DRAINAGE ANALYSIS

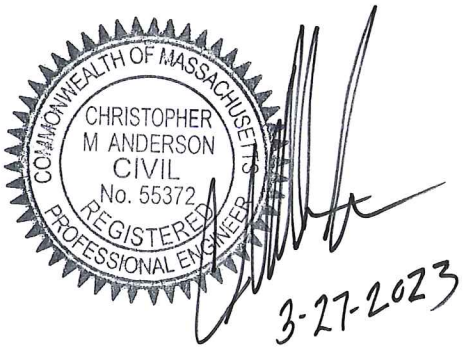
for

ZP Battery DevCo, LLC

256 Murdock Avenue

Winchendon, Massachusetts

March 27, 2023



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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 from the Town of Winchendon for the construction of a new Energy Storage System (ESS). The Project will be situated on a piece of property on the at the end of Murdock Avenue at #256 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 at the end of the Murdock Avenue Right of Way at #256 Murdock Avenue in Winchendon on lot of approximatley 3.75 acres. The property currently contains a pre-existing industrial structure with associated areas of gravel and pavement for access and parking to the structure. The remaining aareas are comprised mostly of woodand areas. 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 two areas of Borderiong Vegeteated Wetland on large area located along the westerly side of the property and second smaller area located along the easterly side of the property.

The project entails the construction of a standalone solar Energy Storage System (ESS) with an estimated capacity of approximately 5-Megawatt AC on the property. The proposed storage systems will be located near the rear of the property, within a stand of existing woodland within a gravel access area utlized for delivery trucks. 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. Thus, extensive clearing is not required. 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 four (4) concrete pads on which the eight (8) ESS units will be situated. Additional electrical components and transformer pads will also be installed to allow the eventual interconnection to the grid. The total area of alteration associated with the project will be approximately 25,000 square feet.

Access to the site will be provided by a single a gravel driveway that will extend off the existing gravel loading area utilized by the exsiting industrial building. This driveway will be 24-ft wide gravel drive will extend onto the ESS area. This gravel drive 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 #2 (DP#2).

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 overland flow to a single rain garden feature located to the north of the ESS site. This rain garden will then discharge the runoff to a new drainage trunkline near the existing building. The new proposed garden 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.

As previously mentioned the proposed rain garden will discharge runoff towards a new drainage trunkline that will replace an existing one. Under the current condition the existing 8" drainage main captures surface runoff from the northerly portion of the site around the building and discharges runoff to the wetland system located to the west of the site. This main is currently undersized for the existing flows. It is the intent that the drunkline be replaced with a new 15" Reinforced Concrete Pipe to accommodate the existing flows and the new rain garden flows. This drainage line will be fitted with a water quality unit to further improve the water quality of the runoff and will discharge to a level spreader device to provide velocity mitigation prior to runoff reaching the wetland area.

1.8 CONCLUSIONS

As stated above, a single Design Points have been established. Design Point #2 (DP#2) has been designated at a low point in the adjancent vegetated wetladn located along the westerly side of development property. 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#2. The results of the Drainage Analysis and resulting decreases in peak rates of runoff are shown below in *Table 1*.

Table #1: Peak Rates of Runoff

Design Point		2-yr Storm	10-yr Storm	25-yr Storm	100-yr Storm
#1	Pre-	9.63	17.83	24.48	36.46
	Post-	9.58	17.48	23.84	35.85

All flows are in cubic feet per second.

As outline 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.
C) Additional improvements to the water quality from the existing condition has been provided.

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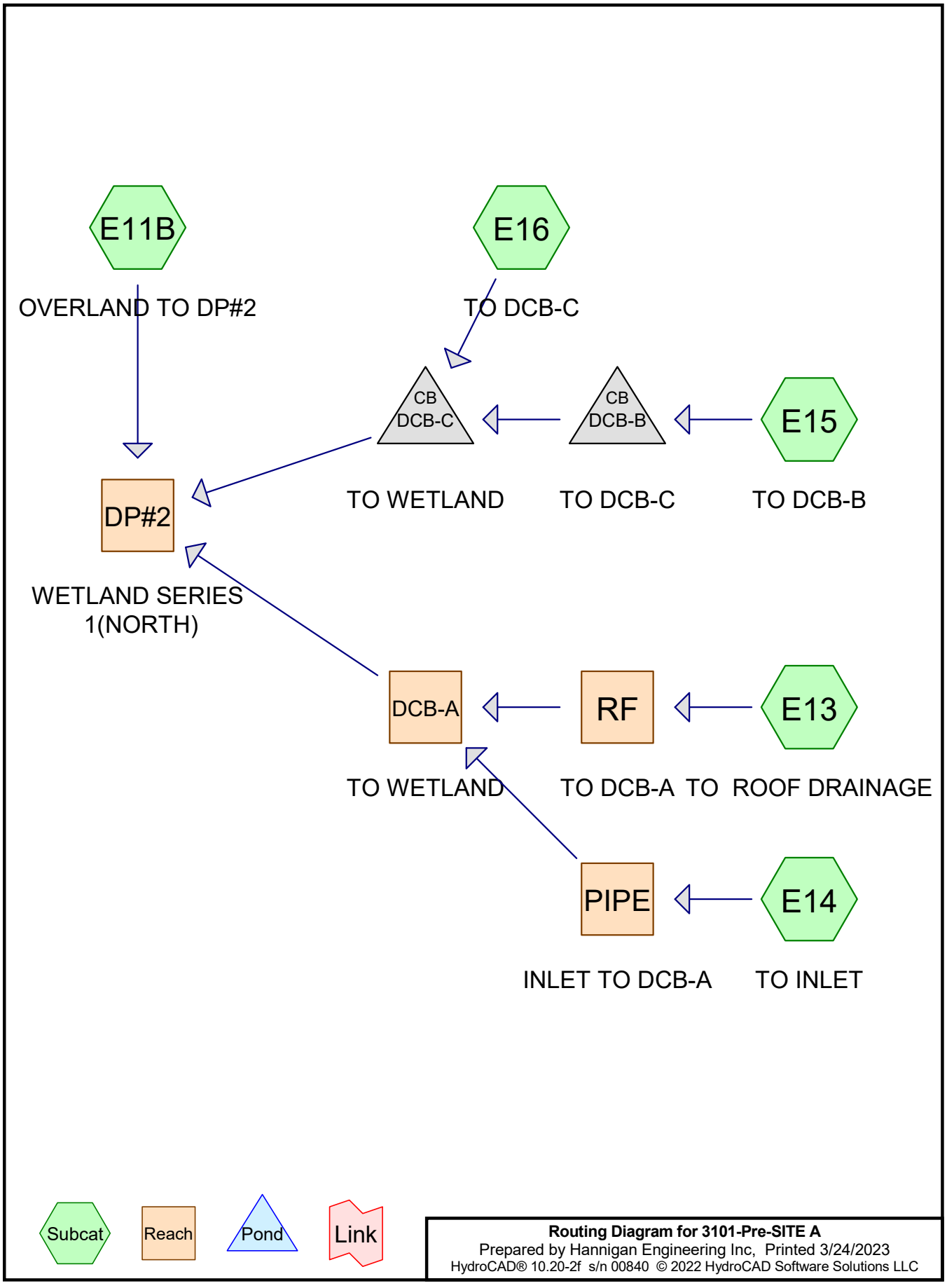
[1]"Urban Hydrology for Small Watersheds (Technical Release Number 55); Engineering Division, United States Dept. of Agriculture ,Soil Conservation Service (Jan. 1975)
[2]"National Engineering Handbook Section 4- Hydrology" ; United States Dept. of Agriculture, Soil Conservation Service (March 1985)
[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



Routing Diagram for 3101-Pre-SITE A
Prepared by Hannigan Engineering Inc, Printed 3/24/2023

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)
0.716	74	>75% Grass cover, Good, HSG C (E11B, E14, E15, E16)
1.866	96	Gravel surface, HSG C (E11B, E14, E15, E16)
1.232	98	Paved parking, HSG C (E11B, E13, E14, E15, E16)
3.676	70	Woods, Good, HSG C (E11B, E14, E15, E16)
7.490	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
7.490	HSG C	E11B, E13, E14, E15, E16
0.000	HSG D	
0.000	Other	
7.490		**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	0.716	0.000	0.000	0.716	>75% Grass cover, Good	E11B, E14, E15, E16
0.000	0.000	1.866	0.000	0.000	1.866	Gravel surface	E11B, E14, E15, E16
0.000	0.000	1.232	0.000	0.000	1.232	Paved parking	E11B, E13, E14, E15, E16
0.000	0.000	3.676	0.000	0.000	3.676	Woods, Good	E11B, E14, E15, E16
0.000	**0.000**	**7.490**	**0.000**	**0.000**	**7.490**	**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	DCB-A	106.90	106.43	131.0	0.0036	0.025	0.0	24.0	0.0
2	PIPE	110.16	106.90	242.0	0.0135	0.012	0.0	24.0	0.0
3	DCB-B	110.28	108.28	196.0	0.0102	0.010	0.0	6.0	0.0
4	DCB-C	107.68	106.47	138.0	0.0088	0.013	0.0	8.0	0.0

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 E11B: OVERLAND TO DP#2 Runoff Area=211,724 sf 0.83% Impervious Runoff Depth=1.22"
Flow Length=414' Tc=9.8 min CN=78 Runoff=5.47 cfs 0.495 af

Subcatchment E13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=2.90"
Tc=5.0 min CN=98 Runoff=3.13 cfs 0.269 af

Subcatchment E14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=1.16"
Flow Length=509' Tc=31.2 min CN=77 Runoff=0.55 cfs 0.084 af

Subcatchment E15: TO DCB-B Runoff Area=13,283 sf 12.86% Impervious Runoff Depth=1.77"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=86 Runoff=0.60 cfs 0.045 af

Subcatchment E16: TO DCB-C Runoff Area=15,007 sf 0.15% Impervious Runoff Depth=1.77"
Flow Length=179' Tc=6.1 min CN=86 Runoff=0.65 cfs 0.051 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=0.95' Max Vel=2.18 fps Inflow=3.28 cfs 0.353 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=3.11 cfs 0.353 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=9.63 cfs 0.944 af
Outflow=9.63 cfs 0.944 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.19' Max Vel=3.54 fps Inflow=0.55 cfs 0.084 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=0.54 cfs 0.084 af

Reach RF: TO DCB-A Inflow=3.13 cfs 0.269 af
Outflow=3.13 cfs 0.269 af

Pond DCB-B: TO DCB-C Peak Elev=110.93' Inflow=0.60 cfs 0.045 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=0.60 cfs 0.045 af

Pond DCB-C: TO WETLAND Peak Elev=108.82' Inflow=1.23 cfs 0.096 af
8.0" Round Culvert n=0.013 L=138.0' S=0.0088 '/' Outflow=1.23 cfs 0.096 af

Total Runoff Area = 7.490 ac Runoff Volume = 0.944 af Average Runoff Depth = 1.51"
83.55% Pervious = 6.258 ac 16.45% Impervious = 1.232 ac

Summary for Subcatchment E11B: OVERLAND TO DP#2

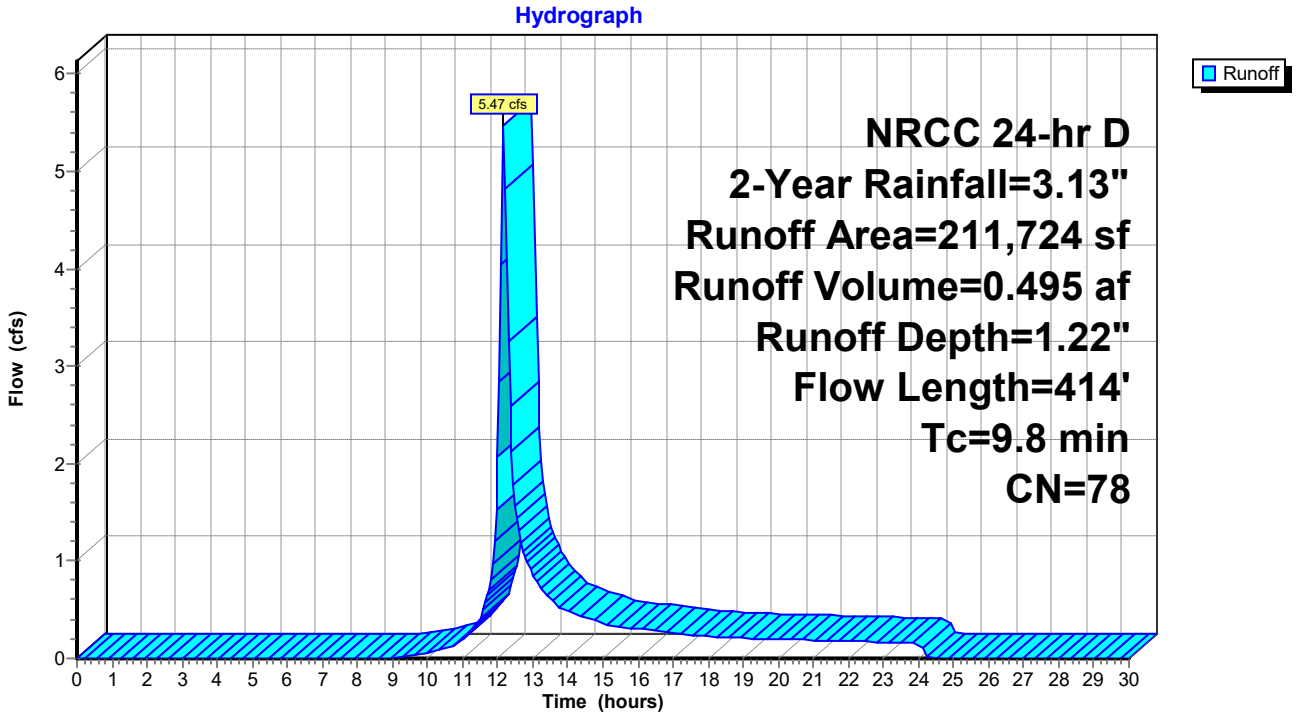
Runoff = 5.47 cfs @ 12.18 hrs, Volume= 0.495 af, Depth= 1.22"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
23,722	74	>75% Grass cover, Good, HSG C
127,829	70	Woods, Good, HSG C
58,406	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
211,724	78	Weighted Average
209,957		99.17% Pervious Area
1,767		0.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment E11B: OVERLAND TO DP#2



Summary for Subcatchment E13: TO ROOF DRAINAGE

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

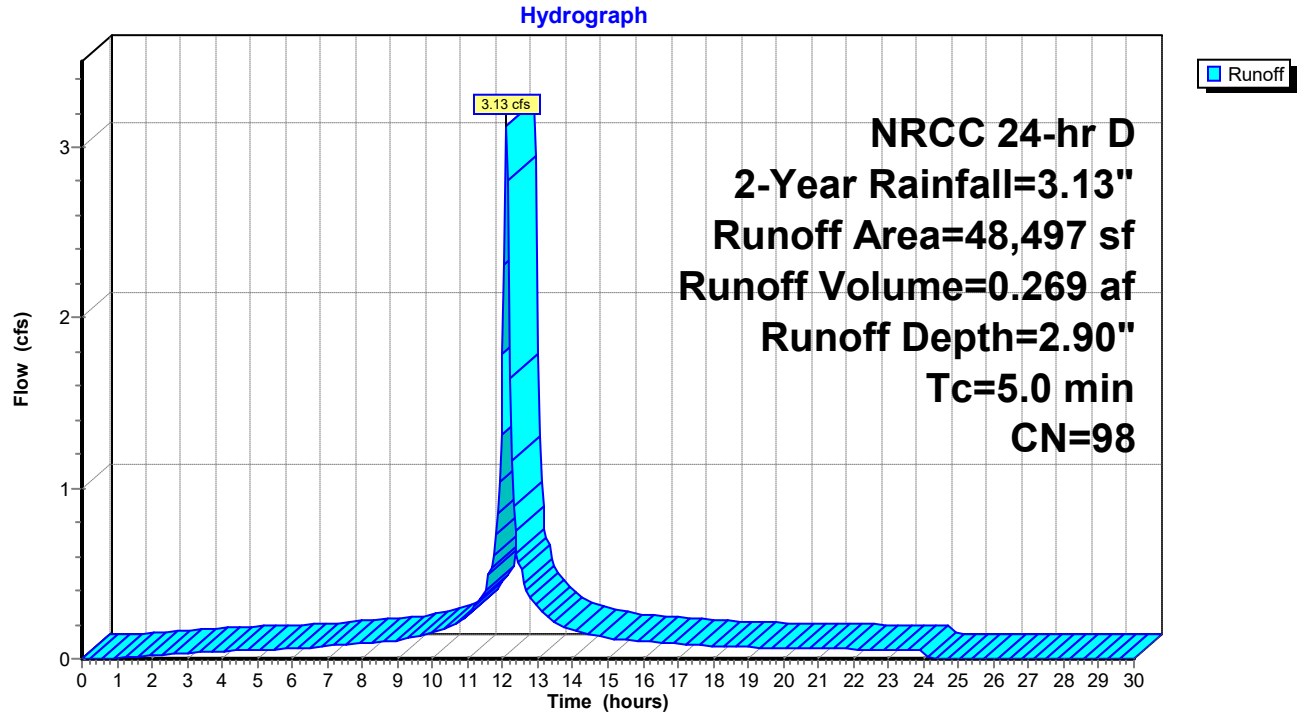
Runoff = 3.13 cfs @ 12.11 hrs, Volume= 0.269 af, Depth= 2.90"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment E13: TO ROOF DRAINAGE



Summary for Subcatchment E14: TO INLET

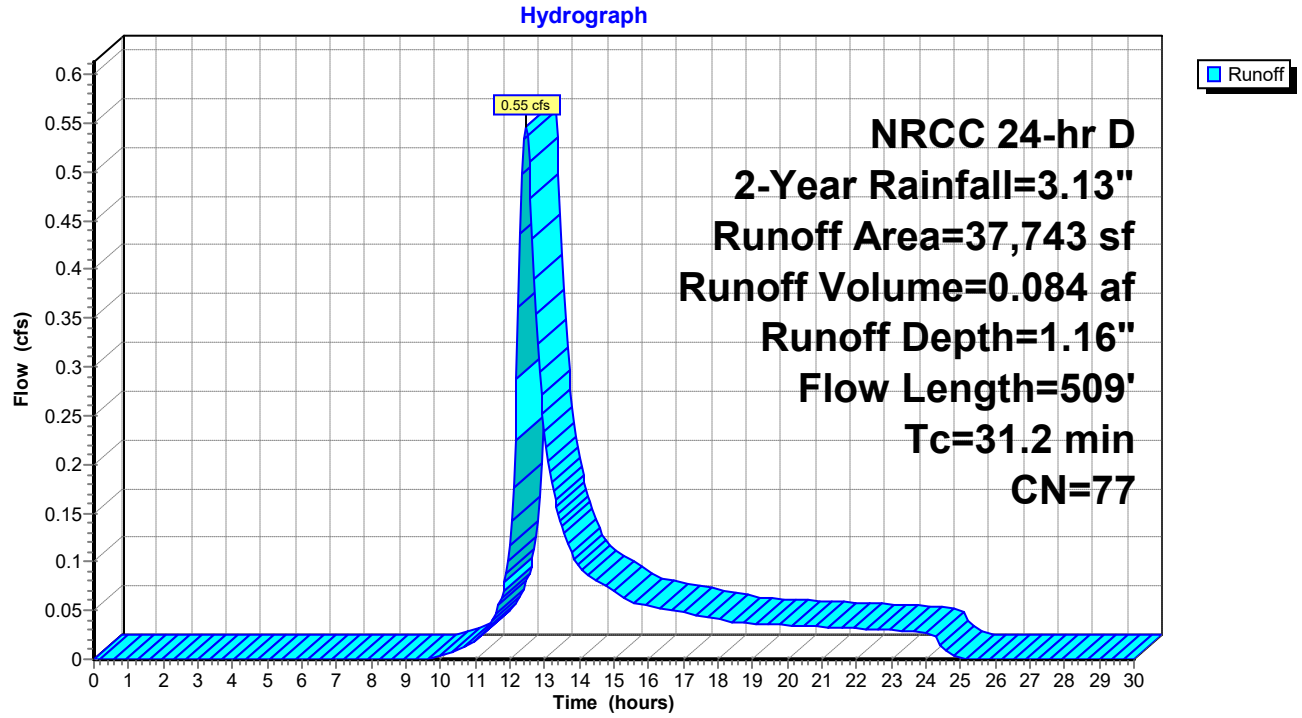
Runoff = 0.55 cfs @ 12.45 hrs, Volume= 0.084 af, Depth= 1.16"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.1	459	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.2	509	Total			

Subcatchment E14: TO INLET



Summary for Subcatchment E15: TO DCB-B

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

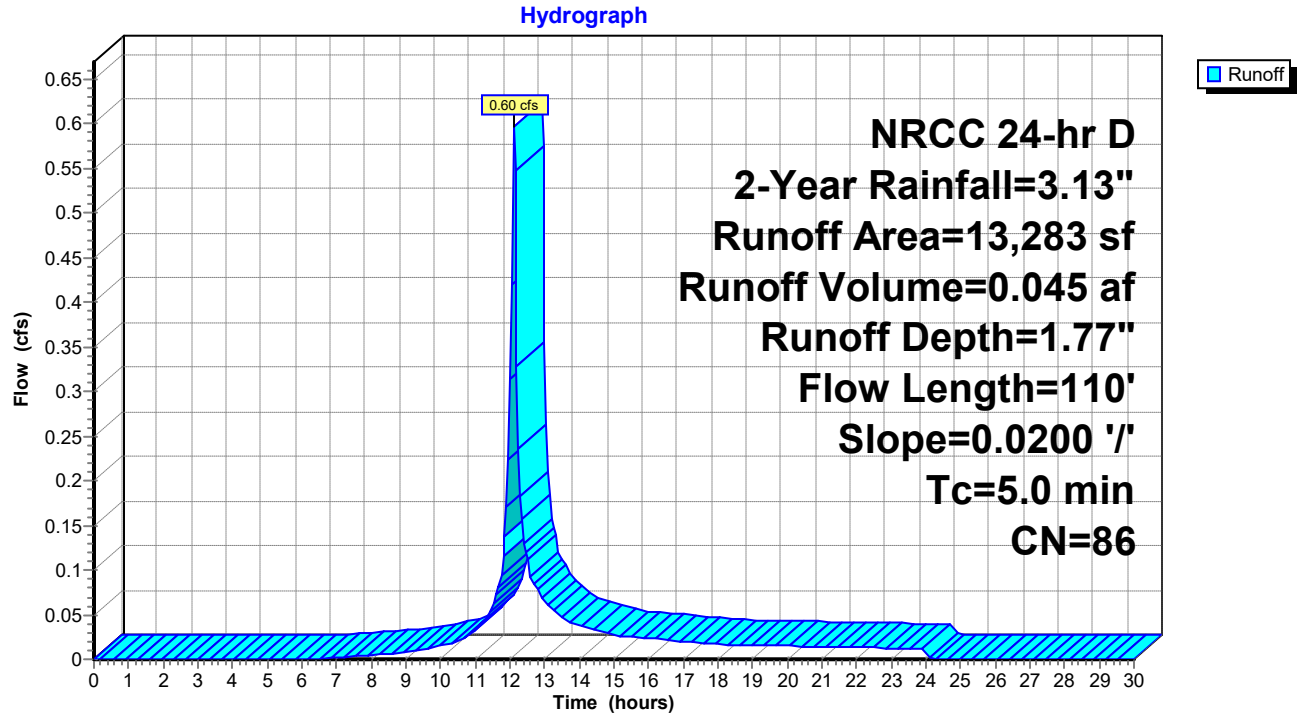
Runoff = 0.60 cfs @ 12.12 hrs, Volume= 0.045 af, Depth= 1.77"
Routed to Pond DCB-B : TO DCB-C

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
2,045	74	>75% Grass cover, Good, HSG C
3,264	70	Woods, Good, HSG C
6,266	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
13,283	86	Weighted Average
11,575		87.14% Pervious Area
1,708		12.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment E15: TO DCB-B



Summary for Subcatchment E16: TO DCB-C

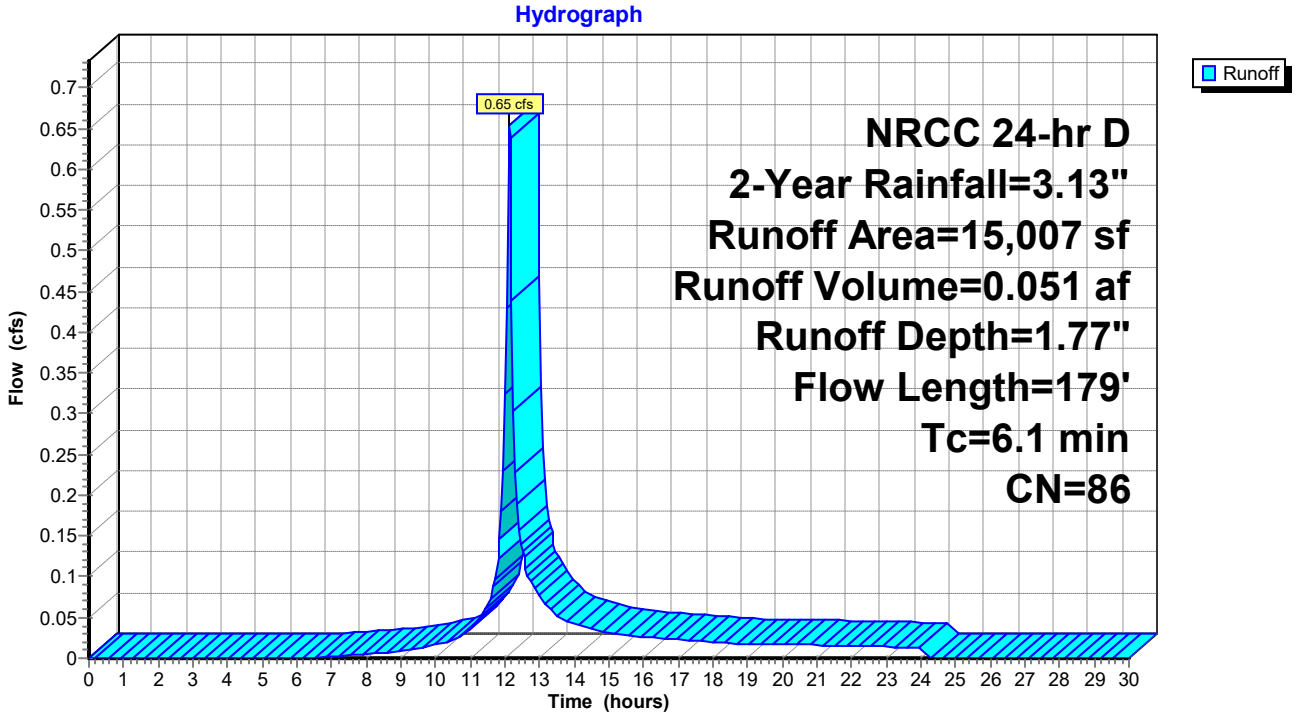
Runoff = 0.65 cfs @ 12.13 hrs, Volume= 0.051 af, Depth= 1.77"
Routed to Pond DCB-C : TO WETLAND

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
2,391	74	>75% Grass cover, Good, HSG C
3,613	70	Woods, Good, HSG C
8,981	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
15,007	86	Weighted Average
14,985		99.85% Pervious Area
22		0.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment E16: TO DCB-C



Summary for Reach DCB-A: TO WETLAND

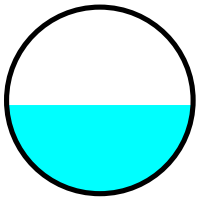
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach PIPE OUTLET depth by 0.82' @ 12.15 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 2.14" for 2-Year event
Inflow = 3.28 cfs @ 12.11 hrs, Volume= 0.353 af
Outflow = 3.11 cfs @ 12.14 hrs, Volume= 0.353 af, Atten= 5%, Lag= 1.8 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

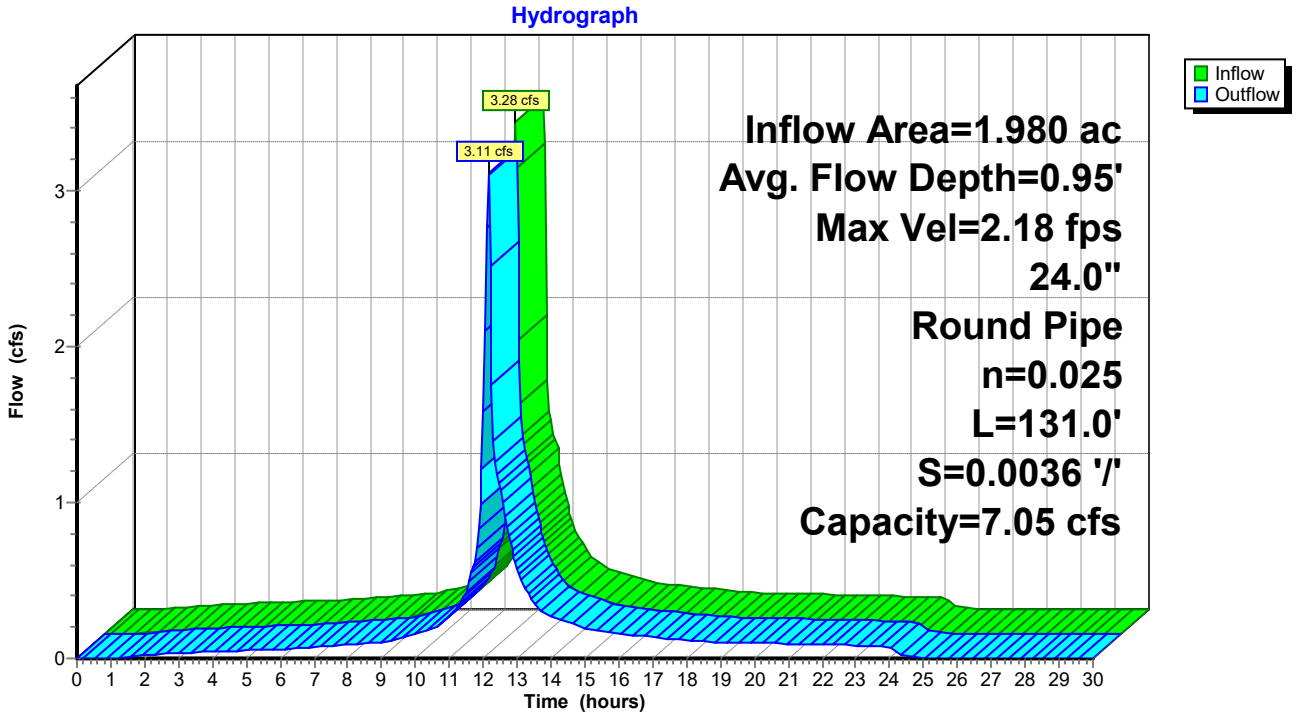
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.18 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 2.7 min

Peak Storage= 193 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.95' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



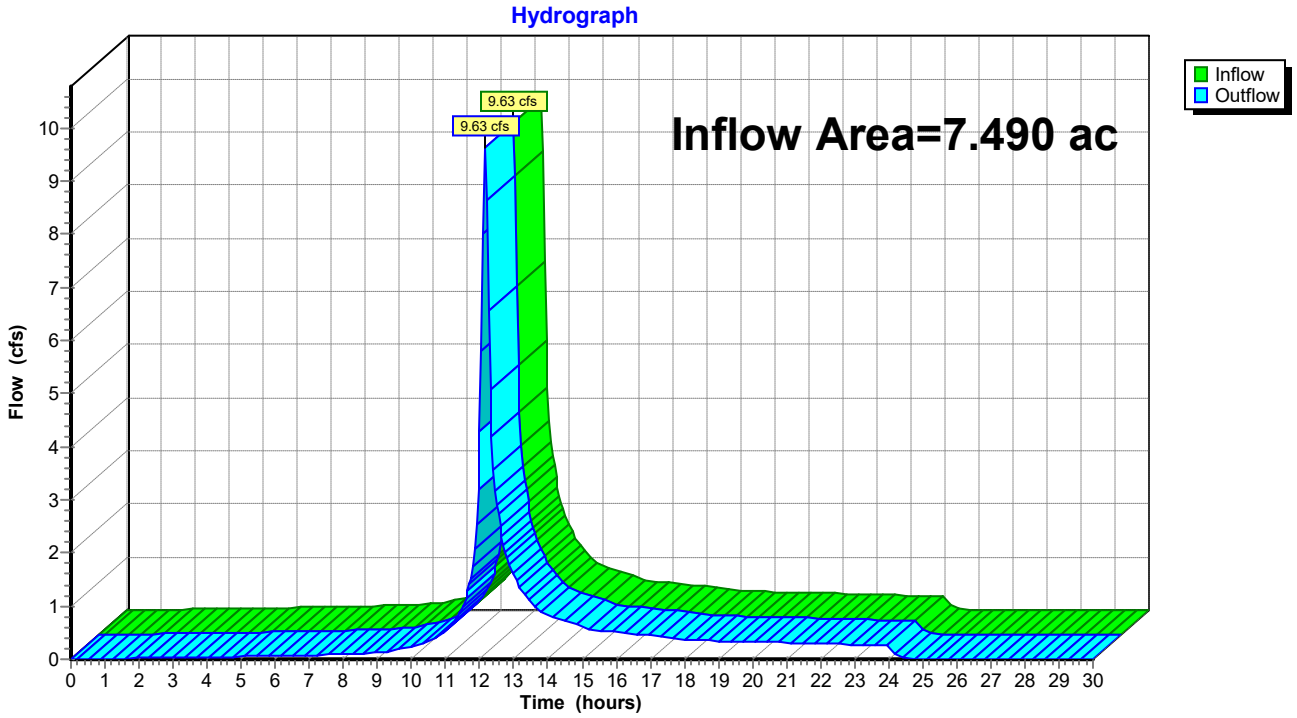
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.490 ac, 16.45% Impervious, Inflow Depth = 1.51" for 2-Year event
Inflow = 9.63 cfs @ 12.16 hrs, Volume= 0.944 af
Outflow = 9.63 cfs @ 12.16 hrs, Volume= 0.944 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

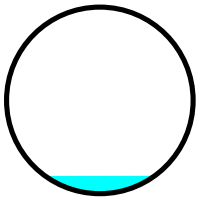
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 1.16" for 2-Year event
Inflow = 0.55 cfs @ 12.45 hrs, Volume= 0.084 af
Outflow = 0.54 cfs @ 12.49 hrs, Volume= 0.084 af, Atten= 1%, Lag= 2.0 min
Routed to Reach DCB-A : TO WETLAND

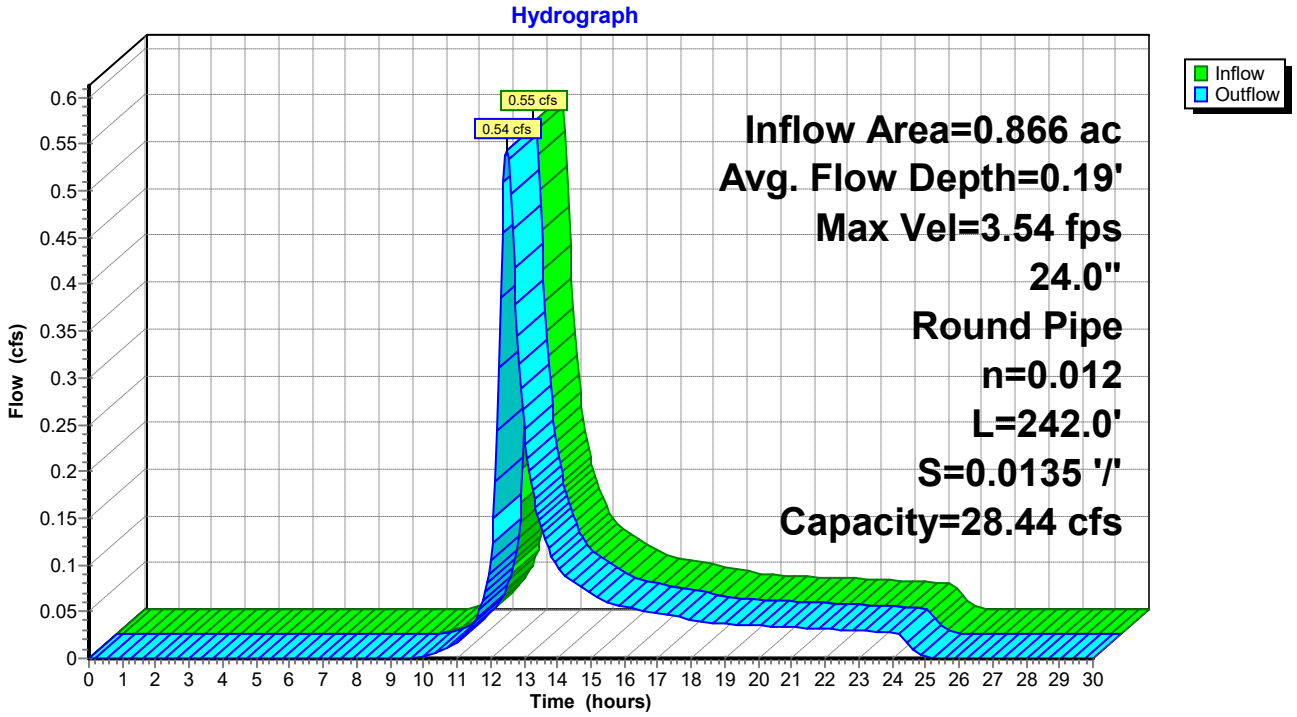
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.54 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.65 fps, Avg. Travel Time= 2.4 min

Peak Storage= 37 cf @ 12.47 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 1.18'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



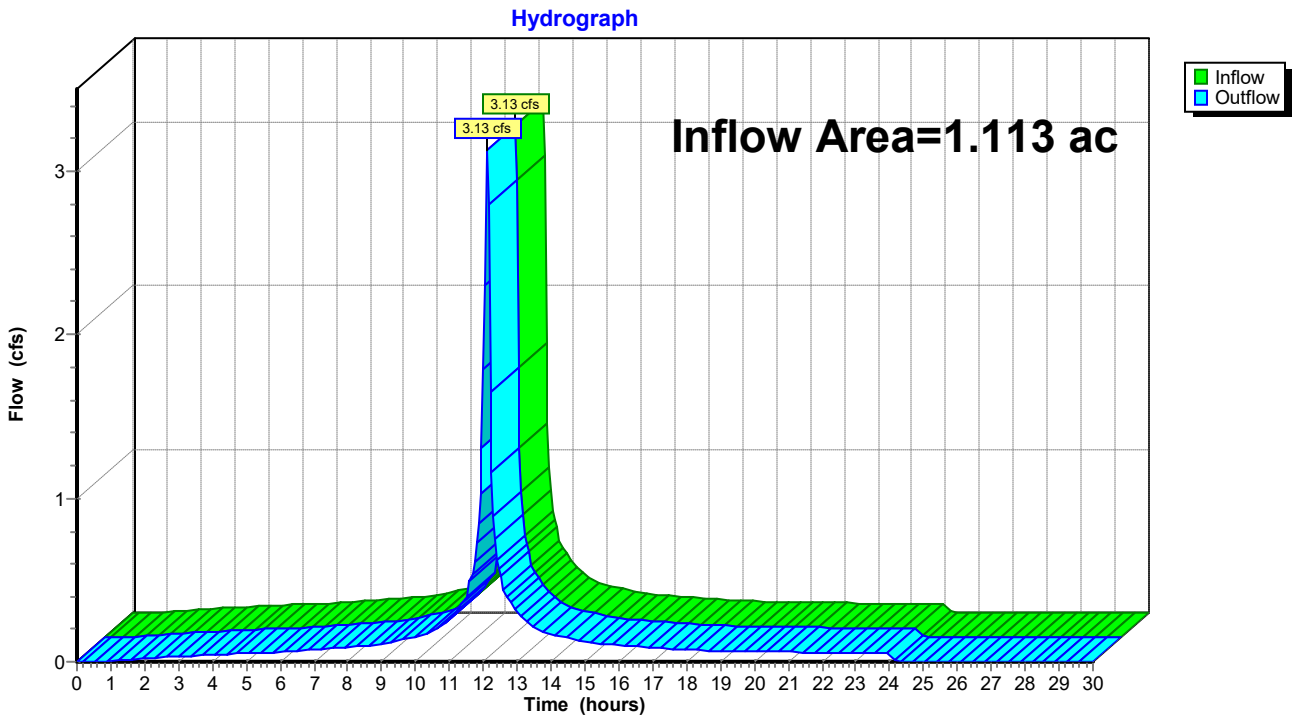
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 2.90" for 2-Year event
Inflow = 3.13 cfs @ 12.11 hrs, Volume= 0.269 af
Outflow = 3.13 cfs @ 12.11 hrs, Volume= 0.269 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 110.93' (Flood elevation advised)

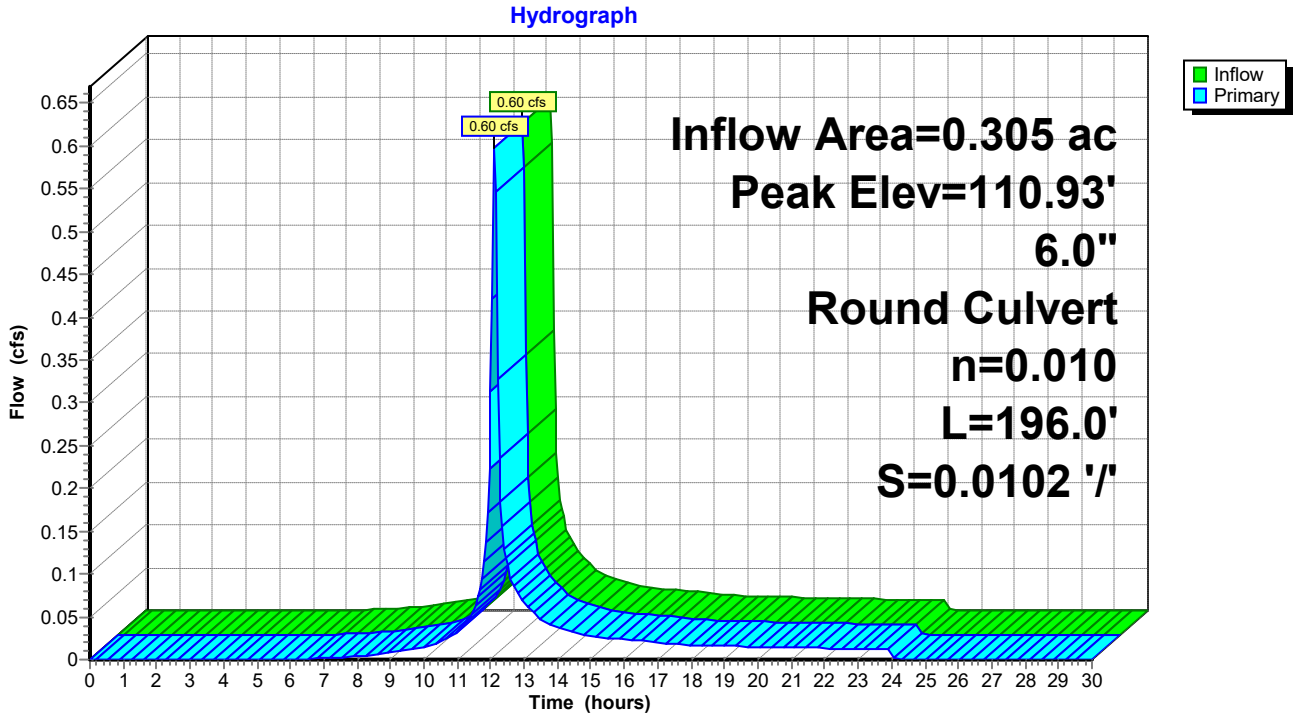
Inflow Area = 0.305 ac, 12.86% Impervious, Inflow Depth = 1.77" for 2-Year event
Inflow = 0.60 cfs @ 12.12 hrs, Volume= 0.045 af
Outflow = 0.60 cfs @ 12.12 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min
Primary = 0.60 cfs @ 12.12 hrs, Volume= 0.045 af
Routed to Pond DCB-C : TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 110.93' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=0.58 cfs @ 12.12 hrs HW=110.90' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.58 cfs @ 2.93 fps)

Pond DCB-B: TO DCB-C



Summary for Pond DCB-C: TO WETLAND

[57] Hint: Peaked at 108.82' (Flood elevation advised)
[79] Warning: Submerged Pond DCB-B Primary device # 1 OUTLET by 0.48'

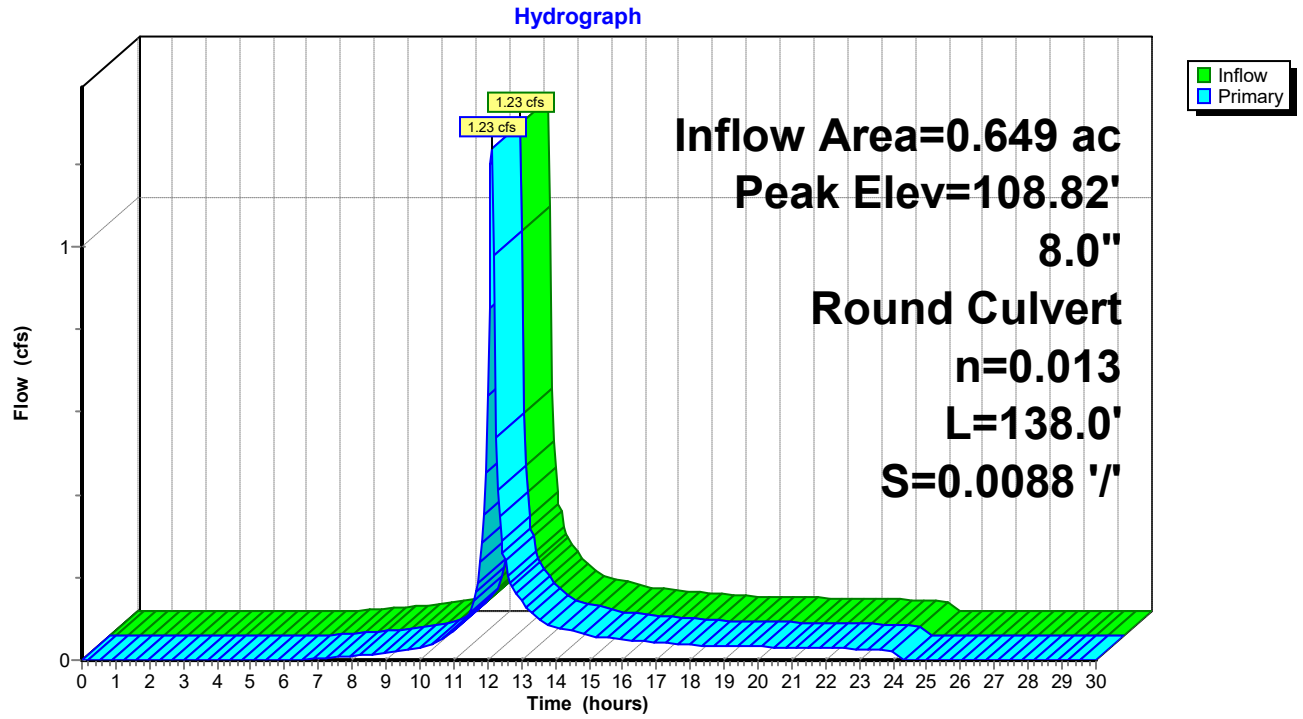
Inflow Area = 0.649 ac, 6.12% Impervious, Inflow Depth = 1.77" for 2-Year event
Inflow = 1.23 cfs @ 12.12 hrs, Volume= 0.096 af
Outflow = 1.23 cfs @ 12.12 hrs, Volume= 0.096 af, Atten= 0%, Lag= 0.0 min
Primary = 1.23 cfs @ 12.12 hrs, Volume= 0.096 af
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 108.82' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	107.68'	**8.0" Round Culvert** L= 138.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 107.68' / 106.47' S= 0.0088 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.19 cfs @ 12.12 hrs HW=108.75' (Free Discharge)
↑**1=Culvert** (Barrel Controls 1.19 cfs @ 3.41 fps)

Pond DCB-C: TO WETLAND



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 E11B: OVERLAND TO DP#2 Runoff Area=211,724 sf 0.83% Impervious Runoff Depth=2.44"
Flow Length=414' Tc=9.8 min CN=78 Runoff=11.14 cfs 0.989 af

Subcatchment E13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=4.44"
Tc=5.0 min CN=98 Runoff=4.71 cfs 0.412 af

Subcatchment E14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=2.36"
Flow Length=509' Tc=31.2 min CN=77 Runoff=1.14 cfs 0.170 af

Subcatchment E15: TO DCB-B Runoff Area=13,283 sf 12.86% Impervious Runoff Depth=3.17"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=86 Runoff=1.05 cfs 0.081 af

Subcatchment E16: TO DCB-C Runoff Area=15,007 sf 0.15% Impervious Runoff Depth=3.17"
Flow Length=179' Tc=6.1 min CN=86 Runoff=1.15 cfs 0.091 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=1.25' Max Vel=2.42 fps Inflow=5.10 cfs 0.583 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=4.87 cfs 0.583 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=17.83 cfs 1.743 af
Outflow=17.83 cfs 1.743 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.27' Max Vel=4.42 fps Inflow=1.14 cfs 0.170 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=1.14 cfs 0.170 af

Reach RF: TO DCB-A Inflow=4.71 cfs 0.412 af
Outflow=4.71 cfs 0.412 af

Pond DCB-B: TO DCB-C Peak Elev=113.47' Inflow=1.05 cfs 0.081 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=1.05 cfs 0.081 af

Pond DCB-C: TO WETLAND Peak Elev=112.43' Inflow=2.17 cfs 0.172 af
8.0" Round Culvert n=0.013 L=138.0' S=0.0088 '/' Outflow=2.17 cfs 0.172 af

Total Runoff Area = 7.490 ac Runoff Volume = 1.743 af Average Runoff Depth = 2.79"
83.55% Pervious = 6.258 ac 16.45% Impervious = 1.232 ac

Summary for Subcatchment E11B: OVERLAND TO DP#2

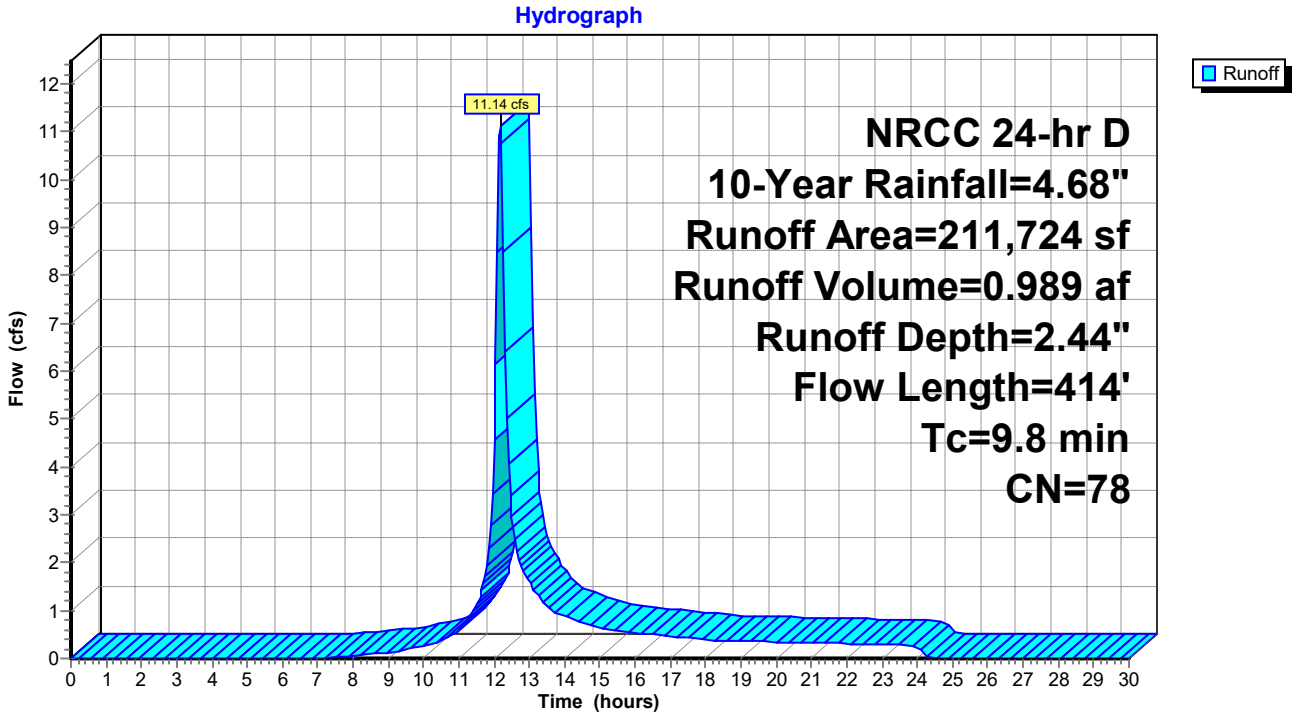
Runoff = 11.14 cfs @ 12.17 hrs, Volume= 0.989 af, Depth= 2.44"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
23,722	74	>75% Grass cover, Good, HSG C
127,829	70	Woods, Good, HSG C
58,406	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
211,724	78	Weighted Average
209,957		99.17% Pervious Area
1,767		0.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment E11B: OVERLAND TO DP#2



Summary for Subcatchment E13: TO ROOF DRAINAGE

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

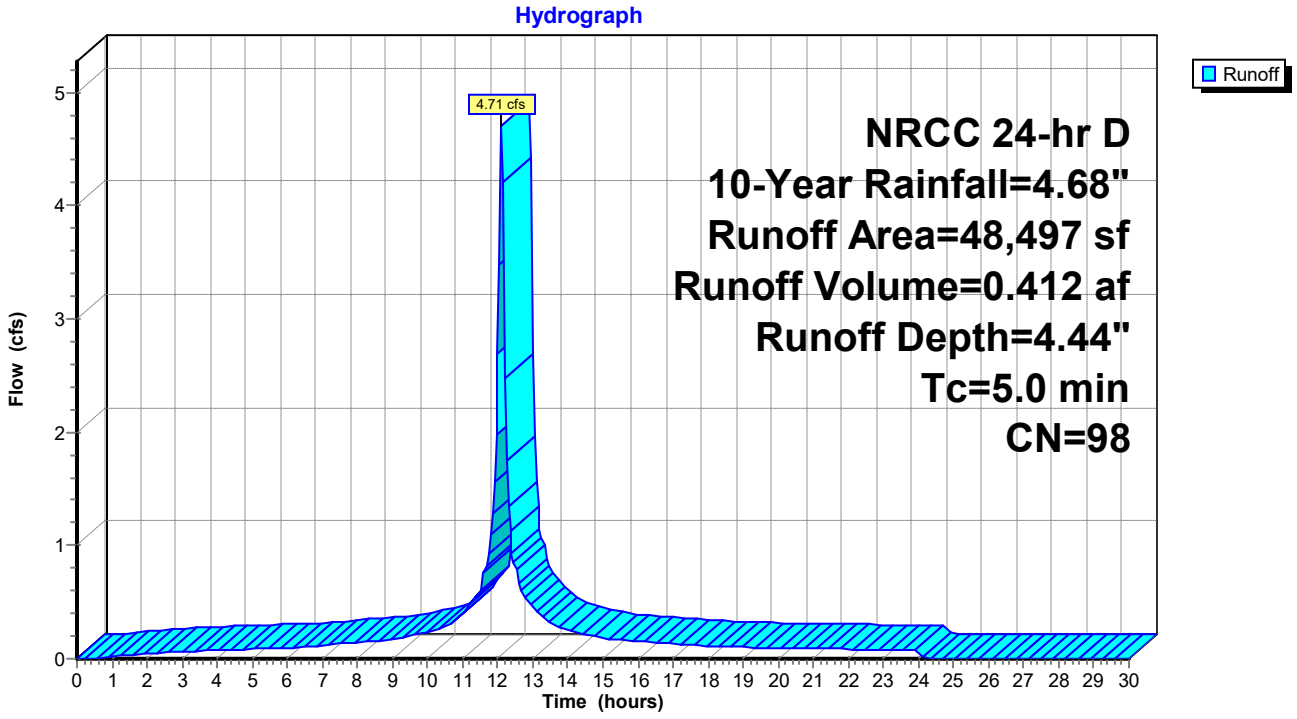
Runoff = 4.71 cfs @ 12.11 hrs, Volume= 0.412 af, Depth= 4.44"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment E13: TO ROOF DRAINAGE



Summary for Subcatchment E14: TO INLET

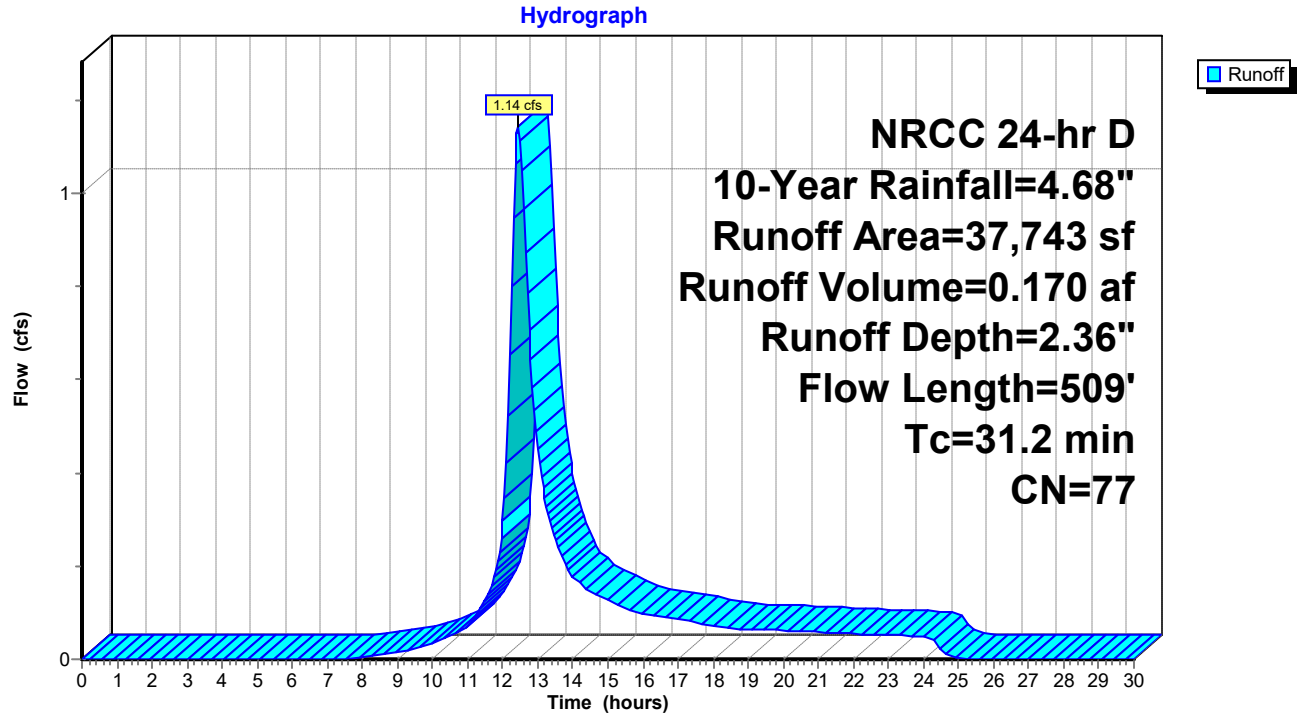
Runoff = 1.14 cfs @ 12.44 hrs, Volume= 0.170 af, Depth= 2.36"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.1	459	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.2	509	Total			

