Ministers Estates

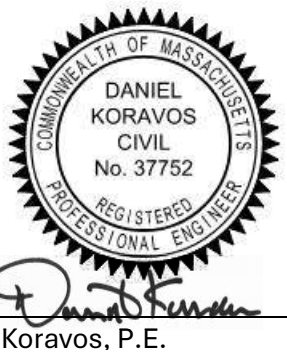
39 Sunset Rock Road
Andover, Massachusetts

PROJECT REPORT

on
Drainage & Sedimentation Control
&
Project Stormwater Report

Prepared For:

MINSTERS LANE, LLC
42 School Street
Andover, MA 01810



Daniel Koravos, P.E.

Date: April 14, 2025
Revised: June 1, 2025

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Ministers Estates

Andover, Massachusetts

I. Table of Contents

II. Project Narrative

i. Introduction

Ministers Estates is a proposed five (5) lot single-family residential subdivision, located on the west side of Sunset Rock Road in Andover, Massachusetts. The subject property consists of approximately 4.7± acres of wooded vegetation. The topography slopes from a high point near the northerly boundary of the property to a low point along the southerly property boundary. The elevations range from a high of 238 to a low of 202, a general vertical elevation difference of approximately thirty-six (36) feet.

The soils within the project consist mainly of the Canton series with a small area of the Woodbridge series along Sunset Rock Road. The Canton series is classified as being within the SCS-Hydrological Soils Group (HSG) A & B; ranked first & second on a scale of four (A, B, C, D) in terms of infiltration capacity and the Woodbridge series is classified as being within the HSG C/D.

These calculations determine Pre-Development and Post-Development peak flow rates (Q) using the SCS-TR20 Runoff Method with HydroCAD. Proposed mitigation of the increase in runoff is being obtained primarily through the proposed detention/infiltration facilities within the property. The results for each drainage area, which experiences an increase in impervious area and therefore an apparent increase in peak runoff, will be tabulated. The objective is to mitigate the storm drainage flows such that there will be no increase in the peak rate of runoff at any point along the parcel's boundary. The calculations will be performed for the 2, 10, 25 and 100-year storm events.

Applicable regulations of the Town of Andover and the State of Massachusetts are incorporated herein.

ii. Summary & Results

As indicated in the Introduction, the objective is to mitigate the storm drainage flows such that there will be no increase in the peak rate of runoff at any point at the parcel's boundary. The following table summarizes the pre-development vs. the post-development peak runoff flow rates for the 2, 10, 25 and 100-year storm event. As indicated, due to the detention/infiltration mitigation facilities located within the project, the peak rates of runoff from the site are not increased under any design storm conditions, therefore, no downstream properties should be adversely affected by this project.

Pre-Development vs. Post-Development Drainage Summary Tables

Point #1 (A)

Design Storm	Peak Flow Rate		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)
2	0.0	0.0	0.0
10	0.0	0.0	0.0
25	0.1	0.2	0.1[1]
100	0.6	0.7	0.1[1]

Point #2 (B)

Design Storm	Peak Flow Rate		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)
2	0.5	0.5	0.0
10	2.9	3.0	0.1[1]
25	5.0	3.6	(1.4)
100	8.6	4.4	(4.2)

[1]An increase of this magnitude is negligible and considered to be zero.

Point #3 (C)

Design Storm	Peak Flow Rate		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)
2	0.0	0.0	0.0
10	0.0	0.0	0.0
25	0.0	0.0	0.0
100	0.2	0.0	(0.2)

Point #4 (D)

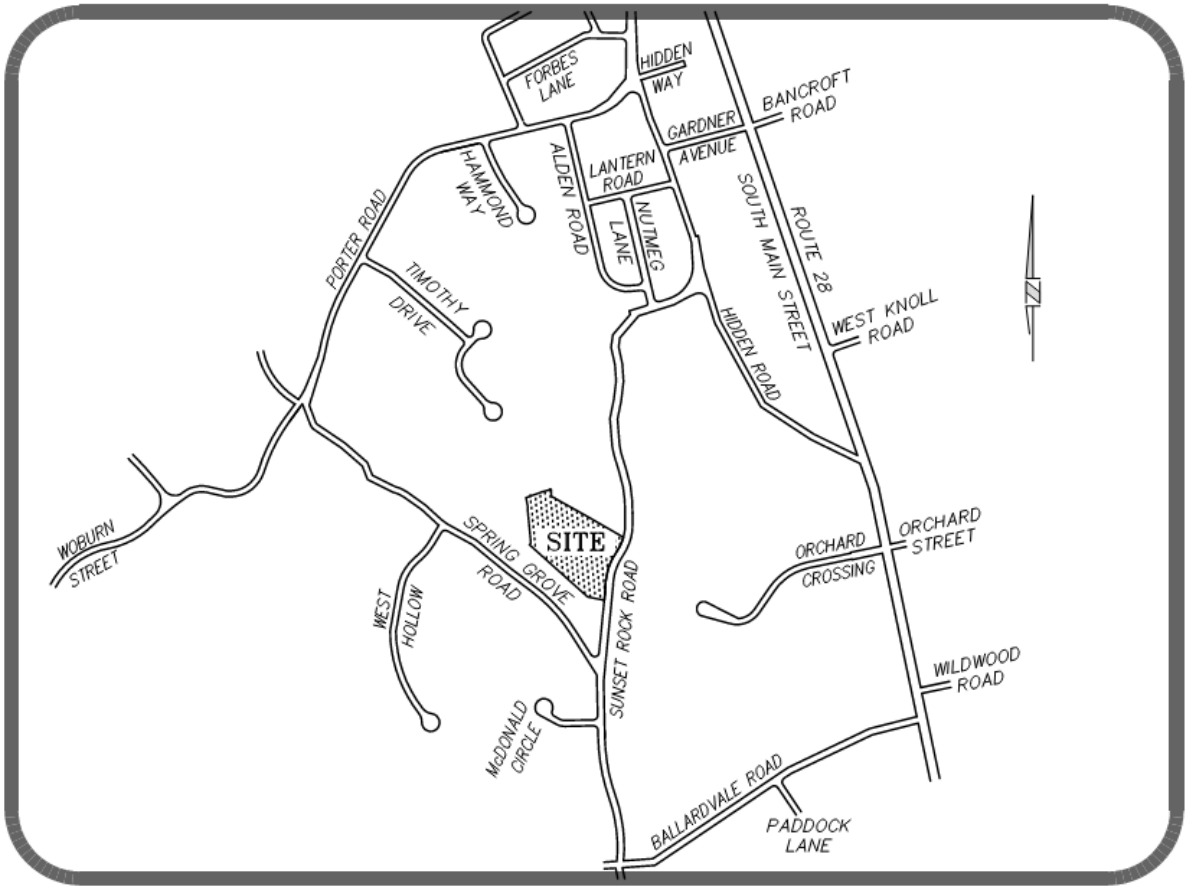
Design Storm	Peak Flow Rate		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)
2	0.0	0.0	0.0
10	0.1	0.0	(0.1)
25	0.2	0.0	0.0
100	1.0	0.9	(0.1)

Point #5 (E)

Design Storm	Peak Flow Rate		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)
2	0.0	0.0	0.0
10	0.1	0.1	0.0
25	0.4	0.3	(0.1)
100	1.3	0.7	(0.6)

These Storm Drainage calculations were prepared in accordance with the applicable Town of Andover Regulations and the Massachusetts DEP Stormwater Handbook. Drainage structures and pipes were designed according to generally accepted engineering principles and in accordance with the stated regulations.

III. Locus Map, USGS Map & FIRMette Map



LOCUS MAP

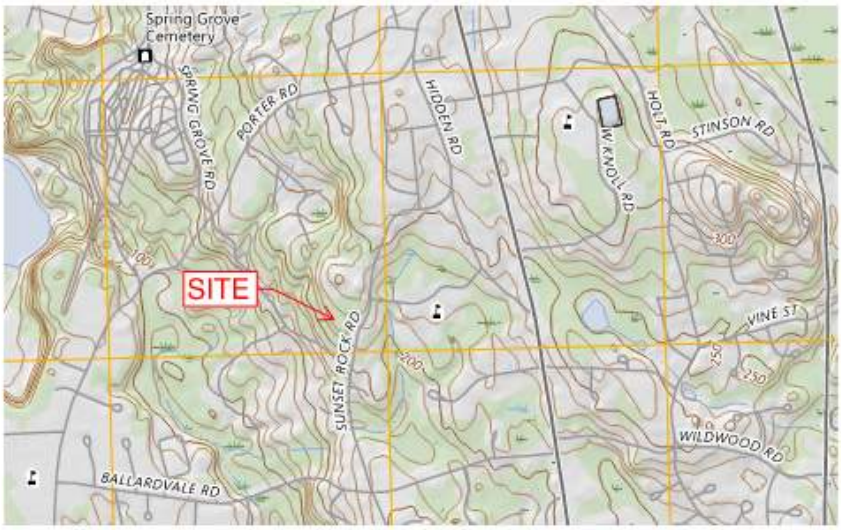
SCALE: 1" = 800'

USGS
science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

7.5-MINUTE TOPO QUADRANGLE
Custom Extent
7.5-MINUTE TOPO

The National Map
OnDemand Topo



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988
CONTOUR SMOOTHNESS = Medium

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 19T

Data is provided by The National Map (TNM), is the best available at the time of map generation, and includes data content from supporting themes of Elevation, Hydrography, Geographic Names, Boundaries, Transportation, Structures, Land Cover, and Orthoimagery. Refer to associated Federal Geographic Data Committee (FGDC) Metadata for additional source data information.

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands. Temporal changes may have occurred since these data were collected and some data may no longer represent actual surface conditions.

Learn About The National Map: https://nationalmap.gov

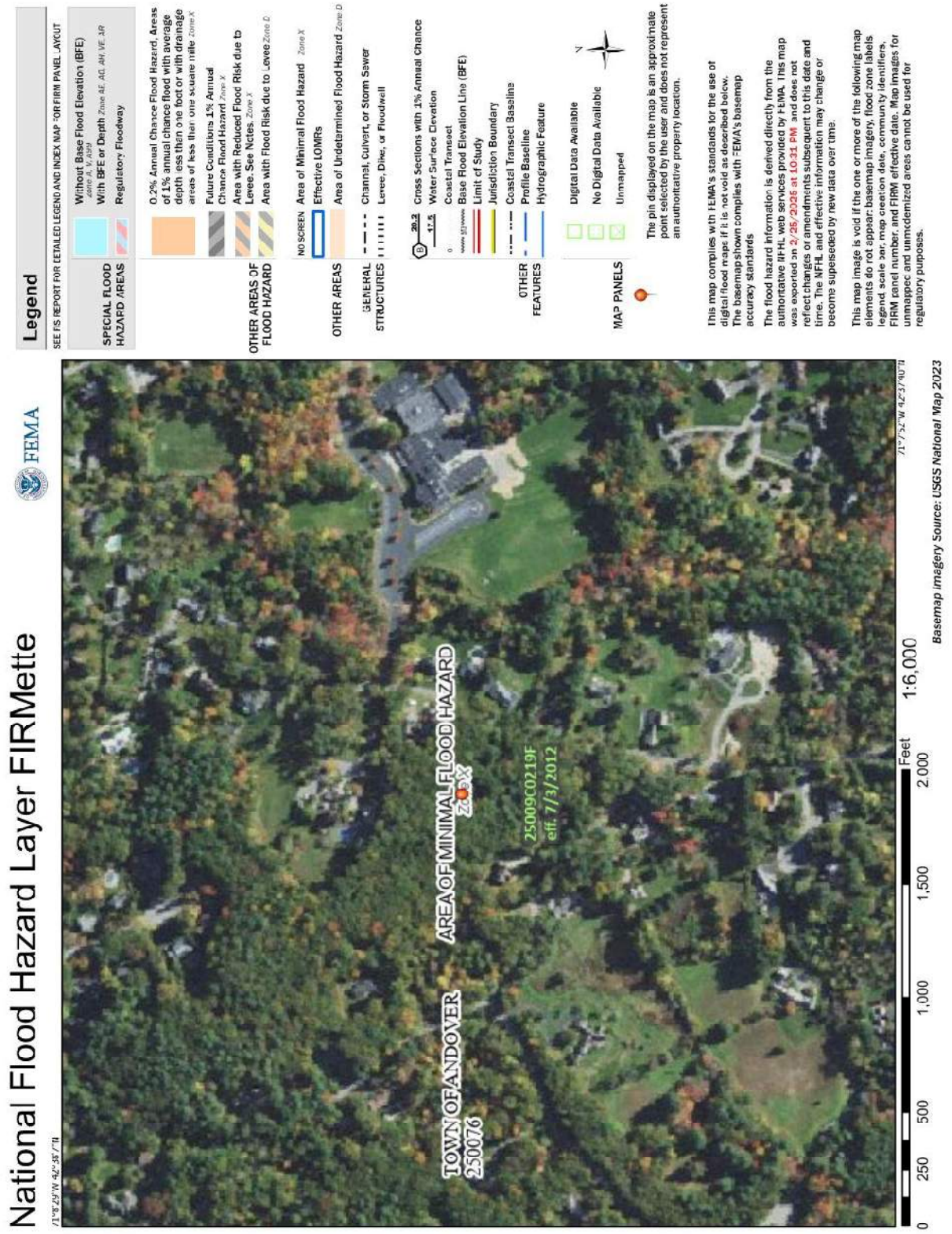
ROAD CLASSIFICATION

Expressway	Local Connector
Secondary Hwy	Local Road
Ramp	4WD

Interstate Route US Route State Route

Ministers Estates

Andover, Massachusetts



IV. Storm Drain Calculations

i. Description of Drainage System

The proposed drainage system is a combination closed and open system. Decreases in the peak flow rates of runoff will be obtained primarily through use of the proposed detention/infiltration facilities. Catch basins will be constructed to collect the runoff and transport it to the closed drainage system and discharge to the detention basin. The basin will serve to detain and store the runoff while discharging a flow rate equal to or less than the calculated pre-development peak flow rate. The difference will be stored in the basin.

Pre- and Post-Development Drainage Area Maps accompany these calculations. The following table summarizes the pre vs. post development drainage areas for the entire site.

Drainage Area	Pre-Dev. (s.f)	Post-Dev. (s.f)
A	42,502	
A-1		42,448
A-2		57,950
B	95,630	
B-1		47,395
B-2		23,776
C	21,190	24,492
D	39,824	17,307
E	40,179	9,142
Roofs (5)		16,815
Total	**239,325**	**239,325**

NOAA Atlas 14, Volume 10, Version 3
Location name: Andover, Massachusetts, USA*
Latitude: 42.6315°, Longitude: -71.1363°
Elevation: 227 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	**0.311** (0.244-0.386)	**0.372** (0.291-0.462)	**0.472** (0.368-0.588)	**0.555** (0.430-0.695)	**0.669** (0.502-0.876)	**0.755** (0.554-1.01)	**0.845** (0.602-1.17)	**0.946** (0.638-1.34)	**1.09** (0.708-1.61)	**1.21** (0.766-1.82)
10-min	**0.441** (0.345-0.546)	**0.527** (0.413-0.654)	**0.668** (0.521-0.832)	**0.786** (0.609-0.984)	**0.948** (0.711-1.24)	**1.07** (0.785-1.43)	**1.20** (0.853-1.66)	**1.34** (0.905-1.90)	**1.55** (1.00-2.28)	**1.72** (1.09-2.58)
15-min	**0.519** (0.406-0.643)	**0.620** (0.485-0.770)	**0.786** (0.612-0.979)	**0.925** (0.717-1.16)	**1.12** (0.836-1.46)	**1.26** (0.923-1.68)	**1.41** (1.00-1.96)	**1.58** (1.06-2.24)	**1.82** (1.18-2.68)	**2.02** (1.28-3.03)
30-min	**0.713** (0.558-0.883)	**0.853** (0.667-1.06)	**1.08** (0.844-1.35)	**1.27** (0.986-1.59)	**1.54** (1.15-2.01)	**1.73** (1.27-2.32)	**1.94** (1.38-2.69)	**2.17** (1.46-3.09)	**2.51** (1.63-3.69)	**2.78** (1.76-4.18)
60-min	**0.907** (0.710-1.12)	**1.08** (0.849-1.35)	**1.38** (1.07-1.71)	**1.62** (1.26-2.03)	**1.95** (1.47-2.56)	**2.20** (1.62-2.95)	**2.47** (1.76-3.43)	**2.77** (1.87-3.93)	**3.20** (2.07-4.70)	**3.55** (2.24-5.33)
2-hr	**1.17** (0.922-1.44)	**1.41** (1.11-1.74)	**1.80** (1.42-2.23)	**2.13** (1.66-2.65)	**2.58** (1.95-3.36)	**2.91** (2.16-3.89)	**3.27** (2.36-4.56)	**3.70** (2.50-5.23)	**4.36** (2.83-6.37)	**4.92** (3.12-7.34)
3-hr	**1.35** (1.07-1.66)	**1.64** (1.30-2.01)	**2.10** (1.66-2.59)	**2.49** (1.95-3.08)	**3.02** (2.30-3.93)	**3.41** (2.54-4.55)	**3.84** (2.79-5.35)	**4.36** (2.96-6.14)	**5.17** (3.37-7.54)	**5.87** (3.74-8.73)
6-hr	**1.73** (1.38-2.10)	**2.10** (1.68-2.56)	**2.71** (2.16-3.32)	**3.22** (2.55-3.96)	**3.92** (3.01-5.08)	**4.43** (3.34-5.89)	**5.00** (3.66-6.94)	**5.70** (3.88-7.97)	**6.80** (4.44-9.84)	**7.75** (4.94-11.4)
12-hr	**2.17** (1.75-2.63)	**2.66** (2.14-3.22)	**3.45** (2.77-4.20)	**4.11** (3.28-5.02)	**5.02** (3.87-6.45)	**5.68** (4.30-7.49)	**6.41** (4.72-8.83)	**7.32** (5.01-10.2)	**8.72** (5.72-12.5)	**9.94** (6.36-14.6)
24-hr	**2.58** (2.10-3.10)	**3.20** (2.60-3.85)	**4.22** (3.42-5.09)	**5.06** (4.07-6.15)	**6.23** (4.85-7.98)	**7.08** (5.40-9.30)	**8.02** (5.96-11.0)	**9.21** (6.33-12.7)	**11.1** (7.29-15.8)	**12.7** (8.16-18.5)
2-day	**2.90** (2.38-3.46)	**3.67** (3.01-4.39)	**4.94** (4.03-5.92)	**5.99** (4.85-7.22)	**7.43** (5.84-9.49)	**8.49** (6.54-11.1)	**9.66** (7.26-13.3)	**11.2** (7.72-15.4)	**13.7** (9.03-19.4)	**15.9** (10.2-23.0)
3-day	**3.18** (2.62-3.78)	**4.01** (3.30-4.77)	**5.37** (4.40-6.41)	**6.50** (5.29-7.80)	**8.05** (6.35-10.2)	**9.18** (7.10-12.0)	**10.4** (7.88-14.3)	**12.1** (8.37-16.5)	**14.8** (9.80-20.9)	**17.2** (11.1-24.8)
4-day	**3.45** (2.86-4.09)	**4.31** (3.56-5.11)	**5.71** (4.70-6.80)	**6.87** (5.62-8.23)	**8.47** (6.70-10.7)	**9.63** (7.47-12.5)	**10.9** (8.27-14.9)	**12.6** (8.76-17.2)	**15.4** (10.2-21.8)	**17.9** (11.6-25.7)
7-day	**4.20** (3.50-4.95)	**5.09** (4.23-6.00)	**6.53** (5.42-7.74)	**7.74** (6.37-9.21)	**9.39** (7.47-11.8)	**10.6** (8.26-13.7)	**11.9** (9.06-16.2)	**13.7** (9.53-18.5)	**16.6** (11.0-23.2)	**19.1** (12.4-27.3)
10-day	**4.88** (4.08-5.73)	**5.79** (4.84-6.81)	**7.27** (6.05-8.58)	**8.50** (7.03-10.1)	**10.2** (8.14-12.7)	**11.4** (8.93-14.7)	**12.8** (9.71-17.2)	**14.6** (10.2-19.6)	**17.4** (11.6-24.3)	**19.9** (12.9-28.3)
20-day	**6.80** (5.74-7.94)	**7.80** (6.58-9.12)	**9.44** (7.93-11.1)	**10.8** (9.00-12.7)	**12.7** (10.2-15.6)	**14.1** (11.0-17.7)	**15.6** (11.7-20.3)	**17.3** (12.1-23.1)	**19.8** (13.3-27.4)	**21.9** (14.2-30.9)
30-day	**8.42** (7.14-9.78)	**9.50** (8.05-11.0)	**11.3** (9.50-13.1)	**12.7** (10.7-14.9)	**14.7** (11.8-18.0)	**16.3** (12.7-20.3)	**17.8** (13.4-23.0)	**19.5** (13.8-25.9)	**21.8** (14.7-30.0)	**23.6** (15.4-33.2)
45-day	**10.5** (8.94-12.1)	**11.6** (9.92-13.5)	**13.6** (11.5-15.8)	**15.1** (12.7-17.7)	**17.3** (13.9-21.0)	**19.0** (14.9-23.4)	**20.7** (15.4-26.3)	**22.3** (15.8-29.5)	**24.4** (16.5-33.4)	**26.0** (17.0-36.4)
60-day	**12.3** (10.5-14.1)	**13.5** (11.5-15.6)	**15.5** (13.2-18.0)	**17.2** (14.5-20.0)	**19.5** (15.7-23.5)	**21.3** (16.7-26.1)	**23.0** (17.2-29.1)	**24.6** (17.5-32.4)	**26.7** (18.0-36.4)	**28.1** (18.4-39.2)

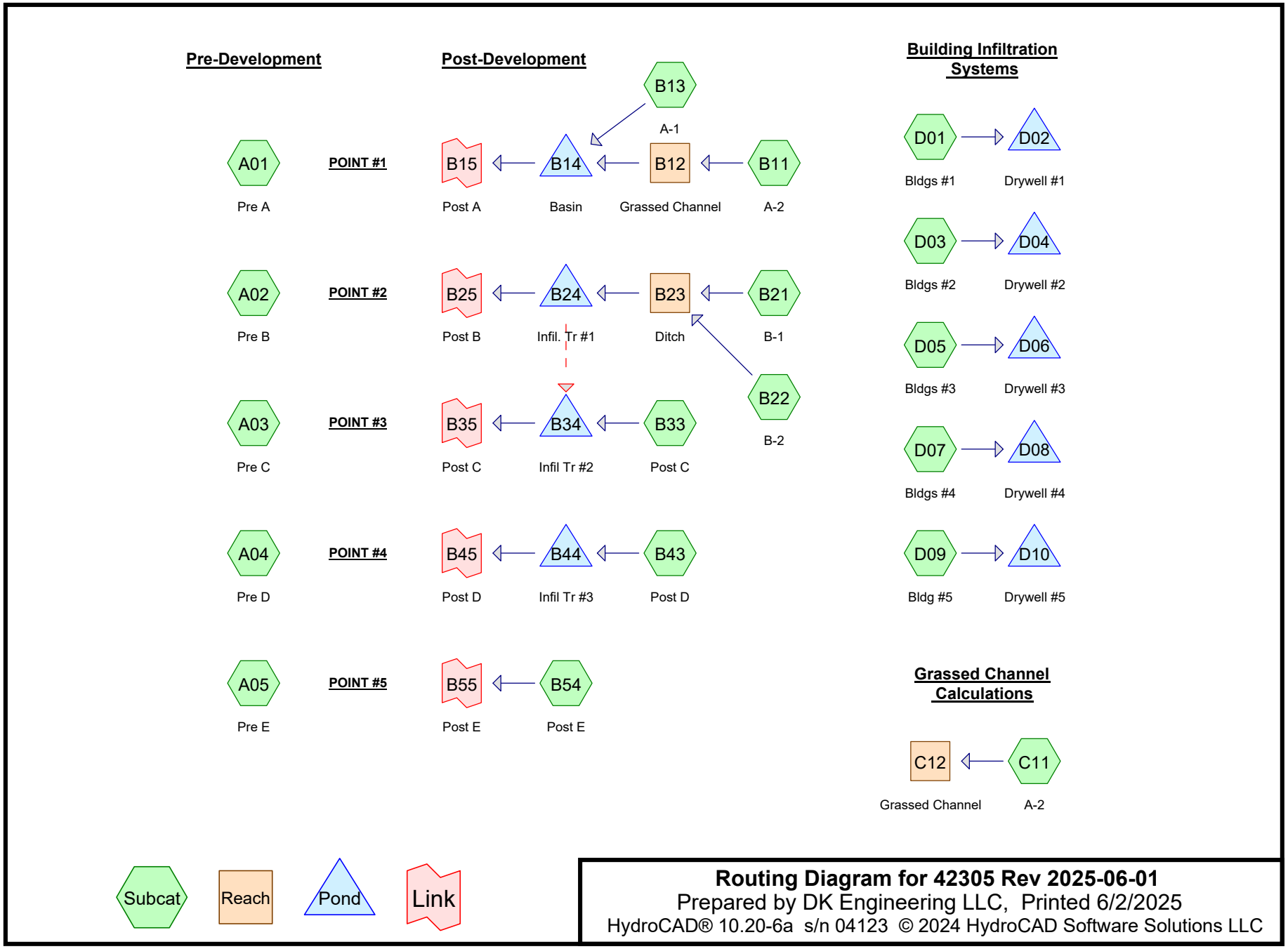
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



Routing Diagram for 42305 Rev 2025-06-01
Prepared by DK Engineering LLC, Printed 6/2/2025
HydroCAD® 10.20-6a s/n 04123 © 2024 HydroCAD Software Solutions LLC

ii. Runoff and Mitigation Design Calculations

25-Year Design Storm Event – Detail

See Following Pages

Summary for Subcatchment A01: Pre A

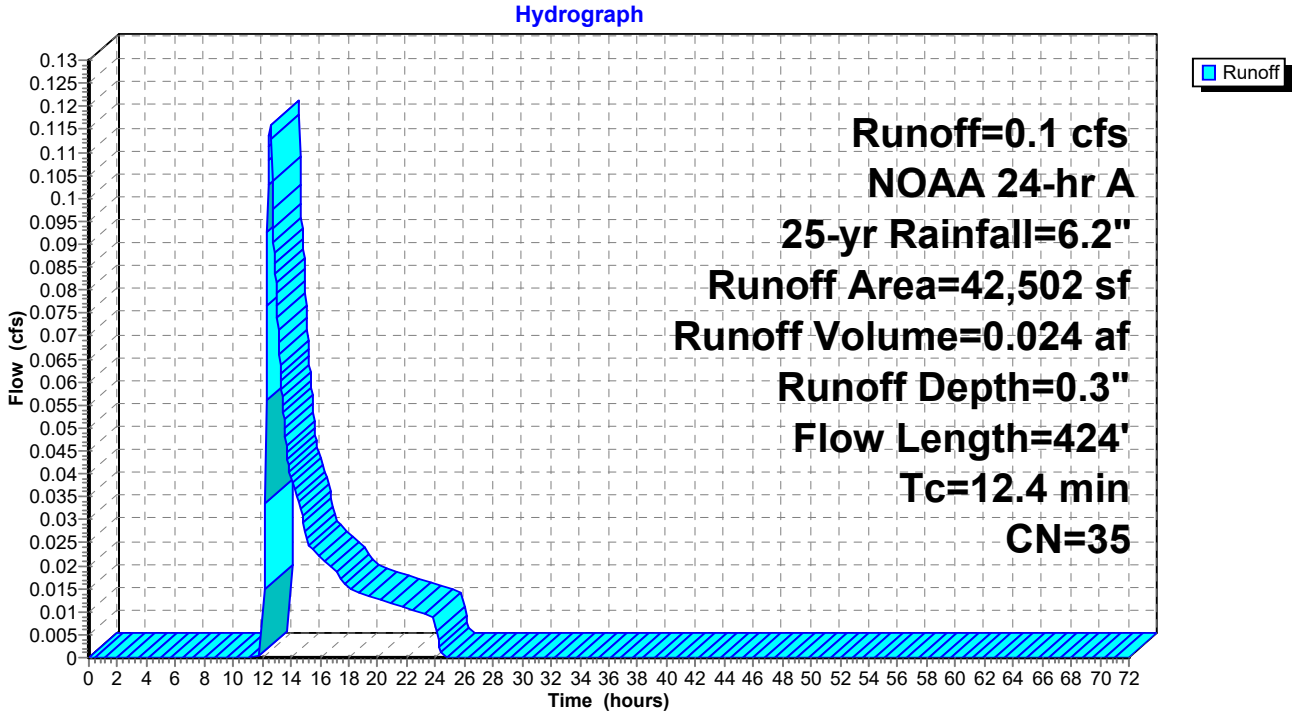
Runoff = 0.1 cfs @ 12.57 hrs, Volume= 0.024 af, Depth= 0.3"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
33,802	30	Woods, Good, HSG A
8,700	55	Woods, Good, HSG B
42,502	35	Weighted Average
42,502		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
2.2	181	0.0750	1.37		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	73	0.1900	2.18		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.5	120	0.0750	1.37		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.4	424	Total			

Subcatchment A01: Pre A



Summary for Subcatchment A02: Pre B

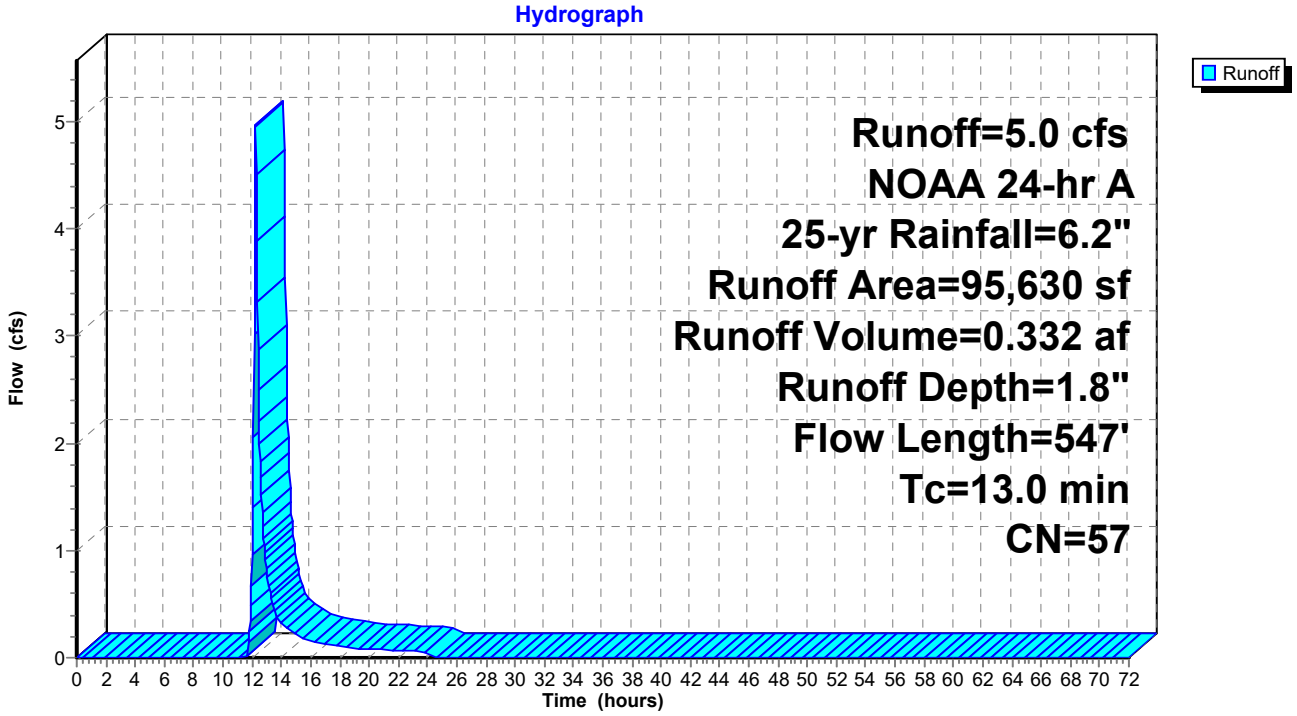
Runoff = 5.0 cfs @ 12.23 hrs, Volume= 0.332 af, Depth= 1.8"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

