



ENGINEERING A BETTER TOMORROW

ENGINEERING | SITE WORK | LAND SURVEYING

# STORMWATER REPORT

June 5, 2019

WS Orchard Street  
New Bedford, MA 02744

ASSESSORS MAP 78 LOTS  
NORTON, MASSACHUSETTS



PREPARED FOR:

Lisciotti Development Co.  
83 Orchard Hill Park Drive  
Leominster, MA 01453

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# STORMWATER MANAGEMENT REPORT AND HYDROLOGIC ANALYSIS

## SECTION 1: Project Summary

The project area associated with the proposed development is located on the west side of Orchard Street, between the cross streets of Swift to the north and Cove Road to the south. The site is comprised of one proposed parcel, identified as a portion of Assessors Map 23, Lots 158 & 294. The parcel contains approximately 1.06 acres and is located entirely within the Mixed-Use Business District.

The site is a portion of a large undeveloped piece of land that has been left vacant for many years prior to this project and has been predominantly used as a stockpile area for abutting projects. Going back several decades, this property was used for a large-scale industrial company, and upon the departure of said company, the existing features were all demolished and the grounds were cleared and left roughly graded. Since then, previous owners have prepped the site for possible future development, and now there are several existing utility stubs, an existing drainage system that services nearby properties that lies within a utility easement and access to the site via an existing curb cut along its frontage. The site's frontage lies along the right-of-way known as Orchard Street, and the site is bounded on the south and west by other vacant property left undeveloped. To the north is a recently developed piece of land that now contains the commercial business known as Family Dollar. The surrounding neighborhood includes businesses as well as residential living and can be classified as largely developed urban areas. All the proposed falls outside of any wetland areas or areas subject to flooding, and no protected wildlife habitats or species are known to exist in this area either.

The applicant is seeking permission to construct a 10,000 S.F. commercial building that will house a retail business, as well as site improvements such as parking areas, ingress/egress driveways, and typical utility services and installations. Specifically, the proposed work will close out the existing curb cut on Orchard Street while installing two new ones, the parking areas will contain a total of 50 individual parking spaces and the site will be serviced by new water, sewer and electrical services to be tied into the existing services within Orchard Street. By utilizing the existing stormwater drainage system on site, the underground recharge area can be reduced, and total site runoff has been nearly eliminated.

Finally, all zoning bylaws have been taken into consideration in terms of dimensional regulations and the site is within full compliance of those. Specifically, setbacks to all property lines and lot coverage percentages have been kept under the maximum allowed.

## SECTION 2: Methodology

Drainage computations were performed using the Natural Resources Conservation Services (NRCS) TR-20 method and HydroCAD<sup>®</sup> Drainage Calculation Software to determine the change in the existing and post-development runoff rates from each drainage area for the 2-, 10-, and 100-year 24-hour storm events. Sketches of the existing and proposed watershed

areas, HydroCAD® Report, and copies of the calculation sheets are included as appendices to this report.

### **SECTION 3: Soil Conditions**

The soils underlying the proposed development site are identified in the Natural Resources Conservation Service (NRCS) Soil Survey of Bristol County, Northern Part, and are solely classified as Urban Fill. This site having been used for industrial means in the past, and then demolished, have left the underlying soils in poor condition and not ranked for hydrologic purposes.

Soil testing was performed by a third-party Geotechnical firm to confirm the soil survey and to determine soil suitability for on-site stormwater management purposes. The locations of these test holes are shown on the Site Plans. Seven deep test-holes were performed to depths varying from approximately four to fifteen feet. Groundwater was observed in the deep holes at depths of approximately 9-12 feet. Native coarse sand soils were encountered in a few of the holes, but all test holes were overlain by deep layers of gravelly fill materials. Several of the test holes were refused at varying depths due to ledge and/or bedrock.

### **SECTION 4: Stormwater Management Overview**

#### Existing Conditions:

One design point was analyzed for this project: Total Off-Site runoff to the surrounding areas mainly to Orchard Street. The subcatchment area that provides the runoff for this design point encompasses the entire property, and is made up of rough graded soils, partial grass cover and large areas of stockpile material from abutting developments.

#### Proposed Conditions:

Under proposed conditions, two design points were utilized: Off-site Runoff as well as the existing stormwater drainage manhole that discharges to the City drainage system. Four sub-catchment areas contribute runoff to the design points in proposed conditions. Runoff toward Orchard Street is described in one sub-catchment area (S-4) and is comprised of grassed/landscape area which sheds untreated runoff toward Orchard Street.

The remaining sub-catchment areas comprise the rest of the site, where runoff is eventually shed toward the southeast corner of the site where the existing drain manhole is located. One sub-catchment area includes the roof runoff which discharge runoff directly to proposed subsurface infiltration chambers. Two sub-catchment areas contribute runoff to two proposed water quality catch basins at either end of the site, and then eventually to the existing drain manhole. The final sub-catchment area, comprised of grassed and landscaped areas, sheds untreated runoff toward the southeast.

The proposed stormwater management practices have been designed in accordance with the DEP Stormwater Handbook to provide appropriate water quality treatment, groundwater recharge, and peak rate attenuation for all storms, including the 100-year storm event.

## SECTION 5: Stormwater Management Standards

### Standard 1:

- There are no new untreated discharges to any design point from on site to water of the Commonwealth, nor are there any bordering vegetated wetlands that may experience untreated runoff or erosion to the soils. This standard has been met.

### Standard 2:

- The stormwater system was designed for the post-development conditions to handle all storms' peak discharges and runoff volume to include the 2, 10, and 100-year storm events.

The results of site drainage calculations are presented in the following Table. The results are based upon evaluation of Pre-development conditions and the design of proposed surface drainage systems for the Post-development condition. These results show the Post-Development offsite runoff rates are reduced to less than the Pre-development conditions, thus meeting the BMP guidelines for this site development. This standard has been met.

Storm Frequency	Pre-Development		Post-Development	
	Rate (cfs)	Volume (af)	Rate (cfs)	Volume (af)
2-Year Storm	1.99	0.143	0.07	0.006
10-Year Storm	3.45	0.247	0.13	0.012
100-Year Storm	5.84	0.423	0.25	0.021

### Standard 3:

- The site is comprised entirely of soils that are "Unclassified" due to the existence of urban fill throughout the whole site. Soil borings were conducted to reveal a mixture of sand w/ gravel, silty sand w/ gravel and sandy silt w/ gravel below the layers of fill which lead to a determination of mostly C-class soils and is therefore required to meet the recharge requirements of Standard 3 to the maximum extent practicable. The required Recharge Volume has been calculated using the Static Method and calculations are provided in **Exhibit C**. Soil test pit data indicates that the vertical separation from the bottom of the infiltration basins is greater than 2 feet to any indications of seasonal high groundwater. This standard has been met to the maximum extent practical.

### Standard 4:

- The proposed stormwater management systems for this project have been designed to remove 80% of the average annual post construction load of Total Suspended Solids in accordance with this standard, as shown in calculations provided in **Exhibit D**. Suitable practices for source control and pollution prevention have been identified in a long-term pollution prevention plan in **Exhibit E**. This standard has been met.

**Standard 5:**

- The use associated with this project is not classified as a Land Use with Higher Potential Pollutant Load (LUHPPL); therefore, Standard 5 is not applicable to this project. This standard does not apply.

**Standard 6:**

- The site does not discharge within the Zone II or IWPA of a public water supply, nor does it discharge near or to any critical areas. This standard does not apply.

**Standard 7:**

- Although a portion of the site may qualify as redevelopment, the project has not been designed as a redevelopment project. This standard does not apply.

**Standard 8:**

- Where there will be less than one acre of disturbance, an EPA Construction General Permit is not required. However, as a form of better management practices, construction period sedimentation and erosion control plans have been incorporated in the Site Plans. Also, safeguards have been incorporated into the construction period sedimentation and erosion control plans to ensure proper operation and maintenance and to prevent negative impacts to the surrounding sites.

**Standard 9:**

- A long-term operation and maintenance plan has been prepared to ensure that stormwater management systems function as designed. (**Exhibit F**)

**Standard 10:**

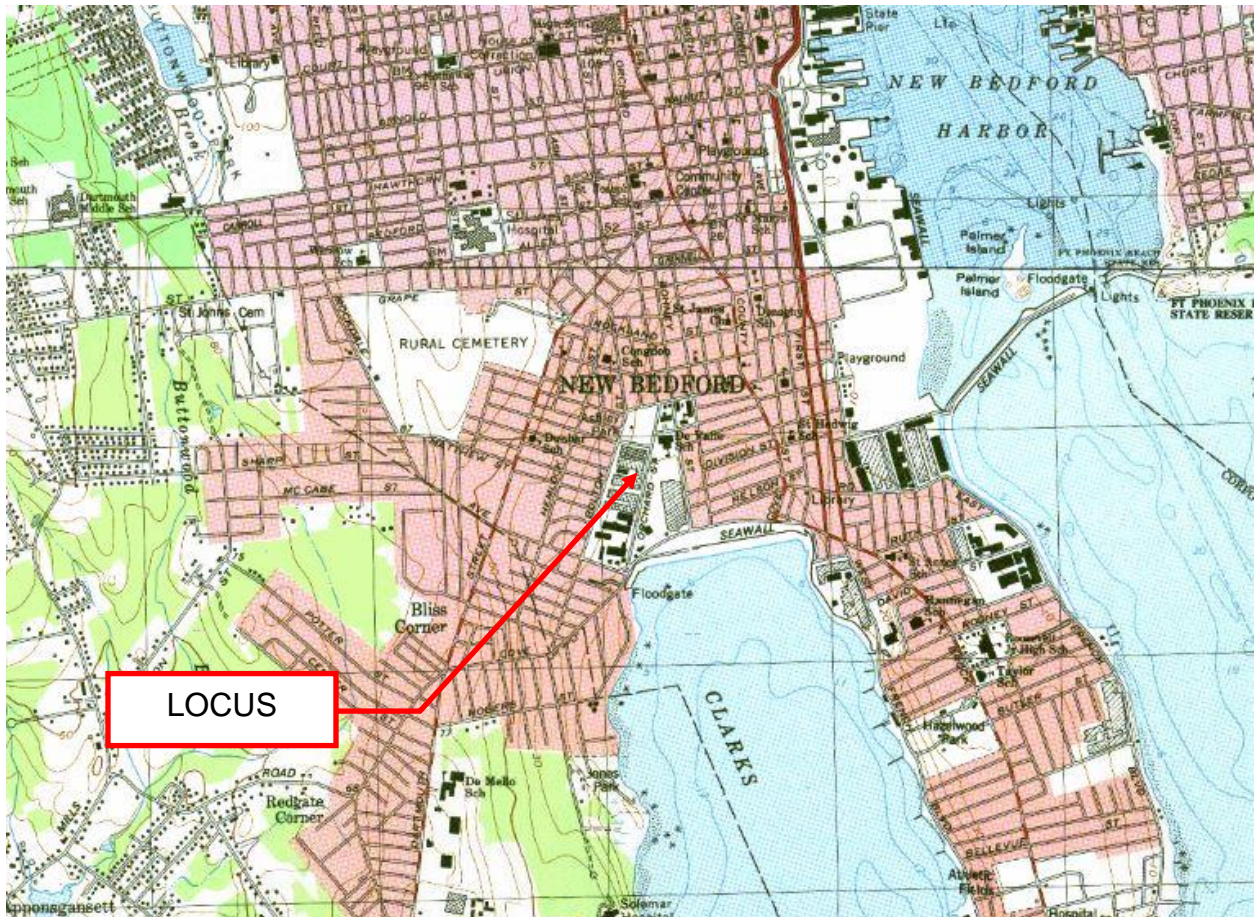
- We are not proposing any illicit discharges as defined in the Stormwater Management Regulations. See attached letter in **Exhibit G**



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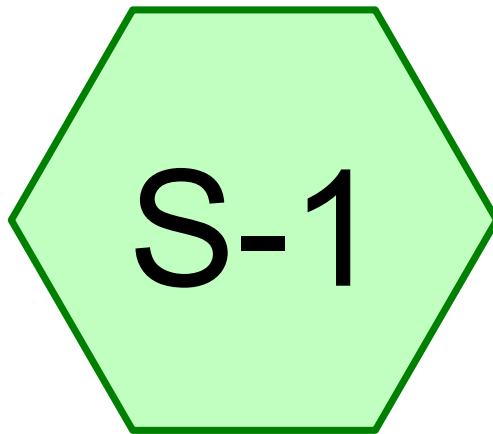
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# USGS MAP TOPO! VERSION 2.1.0

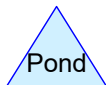
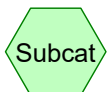


# HYDROLOGIC CALCULATIONS





# Offsite Runoff



# 19210PRE

Prepared by Farland Corp.

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## Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.748	79	50-75% Grass cover, Fair, HSG C (S-1)
0.308	86	<50% Grass cover, Poor, HSG C (S-1)
<b>1.056</b>	<b>81</b>	<b>TOTAL AREA</b>

**Summary for Subcatchment S-1: Offsite Runoff**

Runoff = 1.99 cfs @ 12.09 hrs, Volume= 0.143 af, Depth= 1.63"

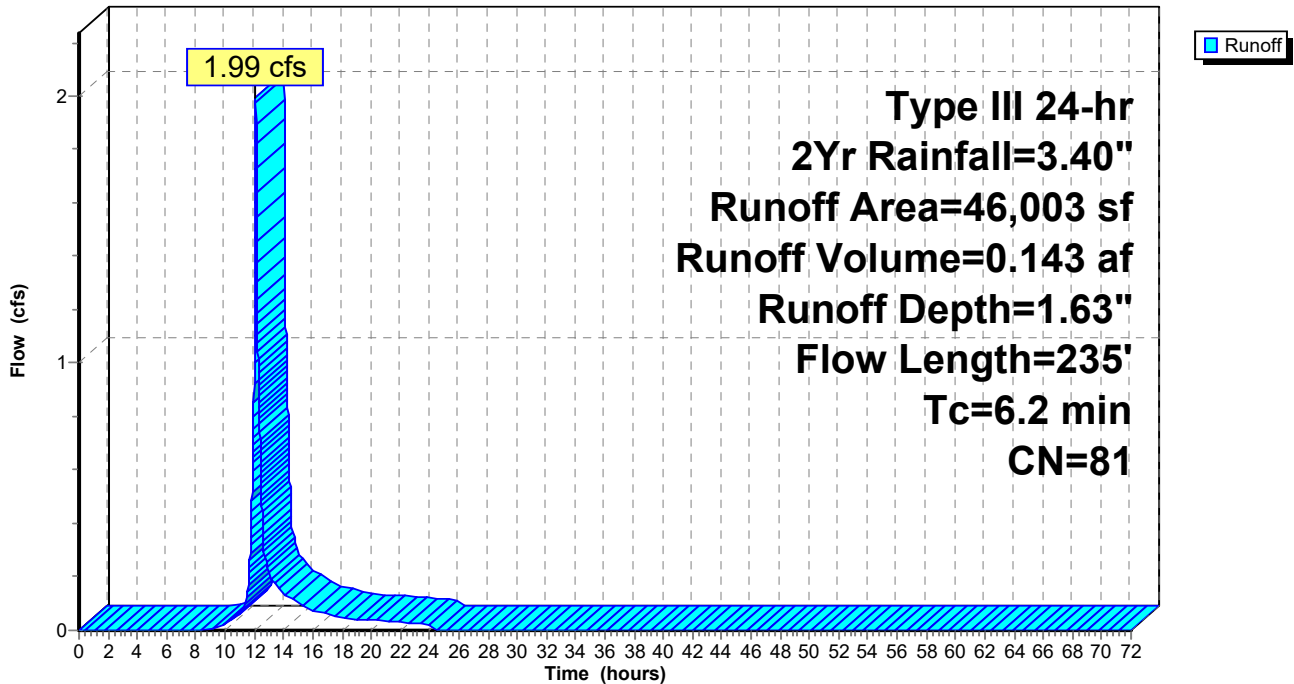
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2Yr Rainfall=3.40"

Area (sf)	CN	Description
32,593	79	50-75% Grass cover, Fair, HSG C
13,410	86	<50% Grass cover, Poor, HSG C
46,003	81	Weighted Average
46,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.1600	0.24		<b>Sheet Flow, First 50'</b> Grass: Dense n= 0.240 P2= 3.40"
2.7	185	0.0127	1.13		<b>Shallow Concentrated Flow, Final Run</b> Nearly Bare & Untilled Kv= 10.0 fps
6.2	235	Total			

