DRAINAGE ANALYSIS
for
ZP Battery DevCo, LLC
0 Murdock Avenue
Winchendon, Massachusetts

March 27, 2023

[Professional Engineer seal: COMMONWEALTH OF MASSACHUSETTS / CHRISTOPHER M ANDERSON / CIVIL / No. 55372 / REGISTERED PROFESSIONAL ENGINEER]
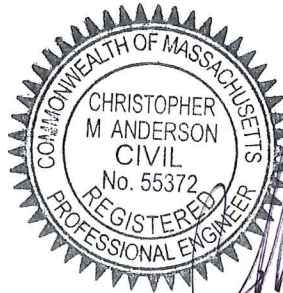
[Signature] 3-27-2023

Prepared for: **ZP BatteryDev Co, LLC**
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1.0
DRAINAGE NARRATIVE

1.0 NARRATIVE

1.1 INTRODUCTION

On behalf of our client, ZP Battery DevCo, LLC, Hannigan Engineering, Inc. has prepared this Drainage Analysis and Report as part of the submittal package for Site Plan Review for a Solar Energy Storage System (ESS) at #0 Murdock Avenue in Winchendon, Massachusetts (Map/Parcel 5A2/25 and 5A2/26). The Project will be situated on a piece of property on the easterly side of Murdock Avenue in Winchendon, Massachusetts. The proposed construction will entail the general regarding of the land in order to facilitate the construction of the ESS sytem including provisions for access and drainage infrastructure.

The purpose of this analysis is to compare the pre-development and post-development peak flow rates to certain design points from the project. In particular, changes in peak rates of runoff generally associated with alterations of land use were studied. These alterations include land being transformed from areas of landscape (grass), woods, and brush to areas of grass, landscape, and impervious areas (rooftops, sidewalks and pavement). The effects of stormwater being re-directed to new areas as a result of the proposed construction and the associated drainage system were reviewed as well. For the purposes of this report, any developed areas which are not impervious will be considered to consist of lawn and landscape areas.

The U.S. Soil Conservation Sevice (SCS) methods were utilized for this analysis in order to establish land use and run-off characteristics in the determination of pre- and post-developement peak run-off rates. All proposed development areas and subsequent impacts on stormwater runoff relative to this development have been incorporated within this analysis and report.

The drainage from the site currently flows to single design point along the westerly side of the overall development, to a large expansive wetland area exists. In the area of the proposed development, an increase in impervious areas due the construction of the concrete pads to store the ESS along with the general clearing of the land will occur, requiring additional provisions be made to provide compliance with the Massachusetts Stormwater Regulations. These measures include the implementation of a rain garden feature to capture and detain a portion of the anticpated runoff from the development.

1.2 METHOD OF ANALYSIS

The enclosed hydrologic calculations utilize the runoff estimating techniques developed by the USDA Soil Conservation Service (SCS). The following publications were used in the preparation of this report:

  1. "Urban Hydrology for Small Watersheds"[1]
  2. "National Engineering Handbook, Hydrology, Section 4" (NEH-4)[2]
  3. "Handbook of Hydraulics" 6th ed. - E.F. Brater & H. Williams[3]
  4. "Soil Survey Report for Northeastern Worcester County" 1985 ed. - USDA NRCS[4]

Using SCS publications and other texts on surface water hydrology, in conjunction with drainage software *HydroCAD* developed by Applied Microcomputer Systems[5], Hannigan Engineering, Inc. has calculated peak rates of runoff relative to the subject site for conditions prior to development as well as conditions upon the completion of construction. The drainage software program *HydroCAD* calculates peak rates of runoff similarly to the computer program known as *Computer Programs for Project Formulations-Hydrology, Technical Release Number 20 (TR-20),* developed by SCS. This program and series of programs are the technical standard utilized by engineers, Planning Boards, Conservation Commission, and Municipal Agencies throughout the region and across the country for the evaluation of storm water conditions.

The analysis reviews certain parameters of sub-watersheds surrounding the subject site and how these parameters are affected by various rainfall conditions. These parameters include land cover and use, soil strata and permeability, and variations in slope. These parameters are used to develop rainfall runoff characteristics, which are used to analyze both pre and post development conditions within and surrounding the proposed construction activity. Some of these characteristics include times of concentration (Tc), peak rates of runoff, runoff volume, and the time the peak rate of runoff occurs within the particular storm event.

Times of concentration were computed by using the SCS "Upland Method" as described in the aforementioned National Engineering Handbook and were utilized for the analysis of the individual watersheds. The Upland Method computes the time of travel of storm waters over segments of the watershed depending upon land conditions, such as surface roughness, channel configuration, slope of land, and flow patterns. The addition of these travel times determines the individual watershed Time of Concentration. This method translates to more accurate Tc's than other more general methods.

1.3 SITE DESCRIPTION

The site is located along either side of Murdock Avenue in Winchendon on two properies with a combined area of approximately 8-acres. The main components of the site are located on the easterly side of Murdock Avenue on Parcel 5A2/26. Portions of the drainage system are located on the westerly side of Murdock Avenue on Parcel 5A2/25. Currently the portions of the property to be developed are comprised of woodland area with no standing structures on the property. Areas subject to protection under the Wetlands Protection Act were reviewed by LEC Environmental Consultants and are depicted on the Site Plans. These areas include Bordering Vegetated Wetlands (BVW) located along the easterly and westerly sides of Murdock Avenue and hydraulically connected via a stone culvert within the roadway with the area generally flowing in a westerly direction.

The project entails the construction of a standalone solar Energy Storage System (ESS) with an estimated capacity of approximately 10-Megawatt AC on the property. The proposed storage systems will be located along the easterly side of Murdock Avenue on Parcel 5A2/26, with Parcel 5A2/25 along the westerly side being utilized for a rain garden for stormwater management. Unlike ground-mounted Solar Energy Systems that involve the generation of energy, this facility is utilized purely for the storage of energy generated from area solar systems connected to the grid.

As part of the initial site preparation, appropriate erosion control measures will be installed to prevent the transport of soils and sediments to the lower elevations of the site. The site development will consist of the installation of eight (8) concrete pads on which the sixteen (16) ESS units will be situated. Additional electrical components and transformer pads will also be installed to allow the eventual interconnection to the grid. The electrical equipment has been separated into two fenced in areas, each containing four concrete pads with a central area between the two sites to utilize a single common electrical connection. The total area of alteration associated with the project will be approximately an acre along the easterly side and 15,000 square feet along the westerly side of Murdock Avenue.

Access to the site will be provided via Murdock Avenue by a 24-foot-wide gravel driveway that extends easterly into the development and then runs parallel to Murdock Avenue. This driveway will provide access between the two fenced areas with three access points to Murdock Avenue. Access points are located at the terminal ends of the driveway and at the center of the project near the connection equipment. The gravel driveway is intended to provide access to the site on a periodic basis for general maintenance and inspections of the facility.

For the purpose of the analysis, certain design points were reviewed. The design points are where the pre-development drainage for the subcatchment areas of the watershed over the property are directed. The same design points have been utilized and reviewed for both pre- and post-development runoff conditions. The drainage from the site currently flows to a single point located at the wetland area along the westerly side of Murdock Avenue, this area has been designated as Design Point #1 (DP#1).

1.4 SOIL CHARACTERISTICS

Soil types for this analysis were based upon review of soils information contained in the SCS publication *Hyrdrologic Soil Group-Worcester County Northwestern Part, Massachusetts.* The original mapping has been reestablished via the Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx) as part of the National Cooperative Soil Survey under the Natural Resource Conservation Service and its website This mapping is the basis for the soil type determinations for this analysis.

The soils are classified by number and name by SCS and, subsequently, the Hydrological Soil Group has been designated within the Urban Hydrology for Small Watersheds manual. Soils within the subject watersheds are also hydrologically classified into different soil groups as defined by the Soil Conservation Service

Soil Designation	Name	Hydrological Group
908C	Becket-Skerry Association	C
917B	Pillsbury-Peacham Association	C/D

1.5 RUNOFF CURVE NUMBERS

The SCS runoff curve numbers used in all watershed modeling contained in this report are based on the Hydrologic Soil Groups and land uses below:

Land Use	Hydrologic Soil Group	Curve #
Grass Cover (good)	C	74
Woods (good)	C	70
Gravel Roads	C	89
Gravel Surface	NA	96
Impervious Area	NA	98

1.6 DESIGN CRITERIA

This drainage analysis was developed utilizing NRCS, 24-hour storm as required by the Local Stormwater Bylaw. The storm frequencies and the corresponding 24-hour rainfall amounts are as follows:

Storm Frequency (years)	Rainfall (inches)
2	3.13
10	4.68
25	5.88
100	8.34

1.7 THE PROPOSED DRAINAGE SYSTEM

As with any development, changes in land use such as the transformation of woodland areas to lawn, landscape and impervious areas cause increased peak rates of runoff to the design points. These areas on this site consist of access drives and pad areas for ESS, as well as alterations in land use from woodland areas to open lawn and landscaped areas. In order to mitigate increases in peak rate of runoff, the site grading has been carefully designed to direct these land alterations to the storm drainage system.

The proposed drainage system captures stormwater runoff the project area via a series of deep-sump catchbasins and directs it towards a central drainage trunkline within the development. This trunkline discharges the runoff to the opposite side of Murdock Avenue to a proposed detention/rain garden feature. The system will be equipped with a PVC sub-drain system and an outlet structure consisting of various orifices to control the discharge rate of the flow. During smaller storm events, the stormwater will back up in the garden controlled by the discharge flow allowed by the subdrain system and outlet control structure.

Upon the completion of the storm event, these discharge control features will control the flow at or below pre-development levels until the stormwater has drained from the basin. It is noted that this subdrain system has a dual purpose of draining the basin between storm events and preventing groundwater from entering the basin from below. In addition to the subdrain and outlet structure, the rain garden will also be equipped with an emergency spillway. Based on the calculations, the emergency spillway will not experience flow in any storm event. Peak rate mitigation has been achieved during all storm events for the design point.

1.8 CONCLUSIONS

As stated above, a single Design Points have been established. Design Point #1 (DP#1) has been designated at a low point in the adjancent vegetated wetladn located along the westerly side of Murdock Ave. Changes in land use are the predominant cause of increases in peak rate of runoff to these design points. Under proposed conditions, the majority of stormwater runoff will be captured by a proposed rain garded before being directed towards DP#1. The results of the Drainage Analysis and resulting decreases in peak rates of runoff are below.

Table #1: Peak Rates of Runoff

Design Point		2-yr Storm	10-yr Storm	25-yr Storm	100-yr Storm
#1	Pre-	5.90	13.60	20.21	34.52
	Post-	5.71	13.52	19.94	33.72

As outlined above, the post-development peak rates of runoff show an decrease in peak rate of runoff for the design point. The storm water management as outlined herein and as shown on the accompanying plans has the following positive values relative to storm water management:

A) Attenuation of the 2-, 10-, 25- and 100-year storm events has mitigated increases in peak rates of runoff, or has been justified herein.
B) The Stormwater Operation and Maintenance Plan (OMP) attached, has been prepared to ensure long-term function of the system, as designed.

[1]"Urban Hydrology for Small Watersheds (Technical Release Number 55); Engineering Division, United States Dept. of Agriculture ,Soil Conservation Service (Jan. 1975)

[2]"National Engineering Handbook Section 4- Hydrology" ; United States Dept. of Agriculture, Soil Conservation Service (March 1985)

[3]"Handbook of Hydraulics" - 6th ed., E.F. Brater & H. Williams (1976)

[4]"Interim Soil Report for Southern Worcester County" 1995 ed., Published by the Southern Worcester County Conservation District, in cooperation with the United States Department of Agriculture, Natural Resources Conservation Service (1995)

[5] "HydroCAD" Drainage software developed by Applied Microcomputer, Page Hill Road, Chocorua, NH

2.0
HYDROLOGICAL CALCULATIONS

2.1
PRE-DEVELOPMENT CALCULATIONS

E11A

OVERLAND TO DP#1

DP#1A

WETLAND SERIES
1(SOUTH

CUL1

E12

TO DP#1   TO CULVERT

Subcat   Reach   Pond   Link

Project Notes

Rainfall events imported from "Atlas-14-Rain.txt" for 449 MA Worcester North

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.13	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.68	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	5.88	2
4	100-Year	NRCC 24-hr	D	Default	24.00	1	8.34	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.081	74	>75% Grass cover, Good, HSG C (E11A)
0.691	96	Gravel surface, HSG C (E11A)
0.305	98	Paved parking, HSG C (E11A)
8.120	70	Woods, Good, HSG C (E11A, E12)
9.198	**73**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
9.198	HSG C	E11A, E12
0.000	HSG D	
0.000	Other	
9.198		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.081	0.000	0.000	0.081	>75% Grass cover, Good	E11A
0.000	0.000	0.691	0.000	0.000	0.691	Gravel surface	E11A
0.000	0.000	0.305	0.000	0.000	0.305	Paved parking	E11A
0.000	0.000	8.120	0.000	0.000	8.120	Woods, Good	E11A, E12
0.000	**0.000**	**9.198**	**0.000**	**0.000**	**9.198**	**TOTAL AREA**	

3101-Pre-SITE b
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NRCC 24-hr D 2-Year Rainfall=3.13"
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E11A: OVERLAND TO DP#1
Runoff Area=264,550 sf 5.03% Impervious Runoff Depth=0.99"
Flow Length=331' Tc=12.2 min CN=74 Runoff=5.00 cfs 0.502 af

Subcatchment E12: TO CULVERT
Runoff Area=136,113 sf 0.00% Impervious Runoff Depth=0.79"
Flow Length=805' Tc=24.0 min CN=70 Runoff=1.40 cfs 0.205 af

Reach CUL1: TO DP#1
Avg. Flow Depth=0.34' Max Vel=2.03 fps Inflow=1.40 cfs 0.205 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=1.40 cfs 0.205 af

Reach DP#1A: WETLAND SERIES 1(SOUTH
Inflow=5.90 cfs 0.707 af
Outflow=5.90 cfs 0.707 af

Total Runoff Area = 9.198 ac   Runoff Volume = 0.707 af   Average Runoff Depth = 0.92"
96.68% Pervious = 8.892 ac   3.32% Impervious = 0.305 ac

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Summary for Subcatchment E11A: OVERLAND TO DP#1

Runoff   =   5.00 cfs @ 12.21 hrs, Volume=   0.502 af, Depth= 0.99"
   Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
3,520	74	>75% Grass cover, Good, HSG C
217,610	70	Woods, Good, HSG C
30,113	96	Gravel surface, HSG C
13,307	98	Paved parking, HSG C
264,550	74	Weighted Average
251,243		94.97% Pervious Area
13,307		5.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.4	25	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	100	0.0840	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	32	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	124	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	331	Total			

Subcatchment E11A: OVERLAND TO DP#1

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=264,550 sf
Runoff Volume=0.502 af
Runoff Depth=0.99"
Flow Length=331'
Tc=12.2 min
CN=74

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NRCC 24-hr D 2-Year Rainfall=3.13"
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Summary for Subcatchment E12: TO CULVERT

Runoff   =   1.40 cfs @ 12.37 hrs, Volume=   0.205 af, Depth= 0.79"
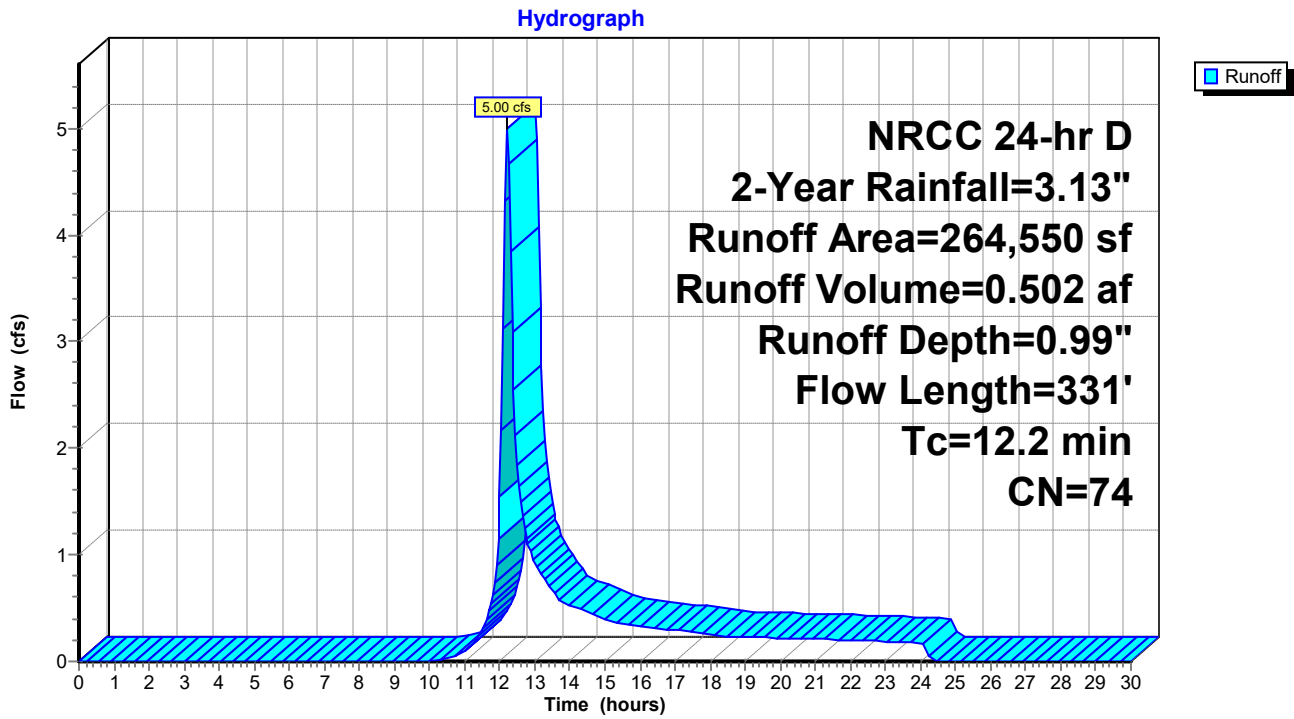   Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
136,113	70	Woods, Good, HSG C
136,113		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment E12: TO CULVERT

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=136,113 sf
Runoff Volume=0.205 af
Runoff Depth=0.79"
Flow Length=805'
Tc=24.0 min
CN=70

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NRCC 24-hr D 2-Year Rainfall=3.13"
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Summary for Reach CUL1: TO DP#1

Inflow Area =   3.125 ac,   0.00% Impervious, Inflow Depth = 0.79"   for 2-Year event
Inflow   =   1.40 cfs @   12.37 hrs, Volume=   0.205 af
Outflow   =   1.40 cfs @   12.38 hrs, Volume=   0.205 af, Atten= 1%, Lag= 0.5 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.87 fps, Avg. Travel Time= 0.7 min

Peak Storage= 25 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Hydrograph

Inflow Area=3.125 ac
Avg. Flow Depth=0.34'
Max Vel=2.03 fps
n=0.025
L=36.0'
S=0.0072 '/'
Capacity=15.42 cfs

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NRCC 24-hr D 2-Year Rainfall=3.13"
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Page 12
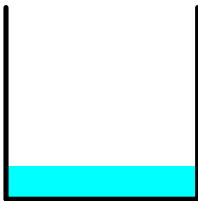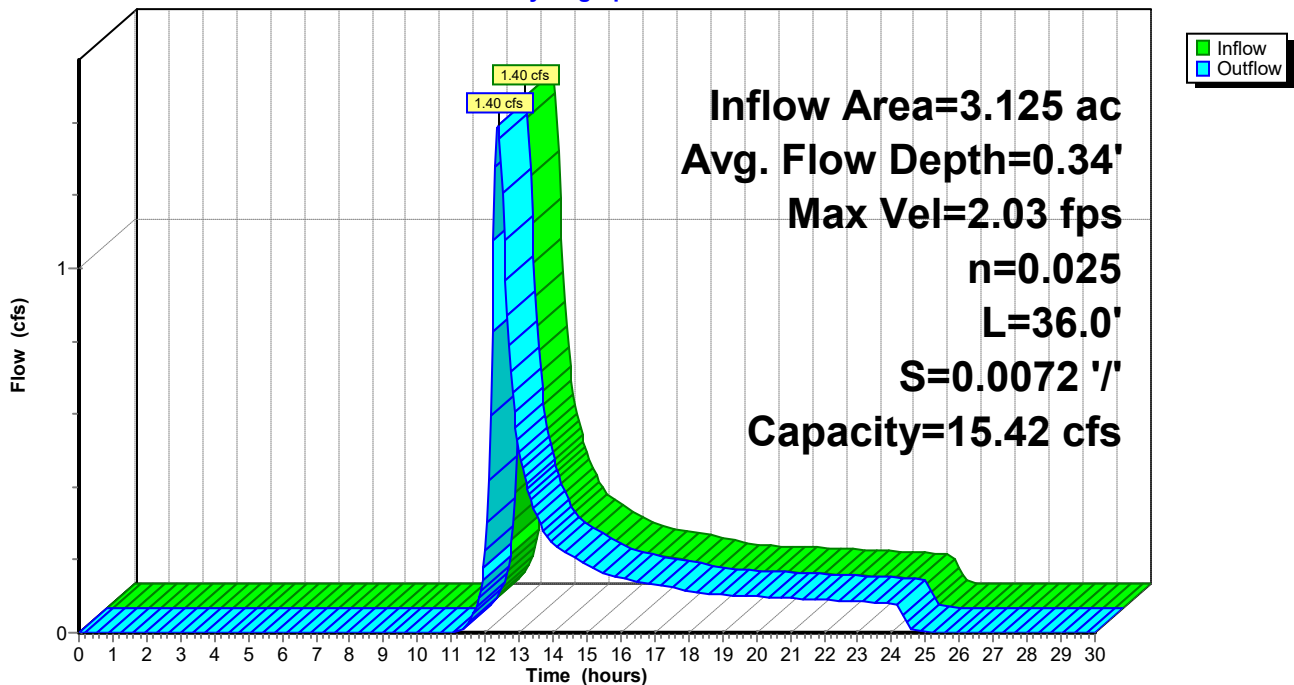
Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH

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

Inflow Area =   9.198 ac,   3.32% Impervious, Inflow Depth =   0.92"   for 2-Year event
Inflow   =   5.90 cfs @ 12.22 hrs, Volume=   0.707 af
Outflow   =   5.90 cfs @ 12.22 hrs, Volume=   0.707 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

3101-Pre-SITE b
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NRCC 24-hr D 10-Year Rainfall=4.68"
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
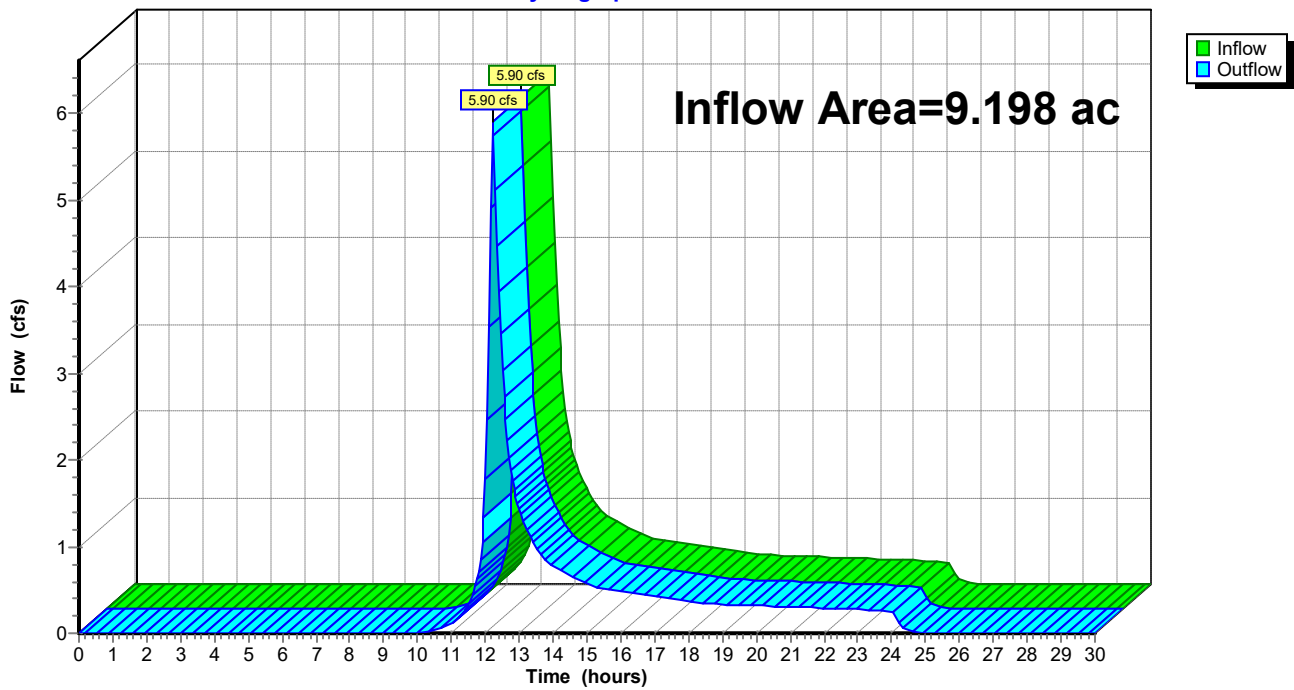Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E11A: OVERLAND TO DP#1
Runoff Area=264,550 sf 5.03% Impervious Runoff Depth=2.11"
Flow Length=331' Tc=12.2 min CN=74 Runoff=11.12 cfs 1.069 af

Subcatchment E12: TO CULVERT
Runoff Area=136,113 sf 0.00% Impervious Runoff Depth=1.80"
Flow Length=805' Tc=24.0 min CN=70 Runoff=3.54 cfs 0.469 af

Reach CUL1: TO DP#1
Avg. Flow Depth=0.65' Max Vel=2.72 fps Inflow=3.54 cfs 0.469 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=3.53 cfs 0.469 af

Reach DP#1A: WETLAND SERIES 1(SOUTH
Inflow=13.60 cfs 1.538 af
Outflow=13.60 cfs 1.538 af

Total Runoff Area = 9.198 ac   Runoff Volume = 1.538 af   Average Runoff Depth = 2.01"
96.68% Pervious = 8.892 ac   3.32% Impervious = 0.305 ac

Summary for Subcatchment E11A: OVERLAND TO DP#1

Runoff   =   11.12 cfs @ 12.20 hrs, Volume=   1.069 af, Depth= 2.11"
   Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
3,520	74	>75% Grass cover, Good, HSG C
217,610	70	Woods, Good, HSG C
30,113	96	Gravel surface, HSG C
13,307	98	Paved parking, HSG C
264,550	74	Weighted Average
251,243		94.97% Pervious Area
13,307		5.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.4	25	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	100	0.0840	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	32	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	124	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	331	Total			

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NRCC 24-hr D 10-Year Rainfall=4.68"
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Subcatchment E11A: OVERLAND TO DP#1

Hydrograph

11.12 cfs

**NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=264,550 sf
Runoff Volume=1.069 af
Runoff Depth=2.11"
Flow Length=331'
Tc=12.2 min
CN=74**

Flow (cfs) — vertical axis
Time (hours) — horizontal axis

Runoff

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NRCC 24-hr D 10-Year Rainfall=4.68"
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Summary for Subcatchment E12: TO CULVERT

Runoff   =   3.54 cfs @ 12.35 hrs, Volume=   0.469 af, Depth= 1.80"
    Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

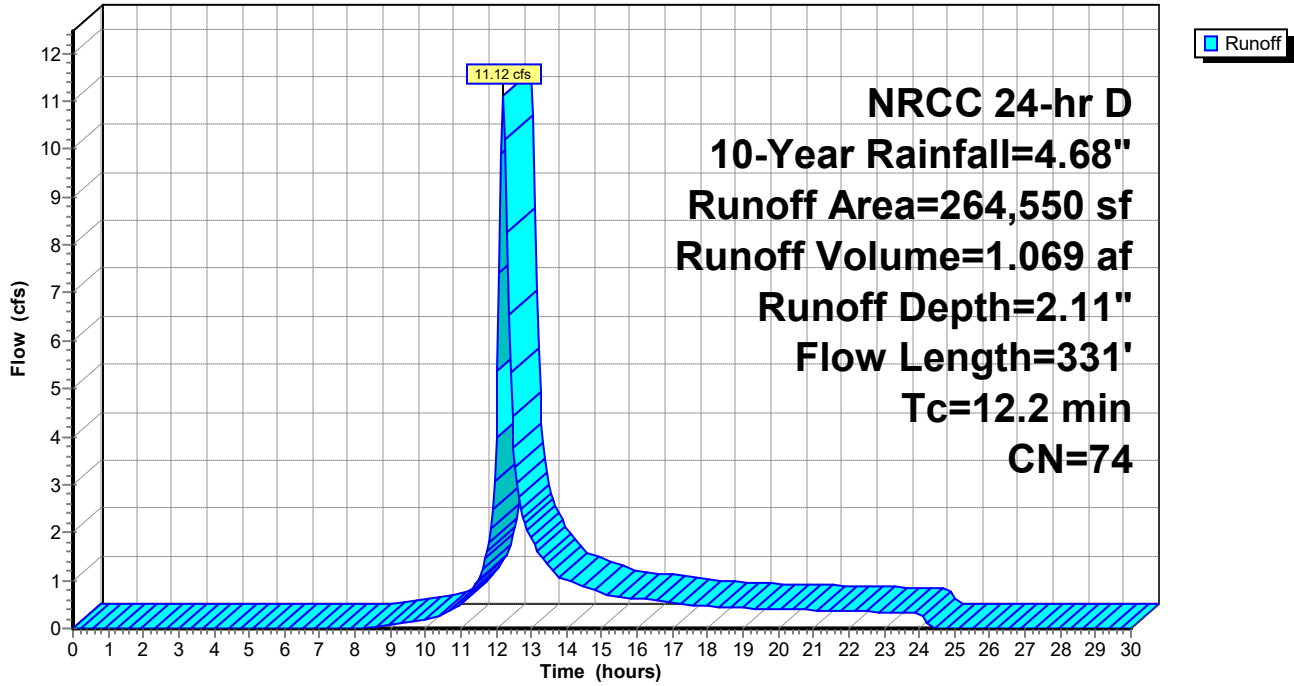| Area (sf)	CN	Description
136,113	70	Woods, Good, HSG C
136,113		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,**
					Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment E12: TO CULVERT

Hydrograph

NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=136,113 sf
Runoff Volume=0.469 af
Runoff Depth=1.80"
Flow Length=805'
Tc=24.0 min
CN=70

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NRCC 24-hr D 10-Year Rainfall=4.68"
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Summary for Reach CUL1: TO DP#1

Inflow Area =   3.125 ac,   0.00% Impervious, Inflow Depth = 1.80"   for 10-Year event
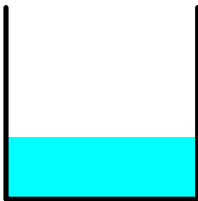Inflow   =   3.54 cfs @   12.35 hrs, Volume=   0.469 af
Outflow   =   3.53 cfs @   12.36 hrs, Volume=   0.469 af, Atten= 0%, Lag= 0.4 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.72 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.08 fps, Avg. Travel Time= 0.6 min

Peak Storage= 47 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.65' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Hydrograph

Inflow Area=3.125 ac
Avg. Flow Depth=0.65'
Max Vel=2.72 fps
n=0.025
L=36.0'
S=0.0072 '/'
Capacity=15.42 cfs

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NRCC 24-hr D 10-Year Rainfall=4.68"
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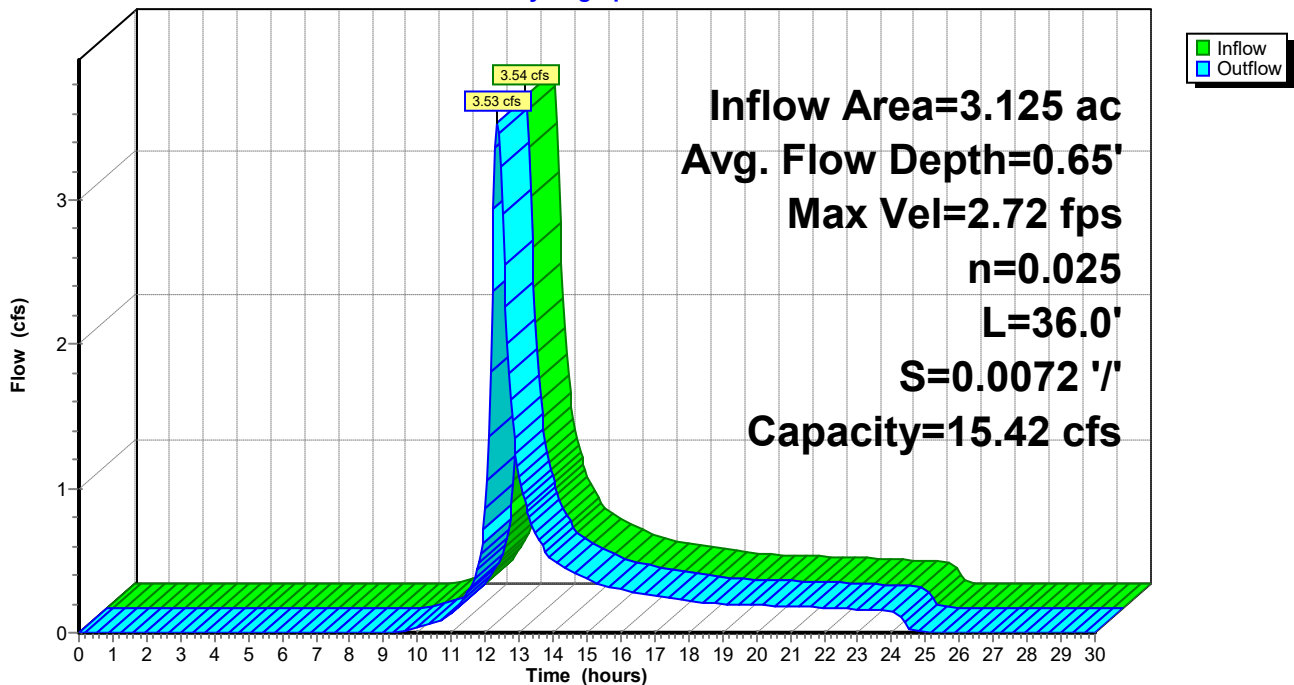
Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH

[40] Hint: Not Described (Outflow=Inflow)
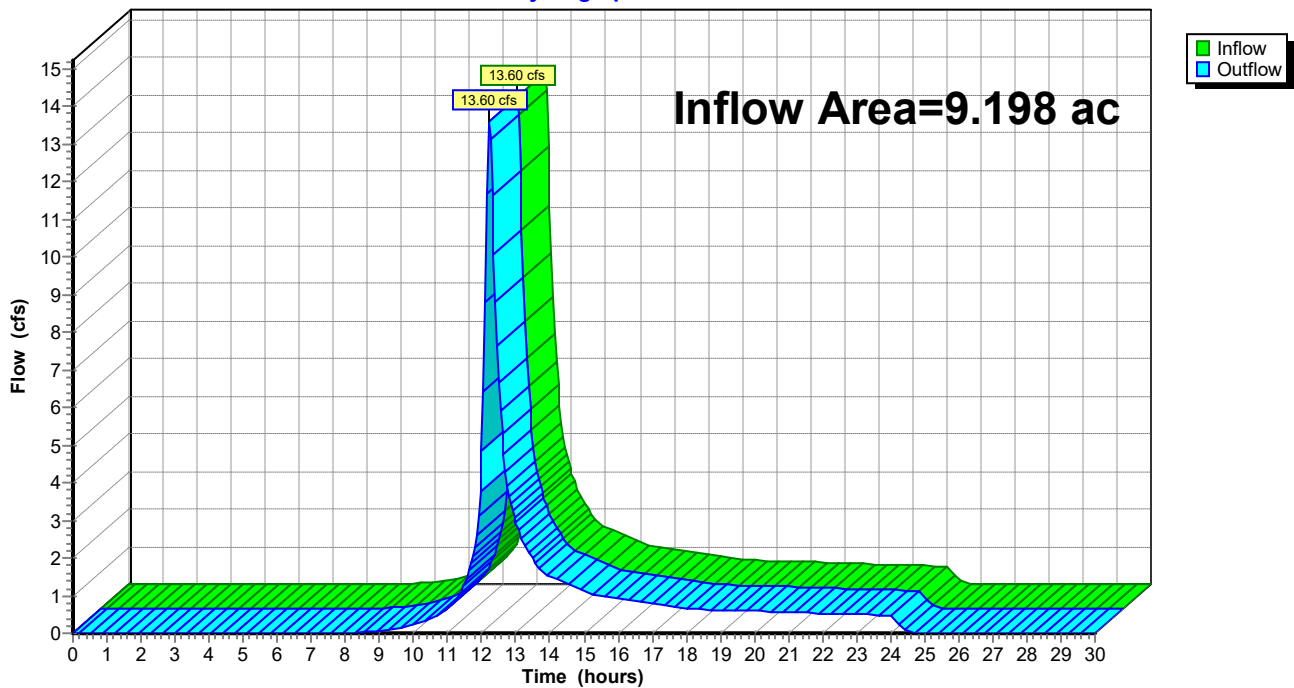
Inflow Area =   9.198 ac,   3.32% Impervious, Inflow Depth = 2.01"   for 10-Year event
Inflow   =   13.60 cfs @ 12.22 hrs, Volume=   1.538 af
Outflow   =   13.60 cfs @ 12.22 hrs, Volume=   1.538 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

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NRCC 24-hr D 25-Year Rainfall=5.88"
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E11A: OVERLAND TO DP#1

Runoff Area=264,550 sf 5.03% Impervious Runoff Depth=3.08"
Flow Length=331' Tc=12.2 min CN=74 Runoff=16.32 cfs 1.561 af

Subcatchment E12: TO CULVERT

Runoff Area=136,113 sf 0.00% Impervious Runoff Depth=2.71"
Flow Length=805' Tc=24.0 min CN=70 Runoff=5.42 cfs 0.706 af

Reach CUL1: TO DP#1

Avg. Flow Depth=0.89' Max Vel=3.06 fps Inflow=5.42 cfs 0.706 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=5.42 cfs 0.706 af

Reach DP#1A: WETLAND SERIES 1(SOUTH

Inflow=20.21 cfs 2.267 af
Outflow=20.21 cfs 2.267 af

Total Runoff Area = 9.198 ac   Runoff Volume = 2.267 af   Average Runoff Depth = 2.96"
96.68% Pervious = 8.892 ac   3.32% Impervious = 0.305 ac

Summary for Subcatchment E11A: OVERLAND TO DP#1

Runoff   =   16.32 cfs @ 12.20 hrs, Volume=   1.561 af, Depth= 3.08"
  Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
3,520	74	>75% Grass cover, Good, HSG C
217,610	70	Woods, Good, HSG C
30,113	96	Gravel surface, HSG C
13,307	98	Paved parking, HSG C
264,550	74	Weighted Average
251,243		94.97% Pervious Area
13,307		5.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.4	25	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	100	0.0840	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	32	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	124	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	331	Total			

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NRCC 24-hr D 25-Year Rainfall=5.88"
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Subcatchment E11A: OVERLAND TO DP#1

Hydrograph

16.32 cfs

Runoff

**NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=264,550 sf
Runoff Volume=1.561 af
Runoff Depth=3.08"
Flow Length=331'
Tc=12.2 min
CN=74**

3101-Pre-SITE b
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NRCC 24-hr D 25-Year Rainfall=5.88"
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Summary for Subcatchment E12: TO CULVERT

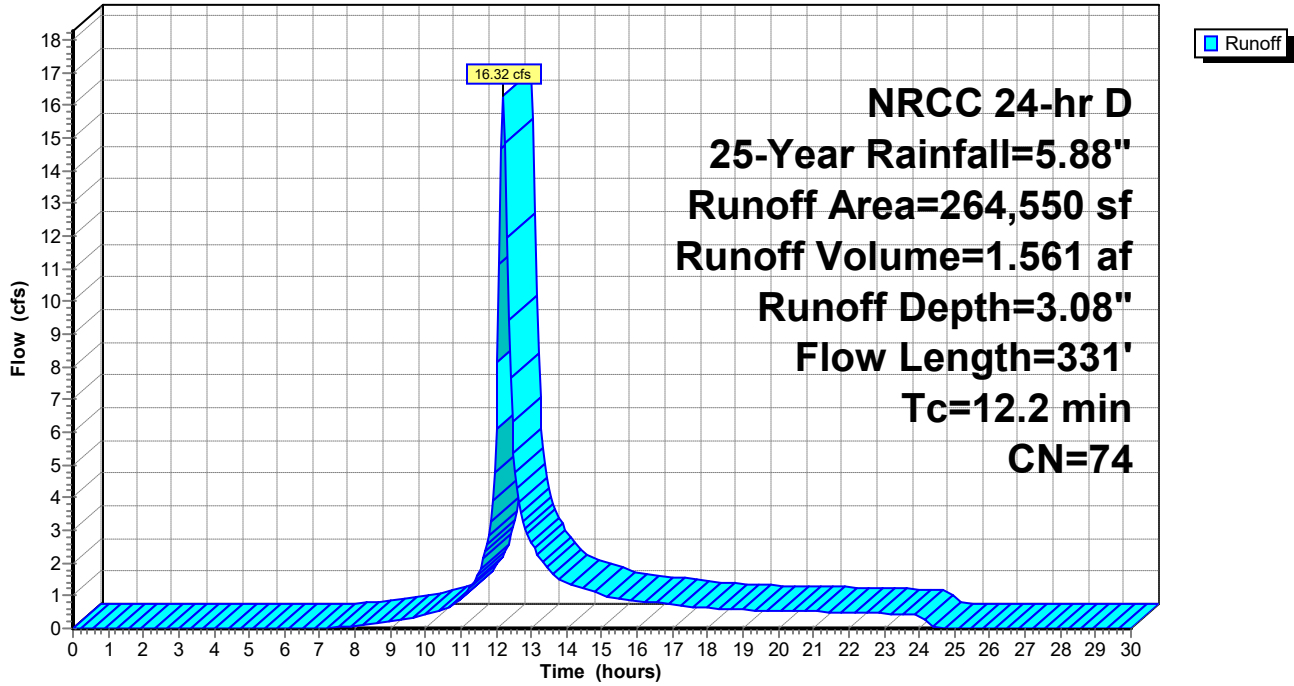Runoff   =   5.42 cfs @ 12.35 hrs, Volume=   0.706 af, Depth= 2.71"
    Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
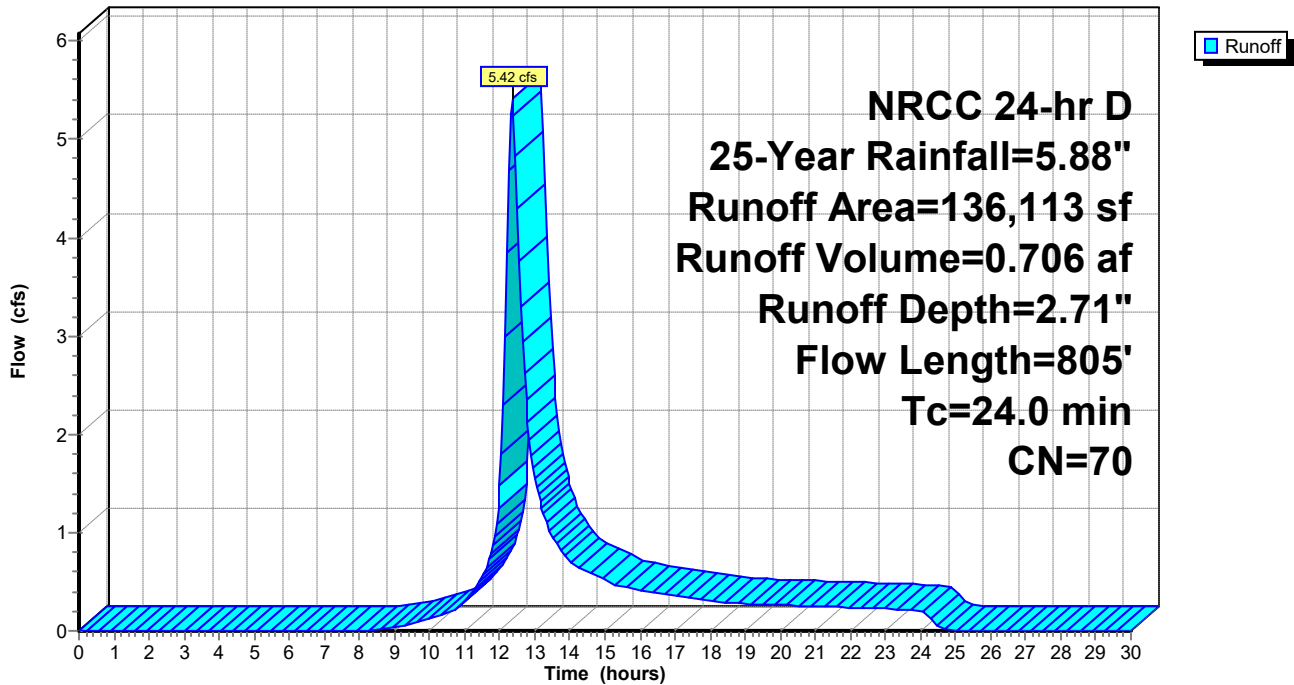NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
136,113	70	Woods, Good, HSG C
136,113		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,**
					Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment E12: TO CULVERT

