EDEN ESTATES

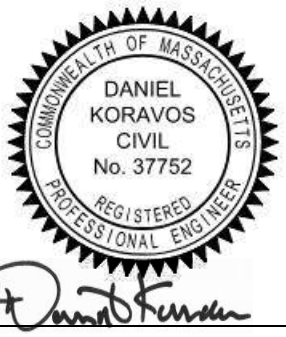
Bancroft Road
Andover, Massachusetts

PROJECT REPORT

on
Drainage & Sedimentation Control
&
Project Stormwater Report

Prepared For:

EDEN LANE, LLC
42 School Street
Andover, MA 01810



Daniel Koravos, P.E.

Date: May 26, 2024
Revised: November 1, 2024

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Eden Estates

Andover, Massachusetts

I. Table of Contents

I. TABLE OF CONTENTS 1

II. PROJECT NARRATIVE 2

i. Introduction 2
ii. Summary & Results 2

III. LOCUS MAP, USGS MAP & FIRMETTE MAP 4

IV. STORM DRAIN CALCULATIONS 7

i. Description of Drainage System 7
ii. Runoff and Mitigation Design Calculations 8
25-Year Design Storm Event – Detail 8
iii. Runoff and Mitigation Design Summary Calculations 9
2, 10, 25 & 100-Year Design Storm Events Summary Calculations 9
iv. Grass Channel [Biofilter Swale] Design 10
1" Rainfall Design 10
2 & 10 Year Design Storm Analysis 10

V. HYDRAULIC ANALYSIS ~ (100-YEAR DESIGN STORM) 11

VI. EROSION AND SEDIMENTATION CONTROL MAINTENANCE PLAN 12

i. Soil Erosion & Sediment Control Narrative 12
ii. Operation and Maintenance Procedures 13

VII. APPENDIX – NORSE ENVIRONMENTAL SERVICES ~ SOIL LOGS 16

VIII. APPENDIX – NRCS SOILS INFORMATION 17

IX. APPENDIX – DRAINAGE AREA MAPS 18

II. Project Narrative

i. Introduction

Eden Estates is a proposed three (3) lot single-family residential subdivision, on a local road, located on the south side of Bancroft Road in Andover, Massachusetts. The subject property consists of approximately 3.9± acres and is mainly grassed areas with wooded areas along portions of the perimeter of the site. The topography slopes from a high point near the easterly most corner property to a low point at the northwesterly most corner of the site. The elevations range from a high of 308 to a low of 284, a general vertical elevation difference of approximately twenty-four (24) feet.

The soils within the project consist of the Woodbridge series. This series is classified as being within the SCS-Hydrological Soils Group (HSG) C/D; ranked third/fourth on a scale of four (A, B, C, D) in terms of infiltration capacity.

These calculations determine Pre-Development and Post-Development peak flow rates (Q) and runoff volumes using the SCS-TR20 Runoff Method with HydroCAD. Proposed mitigation of the increase in runoff is being obtained primarily through the proposed detention facility 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 or volume 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 or volume 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 mitigation facility located within the project, the peak rates and volumes 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

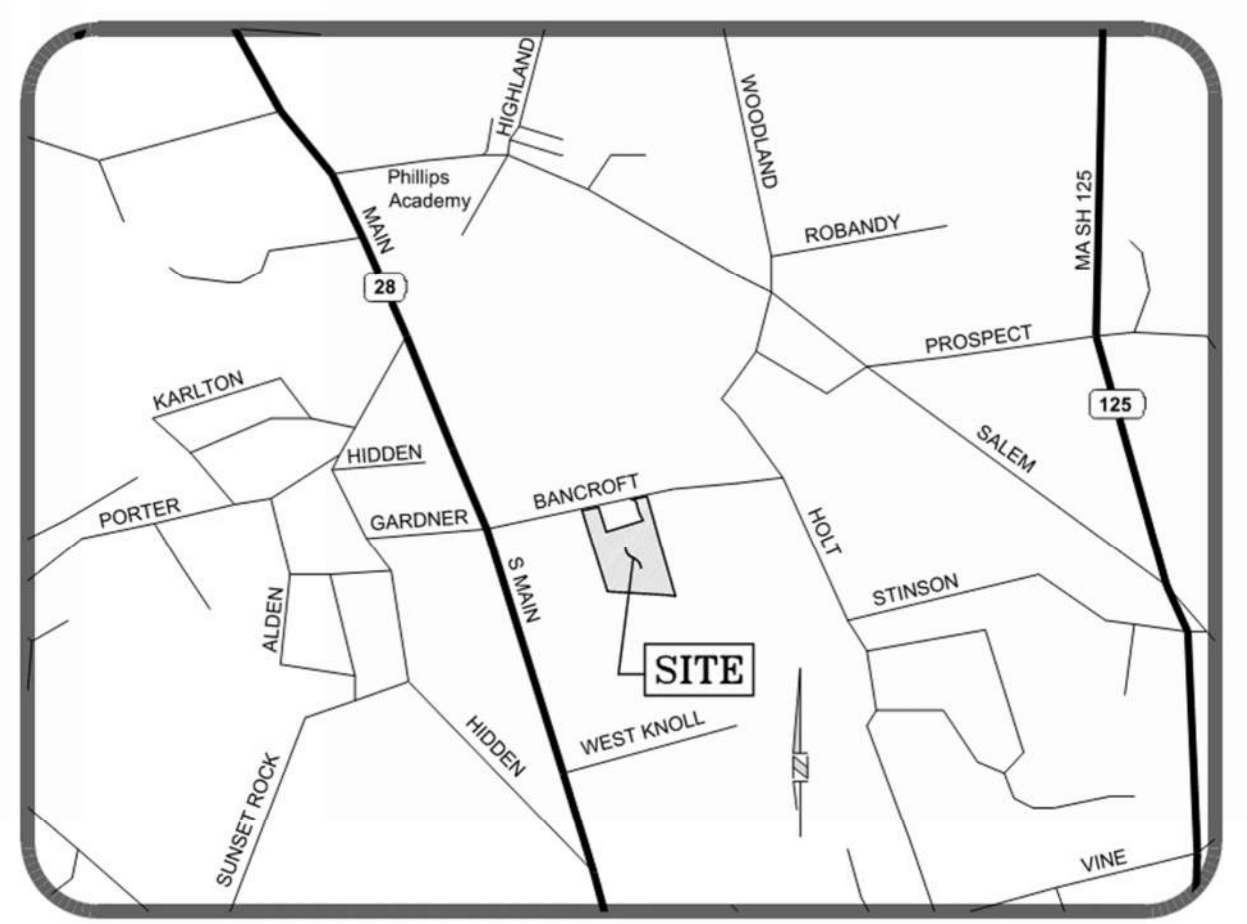
Design Storm	Peak Flow Rate			Runoff Volume		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)	Pre-Dev. (ac.-ft.)	Post-Dev. (ac.-ft.)	Δ (ac.-ft.)
2	1.8	0.4	(1.4)	0.171	0.061	(0.110)
10	4.4	1.0	(3.4)	0.389	0.250	(0.139)
25	6.1	2.1	(4.0)	0.541	0.425	(0.116)
100	8.9	6.4	(2.5)	0.789	0.720	(0.069)

Point #2

Design Storm	Peak Flow Rate			Runoff Volume		
	Pre-Dev. (cfs)	Post-Dev. (cfs)	Δ (cfs)	Pre-Dev. (ac.-ft.)	Post-Dev. (ac.-ft.)	Δ (ac.-ft.)
2	1.8	1.8	0.0	0.221	0.212	(0.009)
10	4.6	4.5	(0.1)	0.523	0.486	(0.037)
25	6.5	6.1	(0.4)	0.735	0.671	(0.064)
100	9.7	8.6	(1.1)	1.084	0.971	(0.113)

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

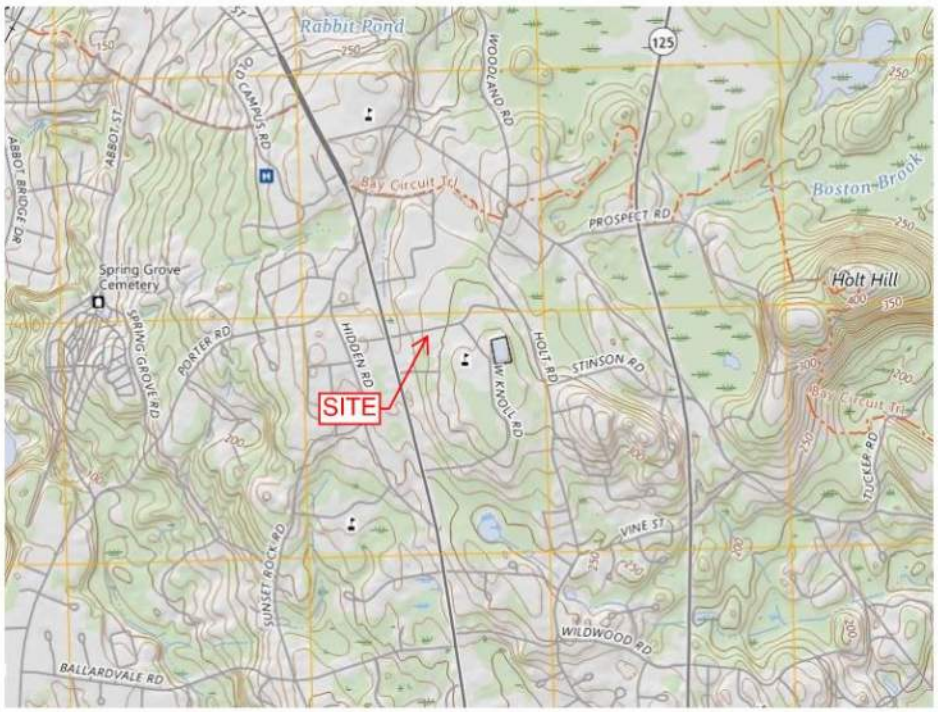
SCALE: 1" = 800'

USGS
science for a changing world

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

The National Map
OnDemand Topo

7.5-MINUTE TOPO QUADRANGLE
Custom Extent
7.5-MINUTE TOPO



SCALE 1:24 000

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

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.

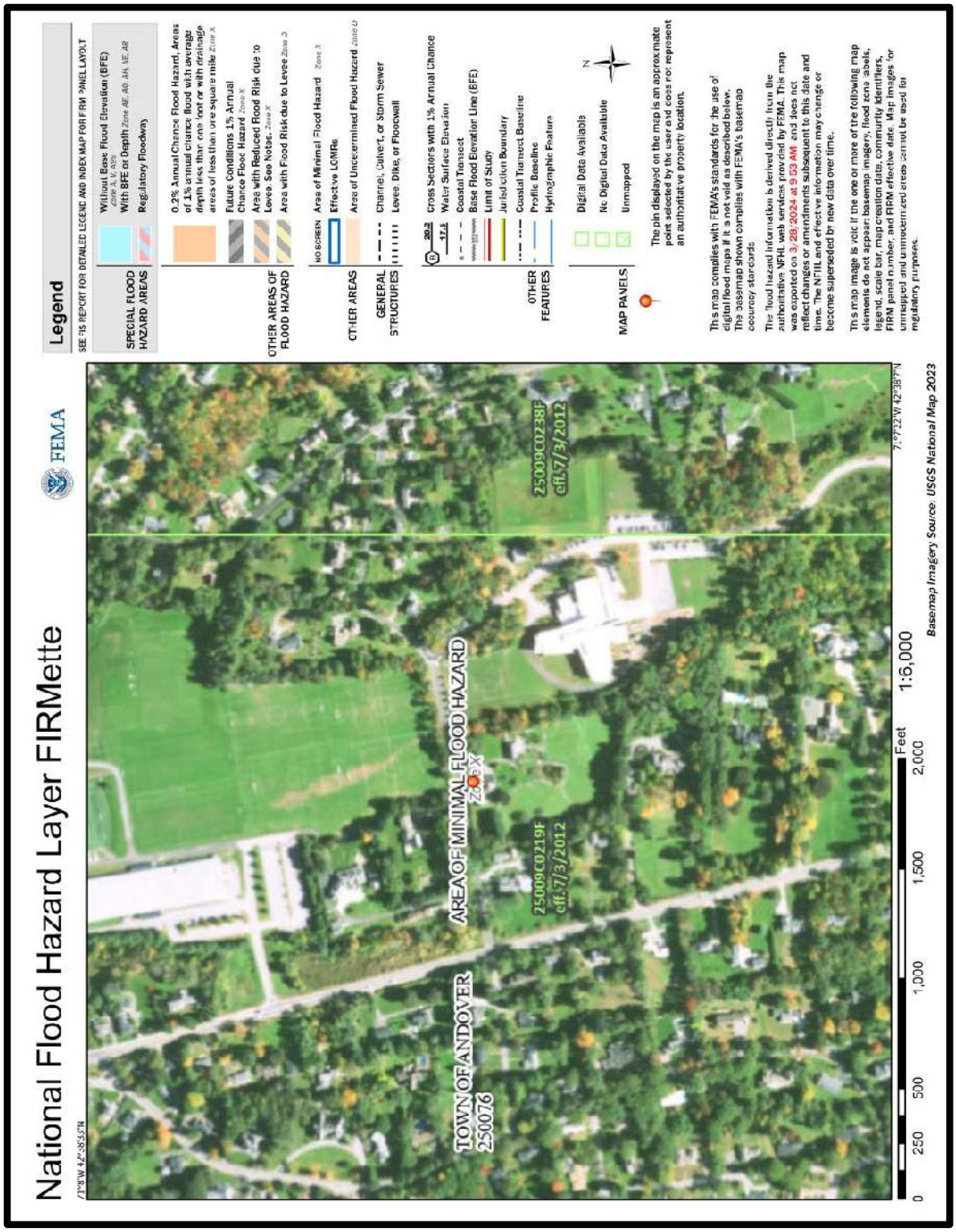
This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands. Temporal changes may have occurred since these data were collected and some data may no longer represent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


National Flood Hazard Layer FIRMette
FEMA
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE)
With BFE or Depth
Regulatory Floodway
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
Future Conditions 1% Annual Chance Flood Hazard
Area with Reduced Flood Risk due to Levee. See Notes.
Area with Flood Risk due to Levee
OTHER AREAS OF FLOOD HAZARD
Area of Minimal Flood Hazard
Effective LOMRs
OTHER AREAS
Area of Undetermined Flood Hazard
Channel, Culvert, or Storm Sewer
GENERAL STRUCTURES
Levee, Dike, or Floodwall
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
OTHER FEATURES
Digital Data Available
No Digital Data Available
Unmapped
MAP PANELS
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below.
The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/28/2024 at 9:53 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
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AREA OF MINIMAL FLOOD HAZARD
Zone X
TOWN OF ANDOVER
250076
25009C0219F
eff. 7/3/2012
25009C0238F
eff. 7/3/2012
71°8'W 42°39'57"N
71°7'22"W 42°38'7"N
0 250 500 1,000 1,500 2,000 Feet
1:6,000
Basemap Imagery Source: USGS National Map 2023

IV. Storm Drain Calculations

i. Description of Drainage System

The proposed drainage system is a combination closed and open system. Decreases in peak flow rates and volumes of runoff will be obtained primarily through use of the proposed detention facility. 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)
SC-1	29,285	
SC-2	52,209	
SC-3	117,357	
SC-5		31,857
SC-6		54,910
SC-7		15,747
SC-8		87,121
Houses		9,216
Total	**198,851**	**198,851**

