A C O R N
ENGINEERING, INC.

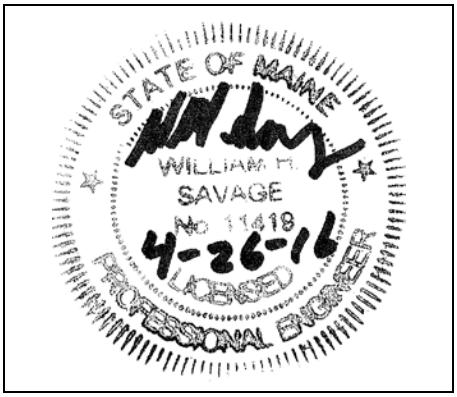
STORMWATER MANAGEMENT REPORT

Prepared For:

Redfern Properties, LLC
70 Anderson Redevelopment
70 Anderson Street
Portland, Maine 04101

Prepared By:

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



April 2016

INTRODUCTION

Acorn Engineering, Inc. has been retained by Redfern Properties, LLC to provide civil engineering services for the proposed redevelopment of 70 Anderson Street (1 East Lancaster Street). The proposed project is to develop an existing single family residence into ten townhouses.

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 III 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 existing, impervious area including rooftops, and paved asphalt and concrete driveways. The project will result in a net increase of impervious area above 1,000 sf, as such, is required to include stormwater management features for stormwater quality & quantity control. The stormwater analysis is documented with supporting calculations and reports attached to this narrative.

The current course of action is to provide primary water quality treatment to the stormwater through filtration utilizing a Maine Department of Environmental Protection – Rain Garden (Bioretention Cell) and Roof Dripline Filtration approved stormwater Best Management Practice (BMP); for the remainder of this report, 'Rain Garden' will be used in place of 'Bioretention Cell'. The implemented BMPs are to provide water quality treatment for no less than 95% of the new impervious area and 80% of the developed area.

EXISTING CONDITIONS

The proposed project site is located on the corner of Anderson and East Lancaster Street within the East Bayside neighborhood. A boundary plan has been prepared by Titcomb Associates of Falmouth, Maine dated January 14th, 2016.

Abutting Uses:

➢ North	R-6 Zone	Multi-Family Residential
➢ West	R-6 Zone	Multi-Family Residential
➢ South	R-6 Zone	Multi-Family Residential
➢ East	R-6 Zone	Multi-Family Residential

The property is also near a recreation open space, Kennedy Park (Cunningham Playground), that is due west of the property.

About half of the property is currently covered by impervious surfaces including two bituminous driveways from Anderson and East Lancaster Street (a portion of the East Lancaster driveway is concrete), a 1.5 story dwelling, a detached garage, and covered shed. The remaining surface is a grassy lawn. The site as a whole is relatively flat with an average

grade of approximately 3% sloping to the rear of the property. Based on existing conditions, the stormwater runoff is directed to the westernmost corner of the site and eventually enters the Fox Street municipal stormwater 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, 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 proposed project is a 10-unit redevelopment of an existing single-family lot. The new ten units will be orientated as such to create a courtyard and central walking space through the property. Within the courtyard, a Rain Garden is proposed as a central focus on stormwater mitigation on site and will be landscaped with perennials and other shrubbery as designed Soren Denoird Design Studio. The side setback along the abandoned paper street, Anderson Lane, is to be partially vegetated and contain the proposed Roof Dripline Filtration BMP. The final landscaping design has been provided by Soren Denoird Design Studio.

Tenant parking is to be provided on-site with a driveway access from East Lancaster Street. Pedestrian access to the site shall be provided off of Anderson Street into the central courtyard and via East Lancaster Street along the parking area.

The development will be served by the Portland Water District, underground power/cable/communications, and the municipal sewer system. The project anticipates incorporating Maine DEP approved stormwater Best Management Practices to meet the General and Flooding Standards.

GENERAL STANDARDS - WATER QUALITY

The Roof Dripline Filtration system and the Rain Garden was sized to meet or exceed to the requirements set forth within the MDEP Volume III BMPs Technical Design Manual, Chapter 7.6 and 7.2 respectively. Filter BMP systems have shown to be effective at filtering out and removing a wide range of pollutants from stormwater runoff.

Impervious Treatment Area

The majority of the impervious runoff is from the roof and 30% of all roof stormwater runoff shall be redirected into the Roof Dripline BMP. The water will then filter through a series of permeable layers before exfiltrating into the ground below the system. All runoff not exiting the BMP will be transported to the municipal stormwater system within Anderson Street via a perforated distribution pipe; the pipe is positioned within the BMP as such to act as the foundation drain as well.

The remaining impervious runoff to be treated shall be redirected into the Rain Garden within the courtyard. This runoff includes that redirected from a portion of the rooftops as well as the internal brick sidewalks and shall flow into the rain garden whose plants and storage area shall provide initial treatment. The stormwater is to be detained above the

surface before flowing vertically through the permeable soil filter layer before exfiltrating into the ground below. All remaining treated stormwater not dispersed into the ground, shall then be collected within perforated pipes and released slowly by the outlet control at an attenuated rate. Larger storm events are to overflow into an oversized horizontal atrium grate.

The treatment of the impervious surface by the BMPs are as follows:

Table 1 - Impervious Treatment Area Table

	Existing Impervious Area (SF)	Proposed Total Impervious Area (SF)	Net change in Impervious Area (SF)	Proposed Impervious Area with Treatment (SF)	% Overall New Imp. Area Treated
Roof Dripline				1260	
Rain Garden				2141	
TOTAL	4376	7266	2890	3401	118%

As shown above the project anticipates meeting and exceeding the required treatment for new impervious surfaces through the use of the filter BMPs.

Rain Garden Calculations

According to the requirements for a rain garden as defined in the Volume III: BMPs Technical Design Manual, Chapter 7.2, the surface area of the filter shall be no less than the sum of 7% of the tributary impervious area and 3% of the tributary vegetated area. The filter area is calculated by the following formula:

[(Imp. SF x 0.07) + (Veg. SF x 0.03)] = Filter Area (SF)

Please refer to Table 2 below.

Table 2 – Total Filter Surface Area, displays the proposed Rain Garden sizing requirements, actual size and the percentage of required area.

Table 2 –Total Filter Surface Area

	Required Filter Area (SF)	Actual Filter Area (SF)	Percentage of Required Area (%)
Rain Garden	150	210	140%

The outflow from the Rain Garden is then tributary to the municipal stormwater system. As shown, the size of the soil filter area will meet and exceed the surface area requirements. Values from the HydroCAD calculations attached to this report.

Water Quality Volume

In accordance with the Volume III: BMPs Technical Design Manual, a water quality volume of 1.0 inch times the tributary impervious area plus 0.4 inch times the tributary landscaped developed area is required to be treated by the Roof Dripline and Rain Garden. The water quality volume is calculated by the following formula:

$$\left(\frac{\text{Imp. SF x 1.0"}}{\text{12"/1'}}\right) + \left(\frac{\text{Dist. SF x 0.4"}}{\text{12"/1'}}\right) = \text{Treatment Volume (CF)}$$

The proposed water quality volume is as follows:

Table 4 - Water Quality Volume Table

	Developed Area (SF)	Impervious Area (SF)	Treatment Volume Required (CF)	Treatment Volume Provided
Roof Dripline	379	1190	**112**	**180**
Rain Garden	0	2255	**188**	**360**
Total	379	3445	**333**	**540**

As shown, the size of the combined water quality volume will meet and exceed the treatment volume requirements. Values from the HydroCAD calculations are attached to this report.

Per the requirements set by Chapter 7.6 of the BMP Technical Manual, Volume III for Roof Dripline Filtration, the Water Quality Volume entering the system defines the width and depth of the rock storage bed. Assuming that the overall depth must be a minimum of four feet to effectively act as a foundation drain as well as a BMP and the maximum storage width is limited to two feet due to site constraints, the rock storage bed must be a minimum of 12" deep to store the 1" of rainfall per impervious area.

HydroCAD Adjustments

Provided the infiltration rates of the water quality volume through the soil filter are variable a water quality outlet is modeled to provide the required minimum 24-hour release time. This is completed by adjusting the rainfall amount in HydroCAD until the inflow volume is equal to or greater than the calculated treatment volume. The storm events are modeled as type III, 24-hour storm events in HydroCAD.

A vertical orifice is modeled in HydroCAD at the outlet structures of each BMP. The orifice diameter is sized to detain the stormwater for an approximate period of 24 hours.

FLOODING STANDARD – WATER QUANTITY

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.

Both the pre and post-development conditions were modelled so that all runoff would enter the Fox Street municipal stormwater system. This assumption is based on the existing grades sloping downward from the property, Anderson Street, and East Lancaster towards Fox Street and allows the two conditions and their corresponding peak flows to be compared directly.

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 project. Due to the small size of the project the stormwater runoff shall be rounded to the nearest tenth of a cubic foot per second (cfs).

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.

Curve Number

Conservative curve number (CN) runoff values were used within the subcatchment for the landscaped area. The stormwater calculations used the following CN values in the post development condition for vegetated areas, as follows:

- Woods/Grass Combination Good

Given the landscaping plan is to design a densely planted perennial gardens within the rain garden and street frontages, the Woods/Grass Combination was deemed an appropriate CN value for the projected portion of the project area to receive such landscaping. The remaining landscaping along the side setbacks to be mostly grass covered.

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 property line to the corner of Anderson and East Lancaster Street

A Pre-Development Watershed Map developed for this project can be viewed in Attachment A, and a copy of the HydroCAD calculations is included within Attachment C, or this report. Peak flow rates for the storm events are as follows:

Table 4 – Pre-Development Peak Stormwater Flows			
Drainage Area	**2 – Year Storm Event (cfs)**	**10 – Year Storm Event (cfs)**	**25 – Year Storm Event (cfs)**
Fox Street	0.2	0.5	0.7

Post-development Calculations:

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

- Subcatchment 1 – Northernmost roof surface and landscaped area along the side setback
- Subcatchment 2 – Centralmost roof surfaces, courtyard brick sidewalks, and landscaped area within the rain garden
- Subcatchment 3 – Southernmost roof surface, paved parking, remaining brick sidewalk surface, and landscaped areas along the East Lancaster Street frontage and rear setback
- Subcatchment 4 – Landscaped area along the Anderson Street frontage

The post development calculations include changes to the land use and compensation provided by the BMP systems. The following table represents comparison of predevelopment and post-development condition peak runoff rates for the proposed development and tributary area.

Table 5 – Comparison of Peak Flows						
Drainage Area	**2 – Year Storm Event (cfs)**		**10 – Year Storm Event (cfs)**		**25 – Year Storm Event (cfs)**	
Fox Street	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
	0.22	0.27	0.5	0.4	0.7	0.6

As shown in Table 5 the net impact of the post development peak flows shall remain below the predevelopment levels for the ten and twenty-five-year storm. The net change between the pre and post-development flows for the two year storm was 0.05 cubic feet per gallon. Given that it is a standard of care to round to the nearest whole number and the analysis was completed to the tenth of a cubic foot due to the small project scope, this net change, though greater, is de minimis.

A Post-Development Watershed Map created for this project can be viewed in Attachment B, and a copy of the HydroCAD calculations is included within Attachment C 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, Deerfield and Hinckley are the existing onsite soil series The Deerfield series is composed of deep, moderately well drained

soils while the Hinckley series consists of very deep, excessively drained soils; both are formed in glaciofluvial materials. The permeability of Deerfield and 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. Acorn has used the conservative exfiltration rate of 2.41 in/hr when modeling the roof dripline and rain garden in HydroCAD.

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.

Table 3 - "K" Value

Soils Type	Subsurface	Substratum
Deerfield	0.17	0.17
Hinckley	0.17	0.17

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 still be of considerable importance.

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: Pre Development Watershed Map
Attachment B: Post Development Watershed Map
Attachment C: HydroCAD Calculations
Attachment D: Soils Map

POI#1

ANDERSON LANE
(private – see easement #2 & note #5)

ANDERSON STREET
(50 feet wide)

N48°55'45"E
105.00'

S48°55'45"W 105.00'

N41°45'55"W
80.00'

S41°45'55"E
80.00'

1

GENERAL NOTES:

1. REFER TO STORMWATER REPORT FOR MORE INFORMATION
2. GIVEN THE URBAN SETTING, SMALL WATERSHED AREA AND PREDOMINANCE OF IMPERVIOUS AREAS A 5 MINUTE TIME OF CONCENTRATION WAS USED FOR BOTH THE PRE-DEVELOPMENT AND POST-DEVELOPMENT CONDITIONS.

1 — SUBCATCHMENT NUMBER

SUBCATCHMENT EXTENTS

POI #1 — POINT OF INTEREST (POI)

PRELIMINARY
NOT ISSUED FOR CONSTRUCTION

ISSUED FOR	BY	DATE
PRELIMINARY APP	WHS	4/26/16

DRAWING NAME: PRE-DEVELOPMENT STORMWATER PLAN

PROJECT NAME: 70 ANDERSON ST REDEVELOPMENT

CLIENT: REDFERN PROPERTIES, LLC
P.O. BOX 8816 PORTLAND, ME 04104

ACORN ENGINEERING, INC.
158 DANFORTH STREET PORTLAND, MAINE 04102
(207) 775-2855

FILE:	1067_CIVIL
JN:	1067
SCALE:	NTS
DESIGNED BY:	WHS
DRAWN BY:	OJD
CHECKED BY:	WHS

STATE OF MAINE
WILLIAM H. SAVAGE
No. 11619
4-26-16
LICENSED PROFESSIONAL ENGINEER

DRAWING NO.
PRE

GENERAL NOTES:

1. REFER TO STORMWATER REPORT FOR MORE INFORMATION
2. GIVEN THE URBAN SETTING, SMALL WATERSHED AREA AND PREDOMINANCE OF IMPERVIOUS AREAS A 5 MINUTE TIME OF CONCENTRATION WAS USED FOR BOTH THE PRE-DEVELOPMENT AND POST-DEVELOPMENT CONDITIONS.

1 — SUBCATCHMENT NUMBER

SUBCATCHMENT EXTENTS

POI #1 — POINT OF INTEREST (POI)

ANDERSON LANE
(private – see easement #2 & note #5)

ANDERSON STREET
(50 feet)

POND 1: ROOF DRIPLINE BMP

POND 1 OUTLET TO ANDERSON STREET SEPARATED STORM SYSTEM

POND 2: RAIN GARDEN

POND 2 OUTLET TO ANDERSON STREET SEPARATED STORM SYSTEM

FLOWLINES, TYP.

UP

N48°55'45"E

N/F Portland Renewal Authority (Portland Housing Authority) 2528/295

N/F Portland Renewal Authority (Portland Housing Authority) 2818/53

apparent fence encroachment into Housing Authority 0.2±

apparent building & overhang encroachment into lane 0.5±

apparent overhang encroachment into right of way 0.3±

location per plan reference #7

bituminous drive

concrete sidewalk

PRELIMINARY
NOT ISSUED FOR CONSTRUCTION

ISSUED FOR	BY	DATE
PRELIMINARY APP	WHS	4/26/16

DRAWING NAME: POST-DEVELOPMENT STORMWATER PLAN

PROJECT NAME: 70 ANDERSON ST REDEVELOPMENT

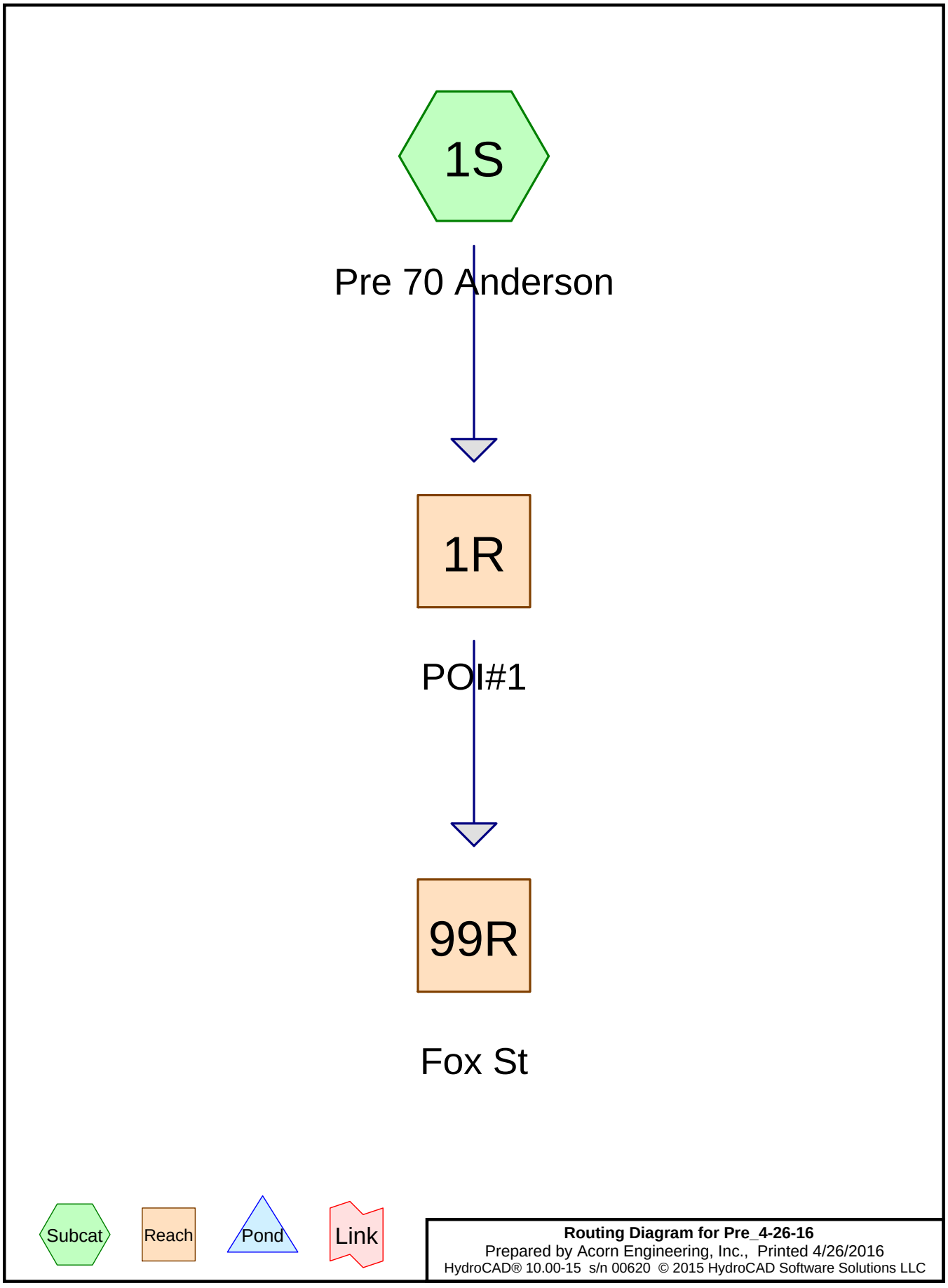
CLIENT: REDFERN PROPERTIES, LLC
P.O. BOX 8816 PORTLAND, ME 04104

ACORN ENGINEERING, INC.
ENGINEERING, INC.
158 DANFORTH STREET PORTLAND, MAINE 04102
(207) 775-2655

FILE:	1067_CIVIL
JN:	1067
SCALE:	NTS
DESIGNED BY:	WHS
DRAWN BY:	OJD
CHECKED BY:	WHS

STATE OF MAINE
WILLIAM H. SAVAGE
4-26-16
LICENSED PROFESSIONAL ENGINEER

DRAWING NO.
POST



Routing Diagram for Pre_4-26-16
Prepared by Acorn Engineering, Inc., Printed 4/26/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.101	49	50-75% Grass cover, Fair, HSG A (1S)
0.004	68	<50% Grass cover, Poor, HSG A (1S)
0.043	98	Building (1S)
0.002	96	Gravel surface, HSG A (1S)
0.058	98	Paved parking & roofs (1S)
0.208	**73**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.108	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.100	Other	1S
0.208		**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
0.101	0.000	0.000	0.000	0.000	0.101	50-75% Grass cover, Fair	1S
0.004	0.000	0.000	0.000	0.000	0.004	<50% Grass cover, Poor	1S
0.000	0.000	0.000	0.000	0.043	0.043	Building	1S
0.002	0.000	0.000	0.000	0.000	0.002	Gravel surface	1S
0.000	0.000	0.000	0.000	0.058	0.058	Paved parking & roofs	1S
0.108	**0.000**	**0.000**	**0.000**	**0.100**	**0.208**	**TOTAL AREA**	