Hydrograph

NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=136,113 sf
Runoff Volume=0.706 af
Runoff Depth=2.71"
Flow Length=805'
Tc=24.0 min
CN=70

5.42 cfs

3101-Pre-SITE b
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NRCC 24-hr D 25-Year Rainfall=5.88"
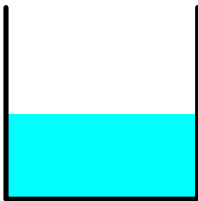Printed 4/12/2023
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Summary for Reach CUL1: TO DP#1

Inflow Area =   3.125 ac,   0.00% Impervious, Inflow Depth = 2.71"   for 25-Year event
Inflow   =   5.42 cfs @   12.35 hrs, Volume=   0.706 af
Outflow   =   5.42 cfs @   12.36 hrs, Volume=   0.706 af, Atten= 0%, Lag= 0.4 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.06 fps, Min. Travel Time= 0.2 min
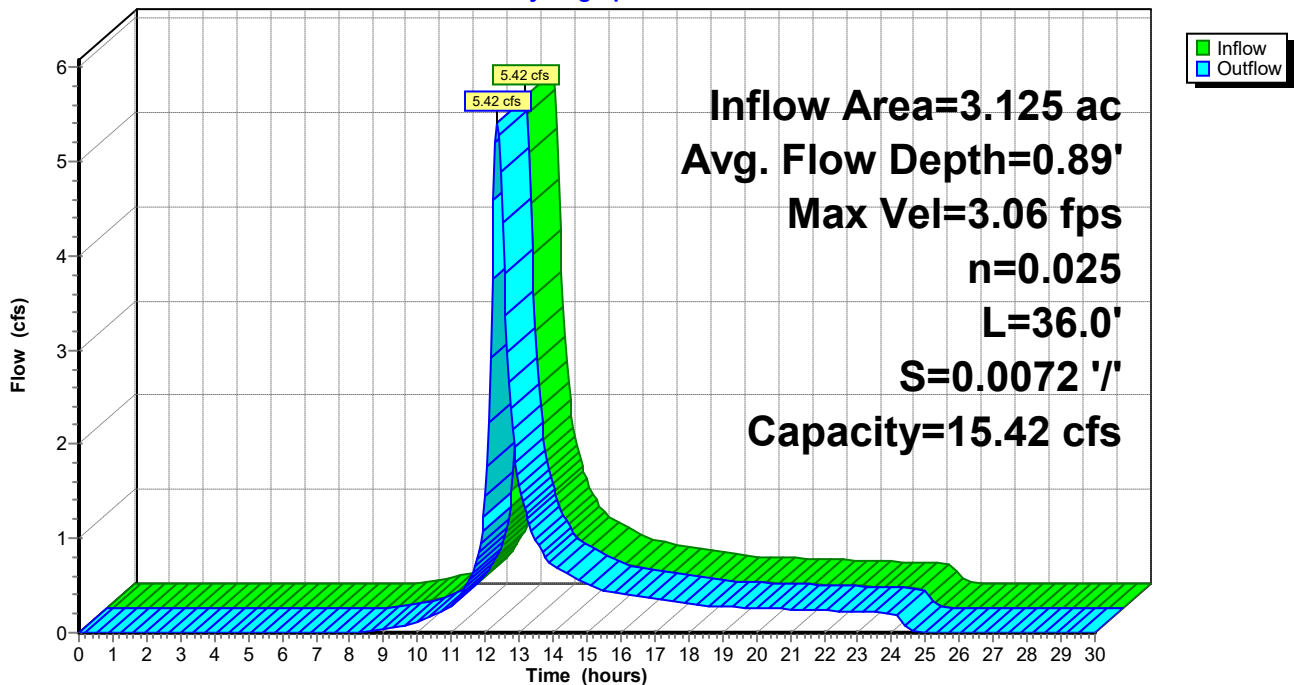Avg. Velocity = 1.20 fps, Avg. Travel Time= 0.5 min

Peak Storage= 64 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.89' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

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NRCC 24-hr D 25-Year Rainfall=5.88"
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Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH

[40] Hint: Not Described (Outflow=Inflow)
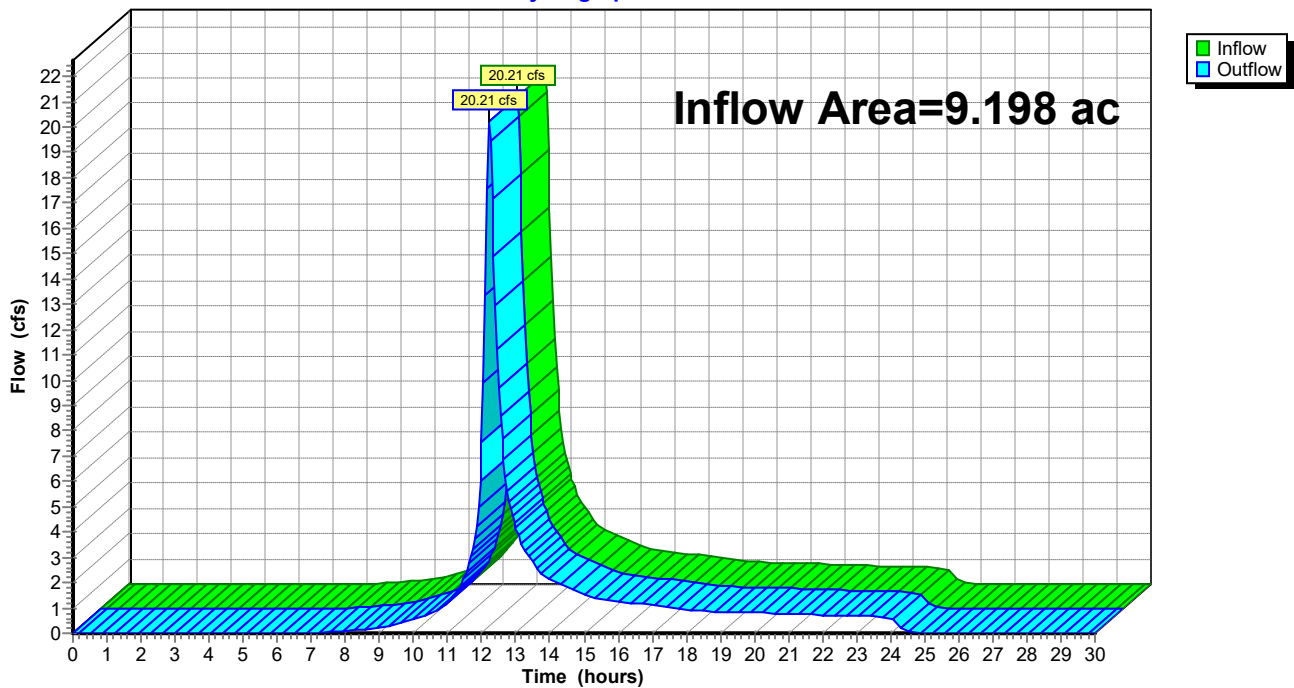
Inflow Area =   9.198 ac,   3.32% Impervious, Inflow Depth = 2.96"   for 25-Year event
Inflow   =   20.21 cfs @ 12.22 hrs, Volume=   2.267 af
Outflow   =   20.21 cfs @ 12.22 hrs, Volume=   2.267 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

Hydrograph

3101-Pre-SITE b
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NRCC 24-hr D 100-Year Rainfall=8.34"
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E11A: OVERLAND TO DP#1
Runoff Area=264,550 sf 5.03% Impervious Runoff Depth=5.23"
Flow Length=331' Tc=12.2 min CN=74 Runoff=27.48 cfs 2.647 af

Subcatchment E12: TO CULVERT
Runoff Area=136,113 sf 0.00% Impervious Runoff Depth=4.76"
Flow Length=805' Tc=24.0 min CN=70 Runoff=9.59 cfs 1.239 af

Reach CUL1: TO DP#1
Avg. Flow Depth=1.37' Max Vel=3.50 fps Inflow=9.59 cfs 1.239 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=9.57 cfs 1.239 af

Reach DP#1A: WETLAND SERIES 1(SOUTH
Inflow=34.52 cfs 3.886 af
Outflow=34.52 cfs 3.886 af

Total Runoff Area = 9.198 ac   Runoff Volume = 3.886 af   Average Runoff Depth = 5.07"
96.68% Pervious = 8.892 ac   3.32% Impervious = 0.305 ac

Summary for Subcatchment E11A: OVERLAND TO DP#1

Runoff   =   27.48 cfs @ 12.20 hrs, Volume=   2.647 af, Depth= 5.23"
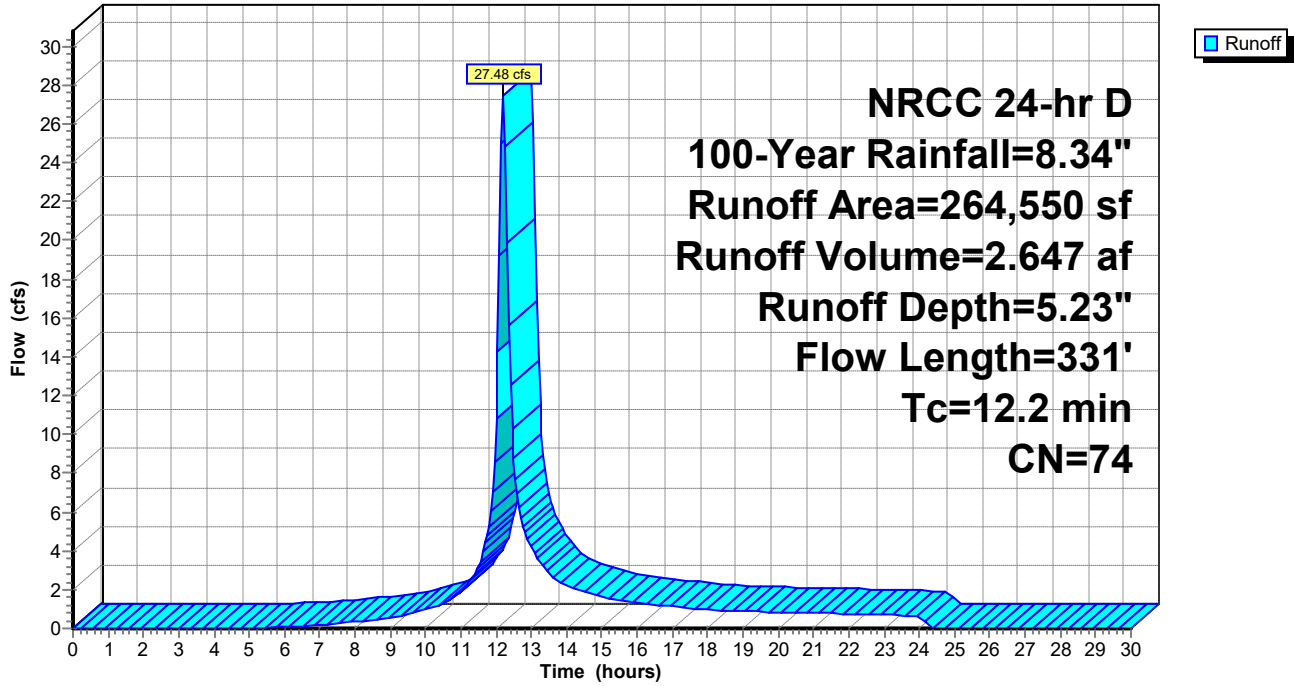 Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
3,520	74	>75% Grass cover, Good, HSG C
217,610	70	Woods, Good, HSG C
30,113	96	Gravel surface, HSG C
13,307	98	Paved parking, HSG C
264,550	74	Weighted Average
251,243		94.97% Pervious Area
13,307		5.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.4	25	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	100	0.0840	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	32	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	124	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	331	Total			

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NRCC 24-hr D 100-Year Rainfall=8.34"
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Subcatchment E11A: OVERLAND TO DP#1

Hydrograph

27.48 cfs

**NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=264,550 sf
Runoff Volume=2.647 af
Runoff Depth=5.23"
Flow Length=331'
Tc=12.2 min
CN=74**

☐ Runoff

Flow (cfs)

Time (hours)

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Summary for Subcatchment E12: TO CULVERT

Runoff   =   9.59 cfs @ 12.34 hrs, Volume=   1.239 af, Depth= 4.76"
   Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
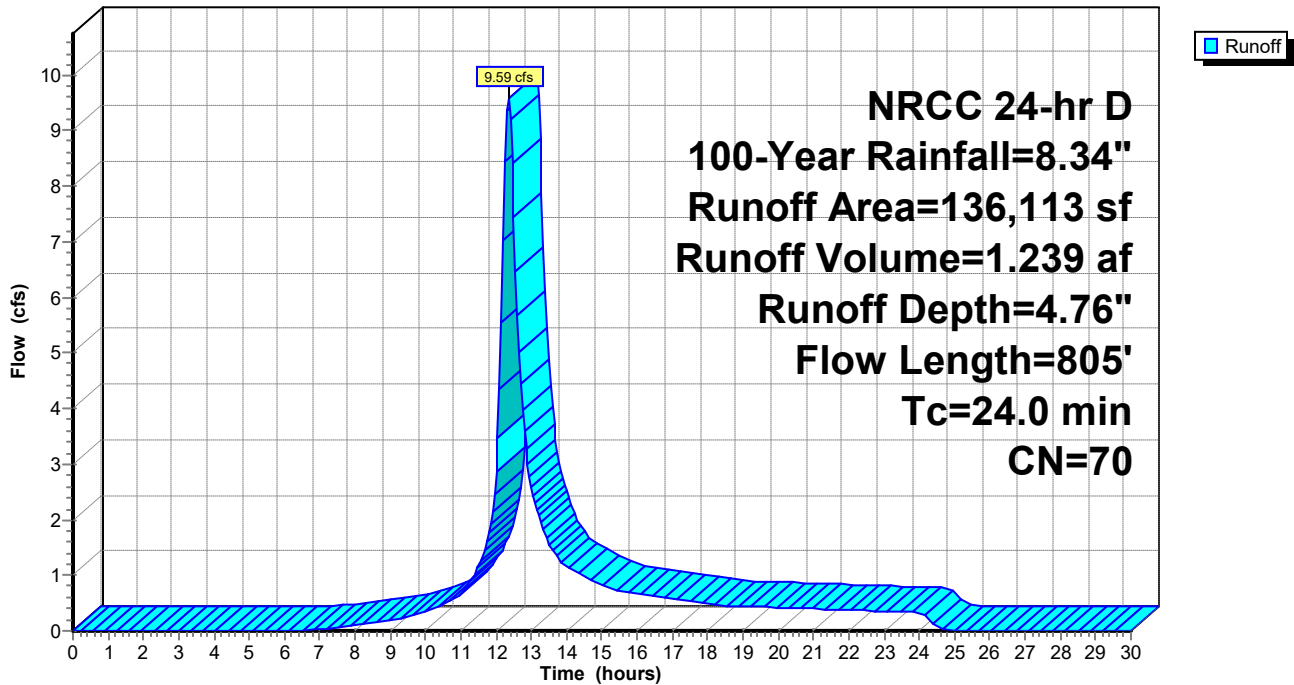NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
136,113	70	Woods, Good, HSG C
136,113		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,**
					Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment E12: TO CULVERT

Hydrograph

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=136,113 sf
Runoff Volume=1.239 af
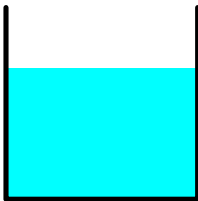Runoff Depth=4.76"
Flow Length=805'
Tc=24.0 min
CN=70

Summary for Reach CUL1: TO DP#1

Inflow Area = 3.125 ac, 0.00% Impervious, Inflow Depth = 4.76" for 100-Year event
Inflow = 9.59 cfs @ 12.34 hrs, Volume= 1.239 af
Outflow = 9.57 cfs @ 12.35 hrs, Volume= 1.239 af, Atten= 0%, Lag= 0.3 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.50 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.38 fps, Avg. Travel Time= 0.4 min

Peak Storage= 99 cf @ 12.35 hrs
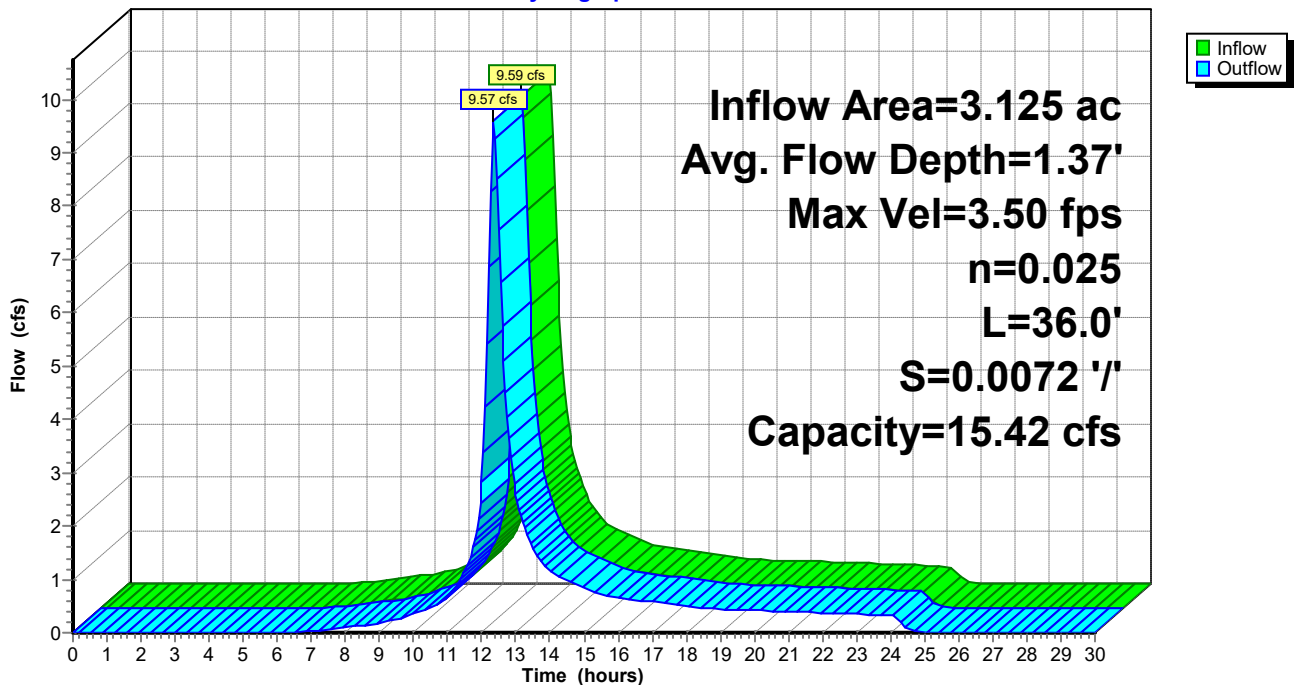Average Depth at Peak Storage= 1.37' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0' Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Inflow Area=3.125 ac
Avg. Flow Depth=1.37'
Max Vel=3.50 fps
n=0.025
L=36.0'
S=0.0072 '/'
Capacity=15.42 cfs

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NRCC 24-hr D 100-Year Rainfall=8.34"
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Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH
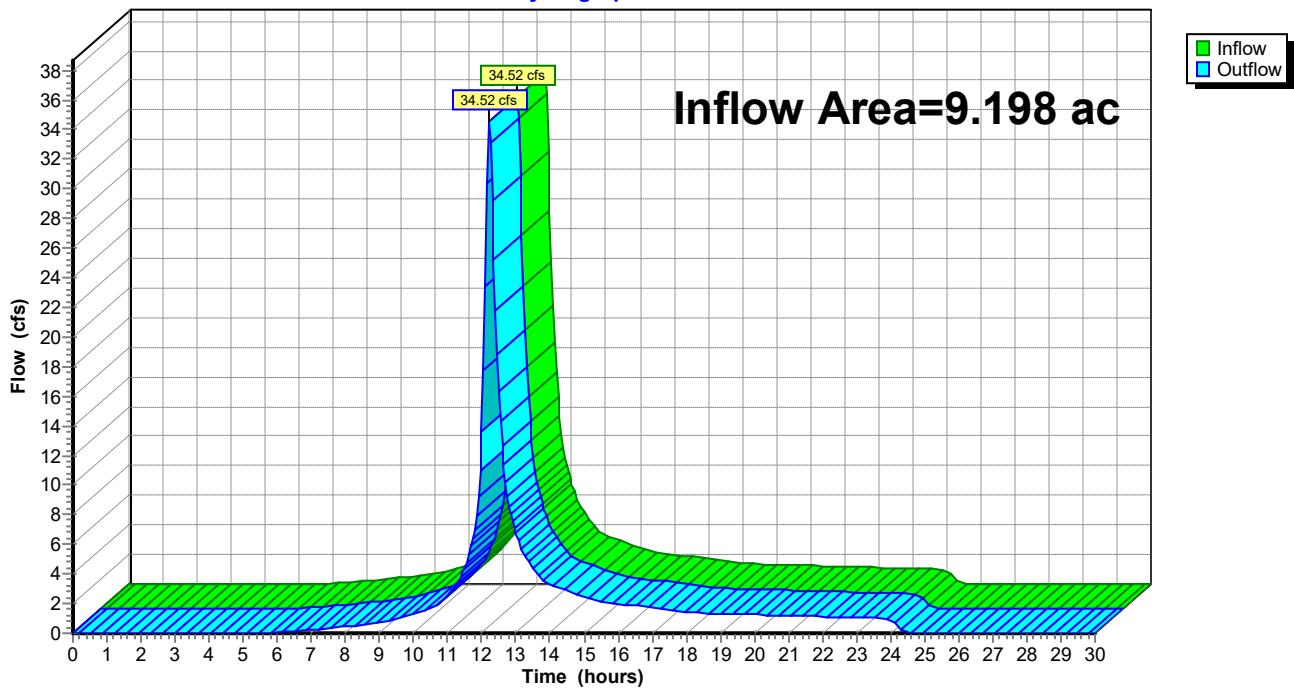
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =   9.198 ac,   3.32% Impervious, Inflow Depth = 5.07"   for 100-Year event
Inflow   =   34.52 cfs @ 12.21 hrs, Volume=   3.886 af
Outflow   =   34.52 cfs @ 12.21 hrs, Volume=   3.886 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

Hydrograph

2.2
POST DEVELOPMENT CALCULATIONS

P101

TO DCB#2

DCB3 ◁ p103

TO DMH#2   TO DCB#3

P100

TO RAIN GARDEN

DCB2 ▷ DMH2

TO DMH#2   TO DMH#1

RG1 ◁ DMH1

TO DP#1   TO RAIN GARDEN

OL1

OVERLAND TO
WETLAND

DCB1 ◁ p102

TO DMH#1   (new Subcat)

P11A

OVERLAND TO DP#1

DP#1A ◁ CUL1 ◁ P12

WETLAND SERIES
1(SOUTH   TO DP#1   TO CULVERT

Subcat   Reach   Pond   Link

Project Notes

Rainfall events imported from "Atlas-14-Rain.txt" for 449 MA Worcester North

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.13	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.68	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	5.88	2
4	100-Year	NRCC 24-hr	D	Default	24.00	1	8.34	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.036	74	>75% Grass cover, Good, HSG C (P100, P101, p102, p103, P11A, P12)
0.230	89	Gravel roads, HSG C (P100, P101, p102, p103, P11A)
1.078	96	Gravel surface, HSG C (P100, P101, p102, p103, P11A)
0.379	98	Paved parking, HSG C (P100, P101, p102, p103, P11A)
6.476	70	Woods, Good, HSG C (P100, P101, p102, p103, P11A, P12)
9.198	**75**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
9.198	HSG C	P100, P101, p102, p103, P11A, P12
0.000	HSG D	
0.000	Other	
9.198		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.036	0.000	0.000	1.036	>75% Grass cover, Good	P100, P101, p102, p103, P11A, P12
0.000	0.000	0.230	0.000	0.000	0.230	Gravel roads	P100, P101, p102, p103, P11A
0.000	0.000	1.078	0.000	0.000	1.078	Gravel surface	P100, P101, p102, p103, P11A
0.000	0.000	0.379	0.000	0.000	0.379	Paved parking	P100, P101, p102, p103, P11A
0.000	0.000	6.476	0.000	0.000	6.476	Woods, Good	P100, P101, p102, p103, P11A, P12
0.000	**0.000**	**9.198**	**0.000**	**0.000**	**9.198**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	DCB1	110.80	110.50	34.0	0.0088	0.010	0.0	12.0	0.0
2	DCB2	114.80	114.50	5.0	0.0600	0.010	0.0	8.0	0.0
3	DCB3	116.00	114.50	165.0	0.0091	0.010	0.0	8.0	0.0
4	DMH1	110.54	109.70	85.0	0.0099	0.011	0.0	15.0	0.0
5	DMH2	114.40	110.50	187.0	0.0209	0.013	0.0	12.0	0.0
6	RG1	106.40	106.00	70.0	0.0057	0.013	0.0	12.0	0.0

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P100: TO RAIN GARDEN

Runoff Area=20,880 sf 15.57% Impervious Runoff Depth=1.41"
Flow Length=290' Tc=6.0 min CN=81 Runoff=0.73 cfs 0.056 af

Subcatchment P101: TO DCB#2

Runoff Area=7,003 sf 5.65% Impervious Runoff Depth=1.77"
Flow Length=173' Tc=5.3 min CN=86 Runoff=0.31 cfs 0.024 af

Subcatchment p102: (new Subcat)

Runoff Area=19,100 sf 5.97% Impervious Runoff Depth=1.85"
Flow Length=272' Tc=5.0 min CN=87 Runoff=0.89 cfs 0.068 af

Subcatchment p103: TO DCB#3

Runoff Area=5,597 sf 16.22% Impervious Runoff Depth=1.85"
Flow Length=143' Tc=8.3 min CN=87 Runoff=0.24 cfs 0.020 af

Subcatchment P11A: OVERLAND TO DP#1

Runoff Area=216,407 sf 4.99% Impervious Runoff Depth=1.10"
Flow Length=307' Tc=12.2 min CN=76 Runoff=4.64 cfs 0.457 af

Subcatchment P12: TO CULVERT

Runoff Area=131,668 sf 0.00% Impervious Runoff Depth=0.79"
Flow Length=805' Tc=24.0 min CN=70 Runoff=1.36 cfs 0.198 af

Reach CUL1: TO DP#1

Avg. Flow Depth=0.34' Max Vel=2.01 fps Inflow=1.36 cfs 0.198 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=1.35 cfs 0.198 af

Reach DCB1: TO DMH#1

Avg. Flow Depth=0.31' Max Vel=4.33 fps Inflow=0.89 cfs 0.068 af
12.0" Round Pipe n=0.010 L=34.0' S=0.0088 '/' Capacity=4.35 cfs Outflow=0.88 cfs 0.068 af

Reach DCB2: TO DMH#2

Avg. Flow Depth=0.13' Max Vel=6.57 fps Inflow=0.31 cfs 0.024 af
8.0" Round Pipe n=0.010 L=5.0' S=0.0600 '/' Capacity=3.85 cfs Outflow=0.31 cfs 0.024 af

Reach DCB3: TO DMH#2

Avg. Flow Depth=0.18' Max Vel=3.11 fps Inflow=0.24 cfs 0.020 af
8.0" Round Pipe n=0.010 L=165.0' S=0.0091 '/' Capacity=1.50 cfs Outflow=0.23 cfs 0.020 af

Reach DMH1: TO RAIN GARDEN

Avg. Flow Depth=0.36' Max Vel=4.66 fps Inflow=1.35 cfs 0.111 af
15.0" Round Pipe n=0.011 L=85.0' S=0.0099 '/' Capacity=7.59 cfs Outflow=1.34 cfs 0.111 af

Reach DMH2: TO DMH#1

Avg. Flow Depth=0.21' Max Vel=4.18 fps Inflow=0.51 cfs 0.044 af
12.0" Round Pipe n=0.013 L=187.0' S=0.0209 '/' Capacity=5.15 cfs Outflow=0.50 cfs 0.044 af

Reach DP#1A: WETLAND SERIES 1(SOUTH

Inflow=5.70 cfs 0.823 af
Outflow=5.70 cfs 0.823 af

Reach OL1: OVERLAND TO WETLAND

Avg. Flow Depth=0.13' Max Vel=0.23 fps Inflow=0.64 cfs 0.168 af
n=0.400 L=61.0' S=0.0656 '/' Capacity=23.52 cfs Outflow=0.63 cfs 0.168 af

Pond RG1: TO DP#1

Peak Elev=109.74' Storage=1,878 cf Inflow=2.07 cfs 0.168 af
Primary=0.64 cfs 0.168 af Secondary=0.00 cfs 0.000 af Outflow=0.64 cfs 0.168 af

Total Runoff Area = 9.198 ac   Runoff Volume = 0.823 af   Average Runoff Depth = 1.07"
95.88% Pervious = 8.819 ac   4.12% Impervious = 0.379 ac

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Summary for Subcatchment P100: TO RAIN GARDEN

Runoff   =   0.73 cfs @ 12.13 hrs, Volume=   0.056 af, Depth= 1.41"
   Routed to Pond RG1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
13,576	74	>75% Grass cover, Good, HSG C
161	70	Woods, Good, HSG C
3,252	98	Paved parking, HSG C
2,891	96	Gravel surface, HSG C
1,000	89	Gravel roads, HSG C
20,880	81	Weighted Average
17,628		84.43% Pervious Area
3,252		15.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	15	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.2	29	0.3330	0.40		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	6	0.0300	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	113	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	81	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	46	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.0	290	Total			

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Subcatchment P100: TO RAIN GARDEN

Hydrograph

**NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=20,880 sf
Runoff Volume=0.056 af
Runoff Depth=1.41"
Flow Length=290'
Tc=6.0 min
CN=81**

□ Runoff

0.73 cfs

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Summary for Subcatchment P101: TO DCB#2

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   0.31 cfs @ 12.12 hrs, Volume=   0.024 af, Depth= 1.77"
   Routed to Reach DCB2 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
1,719	74	>75% Grass cover, Good, HSG C
715	70	Woods, Good, HSG C
396	98	Paved parking, HSG C
2,020	96	Gravel surface, HSG C
2,153	89	Gravel roads, HSG C
7,003	86	Weighted Average
6,607		94.35% Pervious Area
396		5.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	16	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.2	14	0.0300	1.06		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	123	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.3	173				Total

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Subcatchment P101: TO DCB#2

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=7,003 sf
Runoff Volume=0.024 af
Runoff Depth=1.77"
Flow Length=173'
Tc=5.3 min
CN=86

0.31 cfs

Runoff

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Summary for Subcatchment p102: (new Subcat)

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   0.89 cfs @ 12.11 hrs, Volume=   0.068 af, Depth= 1.85"
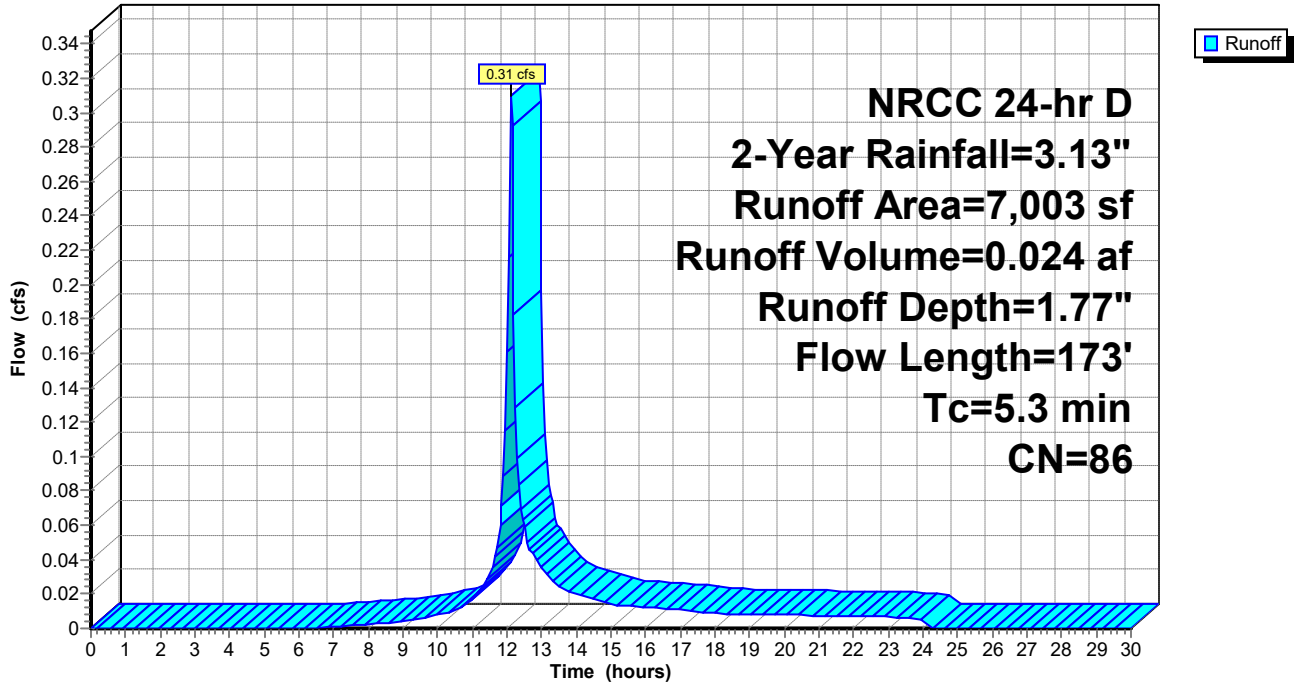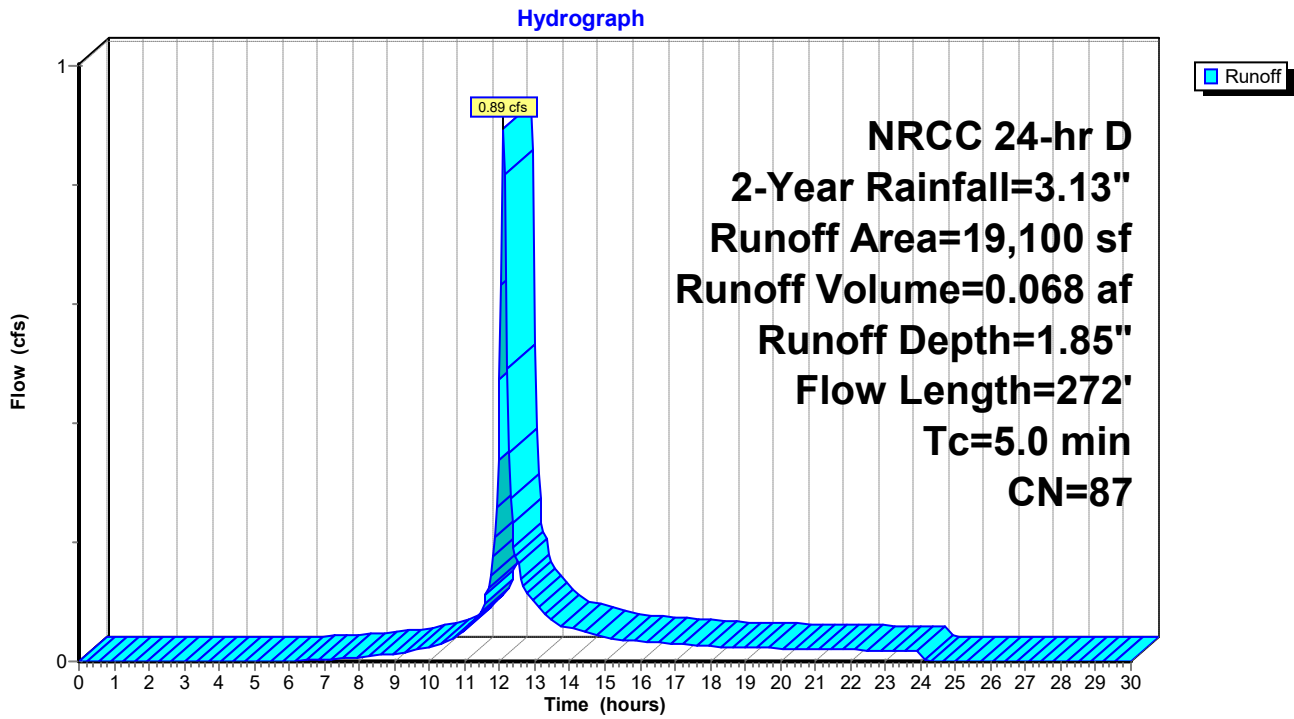   Routed to Reach DCB1 : TO DMH#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
5,623	74	>75% Grass cover, Good, HSG C
528	70	Woods, Good, HSG C
1,140	98	Paved parking, HSG C
7,733	96	Gravel surface, HSG C
4,076	89	Gravel roads, HSG C
19,100	87	Weighted Average
17,960		94.03% Pervious Area
1,140		5.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.4	30	0.0250	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	222	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.9	272				Total, Increased to minimum Tc = 5.0 min

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Subcatchment p102: (new Subcat)

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=19,100 sf
Runoff Volume=0.068 af
Runoff Depth=1.85"
Flow Length=272'
Tc=5.0 min
CN=87

Summary for Subcatchment p103: TO DCB#3

Runoff   =   0.24 cfs @ 12.15 hrs, Volume=   0.020 af, Depth= 1.85"
   Routed to Reach DCB3 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
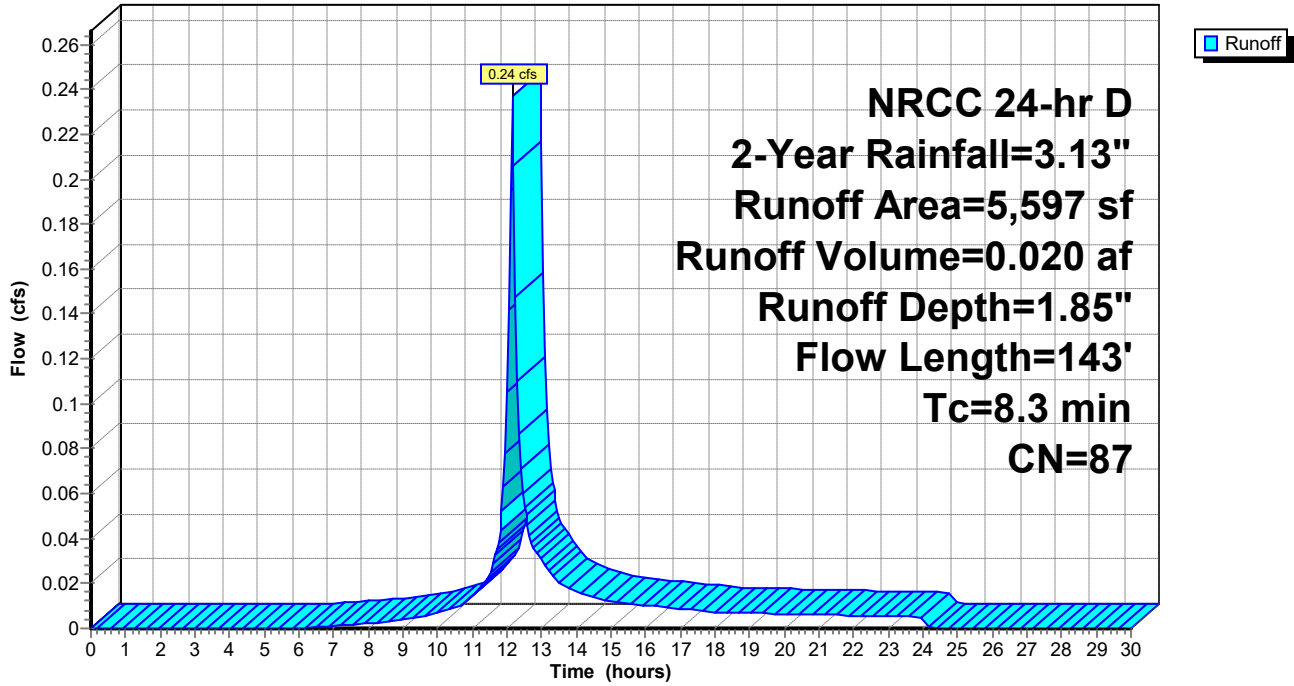NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
1,015	74	>75% Grass cover, Good, HSG C
855	70	Woods, Good, HSG C
908	98	Paved parking, HSG C
1,653	96	Gravel surface, HSG C
1,166	89	Gravel roads, HSG C
5,597	87	Weighted Average
4,689		83.78% Pervious Area
908		16.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	40	0.0540	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.5	10	0.3300	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	93	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.3	143	Total			

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Subcatchment p103: TO DCB#3

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=5,597 sf
Runoff Volume=0.020 af
Runoff Depth=1.85"
Flow Length=143'
Tc=8.3 min
CN=87

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Summary for Subcatchment P11A: OVERLAND TO DP#1

