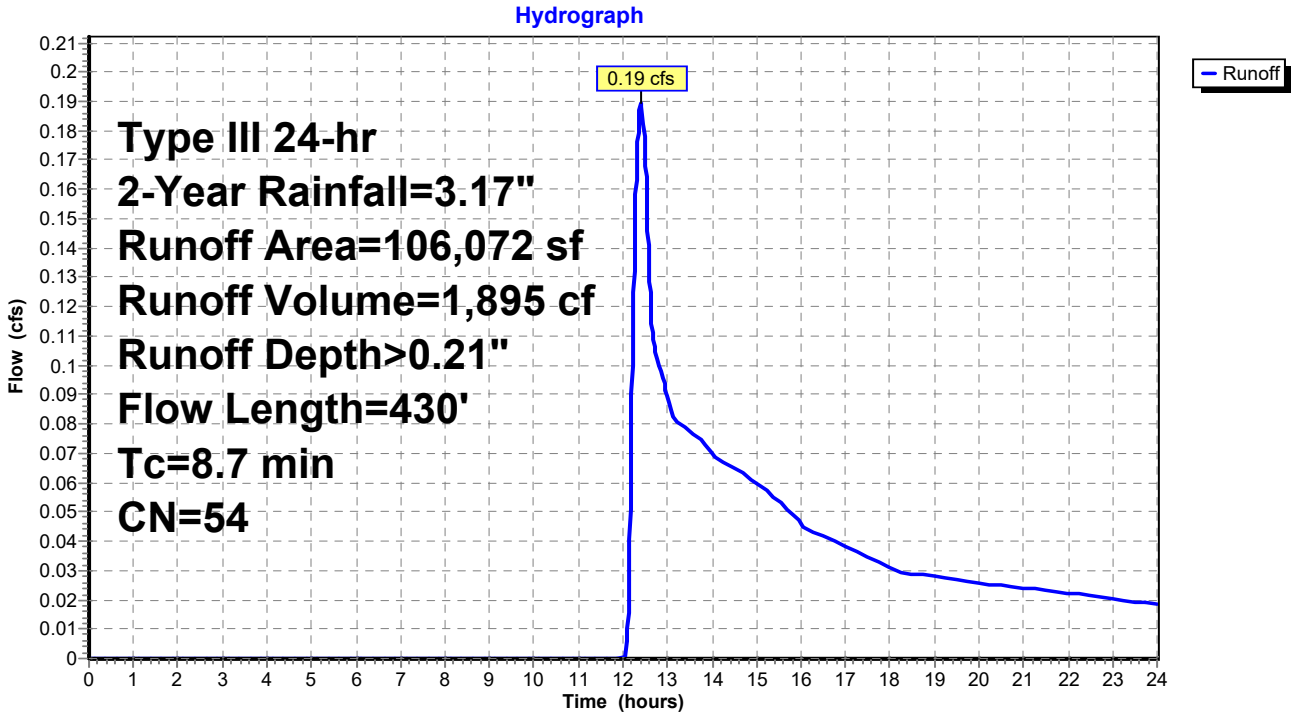
Runoff = 0.19 cfs @ 12.40 hrs, Volume= 1,895 cf, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
	7,784	30	Woods, Good, HSG A
	11,369	55	Woods, Good, HSG B
*	5,689	98	Paved driveways, HSG A
	10,716	98	Paved roads w/curbs & sewers, HSG A
*	976	98	Paved driveways, HSG B
	1,186	98	Paved roads w/curbs & sewers, HSG B
	3,690	98	Roofs, HSG A
*	2,354	35	Stabilized Slope
	55,726	39	>75% Grass cover, Good, HSG A
	6,582	61	>75% Grass cover, Good, HSG B
	106,072	54	Weighted Average
	83,815		79.02% Pervious Area
	22,257		20.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	10	0.0900	0.09		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.3	21	0.3330	0.26		**Sheet Flow, Vegetated Slope** Grass: Dense n= 0.240 P2= 3.17"
1.6	19	0.0650	0.19		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
3.0	235	0.0350	1.31		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.0	11	0.3330	4.04		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	13	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.7	121	0.0200	2.87		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
8.7	430	Total			

Subcatchment S5A: To CB-1



Summary for Subcatchment S5B: To CB-3

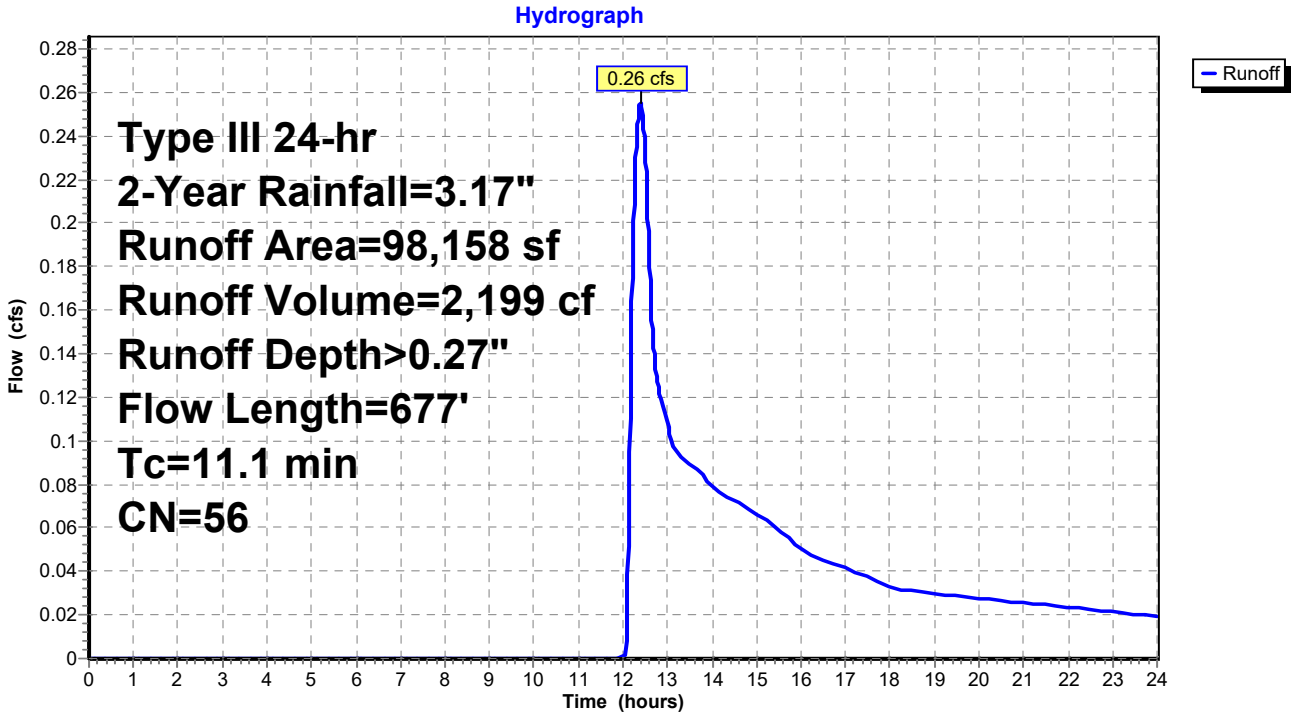
Runoff = 0.26 cfs @ 12.39 hrs, Volume= 2,199 cf, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
	5,935	30	Woods, Good, HSG A
	24,836	55	Woods, Good, HSG B
*	13,017	98	Paved driveways, HSG A
	6,146	98	Paved roads w/curbs & sewers, HSG A
	3,445	98	Roofs, HSG A
*	14,420	35	Stabilized Slope
	30,359	39	>75% Grass cover, Good, HSG A
	98,158	56	Weighted Average
	75,550		76.97% Pervious Area
	22,608		23.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1250	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.8	78	0.1180	1.72		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	73	0.2250	2.37		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.4	47	0.1250	1.77		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.2	54	0.3300	4.02		**Shallow Concentrated Flow, Vegetated Slope** Short Grass Pasture Kv= 7.0 fps
1.5	142	0.0520	1.60		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0200	2.87		**Shallow Concentrated Flow, Sidewalk** Paved Kv= 20.3 fps
0.1	7	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
1.6	222	0.0130	2.31		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
11.1	677	Total			

Subcatchment S5B: To CB-3



Summary for Subcatchment S5C: To CB-2

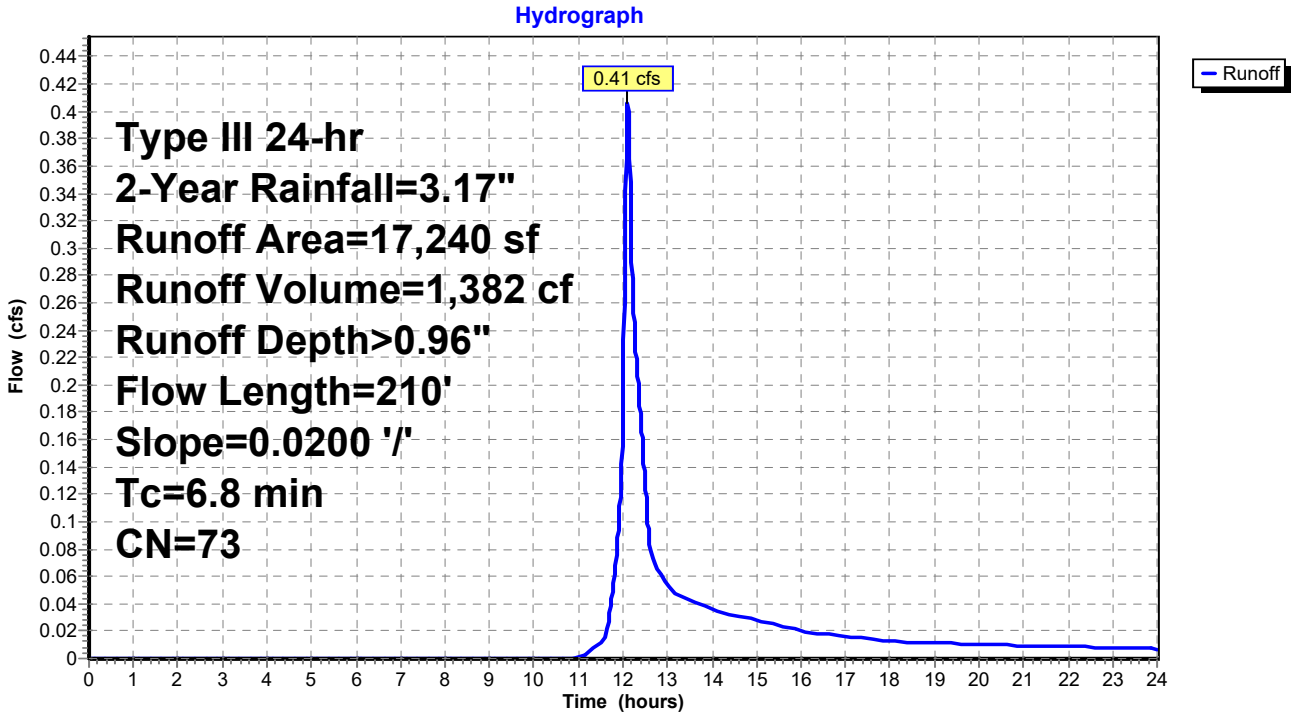
Runoff = 0.41 cfs @ 12.11 hrs, Volume= 1,382 cf, Depth> 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
*	3,448	98	Driveway/Sidewalks
	4,733	98	Paved roads w/curbs & sewers, HSG A
	1,648	98	Roofs, HSG A
	7,411	39	>75% Grass cover, Good, HSG A
	17,240	73	Weighted Average
	7,411		42.99% Pervious Area
	9,829		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	38	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.1	4	0.0200	0.72		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 3.17"
1.3	8	0.0200	0.10		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.9	160	0.0200	2.87		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
6.8	210	Total			

Subcatchment S5C: To CB-2



Summary for Subcatchment S5D: To CB-4

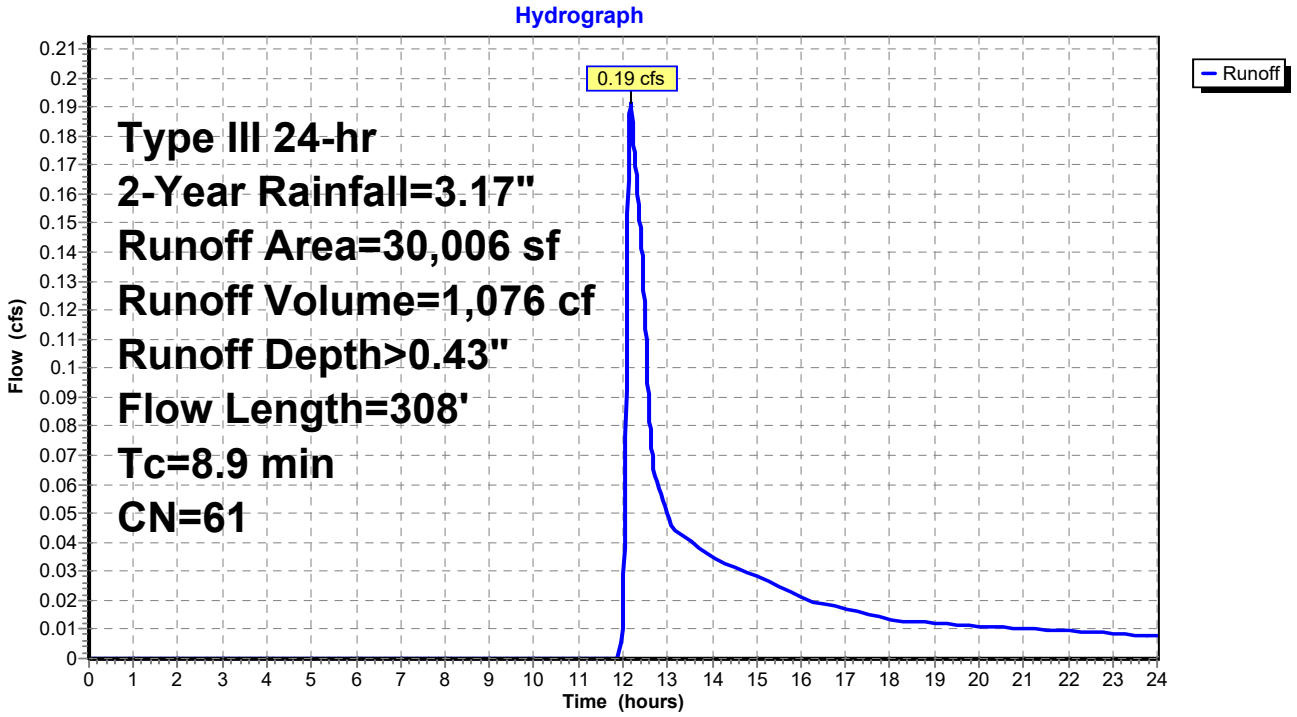
Runoff = 0.19 cfs @ 12.17 hrs, Volume= 1,076 cf, Depth> 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
	626	98	Roofs, HSG A
*	956	98	Roofs, HSG B/D
	17,834	39	>75% Grass cover, Good, HSG A
*	425	61	>75% Grass cover, Good, HSG B/D
*	1,054	61	>75% Grass cover, Good, HSG B/D
*	9,111	98	Pavement
	30,006	61	Weighted Average
	19,313		64.36% Pervious Area
	10,693		35.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	45	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.1	4	0.0200	0.72		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.17"
0.1	7	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
1.8	252	0.0130	2.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
8.9	308	Total			

Subcatchment S5D: To CB-4



Summary for Subcatchment S5E:

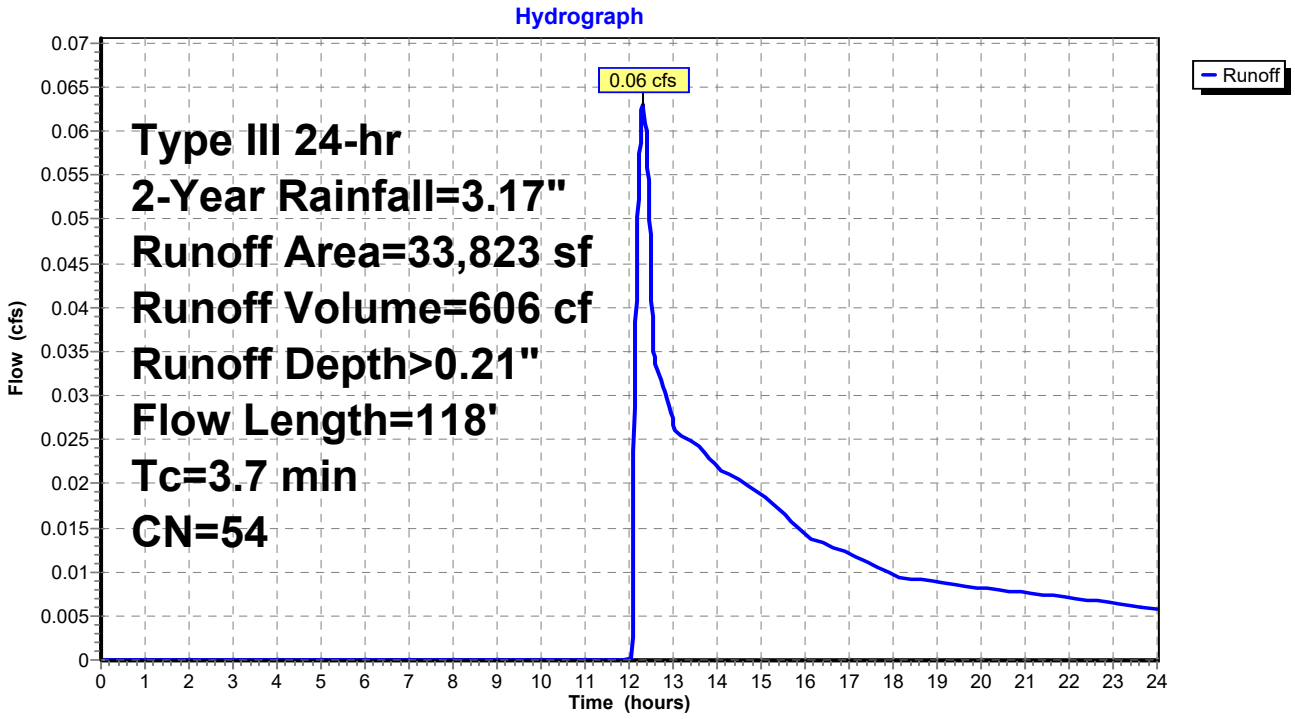
Runoff = 0.06 cfs @ 12.32 hrs, Volume= 606 cf, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
*	1,730	98	Paved Driveway, HSG A
	3,138	98	Roofs, HSG A
	19,630	39	>75% Grass cover, Good, HSG A
*	9,325	61	>75% Grass cover, Good, HSG B/D
	33,823	54	Weighted Average
	28,955		85.61% Pervious Area
	4,868		14.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.0890	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.6	68	0.0780	1.95		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
3.7	118	Total			

Subcatchment S5E:



Summary for Subcatchment S6:

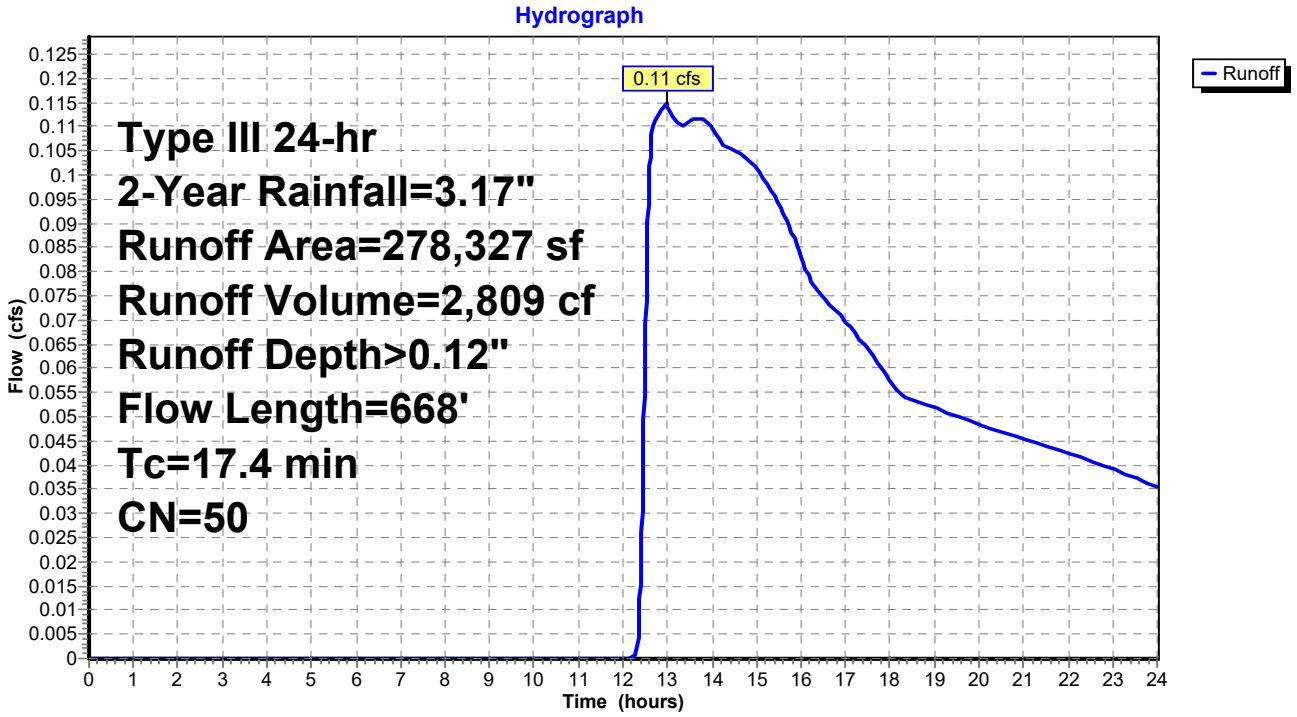
Runoff = 0.11 cfs @ 12.97 hrs, Volume= 2,809 cf, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.17"

	Area (sf)	CN	Description
	165,239	55	Woods, Good, HSG B
	27,727	30	Woods, Good, HSG A
*	9,535	55	Woods, Good, HSG B/D
*	862	56	Stabilized Slope, HSG B
*	16,306	35	Stabilized Slope, HSG A
	936	98	Roofs, HSG A
*	936	98	Roofs, HSG B/D
	37,336	39	>75% Grass cover, Good, HSG A
*	19,450	61	>75% Grass cover, Good, HSG B/D
	278,327	50	Weighted Average
	276,455		99.33% Pervious Area
	1,872		0.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.6	134	0.0740	1.36		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.0	112	0.0350	0.94		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.9	104	0.1340	1.83		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.8	70	0.0850	1.46		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.2	39	0.3150	3.93		**Shallow Concentrated Flow, Vegitated Slope** Short Grass Pasture Kv= 7.0 fps
4.8	159	0.0250	0.55	3.29	**Channel Flow, Grass Swale** Area= 6.0 sf Perim= 324.0' r= 0.02' n= 0.030 Earth, grassed & winding
17.4	668	Total			

Subcatchment S6:



Summary for Reach 1R: DMH-2 to DMH-1

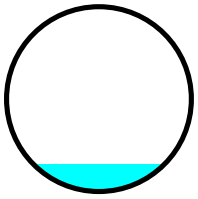
[52] Hint: Inlet/Outlet conditions not evaluated

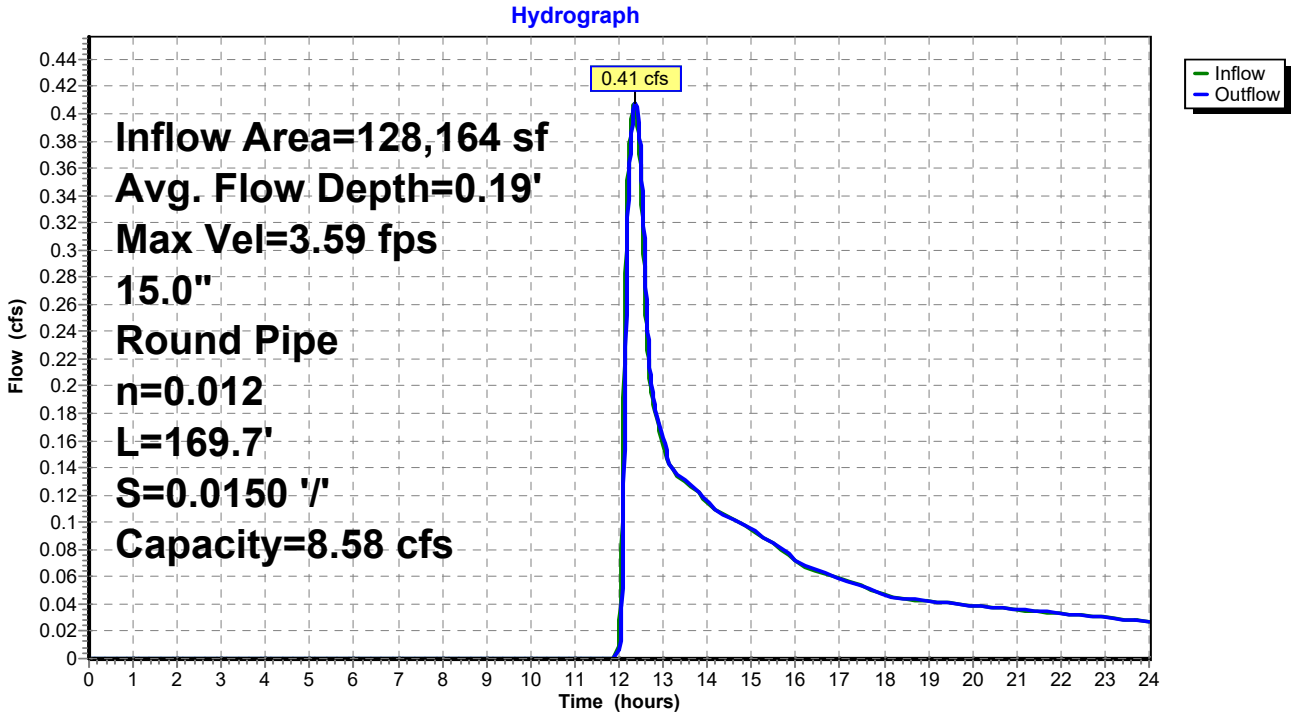
Inflow Area = 128,164 sf, 25.98% Impervious, Inflow Depth > 0.31" for 2-Year event
Inflow = 0.41 cfs @ 12.35 hrs, Volume= 3,275 cf
Outflow = 0.41 cfs @ 12.37 hrs, Volume= 3,271 cf, Atten= 0%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.59 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.04 fps, Avg. Travel Time= 1.4 min

Peak Storage= 19 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 8.58 cfs

15.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 169.7' Slope= 0.0150 '/'
Inlet Invert= 777.16', Outlet Invert= 774.61'





Summary for Reach 2R: DMH-1 - DMH-3

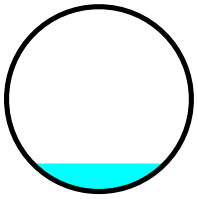
[52] Hint: Inlet/Outlet conditions not evaluated