Subcatchment E14: TO INLET



Summary for Subcatchment E15: TO DCB-B

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

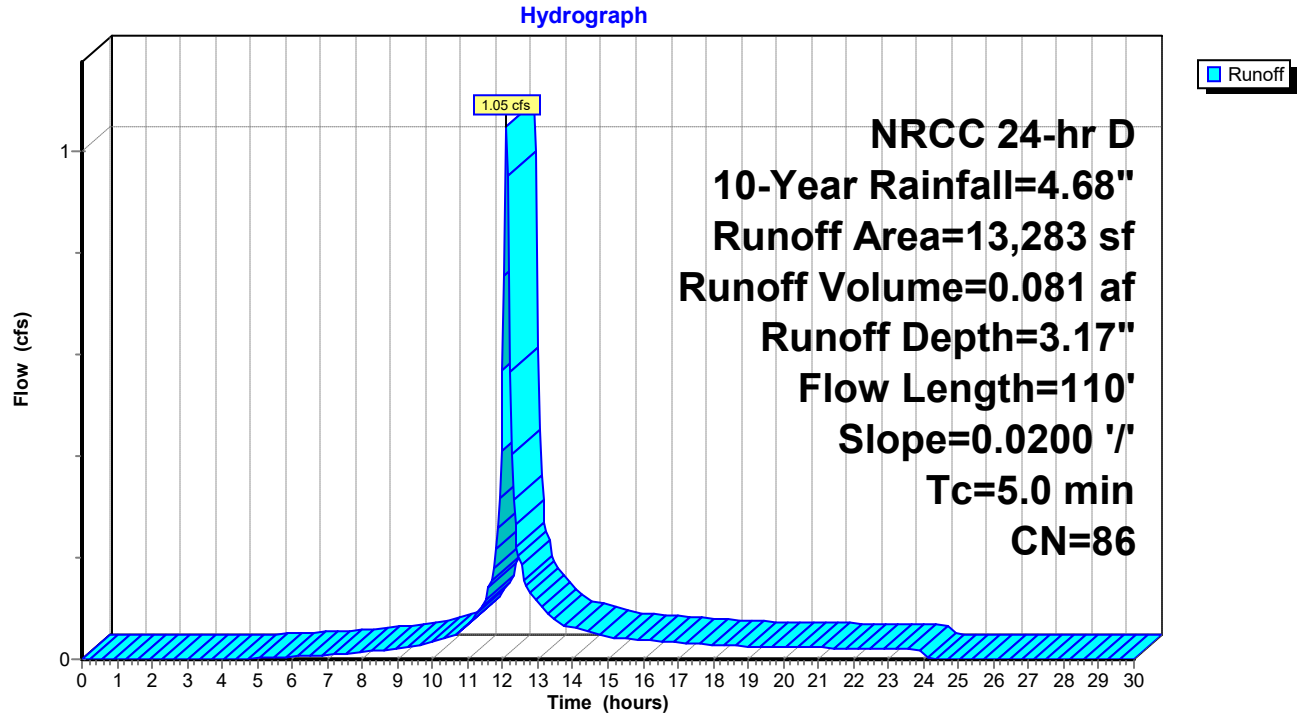
Runoff = 1.05 cfs @ 12.11 hrs, Volume= 0.081 af, Depth= 3.17"
Routed to Pond DCB-B : TO DCB-C

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
2,045	74	>75% Grass cover, Good, HSG C
3,264	70	Woods, Good, HSG C
6,266	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
13,283	86	Weighted Average
11,575		87.14% Pervious Area
1,708		12.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment E15: TO DCB-B



Summary for Subcatchment E16: TO DCB-C

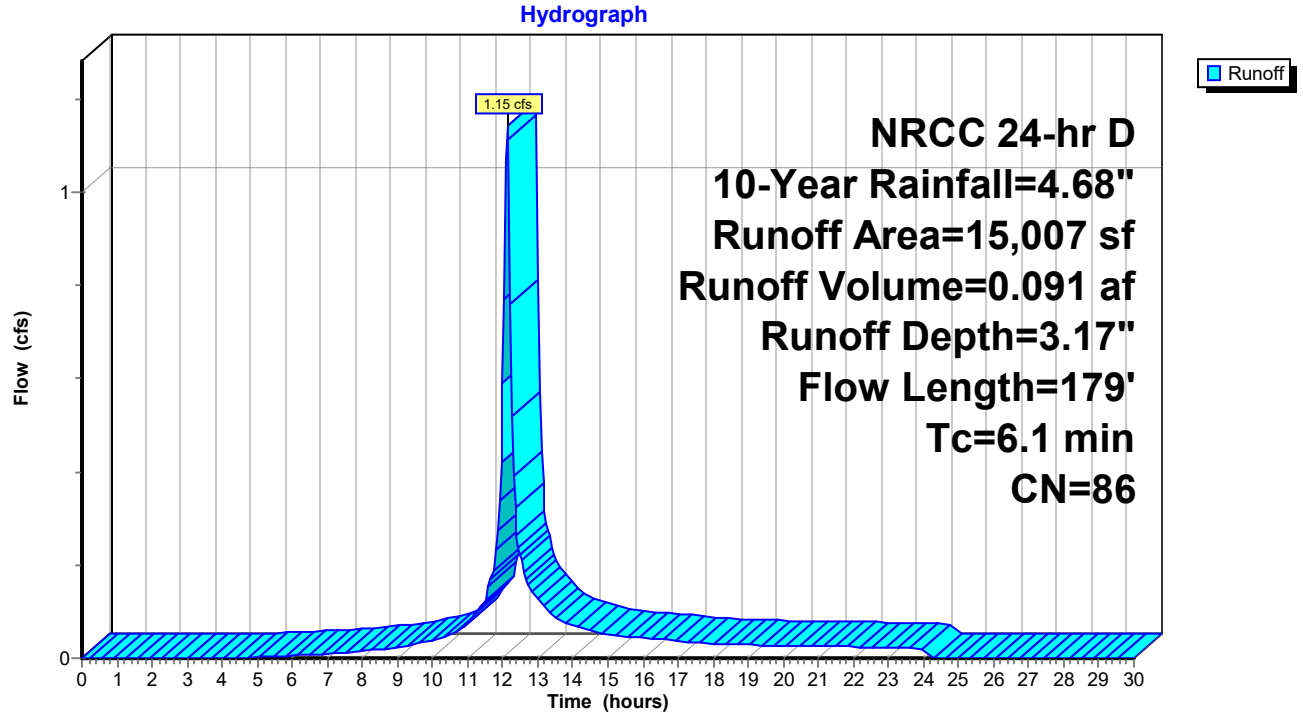
Runoff = 1.15 cfs @ 12.13 hrs, Volume= 0.091 af, Depth= 3.17"
Routed to Pond DCB-C : TO WETLAND

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
2,391	74	>75% Grass cover, Good, HSG C
3,613	70	Woods, Good, HSG C
8,981	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
15,007	86	Weighted Average
14,985		99.85% Pervious Area
22		0.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment E16: TO DCB-C



Summary for Reach DCB-A: TO WETLAND

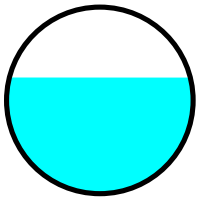
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach PIPE OUTLET depth by 1.05' @ 12.15 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 3.53" for 10-Year event
Inflow = 5.10 cfs @ 12.11 hrs, Volume= 0.583 af
Outflow = 4.87 cfs @ 12.14 hrs, Volume= 0.583 af, Atten= 5%, Lag= 1.7 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

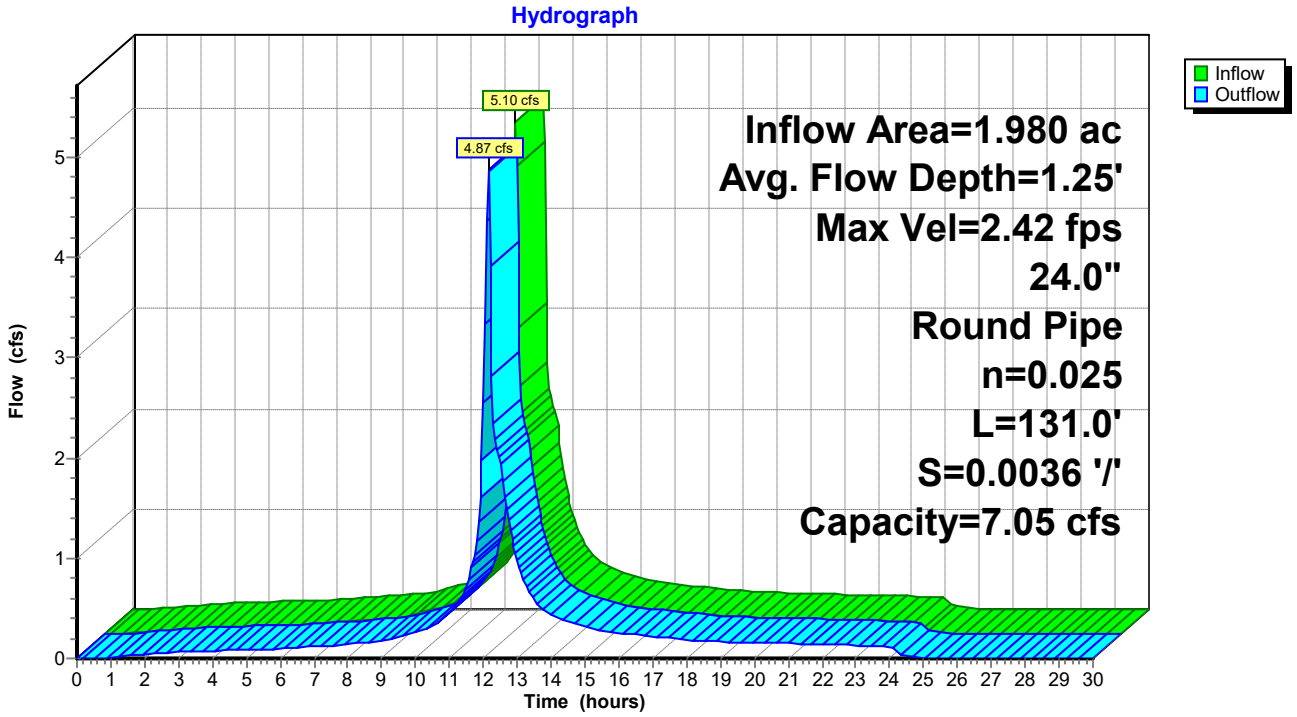
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.42 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 2.4 min

Peak Storage= 270 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.25' , Surface Width= 1.94'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



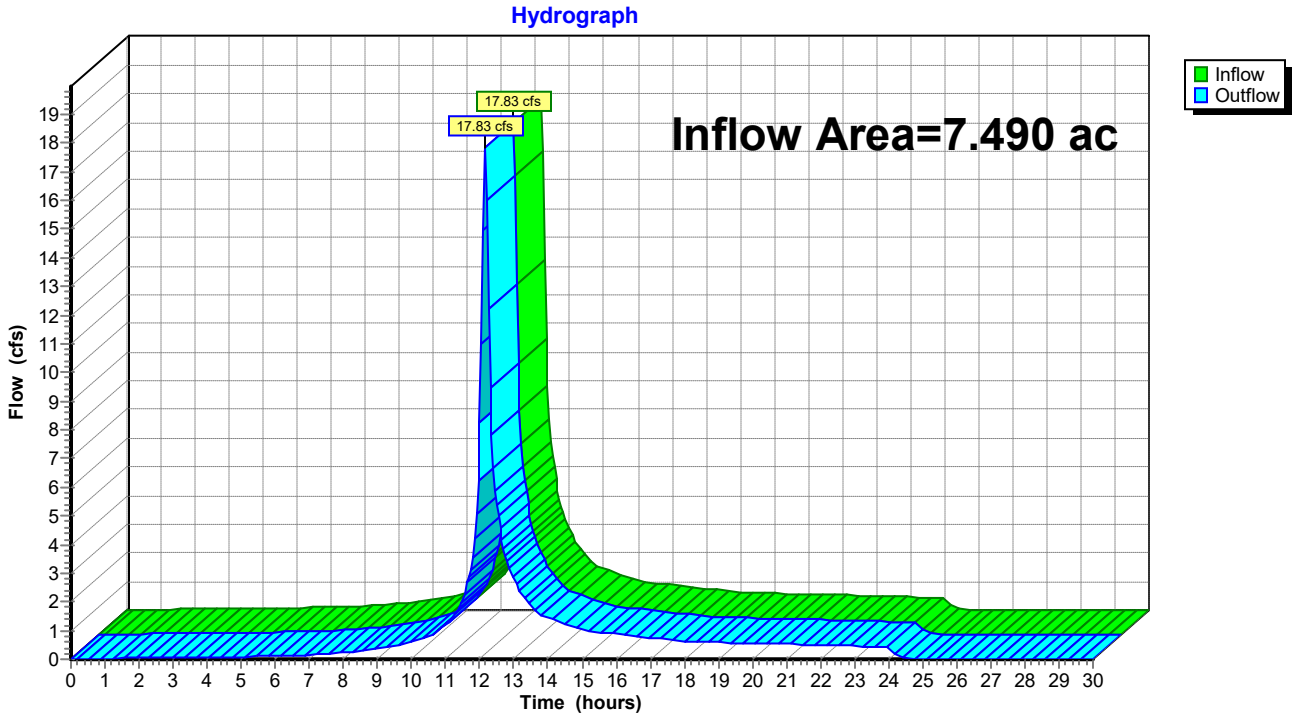
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.490 ac, 16.45% Impervious, Inflow Depth = 2.79" for 10-Year event
Inflow = 17.83 cfs @ 12.16 hrs, Volume= 1.743 af
Outflow = 17.83 cfs @ 12.16 hrs, Volume= 1.743 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

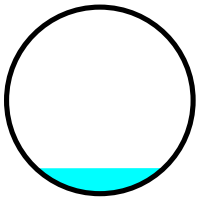
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 2.36" for 10-Year event
Inflow = 1.14 cfs @ 12.44 hrs, Volume= 0.170 af
Outflow = 1.14 cfs @ 12.47 hrs, Volume= 0.170 af, Atten= 0%, Lag= 1.6 min
Routed to Reach DCB-A : TO WETLAND

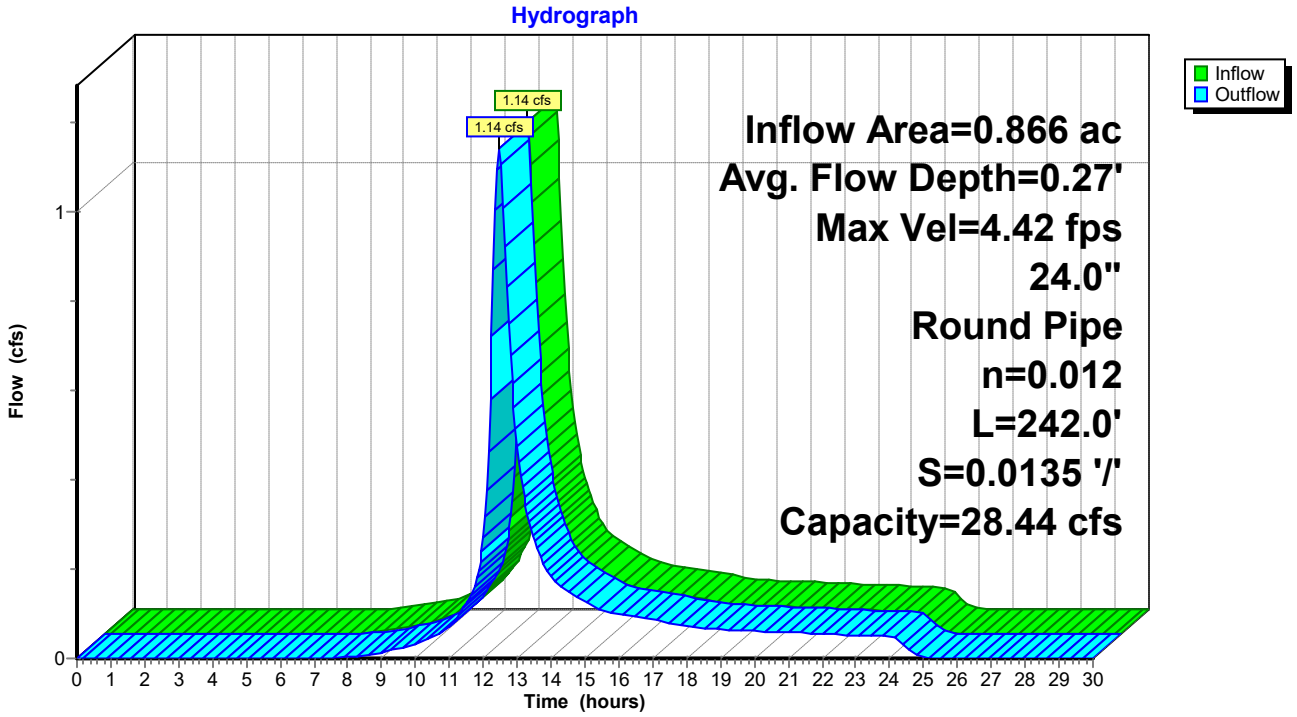
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.42 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.92 fps, Avg. Travel Time= 2.1 min

Peak Storage= 63 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 1.37'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



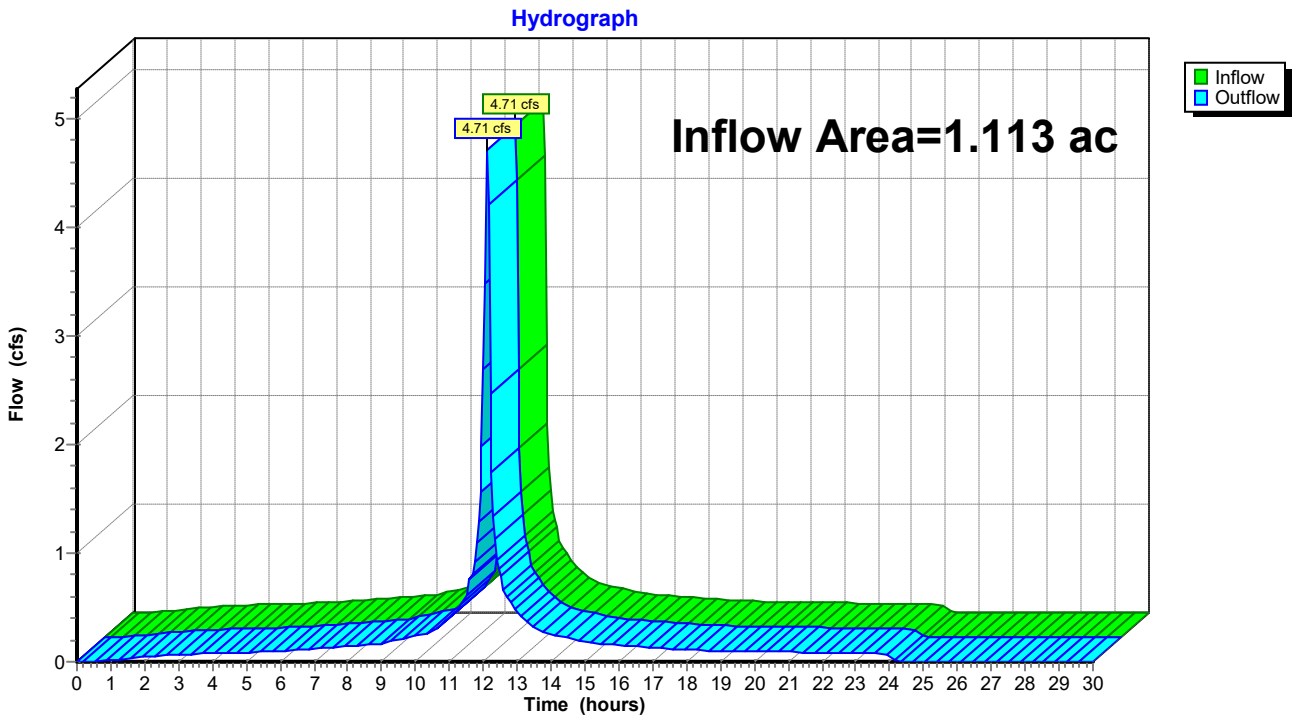
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 4.44" for 10-Year event
Inflow = 4.71 cfs @ 12.11 hrs, Volume= 0.412 af
Outflow = 4.71 cfs @ 12.11 hrs, Volume= 0.412 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 113.47' (Flood elevation advised)

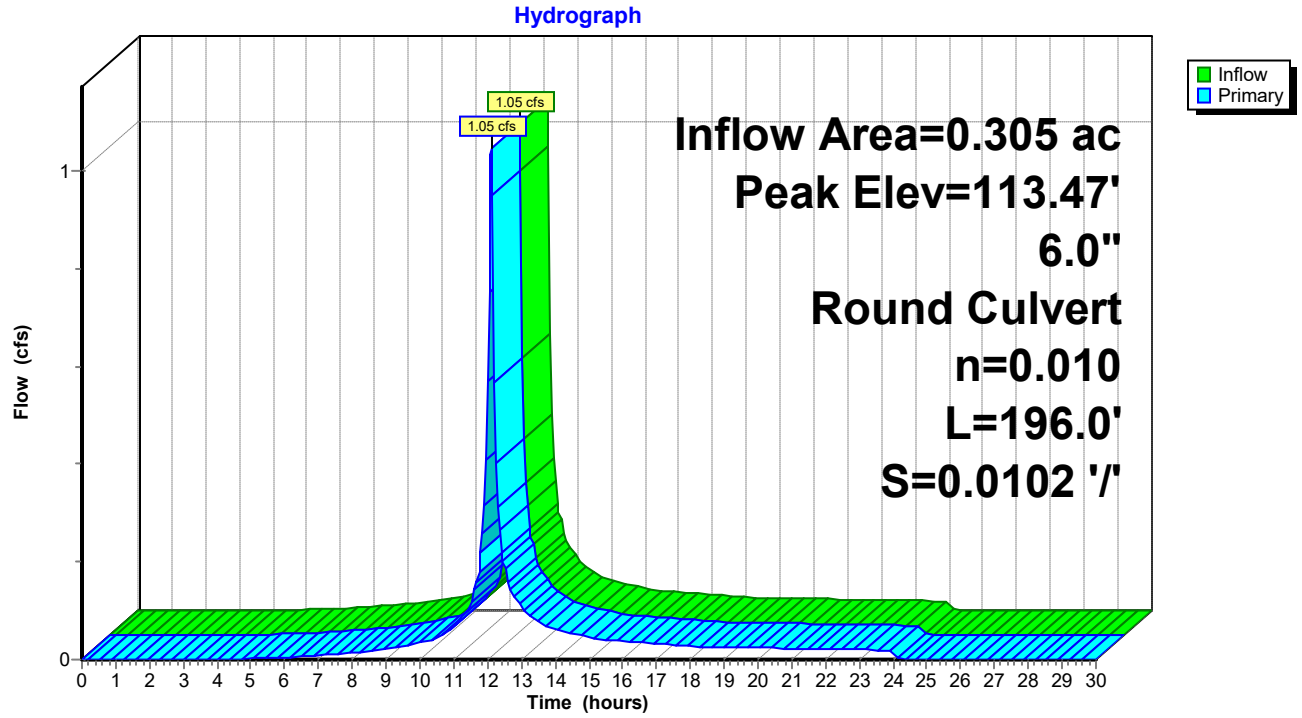
Inflow Area = 0.305 ac, 12.86% Impervious, Inflow Depth = 3.17" for 10-Year event
Inflow = 1.05 cfs @ 12.11 hrs, Volume= 0.081 af
Outflow = 1.05 cfs @ 12.11 hrs, Volume= 0.081 af, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 12.11 hrs, Volume= 0.081 af
Routed to Pond DCB-C : TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 113.47' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=1.01 cfs @ 12.11 hrs HW=113.19' (Free Discharge)
1=Culvert (Barrel Controls 1.01 cfs @ 5.16 fps)

Pond DCB-B: TO DCB-C



Summary for Pond DCB-C: TO WETLAND

[57] Hint: Peaked at 112.43' (Flood elevation advised)
[79] Warning: Submerged Pond DCB-B Primary device # 1 INLET by 1.91'

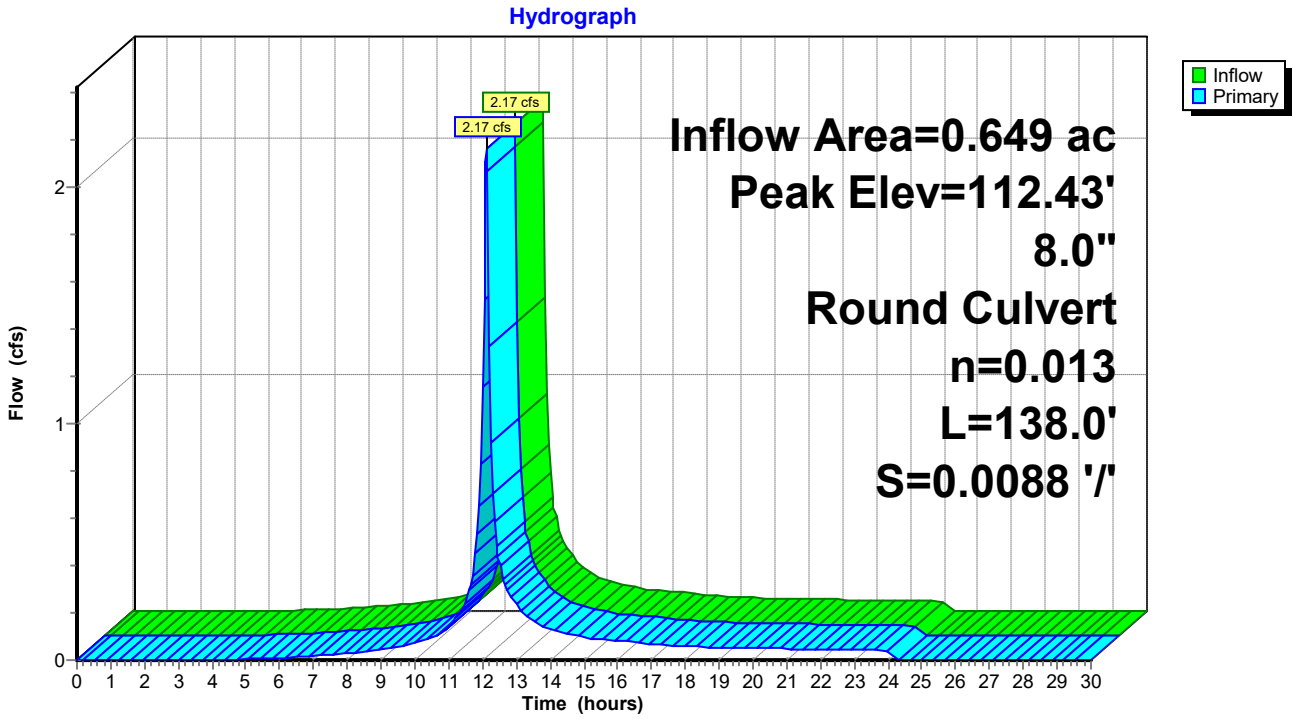
Inflow Area = 0.649 ac, 6.12% Impervious, Inflow Depth = 3.17" for 10-Year event
Inflow = 2.17 cfs @ 12.12 hrs, Volume= 0.172 af
Outflow = 2.17 cfs @ 12.12 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.0 min
Primary = 2.17 cfs @ 12.12 hrs, Volume= 0.172 af
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 112.43' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	107.68'	**8.0" Round Culvert** L= 138.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 107.68' / 106.47' S= 0.0088 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=2.09 cfs @ 12.12 hrs HW=112.11' (Free Discharge)
↑**1=Culvert** (Barrel Controls 2.09 cfs @ 5.99 fps)

Pond DCB-C: TO WETLAND



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 E11B: OVERLAND TO DP#2 Runoff Area=211,724 sf 0.83% Impervious Runoff Depth=3.47"
Flow Length=414' Tc=9.8 min CN=78 Runoff=15.79 cfs 1.407 af

Subcatchment E13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=5.64"
Tc=5.0 min CN=98 Runoff=5.93 cfs 0.523 af

Subcatchment E14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=3.37"
Flow Length=509' Tc=31.2 min CN=77 Runoff=1.64 cfs 0.244 af

Subcatchment E15: TO DCB-B Runoff Area=13,283 sf 12.86% Impervious Runoff Depth=4.30"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=86 Runoff=1.40 cfs 0.109 af

Subcatchment E16: TO DCB-C Runoff Area=15,007 sf 0.15% Impervious Runoff Depth=4.30"
Flow Length=179' Tc=6.1 min CN=86 Runoff=1.53 cfs 0.123 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=1.50' Max Vel=2.54 fps Inflow=6.53 cfs 0.767 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=6.24 cfs 0.767 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=24.48 cfs 2.406 af
Outflow=24.48 cfs 2.406 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.33' Max Vel=4.93 fps Inflow=1.64 cfs 0.244 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=1.64 cfs 0.244 af

Reach RF: TO DCB-A Inflow=5.93 cfs 0.523 af
Outflow=5.93 cfs 0.523 af

Pond DCB-B: TO DCB-C Peak Elev=117.15' Inflow=1.40 cfs 0.109 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=1.40 cfs 0.109 af

Pond DCB-C: TO WETLAND Peak Elev=116.58' Inflow=2.89 cfs 0.232 af
8.0" Round Culvert n=0.013 L=138.0' S=0.0088 '/' Outflow=2.89 cfs 0.232 af

Total Runoff Area = 7.490 ac Runoff Volume = 2.406 af Average Runoff Depth = 3.86"
83.55% Pervious = 6.258 ac 16.45% Impervious = 1.232 ac

Summary for Subcatchment E11B: OVERLAND TO DP#2

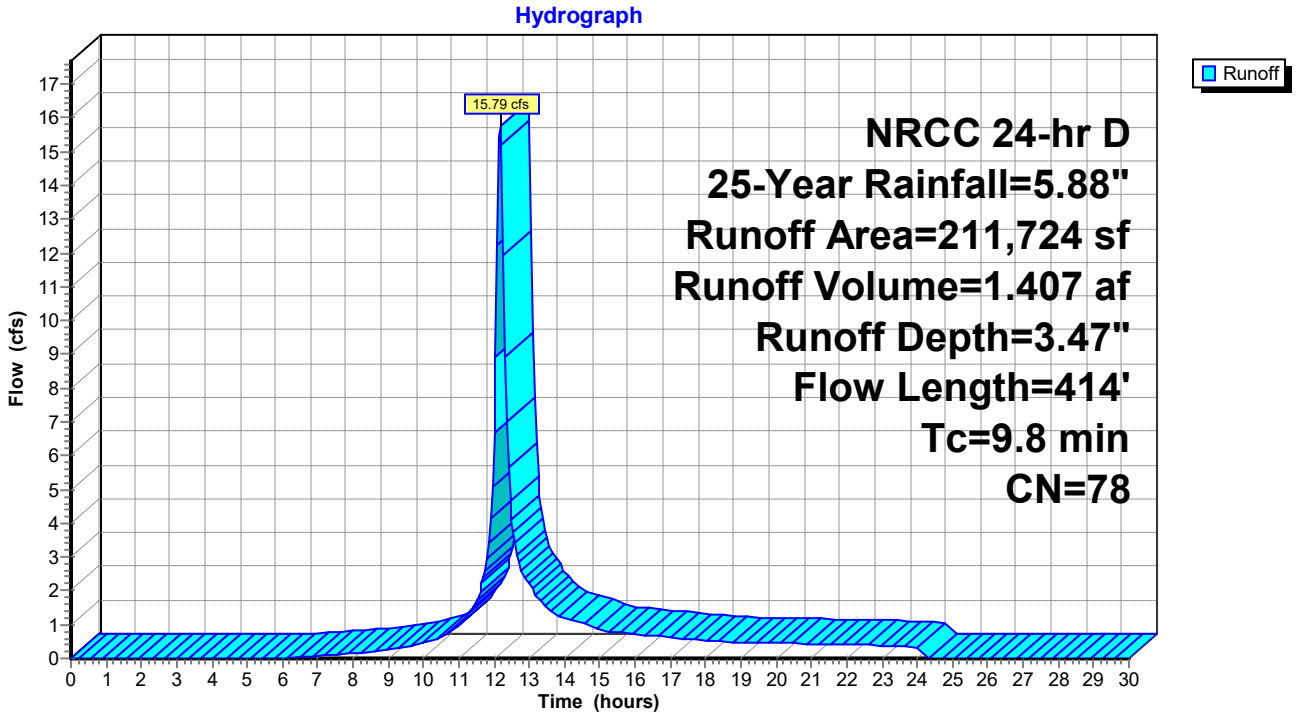
Runoff = 15.79 cfs @ 12.17 hrs, Volume= 1.407 af, Depth= 3.47"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
23,722	74	>75% Grass cover, Good, HSG C
127,829	70	Woods, Good, HSG C
58,406	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
211,724	78	Weighted Average
209,957		99.17% Pervious Area
1,767		0.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment E11B: OVERLAND TO DP#2



Summary for Subcatchment E13: TO ROOF DRAINAGE

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

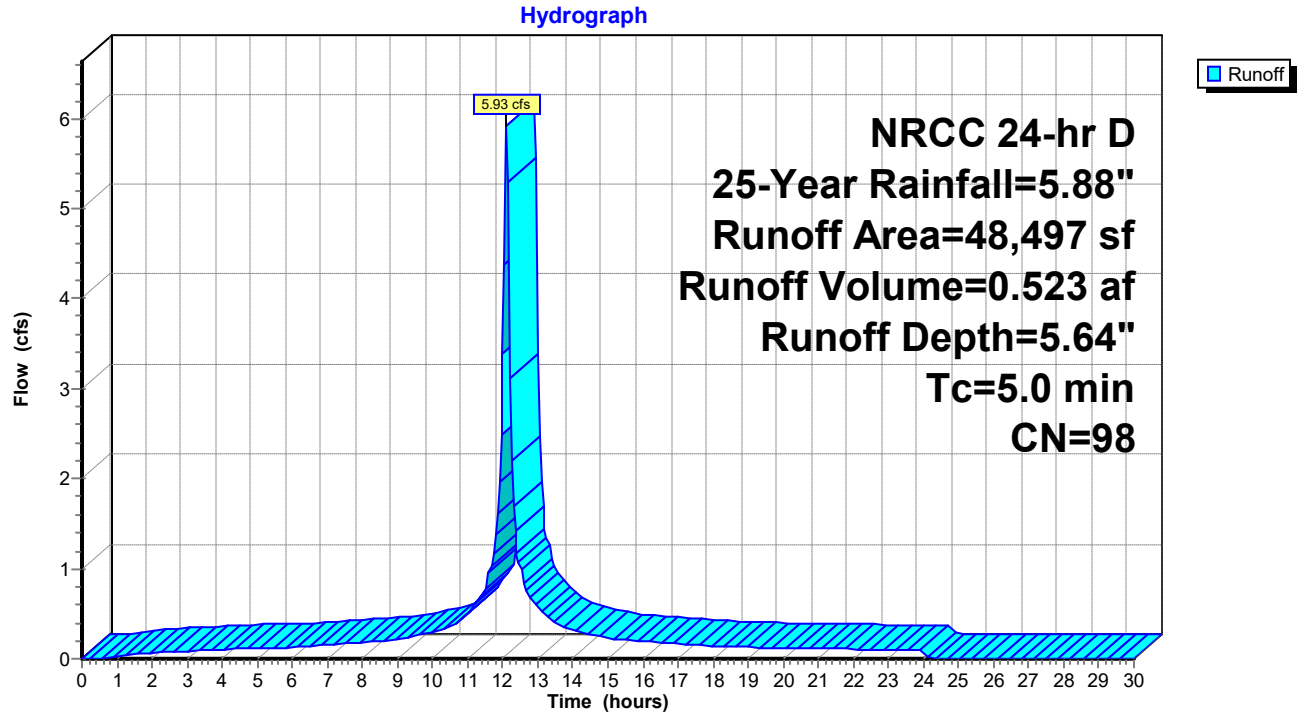
Runoff = 5.93 cfs @ 12.11 hrs, Volume= 0.523 af, Depth= 5.64"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment E13: TO ROOF DRAINAGE



Summary for Subcatchment E14: TO INLET

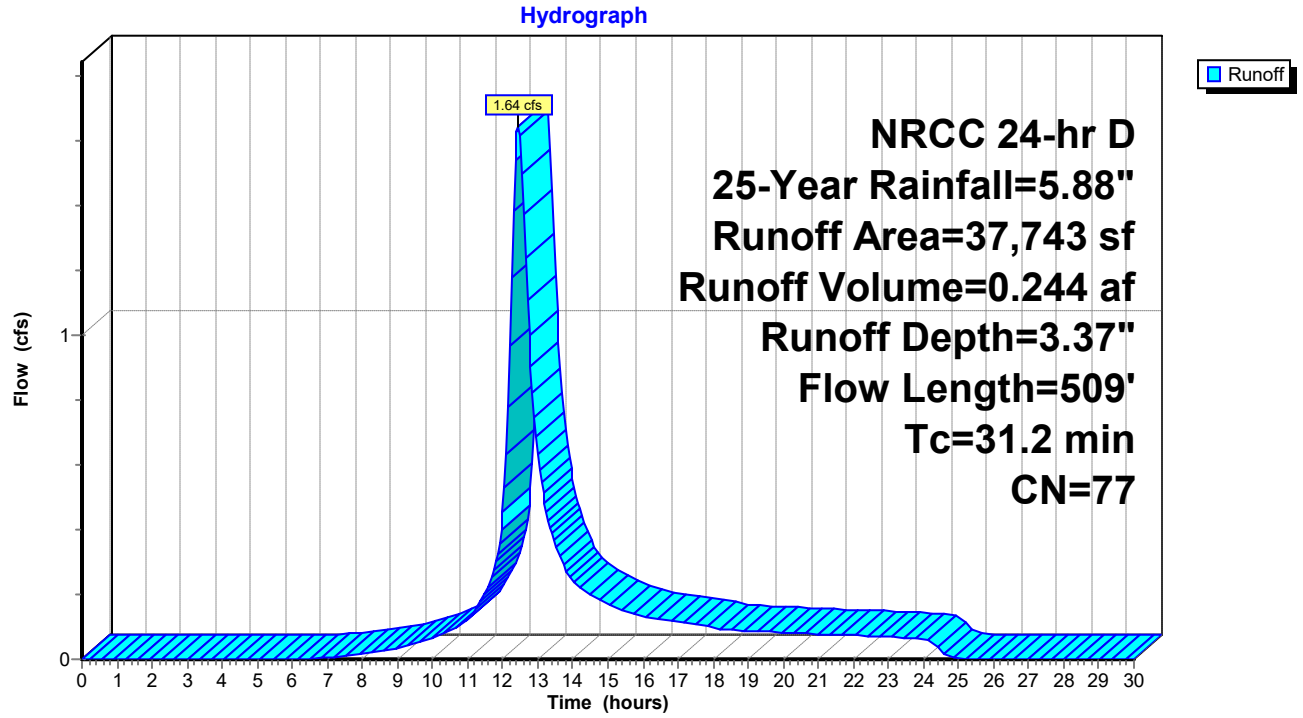
Runoff = 1.64 cfs @ 12.44 hrs, Volume= 0.244 af, Depth= 3.37"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.1	459	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.2	509	Total			

Subcatchment E14: TO INLET



Summary for Subcatchment E15: TO DCB-B

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

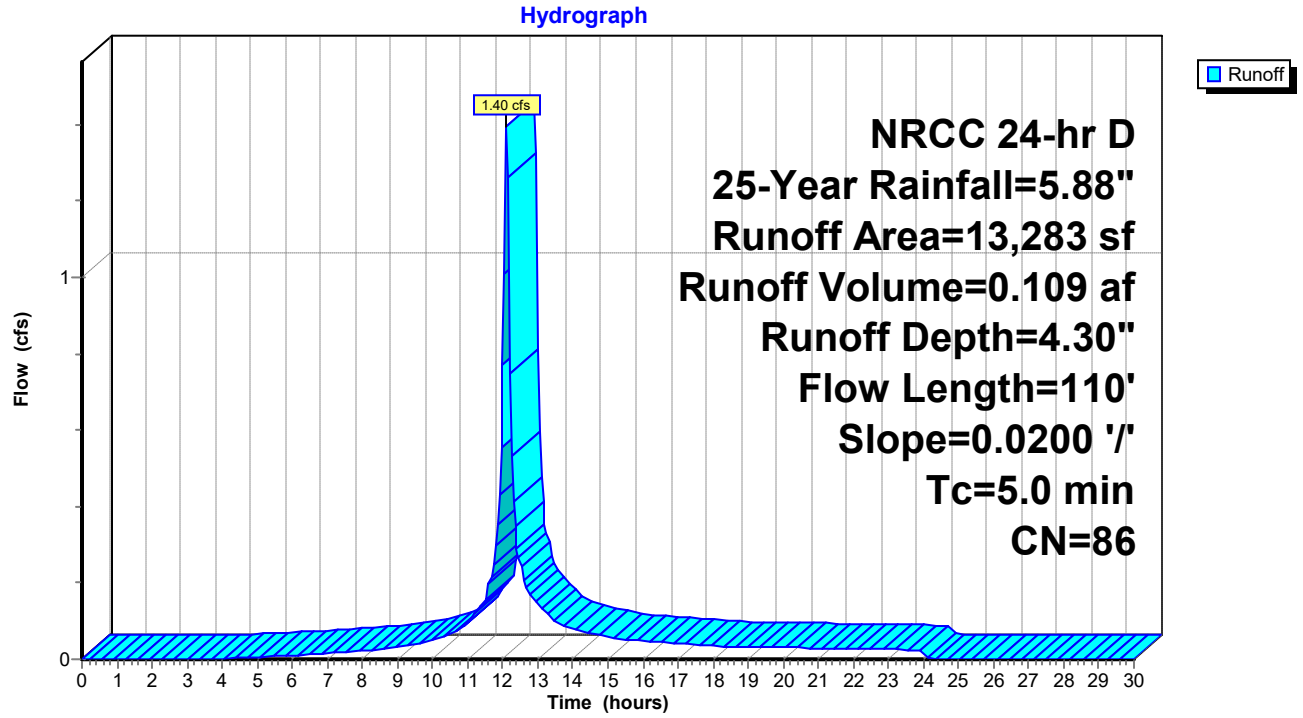
Runoff = 1.40 cfs @ 12.11 hrs, Volume= 0.109 af, Depth= 4.30"
Routed to Pond DCB-B : TO DCB-C

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
2,045	74	>75% Grass cover, Good, HSG C
3,264	70	Woods, Good, HSG C
6,266	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
13,283	86	Weighted Average
11,575		87.14% Pervious Area
1,708		12.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment E15: TO DCB-B



Summary for Subcatchment E16: TO DCB-C

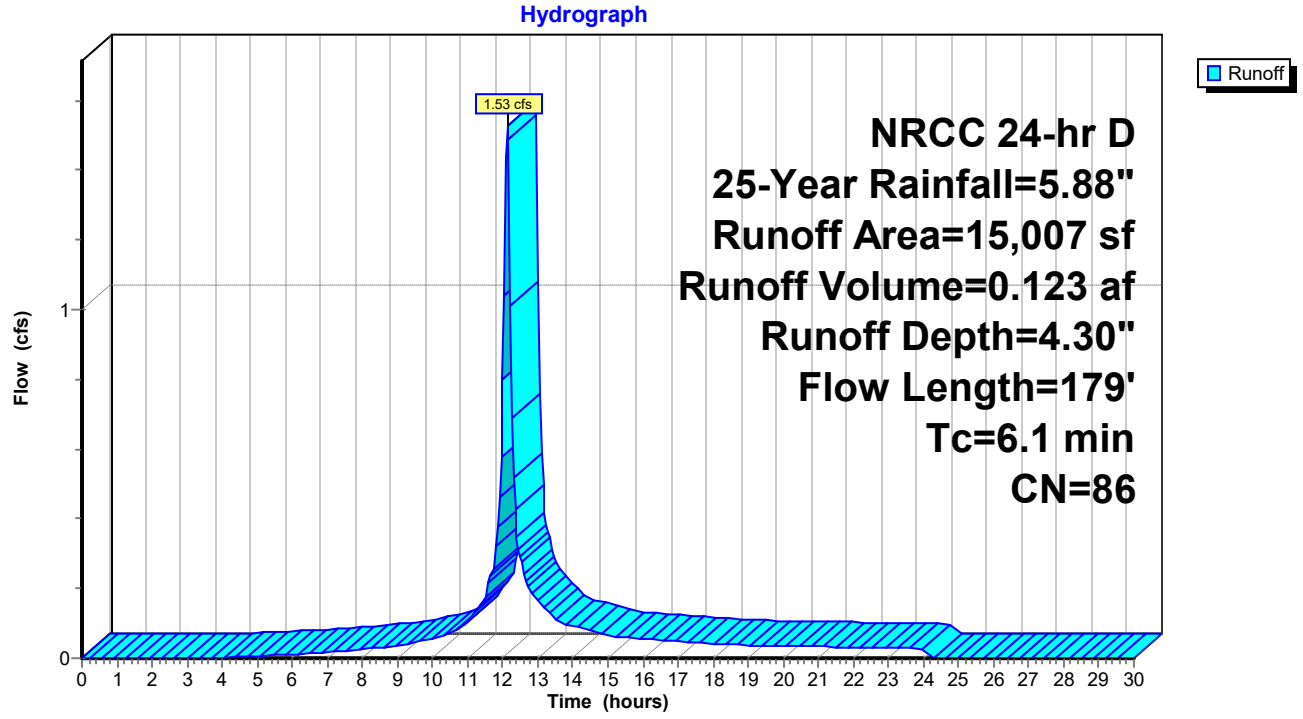
Runoff = 1.53 cfs @ 12.13 hrs, Volume= 0.123 af, Depth= 4.30"
Routed to Pond DCB-C : TO WETLAND

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
2,391	74	>75% Grass cover, Good, HSG C
3,613	70	Woods, Good, HSG C
8,981	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
15,007	86	Weighted Average
14,985		99.85% Pervious Area
22		0.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment E16: TO DCB-C



Summary for Reach DCB-A: TO WETLAND

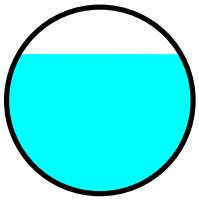
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach PIPE OUTLET depth by 1.25' @ 12.15 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 4.65" for 25-Year event
Inflow = 6.53 cfs @ 12.11 hrs, Volume= 0.767 af
Outflow = 6.24 cfs @ 12.14 hrs, Volume= 0.767 af, Atten= 4%, Lag= 1.7 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

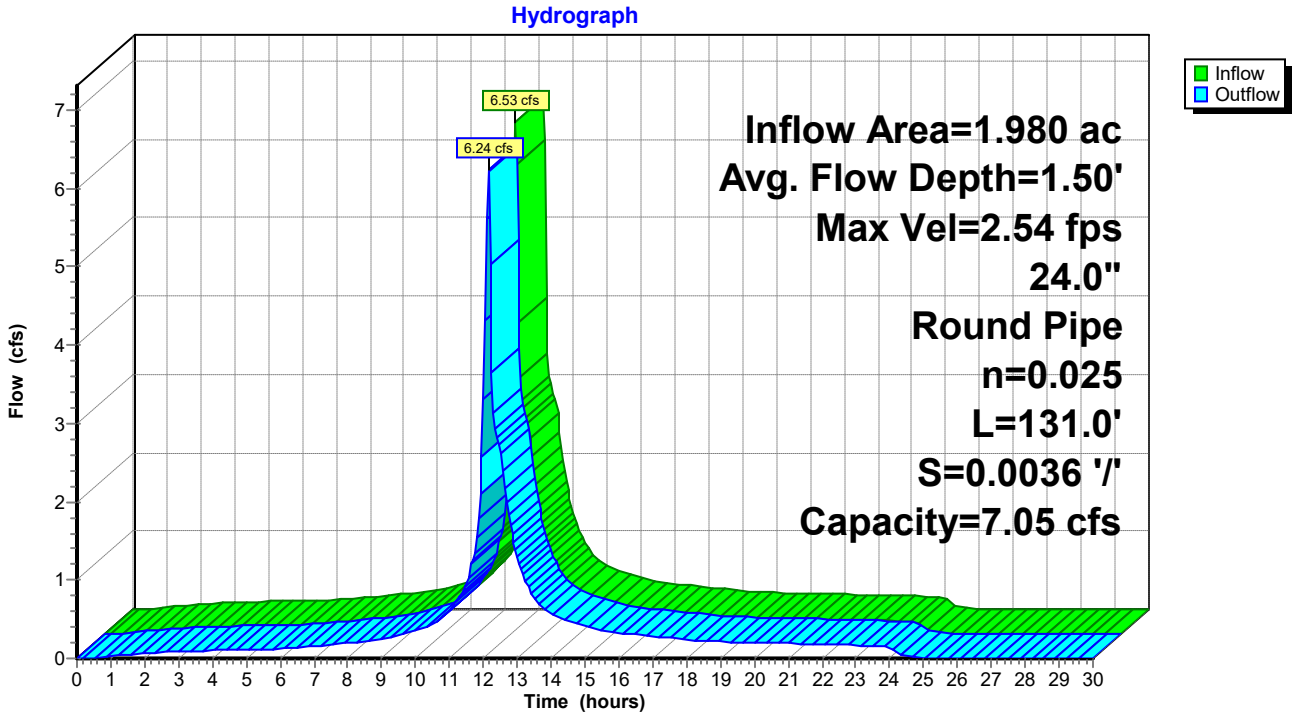
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.54 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.00 fps, Avg. Travel Time= 2.2 min

Peak Storage= 331 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.50' , Surface Width= 1.74'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



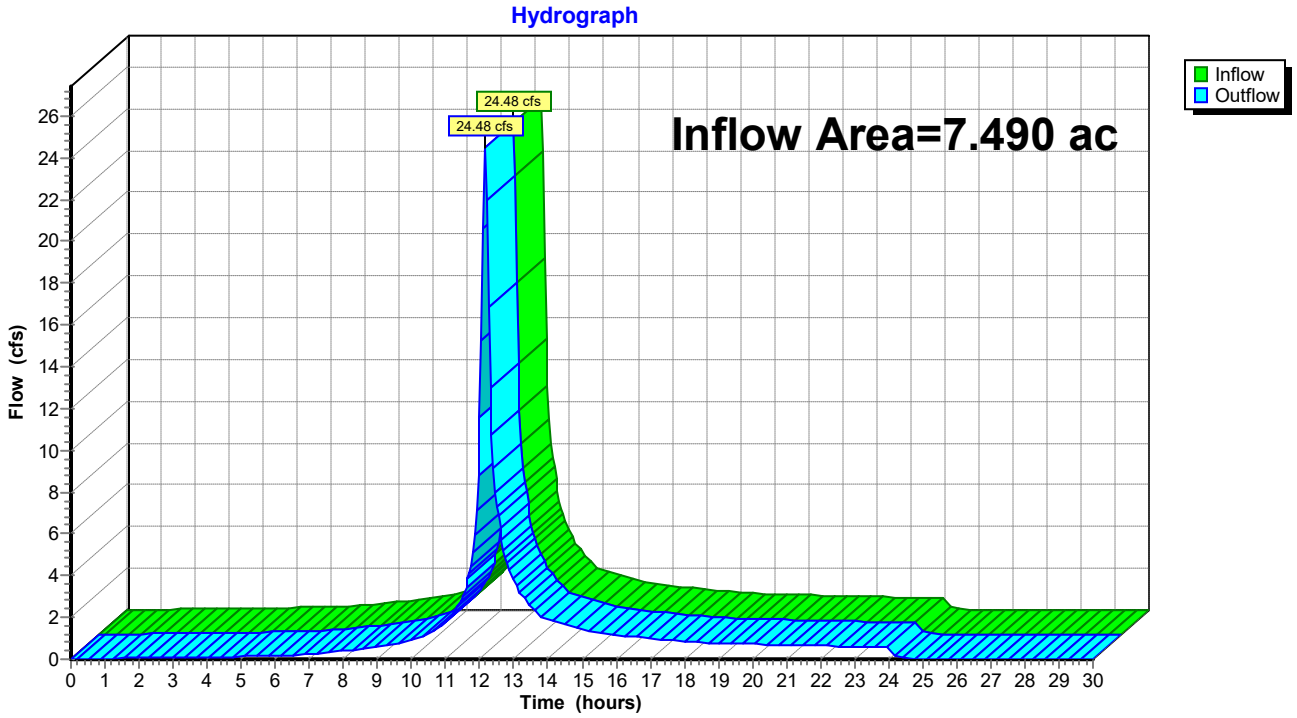
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.490 ac, 16.45% Impervious, Inflow Depth = 3.86" for 25-Year event
Inflow = 24.48 cfs @ 12.16 hrs, Volume= 2.406 af
Outflow = 24.48 cfs @ 12.16 hrs, Volume= 2.406 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

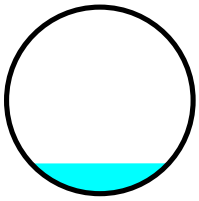
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 3.37" for 25-Year event
Inflow = 1.64 cfs @ 12.44 hrs, Volume= 0.244 af
Outflow = 1.64 cfs @ 12.46 hrs, Volume= 0.244 af, Atten= 0%, Lag= 1.4 min
Routed to Reach DCB-A : TO WETLAND

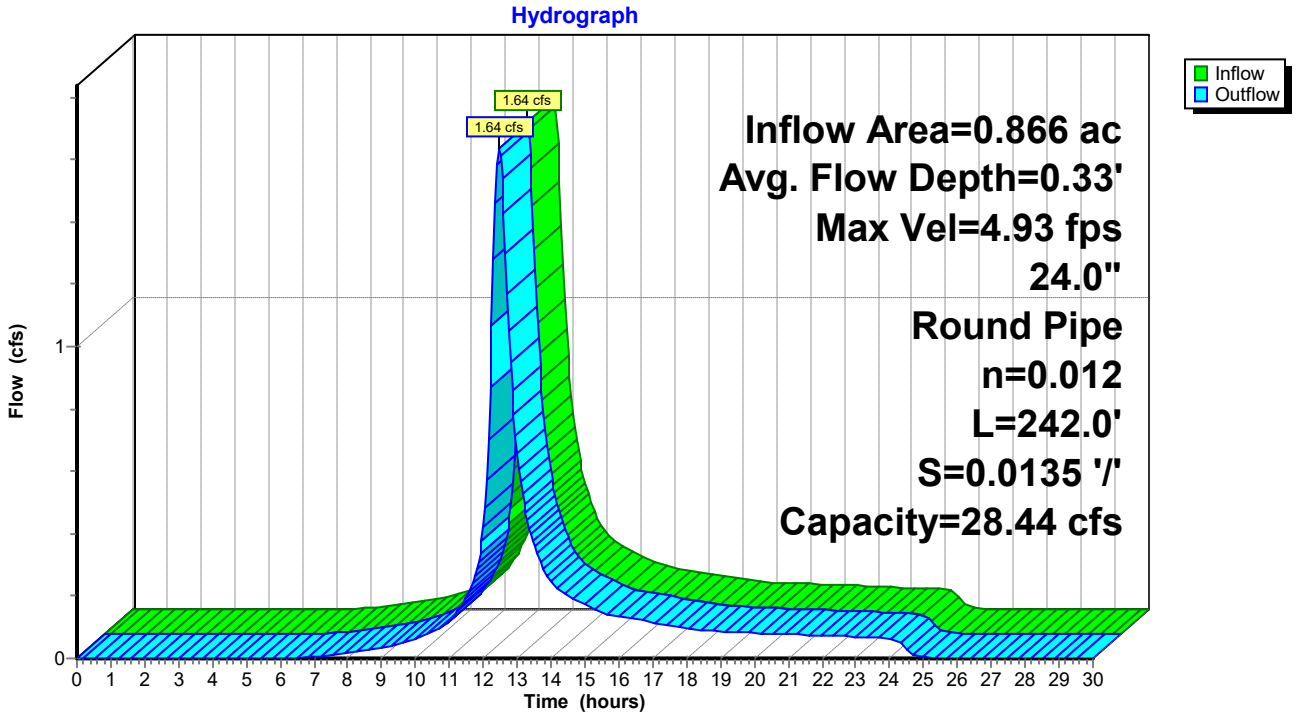
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.93 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.07 fps, Avg. Travel Time= 1.9 min

Peak Storage= 81 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.33' , Surface Width= 1.48'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