	Area (sf)	CN	Description
	452	98	Roofs, HSG A
	246	98	Paved parking, HSG B
	2,752	98	Paved parking, HSG A
*	995	98	Paved parking, HSG B
	589	98	Paved parking, HSG C
	26,841	30	Woods, Good, HSG A
	23,696	55	Woods, Good, HSG B
	19,684	70	Woods, Good, HSG C
	20,375	70	1/2 acre lots, 25% imp, HSG B
	95,630	57	Weighted Average
	85,502		89.41% Pervious Area
	10,128		10.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.1"
2.3	132	0.0380	0.97		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.0	365	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	547	Total			

Subcatchment A02: Pre B



Summary for Subcatchment A03: Pre C

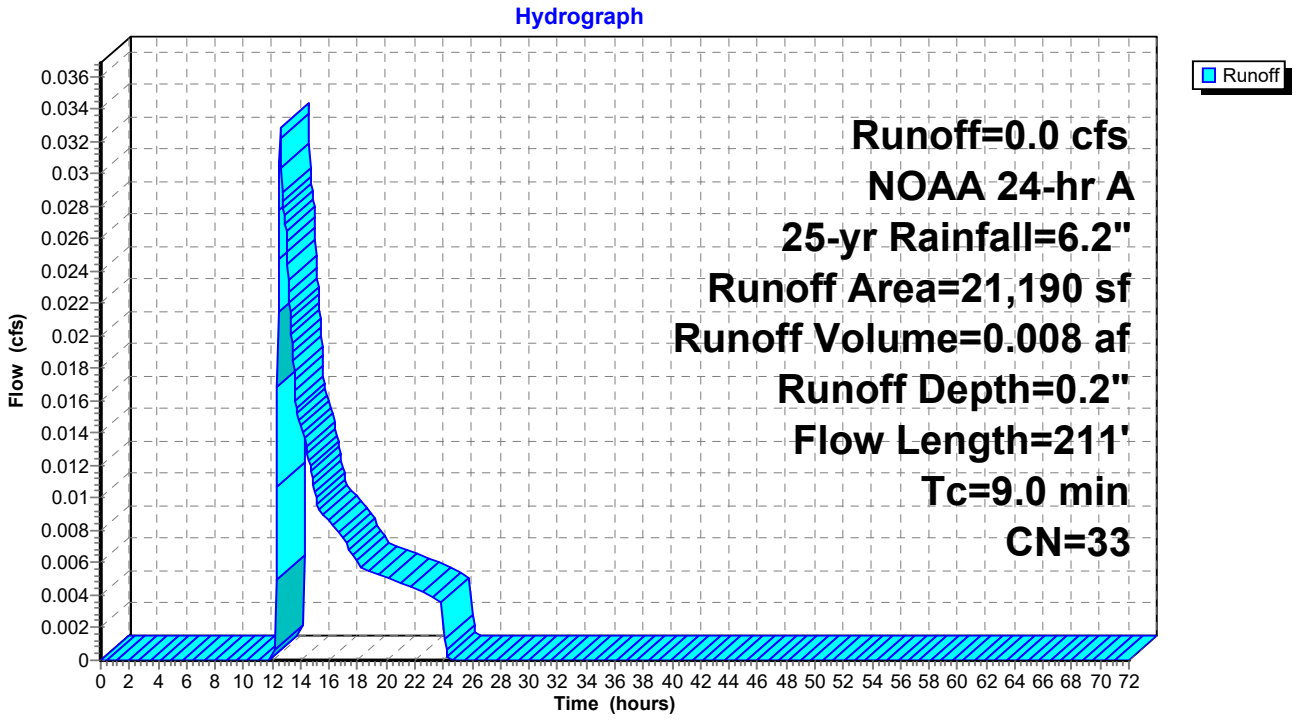
Runoff = 0.0 cfs @ 12.57 hrs, Volume= 0.008 af, Depth= 0.2"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
808	98	Roofs, HSG A
20,382	30	Woods, Good, HSG A
21,190	33	Weighted Average
20,382		96.19% Pervious Area
808		3.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
1.8	161	0.0900	1.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.0	211	Total			

Subcatchment A03: Pre C



Summary for Subcatchment A04: Pre D

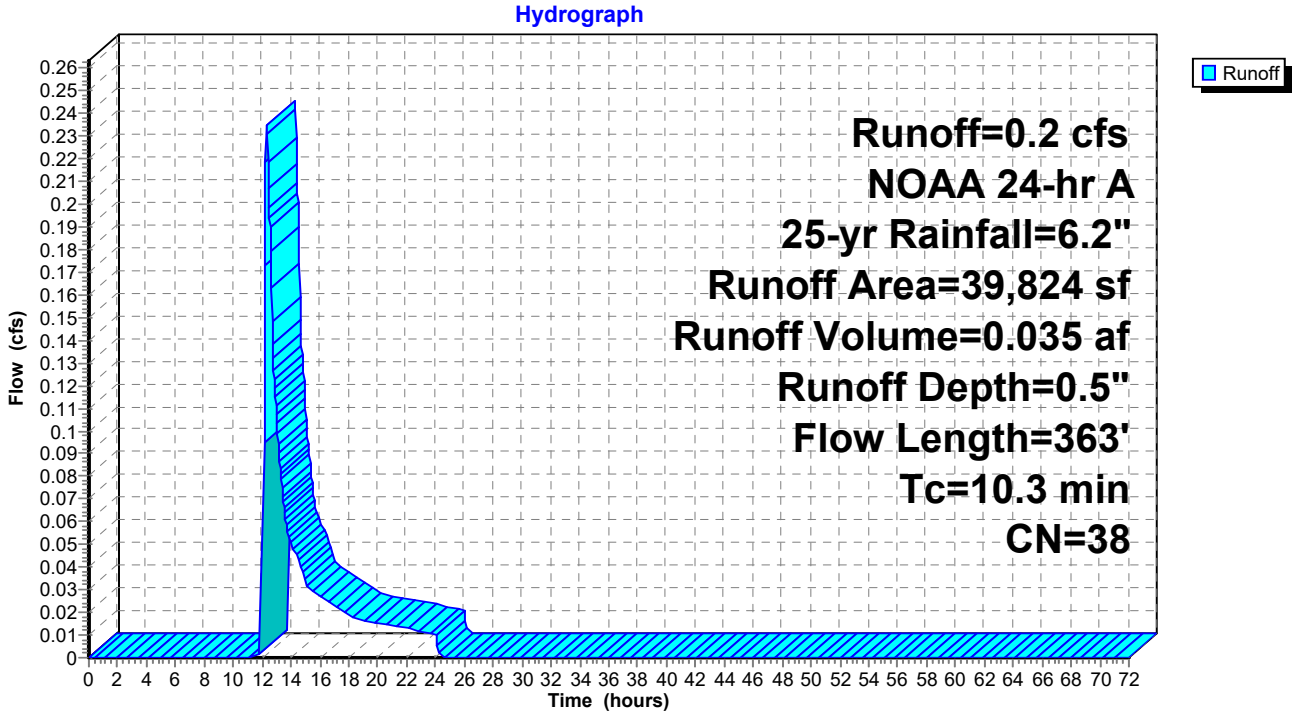
Runoff = 0.2 cfs @ 12.30 hrs, Volume= 0.035 af, Depth= 0.5"
Routed to nonexistent node 91L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
278	98	Roofs, HSG A
574	98	Roofs, HSG B
27,837	30	Woods, Good, HSG A
11,135	55	Woods, Good, HSG B
39,824	38	Weighted Average
38,972		97.86% Pervious Area
852		2.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
2.1	142	0.0490	1.11		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	171	0.1290	1.80		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	363	Total			

Subcatchment A04: Pre D



Summary for Subcatchment A05: Pre E

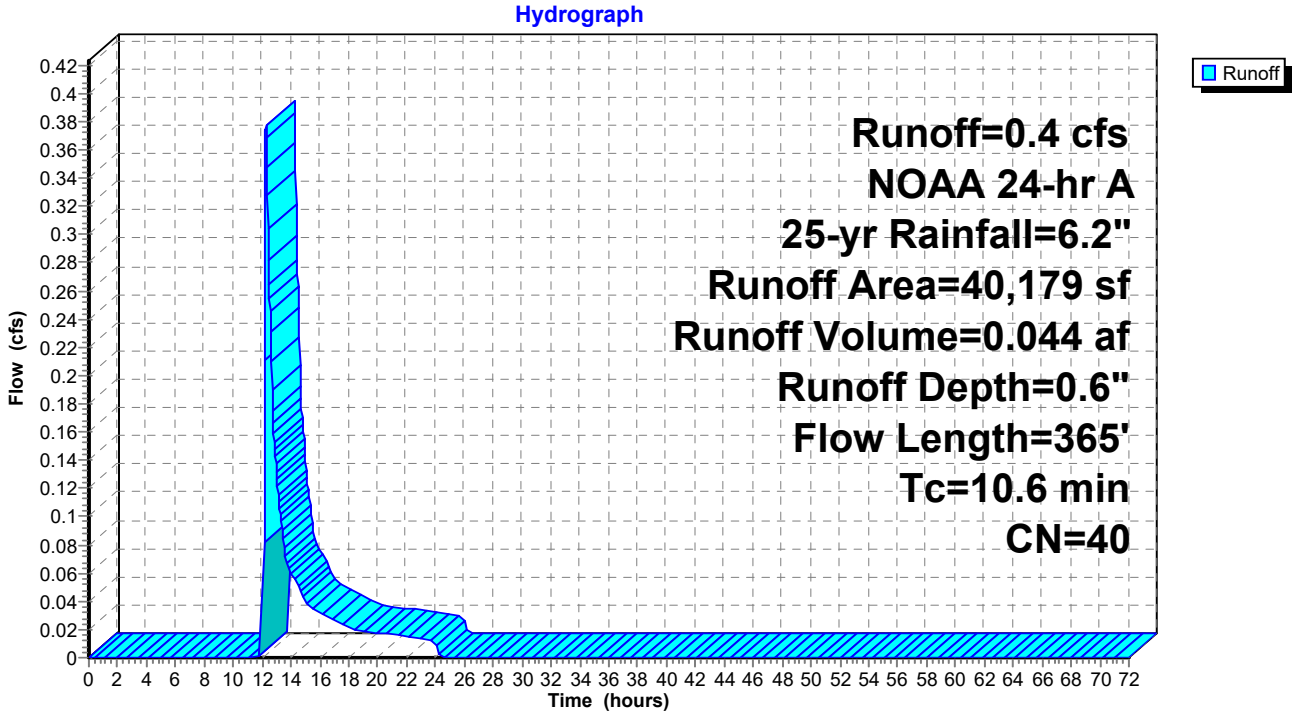
Runoff = 0.4 cfs @ 12.26 hrs, Volume= 0.044 af, Depth= 0.6"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
24,091	30	Woods, Good, HSG A
16,088	55	Woods, Good, HSG B
40,179	40	Weighted Average
40,179		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
1.5	109	0.0550	1.17		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.9	206	0.1260	1.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.6	365	Total			

Subcatchment A05: Pre E



Summary for Subcatchment B11: A-2

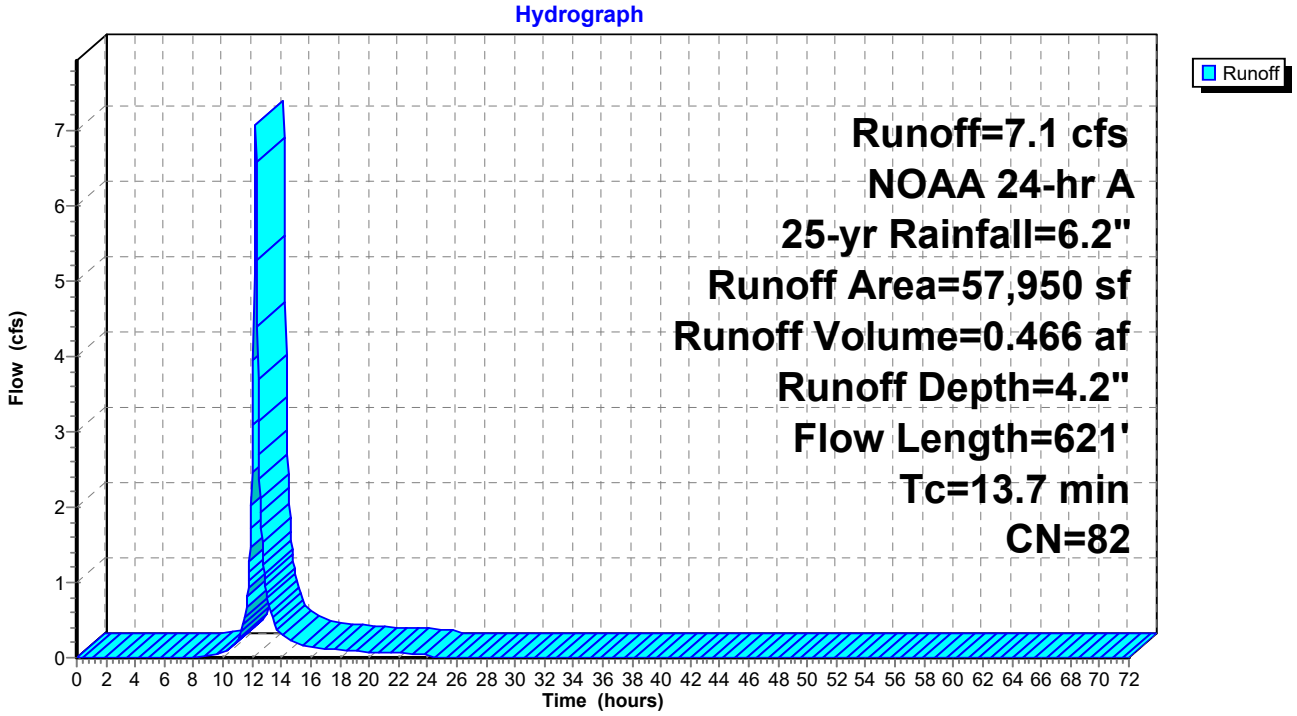
Runoff = 7.1 cfs @ 12.22 hrs, Volume= 0.466 af, Depth= 4.2"
Routed to Reach B12 : Grassed Channel

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

	Area (sf)	CN	Description
	11,250	98	Paved parking, HSG A
	7,293	98	Paved parking, HSG B
*	177	98	Paved parking, HSG A (Sidewalk)
*	887	98	Paved parking, HSG B (Sidewalk)
	7,131	68	<50% Grass cover, Poor, HSG A
	25,654	79	<50% Grass cover, Poor, HSG B
	5,558	55	Woods, Good, HSG B
	57,950	82	Weighted Average
	38,343		66.17% Pervious Area
	19,607		33.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
1.9	197	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.3	339	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	35	0.0450	12.51	9.8	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
13.7	621	Total			

Subcatchment B11: A-2



Summary for Reach B12: Grassed Channel

Inflow Area = 1.330 ac, 33.83% Impervious, Inflow Depth = 4.2" for 25-yr event
Inflow = 7.1 cfs @ 12.22 hrs, Volume= 0.466 af
Outflow = 6.9 cfs @ 12.26 hrs, Volume= 0.466 af, Atten= 2%, Lag= 2.5 min
Routed to Pond B14 : Basin

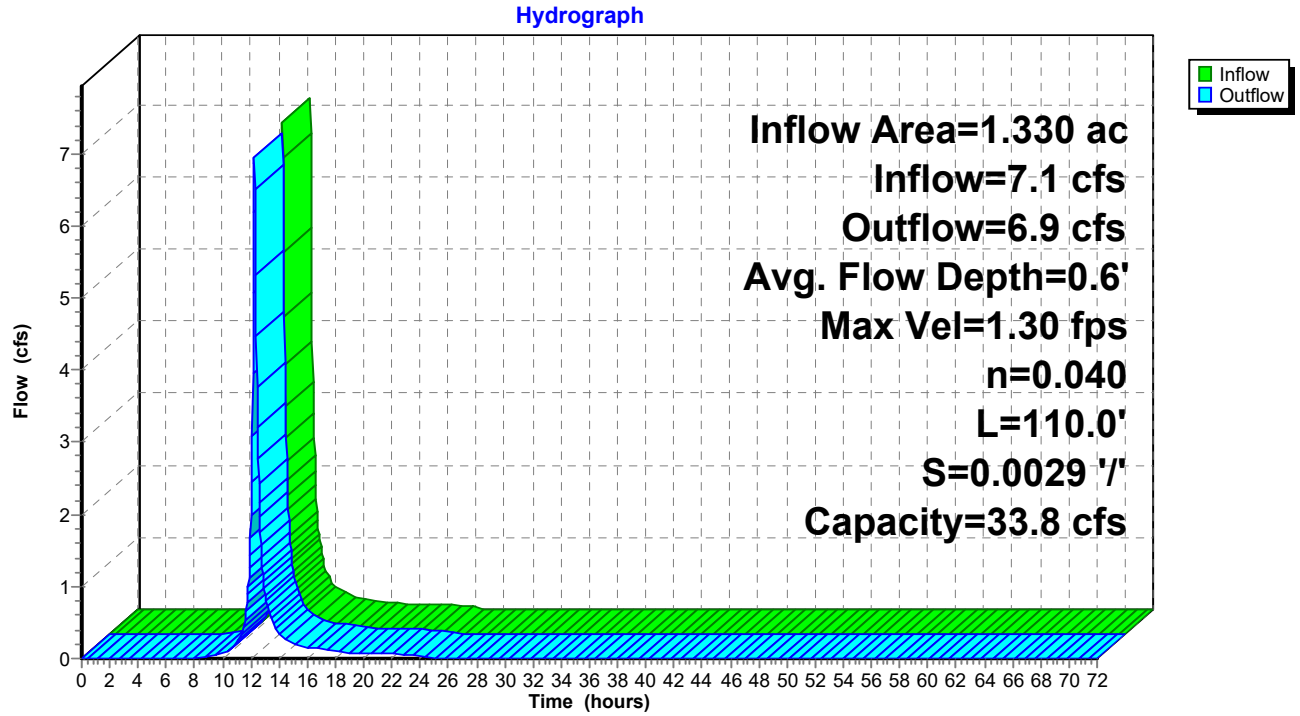
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 1.30 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 6.1 min

Peak Storage= 593 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.6' , Surface Width= 10.0'
Bank-Full Depth= 1.5' Flow Area= 15.8 sf, Capacity= 33.8 cfs

7.50' x 1.50' deep channel, n= 0.040 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 13.50'
Length= 110.0' Slope= 0.0029 '/'
Inlet Invert= 208.00', Outlet Invert= 207.68'

‡

Reach B12: Grassed Channel



Summary for Subcatchment B13: A-1

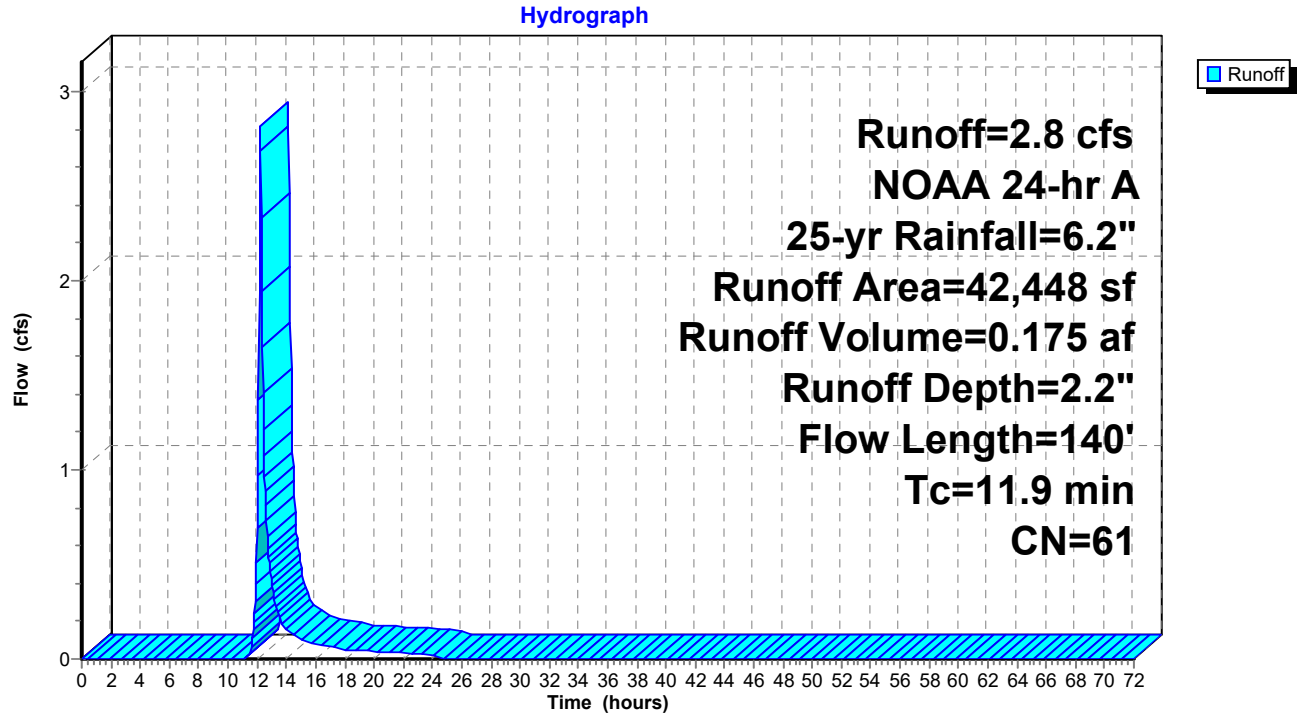
Runoff = 2.8 cfs @ 12.21 hrs, Volume= 0.175 af, Depth= 2.2"
Routed to Pond B14 : Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
29,613	68	<50% Grass cover, Poor, HSG A
2,332	79	<50% Grass cover, Poor, HSG B
7,463	30	Woods, Good, HSG A
3,040	55	Woods, Good, HSG B
42,448	61	Weighted Average
42,448		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.1"
0.5	58	0.0700	1.85		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	32	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.9	140	Total			

Subcatchment B13: A-1



Summary for Pond B14: Basin

Inflow Area = 2.305 ac, 19.53% Impervious, Inflow Depth = 3.3" for 25-yr event
Inflow = 9.6 cfs @ 12.24 hrs, Volume= 0.641 af
Outflow = 0.6 cfs @ 13.62 hrs, Volume= 0.641 af, Atten= 93%, Lag= 82.5 min
Discarded = 0.4 cfs @ 13.62 hrs, Volume= 0.581 af
Primary = 0.2 cfs @ 13.62 hrs, Volume= 0.060 af
Routed to Link B15 : Post A

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 207.04' @ 13.62 hrs Surf.Area= 7,277 sf Storage= 17,226 cf

Plug-Flow detention time= 443.6 min calculated for 0.641 af (100% of inflow)
Center-of-Mass det. time= 443.7 min (1,256.1 - 812.3)

Volume	Invert	Avail.Storage	Storage Description
#1	203.50'	28,618 cf	**Custom Stage Data (Conic)** Listed below

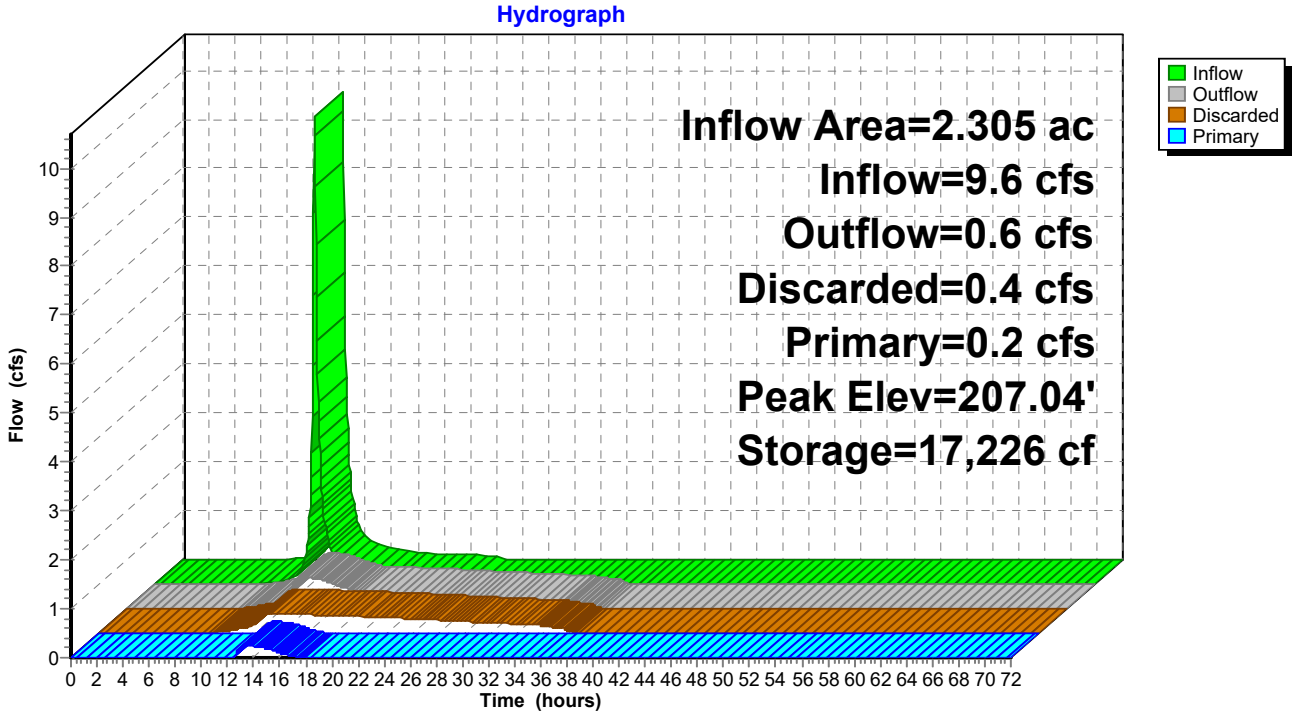
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
203.50	1,497	0	0	1,497
204.00	3,183	1,144	1,144	3,185
206.00	5,574	8,646	9,790	5,621
208.00	8,848	14,296	24,086	8,949
208.50	9,280	4,532	28,618	9,413

Device	Routing	Invert	Outlet Devices
#1	Discarded	203.50'	**2.400 in/hr Exfiltration over Surface area**
#2	Primary	201.50'	**12.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 201.50' / 200.50' S= 0.0200 '/' Cc= 0.900 n= 0.010, Flow Area= 0.79 sf
#3	Device 2	206.55'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	207.70'	**5.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.4 cfs @ 13.62 hrs HW=207.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.4 cfs)

Primary OutFlow Max=0.2 cfs @ 13.62 hrs HW=207.04' (Free Discharge)
└**2=Culvert** (Passes 0.2 cfs of 8.5 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.2 cfs @ 2.74 fps)
  └**4=Orifice/Grate** (Controls 0.0 cfs)

Pond B14: Basin

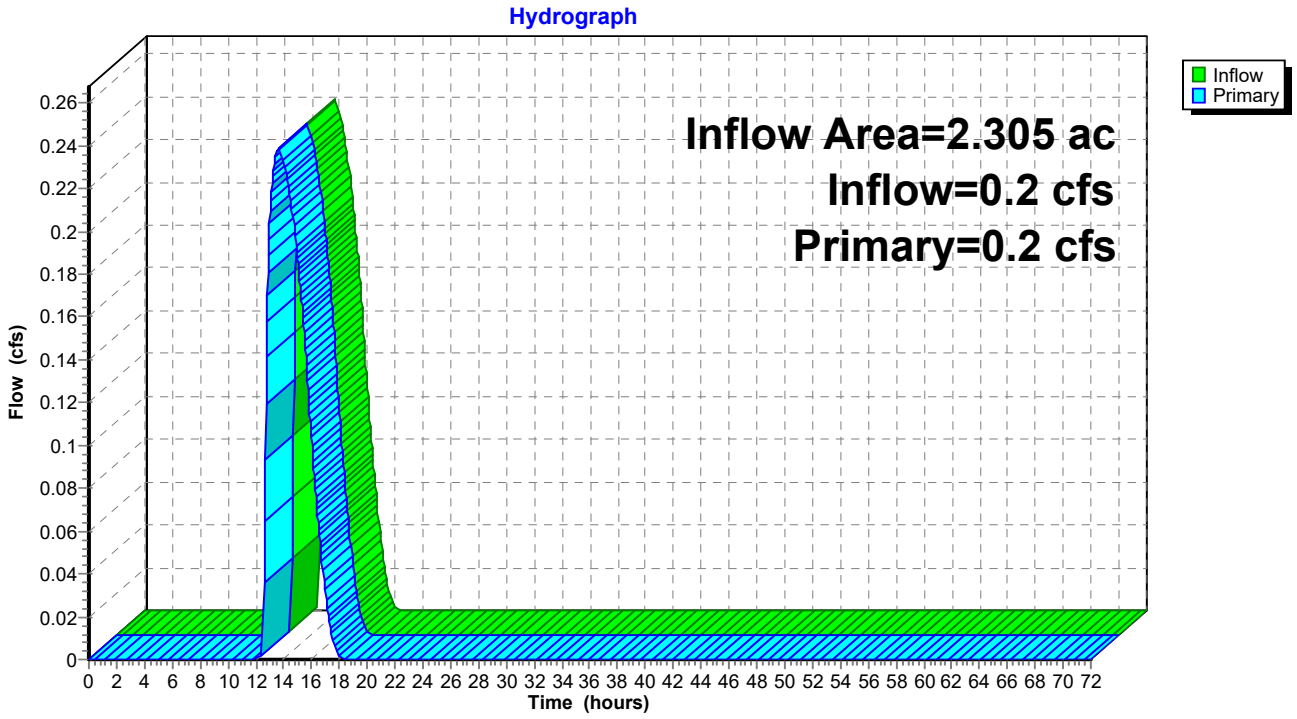


Summary for Link B15: Post A

Inflow Area = 2.305 ac, 19.53% Impervious, Inflow Depth = 0.3" for 25-yr event
Inflow = 0.2 cfs @ 13.62 hrs, Volume= 0.060 af
Primary = 0.2 cfs @ 13.62 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