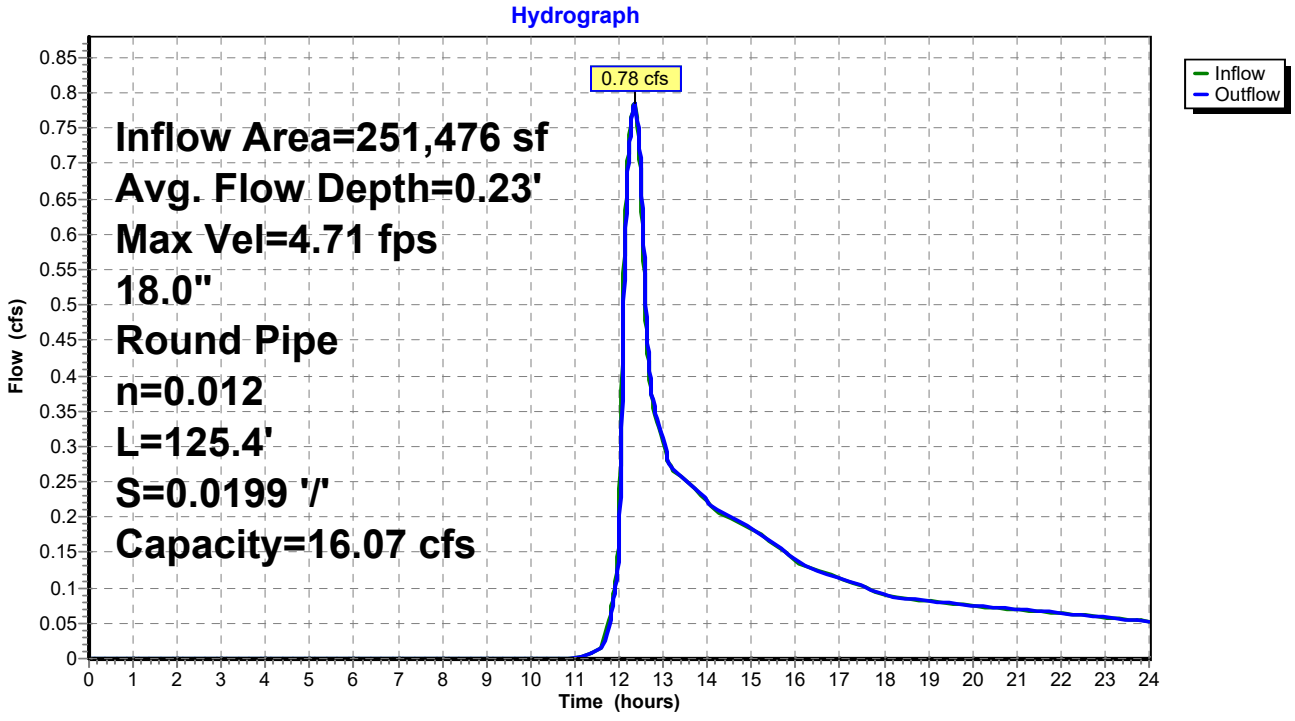
Inflow Area = 251,476 sf, 26.00% Impervious, Inflow Depth > 0.31" for 2-Year event
Inflow = 0.79 cfs @ 12.34 hrs, Volume= 6,548 cf
Outflow = 0.78 cfs @ 12.36 hrs, Volume= 6,543 cf, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.71 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.59 fps, Avg. Travel Time= 0.8 min

Peak Storage= 21 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.07 cfs

18.0" Round Pipe
n= 0.012
Length= 125.4' Slope= 0.0199 '/'
Inlet Invert= 773.50', Outlet Invert= 771.00'





Summary for Reach 3R: DMH-3 to FE-1

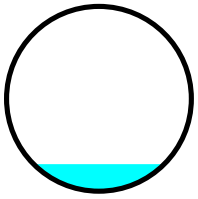
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach 2R outlet invert by 0.12' @ 12.36 hrs

Inflow Area = 251,476 sf, 26.00% Impervious, Inflow Depth > 0.31" for 2-Year event
Inflow = 0.78 cfs @ 12.36 hrs, Volume= 6,543 cf
Outflow = 0.78 cfs @ 12.36 hrs, Volume= 6,542 cf, Atten= 0%, Lag= 0.2 min

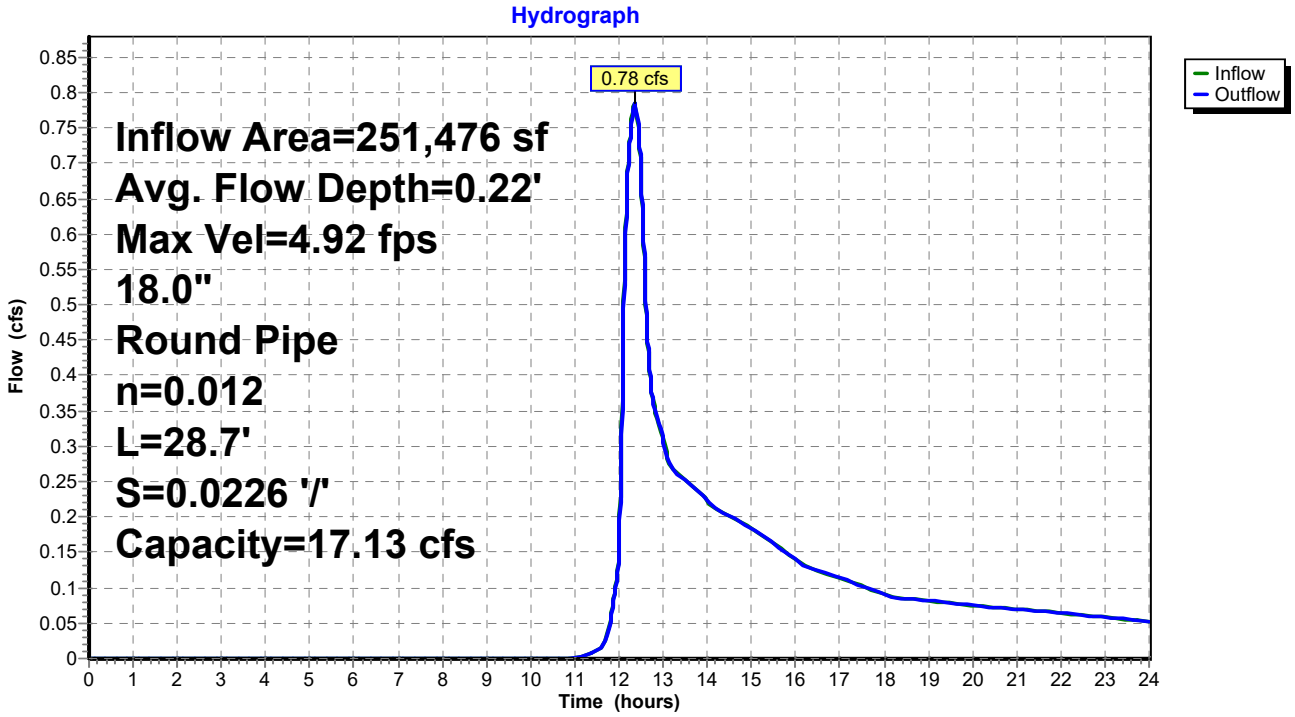
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.92 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.71 fps, Avg. Travel Time= 0.2 min

Peak Storage= 5 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.13 cfs

18.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 28.7' Slope= 0.0226 '/'
Inlet Invert= 770.90', Outlet Invert= 770.25'



Reach 3R: DMH-3 to FE-1



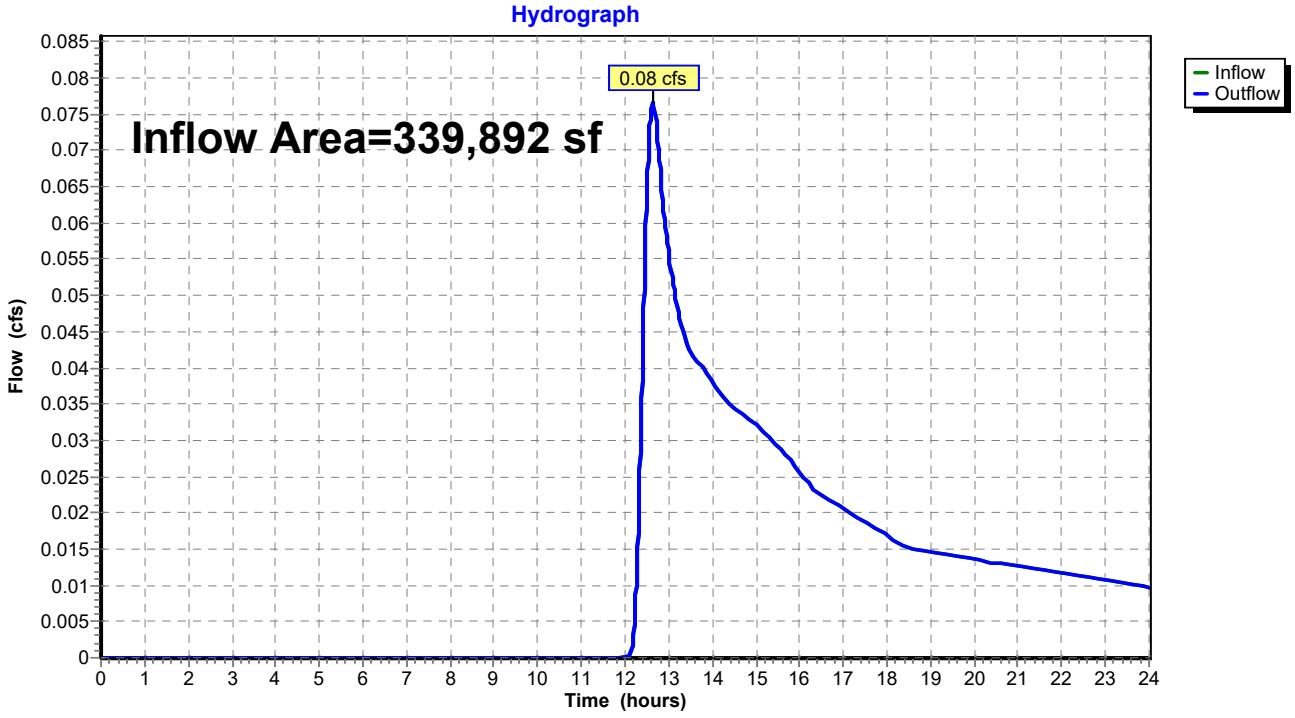
Summary for Reach Post R: Post

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 339,892 sf, 20.67% Impervious, Inflow Depth > 0.03" for 2-Year event
Inflow = 0.08 cfs @ 12.65 hrs, Volume= 967 cf
Outflow = 0.08 cfs @ 12.65 hrs, Volume= 967 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach Post R: Post



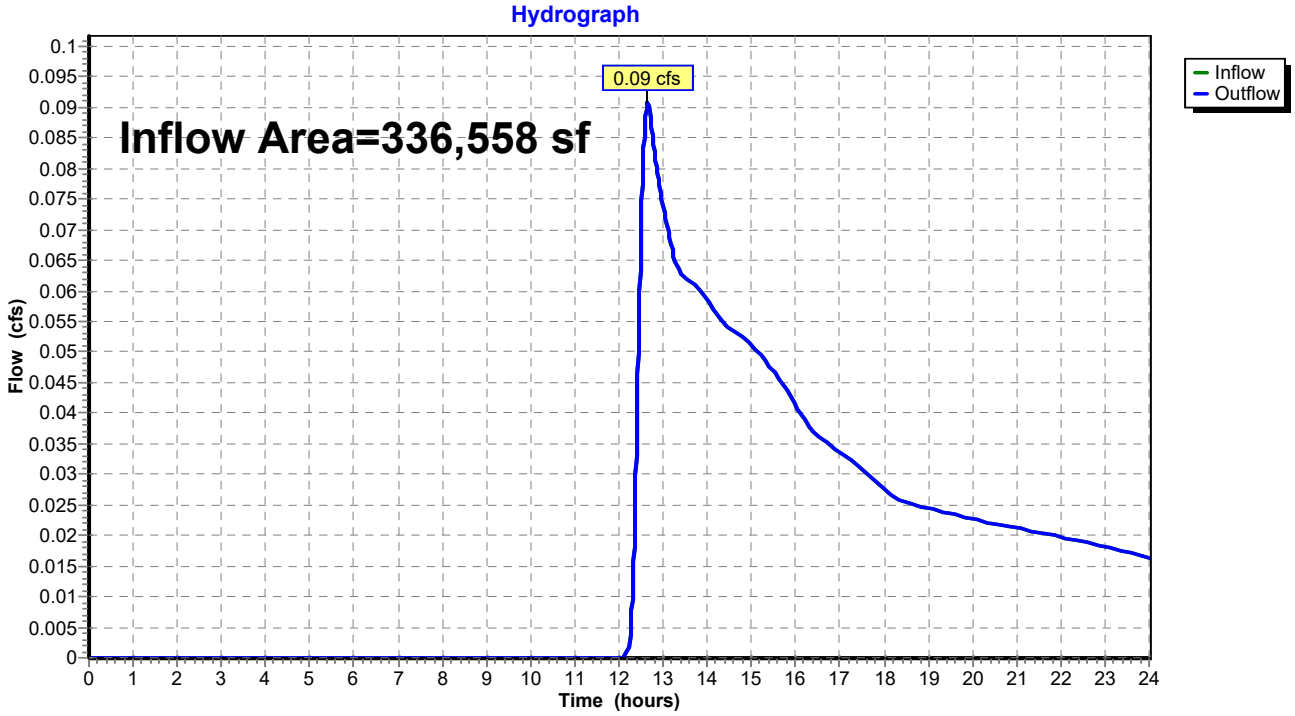
Summary for Reach Pre R: Pre

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 336,558 sf, 2.85% Impervious, Inflow Depth > 0.05" for 2-Year event
Inflow = 0.09 cfs @ 12.65 hrs, Volume= 1,472 cf
Outflow = 0.09 cfs @ 12.65 hrs, Volume= 1,472 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach Pre R: Pre



Summary for Pond 1P: Infiltration Pond

[62] Hint: Exceeded Reach 3R OUTLET depth by 0.27' @ 17.20 hrs

Inflow Area = 285,299 sf, 24.63% Impervious, Inflow Depth > 0.30" for 2-Year event
Inflow = 0.85 cfs @ 12.36 hrs, Volume= 7,148 cf
Outflow = 0.13 cfs @ 16.69 hrs, Volume= 5,497 cf, Atten= 84%, Lag= 260.1 min
Discarded = 0.13 cfs @ 16.69 hrs, Volume= 5,497 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 770.61' @ 16.69 hrs Surf.Area= 4,953 sf Storage= 2,789 cf

Plug-Flow detention time= 237.8 min calculated for 5,494 cf (77% of inflow)
Center-of-Mass det. time= 144.3 min (1,080.6 - 936.2)

Volume	Invert	Avail.Storage	Storage Description
#1	770.00'	36,585 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

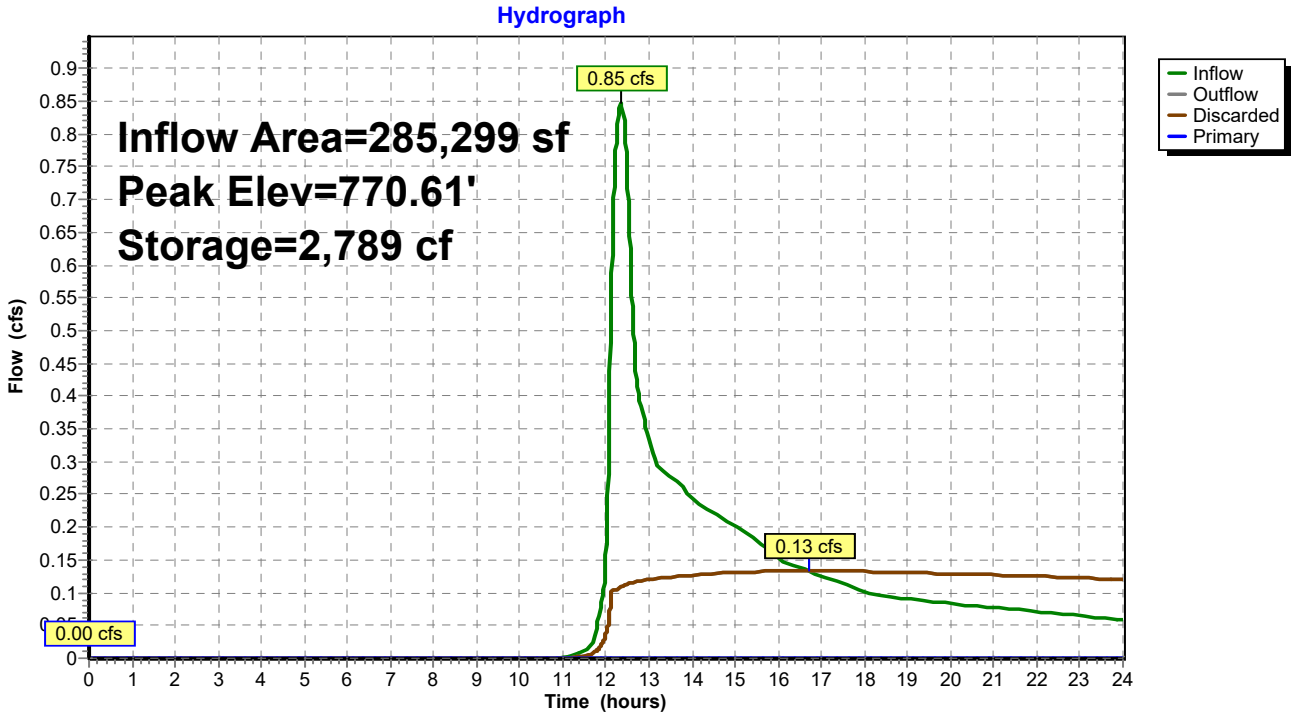
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
770.00	4,236	0	0
770.50	4,825	2,265	2,265
770.75	5,124	1,244	3,509
771.00	5,427	1,319	4,828
772.00	6,675	6,051	10,879
774.00	9,340	16,015	26,894
775.00	10,042	9,691	36,585

Device	Routing	Invert	Outlet Devices
#1	Primary	768.50'	**12.0" Round 12" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 768.50' / 766.00' S= 0.0417 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	773.90'	**48.0" x 48.0" Horiz. 48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	770.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 766.00'
#4	Device 1	772.00'	**0.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#5	Primary	774.00'	**10.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.13 cfs @ 16.69 hrs HW=770.61' (Free Discharge)
└**3=Exfiltration** (Controls 0.13 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=770.00' (Free Discharge)
└**1=12" Round Culvert** (Passes 0.00 cfs of 3.78 cfs potential flow)
└**2=48.0" x 48.0" Horiz. Orifice/Grate** (Controls 0.00 cfs)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Infiltration Pond



Summary for Pond 5P: Detention Pond

Inflow Area = 278,327 sf, 0.67% Impervious, Inflow Depth > 0.12" for 2-Year event
Inflow = 0.11 cfs @ 12.97 hrs, Volume= 2,809 cf
Outflow = 0.02 cfs @ 24.00 hrs, Volume= 563 cf, Atten= 84%, Lag= 661.6 min
Primary = 0.02 cfs @ 24.00 hrs, Volume= 563 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 771.50' @ 24.00 hrs Surf.Area= 4,691 sf Storage= 2,246 cf

Plug-Flow detention time= 362.3 min calculated for 562 cf (20% of inflow)
Center-of-Mass det. time= 134.3 min (1,153.1 - 1,018.8)

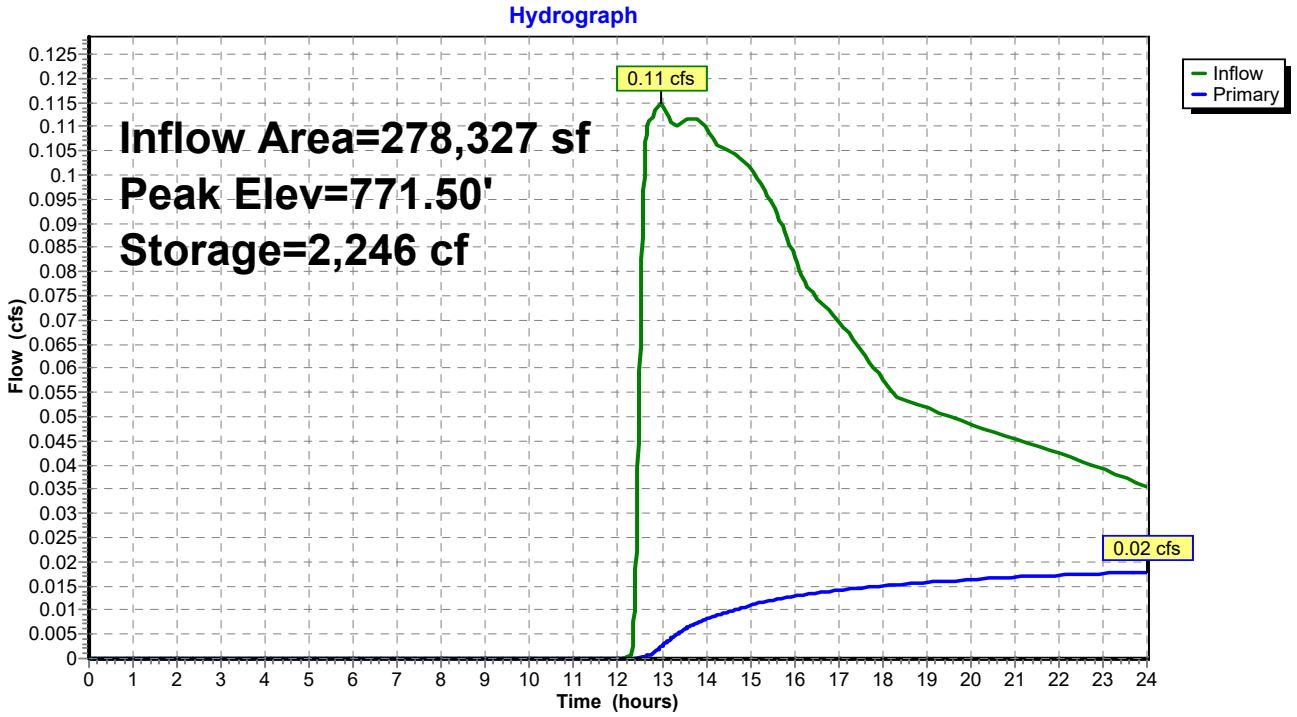
Volume	Invert	Avail.Storage	Storage Description
#1	771.00'	17,096 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
771.00	4,208	0	0
772.00	5,164	4,686	4,686
774.00	7,246	12,410	17,096

Device	Routing	Invert	Outlet Devices
#1	Primary	769.00'	**8.0" Round Culvert** L= 43.0' Ke= 0.500 Inlet / Outlet Invert= 769.00' / 768.00' S= 0.0233 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	771.00'	**1.0" Vert. Orifice/Grate** X 4 rows with 6.3" cc spacing C= 0.600
#3	Device 1	771.50'	**1.0" Vert. Orifice/Grate** X 4 rows with 6.3" cc spacing C= 0.600
#4	Device 1	772.00'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	773.00'	**10.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.02 cfs @ 24.00 hrs HW=771.50' (Free Discharge)
- **1=Culvert** (Passes 0.02 cfs of 2.48 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 3.28 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.24 fps)
  - **4=Orifice/Grate** (Controls 0.00 cfs)
- **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Detention Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Runoff Area=107,735 sf 6.87% Impervious Runoff Depth>0.74"
Flow Length=874' Tc=21.4 min CN=52 Runoff=1.00 cfs 6,684 cf

Subcatchment S2: Runoff Area=228,823 sf 0.96% Impervious Runoff Depth>0.12"
Flow Length=898' Tc=16.0 min CN=37 Runoff=0.08 cfs 2,211 cf

Subcatchment S3: Runoff Area=281,661 sf 0.00% Impervious Runoff Depth>0.40"
Flow Length=813' Tc=21.1 min CN=45 Runoff=0.94 cfs 9,401 cf

Subcatchment S4: Runoff Area=54,593 sf 0.00% Impervious Runoff Depth>0.86"
Flow Length=399' Tc=24.8 min CN=54 Runoff=0.60 cfs 3,890 cf

Subcatchment S5A: To CB-1 Runoff Area=106,072 sf 20.98% Impervious Runoff Depth>0.86"
Flow Length=430' Tc=8.7 min CN=54 Runoff=1.68 cfs 7,603 cf

Subcatchment S5B: To CB-3 Runoff Area=98,158 sf 23.03% Impervious Runoff Depth>0.98"
Flow Length=677' Tc=11.1 min CN=56 Runoff=1.74 cfs 7,990 cf

Subcatchment S5C: To CB-2 Runoff Area=17,240 sf 57.01% Impervious Runoff Depth>2.18"
Flow Length=210' Slope=0.0200 '/' Tc=6.8 min CN=73 Runoff=0.98 cfs 3,137 cf

Subcatchment S5D: To CB-4 Runoff Area=30,006 sf 35.64% Impervious Runoff Depth>1.29"
Flow Length=308' Tc=8.9 min CN=61 Runoff=0.85 cfs 3,237 cf

Subcatchment S5E: Runoff Area=33,823 sf 14.39% Impervious Runoff Depth>0.86"
Flow Length=118' Tc=3.7 min CN=54 Runoff=0.65 cfs 2,429 cf

Subcatchment S6: Runoff Area=278,327 sf 0.67% Impervious Runoff Depth>0.64"
Flow Length=668' Tc=17.4 min CN=50 Runoff=2.14 cfs 14,833 cf

Reach 1R: DMH-2 to DMH-1 Avg. Flow Depth=0.47' Max Vel=6.09 fps Inflow=2.55 cfs 11,227 cf
15.0" Round Pipe n=0.012 L=169.7' S=0.0150 '/' Capacity=8.58 cfs Outflow=2.55 cfs 11,220 cf

Reach 2R: DMH-1 - DMH-3 Avg. Flow Depth=0.57' Max Vel=8.02 fps Inflow=4.98 cfs 21,960 cf
18.0" Round Pipe n=0.012 L=125.4' S=0.0199 '/' Capacity=16.07 cfs Outflow=4.98 cfs 21,952 cf

Reach 3R: DMH-3 to FE-1 Avg. Flow Depth=0.55' Max Vel=8.40 fps Inflow=4.98 cfs 21,952 cf
18.0" Round Pipe n=0.012 L=28.7' S=0.0226 '/' Capacity=17.13 cfs Outflow=4.98 cfs 21,950 cf

Reach Post R: Post Inflow=0.60 cfs 7,640 cf
Outflow=0.60 cfs 7,640 cf

Reach Pre R: Pre Inflow=1.00 cfs 8,895 cf
Outflow=1.00 cfs 8,895 cf

Pond 1P: Infiltration Pond Peak Elev=772.30' Storage=12,944 cf Inflow=5.41 cfs 24,379 cf
Discarded=0.24 cfs 9,908 cf Primary=0.24 cfs 3,750 cf Outflow=0.48 cfs 13,658 cf

Pond 5P: Detention Pond Peak Elev=772.16' Storage=5,511 cf Inflow=2.14 cfs 14,833 cf
Outflow=0.51 cfs 9,946 cf

Total Runoff Area = 1,236,438 sf Runoff Volume = 61,416 cf Average Runoff Depth = 0.60"
93.39% Pervious = 1,154,723 sf 6.61% Impervious = 81,715 sf

Summary for Subcatchment S1:

