

# **STORMWATER MANAGEMENT** **REPORT**

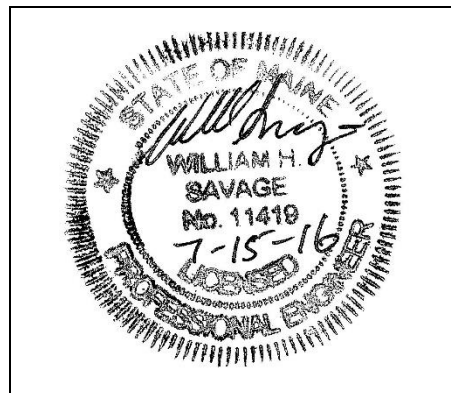
Prepared For:

**Cotton Street Holdings, LLC**  
**The Black Box at 93 Washington Ave**

**Portland, Maine 04101**

Prepared By:

**Acorn Engineering, Inc.**  
**158 Danforth Street**  
**Portland, Maine 04102**



**July 2016**

## **INTRODUCTION**

Acorn Engineering, Inc. has been retained by Cotton Street Holdings, LLC to provide civil engineering services for the proposed redevelopment of 93 Washington Ave. The proposed project is to develop a lot previously occupied by an existing single family, 2-story residence into a five (5) unit retail commercial space.

A stormwater analysis will be prepared to demonstrate that the project will meet the following requirements of the City of Portland (the City):

- City of Portland Land Use Ordinance Chapter 14, Article V. Site Plan Section 14-523. Required Approvals and Applicability (F) Level II Site Plan Review.
- City of Portland Technical Manual – Section 5 – Portland Stormwater Management Standards and Maine DEP Chapter 500 Stormwater Management.

The proposed project will include the redevelopment of the existing impervious and developed area. The project will result in a net increase of impervious area of approximately 950 square feet or just below 1,000 square feet. As such, the project is not required to include stormwater management features for stormwater quality and quantity control. The project as designed is in accordance with the MaineDEP Chapter 500 Basic Standards.

## **EXISTING CONDITIONS**

The proposed project site is located on the corner of Washington Ave and Marion Street within the East End neighborhood at the base of Munjoy Hill. A boundary plan has been prepared by Titcomb Associates of Falmouth, Maine dated April 8<sup>th</sup>, 2016.

Abutting Uses:

- North B-2b Zone Business Community
- West B-2b Zone Business Community
- South B-2b Zone Business Community
- East B-4 Zone Commercial Business

The existing structure within the site was recently demolished in anticipation for future development of the lot. The home was surrounded by small gardens and accessed by a stone walkway held up by wooden retaining walls. There is also an existing gravel drive that encroaches slightly onto the abutting property. The average grade is visibly sloped towards Washington Ave with average slopes around 10% and reaching 40% in the rear of the property. The project area presently drains towards Washington Ave before entering the municipal storm drain system.

The project team is not aware of the presence of any existing significant natural features located on the site. Given the urban setting, and existing free-draining soils at a high point on the peninsula, a field inventory of significant natural feature was not undertaken. The project is not located within a watershed classified as an Urban Impaired Stream.

## **PROPOSED DEVELOPMENT**

The project includes five (5) retail units composed of five (5) shipping containers with a sixth attached in the rear for restrooms and a utility room sitting atop of a concrete foundation. The units will be accessed via five separate entrances and a side entrance for more direct restroom access.

The development will be served by the Portland Water District, underground power/cable/communications, natural gas and the municipal sewer system.

## **GENERAL STANDARDS - WATER QUALITY**

Not required nor accounted for at this time.

## **FLOODING STANDARD – WATER QUANTITY**

Although not required, the proposed project was modeled using HydroCAD to verify that the post-development conditions do not exceed the pre-development conditions. A 24-hour SCS Type III storm distribution for the 2, 10, and 25 year storm events were used. The corresponding rainfall amounts for these storms are 3.10”, 4.60”, and 5.80” respectively. Rainfall amounts are from the Northeast Regional Climate Center website (<http://precip.eas.cornell.edu>), Extreme Precipitation Tables.

Due to the numerous variables, and inherent inaccuracies with the modeling program used to calculate stormwater runoff it is custom at Acorn Engineering, Inc. to round to the nearest whole number or to the nearest tenth for urban infill projects.

### *Time of Concentration ( $T_c$ )*

A time of concentration ( $T_c$ ) of 5 minutes was applied to the subcatchment for both the pre and post-development condition, given the urban setting.

### *Pre-development Calculations*

The pre-development condition was modeled as one subcatchment to determine the net impact of the development.

- Subcatchment 1 – The subcatchment area is defined by the existing building, driveway, internal sidewalks and vegetated area.

A copy of the HydroCAD calculations is included within Attachment A, of this report. Peak flow rates for the storm events are as follows:

<b>Drainage Area</b>	<b>2 – Year Storm Event (cfs)</b>	<b>10 – Year Storm Event (cfs)</b>	<b>25 – Year Storm Event (cfs)</b>
<b>POI #1</b>	0.04	0.2	0.3

### *Post-development Calculations:*

The one predevelopment subcatchment was broken into two separate subcatchments for the post-development condition.

- Subcatchment 1 – This is comprised of the patio and disturbed/landscaped area tributary to the field inlets.
- Subcatchment 2 – This is comprised of the building area tributary to the reservoir and underdrain stone beneath the building.

The post development calculations include changes to the land use, and the detention provided by the reservoir stone below the containers. The following table represents comparison of predevelopment and post-development condition peak runoff rates for the proposed development and tributary area.

<b>Table 2 – Comparison of Peak Flows</b>						
<b>Drainage Area</b>	<b>2 – Year Storm Event (cfs)</b>		<b>10 – Year Storm Event (cfs)</b>		<b>25 – Year Storm Event (cfs)</b>	
	<b>Pre</b>	<b>Post</b>	<b>Pre</b>	<b>Post</b>	<b>Pre</b>	<b>Post</b>
<b>POI #1</b>	0.04	0.02	0.2	0.1	0.3	0.1

As shown in Table 2 the net impact of the post development peak flows shall remain at or below the predevelopment levels. A copy of the HydroCAD calculations is included within Attachment A of this report.

**SOILS**

Onsite soil information includes the following:

- Soil Conservation Service Medium Intensity Soil Survey for Cumberland County

Typical of the East End of Portland the Soil Survey list Hinckley as the existing onsite soil. The Hinckley series consists of very deep, excessively drained soils formed in glaciofluvial materials. The permeability of Hinckley soil is rapid in the surface layer and subsoil and very rapid in the substratum with typically a low groundwater table. Given the soils information, listed above, no onsite wastewater is proposed, the applicant does not intend to perform a more intense hydric soil boundary delineation or permeability test because the waiver requirements set forth in the City of Portland Technical Manual – Section 7 – Soil Survey, Rev. 6/17/12 are met.

The area within and surrounding the project includes soils types listed in the table below. The susceptibility of soils to erosion is indicated on a relative “K” scale of values over a range of 0.02 to 0.69. Higher “K” values indicate more erodible soils.

<b>Table 3 - “K” Value</b>		
<b>Soils Type</b>	<b>Subsurface</b>	<b>Substratum</b>
Hinckley	.17	.17

The soil “K” values for the soils, listed above, show a low susceptibility to erosion. The site’s susceptibility to erosion is from the Soil Conservation Service Medium Intensity Soil Survey for Cumberland County. Although soil “K” values for the soils show a low susceptibility to erosion, implementation of the proposed Erosion & Sedimentation Measures by the contractor will be of the utmost importance, given the long sustained slopes.

### **Conclusion**

The proposed development was designed to meet the requirements implemented by the MDEP under the Stormwater Management Statute (38 M.R.S.A. § 420-D) as well as the City of Portland Technical Manual – Section 5 – Portland Stormwater Management Standards. As a result the design of the proposed development and stormwater system does not anticipate to create erosion, drainage or runoff problems either in the development or with respect to adjoining properties.