NOAA Atlas 14, Volume 10, Version 3
Location name: Andover, Massachusetts, USA*
Latitude: 42.6388°, Longitude: -71.1281°
Elevation: 296 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 (0.244-0.385)	0.372 (0.291-0.461)	0.472 (0.369-0.587)	0.554 (0.430-0.693)	0.668 (0.501-0.873)	0.753 (0.554-1.01)	0.843 (0.601-1.17)	0.944 (0.636-1.34)	1.09 (0.706-1.60)	1.21 (0.763-1.81)
10-min	0.441 (0.345-0.546)	0.527 (0.412-0.653)	0.668 (0.521-0.831)	0.785 (0.609-0.982)	0.946 (0.710-1.24)	1.07 (0.784-1.43)	1.19 (0.851-1.66)	1.34 (0.902-1.90)	1.54 (0.999-2.27)	1.71 (1.08-2.56)
15-min	0.518 (0.406-0.642)	0.620 (0.485-0.768)	0.786 (0.613-0.977)	0.924 (0.717-1.16)	1.11 (0.835-1.46)	1.26 (0.923-1.68)	1.40 (1.00-1.95)	1.57 (1.06-2.23)	1.81 (1.18-2.67)	2.01 (1.27-3.02)
30-min	0.712 (0.558-0.882)	0.852 (0.667-1.06)	1.08 (0.843-1.34)	1.27 (0.985-1.59)	1.53 (1.15-2.00)	1.73 (1.27-2.31)	1.93 (1.38-2.68)	2.17 (1.46-3.08)	2.50 (1.62-3.68)	2.77 (1.75-4.16)
60-min	0.907 (0.710-1.12)	1.08 (0.849-1.34)	1.38 (1.07-1.71)	1.62 (1.26-2.02)	1.95 (1.46-2.55)	2.20 (1.62-2.94)	2.46 (1.76-3.42)	2.76 (1.86-3.92)	3.18 (2.06-4.68)	3.53 (2.24-5.30)
2-hr	1.17 (0.923-1.44)	1.41 (1.11-1.73)	1.80 (1.42-2.22)	2.12 (1.66-2.64)	2.57 (1.95-3.36)	2.90 (2.16-3.88)	3.26 (2.36-4.54)	3.69 (2.50-5.21)	4.34 (2.82-6.35)	4.90 (3.11-7.31)
3-hr	1.35 (1.07-1.66)	1.63 (1.30-2.00)	2.10 (1.66-2.58)	2.48 (1.95-3.07)	3.01 (2.30-3.92)	3.40 (2.54-4.54)	3.83 (2.79-5.34)	4.35 (2.95-6.12)	5.16 (3.36-7.52)	5.86 (3.73-8.70)
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 (3.01-5.07)	4.43 (3.33-5.88)	4.99 (3.66-6.92)	5.69 (3.88-7.96)	6.79 (4.44-9.82)	7.74 (4.94-11.4)
12-hr	2.17 (1.75-2.62)	2.66 (2.14-3.22)	3.45 (2.77-4.19)	4.10 (3.28-5.02)	5.01 (3.87-6.44)	5.68 (4.30-7.48)	6.40 (4.72-8.82)	7.31 (5.00-10.1)	8.71 (5.72-12.5)	9.93 (6.35-14.5)
24-hr	2.57 (2.10-3.09)	3.20 (2.60-3.84)	4.21 (3.42-5.08)	5.06 (4.07-6.14)	6.22 (4.85-7.96)	7.08 (5.40-9.28)	8.02 (5.96-11.0)	9.20 (6.32-12.7)	11.1 (7.28-15.8)	12.7 (8.15-18.5)
2-day	2.89 (2.38-3.45)	3.66 (3.01-4.38)	4.93 (4.03-5.91)	5.98 (4.85-7.20)	7.42 (5.84-9.47)	8.47 (6.54-11.1)	9.65 (7.26-13.3)	11.2 (7.71-15.3)	13.7 (9.02-19.4)	15.9 (10.2-22.9)
3-day	3.17 (2.62-3.77)	4.00 (3.30-4.76)	5.36 (4.40-6.40)	6.49 (5.29-7.79)	8.04 (6.35-10.2)	9.16 (7.10-12.0)	10.4 (7.88-14.3)	12.1 (8.36-16.5)	14.8 (9.78-20.9)	17.2 (11.1-24.7)
4-day	3.44 (2.85-4.08)	4.30 (3.56-5.10)	5.70 (4.70-6.78)	6.86 (5.62-8.21)	8.46 (6.70-10.7)	9.62 (7.47-12.5)	10.9 (8.27-14.9)	12.6 (8.75-17.2)	15.4 (10.2-21.7)	17.9 (11.6-25.7)
7-day	4.19 (3.50-4.94)	5.08 (4.23-5.99)	6.52 (5.42-7.72)	7.72 (6.37-9.19)	9.37 (7.47-11.8)	10.6 (8.25-13.6)	11.9 (9.05-16.1)	13.7 (9.52-18.5)	16.5 (11.0-23.2)	19.1 (12.4-27.2)
10-day	4.87 (4.08-5.72)	5.78 (4.84-6.79)	7.26 (6.05-8.56)	8.49 (7.03-10.1)	10.2 (8.14-12.7)	11.4 (8.93-14.6)	12.8 (9.71-17.2)	14.6 (10.2-19.6)	17.4 (11.6-24.2)	19.9 (12.9-28.2)
20-day	6.79 (5.74-7.92)	7.79 (6.58-9.09)	9.42 (7.93-11.0)	10.8 (9.00-12.7)	12.6 (10.1-15.6)	14.0 (11.0-17.7)	15.5 (11.7-20.3)	17.2 (12.1-23.0)	19.8 (13.2-27.3)	21.9 (14.2-30.9)
30-day	8.40 (7.14-9.75)	9.48 (8.05-11.0)	11.2 (9.50-13.1)	12.7 (10.7-14.9)	14.7 (11.8-17.9)	16.2 (12.7-20.2)	17.8 (13.3-22.9)	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 (9.92-13.4)	13.5 (11.5-15.7)	15.1 (12.7-17.6)	17.3 (13.9-20.9)	19.0 (14.8-23.4)	20.6 (15.4-26.2)	22.3 (15.8-29.4)	24.4 (16.5-33.4)	25.9 (16.9-36.3)
60-day	12.2 (10.5-14.1)	13.5 (11.5-15.5)	15.5 (13.2-17.9)	17.1 (14.5-20.0)	19.4 (15.7-23.4)	21.2 (16.7-26.0)	23.0 (17.2-29.0)	24.6 (17.5-32.3)	26.6 (18.0-36.3)	28.0 (18.3-39.1)

[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.

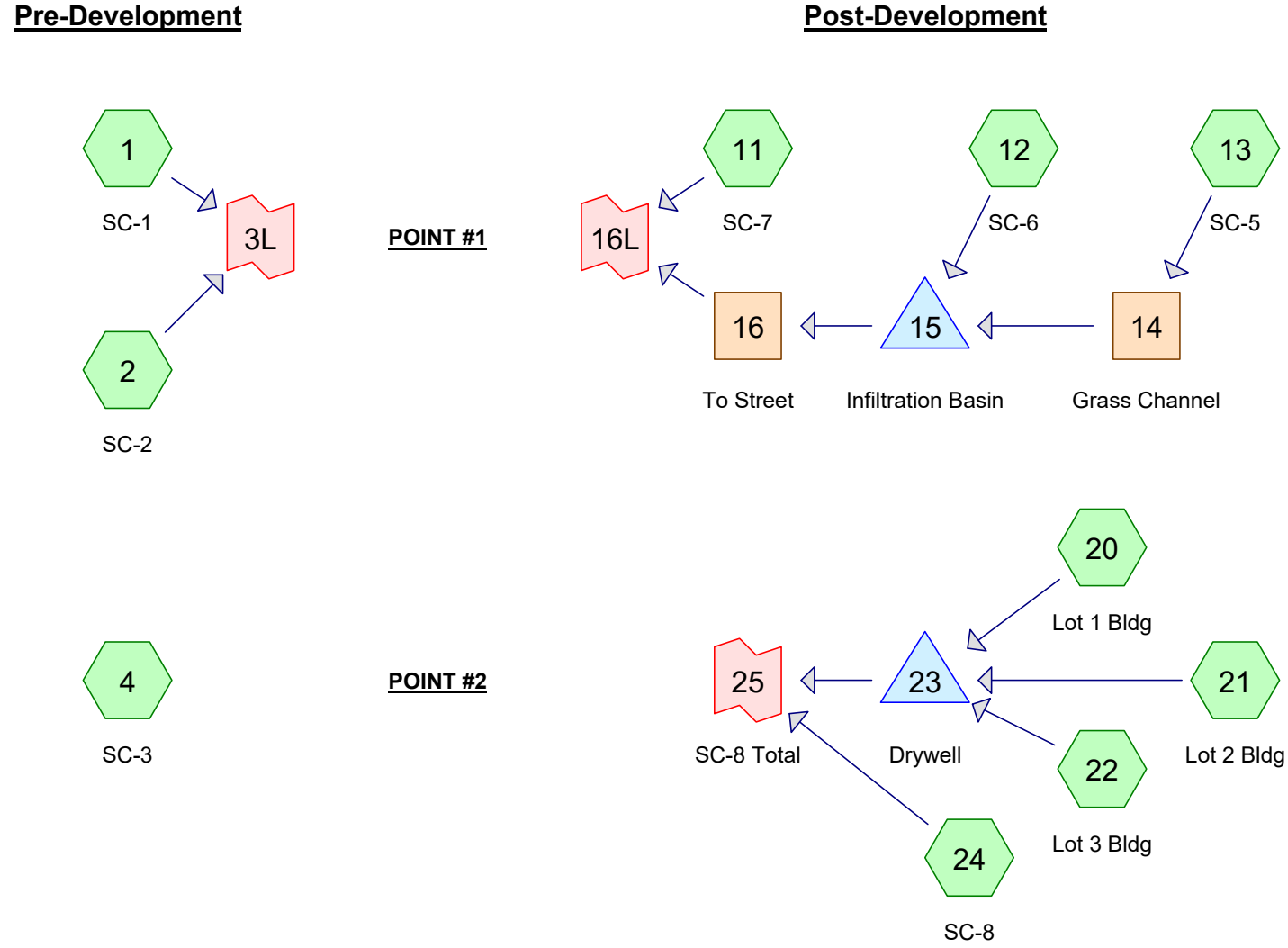
Back to Top

PF graphical

ii. Runoff and Mitigation Design Calculations

25-Year Design Storm Event – Detail

See Following Pages



Routing Diagram for 42215 Rev 2024-11-01
Prepared by DK Engineering LLC, Printed 11/2/2024

Summary for Subcatchment 1: SC-1

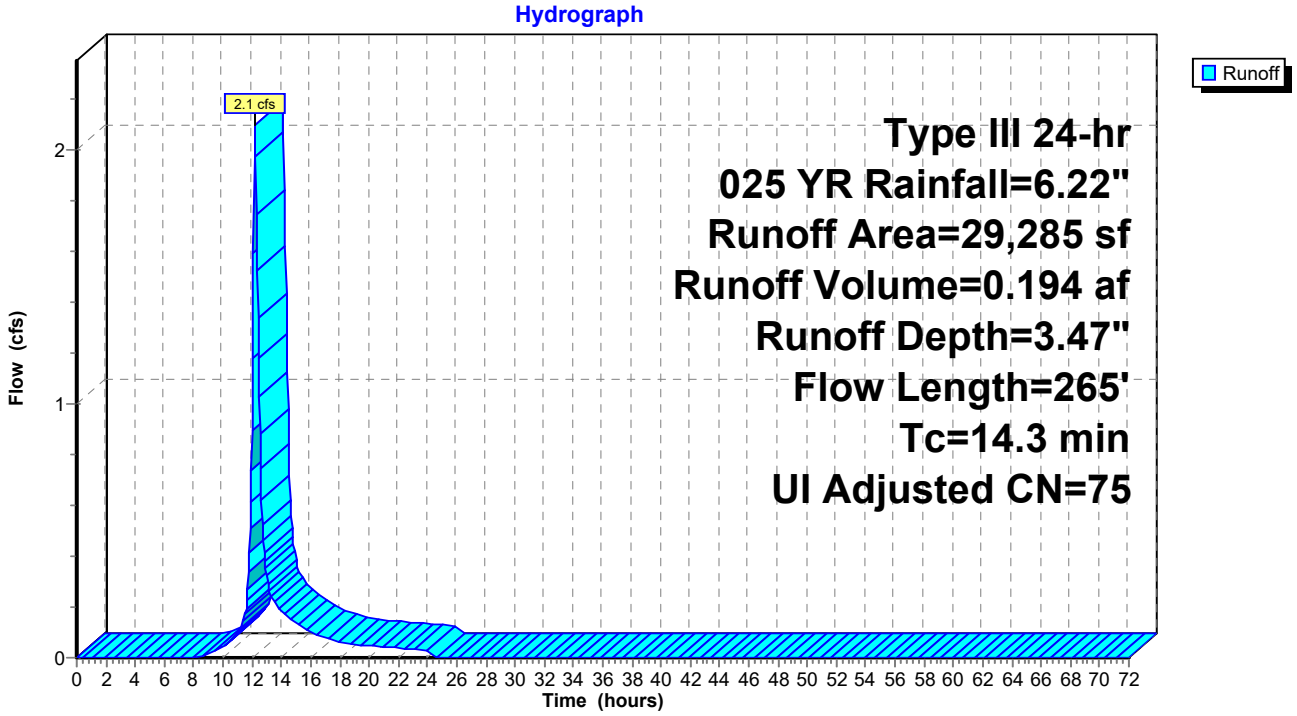
Runoff = 2.1 cfs @ 12.20 hrs, Volume= 0.194 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Adj	Description
4,056	98		Unconnected pavement, HSG C
1,796	98		Unconnected roofs, HSG C
9,879	70		Woods, Good, HSG C
13,554	74		>75% Grass cover, Good, HSG C
29,285	77	75	Weighted Average, UI Adjusted
23,433			80.02% Pervious Area
5,852			19.98% Impervious Area
5,852			100.00% Unconnected

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= 3.10"
0.5	92	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	123	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
14.3	265	Total			

Subcatchment 1: SC-1



Summary for Subcatchment 2: SC-2

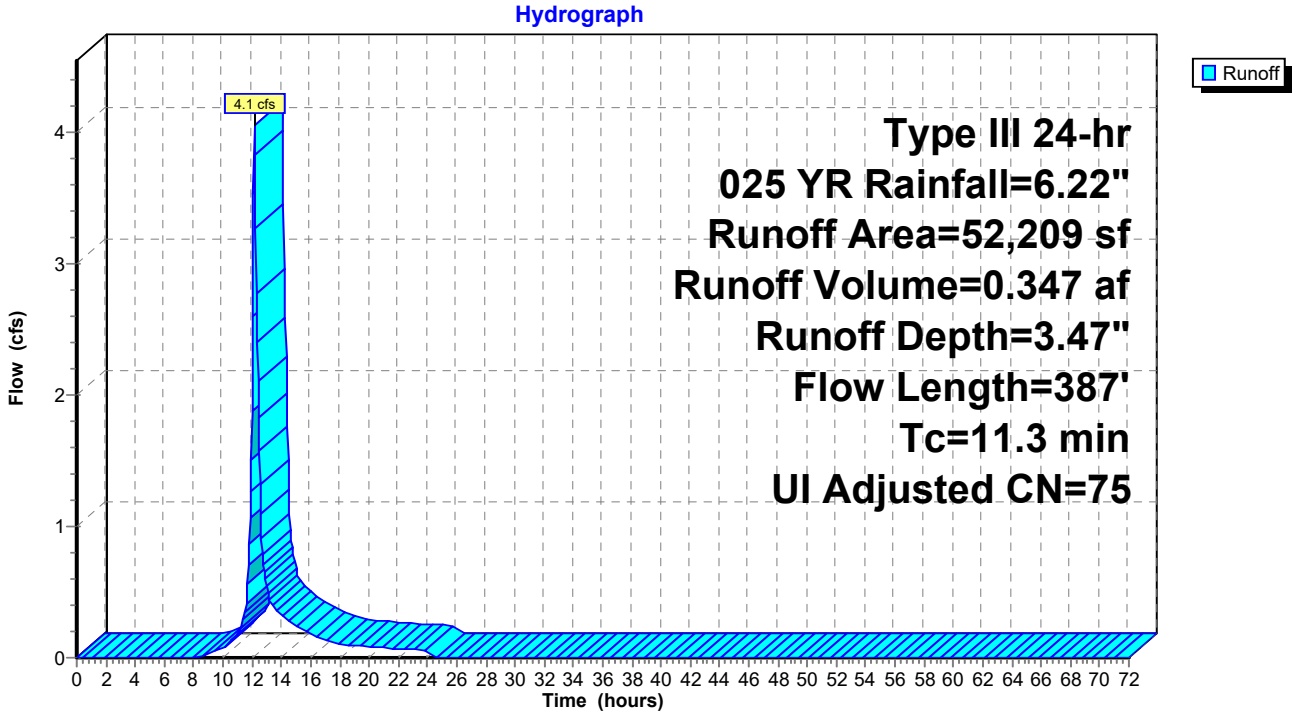
Runoff = 4.1 cfs @ 12.16 hrs, Volume= 0.347 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Adj	Description
2,642	98		Unconnected pavement, HSG C
3,334	98		Unconnected roofs, HSG C
36,346	74		>75% Grass cover, Good, HSG C
9,887	70		Woods, Good, HSG C
52,209	76	75	Weighted Average, UI Adjusted
46,233			88.55% Pervious Area
5,976			11.45% Impervious Area
5,976			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0430	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.7	163	0.0520	1.60		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	62	0.0230	1.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.5	112	0.0230	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.3	387	Total			