Runoff   =   4.64 cfs @ 12.21 hrs, Volume=   0.457 af, Depth= 1.10"
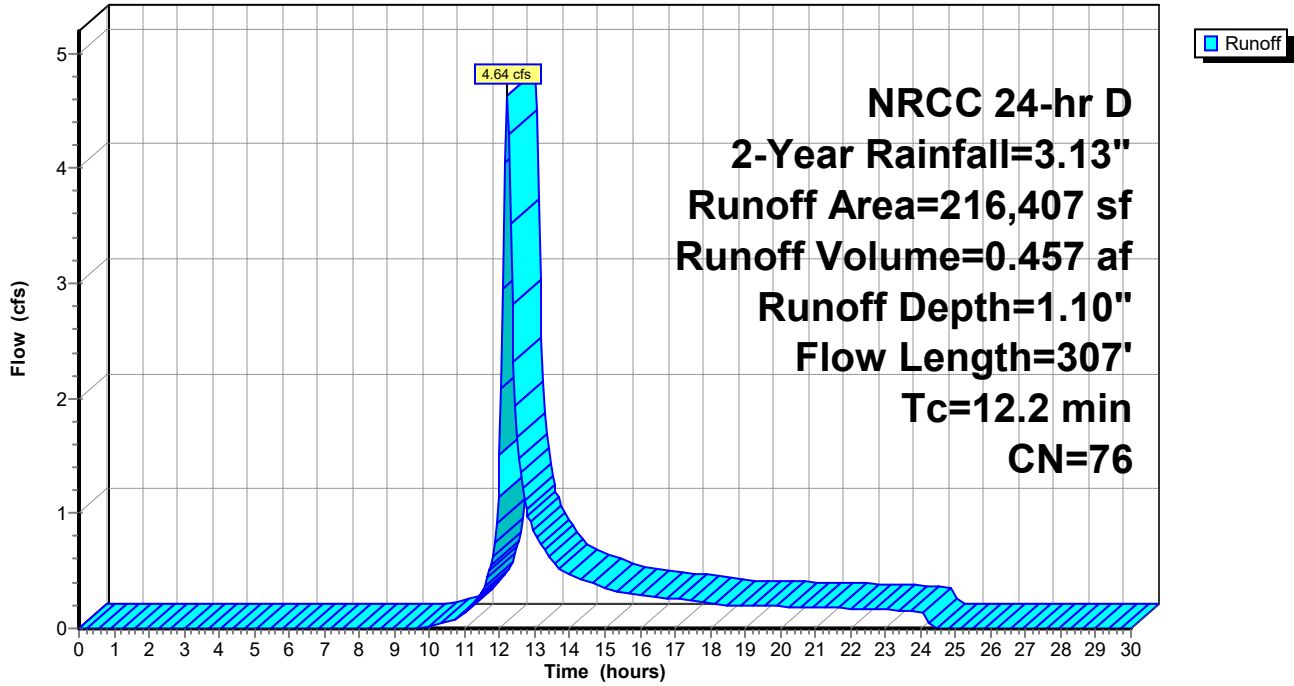 Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
20,934	74	>75% Grass cover, Good, HSG C
150,407	70	Woods, Good, HSG C
32,655	96	Gravel surface, HSG C
10,055	98	Paved parking, HSG C
1,617	89	Gravel roads, HSG C
739	98	Paved parking, HSG C
216,407	76	Weighted Average
205,613		95.01% Pervious Area
10,794		4.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.0	68	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	38	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	27	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.1	124	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	307	Total			

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Subcatchment P11A: OVERLAND TO DP#1

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=216,407 sf
Runoff Volume=0.457 af
Runoff Depth=1.10"
Flow Length=307'
Tc=12.2 min
CN=76

4.64 cfs

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Summary for Subcatchment P12: TO CULVERT

Runoff   =   1.36 cfs @ 12.37 hrs, Volume=   0.198 af, Depth= 0.79"
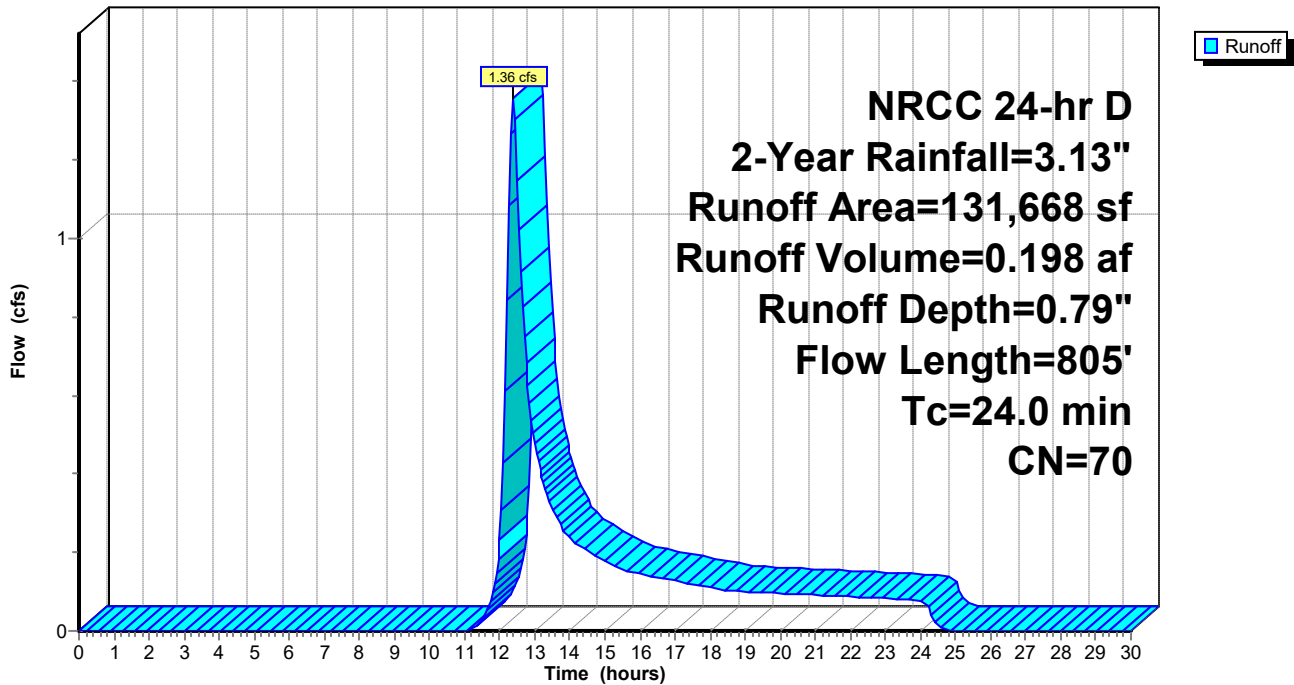   Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.13"

Area (sf)	CN	Description
129,407	70	Woods, Good, HSG C
2,261	74	>75% Grass cover, Good, HSG C
131,668	70	Weighted Average
131,668		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,**
					Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,**
					Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment P12: TO CULVERT

Hydrograph

NRCC 24-hr D
2-Year Rainfall=3.13"
Runoff Area=131,668 sf
Runoff Volume=0.198 af
Runoff Depth=0.79"
Flow Length=805'
Tc=24.0 min
CN=70

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NRCC 24-hr D 2-Year Rainfall=3.13"
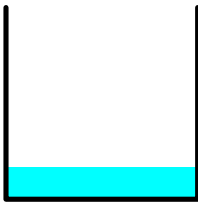Printed 4/12/2023
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Summary for Reach CUL1: TO DP#1

Inflow Area =   3.023 ac,   0.00% Impervious, Inflow Depth = 0.79"   for 2-Year event
Inflow   =   1.36 cfs @ 12.37 hrs, Volume=   0.198 af
Outflow   =   1.35 cfs @ 12.38 hrs, Volume=   0.198 af, Atten= 1%, Lag= 0.5 min
   Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.01 fps, Min. Travel Time= 0.3 min
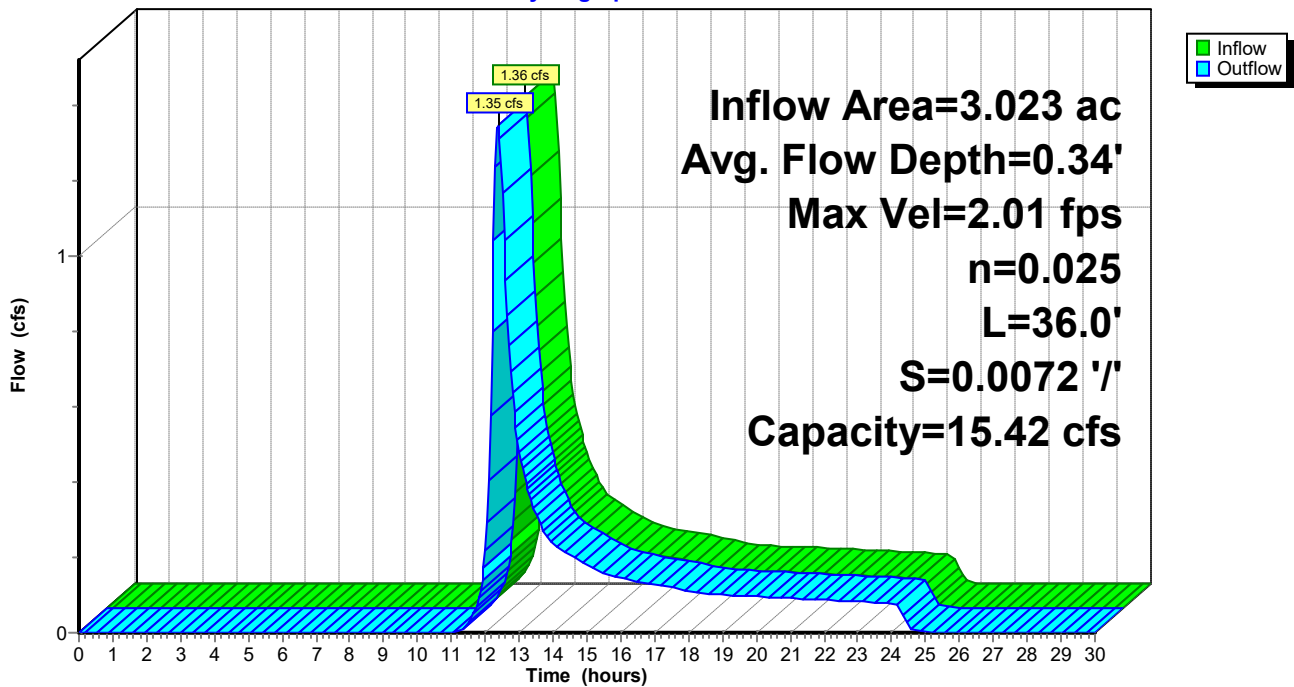Avg. Velocity = 0.86 fps, Avg. Travel Time= 0.7 min

Peak Storage= 24 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Hydrograph

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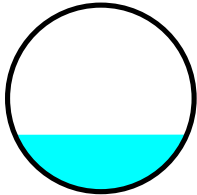## Summary for Reach DCB1: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.438 ac,   5.97% Impervious, Inflow Depth = 1.85"   for 2-Year event
Inflow   =   0.89 cfs @ 12.11 hrs, Volume=   0.068 af
Outflow   =   0.88 cfs @ 12.12 hrs, Volume=   0.068 af, Atten= 2%, Lag= 0.3 min
     Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.33 fps, Min. Travel Time= 0.1 min
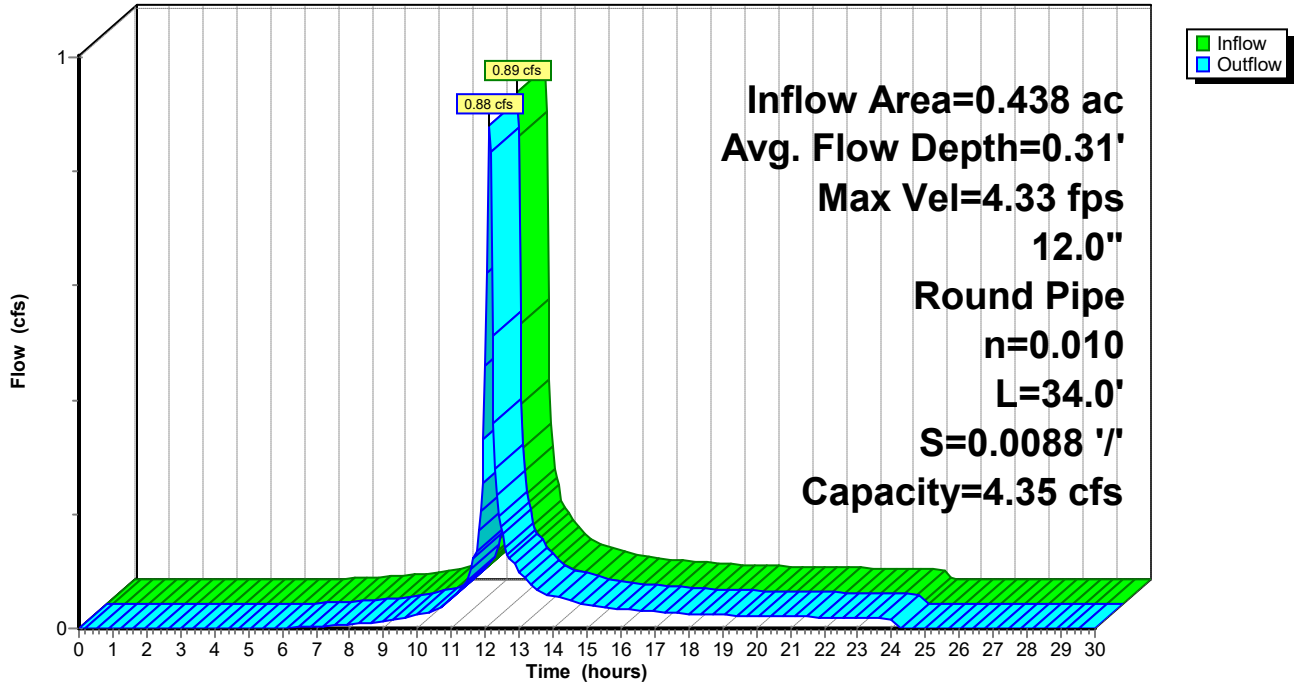Avg. Velocity = 1.55 fps, Avg. Travel Time= 0.4 min

Peak Storage= 7 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.31' , Surface Width= 0.92'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.35 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 34.0'   Slope= 0.0088 '/'
Inlet Invert= 110.80', Outlet Invert= 110.50'

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Reach DCB1: TO DMH#1

Hydrograph

Inflow Area=0.438 ac
Avg. Flow Depth=0.31'
Max Vel=4.33 fps
12.0"
Round Pipe
n=0.010
L=34.0'
S=0.0088 '/'
Capacity=4.35 cfs

0.89 cfs
0.88 cfs

Inflow
Outflow

Flow (cfs)
Time (hours)

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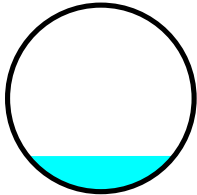## Summary for Reach DCB2: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.161 ac,   5.65% Impervious, Inflow Depth = 1.77"   for 2-Year event
Inflow   =   0.31 cfs @ 12.12 hrs, Volume=   0.024 af
Outflow   =   0.31 cfs @ 12.12 hrs, Volume=   0.024 af, Atten= 0%, Lag= 0.0 min
   Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.57 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.38 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.13' , Surface Width= 0.53'
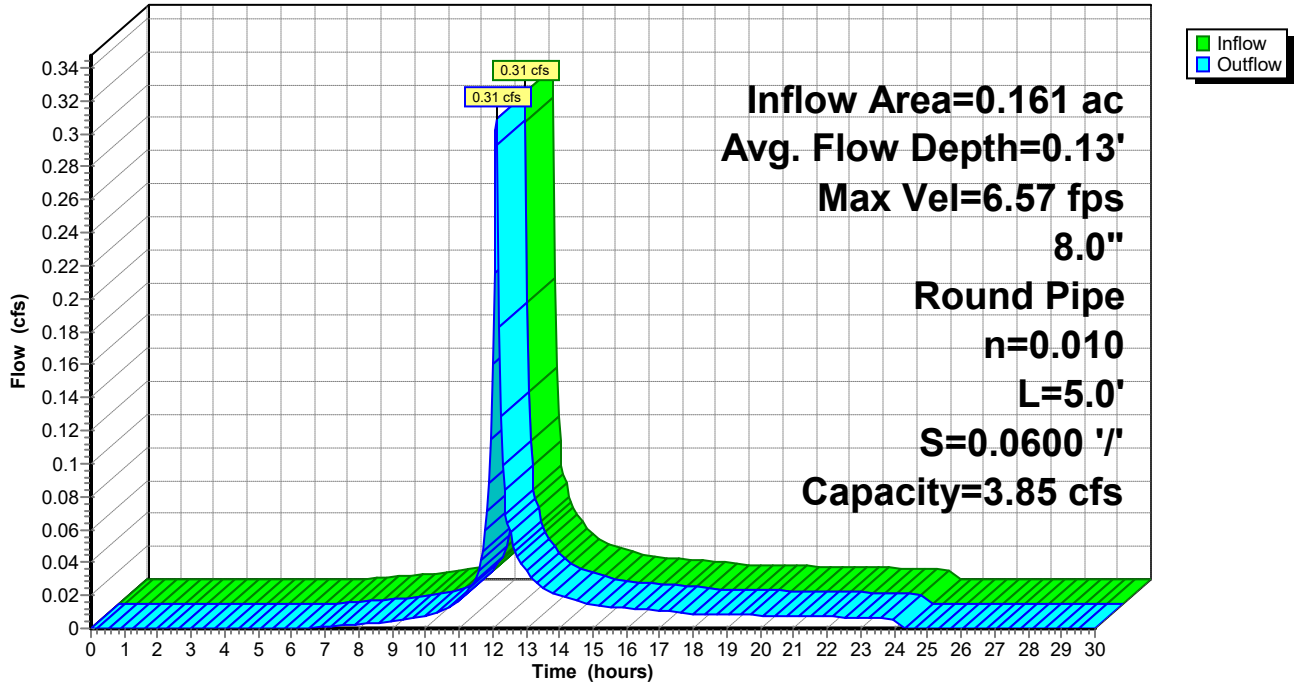Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 3.85 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 5.0'   Slope= 0.0600 '/'
Inlet Invert= 114.80', Outlet Invert= 114.50'

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Reach DCB2: TO DMH#2

Hydrograph

Inflow Area=0.161 ac
Avg. Flow Depth=0.13'
Max Vel=6.57 fps
8.0"
Round Pipe
n=0.010
L=5.0'
S=0.0600 '/'
Capacity=3.85 cfs

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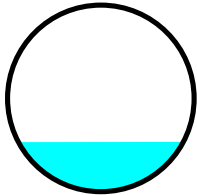## Summary for Reach DCB3: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.128 ac, 16.22% Impervious, Inflow Depth = 1.85"   for 2-Year event
Inflow   =   0.24 cfs @ 12.15 hrs, Volume=   0.020 af
Outflow   =   0.23 cfs @ 12.18 hrs, Volume=   0.020 af, Atten= 5%, Lag= 1.6 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.11 fps, Min. Travel Time= 0.9 min
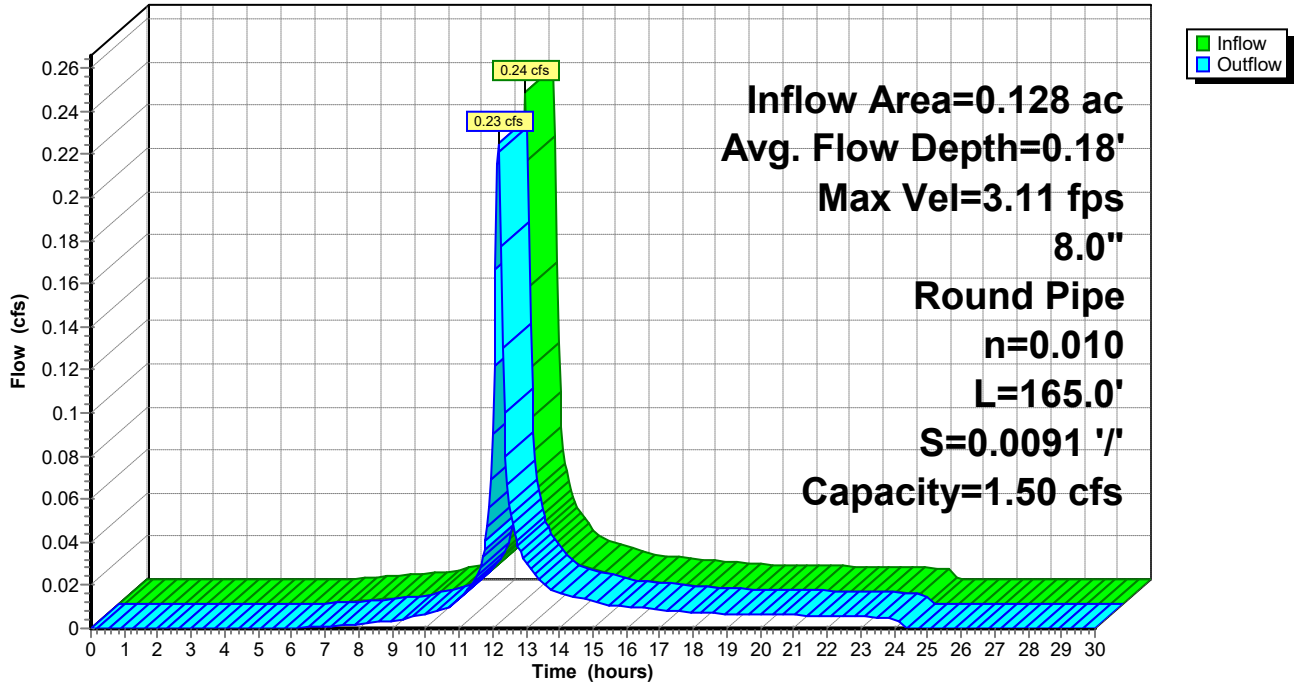Avg. Velocity = 1.14 fps, Avg. Travel Time= 2.4 min

Peak Storage= 12 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.18' , Surface Width= 0.59'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.50 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 165.0'   Slope= 0.0091 '/'
Inlet Invert= 116.00', Outlet Invert= 114.50'

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Reach DCB3: TO DMH#2

Hydrograph

Inflow Area=0.128 ac
Avg. Flow Depth=0.18'
Max Vel=3.11 fps
8.0"
Round Pipe
n=0.010
L=165.0'
S=0.0091 '/'
Capacity=1.50 cfs

■ Inflow
■ Outflow

0.24 cfs

0.23 cfs

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Summary for Reach DMH1: TO RAIN GARDEN

[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach DCB1 OUTLET depth by 0.12' @ 12.20 hrs
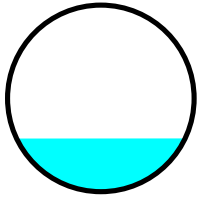[62] Hint: Exceeded Reach DMH2 OUTLET depth by 0.18' @ 12.10 hrs

Inflow Area =   0.728 ac,   7.71% Impervious, Inflow Depth = 1.84"   for 2-Year event
Inflow   =   1.35 cfs @ 12.13 hrs, Volume=   0.111 af
Outflow   =   1.34 cfs @ 12.14 hrs, Volume=   0.111 af, Atten= 1%, Lag= 0.5 min
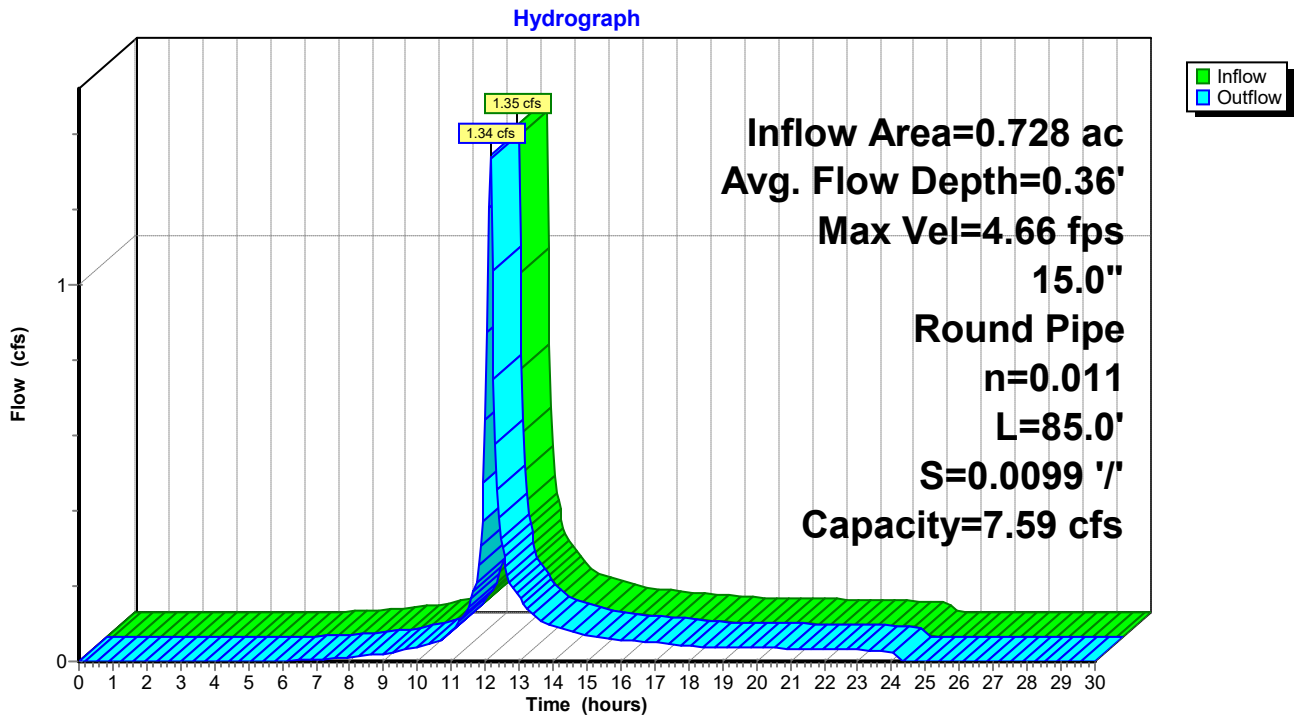   Routed to Pond RG1 : TO DP#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.66 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 0.8 min

Peak Storage= 25 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.36' , Surface Width= 1.13'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 7.59 cfs

15.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 85.0'   Slope= 0.0099 '/'
Inlet Invert= 110.54', Outlet Invert= 109.70'

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Reach DMH1: TO RAIN GARDEN

Hydrograph

Inflow Area=0.728 ac
Avg. Flow Depth=0.36'
Max Vel=4.66 fps
15.0"
Round Pipe
n=0.011
L=85.0'
S=0.0099 '/'
Capacity=7.59 cfs

1.35 cfs
1.34 cfs

Flow (cfs)

Time (hours)

Inflow
Outflow

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Summary for Reach DMH2: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach DCB2 outlet invert by 0.11' @ 12.15 hrs
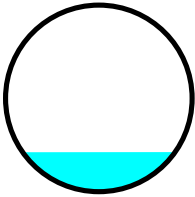[61] Hint: Exceeded Reach DCB3 outlet invert by 0.11' @ 12.15 hrs

Inflow Area =   0.289 ac, 10.35% Impervious, Inflow Depth = 1.81"   for 2-Year event
Inflow   =   0.51 cfs @ 12.14 hrs, Volume=   0.044 af
Outflow   =   0.50 cfs @ 12.16 hrs, Volume=   0.044 af, Atten= 3%, Lag= 1.2 min
    Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.18 fps, Min. Travel Time= 0.7 min
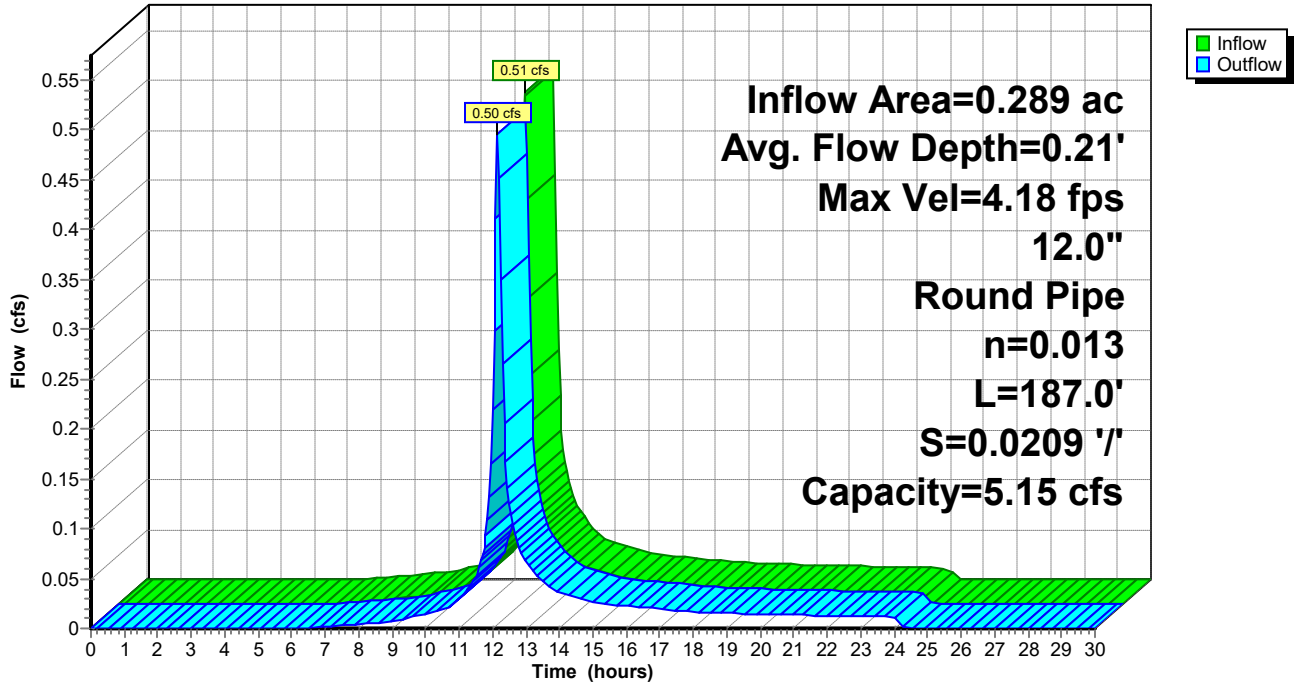Avg. Velocity = 1.52 fps, Avg. Travel Time= 2.0 min

Peak Storage= 23 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.21' , Surface Width= 0.82'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.15 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 187.0' Slope= 0.0209 '/'
Inlet Invert= 114.40', Outlet Invert= 110.50'

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Reach DMH2: TO DMH#1

Hydrograph

Inflow Area=0.289 ac
Avg. Flow Depth=0.21'
Max Vel=4.18 fps
12.0"
Round Pipe
n=0.013
L=187.0'
S=0.0209 '/'
Capacity=5.15 cfs

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Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH
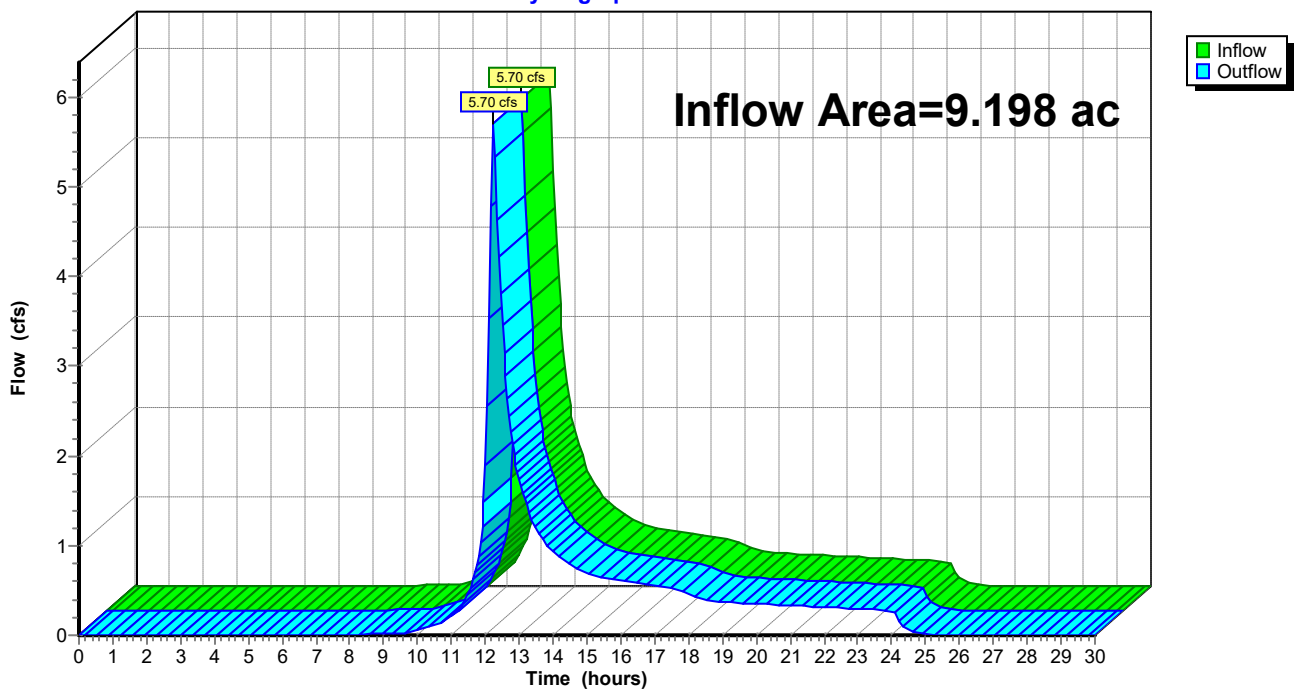
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =   9.198 ac,   4.12% Impervious, Inflow Depth = 1.07"   for 2-Year event
Inflow   =   5.70 cfs @ 12.22 hrs, Volume=   0.823 af
Outflow   =   5.70 cfs @ 12.22 hrs, Volume=   0.823 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

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Summary for Reach OL1: OVERLAND TO WETLAND

[79] Warning: Submerged Pond RG1 Primary device # 5 OUTLET by 0.13'

Inflow Area = 1.207 ac, 10.83% Impervious, Inflow Depth = 1.67" for 2-Year event
Inflow = 0.64 cfs @ 12.37 hrs, Volume= 0.168 af
Outflow = 0.63 cfs @ 12.51 hrs, Volume= 0.168 af, Atten= 2%, Lag= 8.5 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.23 fps, Min. Travel Time= 4.4 min
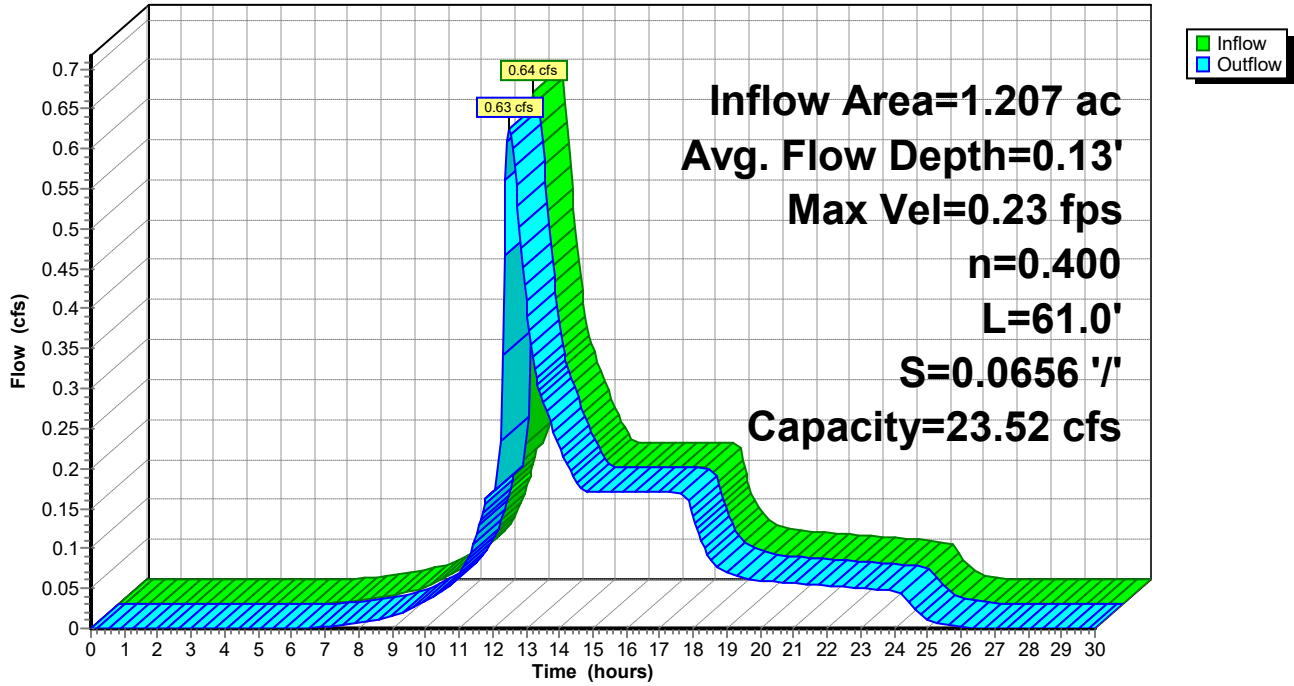Avg. Velocity = 0.09 fps, Avg. Travel Time= 10.8 min

Peak Storage= 165 cf @ 12.43 hrs
Average Depth at Peak Storage= 0.13' , Surface Width= 22.54'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 23.52 cfs

20.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 61.0' Slope= 0.0656 '/'
Inlet Invert= 106.00', Outlet Invert= 102.00'

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Reach OL1: OVERLAND TO WETLAND

Hydrograph

Inflow Area=1.207 ac
Avg. Flow Depth=0.13'
Max Vel=0.23 fps
n=0.400
L=61.0'
S=0.0656 '/'
Capacity=23.52 cfs

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Summary for Pond RG1: TO DP#1

[44] Hint: Outlet device #2 is below defined storage
[61] Hint: Exceeded Reach DMH1 outlet invert by 0.04' @ 12.35 hrs

Inflow Area =   1.207 ac, 10.83% Impervious, Inflow Depth = 1.67"   for 2-Year event
Inflow   =   2.07 cfs @ 12.14 hrs, Volume=   0.168 af
Outflow   =   0.64 cfs @ 12.37 hrs, Volume=   0.168 af, Atten= 69%, Lag= 13.9 min
Primary   =   0.64 cfs @ 12.37 hrs, Volume=   0.168 af
   Routed to Reach OL1 : OVERLAND TO WETLAND
Secondary =   0.00 cfs @   0.00 hrs, Volume=   0.000 af
   Routed to Reach OL1 : OVERLAND TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 109.74' @ 12.37 hrs   Surf.Area= 3,249 sf   Storage= 1,878 cf

Plug-Flow detention time= 57.8 min calculated for 0.168 af (100% of inflow)
Center-of-Mass det. time= 57.8 min (910.0 - 852.2)

Volume	Invert	Avail.Storage	Storage Description
#1	109.00'	17,787 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
109.00	1,833	0	0
110.00	3,749	2,791	2,791
112.00	5,396	9,145	11,936
113.00	6,305	5,851	17,787

Device	Routing	Invert	Outlet Devices
#1	Secondary	112.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Device 5	106.50'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Device 5	109.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 5	110.50'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#5	Primary	106.40'	**12.0" Round Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 106.40' / 106.00' S= 0.0057 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.63 cfs @ 12.37 hrs HW=109.74'   (Free Discharge)
└─**5=Culvert** (Passes 0.63 cfs of 5.03 cfs potential flow)
  ├─**2=Special & User-Defined** (Custom Controls 0.17 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.46 cfs @ 1.66 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=109.00'   (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Pond RG1: TO DP#1

Hydrograph

Inflow Area=1.207 ac
Peak Elev=109.74'
Storage=1,878 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

2.07 cfs
0.64 cfs
0.64 cfs
0.00 cfs
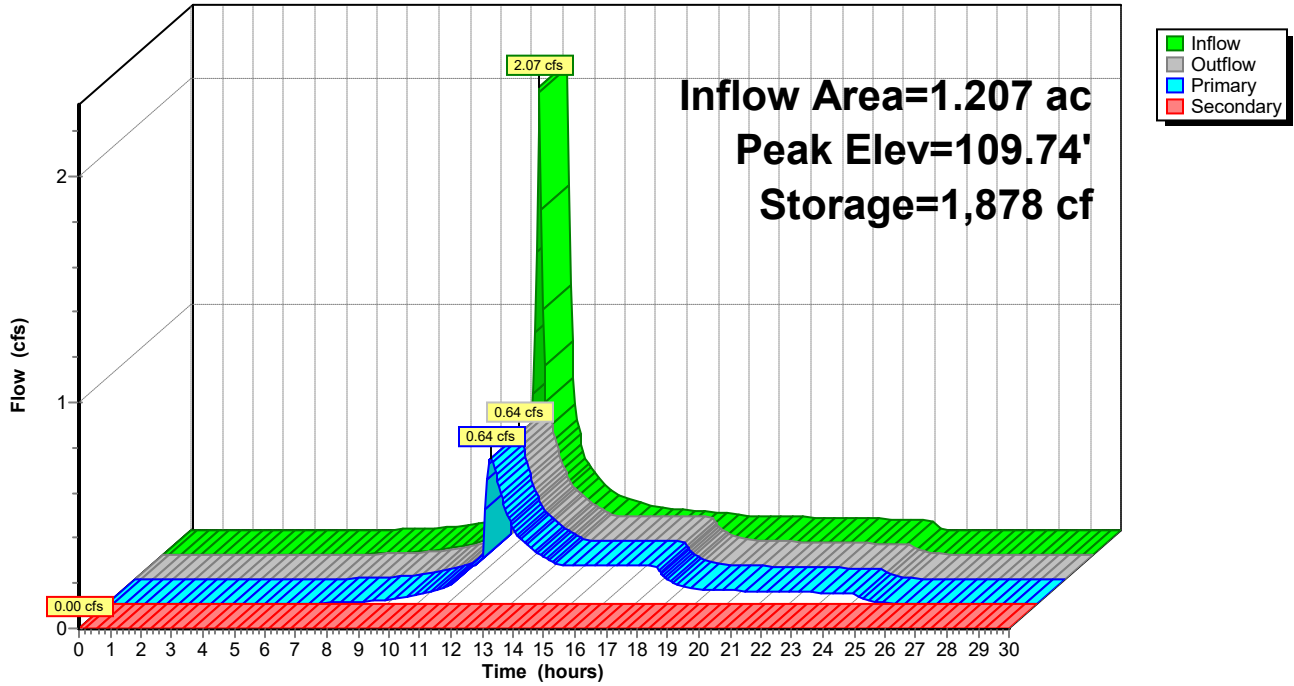
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P100: TO RAIN GARDEN
Runoff Area=20,880 sf 15.57% Impervious Runoff Depth=2.70"
Flow Length=290' Tc=6.0 min CN=81 Runoff=1.39 cfs 0.108 af

Subcatchment P101: TO DCB#2
Runoff Area=7,003 sf 5.65% Impervious Runoff Depth=3.17"
Flow Length=173' Tc=5.3 min CN=86 Runoff=0.54 cfs 0.042 af

Subcatchment p102: (new Subcat)
Runoff Area=19,100 sf 5.97% Impervious Runoff Depth=3.27"
Flow Length=272' Tc=5.0 min CN=87 Runoff=1.55 cfs 0.119 af

Subcatchment p103: TO DCB#3
Runoff Area=5,597 sf 16.22% Impervious Runoff Depth=3.27"
Flow Length=143' Tc=8.3 min CN=87 Runoff=0.41 cfs 0.035 af

Subcatchment P11A: OVERLAND TO DP#1
Runoff Area=216,407 sf 4.99% Impervious Runoff Depth=2.27"
Flow Length=307' Tc=12.2 min CN=76 Runoff=9.83 cfs 0.942 af

Subcatchment P12: TO CULVERT
Runoff Area=131,668 sf 0.00% Impervious Runoff Depth=1.80"
Flow Length=805' Tc=24.0 min CN=70 Runoff=3.42 cfs 0.454 af

Reach CUL1: TO DP#1
Avg. Flow Depth=0.64' Max Vel=2.69 fps Inflow=3.42 cfs 0.454 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=3.42 cfs 0.454 af

Reach DCB1: TO DMH#1
Avg. Flow Depth=0.41' Max Vel=5.04 fps Inflow=1.55 cfs 0.119 af
12.0" Round Pipe n=0.010 L=34.0' S=0.0088 '/' Capacity=4.35 cfs Outflow=1.52 cfs 0.119 af