### **Attachments**

Attachment A: HydroCAD Calculations



### Summary for Subcatchment 1S: Pre 93 Washington Ave

Runoff = 0.04 cfs @ 12.10 hrs, Volume= 0.004 af, Depth= 0.51"

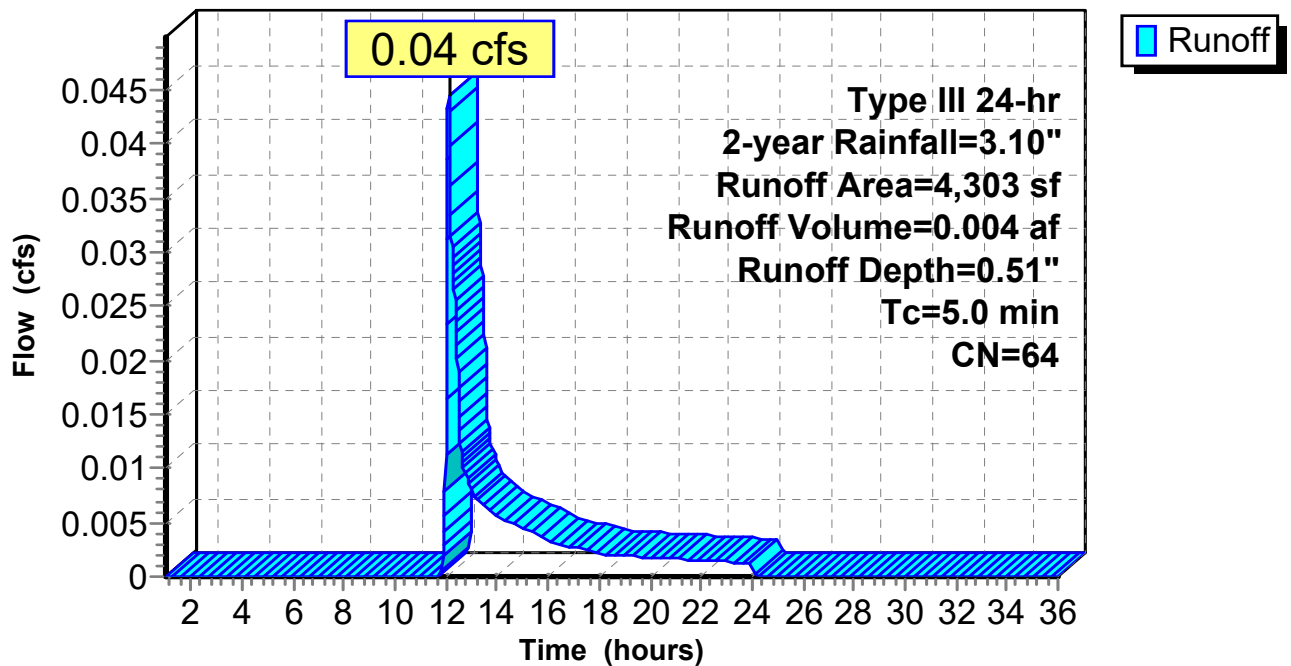
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
* 642	98	Driveway
* 979	98	Home
* 218	98	walkway
2,464	39	>75% Grass cover, Good, HSG A
4,303	64	Weighted Average
2,464		57.26% Pervious Area
1,839		42.74% Impervious Area

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

### Subcatchment 1S: Pre 93 Washington Ave

#### Hydrograph

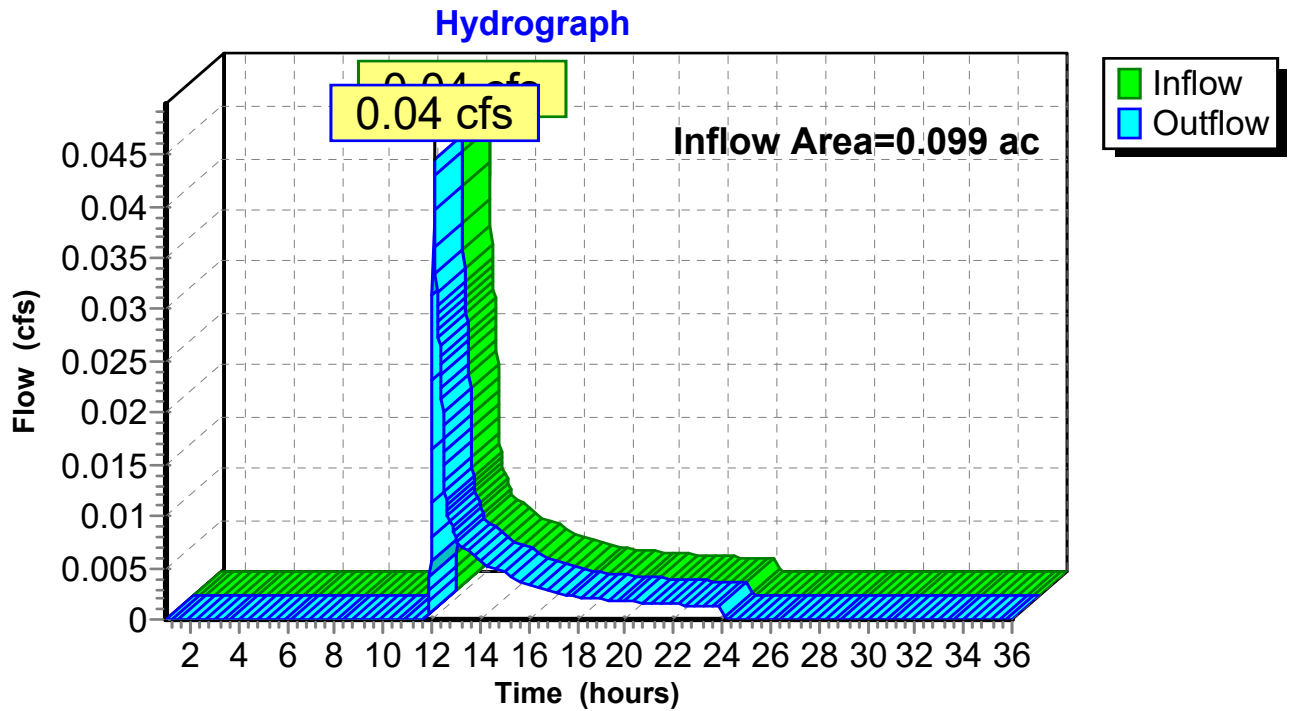


### Summary for Reach 1R: POI#1

Inflow Area = 0.099 ac, 42.74% Impervious, Inflow Depth = 0.51" for 2-year event  
Inflow = 0.04 cfs @ 12.10 hrs, Volume= 0.004 af  
Outflow = 0.04 cfs @ 12.10 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.02 hrs

### Reach 1R: POI#1



**Summary for Subcatchment 1S: Pre 93 Washington Ave**

Runoff = 0.15 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 1.33"

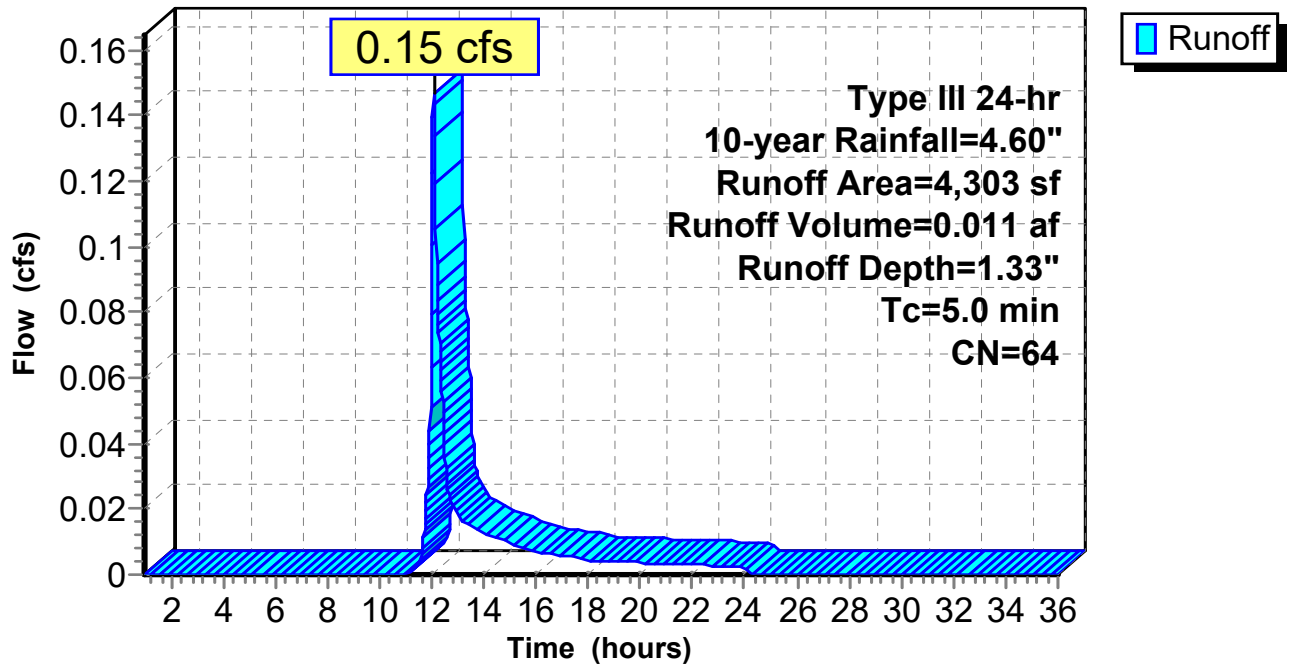
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
* 642	98	Driveway
* 979	98	Home
* 218	98	walkway
2,464	39	>75% Grass cover, Good, HSG A
4,303	64	Weighted Average
2,464		57.26% Pervious Area
1,839		42.74% Impervious Area

