James Engineering, Inc. 125 Great Rock Road, Hanover, Ma 02339

November 03,2021

Drainage Calculations
For
12 Hobart lane, Cohasset, MA

Prepared for;
Joseph A. Maraia
12 Hobart Lane
Cohasset, MA 02043

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Purpose

The purpose of this report is to review the impact of the proposed driveway expansion in the development of this lot and develop stormwater BMPs necessary to treat the additional runoff generated by the proposed driveway expansion and maintain compliance with the stormwater standards.

Method

The calculation will be based upon the SCS TR-20 Model using HYDRO-CAD 10.0 software to conduct the calculations.

Project Description

The proposed work is development is to expand the driveway surface to provide by 470 sq. ft. to provide a turn around from the second garage door and provide a stone lined slope protection along the rear which will provide acceptable access to the rear of the parcel from the deck area. approximately 970 cubic yards of material will be brought onto the site to fill the space between the existing higher areas at the back of the driveway the house and the side yard level with the stones. This slope protection will be set back approximately 7’ from the property line. This will allow the applicant to create a 5’ wide wetlands planting area between the existing rubble wall along the property line and the proposed stone slope.

In order to meet the requirements of the stormwater standards, a subsurface cul-tec storage and treatment facility which will act as a sand filter will be installed along the easterly edge of the parcel between the existing masonry wall and the proposed slope protection. All of the runoff from the that portion of the existing driveway which flows towards the rear of the parcel, and the proposed expansion will be collected by an infiltration trench which will be located along the edge of the proposed expansion. In addition to this runoff, all of the roof leaders from the rear of the house will also be collected and directed into the treatment structure. This structure will consist of 2 rows of 7 storm-tech model 310 chambers. Overall dimensions of the system will be 8’ x 50’ x 2.33’ and will provide a total storage volume of 420 cu. ft. In addition, 48” of sand will be set beneath the system to provide the treatment necessary to meet the 80% TSS removal required by the standards. Based upon the presence of ledge and the limited amount of native soils above the ledge, there is little or no opportunity on site to provide recharge. The flows through the sand beneath the system will remain below the surface however there is no groundwater regime on site to recharge. Accordingly, we will disregard the issues associated with Standard 3. Overall, there is very little change in the proposed use of the lot associated with the proposed improvements. The only real modification to the runoff will be associated with the expansion of the driveway. Accordingly, the additional 470 square feet of pavement will be the only change in use documented between existing and proposed conditions.

Based upon the assumption that the limit of the wetlands will be along the property line, all of the proposed activity will be located within the limits of the 100’ buffer to the vegetated wetlands. Overall, the disturbance within the 50’ buffer will be 4,844 square feet with an additional 802 square feet outside the 50 for a total disturbance area of 5,646 square feet. All of the proposed additional pavement will be located outside the 50’ buffer.

Erosion control will be limited to 12" mulch logs placed along the toe of the slope at the property line. Based upon the limited disturbance area <10,000 s.f., the log should be sufficient.

Existing Conditions

Only that portion of the site at the rear of the house which flows towards the phragmites at the far northeast corner of the lot will be analyzed in this analysis. The watershed data for this area is as follows.

Existing Conditions 1S

Drainage Area- 15,571 sq. ft.
0.357 acres

Land Use

Use	Area (s.f.)	CN
Pavement	1,460	98
Roof	800	98
Lawn	13,311	80

Tc

Sheet flow	l=43' s= 0.025	lawn
Shallow Conc. Flow	l=76' s=0.012	lawn

Proposed Conditions

Driveway 3S

Drainage Area- 1,930 sq. ft.
0.044 acres

Land Use

Use	Area (s.f.)	CN
Ex. Pavement	1,460	98
Pr. Pavement	470	98

Tc

Use 6 minutes minimum

Roof area 4S

Drainage Area- 800 sq. ft.
0.018 acres

Land Use

Use	Area (s.f.)	CN
Roof	2,888	98

Tc
Use 6 minutes minimum

Uncontrolled 5S

Drainage Area- 12,641 sq. ft.
0.290 acres

Land Use

Use	Area (s.f.)	CN
Lawn	12,641	80

Tc

Sheet flow	l=43' s= 0.025 lawn
Shallow Conc. Flow	l=76' s=0.012 lawn

Storm Tech structure 1P

Structure is 8.16 x 50' x 2.33' deep, Bottom El. 16.0
Use 2 rows of 7 Storm-tech chambers model SC-310.

Storage is calculated by hydro-cad
Infiltration through sand beneath units- rate = 8.27" per hour.
Depth = 48"
Tt = 48/ 8.27 in/hr. = 5.80 hrs. ok use 6 hrs lag time.
Outlet is 4" ADS pipe at Inv. El. 17.50

Static Storage Provided – 319 cu. ft.
WQV = 0.5"
Total Impervious = 2730 sq. ft.
WQV = 0.5/12 (2730) = 113.75 cu. ft.
Volume Provided = 1.4" of runoff ok

Storm Water Standards

Standard No. 1, Untreated Discharges

All of the impervious surface runoff from this portion of the site will be treated by the proposed sand filter. The runoff from the driveway will be pretreated by a deep sum manhole at the end of the collection trench. In addition, the proposed Isolator Row will also provide an additional 80% TSS removal Rate as documented in the EPA guidelines.

Standard No. 2, Peak Discharge Rates

Based upon the Hydro-CAD update, the increase in the driveway surface area had very little impact on the flow into the wetlands off site. The lag associated with the time to travel through the sand filter prior to discharge to the phragmites wetland will result in an overall reduction in peak flow rates off site.

Peak Flow Rate	Existing	Proposed	Difference
2 Year Storm	0.65 cfs	0.46 cfs	-29.3%
10 Year Storm in	1.14 cfs	0.84 cfs	-26.3%
25 Year Storm in	1.41 cfs	1.06 cfs	-24.8%
100 Year Storm in	1.91 cfs	1.47 cfs	-23.0%

Because the discharge is to a tidal resource, this standard does not apply however as can be seen there remains a significant reduction in peak flow rates across the board for every event.

Standard No. 3, Recharge

Based upon the lack of soils above ledge, there is no opportunity to recharge groundwater on site. Providing the sand ill beneath the storm tech will provide some storage within the soil profile available to the wetlands regime just beyond the property line. It is important to note that all of the runoff from up to a 25-year frequency storm will remain in the ground. Discharge from the overflow will only occur at the peak of the 100-year frequency storm.

Standard No. 4, Water Quality

Infiltration Basin

Item Description	Removal rate	Actual removal	Remaining	Total Removal
Sand filter	80%	80%	20%	80%

Standard No. 5, Land Use with Higher Potential Pollution Loads

This standard is not applicable

Standard No. 6, Critical Areas

This standard is not applicable to this site

Standard No. 7, Redevelopment

This standard is not applicable to this site

Standard No. 8, Construction Period Pollution Control

The erosion controls associated with the proposed are shown on the site plans.

Standard No. 9, Operation and Maintenance

The O & M manual for the lot is attached hereto.

Standard No. 10, Illicit Discharge statement

I do hereby certify that there are no illicit discharges proposed on site.

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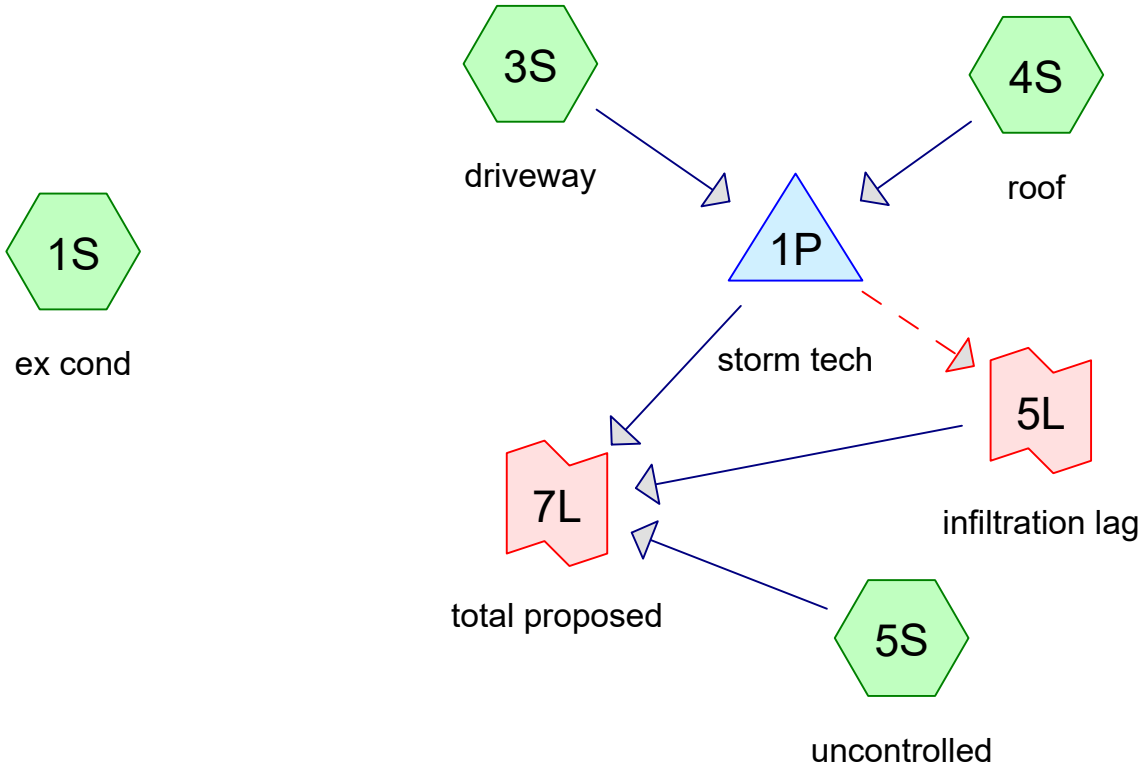
Gary D. James, P.E.

Hydro-Cad Printout



Subcat Reach Pond Link

Routing Diagram for 12 Hobart Lane
Prepared by James Engineering, Inc., Printed 11/4/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.596	80	>75% Grass cover, Good, HSG D (1S, 5S)
0.034	98	Ex Driveway (3S)
0.034	98	Paved parking, HSG D (1S)
0.011	98	Pr driveway (3S)
0.037	98	Roofs, HSG D (1S, 4S)
0.710	**83**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.666	HSG D	1S, 4S, 5S
0.044	Other	3S
0.710		**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	0.000	0.596	0.000	0.596	>75% Grass cover, Good	1S, 5S
0.000	0.000	0.000	0.000	0.034	0.034	Ex Driveway	3S
0.000	0.000	0.000	0.034	0.000	0.034	Paved parking	1S
0.000	0.000	0.000	0.000	0.011	0.011	Pr driveway	3S
0.000	0.000	0.000	0.037	0.000	0.037	Roofs	1S, 4S
0.000	**0.000**	**0.000**	**0.666**	**0.044**	**0.710**	**TOTAL AREA**	

Time span=3.00-30.00 hrs, dt=0.01 hrs, 2701 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: ex cond Runoff Area=15,571 sf 14.51% Impervious Runoff Depth=1.69"
Flow Length=121' Tc=8.3 min CN=83 Runoff=0.65 cfs 0.050 af

Subcatchment 3S: driveway Runoff Area=1,930 sf 100.00% Impervious Runoff Depth>3.05"
Tc=6.0 min CN=98 Runoff=0.14 cfs 0.011 af

Subcatchment 4S: roof Runoff Area=800 sf 100.00% Impervious Runoff Depth>3.05"
Tc=6.0 min CN=98 Runoff=0.06 cfs 0.005 af

Subcatchment 5S: uncontrolled Runoff Area=12,641 sf 0.00% Impervious Runoff Depth=1.48"
Flow Length=121' Tc=8.3 min CN=80 Runoff=0.46 cfs 0.036 af

Pond 1P: storm tech Peak Elev=16.55' Storage=77 cf Inflow=0.20 cfs 0.016 af
Primary=0.00 cfs 0.000 af Secondary=0.08 cfs 0.016 af Outflow=0.08 cfs 0.016 af

Link 5L: infiltration lag delayed by 360.0 min Inflow=0.08 cfs 0.016 af
Primary=0.08 cfs 0.016 af

Link 7L: total proposed Inflow=0.46 cfs 0.052 af
Primary=0.46 cfs 0.052 af

Total Runoff Area = 0.710 ac Runoff Volume = 0.102 af Average Runoff Depth = 1.73"
83.87% Pervious = 0.596 ac 16.13% Impervious = 0.115 ac