Time span=1.00-36.00 hrs, dt=0.03 hrs, 1168 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 1S: Pre 70 Anderson Runoff Area=9,060 sf 48.30% Impervious Runoff Depth=0.92"
Tc=5.0 min CN=73 Runoff=0.22 cfs 0.016 af

Reach 1R: POI#1 Inflow=0.22 cfs 0.016 af
Outflow=0.22 cfs 0.016 af

Reach 99R: Fox St Inflow=0.22 cfs 0.016 af
Outflow=0.22 cfs 0.016 af

Total Runoff Area = 0.208 ac Runoff Volume = 0.016 af Average Runoff Depth = 0.92"
51.70% Pervious = 0.108 ac 48.30% Impervious = 0.100 ac

Summary for Subcatchment 1S: Pre 70 Anderson

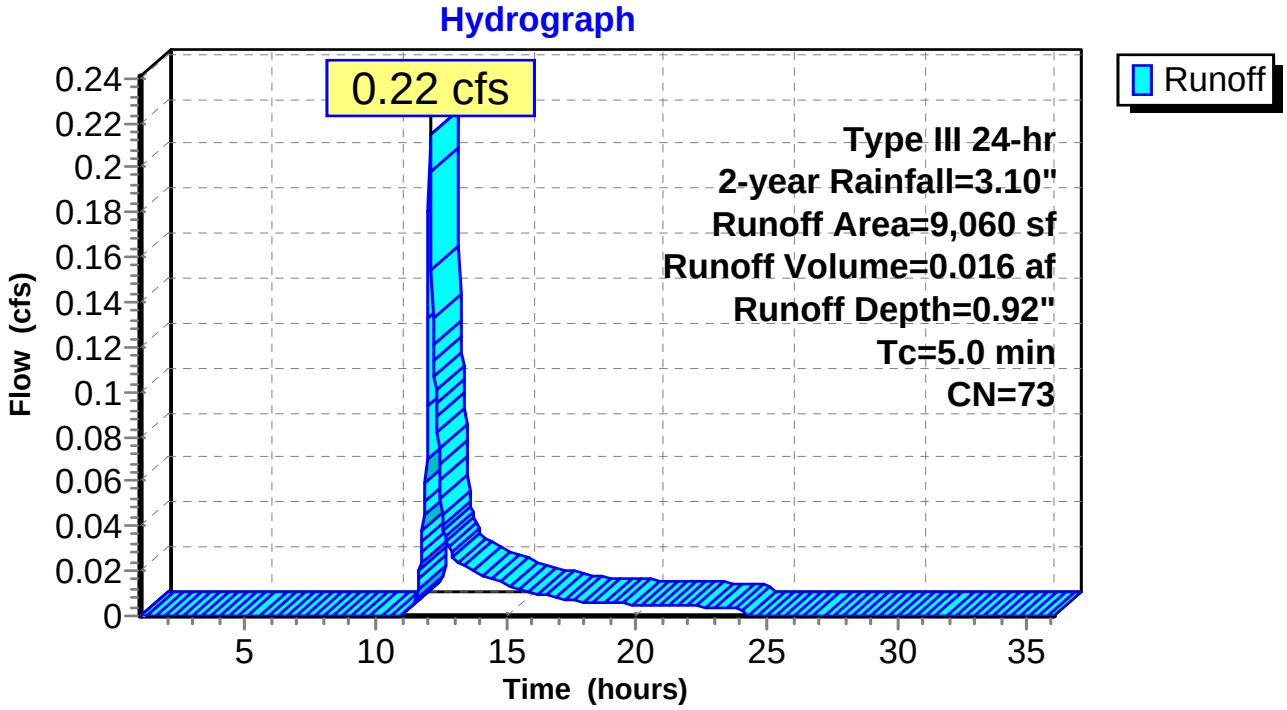
Runoff = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs
Type III 24-hr 2-year Rainfall=3.10"

	Area (sf)	CN	Description
*	1,861	98	Building
	75	96	Gravel surface, HSG A
	188	68	<50% Grass cover, Poor, HSG A
	2,515	98	Paved parking & roofs
	4,421	49	50-75% Grass cover, Fair, HSG A
	9,060	73	Weighted Average
	4,684		51.70% Pervious Area
	4,376		48.30% Impervious Area

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

Subcatchment 1S: Pre 70 Anderson

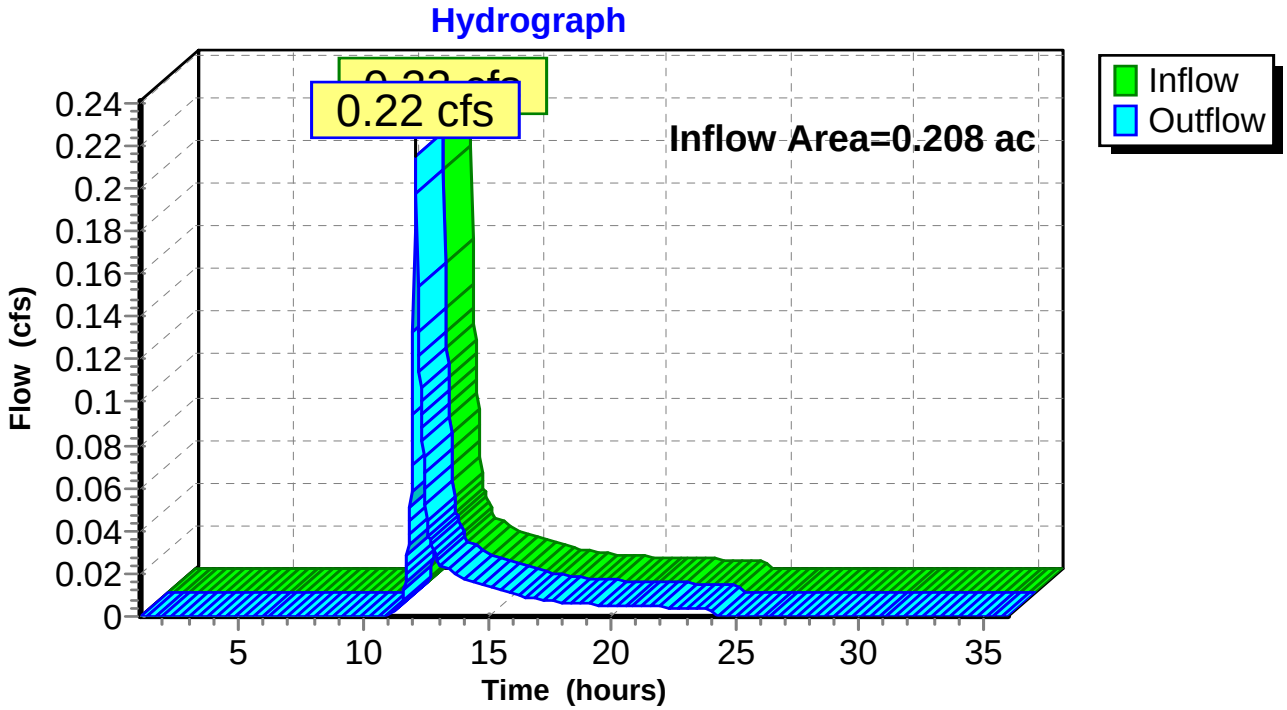


Summary for Reach 1R: POI#1

Inflow Area = 0.208 ac, 48.30% Impervious, Inflow Depth = 0.92" for 2-year event
Inflow = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af
Outflow = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs

Reach 1R: POI#1

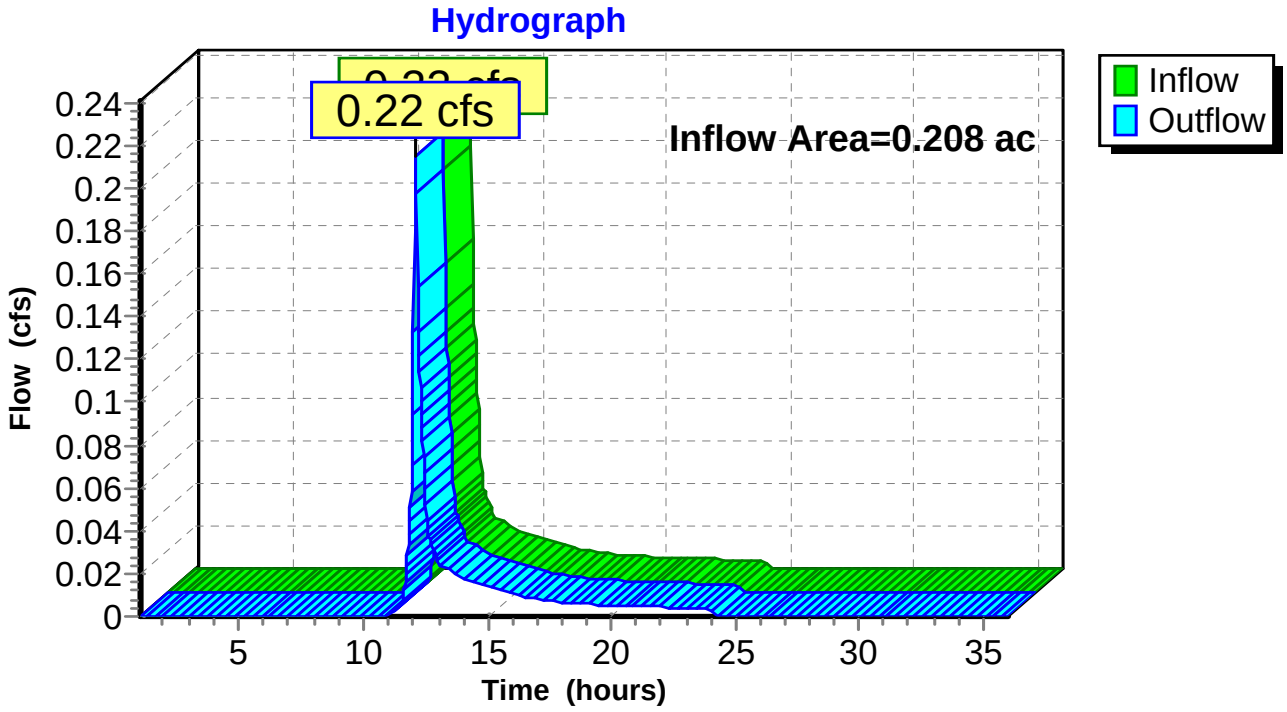


Summary for Reach 99R: Fox St

Inflow Area = 0.208 ac, 48.30% Impervious, Inflow Depth = 0.92" for 2-year event
Inflow = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af
Outflow = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs

Reach 99R: Fox St



Time span=1.00-36.00 hrs, dt=0.03 hrs, 1168 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 1S: Pre 70 Anderson Runoff Area=9,060 sf 48.30% Impervious Runoff Depth=1.97"
Tc=5.0 min CN=73 Runoff=0.49 cfs 0.034 af

Reach 1R: POI#1 Inflow=0.49 cfs 0.034 af
Outflow=0.49 cfs 0.034 af

Reach 99R: Fox St Inflow=0.49 cfs 0.034 af
Outflow=0.49 cfs 0.034 af

Total Runoff Area = 0.208 ac Runoff Volume = 0.034 af Average Runoff Depth = 1.97"
51.70% Pervious = 0.108 ac 48.30% Impervious = 0.100 ac

Summary for Subcatchment 1S: Pre 70 Anderson

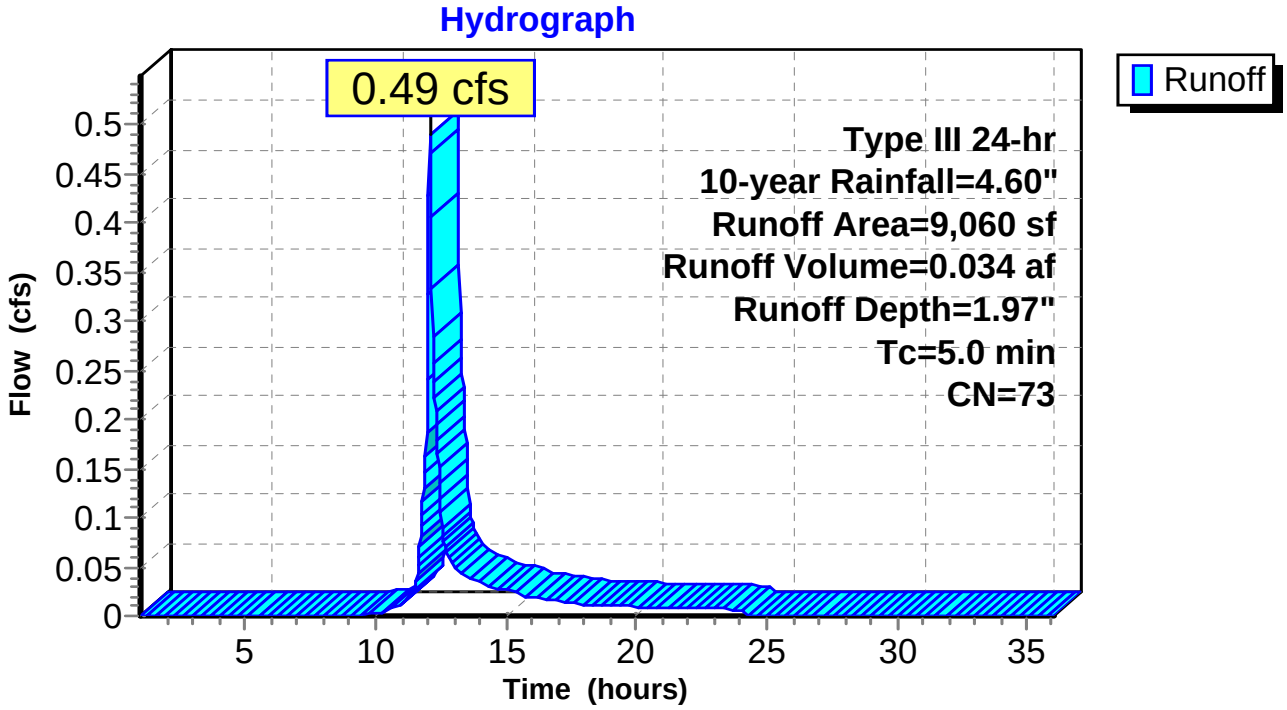
Runoff = 0.49 cfs @ 12.08 hrs, Volume= 0.034 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs
Type III 24-hr 10-year Rainfall=4.60"

	Area (sf)	CN	Description
*	1,861	98	Building
	75	96	Gravel surface, HSG A
	188	68	<50% Grass cover, Poor, HSG A
	2,515	98	Paved parking & roofs
	4,421	49	50-75% Grass cover, Fair, HSG A
	9,060	73	Weighted Average
	4,684		51.70% Pervious Area
	4,376		48.30% Impervious Area

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

Subcatchment 1S: Pre 70 Anderson

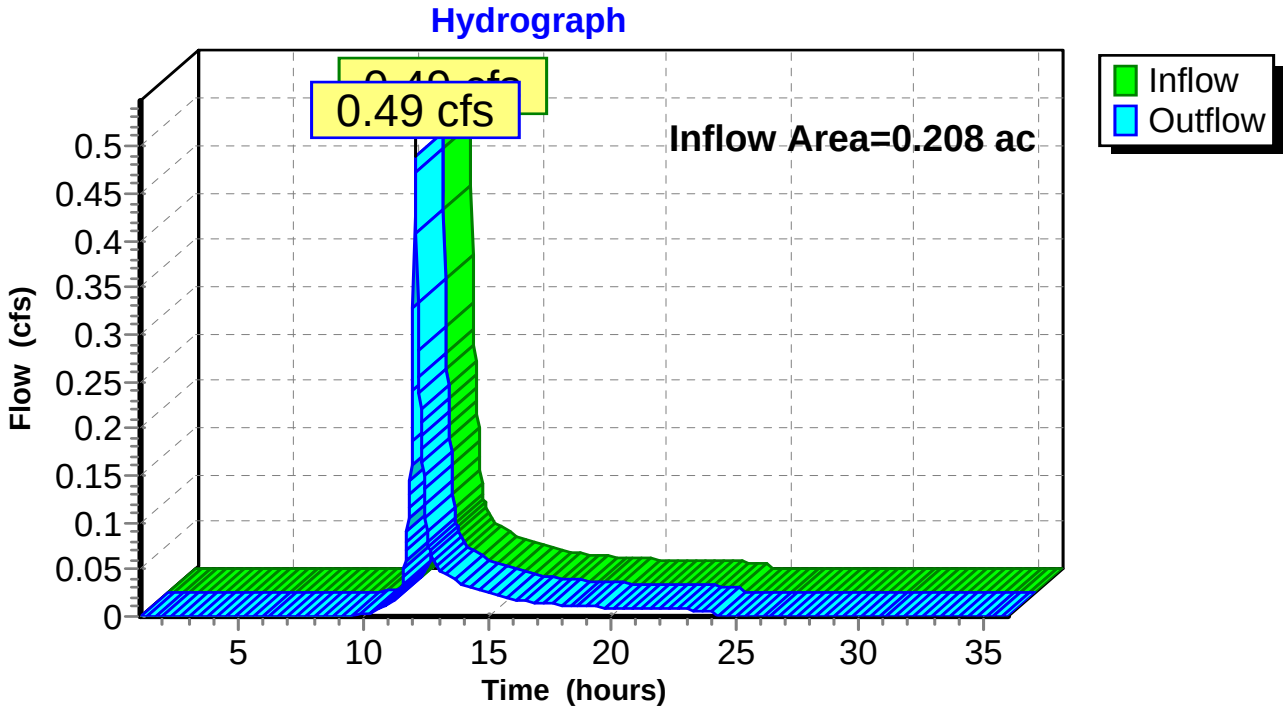


Summary for Reach 1R: POI#1

Inflow Area = 0.208 ac, 48.30% Impervious, Inflow Depth = 1.97" for 10-year event
Inflow = 0.49 cfs @ 12.08 hrs, Volume= 0.034 af
Outflow = 0.49 cfs @ 12.08 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs

Reach 1R: POI#1

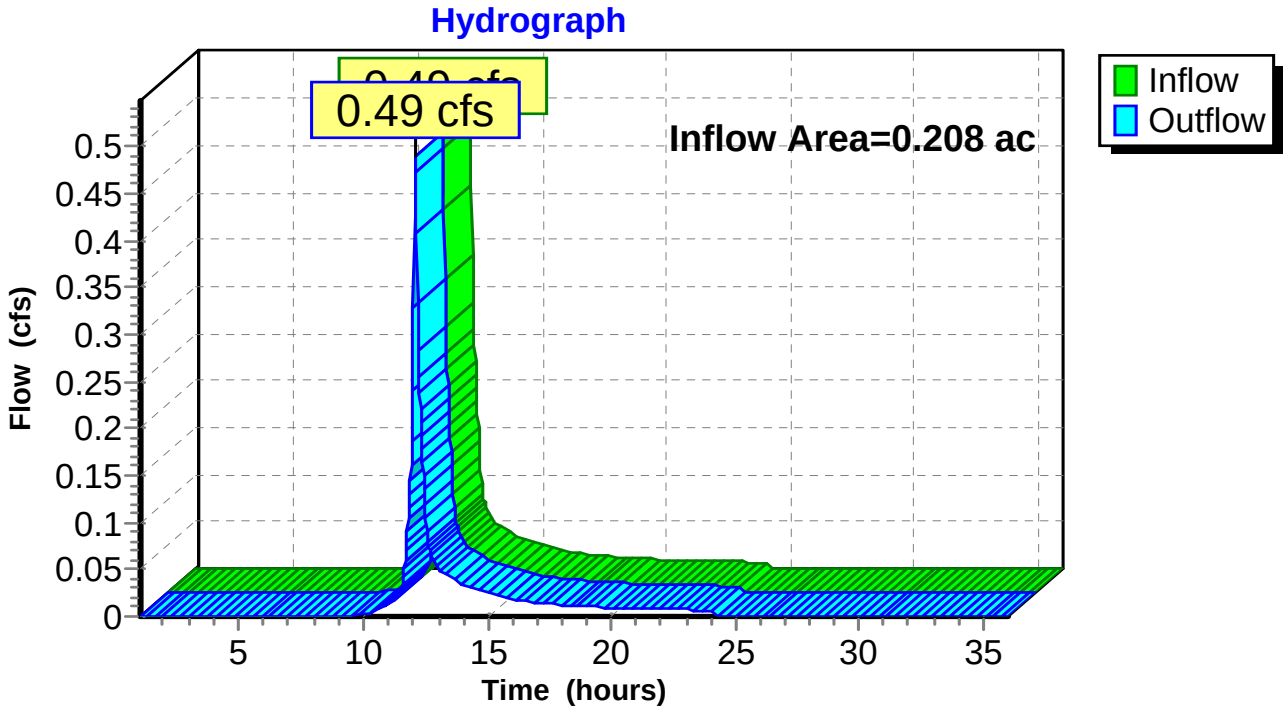


Summary for Reach 99R: Fox St

Inflow Area = 0.208 ac, 48.30% Impervious, Inflow Depth = 1.97" for 10-year event
Inflow = 0.49 cfs @ 12.08 hrs, Volume= 0.034 af
Outflow = 0.49 cfs @ 12.08 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs

Reach 99R: Fox St



Time span=1.00-36.00 hrs, dt=0.03 hrs, 1168 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 1S: Pre 70 Anderson Runoff Area=9,060 sf 48.30% Impervious Runoff Depth=2.92"
Tc=5.0 min CN=73 Runoff=0.73 cfs 0.051 af

Reach 1R: POI#1 Inflow=0.73 cfs 0.051 af
Outflow=0.73 cfs 0.051 af

Reach 99R: Fox St Inflow=0.73 cfs 0.051 af
Outflow=0.73 cfs 0.051 af

Total Runoff Area = 0.208 ac Runoff Volume = 0.051 af Average Runoff Depth = 2.92"
51.70% Pervious = 0.108 ac 48.30% Impervious = 0.100 ac

Summary for Subcatchment 1S: Pre 70 Anderson

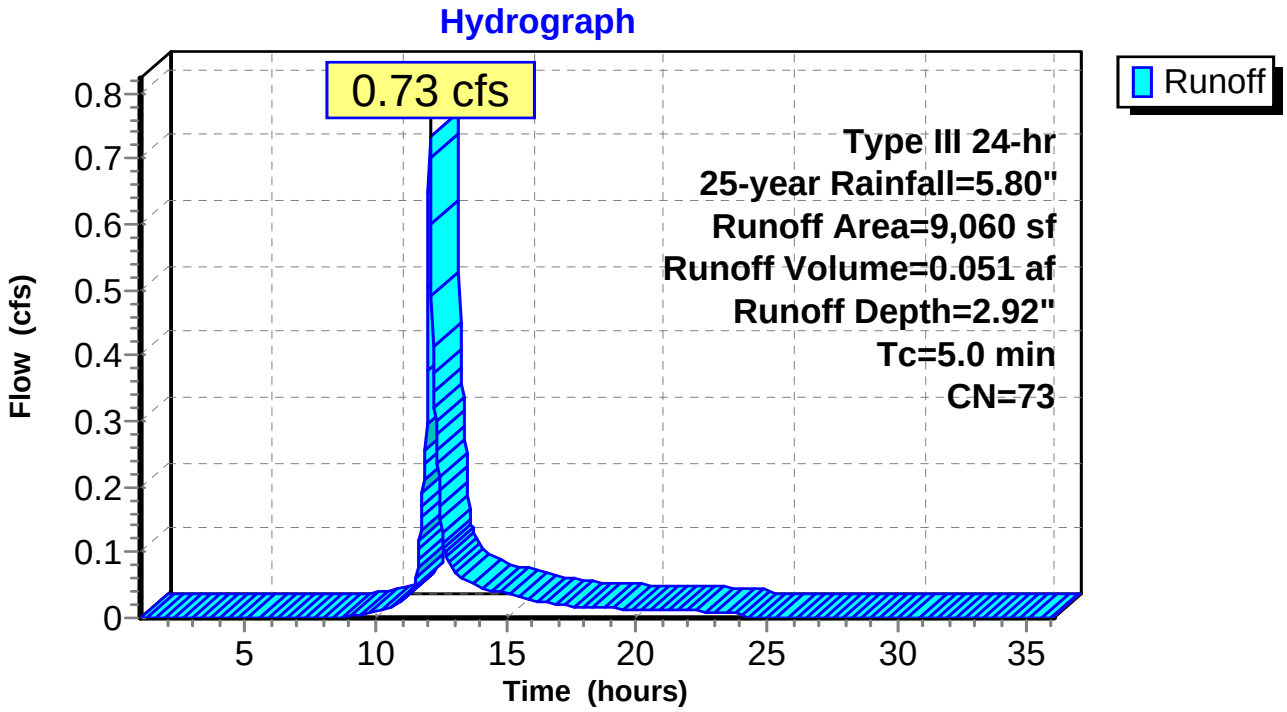
Runoff = 0.73 cfs @ 12.08 hrs, Volume= 0.051 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs
Type III 24-hr 25-year Rainfall=5.80"

	Area (sf)	CN	Description
*	1,861	98	Building
	75	96	Gravel surface, HSG A
	188	68	<50% Grass cover, Poor, HSG A
	2,515	98	Paved parking & roofs
	4,421	49	50-75% Grass cover, Fair, HSG A
	9,060	73	Weighted Average
	4,684		51.70% Pervious Area
	4,376		48.30% Impervious Area

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

Subcatchment 1S: Pre 70 Anderson

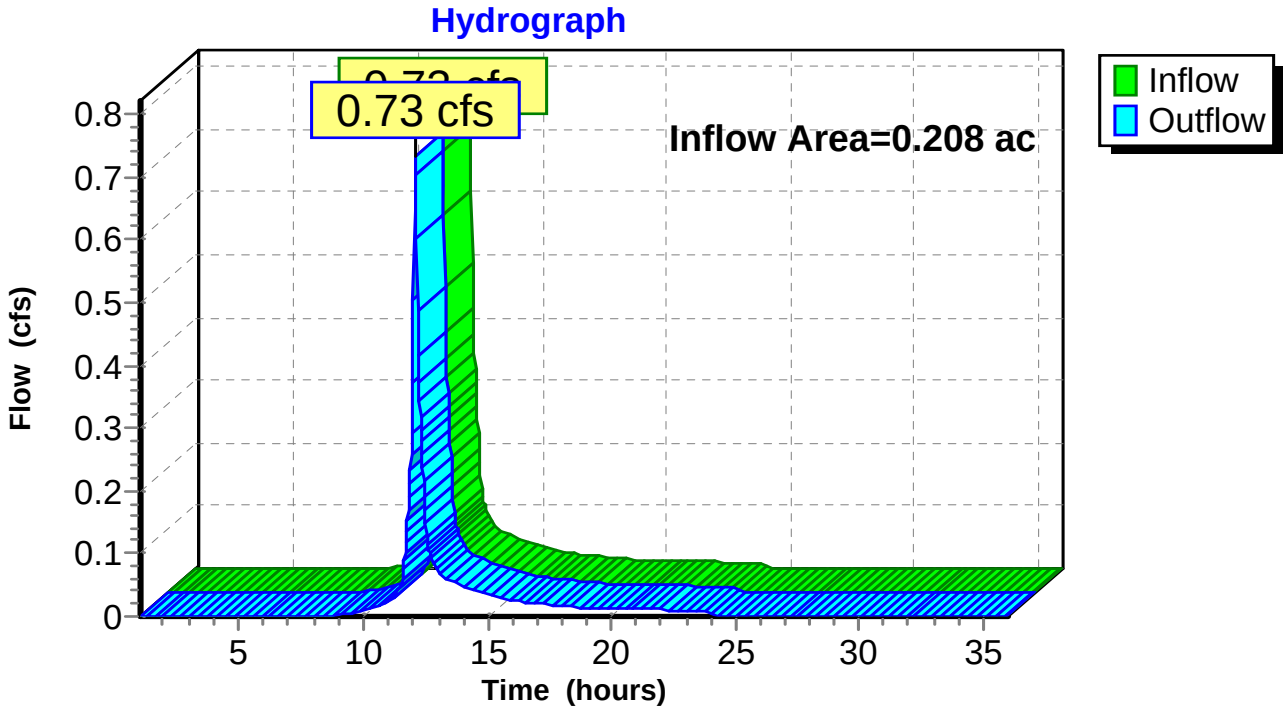


Summary for Reach 1R: POI#1

Inflow Area = 0.208 ac, 48.30% Impervious, Inflow Depth = 2.92" for 25-year event
Inflow = 0.73 cfs @ 12.08 hrs, Volume= 0.051 af
Outflow = 0.73 cfs @ 12.08 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs

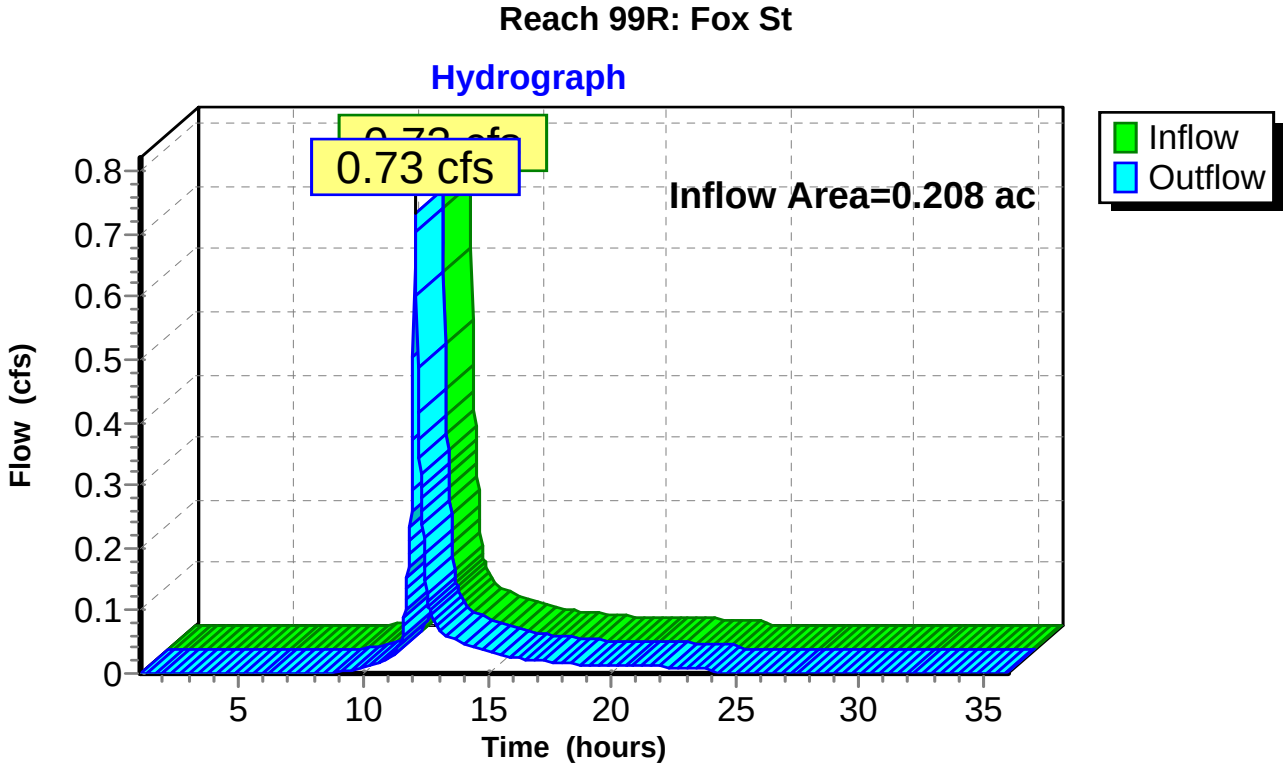
Reach 1R: POI#1

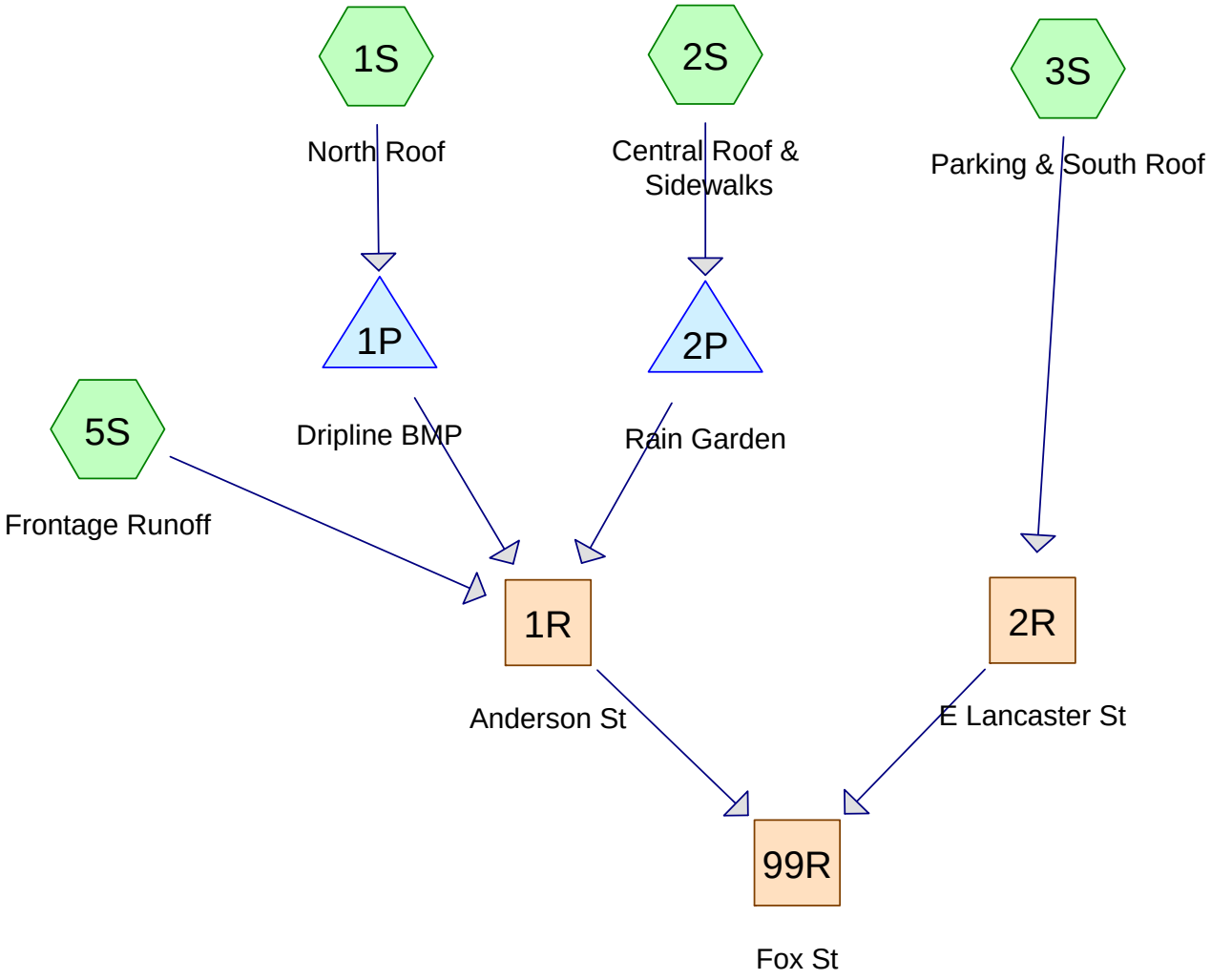


Summary for Reach 99R: Fox St

Inflow Area = 0.208 ac, 48.30% Impervious, Inflow Depth = 2.92" for 25-year event
Inflow = 0.73 cfs @ 12.08 hrs, Volume= 0.051 af
Outflow = 0.73 cfs @ 12.08 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-36.01 hrs, dt= 0.03 hrs





Subcat Reach Pond Link

Routing Diagram for Post_4-26-16
Prepared by Acorn Engineering, Inc., Printed 4/26/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.025	96	Brick Pavers, HSG A (2S, 3S, 5S)
0.003	77	Crushed Stone, HSG A (3S)
0.053	98	Paved Parking, HSG A (3S)
0.064	98	Roofs, HSG A (1S, 2S)
0.035	32	Woods/grass comb., Good, HSG A (1S, 2S, 3S, 5S)
0.027	98	roofs, HSG A (3S)
0.208	**86**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.208	HSG A	1S, 2S, 3S, 5S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.208		**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
0.025	0.000	0.000	0.000	0.000	0.025	Brick Pavers	2S, 3S, 5S
0.003	0.000	0.000	0.000	0.000	0.003	Crushed Stone	3S
0.053	0.000	0.000	0.000	0.000	0.053	Paved Parking	3S
0.064	0.000	0.000	0.000	0.000	0.064	Roofs	1S, 2S
0.035	0.000	0.000	0.000	0.000	0.035	Woods/grass comb., Good	1S, 2S, 3S, 5S
0.027	0.000	0.000	0.000	0.000	0.027	roofs	3S
0.208	**0.000**	**0.000**	**0.000**	**0.000**	**0.208**	**TOTAL AREA**	

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	1P	11.00	10.84	229.0	0.0007	0.010	6.0	0.0	0.0
2	2P	13.40	12.95	43.0	0.0105	0.010	6.0	0.0	0.0

Time span=0.00-36.00 hrs, dt=0.03 hrs, 1201 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 1S: North Roof Runoff Area=1,749 sf 68.04% Impervious Runoff Depth=1.14"
Tc=5.0 min CN=77 Runoff=0.05 cfs 0.004 af

Subcatchment 2S: Central Roof & Sidewalks Runoff Area=2,886 sf 54.89% Impervious Runoff Depth=1.53"
Tc=5.0 min CN=83 Runoff=0.12 cfs 0.008 af

Subcatchment 3S: Parking & South Roof Runoff Area=4,324 sf 80.80% Impervious Runoff Depth=2.35"
Tc=5.0 min CN=93 Runoff=0.27 cfs 0.019 af

Subcatchment 5S: Frontage Runoff Runoff Area=101 sf 0.00% Impervious Runoff Depth=0.15"
Tc=5.0 min CN=52 Runoff=0.00 cfs 0.000 af

Reach 1R: Anderson St Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach 2R: E Lancaster St Inflow=0.27 cfs 0.019 af
Outflow=0.27 cfs 0.019 af

Reach 99R: Fox St Inflow=0.27 cfs 0.020 af
Outflow=0.27 cfs 0.020 af

Pond 1P: Dripline BMP Peak Elev=11.01' Storage=36 cf Inflow=0.05 cfs 0.004 af
Discarded=0.02 cfs 0.004 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.004 af

Pond 2P: Rain Garden Peak Elev=15.04' Storage=172 cf Inflow=0.12 cfs 0.008 af
Discarded=0.01 cfs 0.008 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.008 af

Total Runoff Area = 0.208 ac Runoff Volume = 0.032 af Average Runoff Depth = 1.83"
30.82% Pervious = 0.064 ac 69.18% Impervious = 0.144 ac

Summary for Subcatchment 1S: North Roof

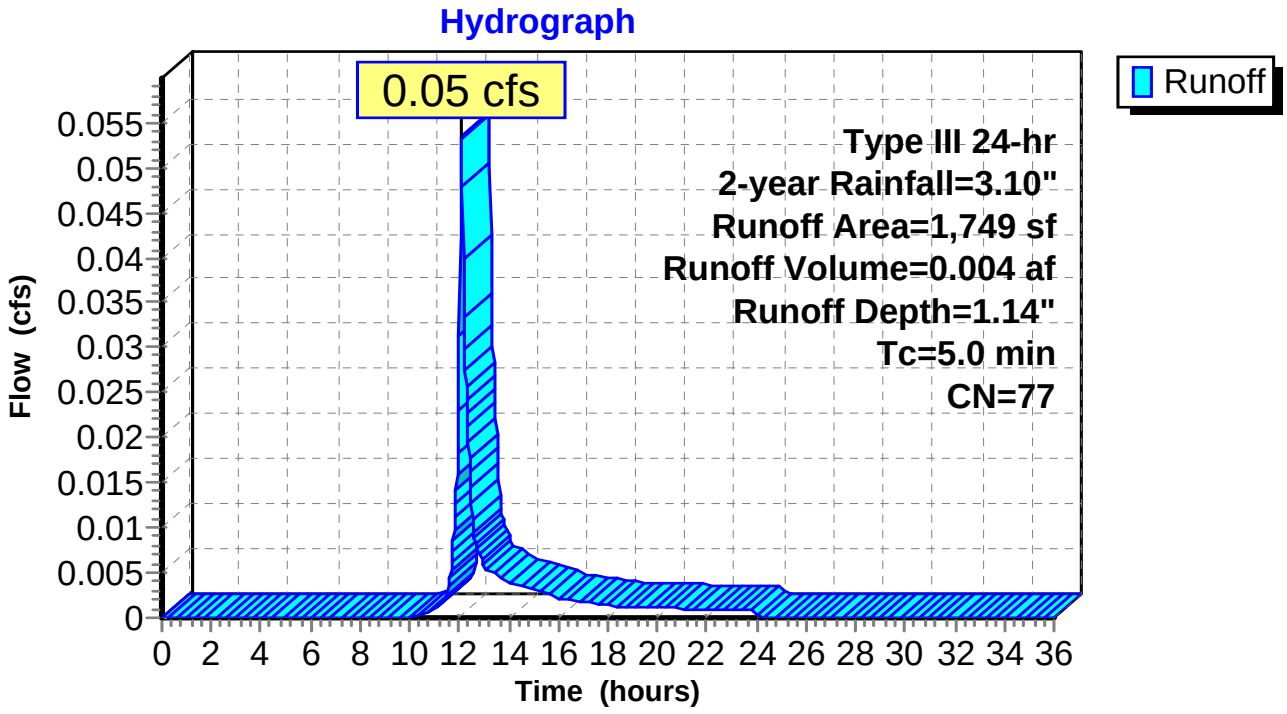
Runoff = 0.05 cfs @ 12.08 hrs, Volume= 0.004 af, Depth= 1.14"