Reach DCB2: TO DMH#2
Avg. Flow Depth=0.17' Max Vel=7.75 fps Inflow=0.54 cfs 0.042 af
8.0" Round Pipe n=0.010 L=5.0' S=0.0600 '/' Capacity=3.85 cfs Outflow=0.54 cfs 0.042 af

Reach DCB3: TO DMH#2
Avg. Flow Depth=0.24' Max Vel=3.63 fps Inflow=0.41 cfs 0.035 af
8.0" Round Pipe n=0.010 L=165.0' S=0.0091 '/' Capacity=1.50 cfs Outflow=0.39 cfs 0.035 af

Reach DMH1: TO RAIN GARDEN
Avg. Flow Depth=0.48' Max Vel=5.44 fps Inflow=2.36 cfs 0.197 af
15.0" Round Pipe n=0.011 L=85.0' S=0.0099 '/' Capacity=7.59 cfs Outflow=2.35 cfs 0.197 af

Reach DMH2: TO DMH#1
Avg. Flow Depth=0.28' Max Vel=4.92 fps Inflow=0.90 cfs 0.077 af
12.0" Round Pipe n=0.013 L=187.0' S=0.0209 '/' Capacity=5.15 cfs Outflow=0.88 cfs 0.077 af

Reach DP#1A: WETLAND SERIES 1(SOUTH
Inflow=13.45 cfs 1.700 af
Outflow=13.45 cfs 1.700 af

Reach OL1: OVERLAND TO WETLAND
Avg. Flow Depth=0.23' Max Vel=0.34 fps Inflow=1.78 cfs 0.305 af
n=0.400 L=61.0' S=0.0656 '/' Capacity=23.52 cfs Outflow=1.76 cfs 0.305 af

Pond RG1: TO DP#1
Peak Elev=110.07' Storage=3,070 cf Inflow=3.73 cfs 0.305 af
Primary=1.78 cfs 0.305 af Secondary=0.00 cfs 0.000 af Outflow=1.78 cfs 0.305 af

Total Runoff Area = 9.198 ac   Runoff Volume = 1.700 af   Average Runoff Depth = 2.22"
95.88% Pervious = 8.819 ac   4.12% Impervious = 0.379 ac

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Summary for Subcatchment P100: TO RAIN GARDEN

Runoff   =   1.39 cfs @ 12.13 hrs, Volume=   0.108 af, Depth= 2.70"
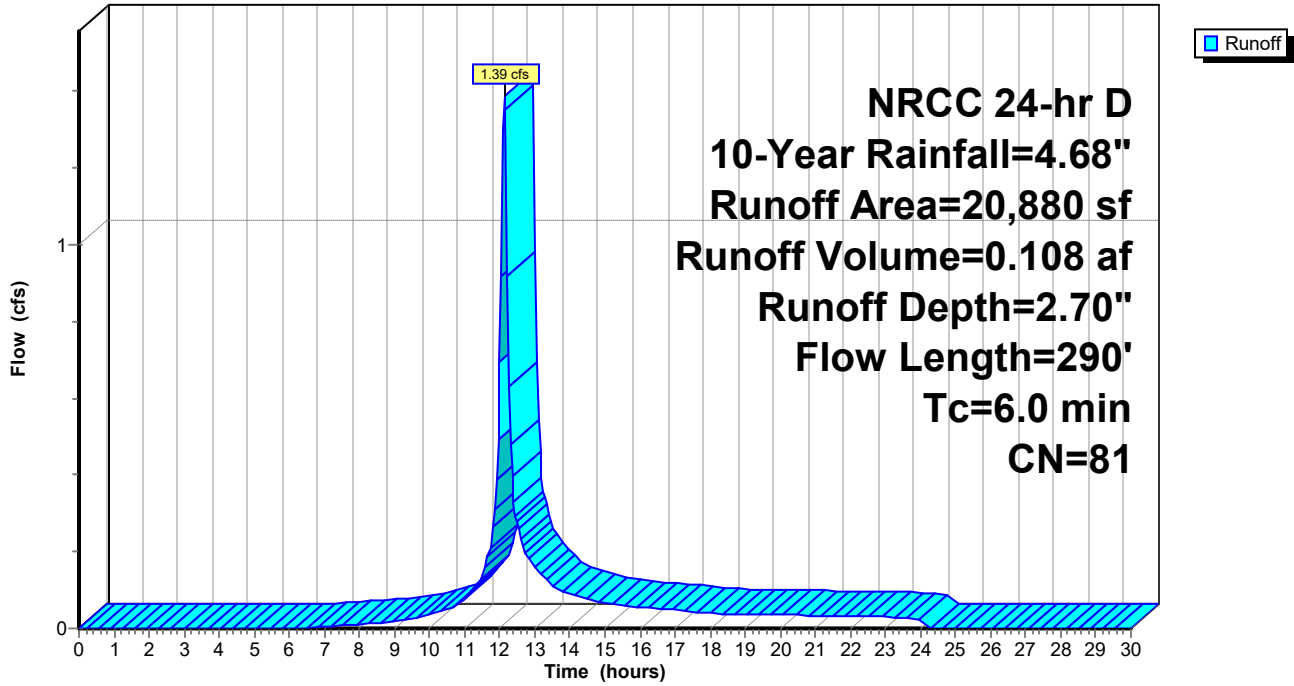   Routed to Pond RG1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
13,576	74	>75% Grass cover, Good, HSG C
161	70	Woods, Good, HSG C
3,252	98	Paved parking, HSG C
2,891	96	Gravel surface, HSG C
1,000	89	Gravel roads, HSG C
20,880	81	Weighted Average
17,628		84.43% Pervious Area
3,252		15.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	15	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.2	29	0.3330	0.40		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	6	0.0300	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	113	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	81	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	46	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.0	290	Total			

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Subcatchment P100: TO RAIN GARDEN

Hydrograph

□ Runoff

1.39 cfs

**NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=20,880 sf
Runoff Volume=0.108 af
Runoff Depth=2.70"
Flow Length=290'
Tc=6.0 min
CN=81**

Flow (cfs)

Time (hours)

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Summary for Subcatchment P101: TO DCB#2

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   0.54 cfs @ 12.12 hrs, Volume=   0.042 af, Depth= 3.17"
   Routed to Reach DCB2 : TO DMH#2

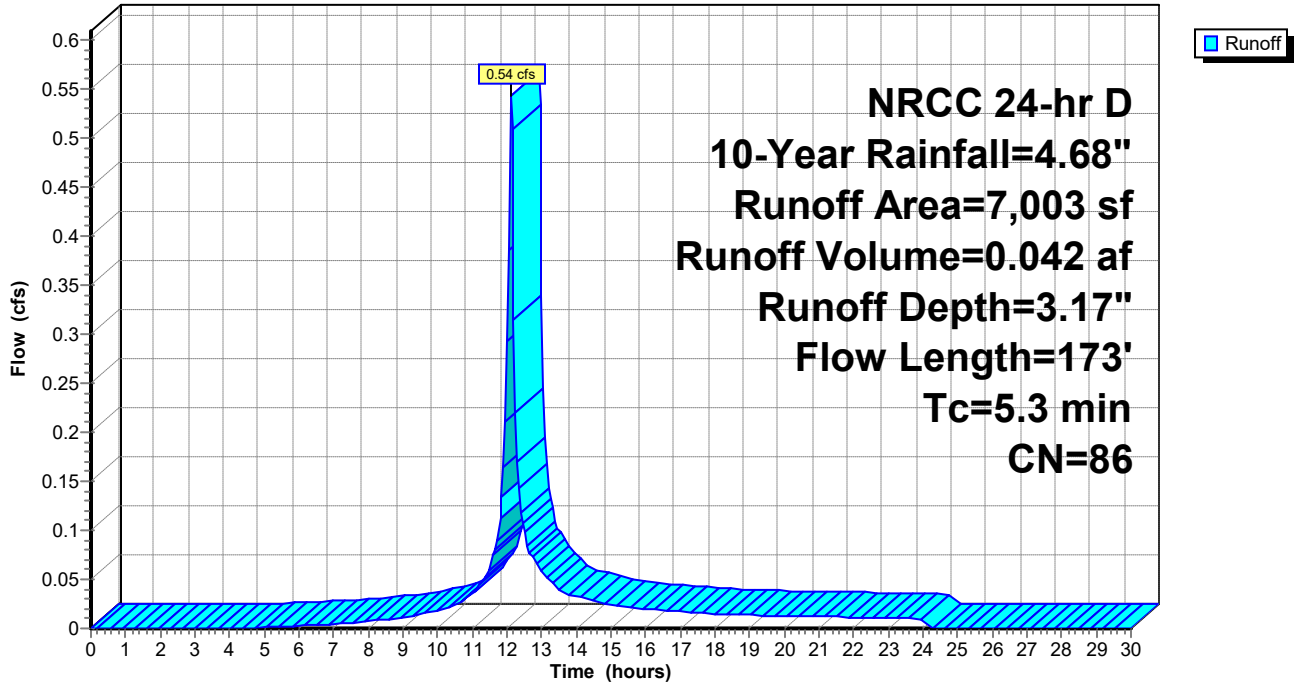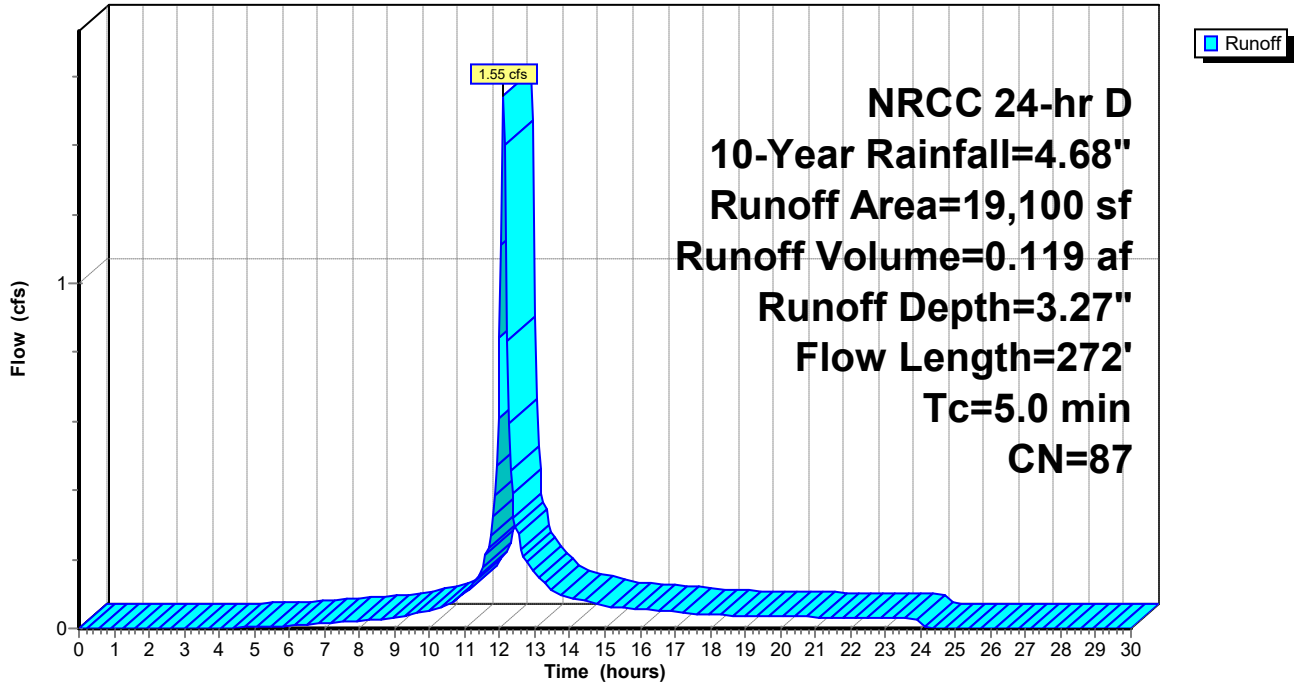Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
1,719	74	>75% Grass cover, Good, HSG C
715	70	Woods, Good, HSG C
396	98	Paved parking, HSG C
2,020	96	Gravel surface, HSG C
2,153	89	Gravel roads, HSG C
7,003	86	Weighted Average
6,607		94.35% Pervious Area
396		5.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	16	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.2	14	0.0300	1.06		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	123	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.3	173	Total			

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Subcatchment P101: TO DCB#2

Hydrograph

0.54 cfs

NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=7,003 sf
Runoff Volume=0.042 af
Runoff Depth=3.17"
Flow Length=173'
Tc=5.3 min
CN=86

Flow (cfs)

Time (hours)

☐ Runoff

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Summary for Subcatchment p102: (new Subcat)

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   1.55 cfs @ 12.11 hrs, Volume=   0.119 af, Depth= 3.27"
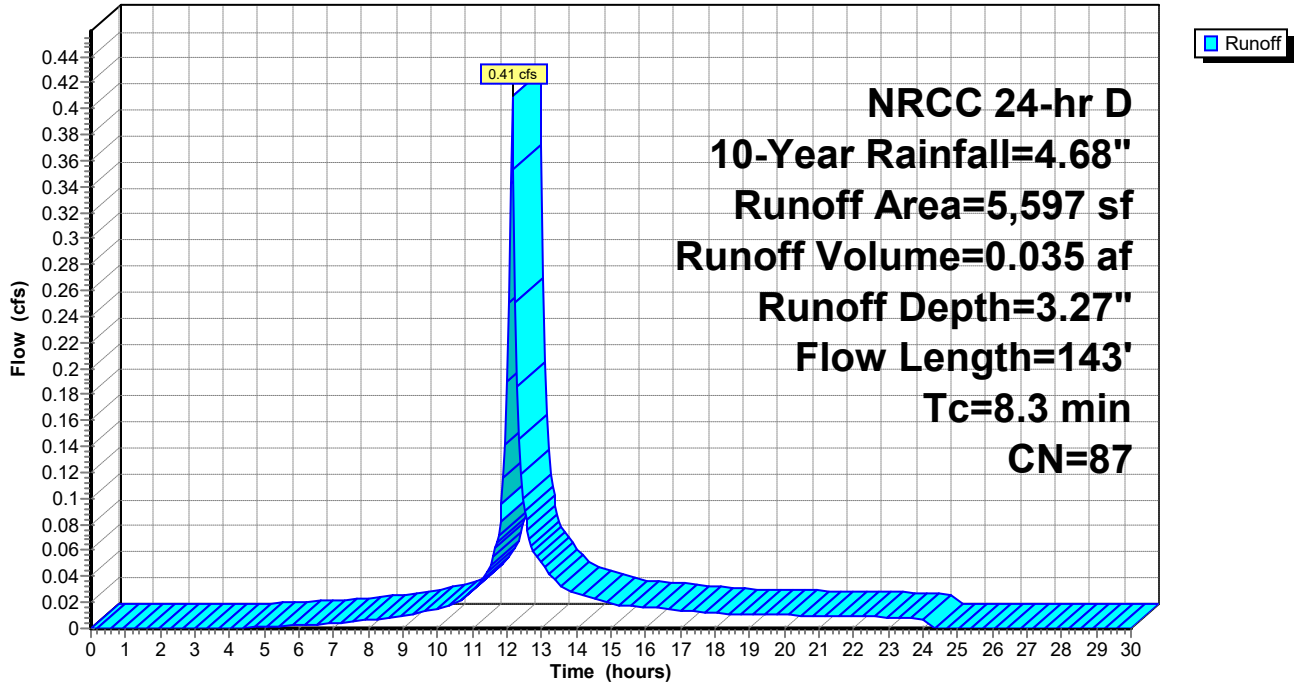   Routed to Reach DCB1 : TO DMH#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
5,623	74	>75% Grass cover, Good, HSG C
528	70	Woods, Good, HSG C
1,140	98	Paved parking, HSG C
7,733	96	Gravel surface, HSG C
4,076	89	Gravel roads, HSG C
19,100	87	Weighted Average
17,960		94.03% Pervious Area
1,140		5.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.4	30	0.0250	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	222	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.9	272				Total, Increased to minimum Tc = 5.0 min

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Subcatchment p102: (new Subcat)

Hydrograph

NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=19,100 sf
Runoff Volume=0.119 af
Runoff Depth=3.27"
Flow Length=272'
Tc=5.0 min
CN=87

1.55 cfs

□ Runoff

Flow (cfs)

Time (hours)

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Summary for Subcatchment p103: TO DCB#3

Runoff   =   0.41 cfs @ 12.15 hrs, Volume=   0.035 af, Depth= 3.27"
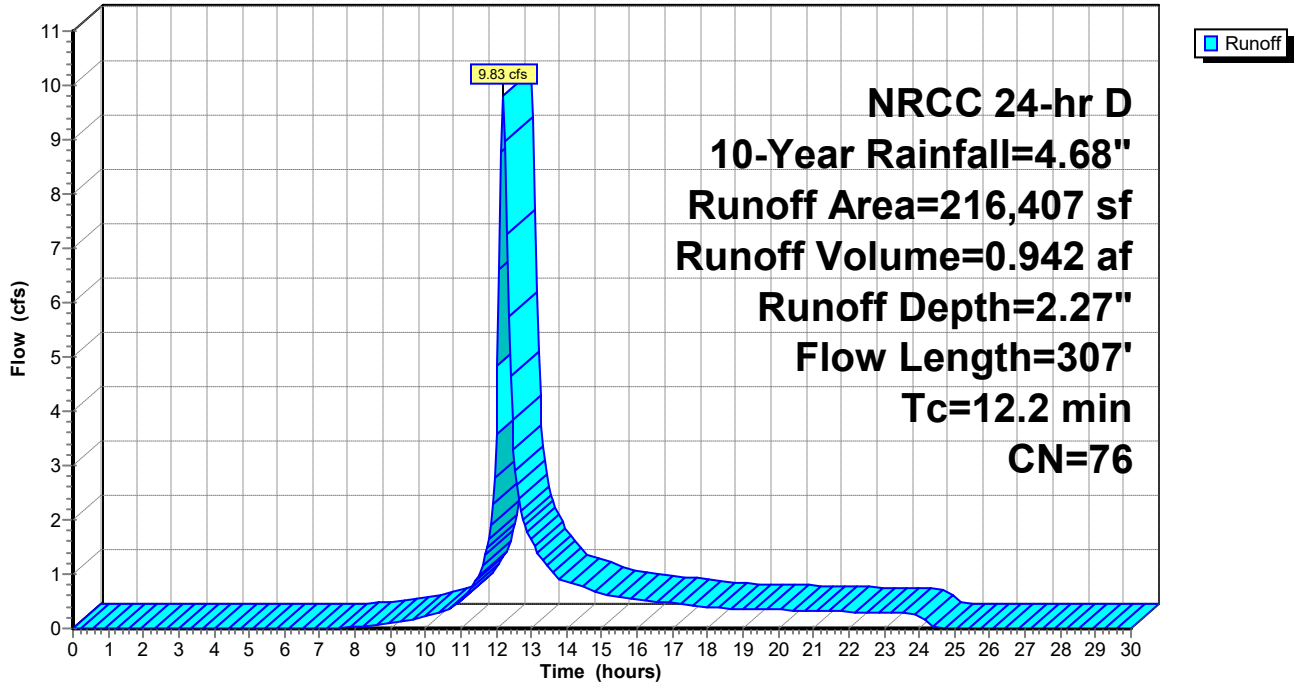 Routed to Reach DCB3 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
1,015	74	>75% Grass cover, Good, HSG C
855	70	Woods, Good, HSG C
908	98	Paved parking, HSG C
1,653	96	Gravel surface, HSG C
1,166	89	Gravel roads, HSG C
5,597	87	Weighted Average
4,689		83.78% Pervious Area
908		16.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	40	0.0540	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.5	10	0.3300	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	93	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.3	143	Total			

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Subcatchment p103: TO DCB#3

Hydrograph

NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=5,597 sf
Runoff Volume=0.035 af
Runoff Depth=3.27"
Flow Length=143'
Tc=8.3 min
CN=87

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Summary for Subcatchment P11A: OVERLAND TO DP#1

Runoff   =   9.83 cfs @ 12.20 hrs, Volume=   0.942 af, Depth= 2.27"
  Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
20,934	74	>75% Grass cover, Good, HSG C
150,407	70	Woods, Good, HSG C
32,655	96	Gravel surface, HSG C
10,055	98	Paved parking, HSG C
1,617	89	Gravel roads, HSG C
739	98	Paved parking, HSG C
216,407	76	Weighted Average
205,613		95.01% Pervious Area
10,794		4.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.0	68	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	38	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	27	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.1	124	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	307	Total			

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NRCC 24-hr D 10-Year Rainfall=4.68"
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Subcatchment P11A: OVERLAND TO DP#1

Hydrograph

**NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=216,407 sf
Runoff Volume=0.942 af
Runoff Depth=2.27"
Flow Length=307'
Tc=12.2 min
CN=76**

9.83 cfs

Runoff

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Summary for Subcatchment P12: TO CULVERT

Runoff   =   3.42 cfs @ 12.35 hrs, Volume=   0.454 af, Depth= 1.80"
   Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.68"

Area (sf)	CN	Description
129,407	70	Woods, Good, HSG C
2,261	74	>75% Grass cover, Good, HSG C
131,668	70	Weighted Average
131,668		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment P12: TO CULVERT

Hydrograph

NRCC 24-hr D
10-Year Rainfall=4.68"
Runoff Area=131,668 sf
Runoff Volume=0.454 af
Runoff Depth=1.80"
Flow Length=805'
Tc=24.0 min
CN=70

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NRCC 24-hr D 10-Year Rainfall=4.68"
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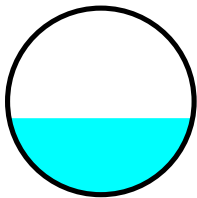Page 48

Summary for Reach CUL1: TO DP#1

Inflow Area =   3.023 ac,   0.00% Impervious, Inflow Depth = 1.80"   for 10-Year event
Inflow   =   3.42 cfs @ 12.35 hrs, Volume=   0.454 af
Outflow   =   3.42 cfs @ 12.36 hrs, Volume=   0.454 af, Atten= 0%, Lag= 0.4 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.69 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.07 fps, Avg. Travel Time= 0.6 min

Peak Storage= 46 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.64' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Inflow Area=3.023 ac
Avg. Flow Depth=0.64'
Max Vel=2.69 fps
n=0.025
L=36.0'
S=0.0072 '/'
Capacity=15.42 cfs
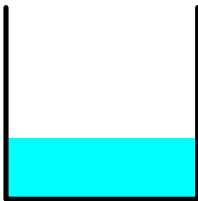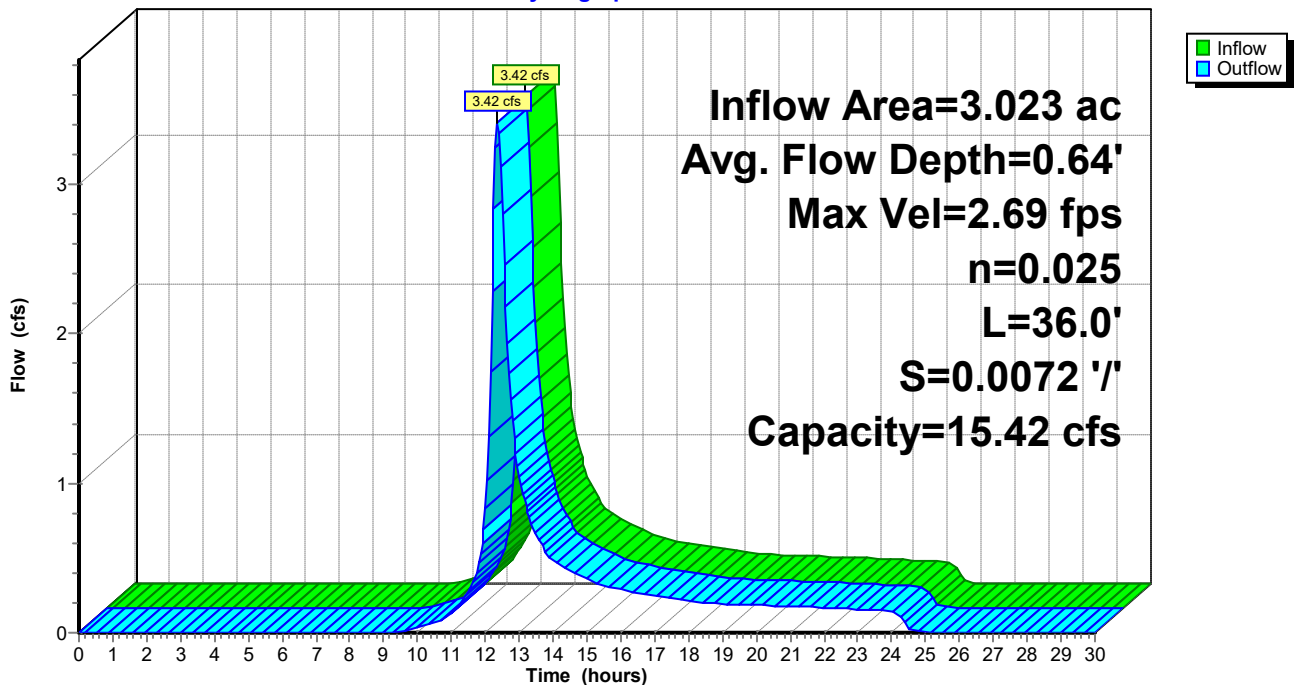
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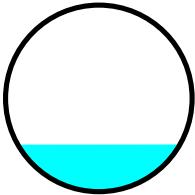
Summary for Reach DCB1: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.438 ac,   5.97% Impervious, Inflow Depth = 3.27"   for 10-Year event
Inflow   =   1.55 cfs @ 12.11 hrs, Volume=   0.119 af
Outflow   =   1.52 cfs @ 12.12 hrs, Volume=   0.119 af, Atten= 1%, Lag= 0.3 min
    Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.04 fps, Min. Travel Time= 0.1 min
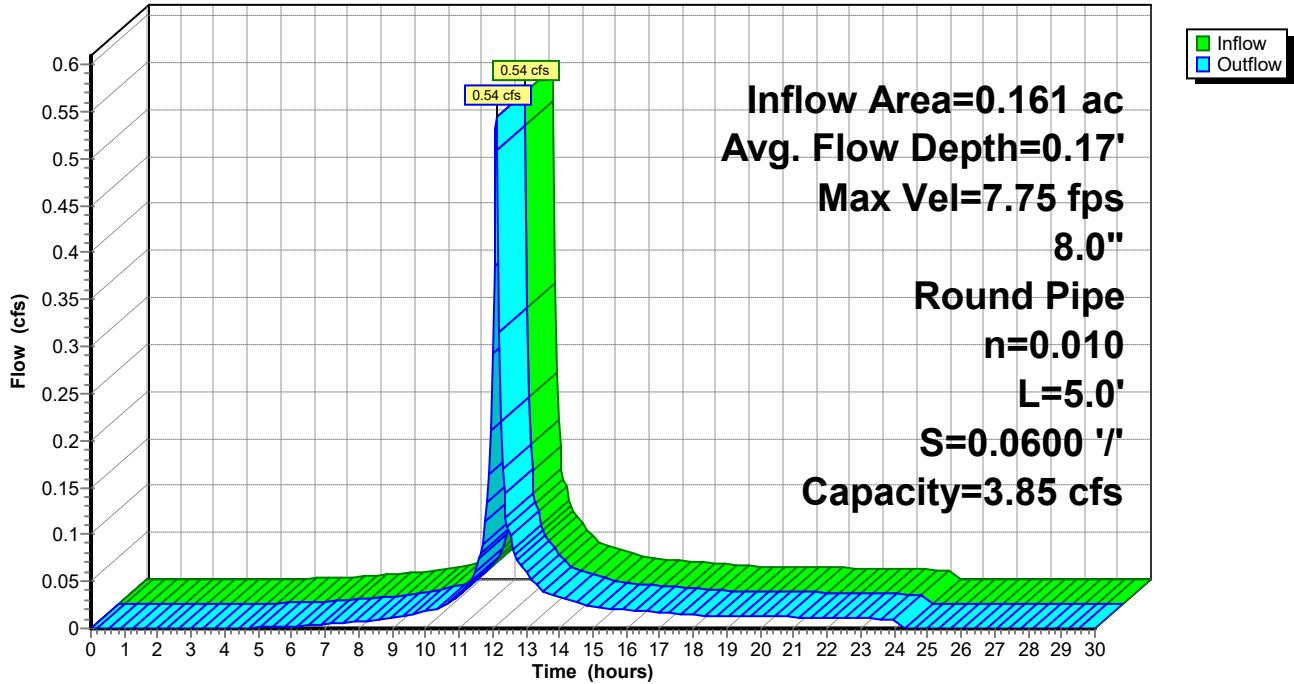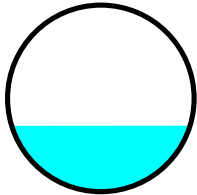Avg. Velocity = 1.78 fps, Avg. Travel Time= 0.3 min

Peak Storage= 10 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.41' , Surface Width= 0.98'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.35 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 34.0' Slope= 0.0088 '/'
Inlet Invert= 110.80', Outlet Invert= 110.50'

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Reach DCB1: TO DMH#1

Hydrograph

Inflow Area=0.438 ac
Avg. Flow Depth=0.41'
Max Vel=5.04 fps
12.0"
Round Pipe
n=0.010
L=34.0'
S=0.0088 '/'
Capacity=4.35 cfs
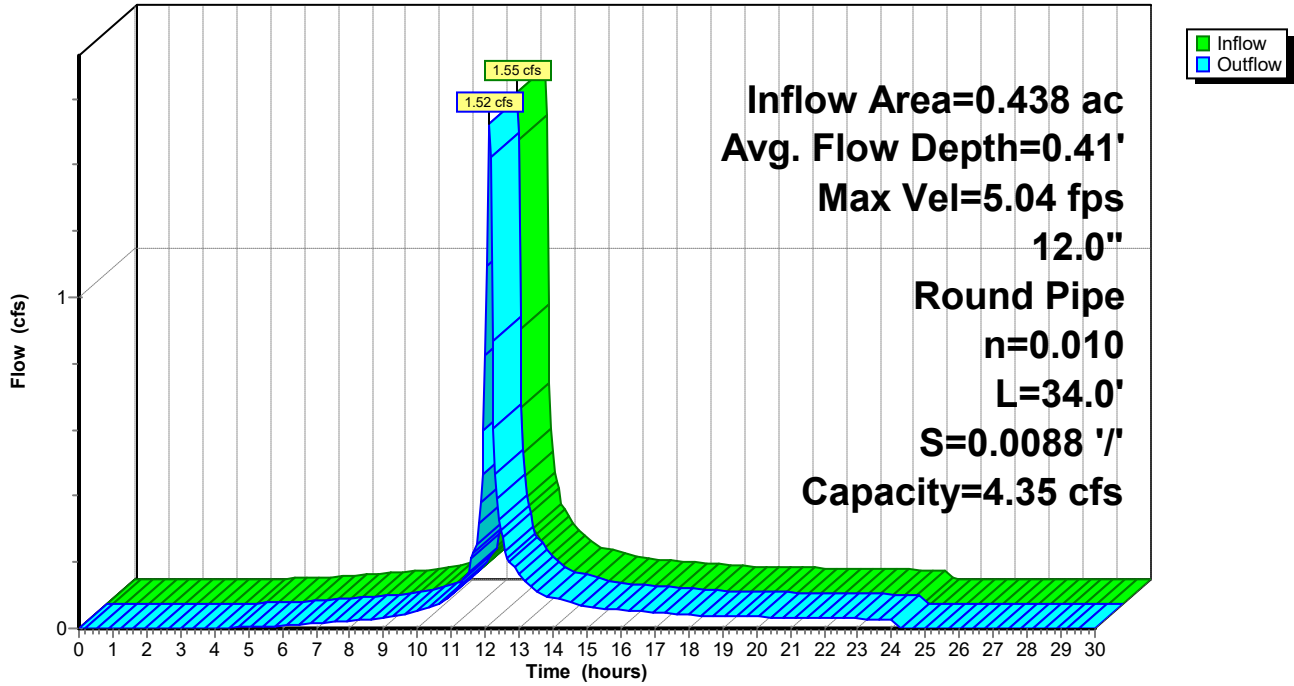
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Summary for Reach DCB2: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.161 ac,   5.65% Impervious, Inflow Depth = 3.17"   for 10-Year event
Inflow   =   0.54 cfs @ 12.12 hrs, Volume=   0.042 af
Outflow   =   0.54 cfs @ 12.12 hrs, Volume=   0.042 af, Atten= 0%, Lag= 0.0 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.75 fps, Min. Travel Time= 0.0 min
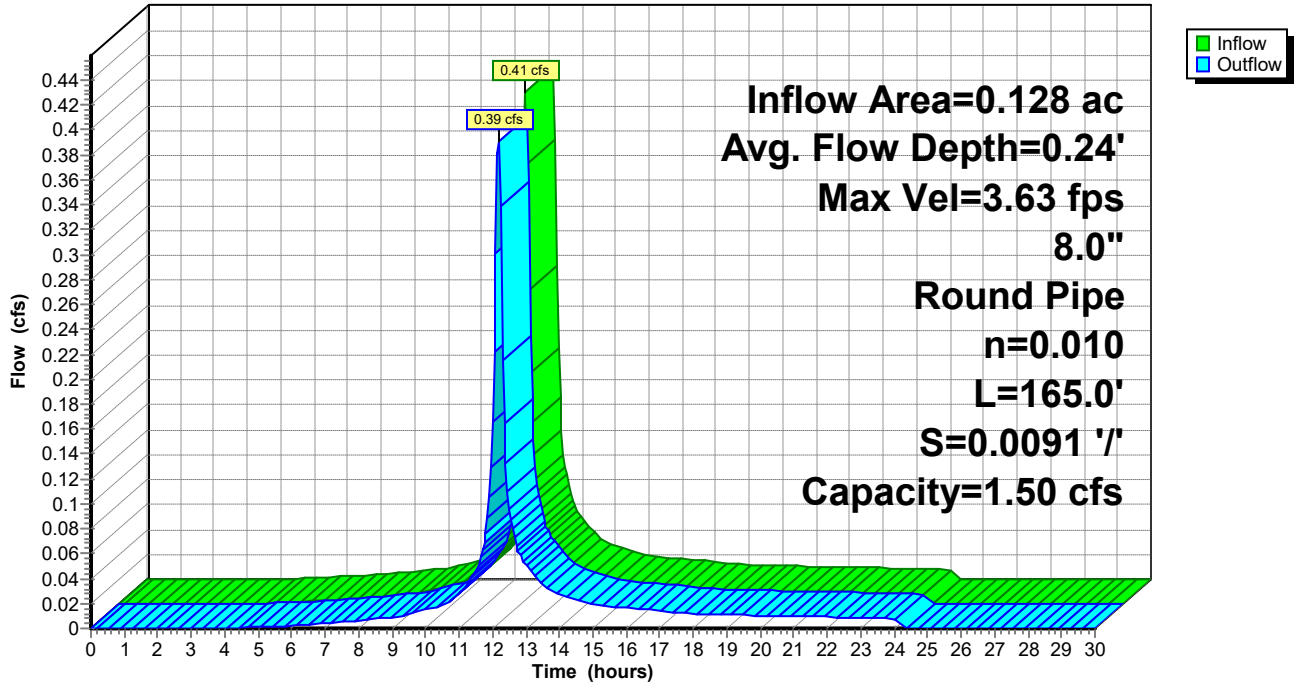Avg. Velocity = 2.73 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 0.58'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 3.85 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 5.0'   Slope= 0.0600 '/'
Inlet Invert= 114.80', Outlet Invert= 114.50'

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Reach DCB2: TO DMH#2

Hydrograph

Inflow Area=0.161 ac
Avg. Flow Depth=0.17'
Max Vel=7.75 fps
8.0"
Round Pipe
n=0.010
L=5.0'
S=0.0600 '/'
Capacity=3.85 cfs

0.54 cfs
0.54 cfs

Inflow
Outflow

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Summary for Reach DCB3: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.128 ac, 16.22% Impervious, Inflow Depth = 3.27"   for 10-Year event
Inflow   =   0.41 cfs @ 12.15 hrs, Volume=   0.035 af
Outflow   =   0.39 cfs @ 12.17 hrs, Volume=   0.035 af, Atten= 5%, Lag= 1.3 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.63 fps, Min. Travel Time= 0.8 min
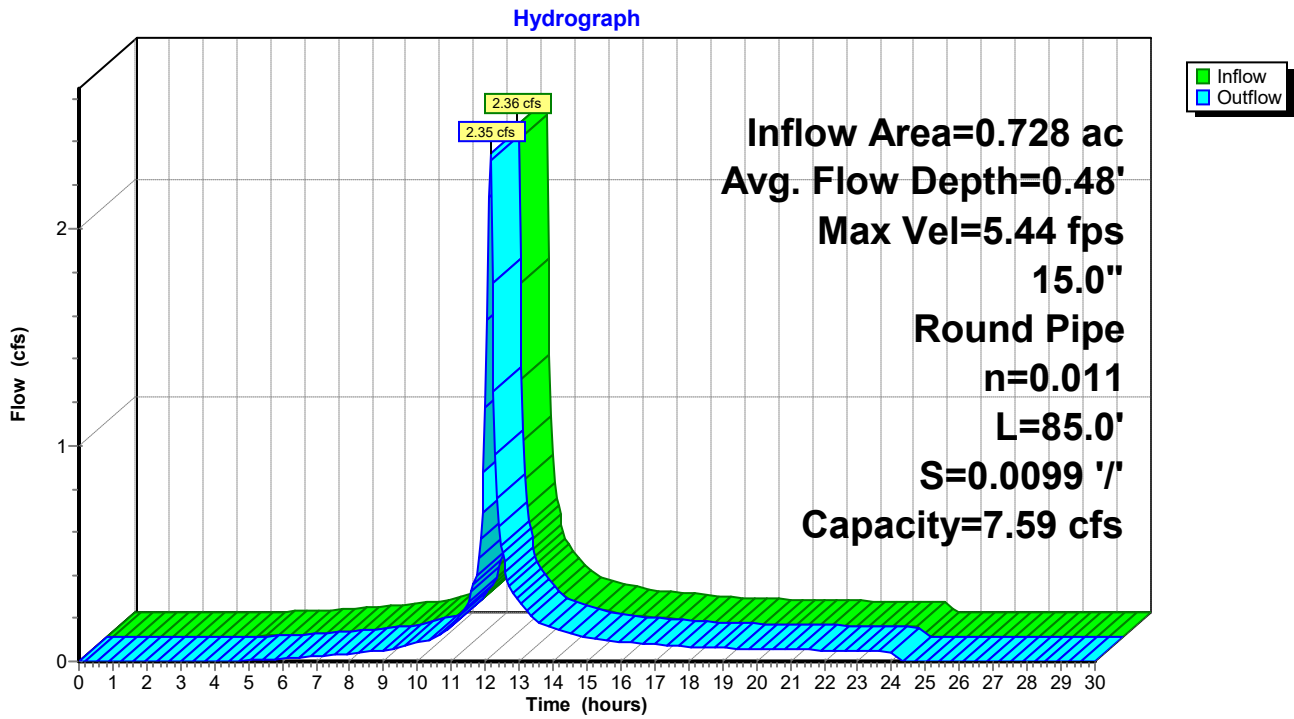Avg. Velocity = 1.31 fps, Avg. Travel Time= 2.1 min

Peak Storage= 18 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.24' , Surface Width= 0.64'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.50 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 165.0' Slope= 0.0091 '/'
Inlet Invert= 116.00', Outlet Invert= 114.50'

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Reach DCB3: TO DMH#2

Hydrograph

Inflow Area=0.128 ac
Avg. Flow Depth=0.24'
Max Vel=3.63 fps
8.0"
Round Pipe
n=0.010
L=165.0'
S=0.0091 '/'
Capacity=1.50 cfs

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Summary for Reach DMH1: TO RAIN GARDEN

[52] Hint: Inlet/Outlet conditions not evaluated
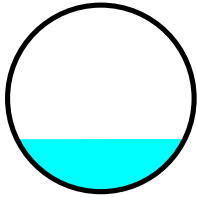[62] Hint: Exceeded Reach DCB1 OUTLET depth by 0.14' @ 12.20 hrs
[62] Hint: Exceeded Reach DMH2 OUTLET depth by 0.24' @ 12.10 hrs

Inflow Area =   0.728 ac,   7.71% Impervious, Inflow Depth = 3.25"   for 10-Year event
Inflow   =   2.36 cfs @ 12.13 hrs, Volume=   0.197 af
Outflow   =   2.35 cfs @ 12.14 hrs, Volume=   0.197 af, Atten= 1%, Lag= 0.5 min
    Routed to Pond RG1 : TO DP#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.44 fps, Min. Travel Time= 0.3 min
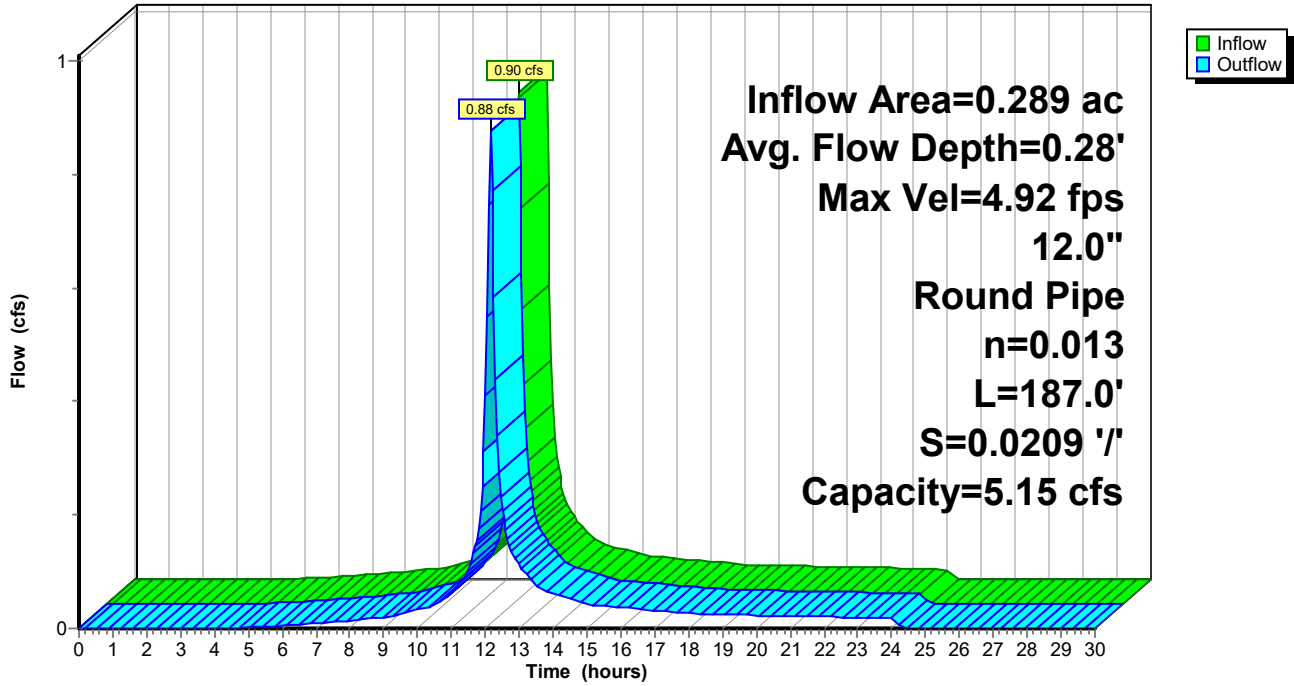Avg. Velocity = 1.92 fps, Avg. Travel Time= 0.7 min

Peak Storage= 37 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 1.22'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 7.59 cfs

15.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 85.0' Slope= 0.0099 '/'
Inlet Invert= 110.54', Outlet Invert= 109.70'