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

**Subcatchment 1S: Pre 93 Washington Ave**

**Hydrograph**



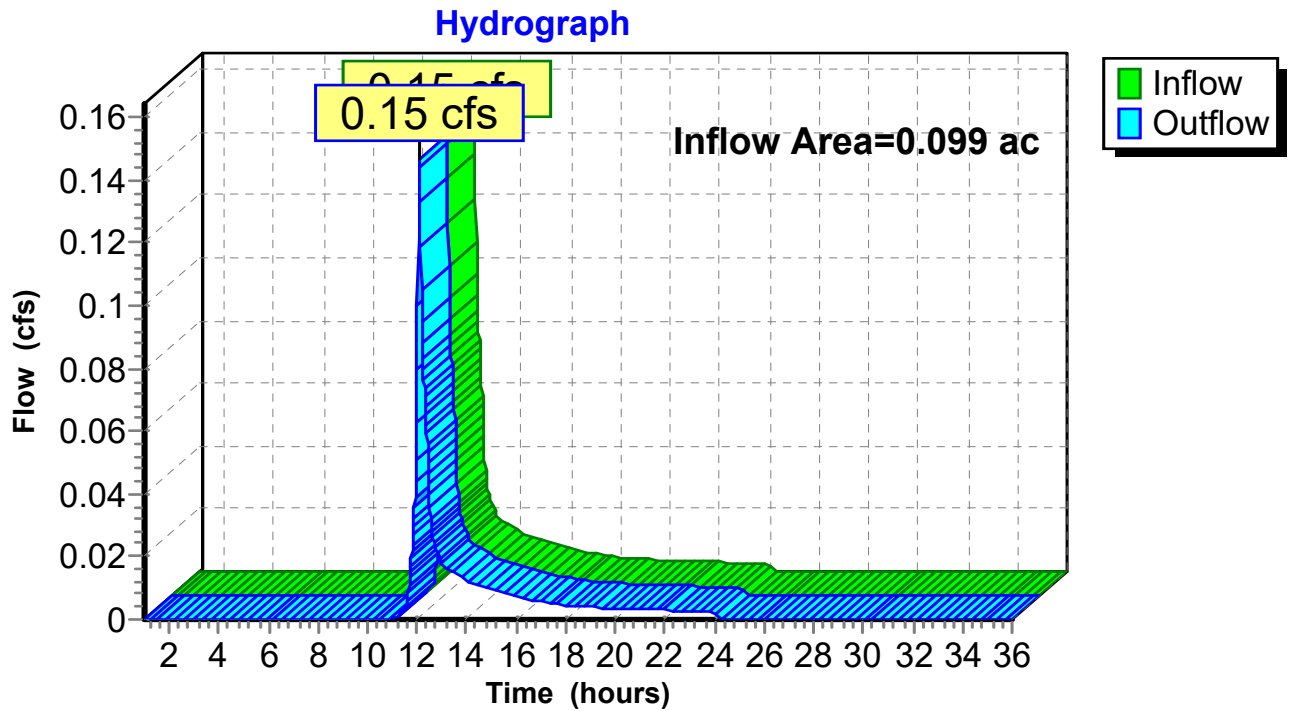


### Summary for Reach 1R: POI#1

Inflow Area = 0.099 ac, 42.74% Impervious, Inflow Depth = 1.33" for 10-year event  
Inflow = 0.15 cfs @ 12.08 hrs, Volume= 0.011 af  
Outflow = 0.15 cfs @ 12.08 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.02 hrs

### Reach 1R: POI#1



**Summary for Subcatchment 1S: Pre 93 Washington Ave**

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.017 af, Depth= 2.12"

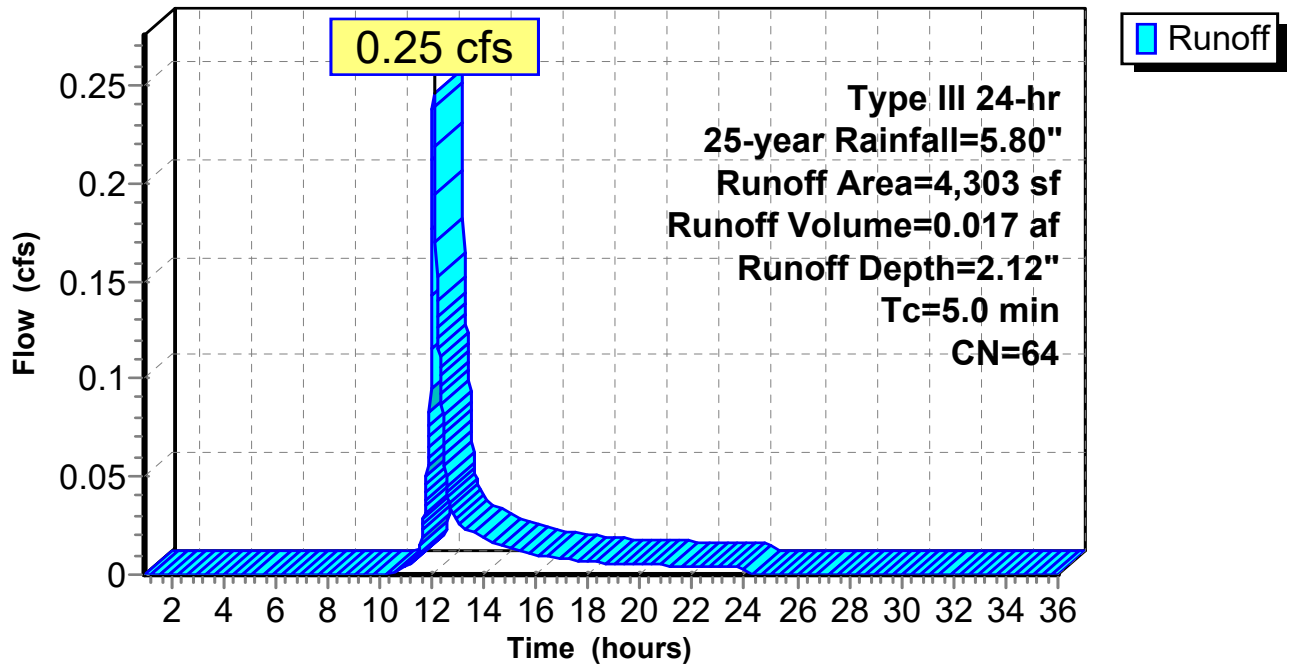
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.02 hrs  
 Type III 24-hr 25-year Rainfall=5.80"

Area (sf)	CN	Description
* 642	98	Driveway
* 979	98	Home
* 218	98	walkway
2,464	39	>75% Grass cover, Good, HSG A
4,303	64	Weighted Average
2,464		57.26% Pervious Area
1,839		42.74% Impervious Area