Link B15: Post A



Summary for Subcatchment B21: B-1

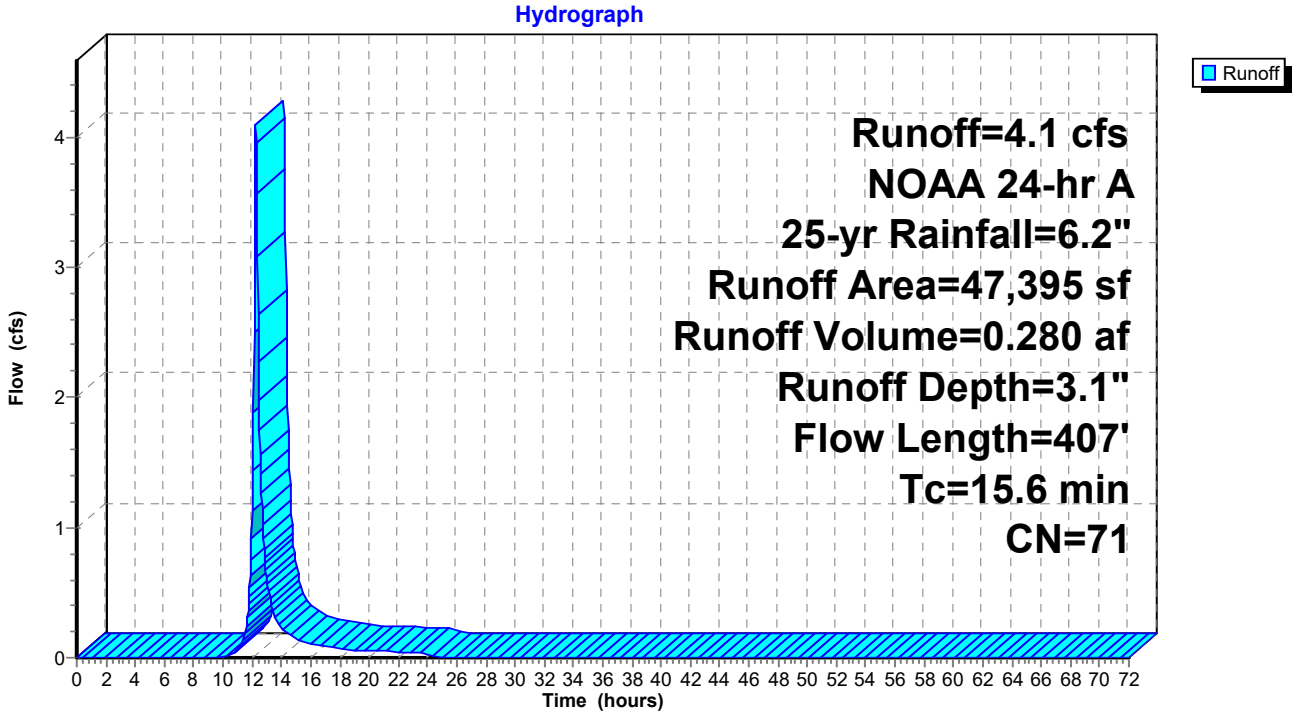
Runoff = 4.1 cfs @ 12.25 hrs, Volume= 0.280 af, Depth= 3.1"
Routed to Reach B23 : Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

	Area (sf)	CN	Description
	3,893	98	Paved parking, HSG A
	501	98	Paved parking, HSG C
*	454	98	Paved parking, HSG A Sdwk
*	107	98	Paved parking, HSG C Sdwk
	10,314	68	<50% Grass cover, Poor, HSG A
	3,533	79	<50% Grass cover, Poor, HSG B
	975	86	<50% Grass cover, Poor, HSG C
	0	30	Woods, Good, HSG A
	7,243	55	Woods, Good, HSG B
	20,375	70	1/2 acre lots, 25% imp, HSG B
	47,395	71	Weighted Average
	37,346		78.80% Pervious Area
	10,049		21.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
2.7	242	0.0460	1.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	115	0.0520	4.63		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.6	407	Total			

Subcatchment B21: B-1



Summary for Subcatchment B22: B-2

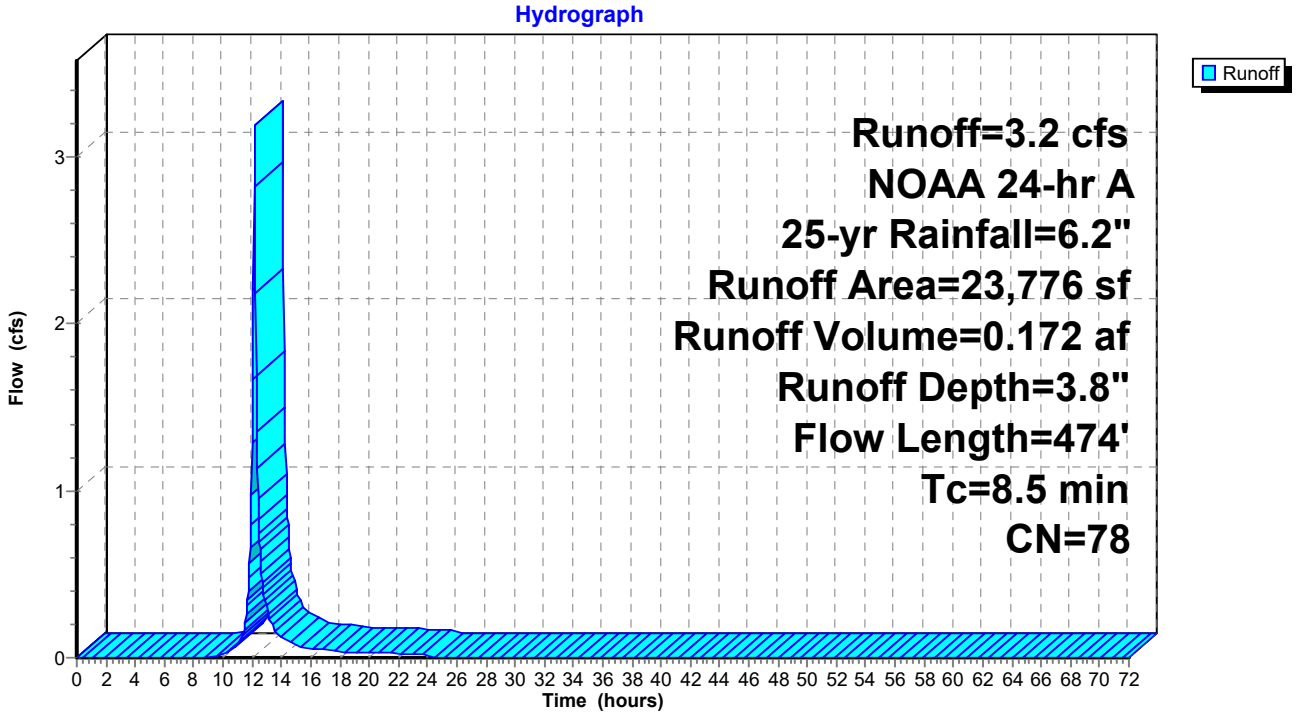
Runoff = 3.2 cfs @ 12.16 hrs, Volume= 0.172 af, Depth= 3.8"
Routed to Reach B23 : Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

	Area (sf)	CN	Description
*	1,075	98	Paved parking, HSG C (Pvmt.)
*	188	98	Paved parking, HSG C (Sdwk.)
	5,197	68	<50% Grass cover, Poor, HSG A
	206	79	<50% Grass cover, Poor, HSG B
	11,142	86	<50% Grass cover, Poor, HSG C
	470	30	Woods, Good, HSG A
	272	55	Woods, Good, HSG B
	5,226	70	Woods, Good, HSG C
	23,776	78	Weighted Average
	22,513		94.69% Pervious Area
	1,263		5.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0800	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.1"
1.2	134	0.0700	1.85		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	35	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.9	120	0.0460	1.07		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	135	0.0600	6.78	13.6	**Channel Flow,** Area= 2.0 sf Perim= 3.8' r= 0.53' n= 0.035 Earth, dense weeds
8.5	474	Total			

Subcatchment B22: B-2



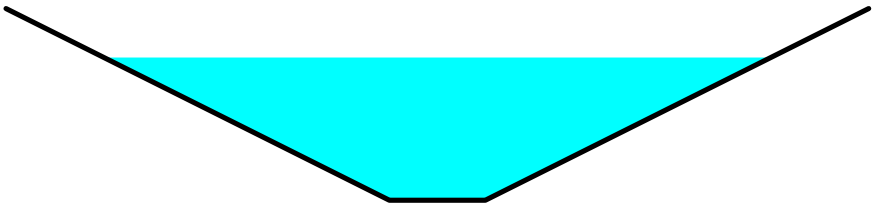
Summary for Reach B23: Ditch

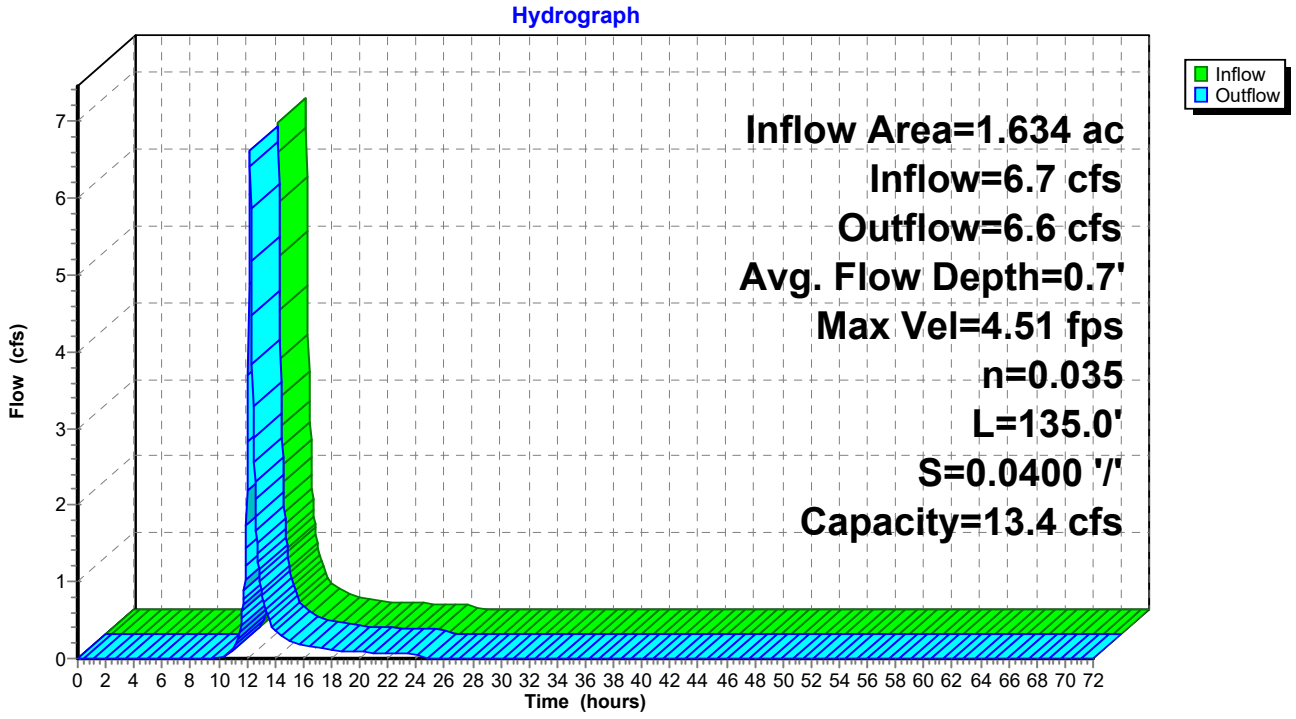
Inflow Area = 1.634 ac, 15.89% Impervious, Inflow Depth = 3.3" for 25-yr event
Inflow = 6.7 cfs @ 12.20 hrs, Volume= 0.452 af
Outflow = 6.6 cfs @ 12.21 hrs, Volume= 0.452 af, Atten= 1%, Lag= 0.9 min
Routed to Pond B24 : Infil. Tr #1

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 4.51 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.57 fps, Avg. Travel Time= 1.4 min

Peak Storage= 200 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.7' , Surface Width= 3.5'
Bank-Full Depth= 1.0' Flow Area= 2.5 sf, Capacity= 13.4 cfs

0.50' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 4.50'
Length= 135.0' Slope= 0.0400 '/'
Inlet Invert= 216.00', Outlet Invert= 210.60'





Summary for Pond B24: Infil. Tr #1

Inflow Area = 1.634 ac, 15.89% Impervious, Inflow Depth = 3.3" for 25-yr event
Inflow = 6.6 cfs @ 12.21 hrs, Volume= 0.452 af
Outflow = 5.9 cfs @ 12.29 hrs, Volume= 0.452 af, Atten= 11%, Lag= 4.6 min
Discarded = 0.2 cfs @ 12.29 hrs, Volume= 0.167 af
Primary = 3.6 cfs @ 12.29 hrs, Volume= 0.259 af
Routed to Link B25 : Post B
Secondary = 2.1 cfs @ 12.29 hrs, Volume= 0.026 af
Routed to Pond B34 : Infil Tr #2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 210.38' @ 12.29 hrs Surf.Area= 1,750 sf Storage= 4,154 cf

Plug-Flow detention time= 84.2 min calculated for 0.452 af (100% of inflow)
Center-of-Mass det. time= 84.3 min (898.8 - 814.6)

Volume	Invert	Avail.Storage	Storage Description
#1	204.80'	4,559 cf	**25.00'W x 70.00'L x 6.75'H Prismatoid** 11,813 cf Overall - 415 cf Embedded = 11,398 cf x 40.0% Voids
#2	205.30'	415 cf	**24.0" Round Pipe Storage** x 2 Inside #1 L= 66.0' S= 0.0050 '/'
		4,974 cf	Total Available Storage

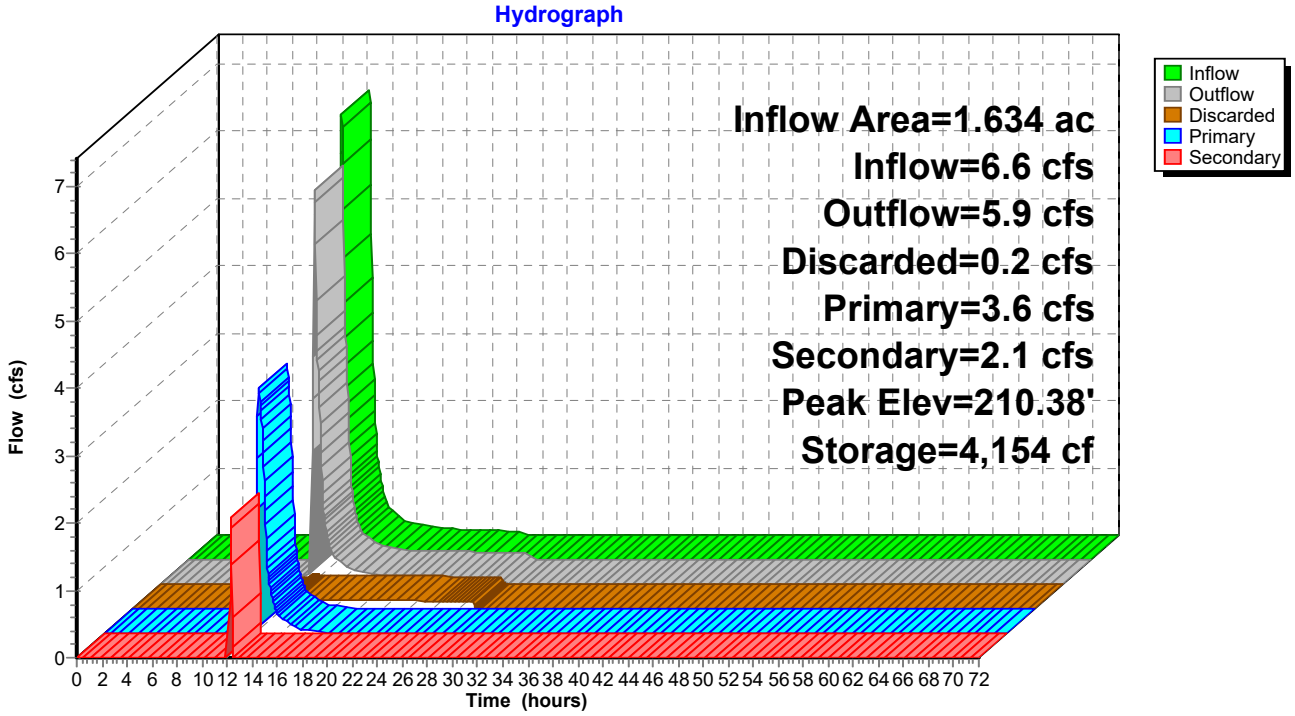
Device	Routing	Invert	Outlet Devices
#1	Discarded	204.80'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	207.50'	**10.0" Round Culvert** L= 5.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 207.50' / 207.38' S= 0.0240 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#3	Secondary	210.00'	**8.0" Horiz. Culvert X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.2 cfs @ 12.29 hrs HW=210.37' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=3.6 cfs @ 12.29 hrs HW=210.37' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 3.6 cfs @ 6.65 fps)

Secondary OutFlow Max=2.0 cfs @ 12.29 hrs HW=210.37' (Free Discharge)
↑—**3=Culvert** (Orifice Controls 2.0 cfs @ 2.92 fps)

Pond B24: Infil. Tr #1

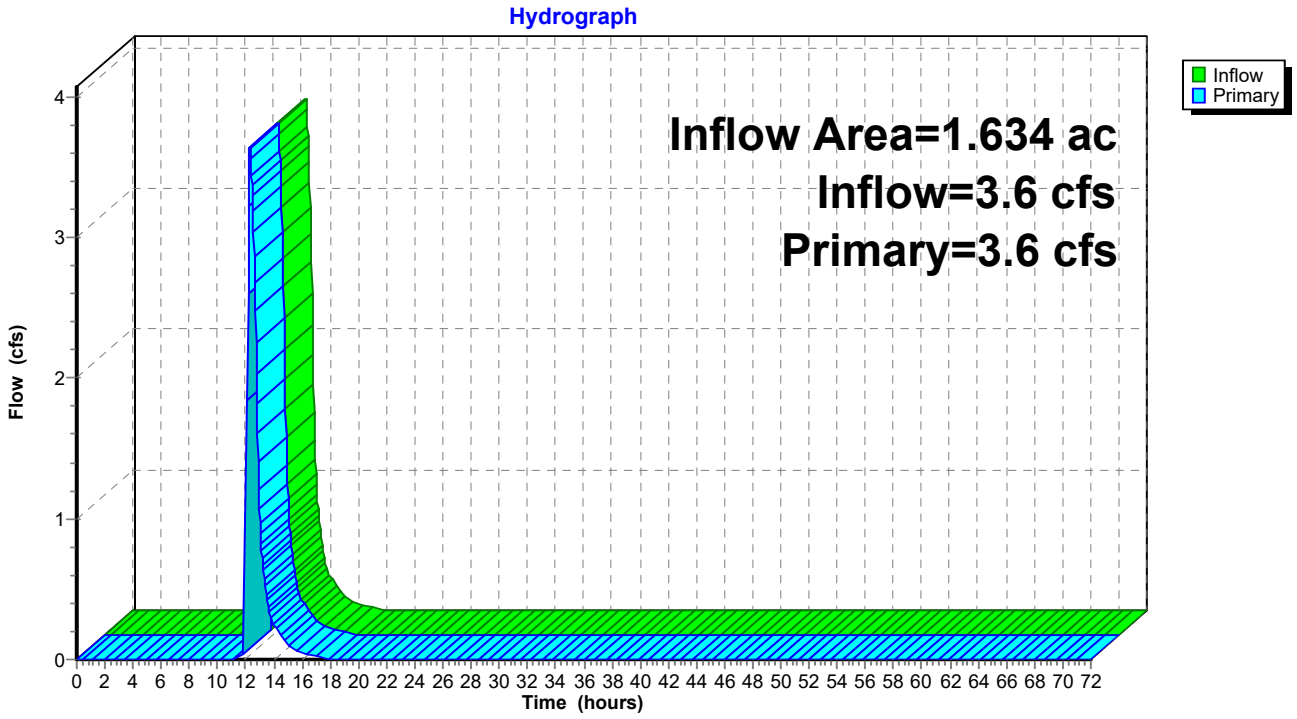


Summary for Link B25: Post B

Inflow Area = 1.634 ac, 15.89% Impervious, Inflow Depth = 1.9" for 25-yr event
Inflow = 3.6 cfs @ 12.29 hrs, Volume= 0.259 af
Primary = 3.6 cfs @ 12.29 hrs, Volume= 0.259 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

Link B25: Post B



Summary for Subcatchment B33: Post C

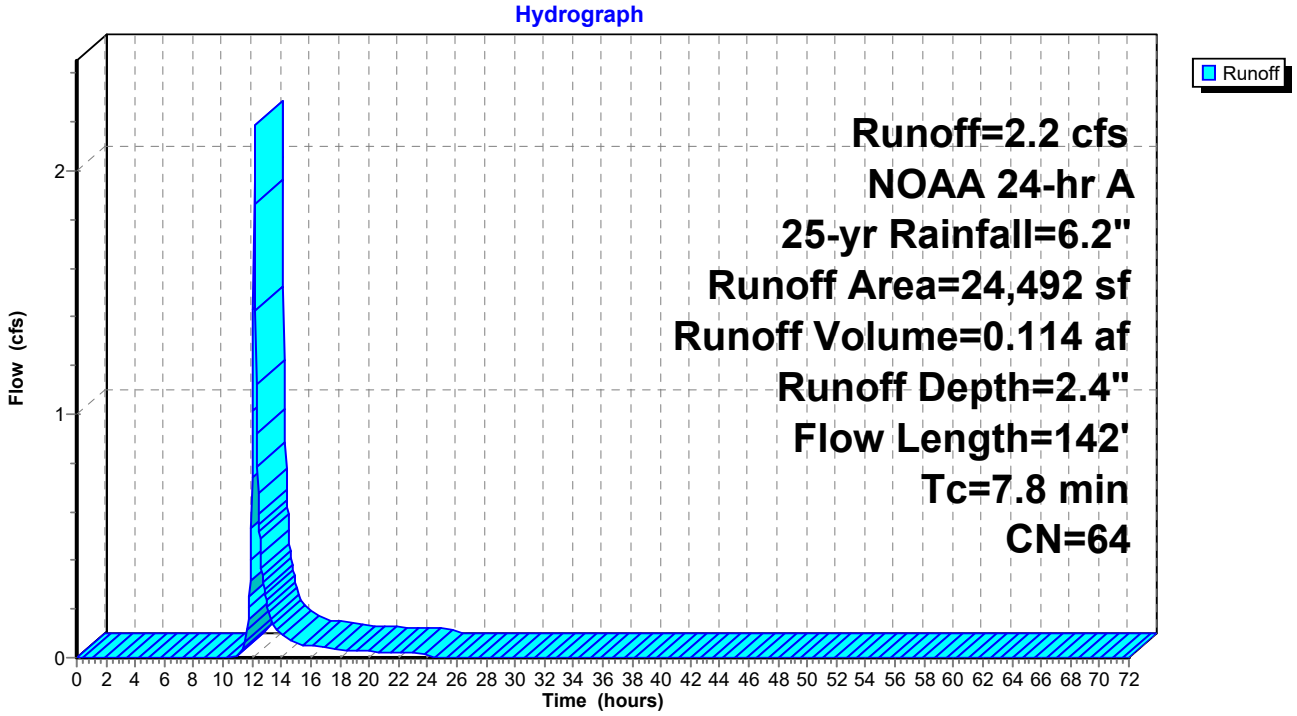
Runoff = 2.2 cfs @ 12.16 hrs, Volume= 0.114 af, Depth= 2.4"
Routed to Pond B34 : Infil Tr #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
3,010	98	Paved parking, HSG A
16,368	68	<50% Grass cover, Poor, HSG A
5,060	30	Woods, Good, HSG A
54	55	Woods, Good, HSG B
24,492	64	Weighted Average
21,482		87.71% Pervious Area
3,010		12.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0300	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.1"
0.3	41	0.1200	2.42		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	51	0.1800	2.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.8	142	Total			

Subcatchment B33: Post C



Summary for Pond B34: Infil Tr #2

Inflow Area = 0.562 ac, 12.29% Impervious, Inflow Depth = 3.0" for 25-yr event
Inflow = 3.4 cfs @ 12.26 hrs, Volume= 0.140 af
Outflow = 0.3 cfs @ 12.81 hrs, Volume= 0.140 af, Atten= 92%, Lag= 33.1 min
Discarded = 0.3 cfs @ 12.81 hrs, Volume= 0.140 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link B35 : Post C

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 208.58' @ 12.81 hrs Surf.Area= 3,979 sf Storage= 3,159 cf

Plug-Flow detention time= 106.7 min calculated for 0.140 af (100% of inflow)
Center-of-Mass det. time= 106.7 min (915.7 - 809.0)

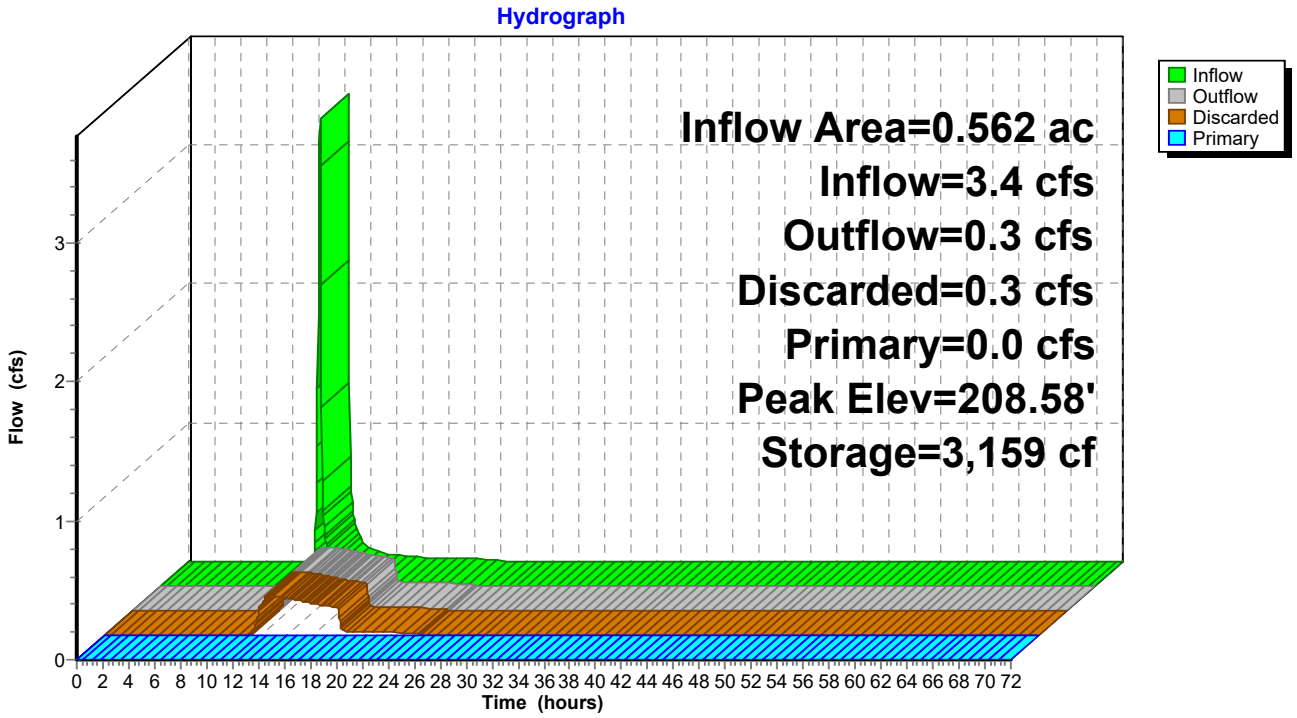
Volume	Invert	Avail.Storage	Storage Description
#1	206.60'	7,056 cf	**18.00'W x 200.00'L x 4.90'H Prismatoid** 17,640 cf Overall x 40.0% Voids
#2	207.10'	622 cf	**24.0" Round Pipe Storage** L= 198.0' S= 0.0050 '/'
		7,678 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	206.60'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	211.50'	**8.0" Horiz. Orifice/Grate X 10.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.3 cfs @ 12.81 hrs HW=208.58' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.3 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=206.60' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.0 cfs)

Pond B34: Infil Tr #2

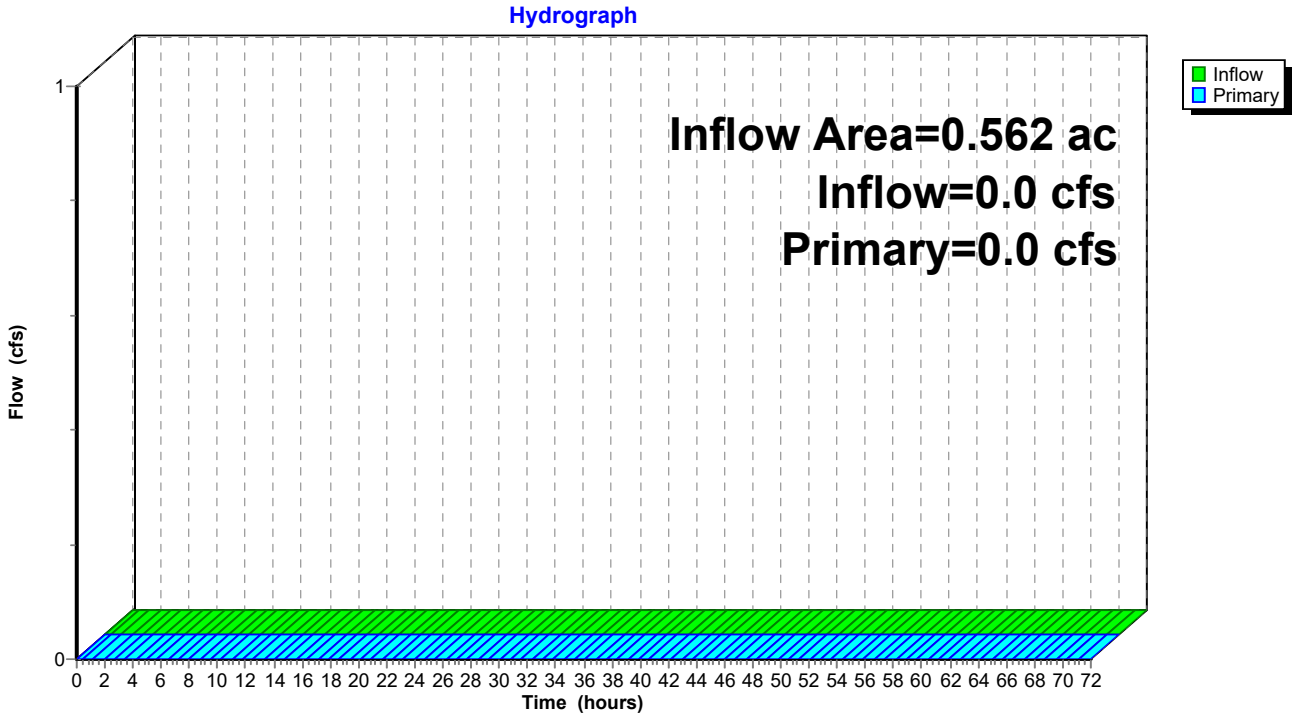


Summary for Link B35: Post C

Inflow Area = 0.562 ac, 12.29% Impervious, Inflow Depth = 0.0" for 25-yr event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 92L