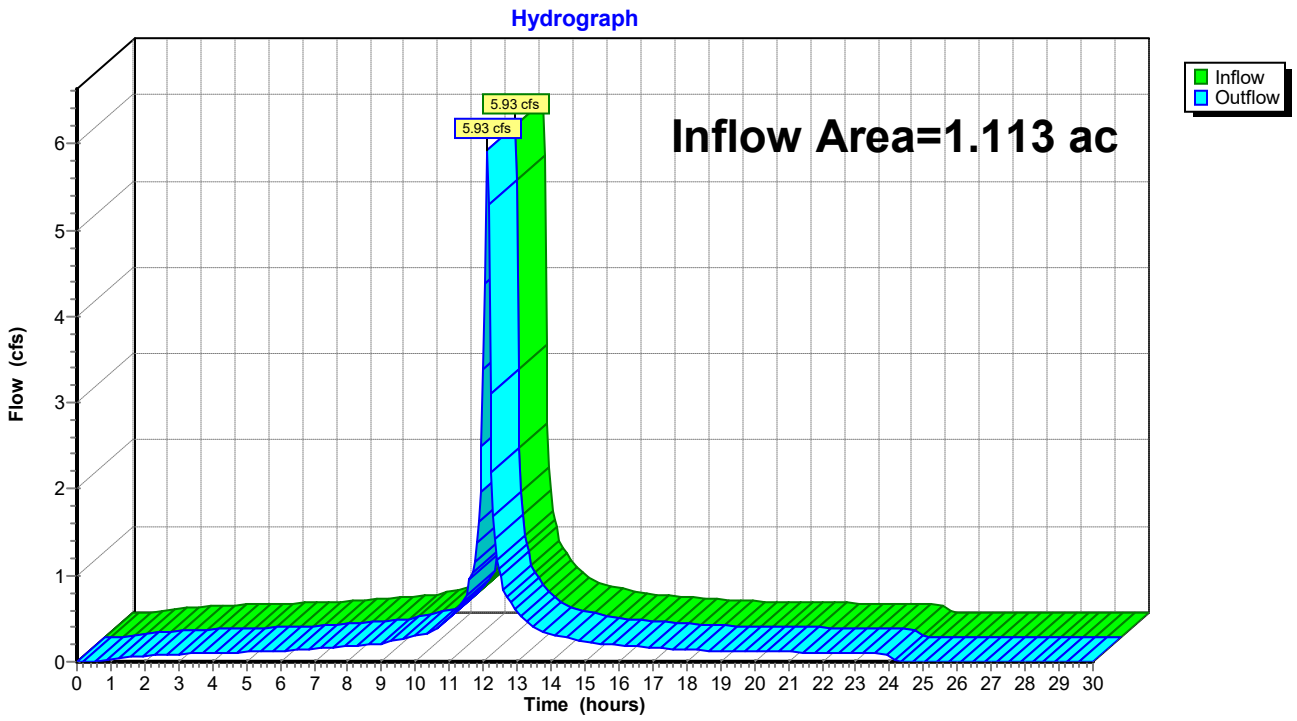
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 5.64" for 25-Year event
Inflow = 5.93 cfs @ 12.11 hrs, Volume= 0.523 af
Outflow = 5.93 cfs @ 12.11 hrs, Volume= 0.523 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 117.15' (Flood elevation advised)

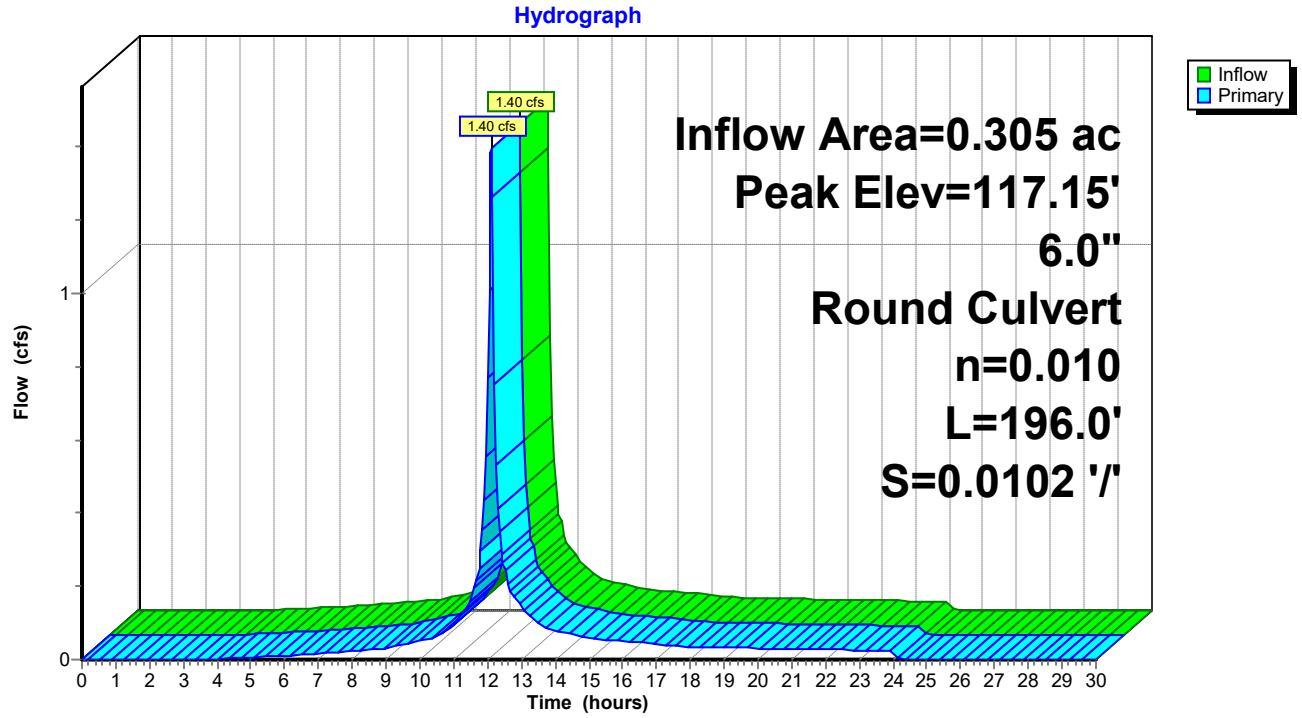
Inflow Area = 0.305 ac, 12.86% Impervious, Inflow Depth = 4.30" for 25-Year event
Inflow = 1.40 cfs @ 12.11 hrs, Volume= 0.109 af
Outflow = 1.40 cfs @ 12.11 hrs, Volume= 0.109 af, Atten= 0%, Lag= 0.0 min
Primary = 1.40 cfs @ 12.11 hrs, Volume= 0.109 af
Routed to Pond DCB-C : TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 117.15' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=1.35 cfs @ 12.11 hrs HW=116.66' (Free Discharge)
1=Culvert (Barrel Controls 1.35 cfs @ 6.89 fps)

Pond DCB-B: TO DCB-C



Summary for Pond DCB-C: TO WETLAND

[57] Hint: Peaked at 116.58' (Flood elevation advised)
[81] Warning: Exceeded Pond DCB-B by 0.09' @ 12.15 hrs

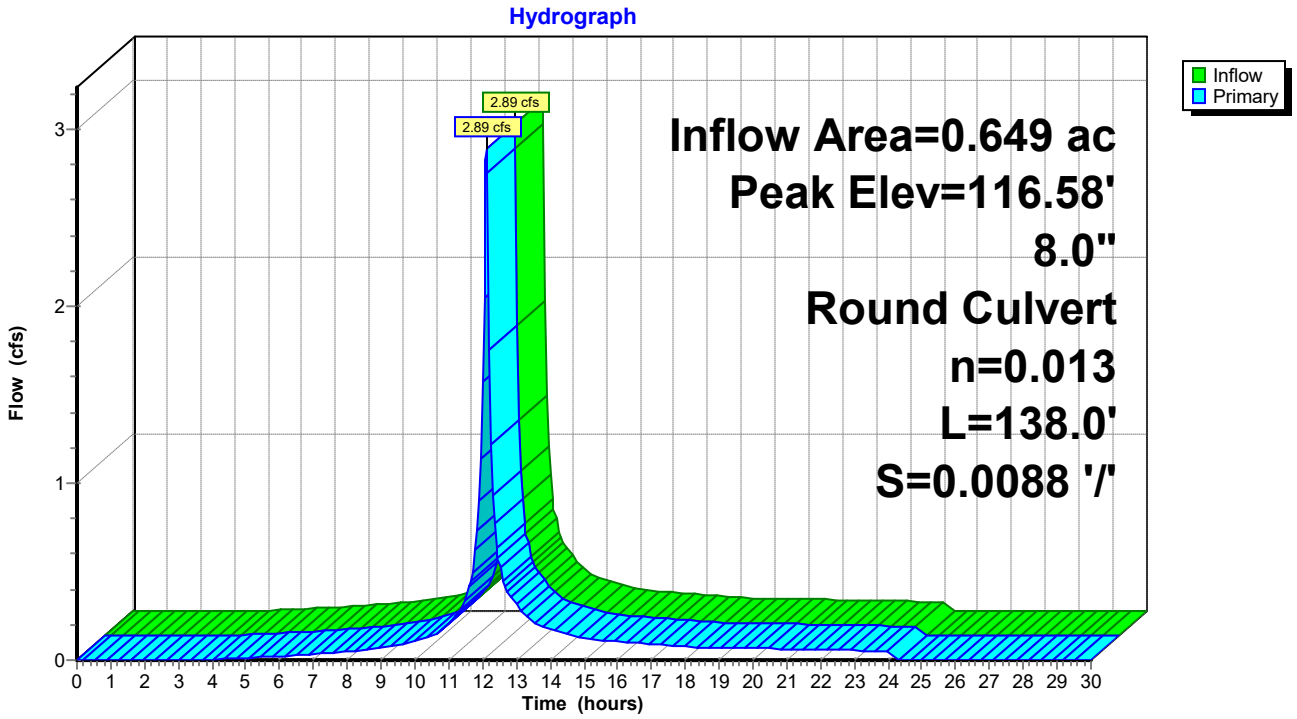
Inflow Area = 0.649 ac, 6.12% Impervious, Inflow Depth = 4.30" for 25-Year event
Inflow = 2.89 cfs @ 12.12 hrs, Volume= 0.232 af
Outflow = 2.89 cfs @ 12.12 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min
Primary = 2.89 cfs @ 12.12 hrs, Volume= 0.232 af
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 116.58' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	107.68'	**8.0" Round Culvert** L= 138.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 107.68' / 106.47' S= 0.0088 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=2.79 cfs @ 12.12 hrs HW=116.01' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 2.79 cfs @ 8.00 fps)

Pond DCB-C: TO WETLAND



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 E11B: OVERLAND TO DP#2 Runoff Area=211,724 sf 0.83% Impervious Runoff Depth=5.71"
Flow Length=414' Tc=9.8 min CN=78 Runoff=25.55 cfs 2.311 af

Subcatchment E13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=8.10"
Tc=5.0 min CN=98 Runoff=8.42 cfs 0.752 af

Subcatchment E14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=5.59"
Flow Length=509' Tc=31.2 min CN=77 Runoff=2.70 cfs 0.403 af

Subcatchment E15: TO DCB-B Runoff Area=13,283 sf 12.86% Impervious Runoff Depth=6.66"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=86 Runoff=2.12 cfs 0.169 af

Subcatchment E16: TO DCB-C Runoff Area=15,007 sf 0.15% Impervious Runoff Depth=6.66"
Flow Length=179' Tc=6.1 min CN=86 Runoff=2.31 cfs 0.191 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=2.00' Max Vel=2.55 fps Inflow=9.48 cfs 1.155 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=7.05 cfs 1.155 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=36.46 cfs 3.827 af
Outflow=36.46 cfs 3.827 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.42' Max Vel=5.70 fps Inflow=2.70 cfs 0.403 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=2.69 cfs 0.403 af

Reach RF: TO DCB-A Inflow=8.42 cfs 0.752 af
Outflow=8.42 cfs 0.752 af

Pond DCB-B: TO DCB-C Peak Elev=127.93' Inflow=2.12 cfs 0.169 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=2.12 cfs 0.169 af

Pond DCB-C: TO WETLAND Peak Elev=128.74' Inflow=4.37 cfs 0.361 af
8.0" Round Culvert n=0.013 L=138.0' S=0.0088 '/' Outflow=4.37 cfs 0.361 af

Total Runoff Area = 7.490 ac Runoff Volume = 3.827 af Average Runoff Depth = 6.13"
83.55% Pervious = 6.258 ac 16.45% Impervious = 1.232 ac

Summary for Subcatchment E11B: OVERLAND TO DP#2

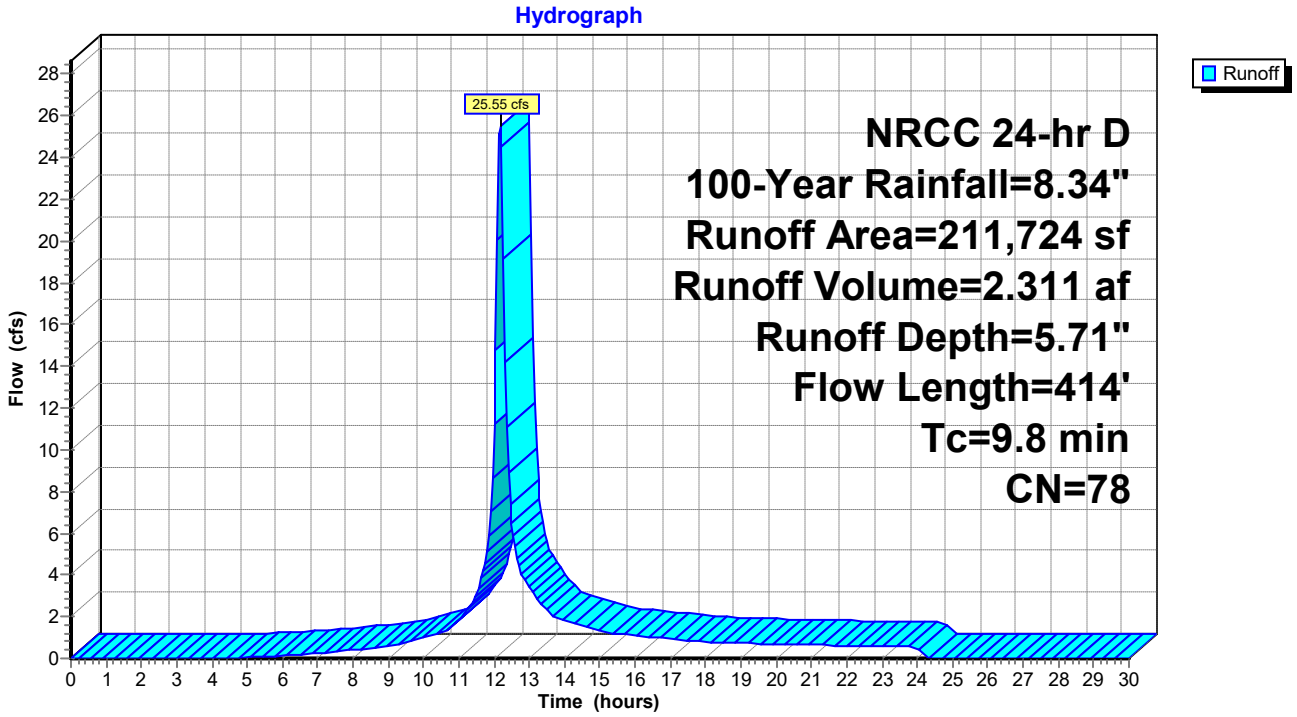
Runoff = 25.55 cfs @ 12.17 hrs, Volume= 2.311 af, Depth= 5.71"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
23,722	74	>75% Grass cover, Good, HSG C
127,829	70	Woods, Good, HSG C
58,406	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
211,724	78	Weighted Average
209,957		99.17% Pervious Area
1,767		0.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment E11B: OVERLAND TO DP#2



Summary for Subcatchment E13: TO ROOF DRAINAGE

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

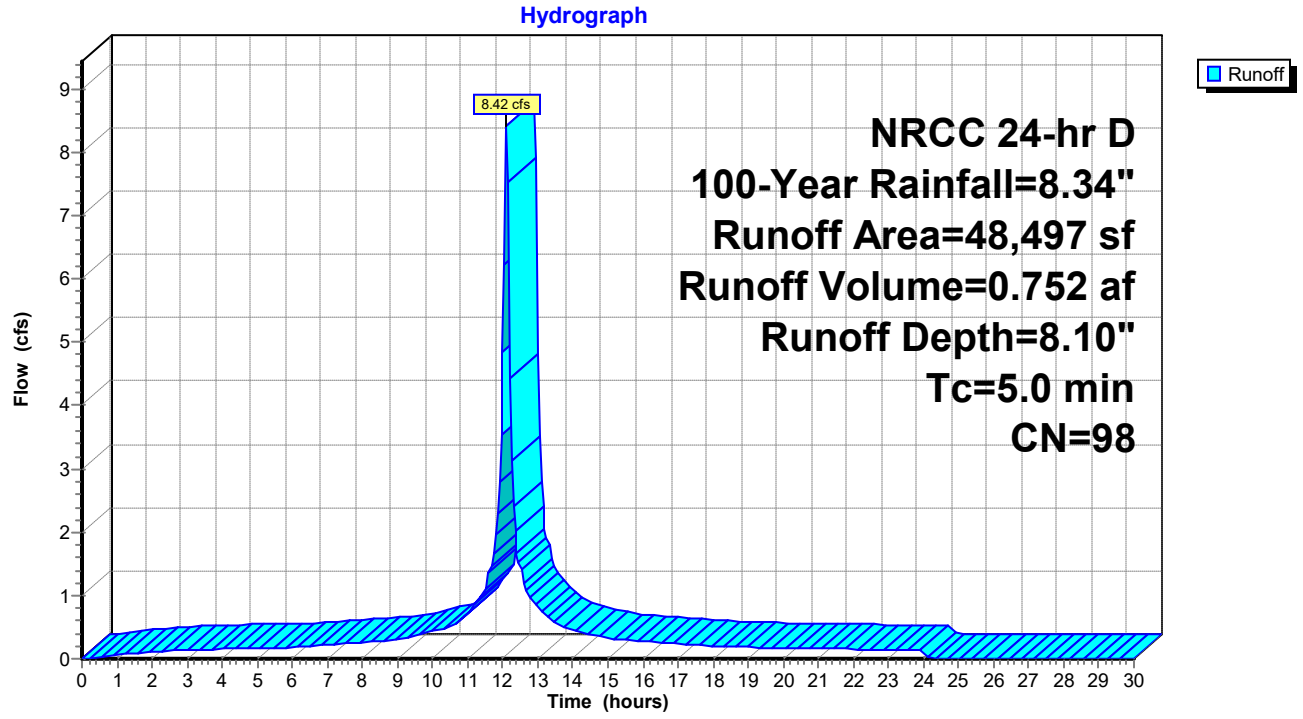
Runoff = 8.42 cfs @ 12.11 hrs, Volume= 0.752 af, Depth= 8.10"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment E13: TO ROOF DRAINAGE



Summary for Subcatchment E14: TO INLET

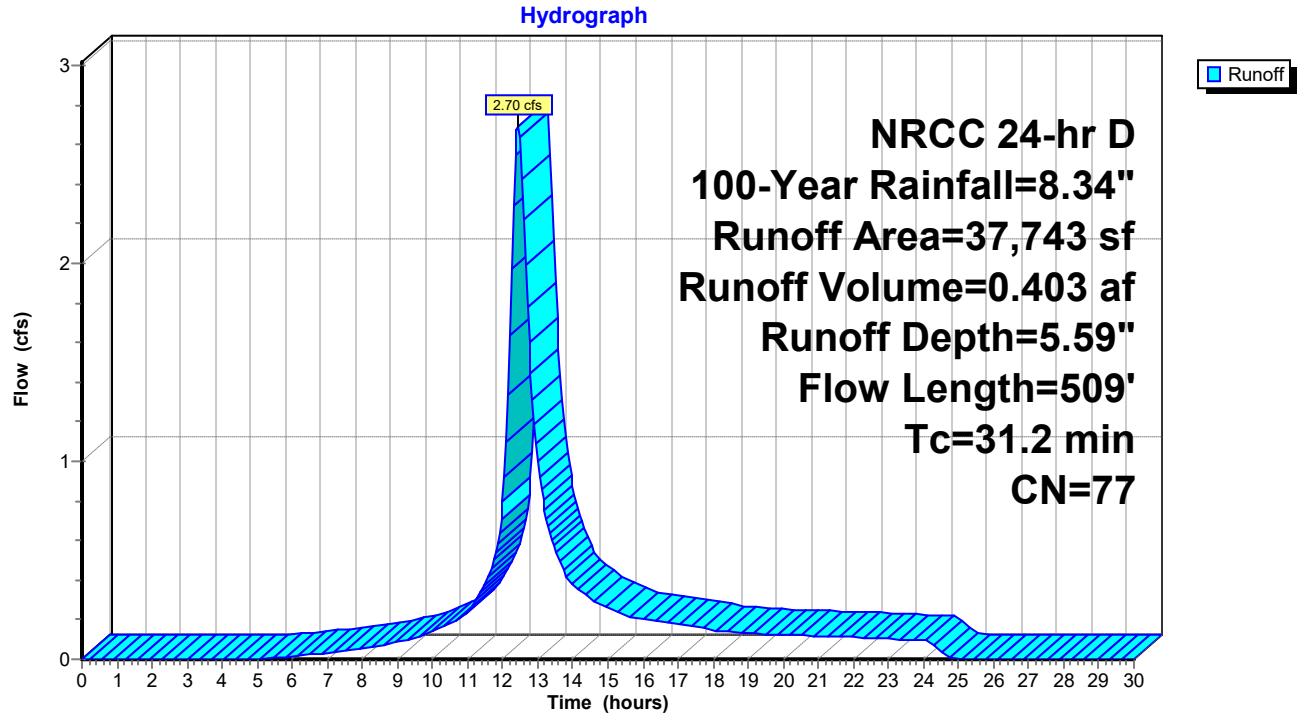
Runoff = 2.70 cfs @ 12.43 hrs, Volume= 0.403 af, Depth= 5.59"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.1	459	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.2	509	Total			

Subcatchment E14: TO INLET



Summary for Subcatchment E15: TO DCB-B

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

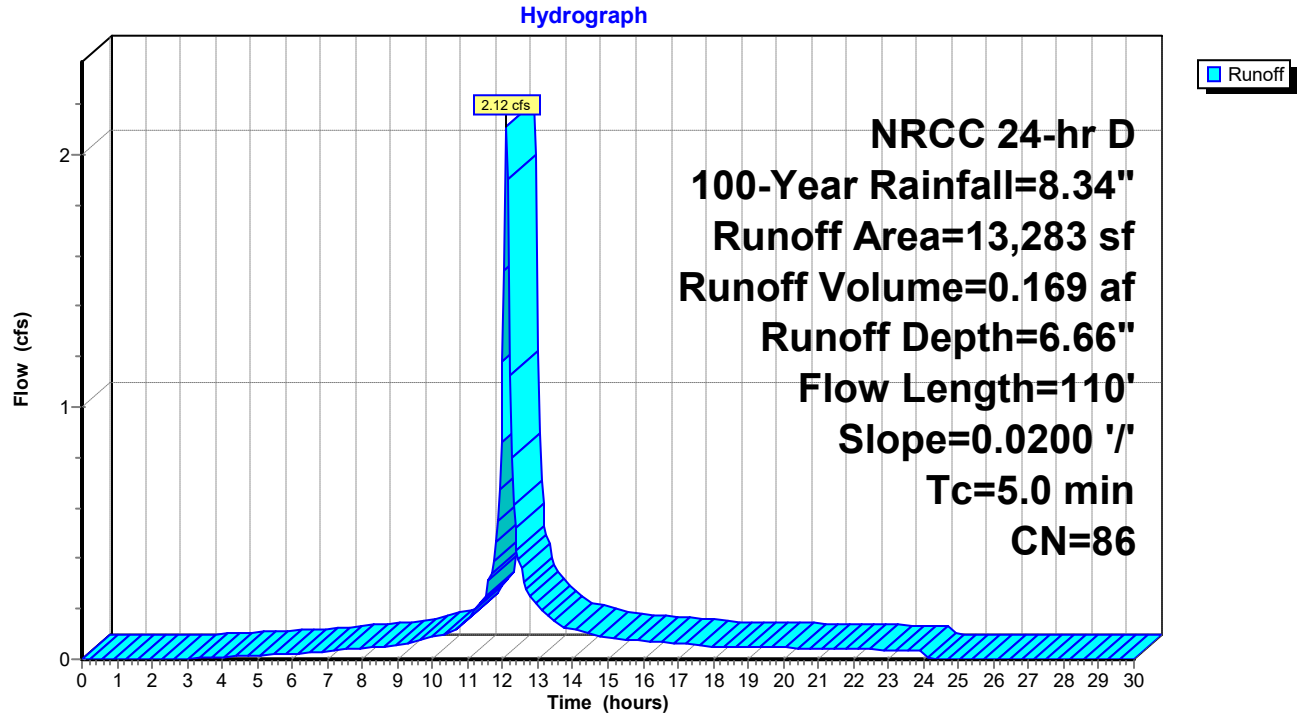
Runoff = 2.12 cfs @ 12.11 hrs, Volume= 0.169 af, Depth= 6.66"
Routed to Pond DCB-B : TO DCB-C

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
2,045	74	>75% Grass cover, Good, HSG C
3,264	70	Woods, Good, HSG C
6,266	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
13,283	86	Weighted Average
11,575		87.14% Pervious Area
1,708		12.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment E15: TO DCB-B



Summary for Subcatchment E16: TO DCB-C

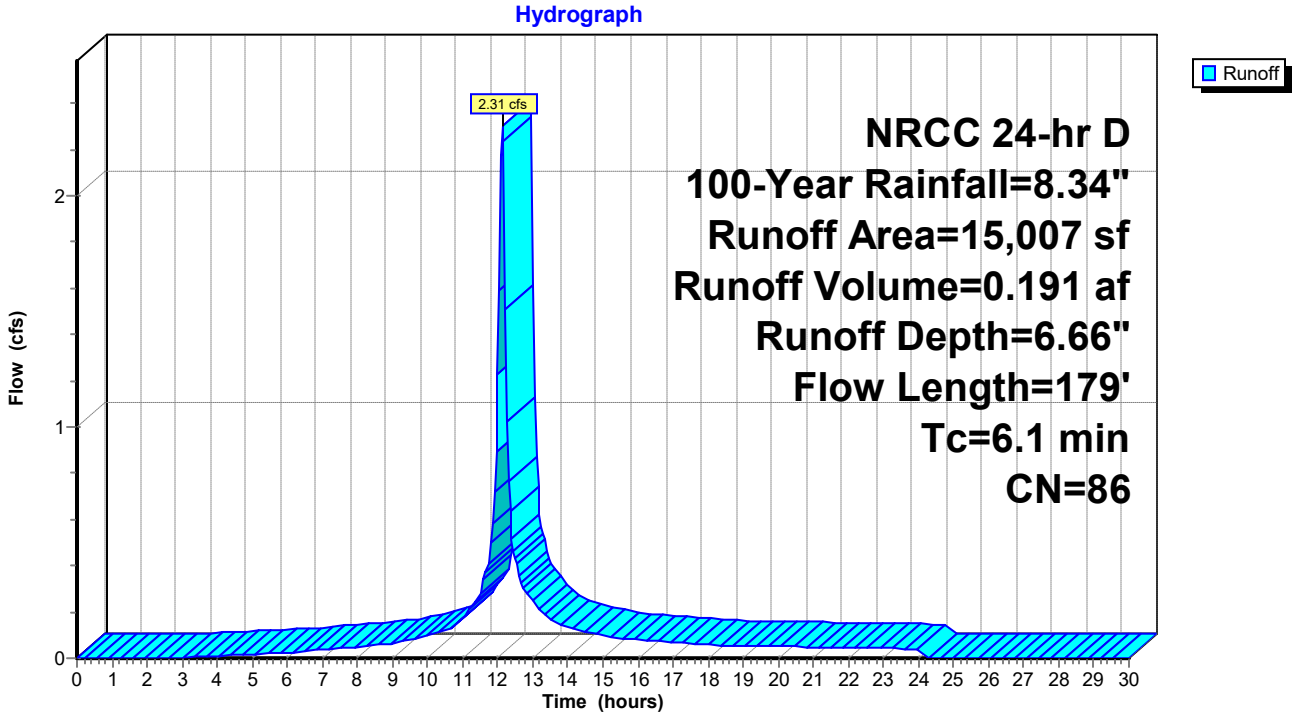
Runoff = 2.31 cfs @ 12.13 hrs, Volume= 0.191 af, Depth= 6.66"
Routed to Pond DCB-C : TO WETLAND

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
2,391	74	>75% Grass cover, Good, HSG C
3,613	70	Woods, Good, HSG C
8,981	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
15,007	86	Weighted Average
14,985		99.85% Pervious Area
22		0.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment E16: TO DCB-C



Summary for Reach DCB-A: TO WETLAND

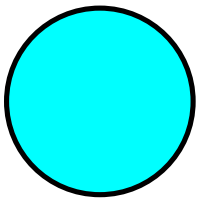
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 135% of Manning's capacity
[76] Warning: Detained 0.017 af (Pond w/culvert advised)
[62] Hint: Exceeded Reach PIPE OUTLET depth by 1.74' @ 12.10 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 7.00" for 100-Year event
Inflow = 9.48 cfs @ 12.11 hrs, Volume= 1.155 af
Outflow = 7.05 cfs @ 12.15 hrs, Volume= 1.155 af, Atten= 26%, Lag= 2.1 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

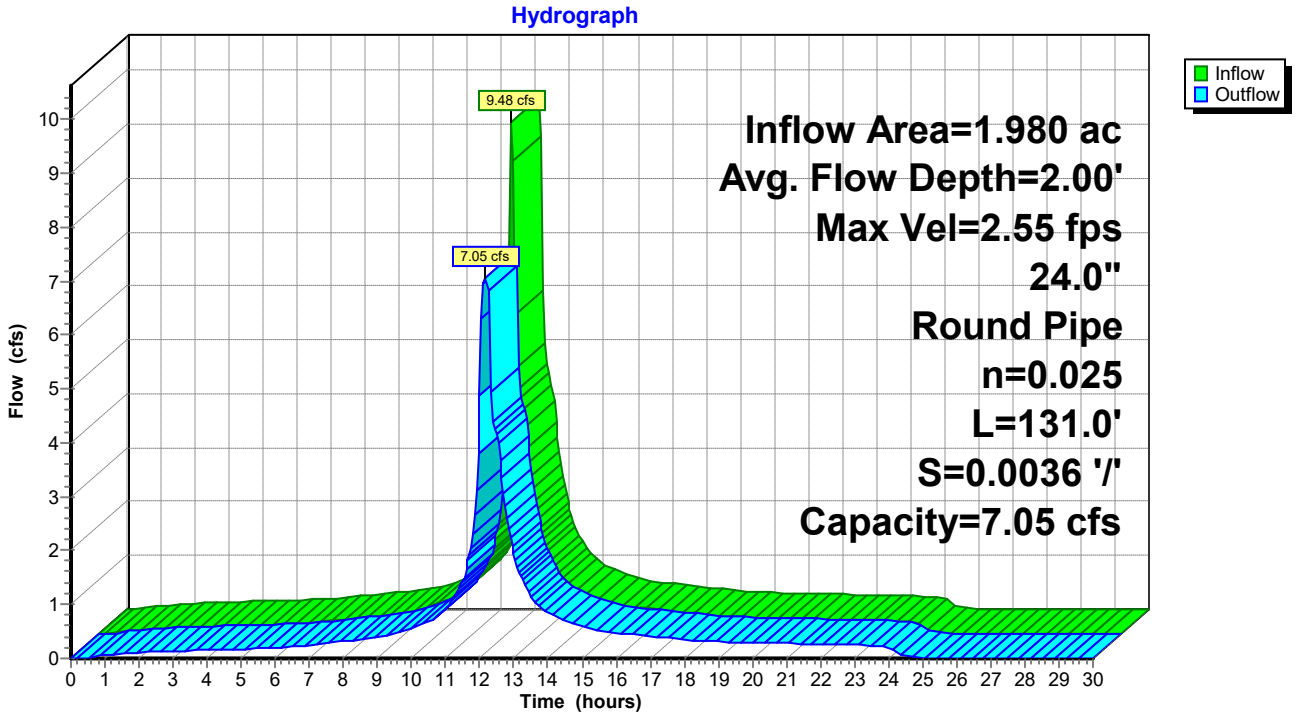
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.55 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 1.9 min

Peak Storage= 412 cf @ 12.10 hrs
Average Depth at Peak Storage= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



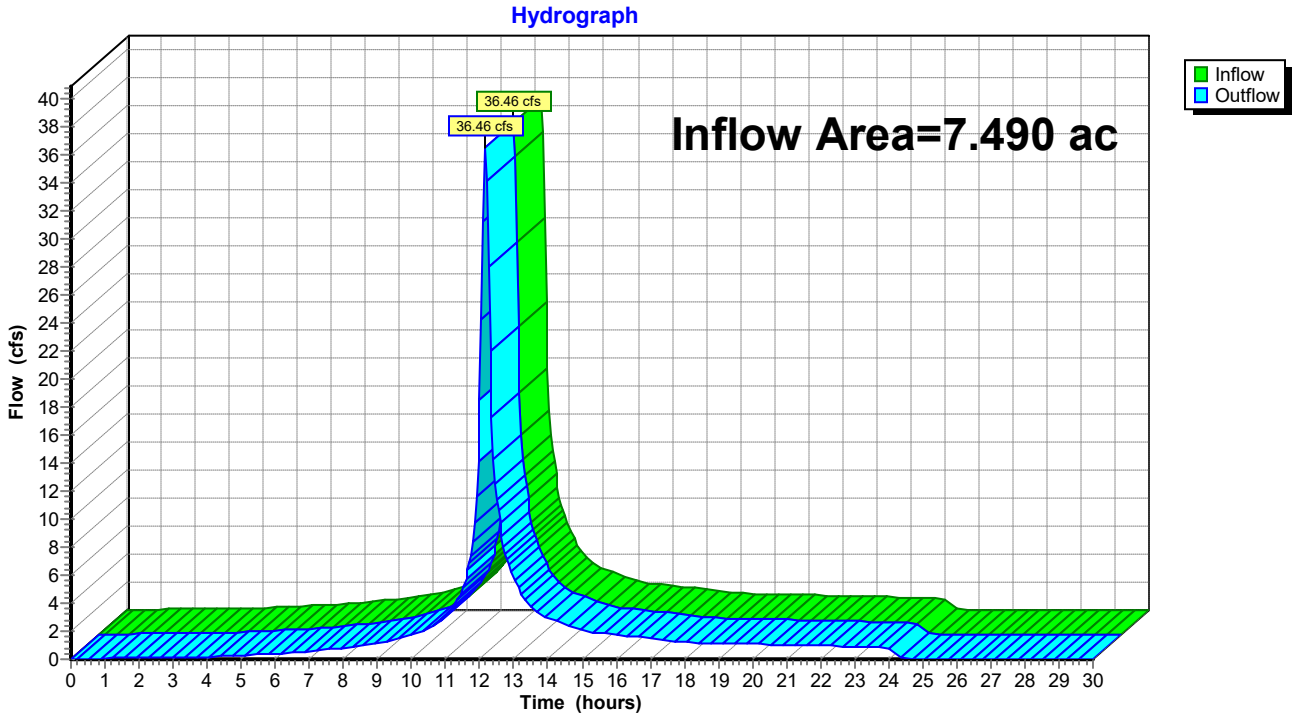
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.490 ac, 16.45% Impervious, Inflow Depth = 6.13" for 100-Year event
Inflow = 36.46 cfs @ 12.16 hrs, Volume= 3.827 af
Outflow = 36.46 cfs @ 12.16 hrs, Volume= 3.827 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

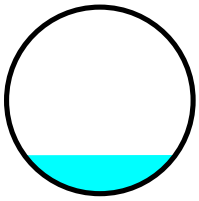
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 5.59" for 100-Year event
Inflow = 2.70 cfs @ 12.43 hrs, Volume= 0.403 af
Outflow = 2.69 cfs @ 12.45 hrs, Volume= 0.403 af, Atten= 0%, Lag= 1.3 min
Routed to Reach DCB-A : TO WETLAND

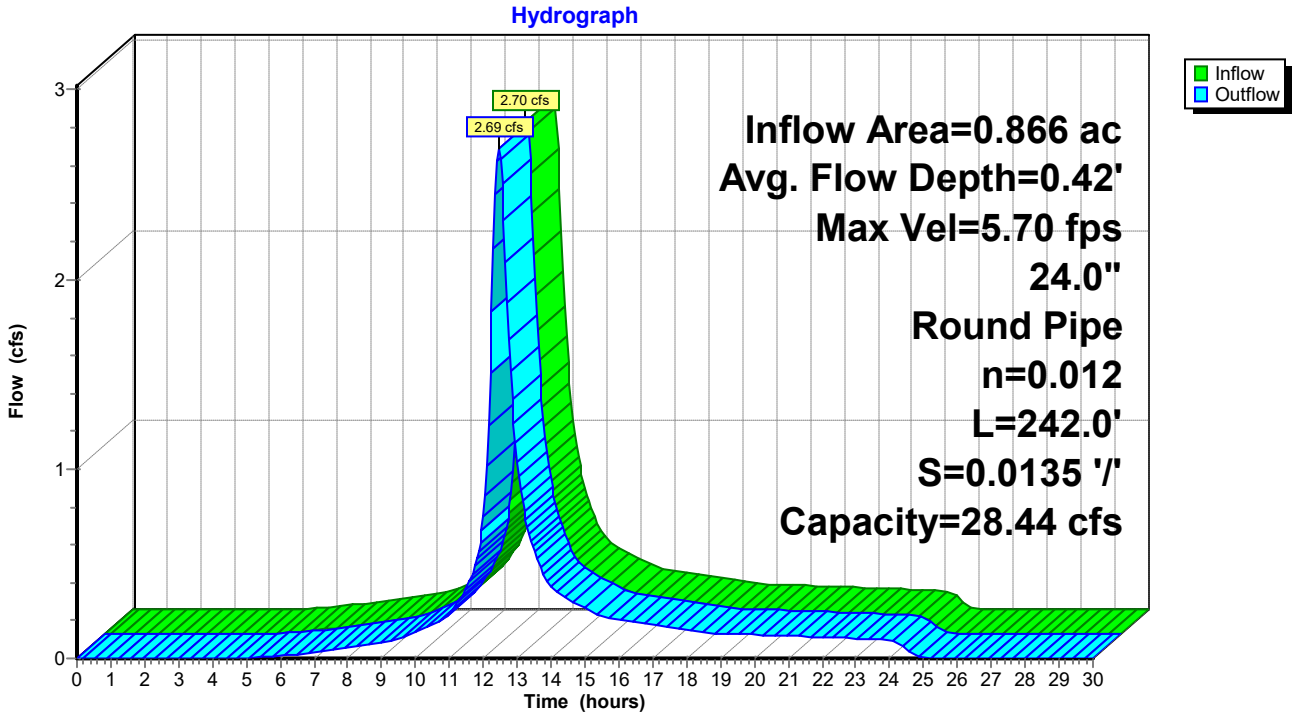
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.70 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.33 fps, Avg. Travel Time= 1.7 min

Peak Storage= 114 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.42' , Surface Width= 1.62'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



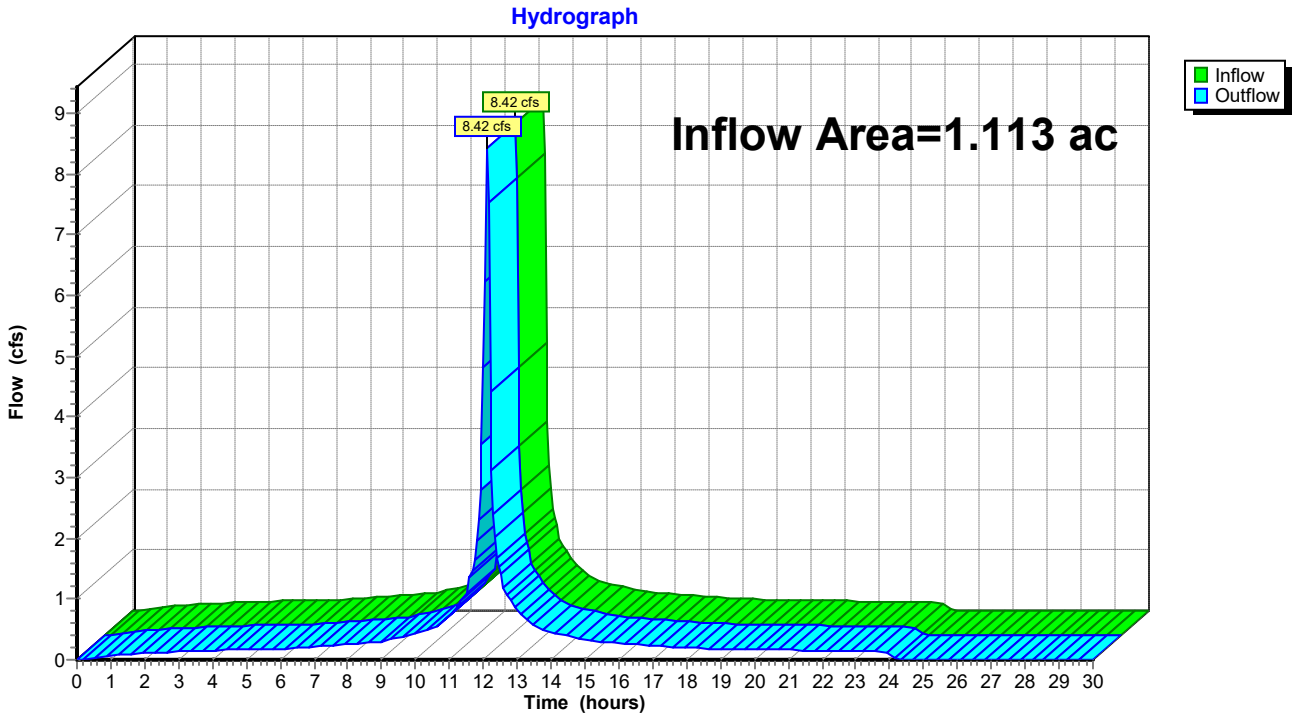
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 8.10" for 100-Year event
Inflow = 8.42 cfs @ 12.11 hrs, Volume= 0.752 af
Outflow = 8.42 cfs @ 12.11 hrs, Volume= 0.752 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 127.93' (Flood elevation advised)

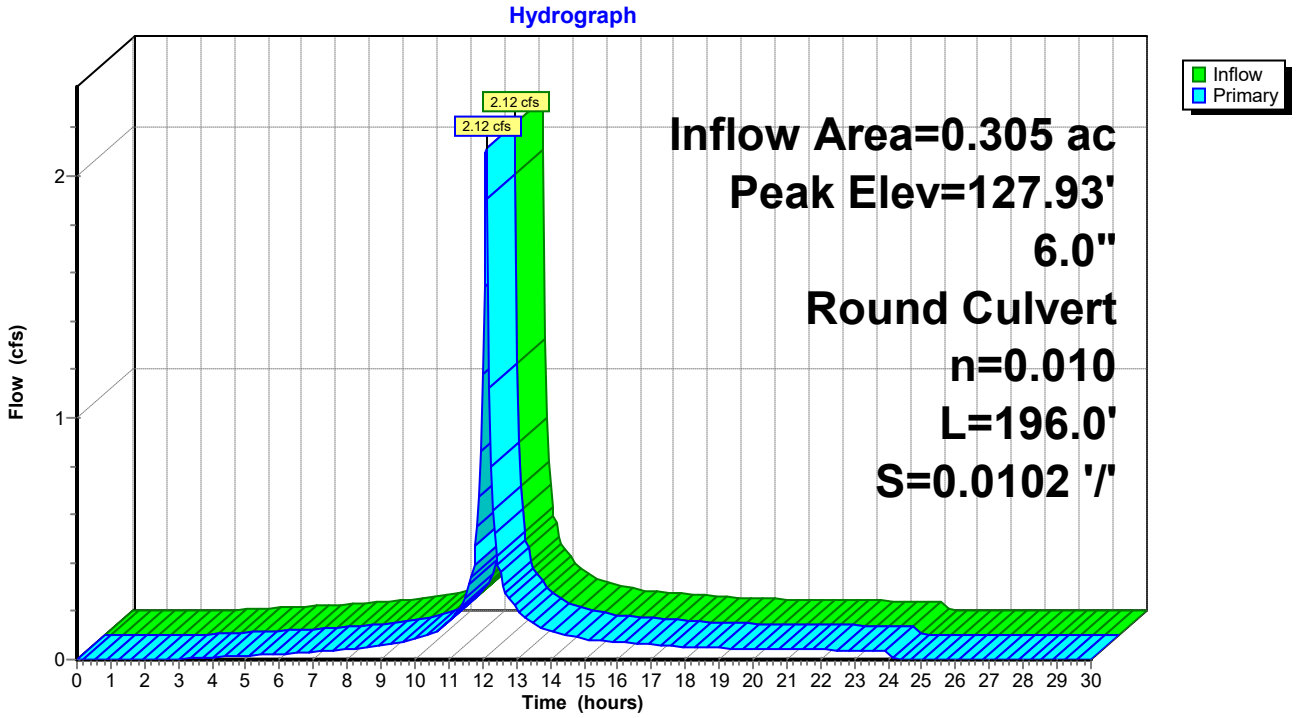
Inflow Area = 0.305 ac, 12.86% Impervious, Inflow Depth = 6.66" for 100-Year event
Inflow = 2.12 cfs @ 12.11 hrs, Volume= 0.169 af
Outflow = 2.12 cfs @ 12.11 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min
Primary = 2.12 cfs @ 12.11 hrs, Volume= 0.169 af
Routed to Pond DCB-C : TO WETLAND

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 127.93' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=2.05 cfs @ 12.11 hrs HW=126.84' (Free Discharge)
1=Culvert (Barrel Controls 2.05 cfs @ 10.44 fps)

Pond DCB-B: TO DCB-C



Summary for Pond DCB-C: TO WETLAND

[57] Hint: Peaked at 128.74' (Flood elevation advised)
[81] Warning: Exceeded Pond DCB-B by 2.33' @ 12.15 hrs

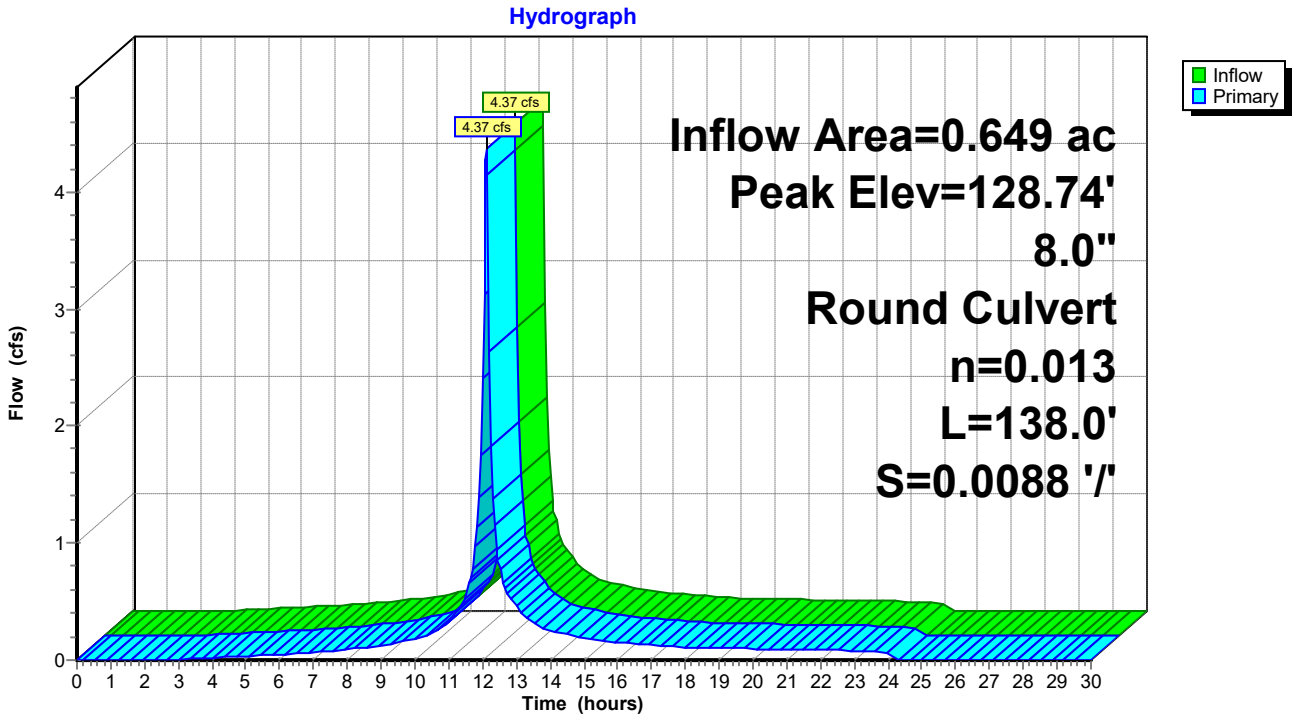
Inflow Area = 0.649 ac, 6.12% Impervious, Inflow Depth = 6.66" for 100-Year event
Inflow = 4.37 cfs @ 12.12 hrs, Volume= 0.361 af
Outflow = 4.37 cfs @ 12.12 hrs, Volume= 0.361 af, Atten= 0%, Lag= 0.0 min
Primary = 4.37 cfs @ 12.12 hrs, Volume= 0.361 af
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 128.74' @ 12.12 hrs

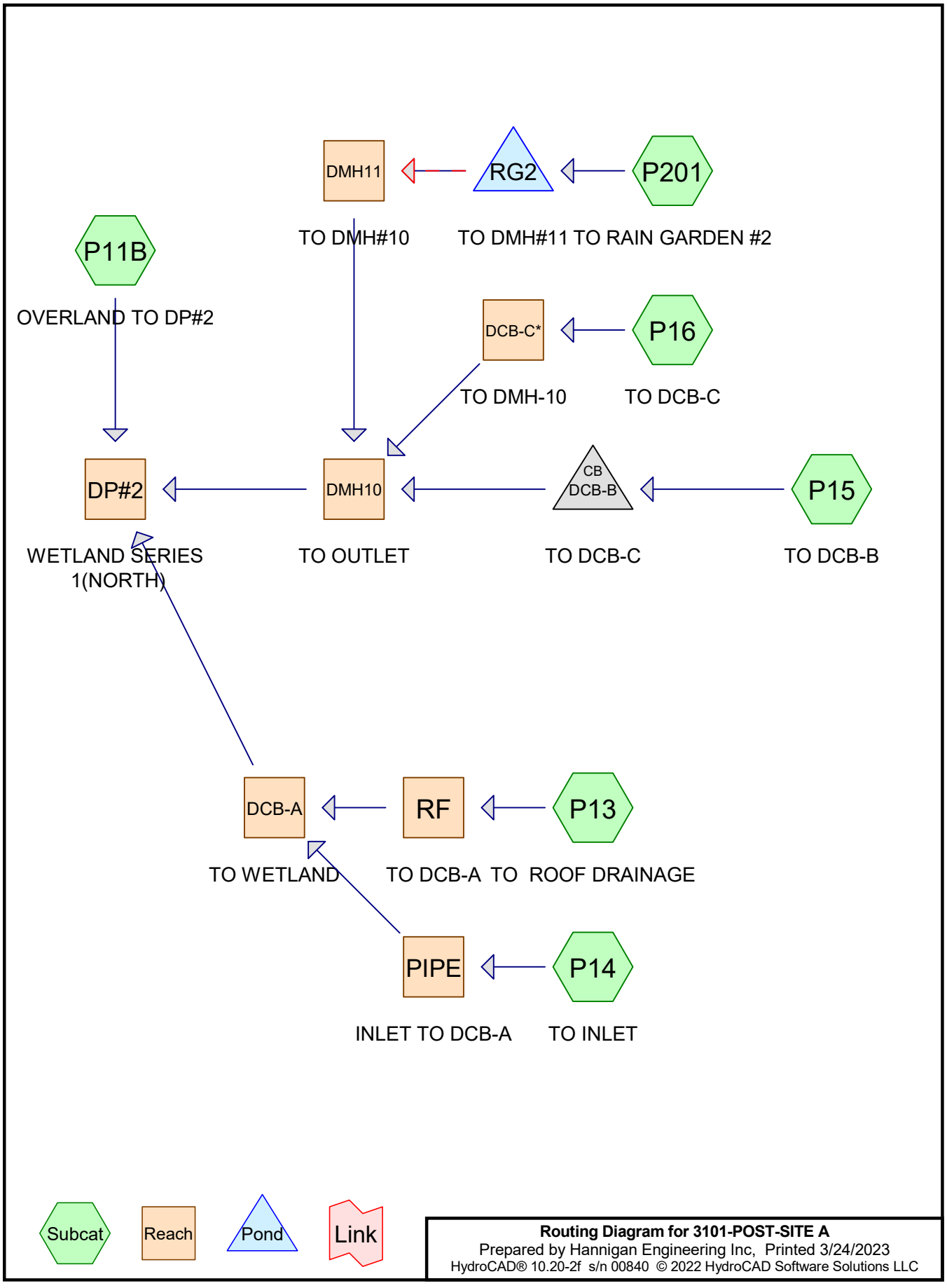
Device	Routing	Invert	Outlet Devices
#1	Primary	107.68'	**8.0" Round Culvert** L= 138.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 107.68' / 106.47' S= 0.0088 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=4.22 cfs @ 12.12 hrs HW=127.44' (Free Discharge)
↑**1=Culvert** (Barrel Controls 4.22 cfs @ 12.10 fps)

Pond DCB-C: TO WETLAND



2.2
POST DEVELOPMENT CALCULATIONS



Routing Diagram for 3101-POST-SITE A

Prepared by Hannigan Engineering Inc, Printed 3/24/2023

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)
0.869	74	>75% Grass cover, Good, HSG C (P11B, P14, P15, P16, P201)
0.160	89	Gravel roads, HSG C (P16, P201)
1.793	96	Gravel surface, HSG C (P11B, P14, P15, P16, P201)
1.273	98	Paved parking, HSG C (P11B, P13, P14, P15, P16, P201)
3.417	70	Woods, Good, HSG C (P11B, P14, P15)
7.511	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
7.511	HSG C	P11B, P13, P14, P15, P16, P201
0.000	HSG D	
0.000	Other	
7.511		**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	0.869	0.000	0.000	0.869	>75% Grass cover, Good	P11B, P14, P15, P16, P201
0.000	0.000	0.160	0.000	0.000	0.160	Gravel roads	P16, P201
0.000	0.000	1.793	0.000	0.000	1.793	Gravel surface	P11B, P14, P15, P16, P201
0.000	0.000	1.273	0.000	0.000	1.273	Paved parking	P11B, P13, P14, P15, P16, P201
0.000	0.000	3.417	0.000	0.000	3.417	Woods, Good	P11B, P14, P15
0.000	**0.000**	**7.511**	**0.000**	**0.000**	**7.511**	**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	DCB-A	106.90	106.43	131.0	0.0036	0.025	0.0	24.0	0.0
2	DCB-C*	107.80	107.70	5.0	0.0200	0.011	0.0	8.0	0.0
3	DMH10	107.60	107.10	101.0	0.0050	0.013	0.0	15.0	0.0
4	DMH11	109.40	107.80	157.0	0.0102	0.011	0.0	12.0	0.0
5	PIPE	110.16	106.90	242.0	0.0135	0.012	0.0	24.0	0.0
6	DCB-B	110.28	108.28	196.0	0.0102	0.010	0.0	6.0	0.0
7	RG2	109.80	109.50	33.0	0.0091	0.011	0.0	12.0	0.0

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 P11B: OVERLAND TO DP#2 Runoff Area=200,631 sf 0.88% Impervious Runoff Depth=1.22"
Flow Length=414' Tc=9.8 min CN=78 Runoff=5.19 cfs 0.469 af

Subcatchment P13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=2.90"
Tc=5.0 min CN=98 Runoff=3.13 cfs 0.269 af

Subcatchment P14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=1.16"
Flow Length=513' Tc=31.4 min CN=77 Runoff=0.54 cfs 0.084 af

Subcatchment P15: TO DCB-B Runoff Area=12,955 sf 13.18% Impervious Runoff Depth=1.93"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=88 Runoff=0.63 cfs 0.048 af

Subcatchment P16: TO DCB-C Runoff Area=12,642 sf 0.17% Impervious Runoff Depth=2.38"
Flow Length=179' Tc=6.1 min CN=93 Runoff=0.71 cfs 0.058 af

Subcatchment P201: TO RAIN GARDEN #2 Runoff Area=14,725 sf 12.12% Impervious Runoff Depth=1.48"
Flow Length=135' Slope=0.0200 '/' Tc=5.0 min CN=82 Runoff=0.55 cfs 0.042 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=0.95' Max Vel=2.18 fps Inflow=3.28 cfs 0.353 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=3.11 cfs 0.353 af

Reach DCB-C*: TO DMH-10 Avg. Flow Depth=0.27' Max Vel=5.23 fps Inflow=0.71 cfs 0.058 af
8.0" Round Pipe n=0.011 L=5.0' S=0.0200 '/' Capacity=2.02 cfs Outflow=0.71 cfs 0.058 af

Reach DMH10: TO OUTLET Avg. Flow Depth=0.48' Max Vel=3.27 fps Inflow=1.44 cfs 0.147 af
15.0" Round Pipe n=0.013 L=101.0' S=0.0050 '/' Capacity=4.55 cfs Outflow=1.41 cfs 0.147 af

Reach DMH11: TO DMH#10 Avg. Flow Depth=0.14' Max Vel=2.64 fps Inflow=0.17 cfs 0.042 af
12.0" Round Pipe n=0.011 L=157.0' S=0.0102 '/' Capacity=4.25 cfs Outflow=0.17 cfs 0.042 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=9.58 cfs 0.969 af
Outflow=9.58 cfs 0.969 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.19' Max Vel=3.54 fps Inflow=0.54 cfs 0.084 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=0.54 cfs 0.084 af

Reach RF: TO DCB-A Inflow=3.13 cfs 0.269 af
Outflow=3.13 cfs 0.269 af

Pond DCB-B: TO DCB-C Peak Elev=110.97' Inflow=0.63 cfs 0.048 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=0.63 cfs 0.048 af