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

**Subcatchment 1S: Pre 93 Washington Ave**

**Hydrograph**

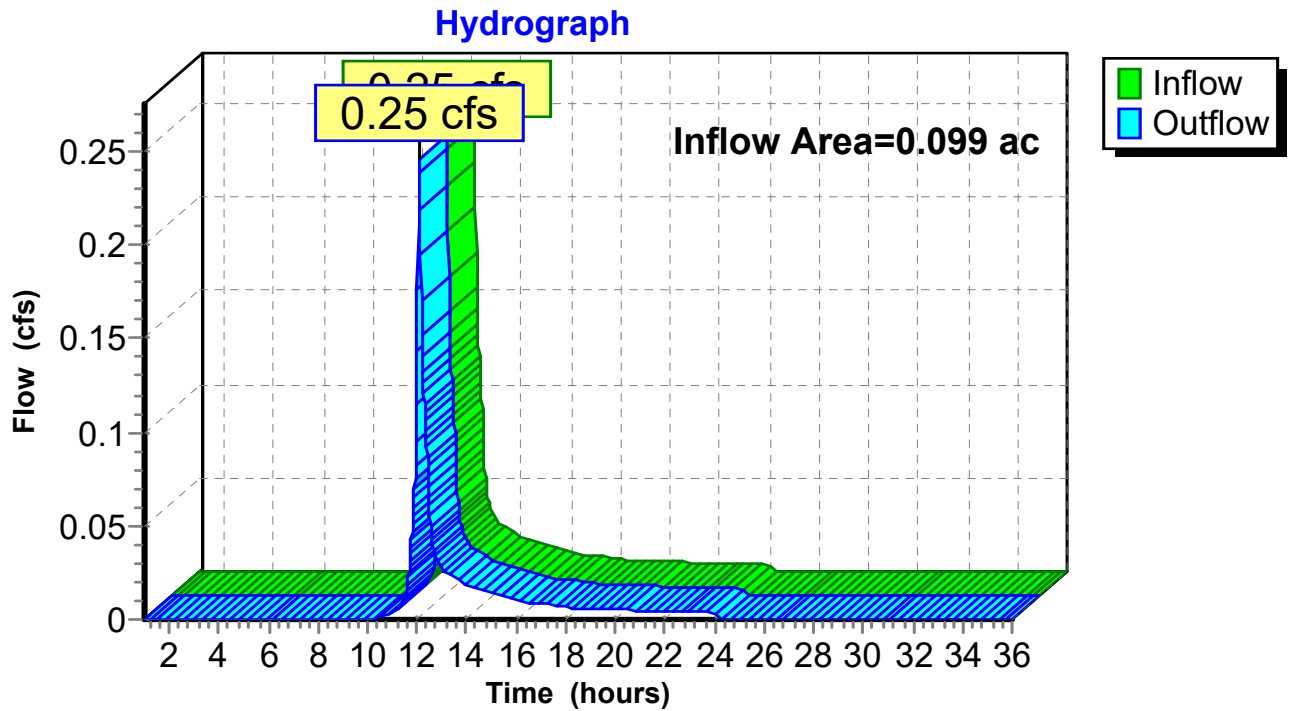


### Summary for Reach 1R: POI#1

Inflow Area = 0.099 ac, 42.74% Impervious, Inflow Depth = 2.12" for 25-year event  
Inflow = 0.25 cfs @ 12.08 hrs, Volume= 0.017 af  
Outflow = 0.25 cfs @ 12.08 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.00 hrs, dt= 0.02 hrs

### Reach 1R: POI#1



**Post\_7-15-16**

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Page 1

**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	69.50	69.00	20.0	0.0250	0.010	6.0	0.0	0.0

**Summary for Subcatchment 1S: Patio/Disturbed**

Runoff = 0.02 cfs @ 12.11 hrs, Volume= 0.002 af, Depth= 0.40"

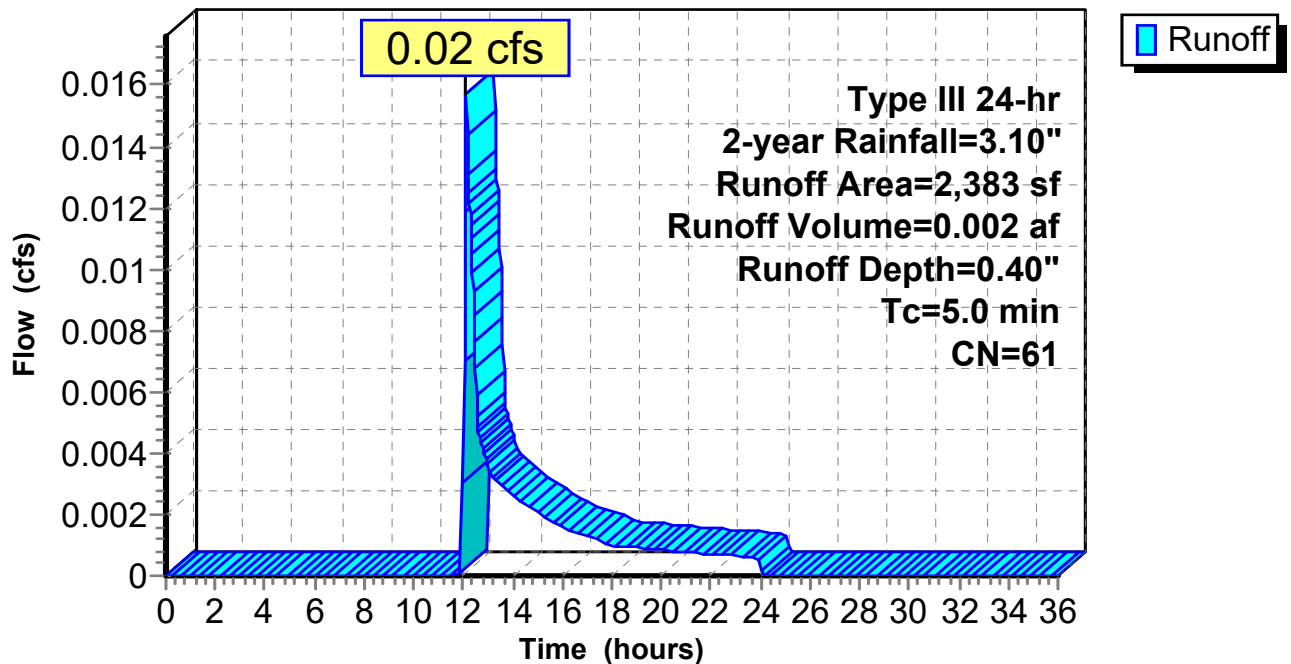
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
* 869	98	Patio/Walk
1,514	39	>75% Grass cover, Good, HSG A
2,383	61	Weighted Average
1,514		63.53% Pervious Area
869		36.47% Impervious Area

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

**Subcatchment 1S: Patio/Disturbed**

**Hydrograph**



### Summary for Subcatchment 2S: Building

Runoff = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 2.87"

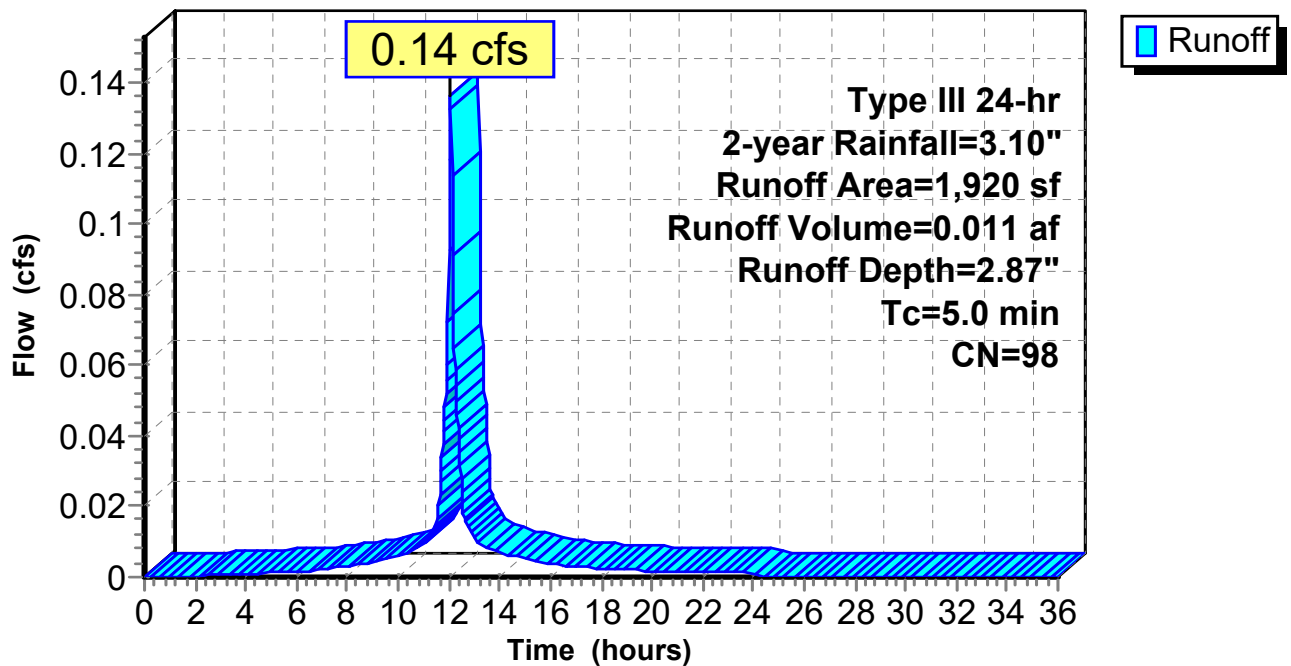
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
* 1,920	98	Building
1,920		100.00% Impervious Area