Summary for Subcatchment 1S: ex cond

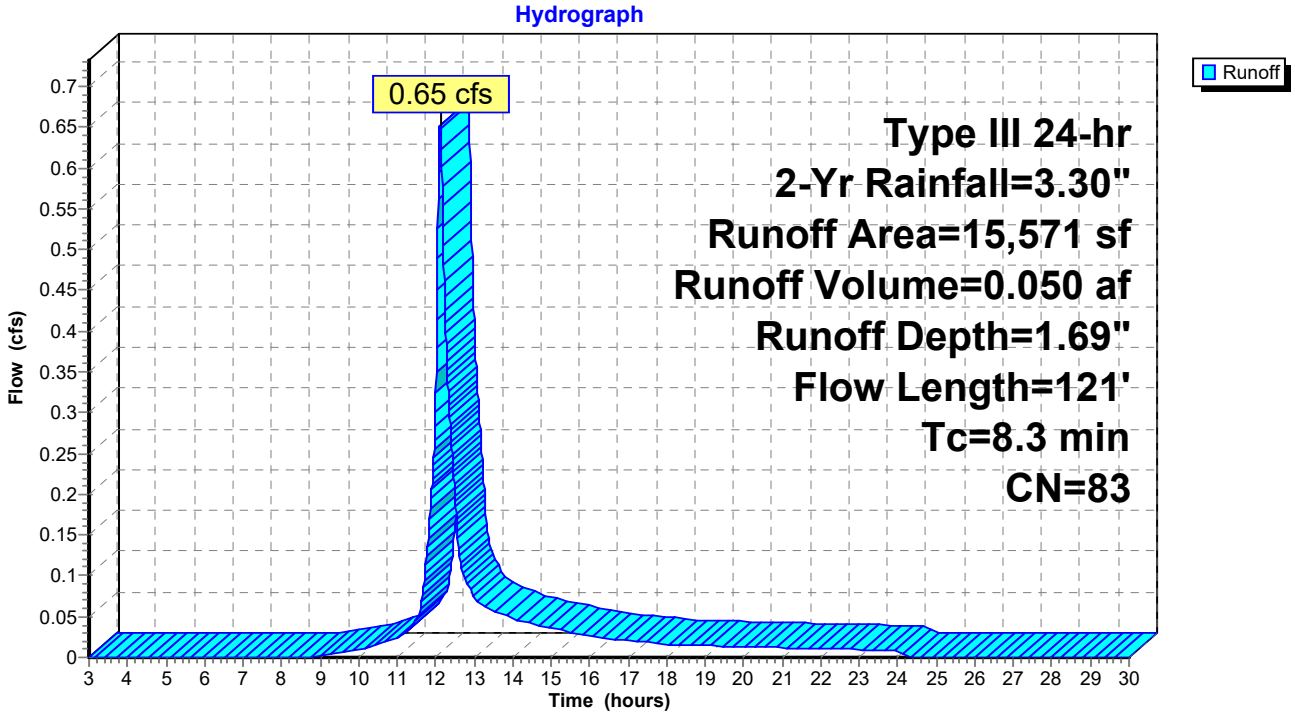
Runoff = 0.65 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 1.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Rainfall=3.30"

Area (sf)	CN	Description
1,460	98	Paved parking, HSG D
800	98	Roofs, HSG D
13,311	80	>75% Grass cover, Good, HSG D
15,571	83	Weighted Average
13,311		85.49% Pervious Area
2,260		14.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 1S: ex cond



Summary for Subcatchment 3S: driveway

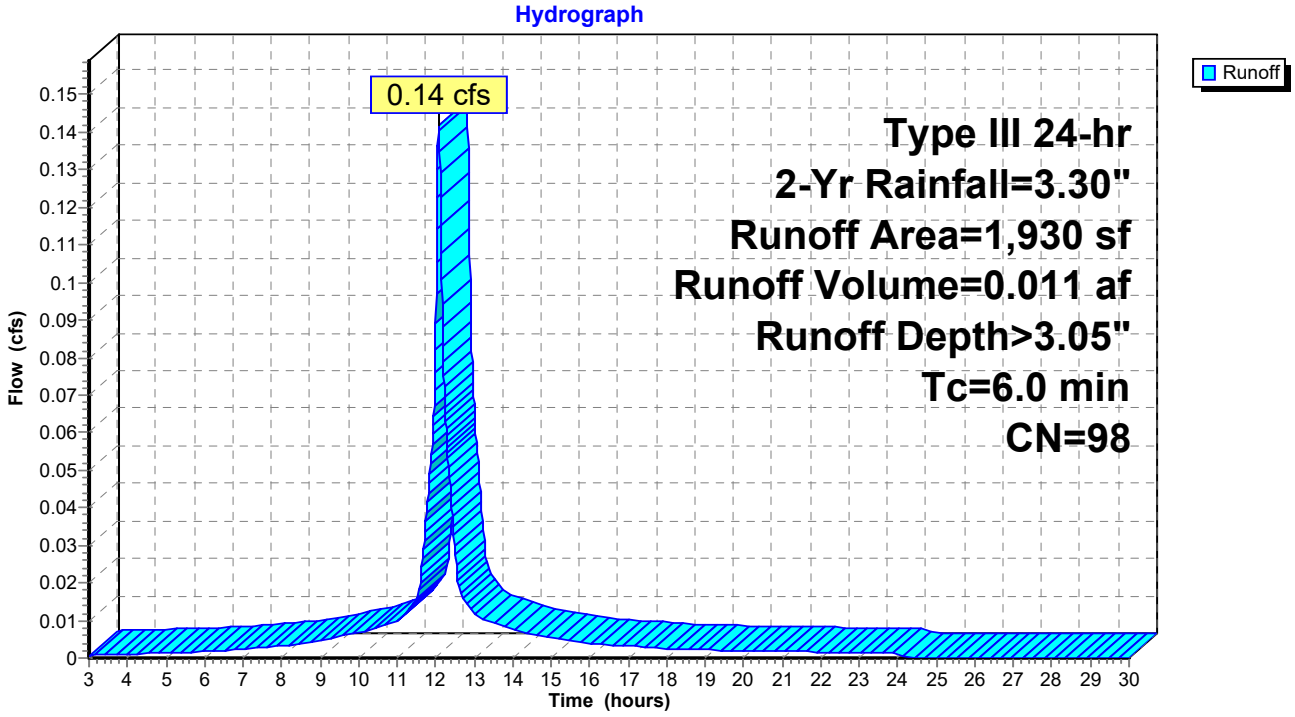
Runoff = 0.14 cfs @ 12.08 hrs, Volume= 0.011 af, Depth> 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Rainfall=3.30"

	Area (sf)	CN	Description
*	1,460	98	Ex Driveway
*	470	98	Pr driveway
	1,930	98	Weighted Average
	1,930		100.00% Impervious Area

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

Subcatchment 3S: driveway



Summary for Subcatchment 4S: roof

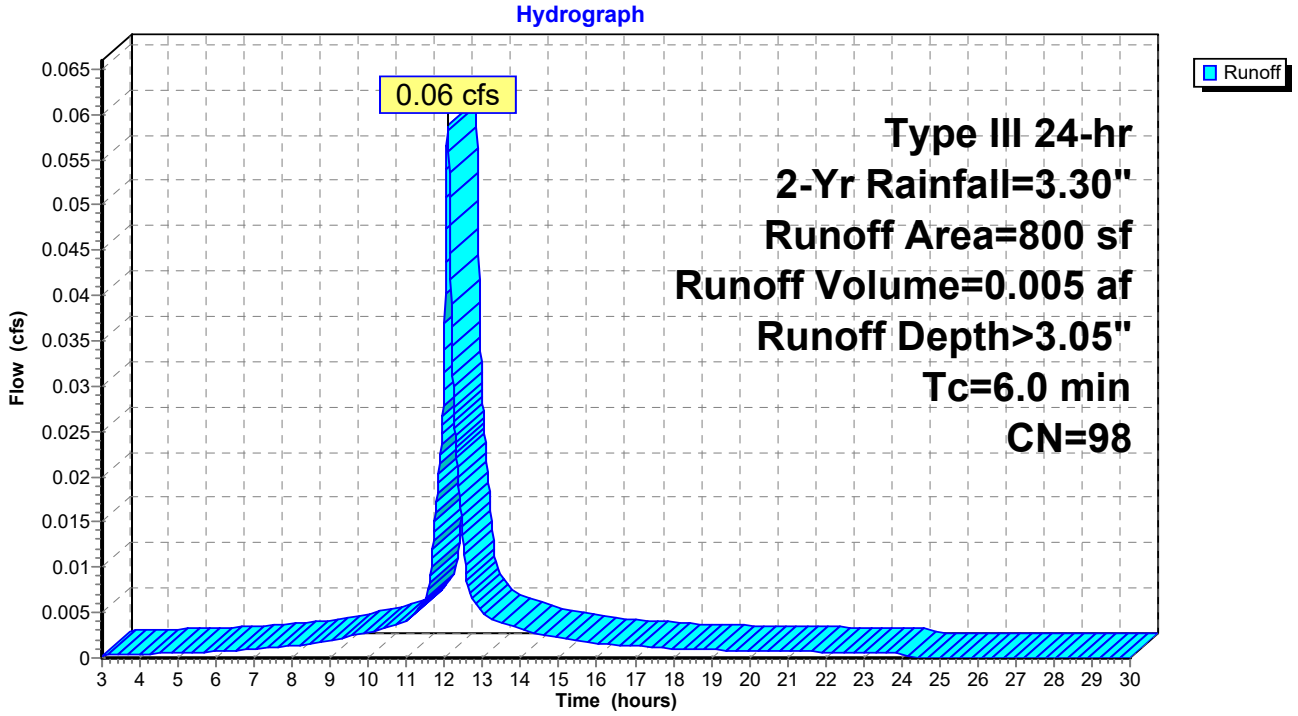
Runoff = 0.06 cfs @ 12.08 hrs, Volume= 0.005 af, Depth> 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Rainfall=3.30"

Area (sf)	CN	Description
800	98	Roofs, HSG D
800		100.00% Impervious Area

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

Subcatchment 4S: roof



Summary for Subcatchment 5S: uncontrolled

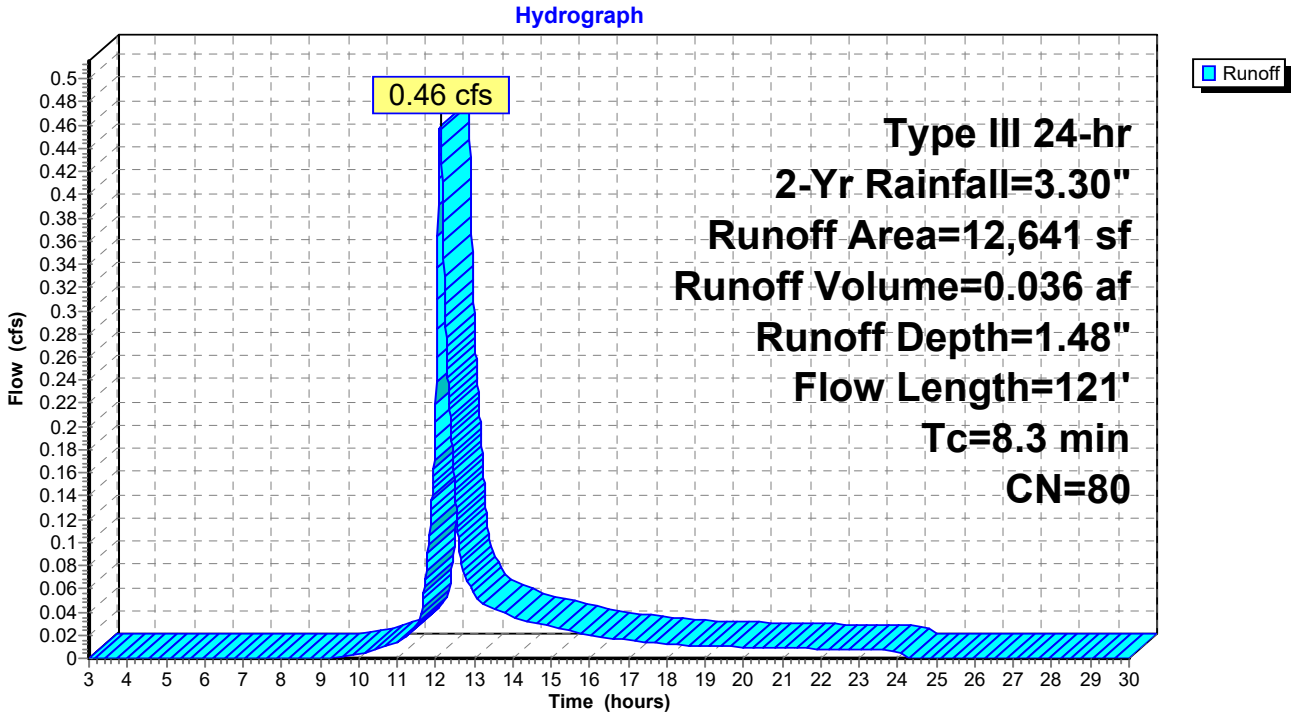
Runoff = 0.46 cfs @ 12.12 hrs, Volume= 0.036 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Rainfall=3.30"

Area (sf)	CN	Description
12,641	80	>75% Grass cover, Good, HSG D
12,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 5S: uncontrolled



Summary for Pond 1P: storm tech

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.063 ac,100.00% Impervious, Inflow Depth > 3.05" for 2-Yr event
Inflow = 0.20 cfs @ 12.08 hrs, Volume= 0.016 af
Outflow = 0.08 cfs @ 11.91 hrs, Volume= 0.016 af, Atten= 61%, Lag= 0.0 min
Primary = 0.00 cfs @ 3.00 hrs, Volume= 0.000 af
Secondary = 0.08 cfs @ 11.91 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 16.55' @ 12.31 hrs Surf.Area= 408 sf Storage= 77 cf

Plug-Flow detention time= 4.0 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 4.0 min (762.3 - 758.2)