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

Link B35: Post C



Summary for Subcatchment B43: Post D

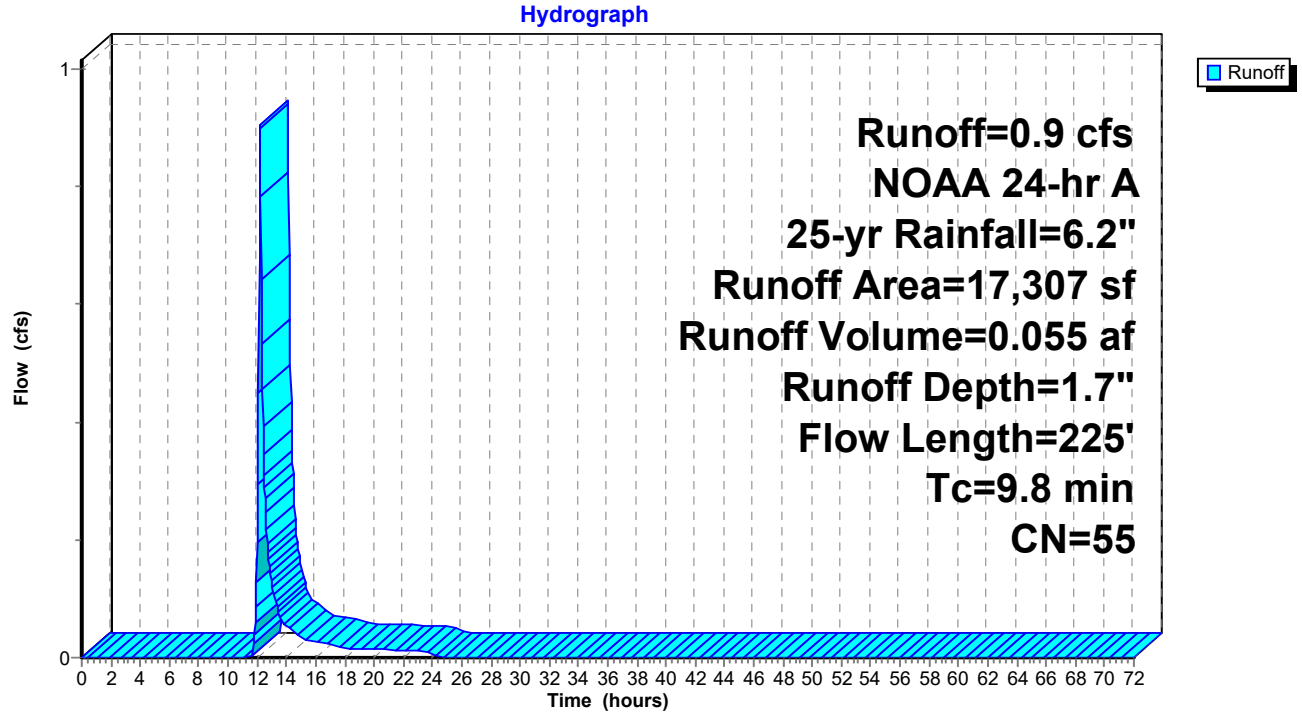
Runoff = 0.9 cfs @ 12.19 hrs, Volume= 0.055 af, Depth= 1.7"
Routed to Pond B44 : Infil Tr #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
11,278	68	<50% Grass cover, Poor, HSG A
46	79	<50% Grass cover, Poor, HSG B
5,983	30	Woods, Good, HSG A
17,307	55	Weighted Average
17,307		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.1"
0.9	75	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	100	0.1500	2.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.8	225	Total			

Subcatchment B43: Post D



Summary for Pond B44: Infil Tr #3

Inflow Area = 0.397 ac, 0.00% Impervious, Inflow Depth = 1.7" for 25-yr event
Inflow = 0.9 cfs @ 12.19 hrs, Volume= 0.055 af
Outflow = 0.1 cfs @ 13.48 hrs, Volume= 0.055 af, Atten= 91%, Lag= 77.4 min
Discarded = 0.1 cfs @ 13.48 hrs, Volume= 0.055 af
Primary = 0.0 cfs @ 13.48 hrs, Volume= 0.000 af
Routed to Link B45 : Post D

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 206.66' @ 13.48 hrs Surf.Area= 800 sf Storage= 1,153 cf

Plug-Flow detention time= 163.5 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 163.4 min (1,008.8 - 845.4)

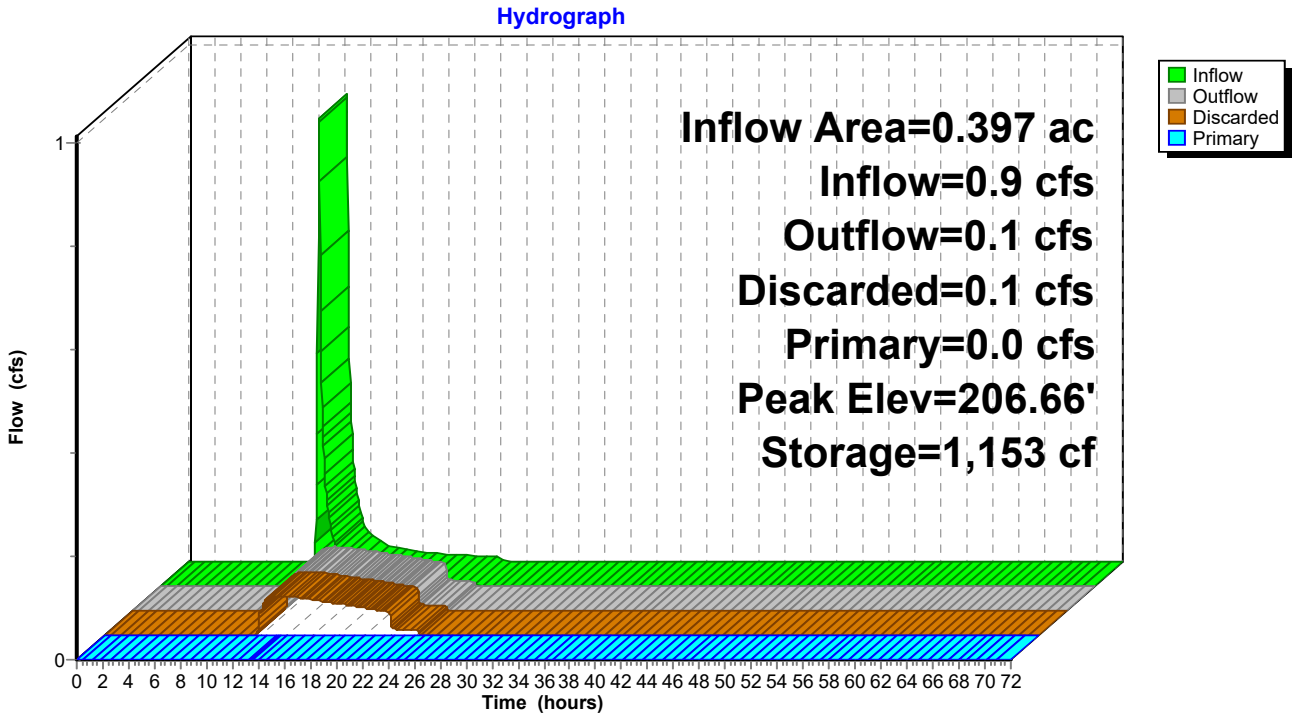
Volume	Invert	Avail.Storage	Storage Description
#1	203.50'	1,024 cf	**10.00'W x 80.00'L x 3.50'H Prismatoid** 2,800 cf Overall - 239 cf Embedded = 2,561 cf x 40.0% Voids
#2	204.50'	239 cf	**24.0" Round Pipe Storage** Inside #1 L= 76.0' S= 0.0050 '/'
		1,263 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	203.50'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	206.66'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 13.48 hrs HW=206.66' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 13.48 hrs HW=206.66' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.0 cfs @ 0.10 fps)

Pond B44: Infil Tr #3

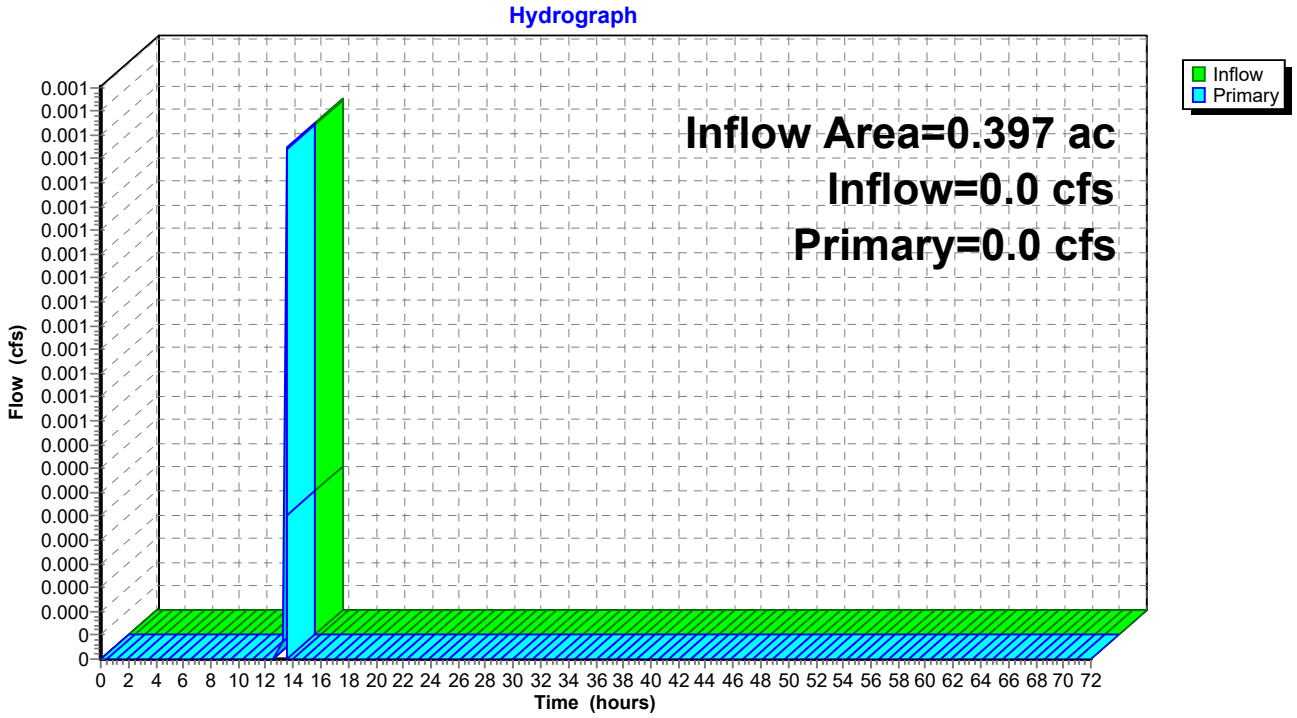


Summary for Link B45: Post D

Inflow Area = 0.397 ac, 0.00% Impervious, Inflow Depth = 0.0" for 25-yr event
Inflow = 0.0 cfs @ 13.48 hrs, Volume= 0.000 af
Primary = 0.0 cfs @ 13.48 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node 92L

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

Link B45: Post D



Summary for Subcatchment B54: Post E

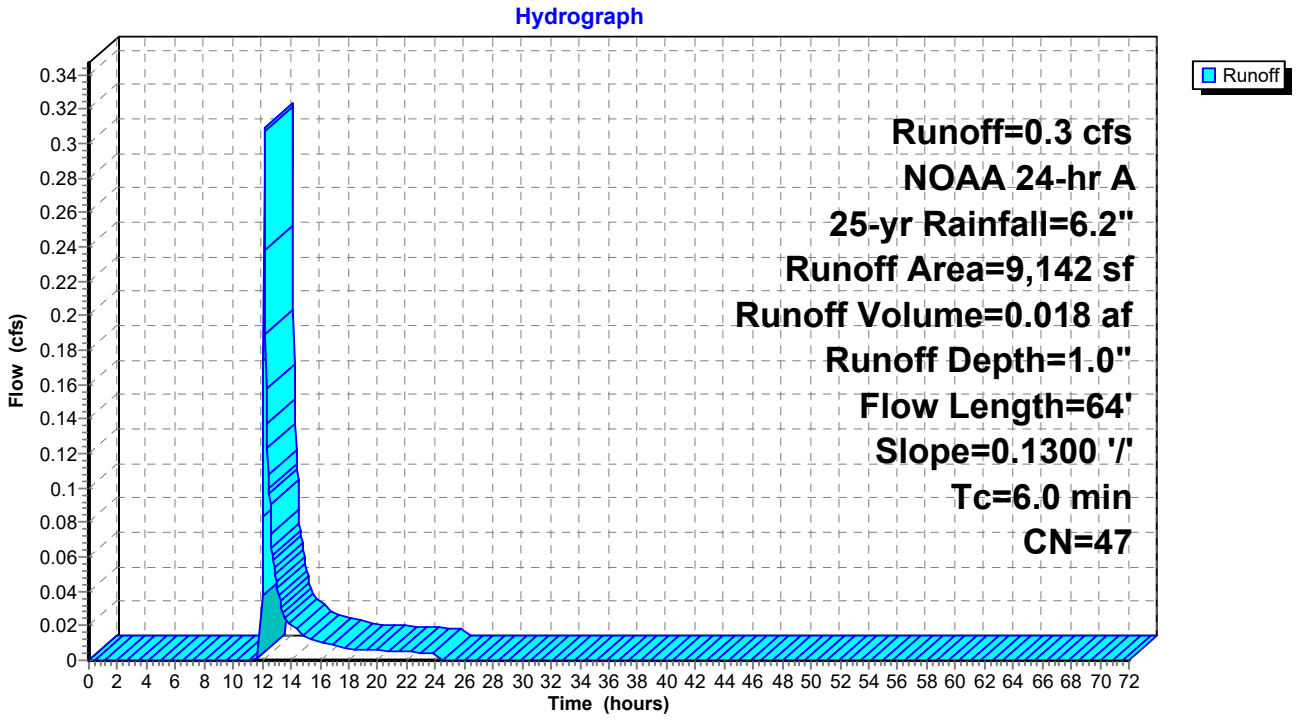
Runoff = 0.3 cfs @ 12.15 hrs, Volume= 0.018 af, Depth= 1.0"
Routed to Link B55 : Post E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 25-yr Rainfall=6.2"

Area (sf)	CN	Description
4,207	68	<50% Grass cover, Poor, HSG A
4,935	30	Woods, Good, HSG A
9,142	47	Weighted Average
9,142		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	32	0.1300	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
0.3	32	0.1300	1.80		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.4	64	Total, Increased to minimum Tc = 6.0 min			

Subcatchment B54: Post E

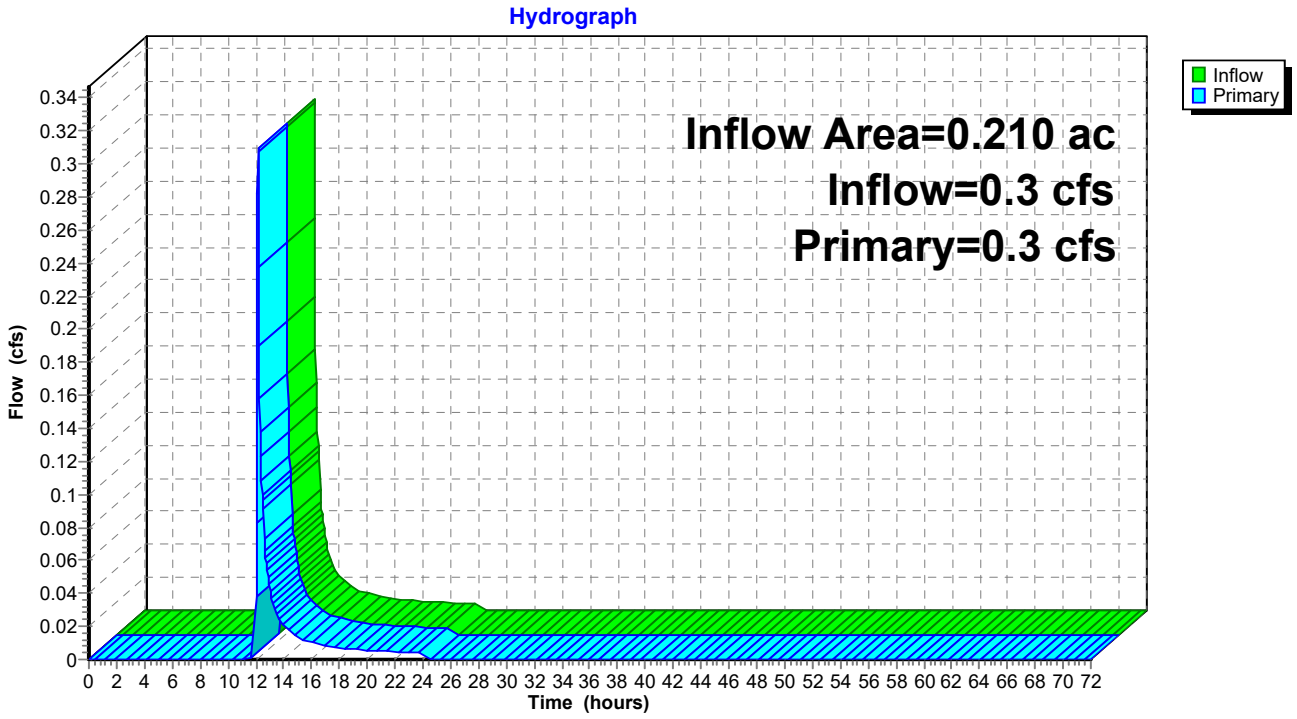


Summary for Link B55: Post E

Inflow Area = 0.210 ac, 0.00% Impervious, Inflow Depth = 1.0" for 25-yr event
Inflow = 0.3 cfs @ 12.15 hrs, Volume= 0.018 af
Primary = 0.3 cfs @ 12.15 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs

Link B55: Post E



iii. Runoff and Mitigation Design Summary Calculations

2, 10, 25 & 100-Year Design Storm Events Summary Calculations

See Following Pages

Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA01: Pre A Runoff Area=42,502 sf 0.00% Impervious Runoff Depth=0.0"
Flow Length=424' Tc=12.4 min CN=35 Runoff=0.0 cfs 0.000 af

SubcatchmentA02: Pre B Runoff Area=95,630 sf 10.59% Impervious Runoff Depth=0.3"
Flow Length=547' Tc=13.0 min CN=57 Runoff=0.5 cfs 0.057 af

SubcatchmentA03: Pre C Runoff Area=21,190 sf 3.81% Impervious Runoff Depth=0.0"
Flow Length=211' Tc=9.0 min CN=33 Runoff=0.0 cfs 0.000 af

SubcatchmentA04: Pre D Runoff Area=39,824 sf 2.14% Impervious Runoff Depth=0.0"
Flow Length=363' Tc=10.3 min CN=38 Runoff=0.0 cfs 0.000 af

SubcatchmentA05: Pre E Runoff Area=40,179 sf 0.00% Impervious Runoff Depth=0.0"
Flow Length=365' Tc=10.6 min CN=40 Runoff=0.0 cfs 0.000 af

SubcatchmentB11: A-2 Runoff Area=57,950 sf 33.83% Impervious Runoff Depth=1.5"
Flow Length=621' Tc=13.7 min CN=82 Runoff=2.6 cfs 0.171 af

Reach B12: Grassed Channel Avg. Flow Depth=0.3' Max Vel=0.92 fps Inflow=2.6 cfs 0.171 af
n=0.040 L=110.0' S=0.0029 '/' Capacity=33.8 cfs Outflow=2.6 cfs 0.171 af

SubcatchmentB13: A-1 Runoff Area=42,448 sf 0.00% Impervious Runoff Depth=0.4"
Flow Length=140' Tc=11.9 min CN=61 Runoff=0.4 cfs 0.036 af

Pond B14: Basin Peak Elev=204.86' Storage=4,854 cf Inflow=3.0 cfs 0.207 af
Discarded=0.2 cfs 0.207 af Primary=0.0 cfs 0.000 af Outflow=0.2 cfs 0.207 af

Link B15: Post A Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

SubcatchmentB21: B-1 Runoff Area=47,395 sf 21.20% Impervious Runoff Depth=0.9"
Flow Length=407' Tc=15.6 min CN=71 Runoff=1.1 cfs 0.080 af

SubcatchmentB22: B-2 Runoff Area=23,776 sf 5.31% Impervious Runoff Depth=1.3"
Flow Length=474' Tc=8.5 min CN=78 Runoff=1.1 cfs 0.058 af

Reach B23: Ditch Avg. Flow Depth=0.4' Max Vel=3.29 fps Inflow=1.9 cfs 0.138 af
n=0.035 L=135.0' S=0.0400 '/' Capacity=13.4 cfs Outflow=1.9 cfs 0.138 af

Pond B24: Infil. Tr #1 Peak Elev=207.89' Storage=2,414 cf Inflow=1.9 cfs 0.138 af
Discarded=0.1 cfs 0.112 af Primary=0.5 cfs 0.025 af Secondary=0.0 cfs 0.000 af Outflow=0.6 cfs 0.138 af

Link B25: Post B Inflow=0.5 cfs 0.025 af
Primary=0.5 cfs 0.025 af

SubcatchmentB33: Post C Runoff Area=24,492 sf 12.29% Impervious Runoff Depth=0.6"
Flow Length=142' Tc=7.8 min CN=64 Runoff=0.4 cfs 0.026 af

Pond B34: Infil Tr #2 Peak Elev=206.70' Storage=145 cf Inflow=0.4 cfs 0.026 af
Discarded=0.2 cfs 0.026 af Primary=0.0 cfs 0.000 af Outflow=0.2 cfs 0.026 af

Link B35: Post C Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B43: Post D Runoff Area=17,307 sf 0.00% Impervious Runoff Depth=0.3"
Flow Length=225' Tc=9.8 min CN=55 Runoff=0.1 cfs 0.008 af

Pond B44: Infil Tr #3 Peak Elev=203.56' Storage=20 cf Inflow=0.1 cfs 0.008 af
Discarded=0.0 cfs 0.008 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.008 af

Link B45: Post D Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B54: Post E Runoff Area=9,142 sf 0.00% Impervious Runoff Depth=0.1"
Flow Length=64' Slope=0.1300 '/' Tc=6.0 min CN=47 Runoff=0.0 cfs 0.001 af

Link B55: Post E Inflow=0.0 cfs 0.001 af
Primary=0.0 cfs 0.001 af

Total Runoff Area = 10.602 ac Runoff Volume = 0.437 af Average Runoff Depth = 0.5"
90.10% Pervious = 9.553 ac 9.90% Impervious = 1.050 ac

Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA01: Pre A Runoff Area=42,502 sf 0.00% Impervious Runoff Depth=0.1"
Flow Length=424' Tc=12.4 min CN=35 Runoff=0.0 cfs 0.007 af

SubcatchmentA02: Pre B Runoff Area=95,630 sf 10.59% Impervious Runoff Depth=1.1"
Flow Length=547' Tc=13.0 min CN=57 Runoff=2.9 cfs 0.208 af

SubcatchmentA03: Pre C Runoff Area=21,190 sf 3.81% Impervious Runoff Depth=0.0"
Flow Length=211' Tc=9.0 min CN=33 Runoff=0.0 cfs 0.002 af

SubcatchmentA04: Pre D Runoff Area=39,824 sf 2.14% Impervious Runoff Depth=0.2"
Flow Length=363' Tc=10.3 min CN=38 Runoff=0.1 cfs 0.014 af

SubcatchmentA05: Pre E Runoff Area=40,179 sf 0.00% Impervious Runoff Depth=0.2"
Flow Length=365' Tc=10.6 min CN=40 Runoff=0.1 cfs 0.019 af

SubcatchmentB11: A-2 Runoff Area=57,950 sf 33.83% Impervious Runoff Depth=3.1"
Flow Length=621' Tc=13.7 min CN=82 Runoff=5.3 cfs 0.347 af

Reach B12: Grassed Channel Avg. Flow Depth=0.5' Max Vel=1.18 fps Inflow=5.3 cfs 0.347 af
n=0.040 L=110.0' S=0.0029 '/' Capacity=33.8 cfs Outflow=5.2 cfs 0.347 af

SubcatchmentB13: A-1 Runoff Area=42,448 sf 0.00% Impervious Runoff Depth=1.4"
Flow Length=140' Tc=11.9 min CN=61 Runoff=1.8 cfs 0.114 af

Pond B14: Basin Peak Elev=206.38' Storage=12,525 cf Inflow=6.9 cfs 0.461 af
Discarded=0.3 cfs 0.461 af Primary=0.0 cfs 0.000 af Outflow=0.3 cfs 0.461 af

Link B15: Post A Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

SubcatchmentB21: B-1 Runoff Area=47,395 sf 21.20% Impervious Runoff Depth=2.2"
Flow Length=407' Tc=15.6 min CN=71 Runoff=2.8 cfs 0.196 af

SubcatchmentB22: B-2 Runoff Area=23,776 sf 5.31% Impervious Runoff Depth=2.8"
Flow Length=474' Tc=8.5 min CN=78 Runoff=2.3 cfs 0.126 af

Reach B23: Ditch Avg. Flow Depth=0.6' Max Vel=4.14 fps Inflow=4.7 cfs 0.322 af
n=0.035 L=135.0' S=0.0400 '/' Capacity=13.4 cfs Outflow=4.7 cfs 0.322 af

Pond B24: Infil. Tr #1 Peak Elev=209.60' Storage=3,607 cf Inflow=4.7 cfs 0.322 af
Discarded=0.1 cfs 0.149 af Primary=3.0 cfs 0.173 af Secondary=0.0 cfs 0.000 af Outflow=3.2 cfs 0.322 af

Link B25: Post B Inflow=3.0 cfs 0.173 af
Primary=3.0 cfs 0.173 af

SubcatchmentB33: Post C Runoff Area=24,492 sf 12.29% Impervious Runoff Depth=1.6"
Flow Length=142' Tc=7.8 min CN=64 Runoff=1.4 cfs 0.076 af

Pond B34: Infil Tr #2 Peak Elev=207.40' Storage=1,166 cf Inflow=1.4 cfs 0.076 af
Discarded=0.2 cfs 0.076 af Primary=0.0 cfs 0.000 af Outflow=0.2 cfs 0.076 af

Link B35: Post C Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B43: Post D Runoff Area=17,307 sf 0.00% Impervious Runoff Depth=1.0"
Flow Length=225' Tc=9.8 min CN=55 Runoff=0.5 cfs 0.033 af

Pond B44: Infil Tr #3 Peak Elev=205.22' Storage=582 cf Inflow=0.5 cfs 0.033 af
Discarded=0.1 cfs 0.033 af Primary=0.0 cfs 0.000 af Outflow=0.1 cfs 0.033 af

Link B45: Post D Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B54: Post E Runoff Area=9,142 sf 0.00% Impervious Runoff Depth=0.6"
Flow Length=64' Slope=0.1300 '/' Tc=6.0 min CN=47 Runoff=0.1 cfs 0.010 af

Link B55: Post E Inflow=0.1 cfs 0.010 af
Primary=0.1 cfs 0.010 af

Total Runoff Area = 10.602 ac Runoff Volume = 1.152 af Average Runoff Depth = 1.3"
90.10% Pervious = 9.553 ac 9.90% Impervious = 1.050 ac

Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA01: Pre A Runoff Area=42,502 sf 0.00% Impervious Runoff Depth=0.3"
Flow Length=424' Tc=12.4 min CN=35 Runoff=0.1 cfs 0.024 af

SubcatchmentA02: Pre B Runoff Area=95,630 sf 10.59% Impervious Runoff Depth=1.8"
Flow Length=547' Tc=13.0 min CN=57 Runoff=5.0 cfs 0.332 af

SubcatchmentA03: Pre C Runoff Area=21,190 sf 3.81% Impervious Runoff Depth=0.2"
Flow Length=211' Tc=9.0 min CN=33 Runoff=0.0 cfs 0.008 af

SubcatchmentA04: Pre D Runoff Area=39,824 sf 2.14% Impervious Runoff Depth=0.5"
Flow Length=363' Tc=10.3 min CN=38 Runoff=0.2 cfs 0.035 af

SubcatchmentA05: Pre E Runoff Area=40,179 sf 0.00% Impervious Runoff Depth=0.6"
Flow Length=365' Tc=10.6 min CN=40 Runoff=0.4 cfs 0.044 af

SubcatchmentB11: A-2 Runoff Area=57,950 sf 33.83% Impervious Runoff Depth=4.2"
Flow Length=621' Tc=13.7 min CN=82 Runoff=7.1 cfs 0.466 af

Reach B12: Grassed Channel Avg. Flow Depth=0.6' Max Vel=1.30 fps Inflow=7.1 cfs 0.466 af
n=0.040 L=110.0' S=0.0029 '/' Capacity=33.8 cfs Outflow=6.9 cfs 0.466 af

SubcatchmentB13: A-1 Runoff Area=42,448 sf 0.00% Impervious Runoff Depth=2.2"
Flow Length=140' Tc=11.9 min CN=61 Runoff=2.8 cfs 0.175 af

Pond B14: Basin Peak Elev=207.04' Storage=17,226 cf Inflow=9.6 cfs 0.641 af
Discarded=0.4 cfs 0.581 af Primary=0.2 cfs 0.060 af Outflow=0.6 cfs 0.641 af

Link B15: Post A Inflow=0.2 cfs 0.060 af
Primary=0.2 cfs 0.060 af

SubcatchmentB21: B-1 Runoff Area=47,395 sf 21.20% Impervious Runoff Depth=3.1"
Flow Length=407' Tc=15.6 min CN=71 Runoff=4.1 cfs 0.280 af

SubcatchmentB22: B-2 Runoff Area=23,776 sf 5.31% Impervious Runoff Depth=3.8"
Flow Length=474' Tc=8.5 min CN=78 Runoff=3.2 cfs 0.172 af

Reach B23: Ditch Avg. Flow Depth=0.7' Max Vel=4.51 fps Inflow=6.7 cfs 0.452 af
n=0.035 L=135.0' S=0.0400 '/' Capacity=13.4 cfs Outflow=6.6 cfs 0.452 af

Pond B24: Infil. Tr #1 Peak Elev=210.38' Storage=4,154 cf Inflow=6.6 cfs 0.452 af
Discarded=0.2 cfs 0.167 af Primary=3.6 cfs 0.259 af Secondary=2.1 cfs 0.026 af Outflow=5.9 cfs 0.452 af

Link B25: Post B Inflow=3.6 cfs 0.259 af
Primary=3.6 cfs 0.259 af

SubcatchmentB33: Post C Runoff Area=24,492 sf 12.29% Impervious Runoff Depth=2.4"
Flow Length=142' Tc=7.8 min CN=64 Runoff=2.2 cfs 0.114 af

Pond B34: Infil Tr #2 Peak Elev=208.58' Storage=3,159 cf Inflow=3.4 cfs 0.140 af
Discarded=0.3 cfs 0.140 af Primary=0.0 cfs 0.000 af Outflow=0.3 cfs 0.140 af

Link B35: Post C Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B43: Post D Runoff Area=17,307 sf 0.00% Impervious Runoff Depth=1.7"
Flow Length=225' Tc=9.8 min CN=55 Runoff=0.9 cfs 0.055 af

Pond B44: Infil Tr #3 Peak Elev=206.66' Storage=1,153 cf Inflow=0.9 cfs 0.055 af
Discarded=0.1 cfs 0.055 af Primary=0.0 cfs 0.000 af Outflow=0.1 cfs 0.055 af

Link B45: Post D Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B54: Post E Runoff Area=9,142 sf 0.00% Impervious Runoff Depth=1.0"
Flow Length=64' Slope=0.1300 '/' Tc=6.0 min CN=47 Runoff=0.3 cfs 0.018 af

Link B55: Post E Inflow=0.3 cfs 0.018 af
Primary=0.3 cfs 0.018 af

Total Runoff Area = 10.602 ac Runoff Volume = 1.724 af Average Runoff Depth = 2.0"
90.10% Pervious = 9.553 ac 9.90% Impervious = 1.050 ac

Time span=0.00-72.00 hrs, dt=0.04 hrs, 1801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA01: Pre A Runoff Area=42,502 sf 0.00% Impervious Runoff Depth=0.8"
Flow Length=424' Tc=12.4 min CN=35 Runoff=0.6 cfs 0.066 af

SubcatchmentA02: Pre B Runoff Area=95,630 sf 10.59% Impervious Runoff Depth=3.0"
Flow Length=547' Tc=13.0 min CN=57 Runoff=8.6 cfs 0.552 af

SubcatchmentA03: Pre C Runoff Area=21,190 sf 3.81% Impervious Runoff Depth=0.6"
Flow Length=211' Tc=9.0 min CN=33 Runoff=0.2 cfs 0.026 af

SubcatchmentA04: Pre D Runoff Area=39,824 sf 2.14% Impervious Runoff Depth=1.1"
Flow Length=363' Tc=10.3 min CN=38 Runoff=1.0 cfs 0.082 af