Subcatchment 2: SC-2

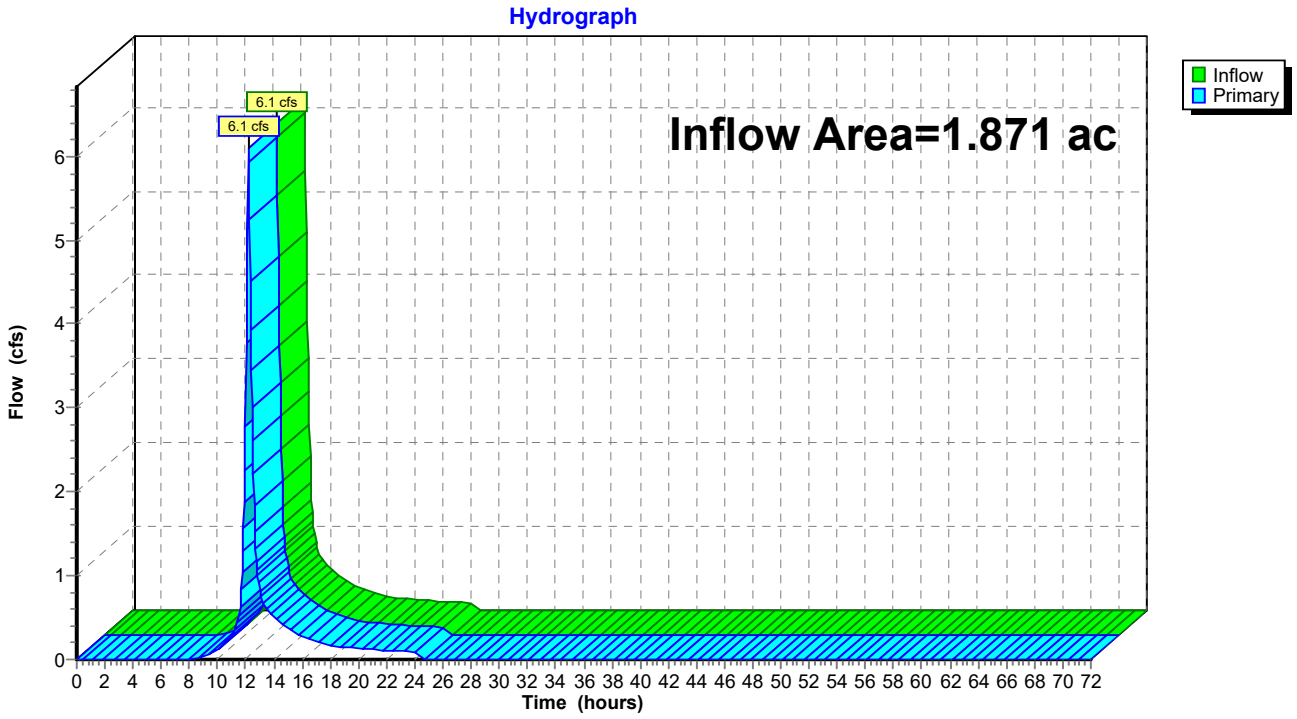


Summary for Link 3L:

Inflow Area = 1.871 ac, 14.51% Impervious, Inflow Depth = 3.47" for 025 YR event
Inflow = 6.1 cfs @ 12.17 hrs, Volume= 0.541 af
Primary = 6.1 cfs @ 12.17 hrs, Volume= 0.541 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 3L:



Summary for Subcatchment 4: SC-3

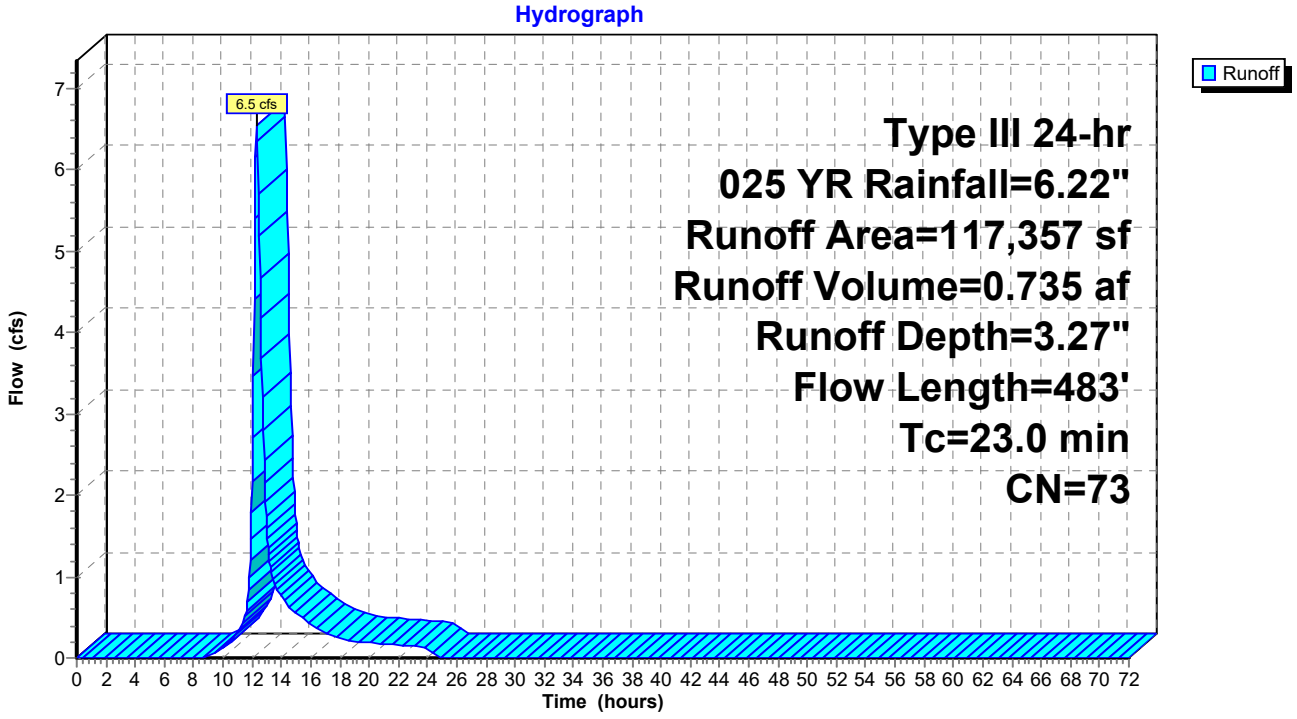
Runoff = 6.5 cfs @ 12.32 hrs, Volume= 0.735 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Description
952	98	Unconnected roofs, HSG C
85,299	74	>75% Grass cover, Good, HSG C
31,106	70	Woods, Good, HSG C
117,357	73	Weighted Average
116,405		99.19% Pervious Area
952		0.81% Impervious Area
952		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
6.5	433	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.0	483	Total			

Subcatchment 4: SC-3



Summary for Subcatchment 11: SC-7

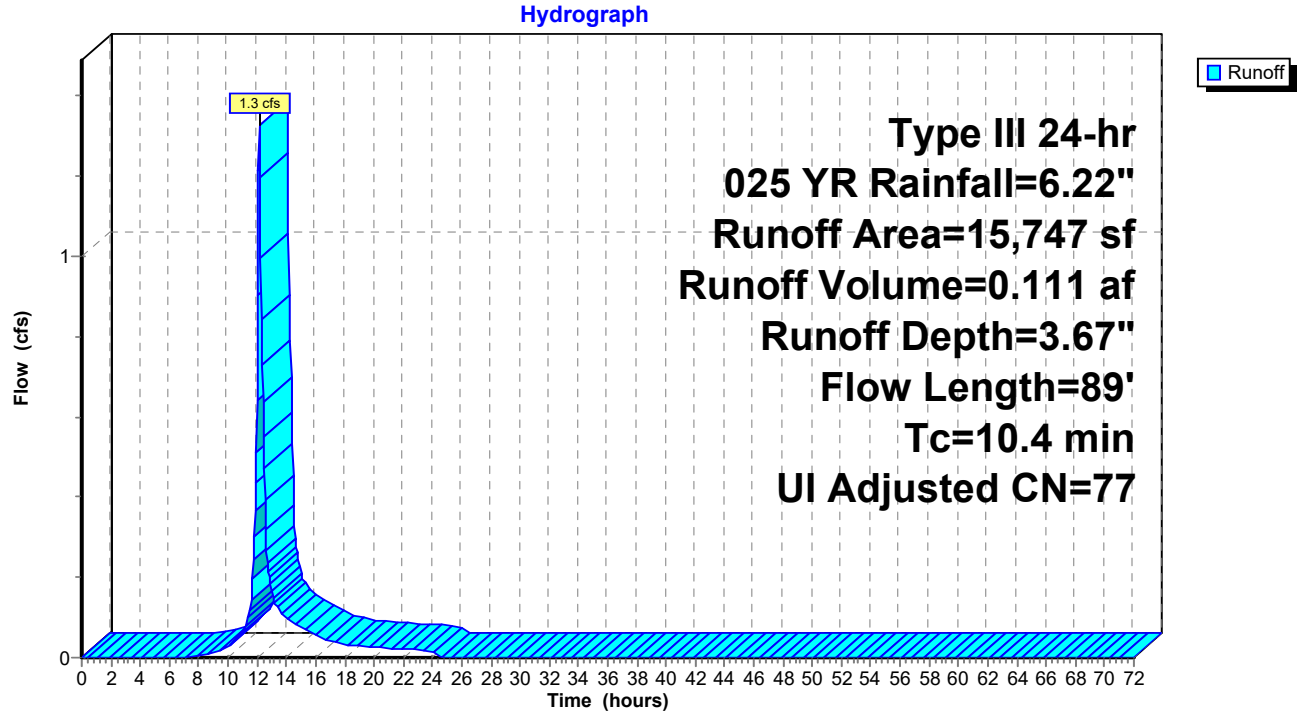
Runoff = 1.3 cfs @ 12.15 hrs, Volume= 0.111 af, Depth= 3.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Adj	Description
3,395	98		Unconnected pavement, HSG C
1,065	98		Unconnected roofs, HSG C
10,044	74		>75% Grass cover, Good, HSG C
1,243	70		Woods, Good, HSG C
15,747	80	77	Weighted Average, UI Adjusted
11,287			71.68% Pervious Area
4,460			28.32% Impervious Area
4,460			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	38	0.0200	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	51	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.4	89	Total			

Subcatchment 11: SC-7



Summary for Subcatchment 12: SC-6

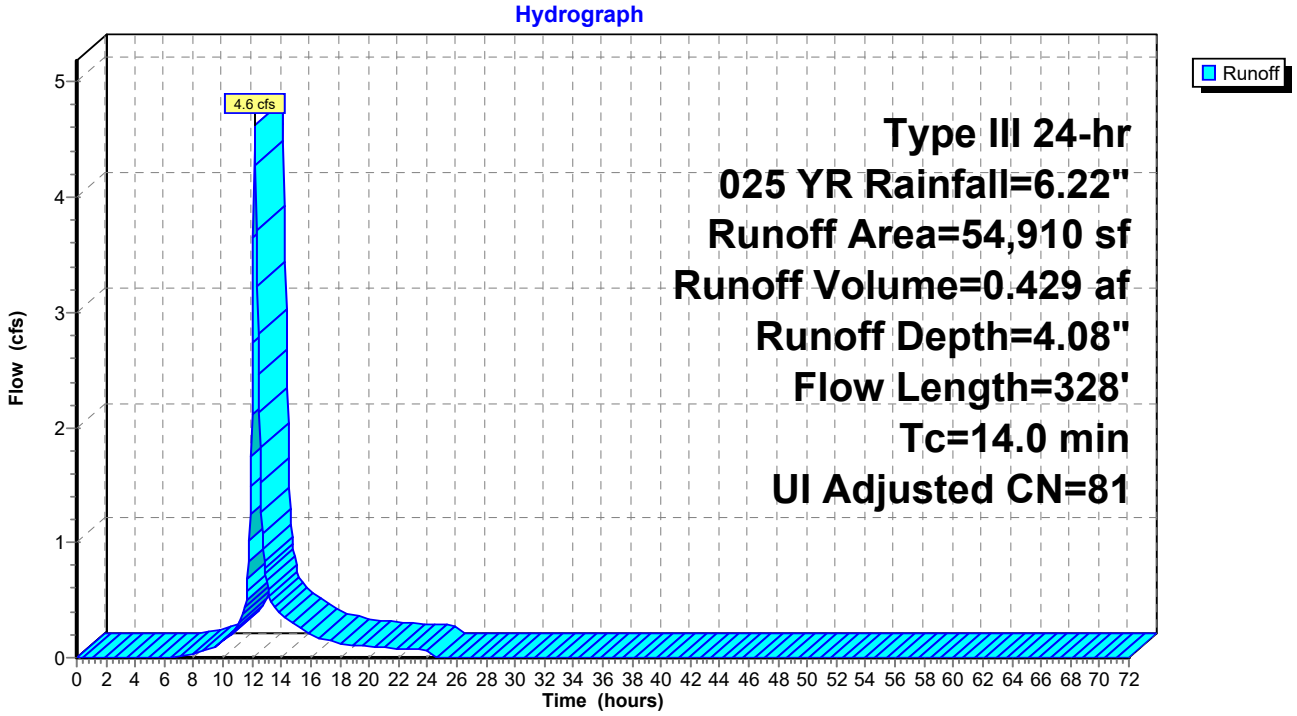
Runoff = 4.6 cfs @ 12.19 hrs, Volume= 0.429 af, Depth= 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Adj	Description
1,944	98		Unconnected pavement, HSG C
3,334	98		Unconnected roofs, HSG C
23,048	74		>75% Grass cover, Good, HSG C
26,584	86		<50% Grass cover, Poor, HSG C
54,910	82	81	Weighted Average, UI Adjusted
49,632			90.39% Pervious Area
5,278			9.61% Impervious Area
5,278			100.00% Unconnected

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= 3.10"
0.9	98	0.0700	1.85		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.1	180	0.0050	1.40	4.2	**Channel Flow,** Area= 3.0 sf Perim= 5.5' r= 0.55' n= 0.050 Earth, cobble bottom, clean sides
14.0	328	Total			