Pond RG2: TO DMH#11 Peak Elev=112.13' Storage=438 cf Inflow=0.55 cfs 0.042 af
Primary=0.17 cfs 0.042 af Secondary=0.00 cfs 0.000 af Outflow=0.17 cfs 0.042 af

Total Runoff Area = 7.511 ac Runoff Volume = 0.969 af Average Runoff Depth = 1.55"
83.06% Pervious = 6.239 ac 16.94% Impervious = 1.273 ac

Summary for Subcatchment P11B: OVERLAND TO DP#2

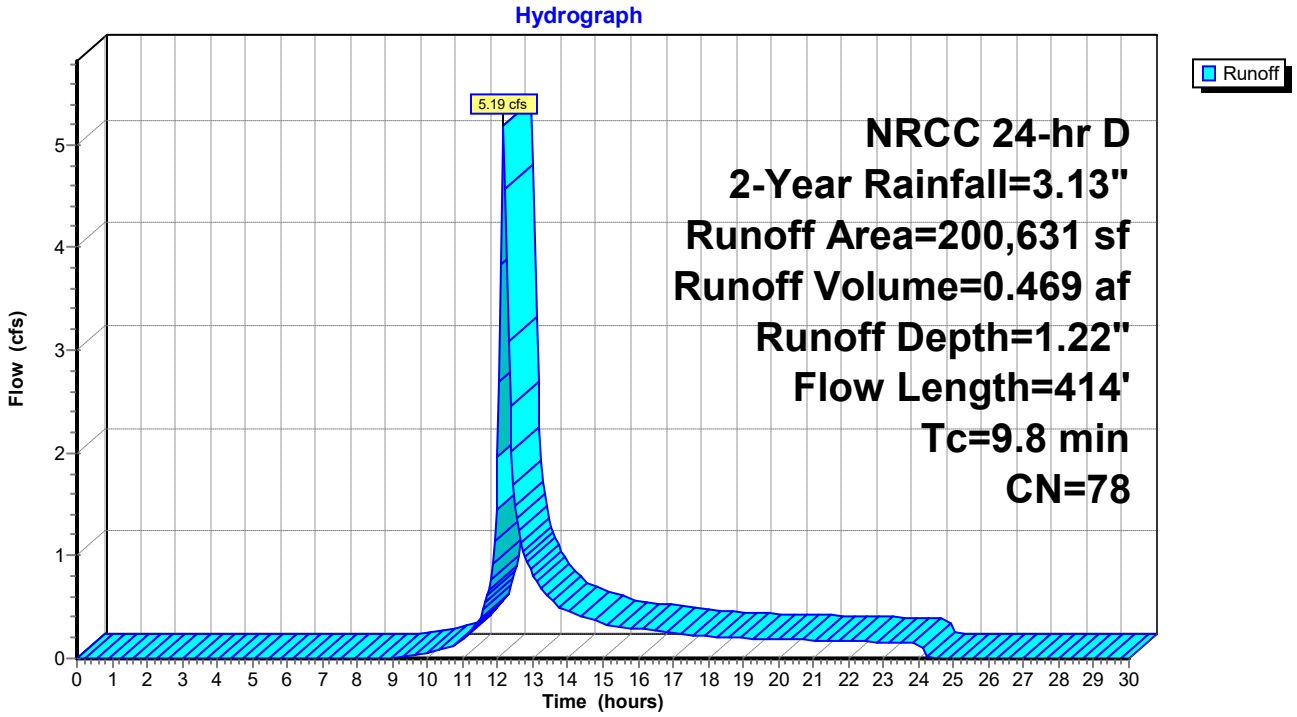
Runoff = 5.19 cfs @ 12.18 hrs, Volume= 0.469 af, Depth= 1.22"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
24,954	74	>75% Grass cover, Good, HSG C
120,262	70	Woods, Good, HSG C
53,648	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
200,631	78	Weighted Average
198,864		99.12% Pervious Area
1,767		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment P11B: OVERLAND TO DP#2



Summary for Subcatchment P13: TO ROOF DRAINAGE

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

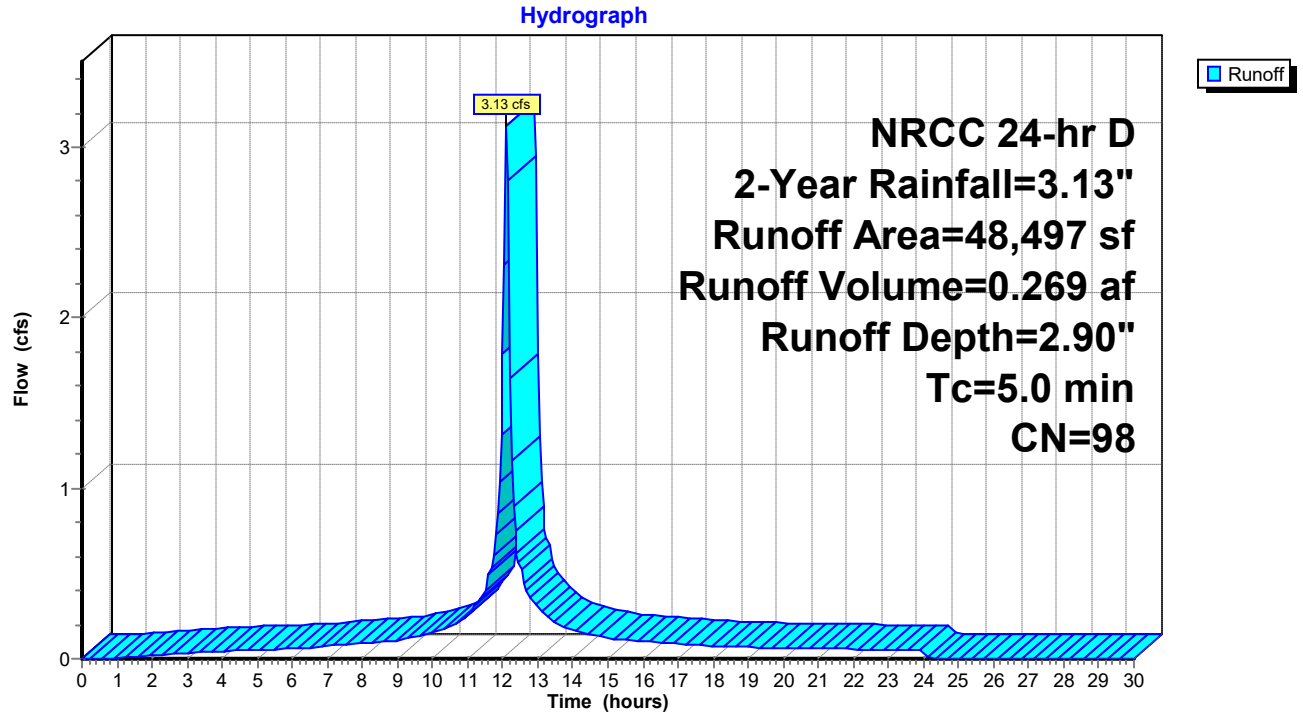
Runoff = 3.13 cfs @ 12.11 hrs, Volume= 0.269 af, Depth= 2.90"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment P13: TO ROOF DRAINAGE



Summary for Subcatchment P14: TO INLET

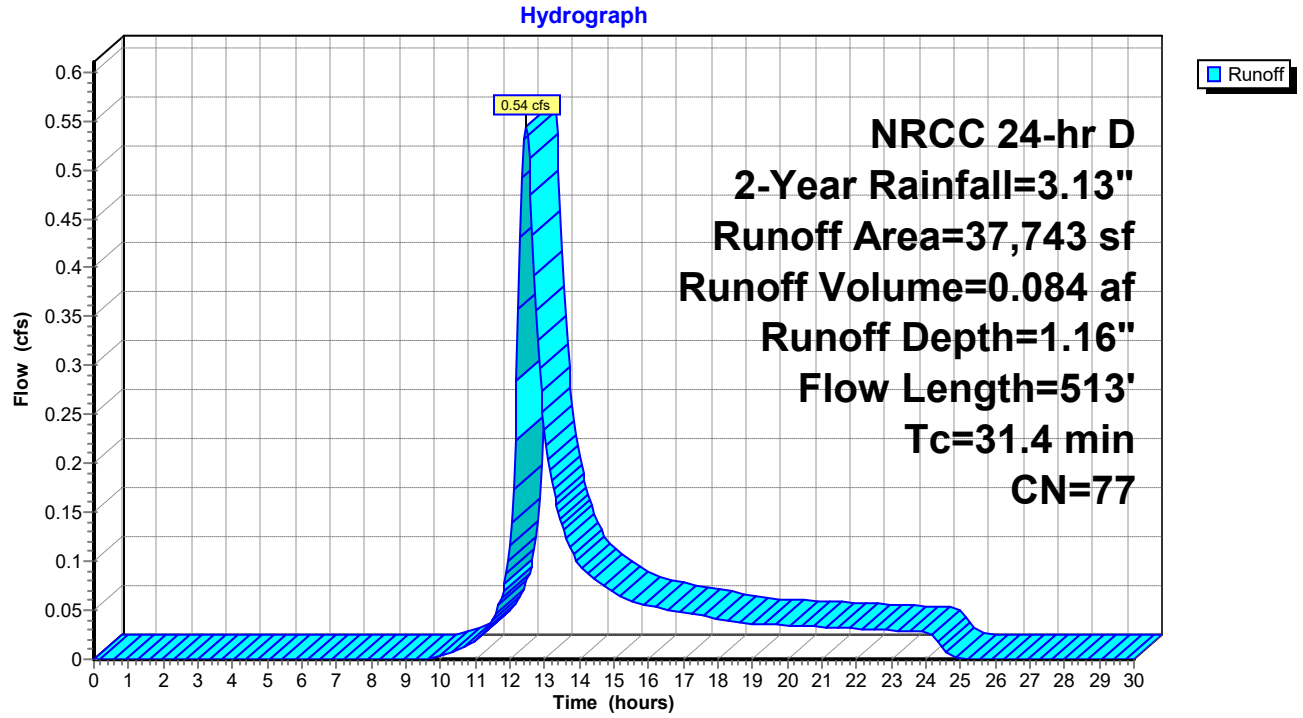
Runoff = 0.54 cfs @ 12.46 hrs, Volume= 0.084 af, Depth= 1.16"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.3	463	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.4	513	Total			

Subcatchment P14: TO INLET



Summary for Subcatchment P15: TO DCB-B

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

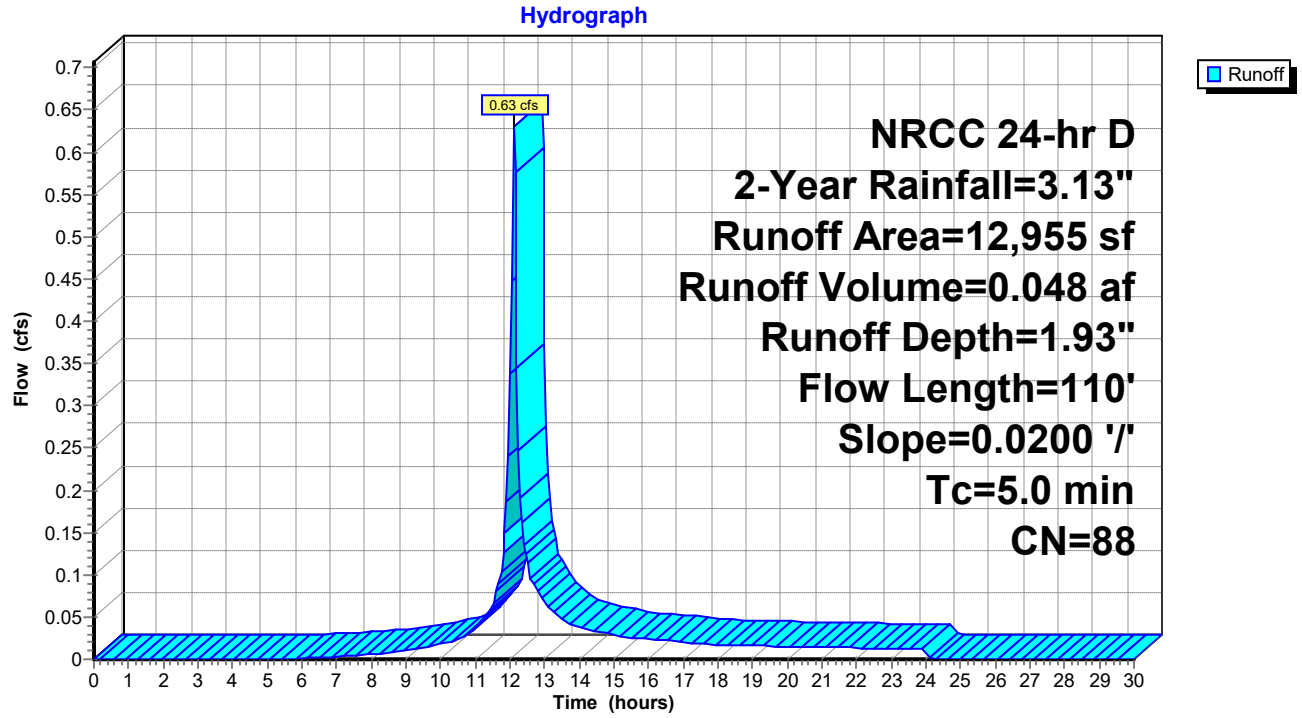
Runoff = 0.63 cfs @ 12.11 hrs, Volume= 0.048 af, Depth= 1.93"
Routed to Pond DCB-B : TO DCB-C

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
1,190	74	>75% Grass cover, Good, HSG C
3,195	70	Woods, Good, HSG C
6,862	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
12,955	88	Weighted Average
11,247		86.82% Pervious Area
1,708		13.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P15: TO DCB-B



Summary for Subcatchment P16: TO DCB-C

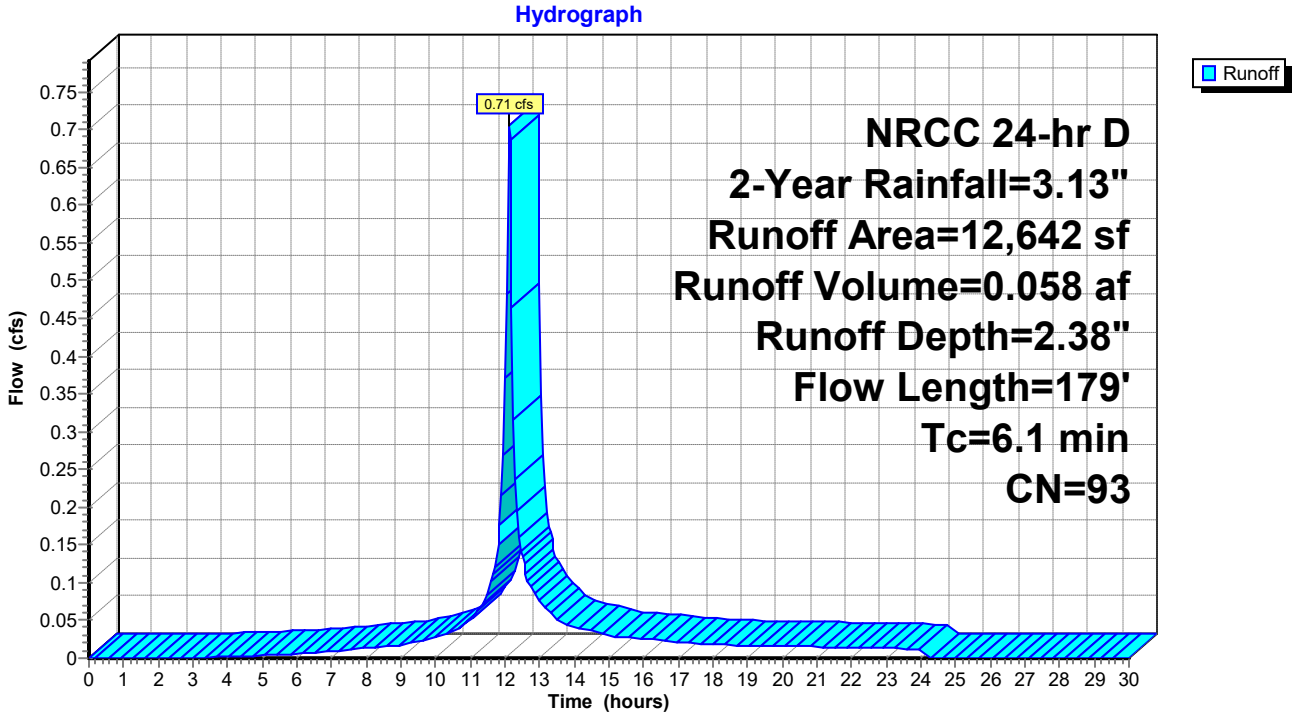
Runoff = 0.71 cfs @ 12.13 hrs, Volume= 0.058 af, Depth= 2.38"
Routed to Reach DCB-C* : TO DMH-10

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
715	74	>75% Grass cover, Good, HSG C
9,014	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
2,891	89	Gravel roads, HSG C
12,642	93	Weighted Average
12,620		99.83% Pervious Area
22		0.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment P16: TO DCB-C



Summary for Subcatchment P201: TO RAIN GARDEN #2

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

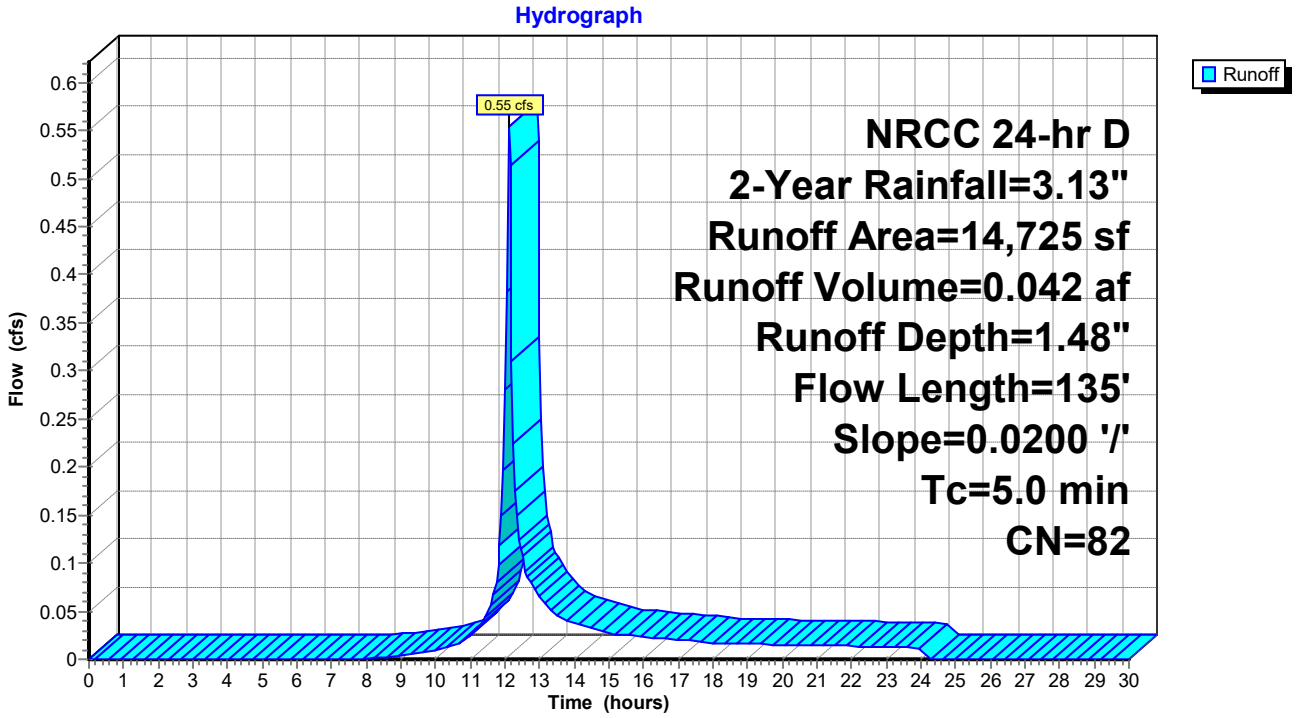
Runoff = 0.55 cfs @ 12.12 hrs, Volume= 0.042 af, Depth= 1.48"
Routed to Pond RG2 : TO DMH#11

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
7,946	74	>75% Grass cover, Good, HSG C
4,075	89	Gravel roads, HSG C
1,784	98	Paved parking, HSG C
920	96	Gravel surface, HSG C
14,725	82	Weighted Average
12,941		87.88% Pervious Area
1,784		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.6	85	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	135	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P201: TO RAIN GARDEN #2



Summary for Reach DCB-A: TO WETLAND

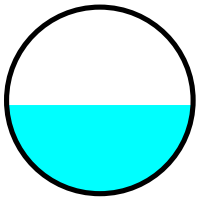
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach PIPE OUTLET depth by 0.82' @ 12.15 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 2.14" for 2-Year event
Inflow = 3.28 cfs @ 12.11 hrs, Volume= 0.353 af
Outflow = 3.11 cfs @ 12.14 hrs, Volume= 0.353 af, Atten= 5%, Lag= 1.8 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

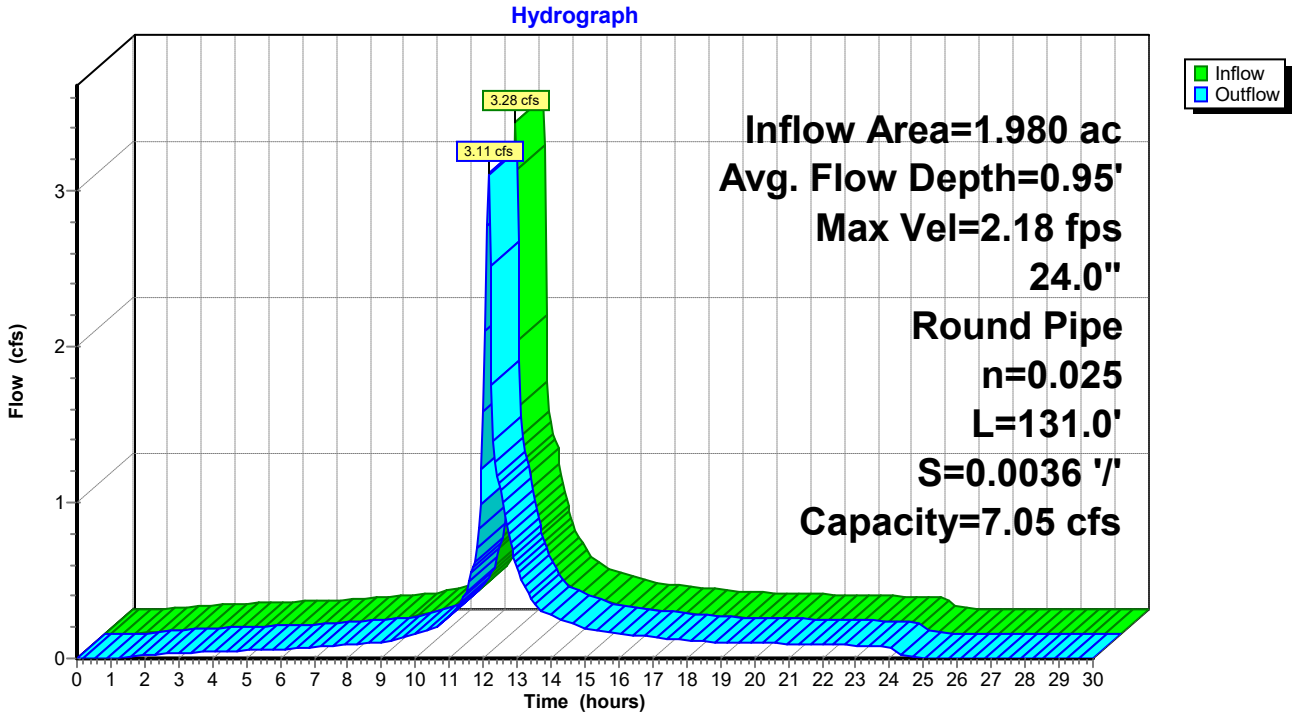
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.18 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 2.7 min

Peak Storage= 193 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.95' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



Summary for Reach DCB-C*: TO DMH-10

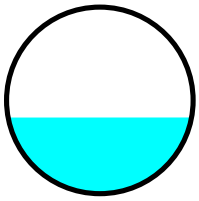
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.290 ac, 0.17% Impervious, Inflow Depth = 2.38" for 2-Year event
Inflow = 0.71 cfs @ 12.13 hrs, Volume= 0.058 af
Outflow = 0.71 cfs @ 12.13 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DMH10 : TO OUTLET

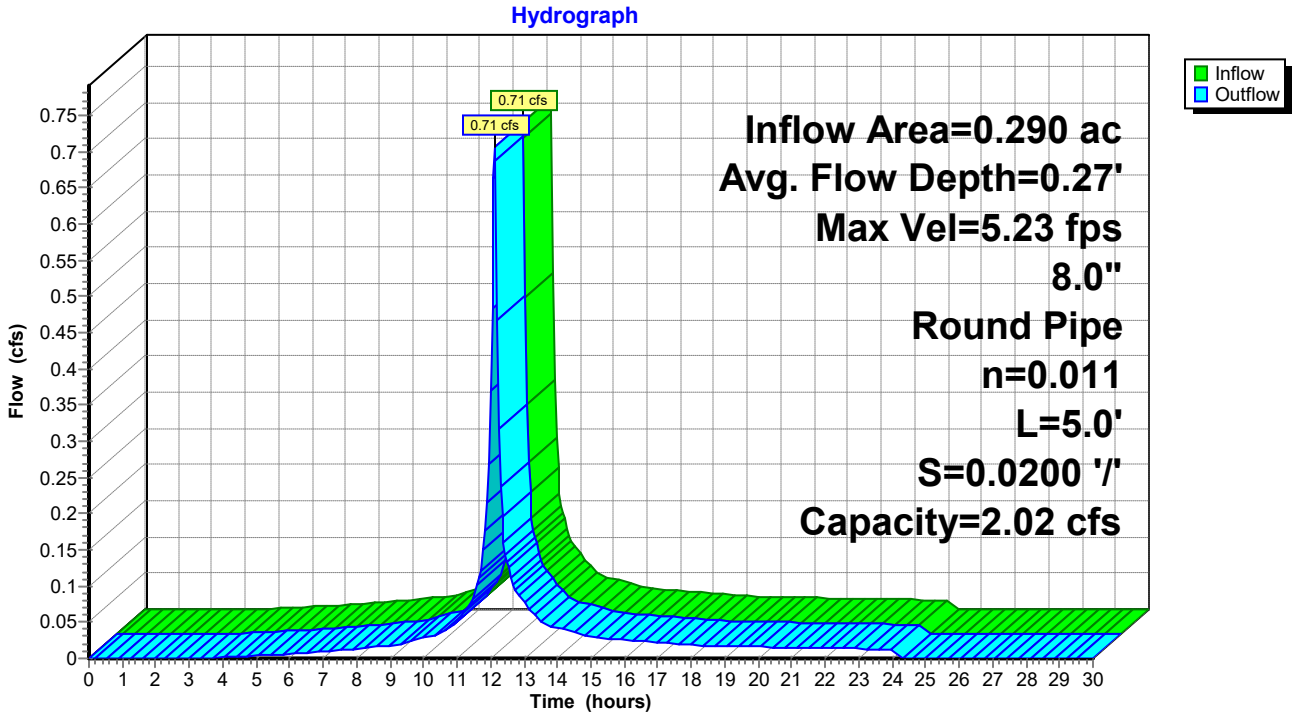
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.23 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.86 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 0.66'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 2.02 cfs

8.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 5.0' Slope= 0.0200 '/'
Inlet Invert= 107.80', Outlet Invert= 107.70'



Reach DCB-C*: TO DMH-10



Summary for Reach DMH10: TO OUTLET

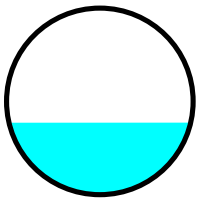
[52] Hint: Inlet/Outlet conditions not evaluated
[63] Warning: Exceeded Reach DCB-C* INLET depth by 0.01' @ 12.15 hrs
[62] Hint: Exceeded Reach DMH11 OUTLET depth by 0.16' @ 12.15 hrs

Inflow Area = 0.926 ac, 8.71% Impervious, Inflow Depth = 1.91" for 2-Year event
Inflow = 1.44 cfs @ 12.13 hrs, Volume= 0.147 af
Outflow = 1.41 cfs @ 12.14 hrs, Volume= 0.147 af, Atten= 2%, Lag= 0.9 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

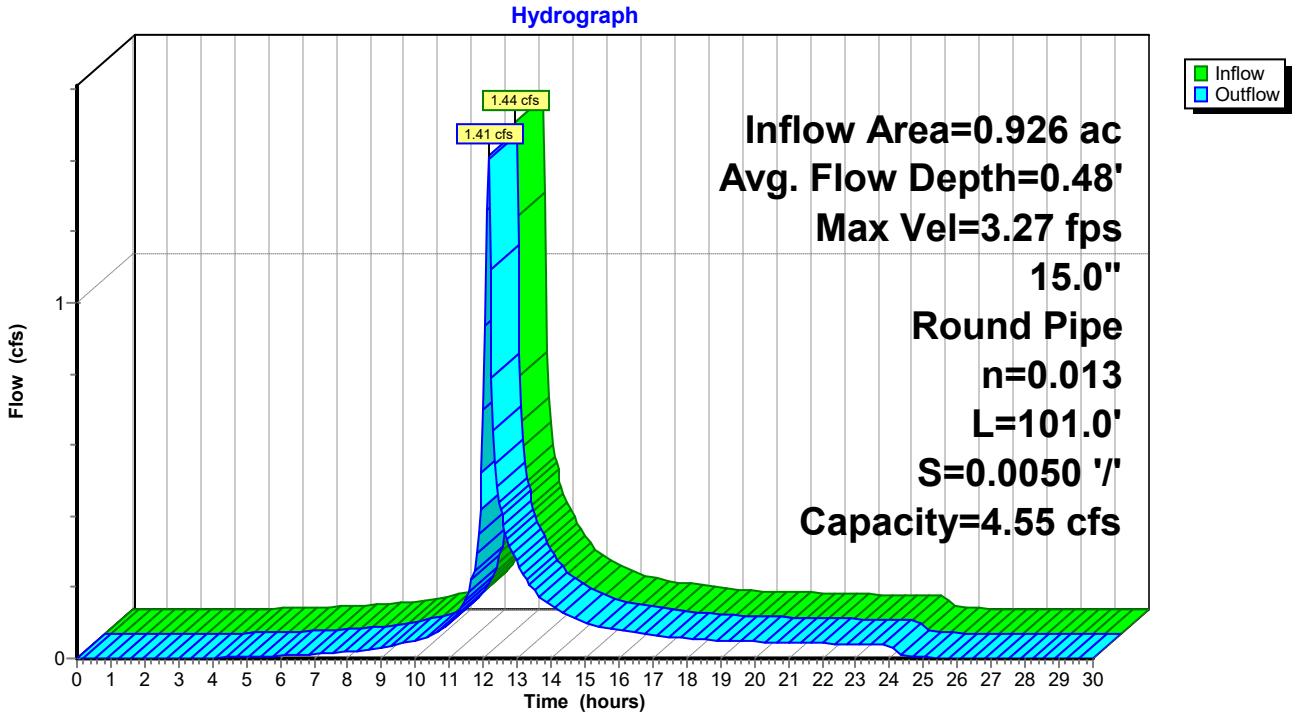
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.27 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 1.5 min

Peak Storage= 44 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= 4.55 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 101.0' Slope= 0.0050 '/'
Inlet Invert= 107.60', Outlet Invert= 107.10'



Reach DMH10: TO OUTLET



Summary for Reach DMH11: TO DMH#10

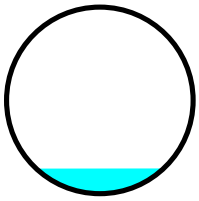
[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond RG2 Primary device # 4 OUTLET by 0.04'

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 1.48" for 2-Year event
Inflow = 0.17 cfs @ 12.32 hrs, Volume= 0.042 af
Outflow = 0.17 cfs @ 12.35 hrs, Volume= 0.042 af, Atten= 0%, Lag= 1.9 min
Routed to Reach DMH10 : TO OUTLET

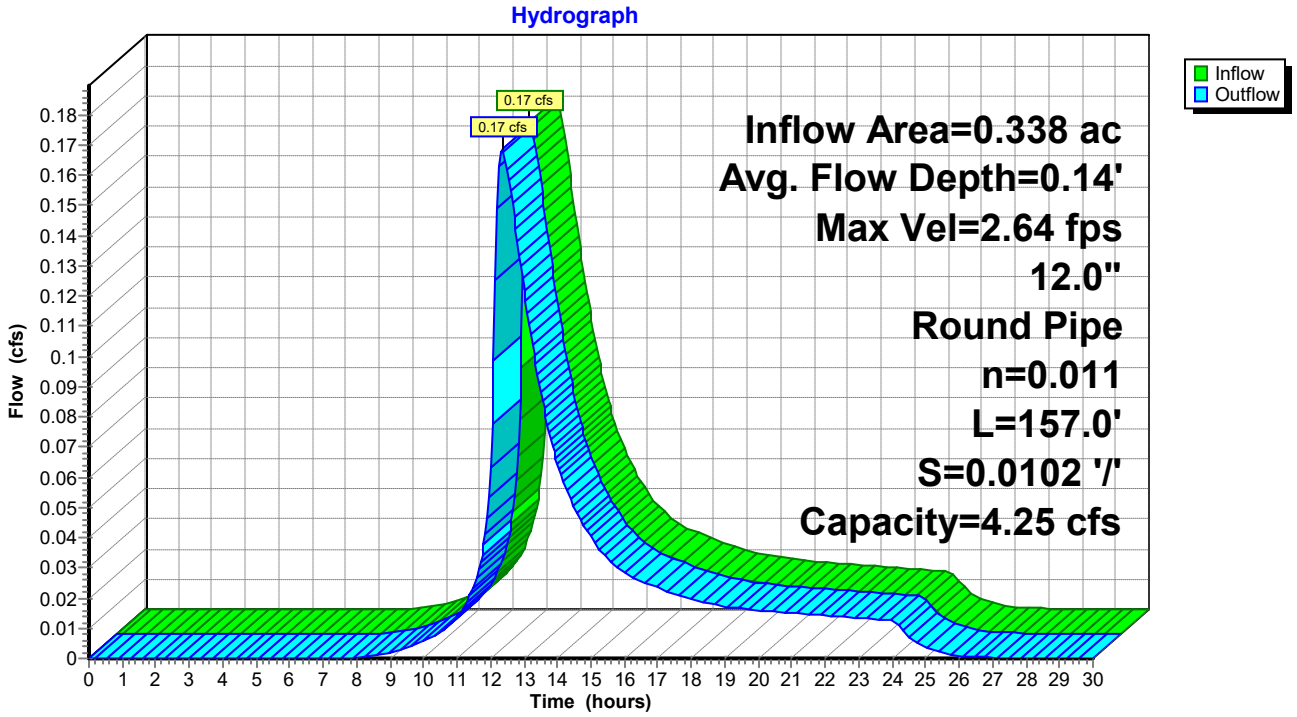
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.64 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.26 fps, Avg. Travel Time= 2.1 min

Peak Storage= 10 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.14' , Surface Width= 0.69'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.25 cfs

12.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 157.0' Slope= 0.0102 '/'
Inlet Invert= 109.40', Outlet Invert= 107.80'



Reach DMH11: TO DMH#10



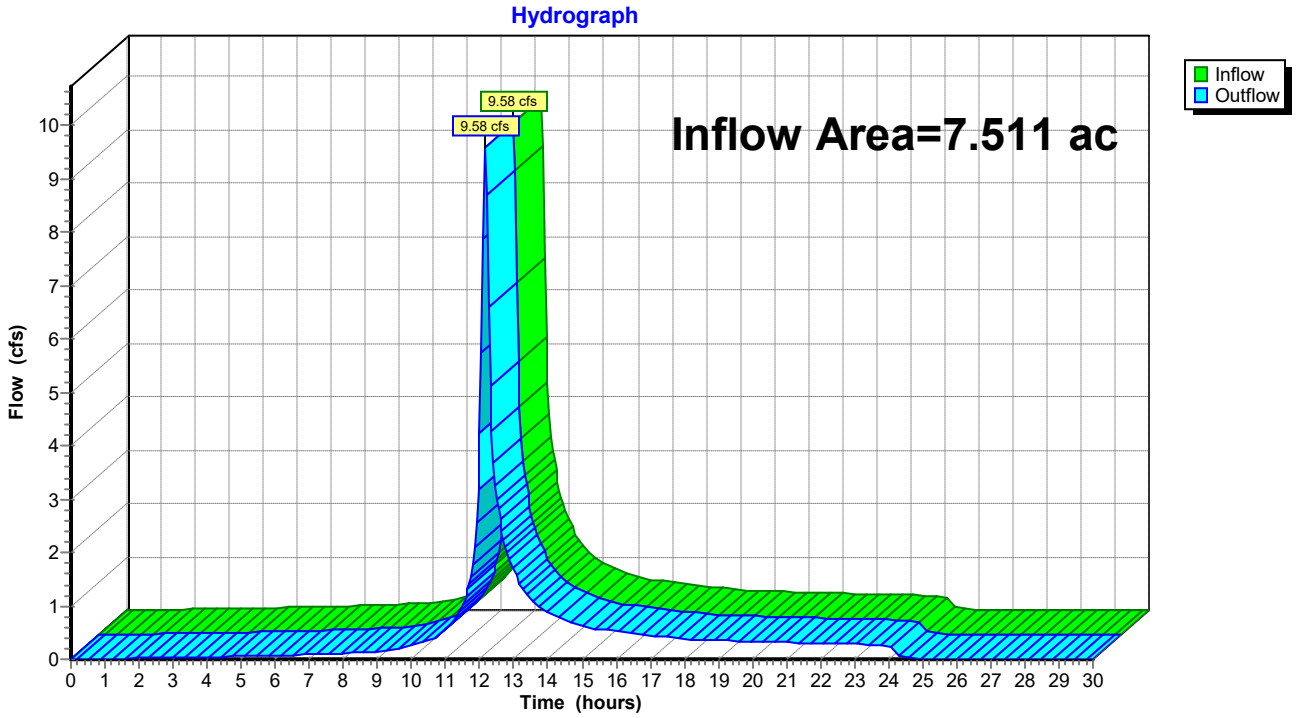
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.511 ac, 16.94% Impervious, Inflow Depth = 1.55" for 2-Year event
Inflow = 9.58 cfs @ 12.16 hrs, Volume= 0.969 af
Outflow = 9.58 cfs @ 12.16 hrs, Volume= 0.969 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

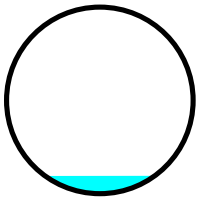
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 1.16" for 2-Year event
Inflow = 0.54 cfs @ 12.46 hrs, Volume= 0.084 af
Outflow = 0.54 cfs @ 12.49 hrs, Volume= 0.084 af, Atten= 1%, Lag= 2.1 min
Routed to Reach DCB-A : TO WETLAND

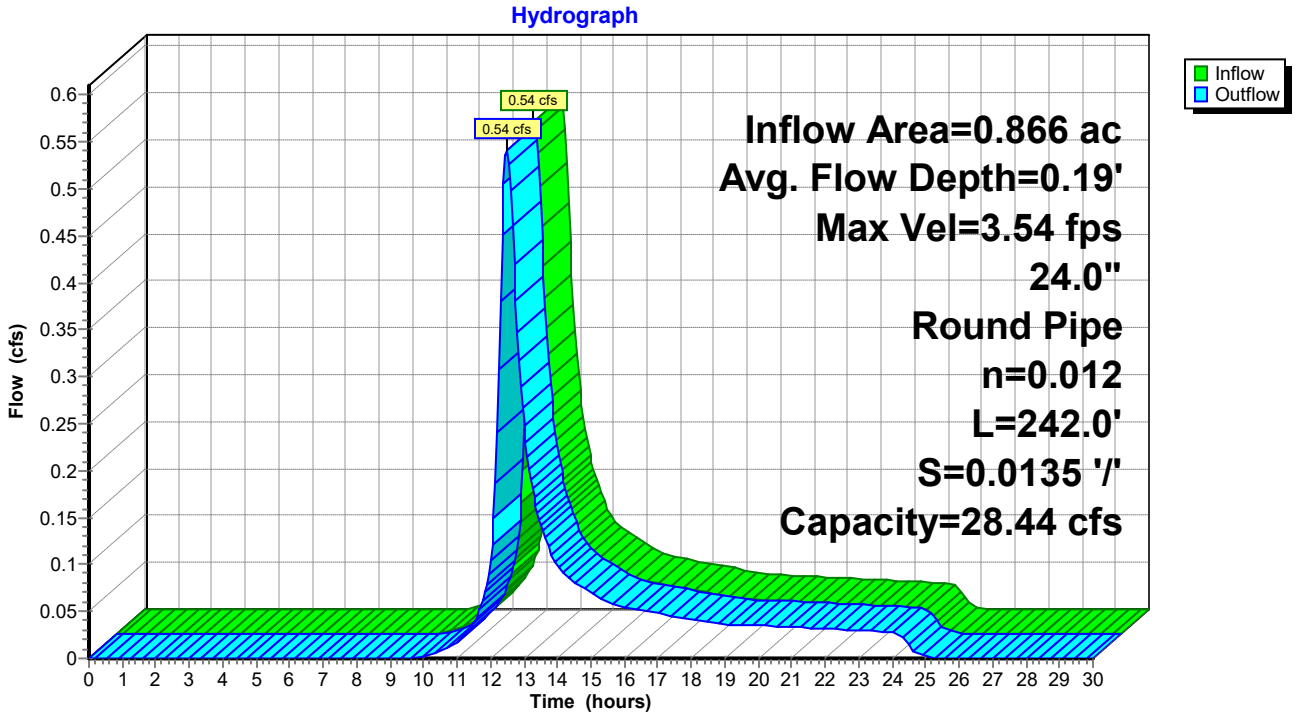
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.54 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.65 fps, Avg. Travel Time= 2.4 min

Peak Storage= 37 cf @ 12.47 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 1.18'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A

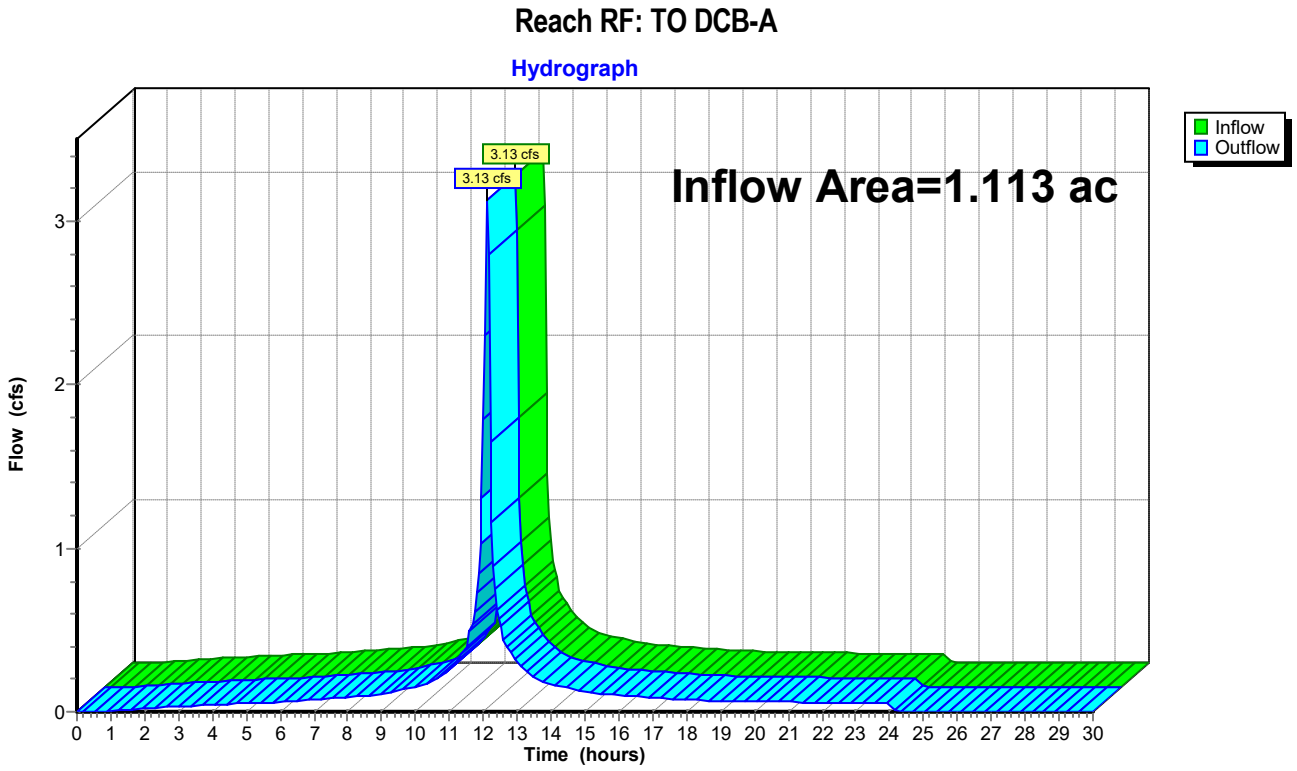


Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 2.90" for 2-Year event
Inflow = 3.13 cfs @ 12.11 hrs, Volume= 0.269 af
Outflow = 3.13 cfs @ 12.11 hrs, Volume= 0.269 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 110.97' (Flood elevation advised)

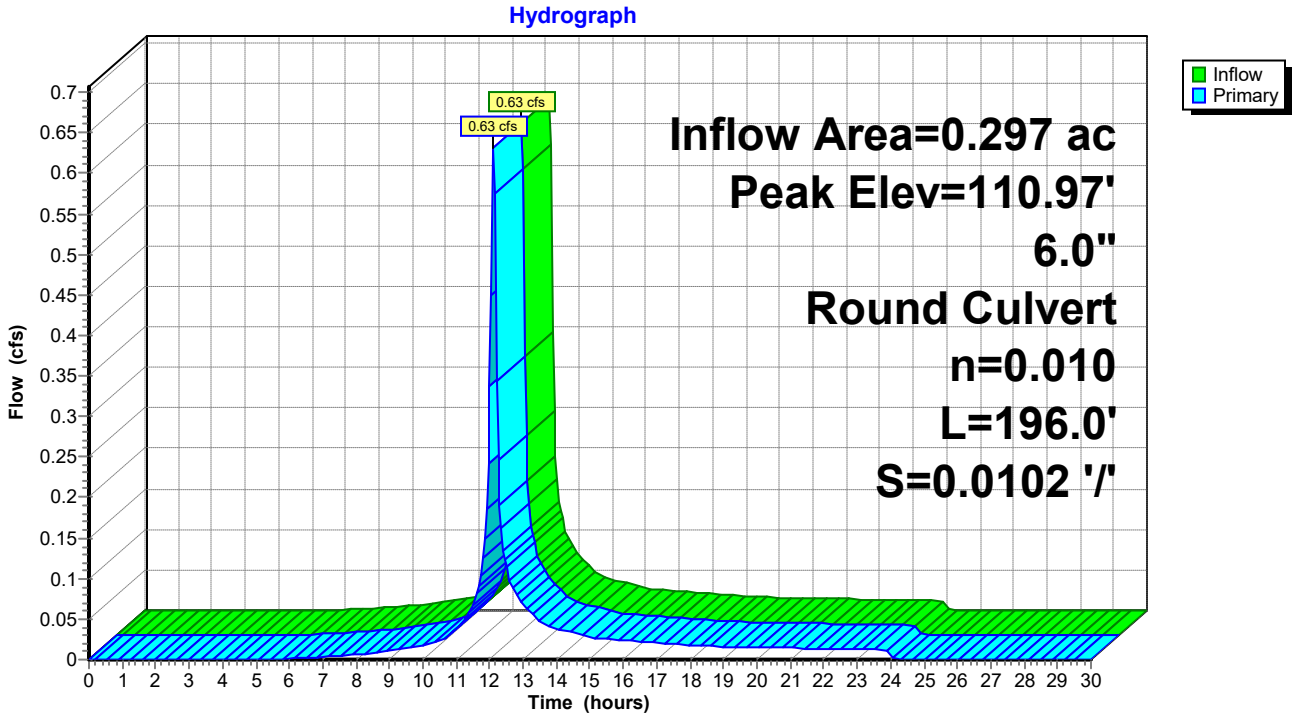
Inflow Area = 0.297 ac, 13.18% Impervious, Inflow Depth = 1.93" for 2-Year event
Inflow = 0.63 cfs @ 12.11 hrs, Volume= 0.048 af
Outflow = 0.63 cfs @ 12.11 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min
Primary = 0.63 cfs @ 12.11 hrs, Volume= 0.048 af
Routed to Reach DMH10 : TO OUTLET

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 110.97' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=0.61 cfs @ 12.11 hrs HW=110.95' (Free Discharge)
1=Culvert (Inlet Controls 0.61 cfs @ 3.10 fps)

Pond DCB-B: TO DCB-C



Summary for Pond RG2: TO DMH#11

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

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 1.48" for 2-Year event
Inflow = 0.55 cfs @ 12.12 hrs, Volume= 0.042 af
Outflow = 0.17 cfs @ 12.32 hrs, Volume= 0.042 af, Atten= 69%, Lag= 12.0 min
Primary = 0.17 cfs @ 12.32 hrs, Volume= 0.042 af
Routed to Reach DMH11 : TO DMH#10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DMH11 : TO DMH#10

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 112.13' @ 12.32 hrs Surf.Area= 3,486 sf Storage= 438 cf

Plug-Flow detention time= 43.2 min calculated for 0.042 af (100% of inflow)
Center-of-Mass det. time= 43.1 min (905.8 - 862.7)

Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	12,045 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

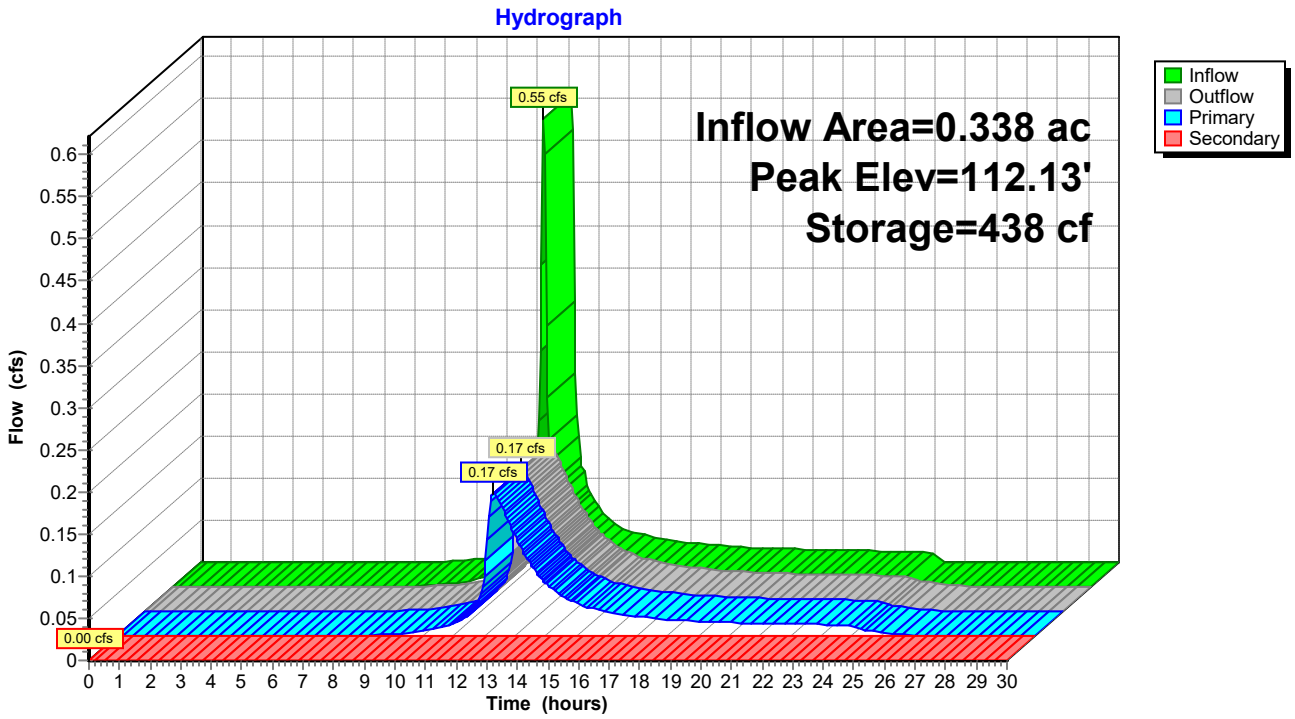
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	3,332	0	0
113.00	4,534	3,933	3,933
114.00	5,693	5,114	9,047
114.50	6,300	2,998	12,045

Device	Routing	Invert	Outlet Devices
#1	Device 4	112.35'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#2	Device 4	109.90'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Secondary	113.50'	**10.0' long + 2.0 '/' SideZ 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
#4	Primary	109.80'	**12.0" Round Culvert** L= 33.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 109.80' / 109.50' S= 0.0091 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.17 cfs @ 12.32 hrs HW=112.13' (Free Discharge)
└**4=Culvert** (Passes 0.17 cfs of 5.77 cfs potential flow)
├**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└**2=Special & User-Defined** (Custom Controls 0.17 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=112.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond RG2: TO DMH#11



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 P11B: OVERLAND TO DP#2 Runoff Area=200,631 sf 0.88% Impervious Runoff Depth=2.44"
Flow Length=414' Tc=9.8 min CN=78 Runoff=10.56 cfs 0.937 af

Subcatchment P13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=4.44"
Tc=5.0 min CN=98 Runoff=4.71 cfs 0.412 af

Subcatchment P14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=2.36"
Flow Length=513' Tc=31.4 min CN=77 Runoff=1.14 cfs 0.170 af

Subcatchment P15: TO DCB-B Runoff Area=12,955 sf 13.18% Impervious Runoff Depth=3.37"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=88 Runoff=1.07 cfs 0.083 af

Subcatchment P16: TO DCB-C Runoff Area=12,642 sf 0.17% Impervious Runoff Depth=3.88"
Flow Length=179' Tc=6.1 min CN=93 Runoff=1.12 cfs 0.094 af

Subcatchment P201: TO RAIN GARDEN #2 Runoff Area=14,725 sf 12.12% Impervious Runoff Depth=2.79"
Flow Length=135' Slope=0.0200 '/' Tc=5.0 min CN=82 Runoff=1.04 cfs 0.079 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=1.25' Max Vel=2.42 fps Inflow=5.10 cfs 0.583 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=4.87 cfs 0.583 af

Reach DCB-C*: TO DMH-10 Avg. Flow Depth=0.35' Max Vel=5.89 fps Inflow=1.12 cfs 0.094 af
8.0" Round Pipe n=0.011 L=5.0' S=0.0200 '/' Capacity=2.02 cfs Outflow=1.12 cfs 0.094 af

Reach DMH10: TO OUTLET Avg. Flow Depth=0.64' Max Vel=3.71 fps Inflow=2.34 cfs 0.256 af
15.0" Round Pipe n=0.013 L=101.0' S=0.0050 '/' Capacity=4.55 cfs Outflow=2.31 cfs 0.256 af

Reach DMH11: TO DMH#10 Avg. Flow Depth=0.14' Max Vel=2.65 fps Inflow=0.17 cfs 0.079 af
12.0" Round Pipe n=0.011 L=157.0' S=0.0102 '/' Capacity=4.25 cfs Outflow=0.17 cfs 0.079 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=17.48 cfs 1.776 af
Outflow=17.48 cfs 1.776 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.27' Max Vel=4.42 fps Inflow=1.14 cfs 0.170 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=1.13 cfs 0.170 af

Reach RF: TO DCB-A Inflow=4.71 cfs 0.412 af
Outflow=4.71 cfs 0.412 af

Pond DCB-B: TO DCB-C Peak Elev=113.70' Inflow=1.07 cfs 0.083 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=1.07 cfs 0.083 af

Pond RG2: TO DMH#11 Peak Elev=112.29' Storage=999 cf Inflow=1.04 cfs 0.079 af
Primary=0.17 cfs 0.079 af Secondary=0.00 cfs 0.000 af Outflow=0.17 cfs 0.079 af

Total Runoff Area = 7.511 ac Runoff Volume = 1.776 af Average Runoff Depth = 2.84"
83.06% Pervious = 6.239 ac 16.94% Impervious = 1.273 ac

Summary for Subcatchment P11B: OVERLAND TO DP#2

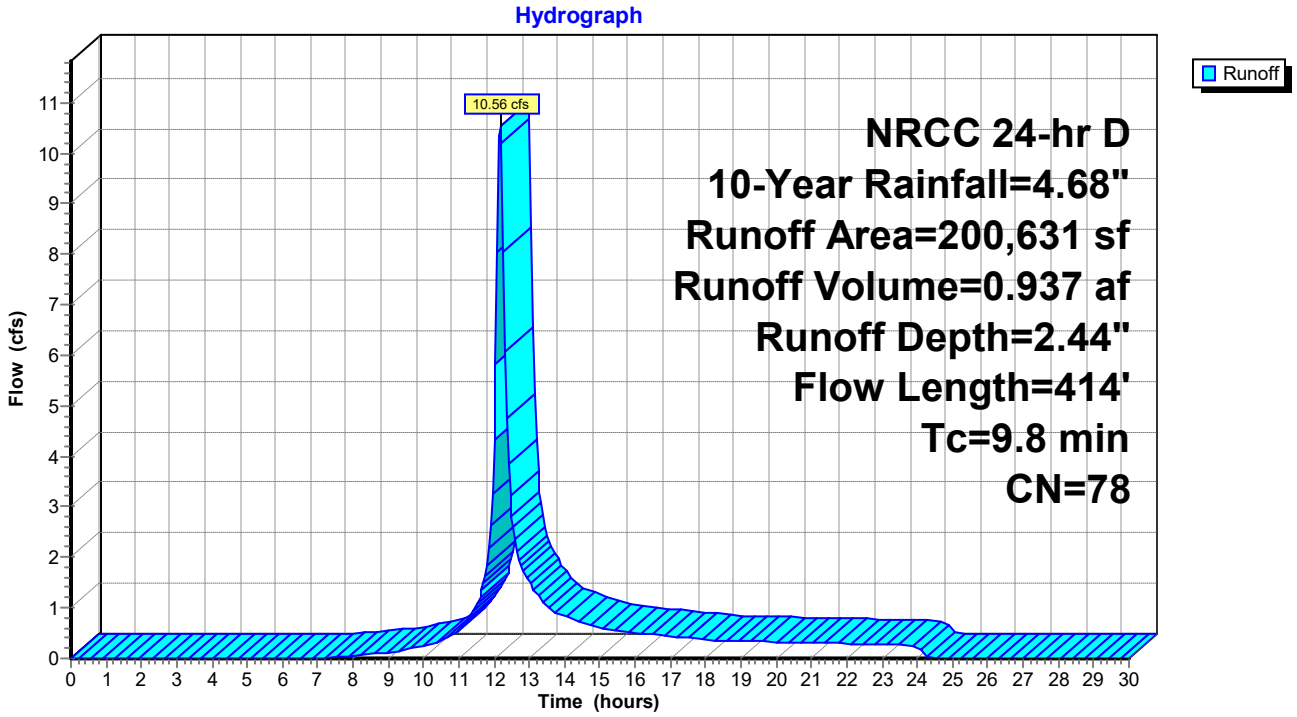
Runoff = 10.56 cfs @ 12.17 hrs, Volume= 0.937 af, Depth= 2.44"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
24,954	74	>75% Grass cover, Good, HSG C
120,262	70	Woods, Good, HSG C
53,648	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
200,631	78	Weighted Average
198,864		99.12% Pervious Area
1,767		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment P11B: OVERLAND TO DP#2