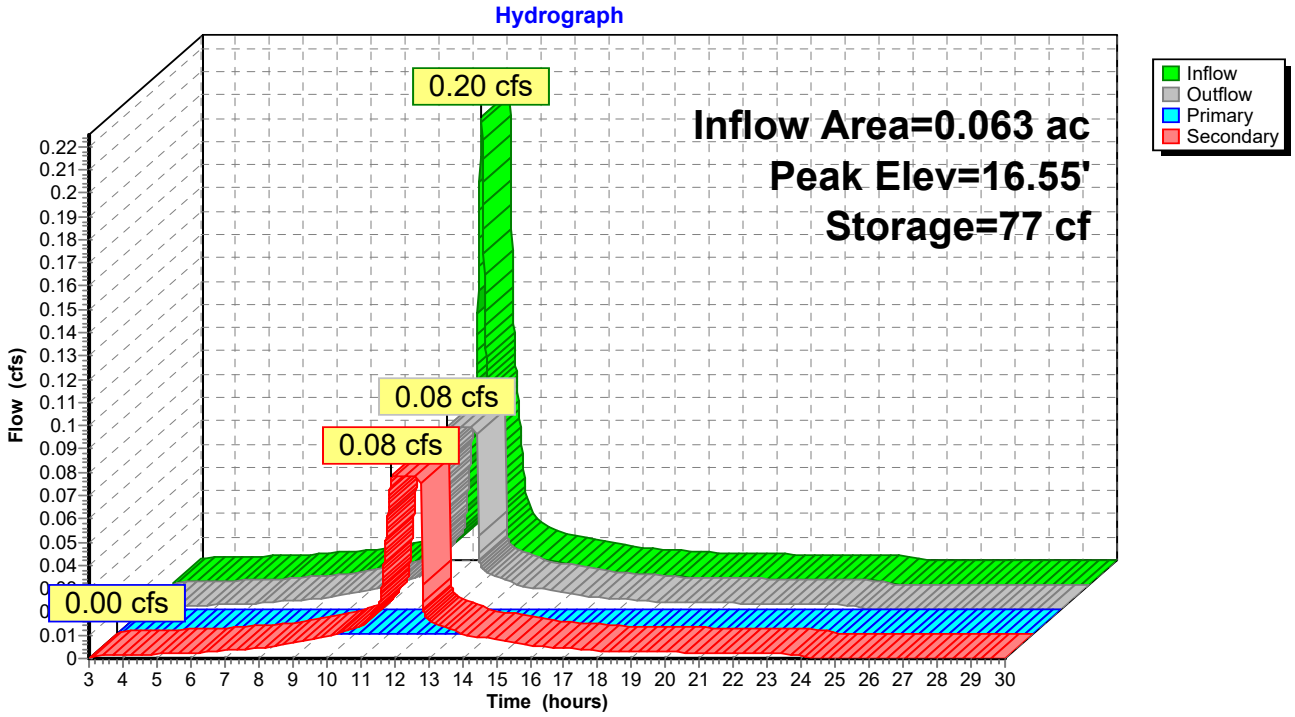
Volume	Invert	Avail.Storage	Storage Description
#1	16.00'	223 cf	**8.16'W x 50.00'L x 2.33'H Prismatoid** 951 cf Overall - 208 cf Embedded = 742 cf x 30.0% Voids
#2	16.50'	208 cf	**ADS_StormTech SC-310** x 14 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 2 rows
		431 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Secondary	16.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	17.50'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 3.00 hrs HW=16.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.08 cfs @ 11.91 hrs HW=16.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 1P: storm tech

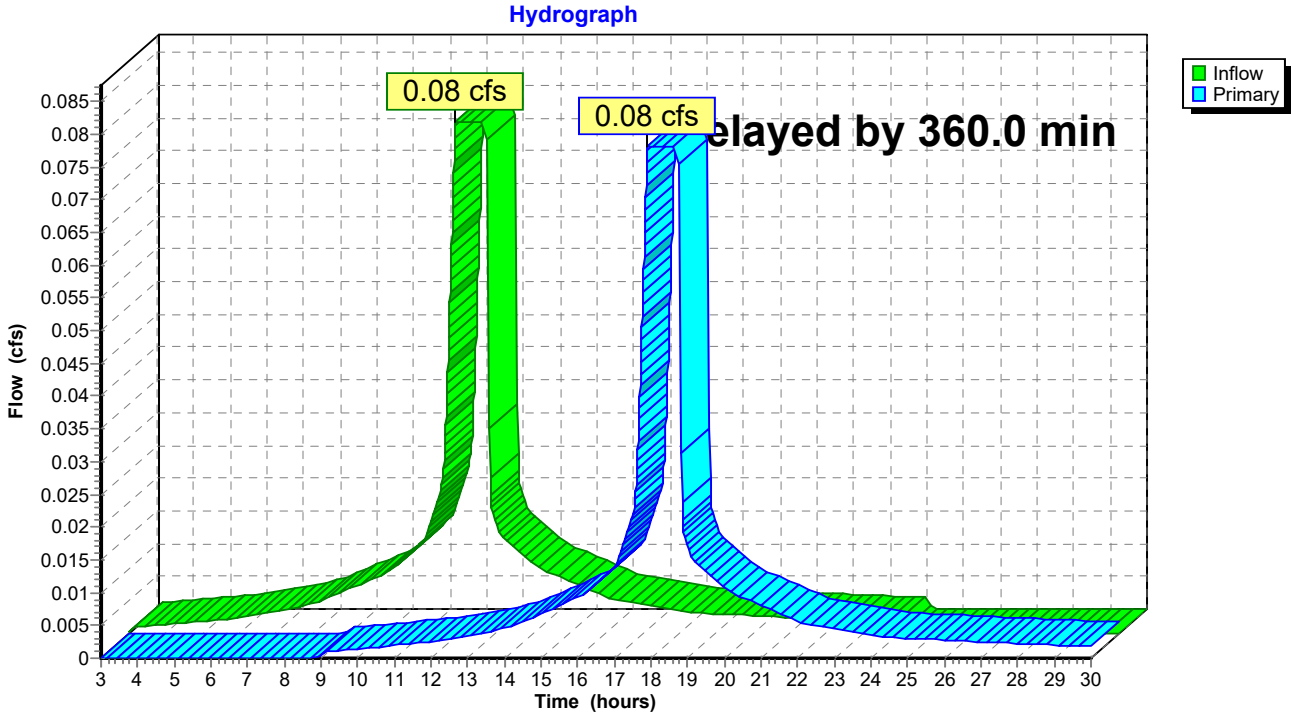


Summary for Link 5L: infiltration lag

Inflow = 0.08 cfs @ 11.91 hrs, Volume= 0.016 af
Primary = 0.08 cfs @ 17.91 hrs, Volume= 0.016 af, Atten= 0%, Lag= 360.0 min

Primary outflow = Inflow delayed by 360.0 min, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 5L: infiltration lag

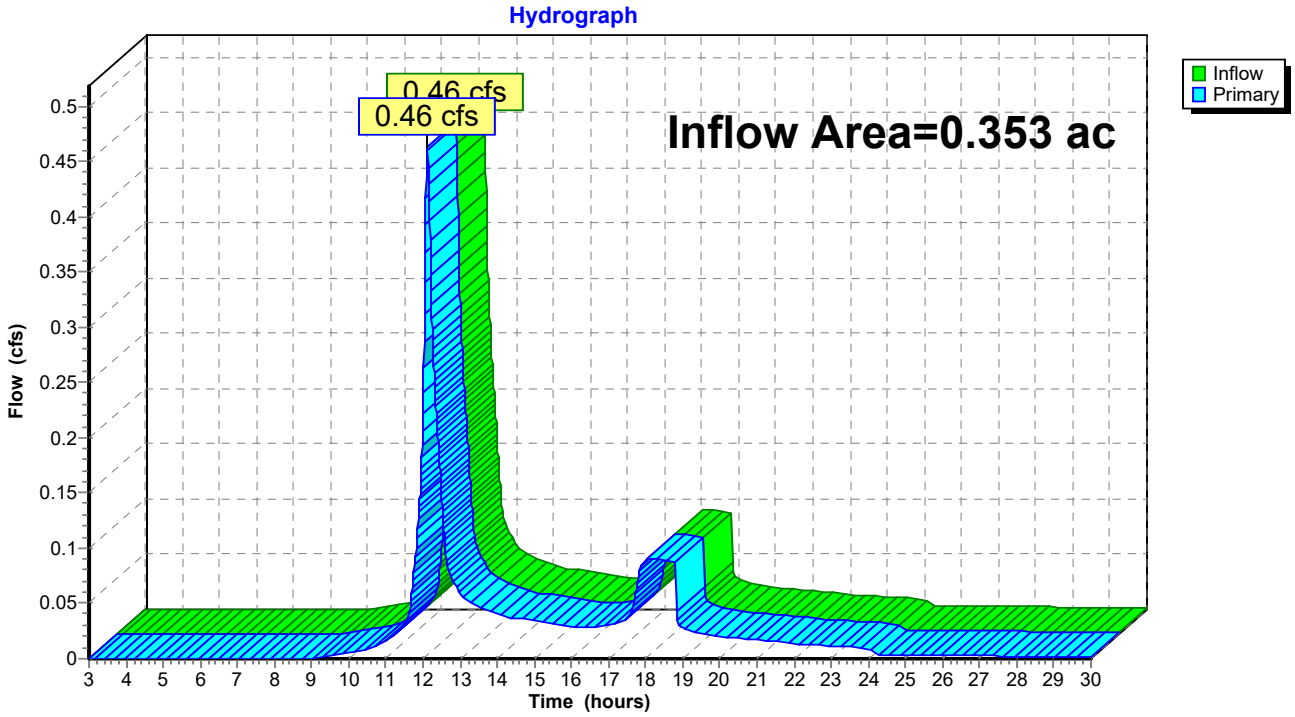


Summary for Link 7L: total proposed

Inflow Area = 0.353 ac, 17.76% Impervious, Inflow Depth > 1.76" for 2-Yr event
Inflow = 0.46 cfs @ 12.12 hrs, Volume= 0.052 af
Primary = 0.46 cfs @ 12.12 hrs, Volume= 0.052 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 7L: total proposed



Time span=3.00-30.00 hrs, dt=0.01 hrs, 2701 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: ex cond Runoff Area=15,571 sf 14.51% Impervious Runoff Depth=2.95"
Flow Length=121' Tc=8.3 min CN=83 Runoff=1.14 cfs 0.088 af

Subcatchment 3S: driveway Runoff Area=1,930 sf 100.00% Impervious Runoff Depth>4.48"
Tc=6.0 min CN=98 Runoff=0.21 cfs 0.017 af

Subcatchment 4S: roof Runoff Area=800 sf 100.00% Impervious Runoff Depth>4.48"
Tc=6.0 min CN=98 Runoff=0.09 cfs 0.007 af

Subcatchment 5S: uncontrolled Runoff Area=12,641 sf 0.00% Impervious Runoff Depth=2.68"
Flow Length=121' Tc=8.3 min CN=80 Runoff=0.84 cfs 0.065 af

Pond 1P: storm tech Peak Elev=16.91' Storage=178 cf Inflow=0.29 cfs 0.023 af
Primary=0.00 cfs 0.000 af Secondary=0.08 cfs 0.023 af Outflow=0.08 cfs 0.023 af

Link 5L: infiltration lag delayed by 360.0 min Inflow=0.08 cfs 0.023 af
Primary=0.08 cfs 0.023 af

Link 7L: total proposed Inflow=0.84 cfs 0.088 af
Primary=0.84 cfs 0.088 af

Total Runoff Area = 0.710 ac Runoff Volume = 0.176 af Average Runoff Depth = 2.97"
83.87% Pervious = 0.596 ac 16.13% Impervious = 0.115 ac

Summary for Subcatchment 1S: ex cond

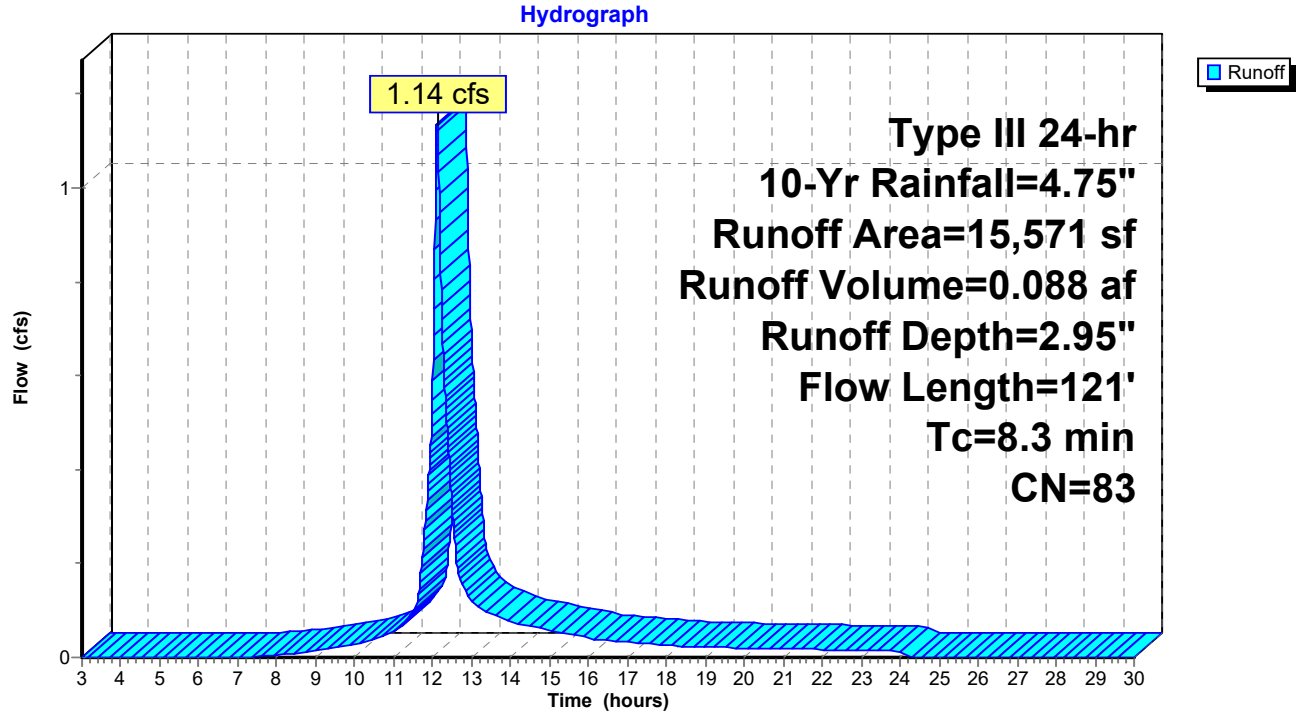
Runoff = 1.14 cfs @ 12.12 hrs, Volume= 0.088 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Rainfall=4.75"

Area (sf)	CN	Description
1,460	98	Paved parking, HSG D
800	98	Roofs, HSG D
13,311	80	>75% Grass cover, Good, HSG D
15,571	83	Weighted Average
13,311		85.49% Pervious Area
2,260		14.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 1S: ex cond