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

### Subcatchment 2S: Building

#### Hydrograph

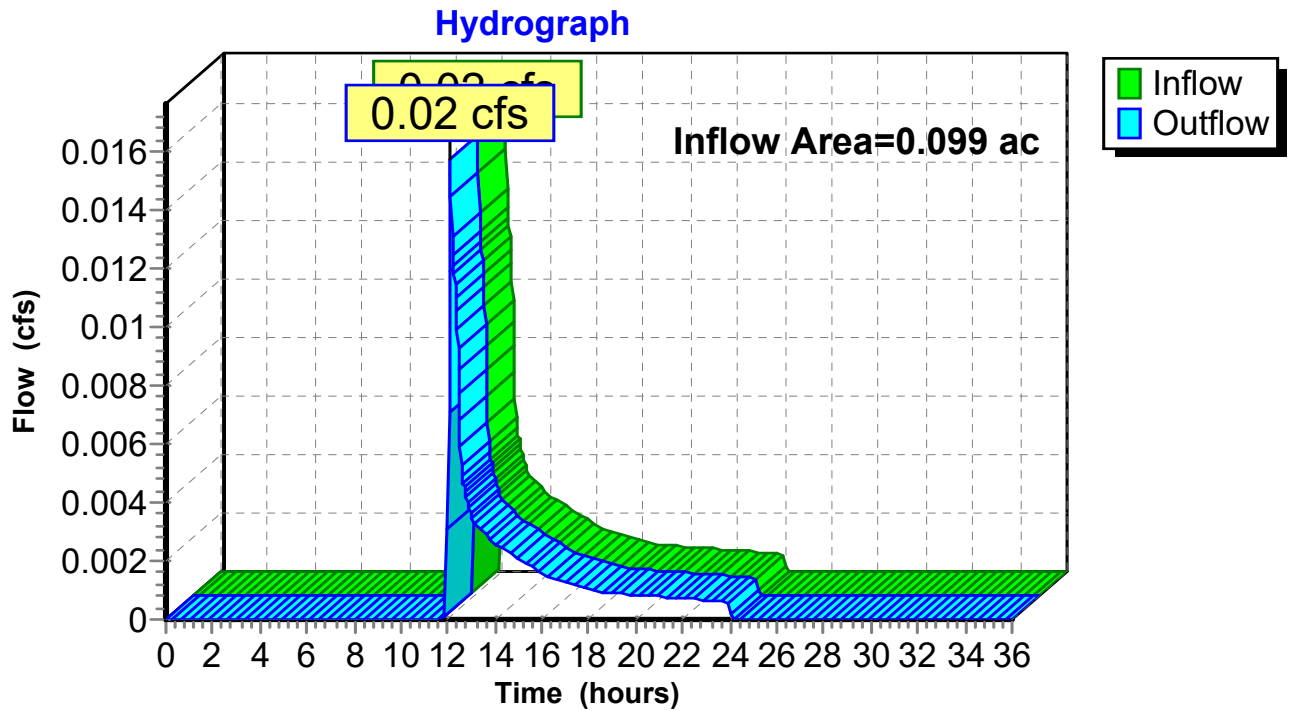


### Summary for Reach 1R: POI#1

Inflow Area = 0.099 ac, 64.82% Impervious, Inflow Depth = 0.22" for 2-year event  
Inflow = 0.02 cfs @ 12.11 hrs, Volume= 0.002 af  
Outflow = 0.02 cfs @ 12.11 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs

### Reach 1R: POI#1



**Summary for Pond 3P: Reservoir Stone**

Inflow Area = 0.044 ac, 100.00% Impervious, Inflow Depth = 2.87" for 2-year event  
 Inflow = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Peak Elev= 69.16' @ 24.30 hrs Surf.Area= 0.010 ac Storage= 0.011 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)  
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	69.50'	0.018 af	<b>40.00'W x 48.00'L x 1.00'H Stone Bedding</b> 0.044 af Overall x 40.0% Voids
#2	66.50'	0.012 af	<b>2.00'W x 216.00'L x 3.00'H Stone Underdrain</b> 0.030 af Overall x 40.0% Voids
		0.030 af	Total Available Storage

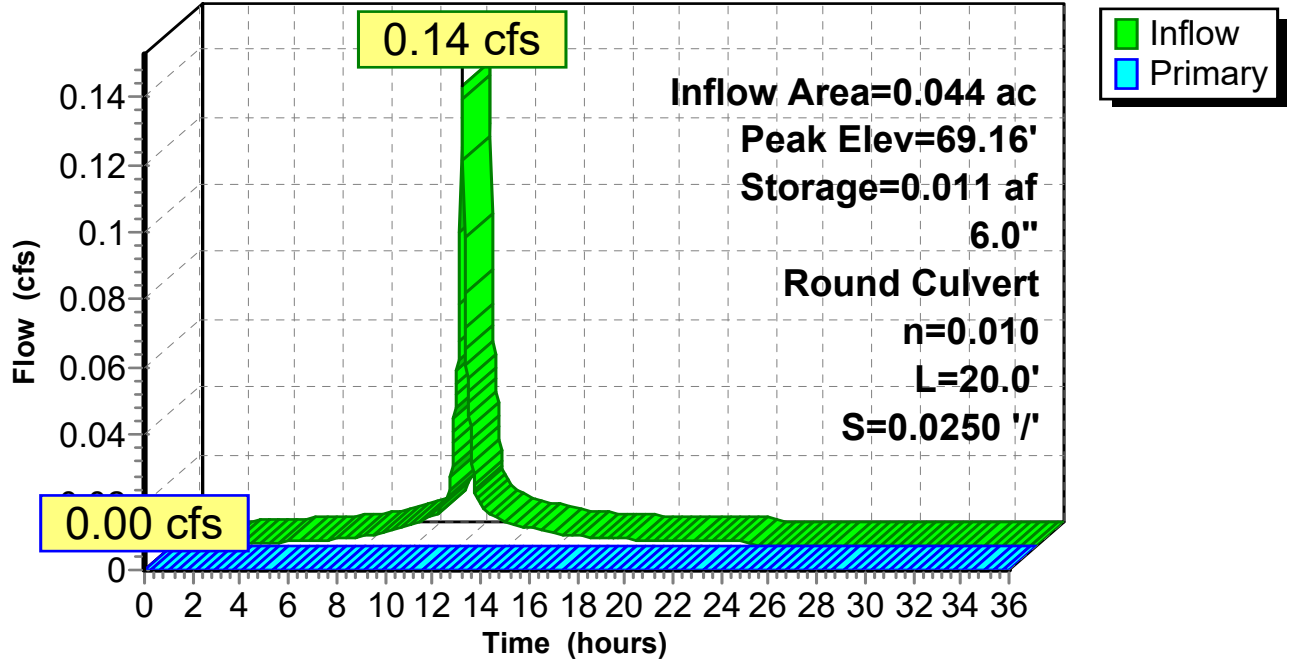
Device	Routing	Invert	Outlet Devices
#1	Primary	69.50'	<b>6.0" Round Culvert</b> L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 69.50' / 69.00' S= 0.0250 ' S= 0.0250 ' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=66.50' (Free Discharge)  
 ↑1=Culvert ( Controls 0.00 cfs)



### Pond 3P: Reservoir Stone

#### Hydrograph



**Summary for Subcatchment 1S: Patio/Disturbed**

Runoff = 0.07 cfs @ 12.09 hrs, Volume= 0.005 af, Depth= 1.14"