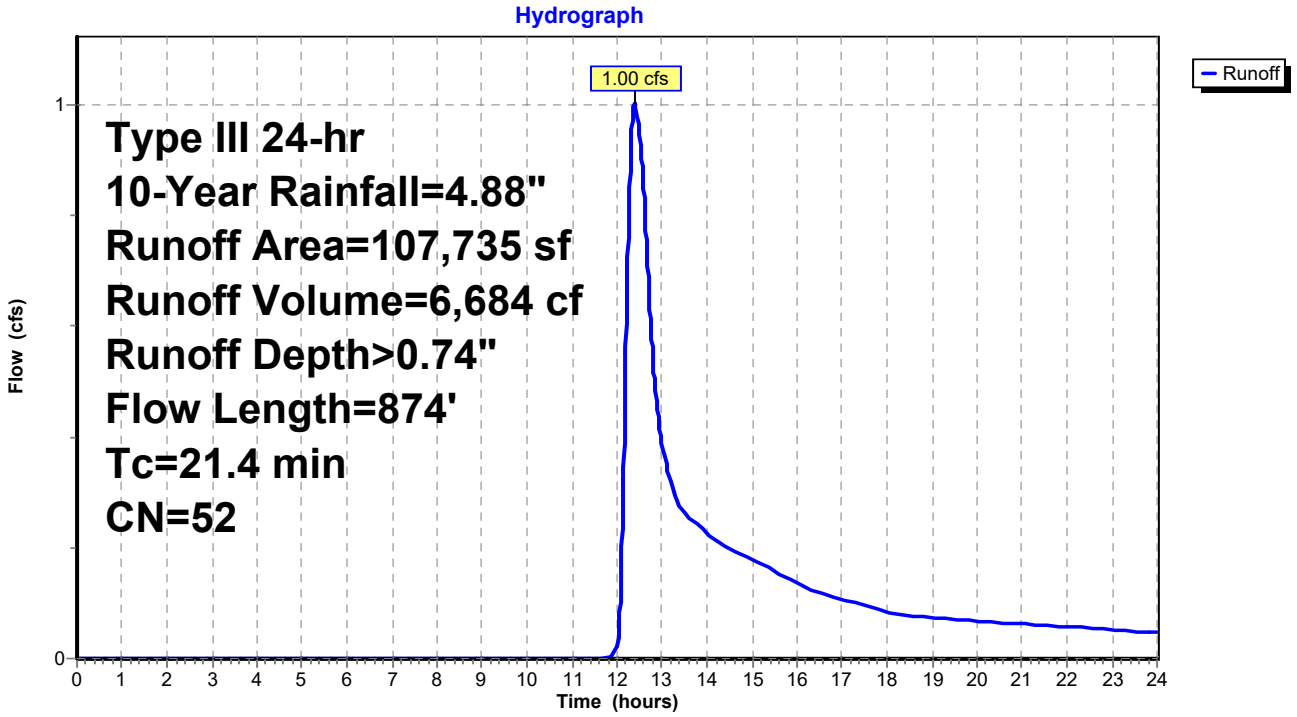
Runoff = 1.00 cfs @ 12.39 hrs, Volume= 6,684 cf, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	35,273	30	Woods, Good, HSG A
	17,691	55	Woods, Good, HSG B
	3,254	98	Paved parking, HSG A
	965	98	Paved parking, HSG B
	3,183	98	Roofs, HSG A
	9,374	49	50-75% Grass cover, Fair, HSG A
	22,101	69	50-75% Grass cover, Fair, HSG B
*	15,894	55	Woods, Good, HSG B/D
	107,735	52	Weighted Average
	100,333		93.13% Pervious Area
	7,402		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1300	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.2	11	0.0370	0.96		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.2	96	0.0370	1.35		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	23	0.0860	2.05		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.6	49	0.0400	1.40		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	31	0.1290	2.51		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.6	47	0.0320	1.25		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.1	11	0.0280	3.40		**Shallow Concentrated Flow, Driveway** Paved Kv= 20.3 fps
3.2	161	0.0280	0.84		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
5.4	162	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	43	0.0900	1.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.2	83	0.0500	1.12		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.8	67	0.0800	1.41		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.3	40	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
21.4	874	Total			

Subcatchment S1:



Summary for Subcatchment S2:

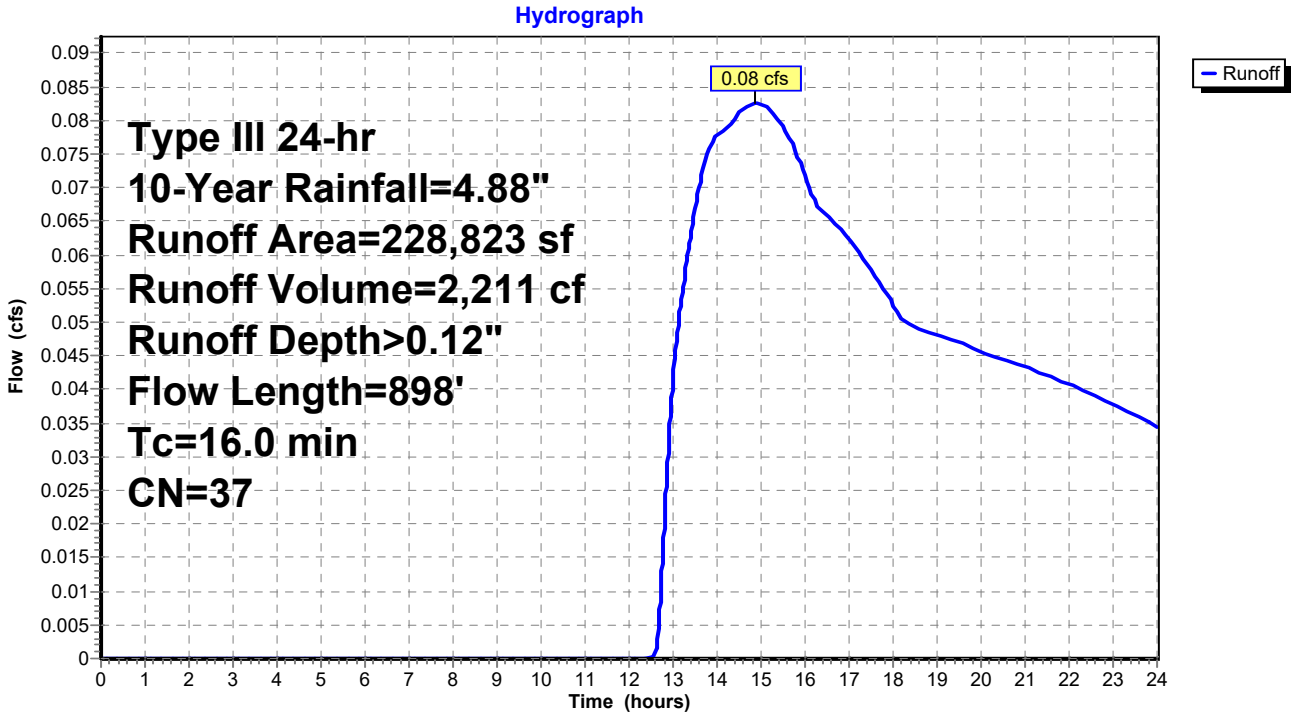
Runoff = 0.08 cfs @ 14.88 hrs, Volume= 2,211 cf, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	2,111	98	Paved parking, HSG A
	75	98	Roofs, HSG A
	28,413	49	50-75% Grass cover, Fair, HSG A
	3,550	55	Woods, Good, HSG B
	161,498	30	Woods, Good, HSG A
*	33,176	55	Woods, Good, HSG B/D
	228,823	37	Weighted Average
	226,637		99.04% Pervious Area
	2,186		0.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.1200	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.8	78	0.1150	1.70		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.0	110	0.1460	1.91		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.5	253	0.0570	1.19		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	71	0.1530	1.96		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.5	132	0.0920	1.52		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.5	204	0.0740	1.36		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
16.0	898	Total			

Subcatchment S2:



Summary for Subcatchment S3:

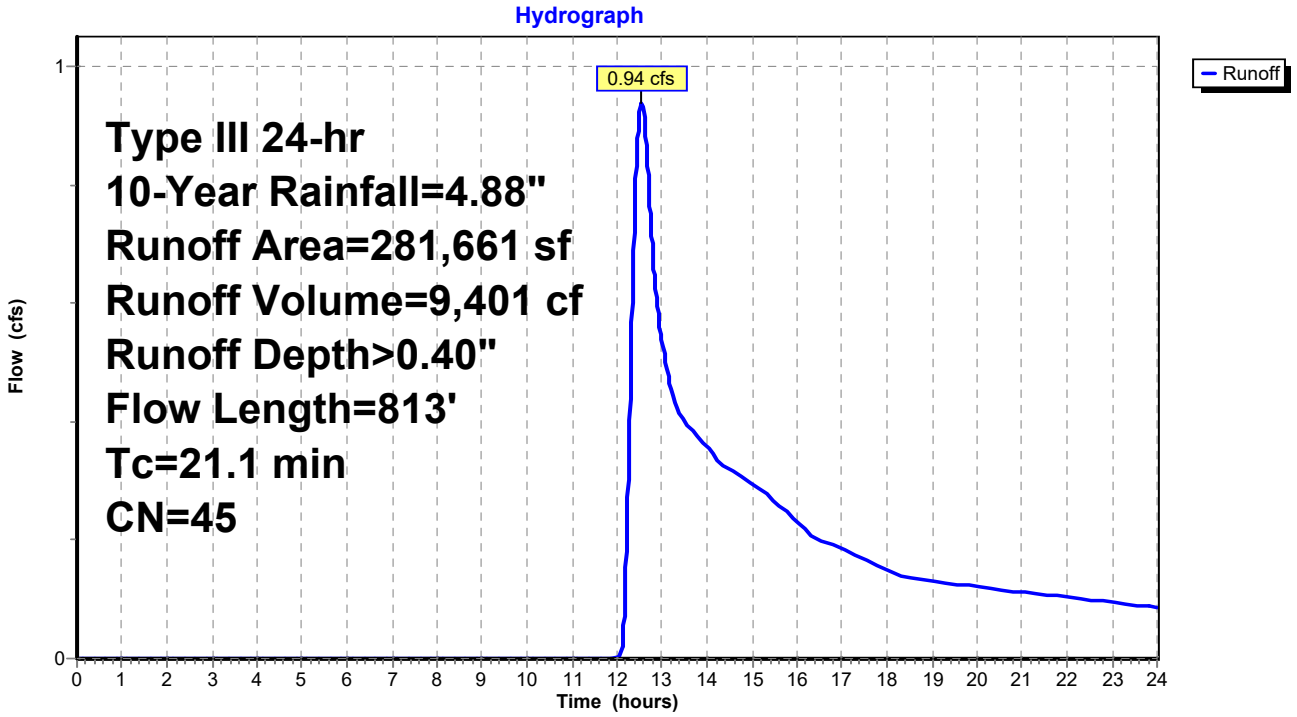
Runoff = 0.94 cfs @ 12.54 hrs, Volume= 9,401 cf, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
166,040	55	Woods, Good, HSG B
115,621	30	Woods, Good, HSG A
281,661	45	Weighted Average
281,661		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.09		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.9	139	0.0570	1.19		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.0	112	0.0350	0.94		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.9	123	0.0110	0.52		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.1	266	0.0820	1.43		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	62	0.1940	2.20		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.7	61	0.0960	1.55		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
21.1	813	Total			

Subcatchment S3:



Summary for Subcatchment S4:

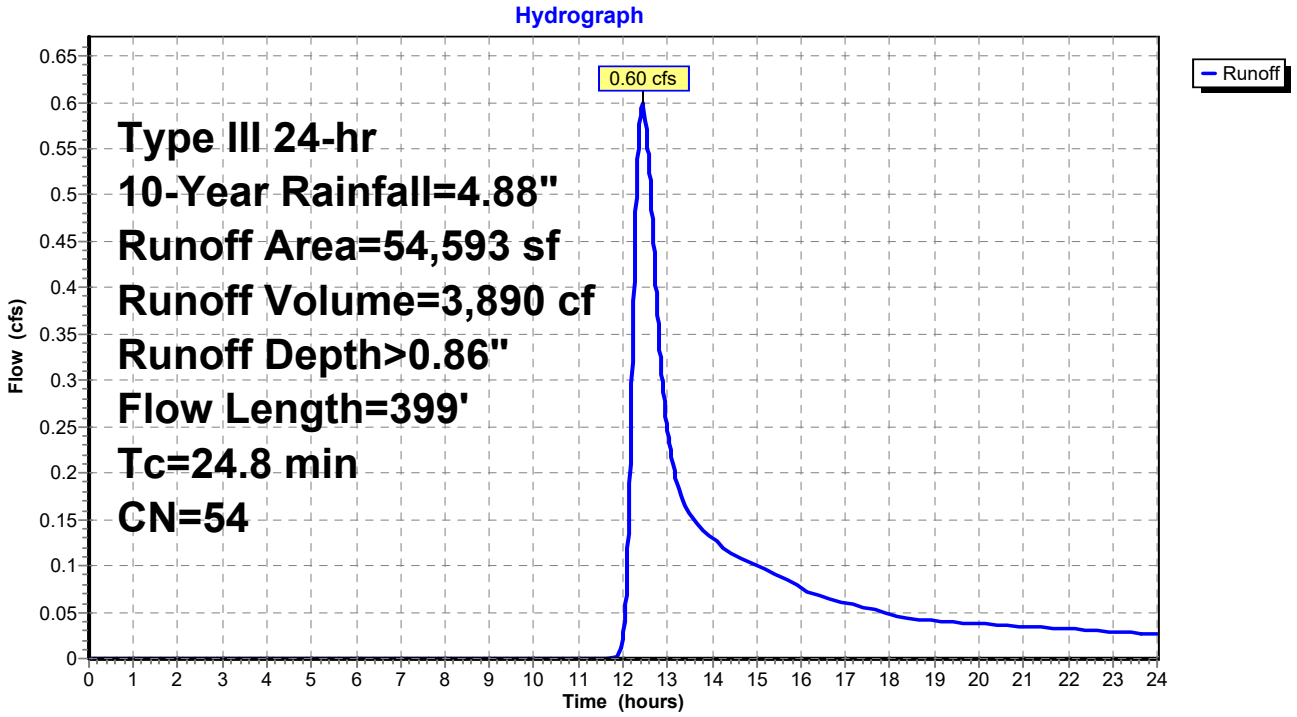
Runoff = 0.60 cfs @ 12.43 hrs, Volume= 3,890 cf, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG A
	0	98	Roofs, HSG A
	5,517	39	>75% Grass cover, Good, HSG A
*	38,812	61	>75% Grass cover, Good, HSG B/D
	1,862	39	>75% Grass cover, Good, HSG A
	804	61	>75% Grass cover, Good, HSG B
	3,792	30	Woods, Good, HSG A
	660	55	Woods, Good, HSG B
	3,146	30	Woods, Good, HSG A
	54,593	54	Weighted Average
	54,593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	13	0.0330	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
16.3	37	0.0220	0.04		**Sheet Flow, Woodland** Woods: Dense underbrush n= 0.800 P2= 3.17"
2.0	87	0.0220	0.74		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.1	87	0.0700	1.32		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	42	0.0500	1.12		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	56	0.1000	1.58		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.6	77	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
24.8	399	Total			

Subcatchment S4:



Summary for Subcatchment S5A: To CB-1

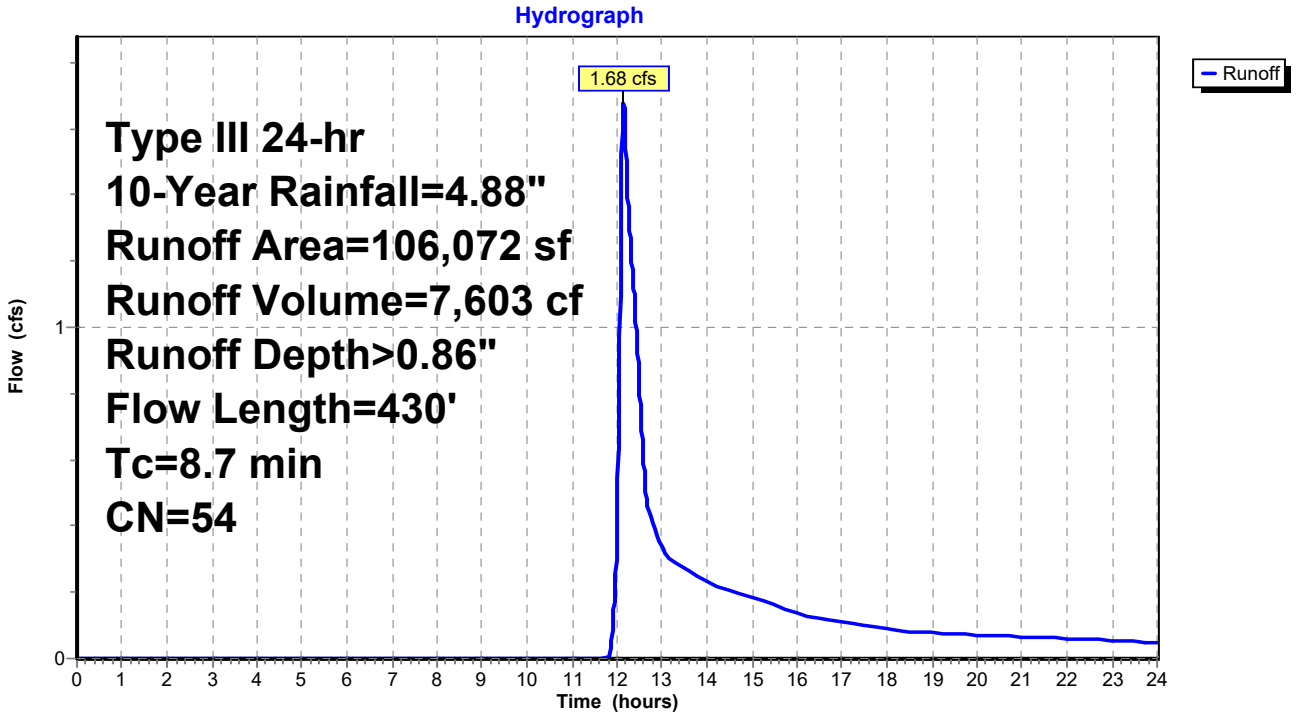
Runoff = 1.68 cfs @ 12.15 hrs, Volume= 7,603 cf, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	7,784	30	Woods, Good, HSG A
	11,369	55	Woods, Good, HSG B
*	5,689	98	Paved driveways, HSG A
	10,716	98	Paved roads w/curbs & sewers, HSG A
*	976	98	Paved driveways, HSG B
	1,186	98	Paved roads w/curbs & sewers, HSG B
	3,690	98	Roofs, HSG A
*	2,354	35	Stabilized Slope
	55,726	39	>75% Grass cover, Good, HSG A
	6,582	61	>75% Grass cover, Good, HSG B
	106,072	54	Weighted Average
	83,815		79.02% Pervious Area
	22,257		20.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	10	0.0900	0.09		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.3	21	0.3330	0.26		**Sheet Flow, Vegetated Slope** Grass: Dense n= 0.240 P2= 3.17"
1.6	19	0.0650	0.19		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
3.0	235	0.0350	1.31		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.0	11	0.3330	4.04		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	13	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.7	121	0.0200	2.87		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
8.7	430	Total			

Subcatchment S5A: To CB-1



Summary for Subcatchment S5B: To CB-3

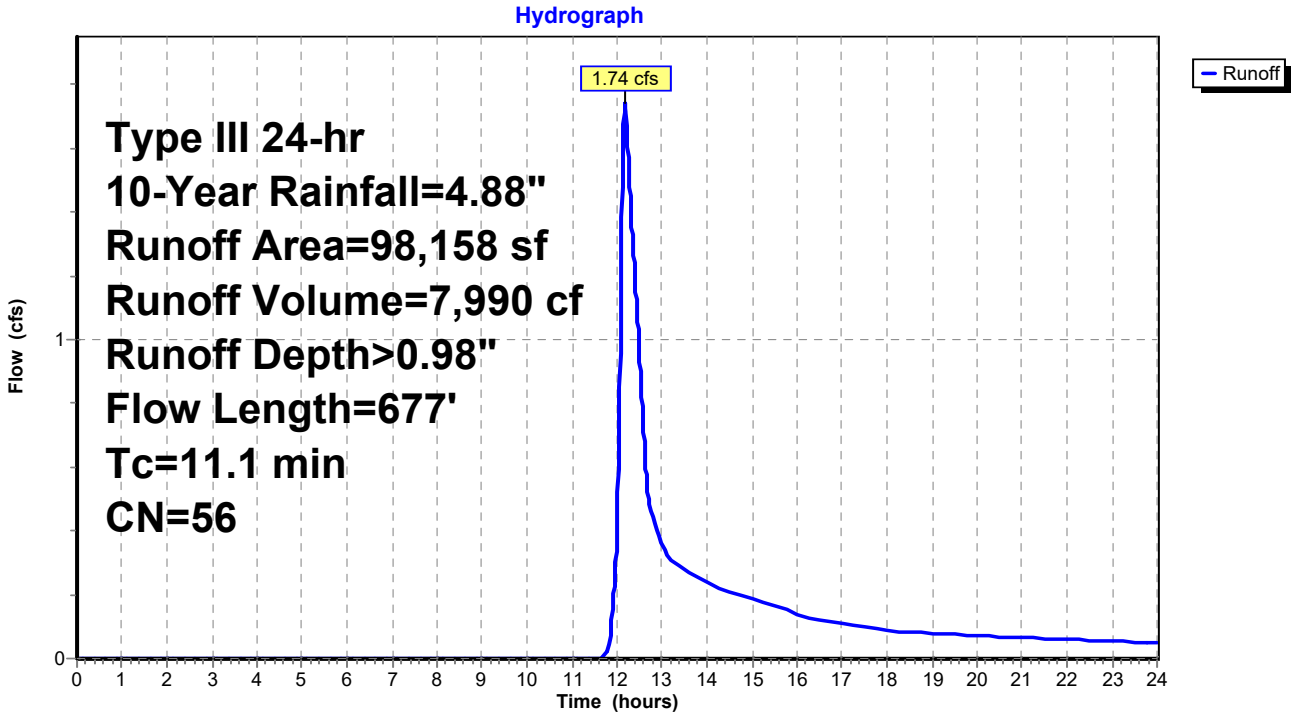
Runoff = 1.74 cfs @ 12.18 hrs, Volume= 7,990 cf, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	5,935	30	Woods, Good, HSG A
	24,836	55	Woods, Good, HSG B
*	13,017	98	Paved driveways, HSG A
	6,146	98	Paved roads w/curbs & sewers, HSG A
	3,445	98	Roofs, HSG A
*	14,420	35	Stabilized Slope
	30,359	39	>75% Grass cover, Good, HSG A
	98,158	56	Weighted Average
	75,550		76.97% Pervious Area
	22,608		23.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1250	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.8	78	0.1180	1.72		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	73	0.2250	2.37		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.4	47	0.1250	1.77		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.2	54	0.3300	4.02		**Shallow Concentrated Flow, Vegetated Slope** Short Grass Pasture Kv= 7.0 fps
1.5	142	0.0520	1.60		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0200	2.87		**Shallow Concentrated Flow, Sidewalk** Paved Kv= 20.3 fps
0.1	7	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
1.6	222	0.0130	2.31		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
11.1	677	Total			

Subcatchment S5B: To CB-3



Summary for Subcatchment S5C: To CB-2

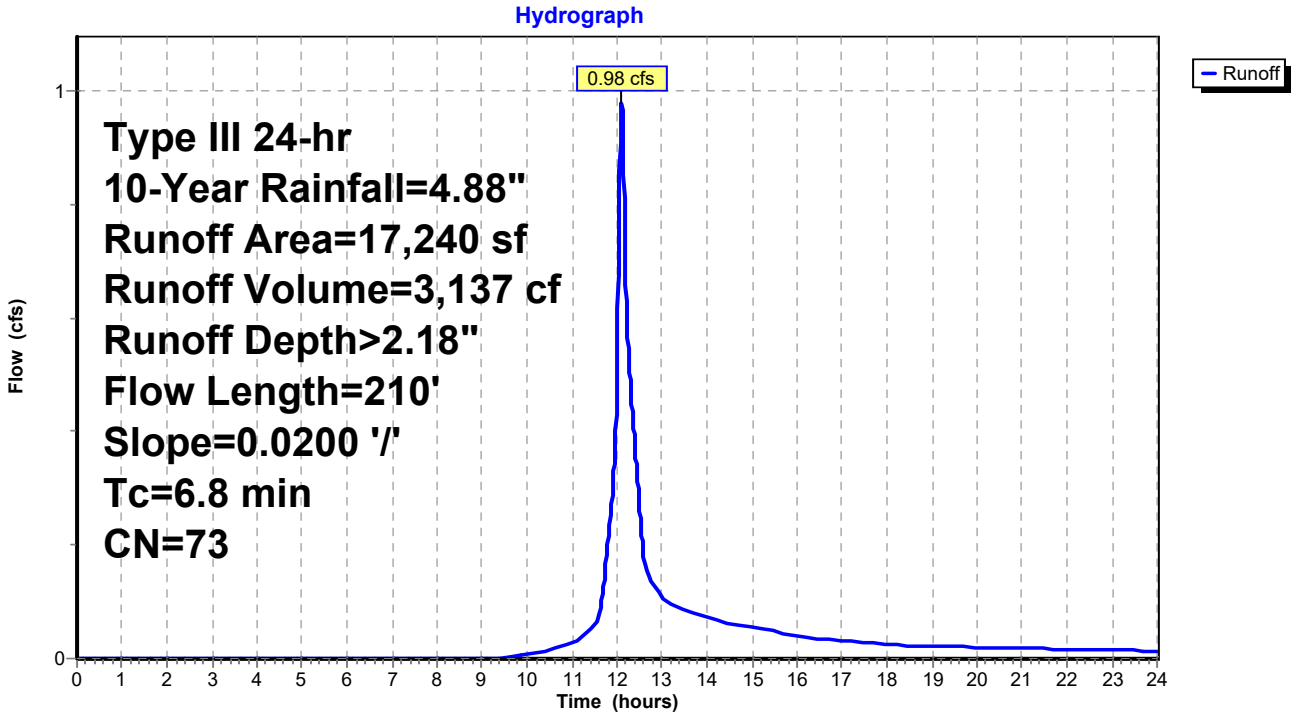
Runoff = 0.98 cfs @ 12.10 hrs, Volume= 3,137 cf, Depth> 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	3,448	98	Driveway/Sidewalks
	4,733	98	Paved roads w/curbs & sewers, HSG A
	1,648	98	Roofs, HSG A
	7,411	39	>75% Grass cover, Good, HSG A
	17,240	73	Weighted Average
	7,411		42.99% Pervious Area
	9,829		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	38	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.1	4	0.0200	0.72		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 3.17"
1.3	8	0.0200	0.10		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.9	160	0.0200	2.87		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
6.8	210	Total			