**Subcatchment S-1: Offsite Runoff**

Hydrograph



**Summary for Subcatchment S-1: Offsite Runoff**

Runoff = 3.45 cfs @ 12.09 hrs, Volume= 0.247 af, Depth= 2.81"

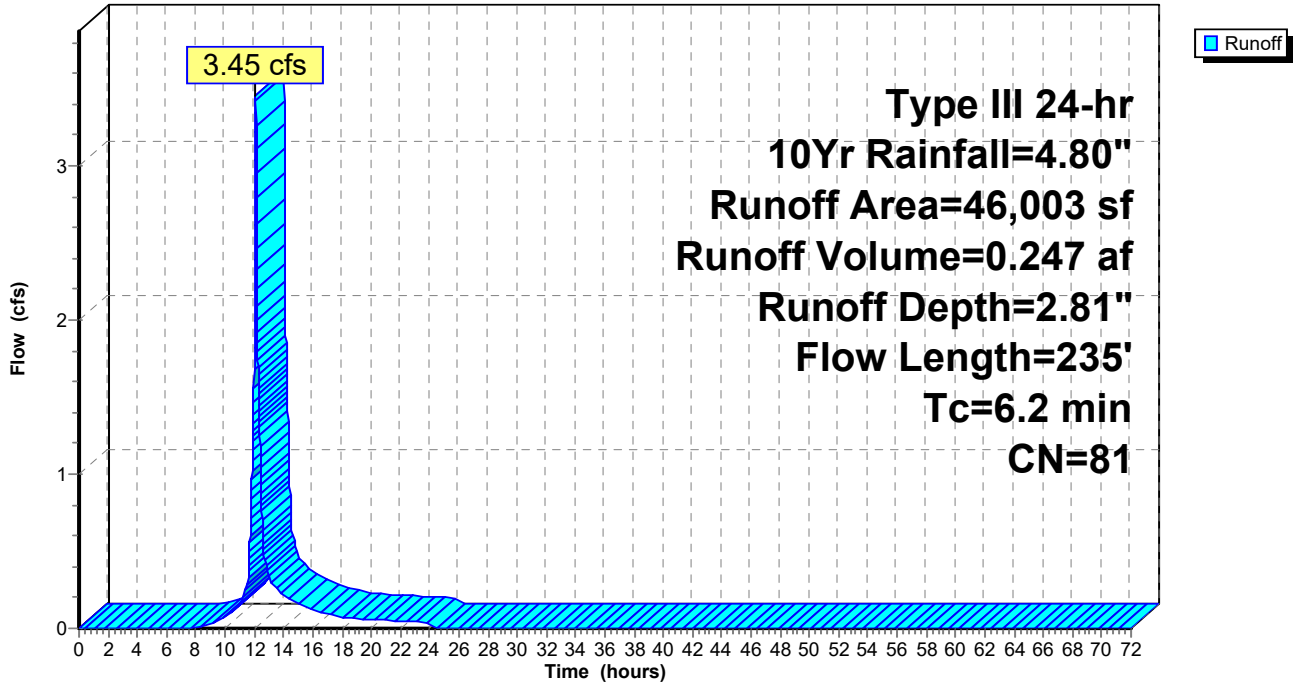
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10Yr Rainfall=4.80"

Area (sf)	CN	Description
32,593	79	50-75% Grass cover, Fair, HSG C
13,410	86	<50% Grass cover, Poor, HSG C
46,003	81	Weighted Average
46,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.1600	0.24		<b>Sheet Flow, First 50'</b> Grass: Dense n= 0.240 P2= 3.40"
2.7	185	0.0127	1.13		<b>Shallow Concentrated Flow, Final Run</b> Nearly Bare & Untilled Kv= 10.0 fps
6.2	235	Total			

**Subcatchment S-1: Offsite Runoff**

Hydrograph



**Summary for Subcatchment S-1: Offsite Runoff**

Runoff = 5.84 cfs @ 12.09 hrs, Volume= 0.423 af, Depth= 4.81"

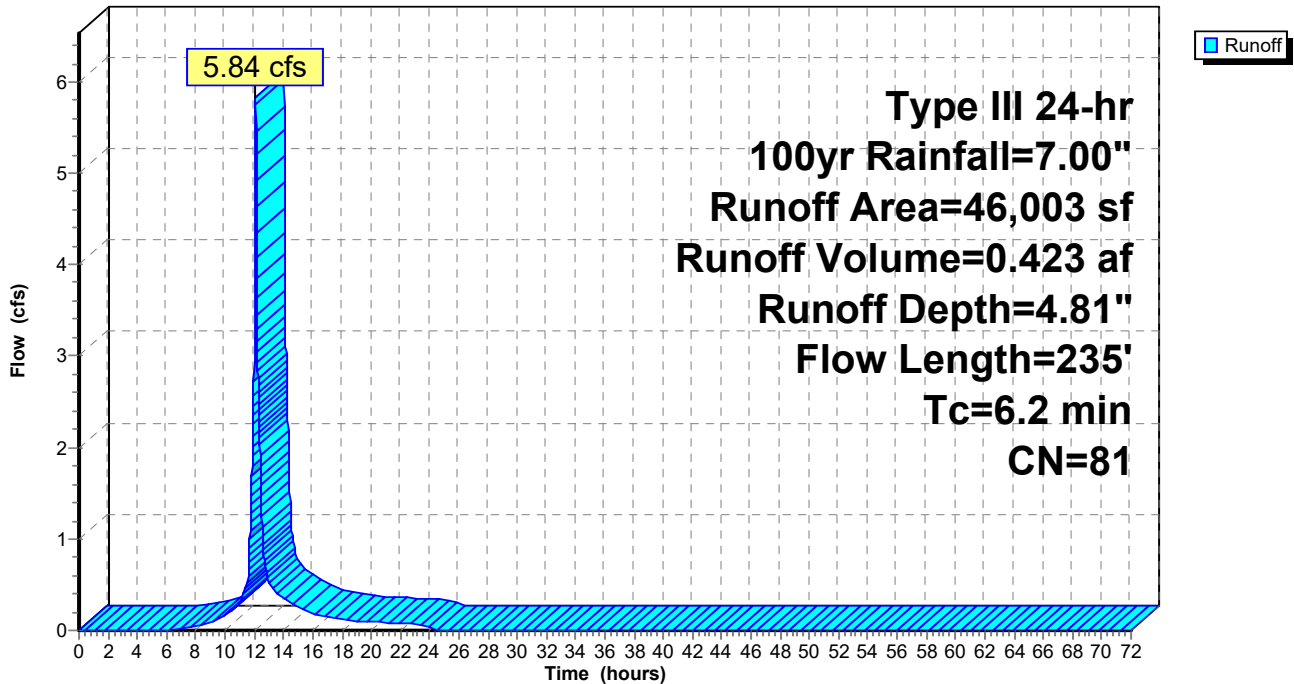
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100yr Rainfall=7.00"

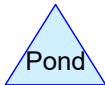
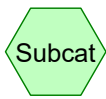
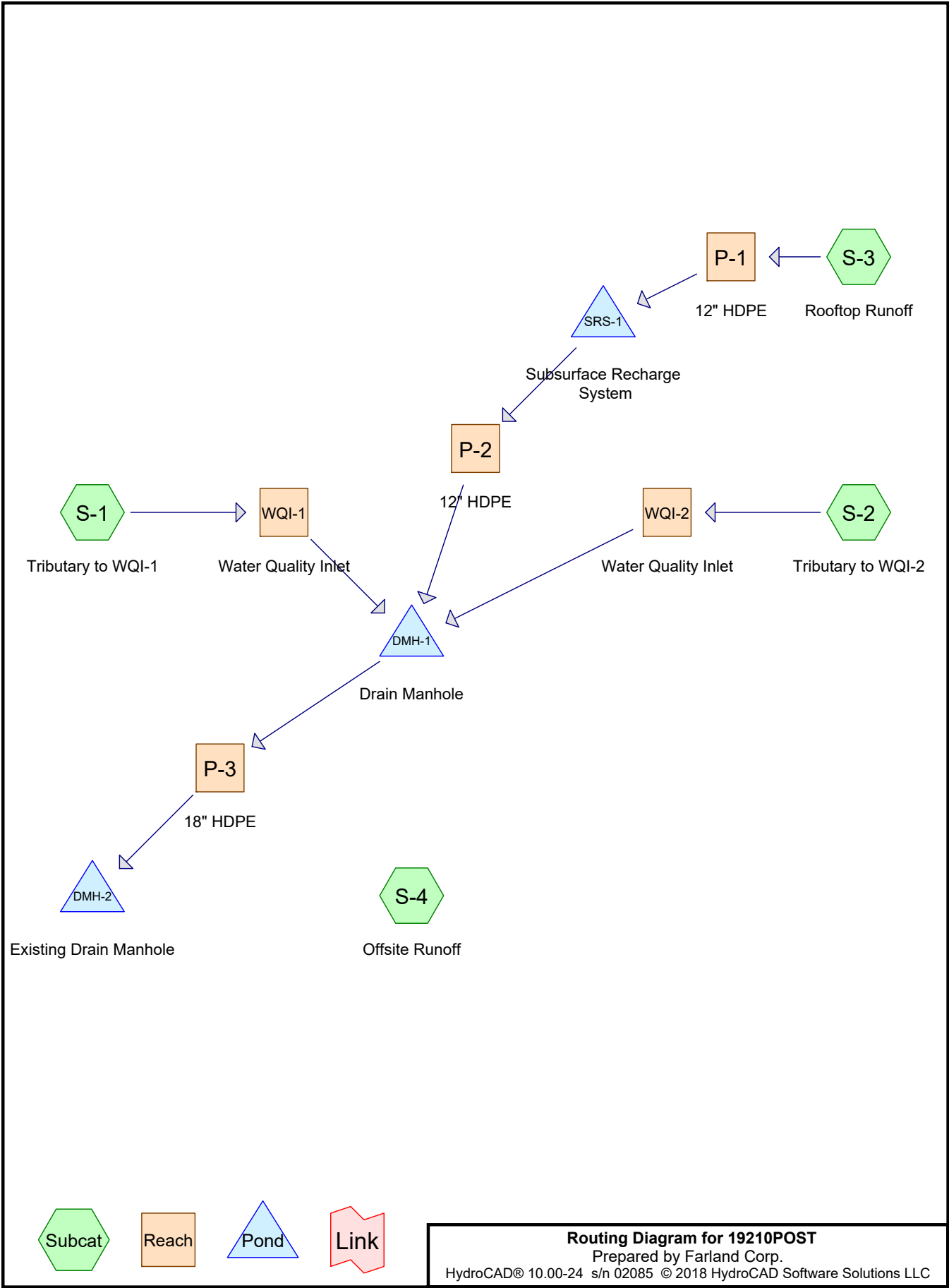
Area (sf)	CN	Description
32,593	79	50-75% Grass cover, Fair, HSG C
13,410	86	<50% Grass cover, Poor, HSG C
46,003	81	Weighted Average
46,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.1600	0.24		<b>Sheet Flow, First 50'</b> Grass: Dense n= 0.240 P2= 3.40"
2.7	185	0.0127	1.13		<b>Shallow Concentrated Flow, Final Run</b> Nearly Bare & Untilled Kv= 10.0 fps
6.2	235	Total			

**Subcatchment S-1: Offsite Runoff**

Hydrograph





**Routing Diagram for 19210POST**  
 Prepared by Farland Corp.  
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# 19210POST

Prepared by Farland Corp.

HydroCAD® 10.00-24 s/n 02085 © 2018 HydroCAD Software Solutions LLC

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## Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.121	74	>75% Grass cover, Good, HSG C (S-1, S-2, S-4)
0.704	98	Paved parking, HSG C (S-1, S-2)
0.230	98	Rooftop (S-3)
<b>1.054</b>	<b>95</b>	<b>TOTAL AREA</b>

**Summary for Subcatchment S-1: Tributary to WQI-1**

Runoff = 1.20 cfs @ 12.08 hrs, Volume= 0.093 af, Depth= 3.06"

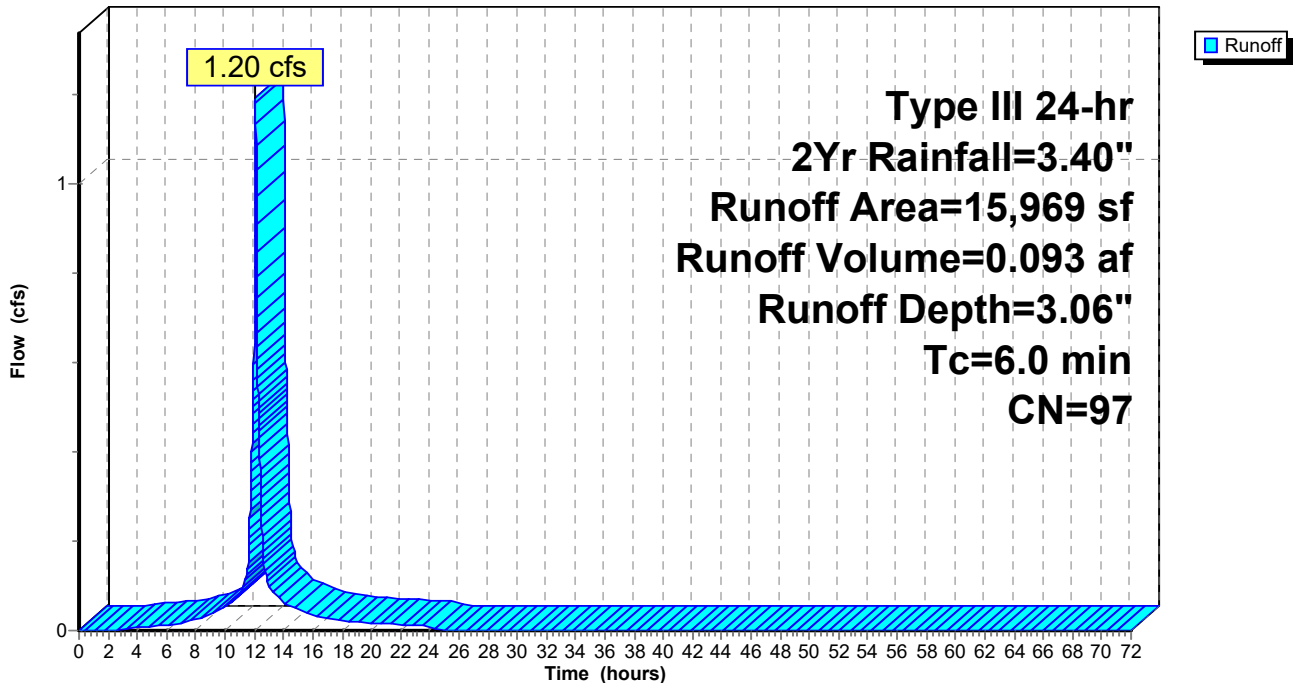
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2Yr Rainfall=3.40"

Area (sf)	CN	Description
15,329	98	Paved parking, HSG C
640	74	>75% Grass cover, Good, HSG C
15,969	97	Weighted Average
640		4.01% Pervious Area
15,329		95.99% Impervious Area

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

**Subcatchment S-1: Tributary to WQI-1**

Hydrograph





**Summary for Subcatchment S-2: Tributary to WQI-2**

Runoff = 1.24 cfs @ 12.08 hrs, Volume= 0.094 af, Depth= 2.84"