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 2-year Rainfall=3.10"

	Area (sf)	CN	Description
*	1,190	98	Roofs, HSG A
	559	32	Woods/grass comb., Good, HSG A
	1,749	77	Weighted Average
	559		31.96% Pervious Area
	1,190		68.04% Impervious Area

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

Subcatchment 1S: North Roof



Summary for Subcatchment 2S: Central Roof & Sidewalks

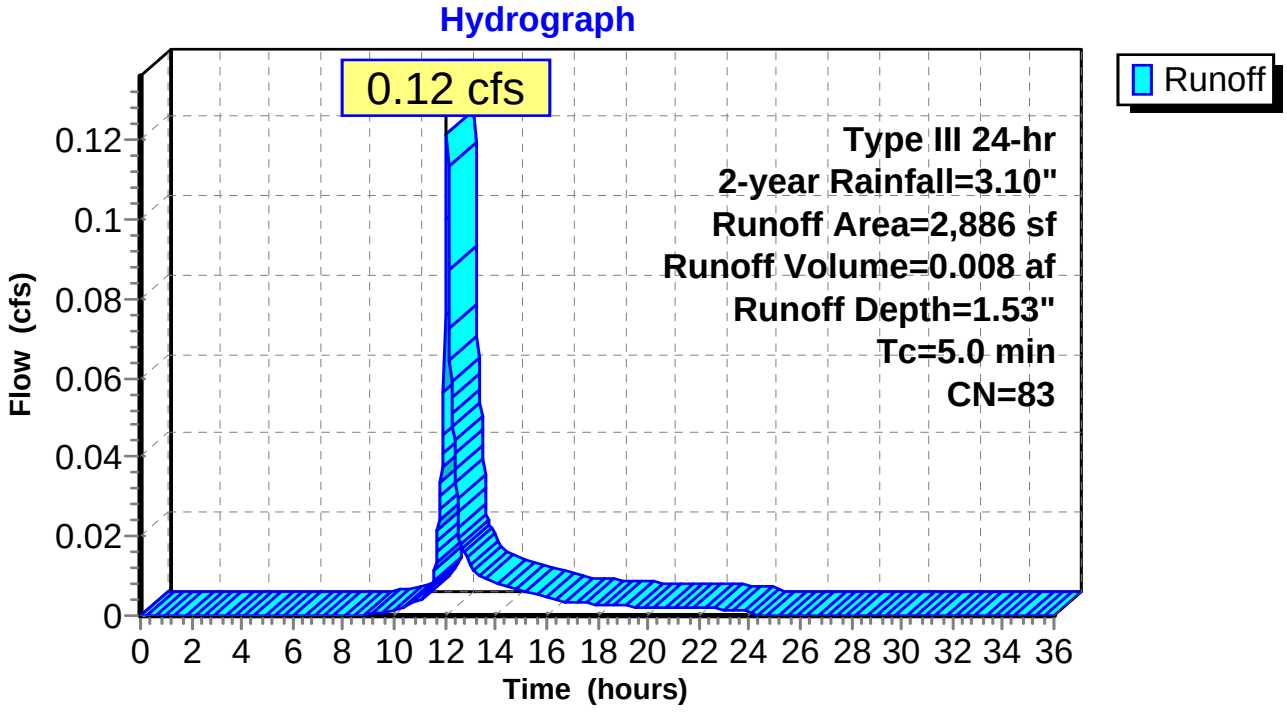
Runoff = 0.12 cfs @ 12.08 hrs, Volume= 0.008 af, Depth= 1.53"

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
*	791	98	Roofs, HSG A
*	793	98	Roofs, HSG A
*	671	96	Brick Pavers, HSG A
	631	32	Woods/grass comb., Good, HSG A
	2,886	83	Weighted Average
	1,302		45.11% Pervious Area
	1,584		54.89% Impervious Area

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

Subcatchment 2S: Central Roof & Sidewalks



Summary for Subcatchment 3S: Parking & South Roof

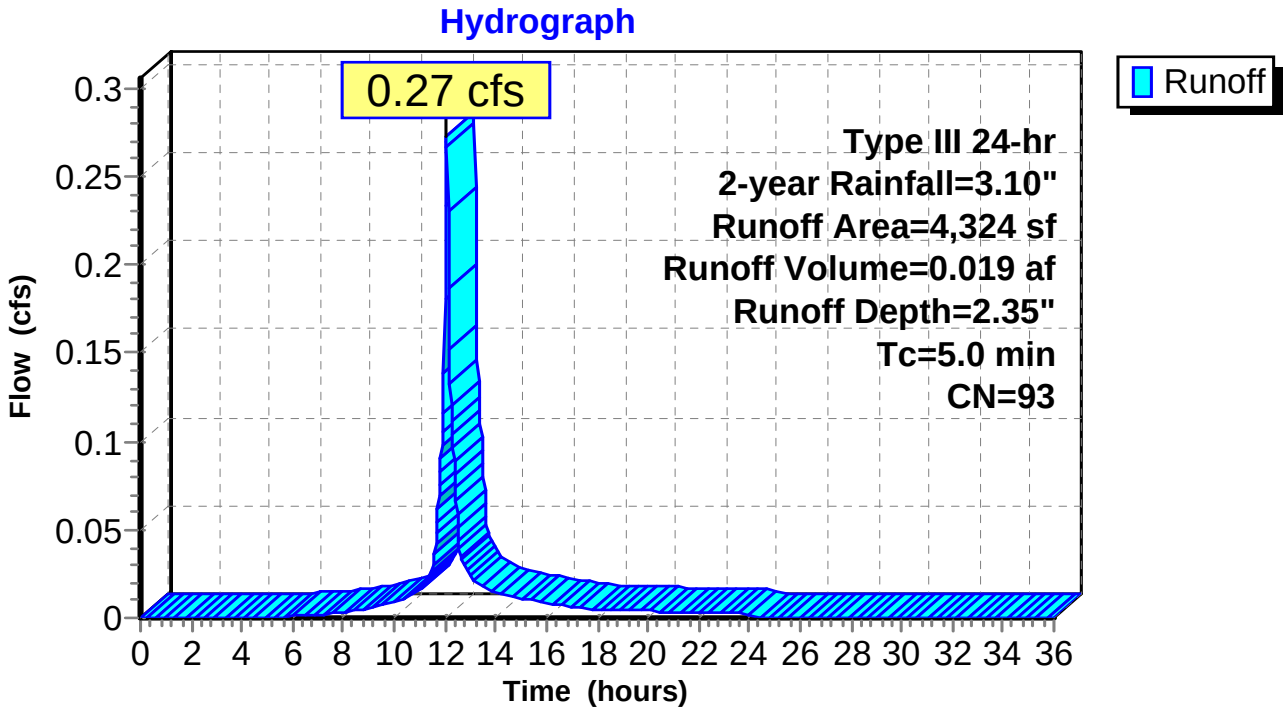
Runoff = 0.27 cfs @ 12.07 hrs, Volume= 0.019 af, Depth= 2.35"

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
*	2,302	98	Paved Parking, HSG A
*	399	96	Brick Pavers, HSG A
*	1,192	98	roofs, HSG A
	280	32	Woods/grass comb., Good, HSG A
*	151	77	Crushed Stone, HSG A
	4,324	93	Weighted Average
	830		19.20% Pervious Area
	3,494		80.80% Impervious Area

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

Subcatchment 3S: Parking & South Roof



Summary for Subcatchment 5S: Frontage Runoff

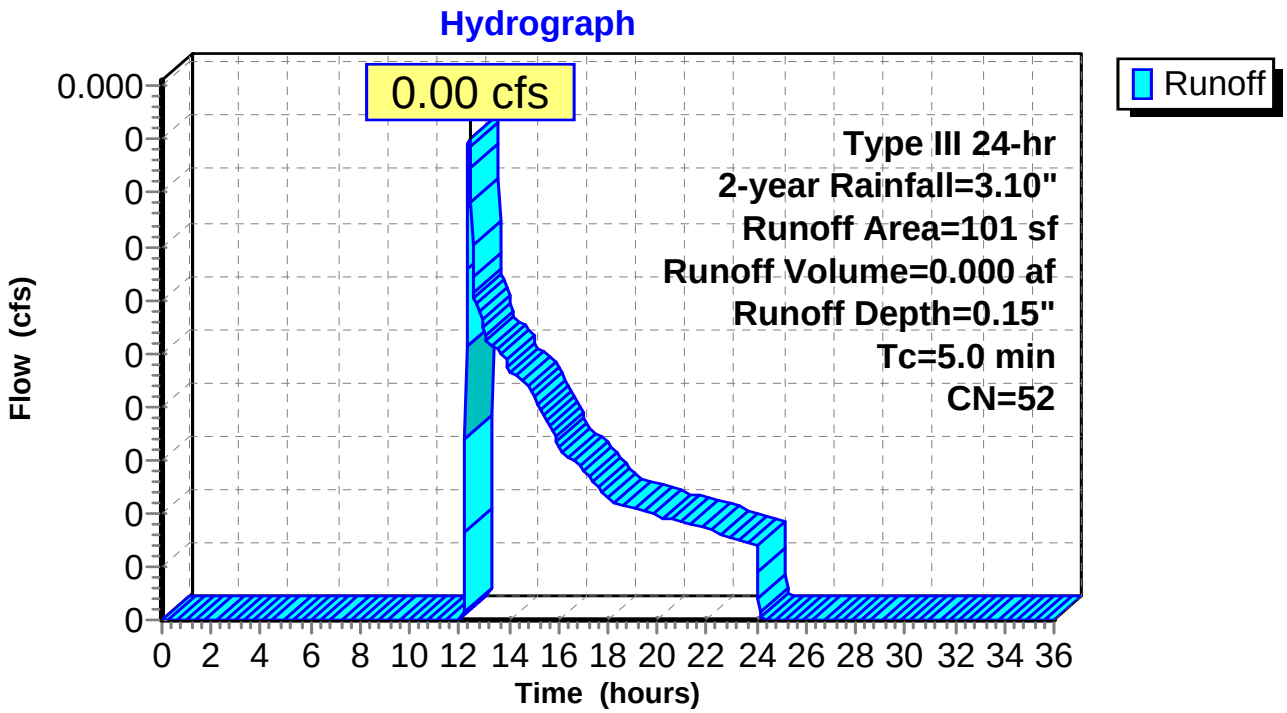
Runoff = 0.00 cfs @ 12.42 hrs, Volume= 0.000 af, Depth= 0.15"

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
	69	32	Woods/grass comb., Good, HSG A
*	32	96	Brick Pavers, HSG A
	101	52	Weighted Average
	101		100.00% Pervious Area

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

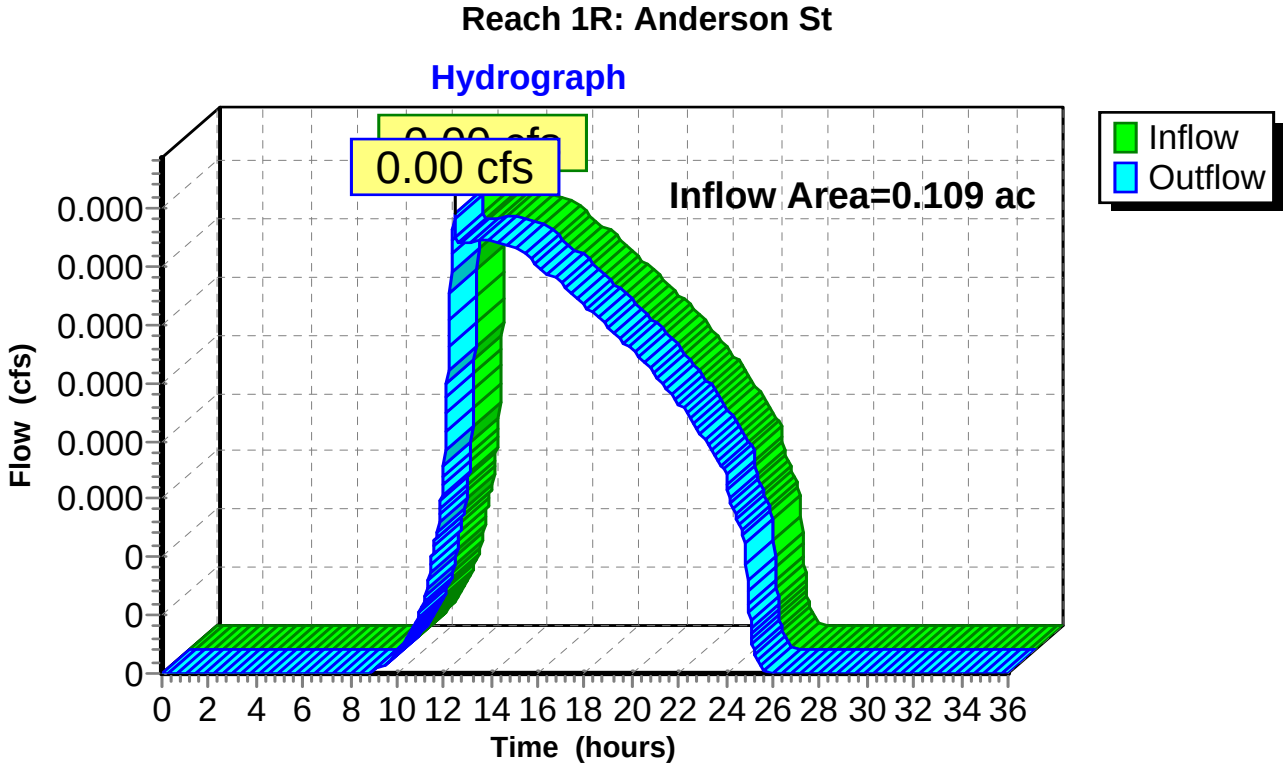
Subcatchment 5S: Frontage Runoff



Summary for Reach 1R: Anderson St

Inflow Area = 0.109 ac, 58.57% Impervious, Inflow Depth = 0.04" for 2-year event
Inflow = 0.00 cfs @ 12.46 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 12.46 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

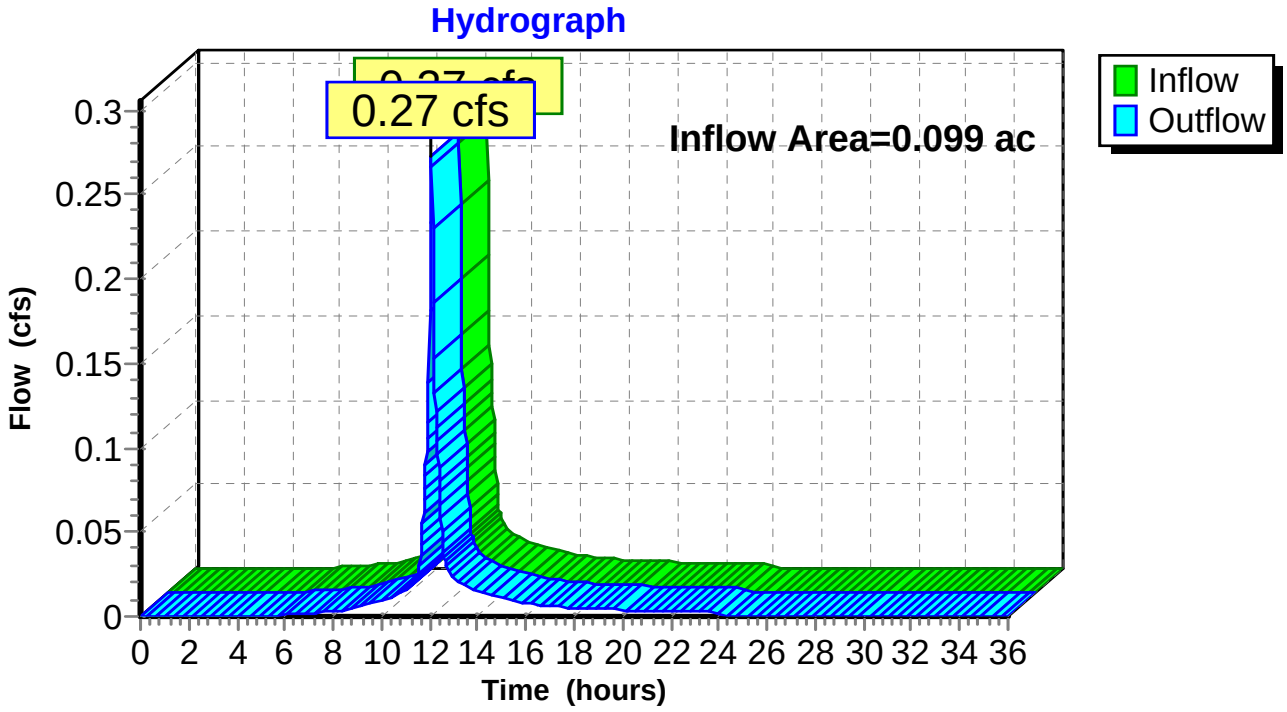


Summary for Reach 2R: E Lancaster St

Inflow Area = 0.099 ac, 80.80% Impervious, Inflow Depth = 2.35" for 2-year event
Inflow = 0.27 cfs @ 12.07 hrs, Volume= 0.019 af
Outflow = 0.27 cfs @ 12.07 hrs, Volume= 0.019 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 2R: E Lancaster St

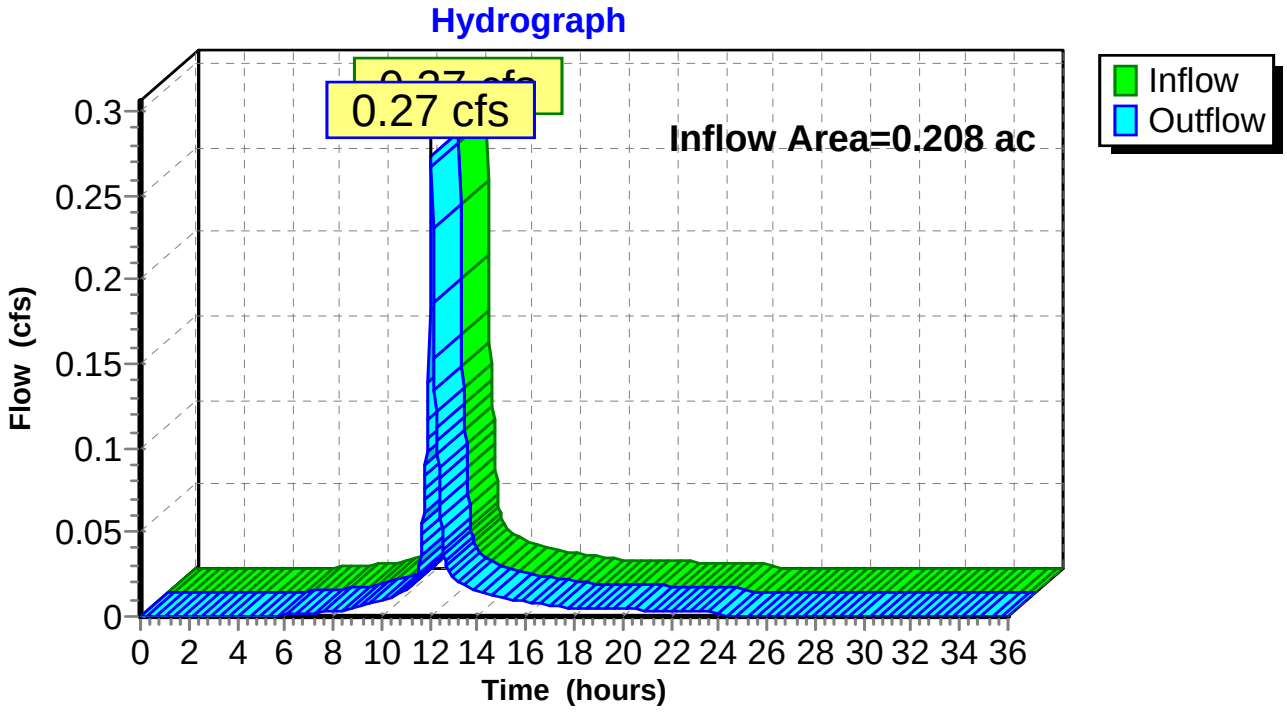


Summary for Reach 99R: Fox St

Inflow Area = 0.208 ac, 69.18% Impervious, Inflow Depth = 1.14" for 2-year event
Inflow = 0.27 cfs @ 12.07 hrs, Volume= 0.020 af
Outflow = 0.27 cfs @ 12.07 hrs, Volume= 0.020 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 99R: Fox St