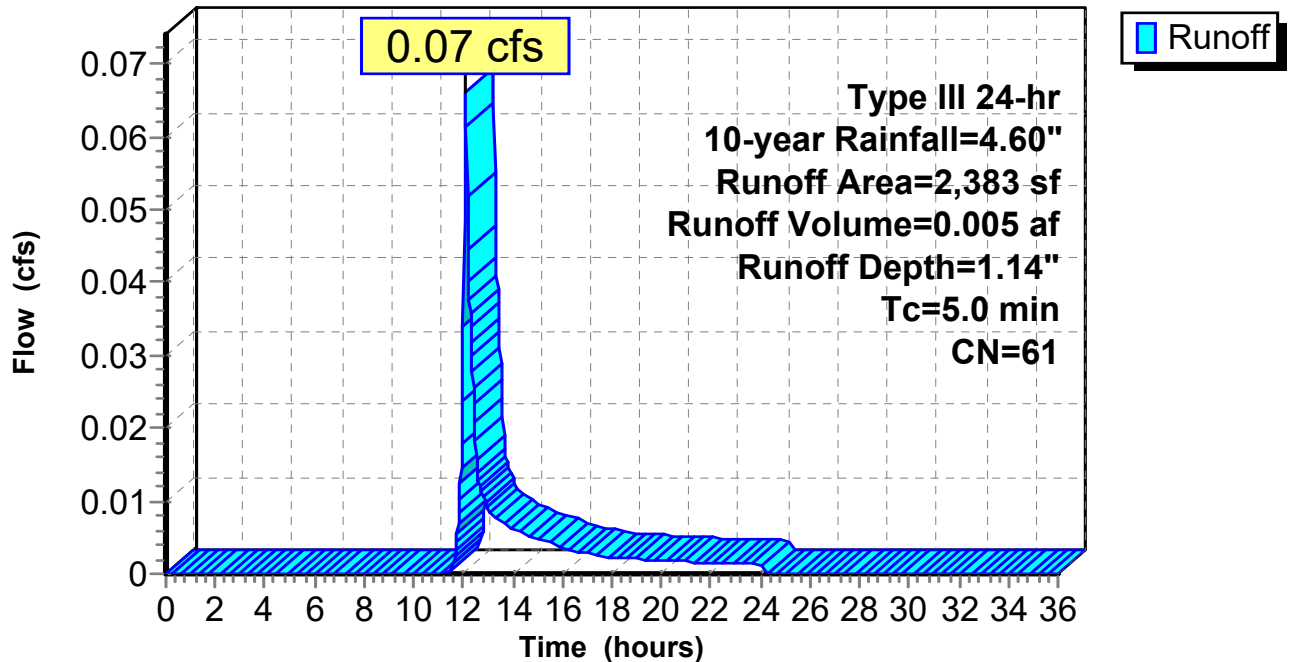
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
* 869	98	Patio/Walk
1,514	39	>75% Grass cover, Good, HSG A
2,383	61	Weighted Average
1,514		63.53% Pervious Area
869		36.47% Impervious Area

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

**Subcatchment 1S: Patio/Disturbed**

**Hydrograph**



### Summary for Subcatchment 2S: Building

Runoff = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af, Depth= 4.36"

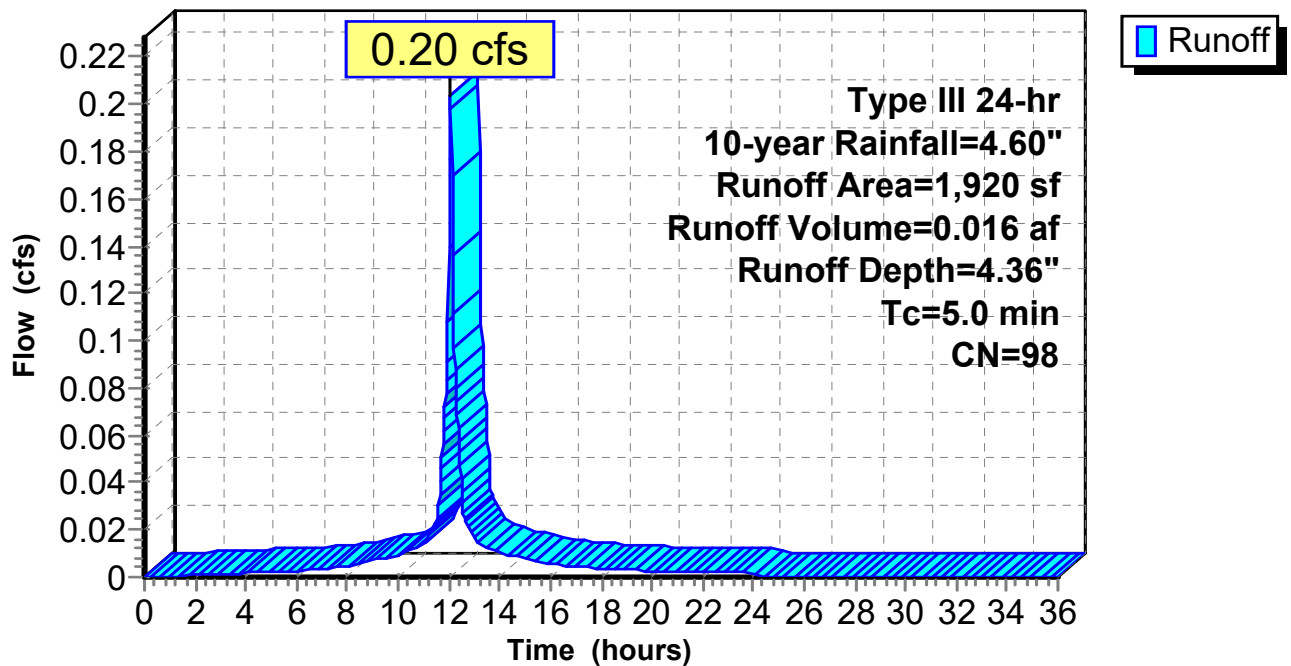
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
* 1,920	98	Building
1,920		100.00% Impervious Area

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

### Subcatchment 2S: Building

#### Hydrograph

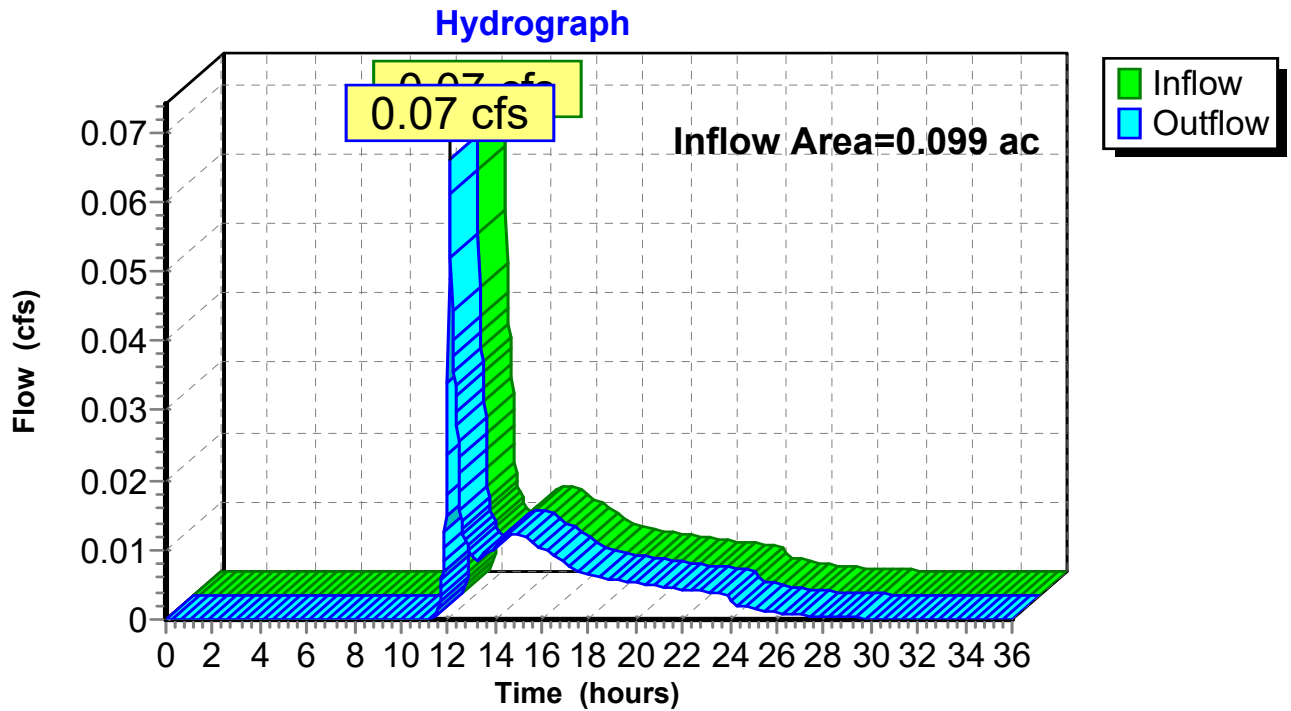


### Summary for Reach 1R: POI#1

Inflow Area = 0.099 ac, 64.82% Impervious, Inflow Depth > 1.13" for 10-year event  
Inflow = 0.07 cfs @ 12.09 hrs, Volume= 0.009 af  
Outflow = 0.07 cfs @ 12.09 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs

### Reach 1R: POI#1



**Summary for Pond 3P: Reservoir Stone**

Inflow Area = 0.044 ac, 100.00% Impervious, Inflow Depth = 4.36" for 10-year event  
 Inflow = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af  
 Outflow = 0.01 cfs @ 15.11 hrs, Volume= 0.004 af, Atten= 96%, Lag= 182.5 min  
 Primary = 0.01 cfs @ 15.11 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Peak Elev= 69.55' @ 15.11 hrs Surf.Area= 0.054 ac Storage= 0.013 af

Plug-Flow detention time= 585.9 min calculated for 0.004 af (26% of inflow)  
 Center-of-Mass det. time= 368.5 min ( 1,117.0 - 748.5 )

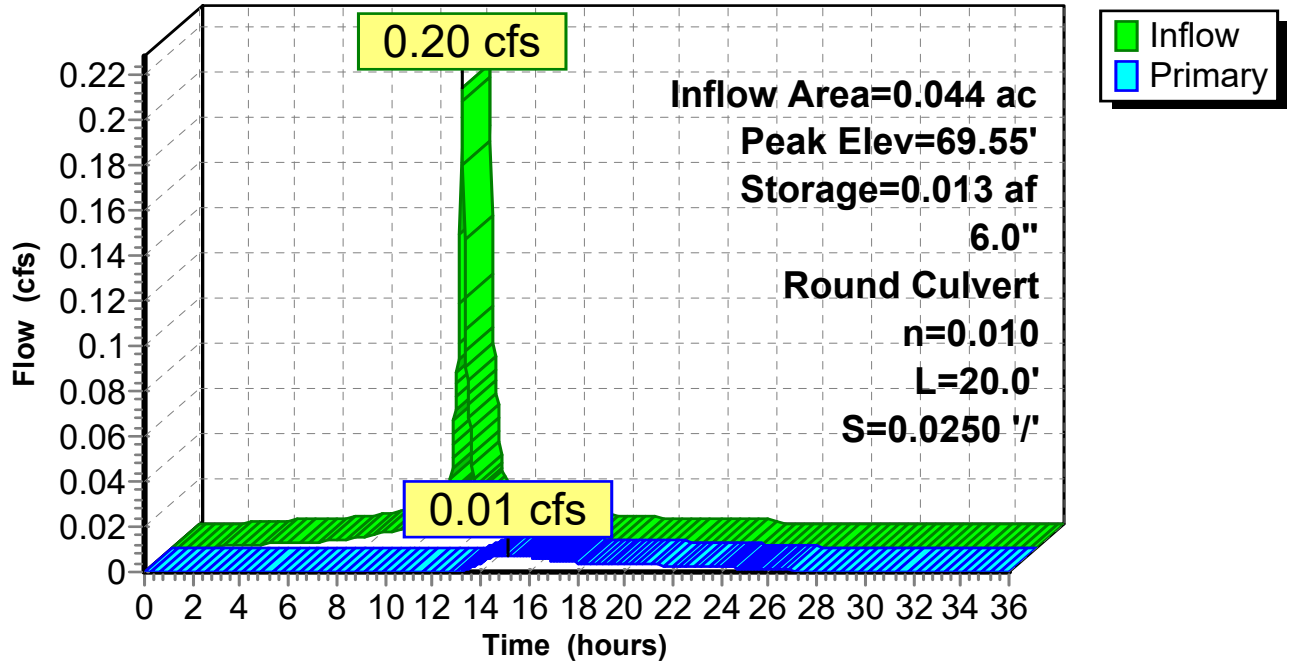
Volume	Invert	Avail.Storage	Storage Description
#1	69.50'	0.018 af	<b>40.00'W x 48.00'L x 1.00'H Stone Bedding</b> 0.044 af Overall x 40.0% Voids
#2	66.50'	0.012 af	<b>2.00'W x 216.00'L x 3.00'H Stone Underdrain</b> 0.030 af Overall x 40.0% Voids
		0.030 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	69.50'	<b>6.0" Round Culvert</b> L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 69.50' / 69.00' S= 0.0250 ' S= 0.0250 ' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

**Primary OutFlow** Max=0.01 cfs @ 15.11 hrs HW=69.55' (Free Discharge)  
 ↑**1=Culvert** (Inlet Controls 0.01 cfs @ 0.62 fps)

### Pond 3P: Reservoir Stone

#### Hydrograph



**Summary for Subcatchment 1S: Patio/Disturbed**

Runoff = 0.12 cfs @ 12.08 hrs, Volume= 0.009 af, Depth= 1.87"

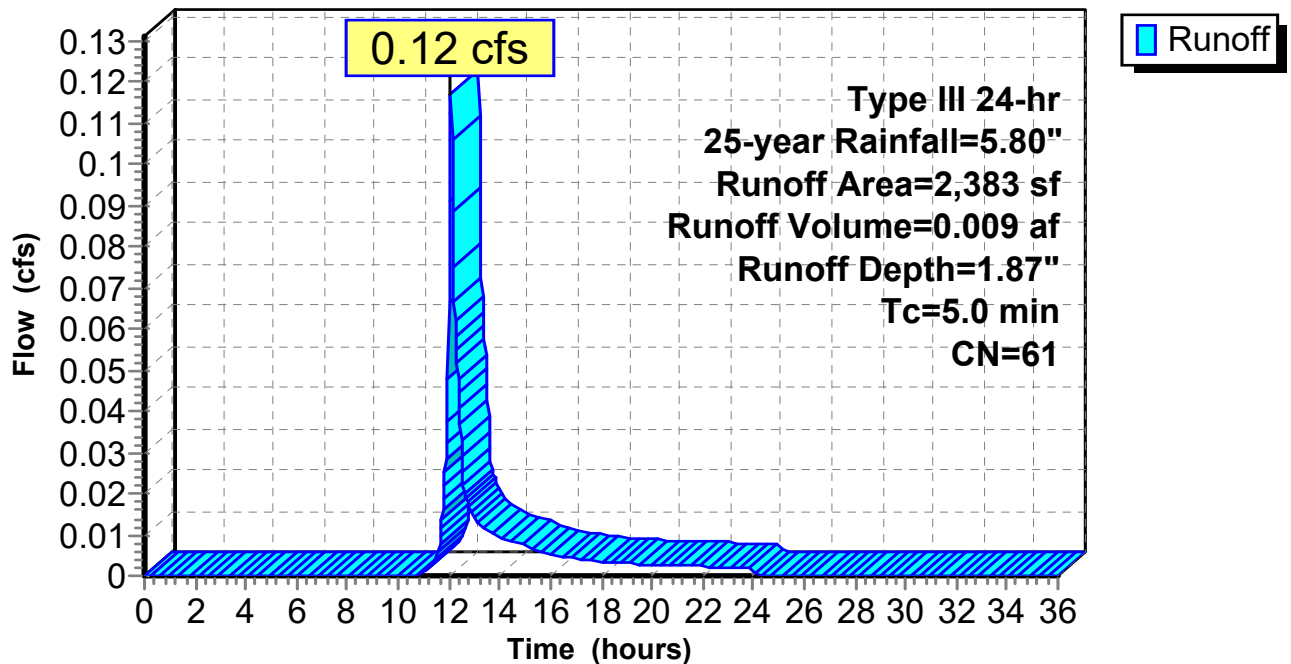
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Type III 24-hr 25-year Rainfall=5.80"