SubcatchmentA05: Pre E Runoff Area=40,179 sf 0.00% Impervious Runoff Depth=1.3"
Flow Length=365' Tc=10.6 min CN=40 Runoff=1.3 cfs 0.097 af

SubcatchmentB11: A-2 Runoff Area=57,950 sf 33.83% Impervious Runoff Depth=5.9"
Flow Length=621' Tc=13.7 min CN=82 Runoff=9.8 cfs 0.652 af

Reach B12: Grassed Channel Avg. Flow Depth=0.7' Max Vel=1.45 fps Inflow=9.8 cfs 0.652 af
n=0.040 L=110.0' S=0.0029 '/' Capacity=33.8 cfs Outflow=9.6 cfs 0.652 af

SubcatchmentB13: A-1 Runoff Area=42,448 sf 0.00% Impervious Runoff Depth=3.5"
Flow Length=140' Tc=11.9 min CN=61 Runoff=4.6 cfs 0.281 af

Pond B14: Basin Peak Elev=208.05' Storage=24,536 cf Inflow=13.9 cfs 0.933 af
Discarded=0.5 cfs 0.700 af Primary=0.7 cfs 0.233 af Outflow=1.2 cfs 0.933 af

Link B15: Post A Inflow=0.7 cfs 0.233 af
Primary=0.7 cfs 0.233 af

SubcatchmentB21: B-1 Runoff Area=47,395 sf 21.20% Impervious Runoff Depth=4.6"
Flow Length=407' Tc=15.6 min CN=71 Runoff=6.1 cfs 0.417 af

SubcatchmentB22: B-2 Runoff Area=23,776 sf 5.31% Impervious Runoff Depth=5.4"
Flow Length=474' Tc=8.5 min CN=78 Runoff=4.5 cfs 0.246 af

Reach B23: Ditch Avg. Flow Depth=0.9' Max Vel=4.96 fps Inflow=9.7 cfs 0.663 af
n=0.035 L=135.0' S=0.0400 '/' Capacity=13.4 cfs Outflow=9.7 cfs 0.663 af

Pond B24: Infil. Tr #1 Peak Elev=211.45' Storage=4,907 cf Inflow=9.7 cfs 0.663 af
Discarded=0.2 cfs 0.189 af Primary=4.4 cfs 0.378 af Secondary=4.1 cfs 0.095 af Outflow=8.6 cfs 0.663 af

Link B25: Post B Inflow=4.4 cfs 0.378 af
Primary=4.4 cfs 0.378 af

SubcatchmentB33: Post C Runoff Area=24,492 sf 12.29% Impervious Runoff Depth=3.8"
Flow Length=142' Tc=7.8 min CN=64 Runoff=3.4 cfs 0.178 af

Pond B34: Infil Tr #2 Peak Elev=211.50' Storage=7,677 cf Inflow=6.4 cfs 0.273 af
Discarded=0.4 cfs 0.273 af Primary=0.0 cfs 0.000 af Outflow=0.4 cfs 0.273 af

Link B35: Post C Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Subcatchment B43: Post D Runoff Area=17,307 sf 0.00% Impervious Runoff Depth=2.8"
Flow Length=225' Tc=9.8 min CN=55 Runoff=1.6 cfs 0.093 af

Pond B44: Infil Tr #3 Peak Elev=206.94' Storage=1,243 cf Inflow=1.6 cfs 0.093 af
Discarded=0.1 cfs 0.065 af Primary=0.9 cfs 0.027 af Outflow=1.0 cfs 0.093 af

Link B45: Post D Inflow=0.9 cfs 0.027 af
Primary=0.9 cfs 0.027 af

Subcatchment B54: Post E Runoff Area=9,142 sf 0.00% Impervious Runoff Depth=2.0"
Flow Length=64' Slope=0.1300 '/' Tc=6.0 min CN=47 Runoff=0.7 cfs 0.034 af

Link B55: Post E Inflow=0.7 cfs 0.034 af
Primary=0.7 cfs 0.034 af

Total Runoff Area = 10.602 ac Runoff Volume = 2.723 af Average Runoff Depth = 3.1"
90.10% Pervious = 9.553 ac 9.90% Impervious = 1.050 ac

iv. Building Infiltration Systems

See Following Page

Summary for Subcatchment D01: Bldgs #1

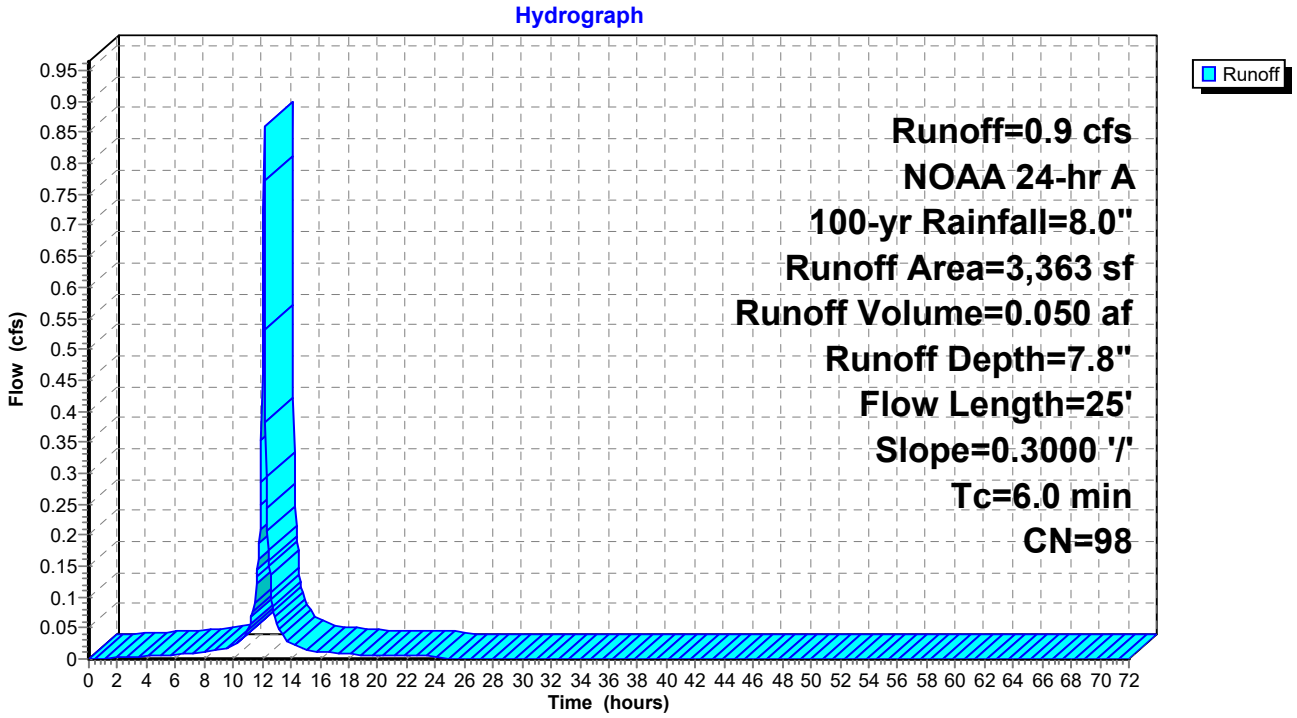
Runoff = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 7.8"
Routed to Pond D02 : Drywell #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 100-yr Rainfall=8.0"

Area (sf)	CN	Description
3,363	98	Unconnected roofs, HSG C
3,363		100.00% Impervious Area
3,363		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.3000	3.03		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.1"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment D01: Bldgs #1



Summary for Pond D02: Drywell #1

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 7.8" for 100-yr event
Inflow = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af
Outflow = 0.1 cfs @ 12.92 hrs, Volume= 0.050 af, Atten= 92%, Lag= 47.8 min
Discarded = 0.1 cfs @ 12.92 hrs, Volume= 0.050 af
Primary = 0.0 cfs @ 12.92 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 224.40' @ 12.93 hrs Surf.Area= 600 sf Storage= 1,081 cf

Plug-Flow detention time= 167.6 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 167.6 min (907.9 - 740.3)

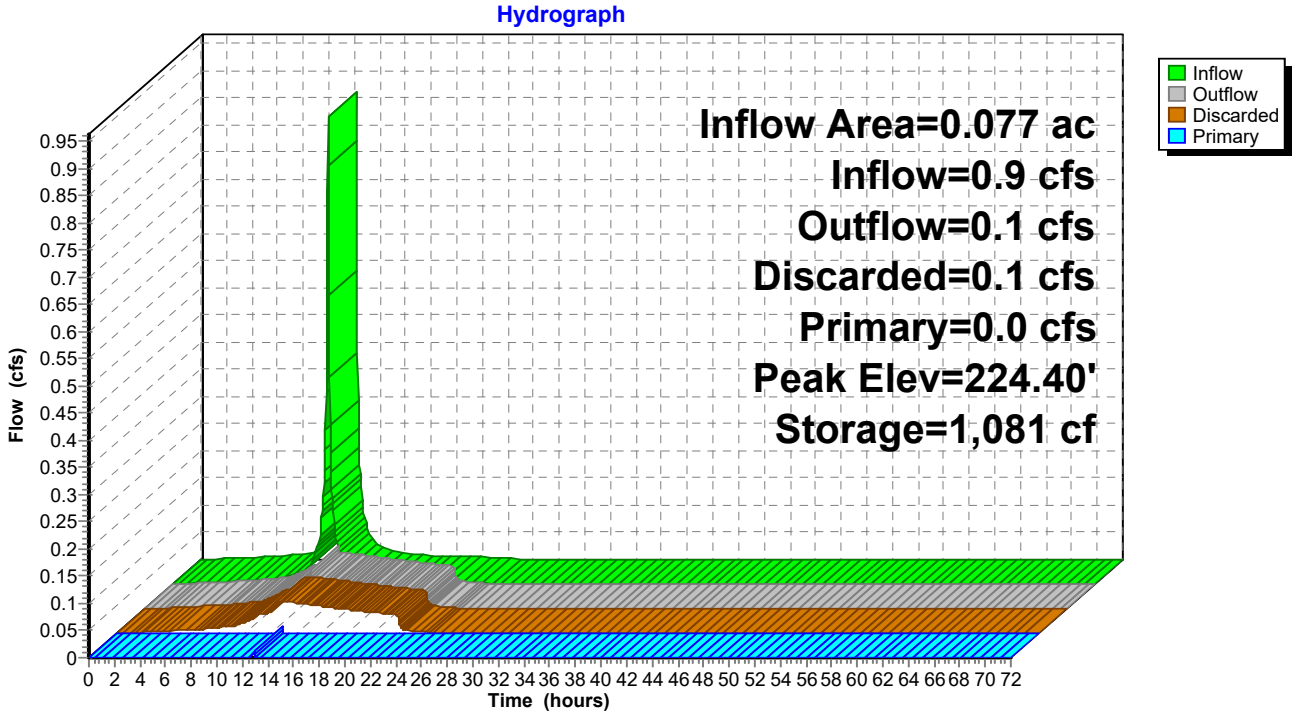
Volume	Invert	Avail.Storage	Storage Description
#1	220.00'	1,040 cf	**20.00'W x 30.00'L x 4.40'H Prismatoid** 2,640 cf Overall - 41 cf Embedded = 2,599 cf x 40.0% Voids
#2	220.50'	41 cf	**12.0" Round Pipe Storage** x 2 Inside #1 L= 26.0' S= 0.0050 '/'
		1,081 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	220.00'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	224.40'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.1 cfs @ 12.92 hrs HW=224.40' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 12.92 hrs HW=224.40' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.14 fps)

Pond D02: Drywell #1



Summary for Subcatchment D03: Bldgs #2

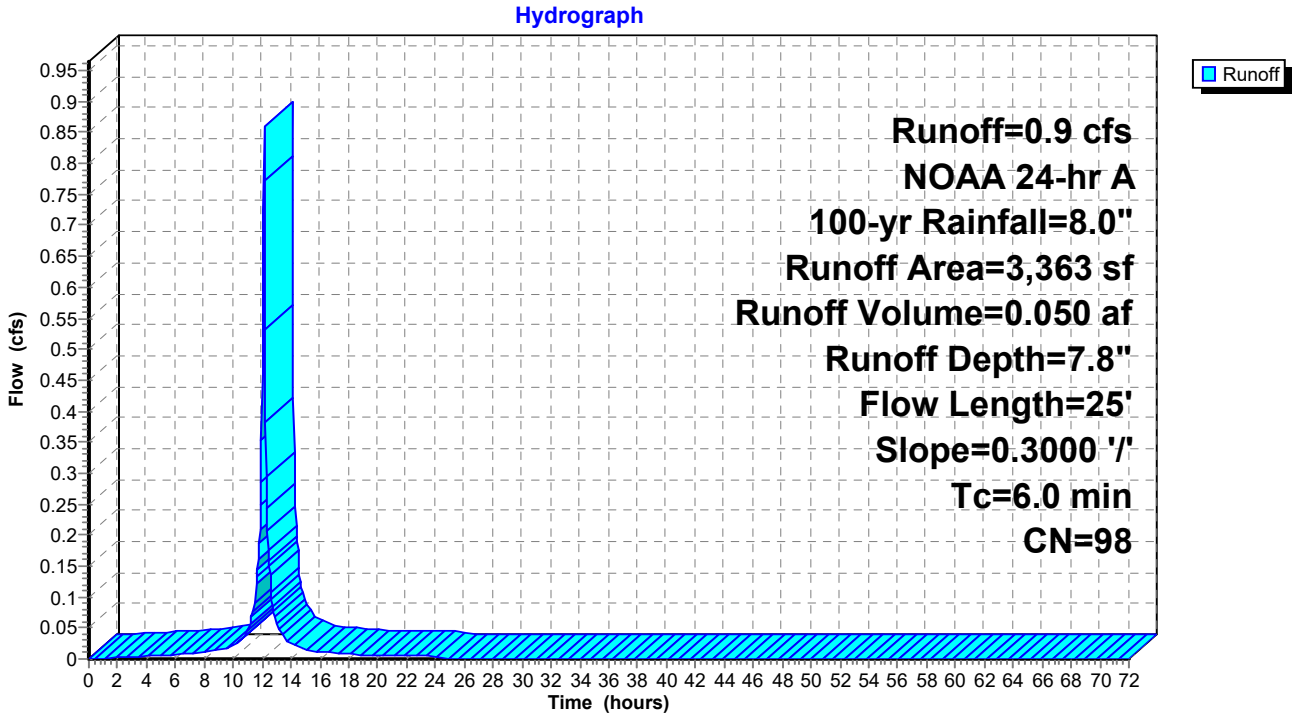
Runoff = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 7.8"
Routed to Pond D04 : Drywell #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 100-yr Rainfall=8.0"

Area (sf)	CN	Description
3,363	98	Unconnected roofs, HSG C
3,363		100.00% Impervious Area
3,363		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.3000	3.03		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.1"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment D03: Bldgs #2



Summary for Pond D04: Drywell #2

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 7.8" for 100-yr event
Inflow = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af
Outflow = 0.1 cfs @ 12.87 hrs, Volume= 0.050 af, Atten= 91%, Lag= 44.7 min
Discarded = 0.1 cfs @ 12.84 hrs, Volume= 0.050 af
Primary = 0.0 cfs @ 12.87 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 223.90' @ 12.88 hrs Surf.Area= 600 sf Storage= 1,081 cf

Plug-Flow detention time= 168.3 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 168.2 min (908.5 - 740.3)

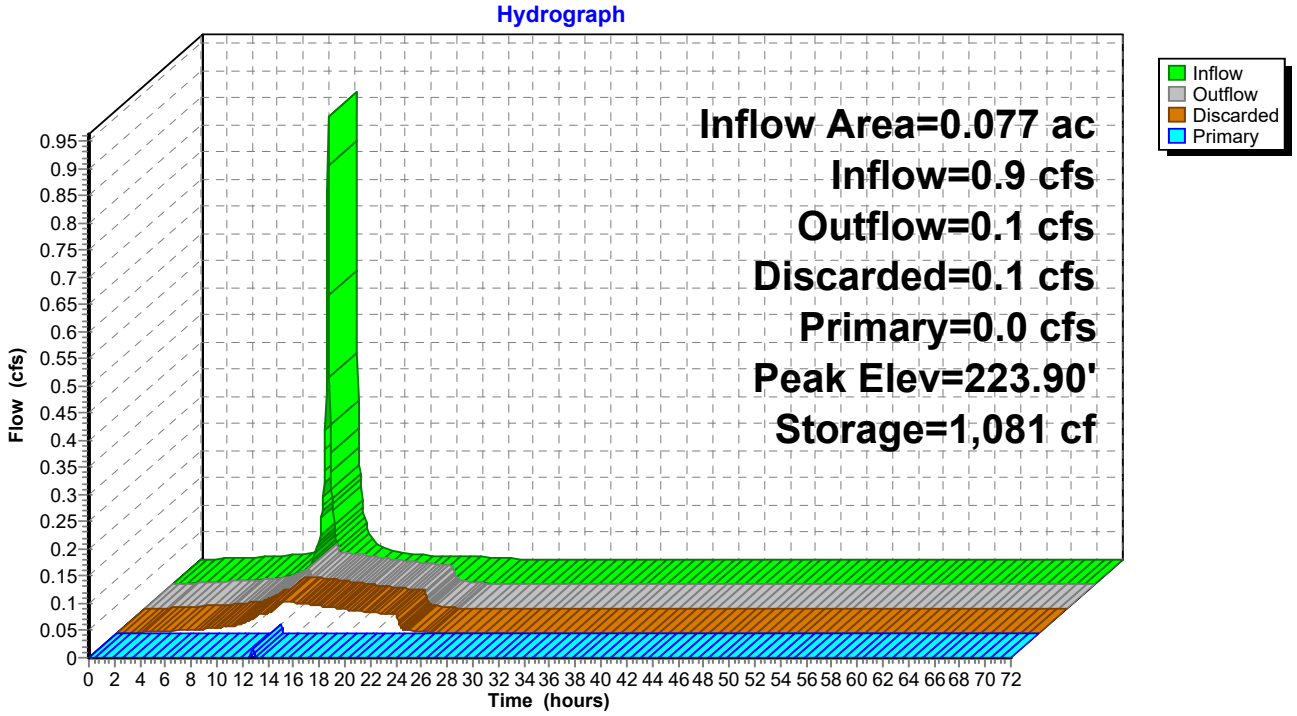
Volume	Invert	Avail.Storage	Storage Description
#1	218.50'	1,040 cf	**20.00'W x 30.00'L x 4.40'H Prismatoid** 2,640 cf Overall - 41 cf Embedded = 2,599 cf x 40.0% Voids
#2	219.00'	41 cf	**12.0" Round Pipe Storage** x 2 Inside #1 L= 26.0' S= 0.0050 '/'
		1,081 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	218.50'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	223.90'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.1 cfs @ 12.84 hrs HW=223.90' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 12.87 hrs HW=223.90' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.14 fps)

Pond D04: Drywell #2



Summary for Subcatchment D05: Bldgs #3

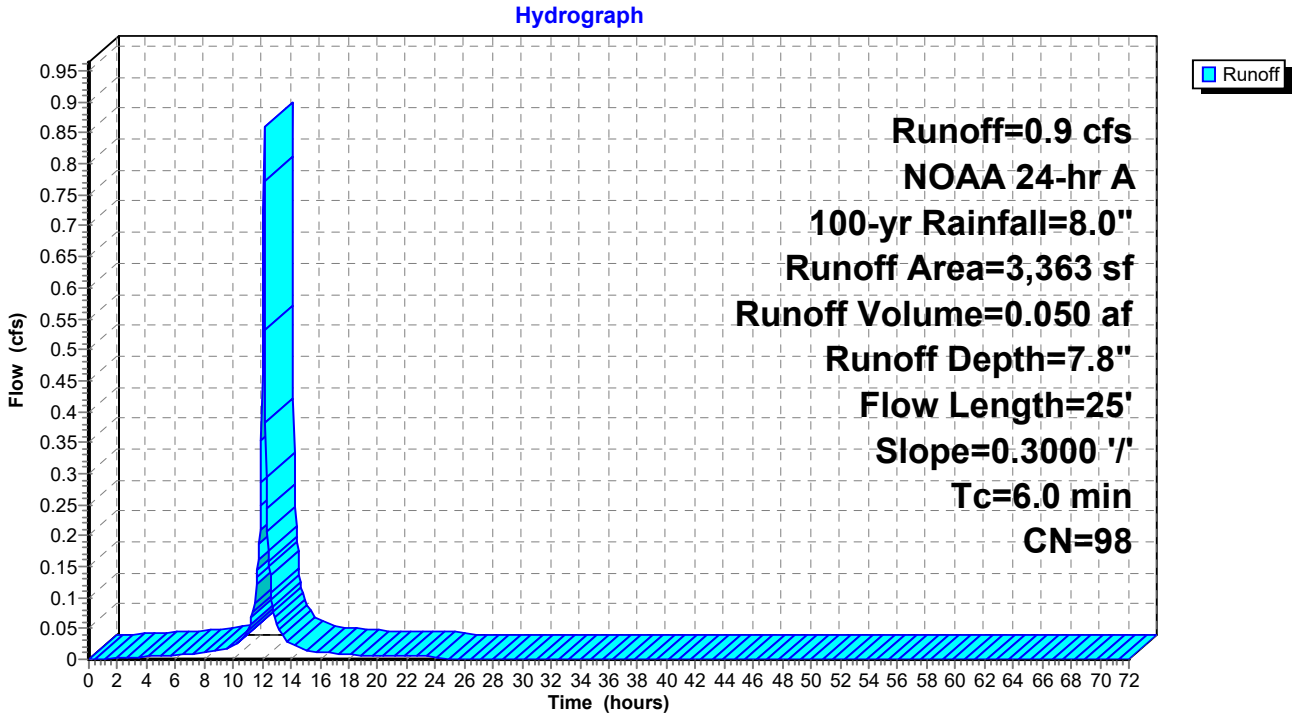
Runoff = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 7.8"
Routed to Pond D06 : Drywell #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 100-yr Rainfall=8.0"

Area (sf)	CN	Description
3,363	98	Roofs, HSG C
3,363		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.3000	3.03		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.1"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment D05: Bldgs #3



Summary for Pond D06: Drywell #3

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 7.8" for 100-yr event
Inflow = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af
Outflow = 0.1 cfs @ 12.92 hrs, Volume= 0.050 af, Atten= 92%, Lag= 47.8 min
Discarded = 0.1 cfs @ 12.92 hrs, Volume= 0.050 af
Primary = 0.0 cfs @ 12.92 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 220.40' @ 12.93 hrs Surf.Area= 600 sf Storage= 1,081 cf

Plug-Flow detention time= 167.6 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 167.6 min (907.9 - 740.3)

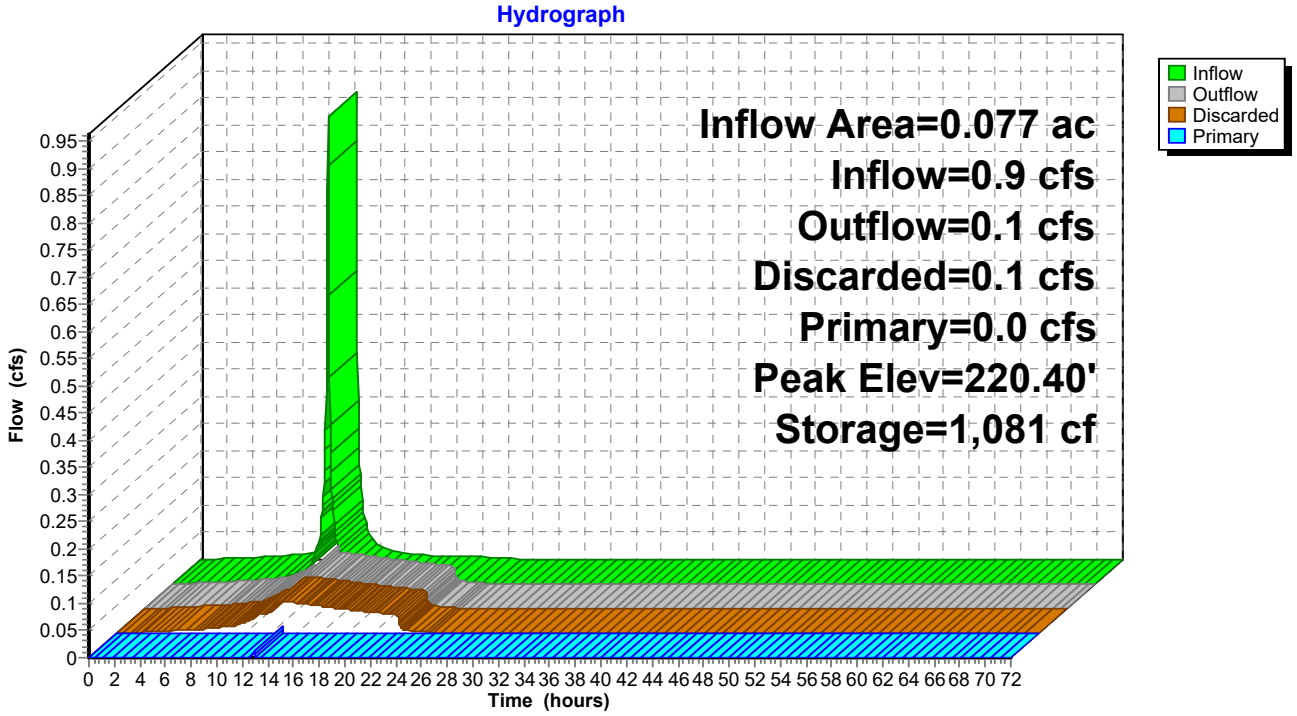
Volume	Invert	Avail.Storage	Storage Description
#1	216.00'	1,040 cf	**20.00'W x 30.00'L x 4.40'H Prismatoid** 2,640 cf Overall - 41 cf Embedded = 2,599 cf x 40.0% Voids
#2	216.50'	41 cf	**12.0" Round Pipe Storage** x 2 Inside #1 L= 26.0' S= 0.0050 '/'
		1,081 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	216.00'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	220.40'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.1 cfs @ 12.92 hrs HW=220.40' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 12.92 hrs HW=220.40' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.14 fps)

Pond D06: Drywell #3



Summary for Subcatchment D07: Bldgs #4

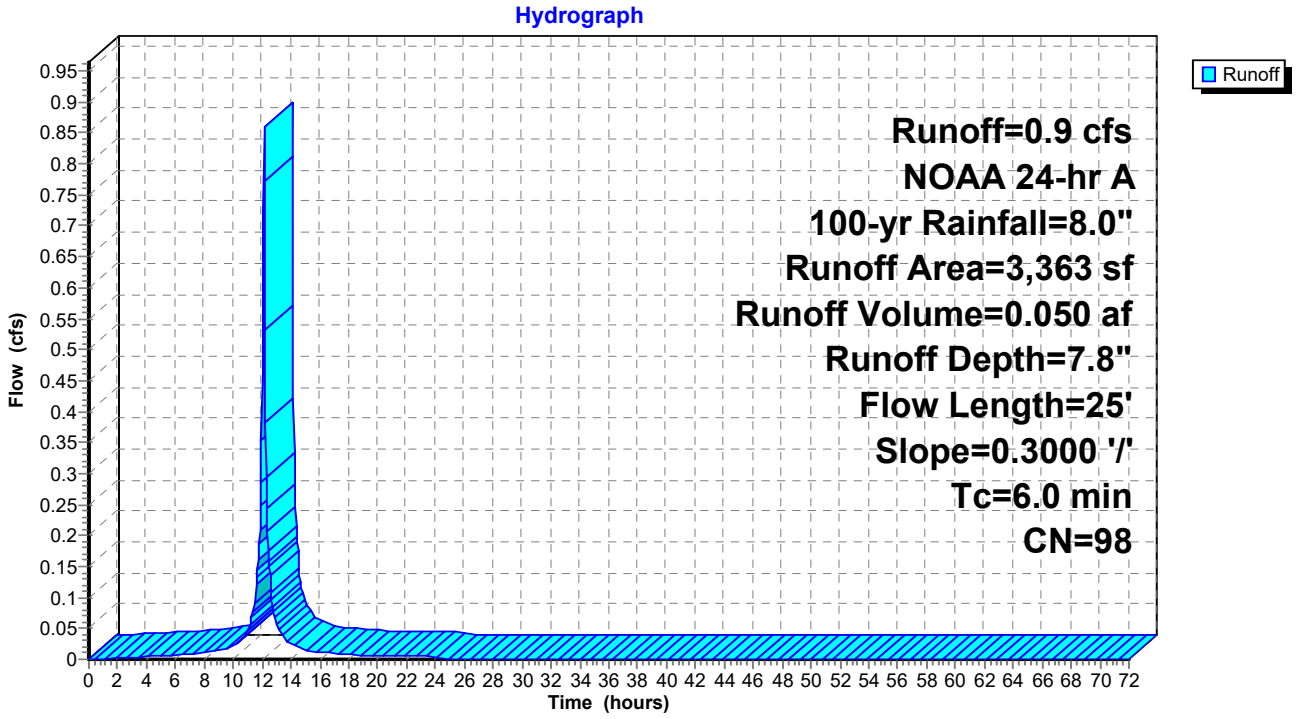
Runoff = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 7.8"
Routed to Pond D08 : Drywell #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 100-yr Rainfall=8.0"

Area (sf)	CN	Description
3,363	98	Roofs, HSG C
3,363		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.3000	3.03		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.1"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment D07: Bldgs #4



Summary for Pond D08: Drywell #4

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 7.8" for 100-yr event
Inflow = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af
Outflow = 0.1 cfs @ 12.97 hrs, Volume= 0.050 af, Atten= 93%, Lag= 50.6 min
Discarded = 0.1 cfs @ 12.97 hrs, Volume= 0.050 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 229.26' @ 12.97 hrs Surf.Area= 600 sf Storage= 1,066 cf

Plug-Flow detention time= 154.9 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 154.9 min (895.2 - 740.3)