Summary for Subcatchment P13: TO ROOF DRAINAGE

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

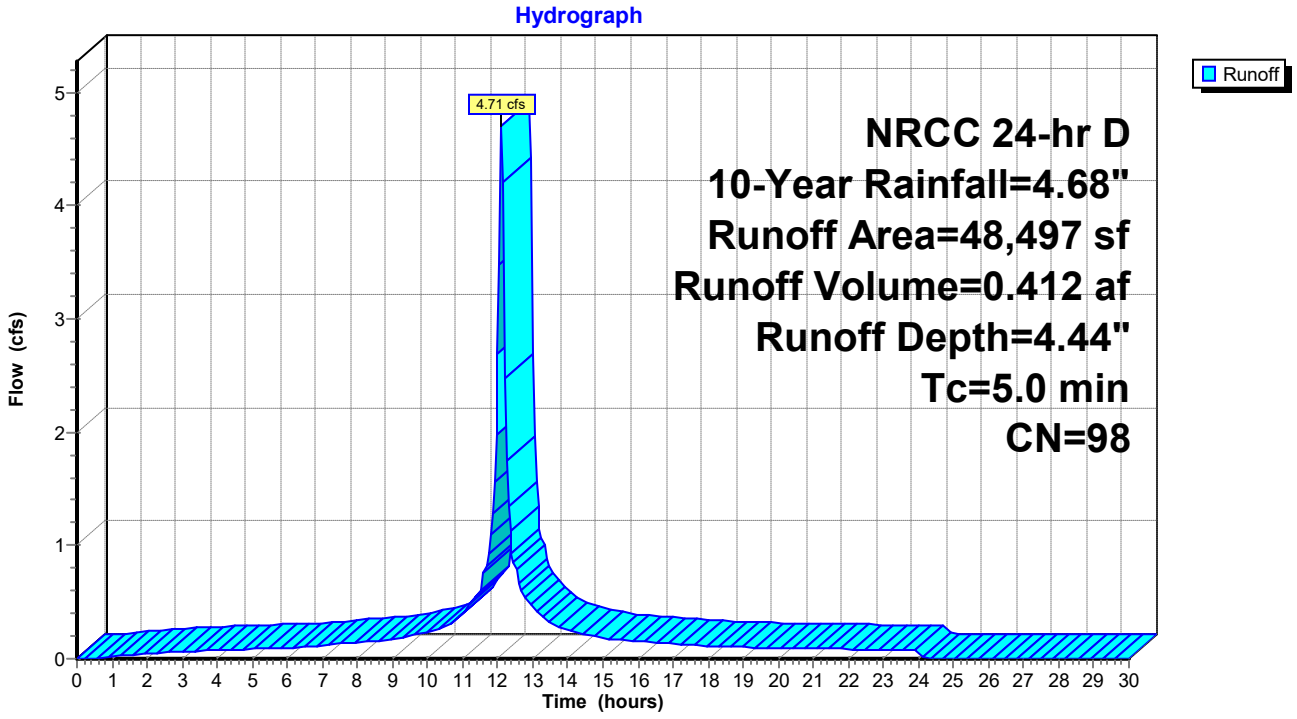
Runoff = 4.71 cfs @ 12.11 hrs, Volume= 0.412 af, Depth= 4.44"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment P13: TO ROOF DRAINAGE



Summary for Subcatchment P14: TO INLET

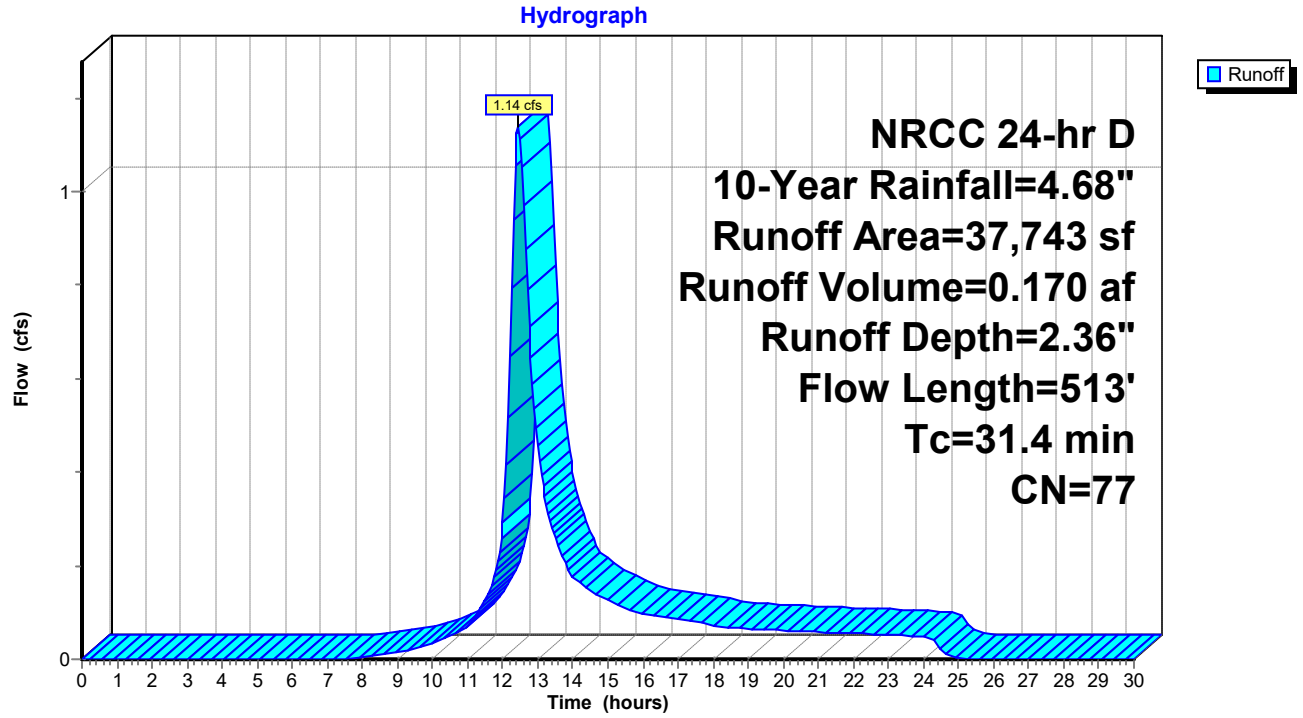
Runoff = 1.14 cfs @ 12.44 hrs, Volume= 0.170 af, Depth= 2.36"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.3	463	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.4	513	Total			

Subcatchment P14: TO INLET



Summary for Subcatchment P15: TO DCB-B

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

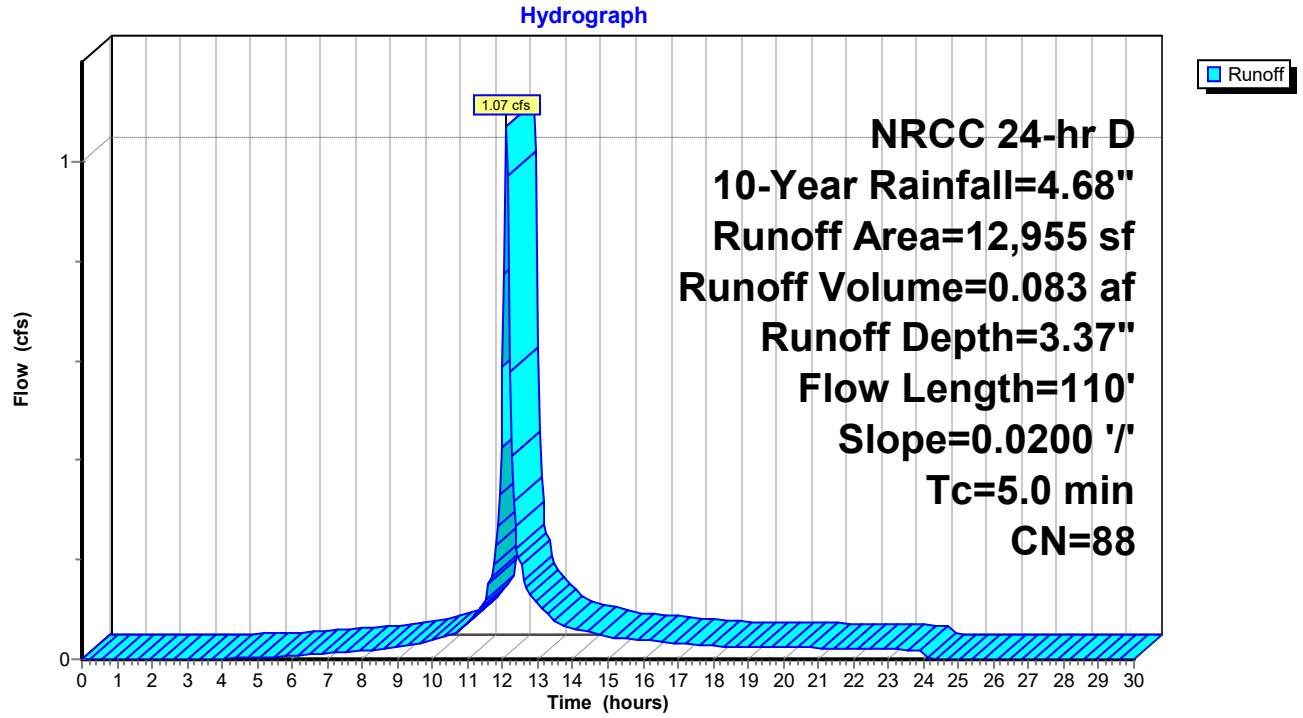
Runoff = 1.07 cfs @ 12.11 hrs, Volume= 0.083 af, Depth= 3.37"
Routed to Pond DCB-B : TO DCB-C

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
1,190	74	>75% Grass cover, Good, HSG C
3,195	70	Woods, Good, HSG C
6,862	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
12,955	88	Weighted Average
11,247		86.82% Pervious Area
1,708		13.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P15: TO DCB-B



Summary for Subcatchment P16: TO DCB-C

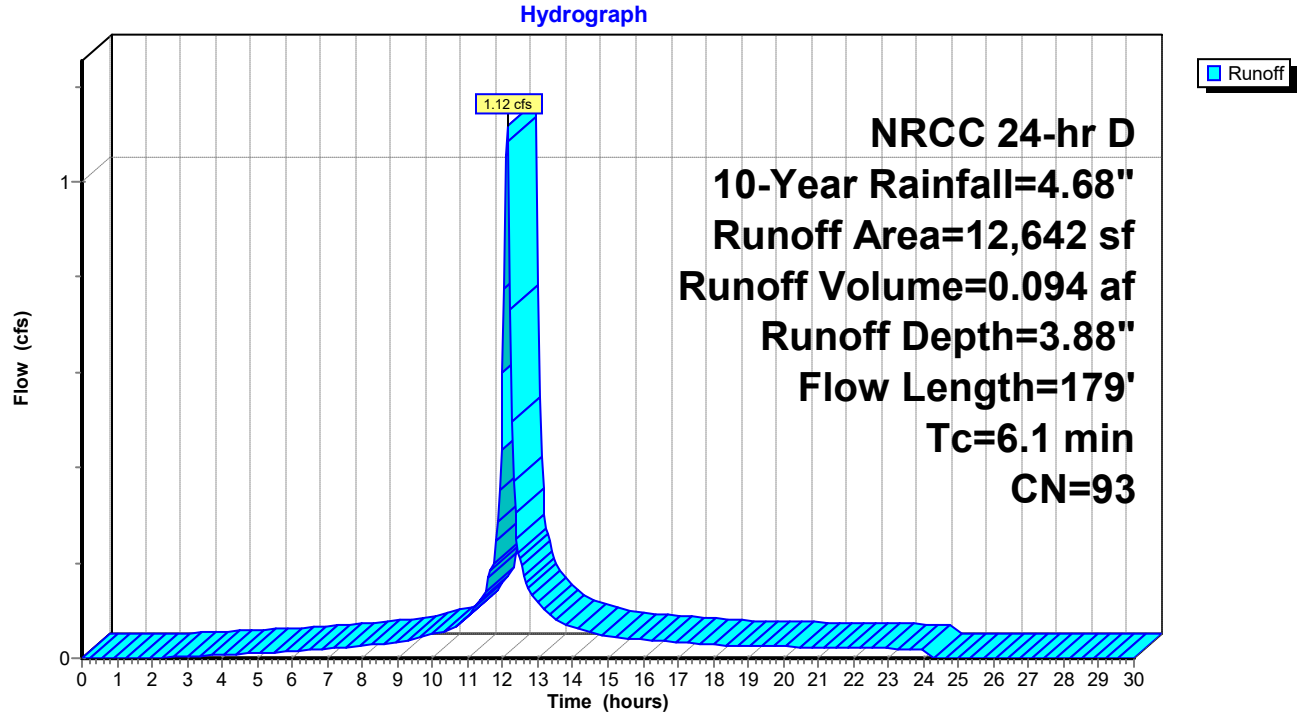
Runoff = 1.12 cfs @ 12.13 hrs, Volume= 0.094 af, Depth= 3.88"
Routed to Reach DCB-C* : TO DMH-10

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
715	74	>75% Grass cover, Good, HSG C
9,014	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
2,891	89	Gravel roads, HSG C
12,642	93	Weighted Average
12,620		99.83% Pervious Area
22		0.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment P16: TO DCB-C



Summary for Subcatchment P201: TO RAIN GARDEN #2

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

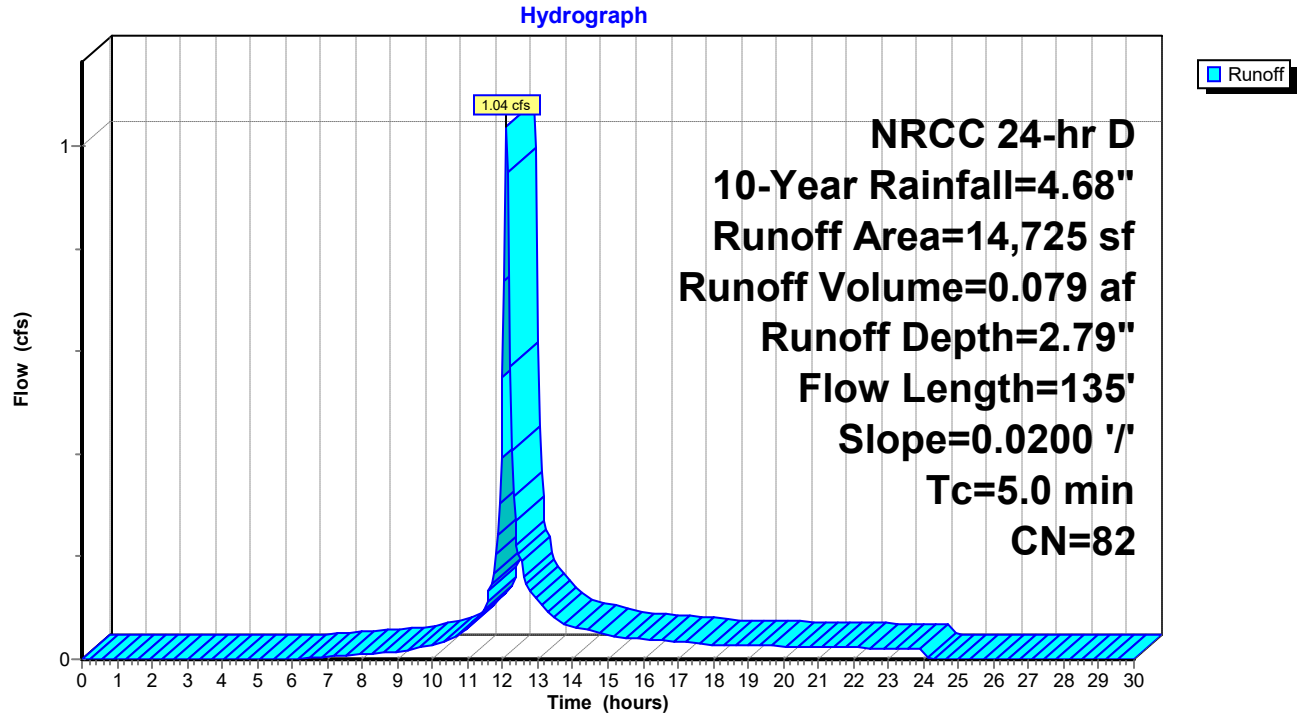
Runoff = 1.04 cfs @ 12.11 hrs, Volume= 0.079 af, Depth= 2.79"
Routed to Pond RG2 : TO DMH#11

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
7,946	74	>75% Grass cover, Good, HSG C
4,075	89	Gravel roads, HSG C
1,784	98	Paved parking, HSG C
920	96	Gravel surface, HSG C
14,725	82	Weighted Average
12,941		87.88% Pervious Area
1,784		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.6	85	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	135	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P201: TO RAIN GARDEN #2



Summary for Reach DCB-A: TO WETLAND

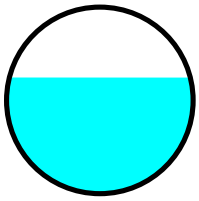
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach PIPE OUTLET depth by 1.05' @ 12.15 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 3.53" for 10-Year event
Inflow = 5.10 cfs @ 12.11 hrs, Volume= 0.583 af
Outflow = 4.87 cfs @ 12.14 hrs, Volume= 0.583 af, Atten= 5%, Lag= 1.7 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

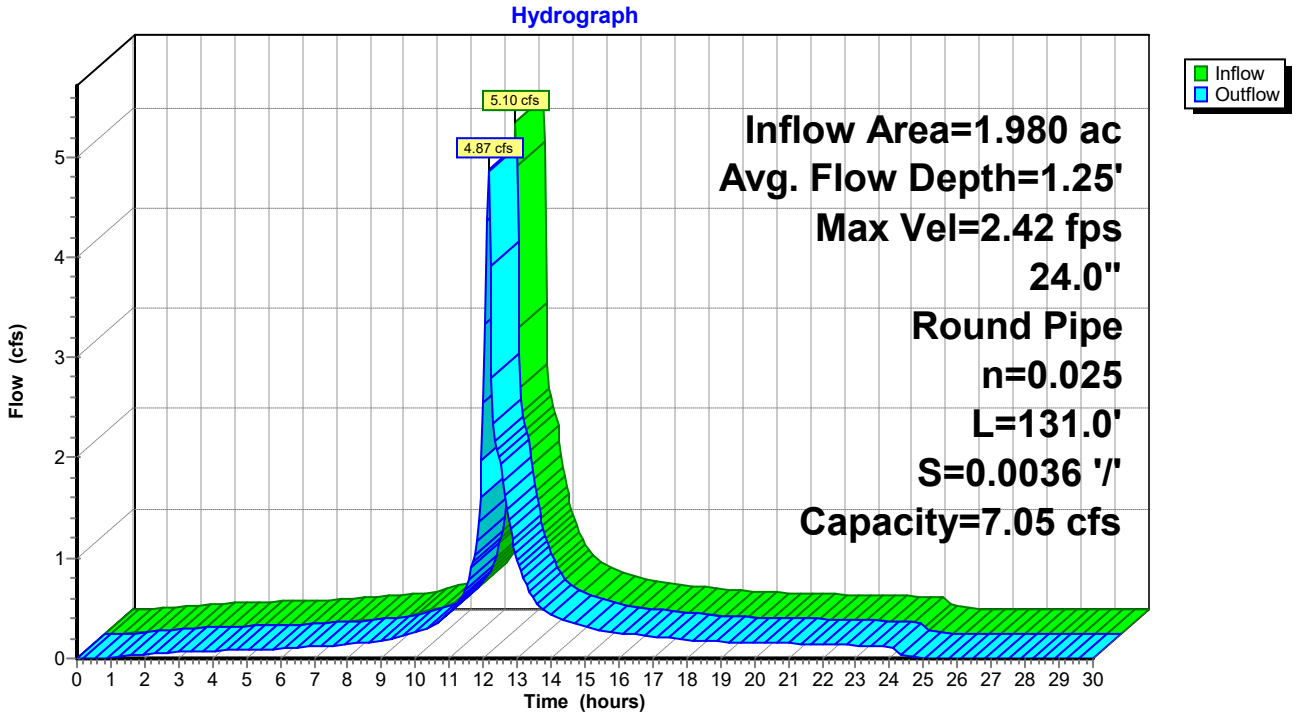
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.42 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 2.4 min

Peak Storage= 270 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.25' , Surface Width= 1.94'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



Summary for Reach DCB-C*: TO DMH-10

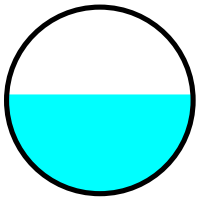
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.290 ac, 0.17% Impervious, Inflow Depth = 3.88" for 10-Year event
Inflow = 1.12 cfs @ 12.13 hrs, Volume= 0.094 af
Outflow = 1.12 cfs @ 12.13 hrs, Volume= 0.094 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DMH10 : TO OUTLET

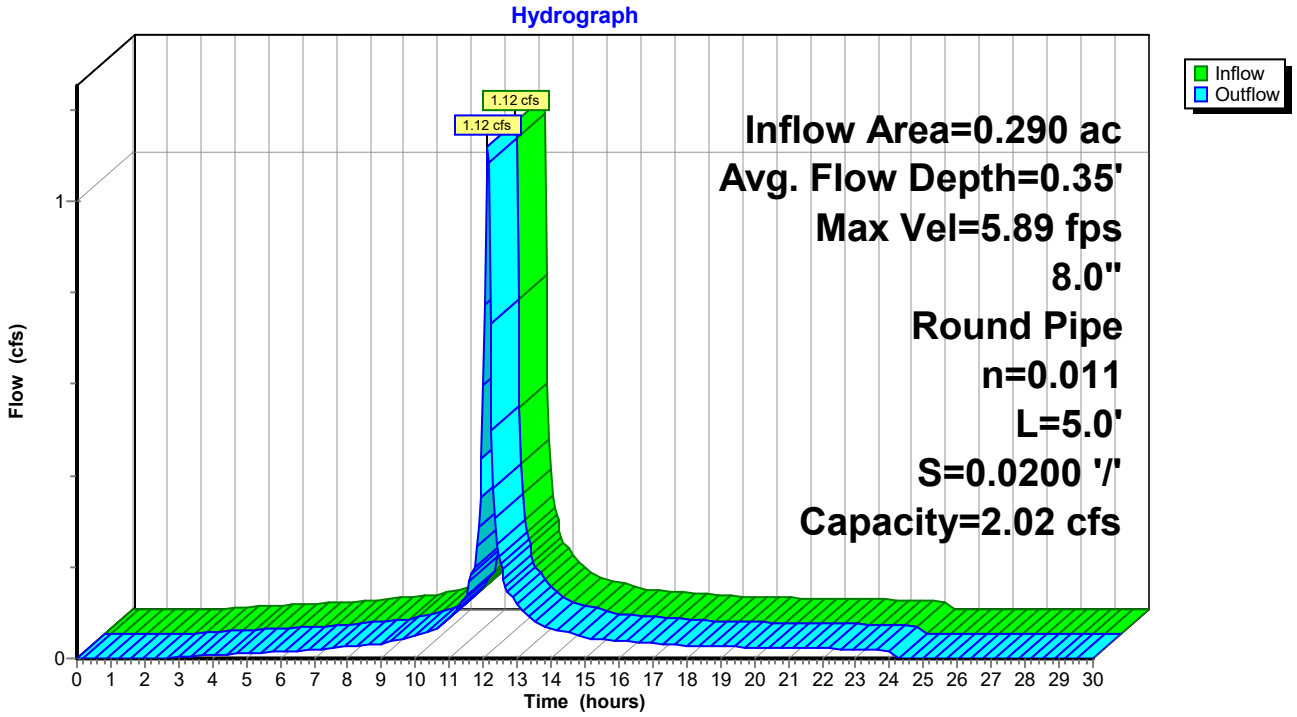
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.89 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.14 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 0.67'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 2.02 cfs

8.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 5.0' Slope= 0.0200 '/'
Inlet Invert= 107.80', Outlet Invert= 107.70'



Reach DCB-C*: TO DMH-10



Summary for Reach DMH10: TO OUTLET

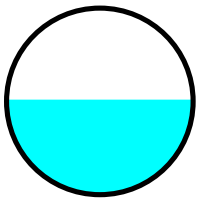
[52] Hint: Inlet/Outlet conditions not evaluated
[63] Warning: Exceeded Reach DCB-C* INLET depth by 0.08' @ 12.15 hrs
[62] Hint: Exceeded Reach DMH11 OUTLET depth by 0.29' @ 12.15 hrs

Inflow Area = 0.926 ac, 8.71% Impervious, Inflow Depth = 3.32" for 10-Year event
Inflow = 2.34 cfs @ 12.12 hrs, Volume= 0.256 af
Outflow = 2.31 cfs @ 12.14 hrs, Volume= 0.256 af, Atten= 1%, Lag= 0.9 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

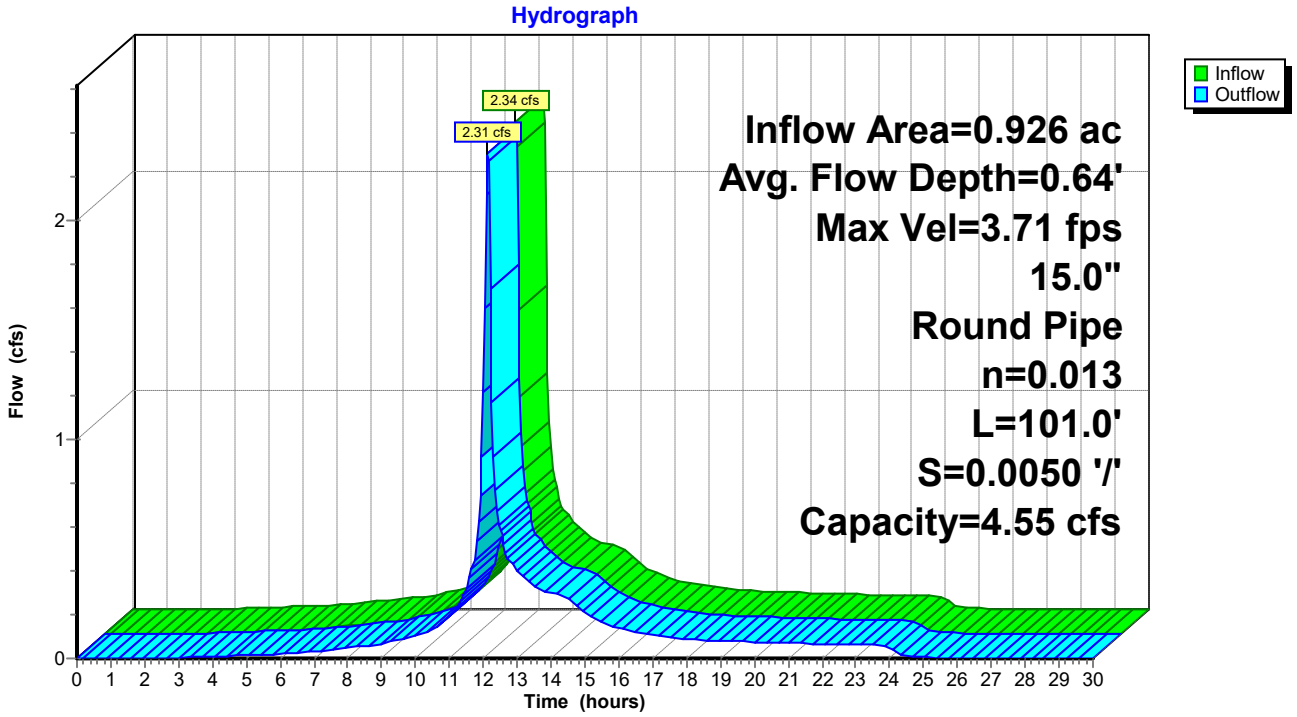
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.71 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.26 fps, Avg. Travel Time= 1.3 min

Peak Storage= 64 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.64' , Surface Width= 1.25'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.55 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 101.0' Slope= 0.0050 '/'
Inlet Invert= 107.60', Outlet Invert= 107.10'



Reach DMH10: TO OUTLET



Summary for Reach DMH11: TO DMH#10

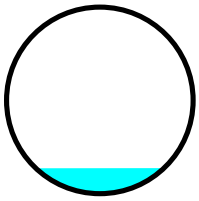
[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond RG2 Primary device # 4 OUTLET by 0.04'

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 2.79" for 10-Year event
Inflow = 0.17 cfs @ 12.05 hrs, Volume= 0.079 af
Outflow = 0.17 cfs @ 12.15 hrs, Volume= 0.079 af, Atten= 0%, Lag= 6.0 min
Routed to Reach DMH10 : TO OUTLET

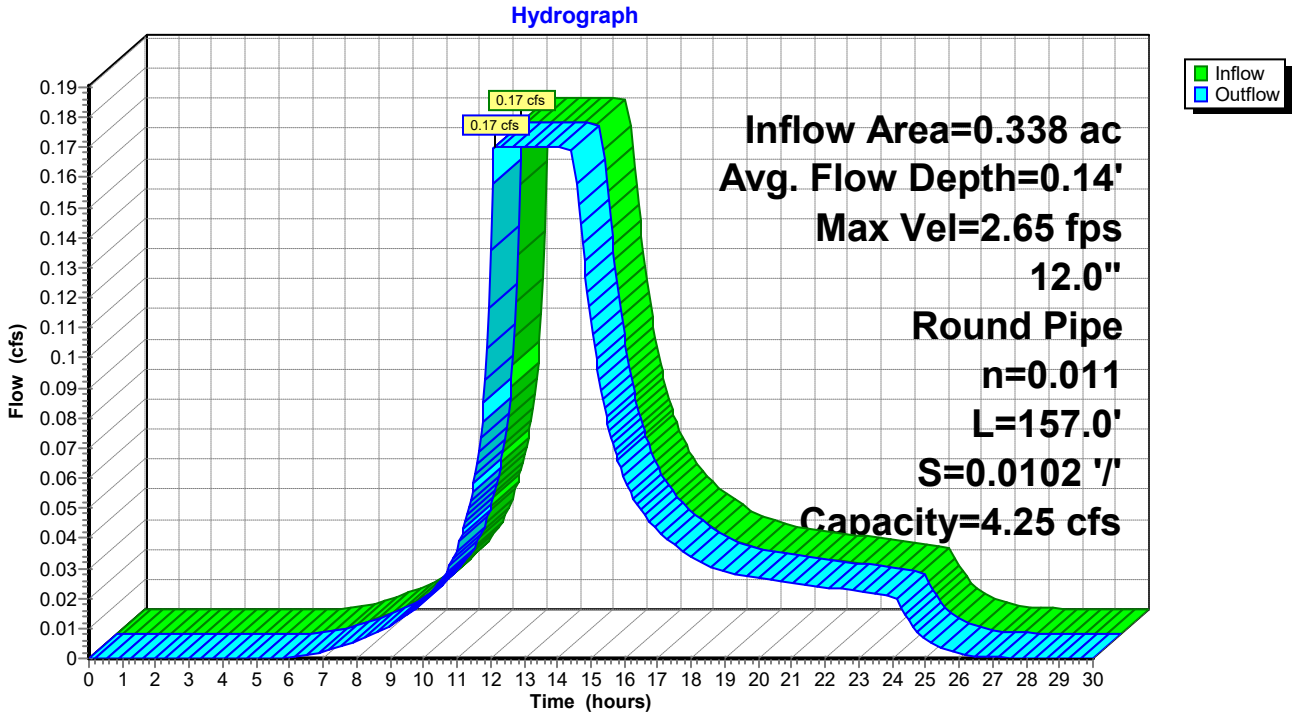
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.65 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 1.8 min

Peak Storage= 10 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.14' , Surface Width= 0.69'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.25 cfs

12.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 157.0' Slope= 0.0102 '/'
Inlet Invert= 109.40', Outlet Invert= 107.80'



Reach DMH11: TO DMH#10



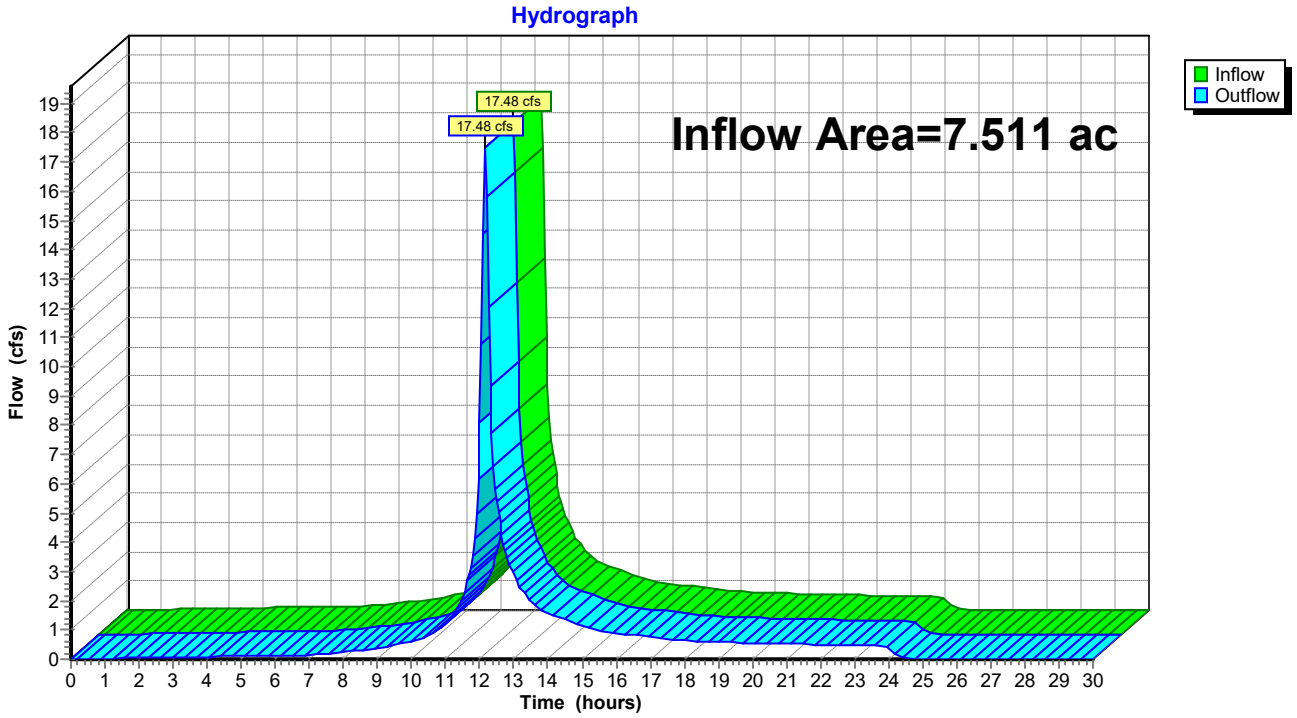
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.511 ac, 16.94% Impervious, Inflow Depth = 2.84" for 10-Year event
Inflow = 17.48 cfs @ 12.16 hrs, Volume= 1.776 af
Outflow = 17.48 cfs @ 12.16 hrs, Volume= 1.776 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

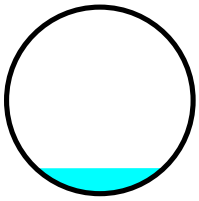
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 2.36" for 10-Year event
Inflow = 1.14 cfs @ 12.44 hrs, Volume= 0.170 af
Outflow = 1.13 cfs @ 12.47 hrs, Volume= 0.170 af, Atten= 0%, Lag= 1.6 min
Routed to Reach DCB-A : TO WETLAND

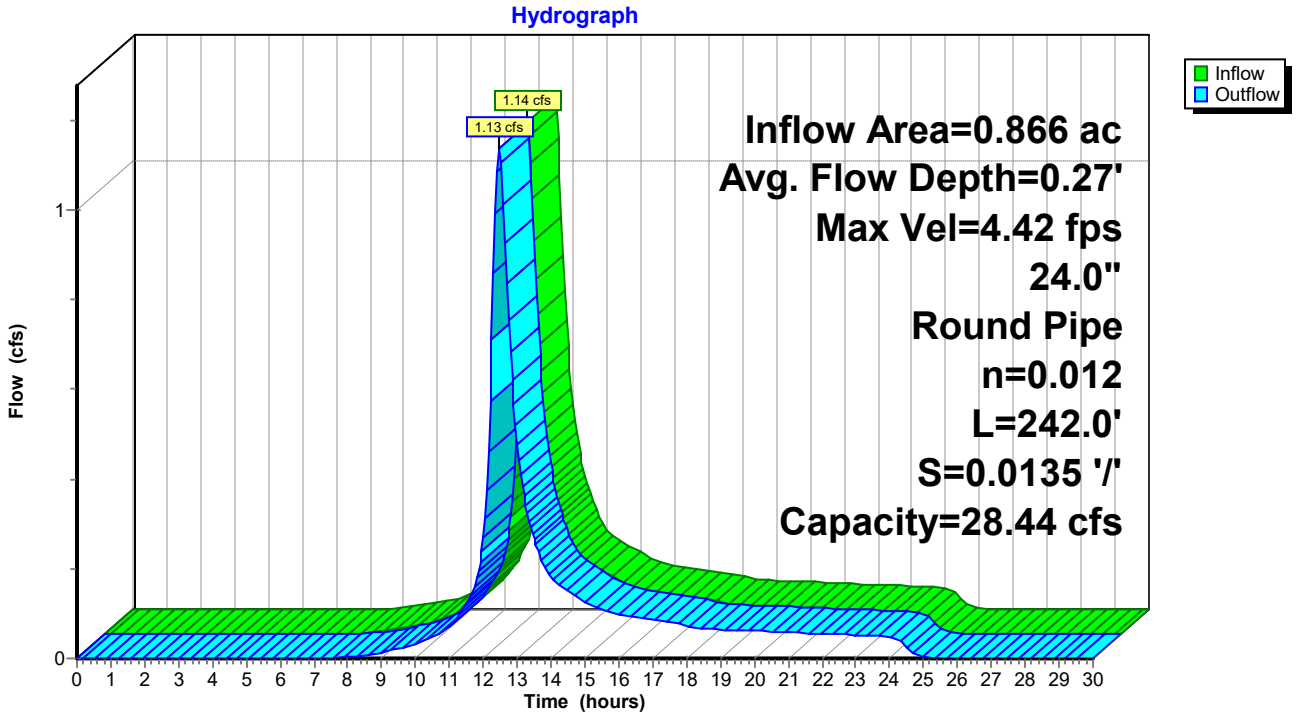
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.42 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.91 fps, Avg. Travel Time= 2.1 min

Peak Storage= 62 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 1.37'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



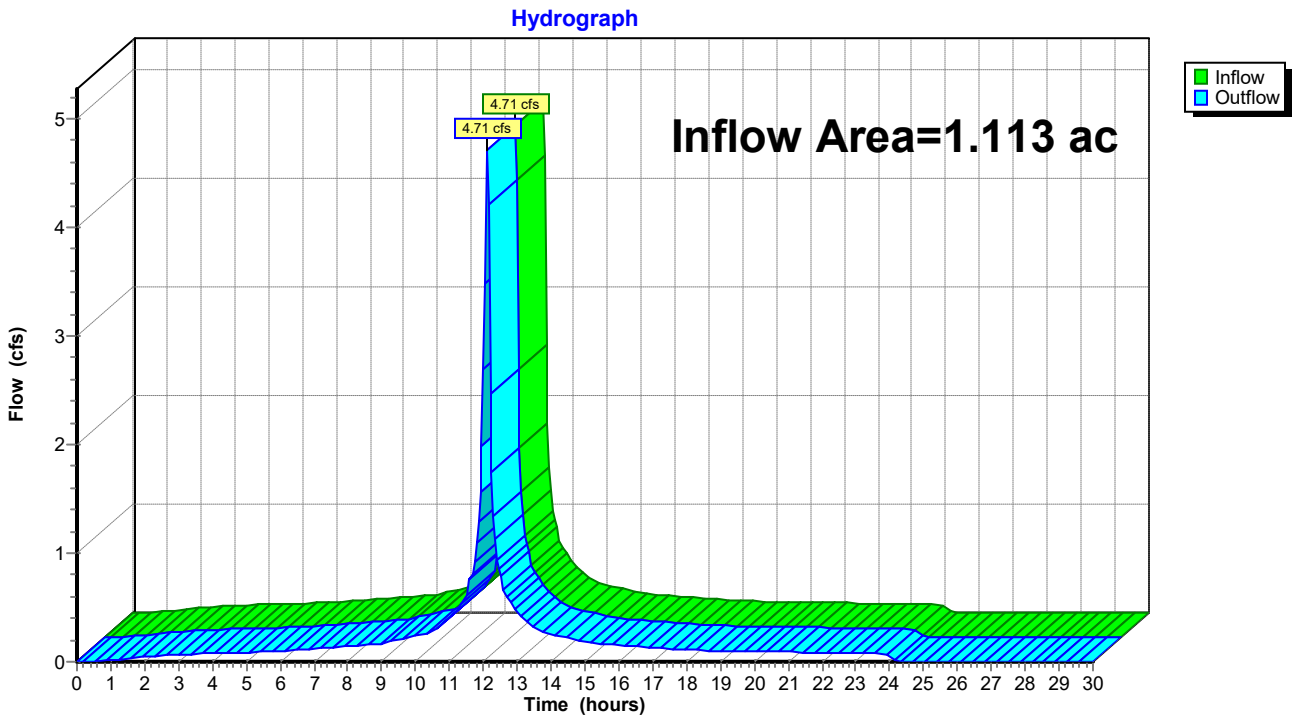
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 4.44" for 10-Year event
Inflow = 4.71 cfs @ 12.11 hrs, Volume= 0.412 af
Outflow = 4.71 cfs @ 12.11 hrs, Volume= 0.412 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 113.70' (Flood elevation advised)

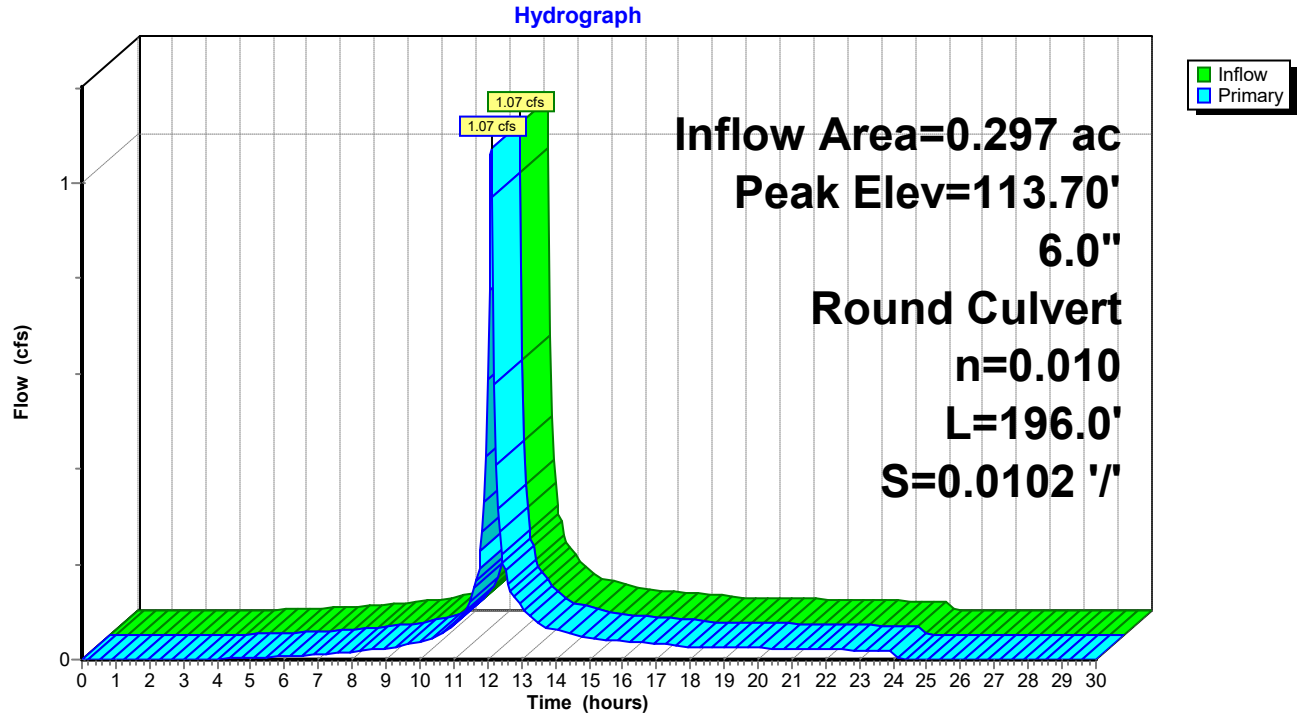
Inflow Area = 0.297 ac, 13.18% Impervious, Inflow Depth = 3.37" for 10-Year event
Inflow = 1.07 cfs @ 12.11 hrs, Volume= 0.083 af
Outflow = 1.07 cfs @ 12.11 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.07 cfs @ 12.11 hrs, Volume= 0.083 af
Routed to Reach DMH10 : TO OUTLET

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 113.70' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=1.04 cfs @ 12.11 hrs HW=113.41' (Free Discharge)
1=Culvert (Barrel Controls 1.04 cfs @ 5.29 fps)

Pond DCB-B: TO DCB-C



Summary for Pond RG2: TO DMH#11

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

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 2.79" for 10-Year event
Inflow = 1.04 cfs @ 12.11 hrs, Volume= 0.079 af
Outflow = 0.17 cfs @ 12.05 hrs, Volume= 0.079 af, Atten= 84%, Lag= 0.0 min
Primary = 0.17 cfs @ 12.05 hrs, Volume= 0.079 af
Routed to Reach DMH11 : TO DMH#10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DMH11 : TO DMH#10

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 112.29' @ 12.58 hrs Surf.Area= 3,675 sf Storage= 999 cf

Plug-Flow detention time= 58.3 min calculated for 0.079 af (100% of inflow)
Center-of-Mass det. time= 58.4 min (897.5 - 839.1)

Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	12,045 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

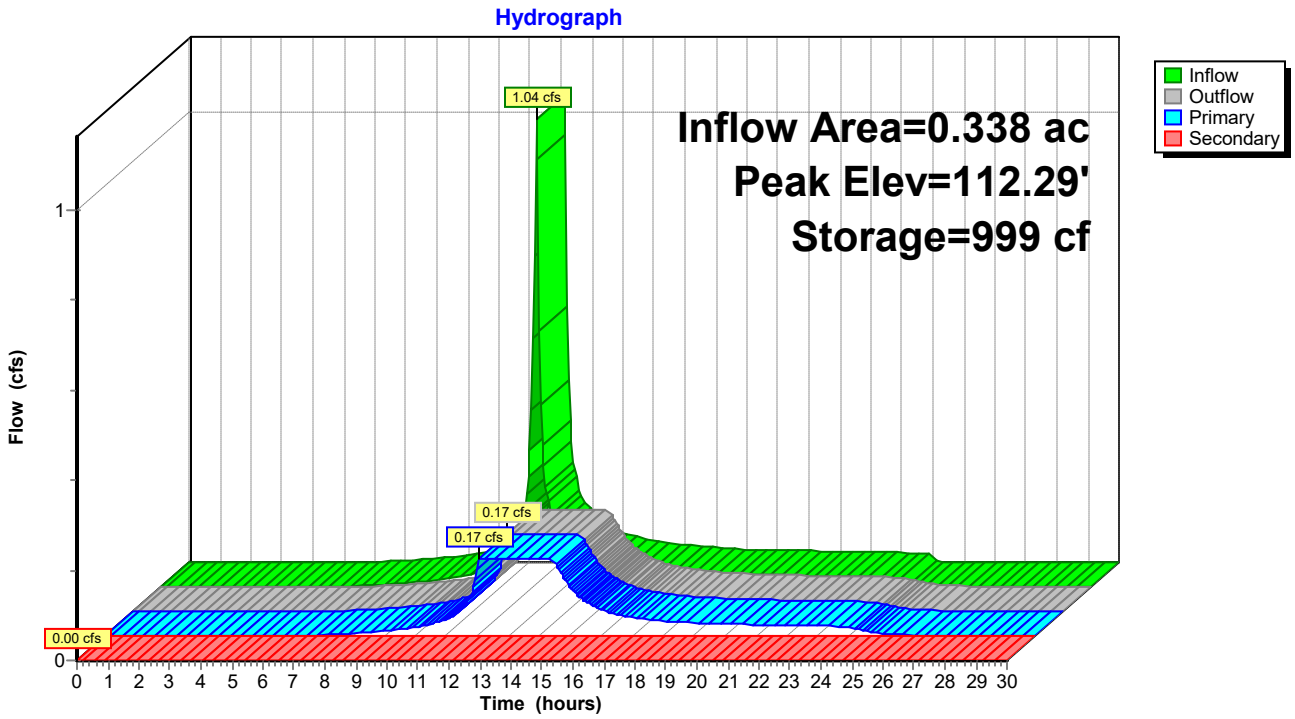
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	3,332	0	0
113.00	4,534	3,933	3,933
114.00	5,693	5,114	9,047
114.50	6,300	2,998	12,045

Device	Routing	Invert	Outlet Devices
#1	Device 4	112.35'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#2	Device 4	109.90'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Secondary	113.50'	**10.0' long + 2.0 '/' SideZ 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
#4	Primary	109.80'	**12.0" Round Culvert** L= 33.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 109.80' / 109.50' S= 0.0091 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.17 cfs @ 12.05 hrs HW=112.14' (Free Discharge)
└**4=Culvert** (Passes 0.17 cfs of 5.79 cfs potential flow)
├**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└**2=Special & User-Defined** (Custom Controls 0.17 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=112.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond RG2: TO DMH#11



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 P11B: OVERLAND TO DP#2 Runoff Area=200,631 sf 0.88% Impervious Runoff Depth=3.47"
Flow Length=414' Tc=9.8 min CN=78 Runoff=14.96 cfs 1.333 af

Subcatchment P13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=5.64"
Tc=5.0 min CN=98 Runoff=5.93 cfs 0.523 af

Subcatchment P14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=3.37"
Flow Length=513' Tc=31.4 min CN=77 Runoff=1.64 cfs 0.244 af

Subcatchment P15: TO DCB-B Runoff Area=12,955 sf 13.18% Impervious Runoff Depth=4.51"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=88 Runoff=1.42 cfs 0.112 af

Subcatchment P16: TO DCB-C Runoff Area=12,642 sf 0.17% Impervious Runoff Depth=5.06"
Flow Length=179' Tc=6.1 min CN=93 Runoff=1.43 cfs 0.122 af

Subcatchment P201: TO RAIN GARDEN #2 Runoff Area=14,725 sf 12.12% Impervious Runoff Depth=3.88"
Flow Length=135' Slope=0.0200 '/' Tc=5.0 min CN=82 Runoff=1.43 cfs 0.109 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=1.50' Max Vel=2.54 fps Inflow=6.53 cfs 0.767 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=6.24 cfs 0.767 af

Reach DCB-C*: TO DMH-10 Avg. Flow Depth=0.42' Max Vel=6.24 fps Inflow=1.43 cfs 0.122 af
8.0" Round Pipe n=0.011 L=5.0' S=0.0200 '/' Capacity=2.02 cfs Outflow=1.43 cfs 0.122 af

Reach DMH10: TO OUTLET Avg. Flow Depth=0.74' Max Vel=3.93 fps Inflow=2.99 cfs 0.343 af
15.0" Round Pipe n=0.013 L=101.0' S=0.0050 '/' Capacity=4.55 cfs Outflow=2.95 cfs 0.343 af

Reach DMH11: TO DMH#10 Avg. Flow Depth=0.19' Max Vel=3.24 fps Inflow=0.34 cfs 0.109 af
12.0" Round Pipe n=0.011 L=157.0' S=0.0102 '/' Capacity=4.25 cfs Outflow=0.34 cfs 0.109 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=23.84 cfs 2.444 af
Outflow=23.84 cfs 2.444 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.33' Max Vel=4.92 fps Inflow=1.64 cfs 0.244 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=1.63 cfs 0.244 af

Reach RF: TO DCB-A Inflow=5.93 cfs 0.523 af
Outflow=5.93 cfs 0.523 af

Pond DCB-B: TO DCB-C Peak Elev=117.35' Inflow=1.42 cfs 0.112 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=1.42 cfs 0.112 af

Pond RG2: TO DMH#11 Peak Elev=112.38' Storage=1,371 cf Inflow=1.43 cfs 0.109 af
Primary=0.34 cfs 0.109 af Secondary=0.00 cfs 0.000 af Outflow=0.34 cfs 0.109 af

Total Runoff Area = 7.511 ac Runoff Volume = 2.444 af Average Runoff Depth = 3.90"
83.06% Pervious = 6.239 ac 16.94% Impervious = 1.273 ac

Summary for Subcatchment P11B: OVERLAND TO DP#2

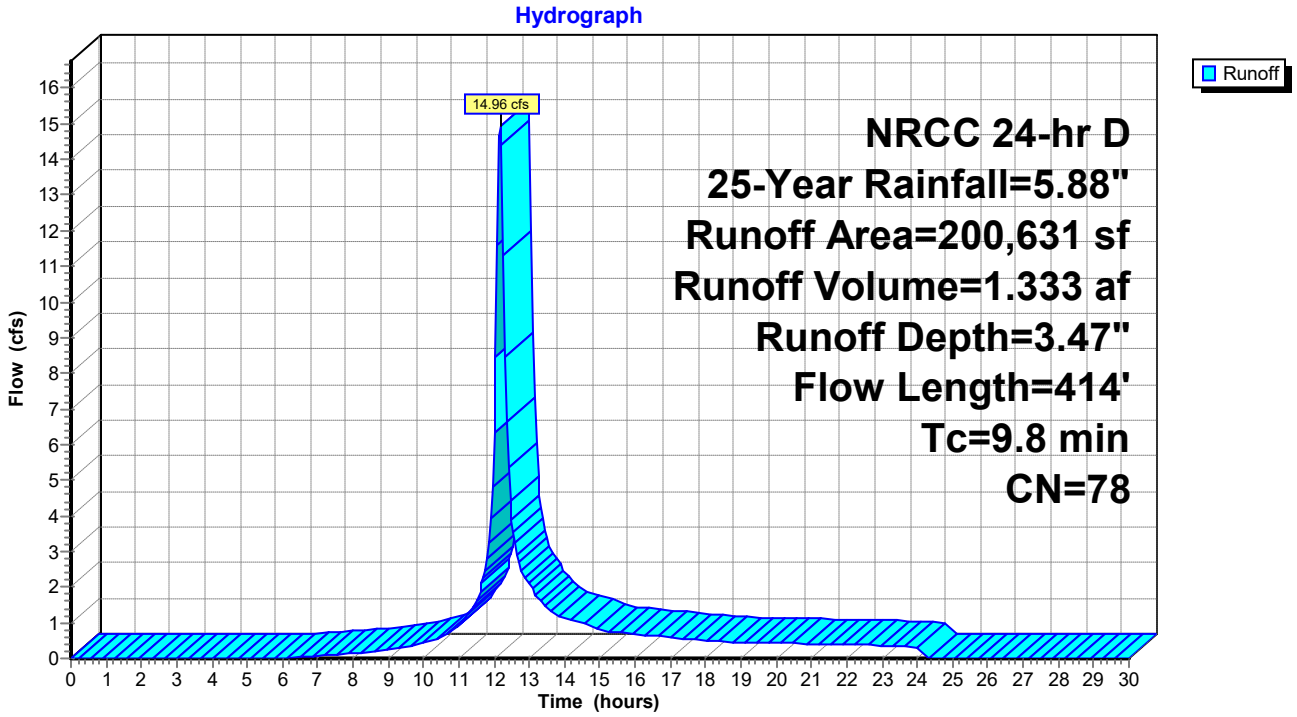
Runoff = 14.96 cfs @ 12.17 hrs, Volume= 1.333 af, Depth= 3.47"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
24,954	74	>75% Grass cover, Good, HSG C
120,262	70	Woods, Good, HSG C
53,648	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
200,631	78	Weighted Average
198,864		99.12% Pervious Area
1,767		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment P11B: OVERLAND TO DP#2