Summary for Pond 1P: Dripline BMP

Inflow Area = 0.040 ac, 68.04% Impervious, Inflow Depth = 1.14" for 2-year event
Inflow = 0.05 cfs @ 12.08 hrs, Volume= 0.004 af
Outflow = 0.02 cfs @ 12.47 hrs, Volume= 0.004 af, Atten= 72%, Lag= 23.1 min
Discarded = 0.02 cfs @ 12.47 hrs, Volume= 0.004 af
Primary = 0.00 cfs @ 12.47 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 11.01' @ 12.47 hrs Surf.Area= 180 sf Storage= 36 cf

Plug-Flow detention time= 17.0 min calculated for 0.004 af (100% of inflow)
Center-of-Mass det. time= 17.0 min (870.3 - 853.3)

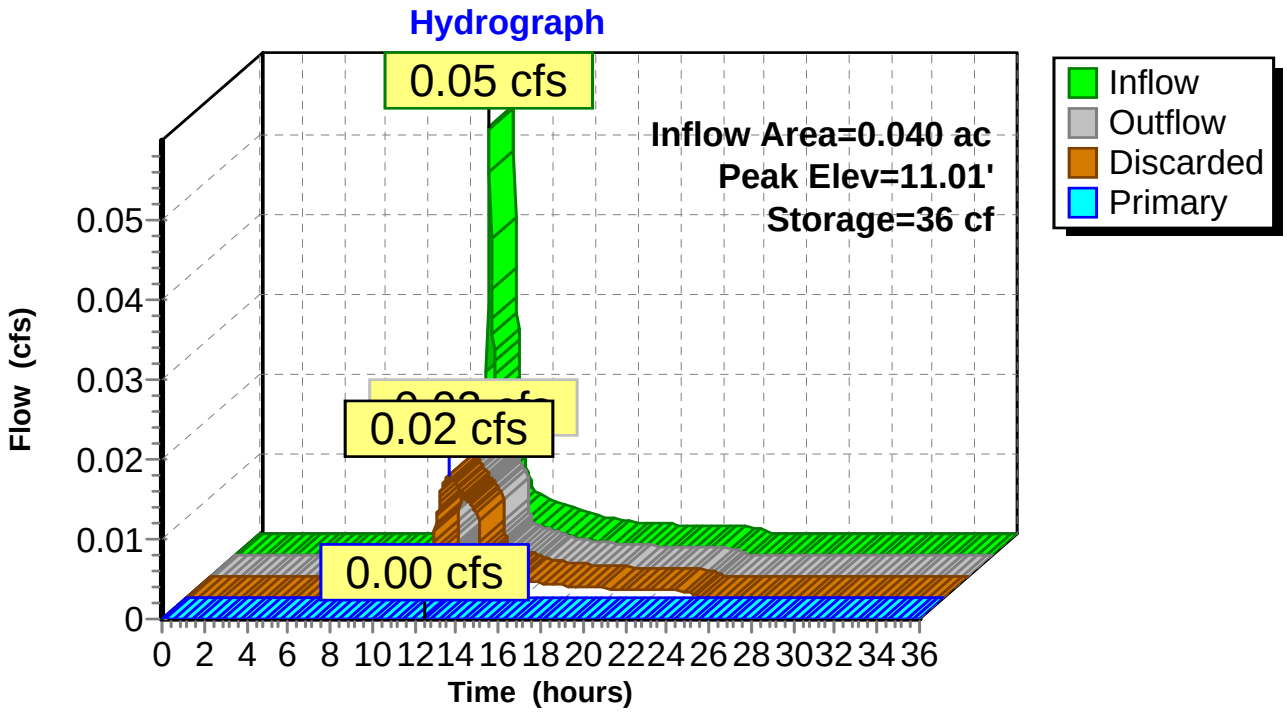
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	72 cf	**2.00'W x 90.00'L x 1.00'H Prismatoid - Water Quality Volume** 180 cf Overall x 40.0% Voids
#2	12.50'	18 cf	**2.00'W x 90.00'L x 1.00'H Prismatoid - Soil Filter Media** 180 cf Overall x 10.0% Voids
#3	10.50'	144 cf	**2.00'W x 90.00'L x 2.00'H Prismatoid - Crushed Stone** 360 cf Overall x 40.0% Voids
		234 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	11.00'	**6.0" Round Culvert** L= 229.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 11.00' / 10.84' S= 0.0007 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#2	Device 1	11.00'	**0.1" Vert. Orifice/Grate** C= 0.600
#3	Discarded	10.50'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.02 cfs @ 12.47 hrs HW=11.01' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 12.47 hrs HW=11.01' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 0.00 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.25 fps)

Pond 1P: Dripline BMP



Summary for Pond 2P: Rain Garden

Inflow Area = 0.066 ac, 54.89% Impervious, Inflow Depth = 1.53" for 2-year event
Inflow = 0.12 cfs @ 12.08 hrs, Volume= 0.008 af
Outflow = 0.01 cfs @ 14.34 hrs, Volume= 0.008 af, Atten= 94%, Lag= 136.0 min
Discarded = 0.01 cfs @ 11.58 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 14.34 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 15.04' @ 14.34 hrs Surf.Area= 124 sf Storage= 172 cf

Plug-Flow detention time= 239.7 min calculated for 0.008 af (100% of inflow)
Center-of-Mass det. time= 239.6 min (1,073.1 - 833.5)

Volume	Invert	Avail.Storage	Storage Description
#1	16.65'	360 cf	**Water Quality Volume (Prismatic)** Listed below (Recalc)
#2	15.15'	248 cf	**Loam/Soil Filter Media (Prismatic)** Listed below (Recalc)
#3	13.65'	186 cf	**Crushed Stone (Prismatic)** Listed below (Recalc)
		794 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.65	124	0	0
17.15	272	99	99
17.82	506	261	360

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.15	124	0	0
17.15	124	248	248

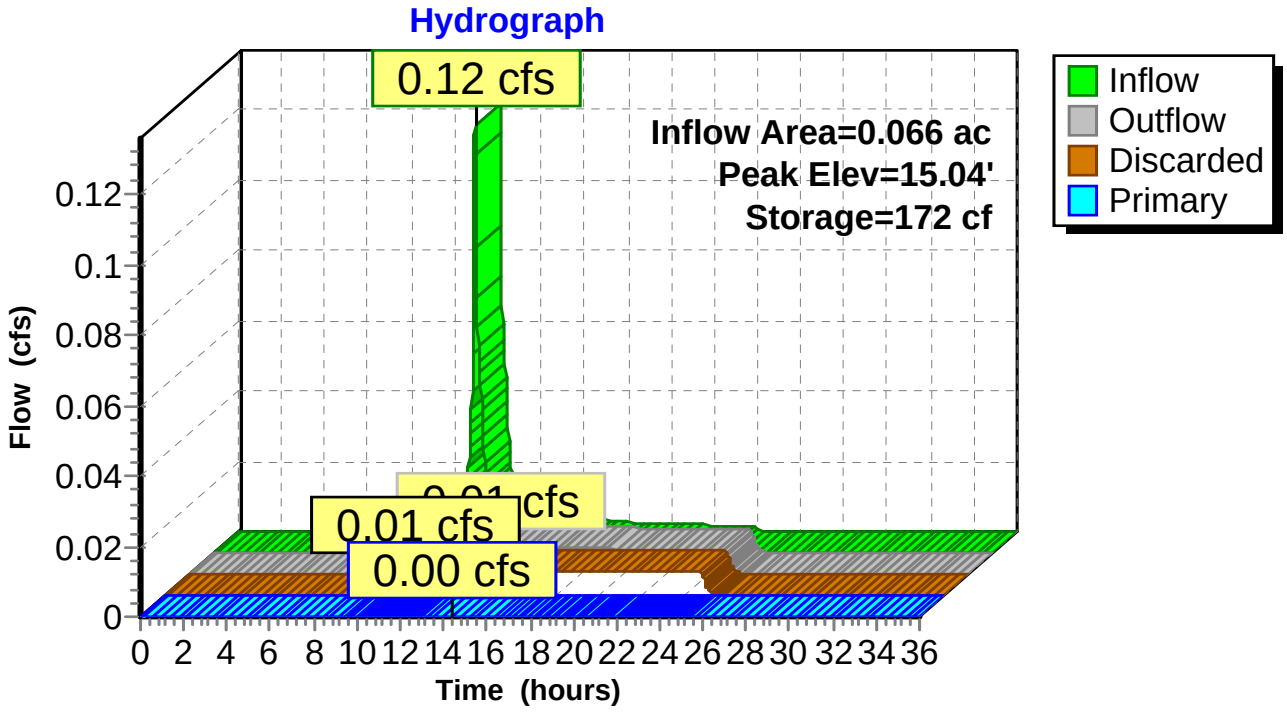
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.65	124	0	0
15.15	124	186	186

Device	Routing	Invert	Outlet Devices
#1	Primary	13.40'	**6.0" Round Culvert** L= 43.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 13.40' / 12.95' S= 0.0105 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#2	Device 1	13.50'	**0.1" Vert. Orifice/Grate** C= 0.600
#3	Device 1	17.15'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	13.65'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.58 hrs HW=13.69' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 14.34 hrs HW=15.04' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 0.98 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 5.96 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Rain Garden



Time span=0.00-36.00 hrs, dt=0.03 hrs, 1201 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 1S: North Roof Runoff Area=1,749 sf 68.04% Impervious Runoff Depth=2.29"
Tc=5.0 min CN=77 Runoff=0.11 cfs 0.008 af

Subcatchment 2S: Central Roof & Sidewalks Runoff Area=2,886 sf 54.89% Impervious Runoff Depth=2.81"
Tc=5.0 min CN=83 Runoff=0.22 cfs 0.016 af

Subcatchment 3S: Parking & South Roof Runoff Area=4,324 sf 80.80% Impervious Runoff Depth=3.81"
Tc=5.0 min CN=93 Runoff=0.43 cfs 0.031 af

Subcatchment 5S: Frontage Runoff Runoff Area=101 sf 0.00% Impervious Runoff Depth=0.63"
Tc=5.0 min CN=52 Runoff=0.00 cfs 0.000 af

Reach 1R: Anderson St Inflow=0.00 cfs 0.001 af
Outflow=0.00 cfs 0.001 af

Reach 2R: E Lancaster St Inflow=0.43 cfs 0.031 af
Outflow=0.43 cfs 0.031 af

Reach 99R: Fox St Inflow=0.43 cfs 0.032 af
Outflow=0.43 cfs 0.032 af

Pond 1P: Dripline BMP Peak Elev=11.86' Storage=98 cf Inflow=0.11 cfs 0.008 af
Discarded=0.02 cfs 0.008 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.008 af

Pond 2P: Rain Garden Peak Elev=16.29' Storage=328 cf Inflow=0.22 cfs 0.016 af
Discarded=0.01 cfs 0.015 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.016 af

Total Runoff Area = 0.208 ac Runoff Volume = 0.055 af Average Runoff Depth = 3.16"
30.82% Pervious = 0.064 ac 69.18% Impervious = 0.144 ac

Summary for Subcatchment 1S: North Roof

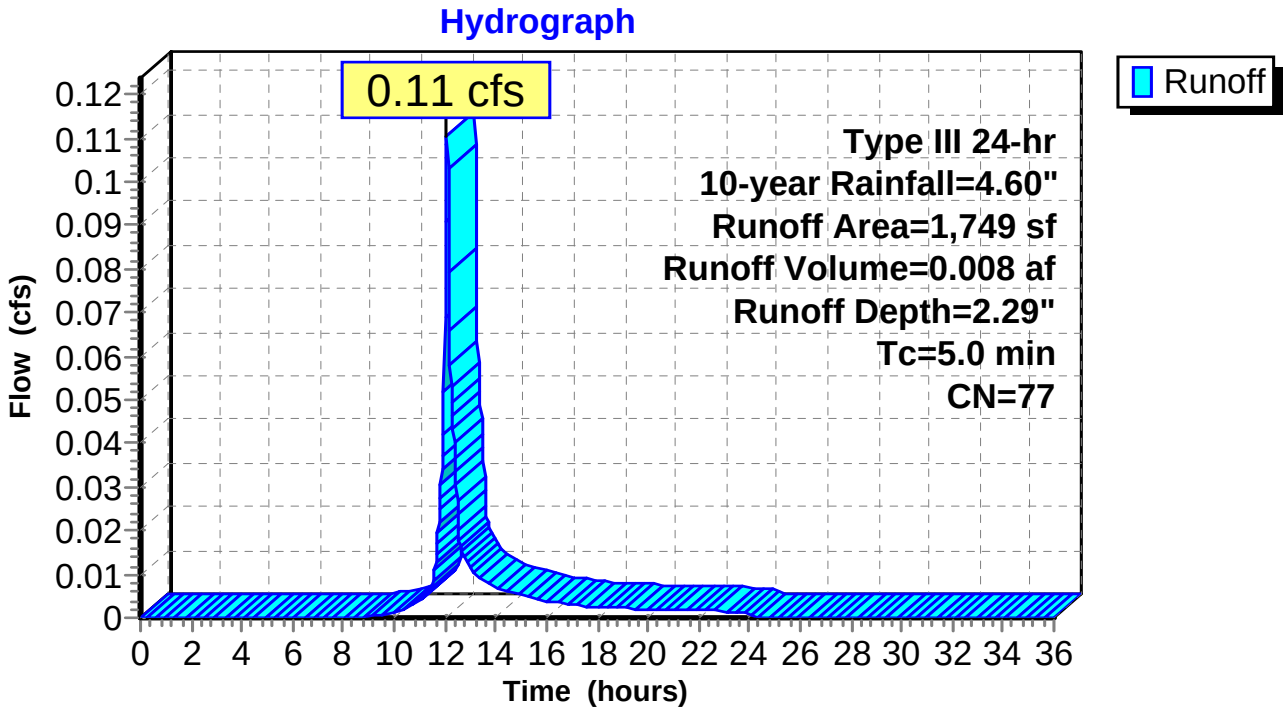
Runoff = 0.11 cfs @ 12.08 hrs, Volume= 0.008 af, Depth= 2.29"

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
*	1,190	98	Roofs, HSG A
	559	32	Woods/grass comb., Good, HSG A
	1,749	77	Weighted Average
	559		31.96% Pervious Area
	1,190		68.04% Impervious Area

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

Subcatchment 1S: North Roof



Summary for Subcatchment 2S: Central Roof & Sidewalks

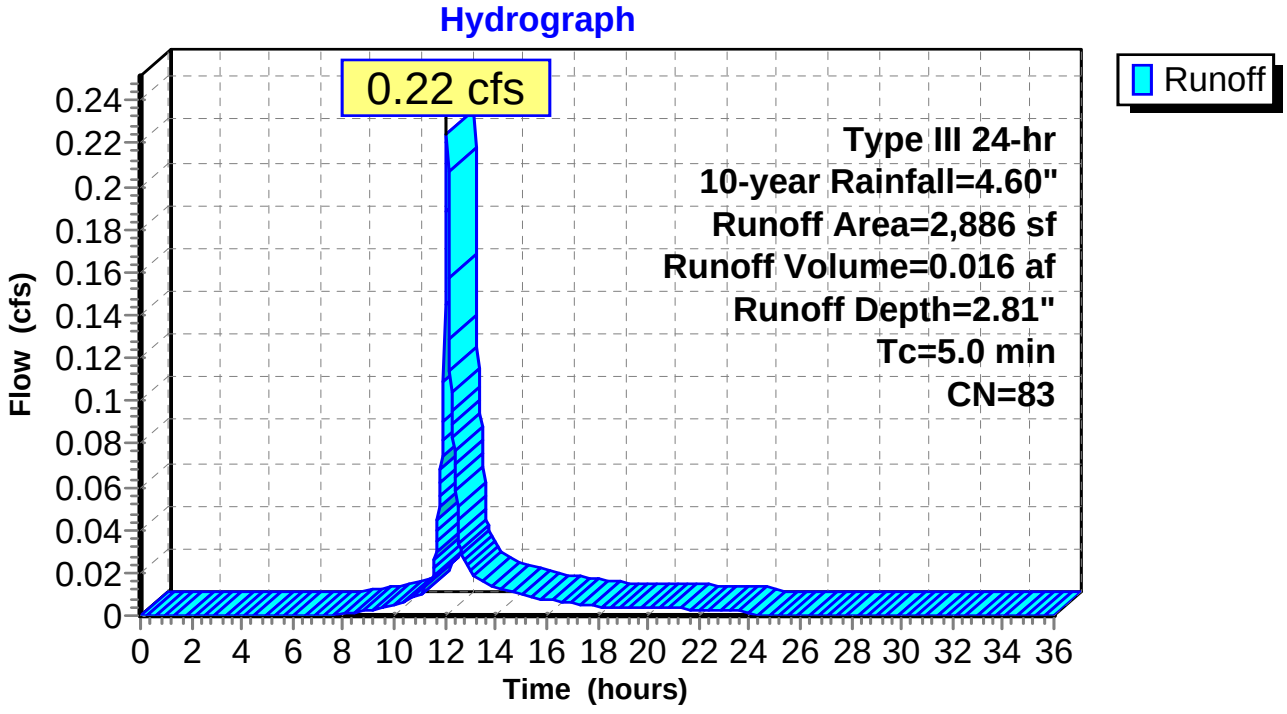
Runoff = 0.22 cfs @ 12.07 hrs, Volume= 0.016 af, Depth= 2.81"

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
*	791	98	Roofs, HSG A
*	793	98	Roofs, HSG A
*	671	96	Brick Pavers, HSG A
	631	32	Woods/grass comb., Good, HSG A
	2,886	83	Weighted Average
	1,302		45.11% Pervious Area
	1,584		54.89% Impervious Area

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

Subcatchment 2S: Central Roof & Sidewalks



Summary for Subcatchment 3S: Parking & South Roof

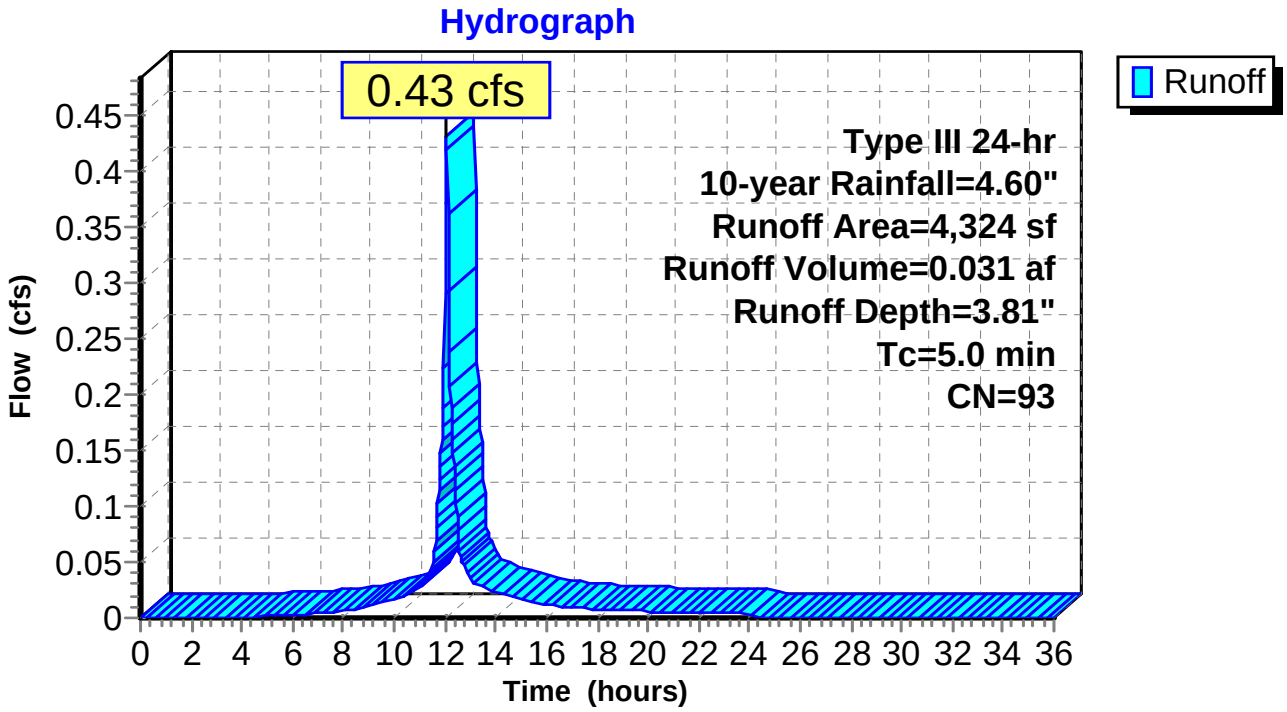
Runoff = 0.43 cfs @ 12.07 hrs, Volume= 0.031 af, Depth= 3.81"