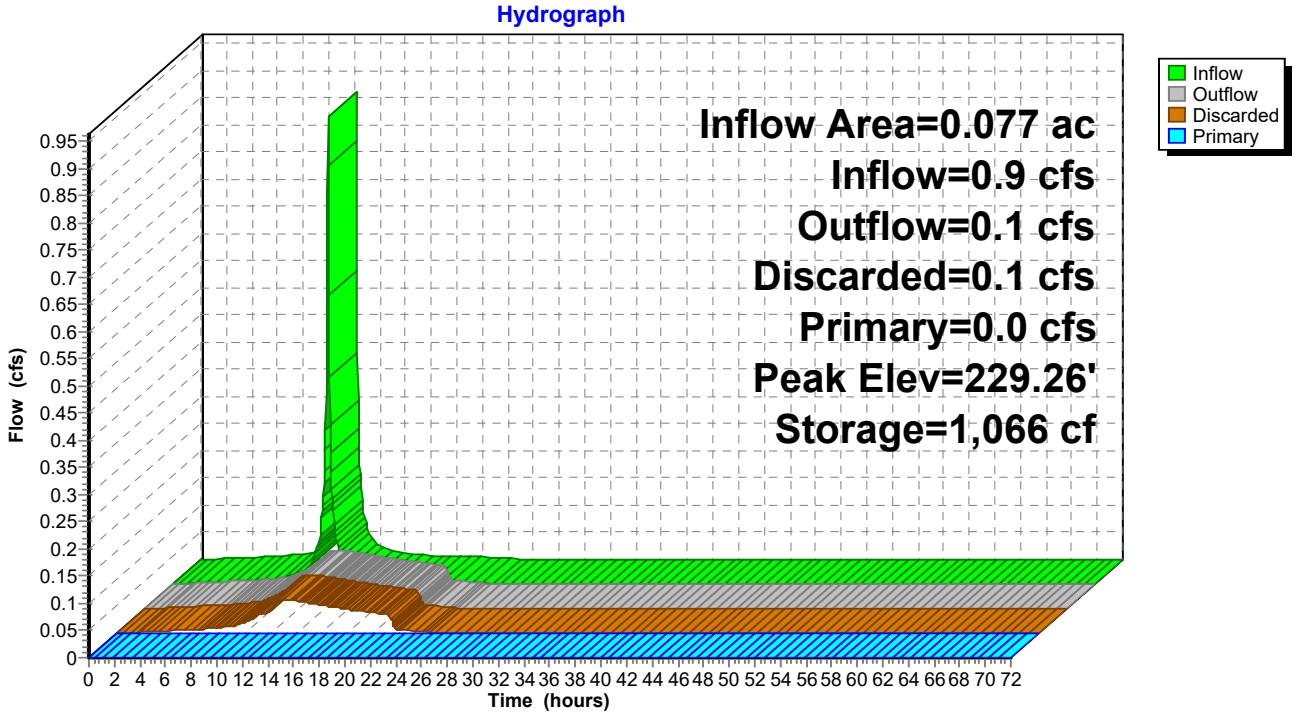
Volume	Invert	Avail.Storage	Storage Description
#1	225.00'	1,015 cf	**12.00'W x 50.00'L x 4.35'H Prismatoid** 2,610 cf Overall - 72 cf Embedded = 2,538 cf x 40.0% Voids
#2	225.50'	72 cf	**12.0" Round Pipe Storage** x 2 Inside #1 L= 46.0' S= 0.0050 '/'
		1,087 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	225.00'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	229.35'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.1 cfs @ 12.97 hrs HW=229.26' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=225.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond D08: Drywell #4



Summary for Subcatchment D09: Bldg #5

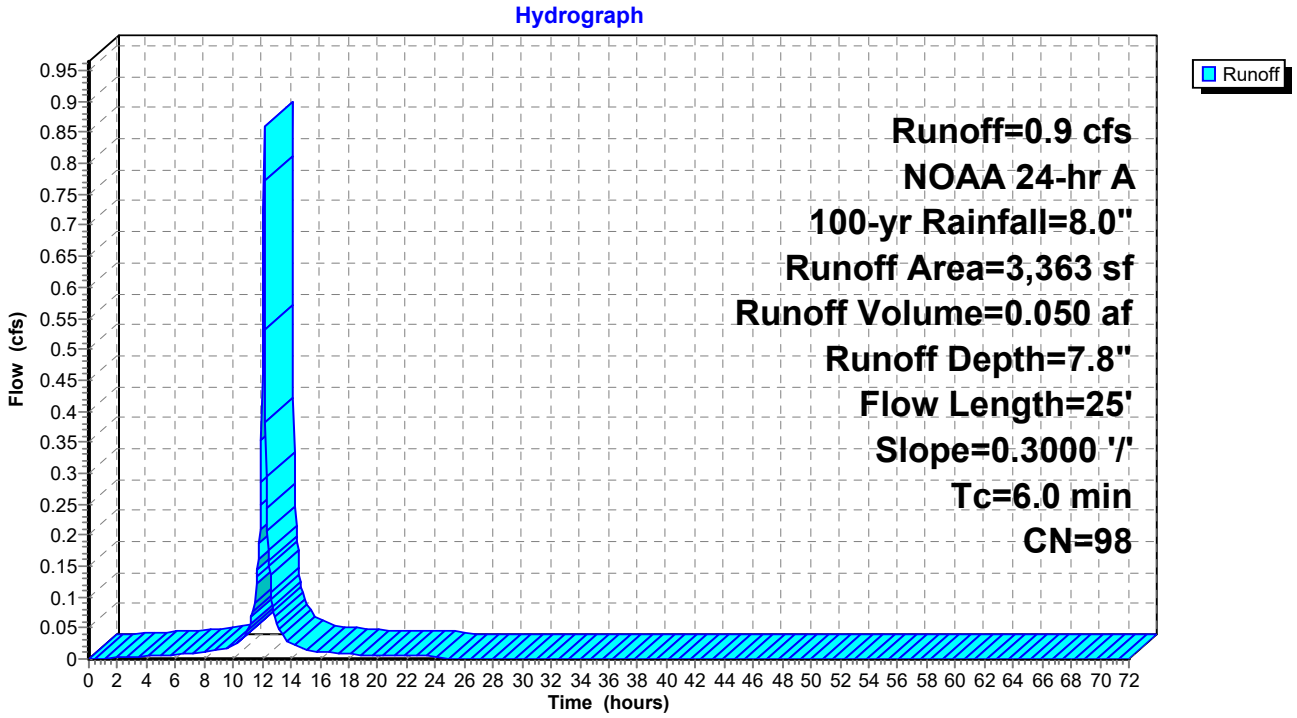
Runoff = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 7.8"
Routed to Pond D10 : Drywell #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 100-yr Rainfall=8.0"

Area (sf)	CN	Description
3,363	98	Unconnected roofs, HSG C
3,363		100.00% Impervious Area
3,363		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.3000	3.03		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.1"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment D09: Bldg #5



Summary for Pond D10: Drywell #5

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 7.8" for 100-yr event
Inflow = 0.9 cfs @ 12.12 hrs, Volume= 0.050 af
Outflow = 0.1 cfs @ 12.92 hrs, Volume= 0.050 af, Atten= 92%, Lag= 47.8 min
Discarded = 0.1 cfs @ 12.92 hrs, Volume= 0.050 af
Primary = 0.0 cfs @ 12.92 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Peak Elev= 224.40' @ 12.93 hrs Surf.Area= 600 sf Storage= 1,081 cf

Plug-Flow detention time= 167.6 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 167.6 min (907.9 - 740.3)

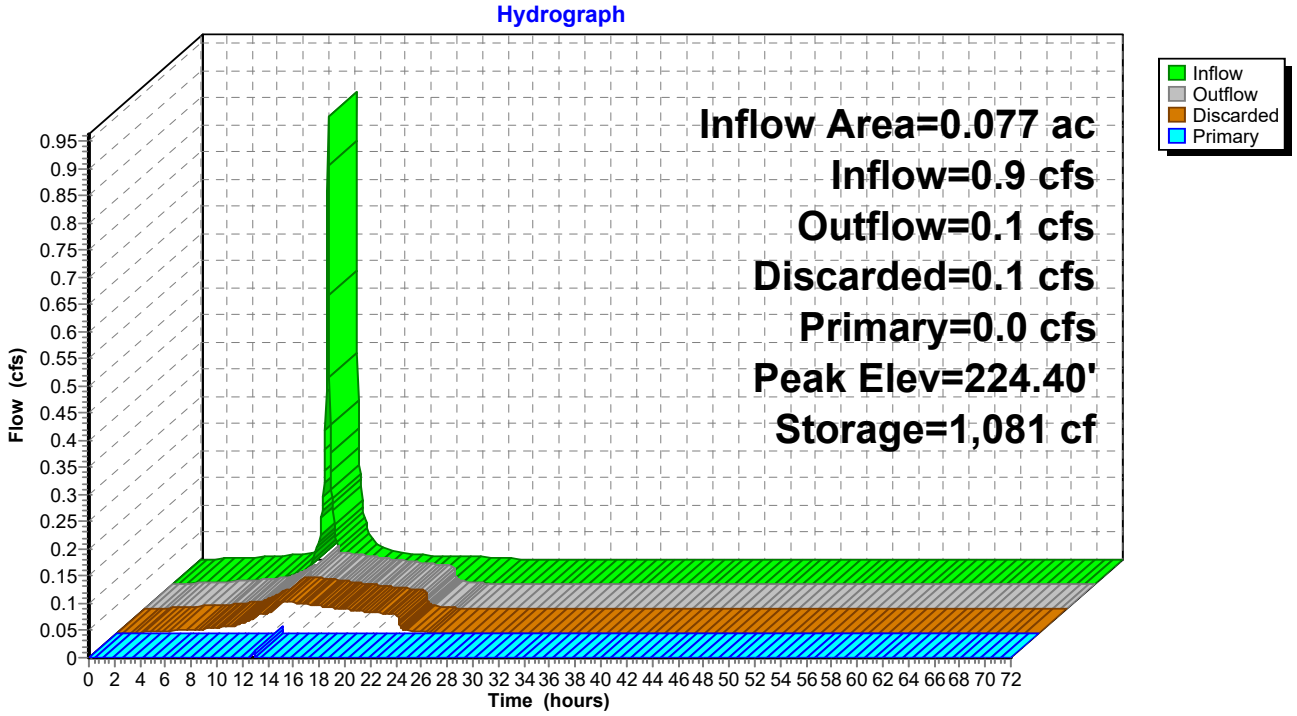
Volume	Invert	Avail.Storage	Storage Description
#1	220.00'	1,040 cf	**20.00'W x 30.00'L x 4.40'H Prismatoid** 2,640 cf Overall - 41 cf Embedded = 2,599 cf x 40.0% Voids
#2	220.50'	41 cf	**12.0" Round Pipe Storage** x 2 Inside #1 L= 26.0' S= 0.0050 '/'
		1,081 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	220.00'	**2.400 in/hr Exfiltration over Wetted area**
#2	Primary	224.40'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.1 cfs @ 12.92 hrs HW=224.40' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 12.92 hrs HW=224.40' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.14 fps)

Pond D10: Drywell #5



v. Groundwater Mounding Calculations

See Following Page

Lots 1, 2, 3 & 5 Roof Infiltration Systems

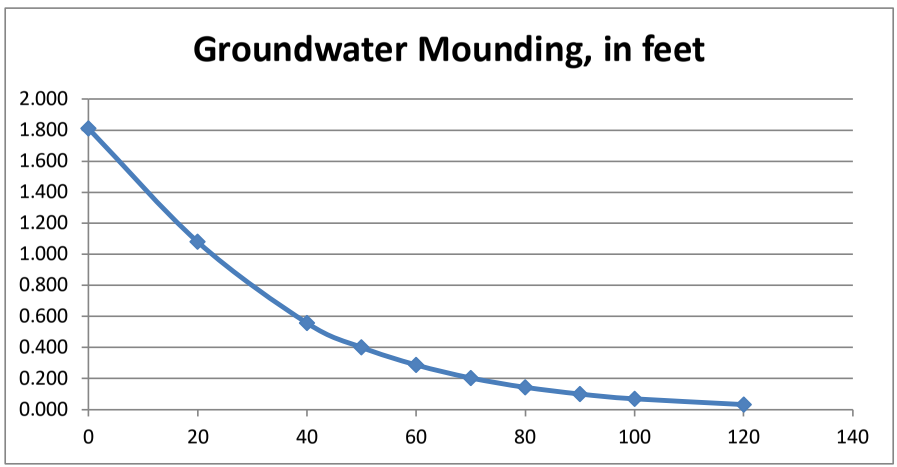
Input Values

4.8000	*R*	Recharge (infiltration) rate (feet/day)
0.190	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
48.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*
10.000	x	1/2 length of basin (x direction, in feet)
15.000	y	1/2 width of basin (y direction, in feet)
0.750	t	duration of infiltration period (days)
10.000	hi(0)	initial thickness of saturated zone (feet)

11.810	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.810	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.810	0
1.081	20
0.557	40
0.402	50
0.288	60
0.205	70
0.144	80
0.101	90
0.070	100
0.034	120

Re-Calculate Now



Lots 4 Roof Infiltration Systems

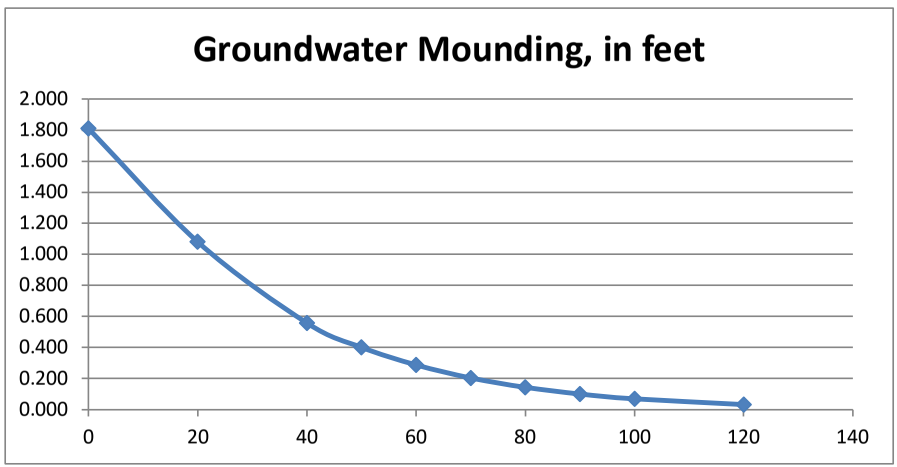
Input Values

4.8000	*R*	Recharge (infiltration) rate (feet/day)
0.190	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
48.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*
6.000	x	1/2 length of basin (x direction, in feet)
25.000	y	1/2 width of basin (y direction, in feet)
0.750	t	duration of infiltration period (days)
10.000	hi(0)	initial thickness of saturated zone (feet)

11.810	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.810	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.810	0
1.081	20
0.557	40
0.402	50
0.288	60
0.205	70
0.144	80
0.101	90
0.070	100
0.034	120

Re-Calculate Now



Infiltration Trench #1

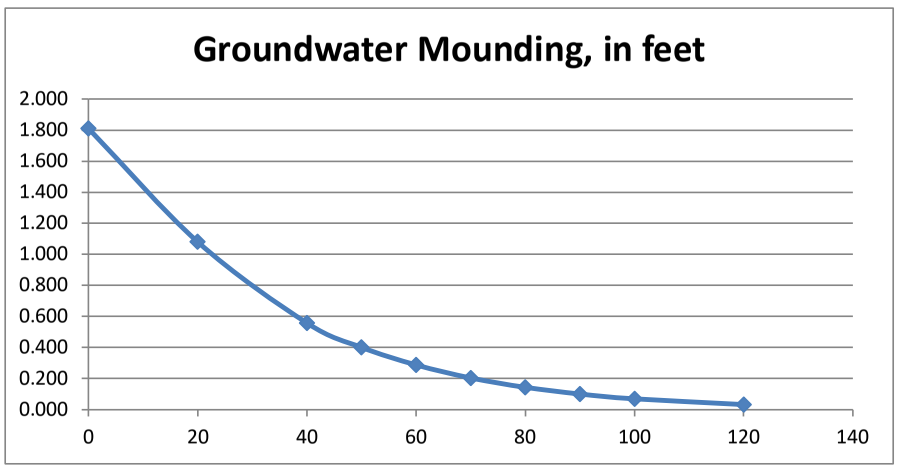
Input Values

4.8000	*R*	Recharge (infiltration) rate (feet/day)
0.190	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
48.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*
12.500	x	1/2 length of basin (x direction, in feet)
35.000	y	1/2 width of basin (y direction, in feet)
1.250	t	duration of infiltration period (days)
10.000	hi(0)	initial thickness of saturated zone (feet)

11.810	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.810	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.810	0
1.081	20
0.557	40
0.402	50
0.288	60
0.205	70
0.144	80
0.101	90
0.070	100
0.034	120

Re-Calculate Now



Infiltration Trench #2

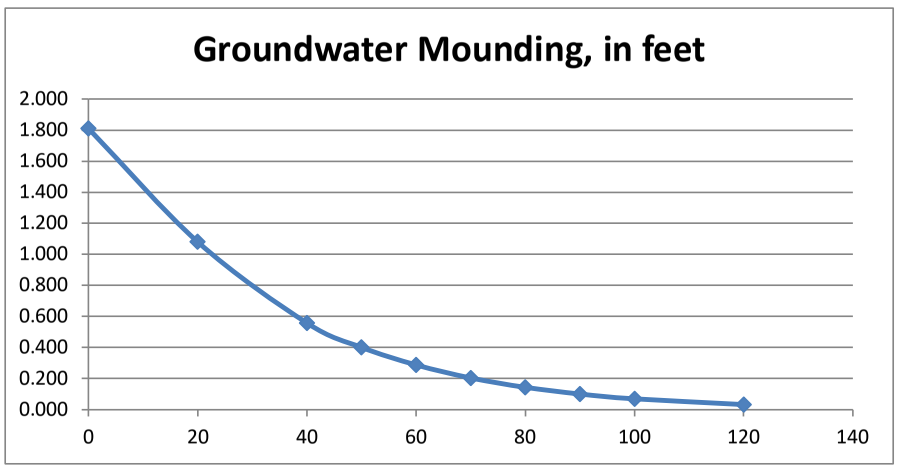
Input Values

4.8000	*R*	Recharge (infiltration) rate (feet/day)
0.190	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
48.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*
9.000	x	1/2 length of basin (x direction, in feet)
100.000	y	1/2 width of basin (y direction, in feet)
1.000	t	duration of infiltration period (days)
10.000	hi(0)	initial thickness of saturated zone (feet)

11.810	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.810	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.810	0
1.081	20
0.557	40
0.402	50
0.288	60
0.205	70
0.144	80
0.101	90
0.070	100
0.034	120

Re-Calculate Now



Infiltration Trench #3

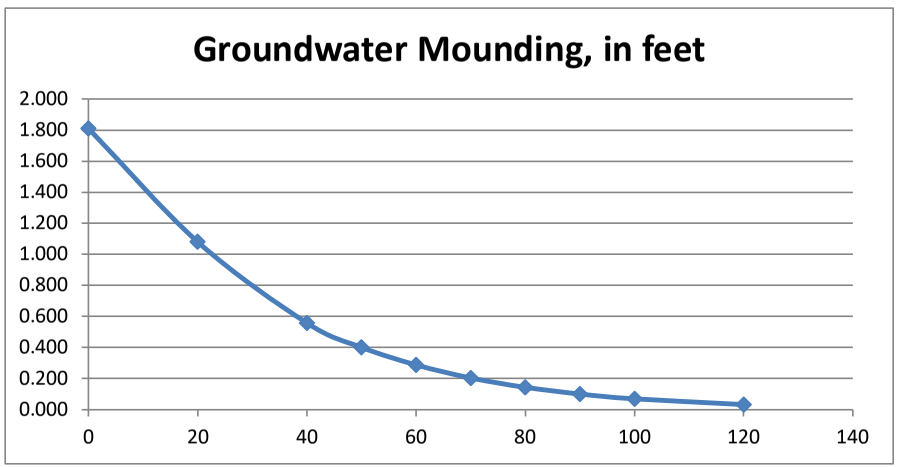
Input Values

4.8000	*R*	Recharge (infiltration) rate (feet/day)
0.190	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
48.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*
12.500	x	1/2 length of basin (x direction, in feet)
35.000	y	1/2 width of basin (y direction, in feet)
1.000	t	duration of infiltration period (days)
10.000	hi(0)	initial thickness of saturated zone (feet)

11.810	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.810	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.810	0
1.081	20
0.557	40
0.402	50
0.288	60
0.205	70
0.144	80
0.101	90
0.070	100
0.034	120

Re-Calculate Now

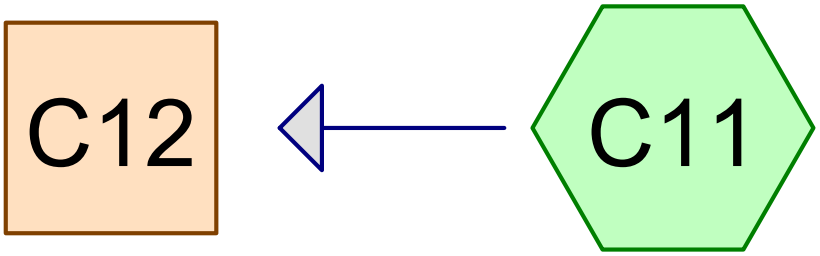


v. *Grass Channel [Biofilter Swale] Design*

1" Rainfall Design
2 & 10 Year Design Storm Analysis

See Following Pages

Grassed Channel Calculations



Grassed Channel A-2

Subcat Reach Pond Link

Routing Diagram for 42305 Rev 2025-06-01
Prepared by DK Engineering LLC, Printed 6/2/2025
HydroCAD® 10.20-6a s/n 04123 © 2024 HydroCAD Software Solutions LLC

Summary for Subcatchment C11: A-2

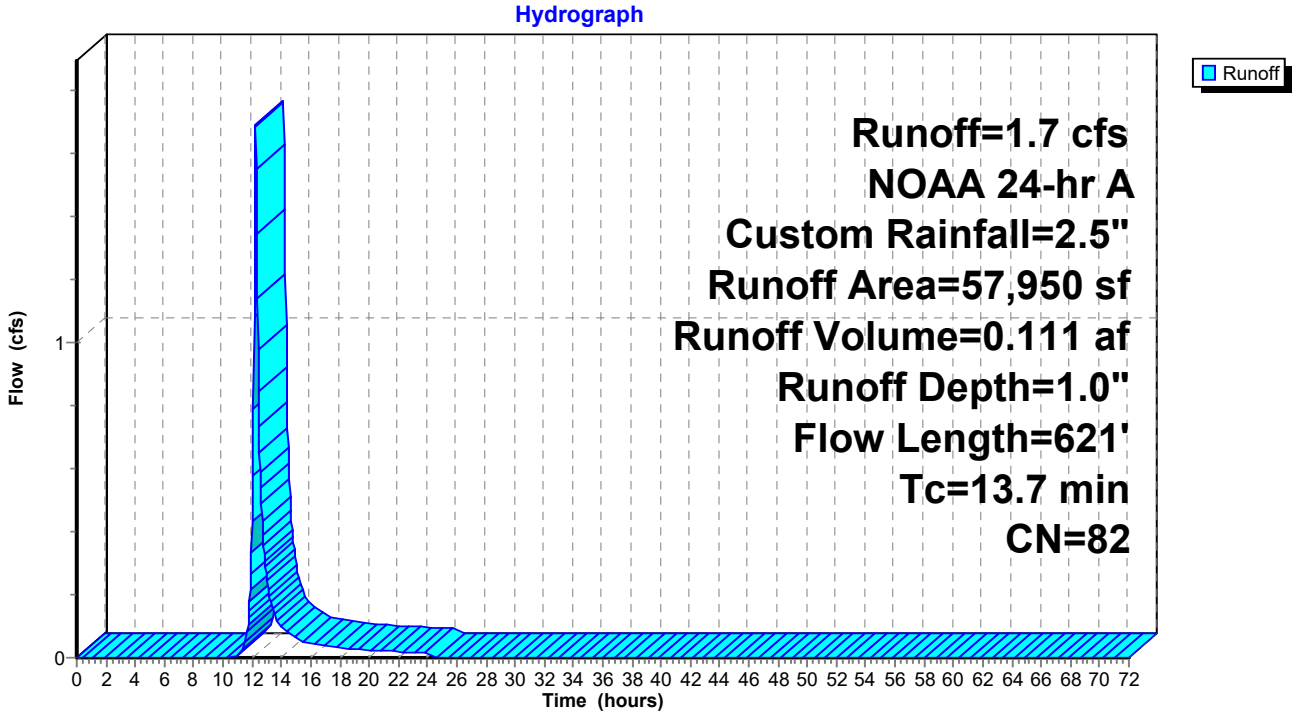
Runoff = 1.7 cfs @ 12.23 hrs, Volume= 0.111 af, Depth= 1.0"
Routed to Reach C12 : Grassed Channel

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A Custom Rainfall=2.5"

	Area (sf)	CN	Description
	11,250	98	Paved parking, HSG A
	7,293	98	Paved parking, HSG B
*	177	98	Paved parking, HSG A (Sidewalk)
*	887	98	Paved parking, HSG B (Sidewalk)
	7,131	68	<50% Grass cover, Poor, HSG A
	25,654	79	<50% Grass cover, Poor, HSG B
	5,558	55	Woods, Good, HSG B
	57,950	82	Weighted Average
	38,343		66.17% Pervious Area
	19,607		33.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
1.9	197	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.3	339	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	35	0.0450	12.51	9.8	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
13.7	621	Total			

Subcatchment C11: A-2



Summary for Reach C12: Grassed Channel

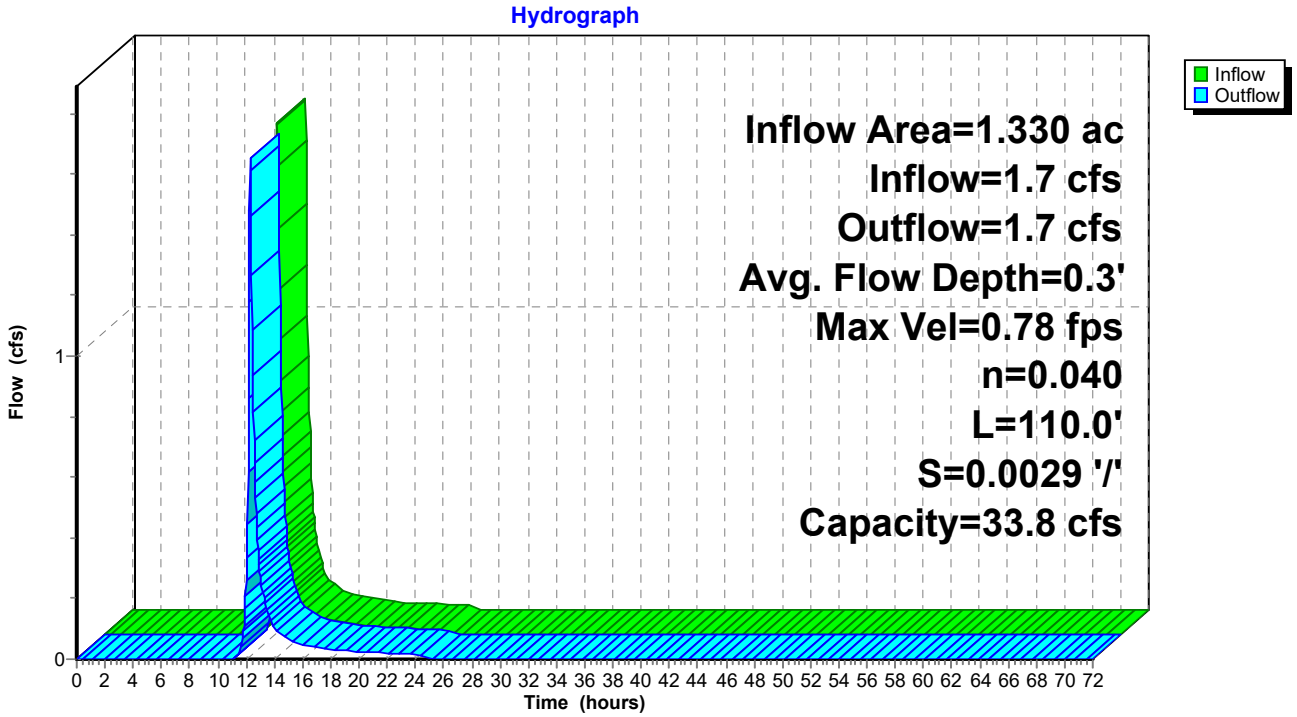
Inflow Area = 1.330 ac, 33.83% Impervious, Inflow Depth = 1.0" for Custom event
Inflow = 1.7 cfs @ 12.23 hrs, Volume= 0.111 af
Outflow = 1.7 cfs @ 12.29 hrs, Volume= 0.111 af, Atten= 2%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 0.78 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.20 fps, Avg. Travel Time= 9.0 min => 9 min. ✔
< 1.0 fps ✔
Peak Storage= 233 cf @ 12.25 hrs < 4 inches ✔
Average Depth at Peak Storage= 0.3', Surface Width= 8.6'
Bank-Full Depth= 1.5' Flow Area= 15.8 sf, Capacity= 33.8 cfs

7.50' x 1.50' deep channel, n= 0.040 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 13.50'
Length= 110.0' Slope= 0.0029 '/'
Inlet Invert= 208.00', Outlet Invert= 207.68'

‡

Reach C12: Grassed Channel



Summary for Subcatchment C11: A-2

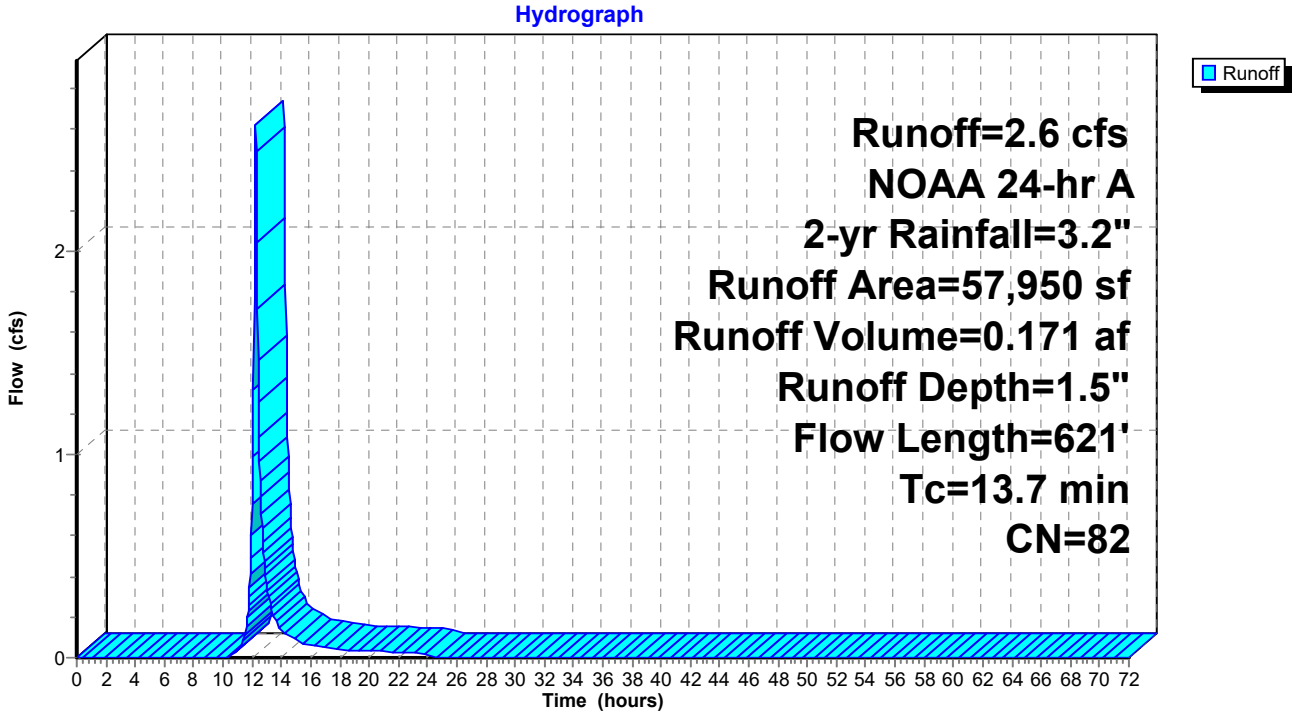
Runoff = 2.6 cfs @ 12.22 hrs, Volume= 0.171 af, Depth= 1.5"
Routed to Reach C12 : Grassed Channel

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 2-yr Rainfall=3.2"

	Area (sf)	CN	Description
	11,250	98	Paved parking, HSG A
	7,293	98	Paved parking, HSG B
*	177	98	Paved parking, HSG A (Sidewalk)
*	887	98	Paved parking, HSG B (Sidewalk)
	7,131	68	<50% Grass cover, Poor, HSG A
	25,654	79	<50% Grass cover, Poor, HSG B
	5,558	55	Woods, Good, HSG B
	57,950	82	Weighted Average
	38,343		66.17% Pervious Area
	19,607		33.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
1.9	197	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.3	339	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	35	0.0450	12.51	9.8	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
13.7	621	Total			