Subcatchment 12: SC-6



Summary for Subcatchment 13: SC-5

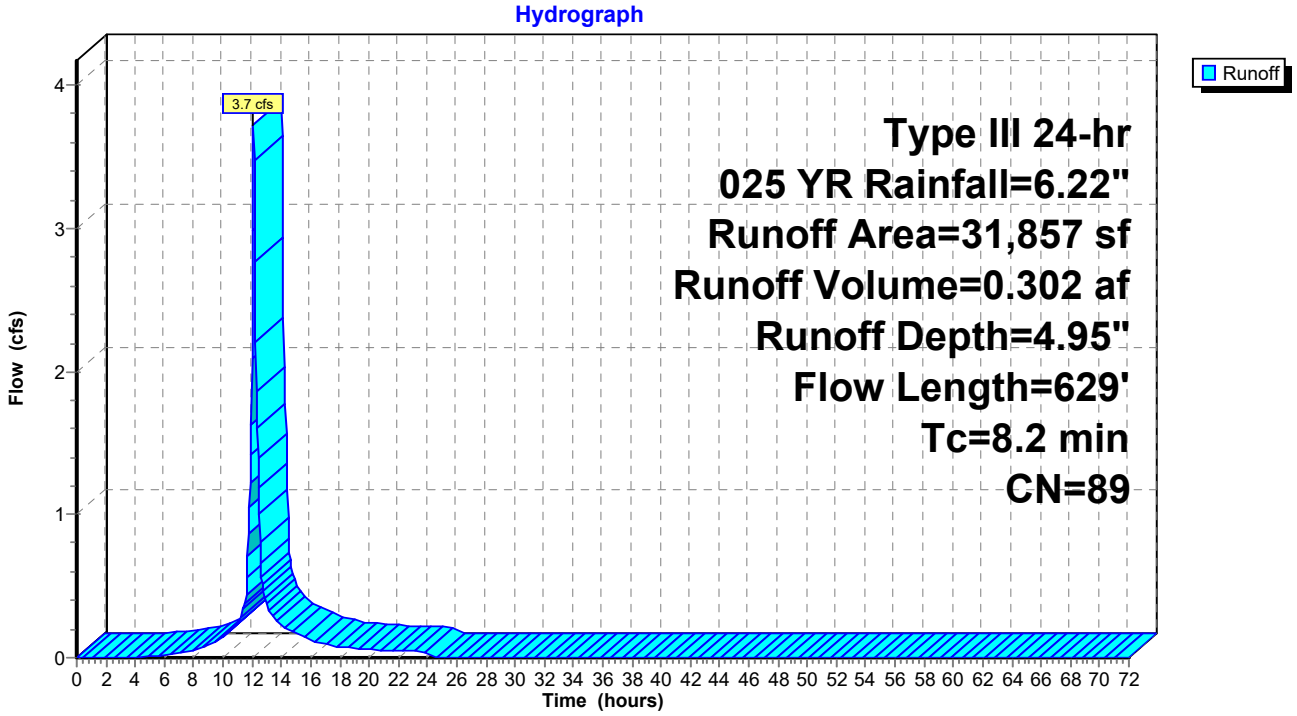
Runoff = 3.7 cfs @ 12.11 hrs, Volume= 0.302 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Description
11,986	98	Paved parking, HSG C
1,048	98	Unconnected pavement, HSG C
15,126	86	<50% Grass cover, Poor, HSG C
3,697	70	Woods, Good, HSG C
31,857	89	Weighted Average
18,823		59.09% Pervious Area
13,034		40.91% Impervious Area
1,048		8.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0550	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.9	300	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	14	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.2	55	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.5	210	0.0120	6.46	5.1	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
8.2	629	Total			

Subcatchment 13: SC-5



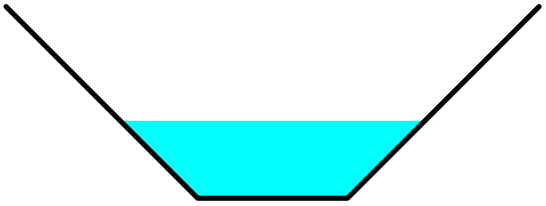
Summary for Reach 14: Grass Channel

Inflow Area = 0.731 ac, 40.91% Impervious, Inflow Depth = 4.95" for 025 YR event
Inflow = 3.7 cfs @ 12.11 hrs, Volume= 0.302 af
Outflow = 3.5 cfs @ 12.17 hrs, Volume= 0.302 af, Atten= 6%, Lag= 3.6 min

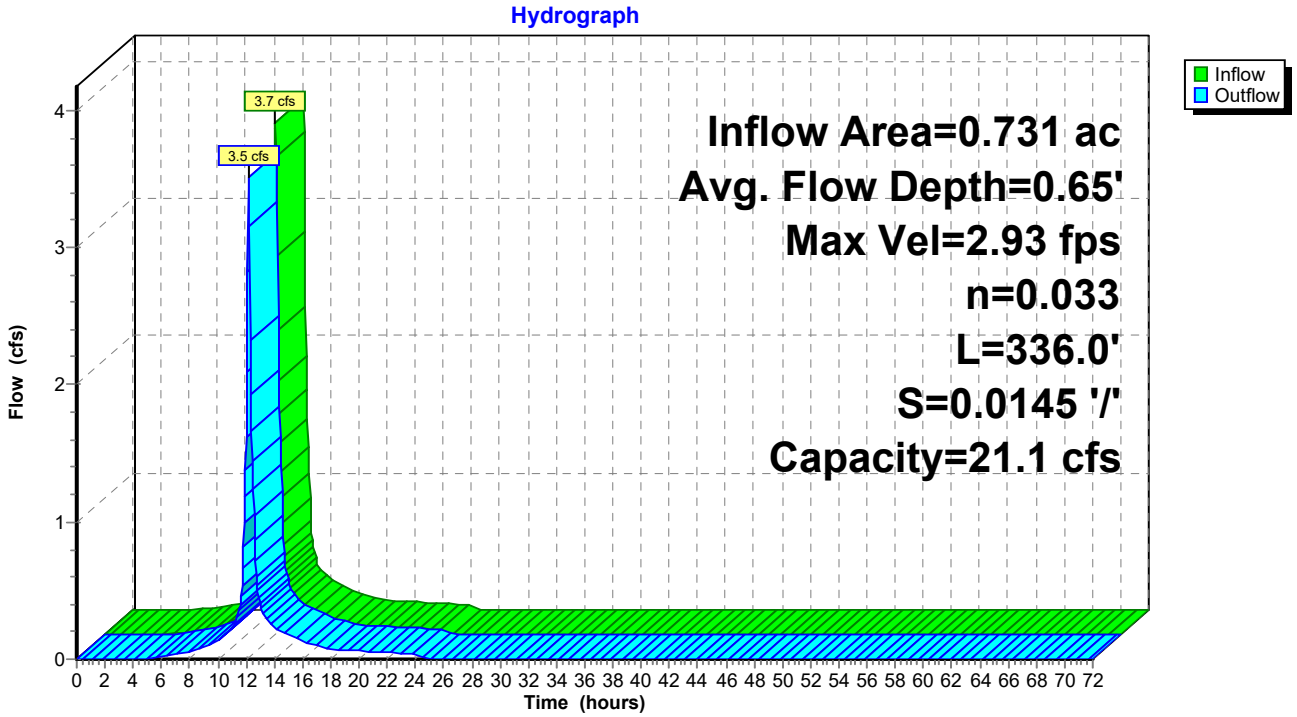
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.93 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 6.3 min

Peak Storage= 412 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.60' Flow Area= 4.6 sf, Capacity= 21.1 cfs

1.25' x 1.60' deep channel, n= 0.033 Earth, grassed & winding
Side Slope Z-value= 1.0 '/' Top Width= 4.45'
Length= 336.0' Slope= 0.0145 '/'
Inlet Invert= 302.00', Outlet Invert= 297.13'



Reach 14: Grass Channel



Summary for Pond 15: Infiltration Basin

Inflow Area = 1.992 ac, 21.10% Impervious, Inflow Depth = 4.40" for 025 YR event
Inflow = 8.1 cfs @ 12.18 hrs, Volume= 0.731 af
Outflow = 2.1 cfs @ 12.65 hrs, Volume= 0.731 af, Atten= 75%, Lag= 27.7 min
Discarded = 0.2 cfs @ 12.65 hrs, Volume= 0.416 af
Primary = 1.8 cfs @ 12.65 hrs, Volume= 0.315 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 288.68' @ 12.65 hrs Surf.Area= 9,822 sf Storage= 14,577 cf

Plug-Flow detention time= 304.2 min calculated for 0.731 af (100% of inflow)
Center-of-Mass det. time= 304.1 min (1,112.3 - 808.2)

Volume	Invert	Avail.Storage	Storage Description
#1	287.00'	41,433 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

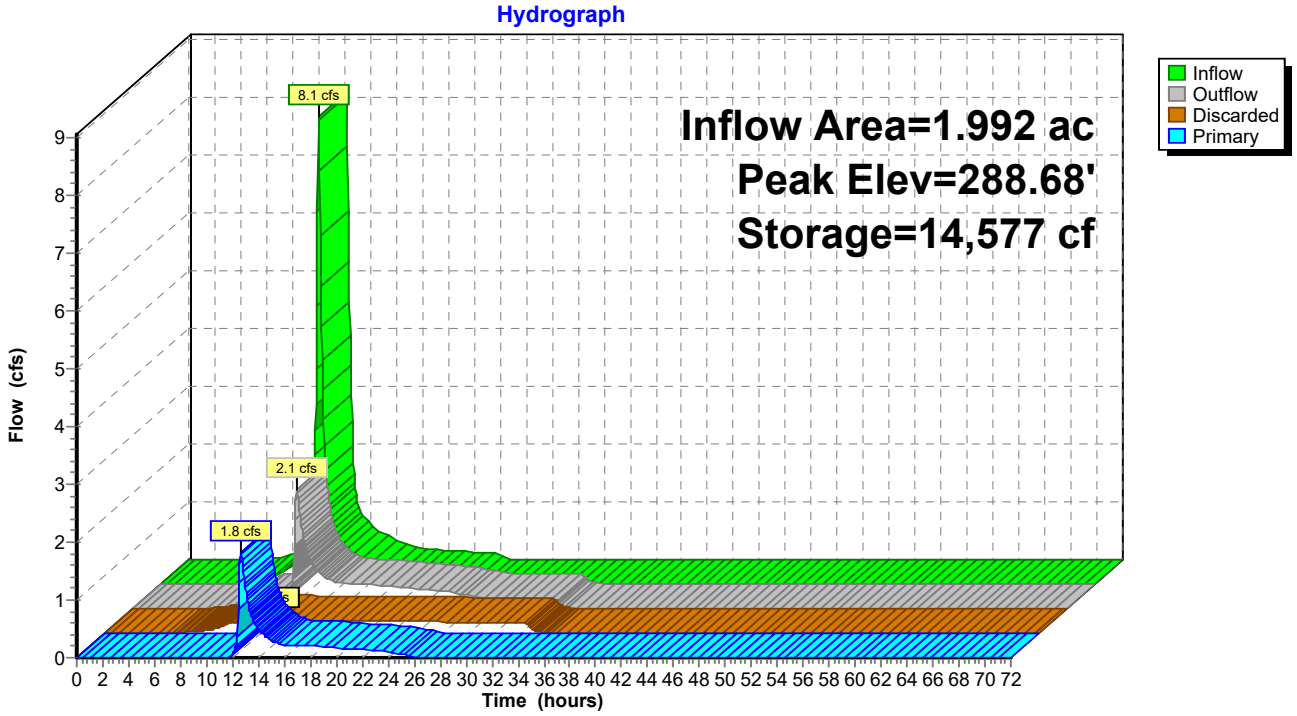
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.00	7,665	0	0
288.00	8,800	8,233	8,233
290.00	11,800	20,600	28,833
291.00	13,400	12,600	41,433

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	287.50'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	288.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.2 cfs @ 12.65 hrs HW=288.68' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=1.8 cfs @ 12.65 hrs HW=288.68' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.2 cfs @ 4.95 fps)
└**3=Orifice/Grate** (Weir Controls 1.6 cfs @ 1.39 fps)

Pond 15: Infiltration Basin



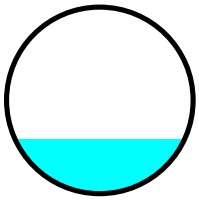
Summary for Reach 16: To Street

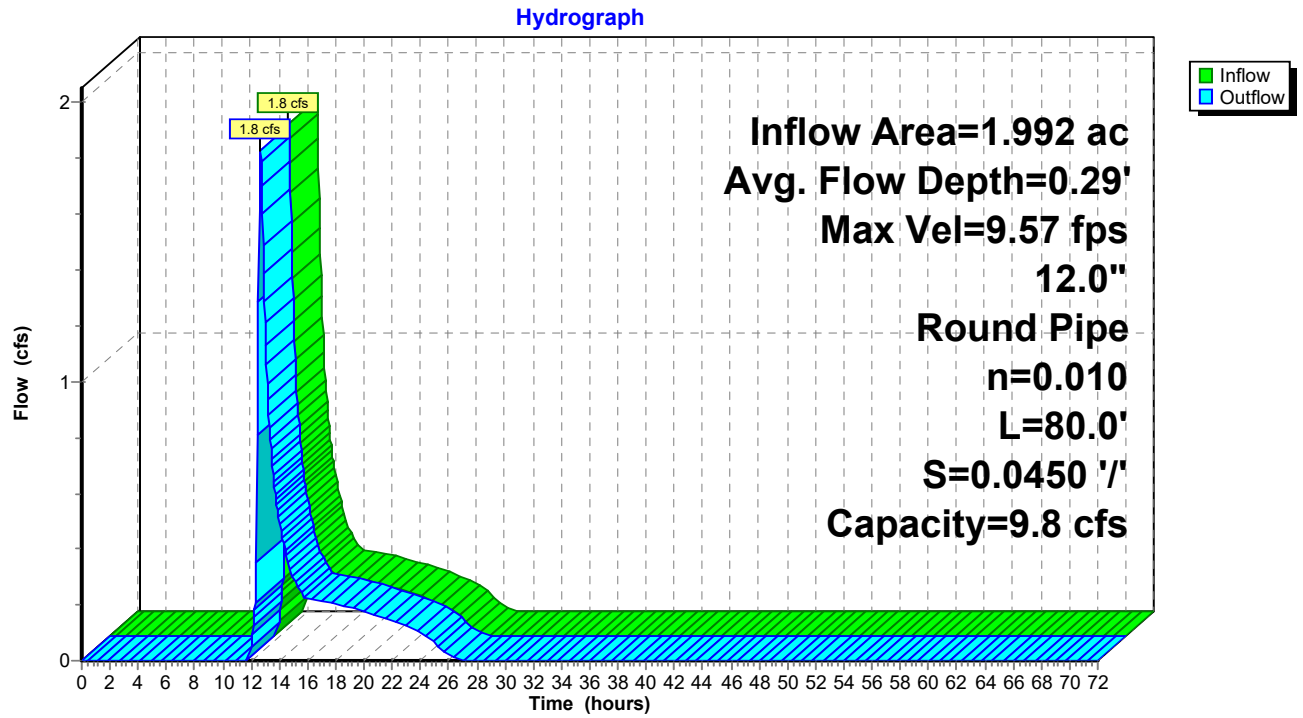
Inflow Area = 1.992 ac, 21.10% Impervious, Inflow Depth = 1.90" for 025 YR event
Inflow = 1.8 cfs @ 12.65 hrs, Volume= 0.315 af
Outflow = 1.8 cfs @ 12.65 hrs, Volume= 0.315 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.57 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.77 fps, Avg. Travel Time= 0.3 min

Peak Storage= 15 cf @ 12.65 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 9.8 cfs