Subcatchment S5C: To CB-2



Summary for Subcatchment S5D: To CB-4

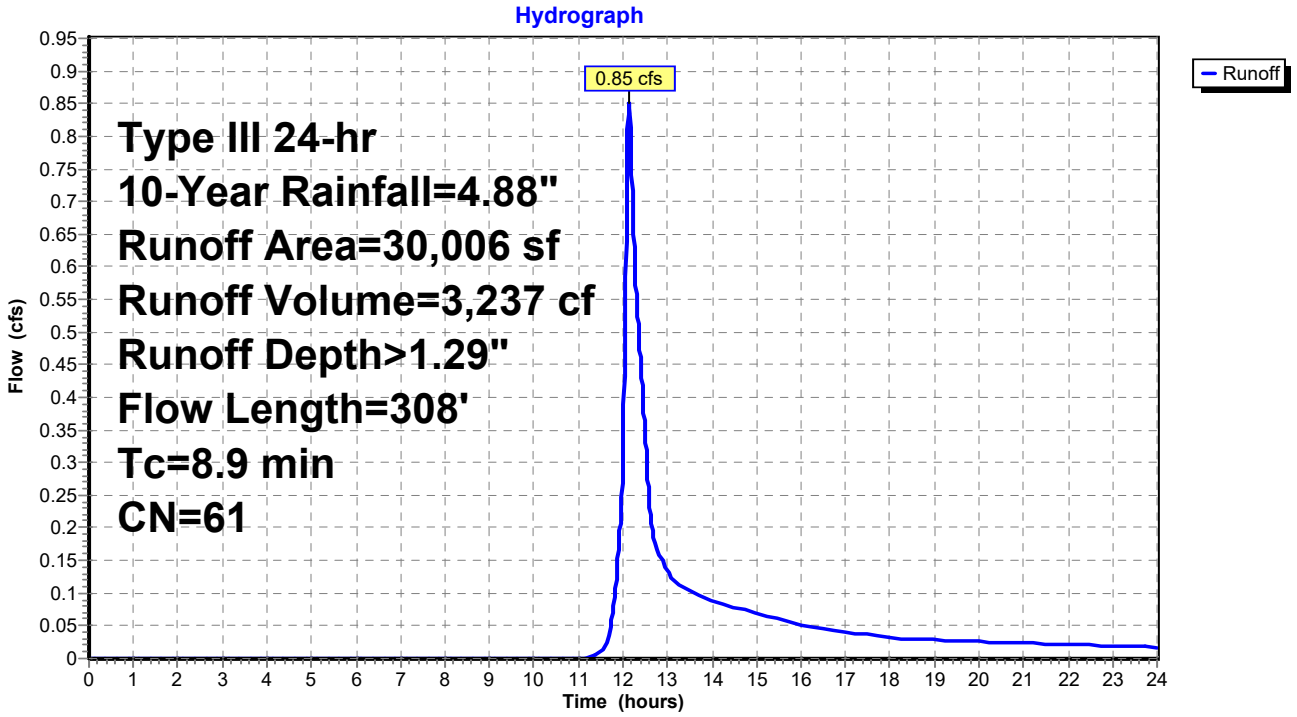
Runoff = 0.85 cfs @ 12.14 hrs, Volume= 3,237 cf, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	626	98	Roofs, HSG A
*	956	98	Roofs, HSG B/D
	17,834	39	>75% Grass cover, Good, HSG A
*	425	61	>75% Grass cover, Good, HSG B/D
*	1,054	61	>75% Grass cover, Good, HSG B/D
*	9,111	98	Pavement
	30,006	61	Weighted Average
	19,313		64.36% Pervious Area
	10,693		35.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	45	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.1	4	0.0200	0.72		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.17"
0.1	7	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
1.8	252	0.0130	2.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
8.9	308	Total			

Subcatchment S5D: To CB-4



Summary for Subcatchment S5E:

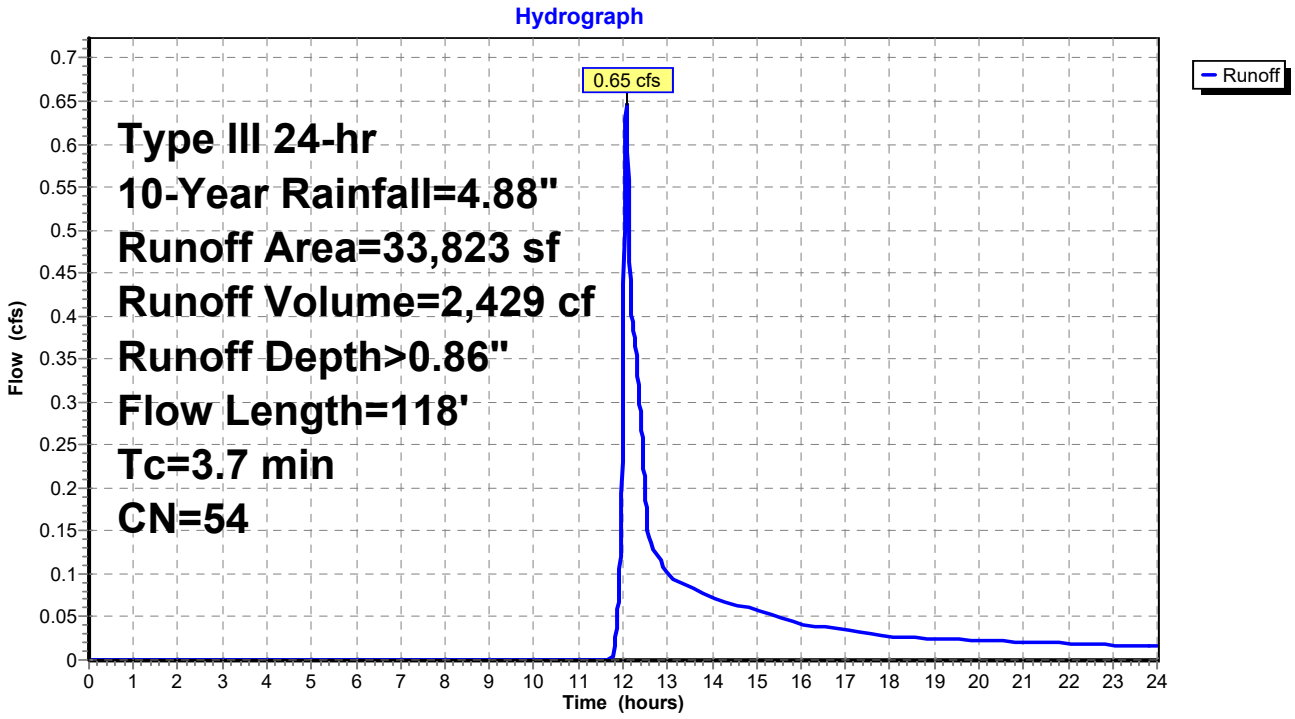
Runoff = 0.65 cfs @ 12.08 hrs, Volume= 2,429 cf, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	1,730	98	Paved Driveway, HSG A
	3,138	98	Roofs, HSG A
	19,630	39	>75% Grass cover, Good, HSG A
*	9,325	61	>75% Grass cover, Good, HSG B/D
	33,823	54	Weighted Average
	28,955		85.61% Pervious Area
	4,868		14.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.0890	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.6	68	0.0780	1.95		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
3.7	118	Total			

Subcatchment S5E:



Summary for Subcatchment S6:

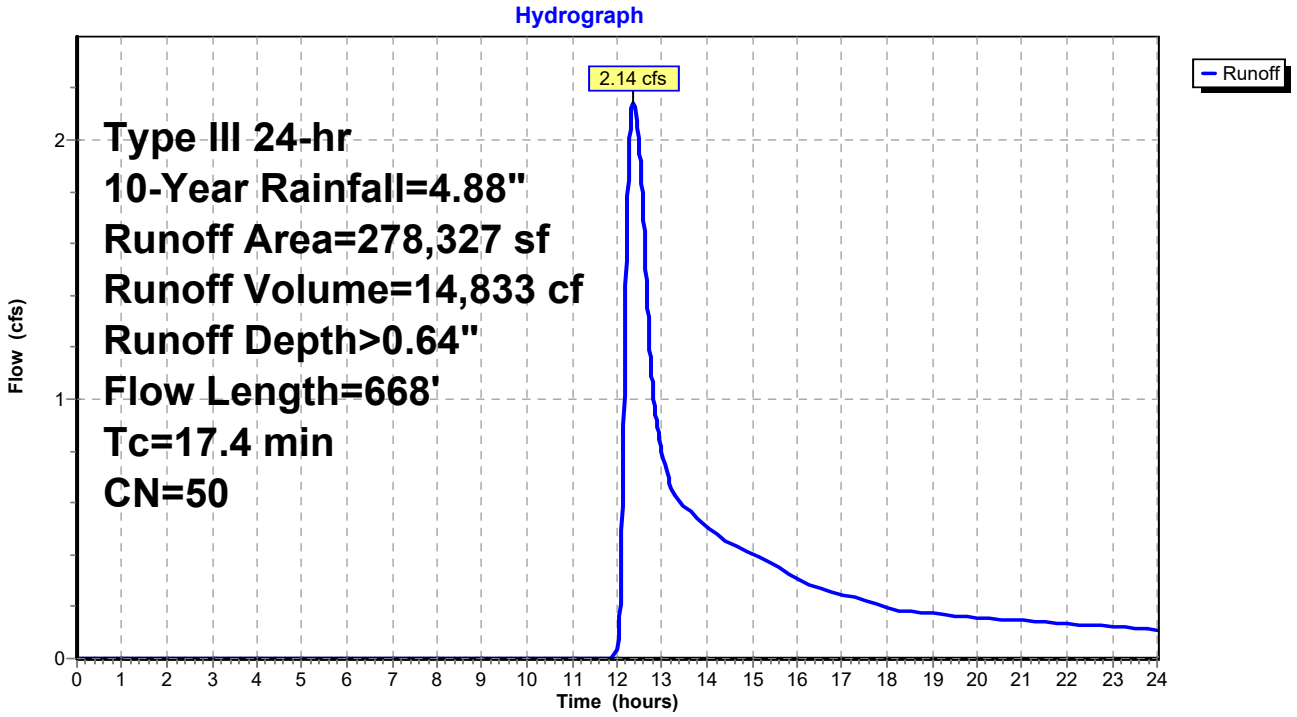
Runoff = 2.14 cfs @ 12.36 hrs, Volume= 14,833 cf, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	165,239	55	Woods, Good, HSG B
	27,727	30	Woods, Good, HSG A
*	9,535	55	Woods, Good, HSG B/D
*	862	56	Stabilized Slope, HSG B
*	16,306	35	Stabilized Slope, HSG A
	936	98	Roofs, HSG A
*	936	98	Roofs, HSG B/D
	37,336	39	>75% Grass cover, Good, HSG A
*	19,450	61	>75% Grass cover, Good, HSG B/D
	278,327	50	Weighted Average
	276,455		99.33% Pervious Area
	1,872		0.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.6	134	0.0740	1.36		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.0	112	0.0350	0.94		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.9	104	0.1340	1.83		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.8	70	0.0850	1.46		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.2	39	0.3150	3.93		**Shallow Concentrated Flow, Vegitated Slope** Short Grass Pasture Kv= 7.0 fps
4.8	159	0.0250	0.55	3.29	**Channel Flow, Grass Swale** Area= 6.0 sf Perim= 324.0' r= 0.02' n= 0.030 Earth, grassed & winding
17.4	668	Total			

Subcatchment S6:



Summary for Reach 1R: DMH-2 to DMH-1

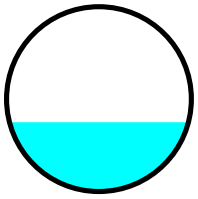
[52] Hint: Inlet/Outlet conditions not evaluated

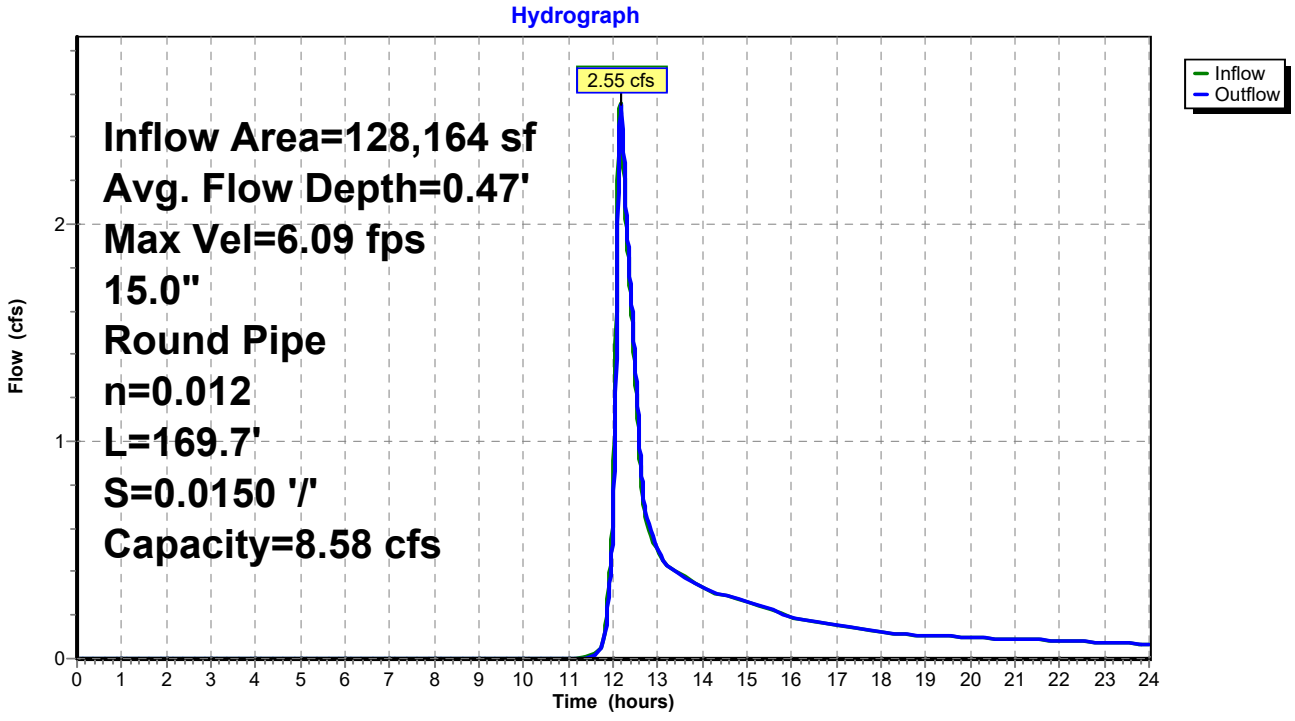
Inflow Area = 128,164 sf, 25.98% Impervious, Inflow Depth > 1.05" for 10-Year event
Inflow = 2.55 cfs @ 12.17 hrs, Volume= 11,227 cf
Outflow = 2.55 cfs @ 12.18 hrs, Volume= 11,220 cf, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.09 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.74 fps, Avg. Travel Time= 1.0 min

Peak Storage= 71 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 8.58 cfs

15.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 169.7' Slope= 0.0150 '/'
Inlet Invert= 777.16', Outlet Invert= 774.61'





Summary for Reach 2R: DMH-1 - DMH-3

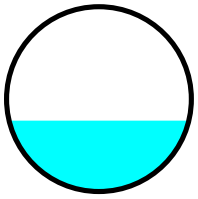
[52] Hint: Inlet/Outlet conditions not evaluated

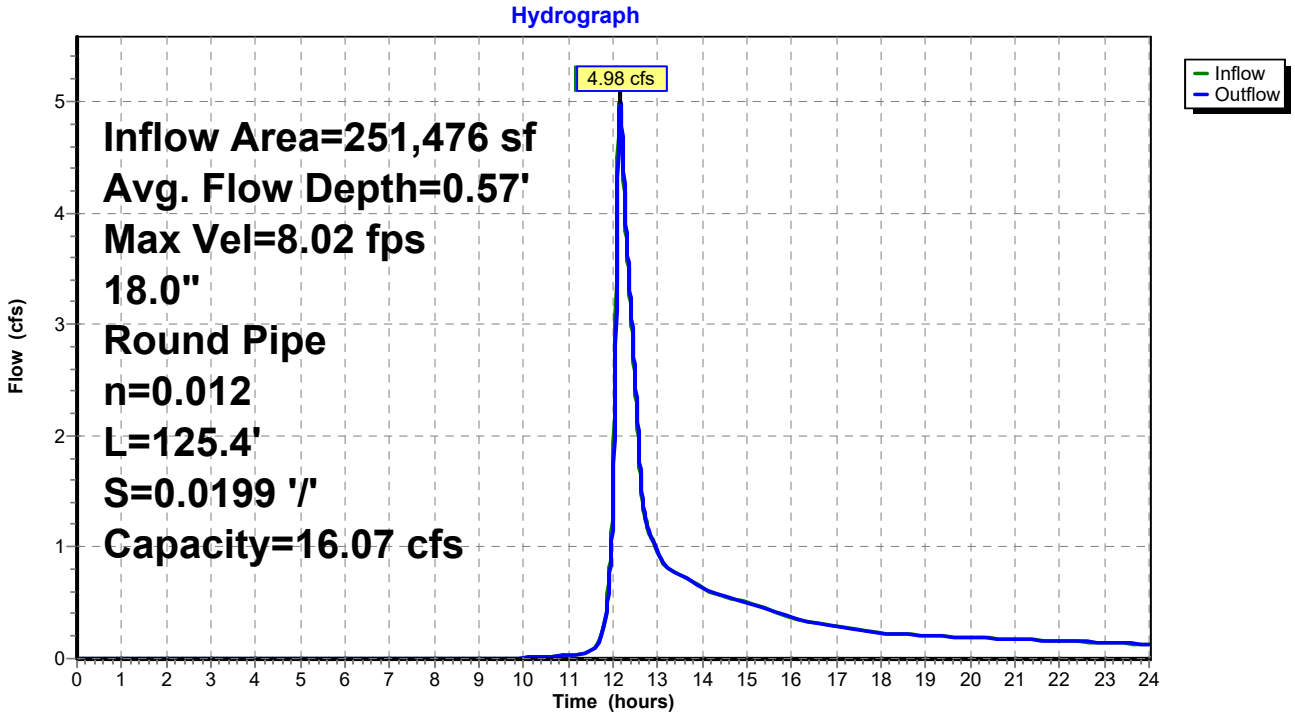
Inflow Area = 251,476 sf, 26.00% Impervious, Inflow Depth > 1.05" for 10-Year event
Inflow = 4.98 cfs @ 12.16 hrs, Volume= 21,960 cf
Outflow = 4.98 cfs @ 12.16 hrs, Volume= 21,952 cf, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.02 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.33 fps, Avg. Travel Time= 0.6 min

Peak Storage= 78 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.07 cfs

18.0" Round Pipe
n= 0.012
Length= 125.4' Slope= 0.0199 '/'
Inlet Invert= 773.50', Outlet Invert= 771.00'





Summary for Reach 3R: DMH-3 to FE-1

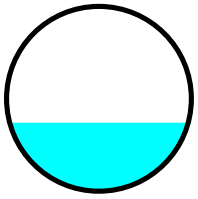
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach 2R outlet invert by 0.45' @ 12.16 hrs

Inflow Area = 251,476 sf, 26.00% Impervious, Inflow Depth > 1.05" for 10-Year event
Inflow = 4.98 cfs @ 12.16 hrs, Volume= 21,952 cf
Outflow = 4.98 cfs @ 12.17 hrs, Volume= 21,950 cf, Atten= 0%, Lag= 0.1 min

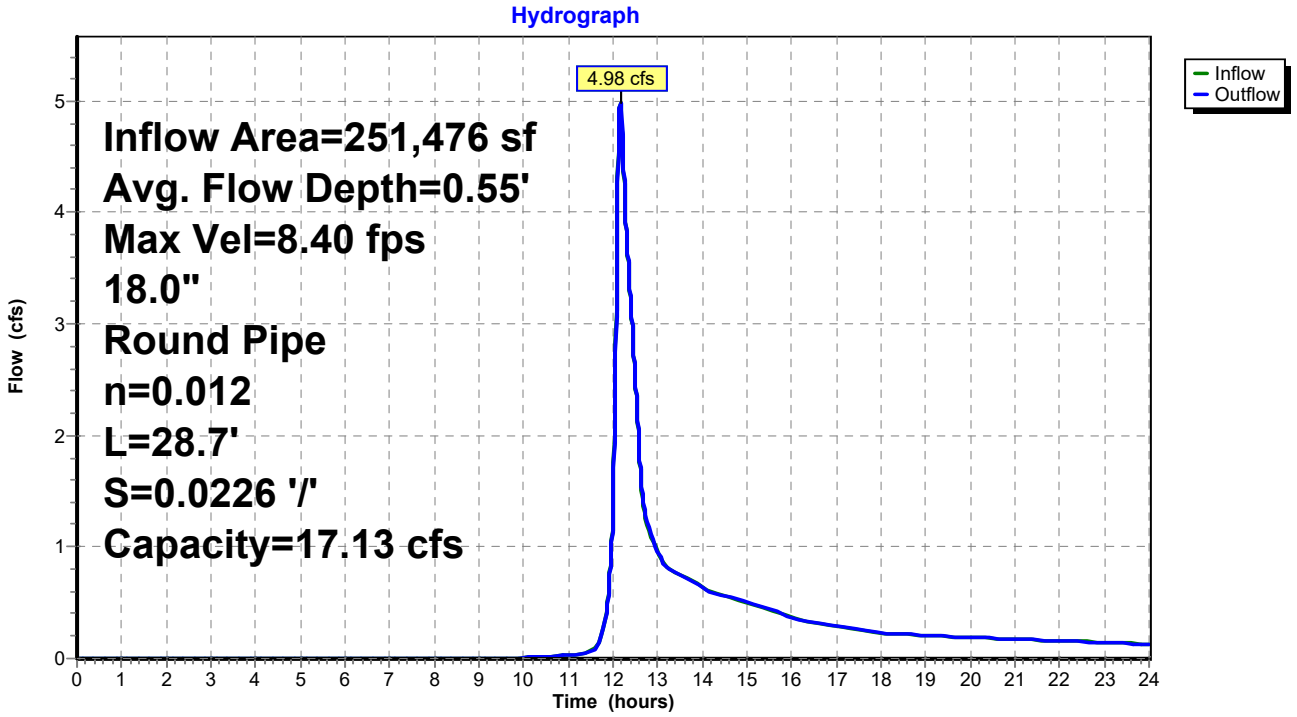
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.40 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.48 fps, Avg. Travel Time= 0.1 min

Peak Storage= 17 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.13 cfs

18.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 28.7' Slope= 0.0226 '/'
Inlet Invert= 770.90', Outlet Invert= 770.25'



Reach 3R: DMH-3 to FE-1



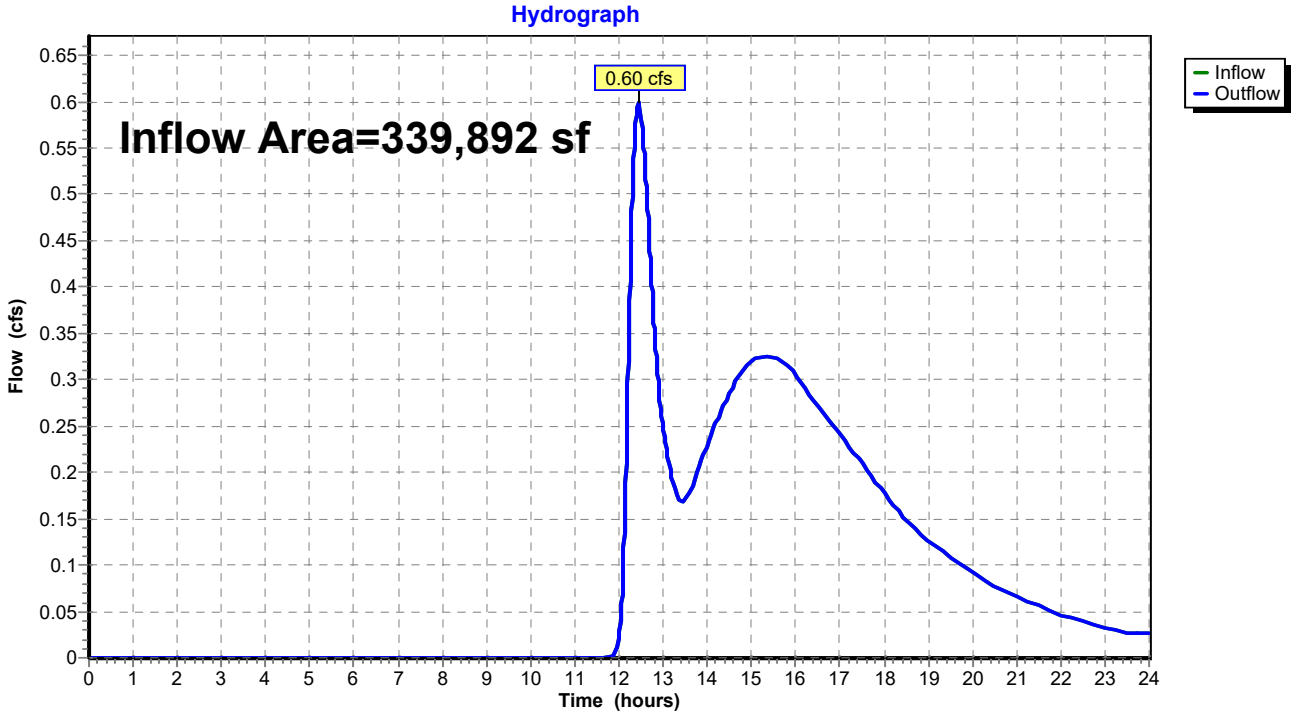
Summary for Reach Post R: Post

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 339,892 sf, 20.67% Impervious, Inflow Depth > 0.27" for 10-Year event
Inflow = 0.60 cfs @ 12.43 hrs, Volume= 7,640 cf
Outflow = 0.60 cfs @ 12.43 hrs, Volume= 7,640 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach Post R: Post



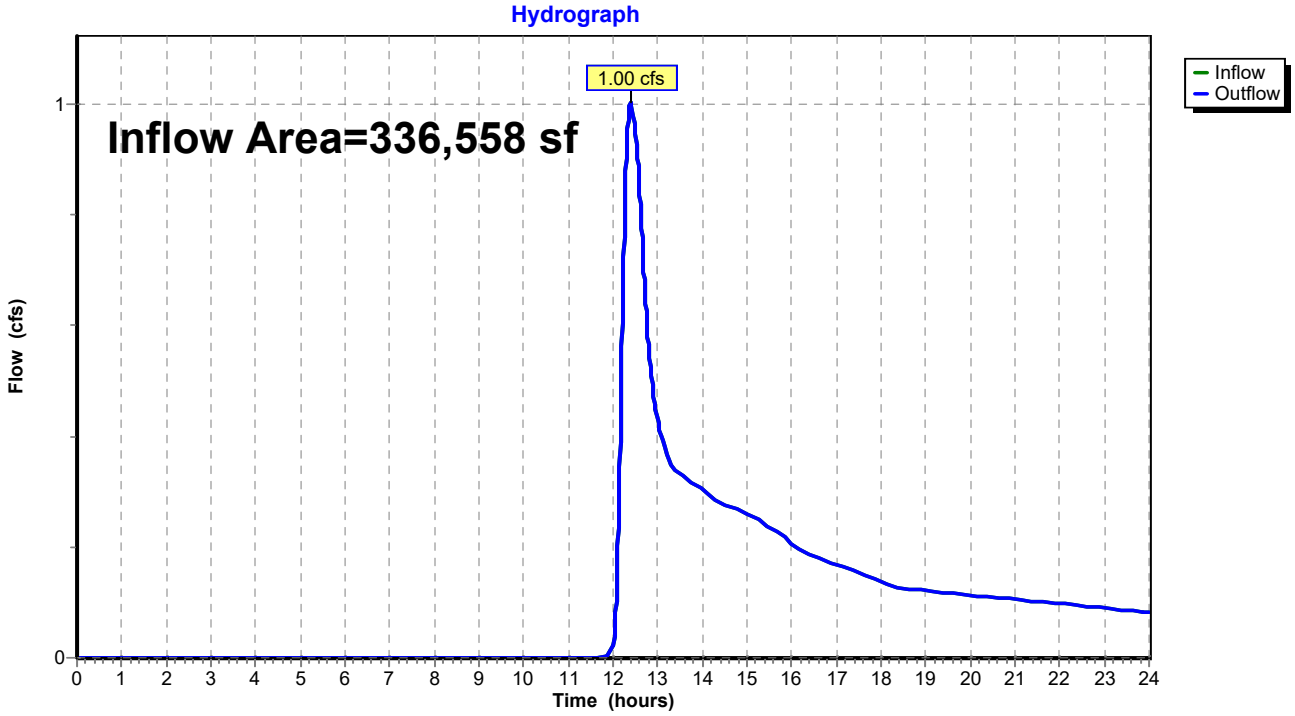
Summary for Reach Pre R: Pre

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 336,558 sf, 2.85% Impervious, Inflow Depth > 0.32" for 10-Year event
Inflow = 1.00 cfs @ 12.39 hrs, Volume= 8,895 cf
Outflow = 1.00 cfs @ 12.39 hrs, Volume= 8,895 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach Pre R: Pre