Summary for Subcatchment 3S: driveway

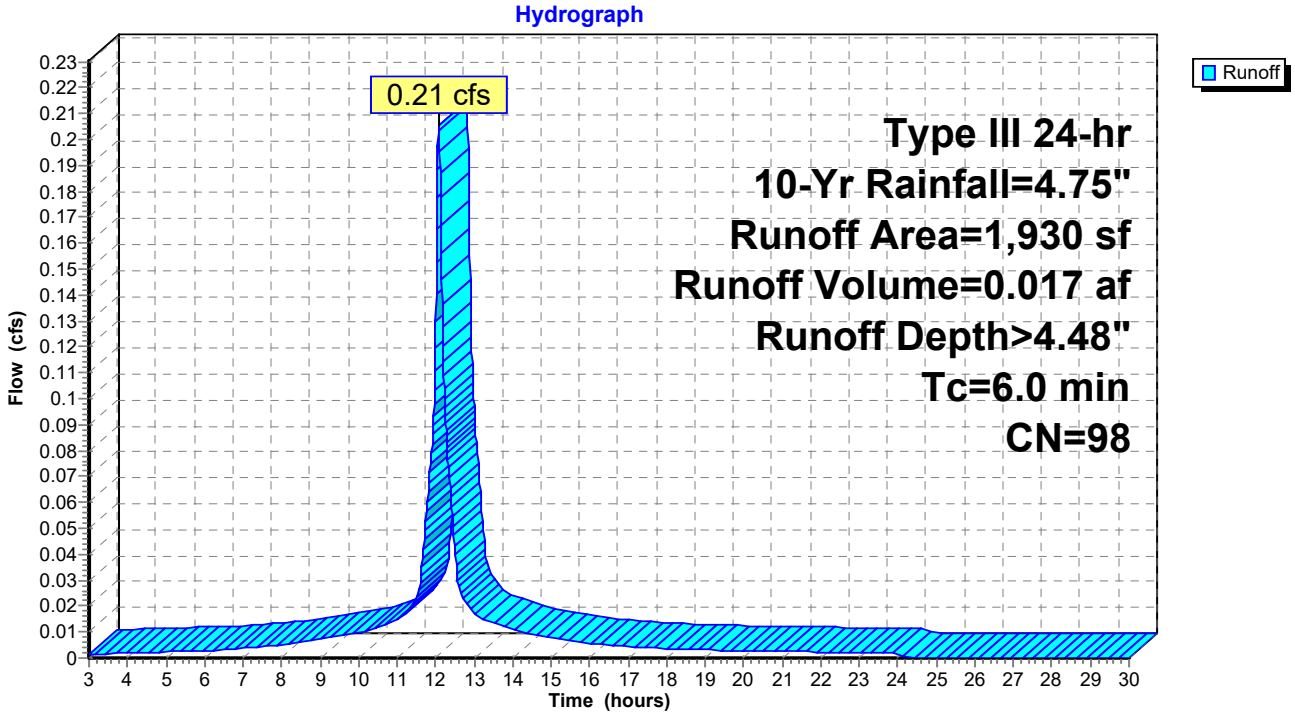
Runoff = 0.21 cfs @ 12.08 hrs, Volume= 0.017 af, Depth> 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Rainfall=4.75"

	Area (sf)	CN	Description
*	1,460	98	Ex Driveway
*	470	98	Pr driveway
	1,930	98	Weighted Average
	1,930		100.00% Impervious Area

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

Subcatchment 3S: driveway



Summary for Subcatchment 4S: roof

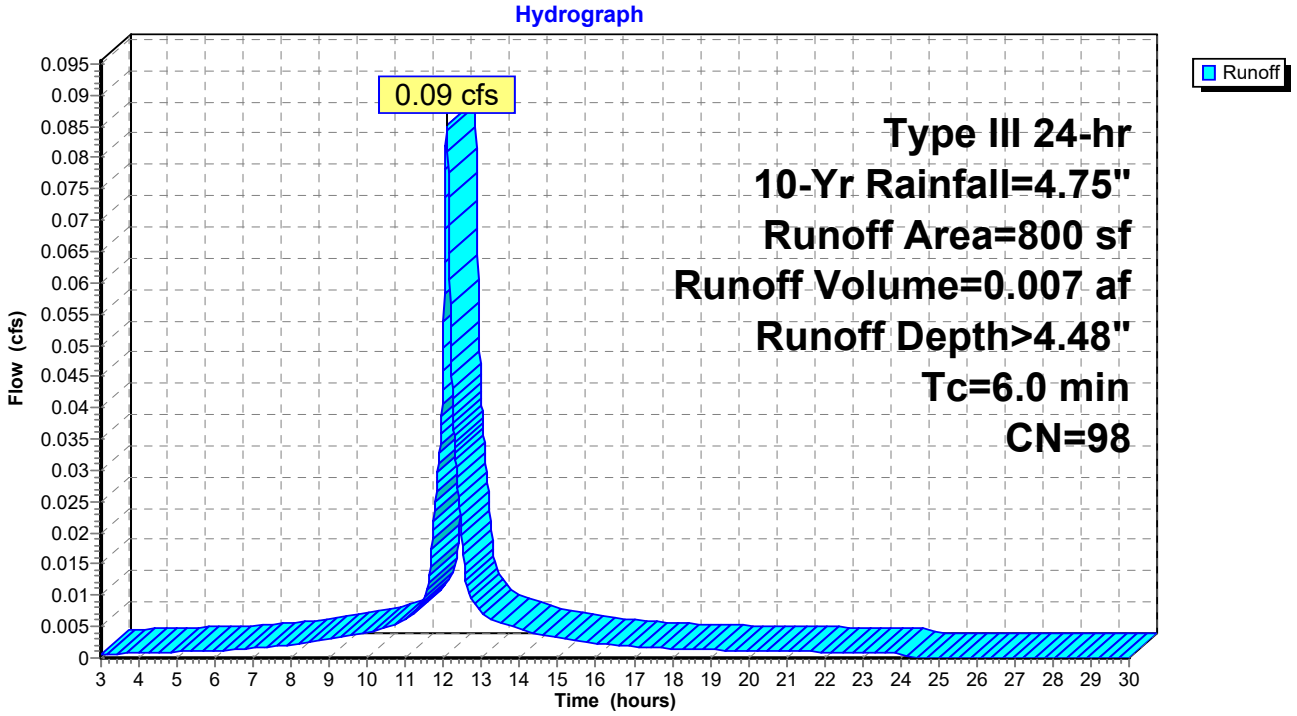
Runoff = 0.09 cfs @ 12.08 hrs, Volume= 0.007 af, Depth> 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Rainfall=4.75"

Area (sf)	CN	Description
800	98	Roofs, HSG D
800		100.00% Impervious Area

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

Subcatchment 4S: roof



Summary for Subcatchment 5S: uncontrolled

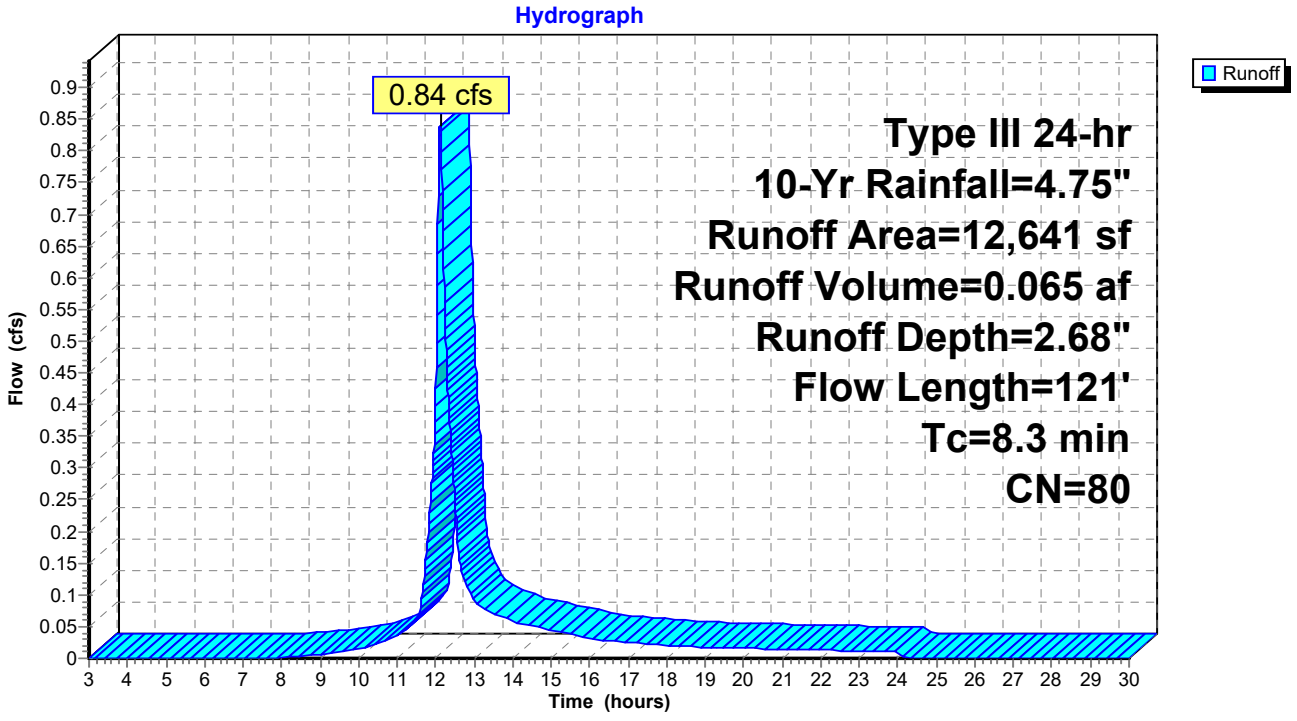
Runoff = 0.84 cfs @ 12.12 hrs, Volume= 0.065 af, Depth= 2.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Rainfall=4.75"

Area (sf)	CN	Description
12,641	80	>75% Grass cover, Good, HSG D
12,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 5S: uncontrolled



Summary for Pond 1P: storm tech

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.063 ac,100.00% Impervious, Inflow Depth > 4.48" for 10-Yr event
Inflow = 0.29 cfs @ 12.08 hrs, Volume= 0.023 af
Outflow = 0.08 cfs @ 11.77 hrs, Volume= 0.023 af, Atten= 73%, Lag= 0.0 min
Primary = 0.00 cfs @ 3.00 hrs, Volume= 0.000 af
Secondary = 0.08 cfs @ 11.77 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 16.91' @ 12.43 hrs Surf.Area= 408 sf Storage= 178 cf

Plug-Flow detention time= 10.1 min calculated for 0.023 af (100% of inflow)
Center-of-Mass det. time= 10.1 min (763.5 - 753.4)

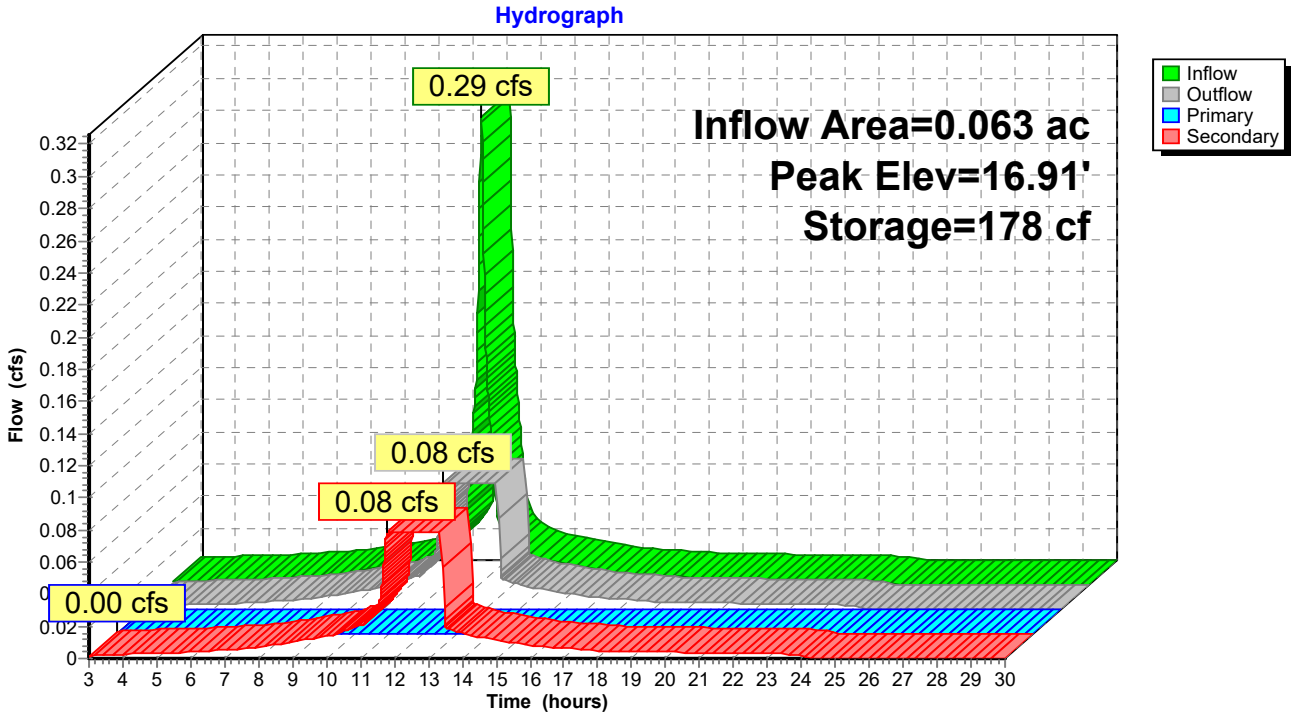
Volume	Invert	Avail.Storage	Storage Description
#1	16.00'	223 cf	**8.16'W x 50.00'L x 2.33'H Prismatoid** 951 cf Overall - 208 cf Embedded = 742 cf x 30.0% Voids
#2	16.50'	208 cf	**ADS_StormTech SC-310** x 14 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 2 rows
		431 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Secondary	16.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	17.50'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 3.00 hrs HW=16.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.08 cfs @ 11.77 hrs HW=16.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 1P: storm tech