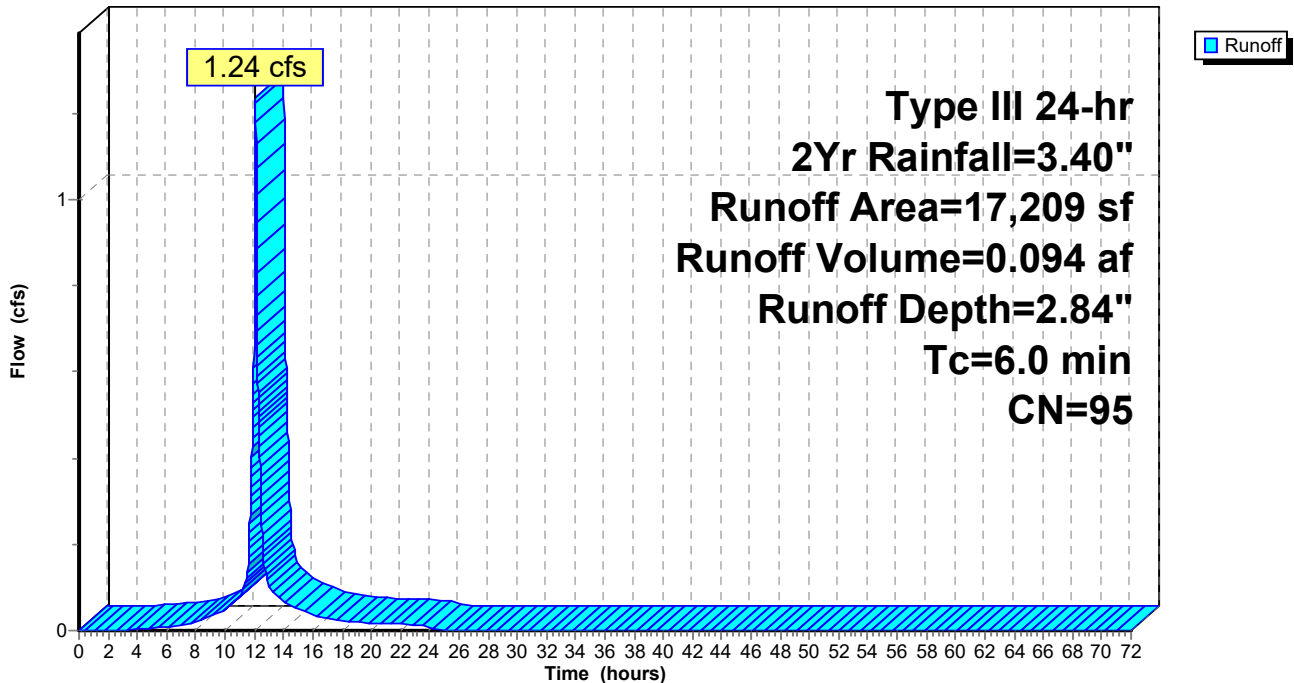
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2Yr Rainfall=3.40"

Area (sf)	CN	Description
1,892	74	>75% Grass cover, Good, HSG C
15,317	98	Paved parking, HSG C
17,209	95	Weighted Average
1,892		10.99% Pervious Area
15,317		89.01% Impervious Area

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

**Subcatchment S-2: Tributary to WQI-2**

Hydrograph



**Summary for Subcatchment S-3: Rooftop Runoff**

Runoff = 0.76 cfs @ 12.08 hrs, Volume= 0.061 af, Depth= 3.17"

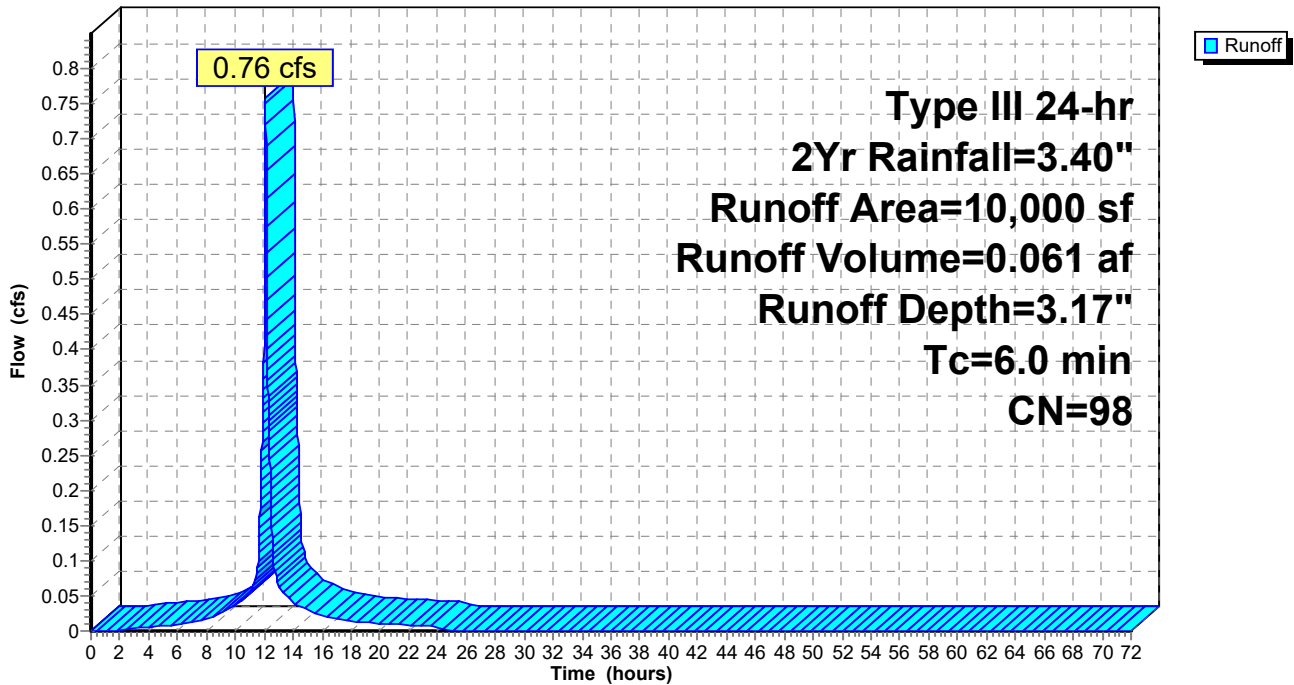
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2Yr Rainfall=3.40"

Area (sf)	CN	Description
* 10,000	98	Rooftop
10,000		100.00% Impervious Area

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

**Subcatchment S-3: Rooftop Runoff**

Hydrograph



**Summary for Subcatchment S-4: Offsite Runoff**

Runoff = 0.07 cfs @ 12.17 hrs, Volume= 0.006 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2Yr Rainfall=3.40"

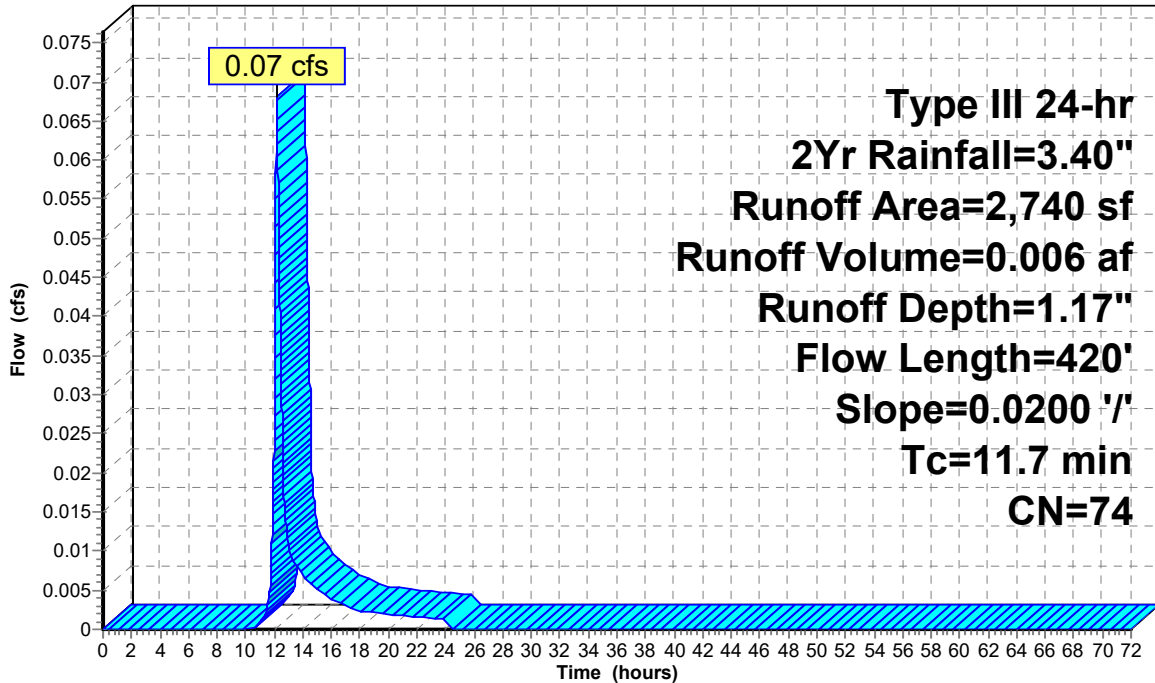
Area (sf)	CN	Description
2,740	74	>75% Grass cover, Good, HSG C
2,740		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0200	0.15		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
6.2	370	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.7	420	Total			

**Subcatchment S-4: Offsite Runoff**

Hydrograph



### Summary for Reach P-1: 12" HDPE

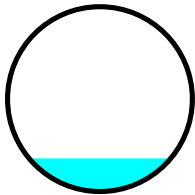
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 3.17" for 2Yr event  
 Inflow = 0.76 cfs @ 12.08 hrs, Volume= 0.061 af  
 Outflow = 0.76 cfs @ 12.08 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 8.03 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity = 2.62 fps, Avg. Travel Time= 0.1 min

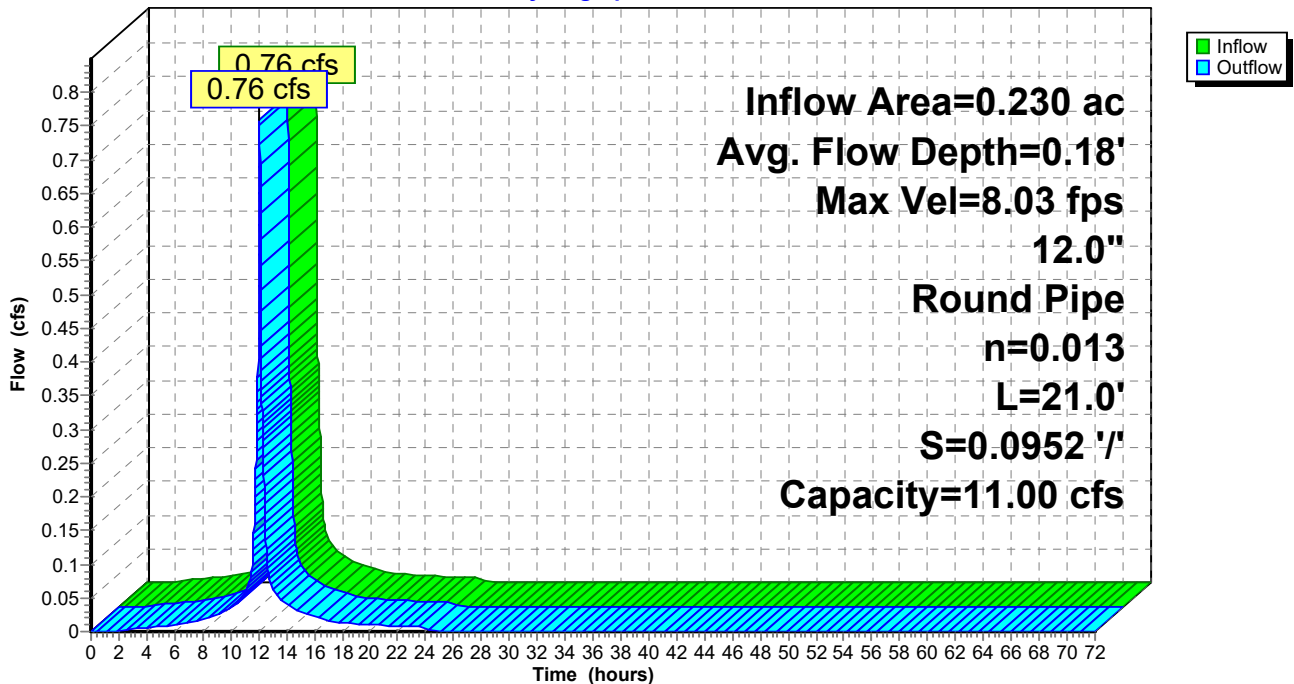
Peak Storage= 2 cf @ 12.08 hrs  
 Average Depth at Peak Storage= 0.18'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 11.00 cfs

12.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 21.0' Slope= 0.0952 '/'  
 Inlet Invert= 7.00', Outlet Invert= 5.00'



### Reach P-1: 12" HDPE

Hydrograph



**Summary for Reach P-2: 12" HDPE**

[52] Hint: Inlet/Outlet conditions not evaluated

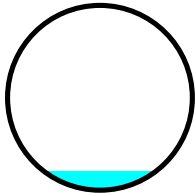
[81] Warning: Exceeded Pond SRS-1 by 0.02' @ 25.27 hrs

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 1.01" for 2Yr event  
Inflow = 0.14 cfs @ 12.52 hrs, Volume= 0.019 af  
Outflow = 0.14 cfs @ 12.53 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Max. Velocity= 3.25 fps, Min. Travel Time= 0.3 min  
Avg. Velocity = 1.58 fps, Avg. Travel Time= 0.5 min

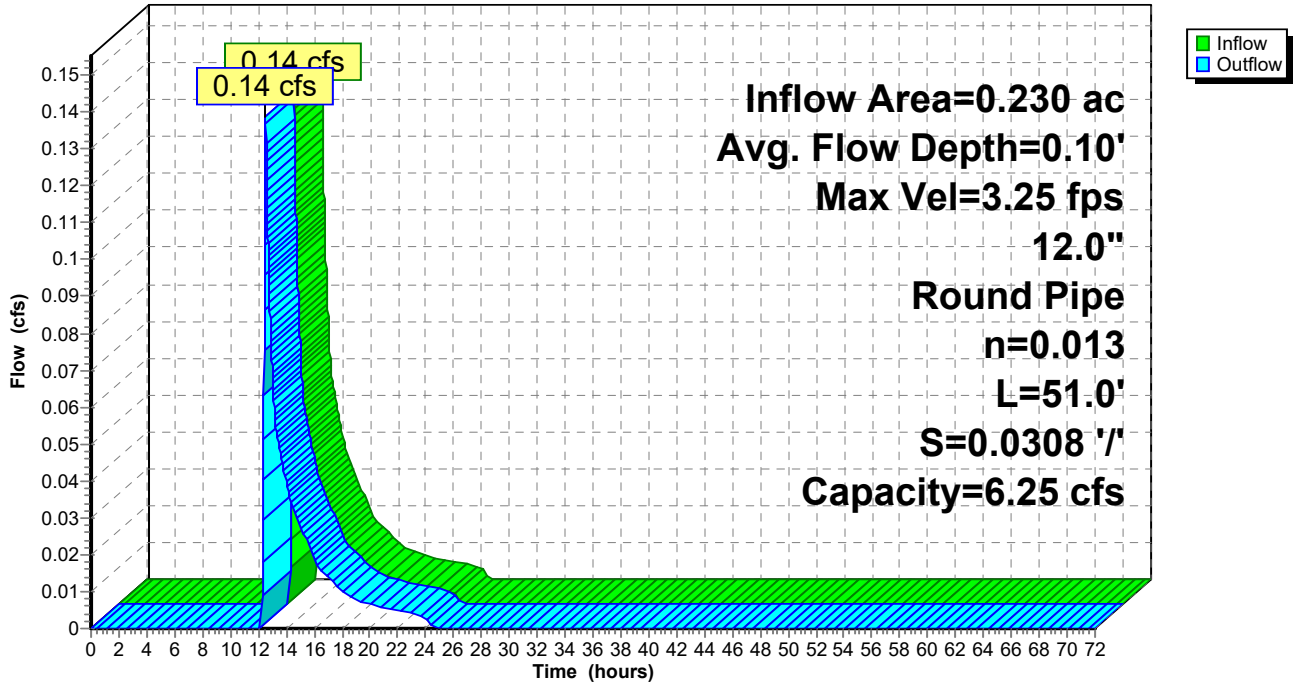
Peak Storage= 2 cf @ 12.52 hrs  
Average Depth at Peak Storage= 0.10'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 6.25 cfs

12.0" Round Pipe  
n= 0.013 Corrugated PE, smooth interior  
Length= 51.0' Slope= 0.0308 '/  
Inlet Invert= 7.46', Outlet Invert= 5.89'



### Reach P-2: 12" HDPE

Hydrograph



### Summary for Reach P-3: 18" HDPE

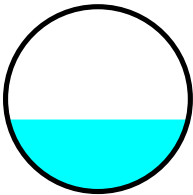
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 2.50" for 2Yr event  
 Inflow = 2.37 cfs @ 12.10 hrs, Volume= 0.206 af  
 Outflow = 2.37 cfs @ 12.10 hrs, Volume= 0.206 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 3.74 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity = 1.24 fps, Avg. Travel Time= 0.3 min