Subcatchment C11: A-2



Summary for Reach C12: Grassed Channel

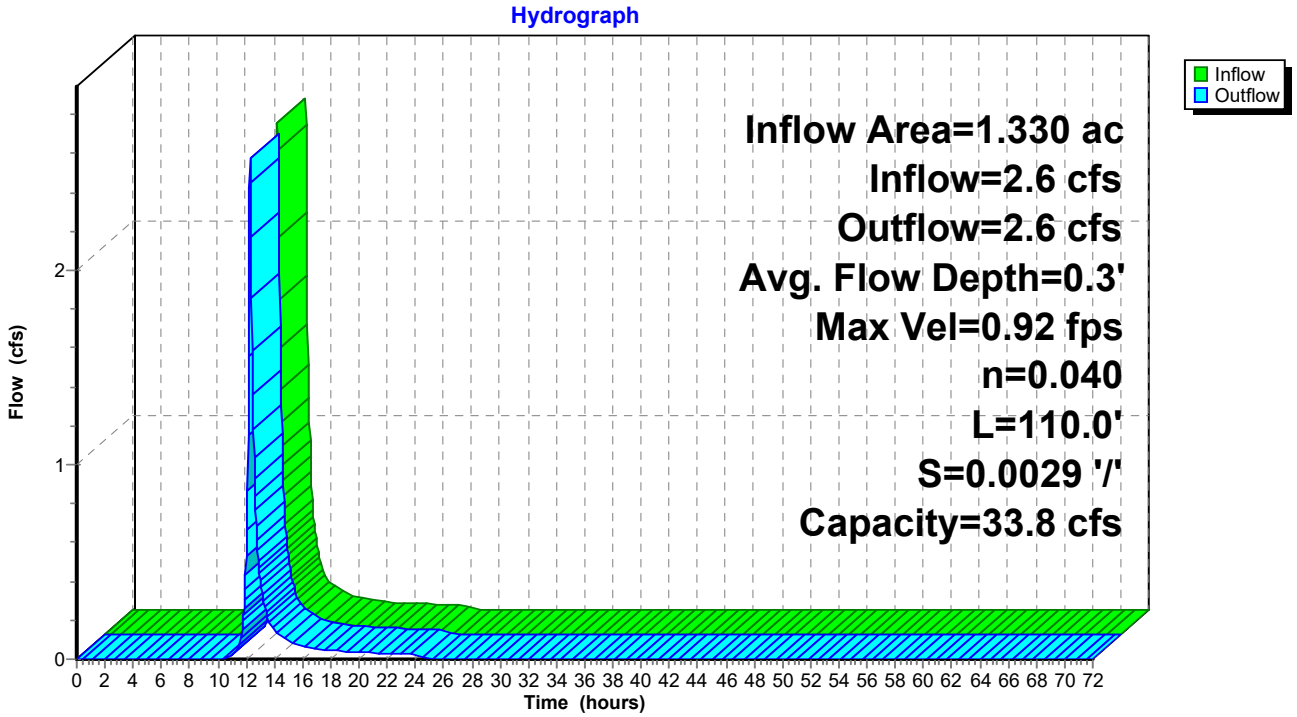
Inflow Area = 1.330 ac, 33.83% Impervious, Inflow Depth = 1.5" for 2-yr event
Inflow = 2.6 cfs @ 12.22 hrs, Volume= 0.171 af
Outflow = 2.6 cfs @ 12.28 hrs, Volume= 0.171 af, Atten= 2%, Lag= 3.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 0.92 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 0.23 fps, Avg. Travel Time= 8.0 min
non-erosive velocity ✔
Peak Storage= 310 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.3' , Surface Width= 8.9'
Bank-Full Depth= 1.5' Flow Area= 15.8 sf, Capacity= 33.8 cfs

7.50' x 1.50' deep channel, n= 0.040 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 13.50'
Length= 110.0' Slope= 0.0029 '/'
Inlet Invert= 208.00', Outlet Invert= 207.68'

‡

Reach C12: Grassed Channel



Summary for Subcatchment C11: A-2

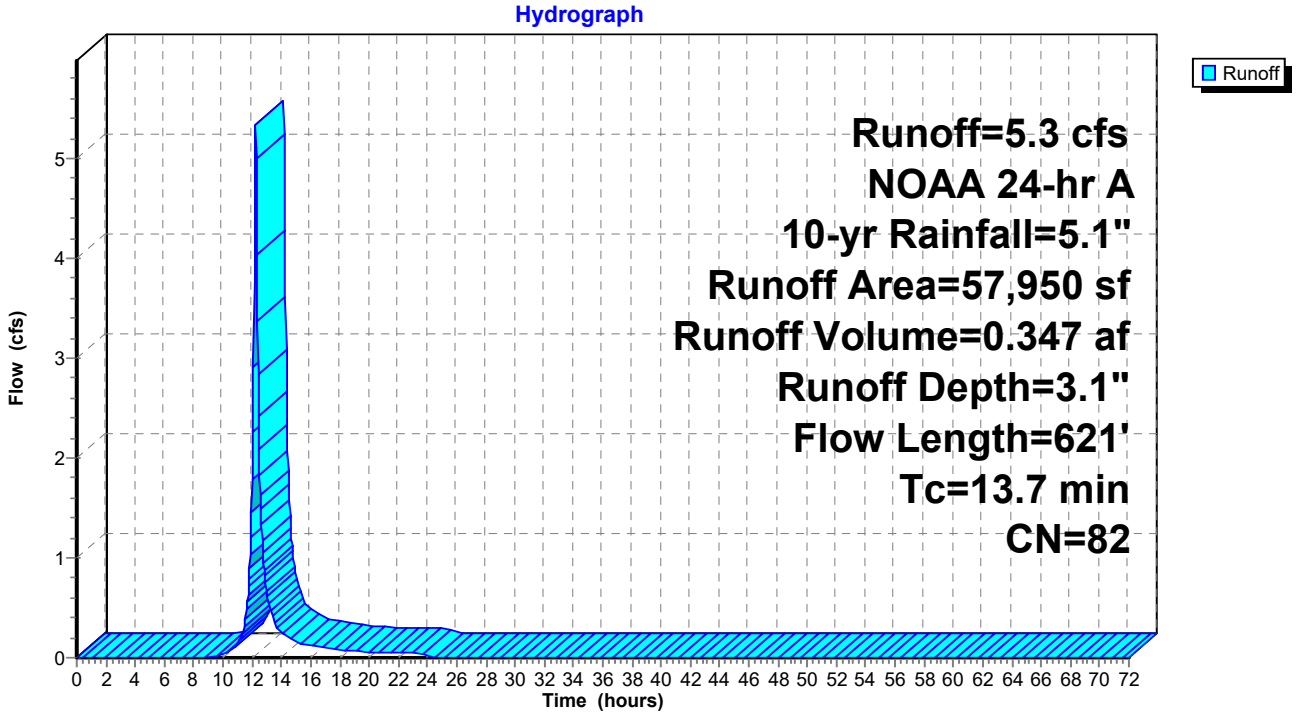
Runoff = 5.3 cfs @ 12.22 hrs, Volume= 0.347 af, Depth= 3.1"
Routed to Reach C12 : Grassed Channel

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
NOAA 24-hr A 10-yr Rainfall=5.1"

	Area (sf)	CN	Description
	11,250	98	Paved parking, HSG A
	7,293	98	Paved parking, HSG B
*	177	98	Paved parking, HSG A (Sidewalk)
*	887	98	Paved parking, HSG B (Sidewalk)
	7,131	68	<50% Grass cover, Poor, HSG A
	25,654	79	<50% Grass cover, Poor, HSG B
	5,558	55	Woods, Good, HSG B
	57,950	82	Weighted Average
	38,343		66.17% Pervious Area
	19,607		33.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.1"
1.9	197	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.3	339	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	35	0.0450	12.51	9.8	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
13.7	621	Total			

Subcatchment C11: A-2



Summary for Reach C12: Grassed Channel

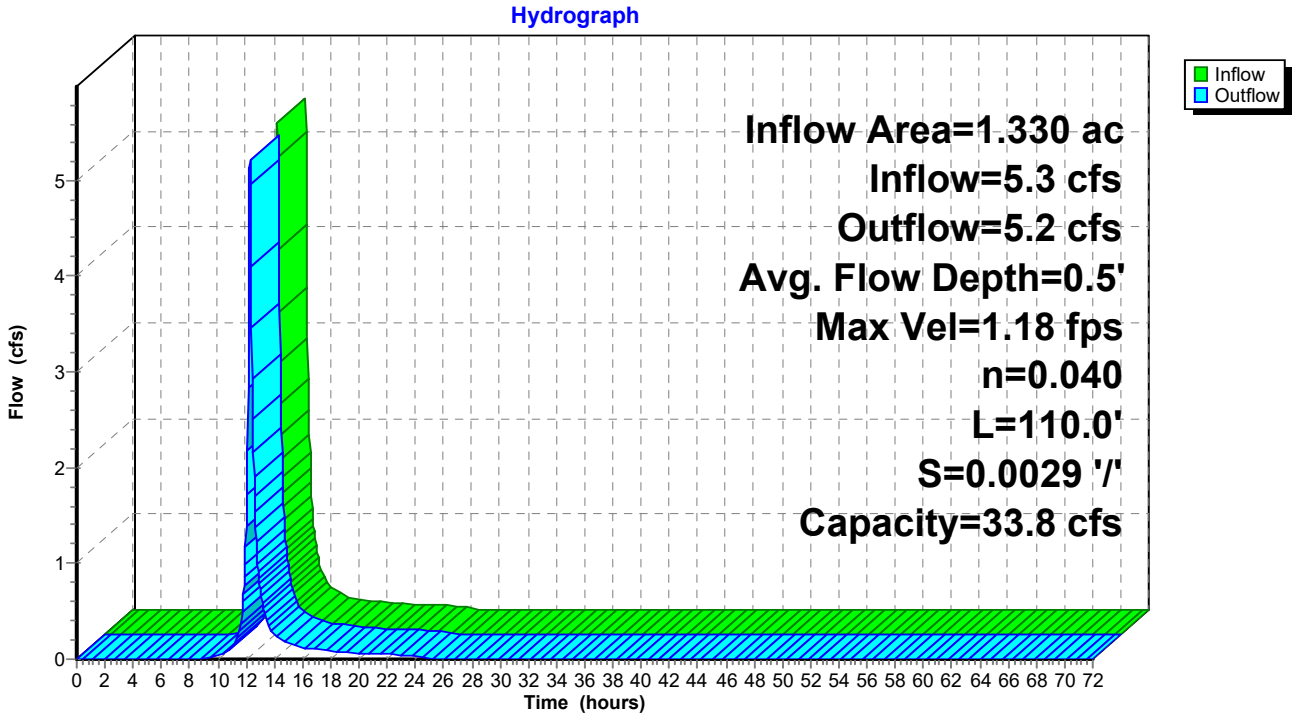
Inflow Area = 1.330 ac, 33.83% Impervious, Inflow Depth = 3.1" for 10-yr event
Inflow = 5.3 cfs @ 12.22 hrs, Volume= 0.347 af
Outflow = 5.2 cfs @ 12.26 hrs, Volume= 0.347 af, Atten= 2%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.04 hrs
Max. Velocity= 1.18 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 6.6 min

Peak Storage= 491 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.5', Surface Width= 9.6'
Bank-Full Depth= 1.5' Flow Area= 15.8 sf, Capacity= 33.8 cfs
=> 1' of freeboard ✔
7.50' x 1.50' deep channel, n= 0.040 Earth, dense weeds
Side Slope Z-value= 2.0 '/' Top Width= 13.50'
Length= 110.0' Slope= 0.0029 '/'
Inlet Invert= 208.00', Outlet Invert= 207.68'

‡

Reach C12: Grassed Channel



V. Erosion And Sedimentation Control Maintenance Plan

i. Soil Erosion & Sediment Control Narrative

In general, the erosion control methodology to be employed on the site involves the installation of straw wattles (Compost Filter Soxx) as shown on the plans to protect abutting properties. These devices will remain in place until the earth disturbing activity is stabilized with loam and seed and grass is growing. Loam and seeding, are permanent methods of site stabilization while the straw wattles placement is considered temporary erosion control methods. If a significant amount of soil is tracked onto the roadway from the lot construction, then, at the direction of the Town Inspector, street sweeping will be performed.

The disturbed portions of the entire site will be hydroseeded if construction including loaming and seeding has not been completed prior to October 1st of a season. This will provide approximately three (3) or four (4) weeks growing season for the grass, which will serve to stabilize the site to accommodate spring runoff periods. No other methods to stabilize the site for winter construction are necessary.

During construction, and upon completion of construction, the project will require some maintenance of erosion control devices. During construction, straw wattles must be checked every couple of weeks and after rainstorms, repaired and replaced as necessary due to sediment buildup behind it or on the device. After large storm events, the cleaning of sediment may be necessary. If storm events occur after the slopes and other areas, which are stabilized, have been planted but prior to seed germination, then replanting and re-grading of those areas might be necessary. This work will be performed by the developer on an as-needed basis, during the construction phase.

The plan set contains the erosion control layout, while the storm drainage calculations attached hereto describe the soils which are present on the site, as well as the methodology for handling storm water flow on the property.

ii. Operation and Maintenance Procedures

Compost Filter Sock

Installation

1. Perimeter control used for control of sediment in storm runoff shall meet Filtrexx Soxx Mesh Material and Filtrexx Certified FilterMedia specifications or equal.
2. Perimeter control will be placed at locations indicated on plans and in a manner as directed by the Engineer or Manufacturer.
3. Perimeter control should be installed parallel to the base of the slope or other disturbed area.
4. Effective Soxx height in the field for 12" diameter Soxx should be = 9.5" high.
5. Stakes should be installed through the middle of the perimeter control on 10 ft centers, using nominal 2 in by 2 in by 3 ft wooden stakes.
6. Staking depth for sand and silt loam soils shall be 12 in.
7. Loose compost may be backfilled along the upslope side of the perimeter control, filling the seam between the soil surface and the device, improving filtration and sediment retention.

Inspection & maintenance

Routine inspection should be conducted within 24 hours of a runoff event or as designated by the regulating authority. Perimeter control should be regularly inspected to make sure they maintain their shape and are producing adequate hydraulic flow-through. If ponding becomes excessive, additional perimeter control may be required to reduce effective slope length or sediment removal may be necessary. Perimeter control shall be inspected until area above has been permanently stabilized and construction activity has ceased.

1. The contractor shall maintain the perimeter control in a functional condition at all times and it shall be routinely inspected.
2. If the perimeter control has been damaged, it shall be repaired or replaced if beyond repair.
3. The contractor shall remove sediment at the base of the upslope side of the perimeter control when accumulation has reached 1/2 of the effective height of the Soxx, or as directed by the Engineer. Alternatively, a new perimeter control can be placed on top of and slightly behind the original one creating more sediment storage capacity without soil disturbance.

4. Perimeter control shall be maintained until the disturbed area above the device has been permanently stabilized and construction activity has ceased.
5. The FilterMedia will be dispersed on site once the disturbed area has been permanently stabilized, construction activity has ceased, or as determined by the engineer.
6. For long-term sediment and pollution control applications, perimeter control can be seeded at the time of installation to create a vegetative filtering system for prolonged and increased filtration of sediment (contained vegetative filter strip). The appropriate seed mix shall be determined by the engineer.

Stabilized Construction Entrance - Developing Areas

Definition

A stabilized pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk, or parking area shall be provided.

Purpose

The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets.

Conditions Where Practice Applies

A stabilized construction entrance shall be used at all points of construction ingress and egress.

Design Criteria

1. Aggregate Size - Use 2-inch stone or reclaimed or recycled concrete equivalent.
2. Thickness - Not less than 6 inches.
3. Width - 10-foot minimum but not less than the full width of points where ingress or egress occurs.
4. Length - As required, but not less than 50 feet (except on a single residence lot where a 30-foot minimum would apply).
5. Filter cloth - To be placed over the entire area to be covered with aggregate. Filter cloth will not be required on a single-family residence lot.
6. Piping of surface water under entrance shall be provided as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.

Maintenance

The entrance shall be maintained in a condition which will prevent tracking of sediment onto public rights-of-way or streets. This may require periodic topdressing with additional aggregate. All sediment spilled, dropped, or washed onto public rights-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance into public rights-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment trapping device. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

Criteria for Filter Cloth

The filter cloth shall be a woven or non-woven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew, rot resistant, and conform to the properties of the following table:

Roads	Light Duty 1-/ Haul Roads	Heavy Duty 2-/ Test Fabric Properties 3/	Grade Subgrade Rough Graded Method
Grab Tensile Strength (lbs.)	200	220	ASTM D1682
Elongation at Failure (%)	50	60	ASTM D1682
Mullen Burst Strength (lbs.)	190	430	ASTM D3786
Puncture Strength (lbs.)	40	125	ASTM D751 modified
Equivalent Opening Size	40-80	40-80	US Std Sieve CW-02215
Aggregate Depth (in.)	6	10	--

1-/ Light Duty Road: Sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.

2-/ Heavy Duty Road: Sites with only rough grading, and where most travel would be multi-axle vehicles. Trevira Spunbond 1135, Mirafi 600X, or equivalent.

3-/ Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

VI. Appendix – Norse Environmental Services ~ Soil Logs

See Following Pages

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

A. Facility Information

1. Owner Information:
   Ministers Lane LLC - Greg Alexandris

   Street Address:
   39 Sunset Rock Road Map/Lot: Map 79 Parcel 18

   Town:
   Andover MA 01810
   City/Town State Zip Code

B. Site Information

1. (Check one) New Construction ☒ Upgrade ☐ Repair ☐

2. Published Soil Survey available? Yes ☒ No ☐ If yes: Web Soil Survey (Year Published) 1:1740 (Publication Scale) 421B, 421D, 310B (Soil Map Unit)

   Canton & Woodbridge (Soil Name) slope, stoniness, wetness, slow permeability (Soil limitations)

3. Surficial Geological Report available? Yes ☐ No ☒ If yes: _____ (Year Published) _____ (Publication Scale) _____ (Map Unit)

   _____ (Geologic Material) _____ (Landform)

4. Flood Rate Insurance Map:

   Above the 500-year flood boundary? Yes ☒ No ☐ Within the 100-year flood boundary? Yes ☐ No ☒

   Within the 500-year flood boundary? Yes ☐ No ☒ Within a Velocity Zone? Yes ☐ No ☒

5. Wetland Area: National Wetland Inventory Map _____ (Map Unit) _____ (Name)

   Wetlands Conservancy Program Map _____ (Map Unit) _____ (Name)

6. Current Water Resource Conditions (USGS) 3/2025 (Month/Year) Range: Above Normal ☐ Normal ☐ Below Normal ☒

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

C. On-Site Review

Deep Observation Hole Number: TP-A–TP-L | 3/7/25 (Date) | 9:00 a.m. (Time) | Cloudy – 42° (Weather)

1. Location

   Ground Elevation at Surface of Hole: See plan

   Location (Identify on Plan) See plan

2. Land Use: 4.6 acre single family wooded lot (e.g. woodland, agricultural field, vacant lot, etc.) | Few (Surface Stones) | Varies (Slope (%))

   Maple, Oak & Pine (Vegetation) | Drumlin (Landform) | Varies along slope (Position on landscape (attach sheet))

3. Distances from: Open Water Body >100 ft. feet | Drainage Way >100 ft. feet | Possible Wet Area >100 ft feet

   Property Line >100 ft. feet | Drinking Water Well >100 ft. feet | Other _____

4. Parent Material: Glacial Till | Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☒ No ☐ - Varies throughout the Test Pits – See next page

   If Yes: Depth Weeping from Pit _____ Depth Standing Water in Hole _____

   Estimated Depth to High Groundwater: _____ inches | _____ elevation

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-A

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-14”	Ap	10YR 2/2				FSL			Granular	Friable	
14-30”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
30-60”	C	2.5Y 6/6	68”	7.5YR 6/8	10%	LS & G	10%	20%	Massive	Friable	Boulders

Additional Notes: ESHWT 68” / No Observed Water.

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-B

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-76”	C	2.5Y 6/6	48”	7.5YR 6/8	10%	LS & G	10%	5%	Massive	Friable	

Additional Notes: ESHWT 48” / Observed Water 73”.

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-C

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-93”	C	2.5Y 6/6	48”	7.5YR 6/6	10%	LS & G	5%	10%	Massive	Friable	

Additional Notes: ESHWT 48” / No Observed Water,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-D

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-90”	C	2.5Y 6/6	48”	7.5YR 6/8	20%	LS & G	10%	10%	Massive	Friable	

Additional Notes: ESHWT 48” / No Observed Water,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-E

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-38”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
38-83”	C	2.5Y 6/6	48”	7.5YR 6/6	20%	LS & G	5%	10%	Massive	Friable	

Additional Notes: ESHWT 48” / Observed Water 65”,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-F

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-14”	Ap	10YR 2/2				FSL			Granular	Friable	
14-30”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
30-88”	C	2.5Y 6/6	50”	7.5YR 6/6	20%	LS & G	10%	5%	Massive	Friable	

Additional Notes: ESHWT 50” / Observed Water 51”,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-G

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-30”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
30-57”	C	2.5Y 6/6	48”	7.5YR6/8	10%	LS & G	15%	10%	Massive	Friable	

Additional Notes: ESHWT 48” / No Observed Water,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-H

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-95”	C	2.5Y 6/6	52”	7.5YR 5/6	20%	LS & G	10%	10%	Massive	Friable	

Additional Notes: ESHWT 52” / No Observed Water,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-I

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-72”	C	2.5Y 6/6	48”	7.5YR 6/8	15%	LS & G	10%	10%	Massive	Friable	

Additional Notes: ESHWT 48” / No Observed Water,

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-J

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-90”	C	2.5Y 6/6	48”	7.5YR 6/8	20%	LS & G	10%	20%	Massive	Friable	

Additional Notes: ESHWT 48” / No Observed Water.

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-K

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-100”	C	2.5Y 6/6	54”	7.5YR 5/6	15%	LS & G	20%	10%	Massive	Friable	

Additional Notes: ESHWT 54” / No Observed Water.

Soil Suitability Assessment

Site: 39 Sunset Rock Road
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: TP-L

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-24”	Bw	10YR 3/6				FSL			Weak Blocky	Friable	
24-84”	C	2.5Y 6/6	48”	7.5YR 6/8	10%	LS & G	10%	20%	Massive	Friable	Boulders

Additional Notes: ESHWT 48” / No Observed Water,

D. Certification

I certify that I have passed the soil evaluator examination* approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience described in 310 CMR 15.017.

Maureen Herald
Signature of Soil Evaluator

4-11-25
Date

Maureen Herald
Typed or Printed Name of Soil Evaluator

SE13578
Soil Evaluator Number

VII. Appendix – NRCS Soils Information

See Following Pages

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part
(39 Sunset Rock Road)

Map Scale: 1:1,930 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	0.6	9.4%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	B	1.7	25.3%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	A	4.4	65.3%
Totals for Area of Interest			**6.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Map Unit Description

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 in this report, 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, soils that are similar to the named components, and some minor components that differ in use and management from the major soils.

Most of the soils similar to the major components 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. Some minor components, however, have properties and behavior 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*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given 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.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Essex County, Massachusetts, Northern Part

310B—Woodbridge fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2ql
Elevation: 0 to 1,470 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

Woodbridge, fine sandy loam, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Fine Sandy Loam

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 8 percent
Landform: Depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
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: Moraines, hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
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
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
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
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate, very stony

Percent of map unit: 9 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Montauk, very stony

Percent of map unit: 5 percent
Landform: Recessionial moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Gloucester, very stony

Percent of map unit: 4 percent
Landform: Moraines, hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 2 percent

Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

421D—Canton fine sandy loam, 15 to 25 percent slopes, very stony

Map Unit Setting

National map unit symbol: vj5c
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Canton

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 33 inches: fine sandy loam
H3 - 33 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 18 to 36 inches to strongly contrasting textural stratification
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate
Percent of map unit: 10 percent
Hydric soil rating: No

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

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 18, Sep 9, 2022

VIII. Appendix – Drainage Area Maps

SOILS LEGEND

Series	HSG
(310B) Woodbridge fine sandy loam, 3 to 8% slopes	C/D
(421B) Canton, fine sandy loam, 0 to 8% slopes	B
(421D) Canton, fine sandy loam, 8 to 25% slopes	A

SCALE: 1" = 60'

0 60 120

50 @ S=0.01'/'

"B" Soils

132 @ S=0.038'/'

NRCS BOUNDARY LINE (TYP.)

"A" Soils

50' @ S=0.08'/'

50' @ S=0.08'/'

"B" Soils

50' @ S=0.10'/'

85' @ S=0.06'/'

109 @ S=0.055'/'

142 @ S=0.049'/'

421B CANTON

PAVED DRIVE

"A" Soils

150' @ S=0.16'/'

206 @ S=0.126'/'

171 @ S=0.129'/'

50' @ S=0.08'/'

365' @ S=0.06'/'

WOODBRIDGE 310B

"C" Soils

421D CANTON "A" Soils

"A" 42,502± s.f.

"B" 95,622± s.f.

"C" 21,190± s.f.

"D" 39,824± s.f.

"E" 40,179± s.f.

Pt-1 Pt-2 Pt-3 Pt-4 Pt-5

MINISTERS ESTATES

DK Engineering LLC
59 Granite Lane, Chester, NH 03036
Tel. Number:: (603) 505-5226
E-mail Address: dan@dke.llc

Assessor's Map & Lot: Map 79 / Lot 18	
Project No.: 42305	Drawing Scale: 1"=60'
Plan Date: 04/14/25	Revised Date: 06/01/25

Sheet Title: PRE-DEV. DRAINAGE AREA MAP

Sheet No.: 1

No. of Shts.: 2

Drawing name: D:_dk data\Projects\42305 ~ ADC - 39 Sunset Rock Rd - Andover_dwg\42305 ~ DSP Adjust per IDR Comments 2025-06-01.dwg

Plotted on Jun 02, 2025 - 3:24pm

SOILS LEGEND

Series	HSG
(310B) Woodbridge fine sandy loam, 3 to 8% slopes	C/D
(421B) Canton, fine sandy loam, 0 to 8% slopes	B
(421D) Canton, fine sandy loam, 8 to 25% slopes	A

SCALE: 1" = 60'

0 60 120

"A-1" 43,965± s.f.

"A-2" 63,163± s.f.

"B-1" 50,756± s.f.

"B-2" 23,774± s.f.

"C" 24,492± s.f.

"D" 17,307± s.f.

"E" 9,142± s.f.

NRCS BOUNDARY LINE (TYP.)

"A" Soils

"B" Soils

"C" Soils

421B CANTOM

421D CANTON

WOODBRIDGE 310B

TRENCH #1

TRENCH #2

TRENCH #3

Pt-1 Pt-2 Pt-3 Pt-4 Pt-5

MINISTERS ESTATES

DK Engineering LLC
59 Granite Lane, Chester, NH 03036
Tel. Number:: (603) 505-5226
E-mail Address: dan@dke.llc

Assessor's Map & Lot: Map 79 / Lot 18	
Project No.: 42305	Drawing Scale: 1"=60'
Plan Date: 04/14/25	Revised Date: 06/01/25

Sheet Title: POST-DEV. DRAINAGE AREA MAP

Sheet No.: 2

No. of Shts.: 2

Drawing name: D:_dk data\Projects\42305 ~ ADC - 39 Sunset Rock Rd - Andover_dwg\42305 ~ DSP Adjust per IDR Comments 2025-06-01.dwg

Plotted on Jun 02, 2025 - 3:24pm

IX. Appendix – Project Stormwater Report

See Following Pages

MINISTERS ESTATES

JN: 42305

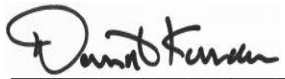
PROJECT STORMWATER REPORT

Applicant:

MINISTERS LANE, LLC
42 School Street
Andover, MA 01810

Date: 04/14/2025
Revised: 06/01/2025

Prepared by:



Daniel Koravos, P.E.

Date: 06/01/2025

DK Engineering LLC
Address: 59 Granite Lane, Chester, NH 03036
Tel. (603) 505-5226 • E-mail dan@dke.llc

TABLE OF CONTENTS

I. Checklist for Stormwater Report

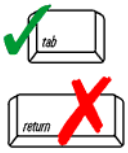
See the following pages for the "Checklist for Stormwater Report"

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.

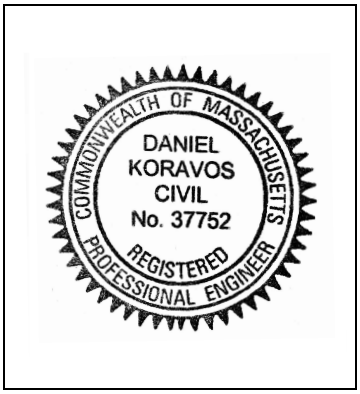
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



04/14/25

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
- [ ] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [ ] Credit 2
  - [ ] 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
- [x] Water Quality Swale
- [x] Grass Channel
- [ ] Green Roof
- [ ] Other (describe): _____

Standard 1: No New Untreated Discharges

- [x] No new untreated discharges
- [x] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [x] 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.

II. Introduction

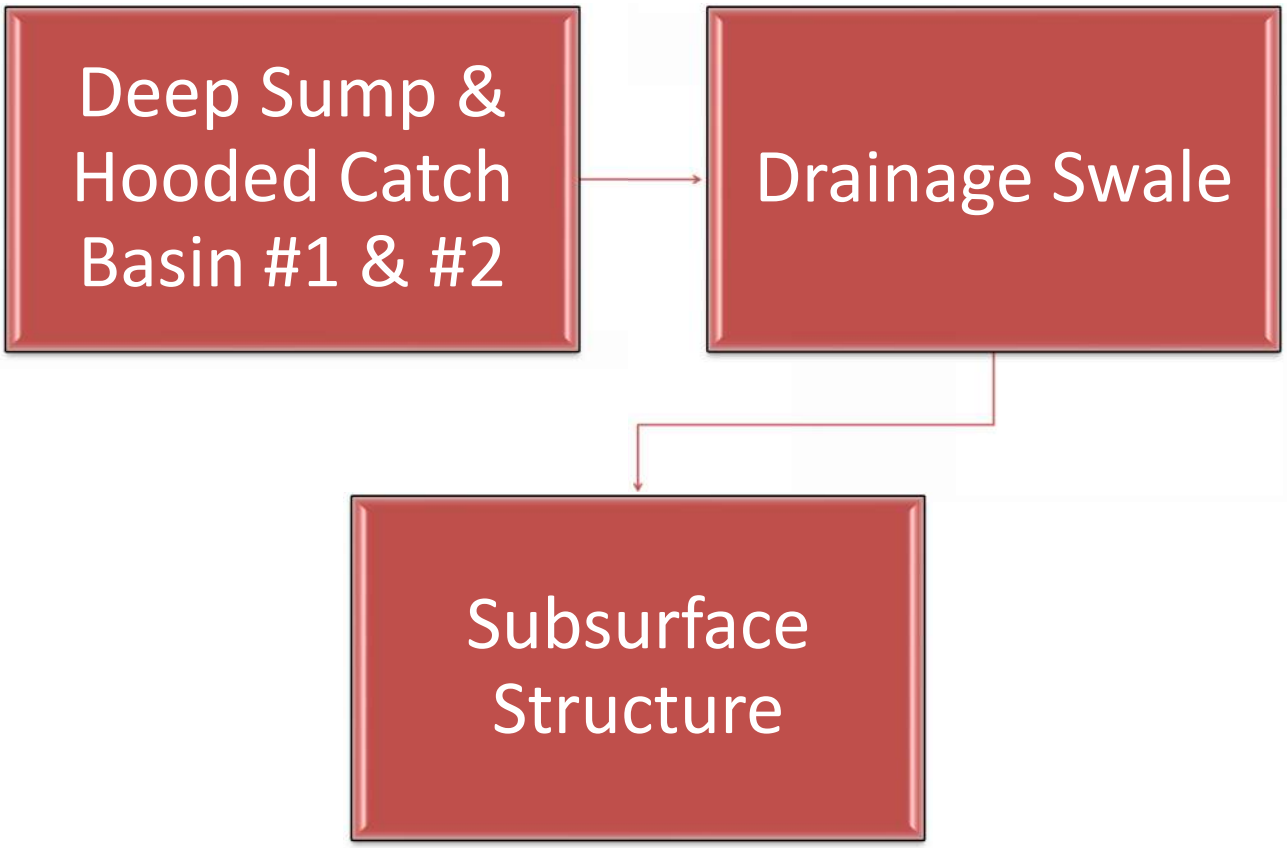
Ministers Estates is a proposed five (5) lot single-family residential. The proposed development involves subdividing one (1) lot into five (5) lots, one (1) parcels and the construction of a minor road (Ministers Lane). The property is located at 39 Sunset Rock Road between Spring Grove Road and the entrance to Pike School in Andover, Massachusetts. The subject land consists of approximately 4.9± acres. The existing vegetation mainly consists of woods. Topography generally slopes from the high point along the northeasterly boundary of the property at elevation 238± to the low point along the southwesterly at elevation 202±, a vertical difference of 36 feet.