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
*	2,302	98	Paved Parking, HSG A
*	399	96	Brick Pavers, HSG A
*	1,192	98	roofs, HSG A
	280	32	Woods/grass comb., Good, HSG A
*	151	77	Crushed Stone, HSG A
	4,324	93	Weighted Average
	830		19.20% Pervious Area
	3,494		80.80% Impervious Area

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

Subcatchment 3S: Parking & South Roof



Summary for Subcatchment 5S: Frontage Runoff

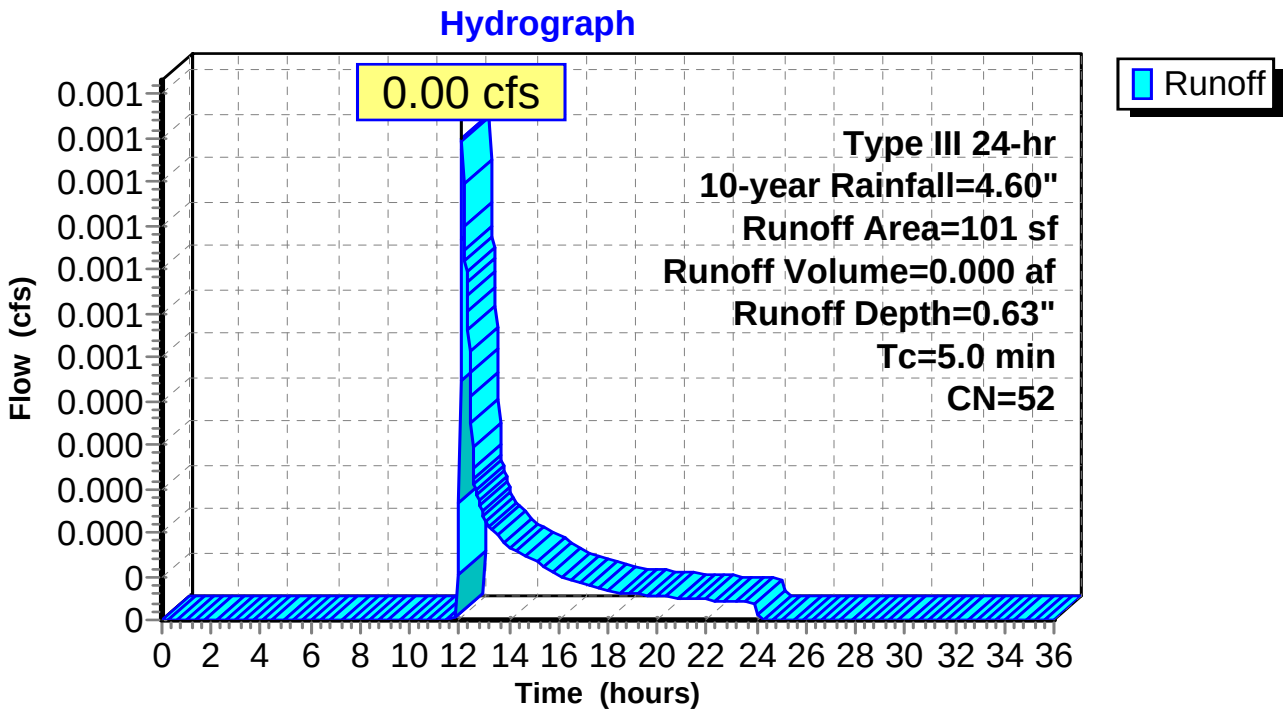
Runoff = 0.00 cfs @ 12.11 hrs, Volume= 0.000 af, Depth= 0.63"

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
	69	32	Woods/grass comb., Good, HSG A
*	32	96	Brick Pavers, HSG A
	101	52	Weighted Average
	101		100.00% Pervious Area

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

Subcatchment 5S: Frontage Runoff

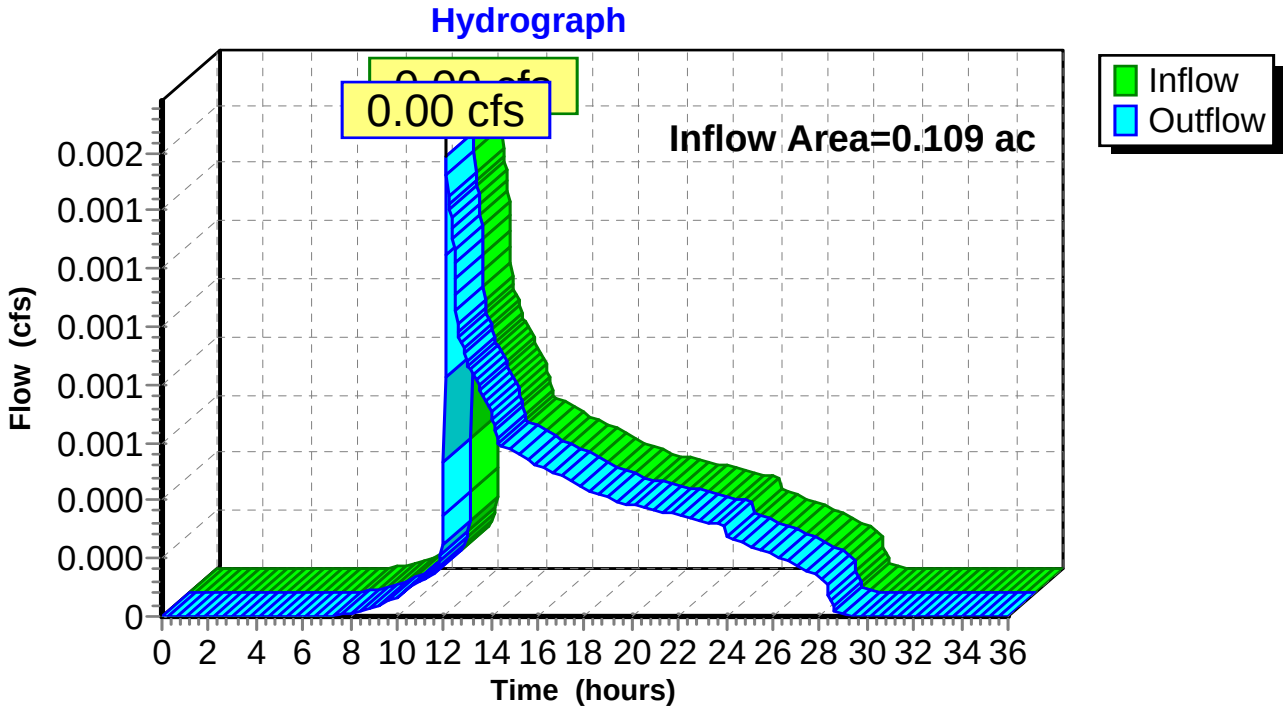


Summary for Reach 1R: Anderson St

Inflow Area = 0.109 ac, 58.57% Impervious, Inflow Depth = 0.07" for 10-year event
Inflow = 0.00 cfs @ 12.12 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 12.12 hrs, Volume= 0.001 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: Anderson St

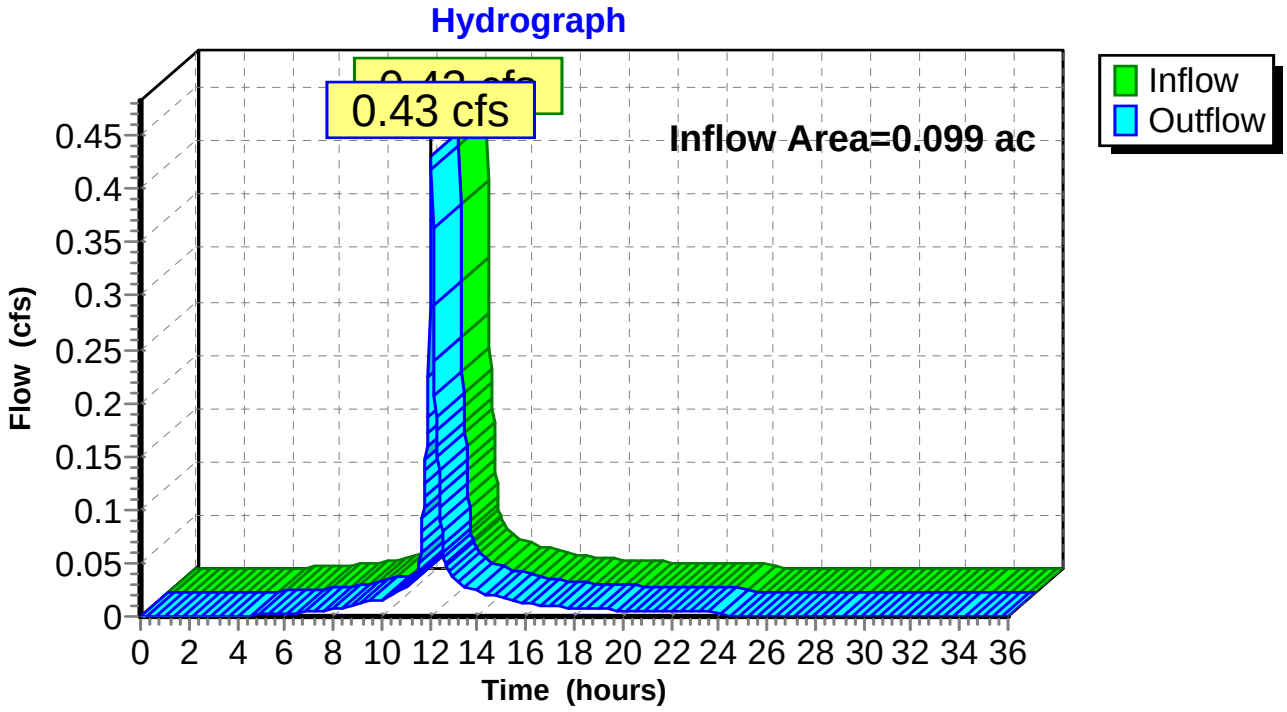


Summary for Reach 2R: E Lancaster St

Inflow Area = 0.099 ac, 80.80% Impervious, Inflow Depth = 3.81" for 10-year event
Inflow = 0.43 cfs @ 12.07 hrs, Volume= 0.031 af
Outflow = 0.43 cfs @ 12.07 hrs, Volume= 0.031 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 2R: E Lancaster St

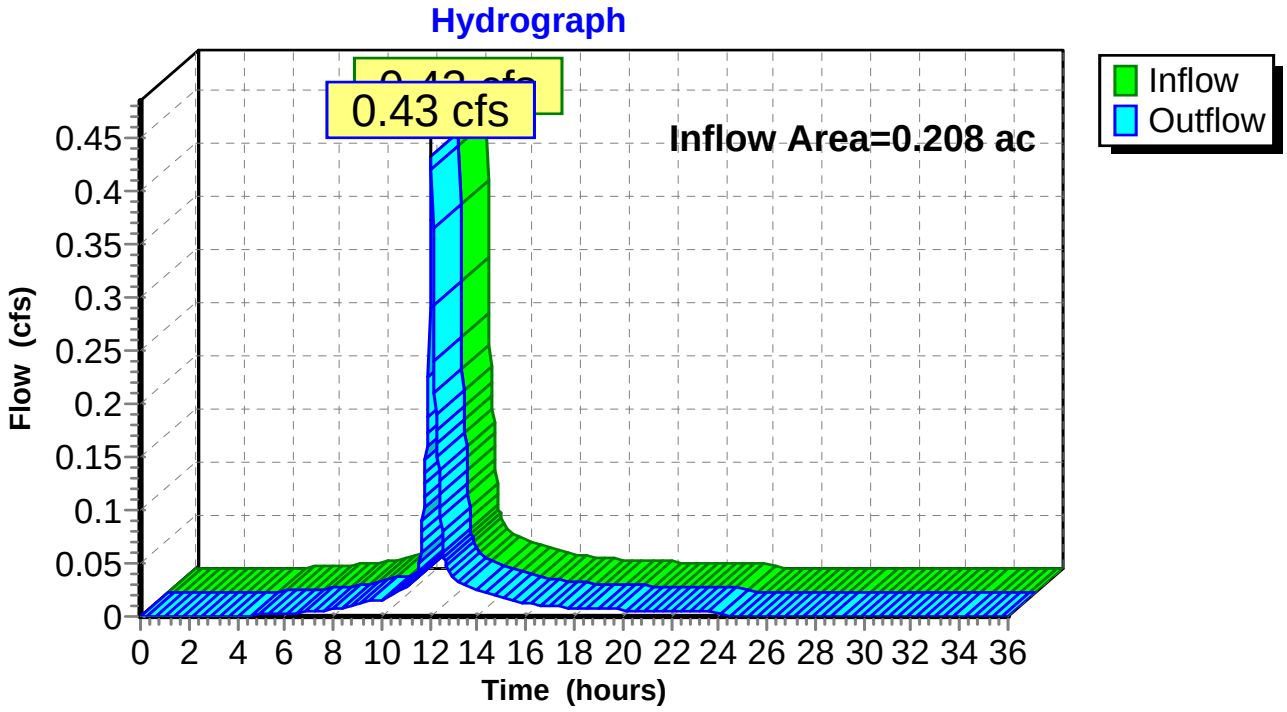


Summary for Reach 99R: Fox St

Inflow Area = 0.208 ac, 69.18% Impervious, Inflow Depth = 1.85" for 10-year event
Inflow = 0.43 cfs @ 12.07 hrs, Volume= 0.032 af
Outflow = 0.43 cfs @ 12.07 hrs, Volume= 0.032 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 99R: Fox St



Summary for Pond 1P: Dripline BMP

Inflow Area = 0.040 ac, 68.04% Impervious, Inflow Depth = 2.29" for 10-year event
Inflow = 0.11 cfs @ 12.08 hrs, Volume= 0.008 af
Outflow = 0.02 cfs @ 12.51 hrs, Volume= 0.008 af, Atten= 78%, Lag= 25.7 min
Discarded = 0.02 cfs @ 12.51 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 12.51 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 11.86' @ 12.51 hrs Surf.Area= 180 sf Storage= 98 cf

Plug-Flow detention time= 34.7 min calculated for 0.008 af (100% of inflow)
Center-of-Mass det. time= 34.7 min (867.4 - 832.7)

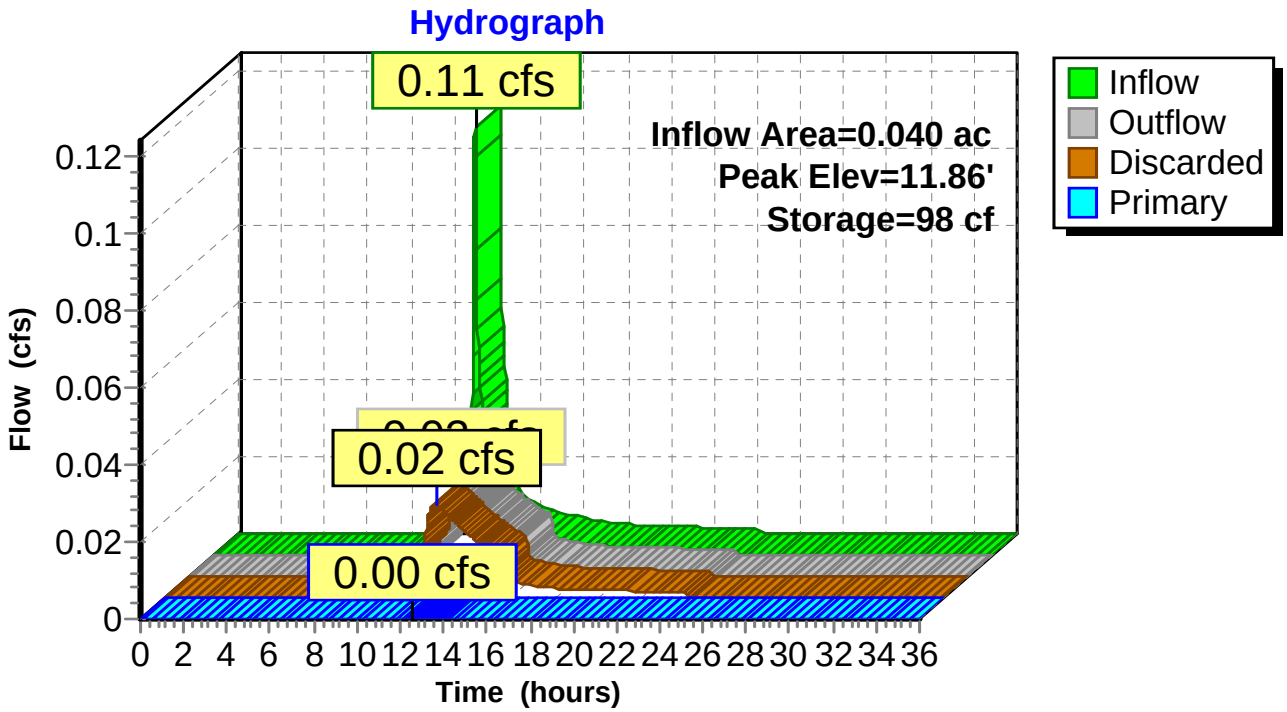
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	72 cf	**2.00'W x 90.00'L x 1.00'H Prismatoid - Water Quality Volume** 180 cf Overall x 40.0% Voids
#2	12.50'	18 cf	**2.00'W x 90.00'L x 1.00'H Prismatoid - Soil Filter Media** 180 cf Overall x 10.0% Voids
#3	10.50'	144 cf	**2.00'W x 90.00'L x 2.00'H Prismatoid - Crushed Stone** 360 cf Overall x 40.0% Voids
		234 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	11.00'	**6.0" Round Culvert** L= 229.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 11.00' / 10.84' S= 0.0007 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#2	Device 1	11.00'	**0.1" Vert. Orifice/Grate** C= 0.600
#3	Discarded	10.50'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.02 cfs @ 12.51 hrs HW=11.86' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 12.51 hrs HW=11.86' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 0.32 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 4.44 fps)

Pond 1P: Dripline BMP



Summary for Pond 2P: Rain Garden

Inflow Area = 0.066 ac, 54.89% Impervious, Inflow Depth = 2.81" for 10-year event
Inflow = 0.22 cfs @ 12.07 hrs, Volume= 0.016 af
Outflow = 0.01 cfs @ 13.85 hrs, Volume= 0.016 af, Atten= 94%, Lag= 106.3 min
Discarded = 0.01 cfs @ 12.12 hrs, Volume= 0.015 af
Primary = 0.00 cfs @ 13.85 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 16.29' @ 13.85 hrs Surf.Area= 248 sf Storage= 328 cf

Plug-Flow detention time= 270.7 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 270.8 min (1,086.7 - 815.9)

Volume	Invert	Avail.Storage	Storage Description
#1	16.65'	360 cf	**Water Quality Volume (Prismatic)** Listed below (Recalc)
#2	15.15'	248 cf	**Loam/Soil Filter Media (Prismatic)** Listed below (Recalc)
#3	13.65'	186 cf	**Crushed Stone (Prismatic)** Listed below (Recalc)
		794 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.65	124	0	0
17.15	272	99	99
17.82	506	261	360

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.15	124	0	0
17.15	124	248	248