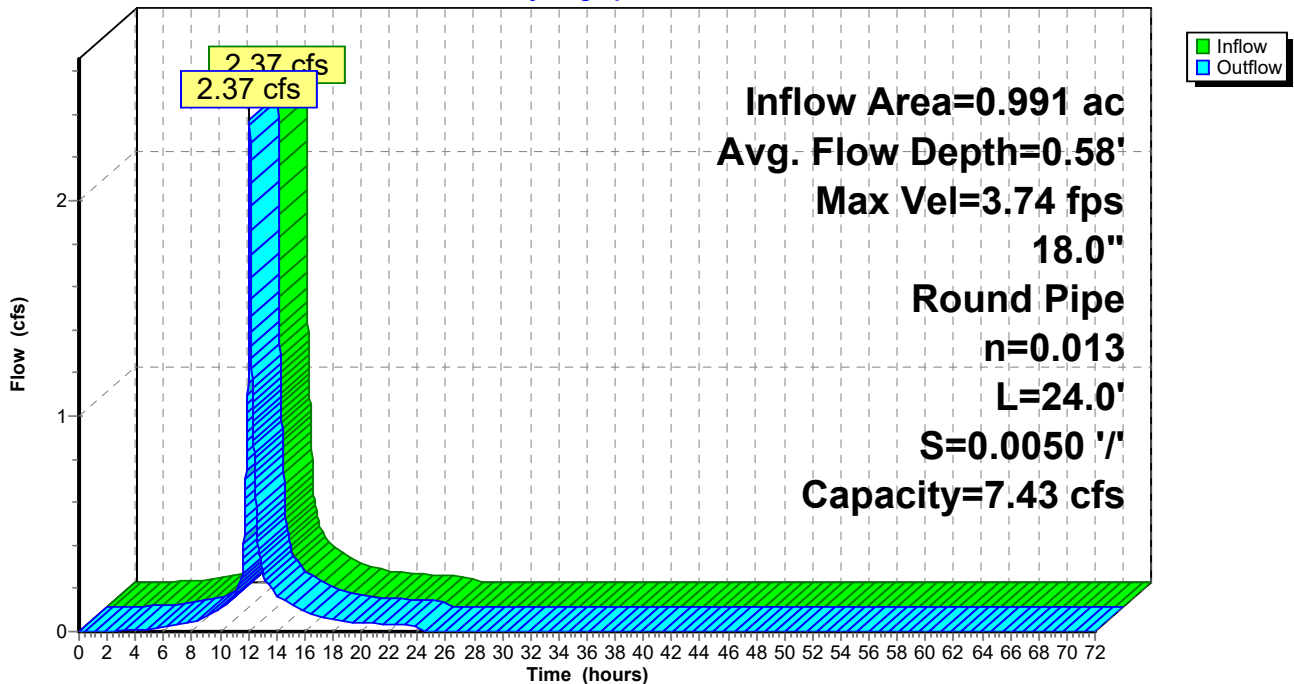
Peak Storage= 15 cf @ 12.10 hrs  
 Average Depth at Peak Storage= 0.58'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe  
 n= 0.013  
 Length= 24.0' Slope= 0.0050 '/'  
 Inlet Invert= 5.89', Outlet Invert= 5.77'



### Reach P-3: 18" HDPE

Hydrograph



### Summary for Reach WQI-1: Water Quality Inlet

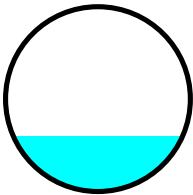
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.367 ac, 95.99% Impervious, Inflow Depth = 3.06" for 2Yr event  
 Inflow = 1.20 cfs @ 12.08 hrs, Volume= 0.093 af  
 Outflow = 1.19 cfs @ 12.09 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 6.04 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity = 1.97 fps, Avg. Travel Time= 0.2 min

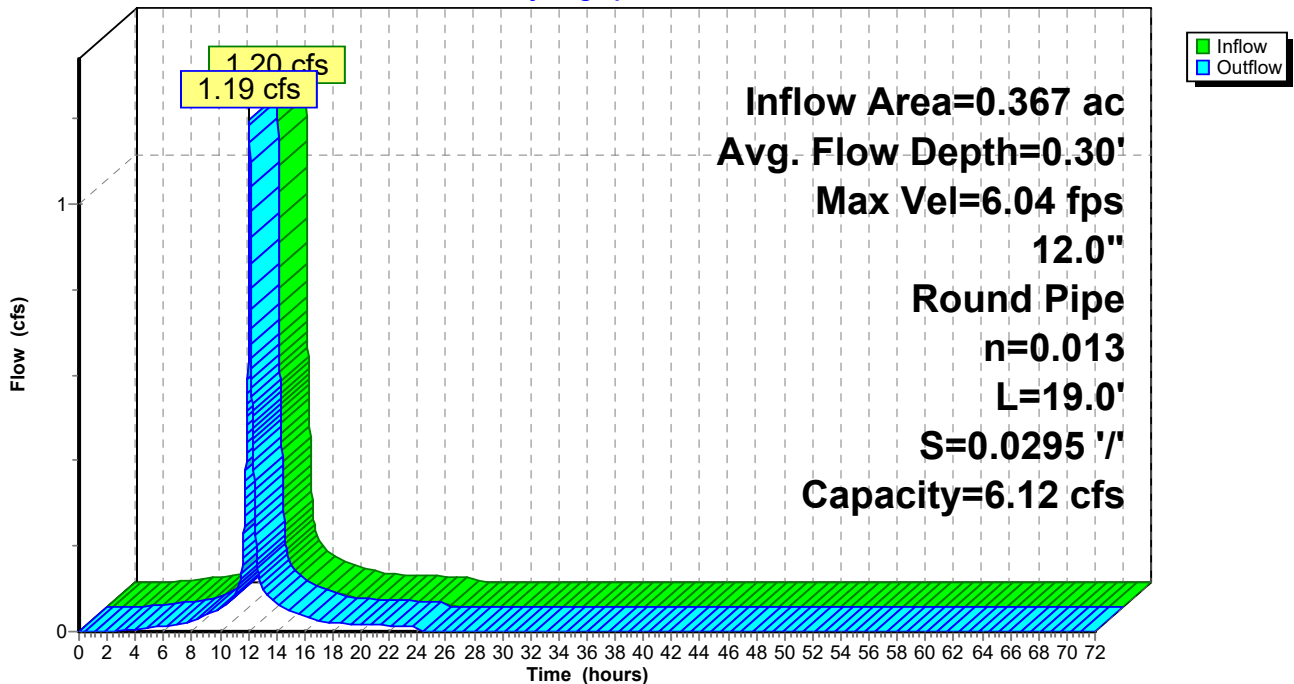
Peak Storage= 4 cf @ 12.08 hrs  
 Average Depth at Peak Storage= 0.30'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 6.12 cfs

12.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 19.0' Slope= 0.0295 '/'  
 Inlet Invert= 6.45', Outlet Invert= 5.89'



### Reach WQI-1: Water Quality Inlet

Hydrograph





### Summary for Reach WQI-2: Water Quality Inlet

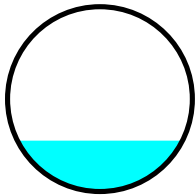
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.395 ac, 89.01% Impervious, Inflow Depth = 2.84" for 2Yr event  
 Inflow = 1.24 cfs @ 12.08 hrs, Volume= 0.094 af  
 Outflow = 1.22 cfs @ 12.12 hrs, Volume= 0.094 af, Atten= 1%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 3.11 fps, Min. Travel Time= 1.1 min  
 Avg. Velocity = 1.00 fps, Avg. Travel Time= 3.4 min

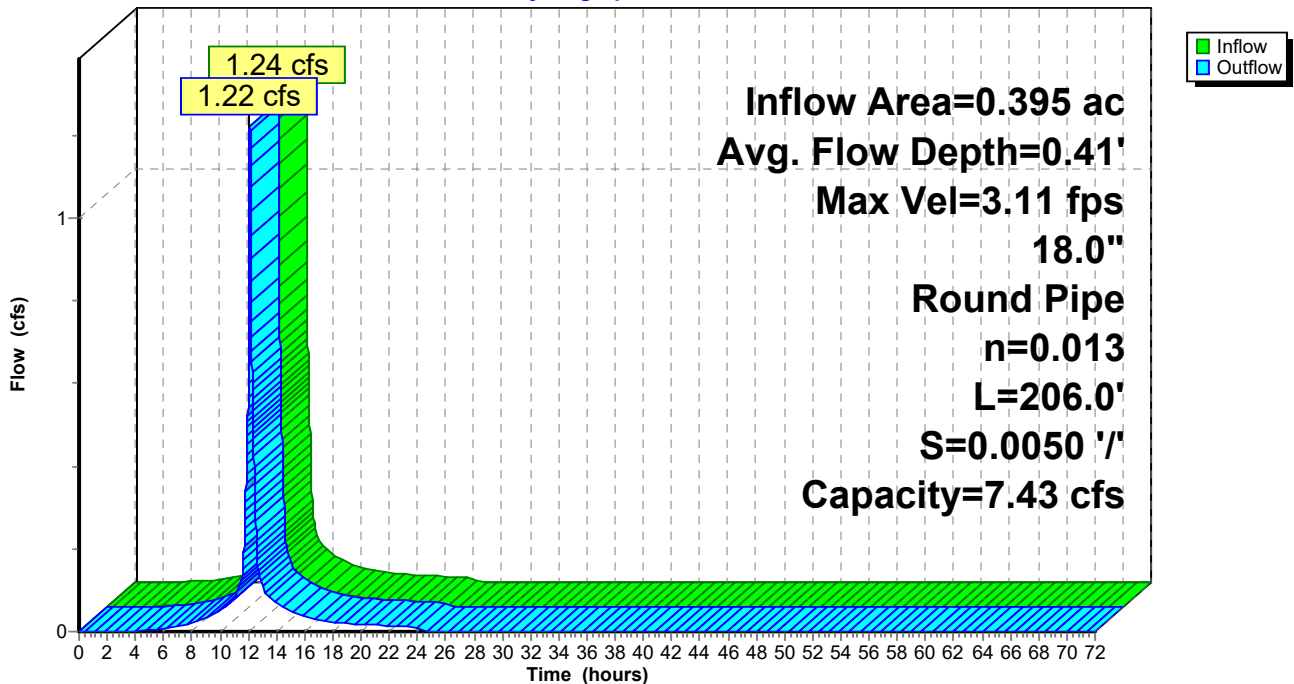
Peak Storage= 81 cf @ 12.10 hrs  
 Average Depth at Peak Storage= 0.41'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 206.0' Slope= 0.0050 '/'  
 Inlet Invert= 6.92', Outlet Invert= 5.89'



### Reach WQI-2: Water Quality Inlet

Hydrograph



### Summary for Pond DMH-1: Drain Manhole

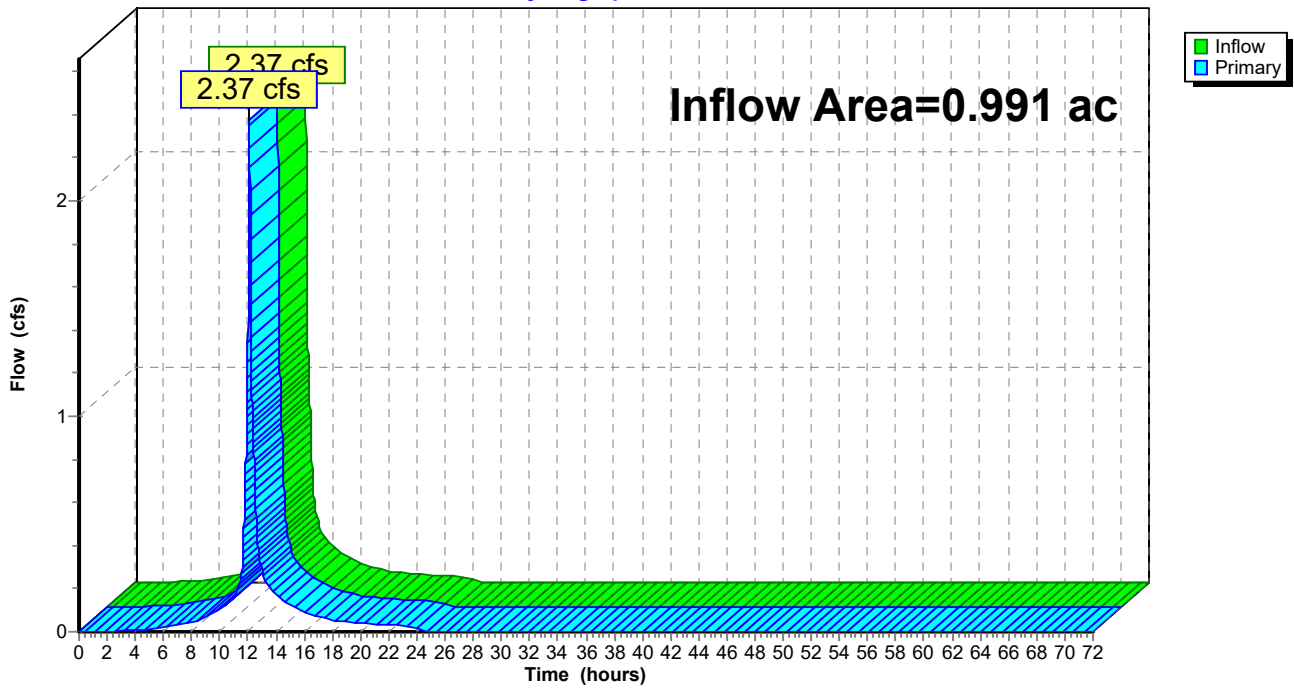
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 2.50" for 2Yr event  
Inflow = 2.37 cfs @ 12.10 hrs, Volume= 0.206 af  
Primary = 2.37 cfs @ 12.10 hrs, Volume= 0.206 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

### Pond DMH-1: Drain Manhole

Hydrograph



### Summary for Pond DMH-2: Existing Drain Manhole

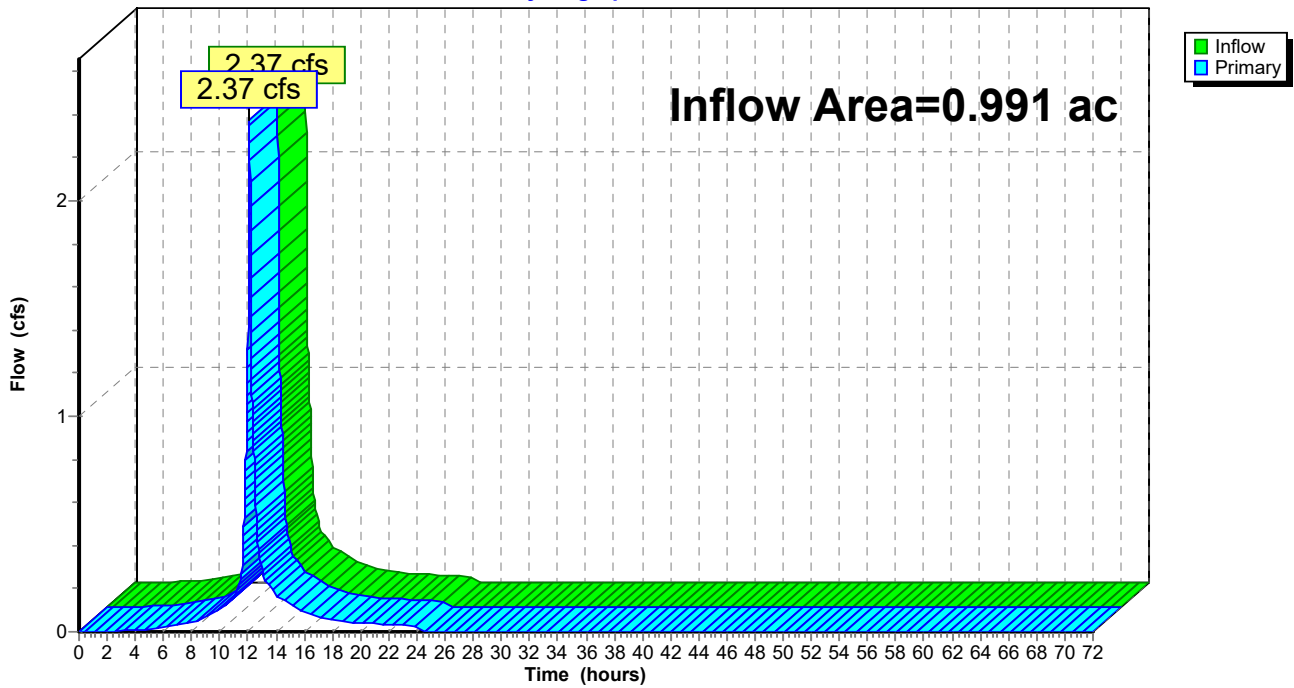
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 2.50" for 2Yr event  
Inflow = 2.37 cfs @ 12.10 hrs, Volume= 0.206 af  
Primary = 2.37 cfs @ 12.10 hrs, Volume= 0.206 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