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Reach DMH1: TO RAIN GARDEN

Hydrograph

Legend: Inflow (green), Outflow (blue)

2.36 cfs
2.35 cfs

**Inflow Area=0.728 ac
Avg. Flow Depth=0.48'
Max Vel=5.44 fps
15.0"
Round Pipe
n=0.011
L=85.0'
S=0.0099 '/'
Capacity=7.59 cfs**

Flow (cfs) vs. Time (hours)
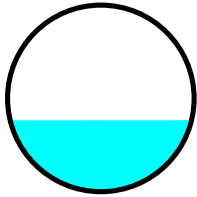
Summary for Reach DMH2: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach DCB2 OUTLET depth by 0.03' @ 12.20 hrs
[61] Hint: Exceeded Reach DCB3 outlet invert by 0.18' @ 12.15 hrs

Inflow Area = 0.289 ac, 10.35% Impervious, Inflow Depth = 3.21" for 10-Year event
Inflow = 0.90 cfs @ 12.14 hrs, Volume= 0.077 af
Outflow = 0.88 cfs @ 12.15 hrs, Volume= 0.077 af, Atten= 3%, Lag= 1.0 min
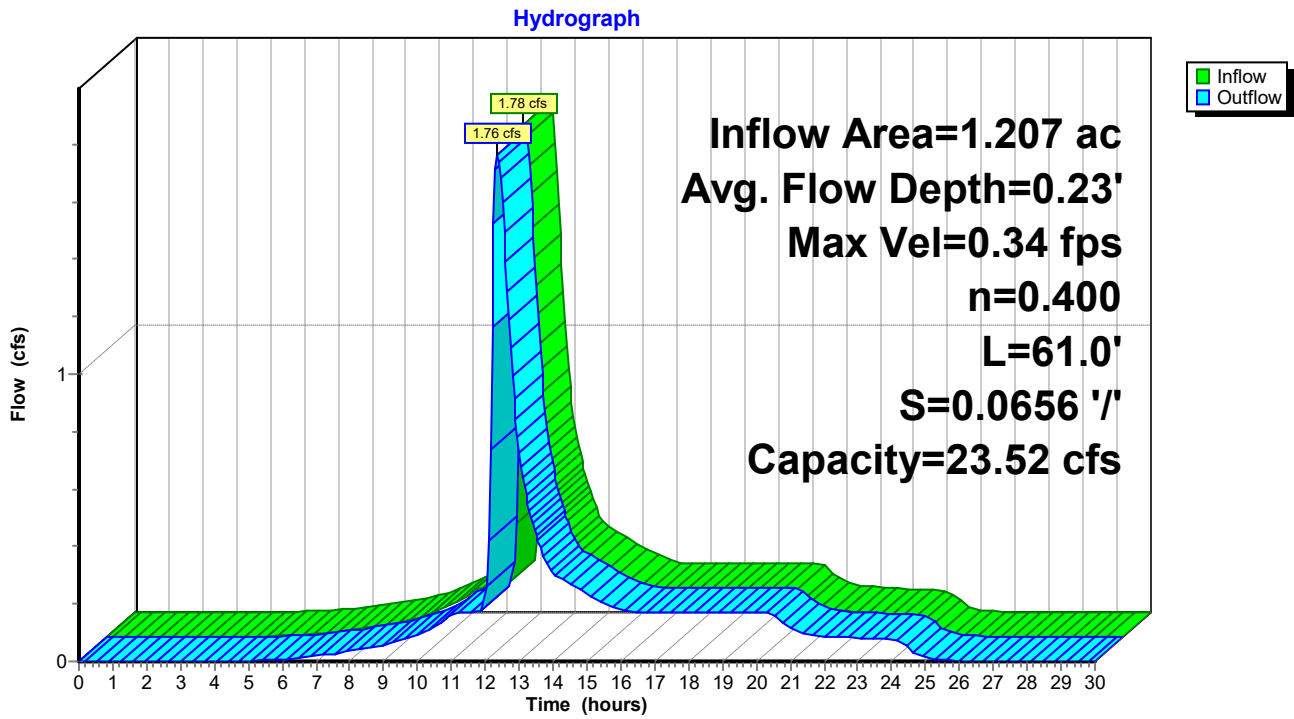   Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.92 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.75 fps, Avg. Travel Time= 1.8 min

Peak Storage= 34 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 0.90'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.15 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 187.0' Slope= 0.0209 '/'
Inlet Invert= 114.40', Outlet Invert= 110.50'

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Reach DMH2: TO DMH#1

Hydrograph

Inflow Area=0.289 ac
Avg. Flow Depth=0.28'
Max Vel=4.92 fps
12.0"
Round Pipe
n=0.013
L=187.0'
S=0.0209 '/'
Capacity=5.15 cfs

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Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH

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

Inflow Area =   9.198 ac,   4.12% Impervious, Inflow Depth = 2.22"   for 10-Year event
Inflow   =   13.45 cfs @ 12.23 hrs, Volume=   1.700 af
Outflow   =   13.45 cfs @ 12.23 hrs, Volume=   1.700 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

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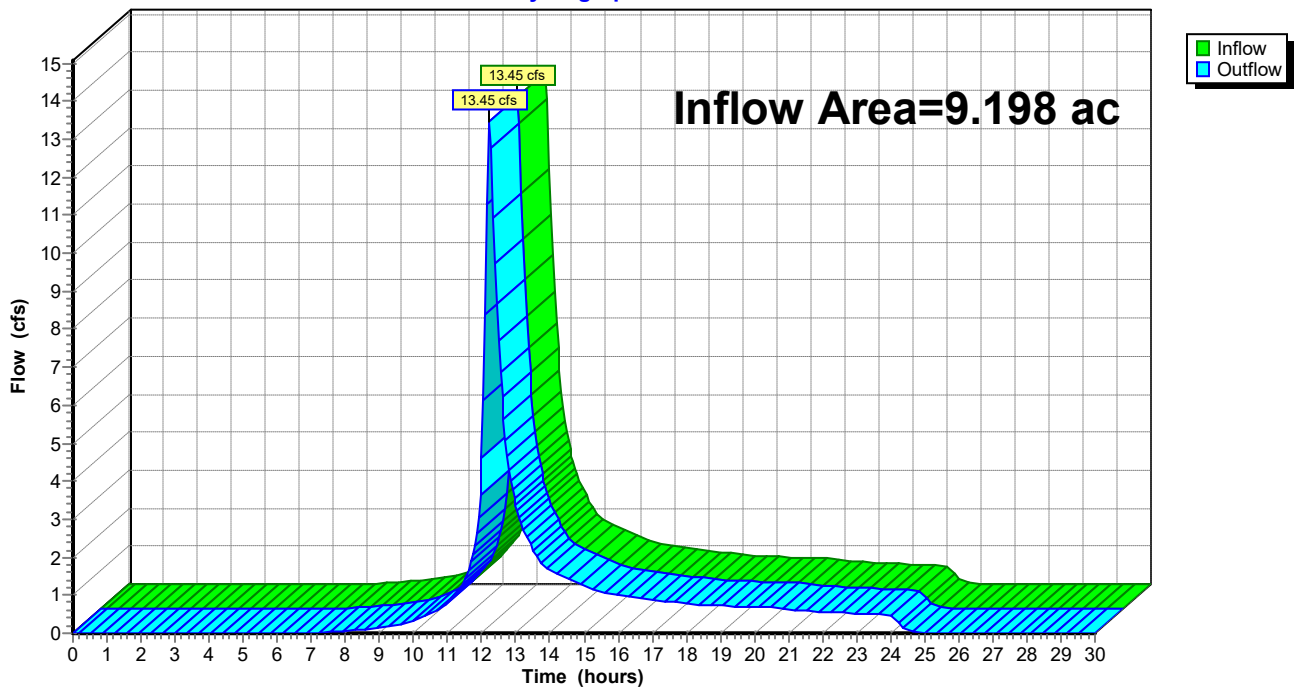
Summary for Reach OL1: OVERLAND TO WETLAND

[79] Warning: Submerged Pond RG1 Primary device # 5 OUTLET by 0.23'

Inflow Area =   1.207 ac, 10.83% Impervious, Inflow Depth = 3.03"   for 10-Year event
Inflow   =   1.78 cfs @ 12.27 hrs, Volume=   0.305 af
Outflow   =   1.76 cfs @ 12.36 hrs, Volume=   0.305 af, Atten= 1%, Lag= 5.6 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.34 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 9.2 min

Peak Storage= 318 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.23' , Surface Width= 24.67'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 23.52 cfs

20.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 10.0 '/'   Top Width= 40.00'
Length= 61.0'   Slope= 0.0656 '/'
Inlet Invert= 106.00', Outlet Invert= 102.00'

‡

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Reach OL1: OVERLAND TO WETLAND

Hydrograph

Inflow Area=1.207 ac
Avg. Flow Depth=0.23'
Max Vel=0.34 fps
n=0.400
L=61.0'
S=0.0656 '/'
Capacity=23.52 cfs

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NRCC 24-hr D 10-Year Rainfall=4.68"
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Summary for Pond RG1: TO DP#1

[44] Hint: Outlet device #2 is below defined storage
[62] Hint: Exceeded Reach DMH1 OUTLET depth by 0.08' @ 12.35 hrs

Inflow Area =	1.207 ac,	10.83% Impervious,	Inflow Depth = 3.03"	for 10-Year event
Inflow =	3.73 cfs @	12.13 hrs, Volume=	0.305 af	
Outflow =	1.78 cfs @	12.27 hrs, Volume=	0.305 af,	Atten= 52%, Lag= 7.9 min
Primary =	1.78 cfs @	12.27 hrs, Volume=	0.305 af	

   Routed to Reach OL1 : OVERLAND TO WETLAND
Secondary =   0.00 cfs @   0.00 hrs, Volume=   0.000 af
   Routed to Reach OL1 : OVERLAND TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 110.07' @ 12.27 hrs   Surf.Area= 3,810 sf   Storage= 3,070 cf

Plug-Flow detention time= 53.1 min calculated for 0.305 af (100% of inflow)
Center-of-Mass det. time= 53.0 min (883.2 - 830.3)

Volume	Invert	Avail.Storage	Storage Description
#1	109.00'	17,787 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
109.00	1,833	0	0
110.00	3,749	2,791	2,791
112.00	5,396	9,145	11,936
113.00	6,305	5,851	17,787

Device	Routing	Invert	Outlet Devices
#1	Secondary	112.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Device 5	106.50'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Device 5	109.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 5	110.50'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#5	Primary	106.40'	**12.0" Round Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 106.40' / 106.00' S= 0.0057 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.78 cfs @ 12.27 hrs HW=110.07'   (Free Discharge)
└─**5=Culvert** (Passes 1.78 cfs of 5.32 cfs potential flow)
  ├─**2=Special & User-Defined** (Custom Controls 0.17 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 1.61 cfs @ 2.73 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=109.00'   (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Pond RG1: TO DP#1
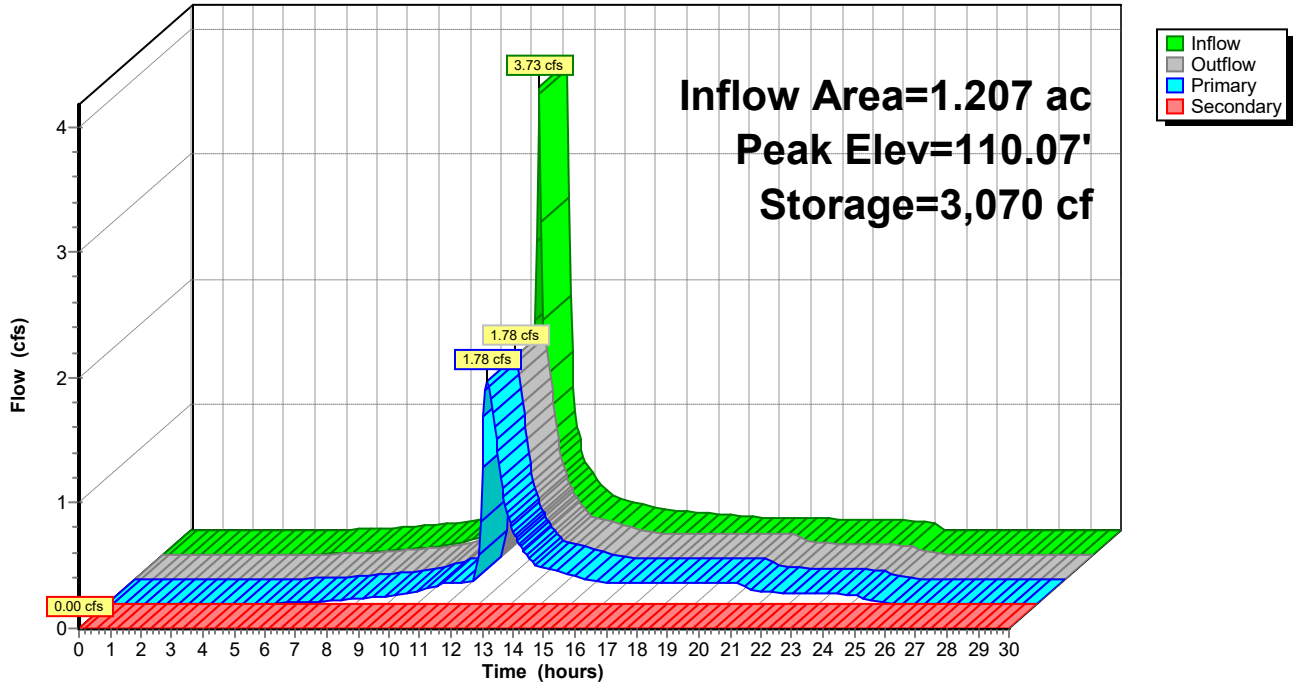
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P100: TO RAIN GARDEN

Runoff Area=20,880 sf 15.57% Impervious Runoff Depth=3.77"
Flow Length=290' Tc=6.0 min CN=81 Runoff=1.92 cfs 0.151 af

Subcatchment P101: TO DCB#2

Runoff Area=7,003 sf 5.65% Impervious Runoff Depth=4.30"
Flow Length=173' Tc=5.3 min CN=86 Runoff=0.73 cfs 0.058 af

Subcatchment p102: (new Subcat)

Runoff Area=19,100 sf 5.97% Impervious Runoff Depth=4.40"
Flow Length=272' Tc=5.0 min CN=87 Runoff=2.05 cfs 0.161 af

Subcatchment p103: TO DCB#3

Runoff Area=5,597 sf 16.22% Impervious Runoff Depth=4.40"
Flow Length=143' Tc=8.3 min CN=87 Runoff=0.54 cfs 0.047 af

Subcatchment P11A: OVERLAND TO DP#1

Runoff Area=216,407 sf 4.99% Impervious Runoff Depth=3.28"
Flow Length=307' Tc=12.2 min CN=76 Runoff=14.17 cfs 1.357 af

Subcatchment P12: TO CULVERT

Runoff Area=131,668 sf 0.00% Impervious Runoff Depth=2.71"
Flow Length=805' Tc=24.0 min CN=70 Runoff=5.25 cfs 0.683 af

Reach CUL1: TO DP#1

Avg. Flow Depth=0.87' Max Vel=3.03 fps Inflow=5.25 cfs 0.683 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=5.24 cfs 0.683 af

Reach DCB1: TO DMH#1

Avg. Flow Depth=0.48' Max Vel=5.43 fps Inflow=2.05 cfs 0.161 af
12.0" Round Pipe n=0.010 L=34.0' S=0.0088 '/' Capacity=4.35 cfs Outflow=2.02 cfs 0.161 af

Reach DCB2: TO DMH#2

Avg. Flow Depth=0.20' Max Vel=8.42 fps Inflow=0.73 cfs 0.058 af
8.0" Round Pipe n=0.010 L=5.0' S=0.0600 '/' Capacity=3.85 cfs Outflow=0.73 cfs 0.058 af

Reach DCB3: TO DMH#2

Avg. Flow Depth=0.28' Max Vel=3.93 fps Inflow=0.54 cfs 0.047 af
8.0" Round Pipe n=0.010 L=165.0' S=0.0091 '/' Capacity=1.50 cfs Outflow=0.52 cfs 0.047 af

Reach DMH1: TO RAIN GARDEN

Avg. Flow Depth=0.56' Max Vel=5.87 fps Inflow=3.15 cfs 0.266 af
15.0" Round Pipe n=0.011 L=85.0' S=0.0099 '/' Capacity=7.59 cfs Outflow=3.13 cfs 0.266 af

Reach DMH2: TO DMH#1

Avg. Flow Depth=0.33' Max Vel=5.34 fps Inflow=1.20 cfs 0.105 af
12.0" Round Pipe n=0.013 L=187.0' S=0.0209 '/' Capacity=5.15 cfs Outflow=1.17 cfs 0.105 af

Reach DP#1A: WETLAND SERIES 1(SOUTH

Inflow=19.92 cfs 2.456 af
Outflow=19.92 cfs 2.456 af

Reach OL1: OVERLAND TO WETLAND

Avg. Flow Depth=0.27' Max Vel=0.37 fps Inflow=2.33 cfs 0.416 af
n=0.400 L=61.0' S=0.0656 '/' Capacity=23.52 cfs Outflow=2.31 cfs 0.416 af

Pond RG1: TO DP#1

Peak Elev=110.33' Storage=4,073 cf Inflow=5.05 cfs 0.416 af
Primary=2.33 cfs 0.416 af Secondary=0.00 cfs 0.000 af Outflow=2.33 cfs 0.416 af

Total Runoff Area = 9.198 ac   Runoff Volume = 2.456 af   Average Runoff Depth = 3.20"
95.88% Pervious = 8.819 ac   4.12% Impervious = 0.379 ac

Summary for Subcatchment P100: TO RAIN GARDEN

Runoff = 1.92 cfs @ 12.13 hrs, Volume= 0.151 af, Depth= 3.77"
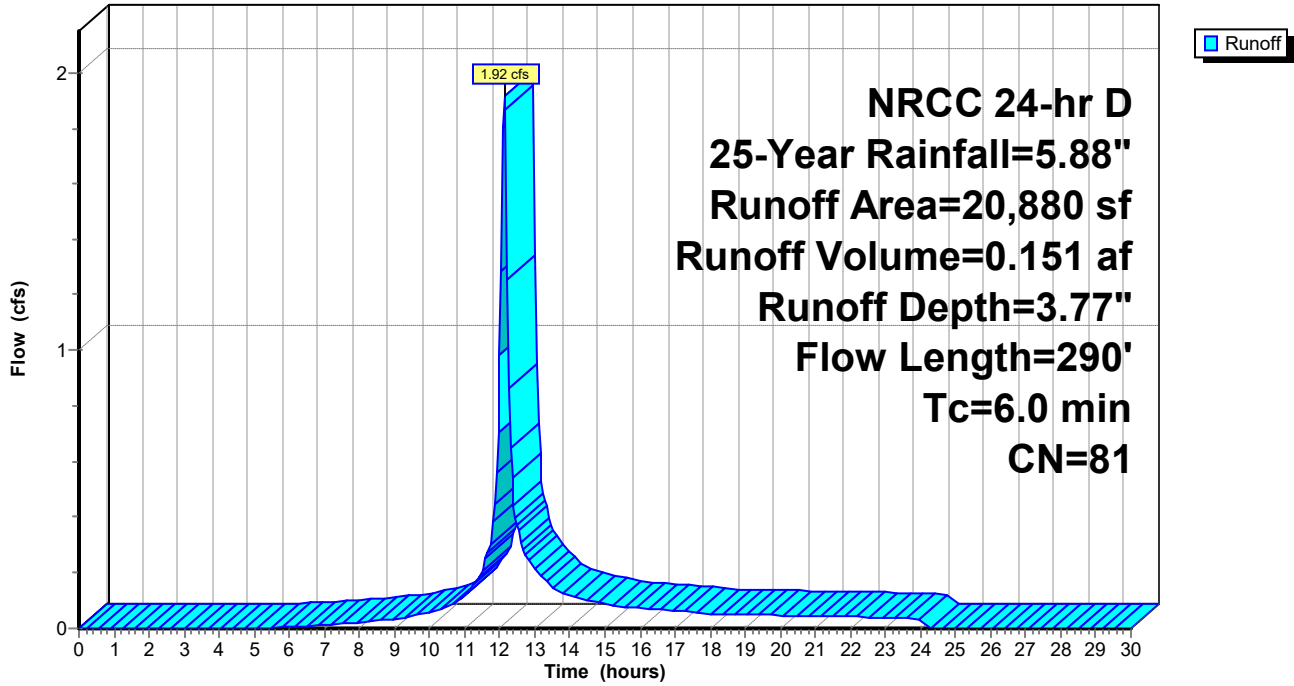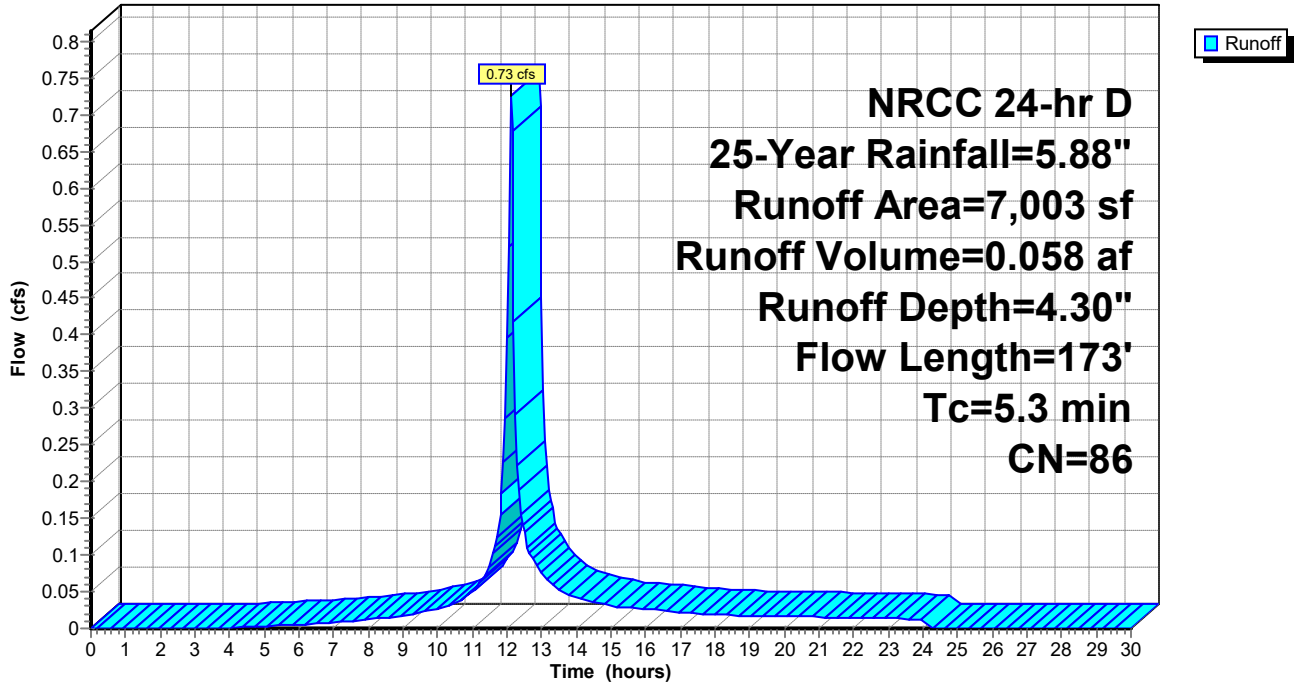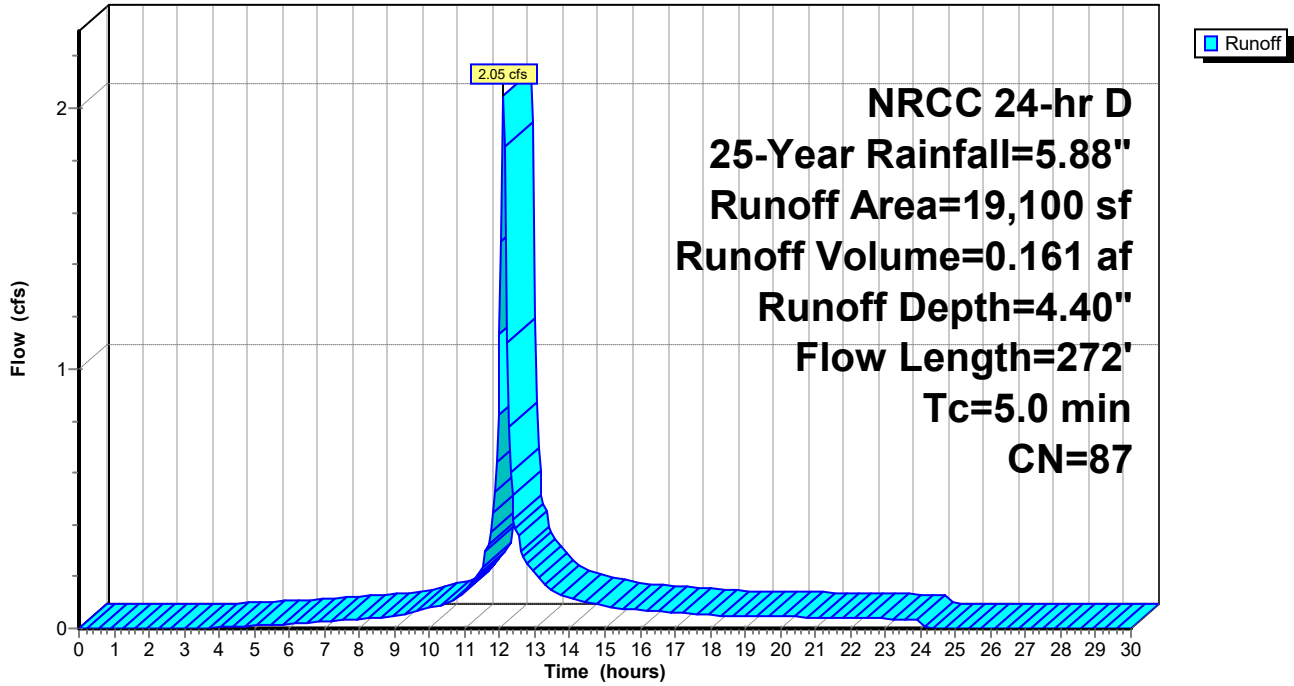 Routed to Pond RG1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
13,576	74	>75% Grass cover, Good, HSG C
161	70	Woods, Good, HSG C
3,252	98	Paved parking, HSG C
2,891	96	Gravel surface, HSG C
1,000	89	Gravel roads, HSG C
20,880	81	Weighted Average
17,628		84.43% Pervious Area
3,252		15.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	15	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.2	29	0.3330	0.40		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	6	0.0300	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	113	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	81	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	46	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.0	290	Total			

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Subcatchment P100: TO RAIN GARDEN

Hydrograph

NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=20,880 sf
Runoff Volume=0.151 af
Runoff Depth=3.77"
Flow Length=290'
Tc=6.0 min
CN=81

1.92 cfs

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Summary for Subcatchment P101: TO DCB#2

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   0.73 cfs @ 12.12 hrs, Volume=   0.058 af, Depth= 4.30"
    Routed to Reach DCB2 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
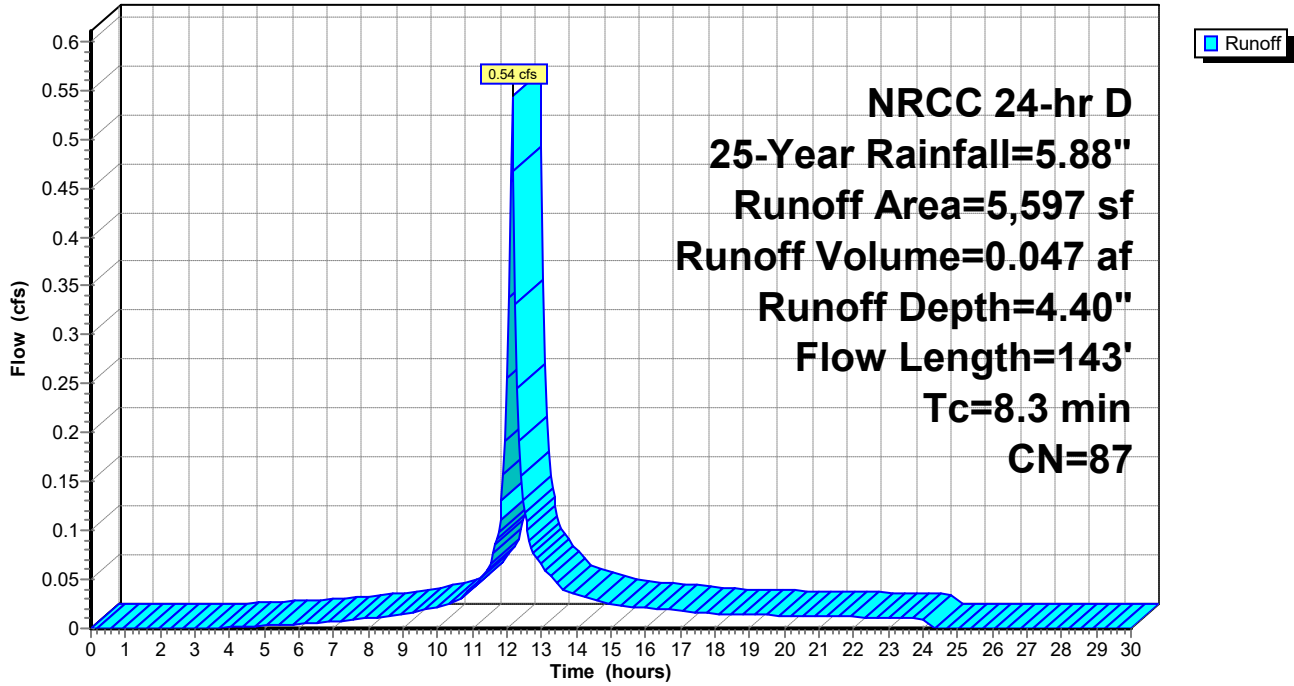NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
1,719	74	>75% Grass cover, Good, HSG C
715	70	Woods, Good, HSG C
396	98	Paved parking, HSG C
2,020	96	Gravel surface, HSG C
2,153	89	Gravel roads, HSG C
7,003	86	Weighted Average
6,607		94.35% Pervious Area
396		5.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	16	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.2	14	0.0300	1.06		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	123	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.3	173	Total			

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NRCC 24-hr D 25-Year Rainfall=5.88"
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Subcatchment P101: TO DCB#2

NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=7,003 sf
Runoff Volume=0.058 af
Runoff Depth=4.30"
Flow Length=173'
Tc=5.3 min
CN=86

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NRCC 24-hr D 25-Year Rainfall=5.88"
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Summary for Subcatchment p102: (new Subcat)

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   2.05 cfs @ 12.11 hrs, Volume=   0.161 af, Depth= 4.40"
    Routed to Reach DCB1 : TO DMH#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
5,623	74	>75% Grass cover, Good, HSG C
528	70	Woods, Good, HSG C
1,140	98	Paved parking, HSG C
7,733	96	Gravel surface, HSG C
4,076	89	Gravel roads, HSG C
19,100	87	Weighted Average
17,960		94.03% Pervious Area
1,140		5.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.4	30	0.0250	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	222	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.9	272				Total, Increased to minimum Tc = 5.0 min

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NRCC 24-hr D 25-Year Rainfall=5.88"
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Subcatchment p102: (new Subcat)

Hydrograph

Runoff

**NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=19,100 sf
Runoff Volume=0.161 af
Runoff Depth=4.40"
Flow Length=272'
Tc=5.0 min
CN=87**

2.05 cfs

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Summary for Subcatchment p103: TO DCB#3

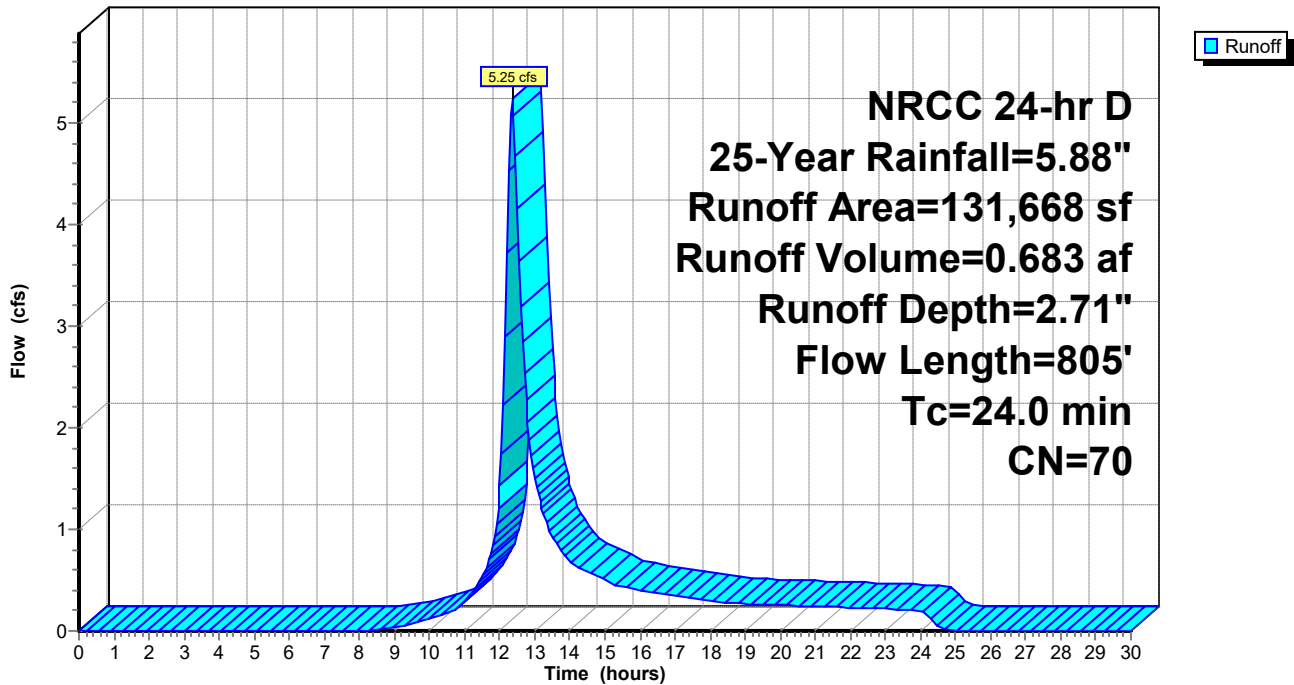Runoff   =   0.54 cfs @ 12.15 hrs, Volume=   0.047 af, Depth= 4.40"
   Routed to Reach DCB3 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
1,015	74	>75% Grass cover, Good, HSG C
855	70	Woods, Good, HSG C
908	98	Paved parking, HSG C
1,653	96	Gravel surface, HSG C
1,166	89	Gravel roads, HSG C
5,597	87	Weighted Average
4,689		83.78% Pervious Area
908		16.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	40	0.0540	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.5	10	0.3300	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	93	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.3	143	Total			

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Subcatchment p103: TO DCB#3

Hydrograph

0.54 cfs

□ Runoff

**NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=5,597 sf
Runoff Volume=0.047 af
Runoff Depth=4.40"
Flow Length=143'
Tc=8.3 min
CN=87**

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Summary for Subcatchment P11A: OVERLAND TO DP#1
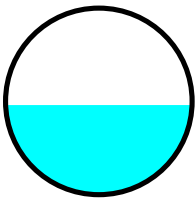
Runoff   =   14.17 cfs @ 12.20 hrs, Volume=   1.357 af, Depth= 3.28"
  Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
20,934	74	>75% Grass cover, Good, HSG C
150,407	70	Woods, Good, HSG C
32,655	96	Gravel surface, HSG C
10,055	98	Paved parking, HSG C
1,617	89	Gravel roads, HSG C
739	98	Paved parking, HSG C
216,407	76	Weighted Average
205,613		95.01% Pervious Area
10,794		4.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.0	68	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	38	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	27	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.1	124	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	307	Total			

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Subcatchment P11A: OVERLAND TO DP#1

Hydrograph

NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=216,407 sf
Runoff Volume=1.357 af
Runoff Depth=3.28"
Flow Length=307'
Tc=12.2 min
CN=76

14.17 cfs

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NRCC 24-hr D 25-Year Rainfall=5.88"
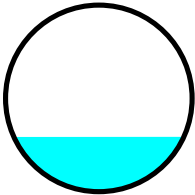Printed 4/12/2023
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Summary for Subcatchment P12: TO CULVERT

Runoff   =   5.25 cfs @ 12.35 hrs, Volume=   0.683 af, Depth= 2.71"
   Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=5.88"

Area (sf)	CN	Description
129,407	70	Woods, Good, HSG C
2,261	74	>75% Grass cover, Good, HSG C
131,668	70	Weighted Average
131,668		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment P12: TO CULVERT

Hydrograph

NRCC 24-hr D
25-Year Rainfall=5.88"
Runoff Area=131,668 sf
Runoff Volume=0.683 af
Runoff Depth=2.71"
Flow Length=805'
Tc=24.0 min
CN=70

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Summary for Reach CUL1: TO DP#1

Inflow Area =   3.023 ac,   0.00% Impervious, Inflow Depth = 2.71"   for 25-Year event
Inflow   =   5.25 cfs @   12.35 hrs, Volume=   0.683 af
Outflow   =   5.24 cfs @   12.36 hrs, Volume=   0.683 af, Atten= 0%, Lag= 0.4 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 0.5 min

Peak Storage= 62 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.87' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Hydrograph

Inflow Area=3.023 ac
Avg. Flow Depth=0.87'
Max Vel=3.03 fps
n=0.025
L=36.0'
S=0.0072 '/'
Capacity=15.42 cfs
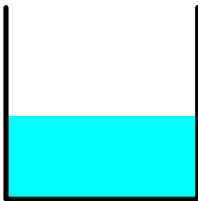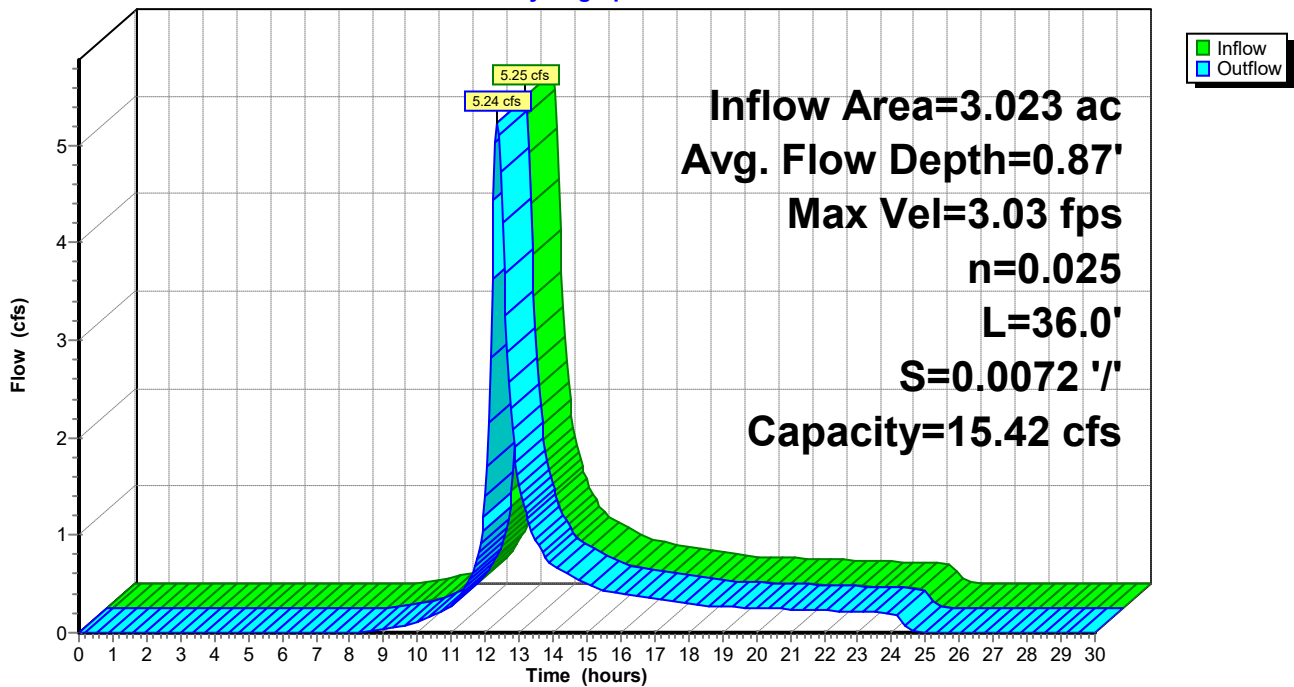
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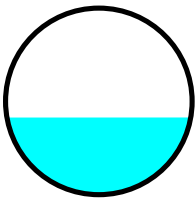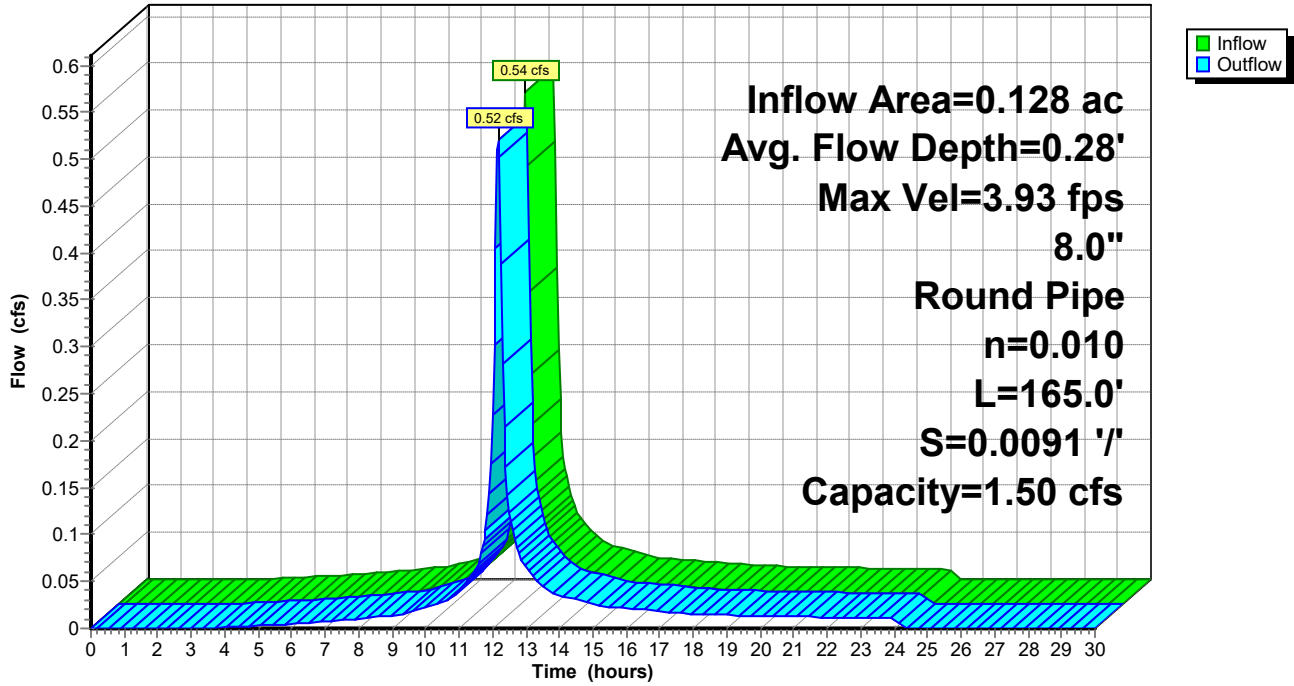## Summary for Reach DCB1: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.438 ac,   5.97% Impervious, Inflow Depth = 4.40"   for 25-Year event
Inflow   =   2.05 cfs @ 12.11 hrs, Volume=   0.161 af
Outflow   =   2.02 cfs @ 12.12 hrs, Volume=   0.161 af, Atten= 1%, Lag= 0.2 min
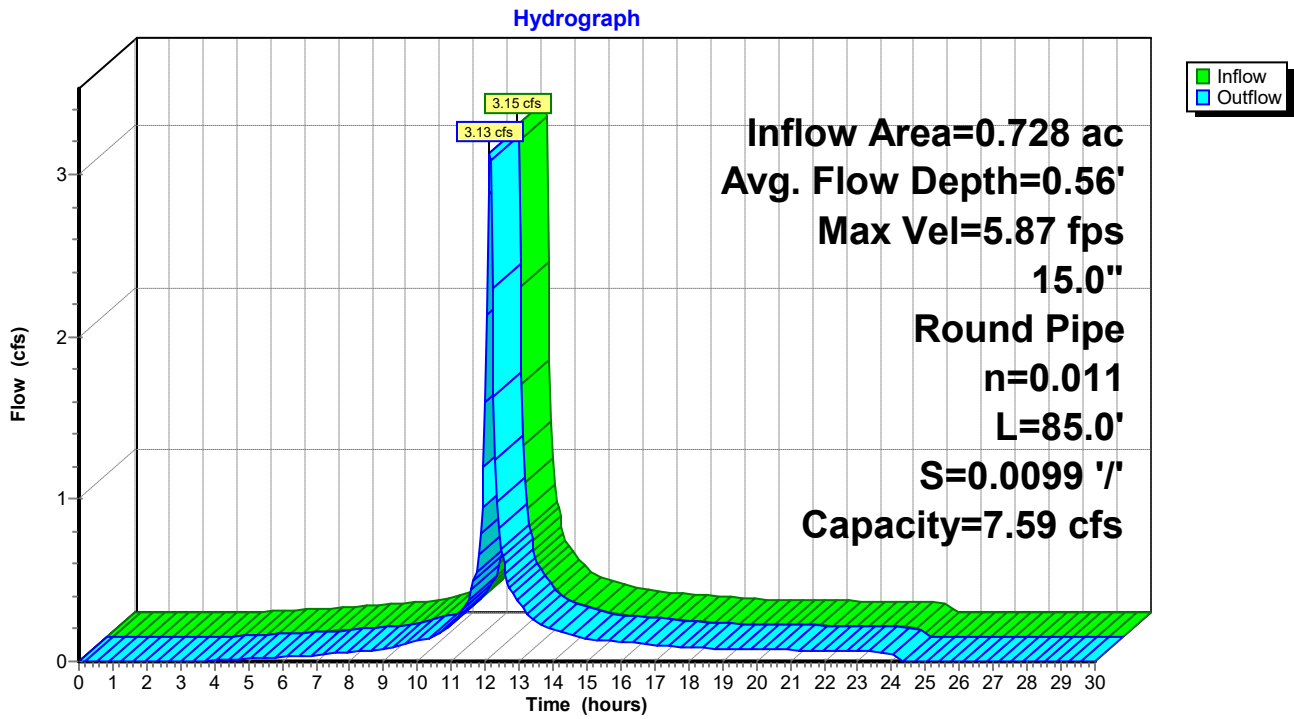   Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.43 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.93 fps, Avg. Travel Time= 0.3 min