Summary for Subcatchment P13: TO ROOF DRAINAGE

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

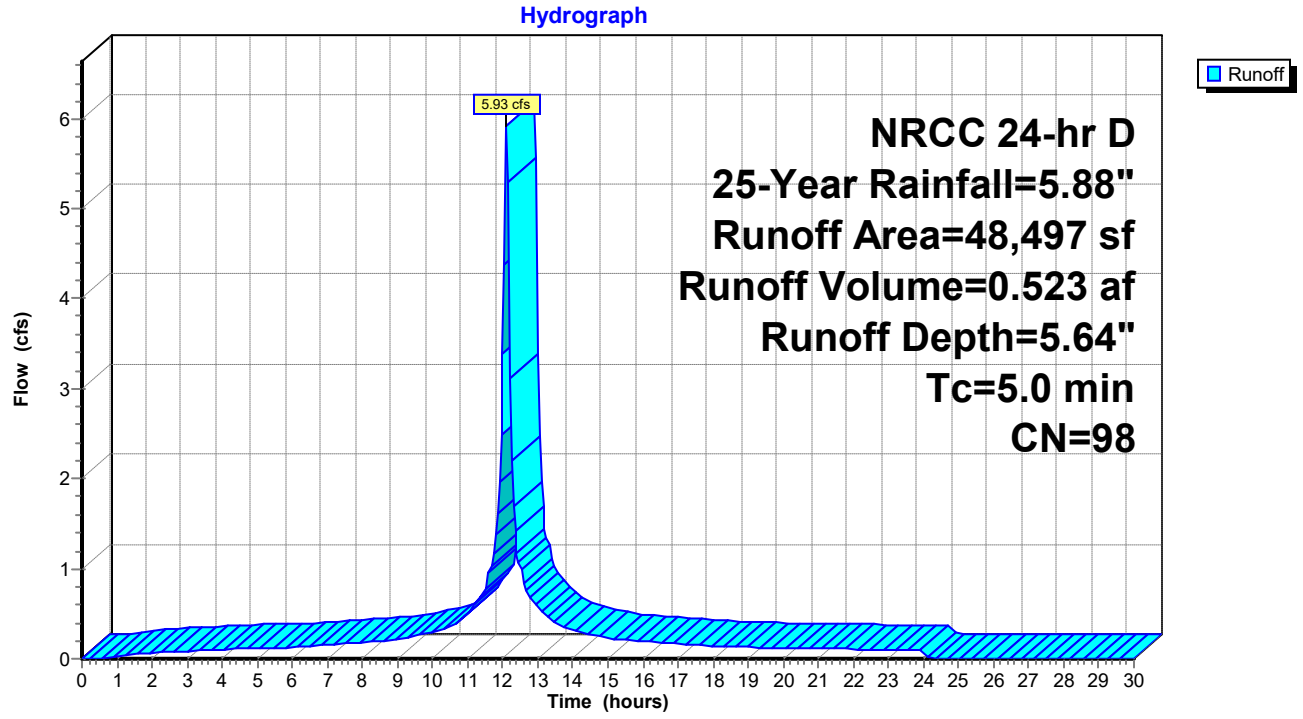
Runoff = 5.93 cfs @ 12.11 hrs, Volume= 0.523 af, Depth= 5.64"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment P13: TO ROOF DRAINAGE



Summary for Subcatchment P14: TO INLET

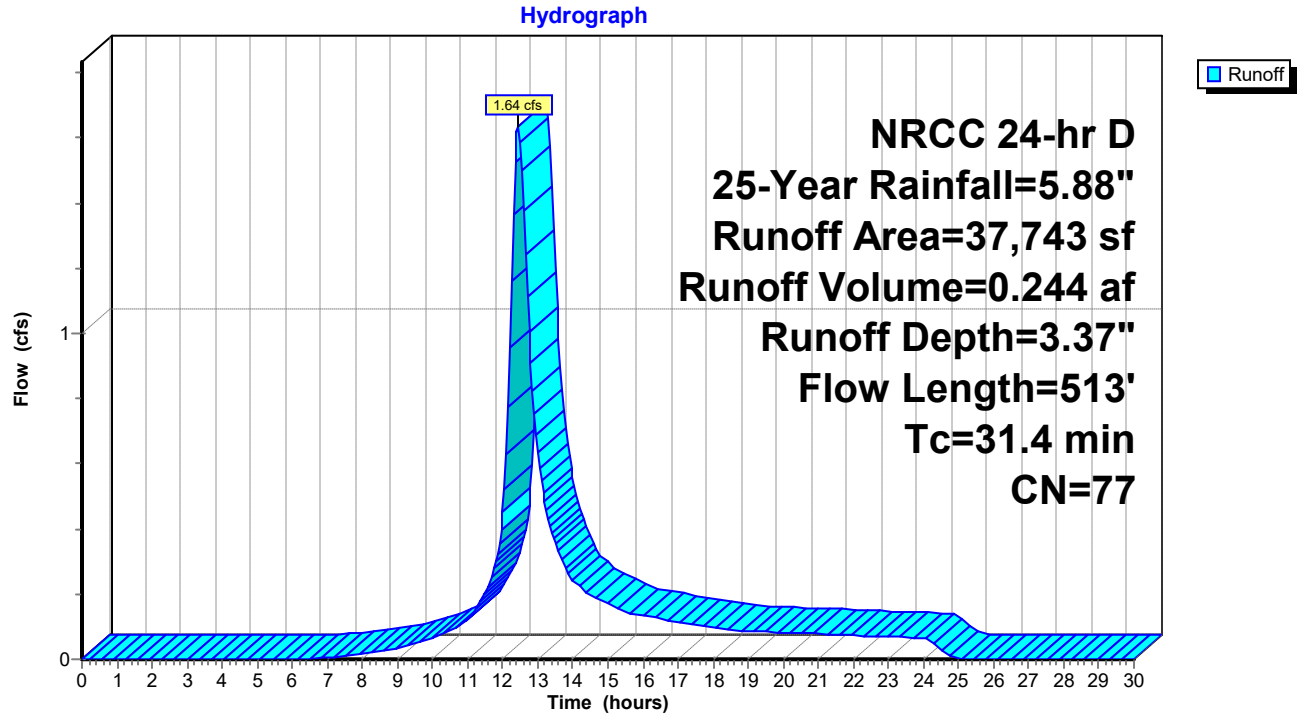
Runoff = 1.64 cfs @ 12.44 hrs, Volume= 0.244 af, Depth= 3.37"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.3	463	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.4	513	Total			

Subcatchment P14: TO INLET



Summary for Subcatchment P15: TO DCB-B

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

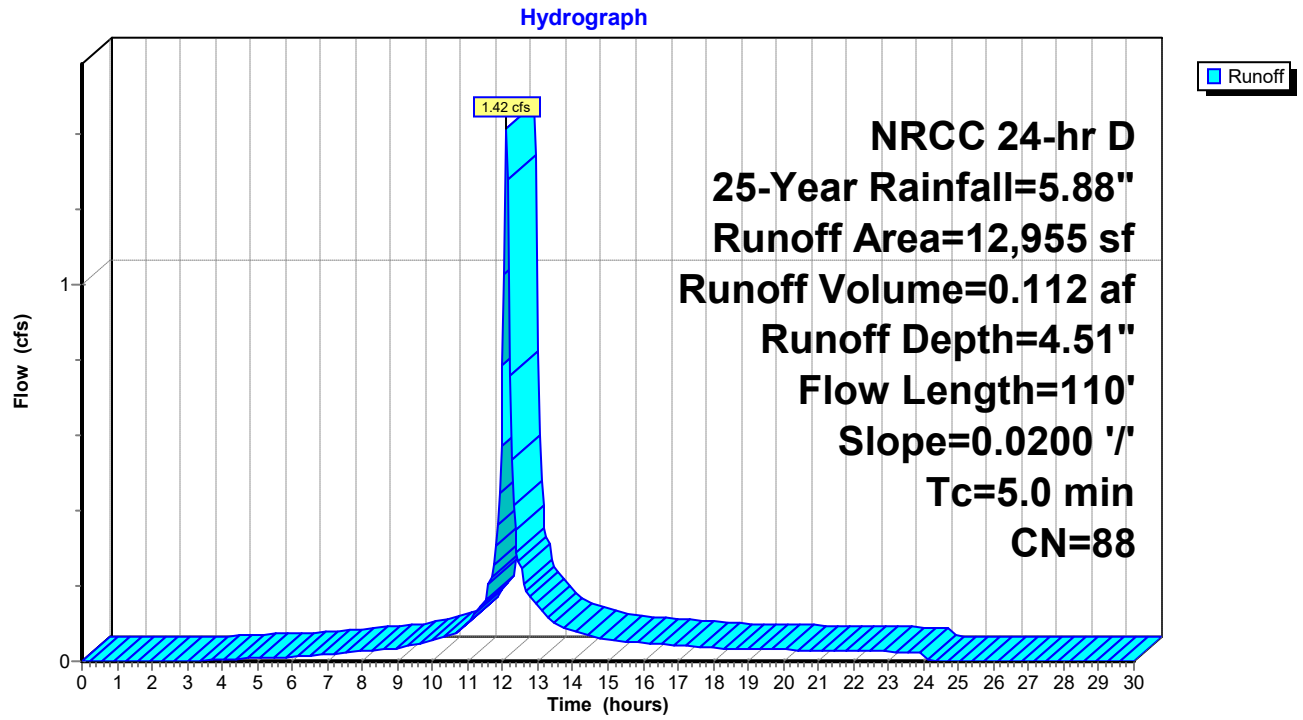
Runoff = 1.42 cfs @ 12.11 hrs, Volume= 0.112 af, Depth= 4.51"
Routed to Pond DCB-B : TO DCB-C

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
1,190	74	>75% Grass cover, Good, HSG C
3,195	70	Woods, Good, HSG C
6,862	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
12,955	88	Weighted Average
11,247		86.82% Pervious Area
1,708		13.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P15: TO DCB-B



Summary for Subcatchment P16: TO DCB-C

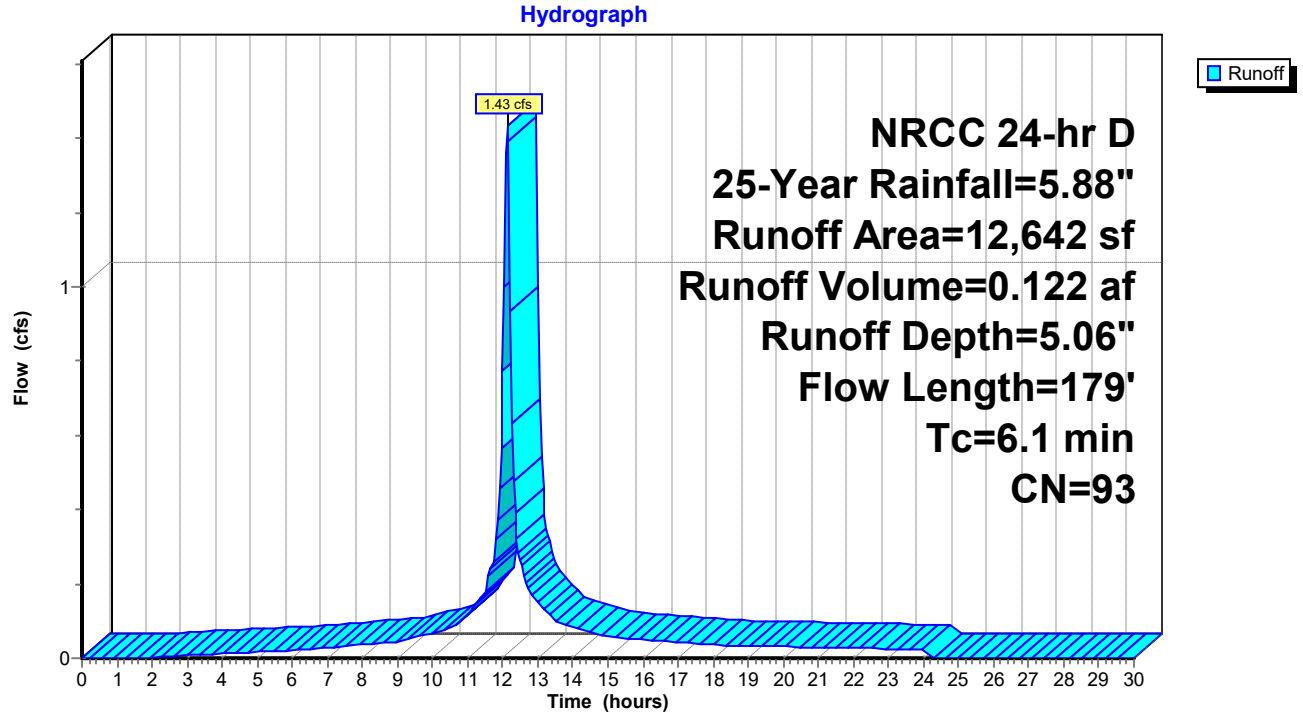
Runoff = 1.43 cfs @ 12.13 hrs, Volume= 0.122 af, Depth= 5.06"
Routed to Reach DCB-C* : TO DMH-10

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
715	74	>75% Grass cover, Good, HSG C
9,014	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
2,891	89	Gravel roads, HSG C
12,642	93	Weighted Average
12,620		99.83% Pervious Area
22		0.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment P16: TO DCB-C



Summary for Subcatchment P201: TO RAIN GARDEN #2

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

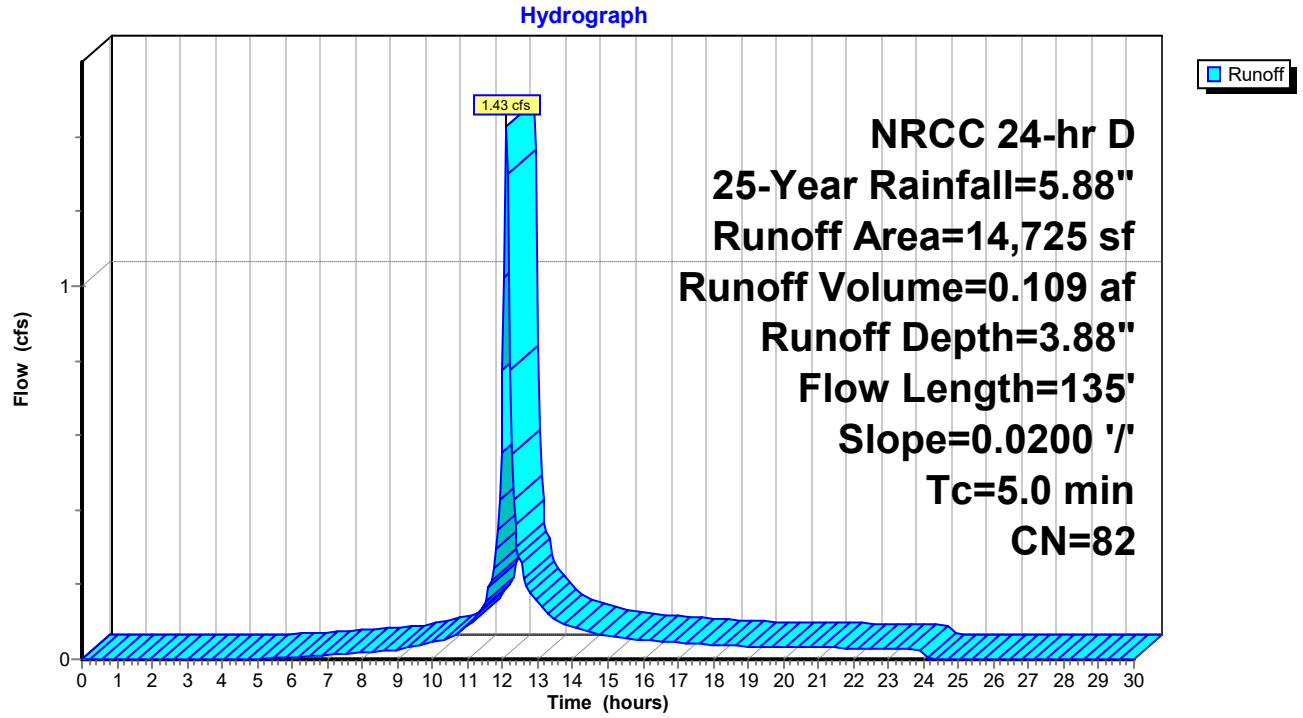
Runoff = 1.43 cfs @ 12.11 hrs, Volume= 0.109 af, Depth= 3.88"
Routed to Pond RG2 : TO DMH#11

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
7,946	74	>75% Grass cover, Good, HSG C
4,075	89	Gravel roads, HSG C
1,784	98	Paved parking, HSG C
920	96	Gravel surface, HSG C
14,725	82	Weighted Average
12,941		87.88% Pervious Area
1,784		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.6	85	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	135	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P201: TO RAIN GARDEN #2



Summary for Reach DCB-A: TO WETLAND

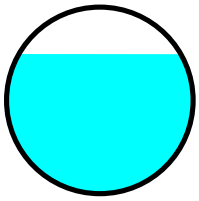
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach PIPE OUTLET depth by 1.25' @ 12.15 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 4.65" for 25-Year event
Inflow = 6.53 cfs @ 12.11 hrs, Volume= 0.767 af
Outflow = 6.24 cfs @ 12.14 hrs, Volume= 0.767 af, Atten= 4%, Lag= 1.7 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

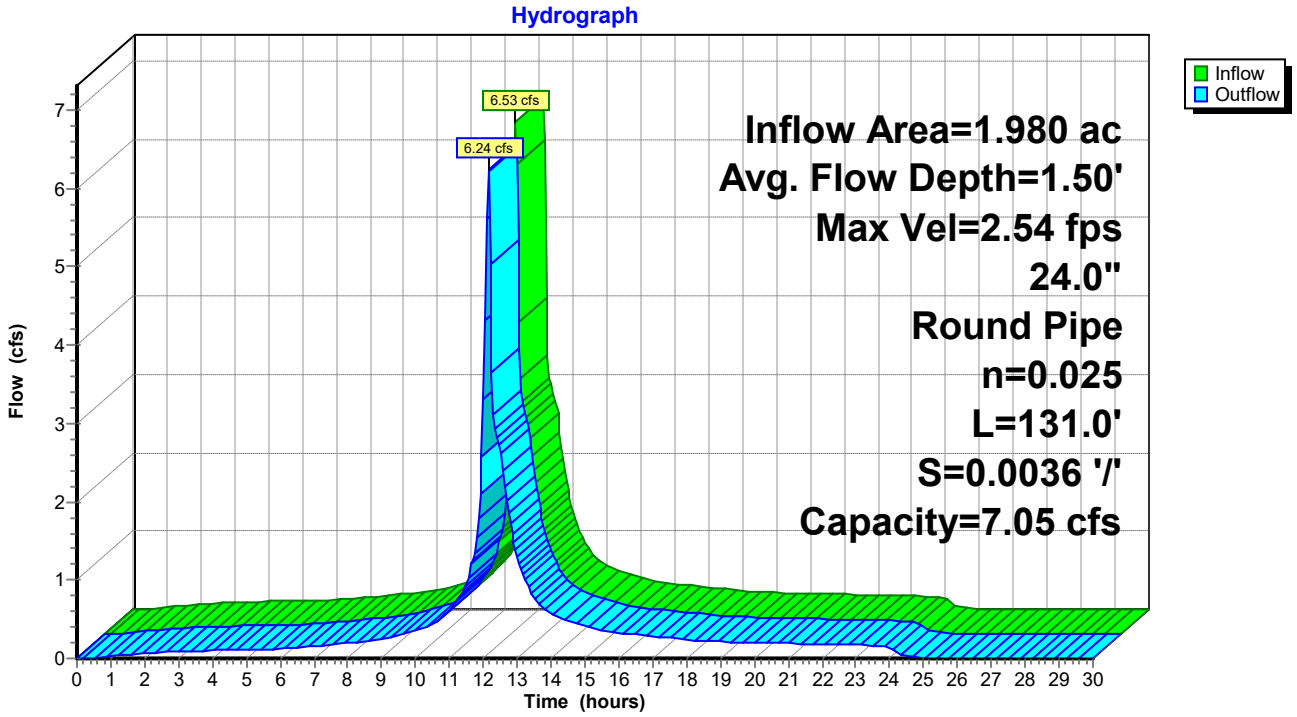
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.54 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.00 fps, Avg. Travel Time= 2.2 min

Peak Storage= 331 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.50' , Surface Width= 1.74'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



Summary for Reach DCB-C*: TO DMH-10

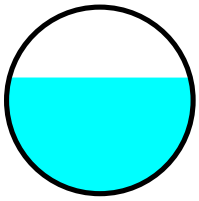
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.290 ac, 0.17% Impervious, Inflow Depth = 5.06" for 25-Year event
Inflow = 1.43 cfs @ 12.13 hrs, Volume= 0.122 af
Outflow = 1.43 cfs @ 12.13 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DMH10 : TO OUTLET

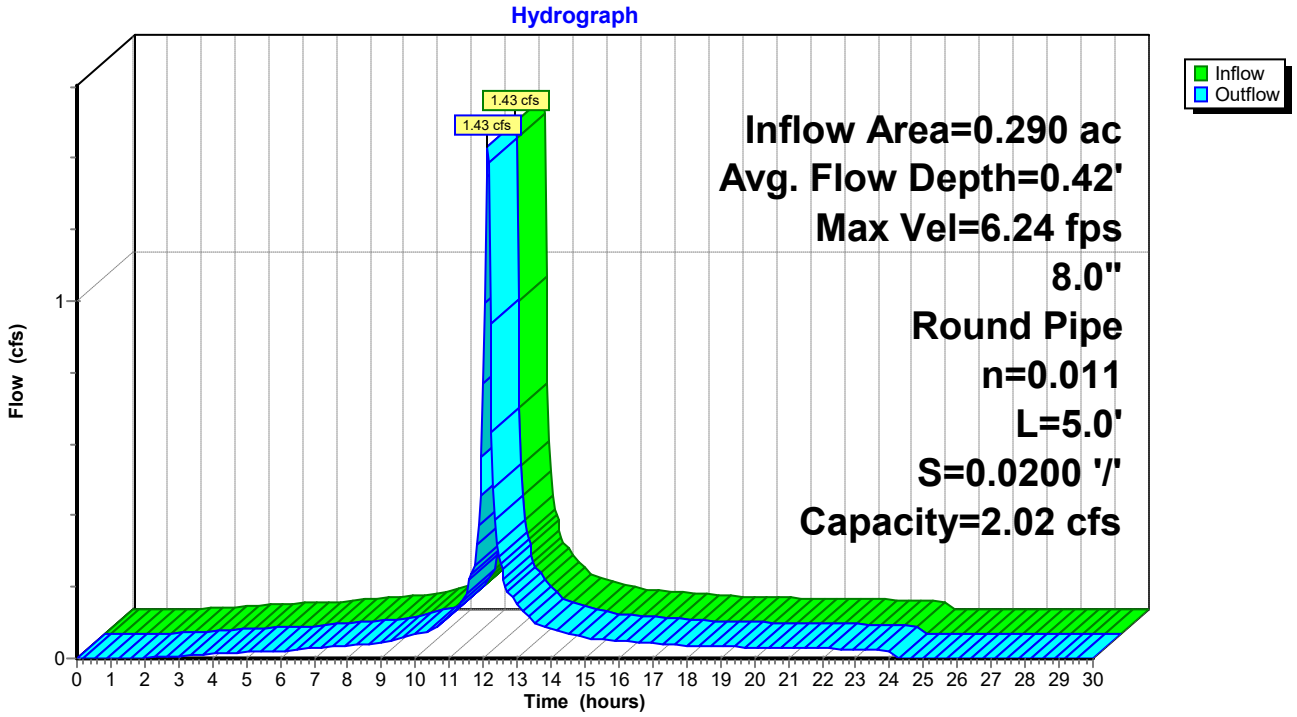
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.24 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.31 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.42' , Surface Width= 0.65'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 2.02 cfs

8.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 5.0' Slope= 0.0200 '/'
Inlet Invert= 107.80', Outlet Invert= 107.70'



Reach DCB-C*: TO DMH-10



Summary for Reach DMH10: TO OUTLET

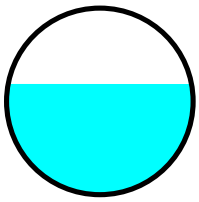
[52] Hint: Inlet/Outlet conditions not evaluated
[63] Warning: Exceeded Reach DCB-C* INLET depth by 0.12' @ 12.15 hrs
[62] Hint: Exceeded Reach DMH11 OUTLET depth by 0.39' @ 12.15 hrs
[79] Warning: Submerged Pond DCB-B Primary device # 1 OUTLET by 0.05'

Inflow Area = 0.926 ac, 8.71% Impervious, Inflow Depth = 4.45" for 25-Year event
Inflow = 2.99 cfs @ 12.12 hrs, Volume= 0.343 af
Outflow = 2.95 cfs @ 12.13 hrs, Volume= 0.343 af, Atten= 1%, Lag= 0.9 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

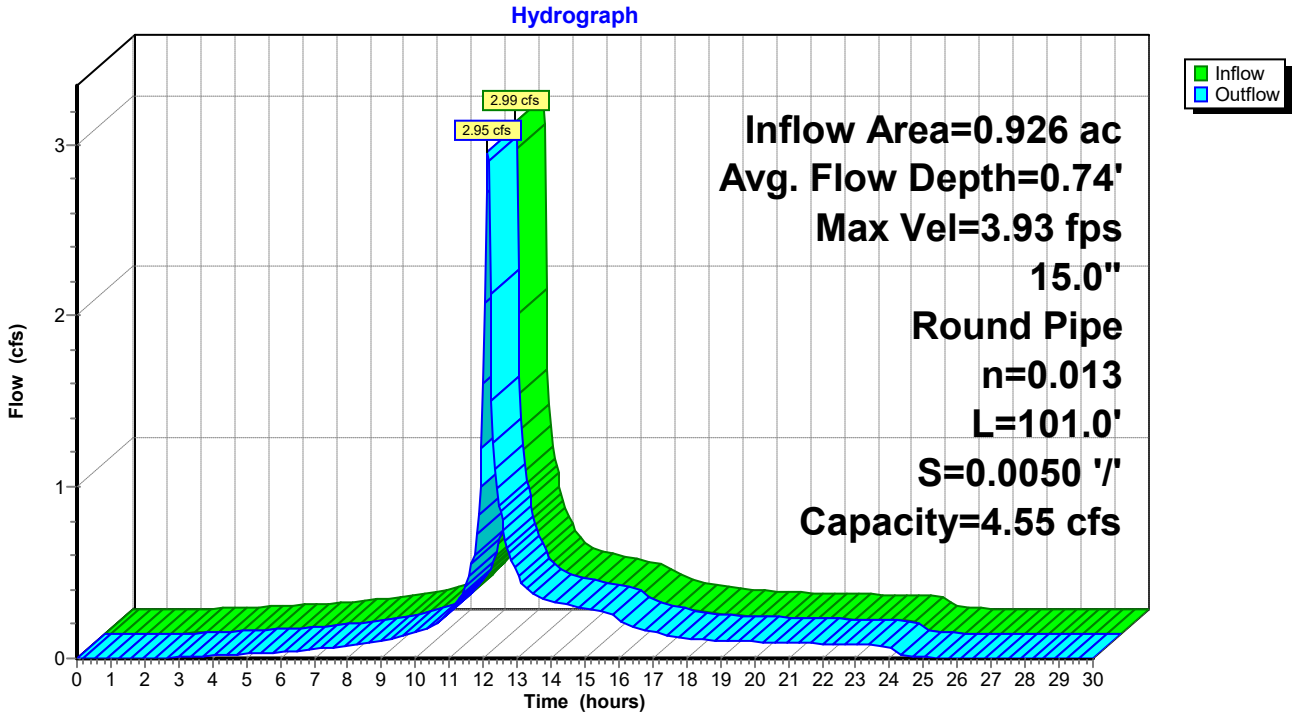
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.93 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 1.2 min

Peak Storage= 77 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.74' , Surface Width= 1.23'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.55 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 101.0' Slope= 0.0050 '/'
Inlet Invert= 107.60', Outlet Invert= 107.10'



Reach DMH10: TO OUTLET



Summary for Reach DMH11: TO DMH#10

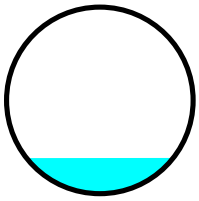
[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond RG2 Primary device # 4 OUTLET by 0.09'

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 3.88" for 25-Year event
Inflow = 0.34 cfs @ 12.37 hrs, Volume= 0.109 af
Outflow = 0.34 cfs @ 12.40 hrs, Volume= 0.109 af, Atten= 1%, Lag= 1.8 min
Routed to Reach DMH10 : TO OUTLET

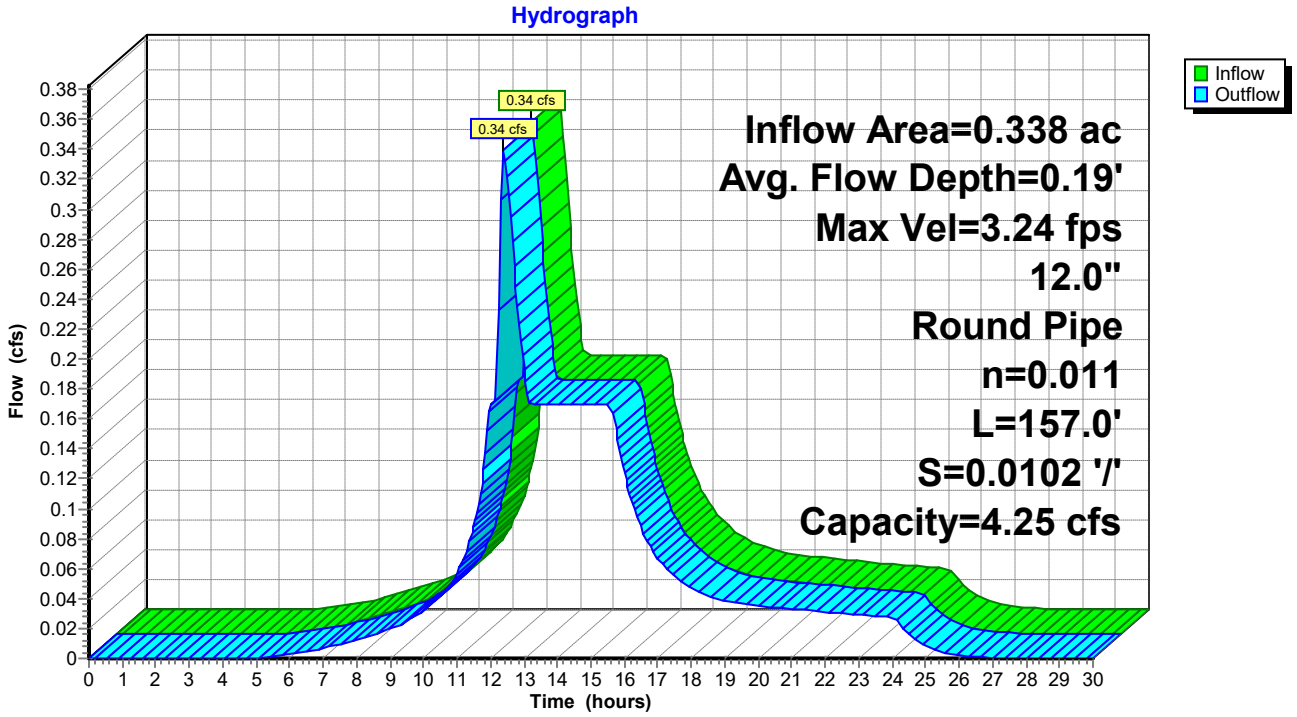
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.24 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.57 fps, Avg. Travel Time= 1.7 min

Peak Storage= 17 cf @ 12.39 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 0.79'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.25 cfs

12.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 157.0' Slope= 0.0102 '/'
Inlet Invert= 109.40', Outlet Invert= 107.80'



Reach DMH11: TO DMH#10



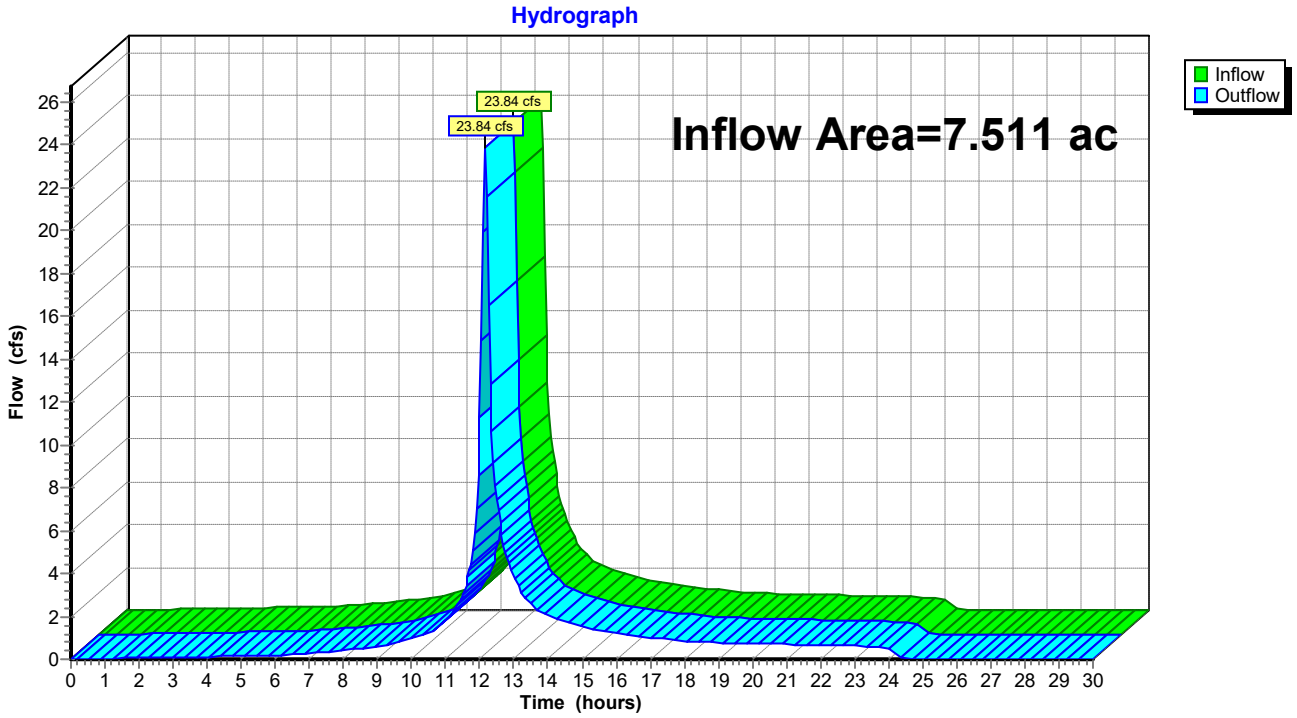
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.511 ac, 16.94% Impervious, Inflow Depth = 3.90" for 25-Year event
Inflow = 23.84 cfs @ 12.16 hrs, Volume= 2.444 af
Outflow = 23.84 cfs @ 12.16 hrs, Volume= 2.444 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

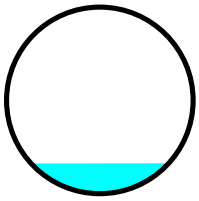
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 3.37" for 25-Year event
Inflow = 1.64 cfs @ 12.44 hrs, Volume= 0.244 af
Outflow = 1.63 cfs @ 12.46 hrs, Volume= 0.244 af, Atten= 0%, Lag= 1.4 min
Routed to Reach DCB-A : TO WETLAND

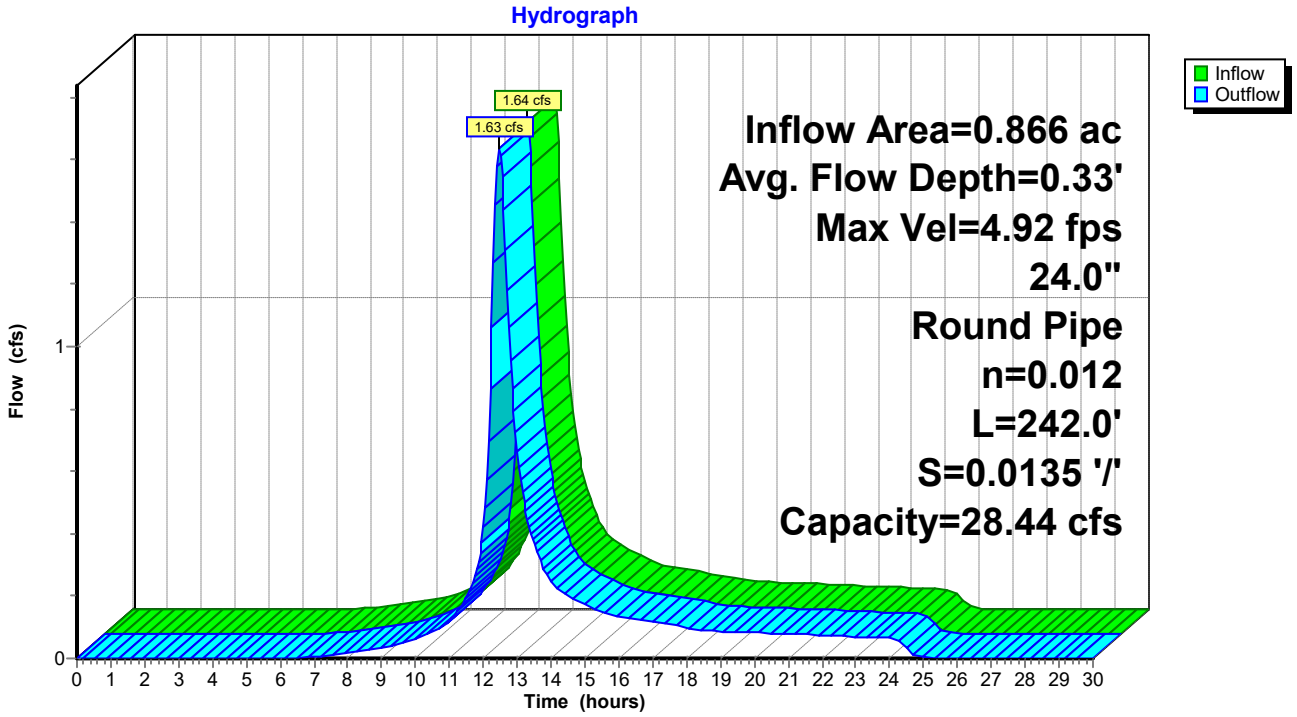
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.92 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.07 fps, Avg. Travel Time= 1.9 min

Peak Storage= 80 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.33' , Surface Width= 1.48'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



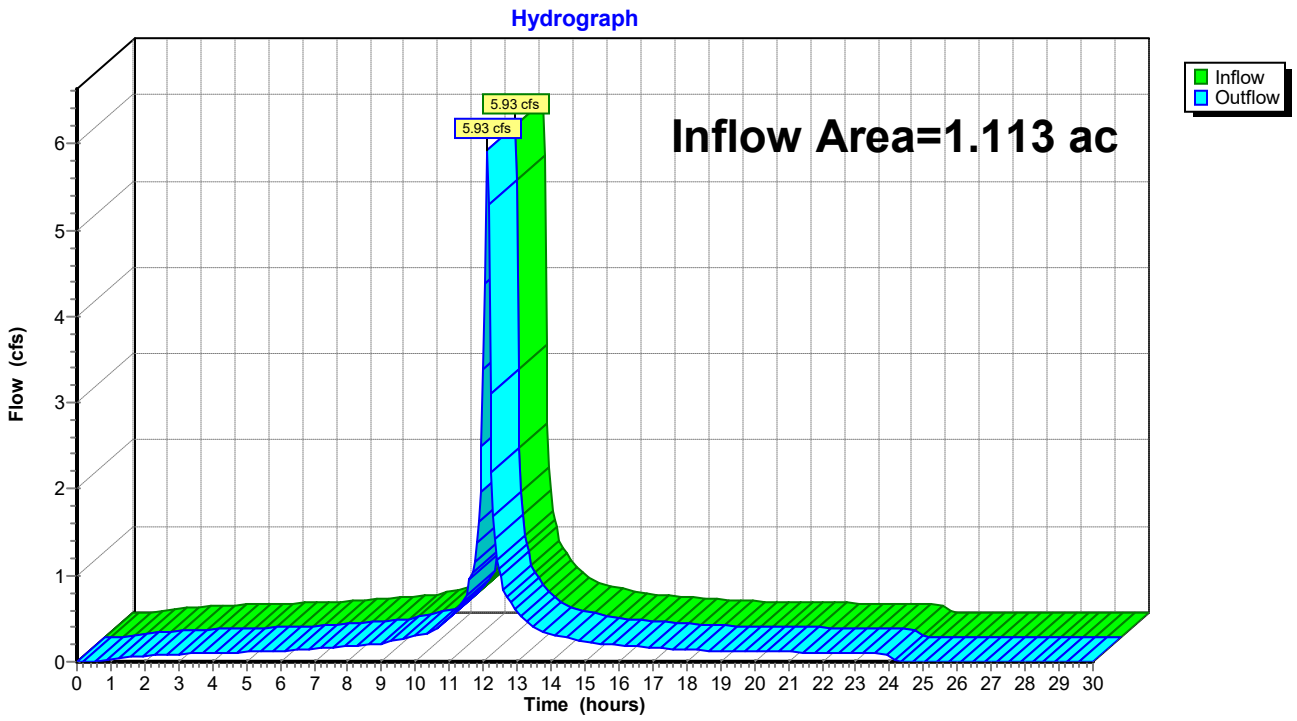
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 5.64" for 25-Year event
Inflow = 5.93 cfs @ 12.11 hrs, Volume= 0.523 af
Outflow = 5.93 cfs @ 12.11 hrs, Volume= 0.523 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 117.35' (Flood elevation advised)

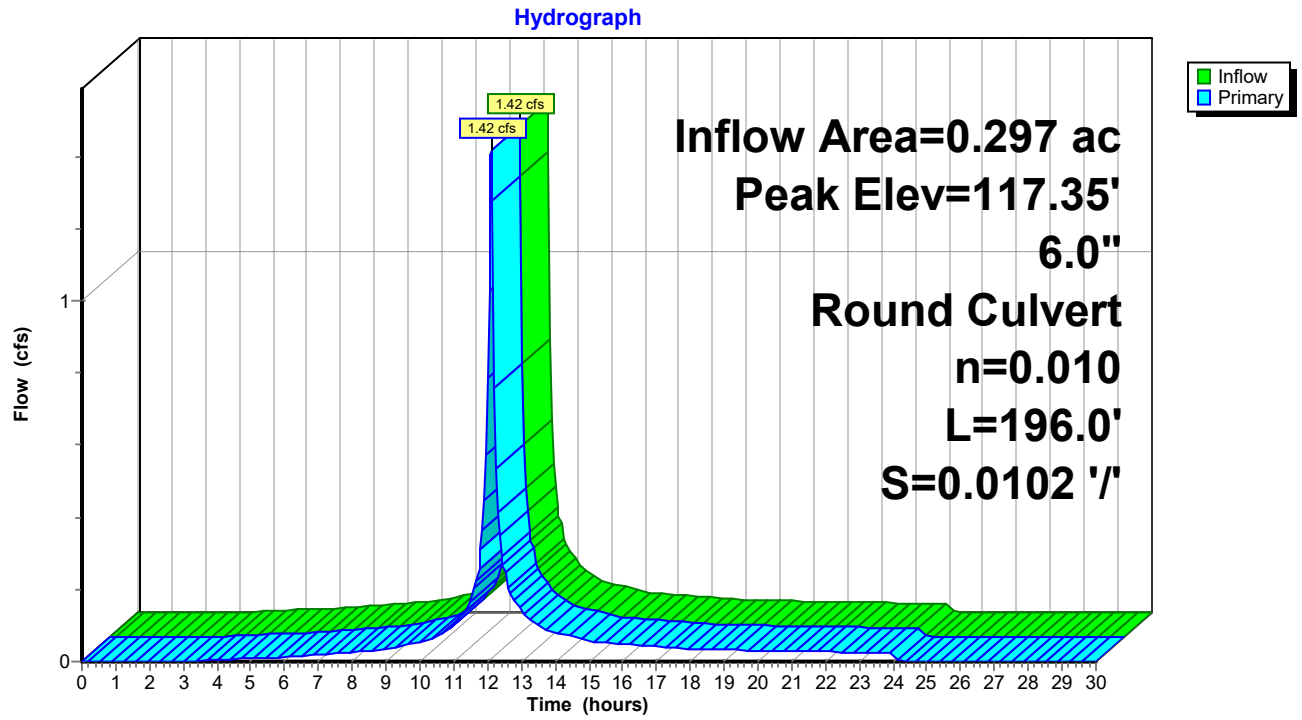
Inflow Area = 0.297 ac, 13.18% Impervious, Inflow Depth = 4.51" for 25-Year event
Inflow = 1.42 cfs @ 12.11 hrs, Volume= 0.112 af
Outflow = 1.42 cfs @ 12.11 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min
Primary = 1.42 cfs @ 12.11 hrs, Volume= 0.112 af
Routed to Reach DMH10 : TO OUTLET

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 117.35' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=1.37 cfs @ 12.11 hrs HW=116.85' (Free Discharge)
1=Culvert (Barrel Controls 1.37 cfs @ 6.98 fps)

Pond DCB-B: TO DCB-C



Summary for Pond RG2: TO DMH#11

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

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 3.88" for 25-Year event
Inflow = 1.43 cfs @ 12.11 hrs, Volume= 0.109 af
Outflow = 0.34 cfs @ 12.37 hrs, Volume= 0.109 af, Atten= 76%, Lag= 15.3 min
Primary = 0.34 cfs @ 12.37 hrs, Volume= 0.109 af
Routed to Reach DMH11 : TO DMH#10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DMH11 : TO DMH#10

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 112.38' @ 12.37 hrs Surf.Area= 3,794 sf Storage= 1,371 cf

Plug-Flow detention time= 66.1 min calculated for 0.109 af (100% of inflow)
Center-of-Mass det. time= 66.0 min (893.0 - 827.0)

Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	12,045 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

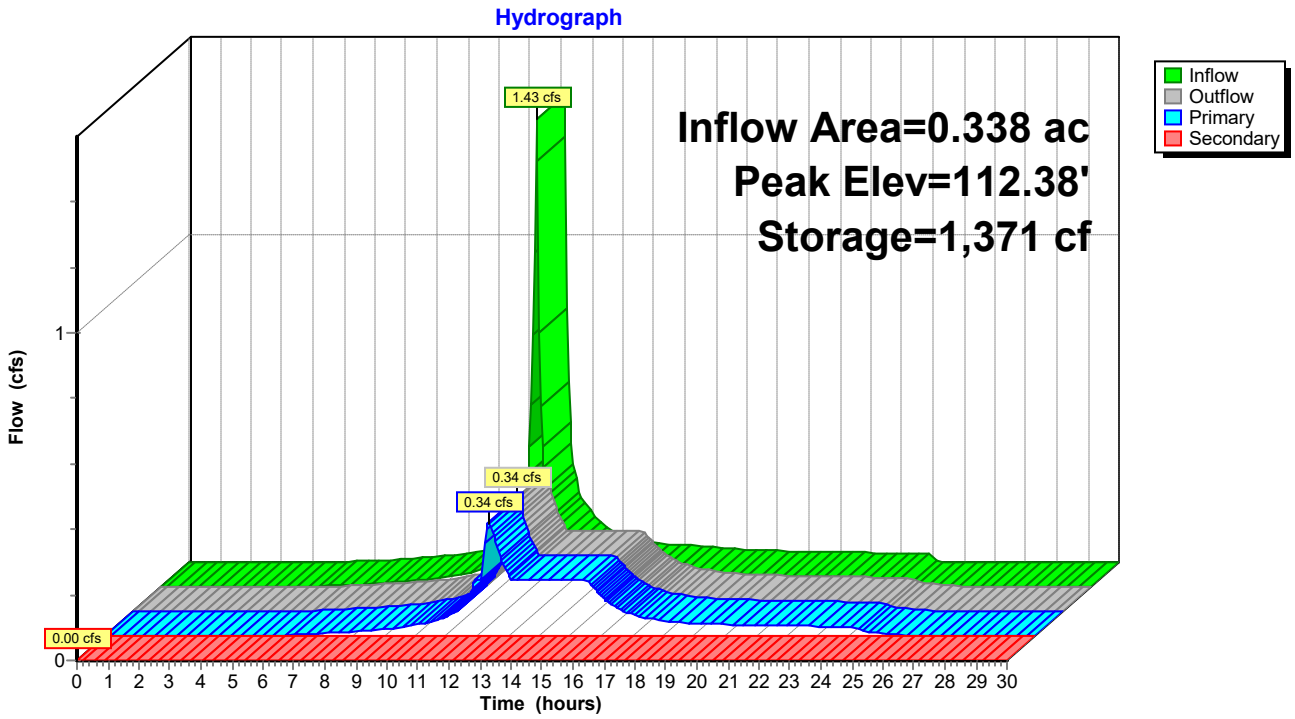
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	3,332	0	0
113.00	4,534	3,933	3,933
114.00	5,693	5,114	9,047
114.50	6,300	2,998	12,045

Device	Routing	Invert	Outlet Devices
#1	Device 4	112.35'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#2	Device 4	109.90'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Secondary	113.50'	**10.0' long + 2.0 '/' SideZ 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
#4	Primary	109.80'	**12.0" Round Culvert** L= 33.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 109.80' / 109.50' S= 0.0091 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.33 cfs @ 12.37 hrs HW=112.38' (Free Discharge)
└**4=Culvert** (Passes 0.33 cfs of 6.21 cfs potential flow)
├**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.16 cfs @ 0.61 fps)
└**2=Special & User-Defined** (Custom Controls 0.17 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=112.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond RG2: TO DMH#11



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 P11B: OVERLAND TO DP#2 Runoff Area=200,631 sf 0.88% Impervious Runoff Depth=5.71"
Flow Length=414' Tc=9.8 min CN=78 Runoff=24.22 cfs 2.190 af

Subcatchment P13: TO ROOF DRAINAGE Runoff Area=48,497 sf 100.00% Impervious Runoff Depth=8.10"
Tc=5.0 min CN=98 Runoff=8.42 cfs 0.752 af

Subcatchment P14: TO INLET Runoff Area=37,743 sf 4.40% Impervious Runoff Depth=5.59"
Flow Length=513' Tc=31.4 min CN=77 Runoff=2.69 cfs 0.403 af

Subcatchment P15: TO DCB-B Runoff Area=12,955 sf 13.18% Impervious Runoff Depth=6.90"
Flow Length=110' Slope=0.0200 '/' Tc=5.0 min CN=88 Runoff=2.11 cfs 0.171 af

Subcatchment P16: TO DCB-C Runoff Area=12,642 sf 0.17% Impervious Runoff Depth=7.50"
Flow Length=179' Tc=6.1 min CN=93 Runoff=2.07 cfs 0.181 af

Subcatchment P201: TO RAIN GARDEN #2 Runoff Area=14,725 sf 12.12% Impervious Runoff Depth=6.18"
Flow Length=135' Slope=0.0200 '/' Tc=5.0 min CN=82 Runoff=2.23 cfs 0.174 af

Reach DCB-A: TO WETLAND Avg. Flow Depth=2.00' Max Vel=2.55 fps Inflow=9.48 cfs 1.155 af
24.0" Round Pipe n=0.025 L=131.0' S=0.0036 '/' Capacity=7.05 cfs Outflow=7.05 cfs 1.155 af

Reach DCB-C*: TO DMH-10 Avg. Flow Depth=0.56' Max Vel=6.60 fps Inflow=2.07 cfs 0.181 af
8.0" Round Pipe n=0.011 L=5.0' S=0.0200 '/' Capacity=2.02 cfs Outflow=2.07 cfs 0.181 af

Reach DMH10: TO OUTLET Avg. Flow Depth=1.25' Max Vel=4.22 fps Inflow=5.09 cfs 0.527 af
15.0" Round Pipe n=0.013 L=101.0' S=0.0050 '/' Capacity=4.55 cfs Outflow=4.70 cfs 0.527 af

Reach DMH11: TO DMH#10 Avg. Flow Depth=0.40' Max Vel=4.91 fps Inflow=1.46 cfs 0.174 af
12.0" Round Pipe n=0.011 L=157.0' S=0.0102 '/' Capacity=4.25 cfs Outflow=1.44 cfs 0.174 af

Reach DP#2: WETLAND SERIES 1(NORTH) Inflow=35.85 cfs 3.872 af
Outflow=35.85 cfs 3.872 af

Reach PIPE: INLET TO DCB-A Avg. Flow Depth=0.42' Max Vel=5.69 fps Inflow=2.69 cfs 0.403 af
24.0" Round Pipe n=0.012 L=242.0' S=0.0135 '/' Capacity=28.44 cfs Outflow=2.68 cfs 0.403 af

Reach RF: TO DCB-A Inflow=8.42 cfs 0.752 af
Outflow=8.42 cfs 0.752 af

Pond DCB-B: TO DCB-C Peak Elev=127.82' Inflow=2.11 cfs 0.171 af
6.0" Round Culvert n=0.010 L=196.0' S=0.0102 '/' Outflow=2.11 cfs 0.171 af

Pond RG2: TO DMH#11 Peak Elev=112.48' Storage=1,725 cf Inflow=2.23 cfs 0.174 af
Primary=1.46 cfs 0.174 af Secondary=0.00 cfs 0.000 af Outflow=1.46 cfs 0.174 af

Total Runoff Area = 7.511 ac Runoff Volume = 3.872 af Average Runoff Depth = 6.19"
83.06% Pervious = 6.239 ac 16.94% Impervious = 1.273 ac

Summary for Subcatchment P11B: OVERLAND TO DP#2

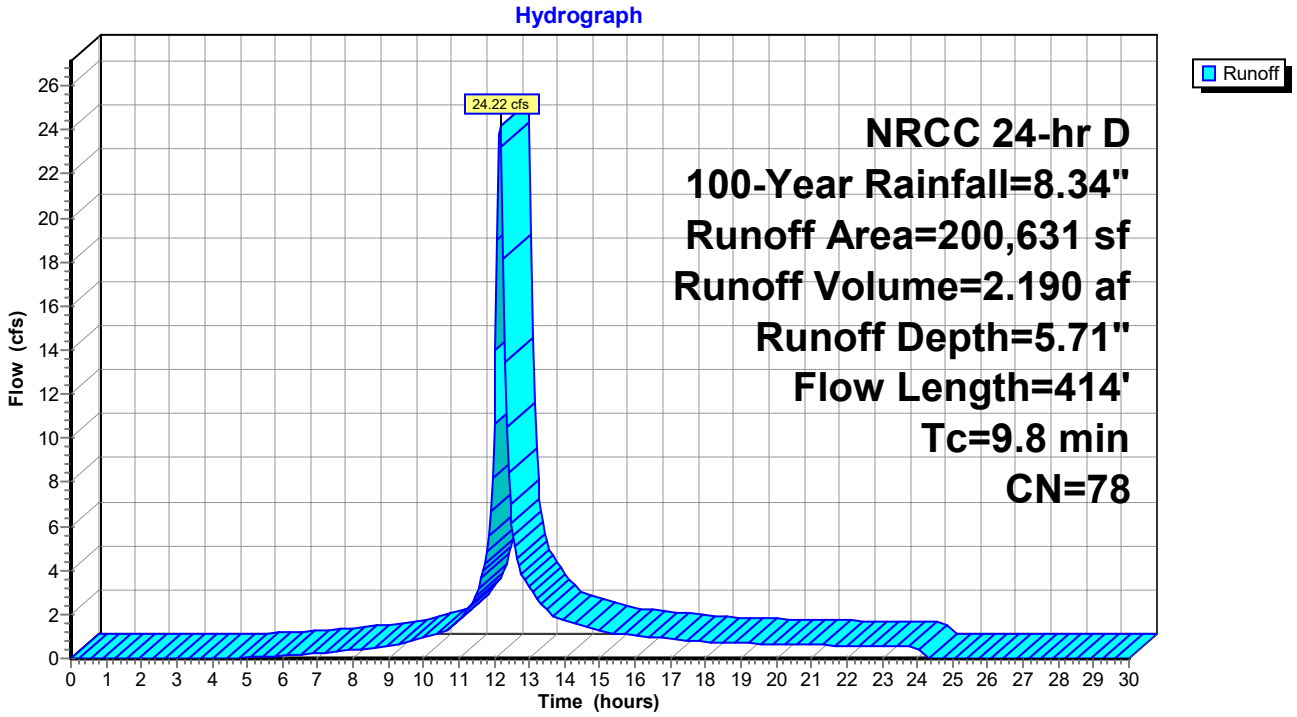
Runoff = 24.22 cfs @ 12.17 hrs, Volume= 2.190 af, Depth= 5.71"
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

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
24,954	74	>75% Grass cover, Good, HSG C
120,262	70	Woods, Good, HSG C
53,648	96	Gravel surface, HSG C
1,767	98	Paved parking, HSG C
200,631	78	Weighted Average
198,864		99.12% Pervious Area
1,767		0.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	47	0.0250	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.1	3	0.0070	0.43		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
3.5	281	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	83	0.0580	1.20		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.8	414	Total			

Subcatchment P11B: OVERLAND TO DP#2



Summary for Subcatchment P13: TO ROOF DRAINAGE

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

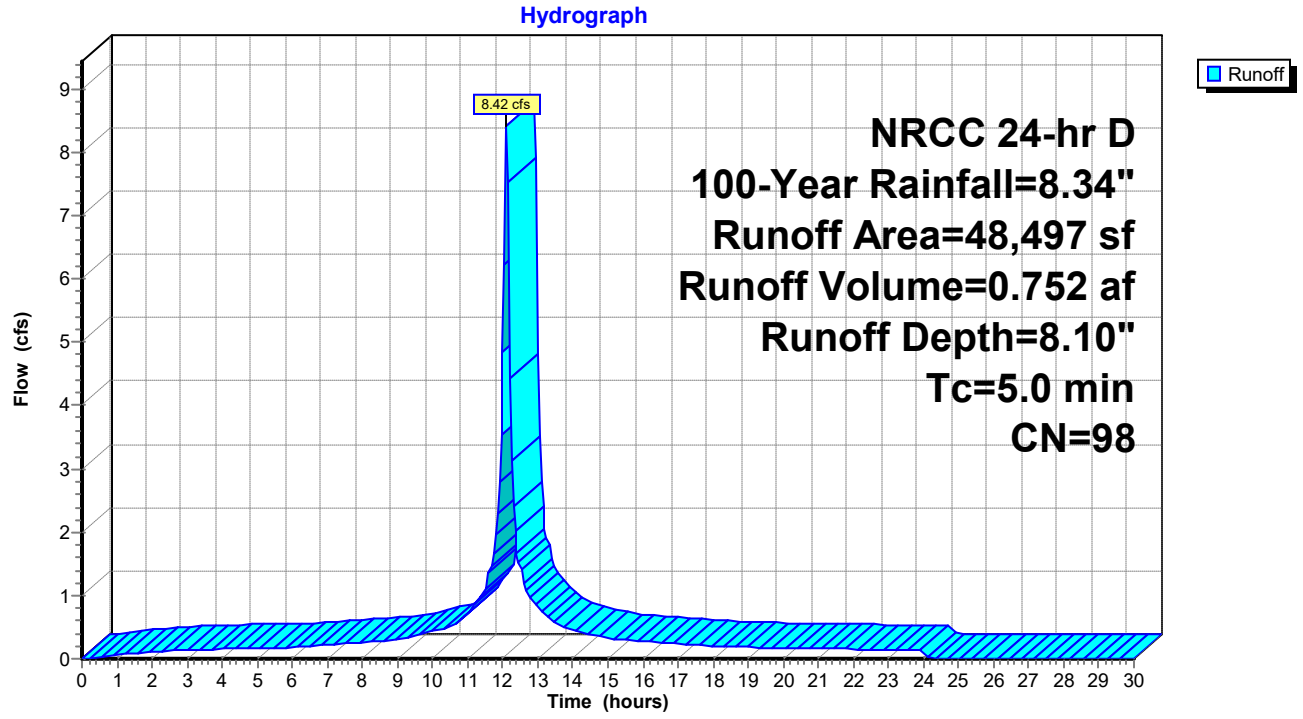
Runoff = 8.42 cfs @ 12.11 hrs, Volume= 0.752 af, Depth= 8.10"
Routed to Reach RF : TO DCB-A