12.0" Round Pipe
n= 0.010
Length= 80.0' Slope= 0.0450 '/'
Inlet Invert= 282.00', Outlet Invert= 278.40'



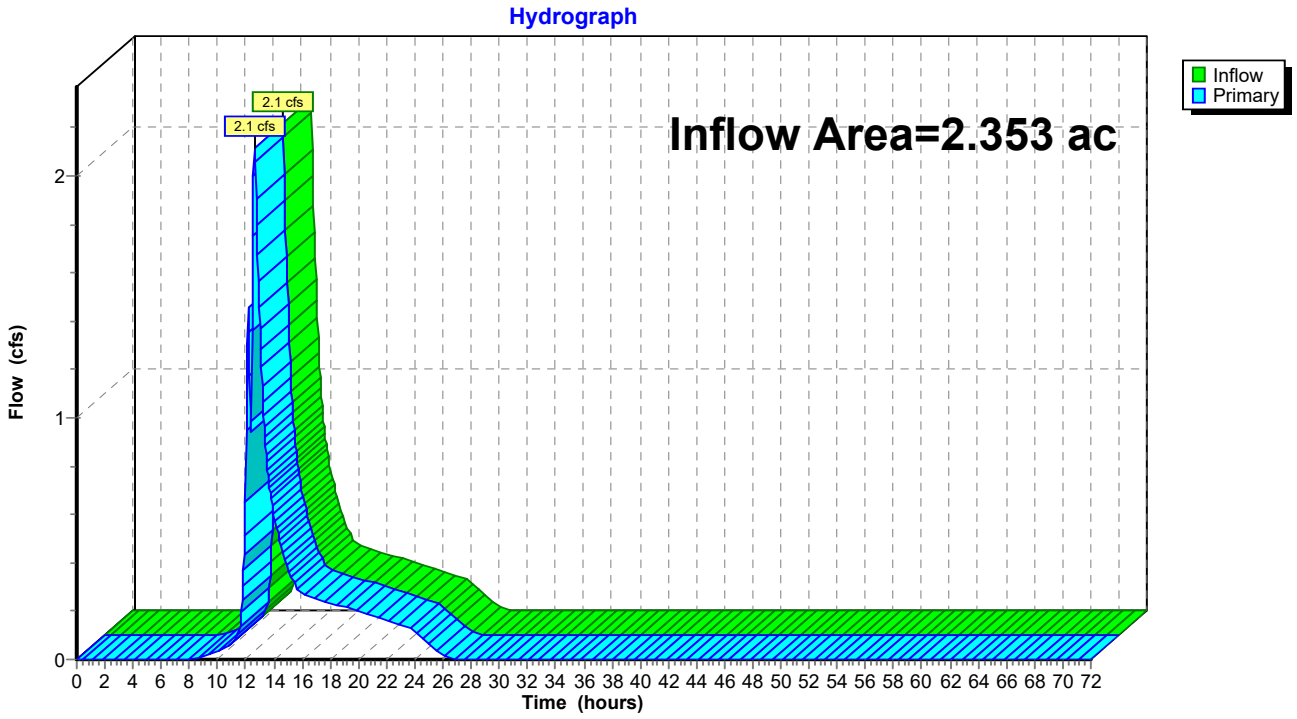


Summary for Link 16L:

Inflow Area = 2.353 ac, 22.21% Impervious, Inflow Depth = 2.17" for 025 YR event
Inflow = 2.1 cfs @ 12.62 hrs, Volume= 0.425 af
Primary = 2.1 cfs @ 12.62 hrs, Volume= 0.425 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 16L:



Summary for Subcatchment 20: Lot 1 Bldg

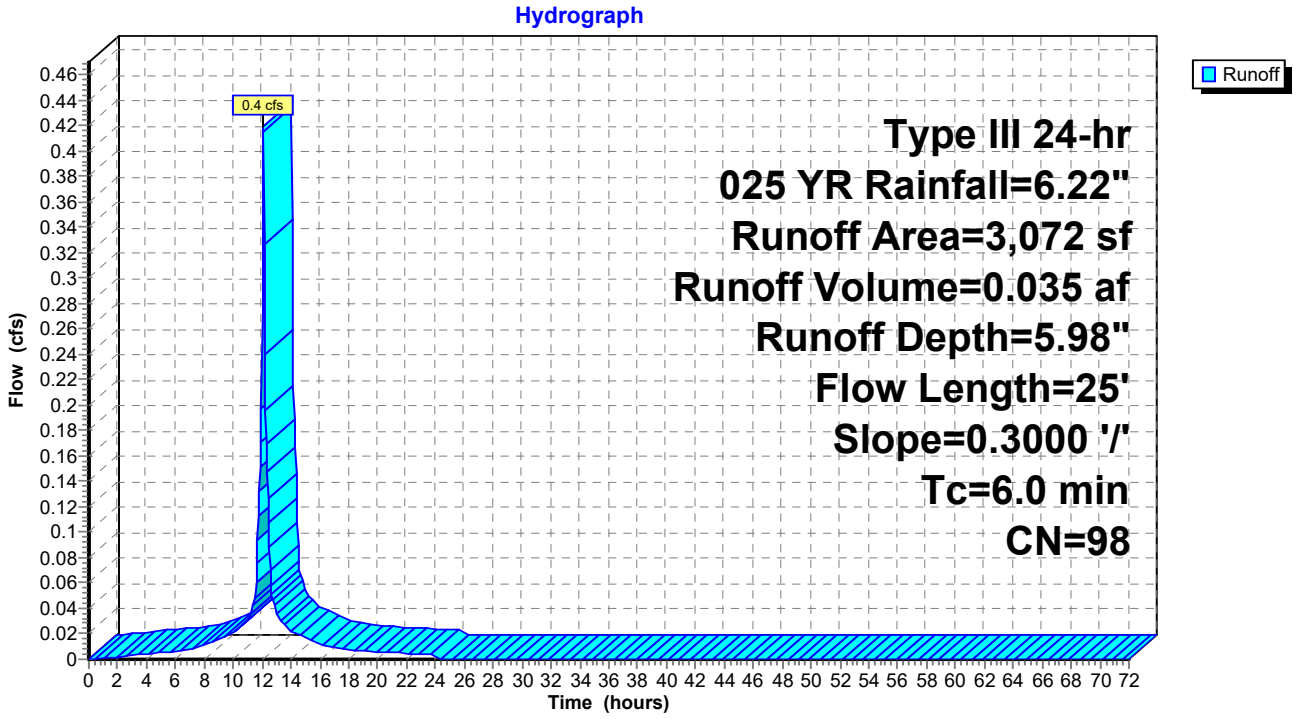
Runoff = 0.4 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 5.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Description
3,072	98	Unconnected roofs, HSG C
3,072		100.00% Impervious Area
3,072		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= 3.10"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 20: Lot 1 Bldg



Summary for Subcatchment 21: Lot 2 Bldg

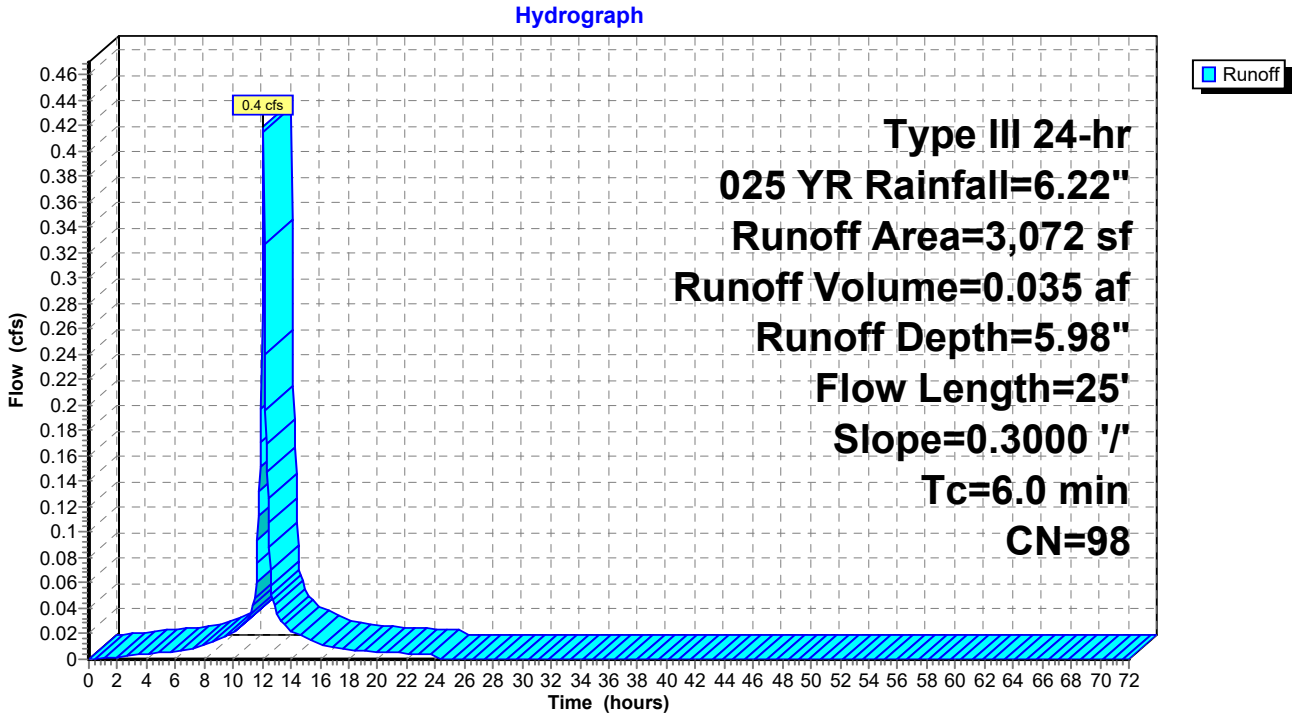
Runoff = 0.4 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 5.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Description
3,072	98	Unconnected roofs, HSG C
3,072		100.00% Impervious Area
3,072		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= 3.10"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 21: Lot 2 Bldg



Summary for Subcatchment 22: Lot 3 Bldg

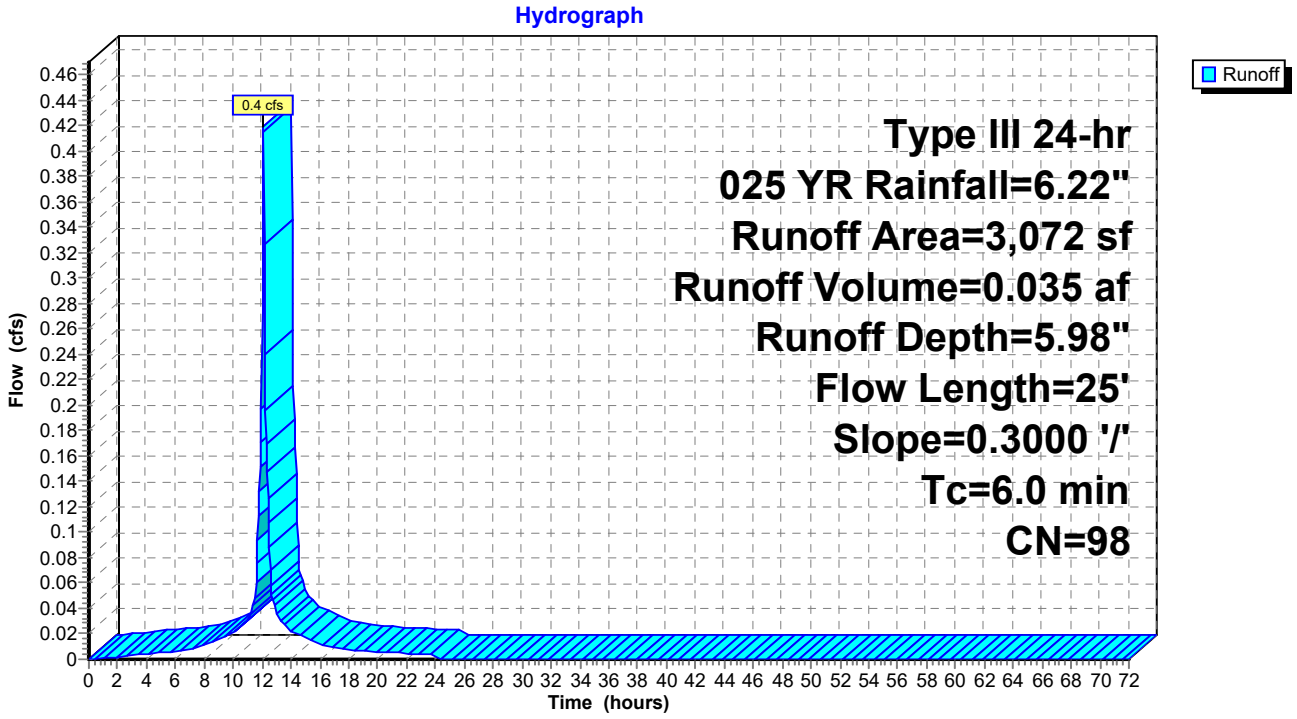
Runoff = 0.4 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 5.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Description
3,072	98	Unconnected roofs, HSG C
3,072		100.00% Impervious Area
3,072		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= 3.10"
0.1	25	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 22: Lot 3 Bldg



Summary for Pond 23: Drywell

Inflow Area = 0.212 ac,100.00% Impervious, Inflow Depth = 5.98" for 025 YR event
Inflow = 1.3 cfs @ 12.09 hrs, Volume= 0.105 af
Outflow = 1.3 cfs @ 12.11 hrs, Volume= 0.105 af, Atten= 0%, Lag= 1.3 min
Discarded = 0.0 cfs @ 7.10 hrs, Volume= 0.063 af
Primary = 1.3 cfs @ 12.11 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 3.23' @ 12.11 hrs Surf.Area= 990 sf Storage= 1,313 cf

Plug-Flow detention time= 292.1 min calculated for 0.105 af (100% of inflow)
Center-of-Mass det. time= 292.5 min (1,037.1 - 744.6)

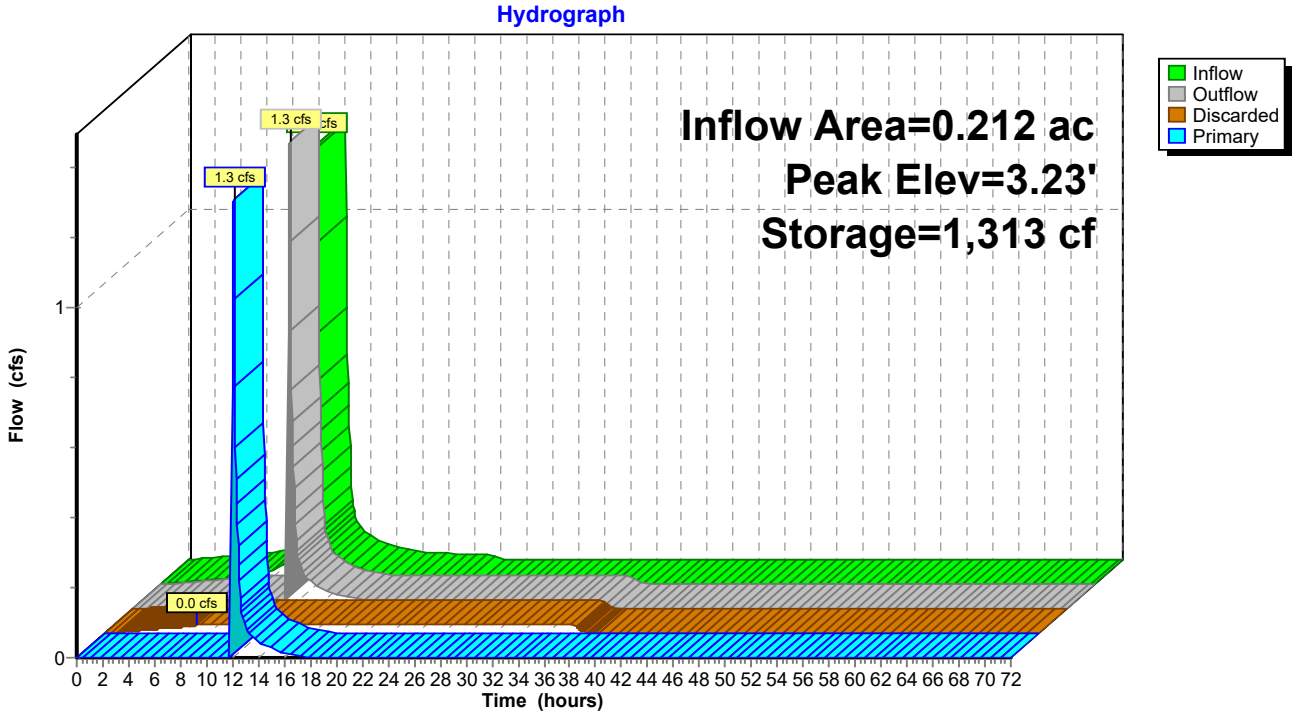
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	454 cf	**15.00'W x 22.00'L x 3.50'H Prismatoid** 1,155 cf Overall - 19 cf Embedded = 1,136 cf x 40.0% Voids
#2	0.50'	19 cf	**12.0" Round Pipe Storage** x 2 Inside #1 L= 12.0' S= 0.0050 '/'
		473 cf	x 3.00 = 1,420 cf Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	3.00'	**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=0.0 cfs @ 7.10 hrs HW=0.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.2 cfs @ 12.11 hrs HW=3.22' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 1.2 cfs @ 1.12 fps)