Area (sf)	CN	Description
* 869	98	Patio/Walk
1,514	39	>75% Grass cover, Good, HSG A
2,383	61	Weighted Average
1,514		63.53% Pervious Area
869		36.47% Impervious Area

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

**Subcatchment 1S: Patio/Disturbed**

**Hydrograph**



### Summary for Subcatchment 2S: Building

Runoff = 0.26 cfs @ 12.07 hrs, Volume= 0.020 af, Depth= 5.56"

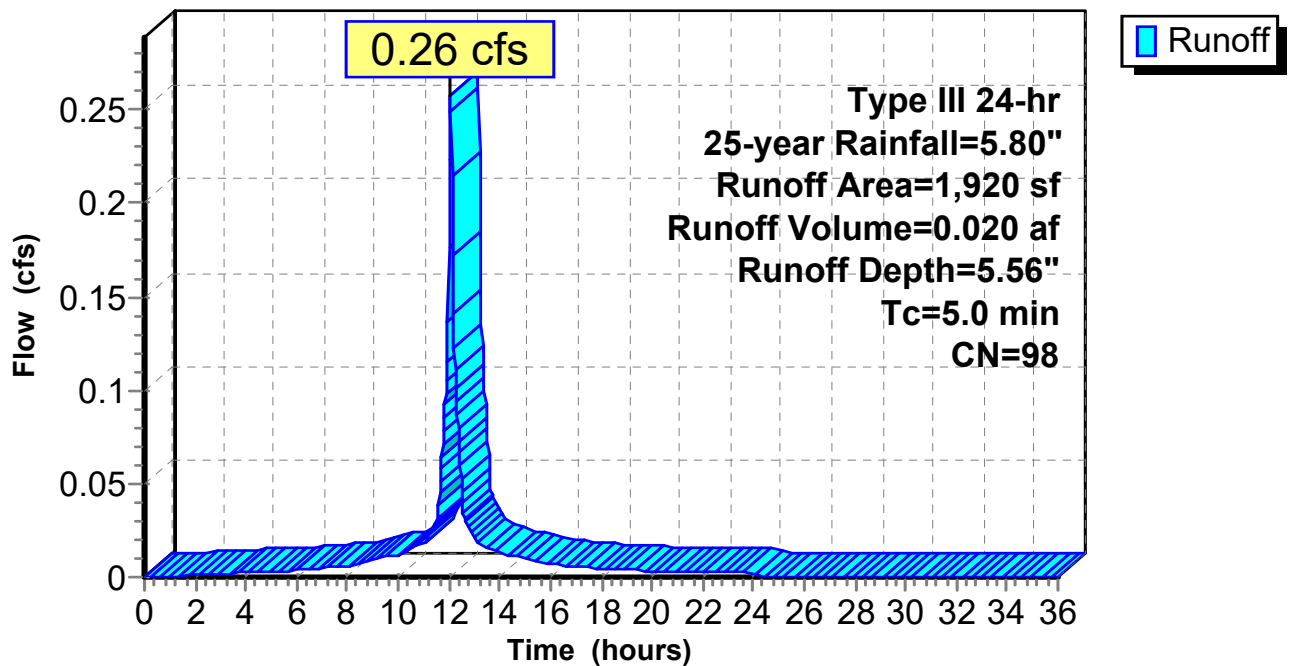
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Type III 24-hr 25-year Rainfall=5.80"

Area (sf)	CN	Description
* 1,920	98	Building
1,920		100.00% Impervious Area

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

### Subcatchment 2S: Building

#### Hydrograph



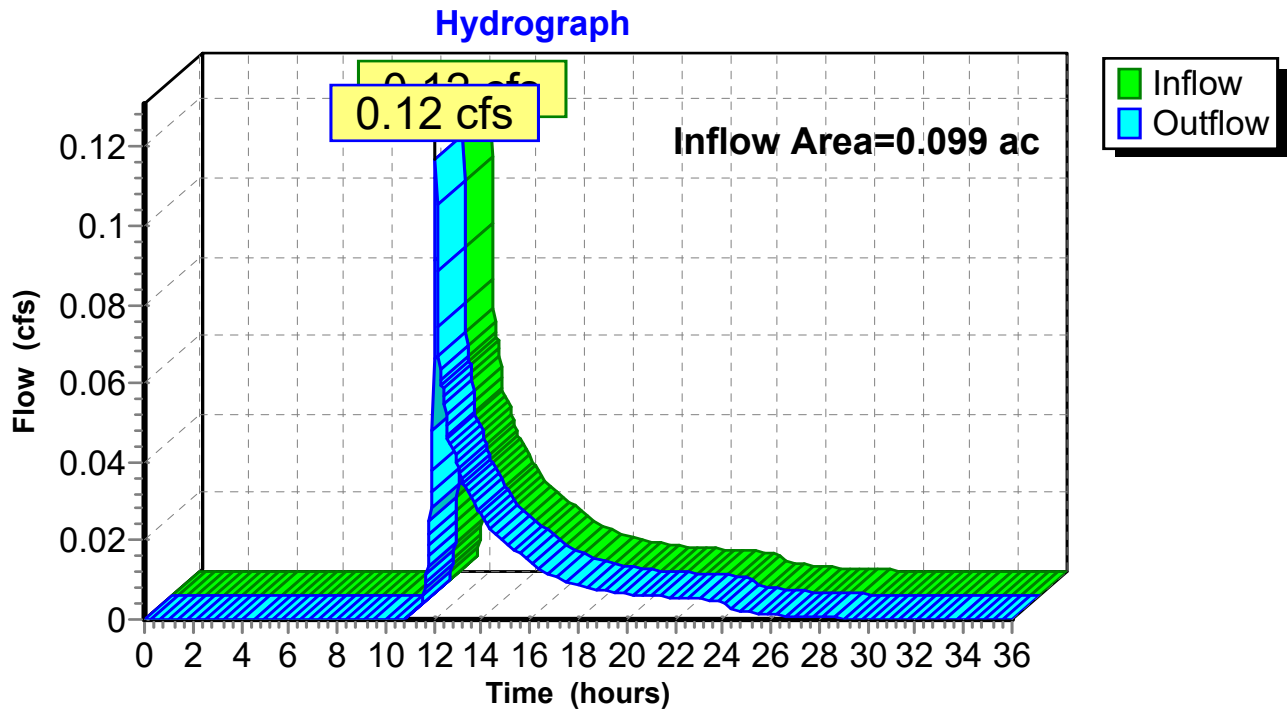


### Summary for Reach 1R: POI#1

Inflow Area = 0.099 ac, 64.82% Impervious, Inflow Depth = 2.07" for 25-year event  
Inflow = 0.12 cfs @ 12.08 hrs, Volume= 0.017 af  
Outflow = 0.12 cfs @ 12.08 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs

### Reach 1R: POI#1



**Summary for Pond 3P: Reservoir Stone**

Inflow Area = 0.044 ac, 100.00% Impervious, Inflow Depth = 5.56" for 25-year event  
 Inflow = 0.26 cfs @ 12.07 hrs, Volume= 0.020 af  
 Outflow = 0.03 cfs @ 12.76 hrs, Volume= 0.009 af, Atten= 90%, Lag= 41.5 min  
 Primary = 0.03 cfs @ 12.76 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs  
 Peak Elev= 69.60' @ 12.76 hrs Surf.Area= 0.054 ac Storage= 0.014 af

Plug-Flow detention time= 395.7 min calculated for 0.009 af (42% of inflow)  
 Center-of-Mass det. time= 244.1 min ( 988.8 - 744.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	69.50'	0.018 af	<b>40.00'W x 48.00'L x 1.00'H Stone Bedding</b> 0.044 af Overall x 40.0% Voids
#2	66.50'	0.012 af	<b>2.00'W x 216.00'L x 3.00'H Stone Underdrain</b> 0.030 af Overall x 40.0% Voids
		0.030 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	69.50'	<b>6.0" Round Culvert</b> L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 69.50' / 69.00' S= 0.0250 ' S= 0.0250 ' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

**Primary OutFlow** Max=0.03 cfs @ 12.76 hrs HW=69.60' (Free Discharge)  
 ↑1=Culvert (Inlet Controls 0.03 cfs @ 0.87 fps)

### Pond 3P: Reservoir Stone

#### Hydrograph