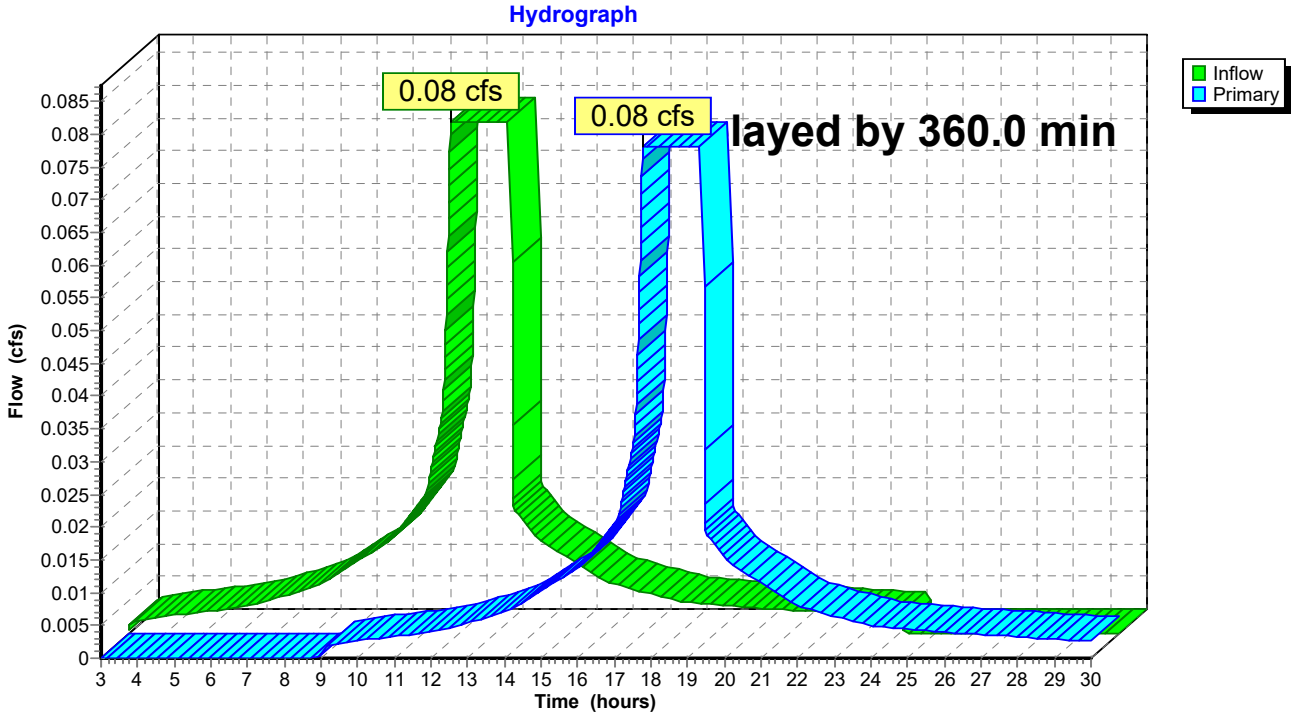


Summary for Link 5L: infiltration lag

Inflow = 0.08 cfs @ 11.77 hrs, Volume= 0.023 af
Primary = 0.08 cfs @ 17.77 hrs, Volume= 0.023 af, Atten= 0%, Lag= 360.0 min

Primary outflow = Inflow delayed by 360.0 min, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 5L: infiltration lag

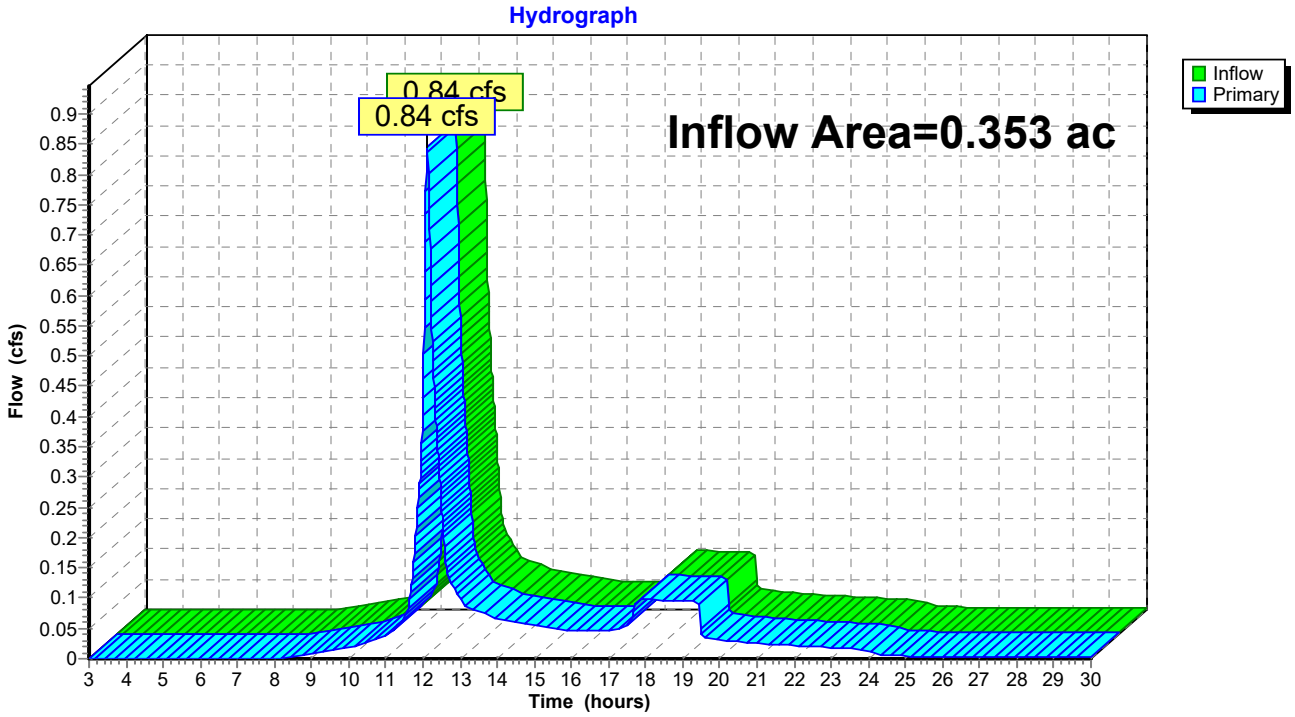


Summary for Link 7L: total proposed

Inflow Area = 0.353 ac, 17.76% Impervious, Inflow Depth > 3.00" for 10-Yr event
Inflow = 0.84 cfs @ 12.12 hrs, Volume= 0.088 af
Primary = 0.84 cfs @ 12.12 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 7L: total proposed



Time span=3.00-30.00 hrs, dt=0.01 hrs, 2701 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: ex cond Runoff Area=15,571 sf 14.51% Impervious Runoff Depth=3.68"
Flow Length=121' Tc=8.3 min CN=83 Runoff=1.41 cfs 0.109 af

Subcatchment 3S: driveway Runoff Area=1,930 sf 100.00% Impervious Runoff Depth>5.27"
Tc=6.0 min CN=98 Runoff=0.24 cfs 0.019 af

Subcatchment 4S: roof Runoff Area=800 sf 100.00% Impervious Runoff Depth>5.27"
Tc=6.0 min CN=98 Runoff=0.10 cfs 0.008 af

Subcatchment 5S: uncontrolled Runoff Area=12,641 sf 0.00% Impervious Runoff Depth=3.38"
Flow Length=121' Tc=8.3 min CN=80 Runoff=1.06 cfs 0.082 af

Pond 1P: storm tech Peak Elev=17.16' Storage=242 cf Inflow=0.34 cfs 0.028 af
Primary=0.00 cfs 0.000 af Secondary=0.08 cfs 0.028 af Outflow=0.08 cfs 0.028 af

Link 5L: infiltration lag delayed by 360.0 min Inflow=0.08 cfs 0.028 af
Primary=0.08 cfs 0.027 af

Link 7L: total proposed Inflow=1.06 cfs 0.109 af
Primary=1.06 cfs 0.109 af

Total Runoff Area = 0.710 ac Runoff Volume = 0.219 af Average Runoff Depth = 3.69"
83.87% Pervious = 0.596 ac 16.13% Impervious = 0.115 ac

Summary for Subcatchment 1S: ex cond

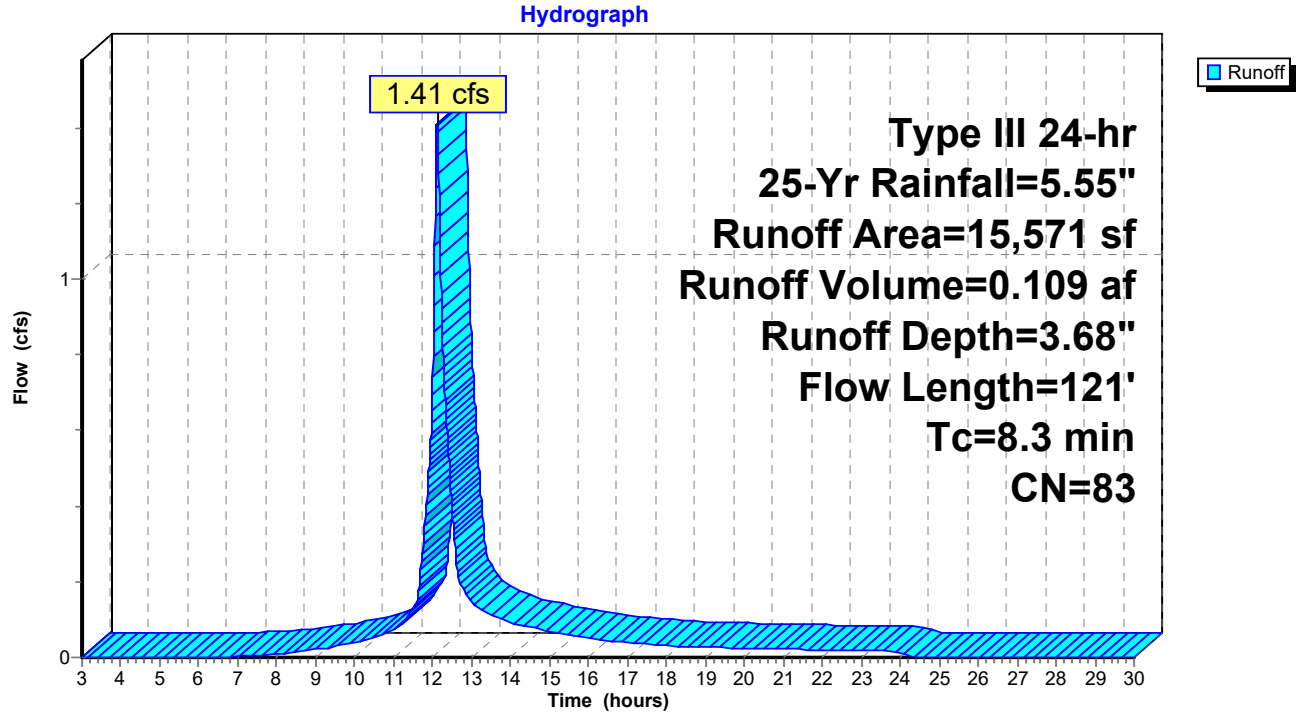
Runoff = 1.41 cfs @ 12.12 hrs, Volume= 0.109 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Rainfall=5.55"

Area (sf)	CN	Description
1,460	98	Paved parking, HSG D
800	98	Roofs, HSG D
13,311	80	>75% Grass cover, Good, HSG D
15,571	83	Weighted Average
13,311		85.49% Pervious Area
2,260		14.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 1S: ex cond



Summary for Subcatchment 3S: driveway

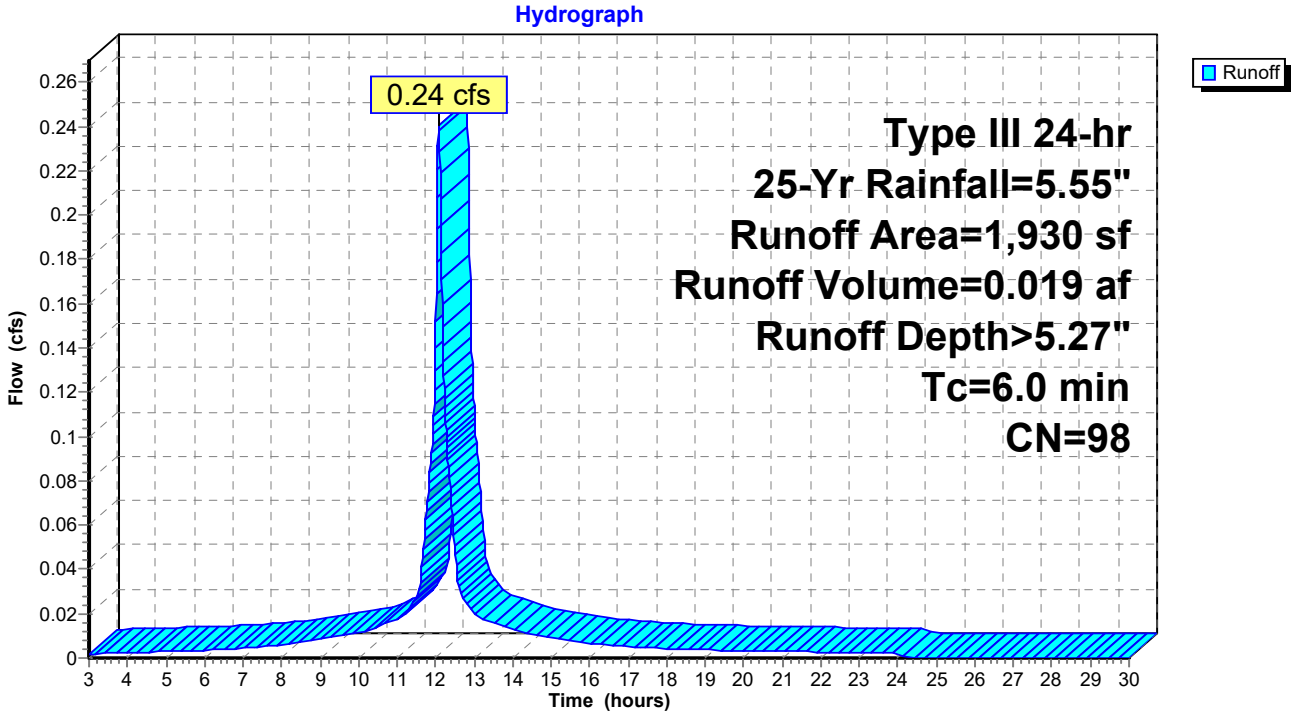
Runoff = 0.24 cfs @ 12.08 hrs, Volume= 0.019 af, Depth> 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Rainfall=5.55"