Peak Storage= 13 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 1.00'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.35 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 34.0' Slope= 0.0088 '/'
Inlet Invert= 110.80', Outlet Invert= 110.50'

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Reach DCB1: TO DMH#1

Hydrograph

Legend: Inflow (green), Outflow (blue)

2.05 cfs

2.02 cfs

Inflow Area=0.438 ac
Avg. Flow Depth=0.48'
Max Vel=5.43 fps
12.0"
Round Pipe
n=0.010
L=34.0'
S=0.0088 '/'
Capacity=4.35 cfs
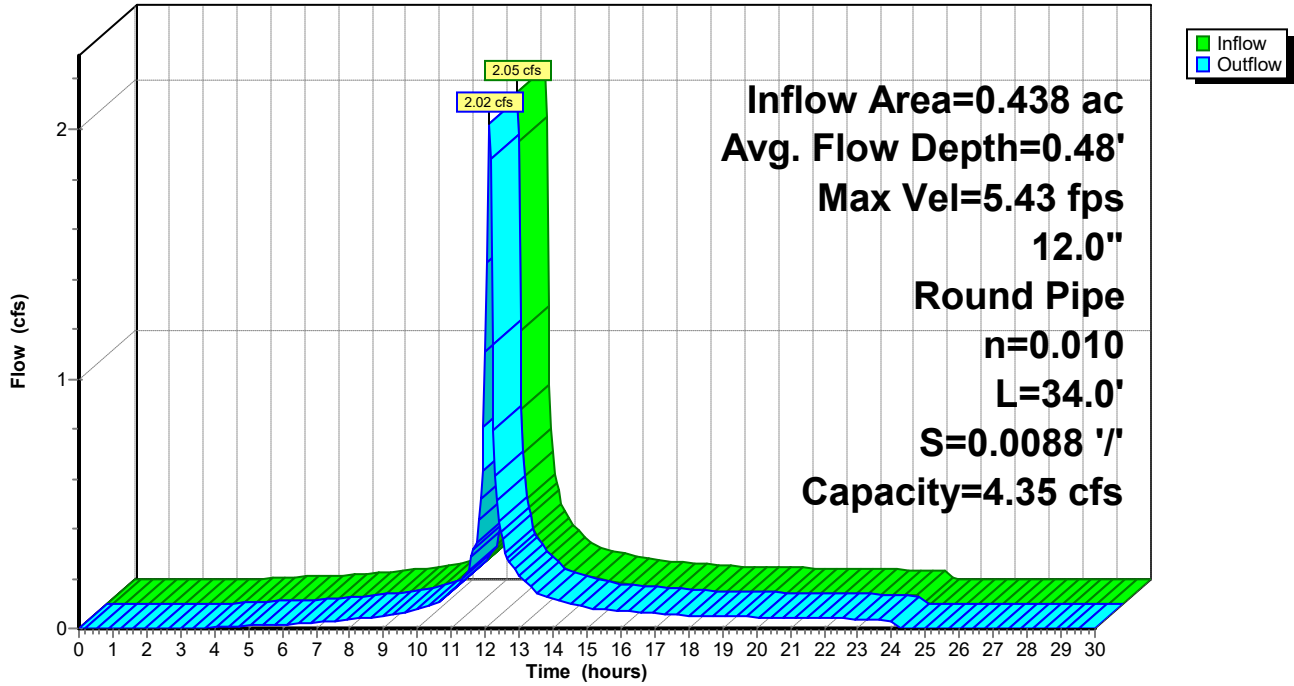
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Summary for Reach DCB2: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.161 ac,   5.65% Impervious, Inflow Depth =   4.30"   for 25-Year event
Inflow   =   0.73 cfs @ 12.12 hrs, Volume=   0.058 af
Outflow   =   0.73 cfs @ 12.12 hrs, Volume=   0.058 af, Atten= 0%, Lag= 0.0 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.42 fps, Min. Travel Time= 0.0 min
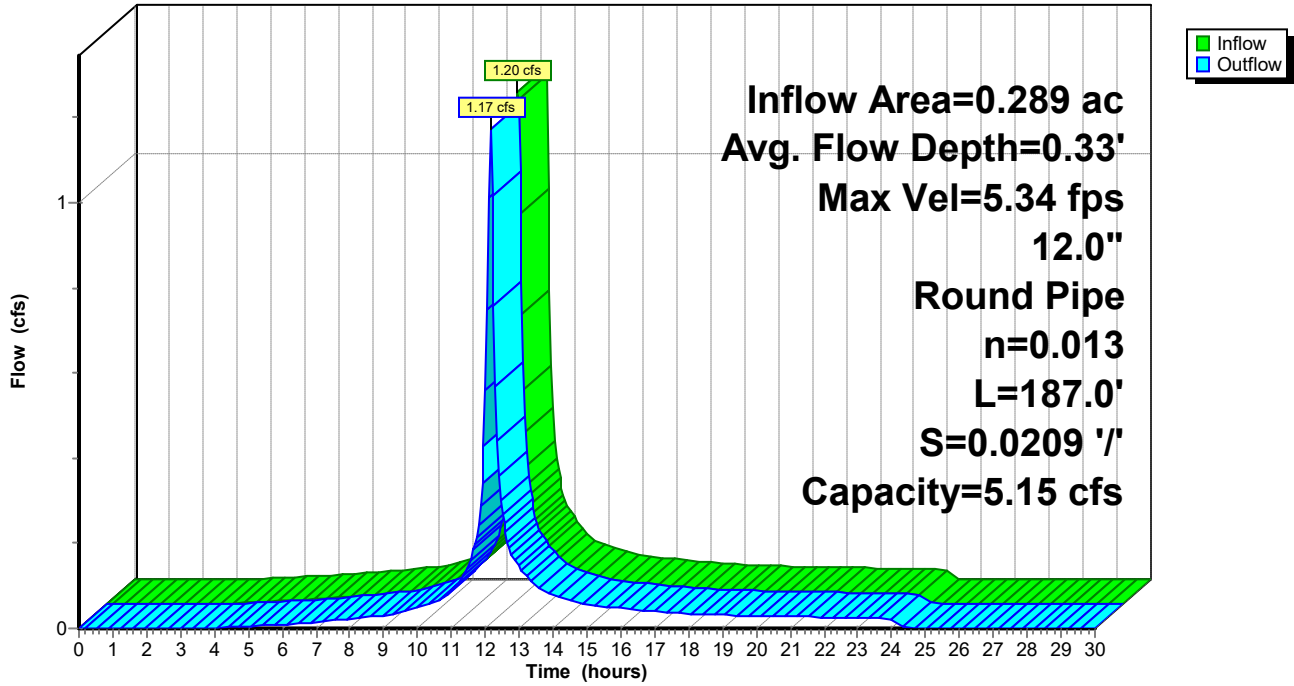Avg. Velocity = 2.95 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.20' , Surface Width= 0.61'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 3.85 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 5.0'   Slope= 0.0600 '/'
Inlet Invert= 114.80', Outlet Invert= 114.50'

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Reach DCB2: TO DMH#2

Hydrograph

Inflow Area=0.161 ac
Avg. Flow Depth=0.20'
Max Vel=8.42 fps
8.0"
Round Pipe
n=0.010
L=5.0'
S=0.0600 '/'
Capacity=3.85 cfs
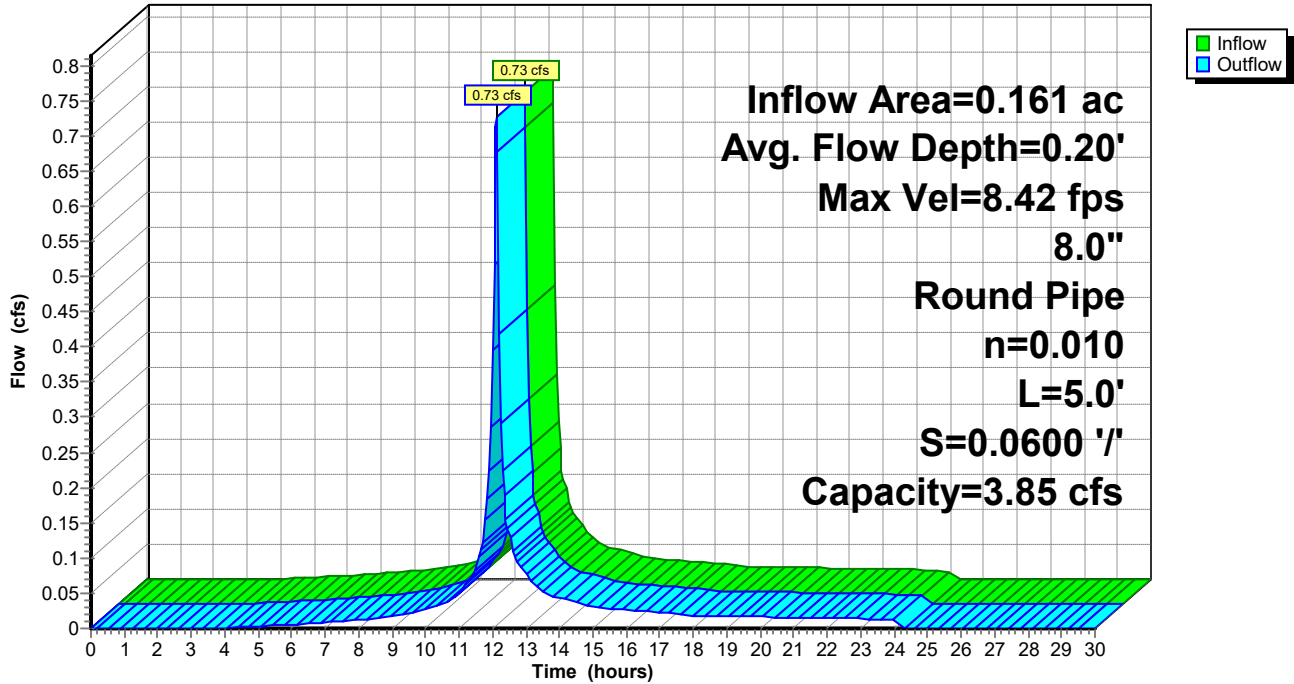
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Summary for Reach DCB3: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.128 ac, 16.22% Impervious, Inflow Depth = 4.40"   for 25-Year event
Inflow   =   0.54 cfs @ 12.15 hrs, Volume=   0.047 af
Outflow   =   0.52 cfs @ 12.17 hrs, Volume=   0.047 af, Atten= 5%, Lag= 1.2 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.93 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 1.9 min

Peak Storage= 23 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 0.66'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.50 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 165.0' Slope= 0.0091 '/'
Inlet Invert= 116.00', Outlet Invert= 114.50'

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Reach DCB3: TO DMH#2

Hydrograph

Inflow Area=0.128 ac
Avg. Flow Depth=0.28'
Max Vel=3.93 fps
8.0"
Round Pipe
n=0.010
L=165.0'
S=0.0091 '/'
Capacity=1.50 cfs

0.54 cfs
0.52 cfs

■ Inflow
■ Outflow

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Summary for Reach DMH1: TO RAIN GARDEN

[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach DCB1 OUTLET depth by 0.16' @ 12.20 hrs
[62] Hint: Exceeded Reach DMH2 OUTLET depth by 0.27' @ 12.10 hrs

Inflow Area =   0.728 ac,   7.71% Impervious, Inflow Depth = 4.38"   for 25-Year event
Inflow   =   3.15 cfs @ 12.13 hrs, Volume=   0.266 af
Outflow   =   3.13 cfs @ 12.14 hrs, Volume=   0.266 af, Atten= 1%, Lag= 0.4 min
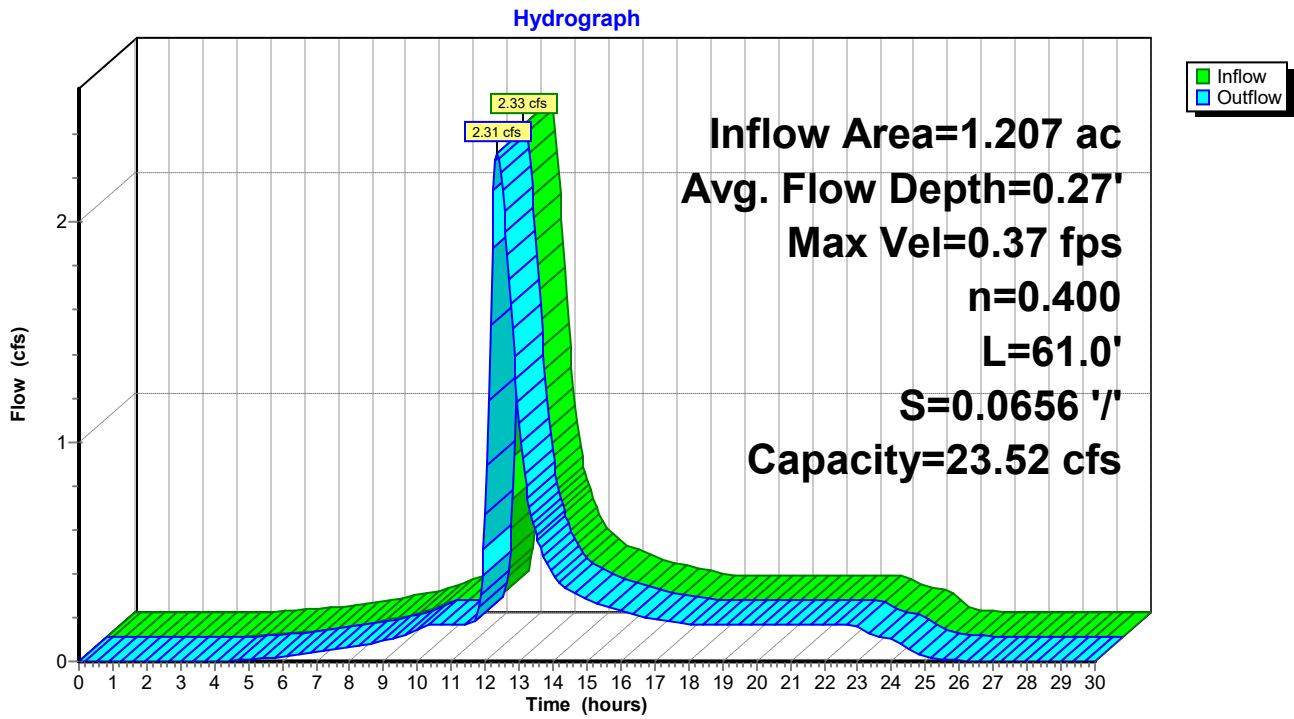   Routed to Pond RG1 : TO DP#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.87 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.08 fps, Avg. Travel Time= 0.7 min

Peak Storage= 46 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.56' , Surface Width= 1.24'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 7.59 cfs

15.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 85.0' Slope= 0.0099 '/'
Inlet Invert= 110.54', Outlet Invert= 109.70'

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Reach DMH1: TO RAIN GARDEN

Hydrograph

Inflow Area=0.728 ac
Avg. Flow Depth=0.56'
Max Vel=5.87 fps
15.0"
Round Pipe
n=0.011
L=85.0'
S=0.0099 '/'
Capacity=7.59 cfs

3.15 cfs
3.13 cfs

Flow (cfs)

Time (hours)

■ Inflow
■ Outflow
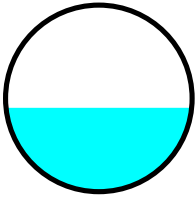
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Summary for Reach DMH2: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach DCB2 OUTLET depth by 0.05' @ 12.20 hrs
[61] Hint: Exceeded Reach DCB3 outlet invert by 0.23' @ 12.15 hrs

Inflow Area =   0.289 ac, 10.35% Impervious, Inflow Depth = 4.34"   for 25-Year event
Inflow   =   1.20 cfs @ 12.14 hrs, Volume=   0.105 af
Outflow   =   1.17 cfs @ 12.15 hrs, Volume=   0.105 af, Atten= 2%, Lag= 0.9 min
    Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.34 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 1.6 min

Peak Storage= 42 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.33' , Surface Width= 0.94'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.15 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 187.0' Slope= 0.0209 '/'
Inlet Invert= 114.40', Outlet Invert= 110.50'

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Reach DMH2: TO DMH#1

Hydrograph

Inflow Area=0.289 ac
Avg. Flow Depth=0.33'
Max Vel=5.34 fps
12.0"
Round Pipe
n=0.013
L=187.0'
S=0.0209 '/'
Capacity=5.15 cfs

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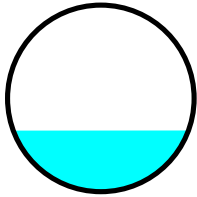
Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH

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

Inflow Area =   9.198 ac,   4.12% Impervious, Inflow Depth = 3.20"   for 25-Year event
Inflow   =   19.92 cfs @ 12.22 hrs, Volume=   2.456 af
Outflow   =   19.92 cfs @ 12.22 hrs, Volume=   2.456 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

Hydrograph

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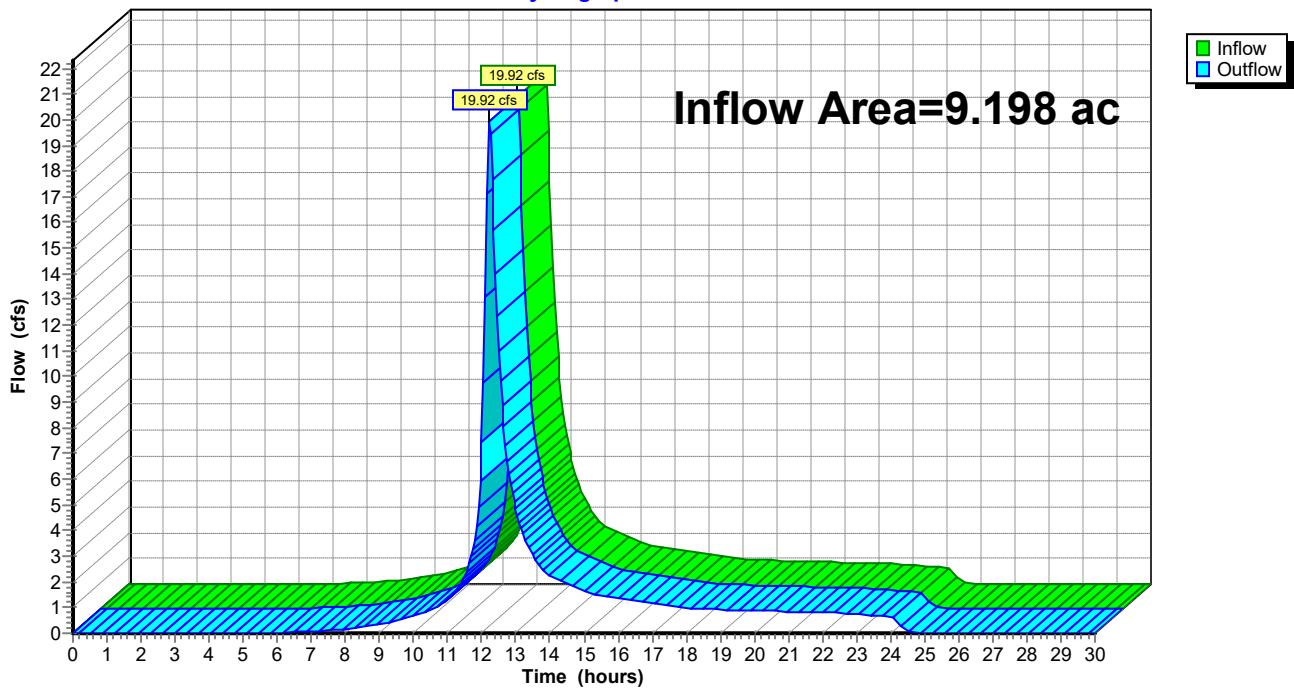
Summary for Reach OL1: OVERLAND TO WETLAND

[79] Warning: Submerged Pond RG1 Primary device # 5 OUTLET by 0.27'

Inflow Area =   1.207 ac, 10.83% Impervious, Inflow Depth = 4.14" for 25-Year event
Inflow   =   2.33 cfs @ 12.27 hrs, Volume=   0.416 af
Outflow   =   2.31 cfs @ 12.35 hrs, Volume=   0.416 af, Atten= 1%, Lag= 5.1 min
   Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.37 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.12 fps, Avg. Travel Time= 8.4 min

Peak Storage= 380 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 25.48'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 23.52 cfs

20.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 61.0' Slope= 0.0656 '/'
Inlet Invert= 106.00', Outlet Invert= 102.00'

‡

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Reach OL1: OVERLAND TO WETLAND

Hydrograph

Inflow Area=1.207 ac
Avg. Flow Depth=0.27'
Max Vel=0.37 fps
n=0.400
L=61.0'
S=0.0656 '/'
Capacity=23.52 cfs

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Summary for Pond RG1: TO DP#1

[44] Hint: Outlet device #2 is below defined storage
[62] Hint: Exceeded Reach DMH1 OUTLET depth by 0.30' @ 12.35 hrs

Inflow Area =   1.207 ac, 10.83% Impervious, Inflow Depth = 4.14"   for 25-Year event
Inflow   =   5.05 cfs @ 12.13 hrs, Volume=   0.416 af
Outflow   =   2.33 cfs @ 12.27 hrs, Volume=   0.416 af, Atten= 54%, Lag= 8.1 min
Primary   =   2.33 cfs @ 12.27 hrs, Volume=   0.416 af
   Routed to Reach OL1 : OVERLAND TO WETLAND
Secondary =   0.00 cfs @   0.00 hrs, Volume=   0.000 af
   Routed to Reach OL1 : OVERLAND TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 110.33' @ 12.27 hrs   Surf.Area= 4,021 sf   Storage= 4,073 cf

Plug-Flow detention time= 52.7 min calculated for 0.416 af (100% of inflow)
Center-of-Mass det. time= 52.5 min (871.4 - 818.9)

Volume	Invert	Avail.Storage	Storage Description
#1	109.00'	17,787 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
109.00	1,833	0	0
110.00	3,749	2,791	2,791
112.00	5,396	9,145	11,936
113.00	6,305	5,851	17,787

Device	Routing	Invert	Outlet Devices
#1	Secondary	112.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Device 5	106.50'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Device 5	109.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 5	110.50'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#5	Primary	106.40'	**12.0" Round Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 106.40' / 106.00' S= 0.0057 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.32 cfs @ 12.27 hrs HW=110.33'   (Free Discharge)
└─**5=Culvert** (Passes 2.32 cfs of 5.53 cfs potential flow)
  ├─**2=Special & User-Defined** (Custom Controls 0.17 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 2.15 cfs @ 3.65 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=109.00'   (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Pond RG1: TO DP#1

Inflow Area=1.207 ac
Peak Elev=110.33'
Storage=4,073 cf
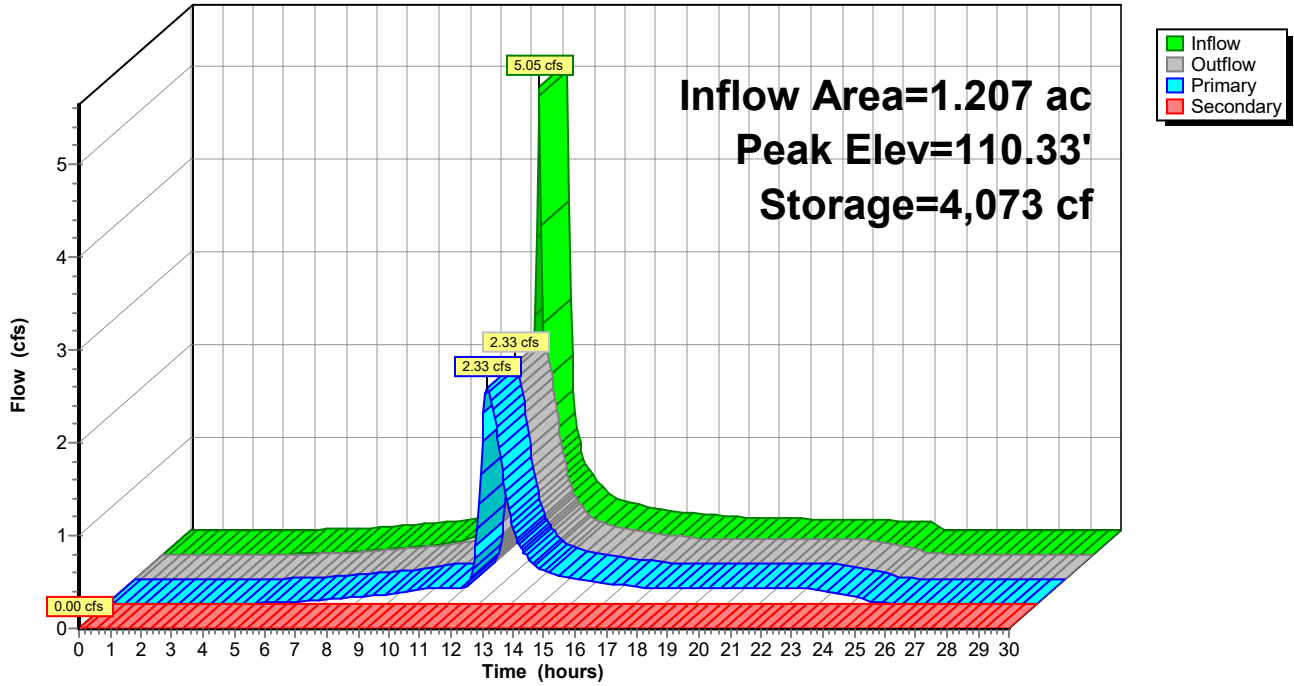
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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P100: TO RAIN GARDEN
Runoff Area=20,880 sf 15.57% Impervious Runoff Depth=6.06"
Flow Length=290' Tc=6.0 min CN=81 Runoff=3.01 cfs 0.242 af

Subcatchment P101: TO DCB#2
Runoff Area=7,003 sf 5.65% Impervious Runoff Depth=6.66"
Flow Length=173' Tc=5.3 min CN=86 Runoff=1.10 cfs 0.089 af

Subcatchment p102: (new Subcat)
Runoff Area=19,100 sf 5.97% Impervious Runoff Depth=6.78"
Flow Length=272' Tc=5.0 min CN=87 Runoff=3.08 cfs 0.248 af

Subcatchment p103: TO DCB#3
Runoff Area=5,597 sf 16.22% Impervious Runoff Depth=6.78"
Flow Length=143' Tc=8.3 min CN=87 Runoff=0.82 cfs 0.073 af

Subcatchment P11A: OVERLAND TO DP#1
Runoff Area=216,407 sf 4.99% Impervious Runoff Depth=5.47"
Flow Length=307' Tc=12.2 min CN=76 Runoff=23.39 cfs 2.264 af

Subcatchment P12: TO CULVERT
Runoff Area=131,668 sf 0.00% Impervious Runoff Depth=4.76"
Flow Length=805' Tc=24.0 min CN=70 Runoff=9.28 cfs 1.198 af

Reach CUL1: TO DP#1
Avg. Flow Depth=1.33' Max Vel=3.48 fps Inflow=9.28 cfs 1.198 af
n=0.025 L=36.0' S=0.0072 '/' Capacity=15.42 cfs Outflow=9.26 cfs 1.198 af

Reach DCB1: TO DMH#1
Avg. Flow Depth=0.62' Max Vel=5.98 fps Inflow=3.08 cfs 0.248 af
12.0" Round Pipe n=0.010 L=34.0' S=0.0088 '/' Capacity=4.35 cfs Outflow=3.04 cfs 0.248 af

Reach DCB2: TO DMH#2
Avg. Flow Depth=0.24' Max Vel=9.46 fps Inflow=1.10 cfs 0.089 af
8.0" Round Pipe n=0.010 L=5.0' S=0.0600 '/' Capacity=3.85 cfs Outflow=1.10 cfs 0.089 af

Reach DCB3: TO DMH#2
Avg. Flow Depth=0.35' Max Vel=4.37 fps Inflow=0.82 cfs 0.073 af
8.0" Round Pipe n=0.010 L=165.0' S=0.0091 '/' Capacity=1.50 cfs Outflow=0.78 cfs 0.073 af

Reach DMH1: TO RAIN GARDEN
Avg. Flow Depth=0.72' Max Vel=6.50 fps Inflow=4.75 cfs 0.410 af
15.0" Round Pipe n=0.011 L=85.0' S=0.0099 '/' Capacity=7.59 cfs Outflow=4.73 cfs 0.410 af

Reach DMH2: TO DMH#1
Avg. Flow Depth=0.41' Max Vel=5.98 fps Inflow=1.82 cfs 0.162 af
12.0" Round Pipe n=0.013 L=187.0' S=0.0209 '/' Capacity=5.15 cfs Outflow=1.78 cfs 0.162 af

Reach DP#1A: WETLAND SERIES 1(SOUTH
Inflow=33.77 cfs 4.114 af
Outflow=33.77 cfs 4.114 af

Reach OL1: OVERLAND TO WETLAND
Avg. Flow Depth=0.42' Max Vel=0.48 fps Inflow=4.94 cfs 0.652 af
n=0.400 L=61.0' S=0.0656 '/' Capacity=23.52 cfs Outflow=4.65 cfs 0.652 af

Pond RG1: TO DP#1
Peak Elev=110.69' Storage=5,575 cf Inflow=7.74 cfs 0.652 af
Primary=4.94 cfs 0.652 af Secondary=0.00 cfs 0.000 af Outflow=4.94 cfs 0.652 af

Total Runoff Area = 9.198 ac   Runoff Volume = 4.114 af   Average Runoff Depth = 5.37"
95.88% Pervious = 8.819 ac   4.12% Impervious = 0.379 ac

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Summary for Subcatchment P100: TO RAIN GARDEN

Runoff   =   3.01 cfs @ 12.13 hrs, Volume=   0.242 af, Depth= 6.06"
  Routed to Pond RG1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
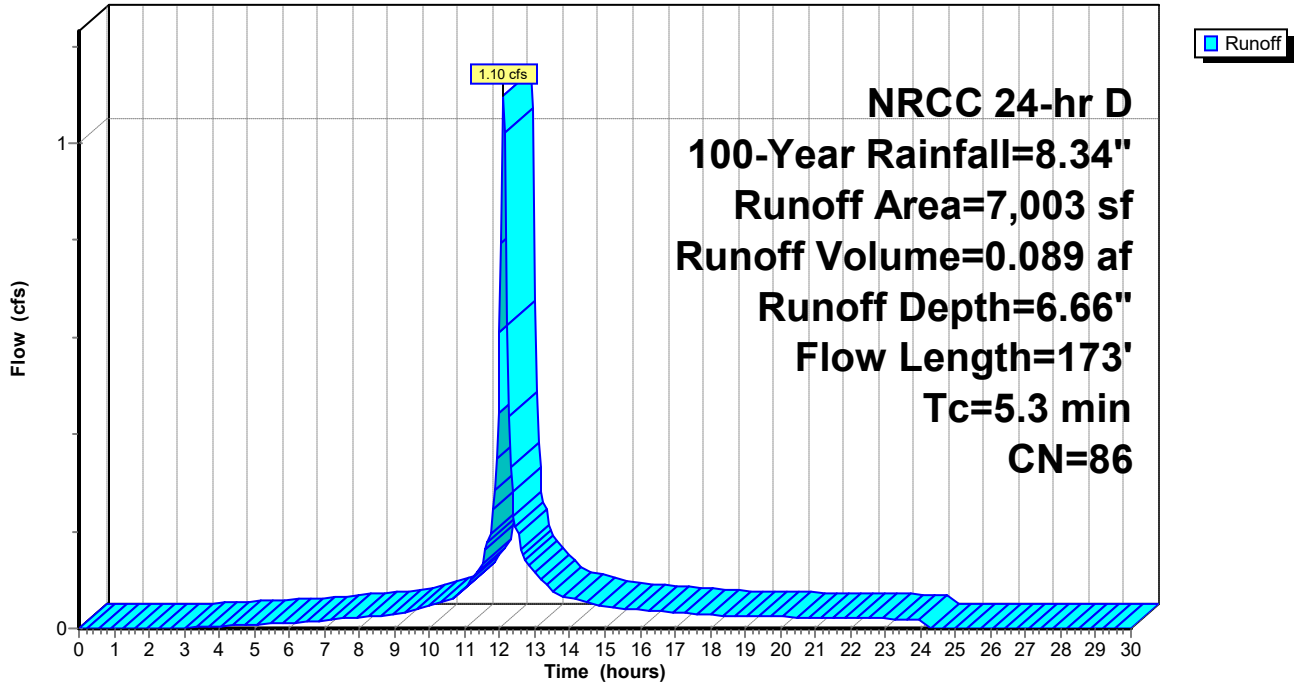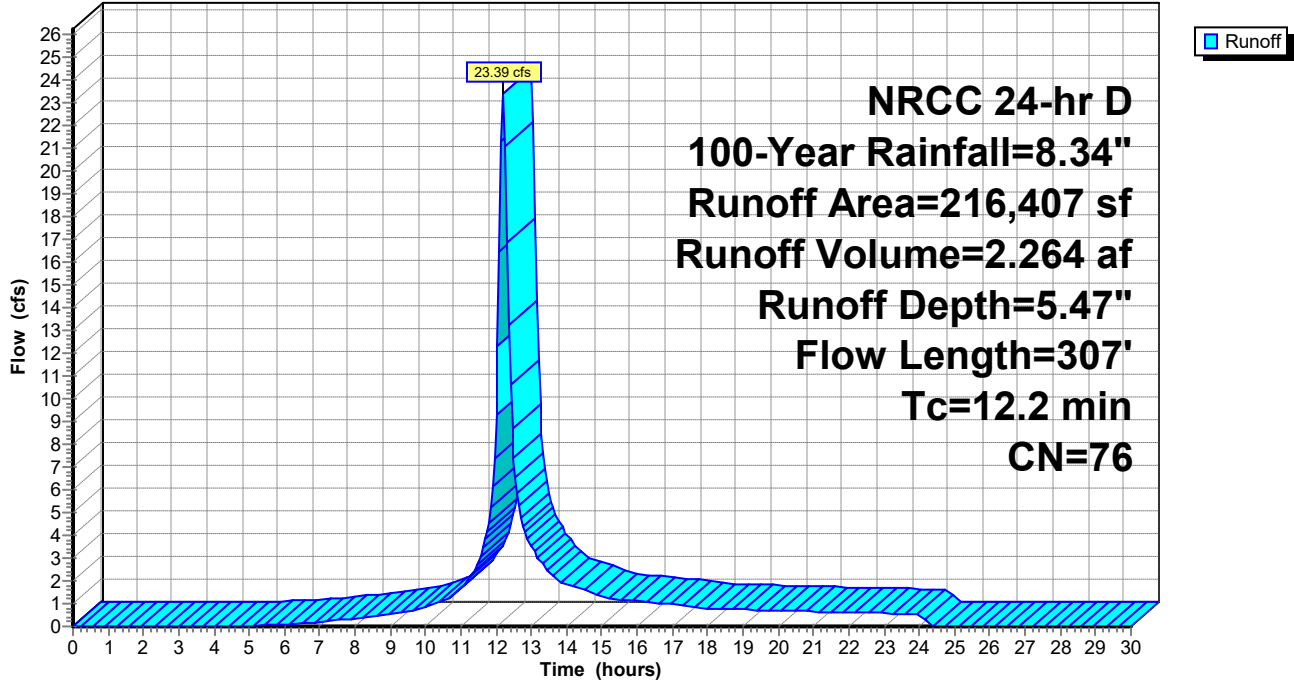NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
13,576	74	>75% Grass cover, Good, HSG C
161	70	Woods, Good, HSG C
3,252	98	Paved parking, HSG C
2,891	96	Gravel surface, HSG C
1,000	89	Gravel roads, HSG C
20,880	81	Weighted Average
17,628		84.43% Pervious Area
3,252		15.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	15	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.2	29	0.3330	0.40		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	6	0.0300	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	113	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	81	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	46	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.0	290	Total			

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Subcatchment P100: TO RAIN GARDEN

Hydrograph

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=20,880 sf
Runoff Volume=0.242 af
Runoff Depth=6.06"
Flow Length=290'
Tc=6.0 min
CN=81

Summary for Subcatchment P101: TO DCB#2

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   1.10 cfs @ 12.12 hrs, Volume=   0.089 af, Depth= 6.66"
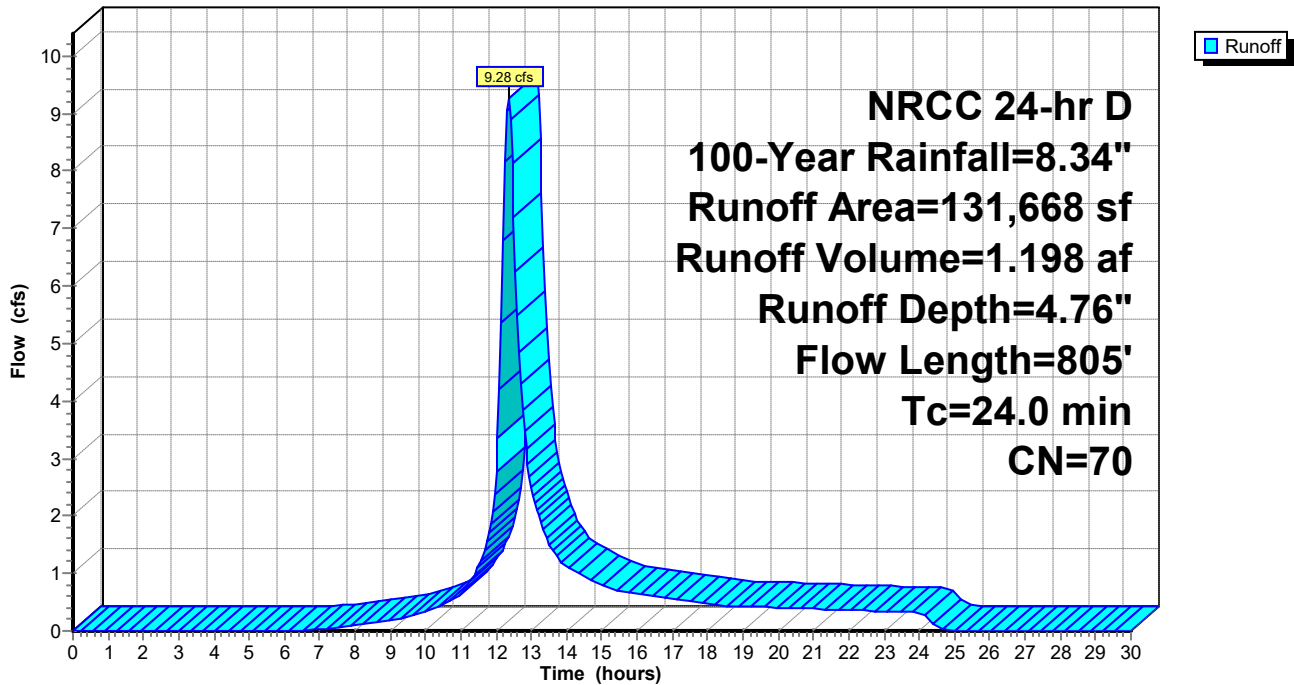   Routed to Reach DCB2 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
1,719	74	>75% Grass cover, Good, HSG C
715	70	Woods, Good, HSG C
396	98	Paved parking, HSG C
2,020	96	Gravel surface, HSG C
2,153	89	Gravel roads, HSG C
7,003	86	Weighted Average
6,607		94.35% Pervious Area
396		5.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	16	0.0530	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.2	14	0.0300	1.06		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	123	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.3	173	Total			

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Subcatchment P101: TO DCB#2

Hydrograph

☐ Runoff

1.10 cfs

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=7,003 sf
Runoff Volume=0.089 af
Runoff Depth=6.66"
Flow Length=173'
Tc=5.3 min
CN=86

Flow (cfs)

Time (hours)

Summary for Subcatchment p102: (new Subcat)

[49] Hint: Tc<2dt may require smaller dt

Runoff   =   3.08 cfs @ 12.11 hrs, Volume=   0.248 af, Depth= 6.78"
   Routed to Reach DCB1 : TO DMH#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
5,623	74	>75% Grass cover, Good, HSG C
528	70	Woods, Good, HSG C
1,140	98	Paved parking, HSG C
7,733	96	Gravel surface, HSG C
4,076	89	Gravel roads, HSG C
19,100	87	Weighted Average
17,960		94.03% Pervious Area
1,140		5.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	20	0.3300	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.4	30	0.0250	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	222	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.9	272				Total, Increased to minimum Tc = 5.0 min

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Subcatchment p102: (new Subcat)