### Pond DMH-2: Existing Drain Manhole

Hydrograph



**Summary for Pond SRS-1: Subsurface Recharge System**

[63] Warning: Exceeded Reach P-1 INLET depth by 0.59' @ 12.56 hrs

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 3.17" for 2Yr event  
 Inflow = 0.76 cfs @ 12.08 hrs, Volume= 0.061 af  
 Outflow = 0.14 cfs @ 12.52 hrs, Volume= 0.044 af, Atten= 81%, Lag= 26.3 min  
 Discarded = 0.00 cfs @ 4.32 hrs, Volume= 0.024 af  
 Primary = 0.14 cfs @ 12.52 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Peak Elev= 7.66' @ 12.52 hrs Surf.Area= 684 sf Storage= 1,559 cf

Plug-Flow detention time= 991.1 min calculated for 0.044 af (72% of inflow)  
 Center-of-Mass det. time= 900.6 min ( 1,655.9 - 755.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	4.25'	1,046 cf	<b>16.68'W x 41.00'L x 5.75'H Prismaoid</b> 3,932 cf Overall - 1,317 cf Embedded = 2,616 cf x 40.0% Voids
#2	5.00'	1,317 cf	<b>Cultec R-902HD x 20 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 20 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		2,363 cf	Total Available Storage

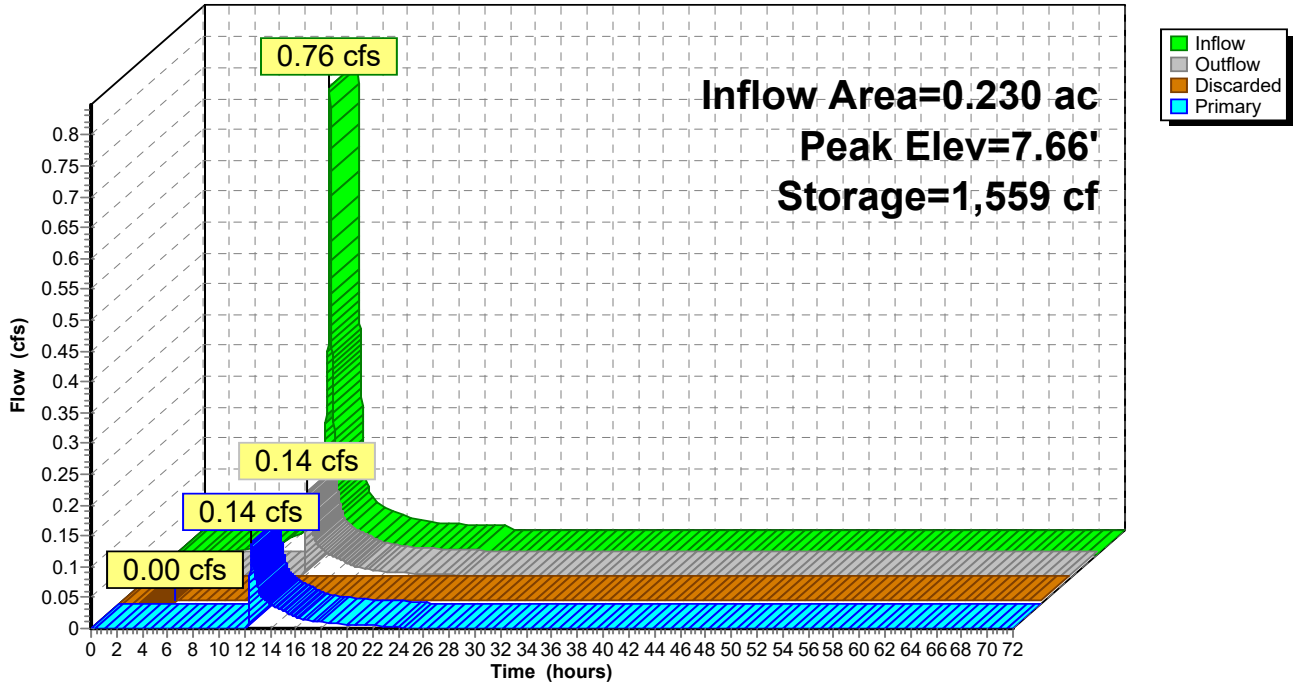
Device	Routing	Invert	Outlet Devices
#1	Discarded	4.25'	<b>0.270 in/hr Exfiltration over Surface area</b>
#2	Primary	7.46'	<b>12.0" Round Culvert</b> L= 51.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 7.46' / 5.89' S= 0.0308 ' S= 0.0308 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Discarded OutFlow** Max=0.00 cfs @ 4.32 hrs HW=4.31' (Free Discharge)  
 ↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.14 cfs @ 12.52 hrs HW=7.66' (Free Discharge)  
 ↑**2=Culvert** (Inlet Controls 0.14 cfs @ 1.21 fps)

### Pond SRS-1: Subsurface Recharge System

Hydrograph



**Summary for Subcatchment S-1: Tributary to WQI-1**

Runoff = 1.71 cfs @ 12.08 hrs, Volume= 0.136 af, Depth= 4.45"

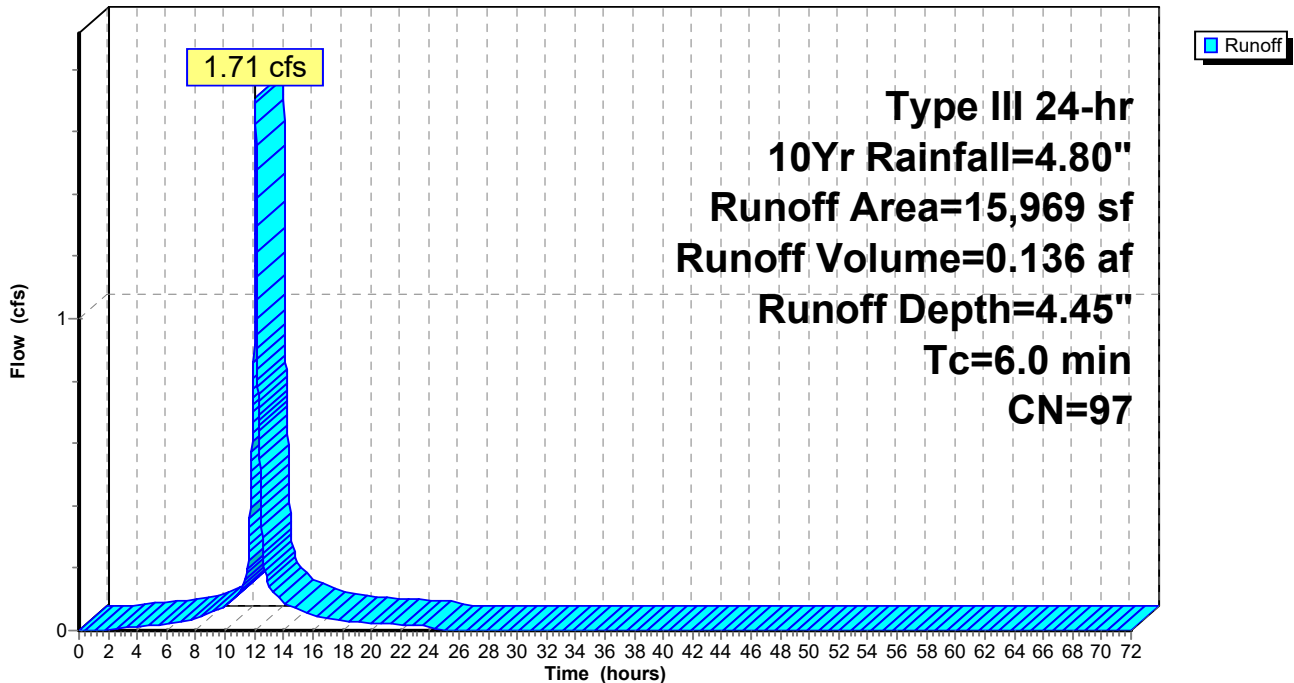
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10Yr Rainfall=4.80"

Area (sf)	CN	Description
15,329	98	Paved parking, HSG C
640	74	>75% Grass cover, Good, HSG C
15,969	97	Weighted Average
640		4.01% Pervious Area
15,329		95.99% Impervious Area

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

**Subcatchment S-1: Tributary to WQI-1**

Hydrograph



**Summary for Subcatchment S-2: Tributary to WQI-2**

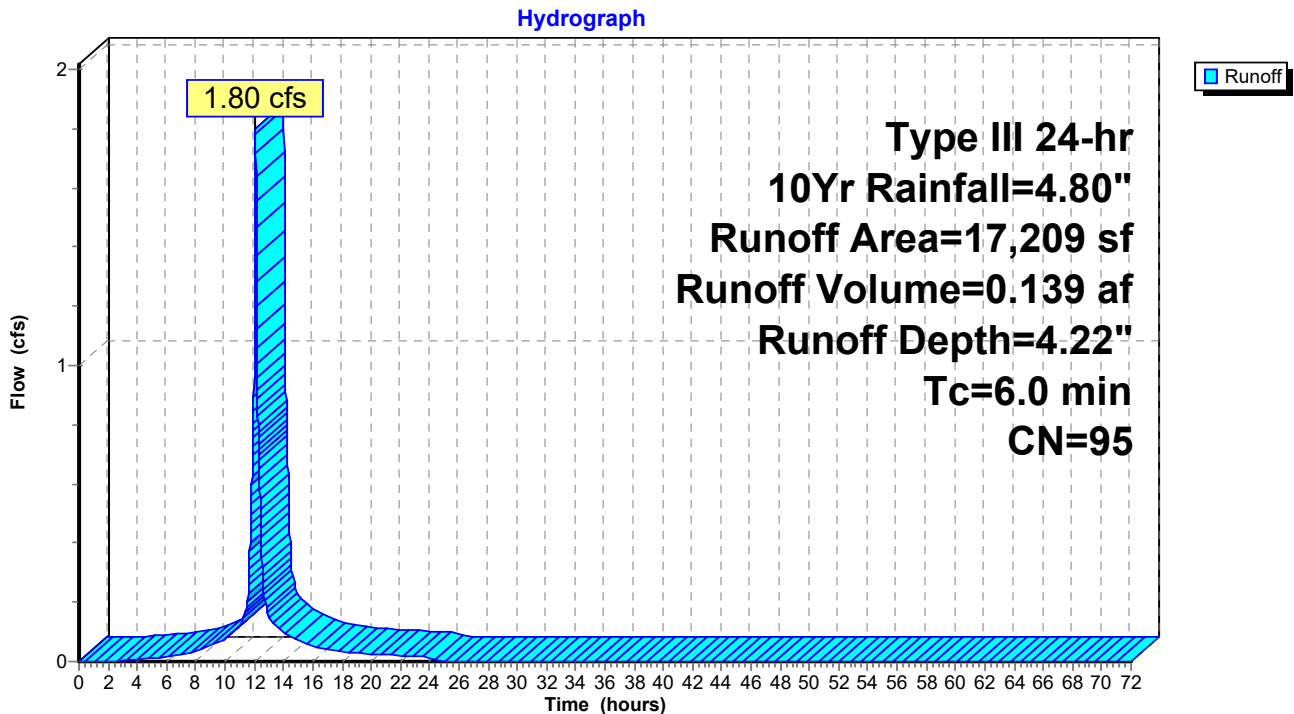
Runoff = 1.80 cfs @ 12.08 hrs, Volume= 0.139 af, Depth= 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10Yr Rainfall=4.80"

Area (sf)	CN	Description
1,892	74	>75% Grass cover, Good, HSG C
15,317	98	Paved parking, HSG C
17,209	95	Weighted Average
1,892		10.99% Pervious Area
15,317		89.01% Impervious Area

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

**Subcatchment S-2: Tributary to WQI-2**



**Summary for Subcatchment S-3: Rooftop Runoff**

Runoff = 1.08 cfs @ 12.08 hrs, Volume= 0.087 af, Depth= 4.56"

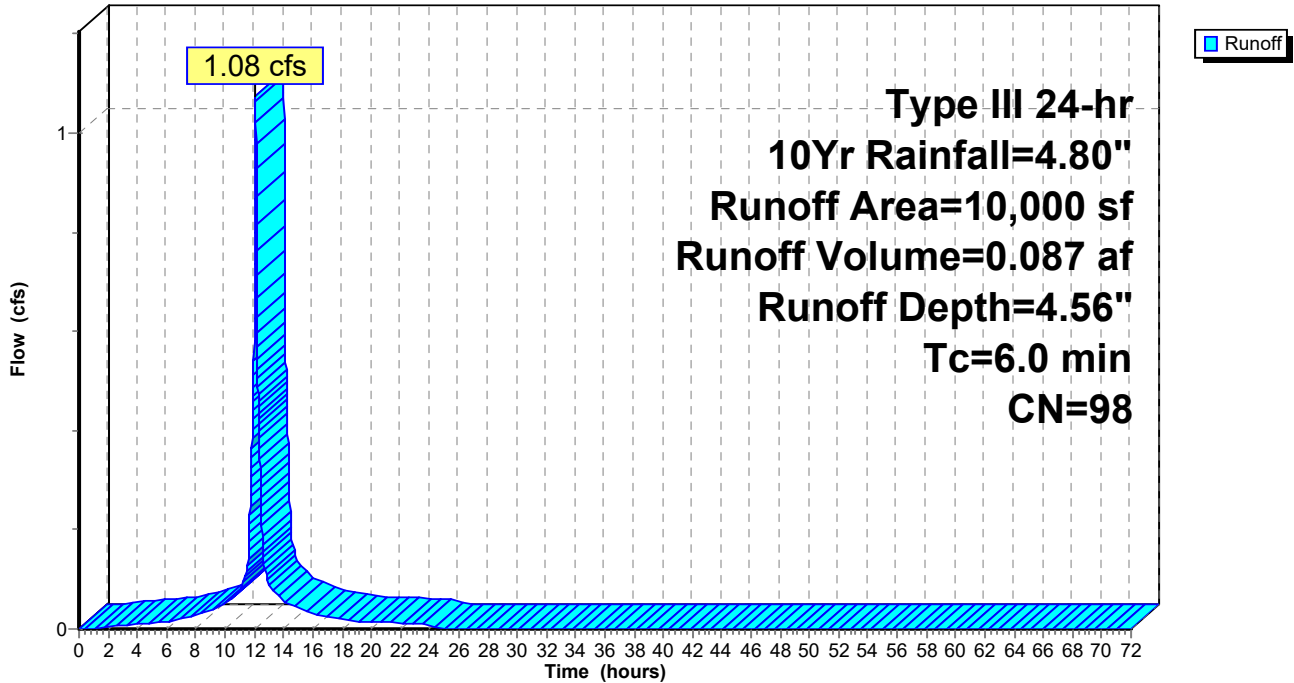
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10Yr Rainfall=4.80"

Area (sf)	CN	Description
* 10,000	98	Rooftop
10,000		100.00% Impervious Area

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

**Subcatchment S-3: Rooftop Runoff**

Hydrograph





**Summary for Subcatchment S-4: Offsite Runoff**

Runoff = 0.13 cfs @ 12.16 hrs, Volume= 0.012 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10Yr Rainfall=4.80"