Summary for Pond 1P: Infiltration Pond

[63] Warning: Exceeded Reach 3R INLET depth by 1.24' @ 15.96 hrs

Inflow Area = 285,299 sf, 24.63% Impervious, Inflow Depth > 1.03" for 10-Year event
Inflow = 5.41 cfs @ 12.16 hrs, Volume= 24,379 cf
Outflow = 0.48 cfs @ 15.58 hrs, Volume= 13,658 cf, Atten= 91%, Lag= 205.0 min
Discarded = 0.24 cfs @ 15.58 hrs, Volume= 9,908 cf
Primary = 0.24 cfs @ 15.58 hrs, Volume= 3,750 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 772.30' @ 15.58 hrs Surf.Area= 7,075 sf Storage= 12,944 cf

Plug-Flow detention time= 302.6 min calculated for 13,652 cf (56% of inflow)
Center-of-Mass det. time= 168.8 min (1,056.5 - 887.8)

Volume	Invert	Avail.Storage	Storage Description
#1	770.00'	36,585 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

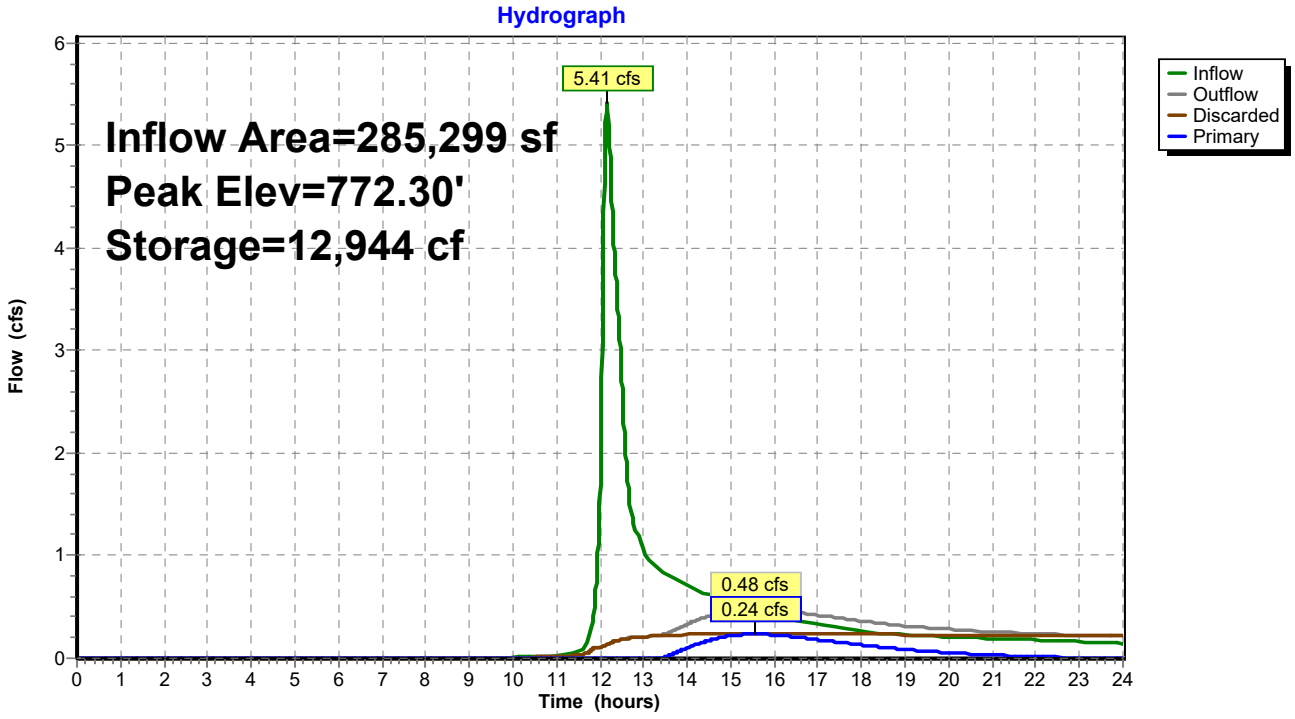
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
770.00	4,236	0	0
770.50	4,825	2,265	2,265
770.75	5,124	1,244	3,509
771.00	5,427	1,319	4,828
772.00	6,675	6,051	10,879
774.00	9,340	16,015	26,894
775.00	10,042	9,691	36,585

Device	Routing	Invert	Outlet Devices
#1	Primary	768.50'	**12.0" Round 12" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 768.50' / 766.00' S= 0.0417 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	773.90'	**48.0" x 48.0" Horiz. 48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	770.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 766.00'
#4	Device 1	772.00'	**0.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#5	Primary	774.00'	**10.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.24 cfs @ 15.58 hrs HW=772.30' (Free Discharge)
└**3=Exfiltration** (Controls 0.24 cfs)

Primary OutFlow Max=0.24 cfs @ 15.58 hrs HW=772.30' (Free Discharge)
└**1=12" Round Culvert** (Passes 0.24 cfs of 6.87 cfs potential flow)
└**2=48.0" x 48.0" Horiz. Orifice/Grate** (Controls 0.00 cfs)
└**4=Broad-Crested Rectangular Weir** (Weir Controls 0.24 cfs @ 1.57 fps)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Infiltration Pond



Summary for Pond 5P: Detention Pond

Inflow Area = 278,327 sf, 0.67% Impervious, Inflow Depth > 0.64" for 10-Year event
Inflow = 2.14 cfs @ 12.36 hrs, Volume= 14,833 cf
Outflow = 0.51 cfs @ 13.99 hrs, Volume= 9,946 cf, Atten= 76%, Lag= 97.7 min
Primary = 0.51 cfs @ 13.99 hrs, Volume= 9,946 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 772.16' @ 13.99 hrs Surf.Area= 5,328 sf Storage= 5,511 cf

Plug-Flow detention time= 218.9 min calculated for 9,942 cf (67% of inflow)
Center-of-Mass det. time= 100.9 min (1,026.0 - 925.1)

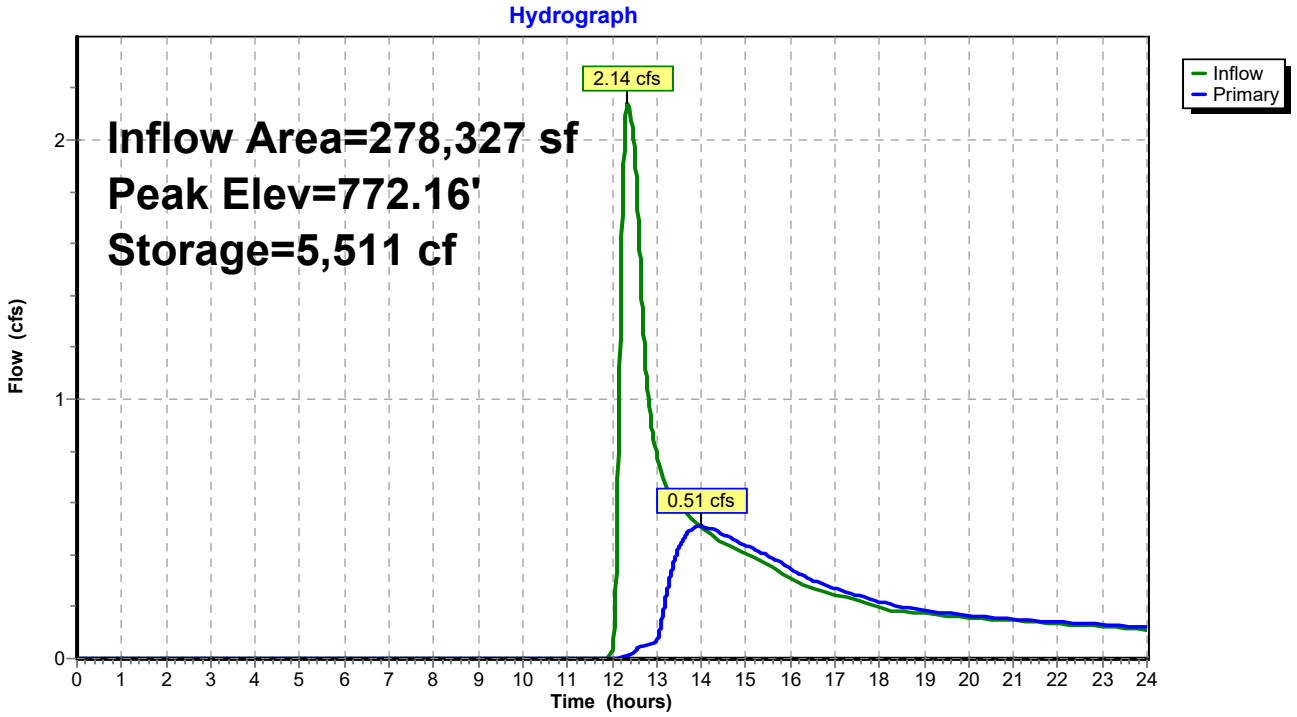
Volume	Invert	Avail.Storage	Storage Description
#1	771.00'	17,096 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
771.00	4,208	0	0
772.00	5,164	4,686	4,686
774.00	7,246	12,410	17,096

Device	Routing	Invert	Outlet Devices
#1	Primary	769.00'	**8.0" Round Culvert** L= 43.0' Ke= 0.500 Inlet / Outlet Invert= 769.00' / 768.00' S= 0.0233 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	771.00'	**1.0" Vert. Orifice/Grate** X 4 rows with 6.3" cc spacing C= 0.600
#3	Device 1	771.50'	**1.0" Vert. Orifice/Grate** X 4 rows with 6.3" cc spacing C= 0.600
#4	Device 1	772.00'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	773.00'	**10.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.51 cfs @ 13.99 hrs HW=772.16' (Free Discharge)
- **1=Culvert** (Passes 0.51 cfs of 2.81 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.05 cfs @ 3.34 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 2.61 fps)
  - **4=Orifice/Grate** (Weir Controls 0.43 cfs @ 1.30 fps)
- **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Detention Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1: Runoff Area=107,735 sf 6.87% Impervious Runoff Depth>2.19"
Flow Length=874' Tc=21.4 min CN=52 Runoff=3.84 cfs 19,660 cf

Subcatchment S2: Runoff Area=228,823 sf 0.96% Impervious Runoff Depth>0.82"
Flow Length=898' Tc=16.0 min CN=37 Runoff=2.02 cfs 15,634 cf

Subcatchment S3: Runoff Area=281,661 sf 0.00% Impervious Runoff Depth>1.51"
Flow Length=813' Tc=21.1 min CN=45 Runoff=6.16 cfs 35,531 cf

Subcatchment S4: Runoff Area=54,593 sf 0.00% Impervious Runoff Depth>2.39"
Flow Length=399' Tc=24.8 min CN=54 Runoff=2.04 cfs 10,869 cf

Subcatchment S5A: To CB-1 Runoff Area=106,072 sf 20.98% Impervious Runoff Depth>2.40"
Flow Length=430' Tc=8.7 min CN=54 Runoff=5.88 cfs 21,213 cf

Subcatchment S5B: To CB-3 Runoff Area=98,158 sf 23.03% Impervious Runoff Depth>2.60"
Flow Length=677' Tc=11.1 min CN=56 Runoff=5.54 cfs 21,293 cf

Subcatchment S5C: To CB-2 Runoff Area=17,240 sf 57.01% Impervious Runoff Depth>4.44"
Flow Length=210' Slope=0.0200 '/' Tc=6.8 min CN=73 Runoff=2.01 cfs 6,383 cf

Subcatchment S5D: To CB-4 Runoff Area=30,006 sf 35.64% Impervious Runoff Depth>3.13"
Flow Length=308' Tc=8.9 min CN=61 Runoff=2.25 cfs 7,824 cf

Subcatchment S5E: Runoff Area=33,823 sf 14.39% Impervious Runoff Depth>2.40"
Flow Length=118' Tc=3.7 min CN=54 Runoff=2.25 cfs 6,773 cf

Subcatchment S6: Runoff Area=278,327 sf 0.67% Impervious Runoff Depth>1.99"
Flow Length=668' Tc=17.4 min CN=50 Runoff=9.55 cfs 46,252 cf

Reach 1R: DMH-2 to DMH-1 Avg. Flow Depth=0.93' Max Vel=7.91 fps Inflow=7.72 cfs 29,117 cf
15.0" Round Pipe n=0.012 L=169.7' S=0.0150 '/' Capacity=8.58 cfs Outflow=7.70 cfs 29,105 cf

Reach 2R: DMH-1 - DMH-3 Avg. Flow Depth=1.16' Max Vel=10.34 fps Inflow=15.17 cfs 56,701 cf
18.0" Round Pipe n=0.012 L=125.4' S=0.0199 '/' Capacity=16.07 cfs Outflow=15.15 cfs 56,688 cf

Reach 3R: DMH-3 to FE-1 Avg. Flow Depth=1.10' Max Vel=10.94 fps Inflow=15.15 cfs 56,688 cf
18.0" Round Pipe n=0.012 L=28.7' S=0.0226 '/' Capacity=17.13 cfs Outflow=15.15 cfs 56,685 cf

Reach Post R: Post Inflow=5.25 cfs 50,016 cf
Outflow=5.25 cfs 50,016 cf

Reach Pre R: Pre Inflow=5.81 cfs 35,294 cf
Outflow=5.81 cfs 35,294 cf

Pond 1P: Infiltration Pond Peak Elev=773.69' Storage=24,028 cf Inflow=16.58 cfs 63,459 cf
Discarded=0.34 cfs 12,054 cf Primary=3.63 cfs 39,147 cf Outflow=3.98 cfs 51,201 cf

Pond 5P: Detention Pond Peak Elev=773.26' Storage=12,048 cf Inflow=9.55 cfs 46,252 cf
Outflow=5.77 cfs 41,084 cf

Total Runoff Area = 1,236,438 sf Runoff Volume = 191,431 cf Average Runoff Depth = 1.86"
93.39% Pervious = 1,154,723 sf 6.61% Impervious = 81,715 sf

Summary for Subcatchment S1:

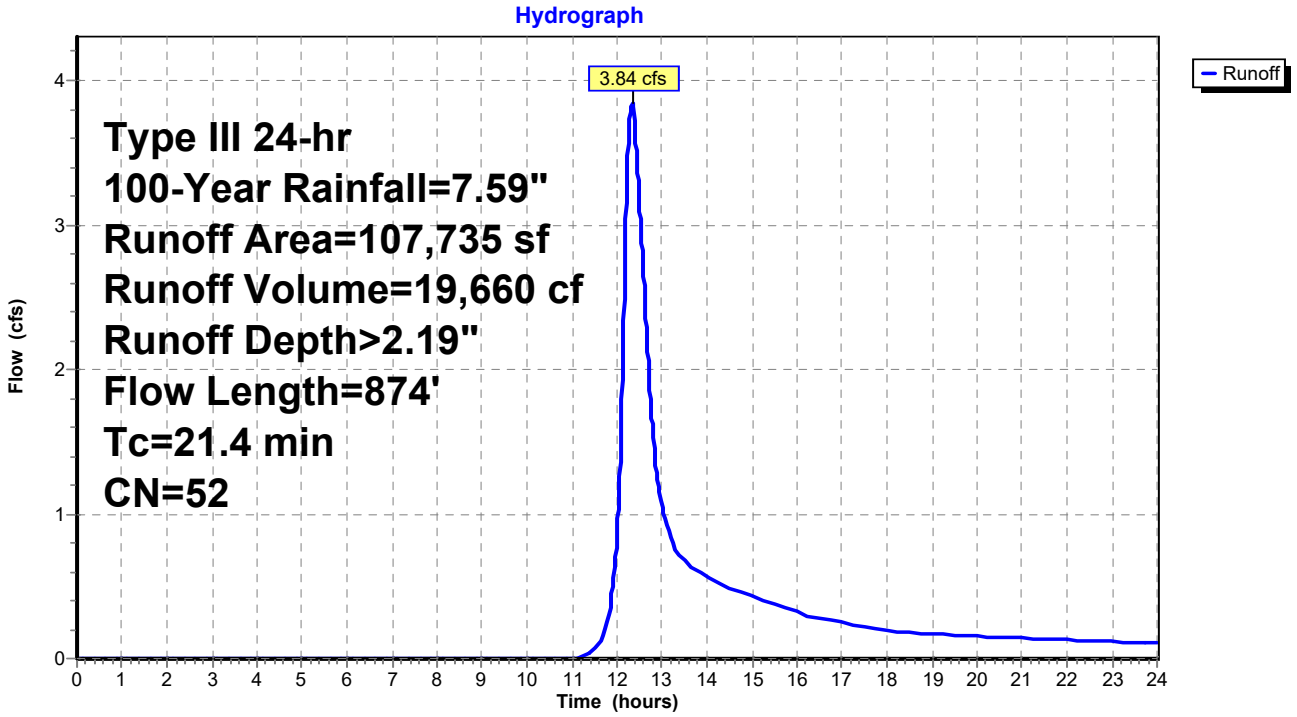
Runoff = 3.84 cfs @ 12.34 hrs, Volume= 19,660 cf, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
	35,273	30	Woods, Good, HSG A
	17,691	55	Woods, Good, HSG B
	3,254	98	Paved parking, HSG A
	965	98	Paved parking, HSG B
	3,183	98	Roofs, HSG A
	9,374	49	50-75% Grass cover, Fair, HSG A
	22,101	69	50-75% Grass cover, Fair, HSG B
*	15,894	55	Woods, Good, HSG B/D
	107,735	52	Weighted Average
	100,333		93.13% Pervious Area
	7,402		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1300	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.2	11	0.0370	0.96		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.2	96	0.0370	1.35		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	23	0.0860	2.05		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.6	49	0.0400	1.40		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	31	0.1290	2.51		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.6	47	0.0320	1.25		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.1	11	0.0280	3.40		**Shallow Concentrated Flow, Driveway** Paved Kv= 20.3 fps
3.2	161	0.0280	0.84		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
5.4	162	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	43	0.0900	1.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.2	83	0.0500	1.12		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.8	67	0.0800	1.41		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.3	40	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
21.4	874	Total			

Subcatchment S1:



Summary for Subcatchment S2:

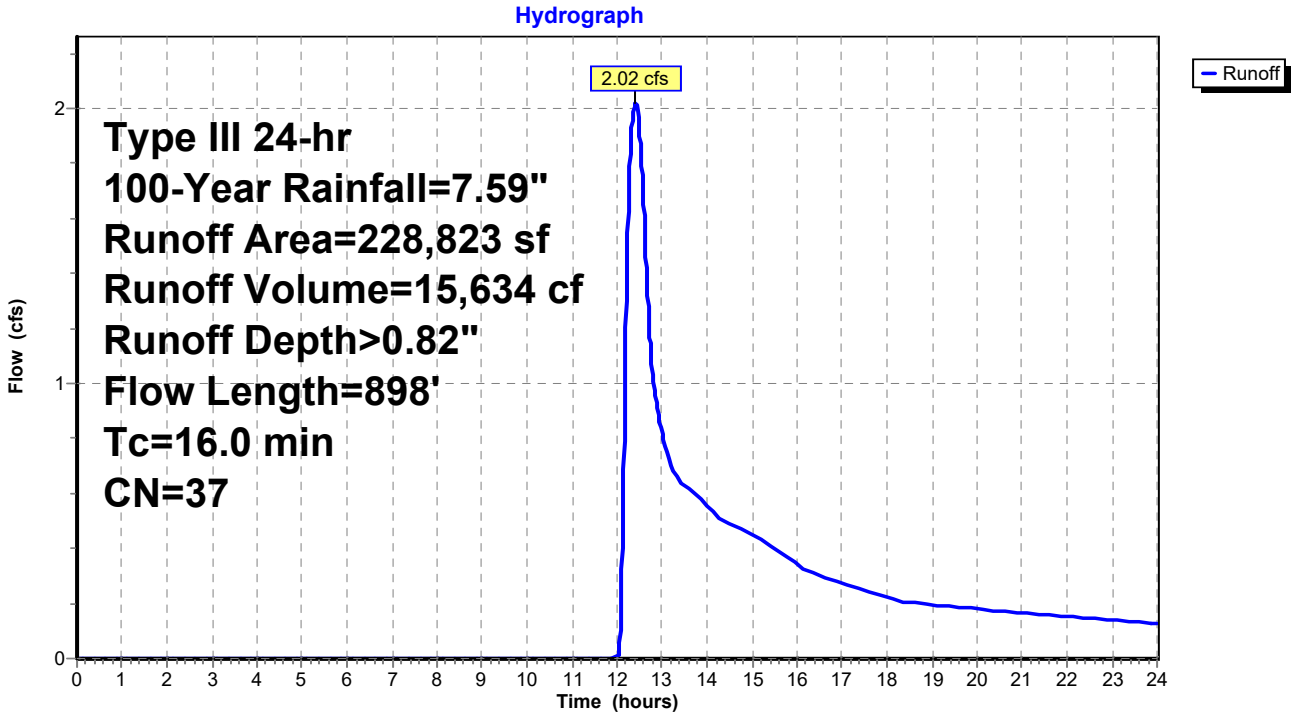
Runoff = 2.02 cfs @ 12.41 hrs, Volume= 15,634 cf, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
*	2,111	98	Paved parking, HSG A
	75	98	Roofs, HSG A
	28,413	49	50-75% Grass cover, Fair, HSG A
	3,550	55	Woods, Good, HSG B
	161,498	30	Woods, Good, HSG A
*	33,176	55	Woods, Good, HSG B/D
	228,823	37	Weighted Average
	226,637		99.04% Pervious Area
	2,186		0.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.1200	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.8	78	0.1150	1.70		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.0	110	0.1460	1.91		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.5	253	0.0570	1.19		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	71	0.1530	1.96		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.5	132	0.0920	1.52		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.5	204	0.0740	1.36		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
16.0	898	Total			

Subcatchment S2:



Summary for Subcatchment S3:

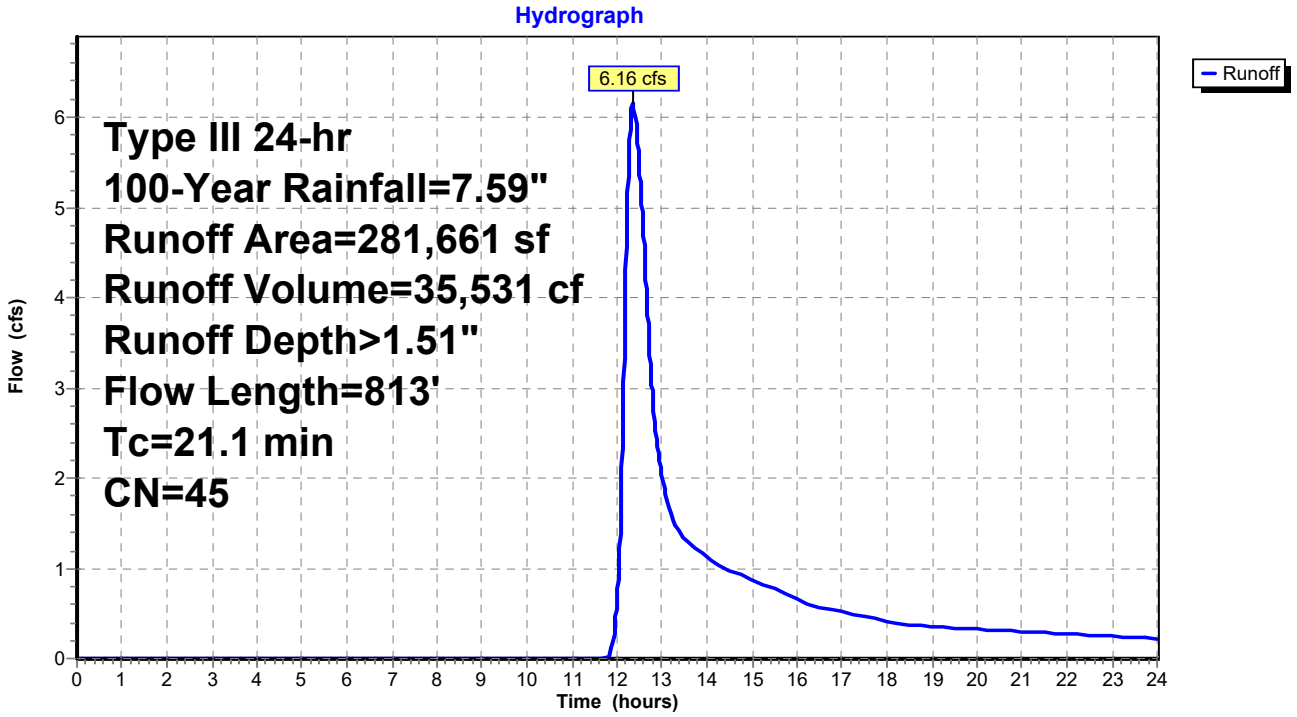
Runoff = 6.16 cfs @ 12.36 hrs, Volume= 35,531 cf, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
166,040	55	Woods, Good, HSG B
115,621	30	Woods, Good, HSG A
281,661	45	Weighted Average
281,661		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.09		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.9	139	0.0570	1.19		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.0	112	0.0350	0.94		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.9	123	0.0110	0.52		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
3.1	266	0.0820	1.43		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	62	0.1940	2.20		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.7	61	0.0960	1.55		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
21.1	813	Total			

Subcatchment S3:



Summary for Subcatchment S4:

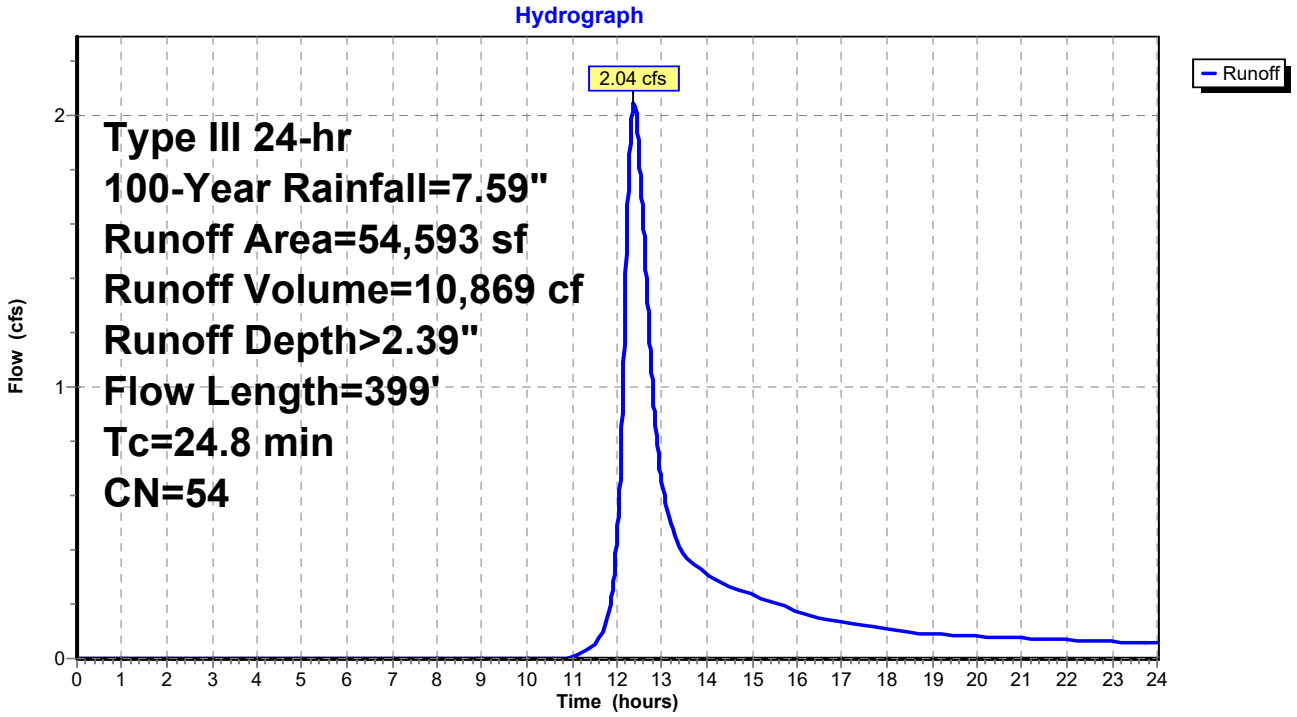
Runoff = 2.04 cfs @ 12.37 hrs, Volume= 10,869 cf, Depth> 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG A
	0	98	Roofs, HSG A
	5,517	39	>75% Grass cover, Good, HSG A
*	38,812	61	>75% Grass cover, Good, HSG B/D
	1,862	39	>75% Grass cover, Good, HSG A
	804	61	>75% Grass cover, Good, HSG B
	3,792	30	Woods, Good, HSG A
	660	55	Woods, Good, HSG B
	3,146	30	Woods, Good, HSG A
	54,593	54	Weighted Average
	54,593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	13	0.0330	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
16.3	37	0.0220	0.04		**Sheet Flow, Woodland** Woods: Dense underbrush n= 0.800 P2= 3.17"
2.0	87	0.0220	0.74		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
1.1	87	0.0700	1.32		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	42	0.0500	1.12		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.6	56	0.1000	1.58		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.6	77	0.0100	0.50		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
24.8	399	Total			