Hydrograph

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=19,100 sf
Runoff Volume=0.248 af
Runoff Depth=6.78"
Flow Length=272'
Tc=5.0 min
CN=87

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Summary for Subcatchment p103: TO DCB#3
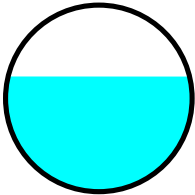
Runoff   =   0.82 cfs @ 12.15 hrs, Volume=   0.073 af, Depth= 6.78"
    Routed to Reach DCB3 : TO DMH#2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
1,015	74	>75% Grass cover, Good, HSG C
855	70	Woods, Good, HSG C
908	98	Paved parking, HSG C
1,653	96	Gravel surface, HSG C
1,166	89	Gravel roads, HSG C
5,597	87	Weighted Average
4,689		83.78% Pervious Area
908		16.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	40	0.0540	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.5	10	0.3300	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	93	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.3	143	Total			

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Subcatchment p103: TO DCB#3

Hydrograph

0.82 cfs

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=5,597 sf
Runoff Volume=0.073 af
Runoff Depth=6.78"
Flow Length=143'
Tc=8.3 min
CN=87

Flow (cfs)

Time (hours)

☐ Runoff

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NRCC 24-hr D 100-Year Rainfall=8.34"
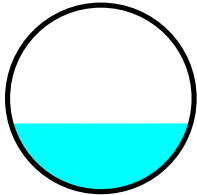Printed 4/12/2023
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Summary for Subcatchment P11A: OVERLAND TO DP#1

Runoff   =   23.39 cfs @ 12.20 hrs, Volume=   2.264 af, Depth= 5.47"
   Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
20,934	74	>75% Grass cover, Good, HSG C
150,407	70	Woods, Good, HSG C
32,655	96	Gravel surface, HSG C
10,055	98	Paved parking, HSG C
1,617	89	Gravel roads, HSG C
739	98	Paved parking, HSG C
216,407	76	Weighted Average
205,613		95.01% Pervious Area
10,794		4.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0540	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.0	68	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	38	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	27	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.1	124	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.2	307	Total			

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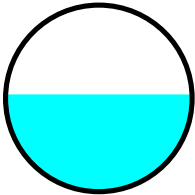Printed 4/12/2023
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Subcatchment P11A: OVERLAND TO DP#1

Hydrograph

Flow (cfs) vs. Time (hours)

23.39 cfs

Runoff

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=216,407 sf
Runoff Volume=2.264 af
Runoff Depth=5.47"
Flow Length=307'
Tc=12.2 min
CN=76

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NRCC 24-hr D 100-Year Rainfall=8.34"
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Summary for Subcatchment P12: TO CULVERT

Runoff = 9.28 cfs @ 12.34 hrs, Volume= 1.198 af, Depth= 4.76"
   Routed to Reach CUL1 : TO DP#1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.34"

Area (sf)	CN	Description
129,407	70	Woods, Good, HSG C
2,261	74	>75% Grass cover, Good, HSG C
131,668	70	Weighted Average
131,668		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0580	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.4	104	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.3	651	0.0229	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.0	805	Total			

Subcatchment P12: TO CULVERT

Hydrograph

NRCC 24-hr D
100-Year Rainfall=8.34"
Runoff Area=131,668 sf
Runoff Volume=1.198 af
Runoff Depth=4.76"
Flow Length=805'
Tc=24.0 min
CN=70

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Summary for Reach CUL1: TO DP#1

Inflow Area =   3.023 ac,   0.00% Impervious, Inflow Depth = 4.76"   for 100-Year event
Inflow   =   9.28 cfs @ 12.34 hrs, Volume=   1.198 af
Outflow   =   9.26 cfs @ 12.35 hrs, Volume=   1.198 af, Atten= 0%, Lag= 0.3 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.48 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 0.4 min

Peak Storage= 96 cf @ 12.35 hrs
Average Depth at Peak Storage= 1.33' , Surface Width= 2.00'
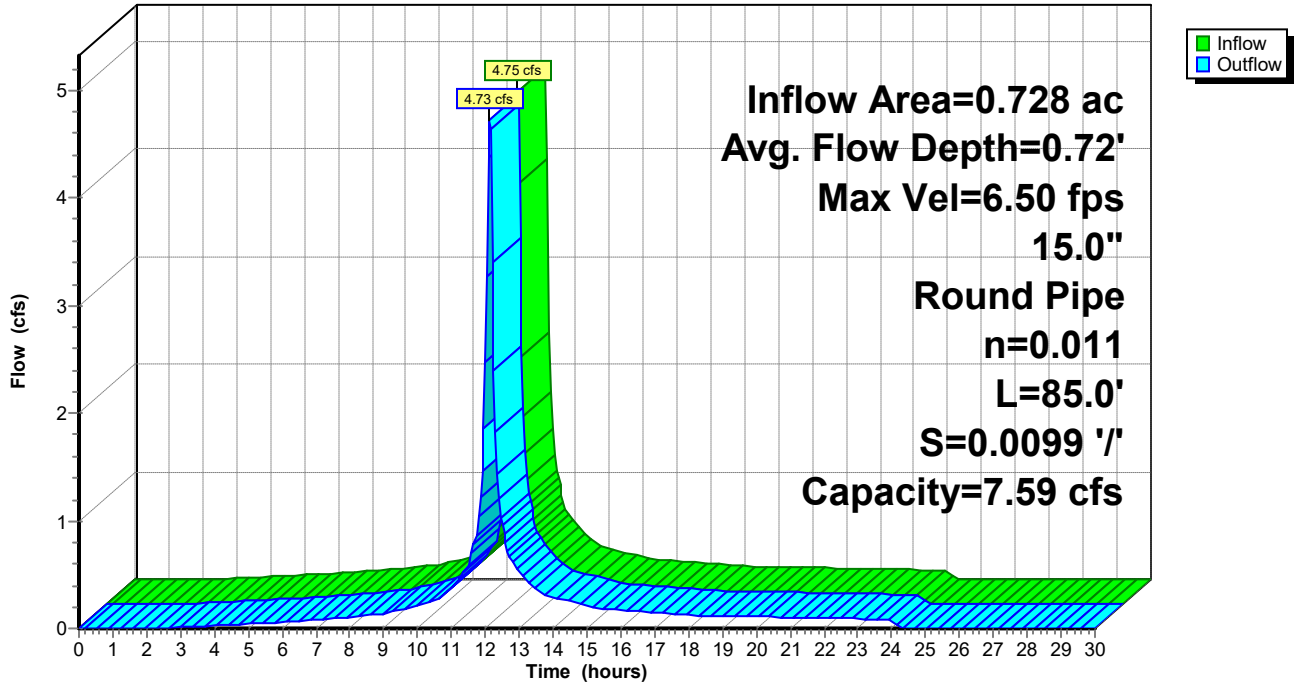Bank-Full Depth= 2.00' Flow Area= 4.0 sf, Capacity= 15.42 cfs

2.00' x 2.00' deep channel, n= 0.025 Rubble masonry, cemented
Length= 36.0'   Slope= 0.0072 '/'
Inlet Invert= 104.26', Outlet Invert= 104.00'

Reach CUL1: TO DP#1

Hydrograph

Inflow Area=3.023 ac
Avg. Flow Depth=1.33'
Max Vel=3.48 fps
n=0.025
L=36.0'
S=0.0072 '/'
Capacity=15.42 cfs
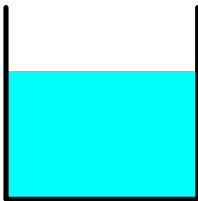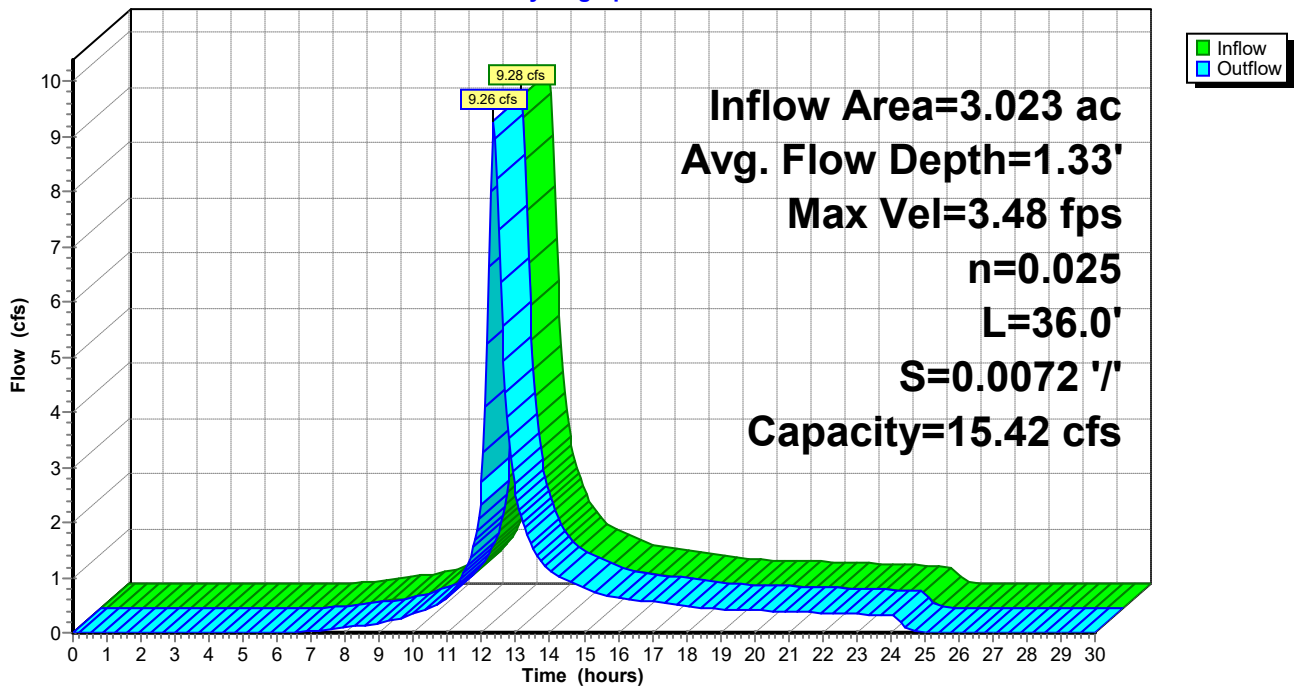
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Summary for Reach DCB1: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.438 ac,   5.97% Impervious, Inflow Depth = 6.78"   for 100-Year event
Inflow   =   3.08 cfs @ 12.11 hrs, Volume=   0.248 af
Outflow   =   3.04 cfs @ 12.12 hrs, Volume=   0.248 af, Atten= 1%, Lag= 0.2 min
    Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.98 fps, Min. Travel Time= 0.1 min
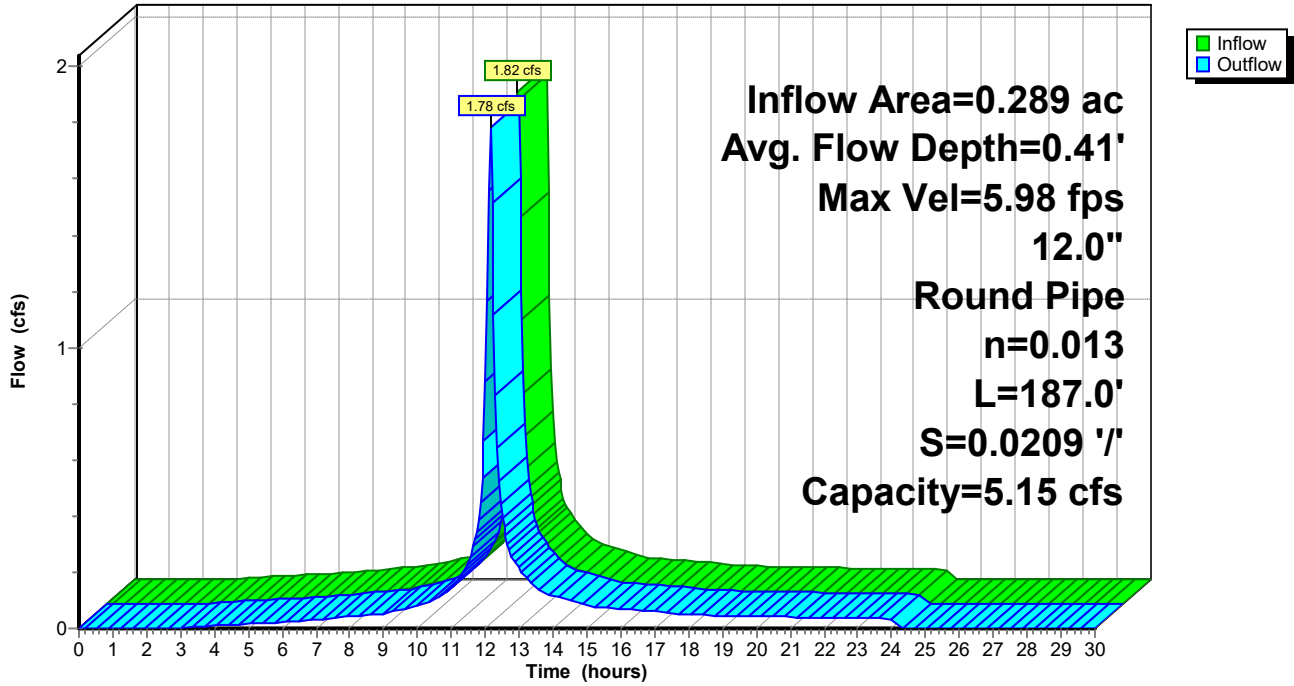Avg. Velocity = 2.18 fps, Avg. Travel Time= 0.3 min

Peak Storage= 17 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.62' , Surface Width= 0.97'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.35 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 34.0'   Slope= 0.0088 '/'
Inlet Invert= 110.80', Outlet Invert= 110.50'

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Reach DCB1: TO DMH#1

Hydrograph

Inflow Area=0.438 ac
Avg. Flow Depth=0.62'
Max Vel=5.98 fps
12.0"
Round Pipe
n=0.010
L=34.0'
S=0.0088 '/'
Capacity=4.35 cfs
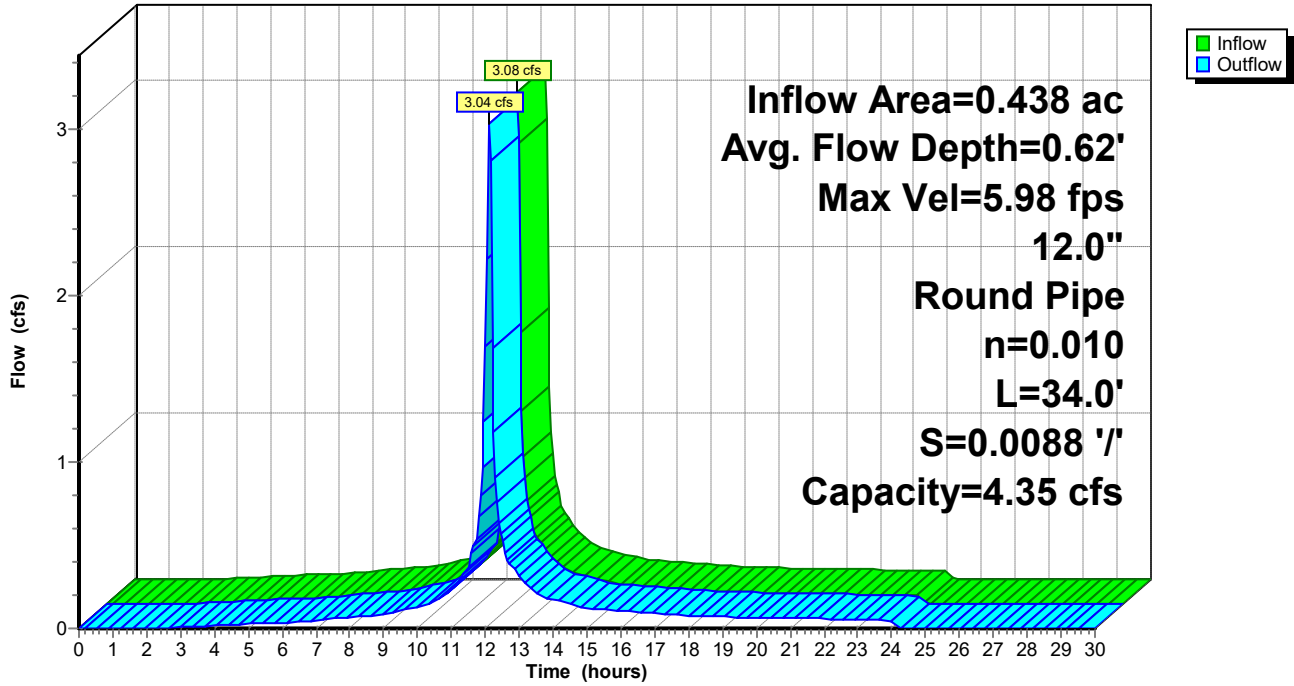
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Summary for Reach DCB2: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.161 ac,   5.65% Impervious, Inflow Depth = 6.66"   for 100-Year event
Inflow   =   1.10 cfs @ 12.12 hrs, Volume=   0.089 af
Outflow   =   1.10 cfs @ 12.12 hrs, Volume=   0.089 af, Atten= 0%, Lag= 0.0 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.46 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.33 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.24' , Surface Width= 0.64'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 3.85 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 5.0'   Slope= 0.0600 '/'
Inlet Invert= 114.80', Outlet Invert= 114.50'

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Reach DCB2: TO DMH#2

Hydrograph

Inflow Area=0.161 ac
Avg. Flow Depth=0.24'
Max Vel=9.46 fps
8.0"
Round Pipe
n=0.010
L=5.0'
S=0.0600 '/'
Capacity=3.85 cfs
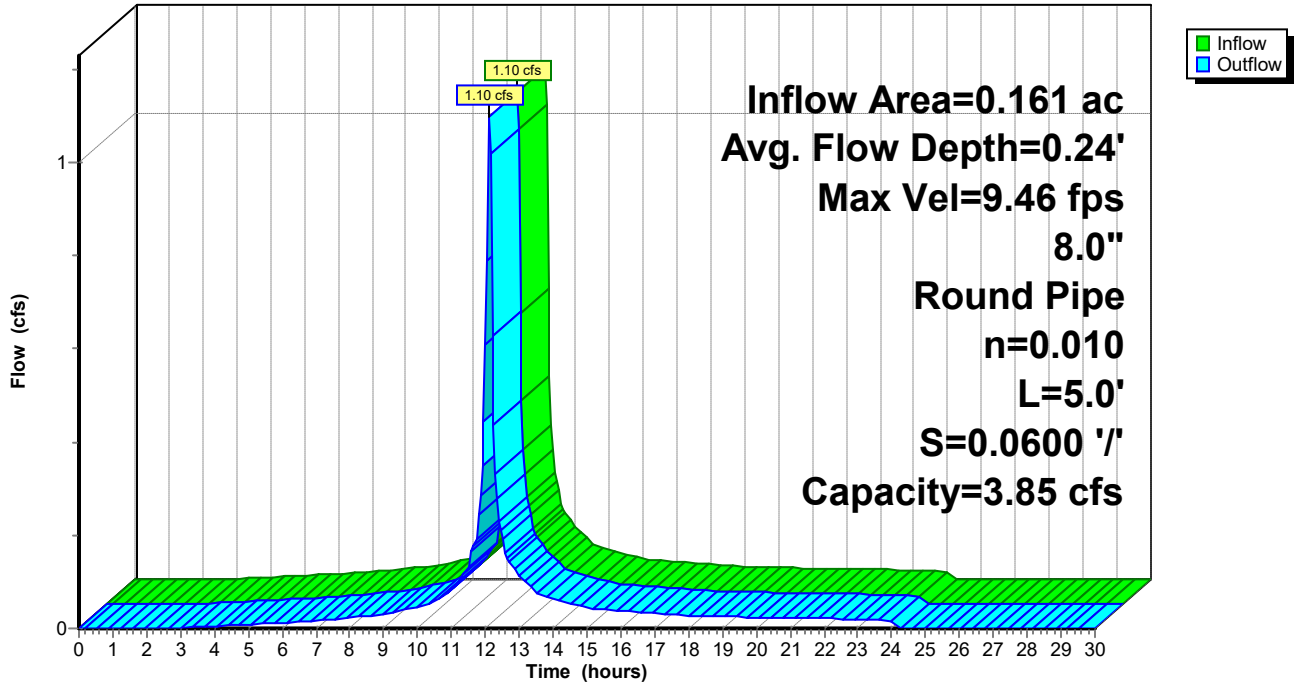
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Summary for Reach DCB3: TO DMH#2

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =   0.128 ac, 16.22% Impervious, Inflow Depth = 6.78"   for 100-Year event
Inflow   =   0.82 cfs @ 12.15 hrs, Volume=   0.073 af
Outflow   =   0.78 cfs @ 12.17 hrs, Volume=   0.073 af, Atten= 4%, Lag= 1.0 min
    Routed to Reach DMH2 : TO DMH#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.37 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.60 fps, Avg. Travel Time= 1.7 min

Peak Storage= 30 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 0.67'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.50 cfs

8.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 165.0' Slope= 0.0091 '/'
Inlet Invert= 116.00', Outlet Invert= 114.50'

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Reach DCB3: TO DMH#2

Hydrograph

Inflow Area=0.128 ac
Avg. Flow Depth=0.35'
Max Vel=4.37 fps
8.0"
Round Pipe
n=0.010
L=165.0'
S=0.0091 '/'
Capacity=1.50 cfs

0.82 cfs
0.78 cfs

Inflow
Outflow

Flow (cfs)

Time (hours)
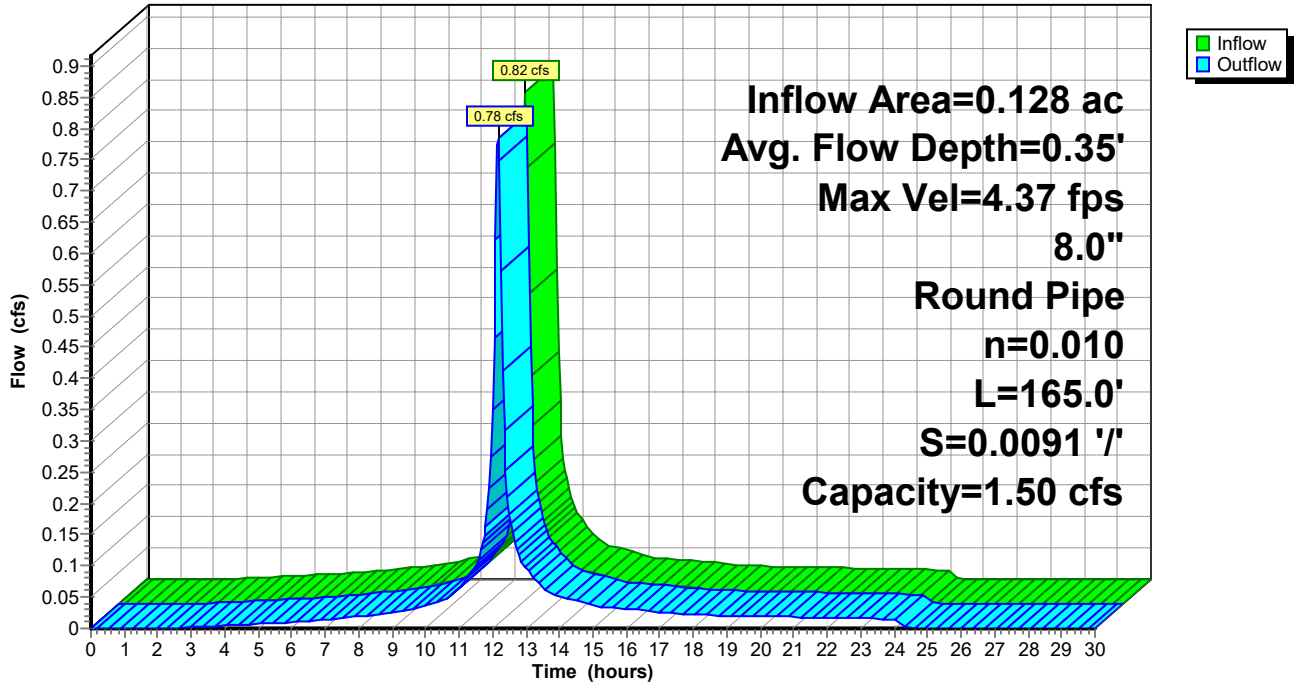
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Summary for Reach DMH1: TO RAIN GARDEN

[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach DCB1 OUTLET depth by 0.19' @ 12.20 hrs
[62] Hint: Exceeded Reach DMH2 OUTLET depth by 0.34' @ 12.10 hrs

Inflow Area =   0.728 ac,   7.71% Impervious, Inflow Depth = 6.75"   for 100-Year event
Inflow   =   4.75 cfs @ 12.13 hrs, Volume=   0.410 af
Outflow   =   4.73 cfs @ 12.13 hrs, Volume=   0.410 af, Atten= 1%, Lag= 0.4 min
   Routed to Pond RG1 : TO DP#1

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.50 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.35 fps, Avg. Travel Time= 0.6 min

Peak Storage= 62 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.72' , Surface Width= 1.24'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 7.59 cfs

15.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 85.0'   Slope= 0.0099 '/'
Inlet Invert= 110.54', Outlet Invert= 109.70'

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Reach DMH1: TO RAIN GARDEN

Hydrograph

- Inflow
- Outflow

4.75 cfs

4.73 cfs

Inflow Area=0.728 ac
Avg. Flow Depth=0.72'
Max Vel=6.50 fps
15.0"
Round Pipe
n=0.011
L=85.0'
S=0.0099 '/'
Capacity=7.59 cfs

Flow (cfs)

Time (hours)
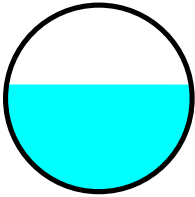
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Summary for Reach DMH2: TO DMH#1

[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach DCB2 OUTLET depth by 0.08' @ 12.20 hrs
[61] Hint: Exceeded Reach DCB3 outlet invert by 0.31' @ 12.15 hrs

Inflow Area =   0.289 ac, 10.35% Impervious, Inflow Depth = 6.71"   for 100-Year event
Inflow   =   1.82 cfs @ 12.13 hrs, Volume=   0.162 af
Outflow   =   1.78 cfs @ 12.15 hrs, Volume=   0.162 af, Atten= 2%, Lag= 0.8 min
   Routed to Reach DMH1 : TO RAIN GARDEN

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.98 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.13 fps, Avg. Travel Time= 1.5 min

Peak Storage= 57 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.41' , Surface Width= 0.98'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.15 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 187.0' Slope= 0.0209 '/'
Inlet Invert= 114.40', Outlet Invert= 110.50'

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Reach DMH2: TO DMH#1

Hydrograph

Inflow Area=0.289 ac
Avg. Flow Depth=0.41'
Max Vel=5.98 fps
12.0"
Round Pipe
n=0.013
L=187.0'
S=0.0209 '/'
Capacity=5.15 cfs

Legend:
- Inflow
- Outflow

1.82 cfs
1.78 cfs

Flow (cfs)

Time (hours)

3101-POST-SITE B
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NRCC 24-hr D 100-Year Rainfall=8.34"
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Page 115
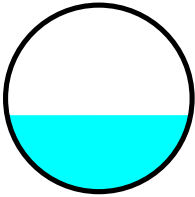
Summary for Reach DP#1A: WETLAND SERIES 1(SOUTH

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

Inflow Area =   9.198 ac,   4.12% Impervious, Inflow Depth = 5.37"   for 100-Year event
Inflow   =   33.77 cfs @ 12.23 hrs, Volume=   4.114 af
Outflow   =   33.77 cfs @ 12.23 hrs, Volume=   4.114 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach DP#1A: WETLAND SERIES 1(SOUTH

Hydrograph
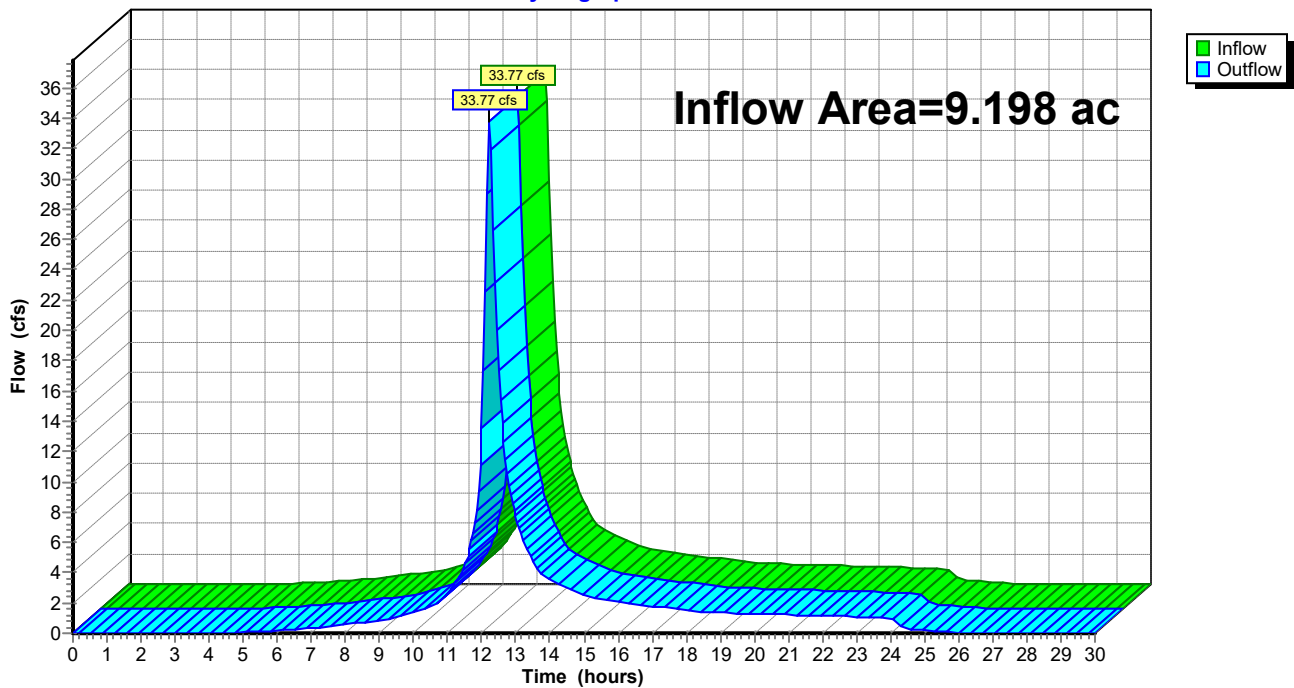
3101-POST-SITE B
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Summary for Reach OL1: OVERLAND TO WETLAND

[79] Warning: Submerged Pond RG1 Primary device # 5 INLET by 0.01'

Inflow Area =   1.207 ac, 10.83% Impervious, Inflow Depth = 6.48"   for 100-Year event
Inflow   =   4.94 cfs @ 12.22 hrs, Volume=   0.652 af
Outflow   =   4.65 cfs @ 12.29 hrs, Volume=   0.652 af, Atten= 6%, Lag= 4.5 min
    Routed to Reach DP#1A : WETLAND SERIES 1(SOUTH

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.48 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 7.3 min

Peak Storage= 611 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.42' , Surface Width= 28.30'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 23.52 cfs

20.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 61.0' Slope= 0.0656 '/'
Inlet Invert= 106.00', Outlet Invert= 102.00'

‡

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Reach OL1: OVERLAND TO WETLAND

Hydrograph

Inflow Area=1.207 ac
Avg. Flow Depth=0.42'
Max Vel=0.48 fps
n=0.400
L=61.0'
S=0.0656 '/'
Capacity=23.52 cfs

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NRCC 24-hr D 100-Year Rainfall=8.34"
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Page 118
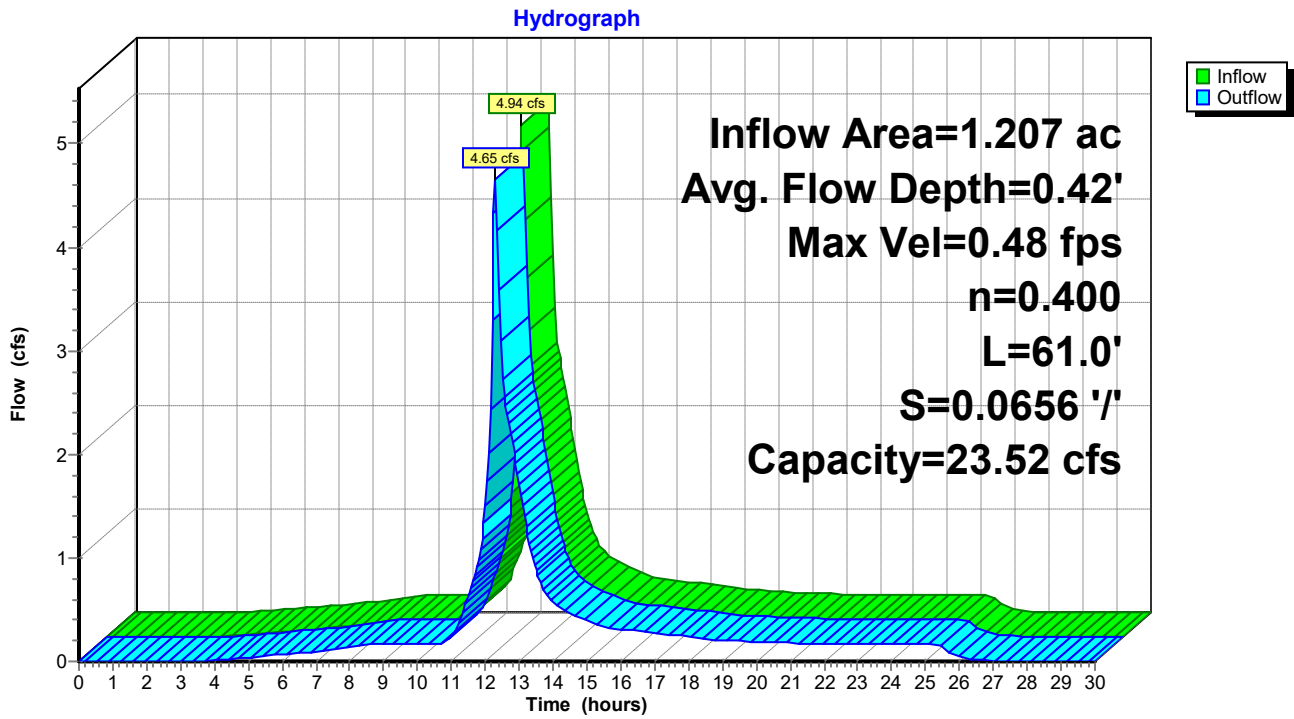
Summary for Pond RG1: TO DP#1

[44] Hint: Outlet device #2 is below defined storage
[62] Hint: Exceeded Reach DMH1 OUTLET depth by 0.52' @ 12.30 hrs

Inflow Area = 1.207 ac, 10.83% Impervious, Inflow Depth = 6.48" for 100-Year event
Inflow   = 7.74 cfs @ 12.13 hrs, Volume=   0.652 af
Outflow   = 4.94 cfs @ 12.22 hrs, Volume=   0.652 af, Atten= 36%, Lag= 5.3 min
Primary   = 4.94 cfs @ 12.22 hrs, Volume=   0.652 af
   Routed to Reach OL1 : OVERLAND TO WETLAND
Secondary = 0.00 cfs @   0.00 hrs, Volume=   0.000 af
   Routed to Reach OL1 : OVERLAND TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 110.69' @ 12.22 hrs   Surf.Area= 4,318 sf   Storage= 5,575 cf

Plug-Flow detention time= 51.5 min calculated for 0.652 af (100% of inflow)
Center-of-Mass det. time= 51.4 min (854.5 - 803.0)

Volume	Invert	Avail.Storage	Storage Description
#1	109.00'	17,787 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
109.00	1,833	0	0
110.00	3,749	2,791	2,791
112.00	5,396	9,145	11,936
113.00	6,305	5,851	17,787

Device	Routing	Invert	Outlet Devices
#1	Secondary	112.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Device 5	106.50'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Device 5	109.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 5	110.50'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#5	Primary	106.40'	**12.0" Round Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 106.40' / 106.00' S= 0.0057 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.87 cfs @ 12.22 hrs HW=110.68'   (Free Discharge)
└─**5=Culvert** (Passes 4.87 cfs of 5.80 cfs potential flow)
  ├─**2=Special & User-Defined** (Custom Controls 0.17 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 2.73 cfs @ 4.64 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 1.97 cfs @ 1.44 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=109.00'   (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Pond RG1: TO DP#1

Hydrograph

Inflow Area=1.207 ac
Peak Elev=110.69'
Storage=5,575 cf

Legend:
- Inflow
- Outflow
- Primary
- Secondary

7.74 cfs
4.94 cfs
4.94 cfs
0.00 cfs

Flow (cfs) vs Time (hours)
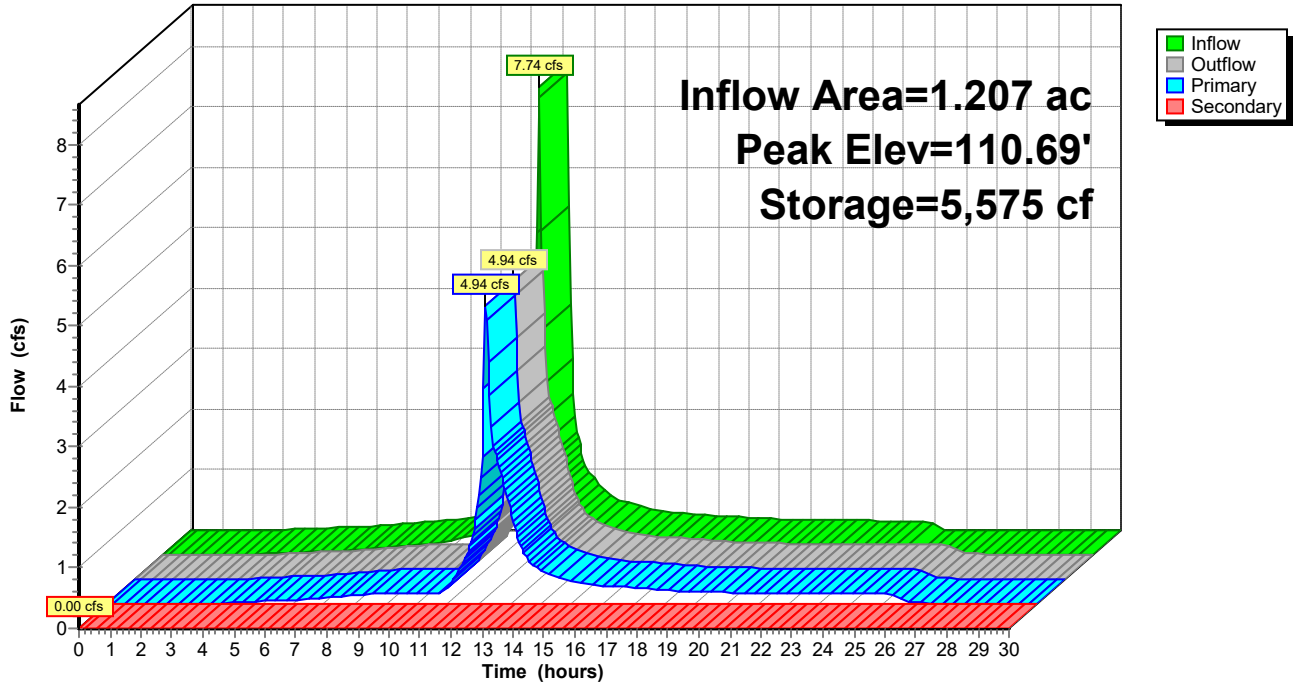
3.0
STORMWATER MANAGEMENT FORMS

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

Checklist for Stormwater Report

A. Introduction

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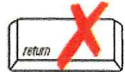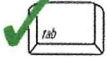
A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

(Seal: COMMONWEALTH OF MASSACHUSETTS, CHRISTOPHER M ANDERSON, CIVIL, No. 55372, REGISTERED PROFESSIONAL ENGINEER)
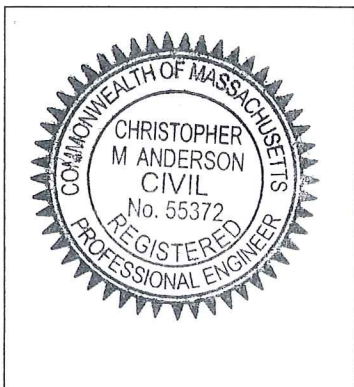
3-27-23

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☒ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

    ☐ Credit 1

    ☐ Credit 2

    ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☒ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe):   Deep Sump Catchbasins, Rain Garden

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided. (per Web Soil Survey & Soil Observation Logs)

☒ Required Recharge Volume calculation provided.

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

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

    ☒ Static   ☐ Simple Dynamic   ☐ Dynamic Field[1]

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

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

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

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

    ☒ Site is comprised solely of C and D soils and/or bedrock at the land surface

    ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

    ☐ Solid Waste Landfill pursuant to 310 CMR 19.000

    ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

    ☐ is within the Zone II or Interim Wellhead Protection Area

    ☐ is near or to other critical areas

    ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

    ☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist (continued)

Standard 4: Water Quality (continued)

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

    ☒ The ½" or 1" Water Quality Volume or

    ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

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

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

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs) *(Not Applicable)*

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas *(Not Applicable)*

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

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

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program
Checklist for Stormwater Report

Checklist (continued)

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

☐ *Portions of the project are* subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

    ☐ Limited Project

    ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.

    ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area

    ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff

    ☐ Bike Path and/or Foot Path

    ☐ Redevelopment Project

    ☐ Redevelopment portion of mix of new and redevelopment.

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

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

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

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

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

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

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

  ☒ Name of the stormwater management system owners;

  ☒ Party responsible for operation and maintenance;

  ☒ Schedule for implementation of routine and non-routine maintenance tasks;

  ☒ Plan showing the location of all stormwater BMPs maintenance access areas;

  ☐ Description and delineation of public safety features;

  ☐ Estimated operation and maintenance budget; and

  ☒ Operation and Maintenance Log Form.

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

  ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;

  ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

Stormwater Compliance Documentation
0 Murdock Ave, Winchendon
March 27, 2023

Standard 1: No Untreated Discharges or Erosion to Wetlands

The drainage from the site currently flows to a single point located at the wetland area along the westerly side of Murdock Avenue, this area has been designated as Design Point #1 (DP#1).

The proposed project develops a single discharge point from a proposed rain garden which capture the majority of the ESS Site. This area is comprised of a series concrete pads that support the battery containers and are serviced by a gravel access drive. No other areas of impervious surfaces (i.e. pavement) occur on the site. Because these pads are not associated with activities that typically generate sediment, for the purposes of this analysis they are also considered similar to roofs. Furthermore, the project will not utilize de-icing chemicals or sand during the winter months as traffic to the development does not occur on a regular basis. As such the development does not generate an Untreated Discharge.

As part of the project the majority of the runoff will be directed towards a small raingarden located along the westerly portion of the project. This will then discharge towards Design Point #1. Provided are the computations showing the calculations per the Connecticut DOT Drainage Manual, Section 11.13 that the proposed rip-rap aprons will provide adequate protection from scouring.

Equation-11.31 $\qquad\qquad\qquad\qquad$ Equation-11.33
$L = 1.80(Q-5)/S_p{}^{(1.5)} + 10$ $\qquad\qquad$ $W_2 = 3S_p + 0.7L_a$

For 15-inch HDPE pipe (FE#1)
$\quad$ $Q_{max} = 4.73$ cfs (100-Year) $\qquad$ $S_p = 15/12$ → 1.25 ft
$L = 1.8(4.73-5)/(1.25{}^{\wedge}1.5) + 10$ $\quad$ → -0.4 + 10 = 9.6 $\qquad$ → 10 feet
$W_2 = 3(1.25) + 0.7(10)$ $\qquad\qquad$ →3.75 + 7 = 10.75 $\qquad$ → 12.0 feet

Provide an apron 10-feet long with a terminus width of 12 feet wide.