	Area (sf)	CN	Description
*	1,460	98	Ex Driveway
*	470	98	Pr driveway
	1,930	98	Weighted Average
	1,930		100.00% Impervious Area

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

Subcatchment 3S: driveway



Summary for Subcatchment 4S: roof

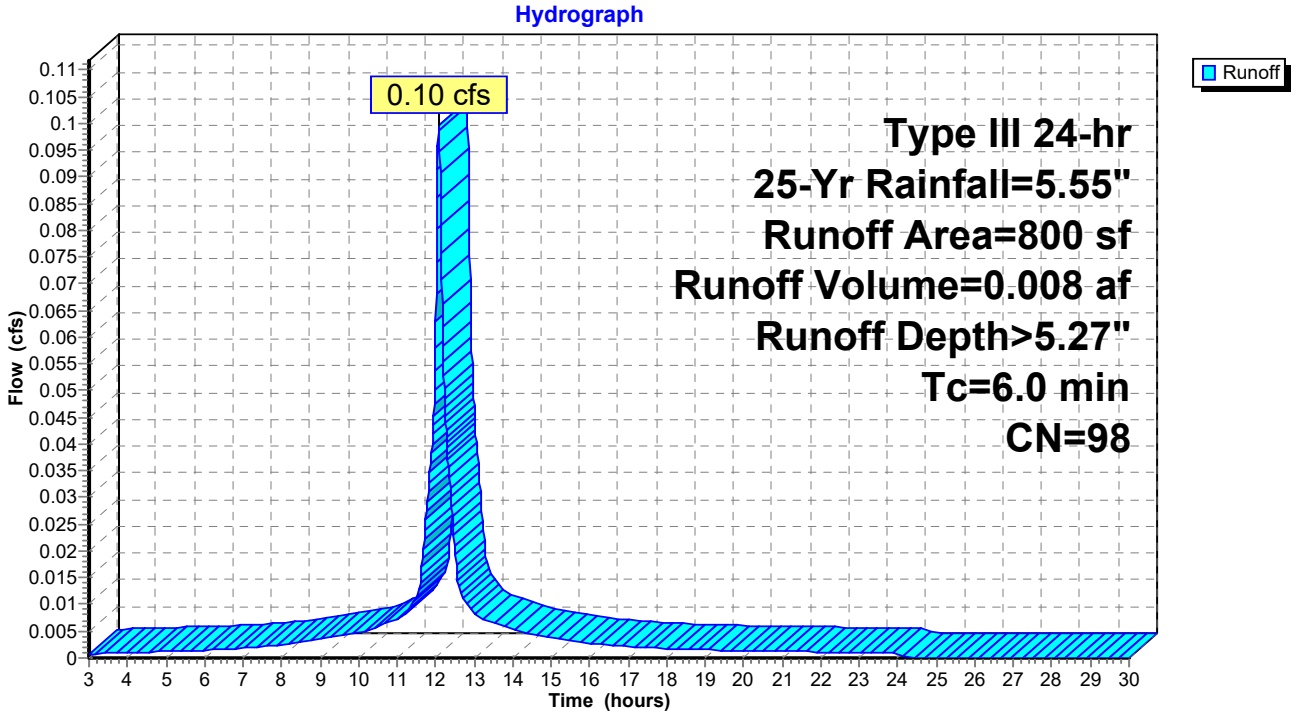
Runoff = 0.10 cfs @ 12.08 hrs, Volume= 0.008 af, Depth> 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Rainfall=5.55"

Area (sf)	CN	Description
800	98	Roofs, HSG D
800		100.00% Impervious Area

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

Subcatchment 4S: roof



Summary for Subcatchment 5S: uncontrolled

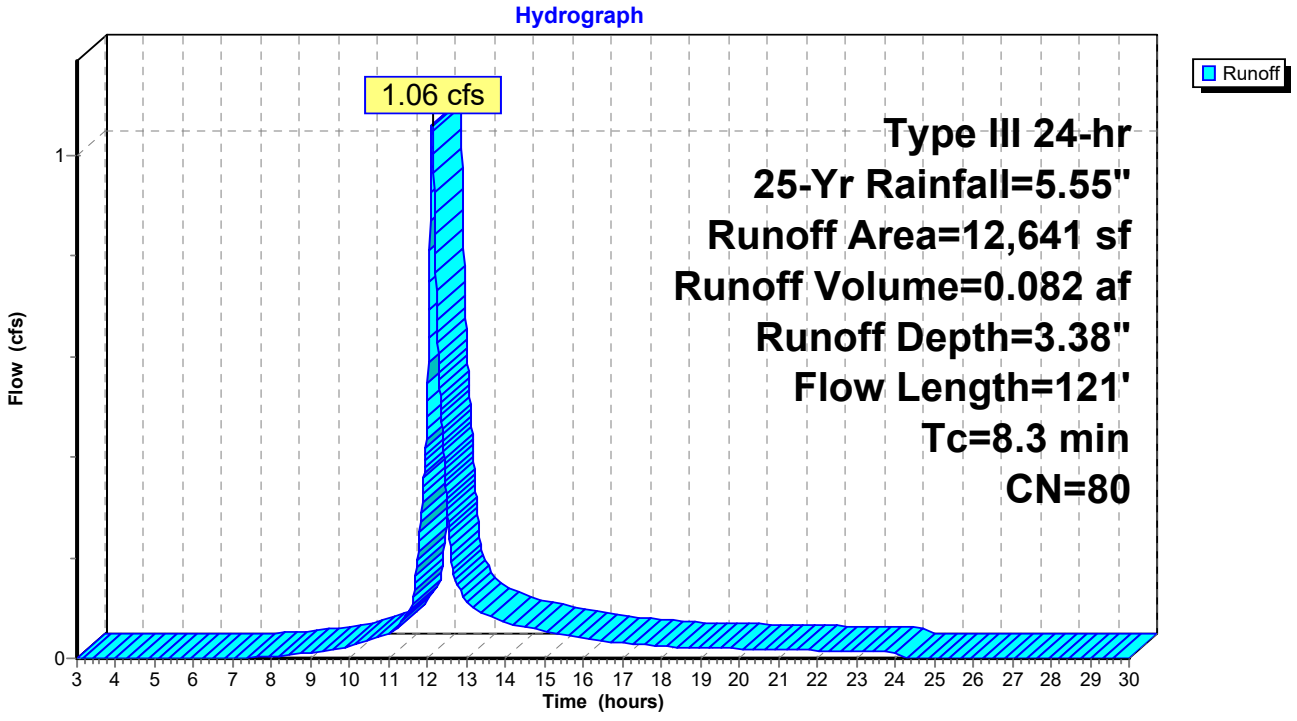
Runoff = 1.06 cfs @ 12.12 hrs, Volume= 0.082 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Rainfall=5.55"

Area (sf)	CN	Description
12,641	80	>75% Grass cover, Good, HSG D
12,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 5S: uncontrolled



Summary for Pond 1P: storm tech

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.063 ac,100.00% Impervious, Inflow Depth > 5.27" for 25-Yr event
Inflow = 0.34 cfs @ 12.08 hrs, Volume= 0.028 af
Outflow = 0.08 cfs @ 11.73 hrs, Volume= 0.028 af, Atten= 77%, Lag= 0.0 min
Primary = 0.00 cfs @ 3.00 hrs, Volume= 0.000 af
Secondary = 0.08 cfs @ 11.73 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 17.16' @ 12.47 hrs Surf.Area= 408 sf Storage= 242 cf

Plug-Flow detention time= 14.5 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 14.4 min (766.2 - 751.8)

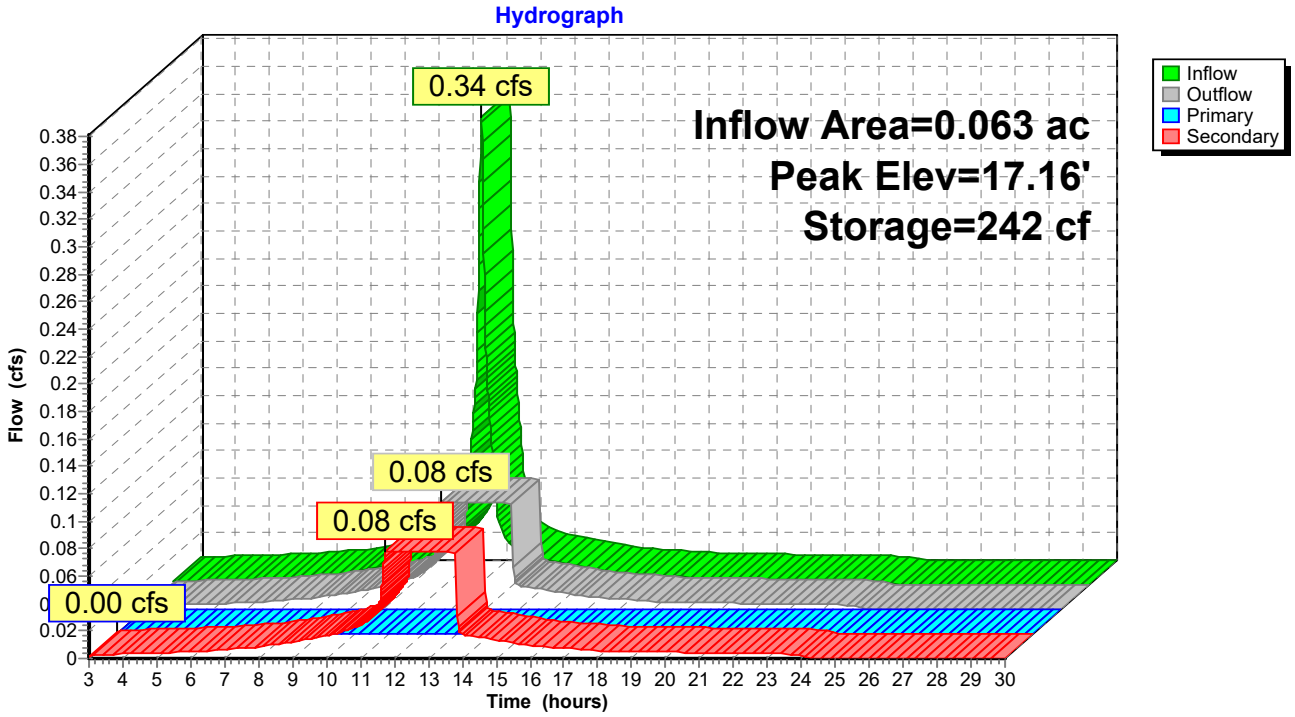
Volume	Invert	Avail.Storage	Storage Description
#1	16.00'	223 cf	**8.16'W x 50.00'L x 2.33'H Prismatoid** 951 cf Overall - 208 cf Embedded = 742 cf x 30.0% Voids
#2	16.50'	208 cf	**ADS_StormTech SC-310** x 14 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 2 rows
		431 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Secondary	16.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	17.50'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 3.00 hrs HW=16.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.08 cfs @ 11.73 hrs HW=16.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 1P: storm tech

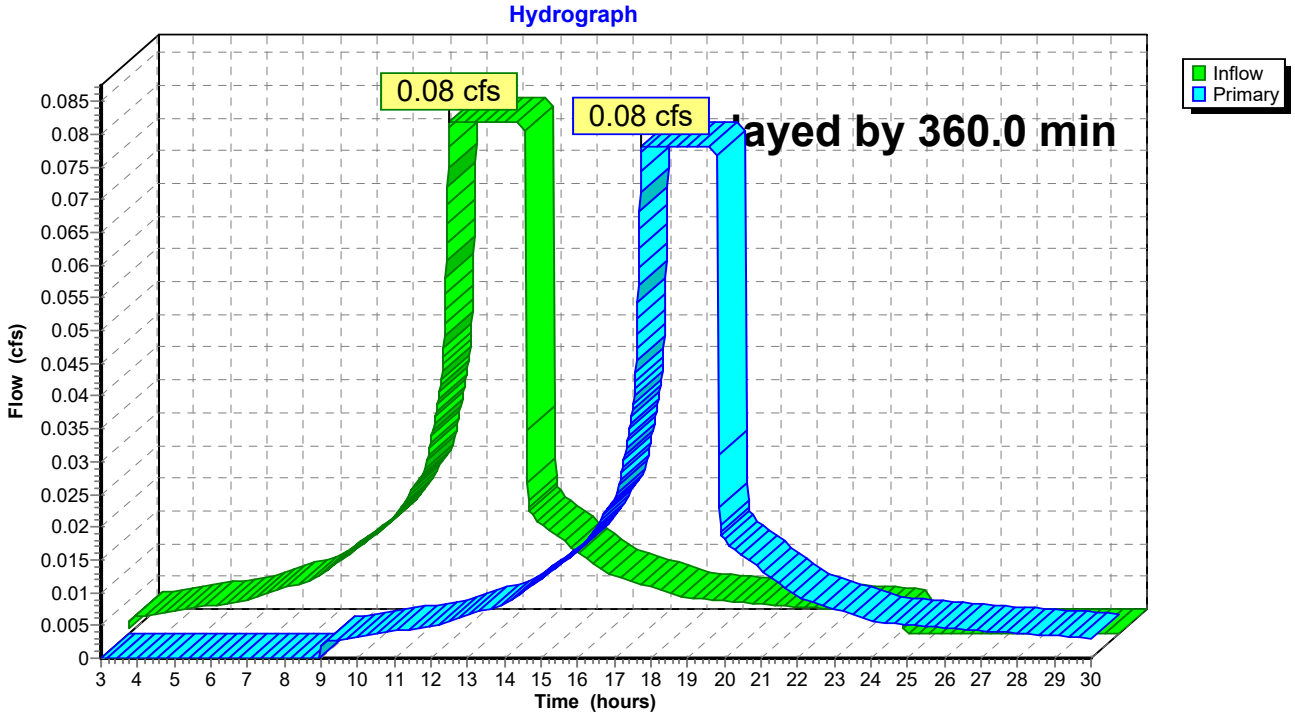


Summary for Link 5L: infiltration lag

Inflow = 0.08 cfs @ 11.73 hrs, Volume= 0.028 af
Primary = 0.08 cfs @ 17.73 hrs, Volume= 0.027 af, Atten= 0%, Lag= 360.0 min