Pond 23: Drywell



Summary for Subcatchment 24: SC-8

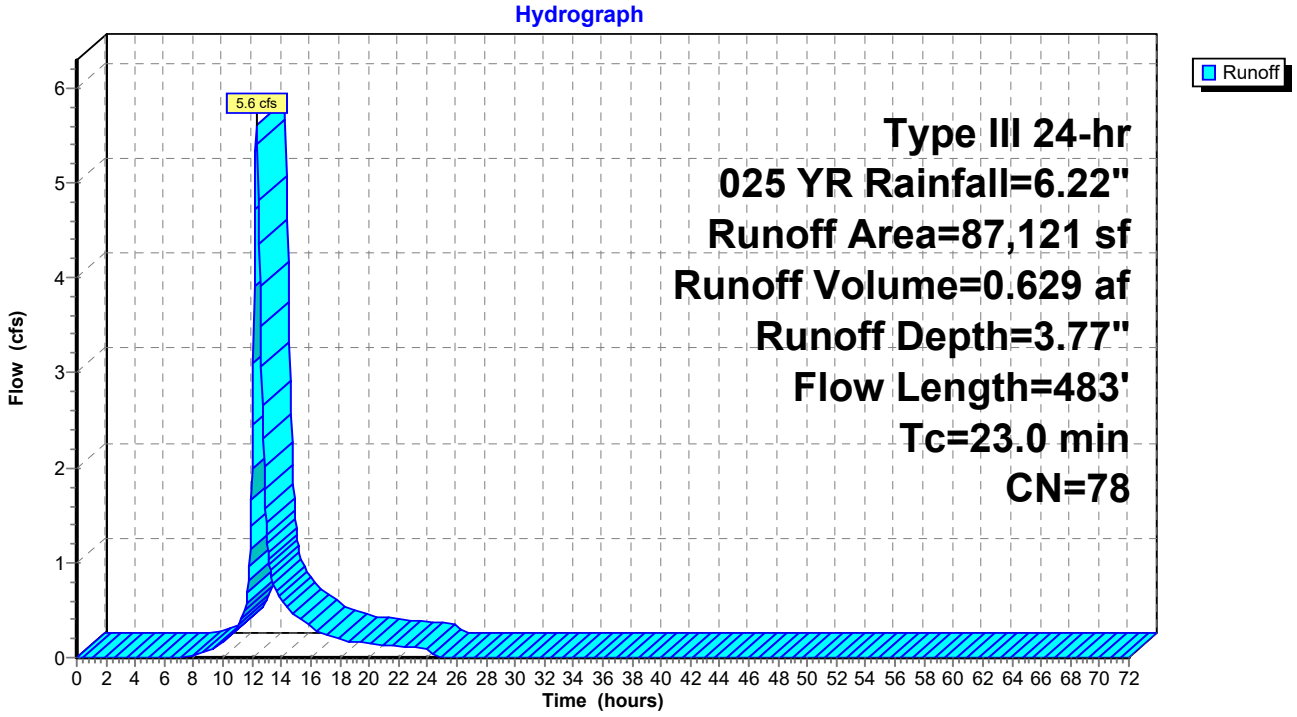
Runoff = 5.6 cfs @ 12.32 hrs, Volume= 0.629 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 025 YR Rainfall=6.22"

Area (sf)	CN	Description
2,640	98	Unconnected pavement, HSG C
33,125	86	<50% Grass cover, Poor, HSG C
33,911	74	>75% Grass cover, Good, HSG C
17,445	70	Woods, Good, HSG C
87,121	78	Weighted Average
84,481		96.97% Pervious Area
2,640		3.03% Impervious Area
2,640		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
6.5	433	0.0490	1.11		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.0	483	Total			

Subcatchment 24: SC-8

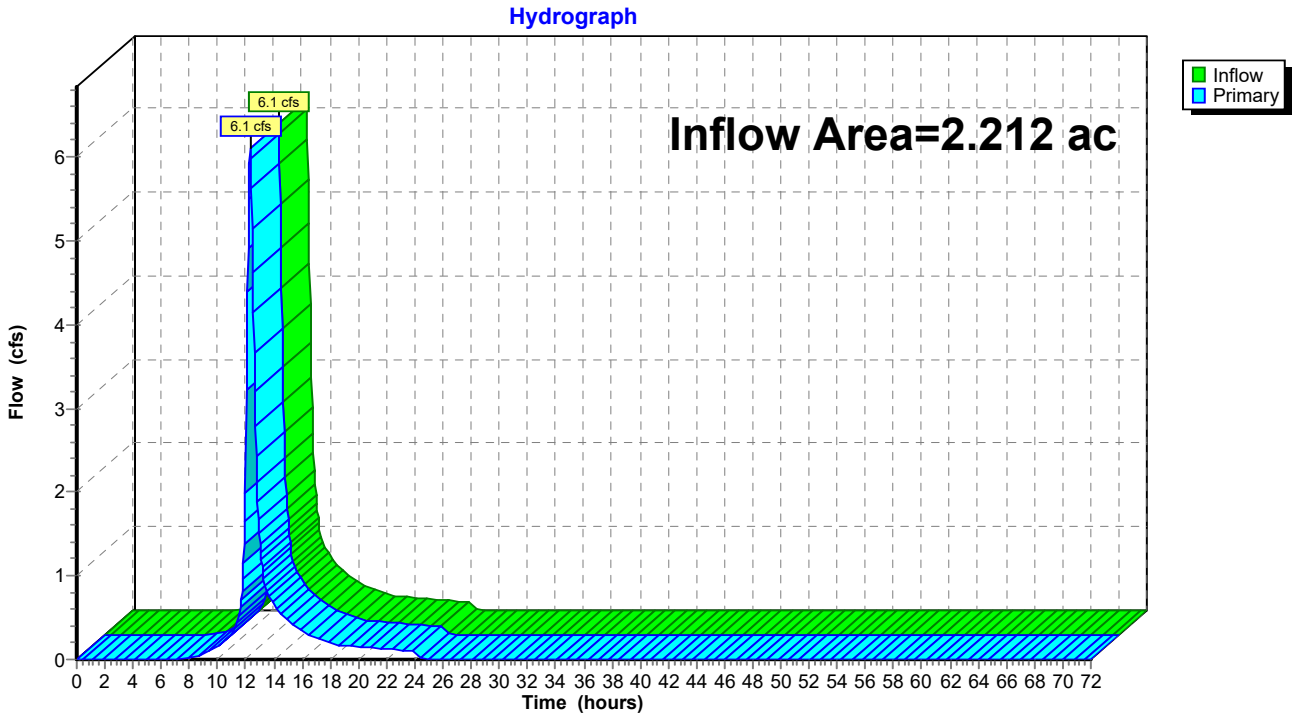


Summary for Link 25: SC-8 Total

Inflow Area = 2.212 ac, 12.31% Impervious, Inflow Depth = 3.64" for 025 YR event
Inflow = 6.1 cfs @ 12.30 hrs, Volume= 0.671 af
Primary = 6.1 cfs @ 12.30 hrs, Volume= 0.671 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link 25: SC-8 Total



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=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: SC-1 Runoff Area=29,285 sf 19.98% Impervious Runoff Depth=1.09"
Flow Length=265' Tc=14.3 min UI Adjusted CN=75 Runoff=0.6 cfs 0.061 af

Subcatchment2: SC-2 Runoff Area=52,209 sf 11.45% Impervious Runoff Depth=1.09"
Flow Length=387' Tc=11.3 min UI Adjusted CN=75 Runoff=1.2 cfs 0.109 af

Link 3L: Inflow=1.8 cfs 0.171 af
Primary=1.8 cfs 0.171 af

Subcatchment4: SC-3 Runoff Area=117,357 sf 0.81% Impervious Runoff Depth=0.98"
Flow Length=483' Tc=23.0 min CN=73 Runoff=1.8 cfs 0.221 af

Subcatchment11: SC-7 Runoff Area=15,747 sf 28.32% Impervious Runoff Depth=1.21"
Flow Length=89' Tc=10.4 min UI Adjusted CN=77 Runoff=0.4 cfs 0.037 af

Subcatchment12: SC-6 Runoff Area=54,910 sf 9.61% Impervious Runoff Depth=1.47"
Flow Length=328' Tc=14.0 min UI Adjusted CN=81 Runoff=1.7 cfs 0.154 af

Subcatchment13: SC-5 Runoff Area=31,857 sf 40.91% Impervious Runoff Depth=2.08"
Flow Length=629' Tc=8.2 min CN=89 Runoff=1.6 cfs 0.127 af

Reach 14: Grass Channel Avg. Flow Depth=0.40' Max Vel=2.32 fps Inflow=1.6 cfs 0.127 af
n=0.033 L=336.0' S=0.0145 '/' Capacity=21.1 cfs Outflow=1.5 cfs 0.127 af

Pond 15: Infiltration Basin Peak Elev=287.72' Storage=5,838 cf Inflow=3.2 cfs 0.281 af
Discarded=0.2 cfs 0.257 af Primary=0.1 cfs 0.024 af Outflow=0.3 cfs 0.281 af

Reach 16: To Street Avg. Flow Depth=0.06' Max Vel=3.69 fps Inflow=0.1 cfs 0.024 af
12.0" Round Pipe n=0.010 L=80.0' S=0.0450 '/' Capacity=9.8 cfs Outflow=0.1 cfs 0.024 af

Link 16L: Inflow=0.4 cfs 0.061 af
Primary=0.4 cfs 0.061 af

Subcatchment20: Lot 1 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=2.97"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.2 cfs 0.017 af

Subcatchment21: Lot 2 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=2.97"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.2 cfs 0.017 af

Subcatchment22: Lot 3 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=2.97"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.2 cfs 0.017 af

Pond 23: Drywell Peak Elev=3.00' Storage=1,222 cf Inflow=0.6 cfs 0.052 af
Discarded=0.0 cfs 0.052 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.052 af

Subcatchment24: SC-8 Runoff Area=87,121 sf 3.03% Impervious Runoff Depth=1.27"
Flow Length=483' Tc=23.0 min CN=78 Runoff=1.8 cfs 0.212 af

Link 25: SC-8 Total

Inflow=1.8 cfs 0.212 af
Primary=1.8 cfs 0.212 af

Total Runoff Area = 9.130 ac Runoff Volume = 0.973 af Average Runoff Depth = 1.28"
88.08% Pervious = 8.042 ac 11.92% Impervious = 1.088 ac

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: SC-1 Runoff Area=29,285 sf 19.98% Impervious Runoff Depth=2.50"
Flow Length=265' Tc=14.3 min UI Adjusted CN=75 Runoff=1.5 cfs 0.140 af

Subcatchment2: SC-2 Runoff Area=52,209 sf 11.45% Impervious Runoff Depth=2.50"
Flow Length=387' Tc=11.3 min UI Adjusted CN=75 Runoff=2.9 cfs 0.250 af

Link 3L: Inflow=4.4 cfs 0.389 af
Primary=4.4 cfs 0.389 af

Subcatchment4: SC-3 Runoff Area=117,357 sf 0.81% Impervious Runoff Depth=2.33"
Flow Length=483' Tc=23.0 min CN=73 Runoff=4.6 cfs 0.523 af

Subcatchment11: SC-7 Runoff Area=15,747 sf 28.32% Impervious Runoff Depth=2.67"
Flow Length=89' Tc=10.4 min UI Adjusted CN=77 Runoff=1.0 cfs 0.081 af

Subcatchment12: SC-6 Runoff Area=54,910 sf 9.61% Impervious Runoff Depth=3.04"
Flow Length=328' Tc=14.0 min UI Adjusted CN=81 Runoff=3.5 cfs 0.319 af

Subcatchment13: SC-5 Runoff Area=31,857 sf 40.91% Impervious Runoff Depth=3.83"
Flow Length=629' Tc=8.2 min CN=89 Runoff=2.9 cfs 0.233 af

Reach 14: Grass Channel Avg. Flow Depth=0.57' Max Vel=2.74 fps Inflow=2.9 cfs 0.233 af
n=0.033 L=336.0' S=0.0145 '/' Capacity=21.1 cfs Outflow=2.7 cfs 0.233 af

Pond 15: Infiltration Basin Peak Elev=288.48' Storage=12,652 cf Inflow=6.2 cfs 0.553 af
Discarded=0.2 cfs 0.383 af Primary=0.2 cfs 0.169 af Outflow=0.4 cfs 0.553 af

Reach 16: To Street Avg. Flow Depth=0.10' Max Vel=5.12 fps Inflow=0.2 cfs 0.169 af
12.0" Round Pipe n=0.010 L=80.0' S=0.0450 '/' Capacity=9.8 cfs Outflow=0.2 cfs 0.169 af

Link 16L: Inflow=1.0 cfs 0.250 af
Primary=1.0 cfs 0.250 af

Subcatchment20: Lot 1 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=4.82"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.3 cfs 0.028 af

Subcatchment21: Lot 2 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=4.82"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.3 cfs 0.028 af

Subcatchment22: Lot 3 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=4.82"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.3 cfs 0.028 af

Pond 23: Drywell Peak Elev=3.18' Storage=1,294 cf Inflow=1.0 cfs 0.085 af
Discarded=0.0 cfs 0.060 af Primary=0.8 cfs 0.025 af Outflow=0.8 cfs 0.085 af

Subcatchment24: SC-8 Runoff Area=87,121 sf 3.03% Impervious Runoff Depth=2.76"
Flow Length=483' Tc=23.0 min CN=78 Runoff=4.1 cfs 0.460 af

Link 25: SC-8 Total

Inflow=4.5 cfs 0.486 af
Primary=4.5 cfs 0.486 af

Total Runoff Area = 9.130 ac Runoff Volume = 2.091 af Average Runoff Depth = 2.75"
88.08% Pervious = 8.042 ac 11.92% Impervious = 1.088 ac

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: SC-1 Runoff Area=29,285 sf 19.98% Impervious Runoff Depth=3.47"
Flow Length=265' Tc=14.3 min UI Adjusted CN=75 Runoff=2.1 cfs 0.194 af

Subcatchment2: SC-2 Runoff Area=52,209 sf 11.45% Impervious Runoff Depth=3.47"
Flow Length=387' Tc=11.3 min UI Adjusted CN=75 Runoff=4.1 cfs 0.347 af