For 12-inch HDPE pipe (FE#2)
$\quad$ $Q_{max} = 4.95$ cfs (100-Year) $\qquad$ $S_p = 12/12$ → 1.25 ft
$L = 1.8(4.95-5)/(1.05{}^{\wedge}1.5) + 10$ $\quad$ → -0.1 + 10 = 9.9 $\qquad$ → 10 feet
$W_2 = 3(1.0) + 0.7(10)$ $\qquad\qquad$ →3.0 + 7 = 10.0 $\qquad$ → 10.0 feet

Provide an apron 10-feet long with a terminus width of 10 feet wide.

Standard 2: Peak Rate Attenuation

Table #1: Peak Rate of Runoff

Design Point		2-yr Storm	10-yr Storm	25-yr Storm	100-yr Storm
#1	Pre-	5.90	13.60	20.21	34.52
	Post-	5.71	13.52	19.94	33.72

All flows are in cubic feet per second.

As outline above, the post-development peak rates are of runoff have been mitigated for all Storm Events.

Standard 3: Stormwater Recharge

Impervious Area Proposed: (This area includes all proposed concrete pads and gravel ways, driveways, etc.)

The soils within the project area classified as HSG C:
Existing Impervious HSG-C: 0 s.f.
Proposed Impervious HSG-C: 20,671 s.f.
Net New Impervious HSG-C: +20,671 s.f.

Total New Impervious area = 20,671 s.f.
Total Project Impervious = 20,671 s.f.

Required Recharge Volume:

Net Increase HSG Soil C
   Net New Impervious HSG C= 20,671 s.f.
   HSG C: 20,671 s.f. x (0.25 in/12) = 431 c.f.

Required Recharge Volume = 431 c.f.

Capture Rate:

Total Impervious to RG#1	19,990 sf
Net Captured Impervious	**19,990 sf**

Capture Rate = 19,990 s.f. / 20,671 s.f. = 97%

Portions of existing roadway are captured by proposed rain garden.

Compliance provided.

Storage Volume Provided:

Volume below lowest outlet within detention facility.

RG-1:   1,162 c.f. of storage volume provided

Recharge Provided:

Total Volume Required: 431 c.f.

Storage Volume
RG-1:   1,162 c.f. of storage volume provided

Required Recharge Volume = 431 c.f.
Provided Recharge Volume = 1,162 c.f.

Compliance is provided

Drawdown Time: (72 Hours Max.)

Time = Storage Volume / (K x Bottom Area)

Where K = Saturated Hydraulic Conductivity (inches/hour) (From table 2.3.3 1982 Rawls Rates – Mass Stormwater Handbook)

    RG #1:   1,162 c.f. of storage volume provided.
    Time = 1,162 c.f. / (0.27 in/hr x (1 ft/ 12 in) x 1,833 s.f.) = **28.2 hrs**

Compliance is provided

Standard 4: Water Quality

Water Quality Volume (WQV) = Water Quality Depth x Impervious Area

    Water Quality Depth = 1/2 inch
    WQV = [(1/2 inch) / 12 inches/foot] x (20,671 s.f.) = 861 cf

    Water Quality Depth -TP = 1 inch
    WQV -TP = [(1-inch) / 12 inches/foot] x (20,671 s.f.) = 1,723 cf

The total new impervious surfaces created by the project are associated with the concrete pads that are used for the transformers and batteries. Because these pads are not associated with activities that typically generate sediment, for the purposes of this analysis they are also considered similar to roofs. Furthermore, the need for regular winter road treatments such as de-icing chemical and sand are not required for this type of development. Therefore, Water Quality Volume is not warranted under Stormwater Management Regulations.

In addition, as required under the Local Stormwater Bylaw, the proposed stormwater management system must be capable of retaining the volumetric runoff equivalent to 1-inch per square foot of post construction impervious areas as a means of providing the 60% Total Phosphorus (TP) removal. To provide compliance, a Rain Garden has been designed in order to capture runoff from the development, these BMP by default provide an area for vegetation to treat runoff and provide the appropriate level of TP removal. Per Volume 2, Chapter 2 of Rain gardens provide between 30% and 90% of TP removal, providing compliance with the regulation. In addition there is a constant ponding depth of approximately 6" which equates to a storage volume of 1,162 c.f. which contributes to providing compliance with the intent of regulation.

Standard 5:   Land Uses with Higher Potential Pollutant Loads

Not Applicable

Standard 6:   Critical Areas

Not Applicable

Standard 7:   Redevelopment

Not Applicable - New Development

Standard 8:   **Construction Period Controls**

Proper erosion controls have been incorporated into the submitted plans and details to ensure compliance with the standard.

Standard 9:   **Operation and Maintenance Plan**

Operation and Maintenance plans for the project have been incorporated into the submitted plans and details to ensure compliance with the standard.

Standard 10:   **Illicit Discharges to Drainage System**

No Illicit discharges to the drainage system will occur as a result of this proposed project. A No Illicit discharge statement shall be provided prior to construction.

INSTRUCTIONS:
1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C value within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: Rain Garden - Pipe Discharge

BMP[1]	A TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catchbasin	0.25	1.00	0.25	0.75
Rain Garden	0.90	0.75	0.68	0.08

Total TSS Removal = 93%

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

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

Project: Murdock Avenue, Winchendon

Prepared By: Hannigan Engineering, Inc.

Date: 3/20/2023

Summary for Pond RG1: (new Pond)

[44] Hint: Outlet device #2 is below defined storage

Inflow Area =	1.207 ac, 10.83% Impervious, Inflow Depth = 0.95" for Custom event			
Inflow =	1.16 cfs @ 12.14 hrs, Volume=	0.095 af		
Outflow =	0.17 cfs @ 12.88 hrs, Volume=	0.095 af, Atten= 85%, Lag= 44.5 min		
Primary =	0.17 cfs @ 12.88 hrs, Volume=	0.095 af		

Routed to Reach OL1 : OVERLAND TO WETLAND

Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach OL1 : OVERLAND TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 109.50' @ 12.88 hrs Surf.Area= 2,795 sf Storage= 1,162 cf <=Storage/Recharge Volume

Plug-Flow detention time= 57.3 min calculated for 0.095 af (100% of inflow)
Center-of-Mass det. time= 57.3 min (930.4 - 873.1)

Volume	Invert	Avail.Storage	Storage Description
#1	109.00'	17,787 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
109.00	1,833	0	0
110.00	3,749	2,791	2,791
112.00	5,396	9,145	11,936
113.00	6,305	5,851	17,787

Device	Routing	Invert	Outlet Devices
#1	Secondary	112.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Device 5	106.50'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Device 5	109.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads
#4	Device 5	110.50'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#5	Primary	106.40'	**12.0" Round Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 106.40' / 106.00' S= 0.0057 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.17 cfs @ 12.88 hrs HW=109.50' (Free Discharge)
└─**5=Culvert** (Passes 0.17 cfs of 4.82 cfs potential flow)
　├─**2=Special & User-Defined** (Custom Controls 0.17 cfs)
　├─**3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.16 fps)
　└─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=109.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

3.1
OPERATION AND MAINTENANCE

STORMWATER OPERATION, MAINTENANCE AND
POLLUTION PREVENTION PLAN

ZP Battery DevCo, LLC
#0 Murdock Avenue
Winchendon, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:
(To be determined)

RESPONSIBLE PARTY POST CONSTRUCTION:
ZPB 2020-16, LLC
10 E. Worcester Street, Suite 3A
Worcester, Massachusetts 01604
pforte@zpeenergy.com

BEST MANAGEMENT PRACTICES

To prevent the migration of soils, Best Management Practices (BMP's) shall be employed. During construction, hay bales and silt fence will be installed as shown on the plans and also at additional locations on an as needed basis to provide sufficient erosion controls on the site. These components shall be installed to catch and trap the migrating soil materials and pollutants.

All applicable BMP's listed below and in the Department of Environmental Protection's Stormwater Management Handbooks (Volume1: Overview of Massachusetts Stormwater Management Standards and Volume 2: Technical Guide for Compliance with Massachusetts Stormwater Management Standards) dated January 2008 (as amended), shall be incorporated in this project.

INSPECTION AND MAINTENANCE (DURING CONSTRUCTION)

1. At all times, hay bales, siltation fabric fencing and wooden stakes sufficient to construct sedimentation control barrier a minimum of 50 feet long will be stockpiled on the site in order to repair established barriers which may have been damaged or breached.

2. Necessary erosion controls shall be in place prior to any clearing or construction on the site. Construction sequence shall be phased in such a manner that the on-site detention basins are stabilized and functioning prior to the establishment of any new impervious areas on the site. The Contractor shall provide temporary stilling or settling basins as needed to catch and trap any migrating soil materials and pollutants from the construction areas.

3. An inspection of all erosion control and stormwater management systems shall be conducted at least once every fourteen (14) calendar days and following significant storm events. Where sites have been finally or temporarily stabilized, or runoff is unlikely due to winter conditions, such inspections shall be conducted at least once every month. (EPA SWPPP IS REQUIRED FOR THIS PROJECT)

In case of any noted breach or failure, the General Contractor shall immediately make appropriate repairs to any erosion control system and notify the engineer of any problems involving storm water management systems.

A significant storm event shall be defined as all or one of the following thresholds.

a. Any storm in which rain is predicted to last for twelve consecutive hours or more.
b. Any storm for which a flash flood watch or warning is issued.
c. Any single storm predicted to have a cumulative rainfall of greater than one inch.
d. Any storm not meeting the previous three thresholds but which would mark a third consecutive day of measurable rainfall.

4. If site inspections identify BMPs not operating effectively, maintenance must be performed as soon as possible and before the next storm event.

5. If BMPs need modification or additional BMPs need to be added, implementation must be completed before the next storm if practicable. If implementation before the next storm event is impracticable, the situation must be documented in the construction log and alternative BMPs must be implemented as soon as possible

6. The General Contractor shall also inspect the erosion control and stormwater management systems at times of significant increase in surface water runoff due to rapid thawing when the risk of failure of erosion control measures is significant.

7. In such instances as remedial action is necessary, the General Contractor shall repair any and all significant deficiencies in erosion control systems within two days.

8. The Department of Public Works and/or Conservation Commission shall be notified of any significant failure of storm water management systems and erosion and sediment control measures and shall be notified of any release of pollutants to a water body (stream, brook, pond, etc.).

9. The General Contractor shall remove the sediment from behind the fence of the sedimentation control barrier when the accumulated sediment has reached one-half of the original installed height of the barrier.

INSPECTION AND MAINTENANCE (POST-CONSTRUCTION)

It is the agreement of the responsible parties to finance, inspect, and perform (respectfully) the long-term maintenance of the erosion control devices and the stormwater management systems within the limits stated below.

1.   A visual inspection of all erosion control and stormwater management systems shall be conducted by the above identified person(s) a minimum of once per month and after every major storm during the first six months of operation (a portion of that time must be in the growing season). Thorough investigations shall be conducted twice a year. Monthly maintenance requirements may be adjusted based upon the results obtained from the first year of operation.

2.   Roads and parking lots shall be swept at least twice per year and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of off-site in accordance with MADEP and other applicable requirements.

3.   Accumulated sediment shall be removed a minimum of one time per year by means of a clamshell bucket or equivalent from the bottom of the deep sump catch basins and manhole. Disposal of accumulated sediment and pollutants must be in accordance with local, state, and federal guidelines and requirements.

4.   All resulting sweepings or sediment removed from catch basins, and manhole connections shall be collected and properly disposed of off-site in accordance with MADEP and other applicable requirements.

5.   **Maintenance Schedule**

Structure Type	Inspection	Maintenance	Task
Outfall Structures	Twice a Year	Every 10 Years	Remove Debris & Add Stone
Subdrain	Twice a Year	Every 10 Years	Replaced peastone

Rain Garden Maintenance Schedule		
Activity	**Time of Year**	**Frequency**
Inspect & Remove Trash	Year Round	Monthly
Mulch	Spring	Annually
Remove Dead Vegetation	Fall or Spring	Annually
Replace Dead Vegetation	Spring	Annually
Prune	Spring or fall	Annually
Replace entire media & all vegetation	Late Spring/Early Summer	As needed

LONG TERM POLLUTION PREVENTION PLAN

1. Access drives to the site shall be swept on an annual basis with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.

2. Trash and other debris shall be removed from the drives periodically as needed. Full inspection of the site shall be made on a semi-annual basis to ensure clean and neat appearance to the site. This measure will help in the overall performance of the onsite systems.

3. Trash and other debris shall be removed from landscaped and planted areas periodically as needed. Full inspection of the site shall be made on a semi-annual basis to ensure clean and neat appearance to the site. This measure will help in the overall performance of the onsite systems.

4. Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system

5. Grass shall be maintained at a minimum blade height of two to three inches and only 1/3 of the plant height shall be removed at a time.

6. Pet waste shall be disposed of in accordance with local regulations. Pet waste shall not be disposed of in a storm drain or catch basin.

7. Winter Access Treatment: Access drives during winter months shall be cleared by mechanical means only (i.e. plowing, etc…). No application of sand or de-icing chemicals shall be applied to drive or other areas associated with the ESS Battery Station.

Inspection Log
0 Murdock Avenue, Winchendon, Massachusetts

DATE	ACTION	RESULT	PERFORMED BY

STORMWATER OPERATION, MAINTENANCE AND POLLUTION PREVENTION PLAN
ZP Battery DevCo, LLC, Winchendon, Massachusetts
March 27, 2023

Maintenance Log

0 Murdock Avenue, Winchendon, Massachusetts

DATE	ACTION	PERFORMED BY

STORMWATER OPERATION, MAINTENANCE AND POLLUTION PREVENTION PLAN
ZP Battery DevCo, LLC, Winchendon, Massachusetts
March 27, 2023

Massachusetts Department of Environmental Protection
Stormwater Management Standard 10:
Illicit Discharge Compliance Statement

I, as Owner/Applicant, certify, that; the property located at:

_____

(Locus Address)

In, _____, Massachusetts;

(City/Town)

The property does not have any illicit or unauthorized stormwater drainage discharges including, but not limited to non-stormwater discharges occurring due to spills, dumping and improper connections to the system from residential, industrial commercial nor institutional establishments.

The plan/map of record clearly identifies the following:

- The location of all on-site systems for conveying wastewater, stormwater and/or groundwater
- The location of any measures taken to prevent the entry of illicit discharges into the storm drain system.
- That there are no connections between the wastewater management system and the on-site/off-site drainage system.

Plan/Map of Record:

_____

Prepared by Hannigan Engineering, Inc., dated _____

Property/System Owner:

Name: _____

Address: _____

Signature: _____

FIGURE 1
LOCUS MAP AND SOILS MAP

Hydrologic Soil Group—Worcester County, Massachusetts, Northwestern Part

Map Scale: 1:5,640 if printed on A portrait (8.5" x 11") sheet.

Meters
0   50   100   200   300

Feet
0   250   500   1000   1500

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 18N WGS84

Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

3/17/2023
Page 1 of 4

Hydrologic Soil Group—Worcester County, Massachusetts, Northwestern Part

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 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northwestern Part
Survey Area Data: Version 16, 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: Oct 15, 2020—Oct 31, 2020

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
1	Water		1.9	1.2%
59A	Bucksport and Wonsqueak mucks, 0 to 2 percent slopes	B/D	0.6	0.4%
365B	Skerry fine sandy loam, 3 to 8 percent slopes	C/D	6.1	3.8%
908C	Becket-Skerry association, 0 to 15 percent slopes, extremely stony	C	110.5	67.6%
917B	Pillsbury-Peacham association, 0 to 8 percent slopes, extremely stony	C/D	44.3	27.1%
Totals for Area of Interest			**163.5**	**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

Commonwealth of Massachusetts
City/Town of WINCHENDON
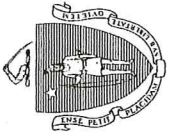
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

BOSTWICK REALTY TRUST
Owner Name

0 MURDOCK AVENUE
Street Address

WINCHENDON   MA   5A2/25
City   State   Map/Lot #

                                             01475
                                             Zip Code

B. Site Information

1. (Check one)   ☒ New Construction   ☐ Upgrade

2. Soil Survey   NRCS   908C
                  Source   Soil Map Unit   Soil Series

   MORRAINE   NONE
   Landform   Soil Limitations

   LODGMENT GLACIAL TILL
   Soil Parent material

3. Surficial Geological Report

                  Year Published/Source   Map Unit

   Description of Geologic Map Unit:

4. Flood Rate Insurance Map   Within a regulatory floodway?   ☐ Yes   ☐ No

5. Within a velocity zone?   ☐ Yes   ☒ No

6. Within a Mapped Wetland Area?   ☐ Yes   ☐ No   If yes, MassGIS Wetland Data Layer:

7. Current Water Resource Conditions (USGS):   02/23   Wetland Type
                                                Month/Day/ Year   Range: ☐ Above Normal   ☒ Normal   ☐ Below Normal

8. Other references reviewed:
   (Zone II, IWPA, Zone A, EEA Data Portal, etc.)

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City/Town of WINCHENDON
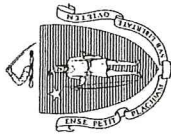
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 0223-2 _Hole #_

1. Land Use WOODLAND
   (e.g., woodland, agricultural field, vacant lot, etc.)

   Date 2/9/23   Time 10:00   Weather SUN

   Vegetation DECIDOUS NEW GROWTH

   Surface Stones (e.g., cobbles, stones, boulders, etc.) NONE

   Latitude _____   Longitude _____   Slope (%) 0-5

   Description of Location: IN WOODLAND ABOUT 60-FT OFF ROAD

2. Soil Parent Material: GLACIAL TILL   Landform MORRAIN   Position on Landscape (SU, SH, BS, FS, TS, Plain) ON SLOPE

3. Distances from: Open Water Body +100 feet   Drainage Way +100 feet   Wetlands 80 feet   Other _____ feet

   Property Line 50 feet   Drinking Water Well _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No   If Yes: ☐ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock
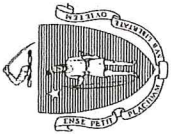
5. Groundwater Observed: ☒ Yes ☐ No   If yes: 52 Depth to Weeping in Hole   _____ Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features Depth	Redoximorphic Features Color	Percent	Coarse Fragments % by Volume Gravel	Cobbles & Stones	Soil Structure	Soil Consistence (Moist)	Other
0-12	A	LOAM	10YR 2/2		Cnc :						
					Dpl:						
12-26+	B	SA LOAM	7.5YR 5/8		Cnc :				MASS	FIRM	
					Dpl:						
26-52	B/V	LO SAND	7.5 YR6/6	28	Cnc :				MASS	FIRM	
					Dpl:						
52-96	C	LO SAND	10YR 6/6		Cnc :				MASS	FIRM	
					Dpl:						
					Cnc :						
					Dpl:						
					Cnc :						
					Dpl:						

Commonwealth of Massachusetts
City/Town of WINCHENDON

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Additional Notes:
NO REFUSAL, GWO@52"

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: 0223-3   Date: 2/9/23   Time: 10:30   Weather: SUNB

Longitude _____   Latitude _____

1. Land Use: WOODLAND
   (e.g., woodland, agricultural field, vacant lot, etc.)

   Surface Stones (e.g., cobbles, stones, boulders, etc.): NONE   Slope (%): 0-5

   Description of Location: IN WOODLAND ABOUT 60-FEET OFF ROAD

2. Soil Parent Material: GLACIAL TILL   Landform: MORRAINE   Position on Landscape (SU, SH, BS, FS, TS, Plain): ON SOPE

3. Distances from: Open Water Body +100 feet   Drainage Way +100 feet   Wetlands 70 feet   Other _____ feet

   Property Line +50 feet   Drinking Water Well _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No   If Yes: ☐ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No   If yes: 47 Depth to Weeping in Hole _____   Depth Standing Water in Hole _____

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features Depth	Redoximorphic Features Color	Percent	Coarse Fragments % by Volume Gravel	Coarse Fragments % by Volume Cobbles & Stones	Soil Structure	Soil Consistence (Moist)	Other
0-12	A	LOAM	10YR 2/2	Cnc : Dpl:							
12-18	B	SA LOAM	7.5YR 5/8	Cnc : Dpl:					MASS	FIRM	
18-26	B/C	LO SAND	7.5 YR 6/6	Cnc : Dpl:					MASS	FIRM	
26-96	C	LO SABD	10YR 6/6	30	Cnc : Dpl:				MASS	FIRM	
				Cnc : Dpl:							
				Cnc : Dpl:							

Vegetation: DECIDOUS NEW GROWTH

3101-DEEP 0223-2-3.doc

Commonwealth of Massachusetts
City/Town of WINCHENDON

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Additional Notes:
NO REFUSAL, GWO@47"

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole #0223-2	Obs. Hole #0223-3
☒ Depth to soil redoximorphic features	28 inches	30 inches
☒ Depth to observed standing water in observation hole	52 inches	47 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number _____ Reading Date _____

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes   ☐ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)?

   Upper boundary: _____ inches   Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed?

   Upper boundary: _____ inches   Lower boundary: _____ inches
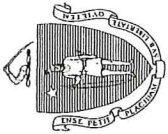
F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator

2/10/23
Date

CHRISTOPHER ANDERSON#14005
Typed or Printed Name of Soil Evaluator / License #

6/30/2025
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:
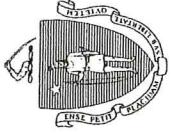
Commonwealth of Massachusetts
City/Town of WINCHENDON

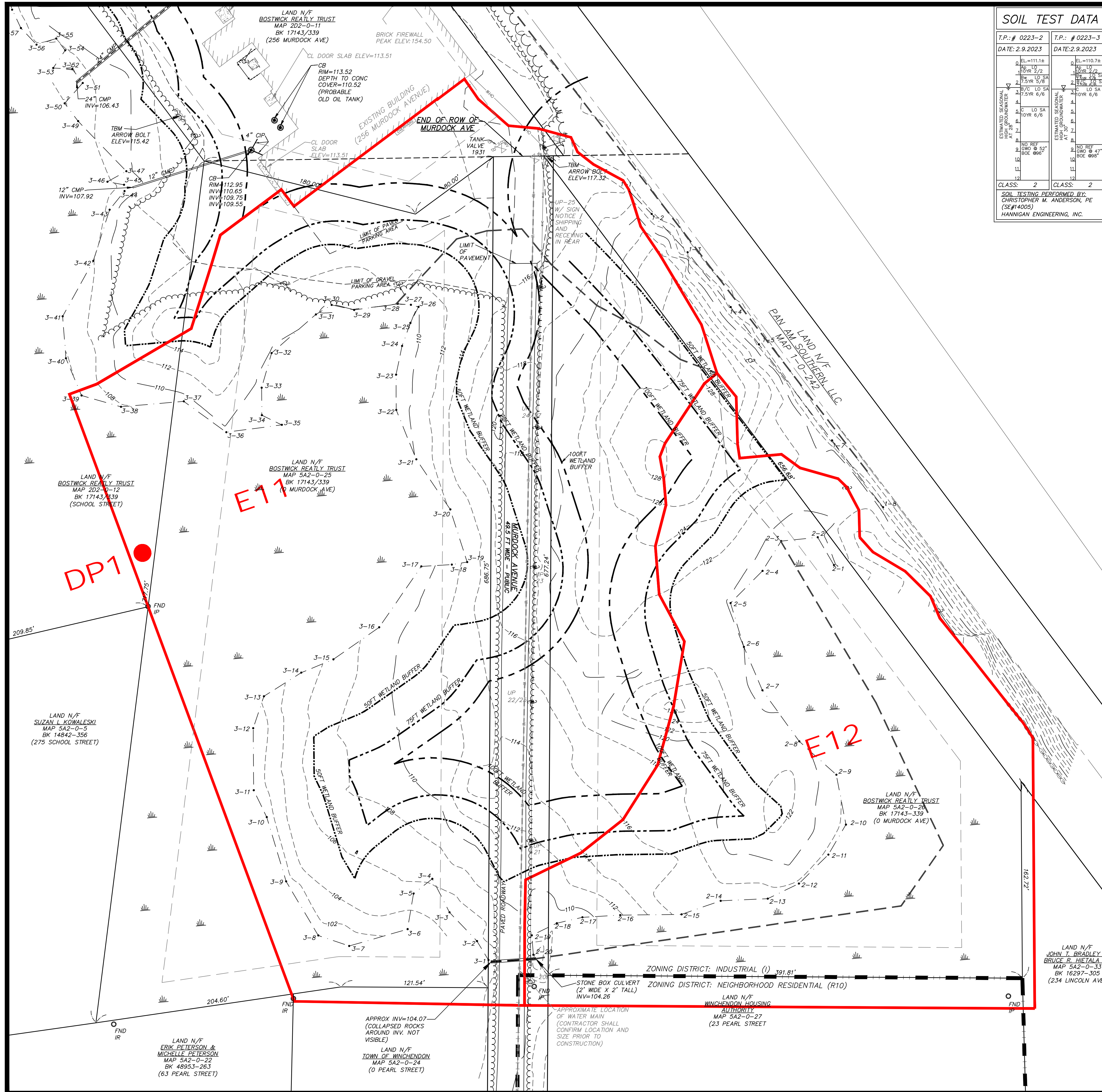# Form 11 – Soil Suitability Assessment for On-Site Sewage Disposal

MURDOCK AVENUE, WINCHENDON, MA

Property Tax Parcels
USGS Topographic Maps

MassMapper

Leaflet | MassGIS

FIGURE 2
PRE-DEVELOMPENT WATERSHED MAP

SOIL TEST DATA

	T.P.: # 0223-2	T.P.: # 0223-3
DATE:	2.9.2023	2.9.2023

SOIL TESTING PERFORMED BY:
CHRISTOPHER M. ANDERSON, PE (SE#14005)
HANNIGAN ENGINEERING, INC.

LOCUS MAP
SCALE: 1" = 1000'

OWNER
BOSTWICK REALTY TRUST
256 MURDOCK AVENUE
WINCHENDON, MASSACHUSETTS

APPLICANT
ZP BATTERY DEVCO, LLC
1 MERCANTILE STREET, SUITE 630
WORCESTER, MASSACHUSETTS 01608

PROJECT NOTES:
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5. IMPERVIOUS COVERAGE FROM THE PROPOSED PROJECT SHALL BE COMPRISED OF CONCRETE AND CRUSHED STONE/GRAVEL FOR ACCESS WAYS.

PROJECT INFORMATION

LAND INFORMATION
MAP/PARCEL: 5A2/25; 5A2/26
DEED BOOK/PAGE: 17143/339
EXISTING FRONTAGE: 686.75 FT (5A2/25); 677.24 FT (5A2/26)
EXISTING AREA: 4.33 ACRES± (5A2/25); 3.67 ACRES±(5A2/26

ZONING INFORMATION
ZONING DISTRICT: INDUSTRIAL
DIMENSIONAL REQUIREMENTS:
MINIMUM AREA: 43,560 SF
MINIMUM FRONTAGE: 150 FEET
MAXIMUM HEIGHT: 50FT
MAXIMUM COVERAGE: NA
MINIMUM SETBACKS:
FRONT YARD: 40 FT
SIDE YARD: 25 FT
REAR YARD: 50 FT

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4. NOTIFICATION REQUIREMENTS SHOWN ON THIS PLAN SHALL NOT RELIEVE THE CONTRACTOR OF ANY OTHER REQUIREMENTS WHICH MAY EXIST UNDER LOCAL, STATE, OR FEDERAL JURISDICTION TO WHICH THE CONTRACTOR IS OBLIGATED.
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LEGEND

EXISTING		PROPOSED
542	CONTOURS	560
	PROPERTY LINES	
	DRAIN	
	SEWER	
W	WATER	W
	ELEC/TELE/CABLE	OHW
ECT	ELEC/TELE/CABLE	ECT
	EDGE OF PAVEMENT	
	CURBLINE	
	EROSION CONTROL	
	STRAW WATTLE AND SILT FENCE	
	WETLAND	
	TREELINE	
	WETLAND BUFFER ZONE	
	HYDRANTS	
	SIGNS	
	LIGHTPOLE	

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CIVIL ENGINEERS & LAND SURVEYORS

8 Monument Square
Leominster, Massachusetts 01453
(978) 534-1234 (T)
(978) 534-6060 (F)
www.hanniganengineering.com

EXISTING WATERSHED PLAN
in
WINCHENDON, MASSACHUSETTS

PREPARED FOR:
ZP BATTERY DEVCO, LLC
PETE FORTE
1 MERCANTILE STREET, SUIT 630
WORCESTER, MASSACHUSETTS 01608
TEL:

GRAPHIC SCALE: 1"=40'

APPROVAL OF THIS PLAN IS GRANTED ON THE CONDITIONS LISTED IN A SEPARATE STATEMENT OF CONDITIONS WHICH PART OF THE APPROVAL OF THIS SITE PLAN.
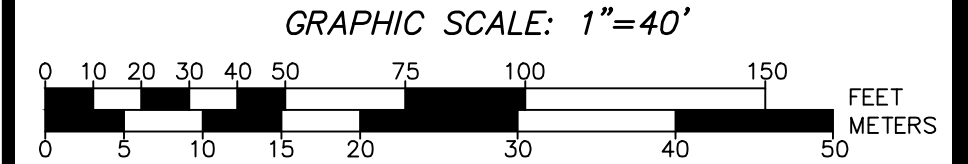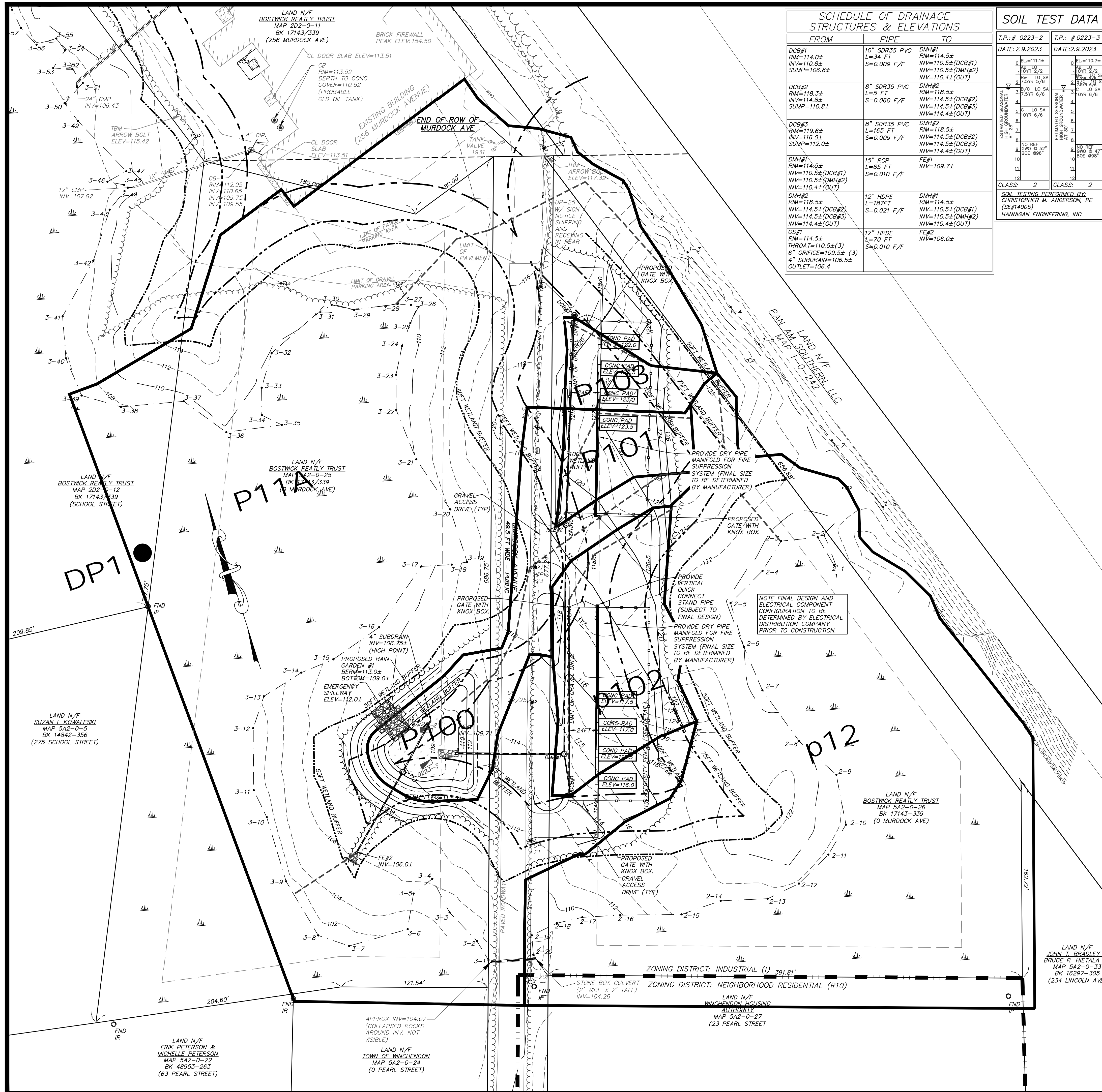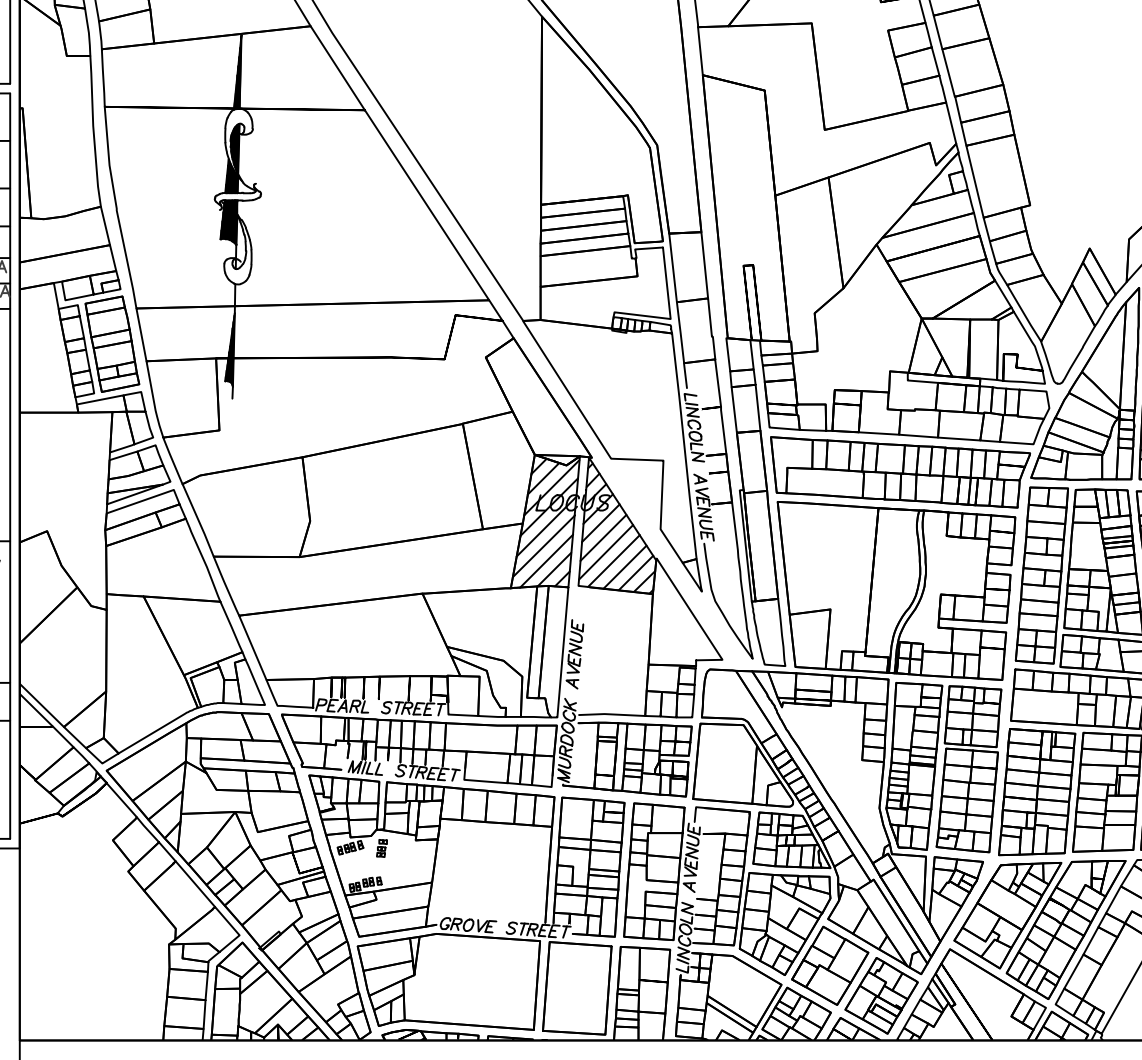
WINCHENDON PLANNING BOARD

DATE: _____

CALC: CMA	DRWN: CMA	SCALE: 1"=40'
CHKD: WDH	APPD: CMA	DATE: MAR 27,2023
SRV: JEF	FB: 75-130	JOB NO: 3101
TAB: WS	SHEET 1 OF 2	PLAN NO: C-18-41

FIGURE 3
POST-DEVELOMPENT WATERSHED MAP

SCHEDULE OF DRAINAGE STRUCTURES & ELEVATIONS

FROM	PIPE	TO
DCB#1 RIM=114.0± INV=110.8± SUMP=106.8±	10" SDR35 PVC L=34 FT S=0.009 F/F	DMH#2 RIM=114.5± INV=110.5±(DCB#1) INV=110.5±(DMH#2) INV=110.4±(OUT)
DCB#2 RIM=118.3± INV=114.8± SUMP=110.8±	8" SDR35 PVC L=5 FT S=0.060 F/F	DMH#2 RIM=118.5± INV=114.5±(DCB#2) INV=114.5±(DCB#3) INV=114.4±(OUT)
DCB#3 RIM=119.6± INV=116.0± SUMP=112.0±	8" SDR35 PVC L=165 FT S=0.009 F/F	DMH#2 RIM=118.5± INV=114.5±(DCB#2) INV=114.5±(DCB#3) INV=114.4±(OUT)
DMH#1 RIM=114.5± INV=110.5±(DCB#1) INV=110.5±(DMH#2) INV=110.4±(OUT)	15" RCP L=85 FT S=0.010 F/F	FE#1 INV=109.7±
DMH#2 RIM=118.5± INV=114.5±(DCB#2) INV=114.5±(DCB#3) INV=114.4±(OUT)	12" HDPE L=187FT S=0.021 F/F	DMH#1 RIM=114.5± INV=110.5±(DCB#1) INV=110.5±(DMH#2) INV=110.4±(OUT)
OS#1 RIM=114.5± THROAT=110.5±(3) 6" ORIFICE=109.5±(3) 4" SUBDRAIN=106.5± OUTLET=106.4	12" HDPE L=70 FT S=0.010 F/F	FE#2 INV=106.0±

SOIL TEST DATA

T.P.: # 0223-2 DATE: 2.9.2023
T.P.: # 0223-3 DATE: 2.9.2023

CLASS: 2   CLASS: 2

SOIL TESTING PERFORMED BY:
CHRISTOPHER M. ANDERSON, PE (SE#14005)
HANNIGAN ENGINEERING, INC.

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LOCUS MAP
SCALE: 1" = 1000'

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LEGEND

EXISTING		PROPOSED
542	CONTOURS	560
	PROPERTY LINES	
	DRAIN	
	SEWER	
W	WATER	
	ELEC/TELE/CABLE	OHW
ECT	ELEC/TELE/CABLE	ECT
	EDGE OF PAVEMENT	
	CURBLINE	
	EROSION CONTROL	
	STRAW WATTLE AND SILT FENCE	
	TREELINE	
	WETLAND	
	WETLAND BUFFER	
	WETLAND BUFFER ZONE	
	HYDRANTS	
	SIGNS	
	LIGHTPOLE	

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PROPOSED WATERSHED PLAN
IN
WINCHENDON, MASSACHUSETTS

PREPARED FOR:
ZP BATTERY DEVCO, LLC
PETE FORTE
1 MERCANTILE STREET, SUIT 630
WORCESTER, MASSACHUSETTS 01608
TEL:

GRAPHIC SCALE: 1"=40'
0 10 20 30 40 50   75   100   150   FEET
0 5 10 15   20   30   40   50   METERS

CALC: CMA	DRWN: CMA	SCALE: 1"=40'
CHKD: WDH	APPD: CMA	DATE: MAR 27,2023
SRV: JEF	FB: 75-130	JOB NO: 3101
TAB: WS	SHEET 2 OF 2	PLAN NO:C-18-41

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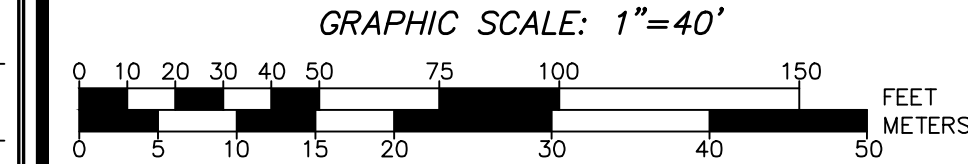
WINCHENDON PLANNING BOARD

DATE:

(Plan labels and callouts)

LAND N/F BOSTWICK REALTY TRUST MAP 202-0-11 BK 17143/339 (256 MURDOCK AVE)

BRICK FIREWALL PEAK ELEV:154.50

EXISTING BUILDING (256 MURDOCK AVENUE)

END OF ROW OF MURDOCK AVE

LAND N/F PAN AM SOUTHERN LLC MAP 1-0-242

LAND N/F BOSTWICK REALTY TRUST MAP 202-0-25 BK 17143/339 (0 MURDOCK AVE) (SCHOOL STREET)

LAND N/F SUZAN L KOWALESKI MAP 5A2-0-5 BK 14842-356 (275 SCHOOL STREET)

LAND N/F BOSTWICK REALTY TRUST MAP 5A2-0-26 BK 17143/339 (0 MURDOCK AVE)

LAND N/F ERIK PETERSON & MICHELLE PETERSON MAP 5A2-0-22 BK 48953-263 (63 PEARL STREET)

TOWN OF WINCHENDON MAP 5A2-0-24 (0 PEARL STREET)

LAND N/F WINCHENDON HOUSING AUTHORITY MAP 5A2-0-27 (23 PEARL STREET)

LAND N/F JOHN T. BRADLEY & BRUCE R. HIETALA JR. MAP 5A2-0-33 BK 16297-305 (234 LINCOLN AVE)

ZONING DISTRICT: INDUSTRIAL (I)
ZONING DISTRICT: NEIGHBORHOOD RESIDENTIAL (R10)

PROPOSED GATE WITH KNOX BOX

PROPOSED RAIN GARDEN #1 BOTTOM=109.0±

EMERGENCY SPILLWAY ELEV=112.0±

DP1
P100 P101 P102 P103 P11A P12

NOTE FINAL DESIGN AND ELECTRICAL COMPONENT CONFIGURATION TO BE DETERMINED BY ELECTRICAL DISTRIBUTION COMPANY PRIOR TO CONSTRUCTION.

PROVIDE DRY PIPE MANIFOLD FOR FIRE SUPPRESSION SYSTEM (FINAL SIZE TO BE DETERMINED BY MANUFACTURER)

PROVIDE VERTICAL QUICK CONNECT STAND PIPE SUBJECT TO FINAL DESIGN)

STONE BOX CULVERT (2' WIDE X 2' TALL)