Primary outflow = Inflow delayed by 360.0 min, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 5L: infiltration lag

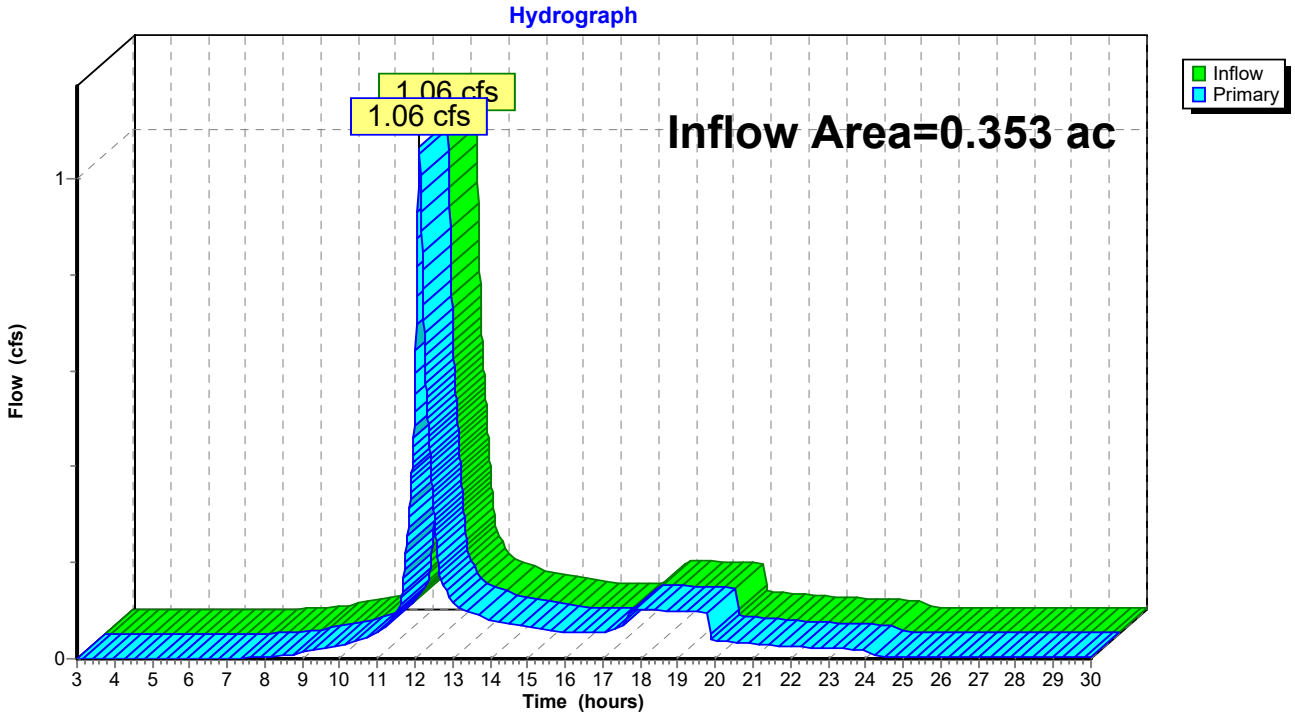


Summary for Link 7L: total proposed

Inflow Area = 0.353 ac, 17.76% Impervious, Inflow Depth > 3.71" for 25-Yr event
Inflow = 1.06 cfs @ 12.12 hrs, Volume= 0.109 af
Primary = 1.06 cfs @ 12.12 hrs, Volume= 0.109 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 7L: total proposed



Time span=3.00-30.00 hrs, dt=0.01 hrs, 2701 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: ex cond Runoff Area=15,571 sf 14.51% Impervious Runoff Depth=5.03"
Flow Length=121' Tc=8.3 min CN=83 Runoff=1.91 cfs 0.150 af

Subcatchment 3S: driveway Runoff Area=1,930 sf 100.00% Impervious Runoff Depth>6.69"
Tc=6.0 min CN=98 Runoff=0.30 cfs 0.025 af

Subcatchment 4S: roof Runoff Area=800 sf 100.00% Impervious Runoff Depth>6.69"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.010 af

Subcatchment 5S: uncontrolled Runoff Area=12,641 sf 0.00% Impervious Runoff Depth=4.69"
Flow Length=121' Tc=8.3 min CN=80 Runoff=1.46 cfs 0.114 af

Pond 1P: storm tech Peak Elev=17.64' Storage=344 cf Inflow=0.43 cfs 0.035 af
Primary=0.05 cfs 0.001 af Secondary=0.08 cfs 0.034 af Outflow=0.12 cfs 0.035 af

Link 5L: infiltration lag delayed by 360.0 min Inflow=0.08 cfs 0.034 af
Primary=0.08 cfs 0.034 af

Link 7L: total proposed Inflow=1.47 cfs 0.148 af
Primary=1.47 cfs 0.148 af

Total Runoff Area = 0.710 ac Runoff Volume = 0.298 af Average Runoff Depth = 5.04"
83.87% Pervious = 0.596 ac 16.13% Impervious = 0.115 ac

Summary for Subcatchment 1S: ex cond

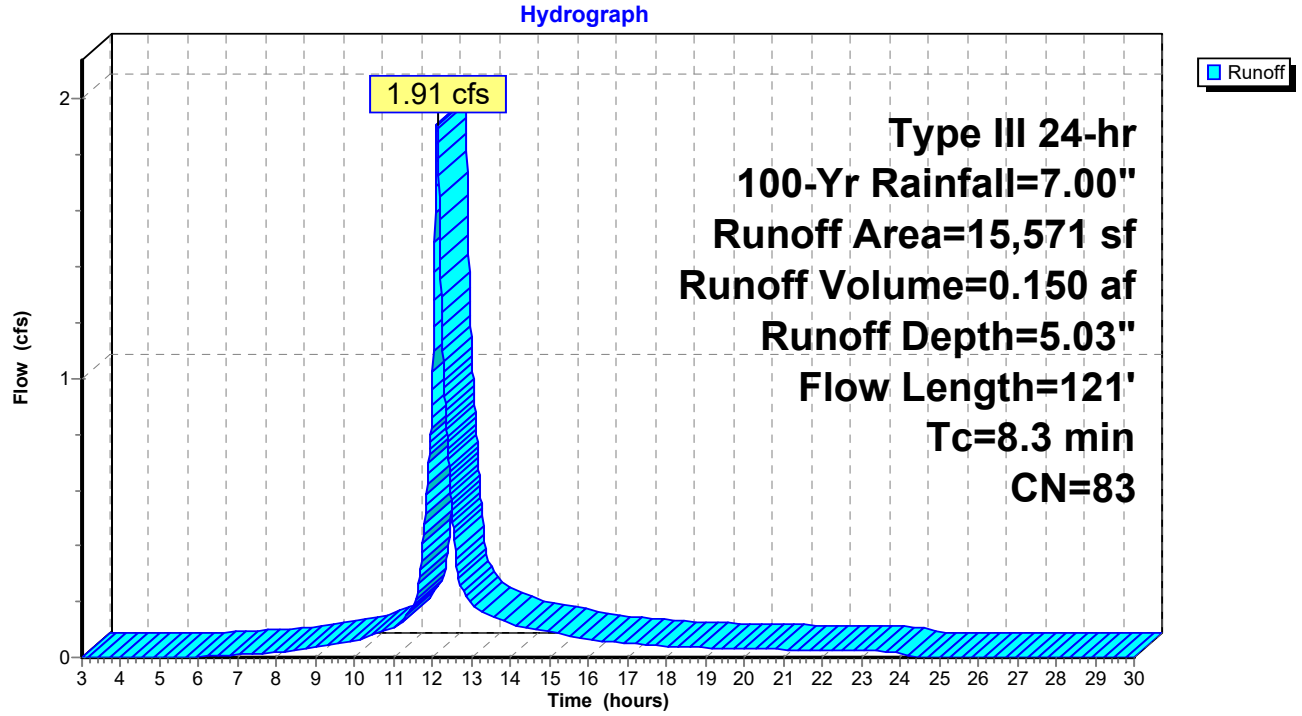
Runoff = 1.91 cfs @ 12.11 hrs, Volume= 0.150 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Rainfall=7.00"

Area (sf)	CN	Description
1,460	98	Paved parking, HSG D
800	98	Roofs, HSG D
13,311	80	>75% Grass cover, Good, HSG D
15,571	83	Weighted Average
13,311		85.49% Pervious Area
2,260		14.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 1S: ex cond



Summary for Subcatchment 3S: driveway

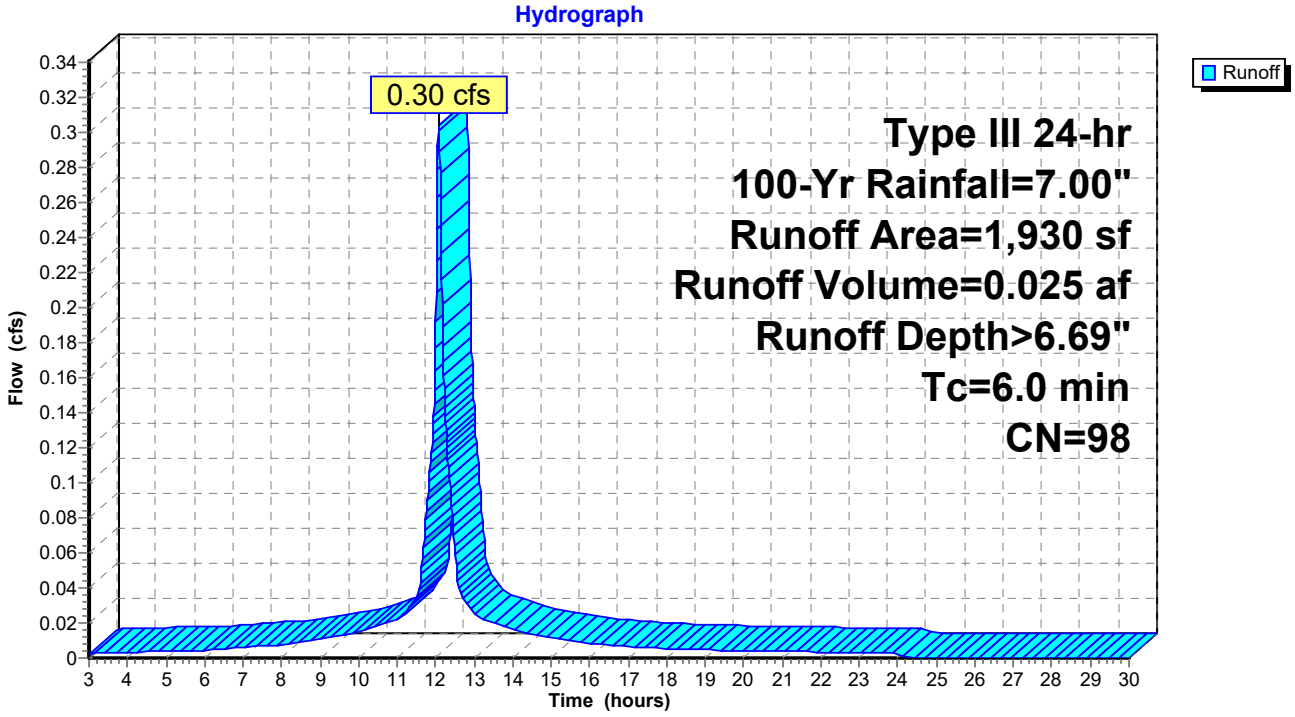
Runoff = 0.30 cfs @ 12.08 hrs, Volume= 0.025 af, Depth> 6.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Rainfall=7.00"

	Area (sf)	CN	Description
*	1,460	98	Ex Driveway
*	470	98	Pr driveway
	1,930	98	Weighted Average
	1,930		100.00% Impervious Area