Subcatchment S4:



Summary for Subcatchment S5A: To CB-1

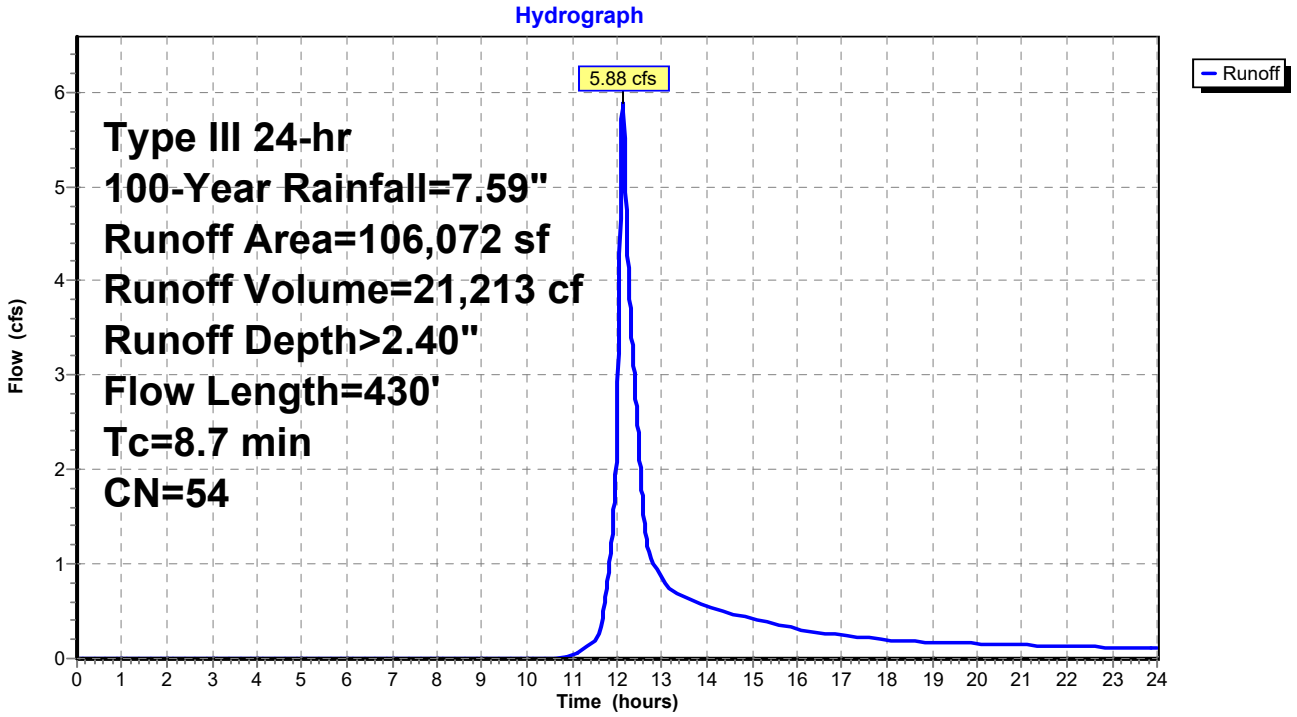
Runoff = 5.88 cfs @ 12.13 hrs, Volume= 21,213 cf, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
	7,784	30	Woods, Good, HSG A
	11,369	55	Woods, Good, HSG B
*	5,689	98	Paved driveways, HSG A
	10,716	98	Paved roads w/curbs & sewers, HSG A
*	976	98	Paved driveways, HSG B
	1,186	98	Paved roads w/curbs & sewers, HSG B
	3,690	98	Roofs, HSG A
*	2,354	35	Stabilized Slope
	55,726	39	>75% Grass cover, Good, HSG A
	6,582	61	>75% Grass cover, Good, HSG B
	106,072	54	Weighted Average
	83,815		79.02% Pervious Area
	22,257		20.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	10	0.0900	0.09		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.3	21	0.3330	0.26		**Sheet Flow, Vegetated Slope** Grass: Dense n= 0.240 P2= 3.17"
1.6	19	0.0650	0.19		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
3.0	235	0.0350	1.31		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.0	11	0.3330	4.04		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.2	13	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.7	121	0.0200	2.87		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
8.7	430	Total			

Subcatchment S5A: To CB-1



Summary for Subcatchment S5B: To CB-3

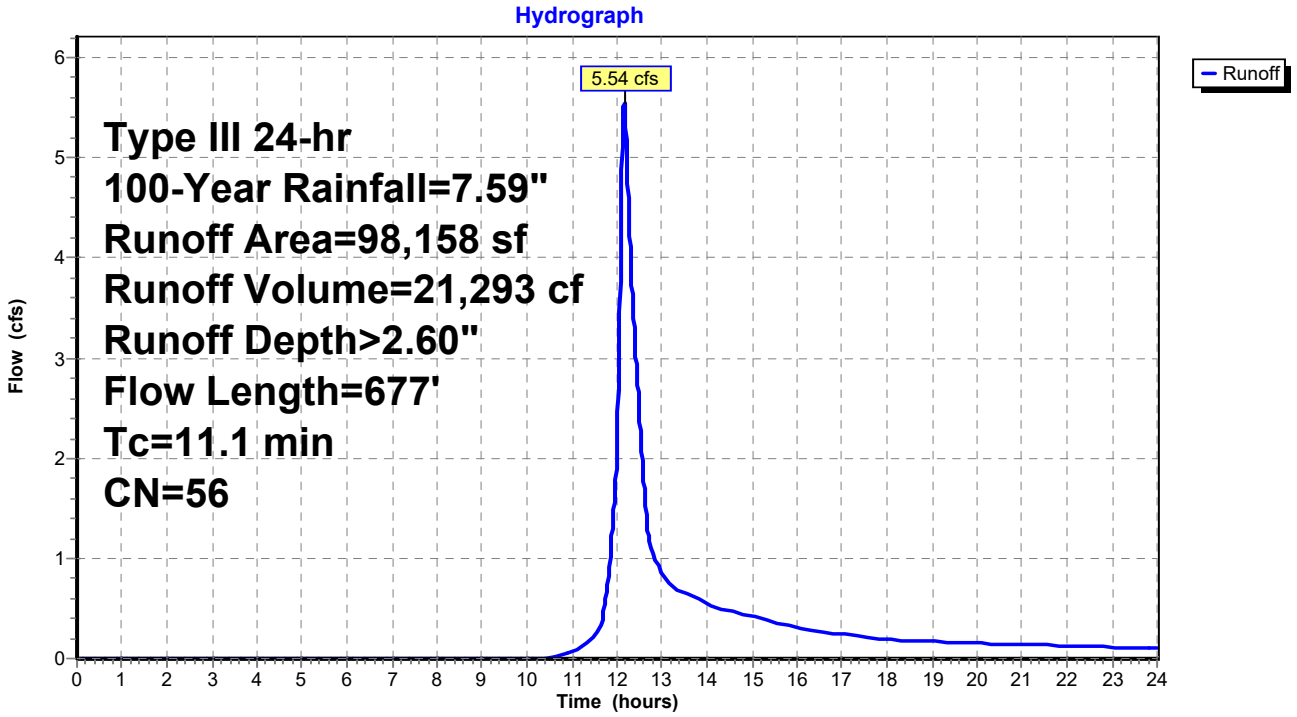
Runoff = 5.54 cfs @ 12.16 hrs, Volume= 21,293 cf, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
	5,935	30	Woods, Good, HSG A
	24,836	55	Woods, Good, HSG B
*	13,017	98	Paved driveways, HSG A
	6,146	98	Paved roads w/curbs & sewers, HSG A
	3,445	98	Roofs, HSG A
*	14,420	35	Stabilized Slope
	30,359	39	>75% Grass cover, Good, HSG A
	98,158	56	Weighted Average
	75,550		76.97% Pervious Area
	22,608		23.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1250	0.14		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
0.8	78	0.1180	1.72		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.5	73	0.2250	2.37		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.4	47	0.1250	1.77		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.2	54	0.3300	4.02		**Shallow Concentrated Flow, Vegetated Slope** Short Grass Pasture Kv= 7.0 fps
1.5	142	0.0520	1.60		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0200	2.87		**Shallow Concentrated Flow, Sidewalk** Paved Kv= 20.3 fps
0.1	7	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
1.6	222	0.0130	2.31		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
11.1	677	Total			

Subcatchment S5B: To CB-3



Summary for Subcatchment S5C: To CB-2

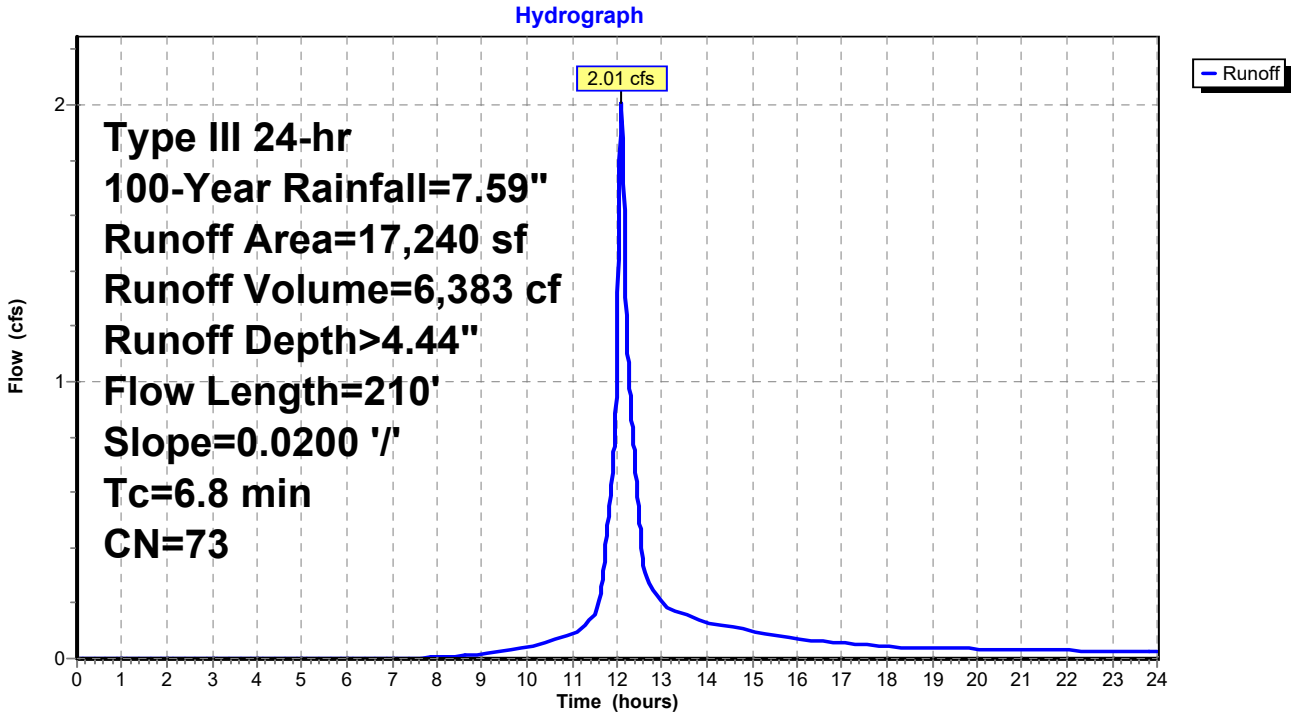
Runoff = 2.01 cfs @ 12.10 hrs, Volume= 6,383 cf, Depth> 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
*	3,448	98	Driveway/Sidewalks
	4,733	98	Paved roads w/curbs & sewers, HSG A
	1,648	98	Roofs, HSG A
	7,411	39	>75% Grass cover, Good, HSG A
	17,240	73	Weighted Average
	7,411		42.99% Pervious Area
	9,829		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	38	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.1	4	0.0200	0.72		**Sheet Flow, Sidewalk** Smooth surfaces n= 0.011 P2= 3.17"
1.3	8	0.0200	0.10		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.9	160	0.0200	2.87		**Shallow Concentrated Flow, Roadway** Paved Kv= 20.3 fps
6.8	210	Total			

Subcatchment S5C: To CB-2



Summary for Subcatchment S5D: To CB-4

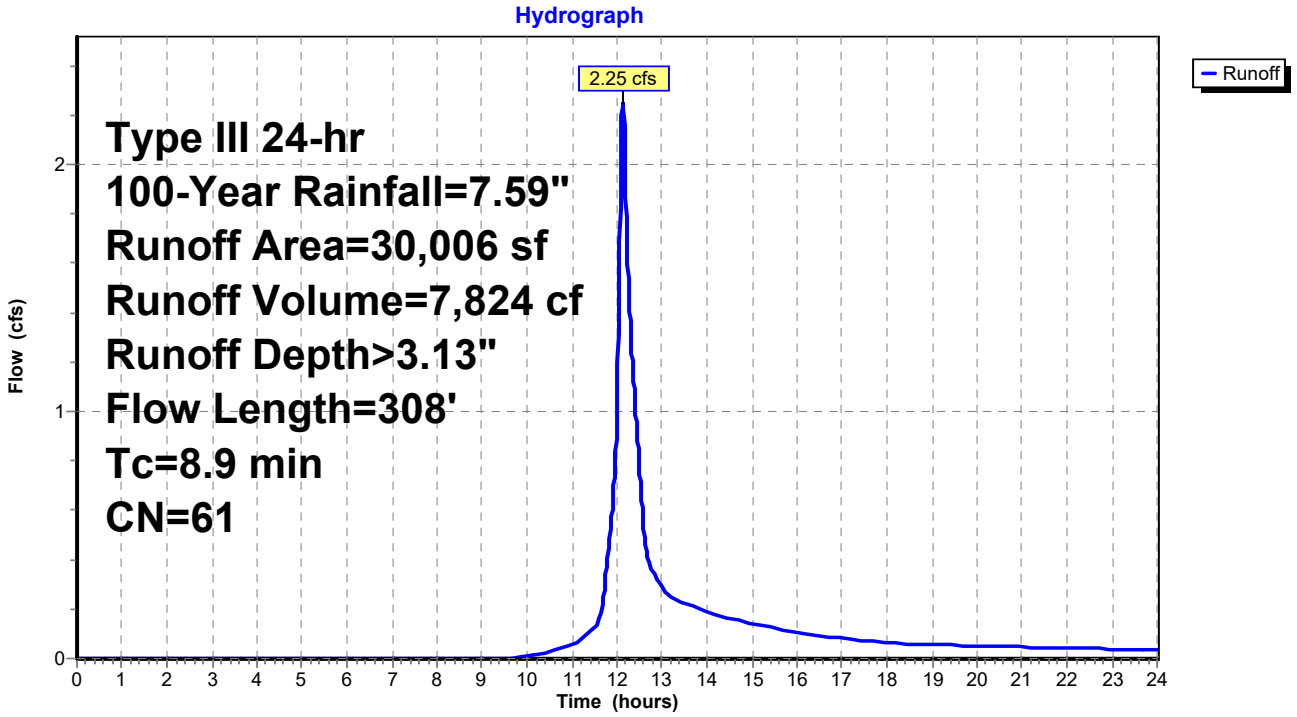
Runoff = 2.25 cfs @ 12.13 hrs, Volume= 7,824 cf, Depth> 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
	626	98	Roofs, HSG A
*	956	98	Roofs, HSG B/D
	17,834	39	>75% Grass cover, Good, HSG A
*	425	61	>75% Grass cover, Good, HSG B/D
*	1,054	61	>75% Grass cover, Good, HSG B/D
*	9,111	98	Pavement
	30,006	61	Weighted Average
	19,313		64.36% Pervious Area
	10,693		35.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	45	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.1	4	0.0200	0.72		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.17"
0.1	7	0.0200	0.99		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
1.8	252	0.0130	2.31		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
8.9	308	Total			

Subcatchment S5D: To CB-4



Summary for Subcatchment S5E:

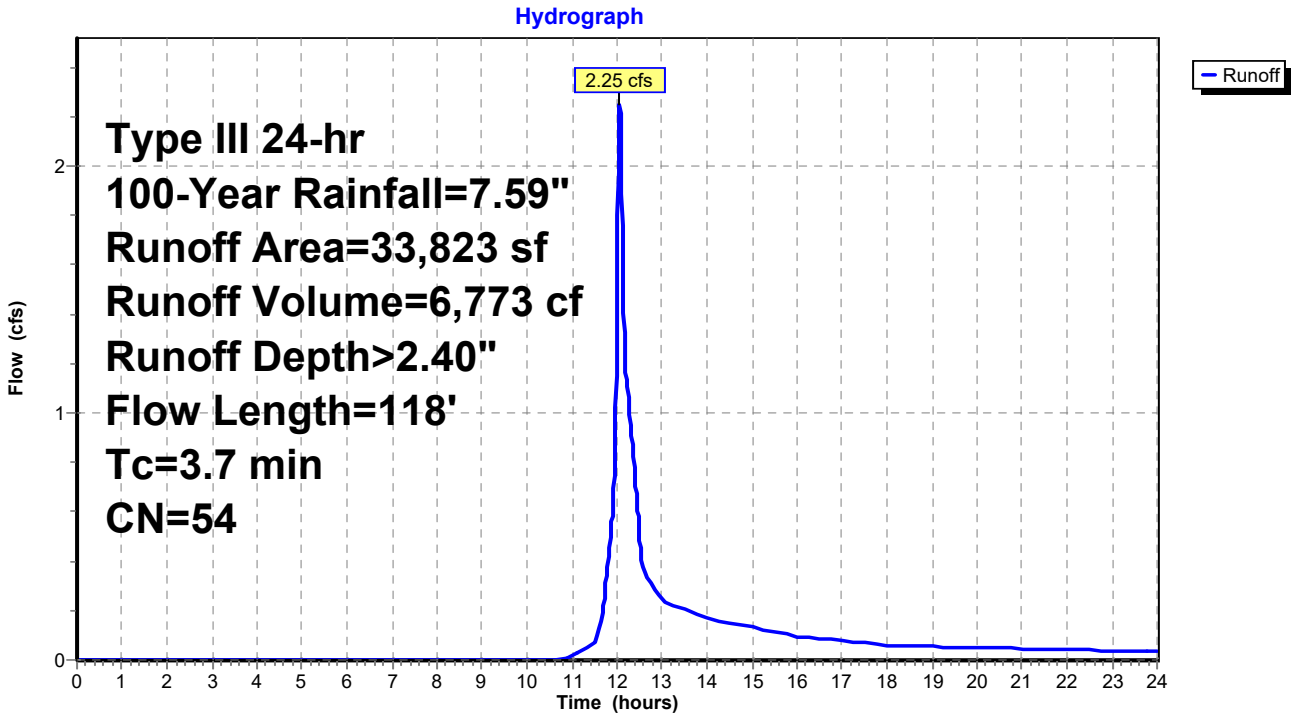
Runoff = 2.25 cfs @ 12.06 hrs, Volume= 6,773 cf, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
*	1,730	98	Paved Driveway, HSG A
	3,138	98	Roofs, HSG A
	19,630	39	>75% Grass cover, Good, HSG A
*	9,325	61	>75% Grass cover, Good, HSG B/D
	33,823	54	Weighted Average
	28,955		85.61% Pervious Area
	4,868		14.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	50	0.0890	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.17"
0.6	68	0.0780	1.95		**Shallow Concentrated Flow, Lawn** Short Grass Pasture Kv= 7.0 fps
3.7	118	Total			

Subcatchment S5E:



Summary for Subcatchment S6:

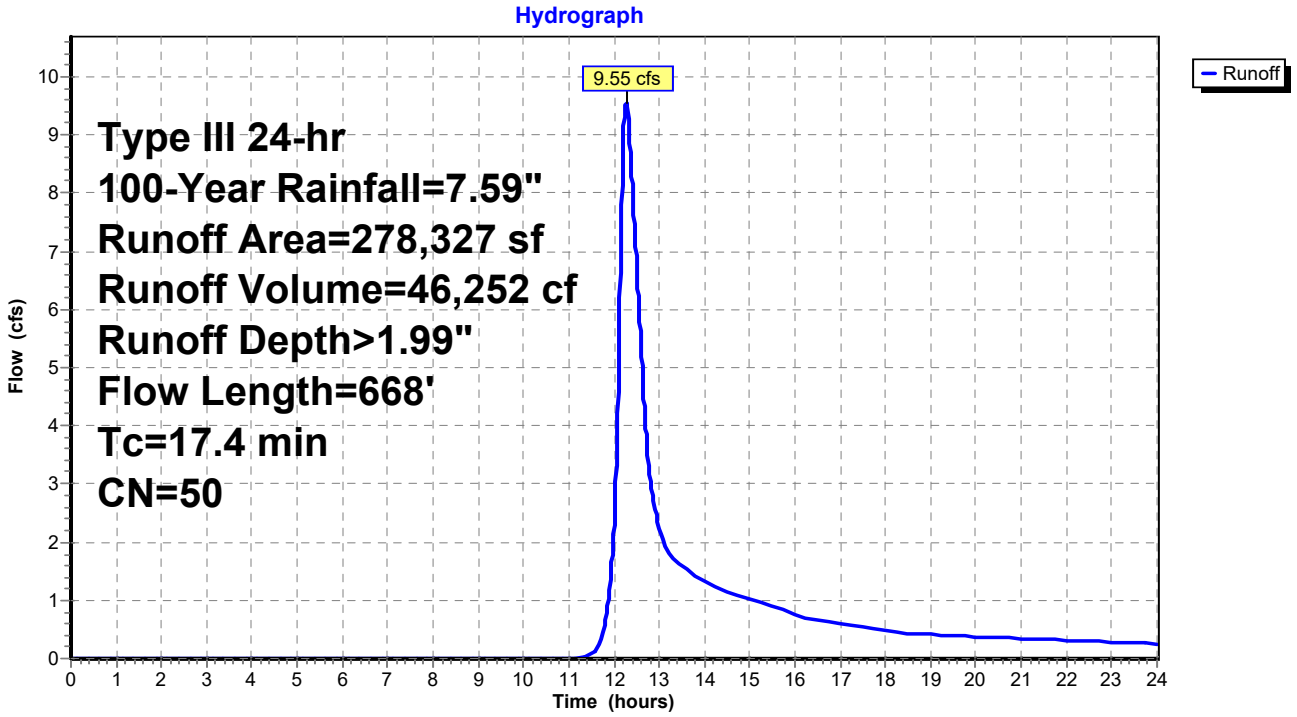
Runoff = 9.55 cfs @ 12.27 hrs, Volume= 46,252 cf, Depth> 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

	Area (sf)	CN	Description
	165,239	55	Woods, Good, HSG B
	27,727	30	Woods, Good, HSG A
*	9,535	55	Woods, Good, HSG B/D
*	862	56	Stabilized Slope, HSG B
*	16,306	35	Stabilized Slope, HSG A
	936	98	Roofs, HSG A
*	936	98	Roofs, HSG B/D
	37,336	39	>75% Grass cover, Good, HSG A
*	19,450	61	>75% Grass cover, Good, HSG B/D
	278,327	50	Weighted Average
	276,455		99.33% Pervious Area
	1,872		0.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Woodland** Woods: Light underbrush n= 0.400 P2= 3.17"
1.6	134	0.0740	1.36		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
2.0	112	0.0350	0.94		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.9	104	0.1340	1.83		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.8	70	0.0850	1.46		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.2	39	0.3150	3.93		**Shallow Concentrated Flow, Vegitated Slope** Short Grass Pasture Kv= 7.0 fps
4.8	159	0.0250	0.55	3.29	**Channel Flow, Grass Swale** Area= 6.0 sf Perim= 324.0' r= 0.02' n= 0.030 Earth, grassed & winding
17.4	668	Total			

Subcatchment S6:



Summary for Reach 1R: DMH-2 to DMH-1

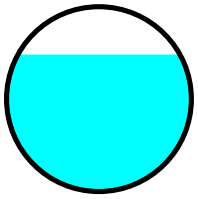
[52] Hint: Inlet/Outlet conditions not evaluated

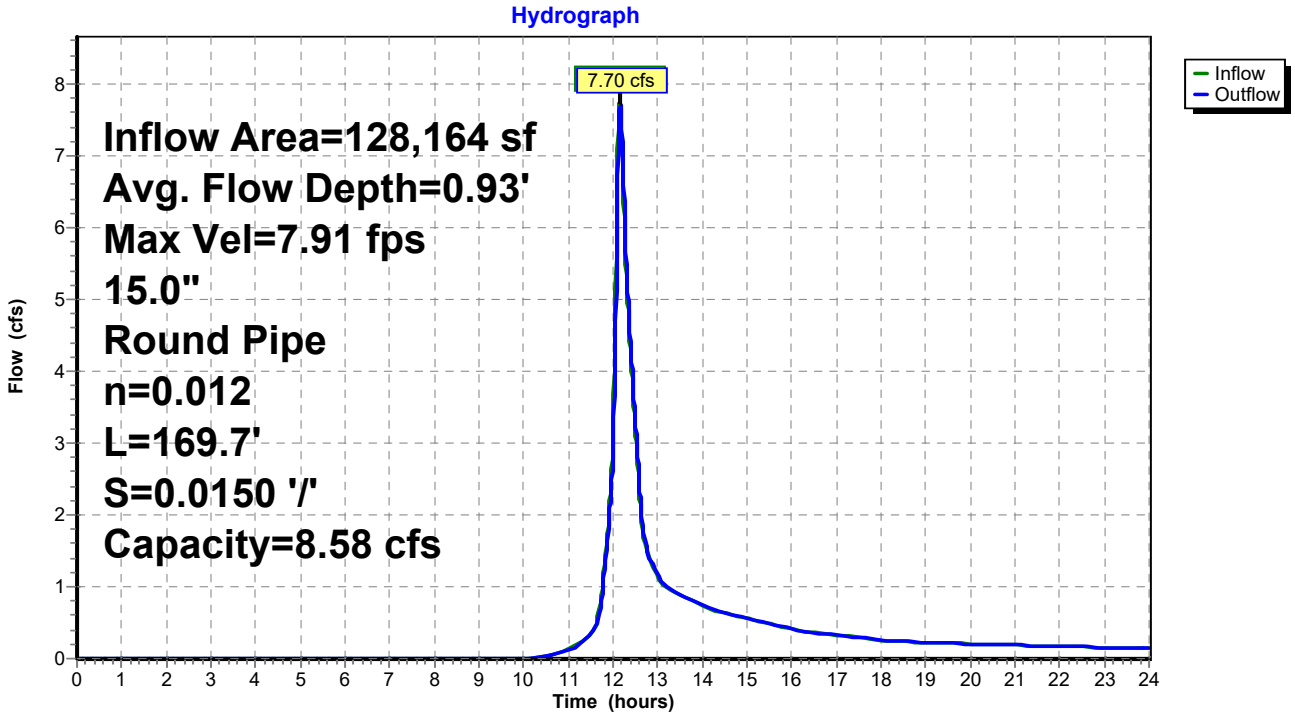
Inflow Area = 128,164 sf, 25.98% Impervious, Inflow Depth > 2.73" for 100-Year event
Inflow = 7.72 cfs @ 12.15 hrs, Volume= 29,117 cf
Outflow = 7.70 cfs @ 12.16 hrs, Volume= 29,105 cf, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.91 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.37 fps, Avg. Travel Time= 0.8 min