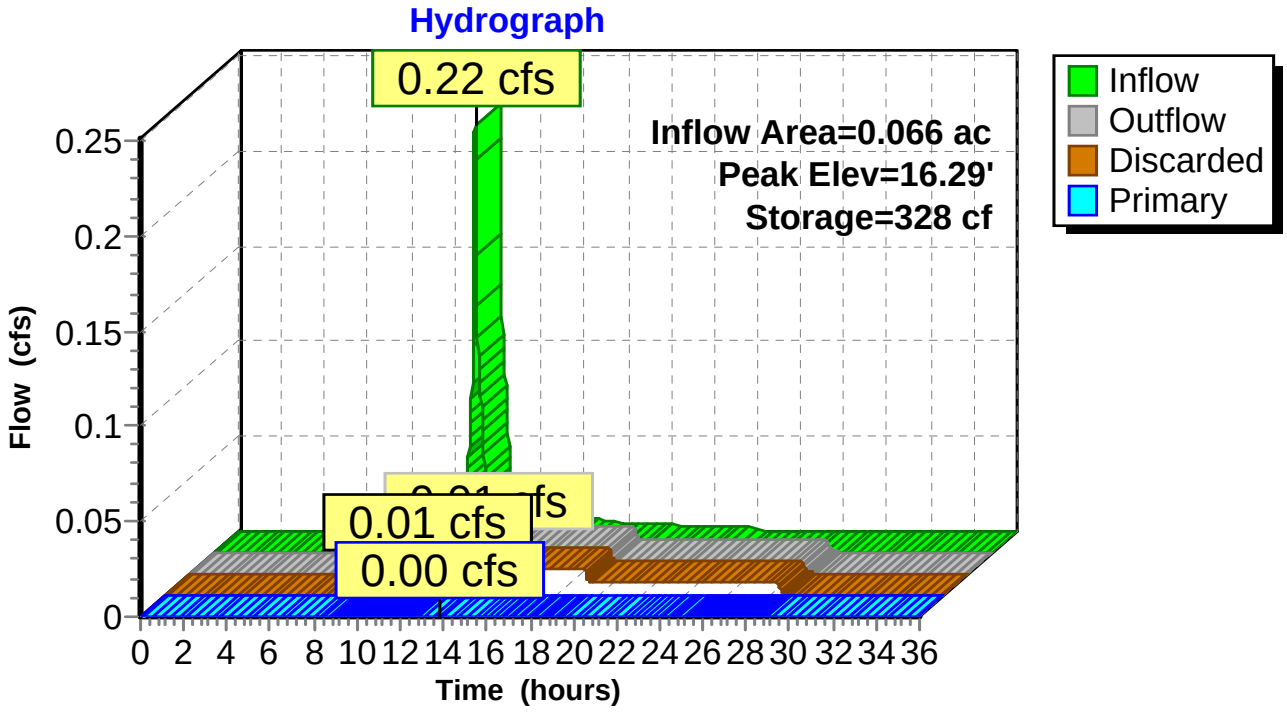
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.65	124	0	0
15.15	124	186	186

Device	Routing	Invert	Outlet Devices
#1	Primary	13.40'	**6.0" Round Culvert** L= 43.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 13.40' / 12.95' S= 0.0105 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#2	Device 1	13.50'	**0.1" Vert. Orifice/Grate** C= 0.600
#3	Device 1	17.15'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	13.65'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 12.12 hrs HW=15.15' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 13.85 hrs HW=16.29' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 1.36 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 8.04 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Rain Garden



Time span=0.00-36.00 hrs, dt=0.03 hrs, 1201 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 1S: North Roof Runoff Area=1,749 sf 68.04% Impervious Runoff Depth=3.31"
Tc=5.0 min CN=77 Runoff=0.16 cfs 0.011 af

Subcatchment 2S: Central Roof & Sidewalks Runoff Area=2,886 sf 54.89% Impervious Runoff Depth=3.91"
Tc=5.0 min CN=83 Runoff=0.31 cfs 0.022 af

Subcatchment 3S: Parking & South Roof Runoff Area=4,324 sf 80.80% Impervious Runoff Depth=4.99"
Tc=5.0 min CN=93 Runoff=0.56 cfs 0.041 af

Subcatchment 5S: Frontage Runoff Runoff Area=101 sf 0.00% Impervious Runoff Depth=1.19"
Tc=5.0 min CN=52 Runoff=0.00 cfs 0.000 af

Reach 1R: Anderson St Inflow=0.00 cfs 0.001 af
Outflow=0.00 cfs 0.001 af

Reach 2R: E Lancaster St Inflow=0.56 cfs 0.041 af
Outflow=0.56 cfs 0.041 af

Reach 99R: Fox St Inflow=0.56 cfs 0.042 af
Outflow=0.56 cfs 0.042 af

Pond 1P: Dripline BMP Peak Elev=12.69' Storage=147 cf Inflow=0.16 cfs 0.011 af
Discarded=0.04 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.011 af

Pond 2P: Rain Garden Peak Elev=16.93' Storage=452 cf Inflow=0.31 cfs 0.022 af
Discarded=0.03 cfs 0.021 af Primary=0.00 cfs 0.001 af Outflow=0.03 cfs 0.022 af

Total Runoff Area = 0.208 ac Runoff Volume = 0.074 af Average Runoff Depth = 4.27"
30.82% Pervious = 0.064 ac 69.18% Impervious = 0.144 ac

Summary for Subcatchment 1S: North Roof

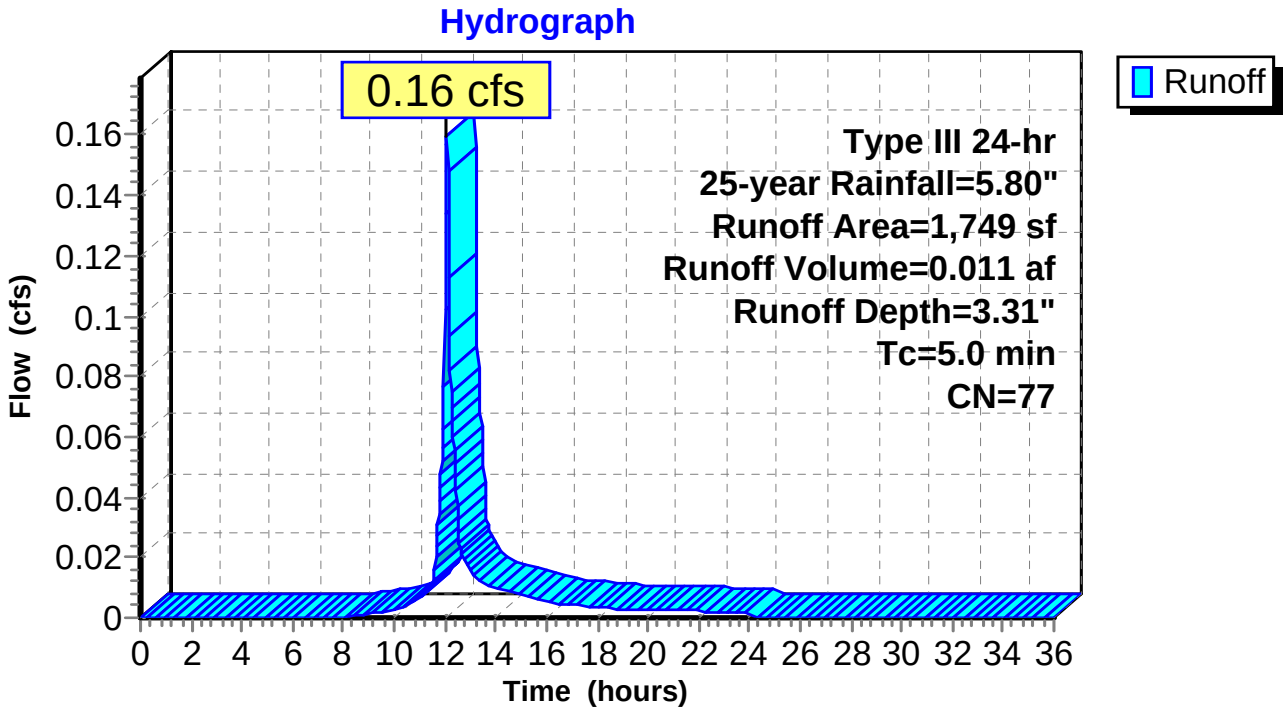
Runoff = 0.16 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 3.31"

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
*	1,190	98	Roofs, HSG A
	559	32	Woods/grass comb., Good, HSG A
	1,749	77	Weighted Average
	559		31.96% Pervious Area
	1,190		68.04% Impervious Area

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

Subcatchment 1S: North Roof



Summary for Subcatchment 2S: Central Roof & Sidewalks

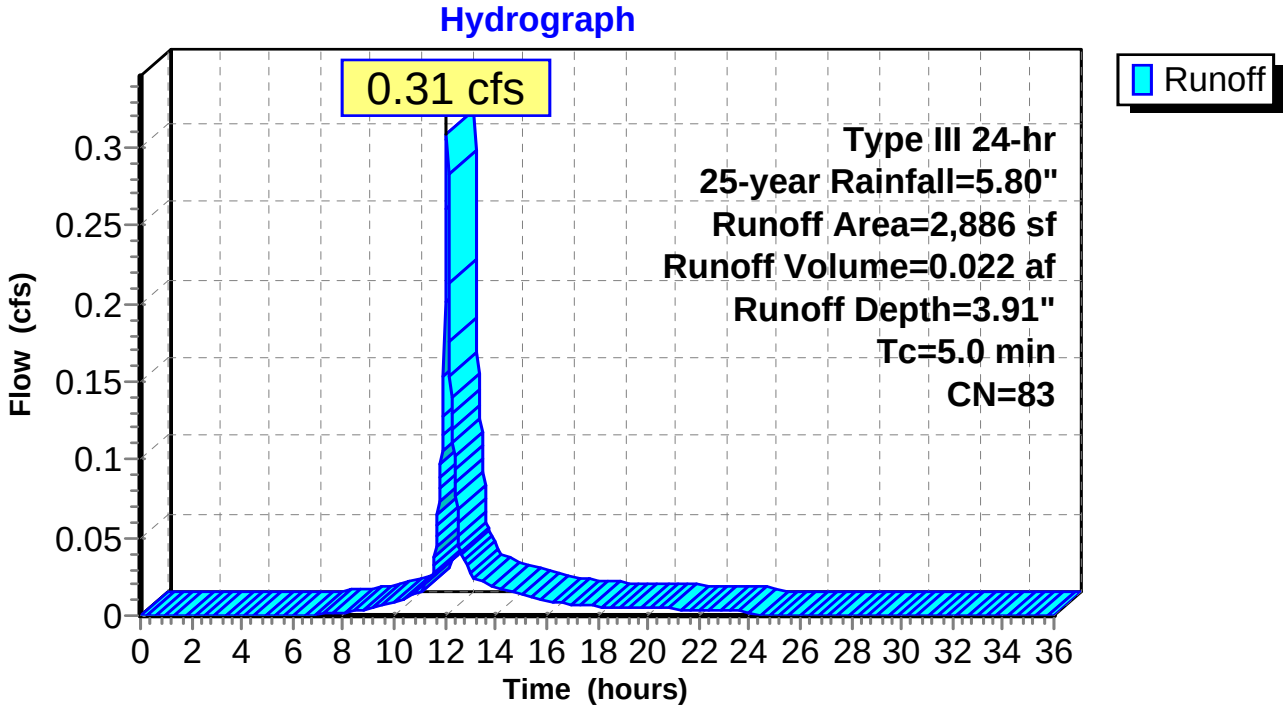
Runoff = 0.31 cfs @ 12.07 hrs, Volume= 0.022 af, Depth= 3.91"

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
*	791	98	Roofs, HSG A
*	793	98	Roofs, HSG A
*	671	96	Brick Pavers, HSG A
	631	32	Woods/grass comb., Good, HSG A
	2,886	83	Weighted Average
	1,302		45.11% Pervious Area
	1,584		54.89% Impervious Area

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

Subcatchment 2S: Central Roof & Sidewalks



Summary for Subcatchment 3S: Parking & South Roof

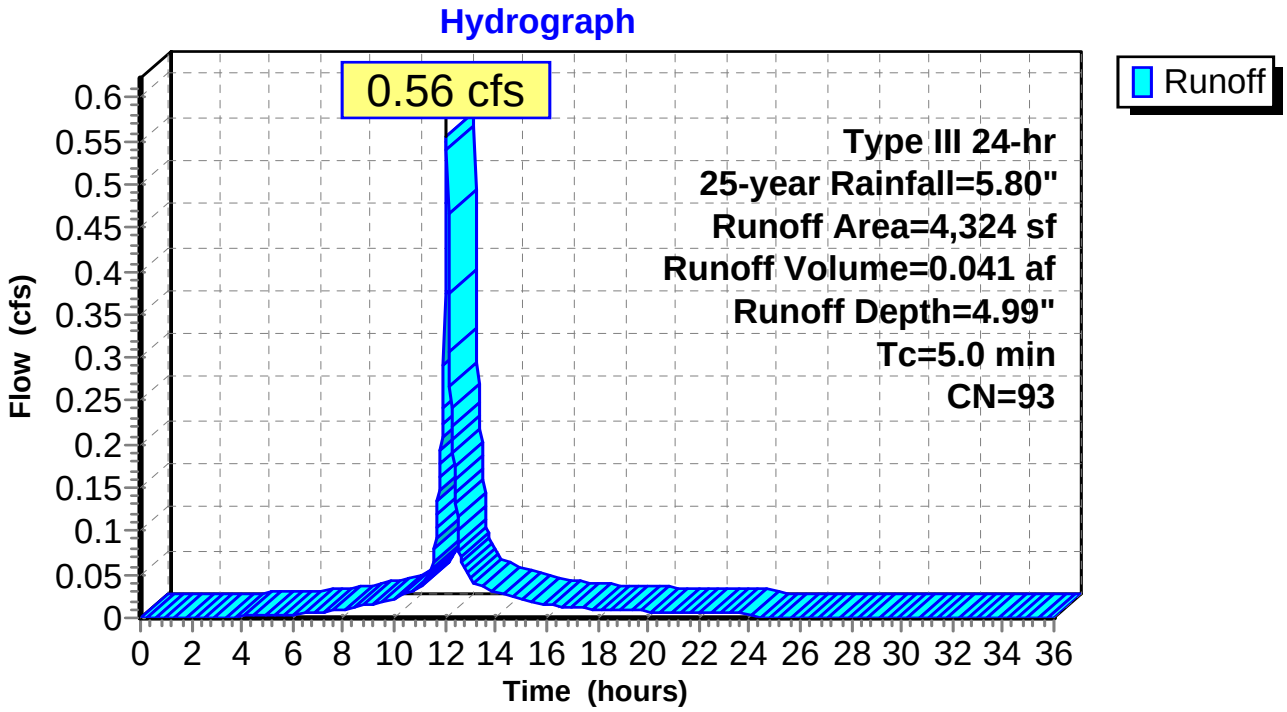
Runoff = 0.56 cfs @ 12.07 hrs, Volume= 0.041 af, Depth= 4.99"

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
*	2,302	98	Paved Parking, HSG A
*	399	96	Brick Pavers, HSG A
*	1,192	98	roofs, HSG A
	280	32	Woods/grass comb., Good, HSG A
*	151	77	Crushed Stone, HSG A
	4,324	93	Weighted Average
	830		19.20% Pervious Area
	3,494		80.80% Impervious Area

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

Subcatchment 3S: Parking & South Roof



Summary for Subcatchment 5S: Frontage Runoff

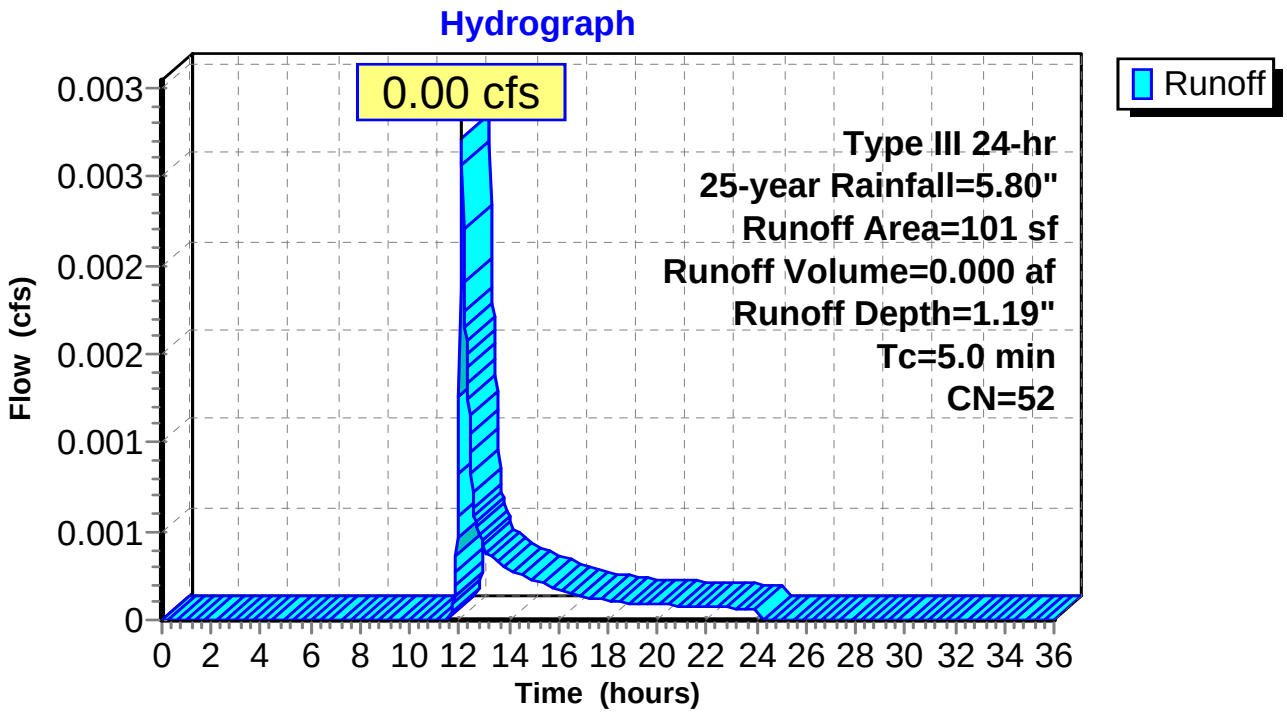
Runoff = 0.00 cfs @ 12.09 hrs, Volume= 0.000 af, Depth= 1.19"

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
	69	32	Woods/grass comb., Good, HSG A
*	32	96	Brick Pavers, HSG A
	101	52	Weighted Average
	101		100.00% Pervious Area

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

Subcatchment 5S: Frontage Runoff

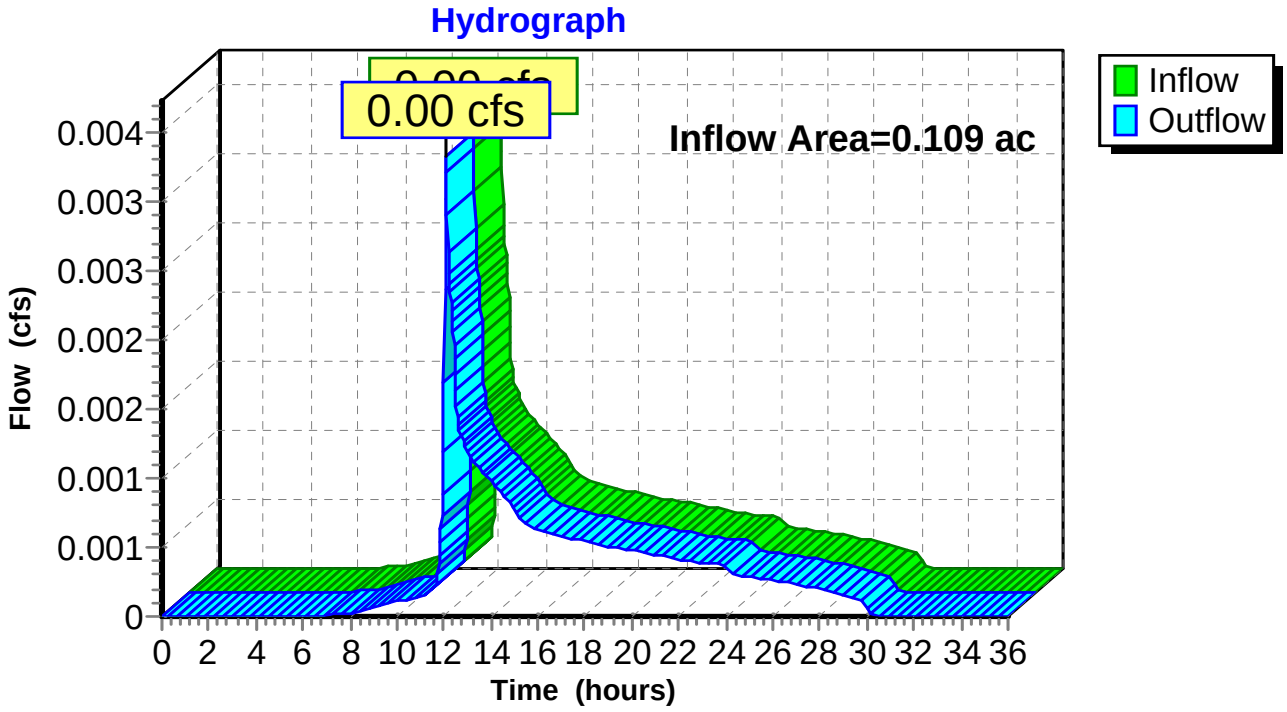


Summary for Reach 1R: Anderson St

Inflow Area = 0.109 ac, 58.57% Impervious, Inflow Depth = 0.09" for 25-year event
Inflow = 0.00 cfs @ 12.10 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 12.10 hrs, Volume= 0.001 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: Anderson St