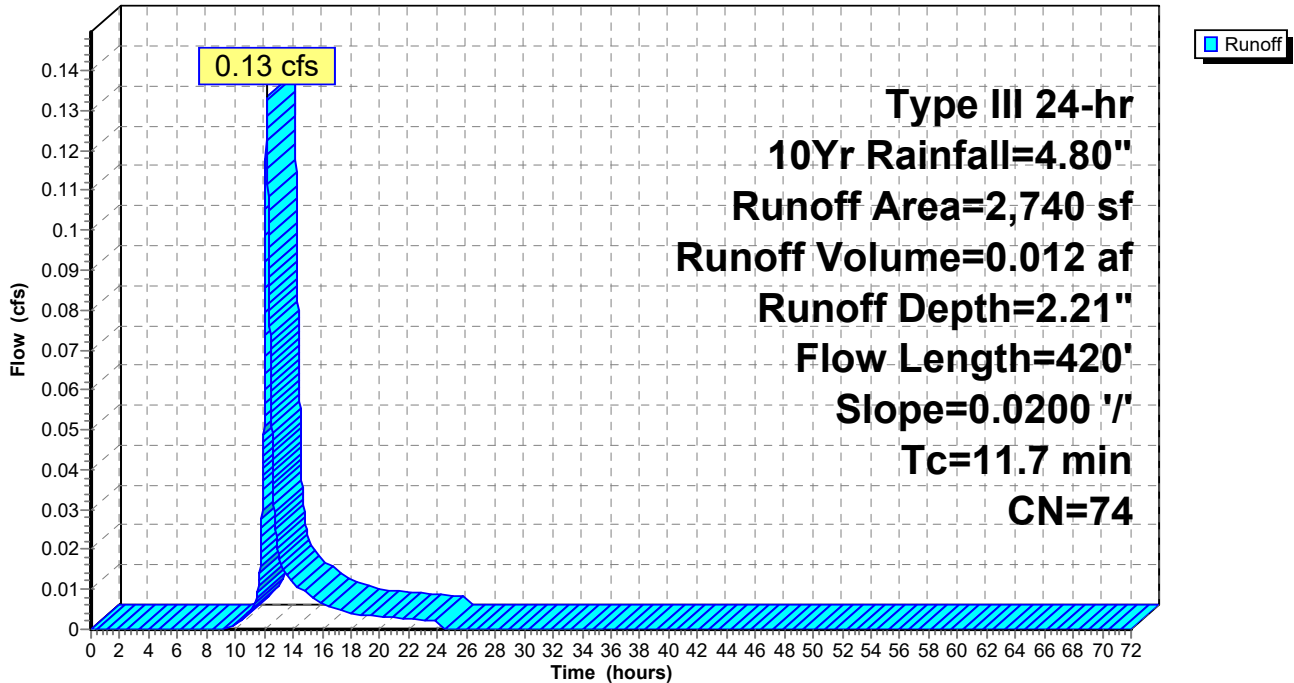
Area (sf)	CN	Description
2,740	74	>75% Grass cover, Good, HSG C
2,740		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0200	0.15		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.40"
6.2	370	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
11.7	420	Total			

**Subcatchment S-4: Offsite Runoff**

Hydrograph



### Summary for Reach P-1: 12" HDPE

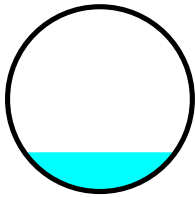
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 4.56" for 10Yr event  
 Inflow = 1.08 cfs @ 12.08 hrs, Volume= 0.087 af  
 Outflow = 1.08 cfs @ 12.08 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 8.90 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity = 2.92 fps, Avg. Travel Time= 0.1 min

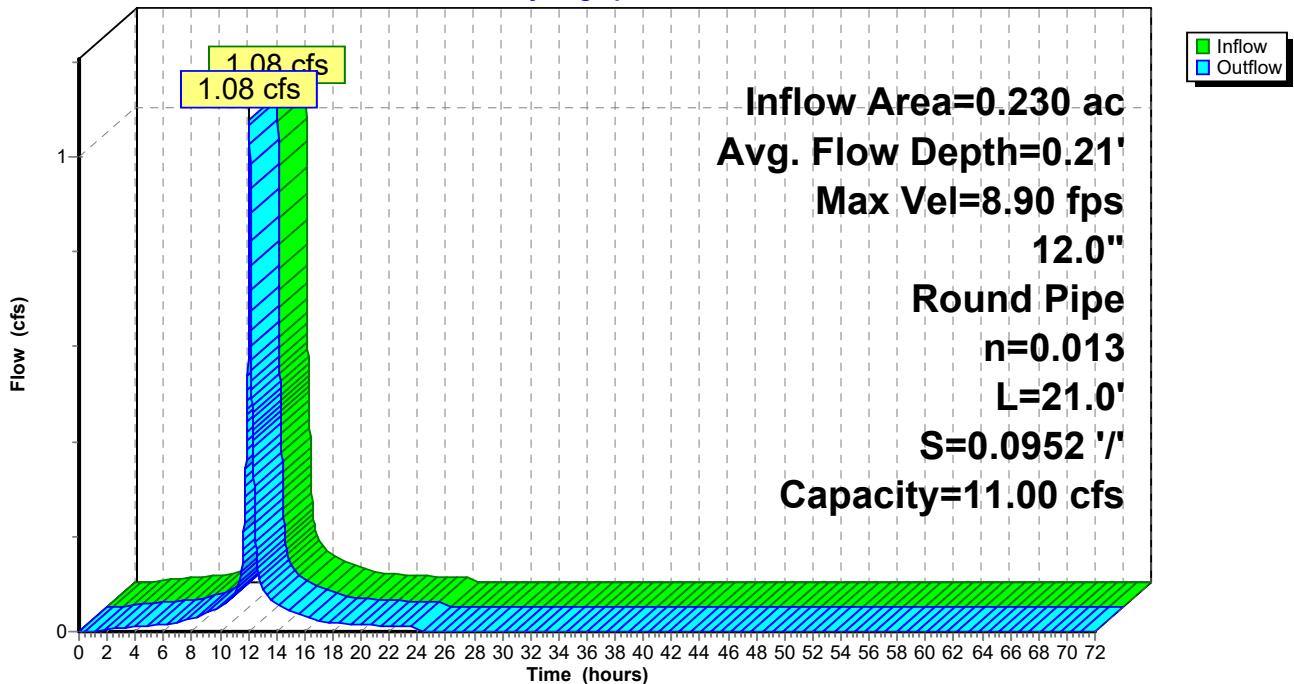
Peak Storage= 3 cf @ 12.08 hrs  
 Average Depth at Peak Storage= 0.21'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 11.00 cfs

12.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 21.0' Slope= 0.0952 '/'  
 Inlet Invert= 7.00', Outlet Invert= 5.00'



### Reach P-1: 12" HDPE

Hydrograph



**Summary for Reach P-2: 12" HDPE**

[52] Hint: Inlet/Outlet conditions not evaluated

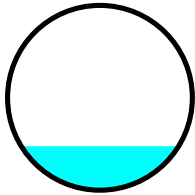
[81] Warning: Exceeded Pond SRS-1 by 0.02' @ 25.49 hrs

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 2.39" for 10Yr event  
Inflow = 0.77 cfs @ 12.16 hrs, Volume= 0.046 af  
Outflow = 0.77 cfs @ 12.16 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Max. Velocity= 5.41 fps, Min. Travel Time= 0.2 min  
Avg. Velocity = 1.88 fps, Avg. Travel Time= 0.5 min

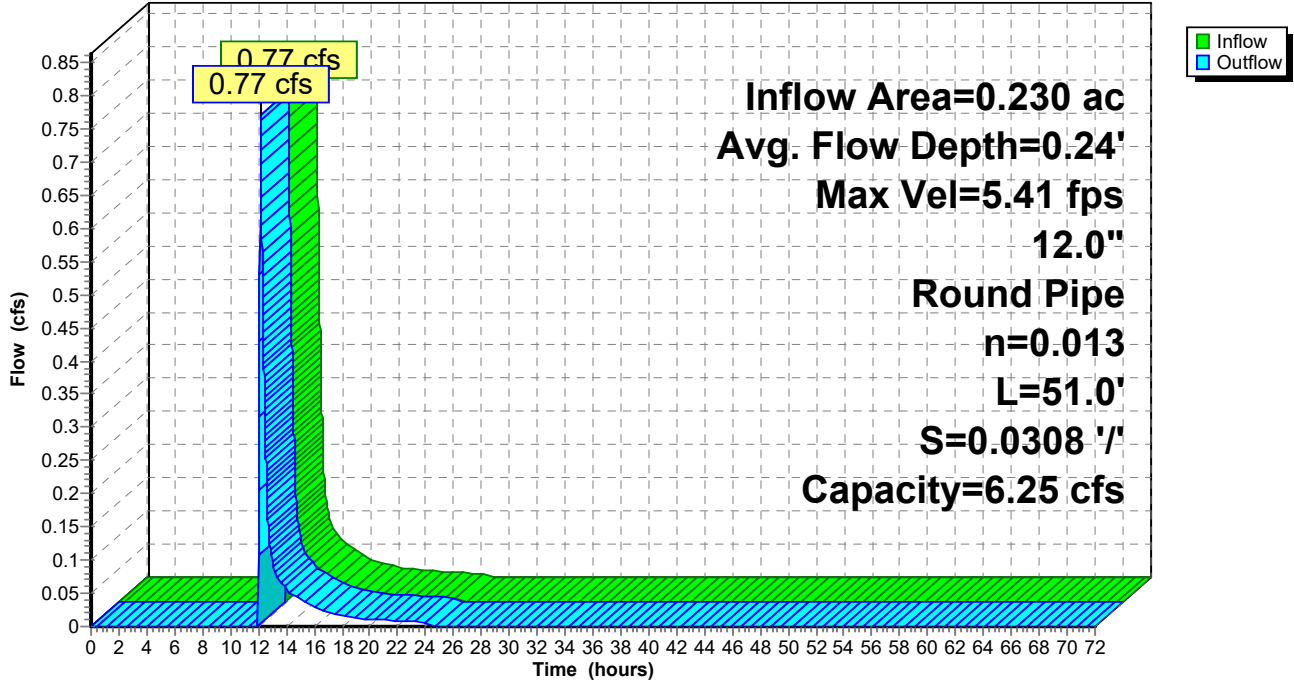
Peak Storage= 7 cf @ 12.16 hrs  
Average Depth at Peak Storage= 0.24'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 6.25 cfs

12.0" Round Pipe  
n= 0.013 Corrugated PE, smooth interior  
Length= 51.0' Slope= 0.0308 '/  
Inlet Invert= 7.46', Outlet Invert= 5.89'



Reach P-2: 12" HDPE

Hydrograph



### Summary for Reach P-3: 18" HDPE

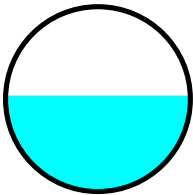
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 3.88" for 10Yr event  
 Inflow = 3.95 cfs @ 12.12 hrs, Volume= 0.321 af  
 Outflow = 3.95 cfs @ 12.12 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 4.27 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity= 1.39 fps, Avg. Travel Time= 0.3 min

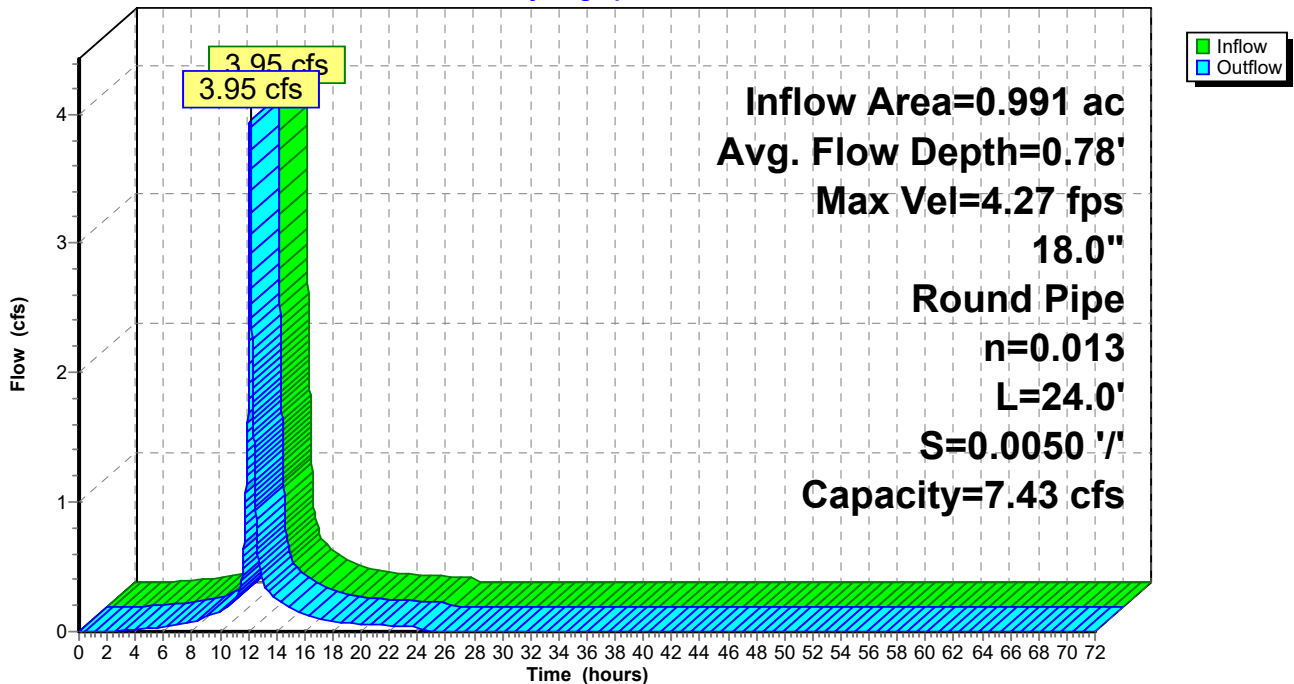
Peak Storage= 22 cf @ 12.12 hrs  
 Average Depth at Peak Storage= 0.78'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe  
 n= 0.013  
 Length= 24.0' Slope= 0.0050 '/'  
 Inlet Invert= 5.89', Outlet Invert= 5.77'



### Reach P-3: 18" HDPE

Hydrograph



### Summary for Reach WQI-1: Water Quality Inlet

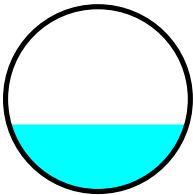
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.367 ac, 95.99% Impervious, Inflow Depth = 4.45" for 10Yr event  
 Inflow = 1.71 cfs @ 12.08 hrs, Volume= 0.136 af  
 Outflow = 1.71 cfs @ 12.08 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 6.67 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity = 2.20 fps, Avg. Travel Time= 0.1 min

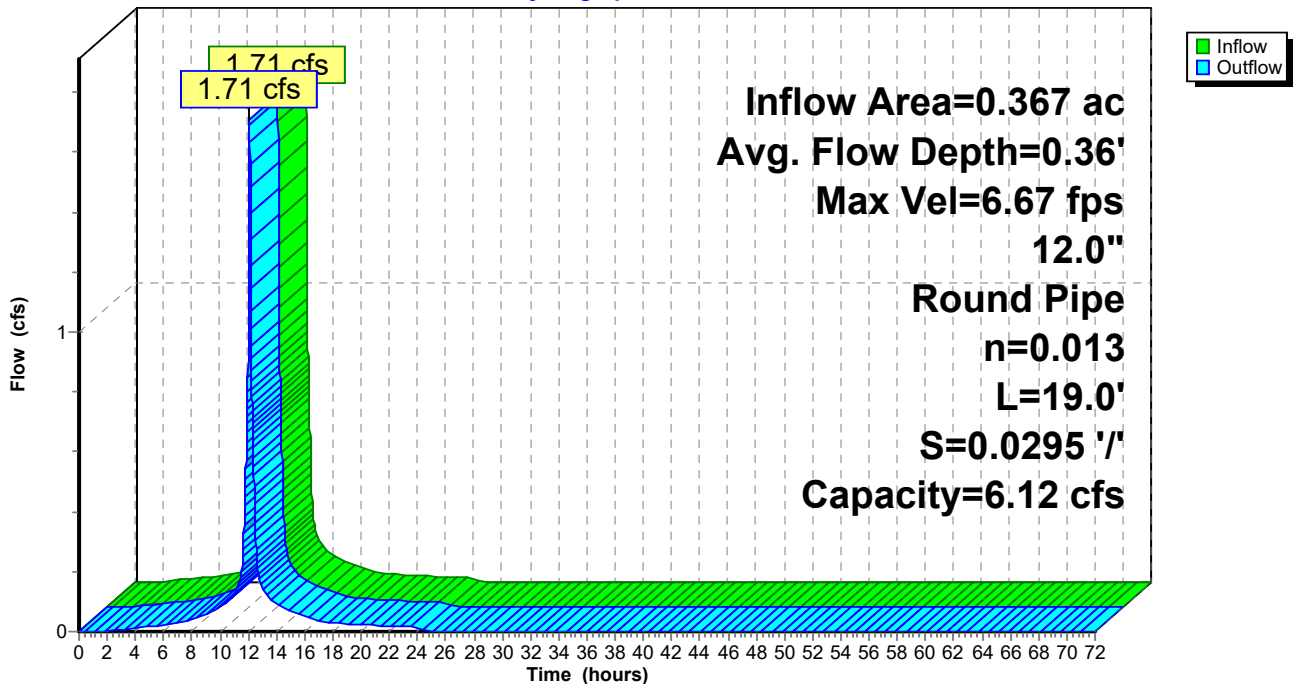
Peak Storage= 5 cf @ 12.08 hrs  
 Average Depth at Peak Storage= 0.36'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 6.12 cfs