Peak Storage= 165 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.93'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 8.58 cfs

15.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 169.7' Slope= 0.0150 '/'
Inlet Invert= 777.16', Outlet Invert= 774.61'





Summary for Reach 2R: DMH-1 - DMH-3

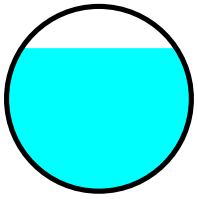
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach 1R outlet invert by 0.05' @ 12.15 hrs

Inflow Area = 251,476 sf, 26.00% Impervious, Inflow Depth > 2.71" for 100-Year event
Inflow = 15.17 cfs @ 12.14 hrs, Volume= 56,701 cf
Outflow = 15.15 cfs @ 12.15 hrs, Volume= 56,688 cf, Atten= 0%, Lag= 0.4 min

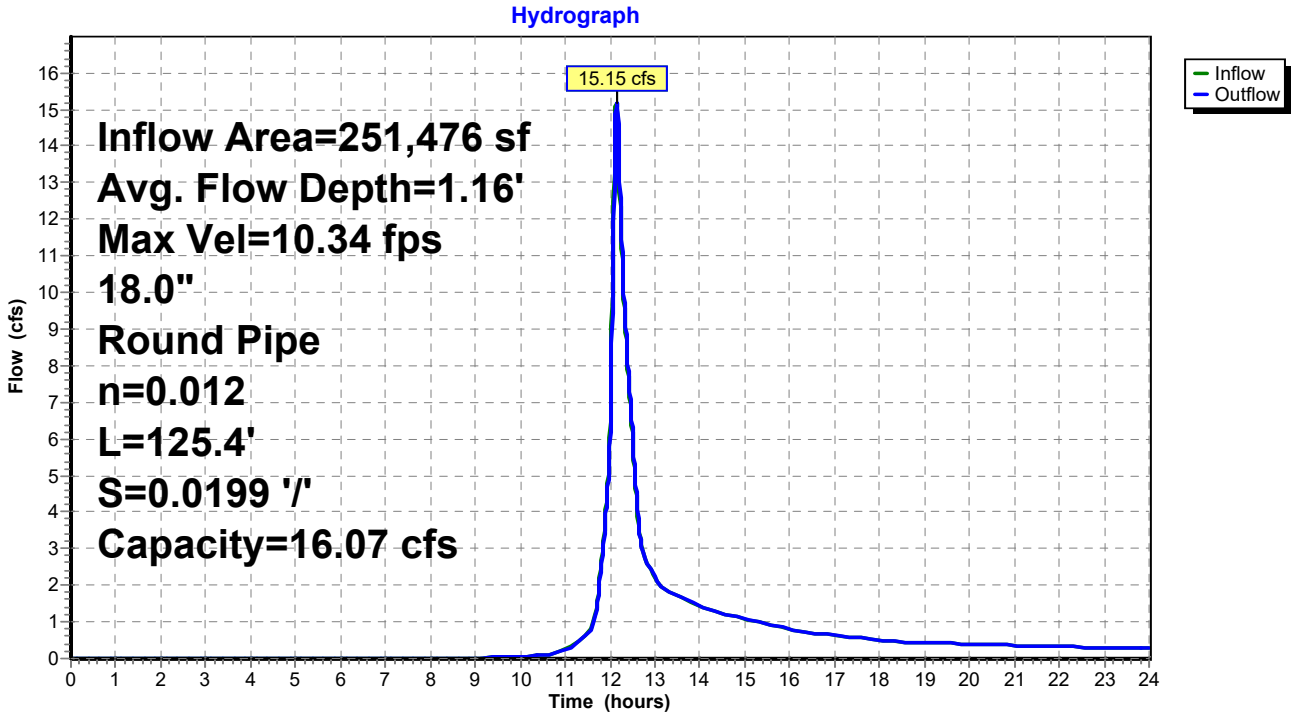
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.34 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.03 fps, Avg. Travel Time= 0.5 min

Peak Storage= 184 cf @ 12.15 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 16.07 cfs

18.0" Round Pipe
n= 0.012
Length= 125.4' Slope= 0.0199 '/'
Inlet Invert= 773.50', Outlet Invert= 771.00'



Reach 2R: DMH-1 - DMH-3



Summary for Reach 3R: DMH-3 to FE-1

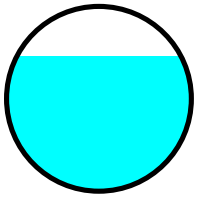
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach 2R outlet invert by 1.00' @ 12.15 hrs

Inflow Area = 251,476 sf, 26.00% Impervious, Inflow Depth > 2.71" for 100-Year event
Inflow = 15.15 cfs @ 12.15 hrs, Volume= 56,688 cf
Outflow = 15.15 cfs @ 12.15 hrs, Volume= 56,685 cf, Atten= 0%, Lag= 0.1 min

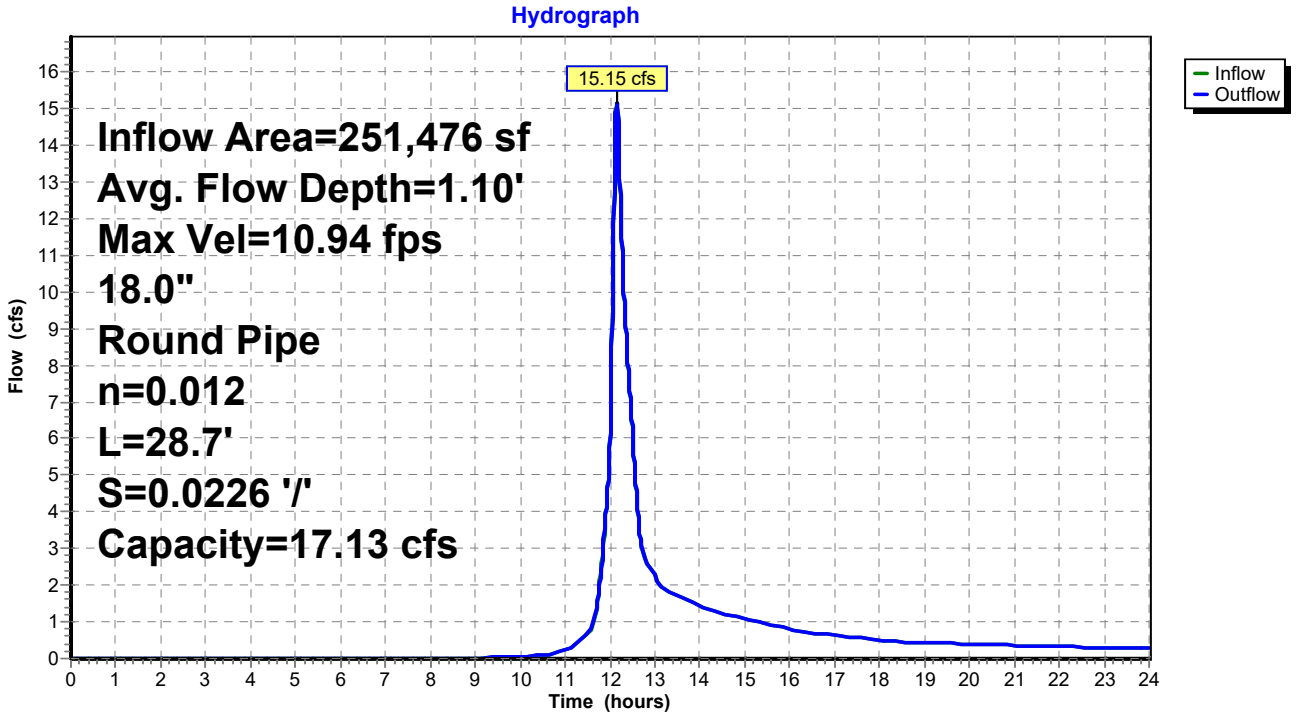
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.94 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 4.22 fps, Avg. Travel Time= 0.1 min

Peak Storage= 40 cf @ 12.15 hrs
Average Depth at Peak Storage= 1.10'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 17.13 cfs

18.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 28.7' Slope= 0.0226 '/'
Inlet Invert= 770.90', Outlet Invert= 770.25'



Reach 3R: DMH-3 to FE-1



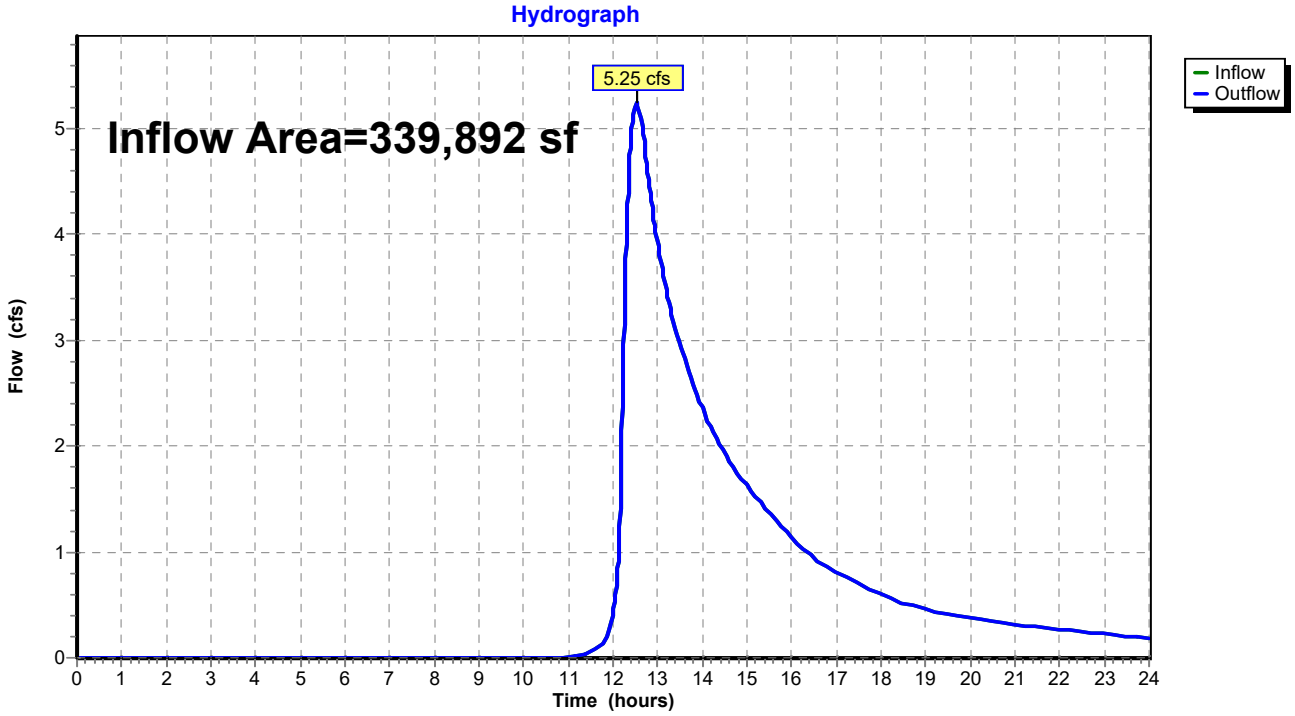
Summary for Reach Post R: Post

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 339,892 sf, 20.67% Impervious, Inflow Depth > 1.77" for 100-Year event
Inflow = 5.25 cfs @ 12.53 hrs, Volume= 50,016 cf
Outflow = 5.25 cfs @ 12.53 hrs, Volume= 50,016 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach Post R: Post



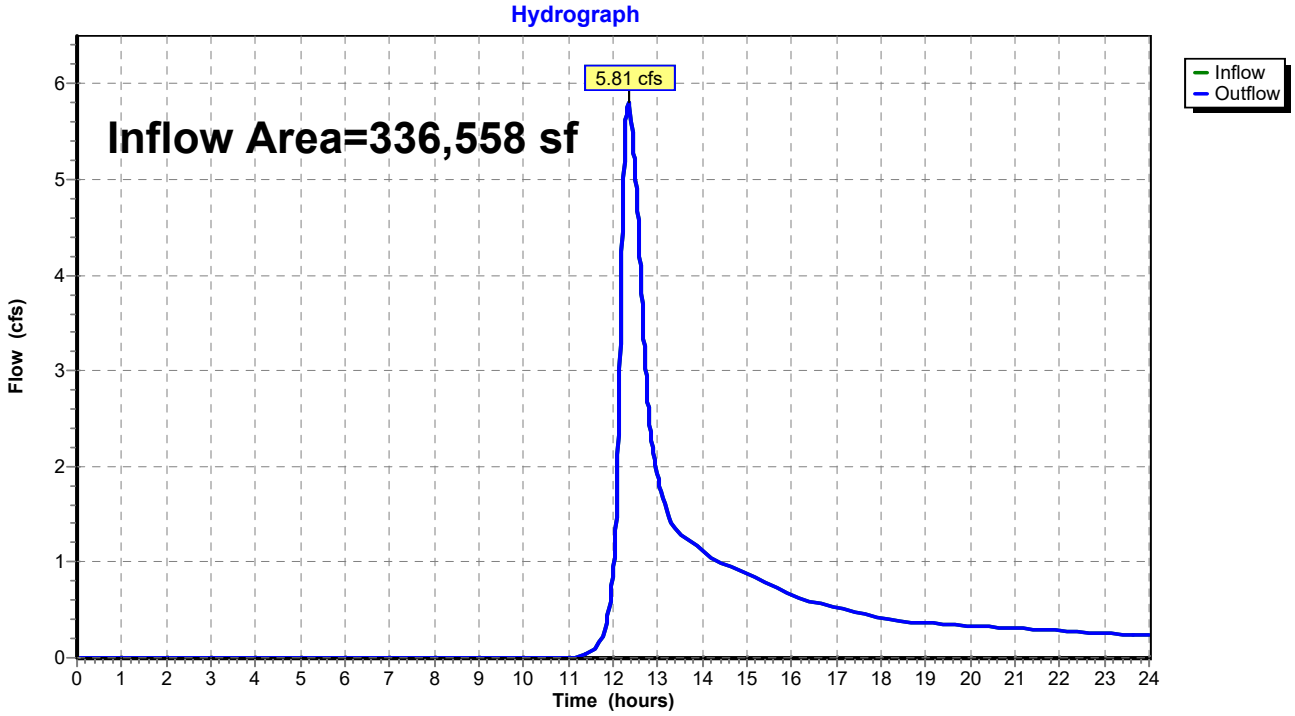
Summary for Reach Pre R: Pre

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 336,558 sf, 2.85% Impervious, Inflow Depth > 1.26" for 100-Year event
Inflow = 5.81 cfs @ 12.34 hrs, Volume= 35,294 cf
Outflow = 5.81 cfs @ 12.34 hrs, Volume= 35,294 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach Pre R: Pre



Summary for Pond 1P: Infiltration Pond

[63] Warning: Exceeded Reach 3R INLET depth by 2.35' @ 12.75 hrs

Inflow Area = 285,299 sf, 24.63% Impervious, Inflow Depth > 2.67" for 100-Year event
Inflow = 16.58 cfs @ 12.14 hrs, Volume= 63,459 cf
Outflow = 3.98 cfs @ 12.64 hrs, Volume= 51,201 cf, Atten= 76%, Lag= 30.0 min
Discarded = 0.34 cfs @ 12.64 hrs, Volume= 12,054 cf
Primary = 3.63 cfs @ 12.64 hrs, Volume= 39,147 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 773.69' @ 12.64 hrs Surf.Area= 8,922 sf Storage= 24,028 cf

Plug-Flow detention time= 156.6 min calculated for 51,180 cf (81% of inflow)
Center-of-Mass det. time= 78.2 min (935.7 - 857.5)

Volume	Invert	Avail.Storage	Storage Description
#1	770.00'	36,585 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

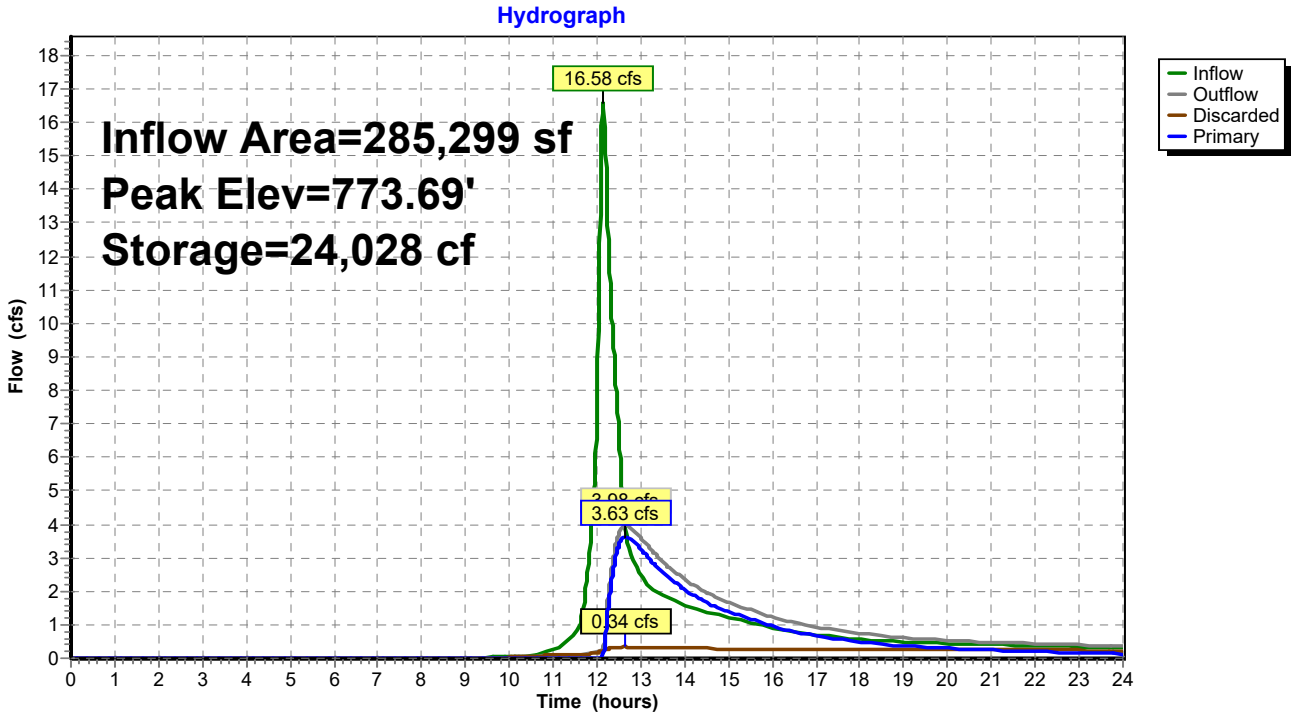
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
770.00	4,236	0	0
770.50	4,825	2,265	2,265
770.75	5,124	1,244	3,509
771.00	5,427	1,319	4,828
772.00	6,675	6,051	10,879
774.00	9,340	16,015	26,894
775.00	10,042	9,691	36,585

Device	Routing	Invert	Outlet Devices
#1	Primary	768.50'	**12.0" Round 12" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 768.50' / 766.00' S= 0.0417 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	773.90'	**48.0" x 48.0" Horiz. 48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	770.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 766.00'
#4	Device 1	772.00'	**0.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#5	Primary	774.00'	**10.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.34 cfs @ 12.64 hrs HW=773.69' (Free Discharge)
└**3=Exfiltration** (Controls 0.34 cfs)

Primary OutFlow Max=3.63 cfs @ 12.64 hrs HW=773.69' (Free Discharge)
└**1=12" Round Culvert** (Passes 3.63 cfs of 8.19 cfs potential flow)
└**2=48.0" x 48.0" Horiz. Orifice/Grate** (Controls 0.00 cfs)
└**4=Broad-Crested Rectangular Weir** (Weir Controls 3.63 cfs @ 4.31 fps)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Infiltration Pond



Summary for Pond 5P: Detention Pond

Inflow Area = 278,327 sf, 0.67% Impervious, Inflow Depth > 1.99" for 100-Year event
Inflow = 9.55 cfs @ 12.27 hrs, Volume= 46,252 cf
Outflow = 5.77 cfs @ 12.57 hrs, Volume= 41,084 cf, Atten= 40%, Lag= 18.0 min
Primary = 5.77 cfs @ 12.57 hrs, Volume= 41,084 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 773.26' @ 12.57 hrs Surf.Area= 6,480 sf Storage= 12,048 cf

Plug-Flow detention time= 97.8 min calculated for 41,084 cf (89% of inflow)
Center-of-Mass det. time= 45.7 min (927.9 - 882.2)

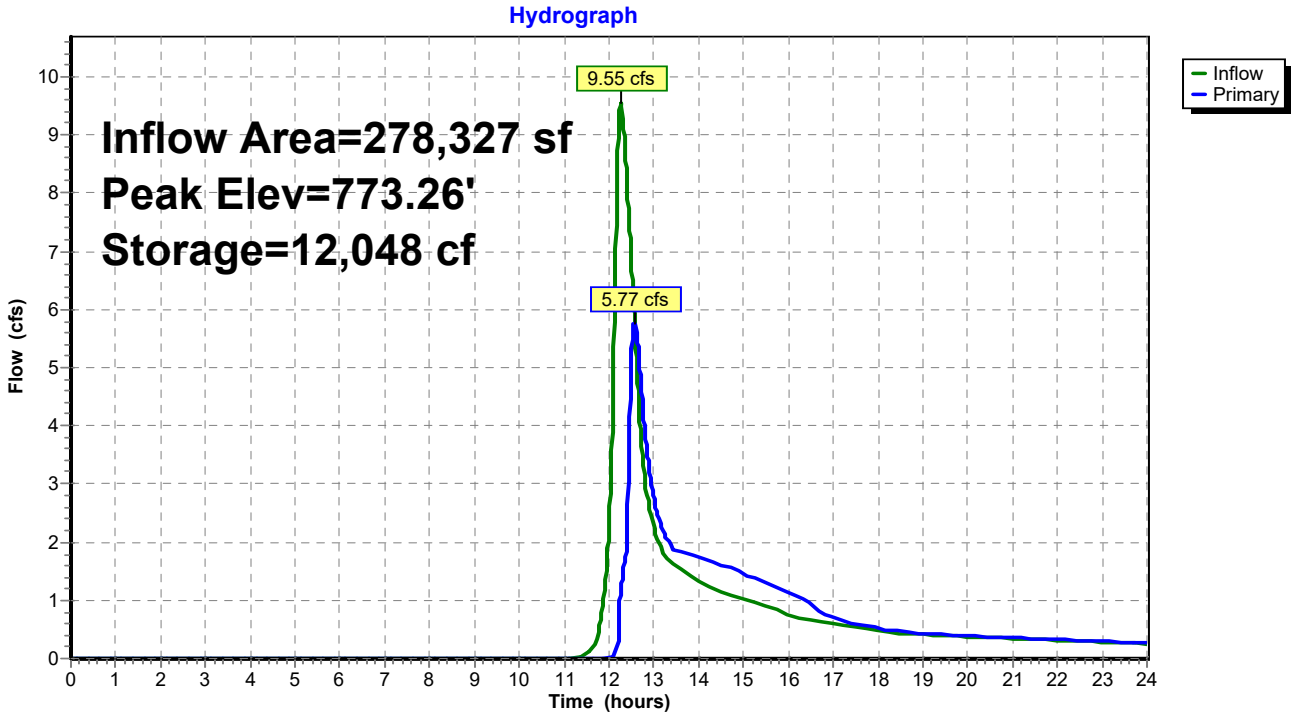
Volume	Invert	Avail.Storage	Storage Description
#1	771.00'	17,096 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
771.00	4,208	0	0
772.00	5,164	4,686	4,686
774.00	7,246	12,410	17,096

Device	Routing	Invert	Outlet Devices
#1	Primary	769.00'	**8.0" Round Culvert** L= 43.0' Ke= 0.500 Inlet / Outlet Invert= 769.00' / 768.00' S= 0.0233 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	771.00'	**1.0" Vert. Orifice/Grate** X 4 rows with 6.3" cc spacing C= 0.600
#3	Device 1	771.50'	**1.0" Vert. Orifice/Grate** X 4 rows with 6.3" cc spacing C= 0.600
#4	Device 1	772.00'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	773.00'	**10.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.76 cfs @ 12.57 hrs HW=773.26' (Free Discharge)
- **1=Culvert** (Passes 2.11 cfs of 3.22 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 5.64 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.09 cfs @ 4.35 fps)
  - **4=Orifice/Grate** (Orifice Controls 1.89 cfs @ 5.41 fps)
- **5=Broad-Crested Rectangular Weir** (Weir Controls 3.65 cfs @ 1.38 fps)

Pond 5P: Detention Pond



Inlet Calculations	Sunshine Ridge - Holden													100 yr Storm n = 0.012	
	Watershed Area					Time of Concentration									
	Impervious	Woodland	Grass			Impervious		Woodland		Grass					
Inlet	Impervious Area (s.f.)	Woodland Area (s.f.)	Lawn Area (s.f.)	Total Area (S.F.)	C (Composite)	Length (ft)	Slope (ft/ft)	Length (ft)	Slope (ft/ft)	Length (ft)	Slope (ft/ft)	Time of Concentration (Minutes, 5 minimum)	Intensity (in/hr)	Runoff (cfs)
CB-1	100 Year flows from HydroCAD			106,072	54	100 Year flows from HydroCAD						8.7	7.59	5.88
CB-2				17,240	73							6.8	7.59	2.01
CB-3				98,158	56							11.1	7.59	5.54
CB-4				30006	61							8.9	7.59	2.25

*Values in table come from Hydrocad 100 yr Storm

= Locations where double grate is required

Pipe Sizing Calculations		**Sunshine Ridge - Holden**											100 yr Storm				n = 0.012
Pipe Run		Runoff											Pipe Properties				
		Inlet Flow					Upstream Pipe Flow										
From	To	Area (sq. ft.)	C	Time of Concentration	Intensity (in/hr)	Run-off (cfs)	Tributary Area (sq. ft.)	Composite C	Travel time in pipe (min)	Total Time of Concentration	Intensity (In/hr)	Run-off (cfs)	Slope of Pipe	Length of Pipe	Min. Pipe Size (in)	Pipe Size Used (in)	Capacity (cfs)	100 Year Velocity (fps)
DMH-2	DMH-1	100 Year flows from HydroCAD										7.70	0.015	169.70	15	15	8.58	7.91
DMH-1	DMH-3											15.15	0.020	125.40	18	18	16.07	10.34
DMH-3	FE-1											15.15	0.023	28.70	18	18	17.13	10.34
OS-1	FE-2											3.63	0.042	60.00	9	12	8.19	4.60
OS-2	FE-3											2.11	0.023	43.00	7	8	3.22	6.02

Section 3

Supporting calculations and documentation for Stormwater Management Standard 3

- Infiltration Calculations
- NCRS Soil Report

Section 3 – Groundwater Recharge

Supporting Calculations for Stormwater Management Standard 3

Recharge volume required:

NRCS Hydrologic Soil Group	Target Depth Factor (Inches)	New Impervious Area* (ft^2)	Recharge Volume (ft^3)
A	0.60	66960 ft^2	3348 ft^3
B	0.35	5167 ft^2	151 ft^3
C	0.25	0 ft^2	0 ft^3
D	0.10	0 ft^2	0 ft^3
Total Required Recharge Volume = 3499 ft^3			

* The new impervious area also accounts for the existing pervious area for this design. The inclusion of existing impervious area exceeds the requirements of Stormwater Standard 3.