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
48,497	98	Paved parking, HSG C
48,497		100.00% Impervious Area

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

Subcatchment P13: TO ROOF DRAINAGE



Summary for Subcatchment P14: TO INLET

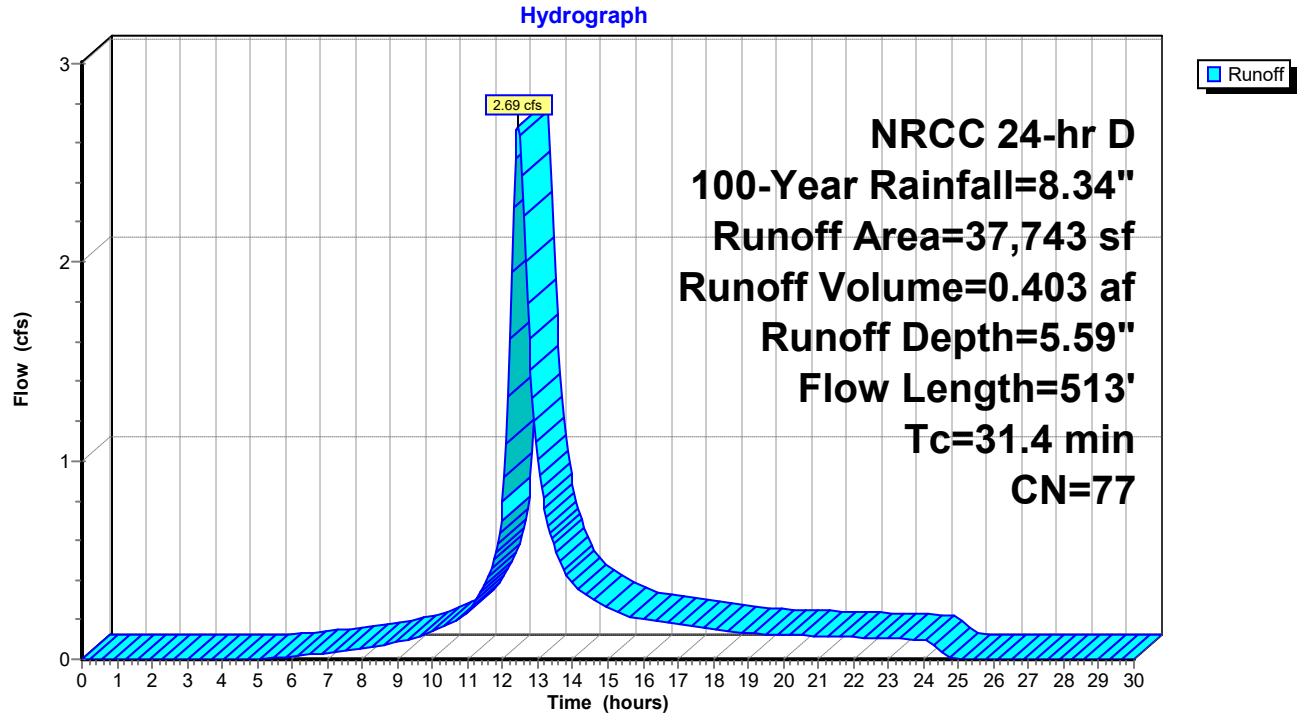
Runoff = 2.69 cfs @ 12.43 hrs, Volume= 0.403 af, Depth= 5.59"
Routed to Reach PIPE : INLET TO DCB-A

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
3,033	74	>75% Grass cover, Good, HSG C
25,403	70	Woods, Good, HSG C
7,646	96	Gravel surface, HSG C
1,661	98	Paved parking, HSG C
37,743	77	Weighted Average
36,082		95.60% Pervious Area
1,661		4.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	21	0.2850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
11.9	29	0.0080	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
17.3	463	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
31.4	513	Total			

Subcatchment P14: TO INLET



Summary for Subcatchment P15: TO DCB-B

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

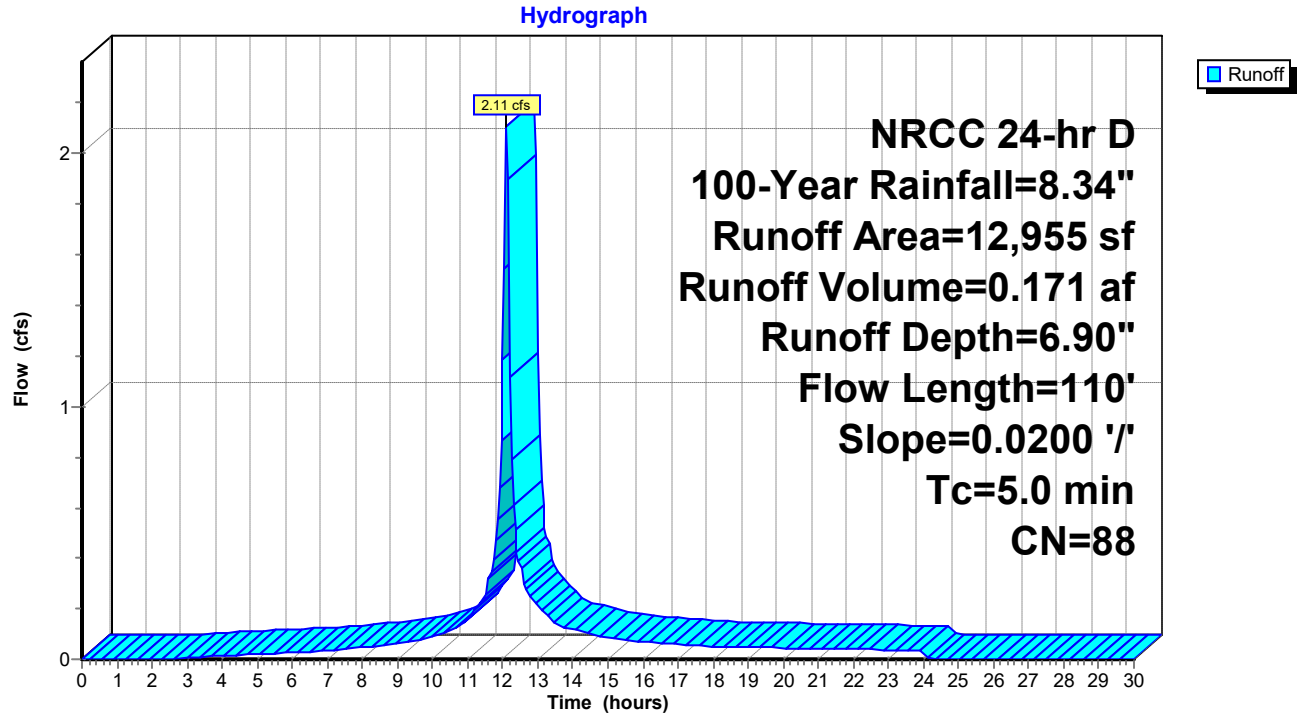
Runoff = 2.11 cfs @ 12.11 hrs, Volume= 0.171 af, Depth= 6.90"
Routed to Pond DCB-B : TO DCB-C

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
1,190	74	>75% Grass cover, Good, HSG C
3,195	70	Woods, Good, HSG C
6,862	96	Gravel surface, HSG C
1,708	98	Paved parking, HSG C
12,955	88	Weighted Average
11,247		86.82% Pervious Area
1,708		13.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	110	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P15: TO DCB-B



Summary for Subcatchment P16: TO DCB-C

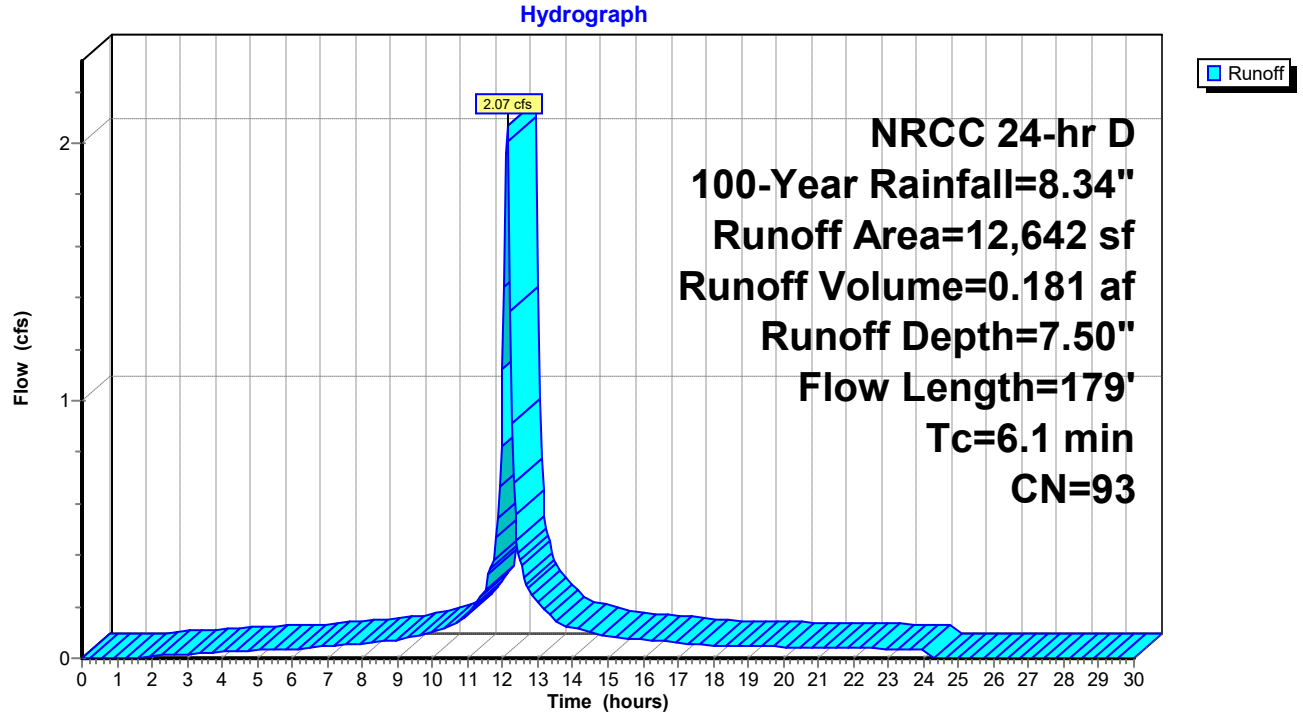
Runoff = 2.07 cfs @ 12.13 hrs, Volume= 0.181 af, Depth= 7.50"
Routed to Reach DCB-C* : TO DMH-10

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
715	74	>75% Grass cover, Good, HSG C
9,014	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
2,891	89	Gravel roads, HSG C
12,642	93	Weighted Average
12,620		99.83% Pervious Area
22		0.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			

Subcatchment P16: TO DCB-C



Summary for Subcatchment P201: TO RAIN GARDEN #2

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

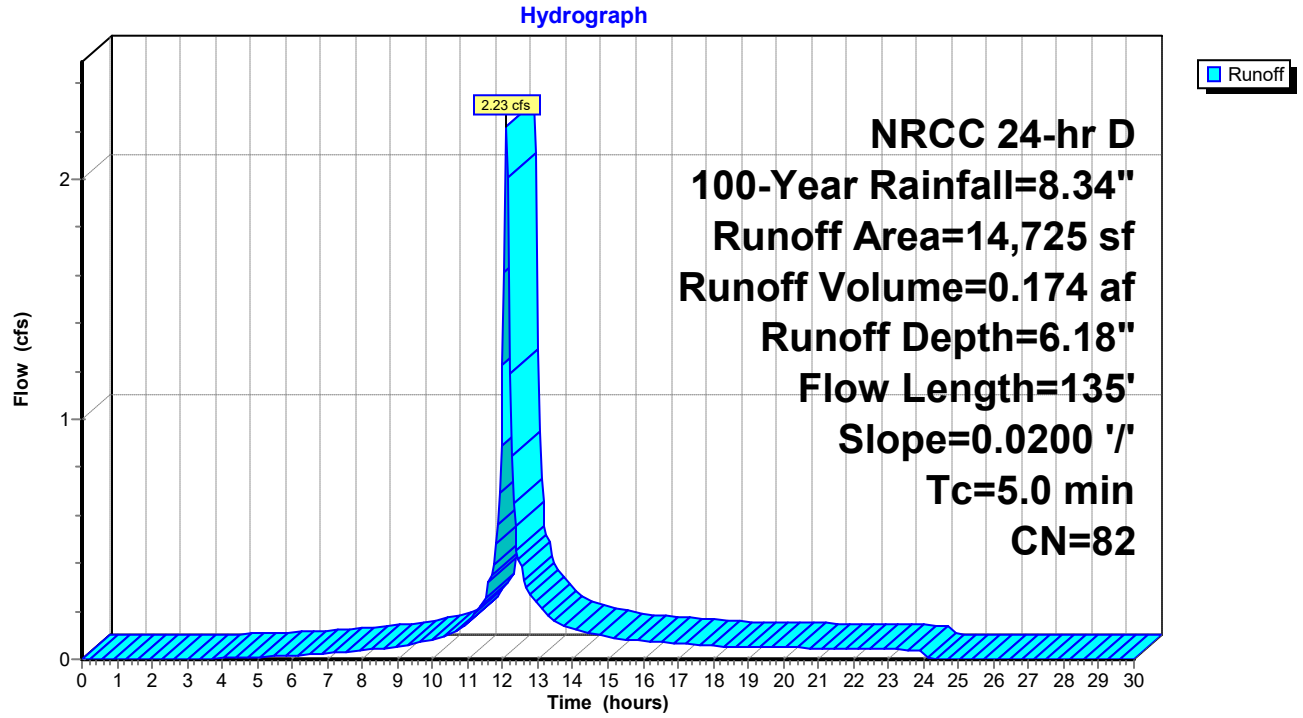
Runoff = 2.23 cfs @ 12.11 hrs, Volume= 0.174 af, Depth= 6.18"
Routed to Pond RG2 : TO DMH#11

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
7,946	74	>75% Grass cover, Good, HSG C
4,075	89	Gravel roads, HSG C
1,784	98	Paved parking, HSG C
920	96	Gravel surface, HSG C
14,725	82	Weighted Average
12,941		87.88% Pervious Area
1,784		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.6	85	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	135	Total, Increased to minimum Tc = 5.0 min			

Subcatchment P201: TO RAIN GARDEN #2



Summary for Reach DCB-A: TO WETLAND

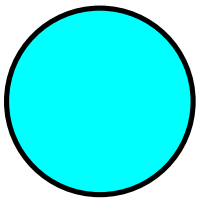
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 134% of Manning's capacity
[76] Warning: Detained 0.017 af (Pond w/culvert advised)
[62] Hint: Exceeded Reach PIPE OUTLET depth by 1.74' @ 12.10 hrs

Inflow Area = 1.980 ac, 58.16% Impervious, Inflow Depth = 7.00" for 100-Year event
Inflow = 9.48 cfs @ 12.11 hrs, Volume= 1.155 af
Outflow = 7.05 cfs @ 12.15 hrs, Volume= 1.155 af, Atten= 26%, Lag= 2.1 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

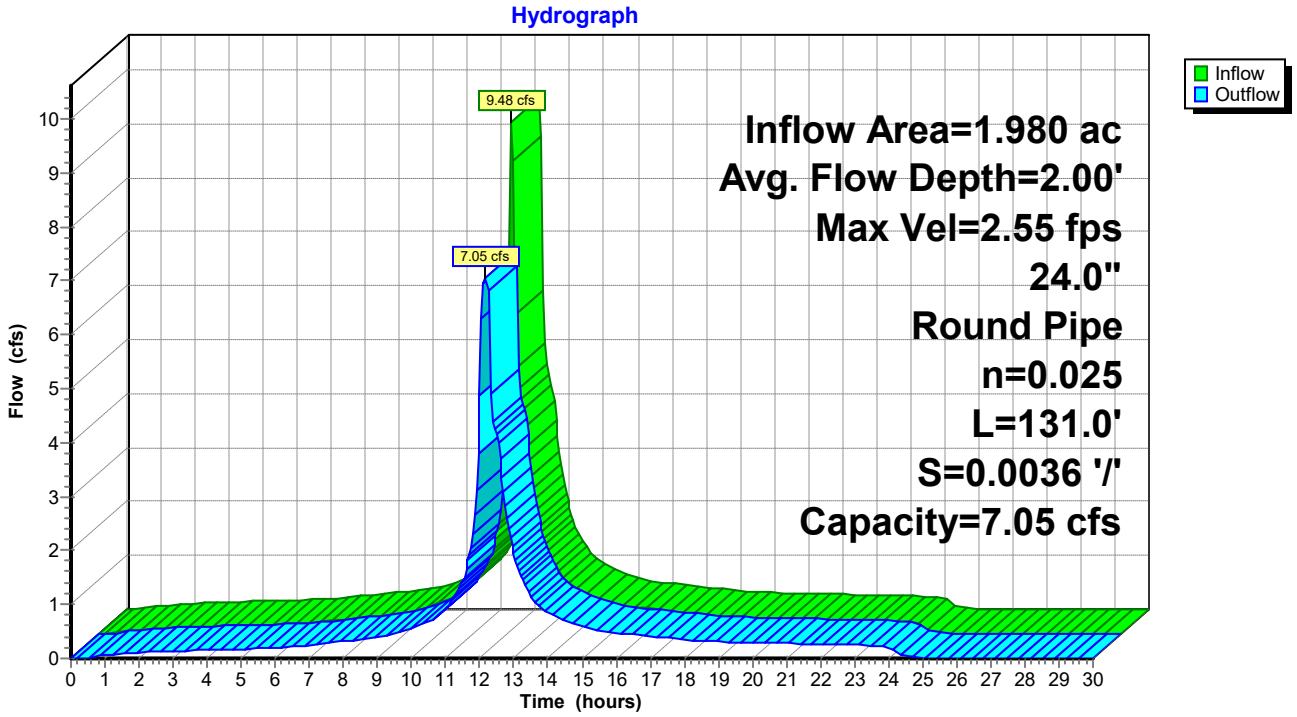
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.55 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 1.9 min

Peak Storage= 412 cf @ 12.10 hrs
Average Depth at Peak Storage= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 7.05 cfs

24.0" Round Pipe
n= 0.025 Corrugated metal
Length= 131.0' Slope= 0.0036 '/'
Inlet Invert= 106.90', Outlet Invert= 106.43'



Reach DCB-A: TO WETLAND



Summary for Reach DCB-C*: TO DMH-10

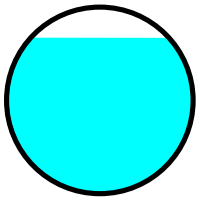
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 103% of Manning's capacity

Inflow Area = 0.290 ac, 0.17% Impervious, Inflow Depth = 7.50" for 100-Year event
Inflow = 2.07 cfs @ 12.13 hrs, Volume= 0.181 af
Outflow = 2.07 cfs @ 12.13 hrs, Volume= 0.181 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DMH10 : TO OUTLET

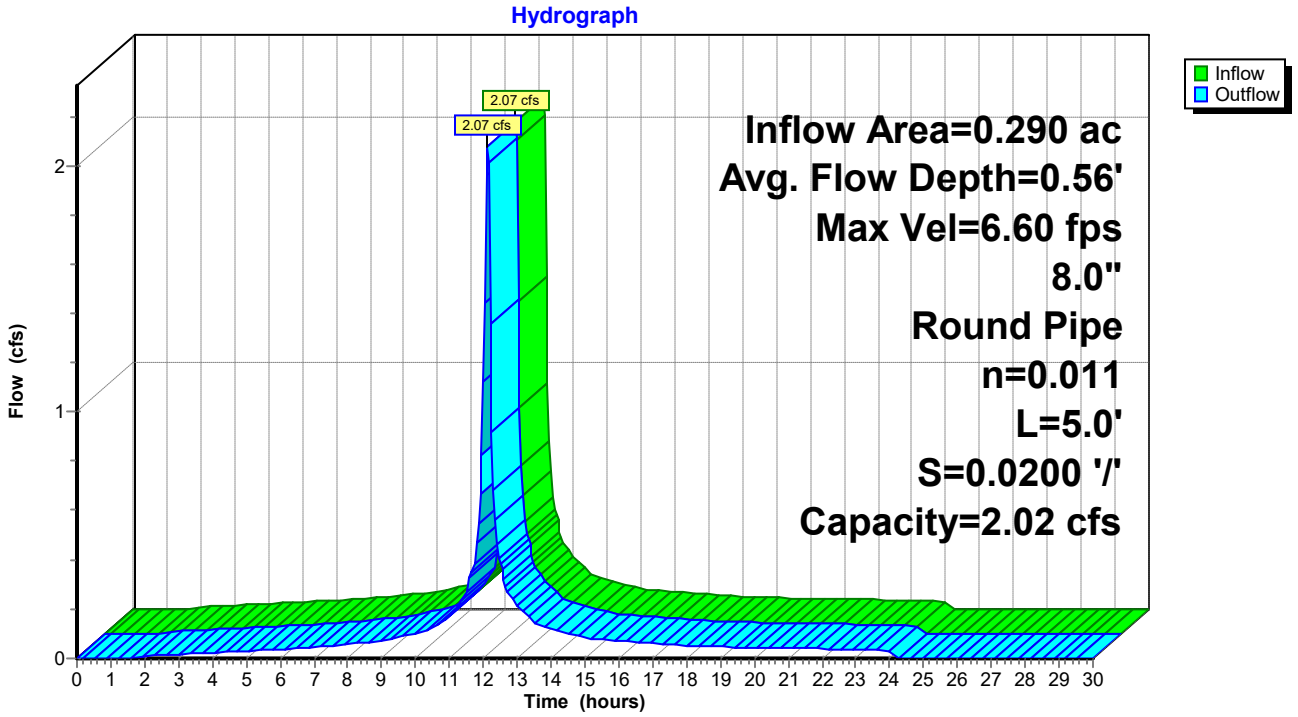
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.60 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.59 fps, Avg. Travel Time= 0.0 min

Peak Storage= 2 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.56' , Surface Width= 0.49'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 2.02 cfs

8.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 5.0' Slope= 0.0200 '/'
Inlet Invert= 107.80', Outlet Invert= 107.70'



Reach DCB-C*: TO DMH-10



Summary for Reach DMH10: TO OUTLET

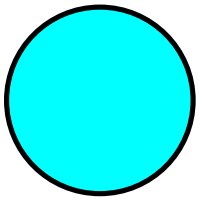
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 112% of Manning's capacity
[76] Warning: Detained 0.002 af (Pond w/culvert advised)
[63] Warning: Exceeded Reach DCB-C* INLET depth by 0.51' @ 12.15 hrs
[62] Hint: Exceeded Reach DMH11 OUTLET depth by 0.67' @ 12.15 hrs
[79] Warning: Submerged Pond DCB-B Primary device # 1 OUTLET by 0.57'

Inflow Area = 0.926 ac, 8.71% Impervious, Inflow Depth = 6.83" for 100-Year event
Inflow = 5.09 cfs @ 12.14 hrs, Volume= 0.527 af
Outflow = 4.70 cfs @ 12.18 hrs, Volume= 0.527 af, Atten= 8%, Lag= 2.2 min
Routed to Reach DP#2 : WETLAND SERIES 1(NORTH)

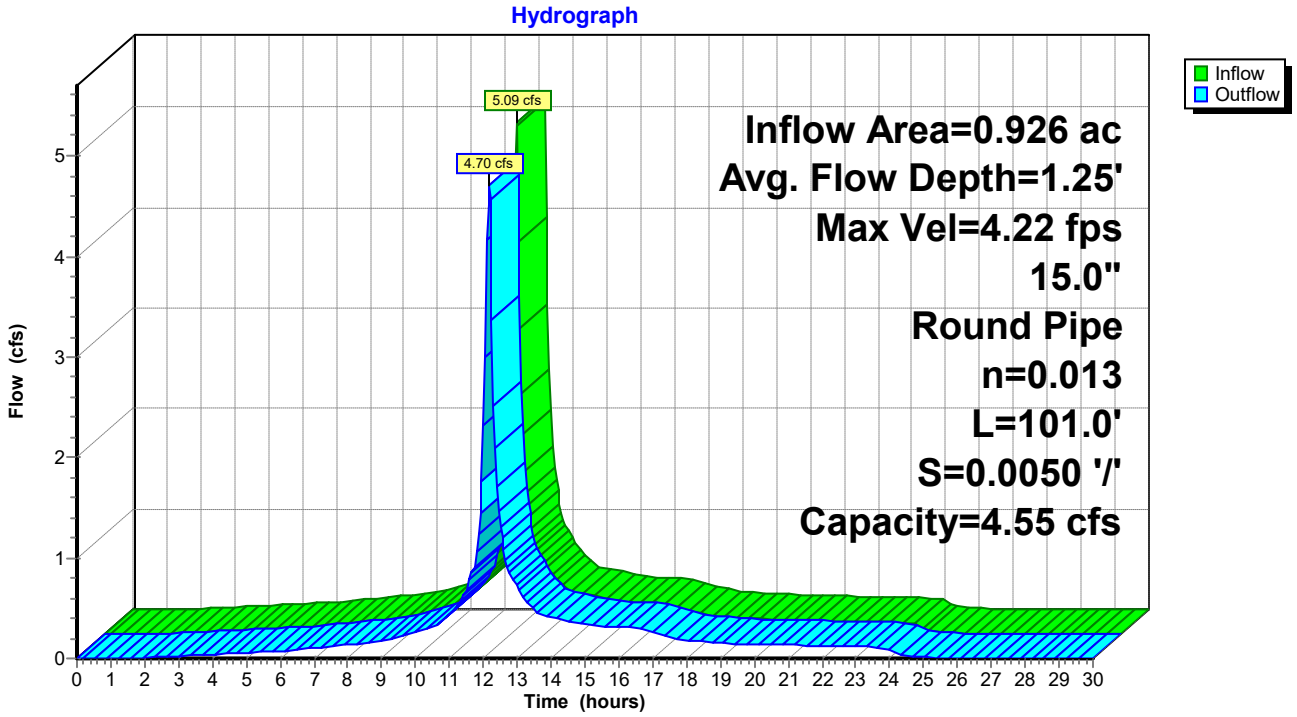
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.22 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.54 fps, Avg. Travel Time= 1.1 min

Peak Storage= 124 cf @ 12.15 hrs
Average Depth at Peak Storage= 1.25'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.55 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 101.0' Slope= 0.0050 '/'
Inlet Invert= 107.60', Outlet Invert= 107.10'



Reach DMH10: TO OUTLET



Summary for Reach DMH11: TO DMH#10

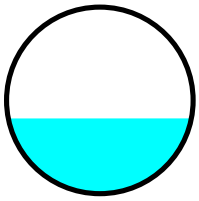
[52] Hint: Inlet/Outlet conditions not evaluated
[79] Warning: Submerged Pond RG2 Primary device # 4 OUTLET by 0.30'

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 6.18" for 100-Year event
Inflow = 1.46 cfs @ 12.19 hrs, Volume= 0.174 af
Outflow = 1.44 cfs @ 12.21 hrs, Volume= 0.174 af, Atten= 1%, Lag= 1.0 min
Routed to Reach DMH10 : TO OUTLET

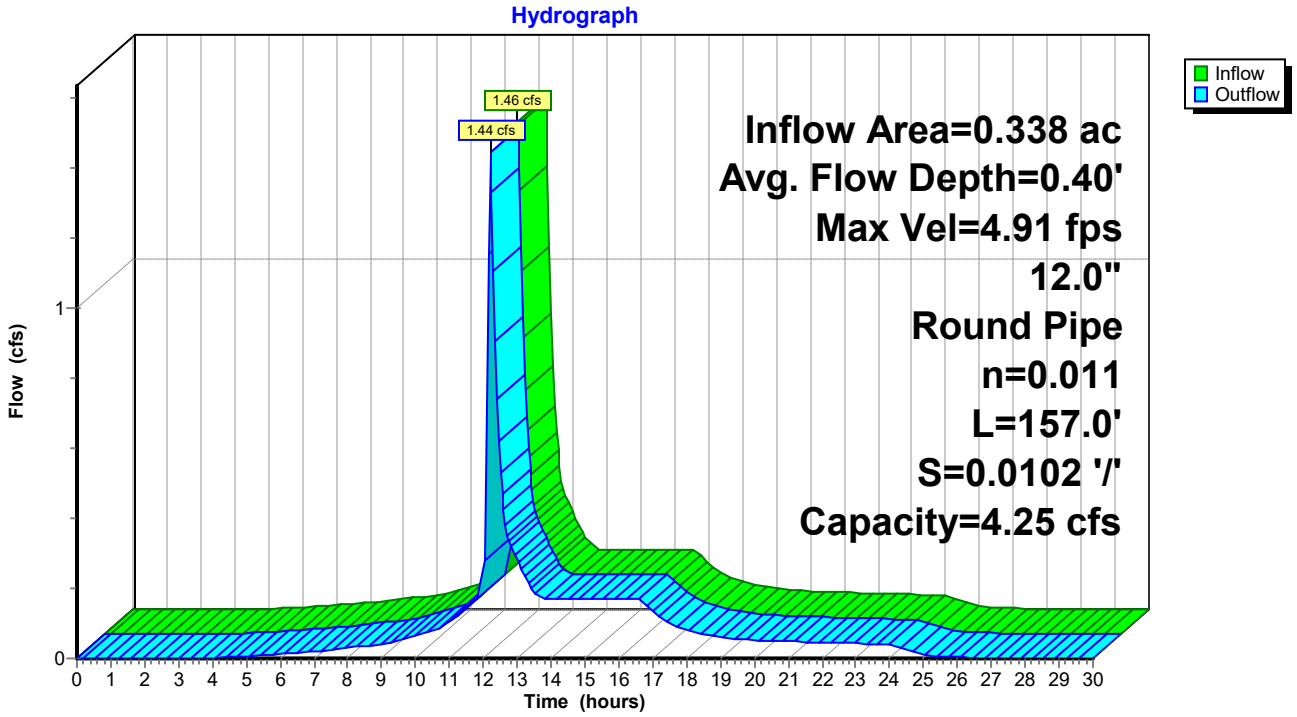
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.91 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.75 fps, Avg. Travel Time= 1.5 min

Peak Storage= 47 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.40' , Surface Width= 0.98'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.25 cfs

12.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 157.0' Slope= 0.0102 '/'
Inlet Invert= 109.40', Outlet Invert= 107.80'



Reach DMH11: TO DMH#10



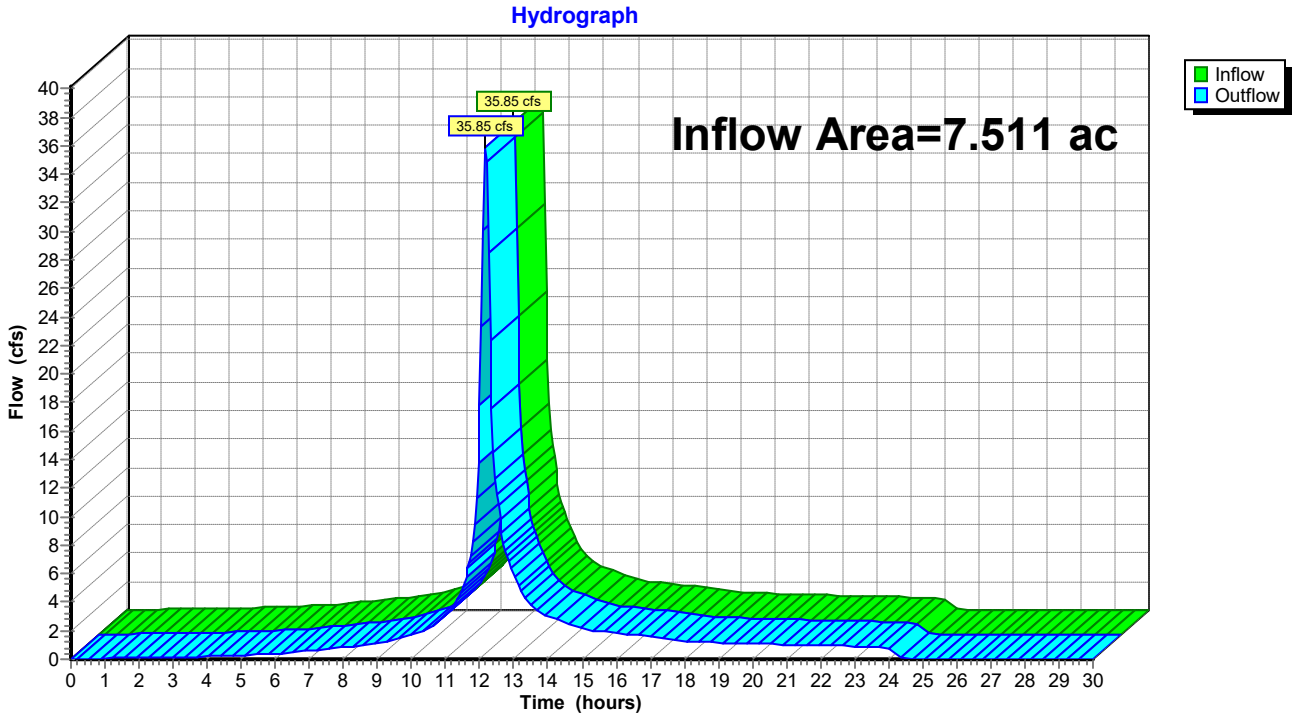
Summary for Reach DP#2: WETLAND SERIES 1(NORTH)

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

Inflow Area = 7.511 ac, 16.94% Impervious, Inflow Depth = 6.19" for 100-Year event
Inflow = 35.85 cfs @ 12.17 hrs, Volume= 3.872 af
Outflow = 35.85 cfs @ 12.17 hrs, Volume= 3.872 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#2: WETLAND SERIES 1(NORTH)



Summary for Reach PIPE: INLET TO DCB-A

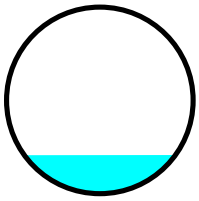
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.866 ac, 4.40% Impervious, Inflow Depth = 5.59" for 100-Year event
Inflow = 2.69 cfs @ 12.43 hrs, Volume= 0.403 af
Outflow = 2.68 cfs @ 12.45 hrs, Volume= 0.403 af, Atten= 0%, Lag= 1.3 min
Routed to Reach DCB-A : TO WETLAND

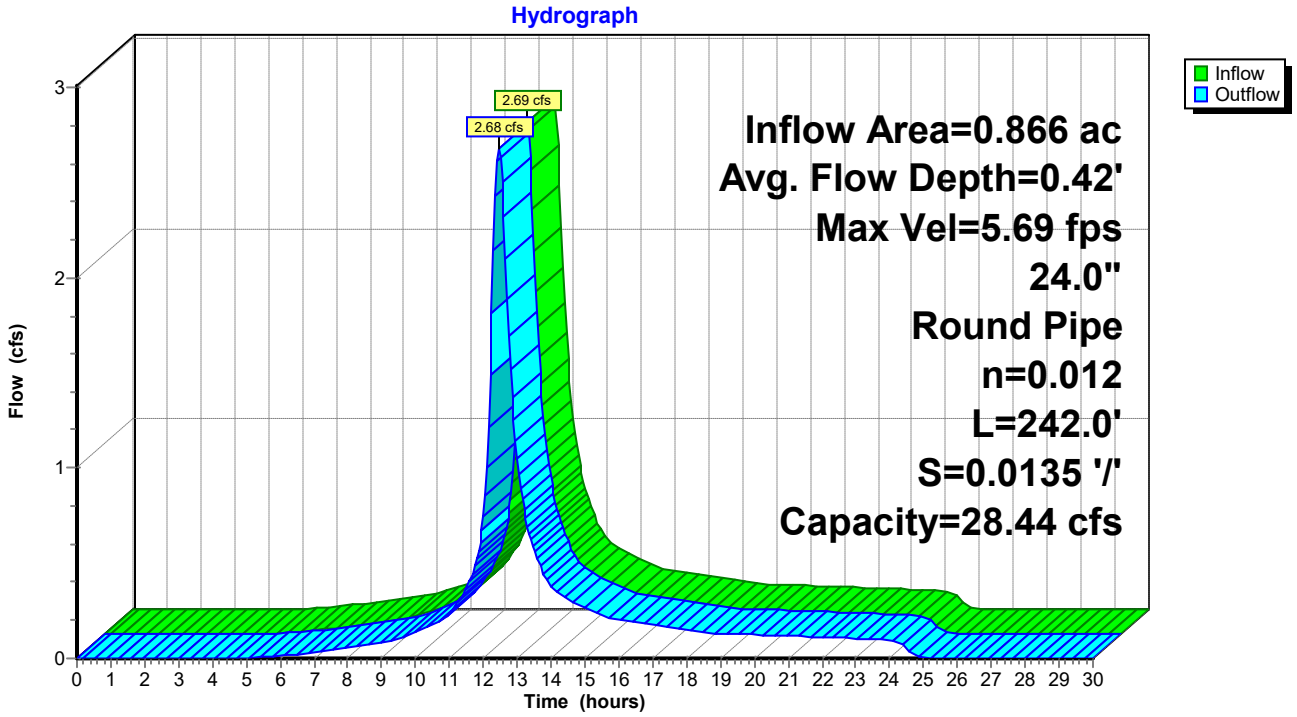
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.69 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.33 fps, Avg. Travel Time= 1.7 min

Peak Storage= 114 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.42' , Surface Width= 1.62'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 28.44 cfs

24.0" Round Pipe
n= 0.012 Steel, smooth
Length= 242.0' Slope= 0.0135 '/'
Inlet Invert= 110.16', Outlet Invert= 106.90'



Reach PIPE: INLET TO DCB-A



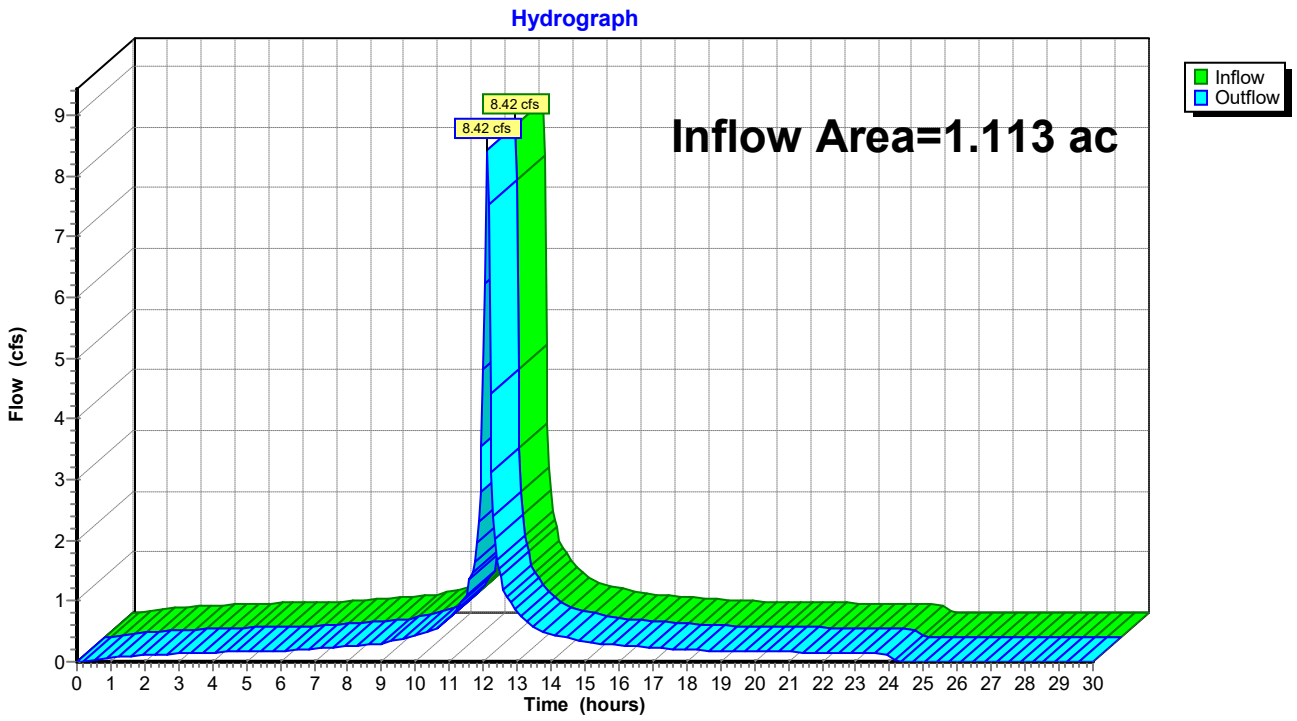
Summary for Reach RF: TO DCB-A

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

Inflow Area = 1.113 ac,100.00% Impervious, Inflow Depth = 8.10" for 100-Year event
Inflow = 8.42 cfs @ 12.11 hrs, Volume= 0.752 af
Outflow = 8.42 cfs @ 12.11 hrs, Volume= 0.752 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DCB-A : TO WETLAND

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

Reach RF: TO DCB-A



Summary for Pond DCB-B: TO DCB-C

[57] Hint: Peaked at 127.82' (Flood elevation advised)

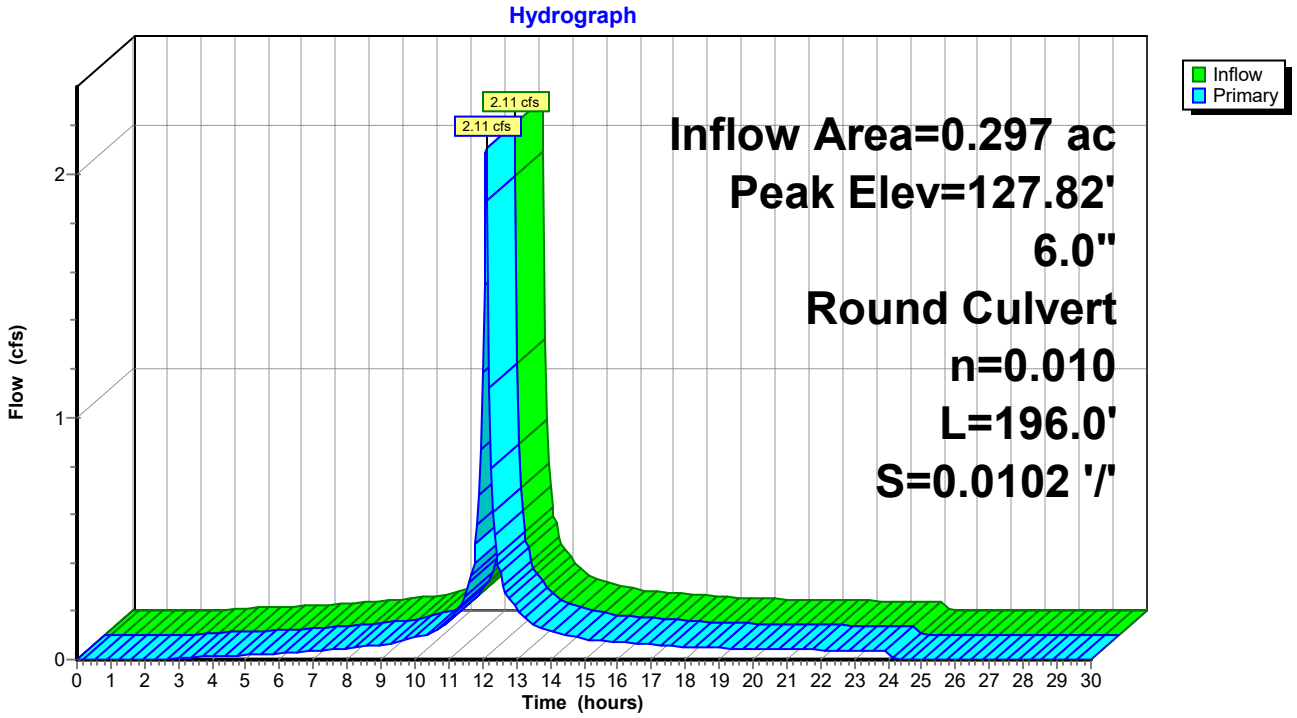
Inflow Area = 0.297 ac, 13.18% Impervious, Inflow Depth = 6.90" for 100-Year event
Inflow = 2.11 cfs @ 12.11 hrs, Volume= 0.171 af
Outflow = 2.11 cfs @ 12.11 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min
Primary = 2.11 cfs @ 12.11 hrs, Volume= 0.171 af
Routed to Reach DMH10 : TO OUTLET

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 127.82' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	110.28'	**6.0" Round Culvert** L= 196.0' Square-edged headwall, Ke= 0.500 Inlet / Outlet Invert= 110.28' / 108.28' S= 0.0102 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=2.04 cfs @ 12.11 hrs HW=126.75' (Free Discharge)
1=Culvert (Barrel Controls 2.04 cfs @ 10.41 fps)

Pond DCB-B: TO DCB-C



Summary for Pond RG2: TO DMH#11

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

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 6.18" for 100-Year event
Inflow = 2.23 cfs @ 12.11 hrs, Volume= 0.174 af
Outflow = 1.46 cfs @ 12.19 hrs, Volume= 0.174 af, Atten= 35%, Lag= 4.9 min
Primary = 1.46 cfs @ 12.19 hrs, Volume= 0.174 af
Routed to Reach DMH11 : TO DMH#10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DMH11 : TO DMH#10

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 112.48' @ 12.19 hrs Surf.Area= 3,905 sf Storage= 1,725 cf

Plug-Flow detention time= 57.7 min calculated for 0.174 af (100% of inflow)
Center-of-Mass det. time= 57.6 min (867.6 - 810.0)

Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	12,045 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

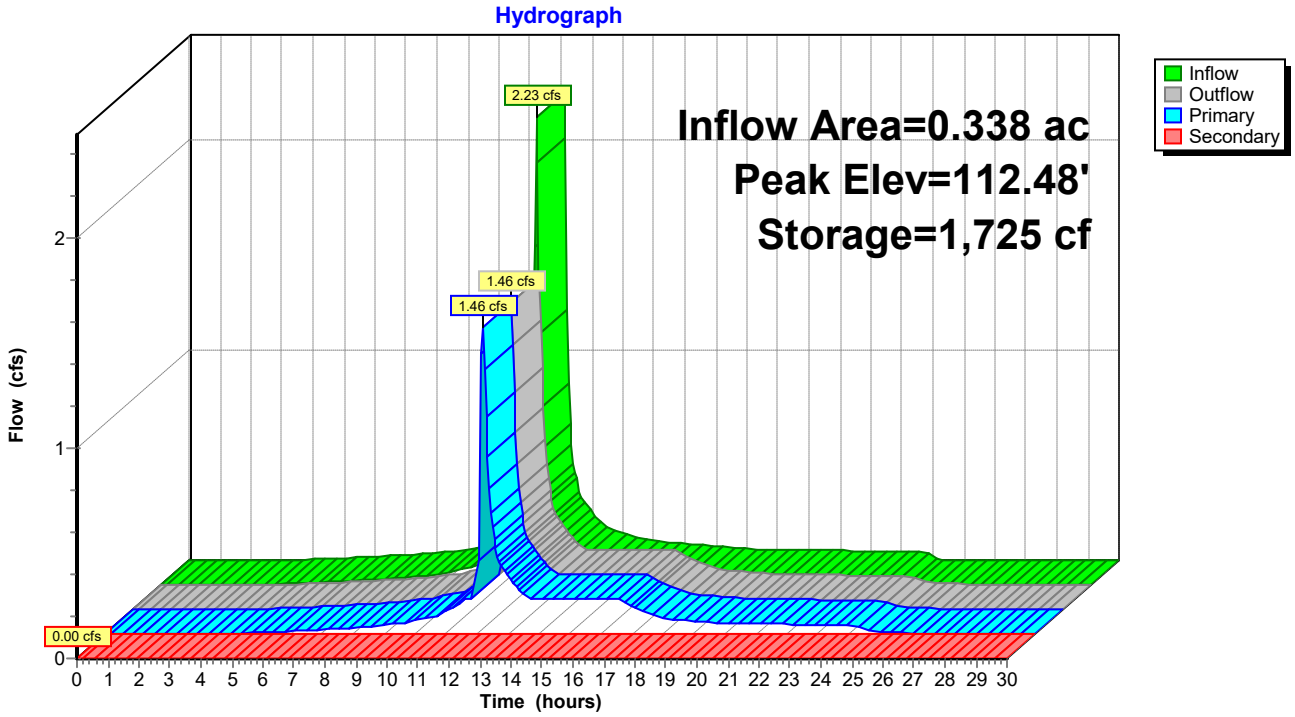
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	3,332	0	0
113.00	4,534	3,933	3,933
114.00	5,693	5,114	9,047
114.50	6,300	2,998	12,045

Device	Routing	Invert	Outlet Devices
#1	Device 4	112.35'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#2	Device 4	109.90'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Secondary	113.50'	**10.0' long + 2.0 '/' SideZ 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
#4	Primary	109.80'	**12.0" Round Culvert** L= 33.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 109.80' / 109.50' S= 0.0091 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.19 hrs HW=112.48' (Free Discharge)
└**4=Culvert** (Passes 1.32 cfs of 6.36 cfs potential flow)
├**1=Sharp-Crested Rectangular Weir** (Weir Controls 1.15 cfs @ 1.19 fps)
└**2=Special & User-Defined** (Custom Controls 0.17 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=112.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond RG2: TO DMH#11



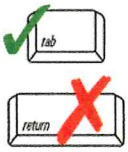
3.0
STORMWATER MANAGEMENT FORMS

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.

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

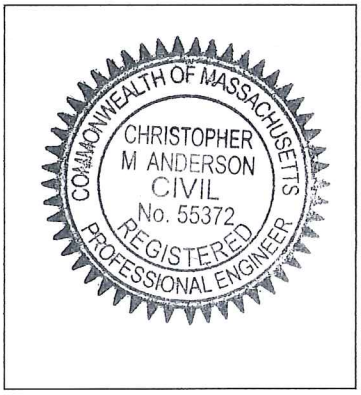
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



3-27-2023

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ 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, Proprietary water quality unit

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 for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

☐ Calculations provided to 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.

Checklist for Stormwater Report

[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 for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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 for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

Stormwater Compliance Documentation

256 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 the property at 256 Murdock Avenue, this area has been designated as Design Point #2 (DP#2).

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. Additionally it is the intent that this rain garden will connect to a proposed water quality unit which will additionally treat a portion of the existing runoff from the surrounding development.

As part of the project the majority of the runoff will be directed towards a small raingarden located along the northly portion of the ESS project area. This will then discharge towards a drainage trunkline prior to being discharged towards Design Point #2. 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
L=1.80(Q-5)/Sp^(1.5) + 10

Equation-11.33
W2=3Sp +0.7La

For 15-inch HDPE pipe (FE#1)

Qmax=4.46 cfs (100-Year) Sp=15/12 → 1.25 ft

L=1.8(4.46-5)/(1.25^1.5) + 10 → -0.7 + 10 = 9.3 → 10 feet

W2=3(1.25) +0.7(10) → 3.75 + 7 = 10.75 → 12.0 feet

FE#3 discharges towards a level spreader that is 12-feet long.

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-	9.63	17.83	24.48	36.46
	Post-	9.58	17.48	23.84	35.85

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: 5,835 s.f.
Proposed Impervious HSG-C: 3,789 s.f.
Net New Impervious HSG-C: -2,046 s.f.

Total New Impervious area = -2,046 s.f.
Total Project Impervious = 3,789 s.f.

Portions of the existing gravel access drive will be removed as part of the development for installation of rain garden

Required Recharge Volume:

Net Increase HSG Soil C

Net New Impervious HSG C= -2,046 s.f.
HSG C: -2,046 s.f. x (0.25 in/12) = 0 c.f.

Required Recharge Volume = 0 c.f.

Capture Rate:

Total Impervious to RG#2	2,704 sf
Net Captured Impervious	**2,704 sf**

Capture Rate = 2,704 s.f. / 3,789 s.f. = 71.4%

Compliance provided.

Storage Volume Provided:

Volume below lowest outlet within detention facility.

RG-1: 1,257 c.f. of storage volume provided

Recharge Provided:

Total Volume Required: 0 c.f.

Storage Volume
RG-1: 1,257 c.f. of storage volume provided

Required Recharge Volume = 0 c.f.
Provided Recharge Volume = 1,257 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: 1,257 c.f. of storage volume provided.
Time = 1,257 c.f. / (0.27 in/hr x (1 ft/ 12 in) x 3,332 s.f.) = **16.8 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 (3,789 s.f.) = 158 cf

Water Quality Depth -TP = 1 inch
WQV -TP = [(1-inch) / 12 inches/foot] x (3,789 s.f.) = 316 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 new 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 4" which equates to a storage volume of 1,257 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.

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: _____

Summary for Pond RG2: TO DMH#11

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

Inflow Area = 0.338 ac, 12.12% Impervious, Inflow Depth = 3.34" for Custom event
Inflow = 1.24 cfs @ 12.11 hrs, Volume= 0.094 af
Outflow = 0.19 cfs @ 12.60 hrs, Volume= 0.094 af, Atten= 84%, Lag= 29.1 min
Primary = 0.19 cfs @ 12.60 hrs, Volume= 0.094 af
Routed to Reach DMH11 : TO DMH#10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DMH11 : TO DMH#10

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 112.35' @ 12.60 hrs Surf.Area= 3,758 sf Storage= 1,257 cf <=Storage/Recharge VOlume

Plug-Flow detention time= 68.3 min calculated for 0.094 af (100% of inflow)
Center-of-Mass det. time= 68.2 min (900.7 - 832.5)

Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	12,045 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	3,332	0	0
113.00	4,534	3,933	3,933
114.00	5,693	5,114	9,047
114.50	6,300	2,998	12,045

Device	Routing	Invert	Outlet Devices
#1	Device 4	112.35'	**2.6' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 0.5' Crest Height
#2	Device 4	109.90'	**Special & User-Defined** Head (feet) 0.00 1.00 15.00 Disch. (cfs) 0.000 0.170 0.170
#3	Secondary	113.50'	**10.0' long + 2.0 '/' SideZ 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
#4	Primary	109.80'	**12.0" Round Culvert** L= 33.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 109.80' / 109.50' S= 0.0091 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.18 cfs @ 12.60 hrs HW=112.35' (Free Discharge)
↑**4=Culvert** (Passes 0.18 cfs of 6.16 cfs potential flow)
↑**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.22 fps)
2=Special & User-Defined (Custom Controls 0.17 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=112.00' (Free Discharge)
↑**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

MASS DEP "Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices"

DMH#10-Water Quality Unit

For First 0.5-Inch Runoff WQV

Step 1: Area of Impervious Surface to Structure

0.926 acres @ 100% Impervious = 0.926 Acres Impervious
0.926 Acres x .0015625 sq mi = ***1.45x(10^-3) square miles.***

Step 2: Tc of Train

P16 to DCB-C*:	6.1 min
DCB-C*to DMH#10:	0.0 min
Total Tc to DMH#10	***6.1 min or 0.102 hours***

Step 3: Determine qu

From Figure 4:

Tc @ 0.100, qu=752csm/in

Step 4: Determine Q(1)

Q(1/2) = (qu)x(A)x(WQV)

Q(1/2) = (752csm/in)x(1.45x(10^-3)) x(0.5 in)

Q(1/1) = 0.55 CFS

Determination
Determination of Water Quality Flow rates for units by Connecticut DOT (CONNDOT)

From Technology Verification
HG 5 Treatment Flow rate
1.7 cf.s > 0.55 c.f.s. "Pass"

HydroGuard HG5 to be utilized in Design.