12.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 19.0' Slope= 0.0295 '/'  
 Inlet Invert= 6.45', Outlet Invert= 5.89'



### Reach WQI-1: Water Quality Inlet

Hydrograph



### Summary for Reach WQI-2: Water Quality Inlet

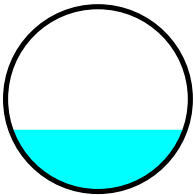
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.395 ac, 89.01% Impervious, Inflow Depth = 4.22" for 10Yr event  
 Inflow = 1.80 cfs @ 12.08 hrs, Volume= 0.139 af  
 Outflow = 1.78 cfs @ 12.11 hrs, Volume= 0.139 af, Atten= 1%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 3.45 fps, Min. Travel Time= 1.0 min  
 Avg. Velocity = 1.12 fps, Avg. Travel Time= 3.1 min

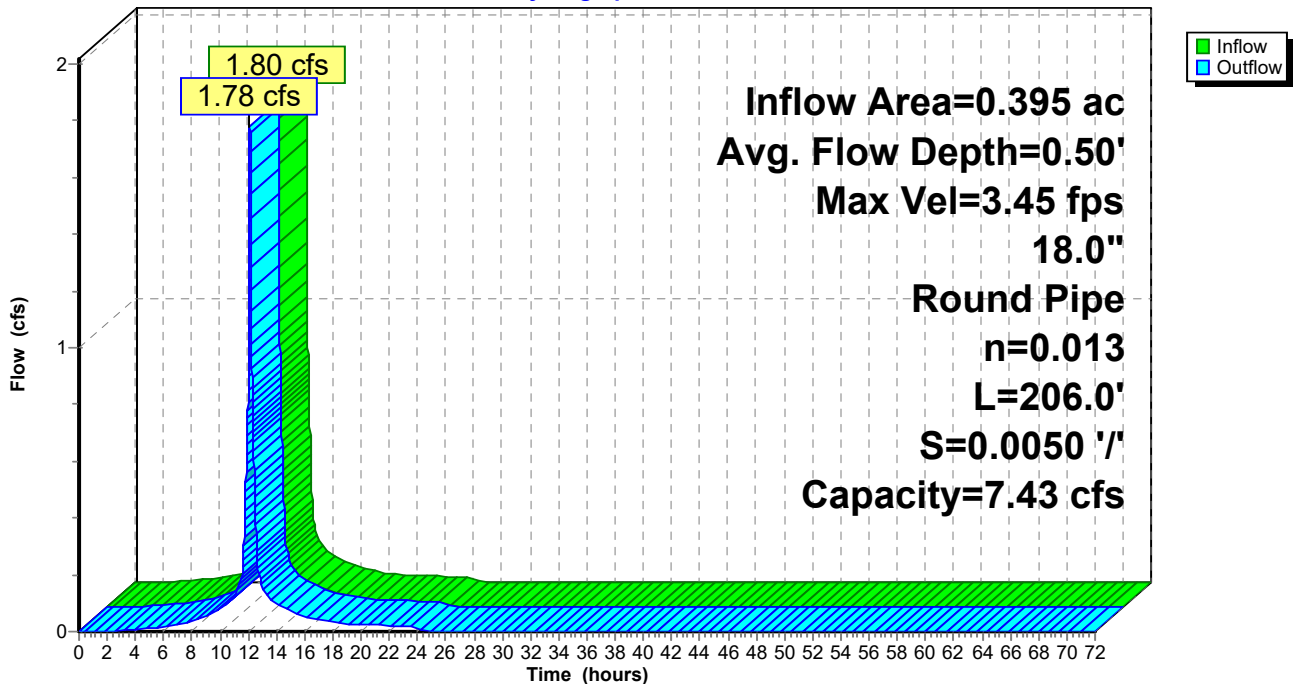
Peak Storage= 106 cf @ 12.10 hrs  
 Average Depth at Peak Storage= 0.50'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 206.0' Slope= 0.0050 '/'  
 Inlet Invert= 6.92', Outlet Invert= 5.89'



### Reach WQI-2: Water Quality Inlet

Hydrograph



### Summary for Pond DMH-1: Drain Manhole

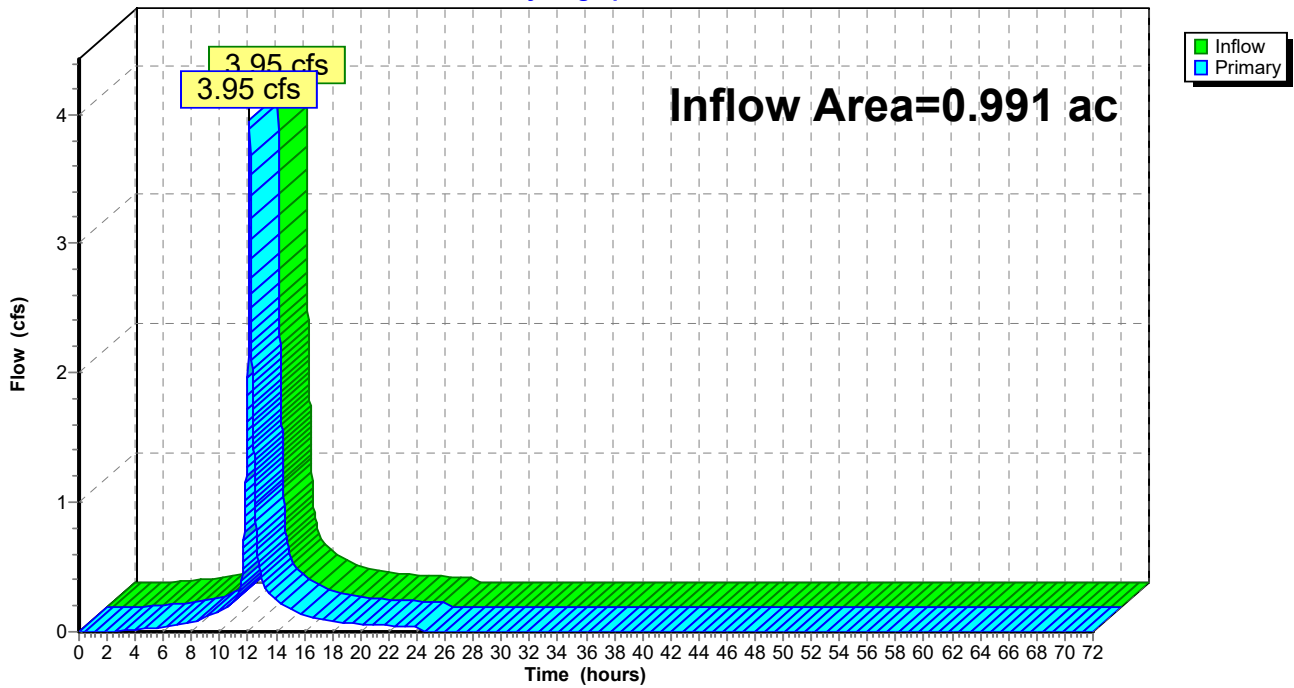
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 3.88" for 10Yr event  
Inflow = 3.95 cfs @ 12.12 hrs, Volume= 0.321 af  
Primary = 3.95 cfs @ 12.12 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

### Pond DMH-1: Drain Manhole

Hydrograph





### Summary for Pond DMH-2: Existing Drain Manhole

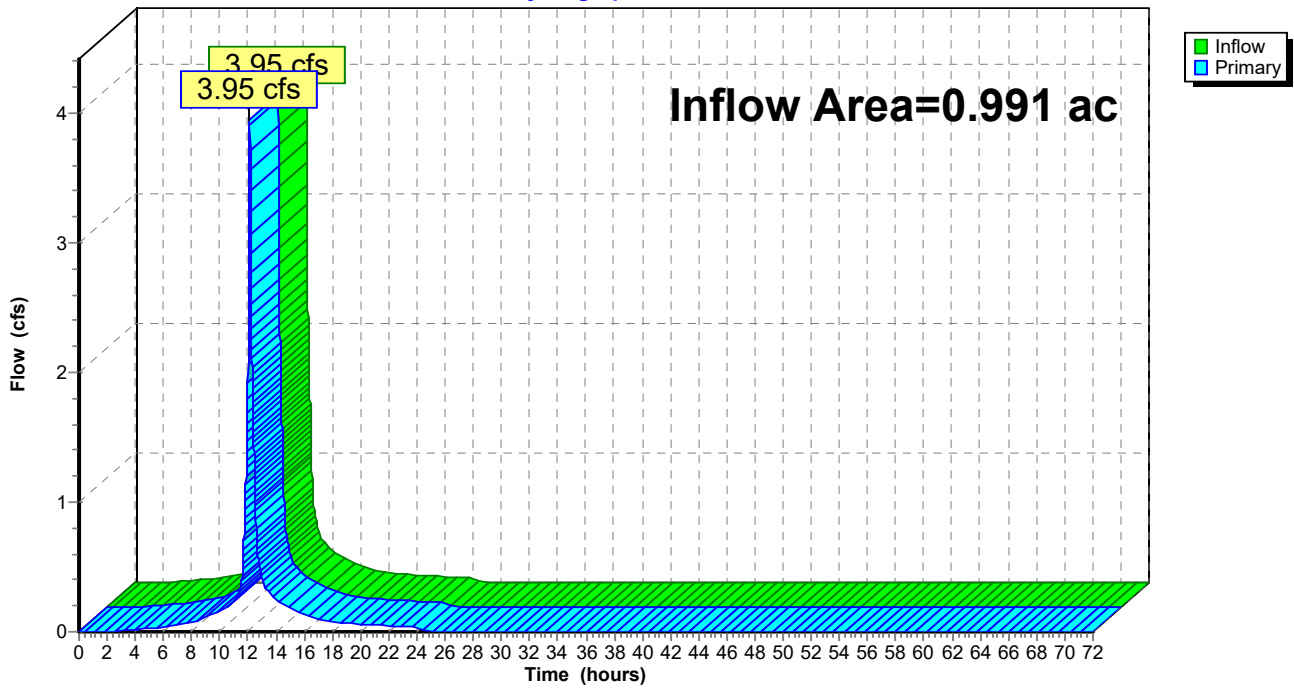
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 3.88" for 10Yr event  
Inflow = 3.95 cfs @ 12.12 hrs, Volume= 0.321 af  
Primary = 3.95 cfs @ 12.12 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

### Pond DMH-2: Existing Drain Manhole

Hydrograph



**Summary for Pond SRS-1: Subsurface Recharge System**

[63] Warning: Exceeded Reach P-1 INLET depth by 0.79' @ 12.18 hrs

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 4.56" for 10Yr event  
 Inflow = 1.08 cfs @ 12.08 hrs, Volume= 0.087 af  
 Outflow = 0.78 cfs @ 12.16 hrs, Volume= 0.070 af, Atten= 28%, Lag= 4.5 min  
 Discarded = 0.00 cfs @ 3.04 hrs, Volume= 0.025 af  
 Primary = 0.77 cfs @ 12.16 hrs, Volume= 0.046 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Peak Elev= 7.97' @ 12.16 hrs Surf.Area= 684 sf Storage= 1,700 cf

Plug-Flow detention time= 658.6 min calculated for 0.070 af (81% of inflow)  
 Center-of-Mass det. time= 582.7 min ( 1,331.5 - 748.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	4.25'	1,046 cf	<b>16.68'W x 41.00'L x 5.75'H Prismaoid</b> 3,932 cf Overall - 1,317 cf Embedded = 2,616 cf x 40.0% Voids
#2	5.00'	1,317 cf	<b>Cultec R-902HD x 20 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 20 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		2,363 cf	Total Available Storage

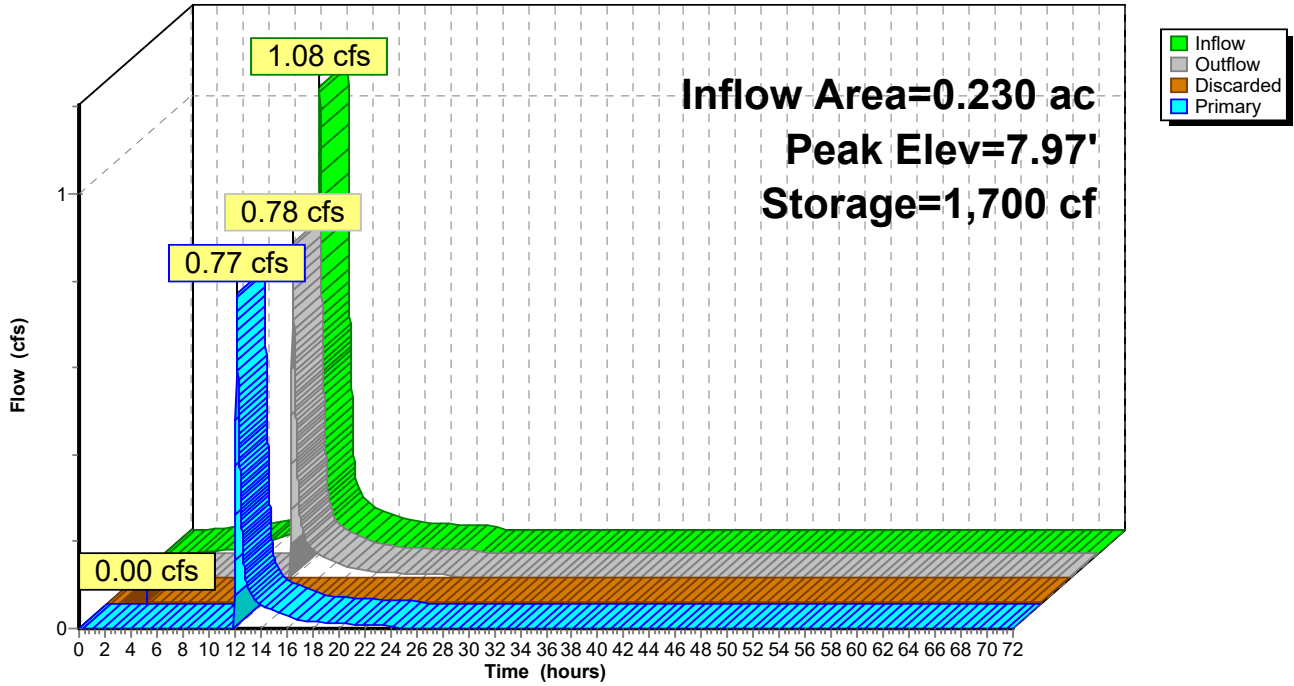
Device	Routing	Invert	Outlet Devices
#1	Discarded	4.25'	<b>0.270 in/hr Exfiltration over Surface area</b>
#2	Primary	7.46'	<b>12.0" Round Culvert</b> L= 51.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 7.46' / 5.89' S= 0.0308 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Discarded OutFlow** Max=0.00 cfs @ 3.04 hrs HW=4.31' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.77 cfs @ 12.16 hrs HW=7.97' (Free Discharge)  
 ↑2=Culvert (Inlet Controls 0.77 cfs @ 1.92 fps)

### Pond SRS-1: Subsurface Recharge System

Hydrograph



**Summary for Subcatchment S-1: Tributary to WQI-1**

Runoff = 2.51 cfs @ 12.08 hrs, Volume= 0.203 af, Depth= 6.64"