The total groundwater recharge volume requirement for this development is 3,499 ft^3. This design has included calculated the recharge requirement and includes the existing impervious areas. The total required recharge volume calculated exceeds the requirements of Stormwater Standard 3.

Recharge volume provided: (Static Method)

Groundwater recharge is provided for through infiltration of the water that flows from the roofs and paved surfaces through the deep sump catch basins or qualifying pervious grassed lawns into the sediment forebays and infiltration basin.

The recharge volume provided equals the storage capacity of the infiltration basin.

Infiltration Basin Storage = 10,879 ft^3

Total recharge provided = 10,879 ft^3

10,879 ft^3 > 3499 ft^3, the recharge volume provided is adequate.
The recharge provided meets the Stormwater Standard 3.

Infiltration System Drawdown Calculations:

Storage Volume= 10,879 ft^3

Rawls Rate = 1.02 in/hr

Bottom Area = 3,300 ft^2

Drawdown Time = $\frac{(10879\ ft^3)(12\ in/ft)}{(3300\ ft^2)(1.02\ in/hr)}$ = 38.8 hours

38.8 hours < 72 hours, Drawdown time is adequate

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Worcester County, Massachusetts, Northeastern Part

Bailey Road - Holden, MA.

June 24, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 14, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
31A	Walpole sandy loam, 0 to 3 percent slopes	4.4	11.1%
52A	Freetown muck, 0 to 1 percent slopes	0.6	1.6%
245C	Hinckley loamy sand, 8 to 15 percent slopes	0.5	1.3%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	7.2	18.2%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	5.9	14.9%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	0.9	2.2%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	2.9	7.4%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	2.6	6.5%
422D	Canton fine sandy loam, 15 to 35 percent slopes, extremely stony	12.0	30.2%
651	Udorthents, smoothed	2.6	6.6%
Totals for Area of Interest		**39.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties

and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Worcester County, Massachusetts, Northeastern Part

31A—Walpole sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svkl
Elevation: 0 to 1,020 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Walpole and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Walpole

Setting

Landform: Outwash terraces, depressions, outwash plains, depressions, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from igneous, metamorphic and sedimentary rock

Typical profile

Oe - 0 to 1 inches: mucky peat
A - 1 to 7 inches: sandy loam
Bg - 7 to 21 inches: sandy loam
BC - 21 to 25 inches: gravelly sandy loam
C - 25 to 65 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Sudbury

Percent of map unit: 10 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Scarboro

Percent of map unit: 10 percent
Landform: Deltas, outwash terraces, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Marshes, kettles, depressions, depressions, swamps, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Swamps, marshes, bogs, kettles, depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

245C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, kames, eskers, outwash terraces, kame terraces, outwash plains, moraines
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, concave, linear
Across-slope shape: Concave, linear, convex
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Kames, eskers, outwash terraces, moraines, outwash plains
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Moraines, kames, outwash terraces, eskers, kame terraces, outwash plains, outwash deltas
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Linear, convex, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash terraces, kame terraces, outwash plains, moraines, outwash deltas
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Kames, eskers, outwash terraces, moraines, outwash plains
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Outwash plains, deltas, kames, eskers
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Outwash plains, deltas, dunes, outwash terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Outwash terraces, moraines, outwash plains, kames, stream terraces, eskers
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

254C—Merrimac fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2tyqt
Elevation: 0 to 1,030 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Merrimac and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, outwash plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Deltas, dunes, outwash terraces, outwash plains
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

260B—Sudbury fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: w3pw
Elevation: 0 to 2,100 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sudbury and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sudbury

Setting

Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 18 inches: fine sandy loam
H3 - 18 to 25 inches: gravelly loamy sand
H4 - 25 to 60 inches: gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Ninigret
Percent of map unit: 5 percent
Hydric soil rating: No

Merrimac
Percent of map unit: 5 percent
Hydric soil rating: No

Agawam
Percent of map unit: 5 percent
Hydric soil rating: No

Walpole
Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

421B—Canton fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting
National map unit symbol: 2w81l
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Canton, very stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Very Stony

Setting
Landform: Hills, ridges, moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile
Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam

Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate, very stony

Percent of map unit: 9 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk, very stony

Percent of map unit: 5 percent
Landform: Hills, ground moraines, recessionial moraines, drumlins
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Gloucester, very stony

Percent of map unit: 4 percent
Landform: Hills, ridges, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 2 percent
Landform: Swamps, bogs, marshes, kettles, depressions

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

421C—Canton fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w814
Elevation: 0 to 1,160 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Canton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Very Stony

Setting

Landform: Hills, ridges, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Montauk, very stony

Percent of map unit: 6 percent
Landform: Drumlins, hills, ground moraines, recessionial moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Scituate, very stony

Percent of map unit: 5 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, very stony

Percent of map unit: 3 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Swamps, bogs, marshes, kettles, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

422D—Canton fine sandy loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w81j
Elevation: 0 to 1,340 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Extremely Stony

Setting

Landform: Hills, ridges, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Montauk, extremely stony

Percent of map unit: 6 percent
Landform: Recessionial moraines, drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ridges, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Hollis, extremely stony

Percent of map unit: 4 percent
Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 4 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: w3q6
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 80 percent
Urban land: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Made land over firm loamy basal till

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Properties and qualities

Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

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Section 4

Supporting calculations for Stormwater Management Standard 4

- Water Quality Treatment Volume Calculations

Section 4 – Water Quality

Supporting Calculations for Stormwater Management Standard 4

These calculations are provided to demonstrate maximum feasible compliance with Stormwater Management Standard 4. This standard establishes the required stormwater treatment volumes and water quality for the discharges proposed within the development. This site has been designed to incorporate stormwater Low Impact Development (LID) Site Design Credits 2 and 3 because portions of the pavement and rooftops from this site are directed to qualifying pervious areas. Areas around the proposed site will be vegetated with grass with slopes that do not exceed 5% to promote treatment and infiltration of stormwater. The use of qualifying pervious areas reduces the required recharge volume as well as the required water quality volume. Even though this credit applies to this project the proposed design provides the required recharge and water quality volumes through the use of a stormwater collection system that discharges to an infiltration basin.

The water quality and treatment requirements are partially satisfied per Stormwater LID Credits 2 & 3.

Stormwater Treatment was provided by the proposed stormwater design implemented at the site even though the treatment and water quality requirement could be reduced by LID Credits 2 & 3. This project uses deep sump catch basins, sediment forbays, and an infiltration basin to provide stormwater treatment for TSS removal and volume attenuation.

Water Quality Treatment Volume:

Total new impervious area for this development = 72,127

ft^2 Required water quality depth = 1.0”

Water quality volume = (1.0 in/12 in/ft)(72127ft^2) = 6,011 ft^3 required

Water quality treated = infiltration storage volume

Infiltration basin storage = 10,879 ft^3

Water quality volume reduction per Credits 2 & 3 were available, but not applied

10,879 ft^3>6,011 ft^3 Therefore the water treatment volume is greater than the required water treatment volume per Standard 4.

Sediment Forebay Sizing:

Impervious area = 72127 ft^2

Forebay volume = (72127 ft^2)(0.1 in)/12 in/ft) = 601 ft^3 required

Forebay volume provided > 615 ft^3 for each forebay

TSS Removal Calculations:

Location:	FE-2			
BMP	**Removal Rate**	**Starting TSS**	**Amt. Removed**	**Remaining Load**
Deep sump catch basins	25%	1.00	0.25	0.75
Forebay 1	25%	0.75	0.1875	0.5625
Forebay 2	25%	0.5625	0.1406	0.4219
Infiltration Basin	80%	0.4219	0.3375	0.0844
Total TSS Removal = 91.6%				

Section 8

Construction Period Erosion, Sedimentation and Pollution Prevention Plan

- SWPPP Report
- Inspection Form
- Spill Report Form

Construction Period
Storm Water Pollution Prevention Plan

Introduction

Storm Water Pollution Prevention Plan Requirements

This Storm Water Pollution Prevention Plan (SWPPP) was developed consistent with the requirements of the National Pollutant Discharge Elimination System (NPDES) General Storm water Permit for Construction Activities.

The Plan, properly implemented, should result in the discharge of water to the environment without the violation of Water Quality Standards.

Content

This SWPPP is broken down into the following sections, consistent with the requirements of the NPDES Construction General Permit.

- Identification of the SWPPP coordinator with a description of this person's duties;
- Description of the existing site conditions including existing land use for the site;
- Identification of the body of water(s) which will receive runoff from the construction site, including the ultimate body of water that receives the storm water;
- Identification of drainage areas and potential storm water contaminants;
- Description of storm water management controls and various Best Management Practices (BMPs) necessary to reduce erosion, sediment and pollutants in storm water discharge;
- Description of the facility monitoring plan and how controls will be coordinated with construction activities and a

Purpose

The purpose of this SWPPP is to:

- Describe the BMPs used to minimize erosion and sediment runoff at the site
- Identify, reduce, eliminate, or prevent the pollution of storm water
- Prevent violations of surface water quality or groundwater quality standards

Facility Description

Site Location

The proposed development is located on Bailey Road, approximately 500 feet north of the Bailey Road/Hubbard Lane intersection.

Construction Type

The proposed development includes the construction of 7 single family homes, serviced by a public water and sewer, along a 500 ft long road with a cul-de-sac. The area impacted by the proposed development is approximately 9.0 acres of land. The development requires construction activities associated with each of the following proposed components:

- Utility construction;
- Building construction;
- Private roadway construction;
- Driveway construction;
- Stormwater management facilities construction;

The owners and their various sub-contractors will be on site from approximately 7am until 5pm, five days per week. Clearing and grading, construction of the roads, drainage structures, utilities and site landscaping is expected to be completed 2 years following ground-breaking.

Existing Conditions

The existing property is approximately 13.23 acres and the site is comprised of woods and a forested Bordering Vegetated Wetland (BVW). The site is located within the Nashua River watershed.

Proposed Conditions

The proposed development includes the construction of 7 single family homes, serviced by a public water and sewer, along a 500 ft long road with a cul-de-sac. The area impacted by the proposed development is approximately 9.0 acres. A stormwater management system that treats the water that flows from the roofs and paved surfaces to qualifying pervious areas and/or deep sump catch basins, sediment forebays, and an infiltration basin will be constructed to attenuate and treat the increased runoff. A detention basin will also be constructed for flow attenuation. Town water & sewer will also be utilized for the development. A stormwater system is provided to attenuate runoff flow rates.

Stormwater runoff is collected by a drainage conveyance and treatment system designed in full compliance with the Stormwater Management Standards. Peak runoff rates are attenuated through the Stormwater System, specifically an infiltration basin with sediment forebays and a detention basin. In consideration of aesthetic and maintenance concerns, the basins are generally located away from the proposed homes.

Water quality is improved through treatment trains consisting of qualifying grassed pervious areas, deep sump catch basins, multiple sediment forebays, a detention basin, and an infiltration basin. All discharges to stormwater basins are provided with a minimum pretreatment rate of 44% as the discharge within the project is located near an area designated as an Outstanding Resource Water.

Identification of Potential Storm Water Contaminants

Significant Material Inventory

Pollutants that result from clearing, grading, excavation and building materials and have the potential to be present in storm water runoff are listed in Table 1. This table includes information regarding material type, chemical and physical description, and the specific regulated storm water pollutants associated with each material.

Potential Areas for Storm Water Contamination

The following potential source areas of storm water contamination have been identified:

- Areas that are to be cleared and grubbed
- Areas to be graded
- House, road, and utility construction
- Stormwater facilities construction

Table 2 contains information regarding storm water pollution potential from each of these areas.

Table 1
Potential Construction Site Storm Water Pollutants

Material	Description	Pollutant
Pesticides	Various colored to colorless liquid, powder, grains, or pellets	Chlorinated hydrocarbons, organophosphates, carbamates, arsenic
Fertilizer	Liquid or solid grains	Nitrogen, Phosphorous
Plaster	White granules or powder	Calcium sulphate, calcium carbonate, sulfuric acid
Cleaning solvents	Colorless, blue, or yellow-green liquid	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates
Asphalt	Black solid	Oil, petroleum distillates
Concrete	White solid	Limestone, sand
Glue, adhesives	White or yellow liquid	Polymers, epoxies
Paints	Various colored liquid	Metal oxides, stoddard solvent, talc, calcium carbonate, arsenic
Curing compounds	Creamy white liquid	Naphtha
Waste water from construction equipment washing	Water	Soil, oil and grease, solids
Wood preservatives	Clear amber or dark brown liquid	Stoddard solvent, petroleum distillates, arsenic, copper, chromium
Hydraulic oil/fluids	Brown oily petroleum hydrocarbon	Mineral oil
Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE
Diesel fuel	Clear, blue-green to yellow liquid	Petroleum distillate, oil and grease, naphthalene, xylenes
Antifreeze/coolant	Clear green/yellow liquid	Ethylene glycol, propylene glycol, heavy metals (copper, zinc, lead)
Erosion	Solid particles	Soil, sediment

Table 2
Locations of Potential Sources of Storm Water Contamination

Potential Point of Contamination	Potential Pollutants	Potential Problems
Areas to be graded	Soil erosion, fertilizer, pesticides	Erosion of soils from cleared and graded areas have the potential to discharge into protected resource areas.
Utility construction	Asphalt, hydraulic oil, gasoline, antifreeze, soil erosion, fertilizer, pesticides	Leaking of hydraulic oil and antifreeze from clearing, grading and asphalt application construction equipment, gasoline and diesel fuel spills while fueling construction equipment, erosion of exposed and stockpiled soils. Asphalt chemicals can be released to storm water if a rain even occurs before curing is complete. Tracking of soil into the road through the construction site entrance.
Building construction	Paints, hydraulic oil, gasoline, antifreeze, soil erosion, fertilizer, pesticides	Leaking hydraulic oil and antifreeze from clearing, grading and asphalt application construction equipment, gasoline and diesel fuel spills while fueling construction equipment, erosion of exposed and stockpiled soils, and degradation of scrap dry wall can contaminate storm water. Asphalt chemicals can be released to storm water if a rain event occurs before curing is complete.
Areas that are to be cleared and grubbed	Soil erosion, fertilizer, pesticides	Ruts caused by logging equipment can fill with water, preventing complete re-vegetation.

Stormwater Management Controls

Temporary and Permanent Erosion Control Practices

A list of best management practices (BMPs) has been developed and the locations of these BMPs are shown on the Sedimentation and Erosion Control Plan.

Construction BMPs

To prevent soil from washing off the site during construction, the following Construction BMPs will be implemented:

- **Sedimentation Barrier:** A sedimentation barrier will be placed along the downhill perimeter of the of the construction area before any clearing or grading takes place.
- **Diversion Berms:** Throughout site grading activities, diversion berms will be placed at the direction of the SWPPP coordinator to ensure runoff is directed toward the other construction BMPs for treatment.
- **Stabilization:** All areas which will not be impacted by construction will be seeded. A permanent seed mix consisting of 20% Red Top, 60% Chewings Fescue and 20% Kentucky Bluegrass is recommended. Each area will be "Hydro-seeded" with high fiber content or mulched with 4,000 pounds per acre of straw. The straw mulch is to be tacked into place by a disk with blades set nearly straight.
- **Stockpiling:** Stockpiles of fill material and gravel shall be surrounded with compost socks. Topsoil stockpiles shall be surrounded with straw wattles and, if not required for use within 14 days, stabilized with temporary seed and mulch. The recommended temporary seed is Rye (grain).
- **Sediment Basins:** Temporary sediment basins will be constructed at all proposed discharge points to settle out suspended solids prior to construction and operation of permanent BMPs.
- **Construction Entrance:** A washed stone construction entrance will be provided to eliminate construction vehicles from tracking soil onto the public ways.

Permanent BMPs

A description of and maintenance plan for the permanent BMPs proposed for this project may be found within the project plans, specifications, and Operation and Maintenance Plan.

Construction Practices to Minimize Storm Water Contamination

All waste materials will be collected and stored in a securely lidded metal dumpster rented from a licensed solid waste management company. All trash and construction debris will be deposited in the dumpster. No construction materials will be buried on-site. All personnel will be instructed regarding the current procedure for waste disposal. All sanitary waste will be collected from portable units by a licensed sanitary waste management company. Good housekeeping and spill control practices will be followed during construction to minimize storm water contamination from petroleum products, fertilizers, paints and concrete. Good housekeeping practices for the site are listed below:

- Fertilizers will be applied only in the minimum amounts recommended by the manufacturer.
- Fertilizers will be worked into the soil to limit exposure to storm water.
- All vehicles on-site will be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage.
- Petroleum products will be stored in tightly sealed containers which are clearly labeled.
- Spill kits will be included with all fueling sources and maintenance activities.
- Sanitary waste will be collected from portable units a minimum of two times a week.
- A covered dumpster will be used for all waste materials
- All paint containers and curing compounds will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm system, but will be disposed of according to the manufacturer's instructions.
- Materials and equipment necessary for spill cleanup will be kept on-site. Equipment will include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, saw dust and plastic and metal trash containers.
- Spray guns will be cleaned on a removable tarp.
- All spills will be cleaned up immediately upon discovery. Spills large enough to reach the storm system will be reported to the National Response Center at 1-800-424-8802
- The paved street adjacent to the site entrance will be swept daily to remove excess mud, dirt or rock tracked from the site.
- Dump trucks hauling material to and from the construction site will be covered with tarpaulins.
- All ruts caused by equipment used for cutting and removing trees will be graded.

Coordination of BMPs with Construction Activities

BMPs will be coordinated with construction activities so the BMP is in place before construction begins. The following BMPs will be coordinated with construction activities:

- The temporary sedimentation control barriers will be installed before any clearing or grading begins.
- Clearing and grading will not occur in an area until it is necessary for construction to proceed.
- Diversion berms and the sediment basin will be constructed, and pumping will be performed at the direction of the SWPPP Coordinator as required throughout construction.
- Once construction activity ceases permanently in an area, that area will be stabilized with permanent seed and mulch.
- After the entire site is stabilized, the accumulated sediment will be removed from all drainage structures.
- The sedimentation control barriers will not be removed until all construction activities at the site are complete and soils have been stabilized.

Certification of Compliance with Federal, State and Local Regulations

This SWPPP reflects the requirement for stormwater management and control as established in the Massachusetts Wetlands Protection Act (310 CMR), the Water Quality Certification Regulations (314 CMR), and the Federal Water Pollution Control Act Amendments of 1972. This plan was prepared in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas.

Maintenance and Inspection Procedures

Inspections

Visual inspections of all cleared and graded areas of the construction site will be performed each week and within 24 hours of the end of a significant rainfall event. The inspection will be conducted by the SWPPP Coordinator or his designated agent. The inspection will verify that the structural BMPs are in good condition and minimizing erosion. The inspection will also verify that the procedures used to prevent stormwater contamination from construction materials and petroleum products are effective. The following inspection and maintenance practices will be used to maintain erosion and sediment controls:

- Built up sediment will be removed from the sedimentation barriers when it has reached one-third the height of the barrier.
- Temporary and permanent seeding will be inspected for bare spots, washouts and healthy growth.
- The construction area entrance will be inspected for sediment tracked on the road.

A maintenance inspection report will be made after each inspection. A copy of the report form to be completed by the SWPPP Coordinator is included herein. Completed forms will be maintained on-site during the entire construction project. Following construction, the completed forms will be retained at the operators' office for a minimum of 1 year.

If construction activities or design modifications are made to the site plan which could impact stormwater, this SWPPP will be amended appropriately. The amended SWPPP will have a description of the new activities that contribute to the increased pollutant loading and the planned source control activities.

Employee Training

An employee training program will be developed and implemented to educate employees about the requirements of the SWPPP. This education program will include background on the components and goals of the SWPPP and hands-on training in erosion controls, spill prevention and response, good housekeeping, proper material handling, disposal and control of waste, equipment fueling and proper storage, washing and inspection procedures. All employees will be trained prior to their first day on the site.

SWPPP Coordinator and Duties

The construction site SWPPP Coordinator for the facility is:

_____ Phone:_____.

The SWPPP Coordinator's duties include the following:

- Implement the SWPPP plan;
- Oversee maintenance practices identified as BMPs in the SWPPP;
- Implement and oversee employee training;
- Conduct or provide for inspection and monitoring activities;
- Identify other potential pollutant sources and make sure they are added to the SWPPP;
- Identify any deficiencies in the SWPPP and make sure they are corrected and
- Ensure that any changes in construction plans are addressed in the SWPPP.

Emergency Numbers

Fire, Police, Ambulance:		911
Operator:		
General Contractor:	Office:	
	Mobile #	
Subcontractors:		
	Office:	
	Office:	
MassDEP Emergency Response Line		1-888-304-1133
National Response Center		1-800-424-8802

Inspection and Maintenance Report Form

Note: This form is to be completed every 7 days and within 24 hours of a rainfall event of 0.5 inches or more.

Inspector:_____ Date: _____

Days since last rainfall:_____ Amount of last rainfall:_____inches

Stabilization Measures

Date of last disturbance	Date of next disturbance	Stabilized (Y/N)	Stabilized with	Condition

Stabilization required:

To be performed by:_____ On or before: _____

Temporary Sedimentation Basin

Depth of sediment	Condition of side slopes	Evidence of overtopping	Condition of outfall

Maintenance required for sedimentation basin swale:

To be performed by:_____ On or before: _____

Construction Entrance

Does much sediment get tracked on to road?	Is the gravel clean or is it filled with sediment?	Does all traffic use the stabilized entrance to leave the site?

Maintenance required:

To be performed by:_____ On or before: _____

Sedimentation Control Barrier

Drainage area	Has silt reached 1/3 of barrier?	Is barrier properly secured?	Is there evidence of washout or over-topping?

Maintenance required:

To be performed by: _____On or before: _____

Spill Report Form

LOCATION: _____

Date: _____ Time: _____

Regulatory agencies notified (date, time, person, agency, and how): _____

Material spilled: _____

Quantity spilled: _____

Source: _____

Cause: _____

Extent of injuries (if any): _____

Adverse environmental impact (if any): _____

Immediate remedial actions taken at time of spill: _____

Measures taken or planned to prevent recurrence: _____

Additional comments: _____

This report prepared by: _____
(Signature)

Section 9

Supporting documentation for

Stormwater Management

Standard 9

- ☐ Operation & Maintenance Plan

Stormwater Operations & Maintenance Plan
Sunshine Ridge, Bailey Road

December 3, 2020

Prepared by: New England Environmental Design, LLC

RESPONSIBILITY

The facility is owned by and to be maintained by Bailey Road Development, LLC. Bailey Road Development can be reached at P.O. Box 413 in Rutland, MA 01543. Upon acceptance of the roads as public ways by the Town of Holden, the responsibility for operation and maintenance will be transferred to the Town for the facilities located within the public ways. Upon the sales of the individual lots, the responsibility for operation and maintenance will be transferred to the lot owner for those facilities located within it. This Operation & Maintenance plan is transferable to future property owners.

FACILITY LOCATION

Sunshine Ridge is located in the Town of Holden on the East side of Bailey Road, approximately 500 feet north of the Bailey Road/Hubbard Lane intersection.

FACILITY DESCRIPTION

The proposed development includes the construction of 7 single family homes, serviced by a public water and sewer, along a 500 ft long road with a cul-de-sac. The average lot size in the development is over one acre.

STORMWATER MANAGEMENT SYSTEM

Stormwater runoff is collected by a drainage conveyance and treatment system designed in full compliance with the Stormwater Management Standards. The stormwater management system treats the water that flows from the roofs and paved surfaces to qualifying pervious areas and/or deep sump catch basins, sediment forebays, an infiltration basin, and a detention basin will be constructed to attenuate and treat the increased runoff. See the table on the next page for descriptions of the various treatment trains.

STORMWATER BMP MAINTENANCE MATRIX

Task	Structural Best Management Practice				Schedule
	Infiltration and Detention Basins	Sediment Forebays	Deep Sump Catch Basins	Grassed qualifying pervious areas	
Remove sediment and debris as necessary	X	X	X	X	Annually after snow and foliage seasons (4 times a year for deep sump catch basins and sediment forebays when sediment depth exceeds 2 feet)
Mow and/or replace vegetation	X	X		X	As needed (At Least twice per year)
Inspect/removal of floatables and debris	X	X	X	X	Twice per year
Inspect for erosion and repair as needed	X	X		X	Annually
Inspect for proper functioning	X	X	X	X	Twice a year and after major storms.
Inspect for ponding and address issues	X	X		X	Annually or as needed

General Maintenance and Housekeeping Requirements:

The site operator will be responsible for the maintenance of the property. The following specifications for maintenance and housekeeping activities are necessary to provide for long-term pollution prevention:

- **Street Sweeping:** Driveways shall be swept twice annually with the first sweeping taking place as soon as practicable following the winter snowmelt.

- **Snow Removal:** Snow within the driveways is to be plowed to sides, onto the lawns. There shall be no stockpiling of snow adjacent to wetlands on this site. Sanding of the driveway surface is not recommended to prevent clogging of the surface structures.

- **Deicing Material Storage and Application:** The outside storage of deicing materials on this property is forbidden (MGL Chapter 85, Section 7A). The application of deicing materials should be kept to the minimum practicable quantities that ensure safe vehicular and pedestrian movement throughout the site.

- **Landscape Maintenance:** Leaves and grass trimmings shall be properly disposed of. If these materials are to be composted on-site, it shall be done outside of any wetland resource area or buffer zones. Pesticides and fertilizers shall be applied per the manufacturer's recommendations at the minimum effective application rates.

- **Material and Waste Product Storage:** Materials and waste products, including vehicle fluids, pesticides, herbicides, fertilizers, paints and solvents, and hazardous chemicals, must be kept inside or under cover. All materials shall be stored in clearly labeled containers.

- **Spill Response:** All spills will be cleaned up immediately upon discovery. Spills shall be reported to the Fire Department and the Mass DEP Emergency Response Section at 1- 888-304-1133. Spills large enough to reach the storm system will be reported to the National Response Center at 1-800-424-8802.

Section 10

Illicit Discharge

- Illicit Discharge Statement

Section 10

Illicit Discharge Statement

I have inspected the site of the proposed development and have not found any illicit discharges located on the property. No discharges other than those entirely comprised of stormwater are proposed.

Illicit discharges are discharges that are not entirely comprised of stormwater. Illicit discharges are prohibited. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents. The developer, contractor, property owner, and stormwater management system operator shall be responsible for the prevention, detection, and elimination of illicit discharges.

Douglas E. Best

12-10-20

Attachments

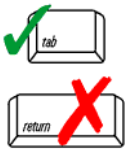
- Stormwater Checklist

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

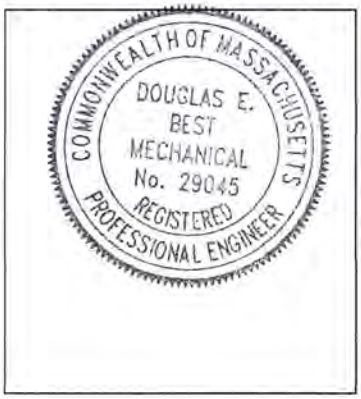
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Douglas E. Best 12-10-20

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- [X] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [X] Minimizing disturbance to existing trees and shrubs
- [X] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [X] Credit 2
  - [X] Credit 3
- [ ] Use of "country drainage" versus curb and gutter conveyance and pipe
- [ ] Bioretention Cells (includes Rain Gardens)
- [ ] Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- [ ] Treebox Filter
- [ ] Water Quality Swale
- [ ] Grass Channel
- [ ] Green Roof
- [ ] Other (describe): _____

Standard 1: No New Untreated Discharges

- [X] No new untreated discharges
- [ ] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [ ] Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☒ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☒ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☒ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☐ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☐ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.