Link 3L: Inflow=6.1 cfs 0.541 af
Primary=6.1 cfs 0.541 af

Subcatchment4: SC-3 Runoff Area=117,357 sf 0.81% Impervious Runoff Depth=3.27"
Flow Length=483' Tc=23.0 min CN=73 Runoff=6.5 cfs 0.735 af

Subcatchment11: SC-7 Runoff Area=15,747 sf 28.32% Impervious Runoff Depth=3.67"
Flow Length=89' Tc=10.4 min UI Adjusted CN=77 Runoff=1.3 cfs 0.111 af

Subcatchment12: SC-6 Runoff Area=54,910 sf 9.61% Impervious Runoff Depth=4.08"
Flow Length=328' Tc=14.0 min UI Adjusted CN=81 Runoff=4.6 cfs 0.429 af

Subcatchment13: SC-5 Runoff Area=31,857 sf 40.91% Impervious Runoff Depth=4.95"
Flow Length=629' Tc=8.2 min CN=89 Runoff=3.7 cfs 0.302 af

Reach 14: Grass Channel Avg. Flow Depth=0.65' Max Vel=2.93 fps Inflow=3.7 cfs 0.302 af
n=0.033 L=336.0' S=0.0145 '/' Capacity=21.1 cfs Outflow=3.5 cfs 0.302 af

Pond 15: Infiltration Basin Peak Elev=288.68' Storage=14,577 cf Inflow=8.1 cfs 0.731 af
Discarded=0.2 cfs 0.416 af Primary=1.8 cfs 0.315 af Outflow=2.1 cfs 0.731 af

Reach 16: To Street Avg. Flow Depth=0.29' Max Vel=9.57 fps Inflow=1.8 cfs 0.315 af
12.0" Round Pipe n=0.010 L=80.0' S=0.0450 '/' Capacity=9.8 cfs Outflow=1.8 cfs 0.315 af

Link 16L: Inflow=2.1 cfs 0.425 af
Primary=2.1 cfs 0.425 af

Subcatchment20: Lot 1 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=5.98"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.4 cfs 0.035 af

Subcatchment21: Lot 2 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=5.98"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.4 cfs 0.035 af

Subcatchment22: Lot 3 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=5.98"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.4 cfs 0.035 af

Pond 23: Drywell Peak Elev=3.23' Storage=1,313 cf Inflow=1.3 cfs 0.105 af
Discarded=0.0 cfs 0.063 af Primary=1.3 cfs 0.042 af Outflow=1.3 cfs 0.105 af

Subcatchment24: SC-8 Runoff Area=87,121 sf 3.03% Impervious Runoff Depth=3.77"
Flow Length=483' Tc=23.0 min CN=78 Runoff=5.6 cfs 0.629 af

Link 25: SC-8 Total

Inflow=6.1 cfs 0.671 af
Primary=6.1 cfs 0.671 af

Total Runoff Area = 9.130 ac Runoff Volume = 2.851 af Average Runoff Depth = 3.75"
88.08% Pervious = 8.042 ac 11.92% Impervious = 1.088 ac

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: SC-1 Runoff Area=29,285 sf 19.98% Impervious Runoff Depth=5.06"
Flow Length=265' Tc=14.3 min UI Adjusted CN=75 Runoff=3.0 cfs 0.283 af

Subcatchment2: SC-2 Runoff Area=52,209 sf 11.45% Impervious Runoff Depth=5.06"
Flow Length=387' Tc=11.3 min UI Adjusted CN=75 Runoff=5.9 cfs 0.505 af

Link 3L: Inflow=8.9 cfs 0.789 af
Primary=8.9 cfs 0.789 af

Subcatchment4: SC-3 Runoff Area=117,357 sf 0.81% Impervious Runoff Depth=4.83"
Flow Length=483' Tc=23.0 min CN=73 Runoff=9.7 cfs 1.084 af

Subcatchment11: SC-7 Runoff Area=15,747 sf 28.32% Impervious Runoff Depth=5.29"
Flow Length=89' Tc=10.4 min UI Adjusted CN=77 Runoff=1.9 cfs 0.159 af

Subcatchment12: SC-6 Runoff Area=54,910 sf 9.61% Impervious Runoff Depth=5.76"
Flow Length=328' Tc=14.0 min UI Adjusted CN=81 Runoff=6.5 cfs 0.605 af

Subcatchment13: SC-5 Runoff Area=31,857 sf 40.91% Impervious Runoff Depth=6.71"
Flow Length=629' Tc=8.2 min CN=89 Runoff=5.0 cfs 0.409 af

Reach 14: Grass Channel Avg. Flow Depth=0.76' Max Vel=3.17 fps Inflow=5.0 cfs 0.409 af
n=0.033 L=336.0' S=0.0145 '/' Capacity=21.1 cfs Outflow=4.7 cfs 0.409 af

Pond 15: Infiltration Basin Peak Elev=288.90' Storage=16,793 cf Inflow=11.1 cfs 1.014 af
Discarded=0.2 cfs 0.453 af Primary=5.5 cfs 0.561 af Outflow=5.8 cfs 1.014 af

Reach 16: To Street Avg. Flow Depth=0.54' Max Vel=12.87 fps Inflow=5.5 cfs 0.561 af
12.0" Round Pipe n=0.010 L=80.0' S=0.0450 '/' Capacity=9.8 cfs Outflow=5.5 cfs 0.561 af

Link 16L: Inflow=6.4 cfs 0.720 af
Primary=6.4 cfs 0.720 af

Subcatchment20: Lot 1 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=7.78"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.5 cfs 0.046 af

Subcatchment21: Lot 2 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=7.78"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.5 cfs 0.046 af

Subcatchment22: Lot 3 Bldg Runoff Area=3,072 sf 100.00% Impervious Runoff Depth=7.78"
Flow Length=25' Slope=0.3000 '/' Tc=6.0 min CN=98 Runoff=0.5 cfs 0.046 af

Pond 23: Drywell Peak Elev=3.26' Storage=1,325 cf Inflow=1.6 cfs 0.137 af
Discarded=0.0 cfs 0.067 af Primary=1.6 cfs 0.070 af Outflow=1.6 cfs 0.137 af

Subcatchment24: SC-8 Runoff Area=87,121 sf 3.03% Impervious Runoff Depth=5.41"
Flow Length=483' Tc=23.0 min CN=78 Runoff=8.0 cfs 0.902 af

Link 25: SC-8 Total

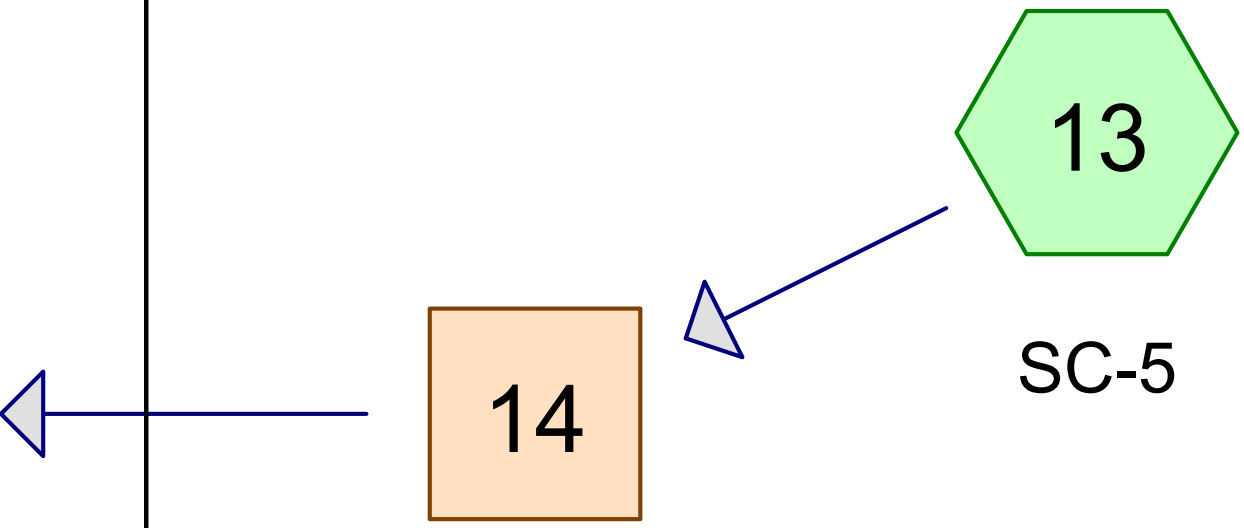
Inflow=8.6 cfs 0.971 af
Primary=8.6 cfs 0.971 af

Total Runoff Area = 9.130 ac Runoff Volume = 4.085 af Average Runoff Depth = 5.37"
88.08% Pervious = 8.042 ac 11.92% Impervious = 1.088 ac

iv. Grass Channel [Biofilter Swale] Design

1" Rainfall Design
2 & 10 Year Design Storm Analysis

See Following Pages



Subcat Reach Pond Link

Routing Diagram for 42215 Rev 2024-08-08a
Prepared by DK Engineering LLC, Printed 8/6/2024

Summary for Subcatchment 13: SC-5

Runoff = 1.6 cfs @ 12.12 hrs, Volume= 0.127 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 002 YR Rainfall=3.20"

Area (sf)	CN	Description
11,986	98	Paved parking, HSG C
1,048	98	Unconnected pavement, HSG C
15,126	86	<50% Grass cover, Poor, HSG C
3,697	70	Woods, Good, HSG C
31,857	89	Weighted Average
18,823		59.09% Pervious Area
13,034		40.91% Impervious Area
1,048		8.04% Unconnected

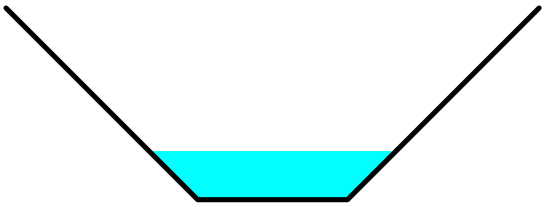
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0550	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.9	300	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	14	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.2	55	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.5	210	0.0120	6.46	5.1	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
8.2	629	Total			

Summary for Reach 14: Grass Channel

Inflow Area = 0.731 ac, 40.91% Impervious, Inflow Depth = 2.08" for 002 YR event
Inflow = 1.6 cfs @ 12.12 hrs, Volume= 0.127 af
Outflow = 1.5 cfs @ 12.19 hrs, Volume= 0.127 af, Atten= 6%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.32 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 8.0 min
Make sure the runoff velocities during a 2-year storm do not cause erosion problems!
Peak Storage= 225 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.60' Flow Area= 4.6 sf, Capacity= 21.1 cfs

1.25' x 1.60' deep channel, n= 0.033 Earth, grassed & winding
Side Slope Z-value= 1.0 '/' Top Width= 4.45'
Length= 336.0' Slope= 0.0145 '/'
Inlet Invert= 302.00', Outlet Invert= 297.13'



Summary for Subcatchment 13: SC-5

Runoff = 2.9 cfs @ 12.11 hrs, Volume= 0.233 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 010 YR Rainfall=5.06"

Area (sf)	CN	Description
11,986	98	Paved parking, HSG C
1,048	98	Unconnected pavement, HSG C
15,126	86	<50% Grass cover, Poor, HSG C
3,697	70	Woods, Good, HSG C
31,857	89	Weighted Average
18,823		59.09% Pervious Area
13,034		40.91% Impervious Area
1,048		8.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0550	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.9	300	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	14	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.2	55	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.5	210	0.0120	6.46	5.1	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
8.2	629	Total			

Summary for Reach 14: Grass Channel

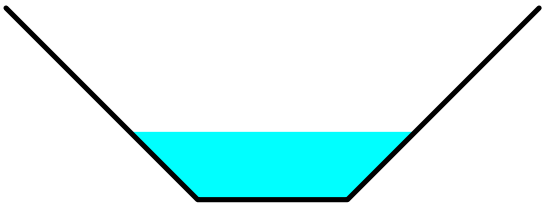
Inflow Area = 0.731 ac, 40.91% Impervious, Inflow Depth = 3.83" for 010 YR event
Inflow = 2.9 cfs @ 12.11 hrs, Volume= 0.233 af
Outflow = 2.7 cfs @ 12.18 hrs, Volume= 0.233 af, Atten= 6%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.74 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 0.82 fps, Avg. Travel Time= 6.8 min

Peak Storage= 345 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.60' Flow Area= 4.6 sf, Capacity= 21.1 cfs

Provide a minimum 1-foot freeboard above the 10-year storm.

1.25' x 1.60' deep channel, n= 0.033 Earth, grassed & winding
Side Slope Z-value= 1.0 '/' Top Width= 4.45'
Length= 336.0' Slope= 0.0145 '/'
Inlet Invert= 302.00', Outlet Invert= 297.13'



Summary for Subcatchment 13: SC-5

Runoff = 0.8 cfs @ 12.12 hrs, Volume= 0.063 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr Custom Rainfall=2.00"

Area (sf)	CN	Description
11,986	98	Paved parking, HSG C
1,048	98	Unconnected pavement, HSG C
15,126	86	<50% Grass cover, Poor, HSG C
3,697	70	Woods, Good, HSG C
31,857	89	Weighted Average
18,823		59.09% Pervious Area
13,034		40.91% Impervious Area
1,048		8.04% Unconnected

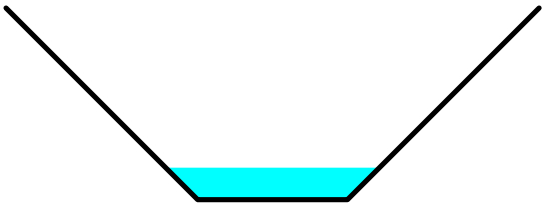
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0550	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.9	300	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.0	14	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.2	55	0.0100	5.90	4.6	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
0.5	210	0.0120	6.46	5.1	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010
8.2	629	Total			

Summary for Reach 14: Grass Channel

Inflow Area = 0.731 ac, 40.91% Impervious, Inflow Depth = 1.03" for Custom event
Inflow = 0.8 cfs @ 12.12 hrs, Volume= 0.063 af
Outflow = 0.8 cfs @ 12.21 hrs, Volume= 0.063 af, Atten= 6%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.87 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 9.6 min
Velocity less than 1 fps Provide at least 9 minutes of HRT within the channel
Peak Storage= 137 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.27' Water depth less than 4 inches
Bank-Full Depth= 1.60' Flow Area= 4.6 sf, Capacity= 21.1 cfs

1.25' x 1.60' deep channel, n= 0.033 Earth, grassed & winding
Side Slope Z-value= 1.0 '/' Top Width= 4.45'
Length= 336.0' Slope= 0.0145 '/'
Inlet Invert= 302.00', Outlet Invert= 297.13'