Summary for Subcatchment P16: TO DCB-C

Runoff = 0.56 cfs @ 12.13 hrs, Volume= 0.045 af, Depth= 1.85"
Routed to Reach DCB-C* : TO DMH-10

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 1-Year Rainfall=2.58"

Area (sf)	CN	Description
715	74	>75% Grass cover, Good, HSG C
9,014	96	Gravel surface, HSG C
22	98	Paved parking, HSG C
2,891	89	Gravel roads, HSG C
12,642	93	Weighted Average
12,620		99.83% Pervious Area
22		0.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.8	129	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	179	Total			<=Tc

Summary for Reach DCB-C*: TO DMH-10

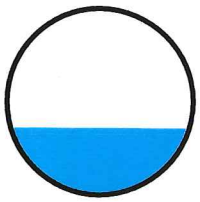
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.290 ac, 0.17% Impervious, Inflow Depth = 1.85" for 1-Year event
Inflow = 0.56 cfs @ 12.13 hrs, Volume= 0.045 af
Outflow = 0.56 cfs @ 12.13 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min
Routed to Reach DMH10 : TO OUTLET

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.91 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.74 fps, Avg. Travel Time= 0.0 min <=tc

Peak Storage= 1 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.24' , Surface Width= 0.64'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 2.02 cfs

8.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 5.0' Slope= 0.0200 '/'
Inlet Invert= 107.80', Outlet Invert= 107.70'



```
**************************************************
*      Storm Water Management Sizing Model       *
*                Hydroworks, LLC                 *
*                 Version 4.4                    *
*                                                *
*        Continuous Simulation Program           *
*              Based on SWMM 4.4H                *
*              Hydroworks, LLC                   *
*               Graham Bryant                    *
*                2003 - 2021                     *
**************************************************

                Developed by

**************************************************
*               Hydroworks, LLC                  *
*             Metcalf & Eddy, Inc.               *
*            University of Florida               *
*       Water Resources Engineers, Inc.          *
*      (Now Camp Dresser & McKee, Inc.)          *
*               Modified SWMM 4.4                *
**************************************************

         Distributed and Maintained by

**************************************************
*                                                *
*               Hydroworks, LLC                  *
*                888-290-7900                    *
*             www.hydroworks.com                 *
*                                                *
**************************************************

**************************************************
*     If any problems occur executing this       *
*     model, contact Mr. Graham Bryant at        *
*     Hydroworks, LLC by phone at 888-290-7900   *
*     or by e-mail: support@hydroworks.com       *
**************************************************

**************************************************
*     This model is based on EPA SWMM 4.4        *
*  "Nature is full of infinite causes which      *
*   have never occurred in experience" da Vinci  *
**************************************************


**************************************************
* Entry made to the Rain Block                   *
* Created by the University of Florida - 1988    *
* Updated by Oregon State University, March 2000 *
**************************************************
```

ZP Battery DevCo, LLC
DMH#10

Hydroguard Simulation

```
 ########################################
 #  Precipitation Block Input Commands  #
 ########################################

Station Name.......................  Sterling 2 Nnw

Station Location...................  Massachusetts

Station, ISTA......................    8159

Beginning date, IYBEG (Yr/Mo/Dy)...  1948/ 1/ 1

Ending date, IYEND (Yr/Mo/Dy)......  1972/12/31

Minimum interevent time, MIT.......     1

Number of ranked storms, NPTS......    10

NWS format, IFORM (See text).......     1

Print storm summary, ISUM (O-No 1-Yes)     0

Print all rainfall, IYEAR (O-No 1-Yes)     0

Save storm event data on NSCRAT(1)....     0
(IFILE =0 -Do not save, =1 -Save data)

IDECID 0 - Create interface file
       1 - Create file and analyze
       2 - Synoptic analysis.......     2

Plotting position parameter, A.....  0.40

Storm event statistics, NOSTAT.....  1100


KODEA (from optional group B0).....     2
 = 0, Do not include NCDC cumulative values.
 = 1, Average NCDC cumulative values.
 = 2, Use NCDC cumulative value as inst. rain.

KODEPR (from optional group B0).....     0
 Print NCDC special codes in event summary:
 = 0, only on days with events.
 = 1, on all days with codes present.
 Codes: A = accumulated value, I = incomplete value,
        M = missing value,     O = other code present
```

```
*****************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
*****************************************************

Location Station Number
-------- --------------
       1.     8159


STATION ID ON PRECIP. DATA INPUT FILE = 5902
REQUESTED STATION ID =     8159  CHECK TO BE SURE THEY MATCH.



$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

#####################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
#####################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins       #
#####################################################



                  ZP Battery DevCo, LLC

                  DMH#10



Snowmelt parameter - ISNOW.....................          0

Number of rain gages - NRGAG...................          1

Horton infiltration equation used - INFILM.....          2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.

Quality is simulated - KWALTY..................          1

IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
```

```
Read evaporation data on line(s) F1 (F2) - IVAP..          1

Hour of day at start of storm - NHR.............          1

Minute of hour at start of storm - NMN..........          1

Time TZERO at start of storm (hours).............      1.017

Use U.S. Customary units for most I/O - METRIC...          0

Runoff input print control...                              0

Runoff graph plot control....                              1

Runoff output print control..                              0

Print headers every 50 lines - NOHEAD (0=yes, 1=no)        0

Print land use load percentages -LANDUPR (0=no, 1=yes)     0

Limit number of groundwater convergence messages to 10000 (if simulated)

Month, day, year of start of storm is:              1/ 1/1948

Wet time step length (seconds).......                   300.

Dry time step length (seconds).......                   900.

Wet/Dry time step length (seconds)...                   450.

Simulation length is......                      19721231.0 Yr/Mo/Dy

Percent of impervious area with zero detention depth    25.0

Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ........................................   0.01000
```



```
*******************************************************
*   Processed Precipitation will be read from file    *
*******************************************************

  ############################
  #        Data Group F1     #
  # Evaporation Rate (in/day) #
  ############################
```

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.00	0.00	0.00	0.10	0.10	0.15	0.15	0.15	0.10	0.10	0.00	0.00

****
* C H A N N E L A N D P I P E D A T A *
****

Input equen umber	NAMEG: Channel ID #	Drains to NGTO:	Channel Type	Width (ft)	Length (ft)	Invert Slope (ft/ft)	L Side Slope (ft/ft)	R Side Slope (ft/ft)	Intial Depth (ft)	Max Depth (ft)	Mann- ings "N"	Full Flow (cfs)
1	201	200	Dummy	0.0	0.0	0.0000	0.0000	0.0000	0.0	0.0	0.0000	0.00E+00

****
* S U B C A T C H M E N T D A T A *
****

NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS

SUBCATCH- MENT NO.	CHANNEL OR INLET	WIDTH (FT)	AREA (AC)	PERCENT IMPERV.	SLOPE (FT/FT)	RESISTANCE IMPERV.	FACTOR PERV.	DEPRES. IMPERV.	STORAGE(IN) PERV.	INFILTRATION RATE(IN/HR) MAXIMUM	INFILTRATION RATE(IN/HR) MINIMUM	DECAY RATE (1/SEC)	GAGE NO.	MAXIMUM VOLUME (INCHES)
1	300	200	200.84	0.93	100.00	0.0200	0.015	0.250	0.020	0.200	2.50	0.40	0.00055	1	4.00000

TOTAL NUMBER OF SUBCATCHMENTS... 1
TOTAL TRIBUTARY AREA (ACRES).... 0.93
IMPERVIOUS AREA (ACRES)..... 0.93
PERVIOUS AREA (ACRES)..... 0.00
TOTAL WIDTH (FEET)..... 200.84
PERCENT IMPERVIOUSNESS..... 100.00

****
* G R O U N D W A T E R I N P U T D A T A *
****

SUB-CATCH NUMBER	CHANNEL OR INLET	ELEVATIONS GROUND (FT)	ELEVATIONS BOTTOM (FT)	ELEVATIONS STAGE (FT)	ELEVATIONS BC (FT)	ELEVATIONS TW (FT)	FLOW CONSTANTS A1 (IN/HR-FT^B1)	FLOW CONSTANTS B1	FLOW CONSTANTS A2 (IN/HR-FT^B2)	FLOW CONSTANTS B2	FLOW CONSTANTS A3 (IN/HR-FT^2)
0	602	10.00	0.00	0.00	2.00	2.00	4.500E-05	2.600	0.000E+00	1.000	0.00E+00

****
* G R O U N D W A T E R I N P U T D A T A (CONTINUED) *
****

S O I L P R O P E R T I E S

E T P A R A M E T E R S

SUBCAT. NO.	POROSITY	SATURATED HYDRAULIC CONDUCTIVITY (in/hr)	WILTING POINT	FIELD CAPACITY	INITIAL MOISTURE	MAX. DEEP PERCOLATION (in/hr)	PERCOLATION PARAMETERS HCO	PERCOLATION PARAMETERS PCO	DEPTH OF ET (ft)	FRACTION OF ET TO UPPER ZONE

```
        0    .4000       5.000     .1500   .3000    .3000     2.000E-03   10.00   15.00       14.00        0.350

*********************************************************
*    Arrangement of Subcatchments and Channel/Pipes     *
*********************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
*********************************************************

   Channel
   or Pipe
      201     No Tributary Channel/Pipes
              No Tributary Subareas.....


    INLET
      200     Tributary Channel/Pipes...        201
              Tributary Subareas........        300


*********************************************************
* Hydrographs will be stored for the following   1 INLETS *
*********************************************************
          200

^
#####################################################
#              Quality Simulation                   #
#####################################################
#      General Quality Control Data Groups          #
#####################################################

 Description                            Variable       Value
 -----------                            --------       -----

 Number of quality constituents.....    NQS.......         1

 Number of land uses................    JLAND.....         1

 Standard catchbasin volume.........    CBVOL.....      4.00 cubic feet

 Erosion is not simulated.........      IROS......         0

 DRY DAYS PRIOR TO START OF STORM...    DRYDAY....      3.00 DAYS

 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN....      5.00 DAYS

 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD....     0.000

 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN....       120
```

DAY OF YEAR ON WHICH STREET
SWEEPING ENDS..... KLNEND..... 270

##
Land use data on data group J2
##

AND USE LNAME)	BUILDUP EQUATION TYPE (METHOD)	FUNCTIONAL DEPENDENCE OF BUILDUP PARAMETER(JACGUT)	LIMITING BUILDUP QUANTITY (DDLIM)	BUILDUP POWER (DDPOW)	BUILDUP COEFF. (DDFACT)	CLEANING INTERVAL IN DAYS (CLFREQ)	AVAIL. FACTOR FRACTION (AVSWP)	DAYS SINCE LAST SWEEPING (DSLCL)
Urban De	EXPONENTIAL(1)	AREA(1)	2.500E+01	0.500	60.000	30.000	0.300	30.000

↑

##
Constituent data on data group J3
##

	Total Su
Constituent units.....	mg/l
Type of units.....	0
KALC.....	2
Type of buildup calc.....	EXPONENTIAL(2)
KWASH.....	0
Type of washoff calc.....	POWER EXPONEN.(0)
KACGUT.....	1
Dependence of buildup....	AREA(1)
LINKUP.....	0
Linkage to snowmelt.....	NO SNOW LINKAGE
Buildup param 1 (QFACT1).	25.000
Buildup param 2 (QFACT2).	0.500
Buildup param 3 (QFACT3).	60.000
Buildup param 4 (QFACT4).	0.000
Buildup param 5 (QFACT5).	0.000
Washoff power (WASHPO)...	1.100
Washoff coef. (RCOEF)....	3.000
Init catchb conc (CBFACT)	100.000
Precip. conc. (CONCRN)...	0.000
Street sweep effic (REFF)	0.000
Remove fraction (REMOVE).	0.000
1st order QDECAY, 1/day..	0.000
Land use number.....	1

****
* Constant Groundwater Quality Concentration(s) *
****

Total Susp has a concentration of.. 0.0000 mg/l

```
*********************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                               *
*********************************************

  CHANNEL/   CONSTITUENT
     PIPE Total Susp
---------- --------
       201    0.000


*****************************************************
*     Subcatchment surface quality on data group L1 *
*****************************************************
```

	No.	Land Usage	Land Use No.	Total Gutter Length 10**2ft	Number of Catch-Basins	Input Loading load/ac Total Su
1	300	Urban De	1	4.00	1.00	0.0E+00
Totals	(Loads in lb or other)			4.00	1.00	0.0E+00

```
    ***********************
    *    DATA GROUP M1    *
    ***********************


TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES.....               0        0


    ***********************
    *    DATA GROUP M3    *
    ***********************

CHANNEL/INLET PRINT DATA GROUPS......       -200




         ****************************************
         * Rainfall from Nat. Weather Serv. file  *
         * in units of hundredths of an inch      *
         ****************************************
```

ZP Battery DevCo, LLC
DMH#10

Rainfall Station Sterling 2 Nnw
State/Province Massachusetts

Rainfall Depth Summary (in)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1948.	1.8	0.0	0.0	0.0	6.8	4.1	4.8	1.6	0.4	2.7	7.7	3.0	32.9
1949.	4.7	3.9	2.2	5.2	3.0	0.4	1.9	2.1	3.7	2.6	1.0	3.8	34.5
1950.	5.6	5.2	4.8	3.7	2.5	1.9	2.0	0.0	0.0	0.3	7.1	3.8	36.9
1951.	4.4	6.8	6.4	3.3	5.2	3.2	6.7	3.2	2.7	5.8	6.9	5.1	59.6
1952.	5.8	2.8	4.5	5.5	4.2	4.7	3.3	8.1	2.4	0.8	5.0	3.0	50.1
1953.	6.4	3.9	8.7	8.2	4.8	2.6	1.9	2.0	2.0	6.4	3.4	5.9	56.3
1954.	2.9	3.4	3.3	5.1	7.2	3.9	2.6	7.8	7.6	4.1	6.7	5.7	60.3
1955.	0.6	4.2	4.6	4.6	1.7	5.7	2.2	10.6	2.3	11.0	5.2	1.6	54.1
1956.	8.4	4.7	6.9	5.4	2.0	3.8	2.3	1.4	3.9	2.7	4.4	6.0	51.9
1957.	2.9	2.1	3.3	2.9	3.8	3.0	0.9	2.7	1.7	4.3	6.3	6.4	40.2
1958.	10.3	3.3	4.8	6.4	4.3	2.3	4.9	3.7	6.6	2.7	4.4	2.6	56.4
1959.	3.9	3.4	5.3	4.7	1.5	3.7	8.8	5.1	2.3	6.7	4.9	6.6	56.9
1960.	2.6	5.3	3.4	4.6	5.6	2.4	6.7	2.3	7.6	3.5	5.2	3.8	52.9
1961.	1.0	3.1	3.0	6.1	3.1	3.4	4.4	2.6	5.6	2.5	4.4	5.4	44.4
1962.	2.4	5.9	2.8	5.4	4.1	4.2	1.4	4.3	8.3	6.6	5.3	5.9	56.5
1963.	3.7	3.6	4.6	1.8	2.7	2.4	1.7	3.0	4.5	1.4	9.1	3.9	42.6
1964.	5.8	3.3	4.1	3.7	2.0	2.0	2.6	1.5	1.8	2.1	2.9	5.6	37.4
1965.	2.5	3.7	3.7	2.6	2.6	1.6	1.9	2.1	2.7	3.1	2.9	2.4	31.9
1966.	4.2	4.6	2.6	1.5	3.5	2.9	2.6	1.1	6.8	3.0	4.4	3.8	40.8
1967.	2.6	4.0	5.1	6.0	7.6	4.5	4.7	3.5	4.3	2.1	5.1	2.8	52.3
1968.	3.3	1.4	7.5	2.0	5.5	9.5	3.3	0.8	2.2	2.5	9.2	4.6	51.7
1969.	1.7	2.2	2.8	4.2	1.8	2.3	3.6	5.0	5.0	0.5	0.0	5.6	34.8
1970.	1.2	5.4	4.4	3.8	0.0	0.0	0.3	3.5	3.2	3.1	1.4	4.3	30.5
1971.	3.2	4.5	2.6	2.7	5.1	3.2	2.6	7.0	0.8	3.4	5.6	3.4	44.2
1972.	2.6	5.6	7.8	1.5	7.9	5.3	2.5	3.4	2.1	0.0	0.0	0.0	38.7

Total Rainfall Depth for Simulation Period 1149.0 (in)

Rainfall Intensity Analysis (in/hr)

(in/hr)	(#)	(%)	(in)	(%)
0.10	26817	69.7	333.	29.0
0.20	7398	19.2	274.	23.9
0.30	1466	3.8	94.	8.2
0.40	1250	3.2	110.	9.5
0.50	371	1.0	42.	3.7
0.60	207	0.5	28.	2.4
0.70	273	0.7	43.	3.8
0.80	174	0.5	33.	2.8
0.90	81	0.2	18.	1.5

1.00	93	0.2	22.	1.9
1.10	34	0.1	9.	0.8
1.20	29	0.1	8.	0.7
1.30	39	0.1	12.	1.1
1.40	35	0.1	12.	1.0
1.50	19	0.0	7.	0.6
1.60	39	0.1	15.	1.3
1.70	6	0.0	3.	0.2
1.80	21	0.1	9.	0.8
1.90	15	0.0	7.	0.6
2.00	14	0.0	7.	0.6
> 2.00	88	0.2	64.	5.5

Total # of Intensities 38469

Daily Rainfall Depth Analysis (in)

(in)	(#)	(%)	(in)	(%)
0.10	693	26.0	40.	3.5
0.20	458	17.2	66.	5.7
0.30	322	12.1	78.	6.8
0.40	232	8.7	80.	6.9
0.50	171	6.4	76.	6.7
0.60	161	6.0	88.	7.6
0.70	116	4.3	75.	6.5
0.80	92	3.4	68.	6.0
0.90	68	2.5	57.	5.0
1.00	62	2.3	59.	5.1
1.10	37	1.4	39.	3.4
1.20	49	1.8	56.	4.9
1.30	38	1.4	47.	4.1
1.40	31	1.2	42.	3.6
1.50	18	0.7	26.	2.3
1.60	24	0.9	37.	3.2
1.70	15	0.6	25.	2.1
1.80	16	0.6	28.	2.4
1.90	13	0.5	24.	2.1
2.00	7	0.3	14.	1.2
> 2.00	46	1.7	124.	10.8

Total # Days with Rain 2669

****
* End of time step DO-loop in Runoff *
****

Final Date (Mo/Day/Year) = 12/31/1972
Total number of time steps = 1668921
Final Julian Date = 1972366
Final time of day = 86400. seconds.
Final time of day = 24.00 hours.
Final running time = 219168.0000 hours.
Final running time = 9132.0000 days.

```
************************************************
*     Extrapolation Summary for Watersheds     *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls     *
************************************************

 Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      300   7220078   1853226

************************************************
*     Extrapolation Summary for Channel/Pipes  *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls       *
************************************************

Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      201         0         0
```

```
*********************************************
*       Continuity Check for Surface Water  *
*********************************************

                                                          Inches over
                                                cubic feet  Total Basin
Total Precipitation (Rain plus Snow)              3856847.      1147.
Total Infiltration                                      0.         0.
Total Evaporation                                  171575.        51.
Surface Runoff from Watersheds                    3713036.      1105.
Total Water remaining in Surface Storage                0.         0.
Infiltration over the Pervious Area...                  0.         0.
                  --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.....                3884611.      1156.
Total Precipitation + Initial Storage.            3856847.      1147.


The error in continuity is calculated as
*************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-----------------------------------*
* Precipitation + Initial Snow Cover  *
*************************************
Error.....................................       -0.720 Percent


*********************************************
```

```
*       Continuity Check for Channel/Pipes   *
*********************************************
                                                    Inches over
                                      cubic feet    Total Basin
Initial Channel/Pipe Storage.....              0.          0.
Final Channel/Pipe Storage.......              0.          0.
Surface Runoff from Watersheds...        3713036.       1105.
Baseflow.........................              0.
Groundwater Subsurface Inflow....              0.          0.
Evaporation Loss from Channels...              0.          0.
Channel/Pipe/Inlet Outflow.......        3713036.       1105.
Initial Storage + Inflow.........        3713036.       1105.
Final Storage + Outflow..........        3713036.       1105.
*********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
*********************************************
Error.....................................      0.000 Percent
```

```
************************************************
*     Continuity Check for Subsurface Water    *
************************************************
                                                    Inches over
                                      cubic feet    Subsurface Basin

Total Infiltration                             0.          0.
Total Upper Zone ET                            0.          0.
Total Lower Zone ET                            0.          0.
Total Groundwater flow                         0.          0.
Total Deep percolation                         0.          0.
Initial Subsurface Storage                121010.         36.
Final Subsurface Storage                  121010.         36.
Upper Zone ET over Pervious Area               0.          0.
Lower Zone ET over Pervious Area               0.          0.


****************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* ---------------------------------- *
*     Infiltration + Initial Storage     *
****************************************
Error ....................................     0.000 Percent
```

SUMMARY STATISTICS FOR SUBCATCHMENTS
====================================

SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (AC)	PERCENT IMPER.	TOTAL SIMULATED RAINFALL (IN)	PERVIOUS AREA: TOTAL RUNOFF DEPTH (IN)	PERVIOUS AREA: TOTAL LOSSES (IN)	PERVIOUS AREA: PEAK RUNOFF RATE (CFS)	IMPERVIOUS AREA: RUNOFF DEPTH (IN)	IMPERVIOUS AREA: PEAK RUNOFF RATE (CFS)	TOTAL SUBCATCHMENT AREA: RUNOFF DEPTH (IN)	TOTAL SUBCATCHMENT AREA: PEAK RUNOFF RATE (CFS)	TOTAL SUBCATCHMENT AREA: PEAK UNIT RUNOFF (IN/HR)
300	200	0.93	100.0	1147.40	0.000	0.000	0.000	1104.121	5.528	1104.121	5.528	5.969

*** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

SUMMARY STATISTICS FOR CHANNEL/PIPES

CHANNEL NUMBER	FULL FLOW (CFS)	FULL VELOCITY (FPS)	FULL DEPTH (FT)	MAXIMUM COMPUTED INFLOW (CFS)	MAXIMUM COMPUTED OUTFLOW (CFS)	MAXIMUM COMPUTED DEPTH (FT)	MAXIMUM COMPUTED VELOCITY (FPS)	TIME OF OCCURRENCE DAY	TIME OF OCCURRENCE HR.	LENGTH OF SURCHARGE (HOUR)	MAXIMUM SURCHARGE VOLUME (AC-FT)	RATIO OF MAX. TO FULL FLOW	RATIO OF MAX. DEPTH TO FULL DEPTH
201				0.00				1/ 0/1900	0.00				
200				5.53				11/13/1968	5.50				

TOTAL NUMBER OF CHANNELS/PIPES = 2

*** NOTE *** THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
#######################################################
#             Runoff Quality Summary Page             #
# If NDIM = 0 Units for:   loads    mass rates        #
#             METRIC = 1    lb       lb/sec          #
#             METRIC = 2    kg       kg/sec          #
# If NDIM = 1 Loads are in units of quantity          #
#             and mass rates are quantity/sec         #
# If NDIM = 2 loads are in units of concentration     #
#             times volume and mass rates have units  #
#             of concentration times volume/second    #
#######################################################
```

Total Su NDIM = 0
METRIC = 1

	Total Su
Inputs	
1. INITIAL SURFACE LOAD.....	18.
2. TOTAL SURFACE BUILDUP.....	19499.
3. INITIAL CATCHBASIN LOAD.....	0.
4. TOTAL CATCHBASIN LOAD.....	0.

5.	TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4).....	19499.

Remaining Loads

6.	LOAD REMAINING ON SURFACE...	3.
7.	REMAINING IN CATCHBASINS....	0.
8.	REMAINING IN CHANNEL/PIPES..	0.

Removals

9.	STREET SWEEPING REMOVAL.....	0.
10.	NET SURFACE BUILDUP (2-9)...	19499.
11.	SURFACE WASHOFF.....	19490.
12.	CATCHBASIN WASHOFF.....	0.
13.	TOTAL WASHOFF (11+12).....	19490.
14.	LOAD FROM OTHER CONSTITUENTS	0.
15.	PRECIPITATION LOAD.....	0.
15a.	SUM SURFACE LOAD (13+14+15).	19490.
16.	TOTAL GROUNDWATER LOAD.....	0.
16a.	TOTAL I/I LOAD.....	0.
17.	NET SUBCATCHMENT LOAD (15a-15b-15c-15d+16+16a)....	19490.
>>Removal in channel/pipes (17a, 17b):		
17a.	REMOVE BY BMP FRACTION.....	0.
17b.	REMOVE BY 1st ORDER DECAY...	0.
18.	TOTAL LOAD TO INLETS.....	19490.
19.	FLOW WT'D AVE.CONCENTRATION mg/l (INLET LOAD/TOTAL FLOW).....	84.

Percentages

20.	STREET SWEEPING (9/2).....	0.
21.	SURFACE WASHOFF (11/2).....	100.
22.	NET SURFACE WASHOFF(11/10)..	100.
23.	WASHOFF/SUBCAT LOAD(11/17)..	100.
24.	SURFACE WASHOFF/INLET LOAD (11/18).....	100.
25.	CATCHBASIN WASHOFF/ SUBCATCHMENT LOAD (12/17)...	0.
26.	CATCHBASIN WASHOFF/ INLET LOAD (12/18).....	0.
27.	OTHER CONSTITUENT LOAD/ SUBCATCHMENT LOAD (14/17)...	0.
28.	INSOLUBLE FRACTION/ INLET LOAD (14/18).....	0.
29.	PRECIPITATION/ SUBCATCHMENT LOAD (15/17)...	0.
30.	PRECIPITATION/ INLET LOAD (15/18).....	0.
31.	GROUNDWATER LOAD/ SUBCATCHMENT LOAD (16/17)...	0.
32.	GROUNDWATER LOAD/ INLET LOAD (16/18).....	0.
32a.	INFILTRATION/INFLOW LOAD/	

```
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.


*******************************************************
*            TSS Particle Size Distribution           *
*******************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)            Gravity        (ft/s)               Number


      1.     5.0      2.65         0.000002            0.003500
      4.     5.0      2.65         0.000035            0.014000
      7.    10.0      2.65         0.000108            0.024500
     18.    15.0      2.65         0.000710            0.063000
     45.    10.0      2.65         0.004352            0.157500
     70.     5.0      2.65         0.010215            0.245000
     90.    10.0      2.65         0.016354            0.315000
    125.    15.0      2.65         0.029465            0.437500
    200.    15.0      2.65         0.063279            0.700000
    400.     5.0      2.65         0.156843            1.400000
    850.     5.0      2.65         0.321303            2.975000

↑
*************************************************
*                                               *
*              Summary of TSS Removal           *
*                                               *
*************************************************

TSS Removal based on NJCAT Lab Performance Curve

 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cfs)          (cfs)               (%)                 (%)

 HG 4          1.145          4.568              96.0                 75.9
 HG 5          1.422          4.568              97.2                 81.7<=tss removal
 HG 6          1.720          4.568              98.1                 85.7
 HG 7          2.052          4.568              98.7                 88.6
 HG 8          2.396          4.568              99.2                 90.9
```

Unavailabl	2.767	4.568	99.5	93.1
HG 10	3.159	4.568	99.6	94.6
HG 12	3.941	4.568	99.8	96.6

****
*
* Summary of Annual Flow Treatmnet & TSS Removal *
*
****

HG 4

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1132626.	556.	420.	137.	0.	97.5	75.4
1949.	1218690.	1216495.	743.	598.	145.	0.	99.8	80.5
1950.	1326930.	1301778.	654.	526.	129.	0.	98.1	80.4
1951.	2125380.	2090795.	918.	725.	194.	0.	98.4	78.9
1952.	1783463.	1745148.	812.	627.	185.	0.	97.9	77.2
1953.	2020325.	1972231.	867.	669.	197.	0.	97.6	77.2
1954.	2146006.	2072194.	924.	731.	192.	0.	96.6	79.2
1955.	1936123.	1892205.	726.	557.	170.	0.	97.7	76.6
1956.	1849249.	1825234.	886.	700.	186.	0.	98.7	79.0
1957.	1428747.	1403970.	730.	564.	166.	0.	98.3	77.3
1958.	1984822.	1928585.	892.	673.	219.	0.	97.2	75.5
1959.	2013579.	1891672.	856.	667.	189.	0.	93.9	77.9
1960.	1875523.	1849292.	864.	674.	191.	0.	98.6	77.9
1961.	1563988.	1466908.	832.	592.	240.	0.	93.8	71.2
1962.	2014433.	1972781.	839.	650.	190.	0.	97.9	77.4
1963.	1504731.	1471844.	778.	612.	166.	0.	97.8	78.6
1964.	1320210.	1242335.	759.	575.	184.	0.	94.1	75.8
1965.	1113984.	1105120.	726.	569.	157.	0.	99.2	78.4
1966.	1450710.	1422660.	773.	619.	154.	0.	98.1	80.1
1967.	1849232.	1818514.	926.	701.	225.	0.	98.3	75.7
1968.	1852983.	1668467.	786.	552.	235.	1.	90.0	70.0
1969.	1227124.	1067693.	602.	406.	196.	0.	87.0	67.5
1970.	1124175.	762140.	548.	288.	261.	1.	67.8	52.4
1971.	1578114.	1544116.	842.	620.	222.	0.	97.8	73.6
1972.	1364937.	1316944.	661.	489.	172.	0.	96.5	74.0

HG 5

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1145685.	556.	454.	102.	0.	98.6	81.7
1949.	1218690.	1218690.	743.	635.	108.	0.	100.0	85.4
1950.	1326930.	1307380.	654.	557.	97.	0.	98.5	85.1
1951.	2125380.	2105963.	918.	776.	142.	0.	99.1	84.5
1952.	1783463.	1764275.	812.	673.	140.	0.	98.9	82.8
1953.	2020325.	1981597.	867.	718.	149.	0.	98.1	82.8

1954.	2146006.	2104769.	924.	779.	145.	0.	98.1	84.3
1955.	1936123.	1917200.	726.	601.	126.	0.	99.0	82.7
1956.	1849249.	1839074.	886.	750.	136.	0.	99.4	84.6
1957.	1428747.	1421300.	730.	604.	126.	0.	99.5	82.7
1958.	1984822.	1946112.	892.	725.	167.	0.	98.0	81.3
1959.	2013579.	1929612.	856.	714.	142.	0.	95.8	83.4
1960.	1875523.	1867708.	864.	723.	141.	0.	99.6	83.7
1961.	1563988.	1497964.	832.	649.	183.	0.	95.8	78.0
1962.	2014433.	1996685.	839.	700.	139.	0.	99.1	83.5
1963.	1504731.	1485290.	778.	655.	124.	0.	98.7	84.1
1964.	1320210.	1266632.	759.	619.	140.	0.	95.9	81.6
1965.	1113984.	1109707.	726.	608.	118.	0.	99.6	83.7
1966.	1450710.	1433462.	773.	661.	111.	0.	98.8	85.6
1967.	1849232.	1837223.	926.	758.	168.	0.	99.4	81.8
1968.	1852983.	1705221.	786.	599.	187.	1.	92.0	76.1
1969.	1227124.	1097337.	602.	444.	158.	0.	89.4	73.7
1970.	1124175.	821582.	548.	329.	219.	1.	73.1	60.0
1971.	1578114.	1567558.	842.	673.	170.	0.	99.3	79.9
1972.	1364937.	1333076.	661.	530.	131.	0.	97.7	80.3

HG 6

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1150970.	556.	476.	81.	0.	99.1	85.5
1949.	1218690.	1218690.	743.	661.	82.	0.	100.0	89.0
1950.	1326930.	1313228.	654.	580.	74.	0.	99.0	88.7
1951.	2125380.	2115889.	918.	813.	106.	0.	99.6	88.5
1952.	1783463.	1775224.	812.	705.	107.	0.	99.5	86.9
1953.	2020325.	1987477.	867.	752.	114.	0.	98.4	86.8
1954.	2146006.	2128100.	924.	816.	108.	0.	99.2	88.3
1955.	1936123.	1928698.	726.	629.	97.	0.	99.6	86.6
1956.	1849249.	1848854.	886.	780.	106.	0.	100.0	88.1
1957.	1428747.	1427363.	730.	630.	100.	0.	99.9	86.3
1958.	1984822.	1962908.	892.	762.	130.	0.	98.9	85.4
1959.	2013579.	1962197.	856.	747.	109.	0.	97.4	87.3
1960.	1875523.	1873482.	864.	757.	107.	0.	99.9	87.6
1961.	1563988.	1522299.	832.	686.	146.	0.	97.3	82.4
1962.	2014433.	2006200.	839.	731.	108.	0.	99.6	87.1
1963.	1504731.	1497920.	778.	682.	96.	0.	99.5	87.6
1964.	1320210.	1281972.	759.	648.	110.	0.	97.1	85.5
1965.	1113984.	1113984.	726.	634.	92.	0.	100.0	87.4
1966.	1450710.	1441306.	773.	690.	83.	0.	99.4	89.3
1967.	1849232.	1848488.	926.	794.	133.	0.	100.0	85.7
1968.	1852983.	1735234.	786.	636.	150.	1.	93.6	80.7
1969.	1227124.	1124520.	602.	476.	126.	0.	91.6	79.1
1970.	1124175.	875778.	548.	362.	186.	1.	77.9	65.9
1971.	1578114.	1576123.	842.	708.	134.	0.	99.9	84.1
1972.	1364937.	1346304.	661.	558.	103.	0.	98.6	84.5

HG 7

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1156452.	556.	490.	67.	0.	99.6	88.0
1949.	1218690.	1218690.	743.	680.	63.	0.	100.0	91.5
1950.	1326930.	1318710.	654.	595.	59.	0.	99.4	91.0
1951.	2125380.	2124911.	918.	838.	81.	0.	100.0	91.2
1952.	1783463.	1780702.	812.	726.	87.	0.	99.8	89.3
1953.	2020325.	1994053.	867.	779.	88.	0.	98.7	89.9
1954.	2146006.	2141096.	924.	842.	82.	0.	99.8	91.2
1955.	1936123.	1936123.	726.	650.	76.	0.	100.0	89.5
1956.	1849249.	1849249.	886.	806.	80.	0.	100.0	90.9
1957.	1428747.	1428747.	730.	651.	79.	0.	100.0	89.2
1958.	1984822.	1973290.	892.	792.	100.	0.	99.4	88.8
1959.	2013579.	1982222.	856.	770.	86.	0.	98.4	90.0
1960.	1875523.	1875523.	864.	779.	85.	0.	100.0	90.1
1961.	1563988.	1544828.	832.	716.	117.	0.	98.8	86.0
1962.	2014433.	2011684.	839.	754.	85.	0.	99.9	89.9
1963.	1504731.	1504731.	778.	704.	74.	0.	100.0	90.5
1964.	1320210.	1291832.	759.	667.	92.	0.	97.9	87.9
1965.	1113984.	1113984.	726.	655.	71.	0.	100.0	90.3
1966.	1450710.	1449862.	773.	710.	63.	0.	99.9	91.9
1967.	1849232.	1849232.	926.	822.	104.	0.	100.0	88.8
1968.	1852983.	1762121.	786.	664.	122.	1.	95.1	84.3
1969.	1227124.	1145132.	602.	496.	106.	0.	93.3	82.4
1970.	1124175.	933591.	548.	389.	160.	1.	83.0	70.8
1971.	1578114.	1578114.	842.	731.	111.	0.	100.0	86.8
1972.	1364937.	1359198.	661.	578.	83.	0.	99.6	87.4

HG 8

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1161569.	556.	503.	53.	0.	100.0	90.5
1949.	1218690.	1218690.	743.	696.	48.	0.	100.0	93.6
1950.	1326930.	1324392.	654.	606.	48.	0.	99.8	92.7
1951.	2125380.	2125380.	918.	859.	60.	0.	100.0	93.5
1952.	1783463.	1783463.	812.	742.	70.	0.	100.0	91.3
1953.	2020325.	2000872.	867.	796.	71.	0.	99.0	91.8
1954.	2146006.	2146006.	924.	859.	65.	0.	100.0	93.0
1955.	1936123.	1936123.	726.	668.	59.	0.	100.0	91.9
1956.	1849249.	1849249.	886.	823.	63.	0.	100.0	92.9
1957.	1428747.	1428747.	730.	668.	62.	0.	100.0	91.5
1958.	1984822.	1982381.	892.	813.	79.	0.	99.9	91.1
1959.	2013579.	1999635.	856.	785.	71.	0.	99.3	91.7
1960.	1875523.	1875523.	864.	799.	66.	0.	100.0	92.4
1961.	1563988.	1557721.	832.	735.	97.	0.	99.6	88.4
1962.	2014433.	2014433.	839.	773.	66.	0.	100.0	92.1
1963.	1504731.	1504731.	778.	719.	59.	0.	100.0	92.4
1964.	1320210.	1301937.	759.	683.	75.	0.	98.6	90.1

1965.	1113984.	1113984.	726.	670.	56.	0.	100.0	92.4
1966.	1450710.	1450710.	773.	725.	48.	0.	100.0	93.7
1967.	1849232.	1849232.	926.	843.	83.	0.	100.0	91.0
1968.	1852983.	1787895.	786.	685.	102.	1.	96.5	86.9
1969.	1227124.	1161041.	602.	511.	91.	0.	94.6	84.9
1970.	1124175.	983757.	548.	411.	137.	1.	87.5	74.9
1971.	1578114.	1578114.	842.	751.	92.	0.	100.0	89.1
1972.	1364937.	1364582.	661.	596.	65.	0.	100.0	90.1

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Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1161569.	556.	515.	41.	0.	100.0	92.6
1949.	1218690.	1218690.	743.	708.	36.	0.	100.0	95.2
1950.	1326930.	1326930.	654.	618.	36.	0.	100.0	94.4
1951.	2125380.	2125380.	918.	876.	43.	0.	100.0	95.3
1952.	1783463.	1783463.	812.	764.	48.	0.	100.0	94.1
1953.	2020325.	2007766.	867.	815.	52.	0.	99.4	94.0
1954.	2146006.	2146006.	924.	878.	46.	0.	100.0	95.0
1955.	1936123.	1936123.	726.	681.	46.	0.	100.0	93.7
1956.	1849249.	1849249.	886.	842.	44.	0.	100.0	95.0
1957.	1428747.	1428747.	730.	687.	42.	0.	100.0	94.2
1958.	1984822.	1984822.	892.	836.	56.	0.	100.0	93.7
1959.	2013579.	2009098.	856.	802.	54.	0.	99.8	93.7
1960.	1875523.	1875523.	864.	817.	48.	0.	100.0	94.5
1961.	1563988.	1563588.	832.	752.	80.	0.	100.0	90.4
1962.	2014433.	2014433.	839.	787.	52.	0.	100.0	93.8
1963.	1504731.	1504731.	778.	734.	44.	0.	100.0	94.3
1964.	1320210.	1311733.	759.	701.	57.	0.	99.4	92.5
1965.	1113984.	1113984.	726.	685.	41.	0.	100.0	94.4
1966.	1450710.	1450710.	773.	735.	38.	0.	100.0	95.1
1967.	1849232.	1849232.	926.	863.	63.	0.	100.0	93.2
1968.	1852983.	1801009.	786.	707.	79.	1.	97.2	89.8
1969.	1227124.	1178054.	602.	532.	71.	0.	96.0	88.3
1970.	1124175.	1029411.	548.	434.	114.	1.	91.6	79.1
1971.	1578114.	1578114.	842.	770.	72.	0.	100.0	91.4
1972.	1364937.	1364937.	661.	613.	48.	0.	100.0	92.7

HG 10

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1161569.	556.	523.	33.	0.	100.0	94.0
1949.	1218690.	1218690.	743.	718.	25.	0.	100.0	96.6
1950.	1326930.	1326930.	654.	628.	26.	0.	100.0	96.0
1951.	2125380.	2125380.	918.	888.	30.	0.	100.0	96.7
1952.	1783463.	1783463.	812.	778.	34.	0.	100.0	95.8
1953.	2020325.	2014228.	867.	828.	38.	0.	99.7	95.6

1954.	2146006.	2146006.	924.	891.	33.	0.	100.0	96.5
1955.	1936123.	1936123.	726.	691.	35.	0.	100.0	95.2
1956.	1849249.	1849249.	886.	851.	35.	0.	100.0	96.0
1957.	1428747.	1428747.	730.	696.	34.	0.	100.0	95.4
1958.	1984822.	1984822.	892.	847.	45.	0.	100.0	95.0
1959.	2013579.	2013579.	856.	815.	40.	0.	100.0	95.3
1960.	1875523.	1875523.	864.	829.	35.	0.	100.0	95.9
1961.	1563988.	1563988.	832.	769.	63.	0.	100.0	92.4
1962.	2014433.	2014433.	839.	798.	41.	0.	100.0	95.1
1963.	1504731.	1504731.	778.	742.	36.	0.	100.0	95.4
1964.	1320210.	1320210.	759.	713.	46.	0.	100.0	94.0
1965.	1113984.	1113984.	726.	698.	28.	0.	100.0	96.2
1966.	1450710.	1450710.	773.	743.	29.	0.	100.0	96.2
1967.	1849232.	1849232.	926.	877.	49.	0.	100.0	94.7
1968.	1852983.	1808766.	786.	724.	63.	1.	97.6	91.9
1969.	1227124.	1190579.	602.	545.	57.	0.	97.0	90.5
1970.	1124175.	1063066.	548.	450.	98.	1.	94.6	82.0
1971.	1578114.	1578114.	842.	786.	57.	0.	100.0	93.3
1972.	1364937.	1364937.	661.	624.	37.	0.	100.0	94.4

HG 12

Year	Flow Vol (ft3)	Flow Treated (ft3)	TSS In (lb)	TSS Rem (lb)	TSS Out (lb)	TSS Byp (lb)	Flow Treated (%)	TSS Removal (%)
1948.	1161569.	1161569.	556.	536.	20.	0.	100.0	96.4
1949.	1218690.	1218690.	743.	731.	13.	0.	100.0	98.3
1950.	1326930.	1326930.	654.	637.	17.	0.	100.0	97.4
1951.	2125380.	2125380.	918.	902.	17.	0.	100.0	98.2
1952.	1783463.	1783463.	812.	792.	20.	0.	100.0	97.6
1953.	2020325.	2020325.	867.	846.	21.	0.	100.0	97.6
1954.	2146006.	2146006.	924.	904.	20.	0.	100.0	97.9
1955.	1936123.	1936123.	726.	705.	21.	0.	100.0	97.1
1956.	1849249.	1849249.	886.	865.	21.	0.	100.0	97.7
1957.	1428747.	1428747.	730.	711.	19.	0.	100.0	97.4
1958.	1984822.	1984822.	892.	863.	29.	0.	100.0	96.7
1959.	2013579.	2013579.	856.	827.	28.	0.	100.0	96.7
1960.	1875523.	1875523.	864.	846.	18.	0.	100.0	97.9
1961.	1563988.	1563988.	832.	790.	42.	0.	100.0	94.9
1962.	2014433.	2014433.	839.	814.	25.	0.	100.0	97.0
1963.	1504731.	1504731.	778.	756.	22.	0.	100.0	97.1
1964.	1320210.	1320210.	759.	728.	31.	0.	100.0	95.9
1965.	1113984.	1113984.	726.	709.	17.	0.	100.0	97.7
1966.	1450710.	1450710.	773.	756.	17.	0.	100.0	97.8
1967.	1849232.	1849232.	926.	897.	29.	0.	100.0	96.9
1968.	1852983.	1824244.	786.	740.	47.	1.	98.4	93.9
1969.	1227124.	1213042.	602.	560.	42.	0.	98.9	93.0
1970.	1124175.	1097745.	548.	472.	76.	1.	97.6	86.0
1971.	1578114.	1578114.	842.	809.	33.	0.	100.0	96.1
1972.	1364937.	1364937.	661.	636.	25.	0.	100.0	96.2

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**************************************************
*  Summary of Quantity and Quality Results at    *
*  Location        200  INFlow in cfs.           *
*  Values are instantaneous at indicated time step *
**************************************************

  ZP Battery DevCo, LLC
  DMH#10

     Date      Time         Flow   Total Su
 Mo/Da/Year  Hr:Min          cfs    mg/l
 ----------  -------     -------  --------
Flow wtd means.....         0.011       84.
Flow wtd std devs..         0.066       70.
Maximum value......         5.528      292.
Minimum value......         0.000        0.
Total loads........      3711303.    19501.
                         Cub-Ft     POUNDS

===> Runoff simulation ended normally.

===> SWMM 4.4    simulation ended normally.
     Always check output file for possible warning messages.

**************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
**************************************************
* Starting Date... March      22, 2023              *
*          Time...          15:53:43.328            *
*   Ending Date... March      22, 2023              *
*          Time...          15:53:46.252            *
*  Elapsed Time...               0.049 minutes.     *
*  Elapsed Time...               2.924 seconds.     *
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3.1
OPERATION AND MAINTENANCE

STORMWATER OPERATION, MAINTENANCE AND POLLUTION PREVENTION PLAN

ZP Battery DevCo, LLC
#256 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. Hydroworks Units shall be inspected and maintained per the manufactures recommendations or as needed.

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

6. **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
Deep Sump Catchbasin	Quarterly and at the end of the foliage and snow removal seasons	Quarterly, or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe	Clean/Remove Debris and Sediment
Hydroworks Unit	Annually in the spring	Annually in the spring	Clean/Remove Debris and sediment

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

256 Murdock Avenue, Winchendon, Massachusetts

DATE	ACTION	RESULT	PERFORMED BY

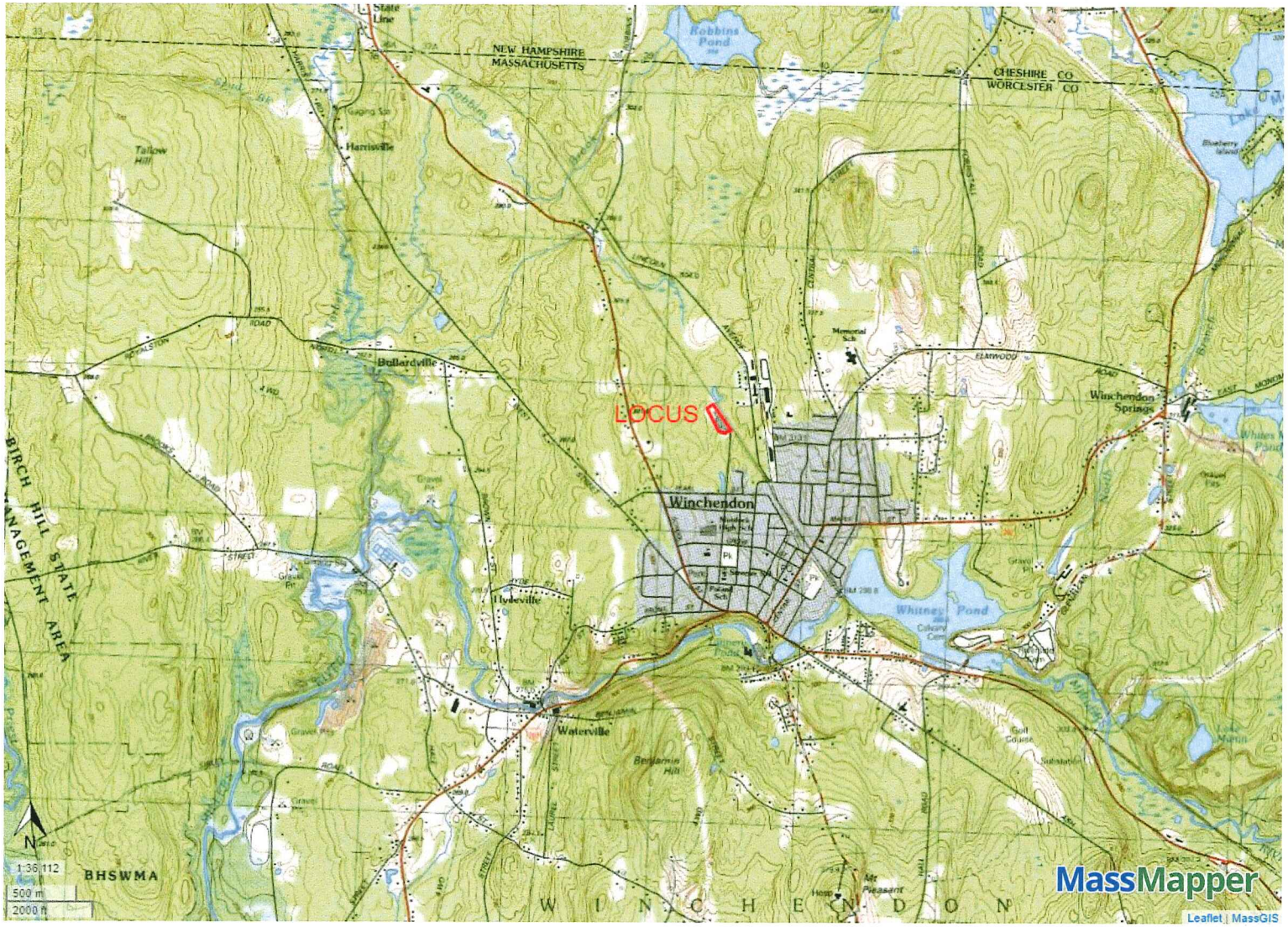
Maintenance Log

256 Murdock Avenue, Winchendon, Massachusetts

DATE	ACTION	PERFORMED BY

FIGURE 1
LOCUS MAP AND SOILS MAP

256 MURDOCK AVENUE, WINCHENDON



Property Tax Parcels
USGS Topographic Maps

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

256 MURDOCK AVENUE
Street Address

2D2/11
Map/Lot #

WINCHENDON
City

MA
State

01475
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade

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

MORRAINE
Landform

NONE
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: (Wetland Type)

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

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

Commonwealth of Massachusetts
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: 0223-1 (Hole #) | 2/9/23 (Date) | 9:00 (Time) | SUN (Weather) | _____ (Latitude) | _____ (Longitude)

1. Land Use: WOODLAND (e.g., woodland, agricultural field, vacant lot, etc.) | DECIDOUS NEW GROWTH (Vegetation) | NONE (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-5 (Slope (%))

Description of Location: IN CENTER ISLAND WITHIN LOADING AREA

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

3. Distances from: Open Water Body +100 feet | Drainage Way +100 feet | Wetlands 80 feet | Property Line 50 feet | Drinking Water Well _____ feet | Other _____ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 53 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			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	FILL				Cnc : Dpl:						
12-15	B	SA LOAM	7.5YR 5/8		Cnc : Dpl:				MASS	FIRM	
15-20	B/C	SA LOAM	7.5 YR6/6		Cnc : Dpl:				MASS	FIRM	
20-80	C	LO SAND	10YR 6/6	41	Cnc : Dpl:				MASS	FIRM	
					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@53

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

Deep Observation Hole Number: _____ (Hole #) _____ (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ (Longitude)

1. Land Use: _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ (Vegetation) _____ (Surface Stones (e.g., cobbles, stones, boulders, etc.)) \ _____ (Slope (%))

   Description of Location: _____

2. Soil Parent Material: _____ _____ (Landform) _____ (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet

   Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ 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			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):	Obs. Hole #0223-1	Obs. Hole #_____
☒ Depth to soil redoximorphic features	40 inches	_____ inches
☒ Depth to observed standing water in observation hole	53 inches	_____ 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

Commonwealth of Massachusetts
City/Town of WINCHENDON

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

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	Date: 2/11/2023
CHRISTOPHER ANDERSON#14005	6/30/2025
Typed or Printed Name of Soil Evaluator / License #	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:

Hydrologic Soil Group—Worcester County, Massachusetts, Northwestern Part

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

N

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

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

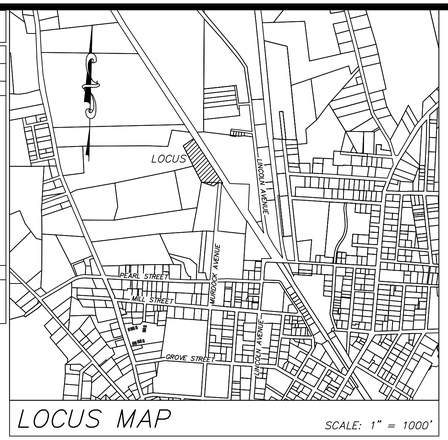
FIGURE 2
PRE-DEVELOMPENT WATERSHED MAP

SOIL TEST DATA

T.P.: # 0223-1	T.P.: #
DATE: 2.9.2023	DATE:
EL.=113.5±	
FILL 10YR 5/8 SA LO	
B/C 7.5YR 6/8 SA LO	
C 10YR 6/6 SA LO	
NO REF GWO @ 53" BOE @80"	
CLASS: 2	

ESTIMATED SEASONAL HIGH GROUNDWATER AT 41"

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



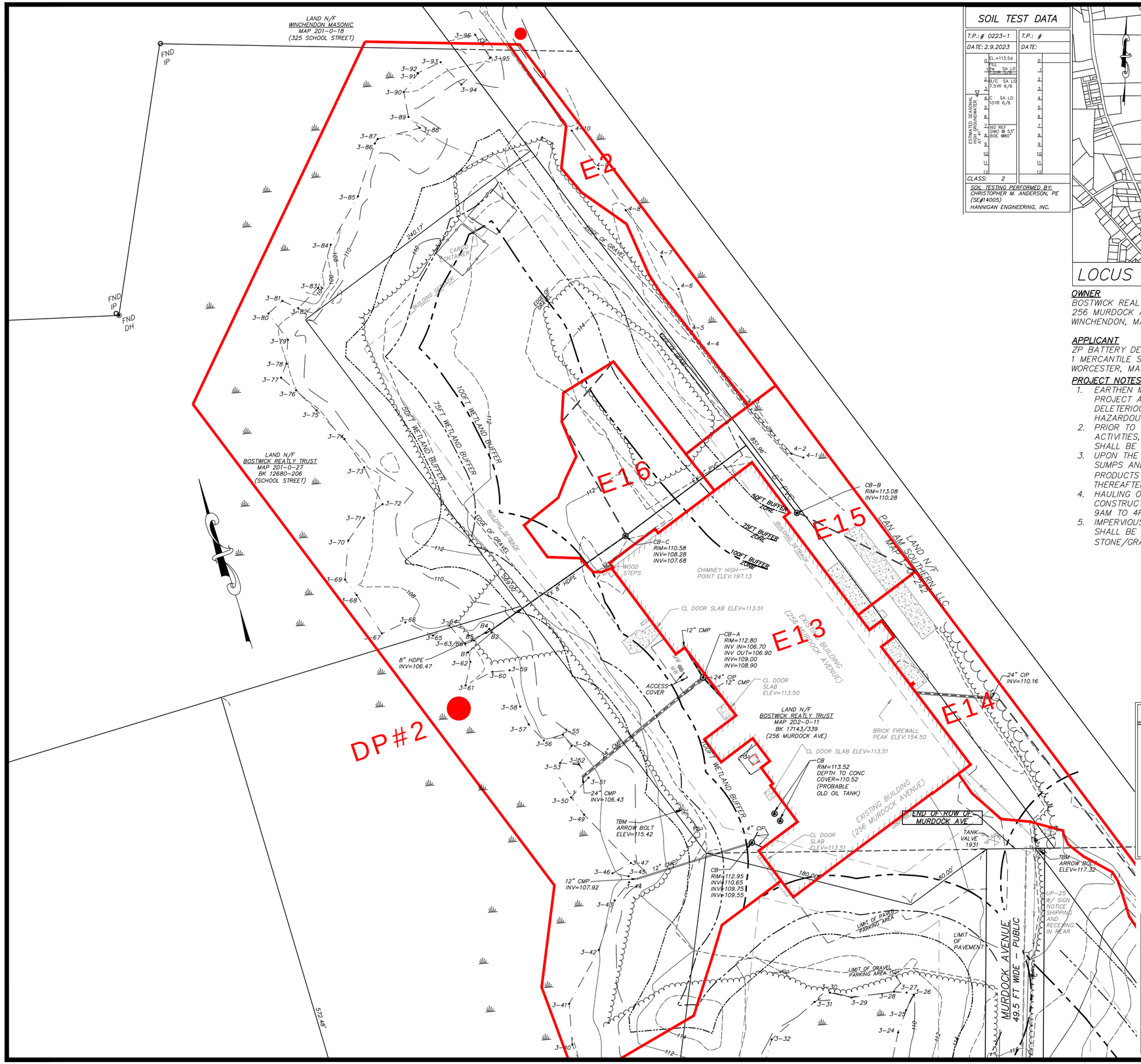
LOCUS MAP SCALE: 1" = 1000'

OWNER
BOSTWICK REALTY TRUST
256 MURDOCK AVENUE
WINCHENDON, MASSACHUSETTS

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

PROJECT NOTES:

1. EARTHEN MATERIALS UTILIZED AS FILL WITHIN THE PROJECT AREA SHALL BE CLEAN AND FREE OF DELETERIOUS MATERIALS AND SHALL NOT CONTAIN ANY HAZARDOUS MATERIALS
2. PRIOR TO THE START OF CONSTRUCTION AND CLEARING ACTIVITIES, THE APPROVED LIMITS OF CONSTRUCTIONS SHALL BE FIELD STAKED AND REVIEWED BY THIS OFFICE
3. UPON THE COMPLETION OF CONSTRUCTION CATCHBASINS, SUMPS AND STORMWATER BASINS OR BEST MANAGEMENT PRODUCTS (BMPs) SHALL BE CLEANED AND ANNUALLY THEREAFTER.
4. HAULING OF EARTHEN MATERIALS TO OR FROM THE CONSTRUCTION SITE SHALL BE LIMITED TO THE HOURS OF 9AM TO 4PM MONDAY THROUGH FRIDAY.
5. IMPERVIOUS COVERAGE FROM THE PROPOSED PROJECT SHALL BE COMPRISED OF CONCRETE AND CRUSHED STONE/GRAVEL FOR ACCESS WAYS.



LEGEND

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

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: _____

HANNIGAN ENGINEERING, INC.
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'

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-A	SHEET 1 OF 2	PLAN NO:C-18-41

FIGURE 3
POST-DEVELOMPENT WATERSHED MAP

SOIL TEST DATA

T.P.: # 0223-1	T.P.: #
DATE: 2.9.2023	DATE:
0 EL.=113.5± FILL	0
1 10YR 5/8 SA LO	1
2 B/C SA LO 7.5YR 6/8	2
3	3
4 C SA LO 10YR 6/6	4
5	5
6	6
7 NO REF IOWO @ 53"	7
8 BOE @80"	8
9	9
10	10
11	11
12	12
CLASS: 2	

ESTIMATED SEASONAL HIGH GROUNDWATER AT 4'

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

LOCUS MAP

SCALE: 1" = 1000'

LOCUS
LEARNON AVENUE
PEARL STREET
MILL STREET
MURDOCK AVENUE
GROVE STREET
CROCKER AVENUE
MAIN STREET

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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3. UPON THE COMPLETION OF CONSTRUCTION CATCHBASINS, SUMPS AND STORMWATER BASINS OR BEST MANAGEMENT PRODUCTS (BMPs) SHALL BE CLEANED AND ANNUALLY THEREAFTER.
4. HAULING OF EARTHEN MATERIALS TO OR FROM THE CONSTRUCTION SITE SHALL BE LIMITED TO THE HOURS OF 9AM TO 4PM MONDAY THROUGH FRIDAY.
5. IMPERVIOUS COVERAGE FROM THE PROPOSED PROJECT SHALL BE COMPRISED OF CONCRETE AND CRUSHED STONE/GRAVEL FOR ACCESS WAYS.

LEGEND

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

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: _____

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

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-A	SHEET 2 OF 2	PLAN NO:C-18-41