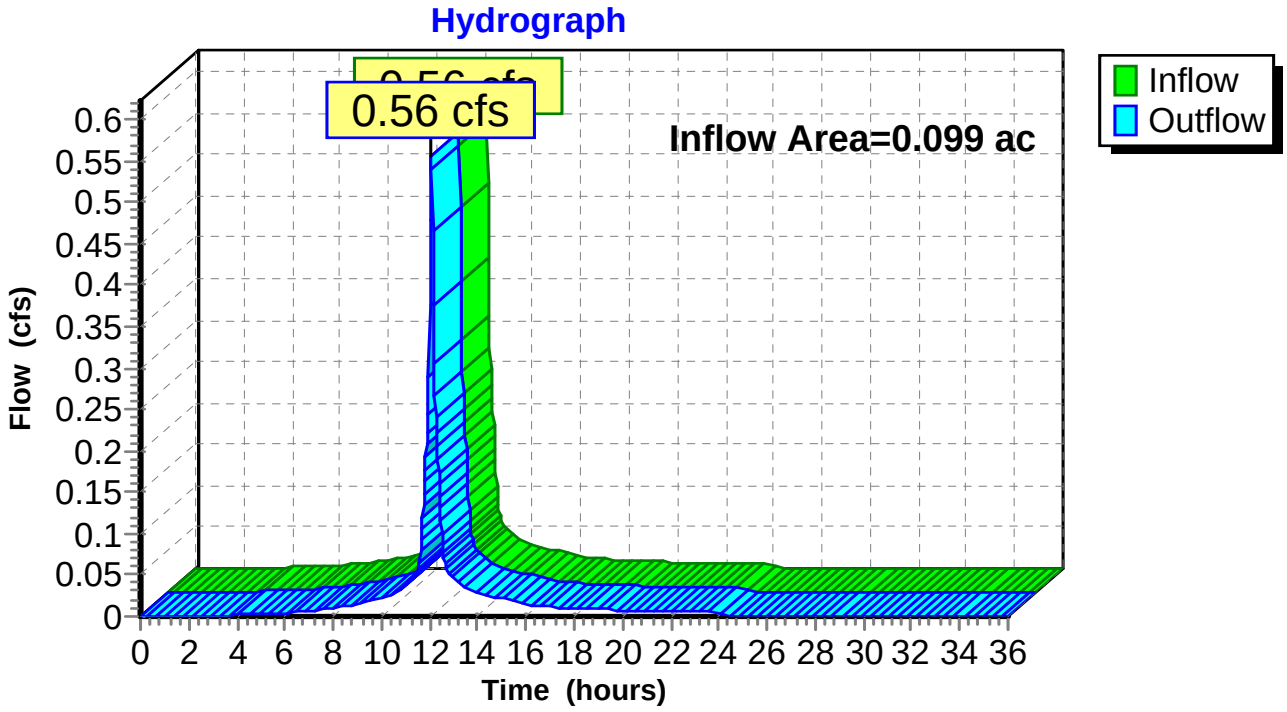


Summary for Reach 2R: E Lancaster St

Inflow Area = 0.099 ac, 80.80% Impervious, Inflow Depth = 4.99" for 25-year event
Inflow = 0.56 cfs @ 12.07 hrs, Volume= 0.041 af
Outflow = 0.56 cfs @ 12.07 hrs, Volume= 0.041 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 2R: E Lancaster St

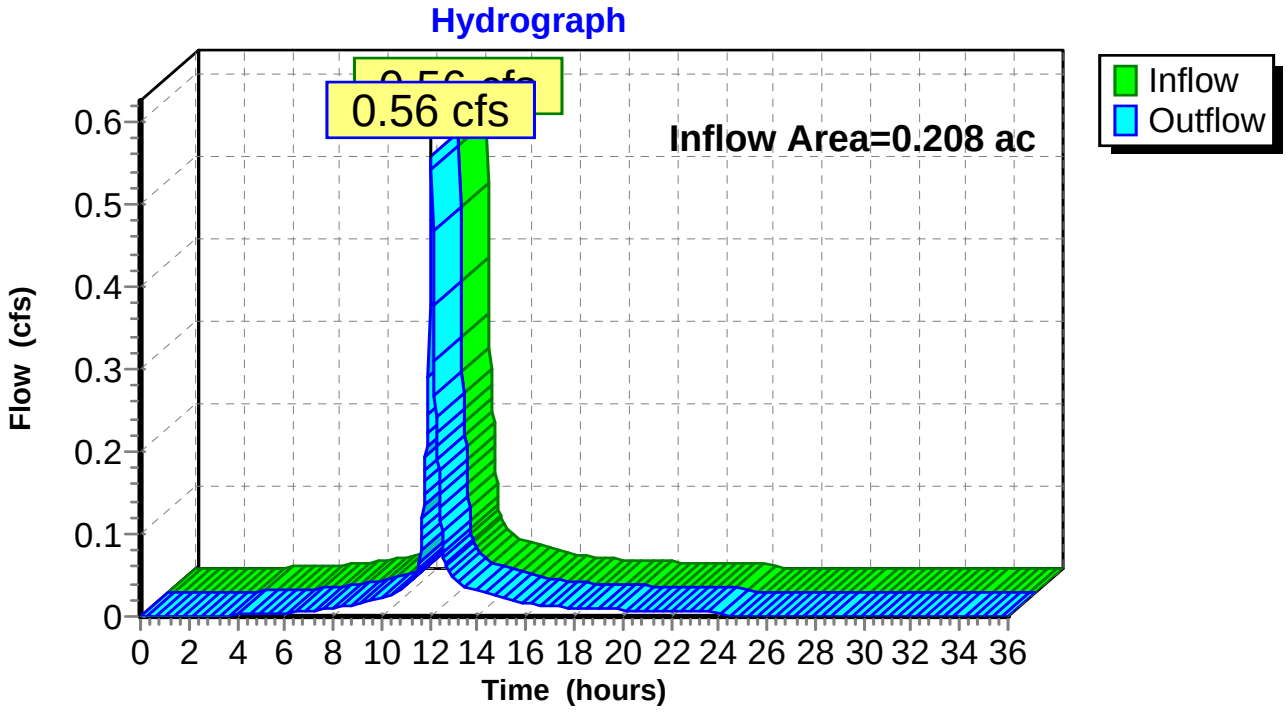


Summary for Reach 99R: Fox St

Inflow Area = 0.208 ac, 69.18% Impervious, Inflow Depth = 2.43" for 25-year event
Inflow = 0.56 cfs @ 12.07 hrs, Volume= 0.042 af
Outflow = 0.56 cfs @ 12.07 hrs, Volume= 0.042 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 99R: Fox St



Summary for Pond 1P: Dripline BMP

Inflow Area = 0.040 ac, 68.04% Impervious, Inflow Depth = 3.31" for 25-year event
Inflow = 0.16 cfs @ 12.08 hrs, Volume= 0.011 af
Outflow = 0.04 cfs @ 12.45 hrs, Volume= 0.011 af, Atten= 73%, Lag= 22.2 min
Discarded = 0.04 cfs @ 12.45 hrs, Volume= 0.011 af
Primary = 0.00 cfs @ 12.45 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 12.69' @ 12.45 hrs Surf.Area= 360 sf Storage= 147 cf

Plug-Flow detention time= 42.6 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 42.5 min (864.7 - 822.1)

Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	72 cf	**2.00'W x 90.00'L x 1.00'H Prismatoid - Water Quality Volume** 180 cf Overall x 40.0% Voids
#2	12.50'	18 cf	**2.00'W x 90.00'L x 1.00'H Prismatoid - Soil Filter Media** 180 cf Overall x 10.0% Voids
#3	10.50'	144 cf	**2.00'W x 90.00'L x 2.00'H Prismatoid - Crushed Stone** 360 cf Overall x 40.0% Voids
		234 cf	Total Available Storage

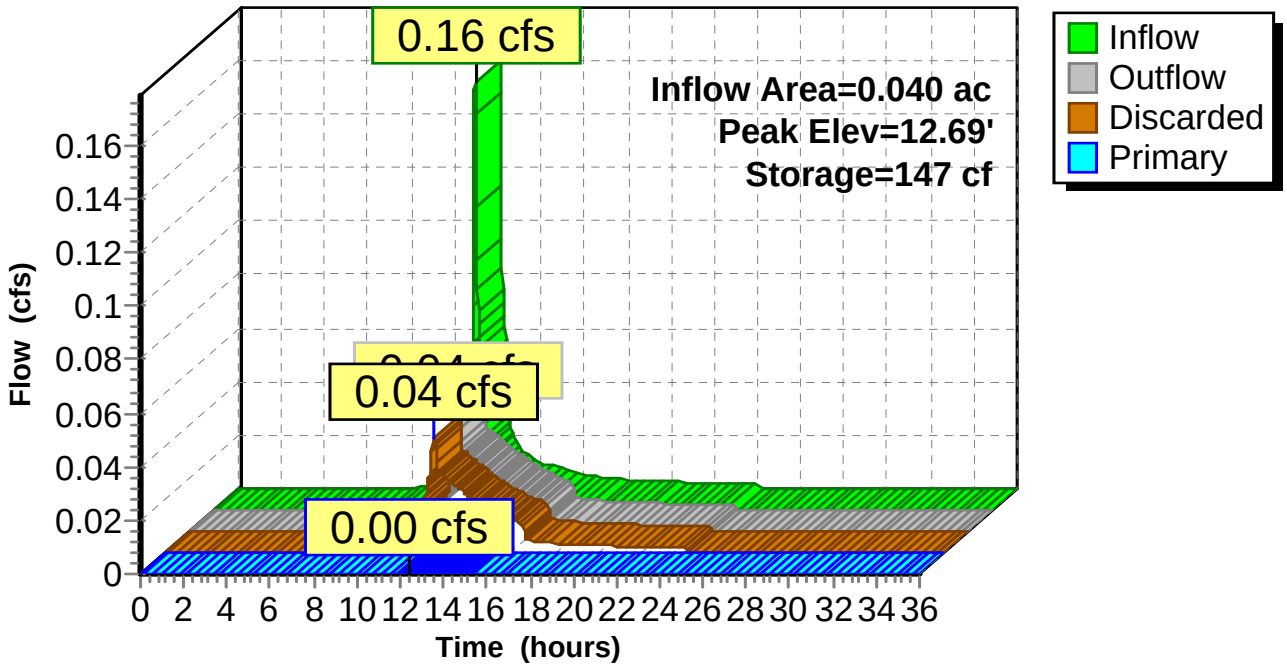
Device	Routing	Invert	Outlet Devices
#1	Primary	11.00'	**6.0" Round Culvert** L= 229.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 11.00' / 10.84' S= 0.0007 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#2	Device 1	11.00'	**0.1" Vert. Orifice/Grate** C= 0.600
#3	Discarded	10.50'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.04 cfs @ 12.45 hrs HW=12.68' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 12.45 hrs HW=12.68' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 0.52 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 6.24 fps)

Pond 1P: Dripline BMP

Hydrograph



Summary for Pond 2P: Rain Garden

Inflow Area = 0.066 ac, 54.89% Impervious, Inflow Depth = 3.91" for 25-year event
Inflow = 0.31 cfs @ 12.07 hrs, Volume= 0.022 af
Outflow = 0.03 cfs @ 13.05 hrs, Volume= 0.022 af, Atten= 92%, Lag= 58.9 min
Discarded = 0.03 cfs @ 13.05 hrs, Volume= 0.021 af
Primary = 0.00 cfs @ 13.05 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 16.93' @ 13.05 hrs Surf.Area= 454 sf Storage= 452 cf

Plug-Flow detention time= 271.4 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 271.5 min (1,078.1 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1	16.65'	360 cf	**Water Quality Volume (Prismatic)** Listed below (Recalc)
#2	15.15'	248 cf	**Loam/Soil Filter Media (Prismatic)** Listed below (Recalc)
#3	13.65'	186 cf	**Crushed Stone (Prismatic)** Listed below (Recalc)
		794 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.65	124	0	0
17.15	272	99	99
17.82	506	261	360

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.15	124	0	0
17.15	124	248	248

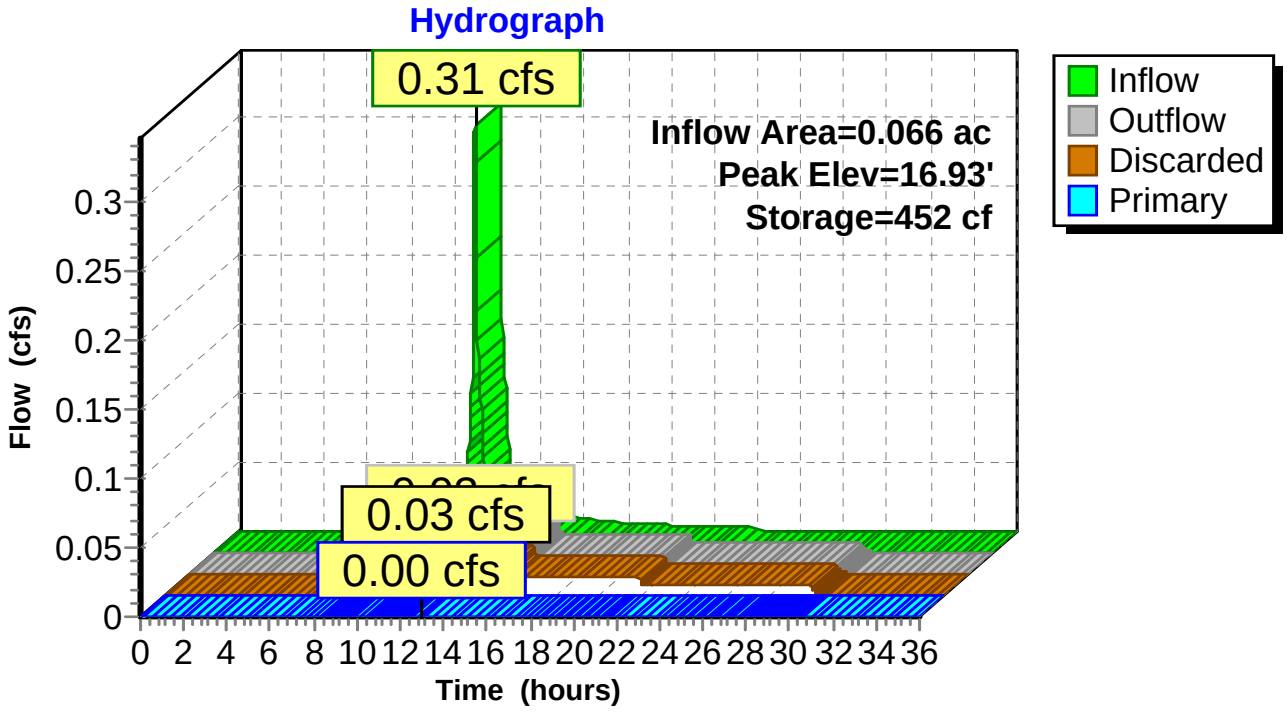
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.65	124	0	0
15.15	124	186	186

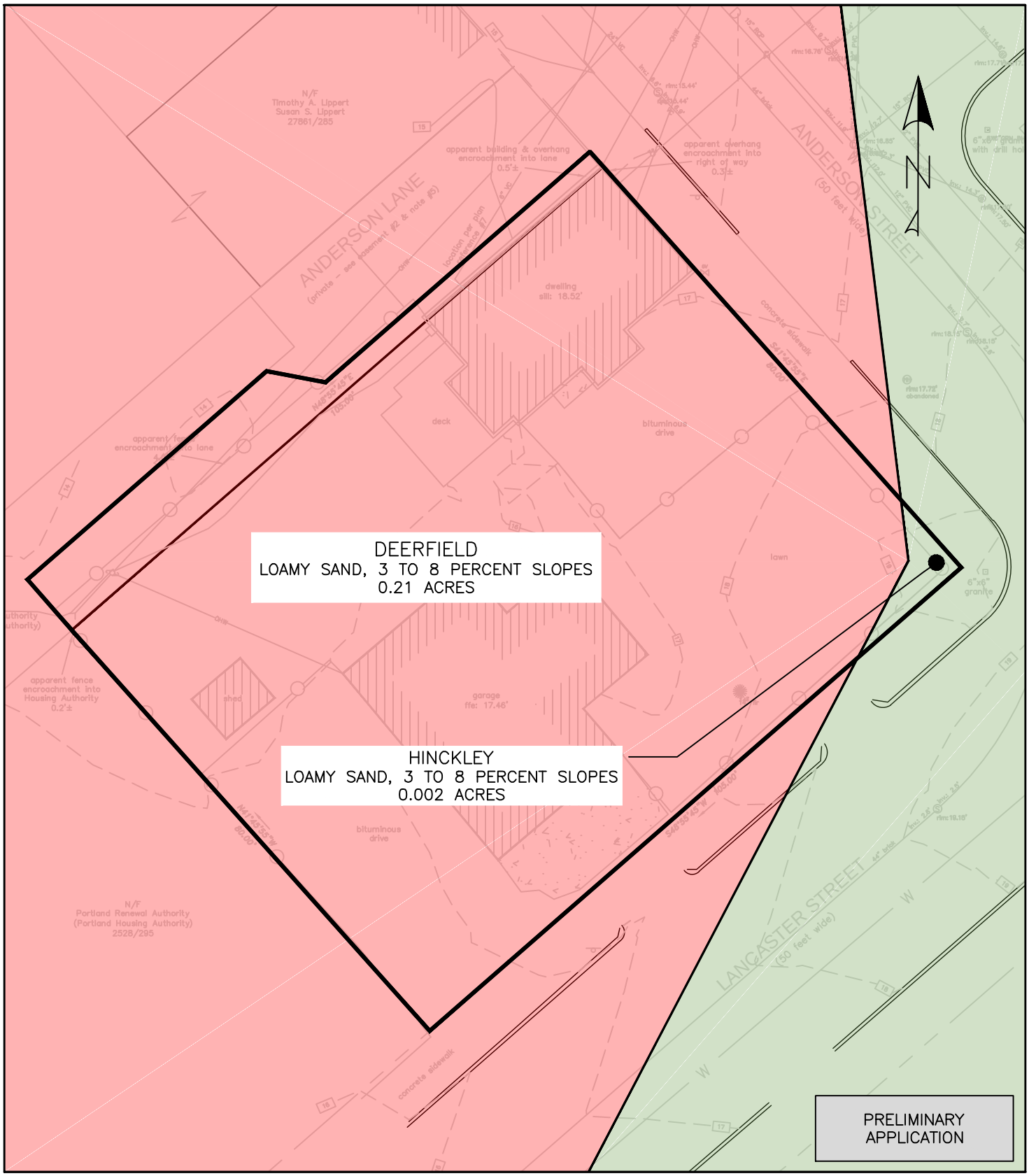
Device	Routing	Invert	Outlet Devices
#1	Primary	13.40'	**6.0" Round Culvert** L= 43.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 13.40' / 12.95' S= 0.0105 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#2	Device 1	13.50'	**0.1" Vert. Orifice/Grate** C= 0.600
#3	Device 1	17.15'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	13.65'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 13.05 hrs HW=16.93' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 13.05 hrs HW=16.93' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 1.51 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 8.91 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: Rain Garden





DRAWING NO.
SOILS

FILE:	CIVIL_1067
DATE:	4/22/16
JN:	1067
SCALE:	1":20'
DESIGN BY:	OJD
DRAWN BY:	OJD
CHECKED BY:	WHS

ACORN ENGINEERING, INC
ACORN ENGINEERING, INC. P.O. BOX 3372
PORTLAND, MAINE 04104 (207) 775-2655

DRAWING NAME: SOILS MAP

PROJECT NAME: 70 ANDERSON STREET REDEVELOPMENT

CLIENT: **REDFERN PROPERTIES, LLC**
PORTLAND, ME 04104

ISSUED FOR	BY	DATE
PRELIM APP	WHS	4/26/16

REV. DATE