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

Subcatchment 3S: driveway



Summary for Subcatchment 4S: roof

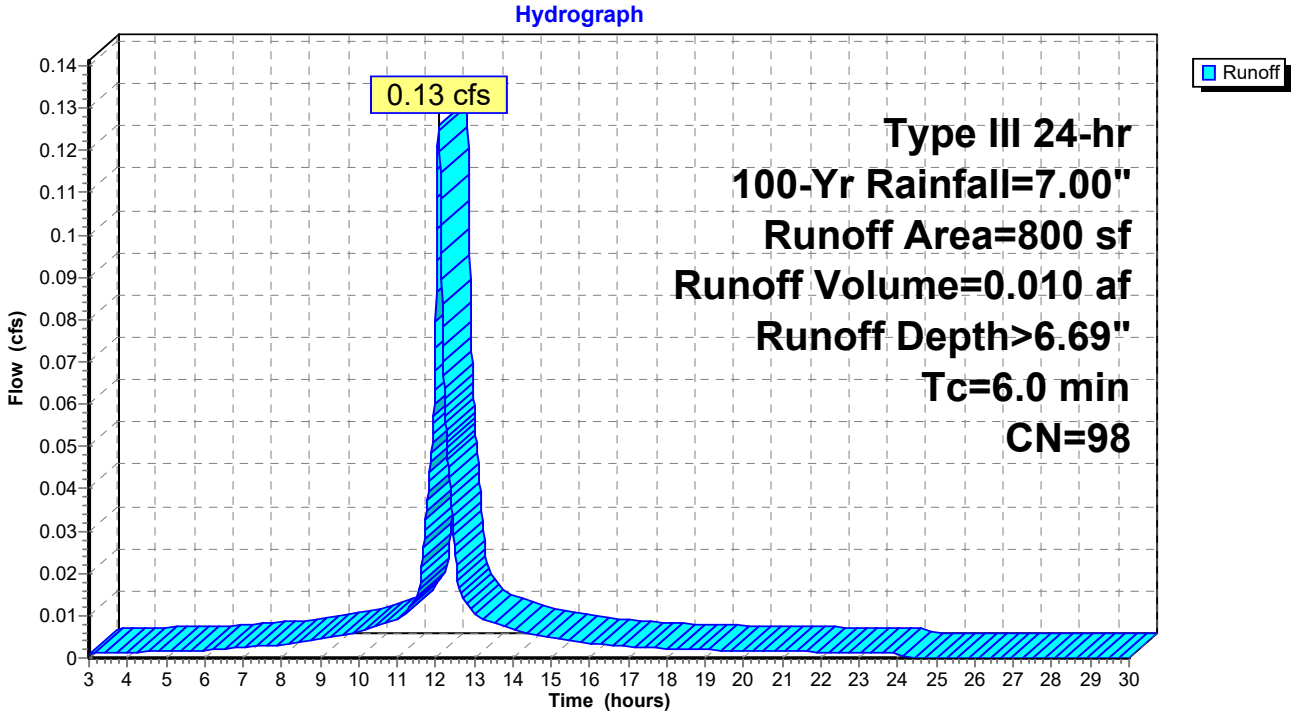
Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.010 af, Depth> 6.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Rainfall=7.00"

Area (sf)	CN	Description
800	98	Roofs, HSG D
800		100.00% Impervious Area

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

Subcatchment 4S: roof



Summary for Subcatchment 5S: uncontrolled

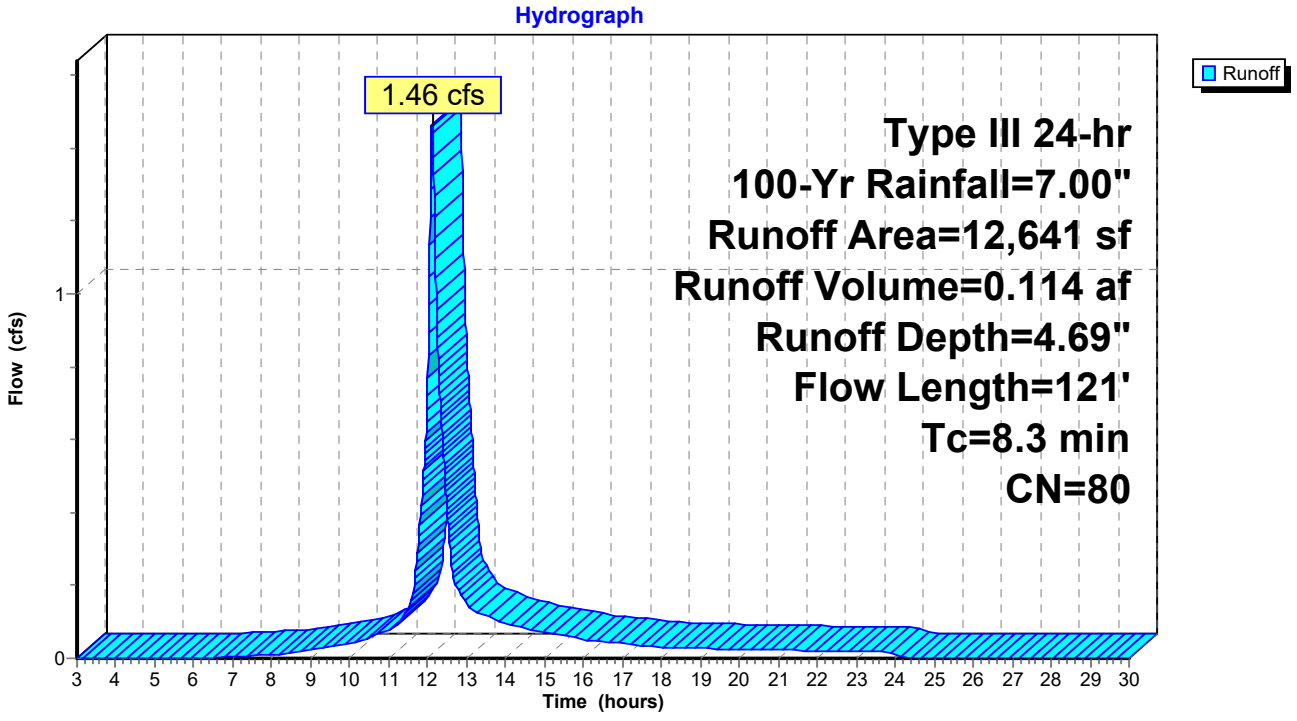
Runoff = 1.46 cfs @ 12.12 hrs, Volume= 0.114 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Rainfall=7.00"

Area (sf)	CN	Description
12,641	80	>75% Grass cover, Good, HSG D
12,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	45	0.0270	0.11		**Sheet Flow, lawn** Grass: Dense n= 0.240 P2= 3.20"
1.6	76	0.0125	0.78		**Shallow Concentrated Flow, below wall** Short Grass Pasture Kv= 7.0 fps
8.3	121	Total			

Subcatchment 5S: uncontrolled



Summary for Pond 1P: storm tech

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.063 ac,100.00% Impervious, Inflow Depth > 6.69" for 100-Yr event
Inflow = 0.43 cfs @ 12.08 hrs, Volume= 0.035 af
Outflow = 0.12 cfs @ 12.41 hrs, Volume= 0.035 af, Atten= 71%, Lag= 19.7 min
Primary = 0.05 cfs @ 12.41 hrs, Volume= 0.001 af
Secondary = 0.08 cfs @ 11.67 hrs, Volume= 0.034 af

Routing by Stor-Ind method, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 17.64' @ 12.41 hrs Surf.Area= 408 sf Storage= 344 cf

Plug-Flow detention time= 21.0 min calculated for 0.035 af (100% of inflow)
Center-of-Mass det. time= 20.9 min (770.8 - 749.8)

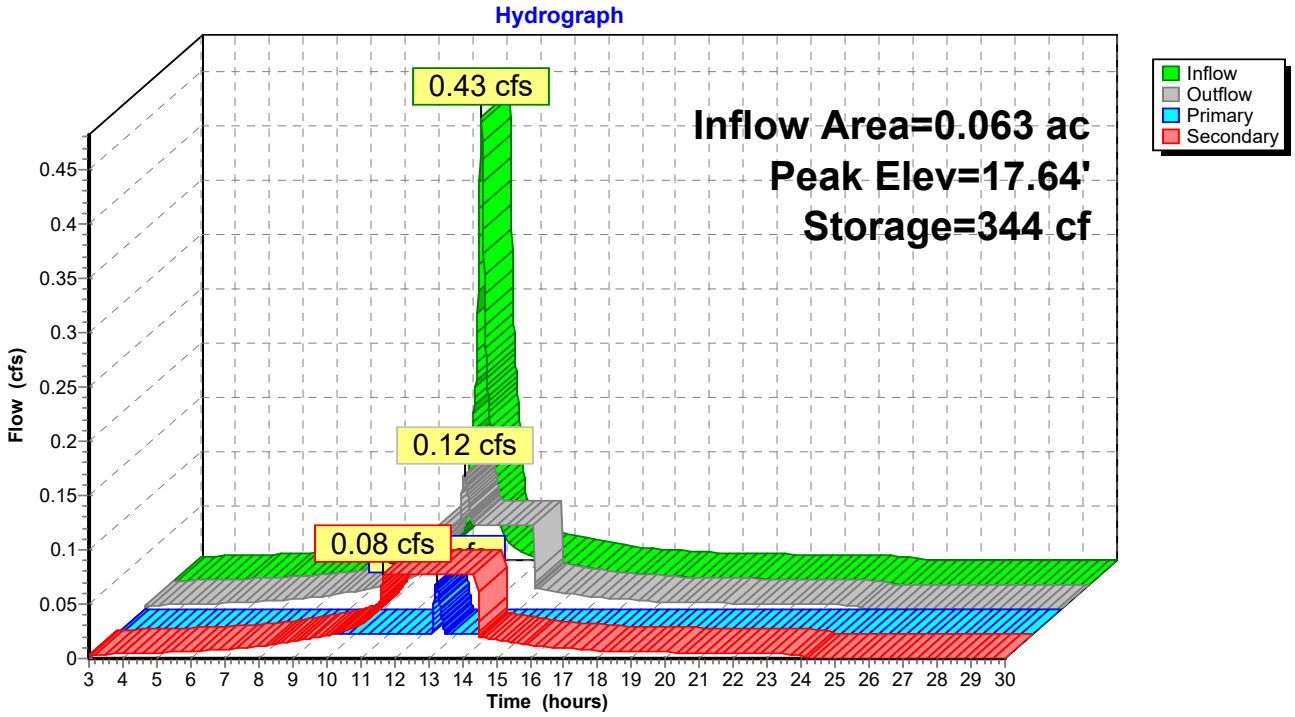
Volume	Invert	Avail.Storage	Storage Description
#1	16.00'	223 cf	**8.16'W x 50.00'L x 2.33'H Prismatoid** 951 cf Overall - 208 cf Embedded = 742 cf x 30.0% Voids
#2	16.50'	208 cf	**ADS_StormTech SC-310** x 14 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 2 rows
		431 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Secondary	16.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	17.50'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.04 cfs @ 12.41 hrs HW=17.64' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.04 cfs @ 1.28 fps)

Secondary OutFlow Max=0.08 cfs @ 11.67 hrs HW=16.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 1P: storm tech

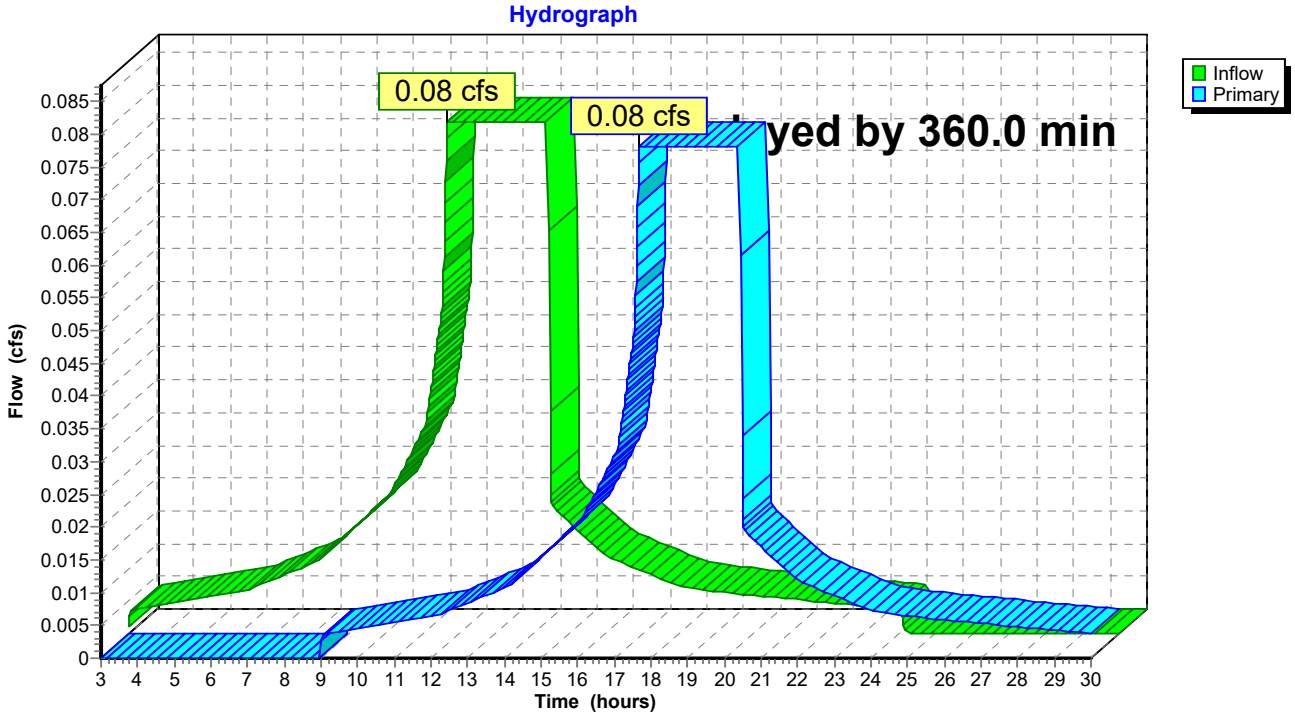


Summary for Link 5L: infiltration lag

Inflow = 0.08 cfs @ 11.67 hrs, Volume= 0.034 af
Primary = 0.08 cfs @ 17.67 hrs, Volume= 0.034 af, Atten= 0%, Lag= 360.0 min

Primary outflow = Inflow delayed by 360.0 min, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 5L: infiltration lag



Summary for Link 7L: total proposed

Inflow Area = 0.353 ac, 17.76% Impervious, Inflow Depth > 5.05" for 100-Yr event
Inflow = 1.47 cfs @ 12.12 hrs, Volume= 0.148 af
Primary = 1.47 cfs @ 12.12 hrs, Volume= 0.148 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.01 hrs

Link 7L: total proposed