V. Hydraulic Analysis ~ (100-Year Design Storm)

See Following Pages

FL-DOT Report

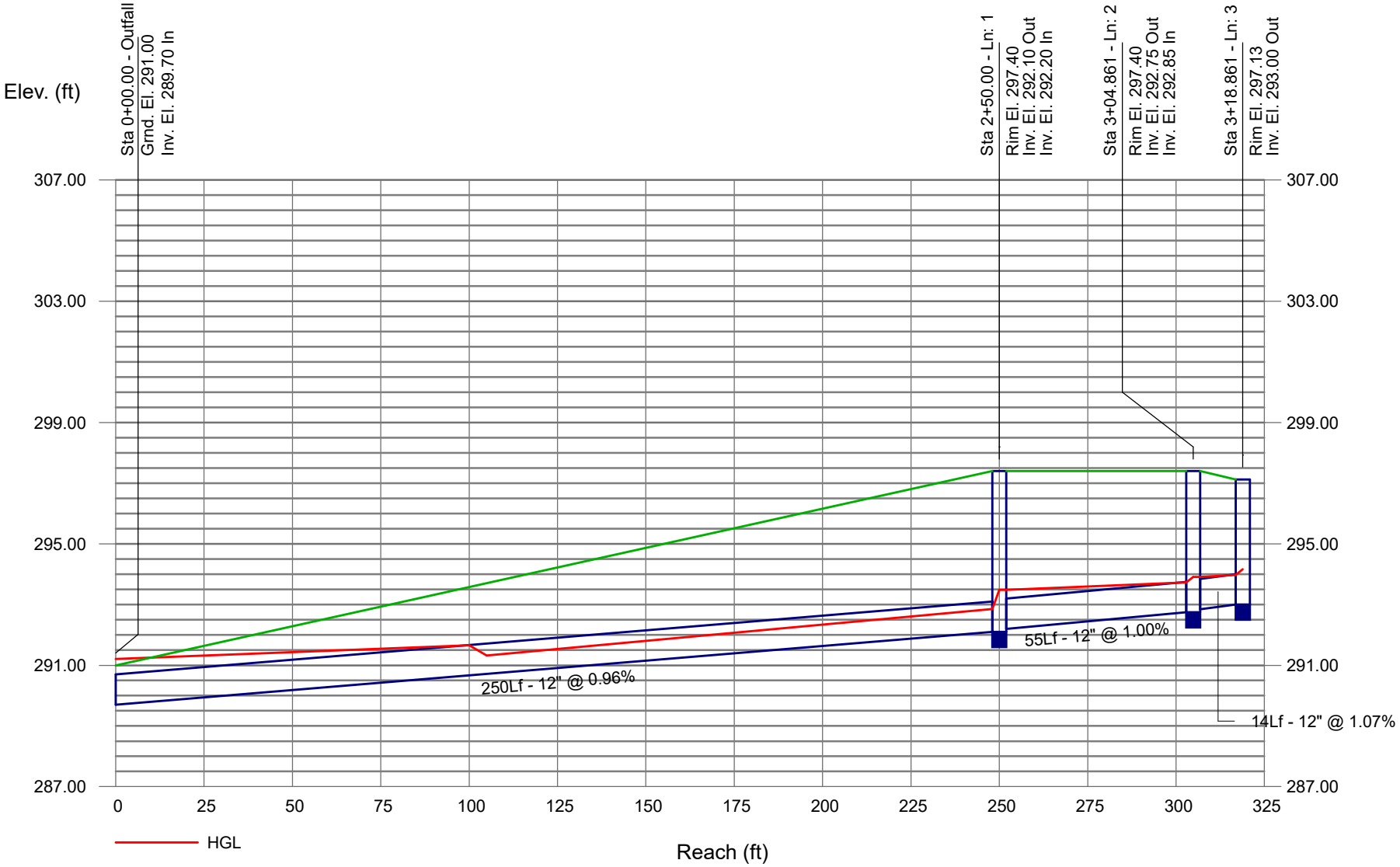
Line No	To Line	Type of struc	n - value	Len	Drainage Area			Time of conc	Time of flow in sect	Inten (I)	Total CA	Add Q	Inlet elev	Elev of HGL			Rise	HGL	Actual		Date: 07-14-2024
					C1 = 0.2 C2 = 0.5 C3 = 0.9							Total flow		Elev of Crown			Span	Pipe	Full Flow		Frequency: 100 yrs
														Elev of Invert							Proj: 42215 ~ Pipes.stm
					Incre-ment (ac)	Sub-total (ac)	Sum CA					Q		Up	Down	Fall	Size	Slope	Vel	Cap	
				(ft)				(min)	(min)	(in/hr)		(cfs)	(ft)	(ft)	(ft)	(ft)	(in)	(%)	(ft/s)	(cfs)	Line description
3	2	Grate	0.010	14	0.08	0.08	0.02	17.00	0.06	6.96	0.46	0.00	297.13	293.98	293.92	0.06	12	0.42	4.09	3.20	
					0.35	0.35	0.18					3.20		294.00	293.85		12	1.07	6.10	4.79	
					0.30	0.30	0.27							293.00	292.85	0.15	Cir				
2	1	MH	0.010	55	0.00	0.08	0.02	17.06	0.22	6.95	0.46	0.00	297.40	293.73	293.48	0.24	12	0.45	4.08	3.19	
					0.00	0.35	0.18					3.19		293.75	293.20		12	1.00	5.90	4.64	
					0.00	0.30	0.27							292.75	292.20	0.55	Cir				
1	End	MH	0.010	250	0.00	0.08	0.02	17.28	1.03	6.91	0.46	0.00	297.40	292.86	291.21	1.65	12	0.66	4.52	3.18	
					0.00	0.35	0.18					3.18		293.10	290.70		12	0.96	5.78	4.54	
					0.00	0.30	0.27							292.10	289.70	2.40	Cir				

NOTES: Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82 (in/hr) ; Time of flow in section is based on full flow.

42215 ~ SD

Storm Sewer Profile

Proj. file: 42215 ~ Pipes.stm



VI. 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 disturbed area above the device has been permanently stabilized and construction activity has ceased.
5. The FilterMedia 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	Haul Roads Test Fabric Properties 3/	Light Duty 1-/ Heavy Duty 2-/ 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.

VII. Appendix – Norse Environmental Services ~ Soil Logs

See Following Pages

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

A. Facility Information

1. Owner Information:
   Greg Alexandris

   Street Address:
   9 Bancroft Street

   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"=1410 (Publication Scale) 310 (Soil Map Unit)

   Woodbridge (Soil Name) None (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) Aug/2022 (Month/Year) Range: Above Normal ☐ Normal ☐ Below Normal ☒

7. Other references reviewed: _____

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

C. On-Site Review

Deep Observation Hole Number: DH 1 – DH 4 | 12/12/22 (Date) | 10:00 a.m. (Time) | Cloudy - 33F (Weather)

1. Location

   Ground Elevation at Surface of Hole: See Plan

   Location (Identify on Plan): See Plan

2. Land Use: Residential site – farm field (e.g. woodland, agricultural field, vacant lot, etc.) | None (Surface Stones) | Varies (Slope (%))

   Grasses (Vegetation) | Drumloidal (Landform) | Back Slope (Position on landscape (attach sheet))

3. Distances from: Open Water Body >10 ft. (feet) | Drainage Way >100 ft. (feet) | Possible Wet Area >100 ft (feet)

   Property Line >10 ft. (feet) | Drinking Water Well _____ (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 Deep Holes – 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: 9 Bancroft Street

City/Town: Andover, MA

Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-1

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	
14-33”	Bw	10YR 5/6				FSL			Weak Blocky	Friable	
33-48”	C	2.5Y 5/3	43”	7.5YR 5/6	20%	SL			Massive	Friable	

Additional Notes: ESHWT 43” / No Observed Water

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-2

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	
14-28”	Bw	10YR 5/6				FSL			Weak Blocky	Friable	
28-51”	C	2.5Y 5/3	32”	7.5YR 5/6	20%	SL			Massive	Friable	

Additional Notes: ESHWT 32” / No Observed Water .

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-3

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	
14-25”	Bw	10YR 5/6				FSL			Weak Blocky	Friable	
25-55”	C	2.5Y 5/3	43”	7.5YR 5/6	15%	SL			Massive	Friable	

Additional Notes: ESHWT 43”/ No Observed Water

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-4

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			
0-9”	Ap	10YR 2/2				FSL			Granular	Friable	
9-24”	Bw	10YR 5/6				FSL			Weak Blocky	Friable	
24-51”	C	2.5Y 5/4	43”	7.5YR 6/6	20%	SL			Massive	Friable	

Additional Notes: ESHWT 43” / 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.

Signature of Soil Evaluator	Date
Maureen Herald	SE13578
Typed or Printed Name of Soil Evaluator	Soil Evaluator Number

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

A. Facility Information

1. Owner Information:
   Greg Alexandris
   Street Address:
   9 Bancroft Street
   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"=1,110 (Publication Scale) 310B (Soil Map Unit)

   Woodbridge (Soil Name) None (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) Aug/2024 (Month/Year) Range: Above Normal ☐ Normal ☒ Below Normal ☐

7. Other references reviewed: _____

C. On-Site Review

Deep Observation Hole Number: DHA – DHF | 8/6/24 (Date) | 10:30 a.m. (Time) | Rainy- 75 F (Weather)

1. Location

   Ground Elevation at Surface of Hole: See Plan

   Location (Identify on Plan): See Plan

2. Land Use: Residential site – farm field (e.g. woodland, agricultural field, vacant lot, etc.) | None (Surface Stones) | Varies (Slope (%))

   Grasses (Vegetation) | Drumloidal (Landform) | Back Slope (Position on landscape (attach sheet))

3. Distances from: Open Water Body >10 ft. feet | Drainage Way >100 ft. feet | Possible Wet Area >100 ft feet

   Property Line >10 ft. feet | Drinking Water Well _____ 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 Deep Holes – See next page

   If Yes: Depth Weeping from Pit: N/A Depth Standing Water in Hole: N/A

   Estimated Depth to High Groundwater: _____ inches | _____ elevation

Soil Suitability Assessment

Site: 9 Bancroft Street

City/Town: Andover, MA

Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-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			
0-12”	Ap	10YR 2/2				FSL			Granular	Friable	
12-25”	Bw	10YR 5/4				FSL			Weak Blocky	Friable	
25-67”	C	2.5Y 5/3	50”	7.5YR 5/6	15%	SL			Massive	Friable	

Additional Notes: ESHWT 50” / No Observed Water

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-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			
0-16”	Ap	10YR 2/2				FSL			Granular	Friable	
16-45”	Bw	10YR 5/4				FSL			Weak Blocky	Friable	
45-85”	C	2.5Y 5/3	48”	7.5YR 5/6	15%	SL			Massive	Friable	

Additional Notes: ESHWT 48” / No Observed Water .

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-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			
0-16”	Ap	10YR 2/2				FSL			Granular	Friable	
16-30”	Bw	10YR 5/4				FSL			Weak Blocky	Friable	
30-114”	C	2.5Y 5/3	75”	7.5YR 5/6	20%	SL			Massive	Friable	

Additional Notes: ESHWT 75”/ No Observed Water

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-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”	Fill										
12-18”	Ab	10YR 2/2				FSL			Weak Blocky	Friable	
18-26”	B	10YR 5/4				FSL			Massive	Friable	
26-80”	C	2.5Y 5/3	50”	7.5 YR 6/6	15%	SL			Massive	Friable	

Additional Notes: ESHWT 50” / No Observed Water ,

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-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			
0-14”	Ap	10YR 2/2				FSL			Granular	Friable	
14-27”	Bw	10YR 5/4				FSL			Weak Blocky	Friable	
27-79”	C	2.5Y 5/3	50”	7.5YR 5/6	20%	SL			Massive	Friable	

Additional Notes: ESHWT 50”/ No Observed Water

Soil Suitability Assessment

Site: 9 Bancroft Street
City/Town: Andover, MA
Soil Evaluator/Soil Scientist: Maureen Herald – Norse Environmental Services, Inc.

Deep Observation Hole Number: DH-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 5/4				SL			Weak Blocky	Friable	
30-80”	C	2.5Y 5/3	55”	7.5 YR 6/6	15%	SL			Massive	Friable	

Additional Notes: ESHWT 55”/ 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	8-12-24
Signature of Soil Evaluator	Date
Maureen Herald	SE13578
Typed or Printed Name of Soil Evaluator	Soil Evaluator Number

E. Test Pit Locations

See Plan

VIII. Appendix – NRCS Soils Information

See Following Pages

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part
(42215 ~ 9 Bancroft Rd, Andover, MA)

Map Scale: 1:1,210 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

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
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	C/D	1.8	38.6%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	2.8	59.9%
310C	Woodbridge fine sandy loam, 8 to 15 percent slopes	C/D	0.1	1.5%
Totals for Area of Interest			**4.7**	**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

310A—Woodbridge fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w686
Elevation: 0 to 1,420 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 and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Crest
Down-slope shape: Convex
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: 0 to 3 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Very high
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 4.7 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: 7 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder

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

Ridgebury

Percent of map unit: 6 percent
Landform: Depressions, ground moraines, drainageways, drumlins, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman, extremely stony

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

Sutton

Percent of map unit: 1 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

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

310C—Woodbridge fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w689
Elevation: 0 to 1,370 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

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

Description of Woodbridge

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
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: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Very high
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 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
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: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 4 percent
Landform: Depressions, ground moraines, hills, drainageways, drumlins
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton

Percent of map unit: 1 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

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

IX. Appendix – Drainage Area Maps

See Following Pages

EDEN LANE

BANCROFT ROAD

EXISTING BARN

STRAND OF COMMON LILACS ALONG WALL

WOODBRIDGE 310A

WOODBRIDGE 310B

WOODBRIDGE 310C

DRAINAGE AREA DESIGNATION (TYP.)

NRCS SOIL SERIES BOUNDARY (TYP.)

SC-1

SC-2

SC-3

Pt-1

Pt-2

50 LF @ 2%

92 LF @ 2.2%

123 LF @ 1%

50 LF @ 4.3%

163 LF @ 5.2%

62 LF @ 2.3%

112 LF @ 2.3%

50 LF @ 1%

433 LF @ 5%

SOILS LEGEND

Series	HSG
(310A) Woodbridge fine sandy loam, 0 to 3% slopes	C/D
(310B) Woodbridge fine sandy loam, 3 to 8% slopes	C/D
(310C) Woodbridge fine sandy loam, 8 to 15% slopes	C/D

SCALE: 1" = 50'

0 50 100

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 59 & Lot 30

Project No.:	Drawing Scale:
42215	1" = 50'
Plan Date:	Revised Date:
07/02/24	08/08/24

Sheet Title: PRE-DEV. DRAINAGE AREA MAP

Sheet No.: 1

No. of Shts.: 2

EDEN LANE

SC-5

SC-7

SC-6

SC-8

BANCROFT ROAD

WOODBRIDGE 310A

WOODBRIDGE 310B

WOODBRIDGE 310C

300 LF @ 1.6%

55 LF @ 1%

50 LF @ 5.5%

50 LF @ 2%

38 LF @ 2%

51 LF @ 3%

210 LF @ 1%

50 LF @ 1%

210 LF @ 7%

433 LF @ 4.9%

LOT #1
30,793± s.f.
FF=304.02
CF=296.35
GF=299.7

LOT #2
36,999± s.f.
FF=303.17
CF=293.50
GF=303.00

LOT #3
43,655± s.f.
FF=305.38
CF=297.71
GF=302.70

16,575

31,702

EXISTING 2-STY. BUILDING

CONSTRUCTION LIMIT (TYP.)

EX. NATURAL FIELD (TYP.)

DRAINAGE AREA DESIGNATION (TYP.)

PROPOSED TREELINE AND LIMIT OF CLEARING (TYP.)

CONSTRUCTION LIMIT (TYP.)

EX. NATURAL FIELD (TYP.)

NRCS SOIL SERIES BOUNDARY (TYP.)

Pt-1

Pt-2

285.5±

SOILS LEGEND

Series	HSG
(310A) Woodbridge fine sandy loam, 0 to 3% slopes	C/D
(310B) Woodbridge fine sandy loam, 3 to 8% slopes	C/D
(310C) Woodbridge fine sandy loam, 8 to 15% slopes	C/D

SCALE: 1" = 50'

0 50 100

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 59 & Lot 30

Project No.:	Drawing Scale:
42215	1" = 50'
Plan Date:	Revised Date:
07/02/24	08/08/24

Sheet Title: POST-DEV. DRAINAGE AREA MAP

Sheet No.: 2

No. of Shts.: 2

Drawing name: D:_dk data\Projects\42215 ~ADC - 9 Bancroft St - Andover_dwg\42215 ~ Subd Plan 2024-08-08a.dwg

Plotted on Aug 06, 2024 - 7:38pm