The soils within the project as mapped by the Natural Resource Conservation Service (NRCS) as mainly the Canton series with a small area of the Woodbridge series along Sunset Rock Road. The Canton series is classified as being within the NRCS-Hydrological Soils Group (HSG) A & B; ranked first and second on a scale of four (A, B, C, D) in terms of infiltration capacity. The Woodbridge series is within the HSG C/D. For a more detailed description of these soils see the "Project Report on Drainage & Sedimentation Control".

The proposed stormwater management system for the project includes the installation of deep sump catch basins that will collect the roadway runoff and direct the flow to the closed drainage system. The catch basins are the start of the two BMP Treatment Trains as presented and described on the following pages.

The primary low impact development element of the project is the utilization of the infiltration facilities throughout the site.

BMP Treatment Train #1



INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: 39 Sunset Rock Road, Andover, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Grass Channel	**0.50**	**0.75**	**0.38**	**0.38**
Infiltration Trench	**0.80**	**0.38**	**0.30**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = **93%**

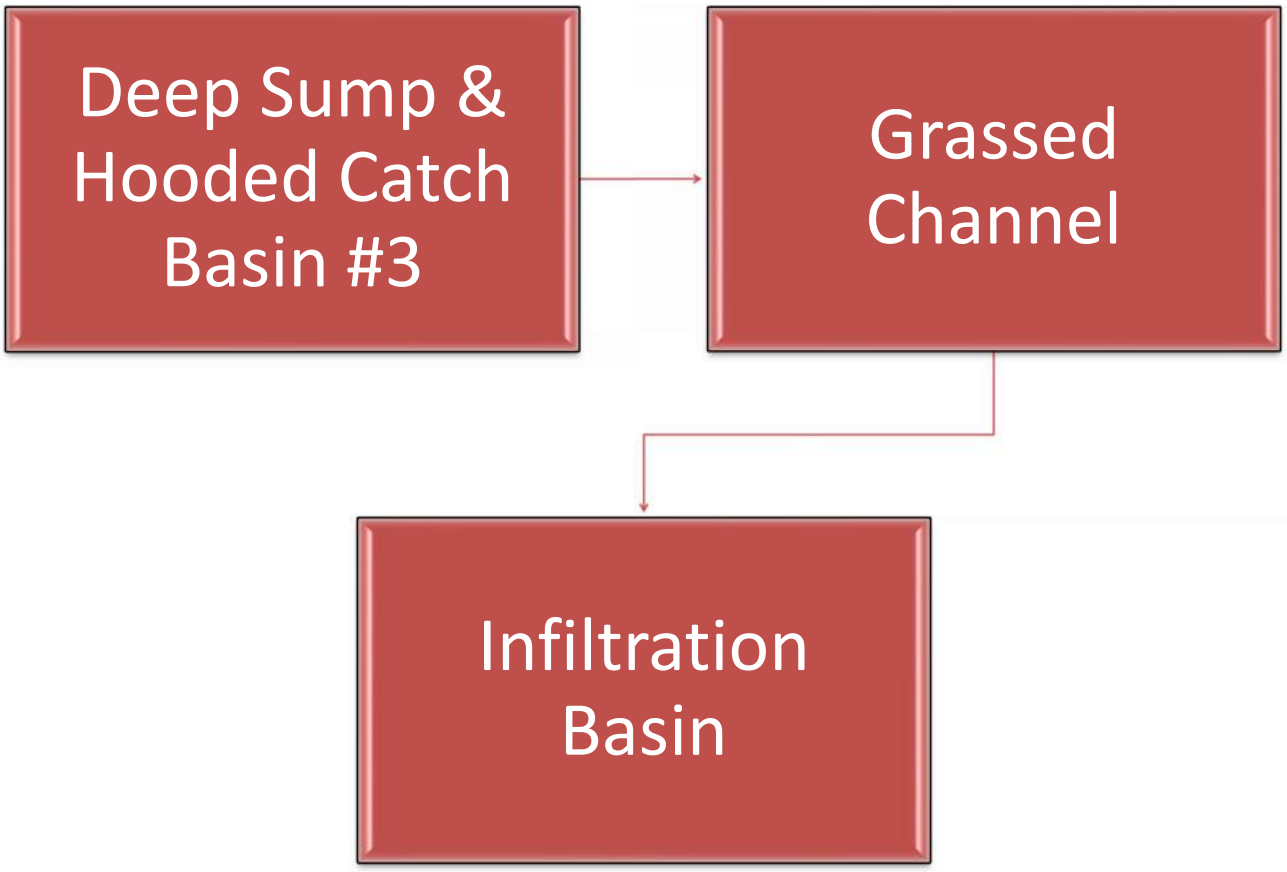
Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Minsters Estate**
Prepared By: **D. Koravos**
Date: **4/14/2025**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

BMP Treatment Train #2



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Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Grass Channel	**0.50**	**0.75**	**0.38**	**0.38**
Infiltration Basin	**0.80**	**0.38**	**0.30**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Minsters Estate**
Prepared By: **D. Koravos**
Date: **4/14/2025**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

III. Standard 1: No New Untreated Discharge

The first proposed BMP Train consists of the drainage area catch basins CB-1 and CB-2. These catch basins are constructed with a deep sump and hood. The runoff flows to the proposed catch basins in roadways and is transported to a drainage swale that discharges to the forebay before entering a subsurface infiltration system. The water quality transports the runoff to an extended dry detention basin.

The second proposed BMP Train consists of the drainage area catch basin CB-3. Again, the catch basin is constructed with a deep sump and hood. The runoff discharges to a grass channel and transported to the forebay and infiltration basin.

IV. Standard 2: Peak Rate Attenuation

See the "Project Report on Drainage & Sedimentation Control" dated April 14, 2025, with latest revisions

V. Standard 3: Recharge

Required Recharge Volume

Treatment Train #1

R_v = F * A = (0.60/12) ft * 4,429 sf + (0.25/12) ft * 608 sf = **234 cf**

F = Target Depth Factor ("A" Soils = 0.60 / "C" Soils = 0.25-inch)
A = Impervious Area

Treatment Train #2

R_v = F * A = (0.60/12) ft * 11430 sf + (0.35/12) ft * 8,180 sf = **810 cf**

F = Target Depth Factor ("A" Soils = 0.60 / "B" Soils = 0.35-inch)
A = Impervious Area

Provided Recharge Volume

Treatment Train #1

Infiltration Trench
Bottom of the trench elevation = 204.8 ft
Bottom area of the trench = 1,750 sf
Lowest pond outlet elevation = 207.5
Surface area at elevation 207.5 = 1,750 sf
Void Ratio = 0.40

Recharge Volume Provided = 1,750 * (207.5-204.8) * 0.40 = 2,975 cf

1,890 cf > 230 cf Required

Treatment Train #2 (Infiltration Basin)

Infiltration Basin
Bottom of the basin elevation = 203.5 ft
Bottom area of the basin = 1,491 sf
Lowest pond outlet elevation = 206.55 ft
Surface area at elevation 204.5 = 6,085 sf

Recharge Volume Provided = (6,085 + 1,491)/2 * (206.55-203.5) = 11,553 cf

11,553 cf > 810 c.f. Required

Drawdown Time Calculation

Volume Below Outlet

$Time_{Drawdown} = R_v \div (K * Area)$ = **8.1 hours**

K = Saturated Hydraulic Conductivity = 2.4 in./hr. = 0.20 ft./hr.

R_v = Storage Volume = 2,835 c.f.

Bottom Area = 1750 s.f.

Recharge Volume

$Time_{Drawdown} = R_v \div (K * Area)$ = **38.7 hours**

K = Saturated Hydraulic Conductivity = 2.4 in./hr. = 0.20 ft./hr.

R_v = Storage Volume = 11,553 c.f.

Bottom Area = 1,491 s.f.

Pretreatment

Total Area of the Roadway Pavement = 0.12 acs. (CB #1 & 2)

Annual Sediment Volume

= 0.12 acs. * 750 lbs./acre-storm ÷ 90 lbs./c.f. * 10 storms/year

= 10 c.f./year

Volume of 2 Catch Basin Sumps

Area * Depth = $2^2 * \pi * 4$ ft. * 2 = **100 c.f. of Storage Provided**

Total Area of the Roadway Pavement = 0.45 acs. (CB #3)

Annual Sediment Volume

= 0.45 acs. * 750 lbs./acre-storm ÷ 90 lbs./c.f. * 10 storms/year

= 38 c.f./year

Volume of Catch Basin Sump

Area * Depth = $2^2 * \pi * 4$ ft. = **50 c.f. of Storage Provided**

VI. Standard 4: Water Quality

Water Quality Treatment Volume

$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) * (A_{IMP} * 43{,}560 \text{ square feet/acre})$

V_{WQ} = Required Water Quality Volume (in cubic feet)
D_{WQ} = Water Quality Depth = 1/2 inch
A_{IMP} = Impervious Area (in acres) = 0.12 acs.

$V_{WQ} = (0.5/12 \text{ inches/foot}) * (0.12 * 43{,}560 \text{ square feet/acre})$

V_{WQ} = 218 c.f. ~ Treatment Train #1

$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) * (A_{IMP} * 43{,}560 \text{ square feet/acre})$

V_{WQ} = Required Water Quality Volume (in cubic feet)
D_{WQ} = Water Quality Depth = 1/2 inch
A_{IMP} = Impervious Area (in acres) = 0.45 acs.

$V_{WQ} = (0.5/12 \text{ inches/foot}) * (0.45 * 43{,}560 \text{ square feet/acre})$

V_{WQ} = 817 c.f. ~ Treatment Train #2

VII. Standard 5: Land Uses with Higher Potential Loads

Not Applicable

VIII. Standard 6: Critical Areas

Not Applicable

IX. Standard 7: Redevelopments

Not Applicable

X. Standard 8: Construction Period Pollution Prevention & Erosion and Sedimentation Control

Sequence of Major Activities

The order of activities will be as follows:

1. Install the erosion control line to protect surrounding areas
2. Install the construction stabilization entrance
3. Clear and grub for roadway and infiltration basin
4. Construction of the infiltration basin, subsurface structures and swales
5. Stockpile loam in designated areas
6. Grade for roadway
7. Install utilities including water, sewer, electric and storm drain
8. Place base course of pavement
9. Construct buildings
10. Complete grading and install permanent seeding and plantings
11. Complete final paving
12. Remove accumulated sediment from the basin and clean drainage system
13. When all construction activity is complete and the site is stabilized, remove silt socks and reseed any areas disturbed by their removal

Controls - Erosion and Sediment Controls

Stabilization practices

Permanent stabilization – Disturbed portions of the site where construction activities have permanently ceased shall be hydroseeded within three weeks of completion and the roadway has been paved with a base course.

Storm Water Management - Storm water drainage will be provided by storm sewer and catch basins for the developed areas. The areas which are not developed will be graded as shown on the Grading Plan and have permanent seeding or plantings. When construction is complete, the majority of the developed portions of the site will drain to an infiltration basin. When upslope areas are stabilized and the areas on the sides of the basin will be planted with vegetation. It is expected that the drainage system will result in over 90 percent removal of total suspended solids from the site's storm water runoff. The pond has been designed by a professional engineer to keep peak flow rates from the two, ten, twenty-five and one hundred year/ 24 hour storms at their pre-development rates. Discharge from the basin will be directed to maintain the existing flows down towards Spring Grove Road.

Other Controls - Waste Disposal

Waste Materials

All waste materials will be collected and stored in a metal dumpster. The dumpster will meet all local and state solid waste management regulations. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied as necessary, and the trash will be hauled to the local dump. No construction waste materials will be buried onsite. All personnel will be instructed regarding the correct procedure for waste disposal. Mr. Greg Alexandris, the individual who manages the day-to-day site operations, will be responsible for seeing that these procedures are followed.

Hazardous Waste

All hazardous waste materials, if any, will be disposed of in the manner specified by local or state regulations or by the manufacturer. Site personnel will be instructed in these practices and Mr. Greg Alexandris, the individual who manages day-to-day site operations, will be responsible for seeing that these practices are followed.

Sanitary Waste

All sanitary waste will be collected from the portable units as required by local regulations.

Offsite Vehicle Tracking

A stabilized construction entrance has been provided to help reduce vehicle tracking of sediments. The paved street adjacent to the site entrance will be swept as necessary to remove any excess mud, dirt or rock tracked from the site.

Timing of Controls/Measures

As indicated in the Sequence of Major Activities, installation of the erosion control line and stabilized construction entrance will be constructed prior to clearing or grading of any other portions of the site. The basin and all disturbed areas associated with the construction of the roadway will be hydroseeded within three weeks of completion. The individual lots will be constructed at different times and seeded as soon as the site work for the lot is completed.

Compliance with Federal, State and Local Regulations

The storm water pollution prevention plan reflects the requirements for storm water management and erosion and sediment control, as established. To ensure compliance, this plan was prepared in accordance with the requirements of the town of Andover, Massachusetts, and the Massachusetts Department of Environmental Protection.

Maintenance/Inspection Procedures

Erosion and Sediment Control Inspection and Maintenance Practices

These are the inspection and maintenance practices that will be used to maintain erosion and sediment controls:

- All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater.
- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of it being reported.
- Built up sediment will be removed from compost filter socks when it has reached one half the height of the barrier.
- Compost filter socks will be inspected for depth of sediment and tears, to see if the fabric is securely attached and to see that the stakes are firmly in the ground.
- The sediment basin will be inspected for depth of sediment and built up sediment will be removed when it reaches 10 percent of the design capacity or at the end of the job.
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.
- A maintenance inspection report will be made after each inspection.
- Mr. Greg Alexandris, site superintendent, will select individuals who will be responsible for inspections, maintenance, and repair activities, and filling out the inspection and maintenance report.
- Personnel selected for inspection and maintenance responsibilities will receive training as required. They will be trained in all the inspection and maintenance practices necessary for keeping the erosion and sediment controls used onsite in good working order.

Non-Storm Water Discharges

It is expected that the following non-storm water discharges will occur from the site during the construction period:

- Water from water line flashings
- Pavement wash waters (where no spills or leaks of toxic or hazardous materials have occurred)
- All non-storm water discharges will be directed to the sediment basin prior to discharge.

Inventory for pollution prevention plan

The materials or substances listed below are expected to be present onsite during construction:

Concrete	Petroleum based products
Detergents	Cleaning solvents
Paints (enamel & latex)	Wood
Tar	Masonry block
Fertilizers	Roofing shingles

Spill Prevention

Material Management Practices

The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

Good Housekeeping

The following good housekeeping practices will be followed onsite during the construction project:

- An effort will be made to store only enough product required to do the job
- All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure
- Products will be kept in their original containers with the original manufacturer's label
- Substances will not be mixed with one another unless recommended by the manufacturer
- Whenever possible, all of a product will be used up before disposing of the container
- Manufacturer recommendations for proper use and disposal will be followed
- The site superintendent will inspect daily to ensure proper use and disposal of materials onsite

Hazardous Products

These practices are used to reduce the risks associated with hazardous materials

- Original labels and material safety data will be retained; they contain important product information
- If surplus product must be disposed of, manufacturer's or local and state recommended methods for proper disposal will be followed

Product Specific Practices

Petroleum Products

All onsite vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers, which are clearly labeled. Any asphalt substances used onsite will be applied according to the manufacturer's recommendations.

Fertilizers

Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. Storage will be in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

Paints

All containers will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to manufacturer's instructions or state and local regulations.

Spill Control Practices

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup:

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the materials storage area onsite. Equipment and materials will include but not be limited to brooms, dustpans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well-ventilated area and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous materials will be reported to the appropriate State or local government agency, regardless of the size.
- The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures will also be included.
- Mr. Greg Alexandris, the site superintendent responsible for the day-to-day site operations, will be the spill prevention and cleanup coordinator. He will designate at least one (1) other site personnel who will receive spill prevention and cleanup training. This individual will each become responsible for a particular phase of prevention and cleanup. The name of responsible spill personnel will be posted in the material storage area and in the office trailer onsite.

Erosion and Sedimentation Control Specifications

Compost Filter Soxx (or equal)

Installation

1. Perimeter control used for control of sediment in storm runoff shall meet filtrexx soxx mesh material and filtrexx certified filter media specifications.
2. Perimeter control will be placed at locations indicated on plans and in a manner as directed by the engineer or manufacturer.
3. Perimeter control should be installed parallel to the base of the slope or other disturbed area.
4. Effective soxx height in the field for 12" diameter soxx should be = 9.5" high.
5. Stakes should be installed through the middle of the perimeter control at 10 ft. on center using nominal 2 in by 2 in by 3 ft wooden stakes.
6. Staking depth for sand and silt loam soils shall be 12 in.
7. Loose compost may be backfilled along the upslope side of the perimeter control, filling the seam between the soil surface and the device, improving filtration and sediment retention.

Inspection & maintenance

Routine inspection should be conducted within 24 hrs. of a runoff event or as designated by the regulating authority. Perimeter control should be regularly inspected to make sure they maintain their shape and are producing adequate hydraulic flow-through. If ponding becomes excessive, additional perimeter control may be required to reduce effective slope length or sediment removal may be necessary. Perimeter control shall be inspected until areas above have been permanently stabilized and construction activity has ceased.

1. The contractor shall maintain the perimeter control in a functional condition at all times and it shall be routinely inspected.
2. If the perimeter control has been damaged, it shall be repaired, or replaced if beyond repair.
3. The contractor shall remove sediment at the base of the upslope side of the perimeter control when accumulation has reached 1/2 of the effective height of the soxx, or as directed by the engineer. Alternatively, a new perimeter control can be placed on top of and slightly behind the original one creating more sediment storage capacity without soil disturbance.
4. Perimeter control shall be maintained until disturbed area above the device has been permanently stabilized and construction activity has ceased.
5. The filter media will be dispersed on site once disturbed area has been permanently stabilized, construction activity has ceased, or as determined by the engineer.
6. For long-term sediment and pollution control applications, perimeter control can be seeded at the time of installation to create a vegetative filtering system for prolonged and increased filtration of sediment (contained vegetative filter strip). The appropriate seed mix shall be determined by the engineer.

Stabilized Construction Entrance - Developing Areas

Definition

A stabilized pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk, or parking area shall be provided.

Purpose

The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets.

Conditions Where Practice Applies

A stabilized construction entrance shall be used at all points of construction ingress and egress.

Design Criteria

1. Aggregate Size - Use 2-inch stone or reclaimed or recycled concrete equivalent.
2. Thickness - Not less than 6 inches.
3. Width - 10-foot minimum but not less than the full width of points where ingress or egress occurs.
4. Length - As required, but not less than 50 feet (except on a single residence lot where a 30-foot minimum would apply).
5. Filter cloth - To be placed over the entire area to be covered with aggregate. Filter cloth will not be required on a single-family residence lot.
6. Piping of surface water under entrance shall be provided as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.

Maintenance

The entrance shall be maintained in a condition which will prevent tracking of sediment onto public rights-of-way or streets. This may require periodic topdressing with additional aggregate. All sediment spilled, dropped, or washed onto public rights-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment trapping device. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

Criteria for Filter Cloth

The filter cloth shall be a woven or non-woven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew, rot resistant, and conform to the properties of the following table:

Roads	Light Duty 1-/ Haul Roads Test	Heavy Duty 2-/ Fabric Properties 3/ Grade Subgrade Rough Graded	Method
Grab Tensile Strength (lbs.)	200	220	ASTM D1682
Elongation at Failure (%)	50	60	ASTM D1682
Mullen Burst Strength (lbs.)	190	430	ASTM D3786
Puncture Strength (lbs.)	40	125	ASTM D751 modified
Equivalent Opening Size	40-80	40-80	US Std Sieve CW-02215
Aggregate Depth (in.)	6	10	--

1-/ Light Duty Road: Sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.

2-/ Heavy Duty Road: Sites with only rough grading, and where most travel would be multi-axle vehicles. Trevira Spunbond 1135, Mirafi 600X, or equivalent.

3-/ Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

XI. Standard 9: Operation and Maintenance Plan

Erosion and Sedimentation Control Maintenance Plan

In general, the erosion control methodology to be employed on the site involves the installation of Compost Filter Soxx (or equal) in any area in which land disturbing activities could result in sediment spilling onto abutting property. The Filter Soxx will remain in place until the earth disturbing activity is stabilized with loam and seed and grass is growing, and/or houses are constructed, and roadway paved. Paving, loaming, and seeding, are permanent methods of site stabilization while the Compost Filter Soxx placement is considered temporary erosion control methods. Compost Filter Soxx are also specified to be placed around each of the catch basins, which will be constructed in the road, to prevent sediment travel into the storm drainage system. The storm drain catch basins are specified with 4' sumps to maximize the sediment trapping capability of the system. The protective Compost Filter Soxx are considered temporary measures to be employed during construction and not necessary after the roadway pavement is put in place. If a significant amount of soil is tracked onto the roadway from the on lot construction, then, at the direction of the Town Agent and/or Inspector, Compost Filter Soxx can be reinstalled adjacent to the catch basins.

The infiltration basin has the effect of collecting and holding runoff from the street drainage system, and allowing it to be treated and controlled, before being infiltrated into the ground or discharged. The pond will be loamed and seeded. Overland outlets from the ponds will be loamed and seeded or riprap, depending upon the pond location and slope.

The disturbed portions of the entire site will be hydroseeded if construction including loaming and seeding has not been completed prior to October 1st of a season. This will provide approximately three (3) or four (4) weeks growing season for the grass, which will serve to stabilize the site to accommodate spring runoff periods. No other methods to stabilize the site for winter construction are necessary.

During construction, and upon completion of construction, the project will require some maintenance of erosion control devices. During construction, Compost Filter Soxx must be checked every couple of weeks and after rainstorms, repaired and replaced as necessary due to sediment buildup behind it or on the device. After large storm events, the infiltration pond might require cleaning of sediment to restore them to the pre-event condition. If storm events occur after the side slopes and other areas, which are stabilized, have been planted but prior to seed germination, then replanting and re-grading of those areas might be necessary. This work will be performed by the developer on an as-needed basis, during the construction phase. After the subdivision is constructed, cleaning of catch basin sumps, drainage swale

and sediment ponds/sumps are probably the only item of maintenance, which will be necessary, other than to restore any grass areas, which are disturbed through normal use of roadways. The property owner will perform this work

The plan set contains the erosion and sedimentation control layout, while the storm drainage calculations attached hereto describe the soils which are present on the site, as well as the methodology for handling storm water flow on the property.

Operation and Maintenance Procedures

Infiltration Basin

The Infiltration Basin will be inspectioned and preventive maintenance at least twice a year, and after every time drainage discharges through the high outlet orifice. The inspection of the pretreatment BMPs in accordance with the minimal requirements specified for those practices and after every major storm event is required. A major storm event is defined as a storm that is equal to or greater than the 2-year, 24-hour storm (generally 2.9 to 3.6 inches in a 24-hour period, depending in geographic location in Massachusetts).

Once the basin is in use, inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion, excessive compaction of soils, or low spots). Thereafter, inspect the infiltration basin at least twice per year. Important items to check during the inspection include:

- Signs of differential settlement,
- Cracking,
- Erosion,
- Leakage in the embankments
- Tree growth on the embankments
- Condition of riprap,
- Sediment accumulation and
- The health of the turf.

At least twice a year, mow the buffer area, side slopes, and basin bottom. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Use deep tilling to break up clogged surfaces and revegetate immediately.

Remove sediment from the basin as necessary but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Deeply till the remaining soil and revegetate as soon as possible. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

Maintenance Criteria

- Preventative maintenance – twice a year.
- Inspect to ensure proper functioning – after every major storm during the first three months of operation and twice a year thereafter and when there are discharges through the high outlet orifice.
- Mow the buffer area, side slopes, and basin bottom if grassed floor; rake if stone bottom; remove trash and debris; remove grass clippings and accumulated organic matter – twice a year.
- Inspect and clean pretreatment devices – every other month recommended and at least twice a year and after every major storm event.

Deep Sump Catch Basins

The actual removal of sediments and associated pollutants and trash occurs only when inlets or sumps are cleaned out; therefore, regular maintenance is required. Most studies have linked the failure of inlets to the lack of regular maintenance. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for future storms and enhances the overall performance. Ideally, in areas of high sediment loading, inlets shall be inspected, and cleaned, after every major storm event. At a minimum, water quality inlets and deep sumps shall be cleaned four times per year and inspected monthly. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

Maintenance Criteria

- Inlets shall be cleaned a minimum of four (4) times per year and inspected monthly.
- All sediments and hydrocarbons shall be properly handled and disposed of, in accordance with local, state, and federal guidelines and regulations.

Sediment Forebays

The actual removal of sediments and associated pollutants occurs only when sediment traps and forebays are cleaned; therefore, regular maintenance is required. Frequently the removal of accumulated sediments will make it less likely that sediments will be re-suspended. At a minimum, sediment traps shall be cleaned four (4) times per year and inspected monthly.

Maintenance Criteria

- Traps shall be cleaned four (4) times per year and inspected monthly.
- All sediments and hydrocarbons shall be handled properly and disposed in accordance with local, state, and federal guidelines and regulations.

Drainage Swale

A maintenance and inspection schedule shall be incorporated into the design to ensure the effectiveness of water quality swales. Swales shall be inspected on a semi-annual basis; additional inspections shall be scheduled during the first few months to make sure that the vegetation in the swales becomes adequately established. The water quality swales shall be inspected for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding, and sedimentation.

Regular maintenance tasks include mowing, fertilizing, liming, watering, pruning, and weed and pest control. Swales shall be mowed at least once per year. The grass must not be cut shorter than four (4) inches because the effectiveness of the vegetation in reducing flow velocity and pollutant removal may be reduced.

Sediment and debris shall be removed manually, at least once per year, and periodic reseeding may be required to maintain the dense growth of vegetation. Care shall be taken to protect water quality swales from snow removal and disposal practices and off street parking. Since swales may be located on private residential property, it is important for developers to clearly outline the maintenance requirements to property purchasers.

Maintenance Criteria

- Inspect swales to make sure vegetation is adequate and slopes are not eroding. Check for rilling and gullying. Repair eroded areas and revegetate - the first few months after construction and twice a year thereafter.
- Mow dry swales. Wet swales may not need to be mowed depending on vegetation - as needed.

- Remove sediment and debris manually - at least once a year.
- Re-seed - as necessary.

Grassed Channel

Grassed Channels (formerly known as Biofilter swales) are treatment systems with a longer hydraulic residence time than drainage channels. The removal mechanisms are sedimentation and gravity separation, rather than filtration. To receive TSS credit, a sediment forebay or equivalent must be provided for pretreatment.

Maintenance

Mowing: Set the mower blades no lower than three (3) to four (4) inches above the ground. Mow on an as-needed basis during the growing season so that the grass height does not exceed six (6) inches.

Inspection: Inspect semi-annually the first year, and at least once a year thereafter. Inspect the grass for growth and the side slopes for signs of erosion and formation of rills and gullies. Plant an alternative grass species if the original grass cover is not successfully established.

Trash/Debris Removal: Remove accumulated trash and debris prior to mowing.

Sediment Removal: Check on a yearly basis and clean as needed. Use hand methods (i.e., a person with a shovel) when cleaning to minimize disturbance to vegetation and underlying soils. Sediment build-up in the grass channel reduces its capacity to treat and convey the water quality event, 2-year, and 10-year 24-hour storm.

Maintenance Budget

The following is an approximate maintenance budget for the inspections and items outlined above:

1. Inspections of the BMP elements.....$1,200
2. Remove and dispose of debris from treatment BMP Including the Grass Channel, Infiltration Basin and Forebay & Drainage Swale.....$1,300
3. Mowing of the BMP's including the Grass Channel, Infiltration Basin and Drainage Swale $750
4. Catch Basin cleaning $1,000

STORMWATER MANAGEMENT BEST MANAGEMENT PRACTICES

INSPECTION SCHEDULE & EVALUATION CHECKLIST

POST CONSTRUCTION PHASE

BMP	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance & Key Items to Check	Cleaning/ Repair Needed YES/NO List Items	Date of Cleaning/ Repair	Performed By	Water Level in Drainage System
Grass Channel	Annually							
Deep Sump & Hooded Catch Basin	Monthly							
Forebay	Monthly							
Infiltration Basin	Twice a year							
Drainage Swale	Twice a year							

XII. Standard 10: Prohibition of Illicit Discharges

ILLICIT DISCHARGE COMPLIANCE STATEMENT

As the owner of the Ministers Estates Subdivision, I am responsible for identifying and eliminating illicit discharges as defined by the USEPA and compliance with the provisions of the Massachusetts Stormwater Management Policy and the USEPA NPDES Construction General Permit.

To the best of my knowledge, the accompanying plans, calculations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site.

Property Owner:	Ministers Lane, LLC	
Contact Personal:	Greg Alexandris	Signature: _____
Address:	42 School Street, Andover, MA 01810	
Phone No.:	(978) 375-4418	

The signed copy has been submitted separately.

XIII. Inspection Forms

See the following pages for Sample Project Inspection Forms

Inspection Form

To be completed every 7 days and within 24 hours of a rainfall event of 0.5 inches or

Inspector: Date:

Inspector's Qualifications:

Days since last rainfall: Amount of last rainfall: Inches

Stabilization Measures:

more

Area Disturbed	Date Since Last Disturbance	Date of Next Disturbance	Stabilized (Yes/No)	Stabilized With	Condition

Stabilization required:

_____
_____
_____
_____
_____

On or before: _____

To be performed by: _____

Maintenance Report Form

Detention/Sediment Basins:

Depth of sediment basin	Condition of basin side slopes	Any evidence of overtopping of the embankment	Condition of outfall from sediment basin

Maintenance required for sediment basin:

_____
_____

On or before:

_____
_____

To be performed by:

_____
_____

Stabilization to avoid off-site sedimentation:

Does sediment get transported to the road?	Is the gravel clean, or does it contain sediment?	Does all traffic use stabilized areas to leave the site?	Do the construction vehicles exit through a wash-down area prior to leaving the site, if necessary?

Maintenance required for stabilized construction:

_____
_____
_____

On or before: _____

To be performed by: _____

Erosion Control Barrier Inspection and Maintenance Report Form

Perimeter Structural Controls: Date:

Silt Fence and/or Straw Bales

Barrier Location	Has silt reached 1/3 of fence height?	Is the fence properly secured?	Is there evidence of washout or overtopping?

Maintenance required for silt fence and straw bales:

_____
_____
_____
_____
_____
_____

On or before: _____

To be performed by: _____