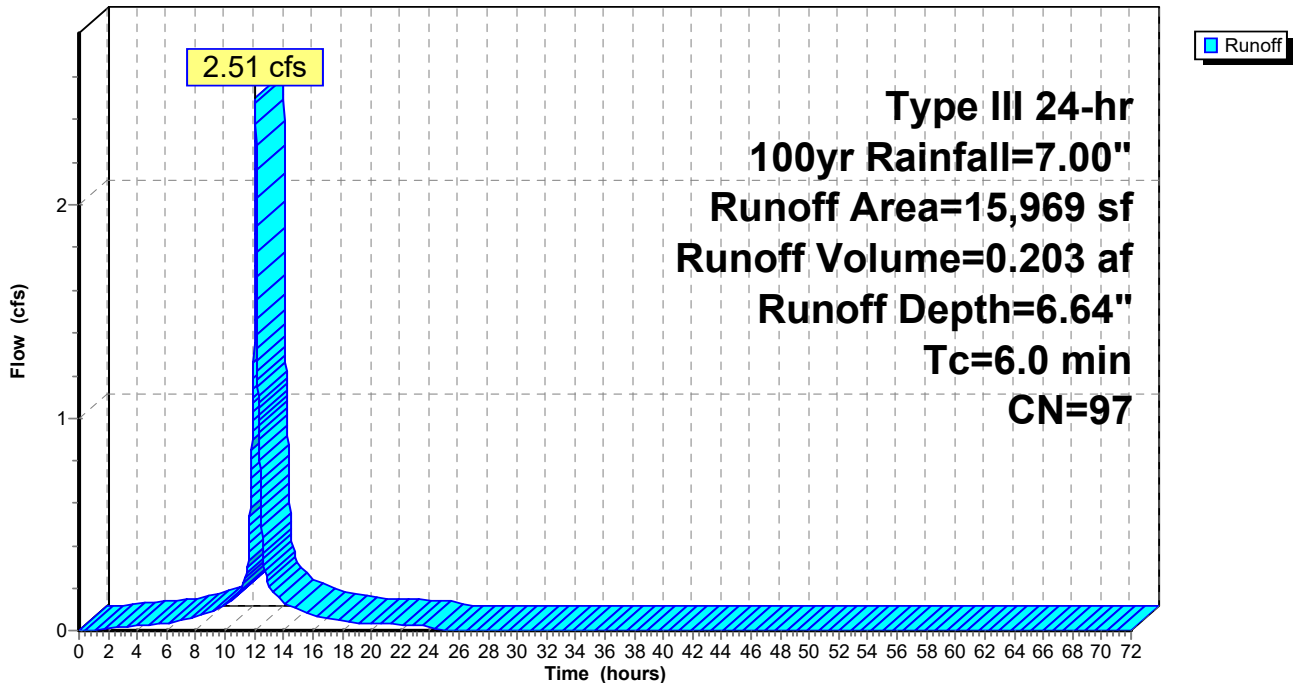
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100yr Rainfall=7.00"

Area (sf)	CN	Description
15,329	98	Paved parking, HSG C
640	74	>75% Grass cover, Good, HSG C
15,969	97	Weighted Average
640		4.01% Pervious Area
15,329		95.99% Impervious Area

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

**Subcatchment S-1: Tributary to WQI-1**

Hydrograph



**Summary for Subcatchment S-2: Tributary to WQI-2**

Runoff = 2.67 cfs @ 12.08 hrs, Volume= 0.211 af, Depth= 6.41"

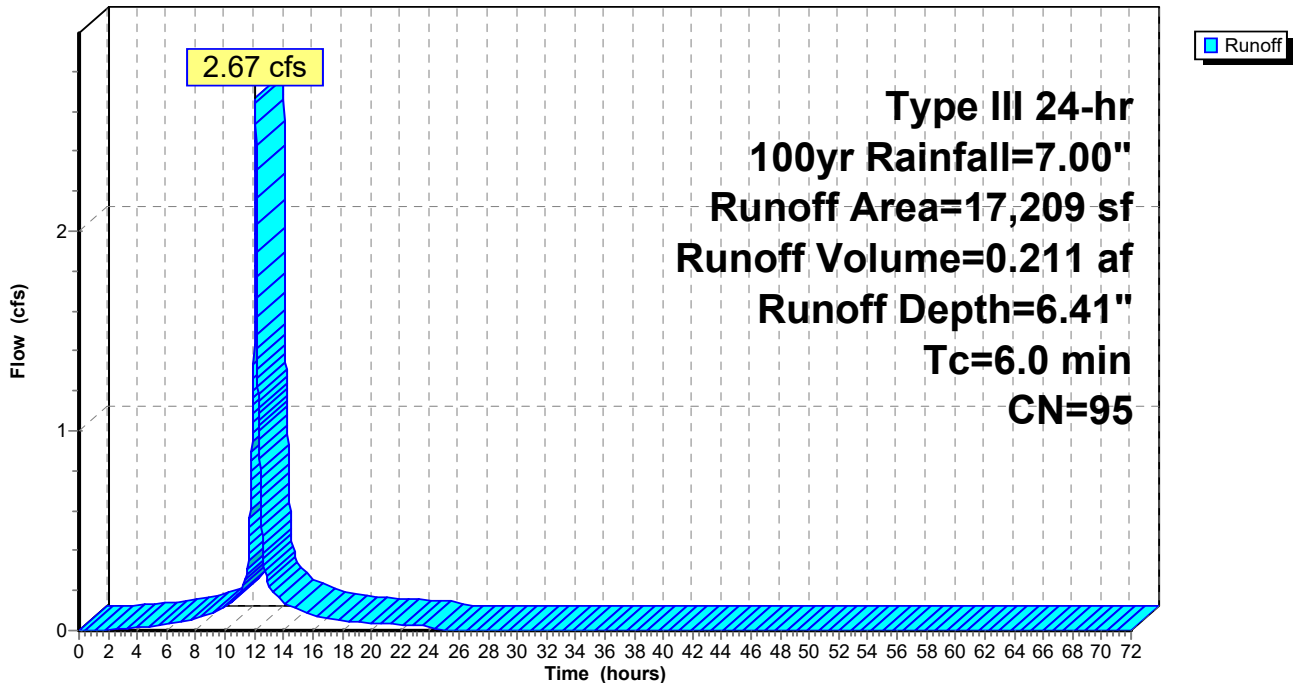
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100yr Rainfall=7.00"

Area (sf)	CN	Description
1,892	74	>75% Grass cover, Good, HSG C
15,317	98	Paved parking, HSG C
17,209	95	Weighted Average
1,892		10.99% Pervious Area
15,317		89.01% Impervious Area

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

**Subcatchment S-2: Tributary to WQI-2**

Hydrograph



### Summary for Subcatchment S-3: Rooftop Runoff

Runoff = 1.58 cfs @ 12.08 hrs, Volume= 0.129 af, Depth= 6.76"

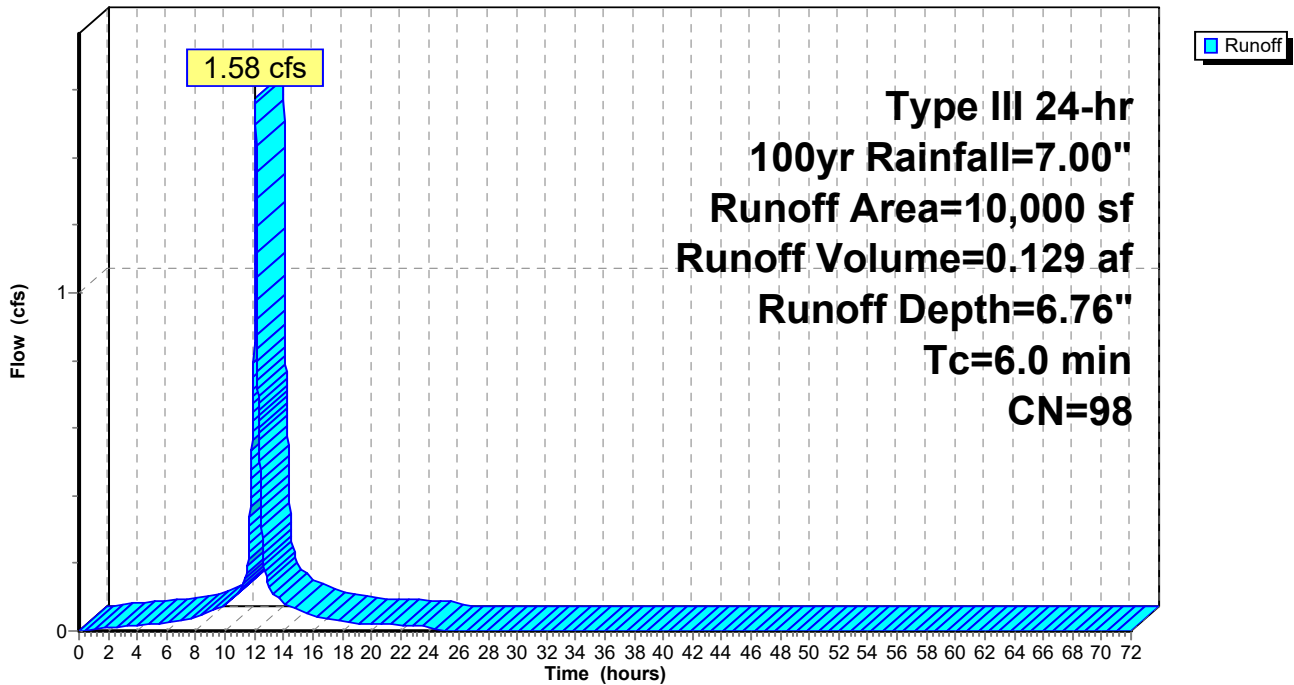
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100yr Rainfall=7.00"

Area (sf)	CN	Description
* 10,000	98	Rooftop
10,000		100.00% Impervious Area

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

### Subcatchment S-3: Rooftop Runoff

Hydrograph



**Summary for Subcatchment S-4: Offsite Runoff**

Runoff = 0.25 cfs @ 12.16 hrs, Volume= 0.021 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100yr Rainfall=7.00"

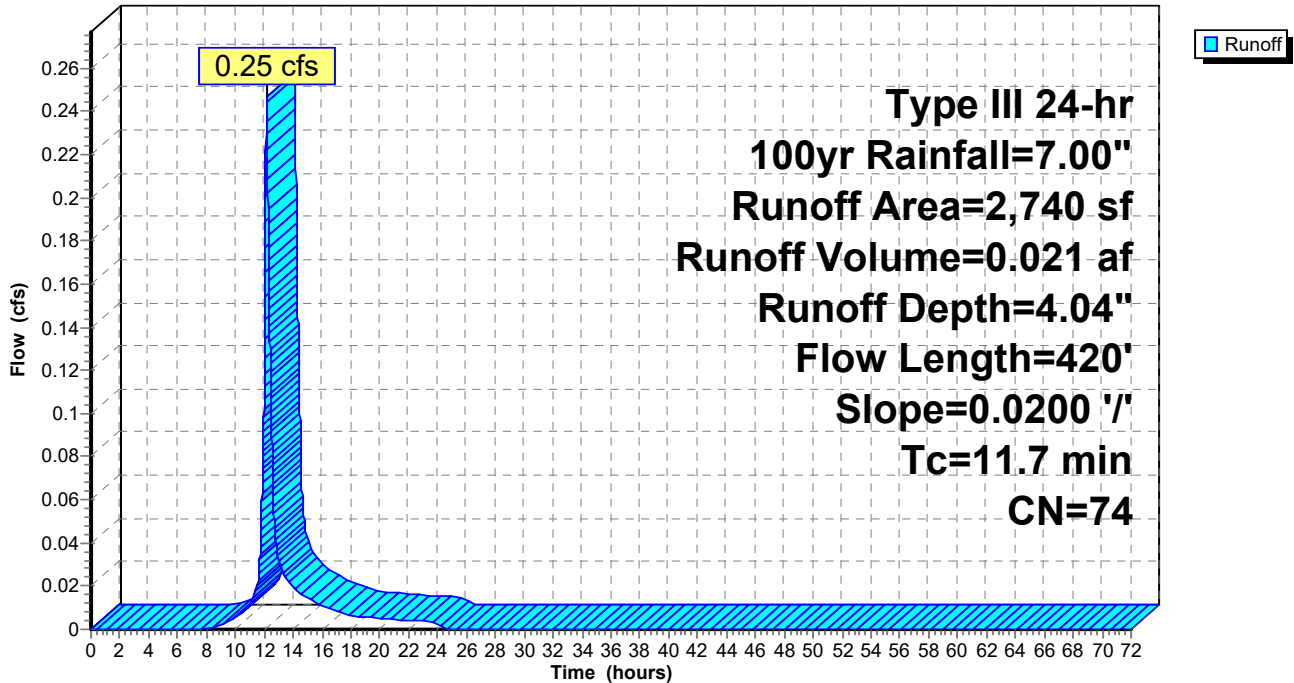
Area (sf)	CN	Description
2,740	74	>75% Grass cover, Good, HSG C
2,740		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0200	0.15		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
6.2	370	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.7	420	Total			

**Subcatchment S-4: Offsite Runoff**

Hydrograph



### Summary for Reach P-1: 12" HDPE

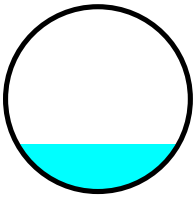
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 6.76" for 100yr event  
 Inflow = 1.58 cfs @ 12.08 hrs, Volume= 0.129 af  
 Outflow = 1.58 cfs @ 12.08 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 9.94 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity = 3.28 fps, Avg. Travel Time= 0.1 min

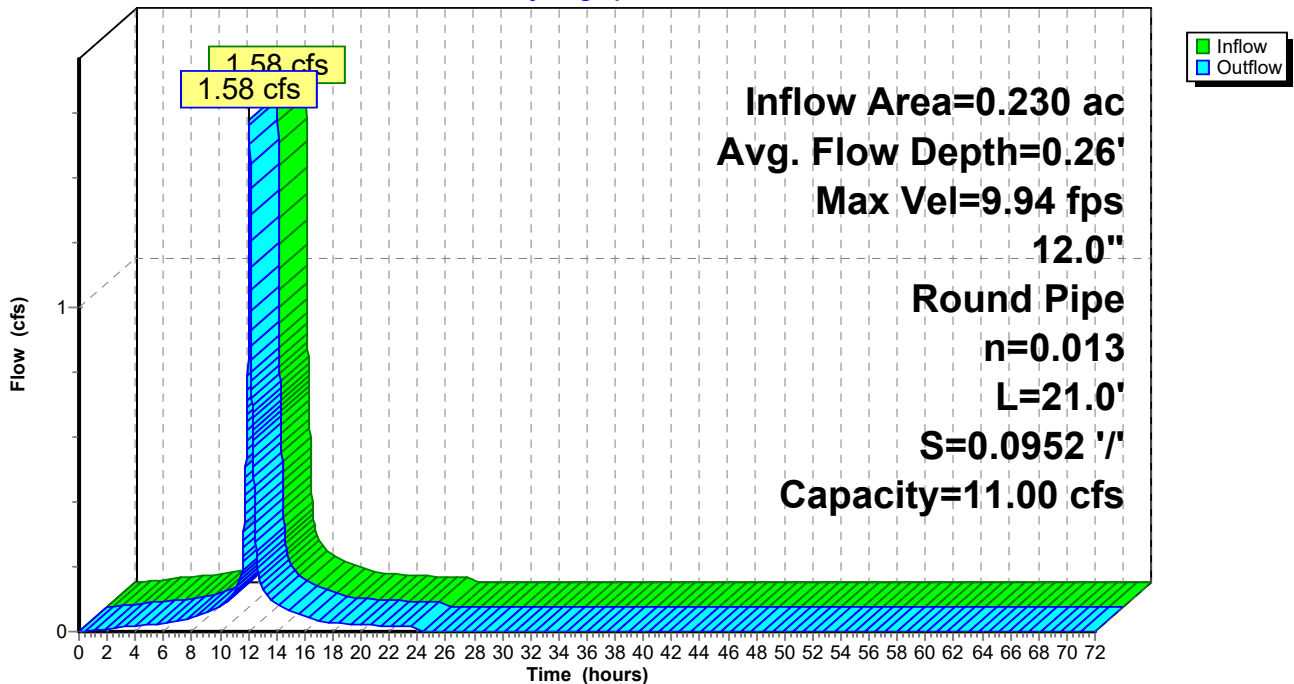
Peak Storage= 3 cf @ 12.08 hrs  
 Average Depth at Peak Storage= 0.26'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 11.00 cfs

12.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 21.0' Slope= 0.0952 '/'  
 Inlet Invert= 7.00', Outlet Invert= 5.00'



### Reach P-1: 12" HDPE

Hydrograph





**Summary for Reach P-2: 12" HDPE**

[52] Hint: Inlet/Outlet conditions not evaluated

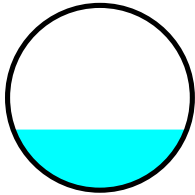
[81] Warning: Exceeded Pond SRS-1 by 0.02' @ 25.63 hrs

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 4.57" for 100yr event  
Inflow = 1.45 cfs @ 12.12 hrs, Volume= 0.087 af  
Outflow = 1.44 cfs @ 12.12 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Max. Velocity= 6.47 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 2.19 fps, Avg. Travel Time= 0.4 min

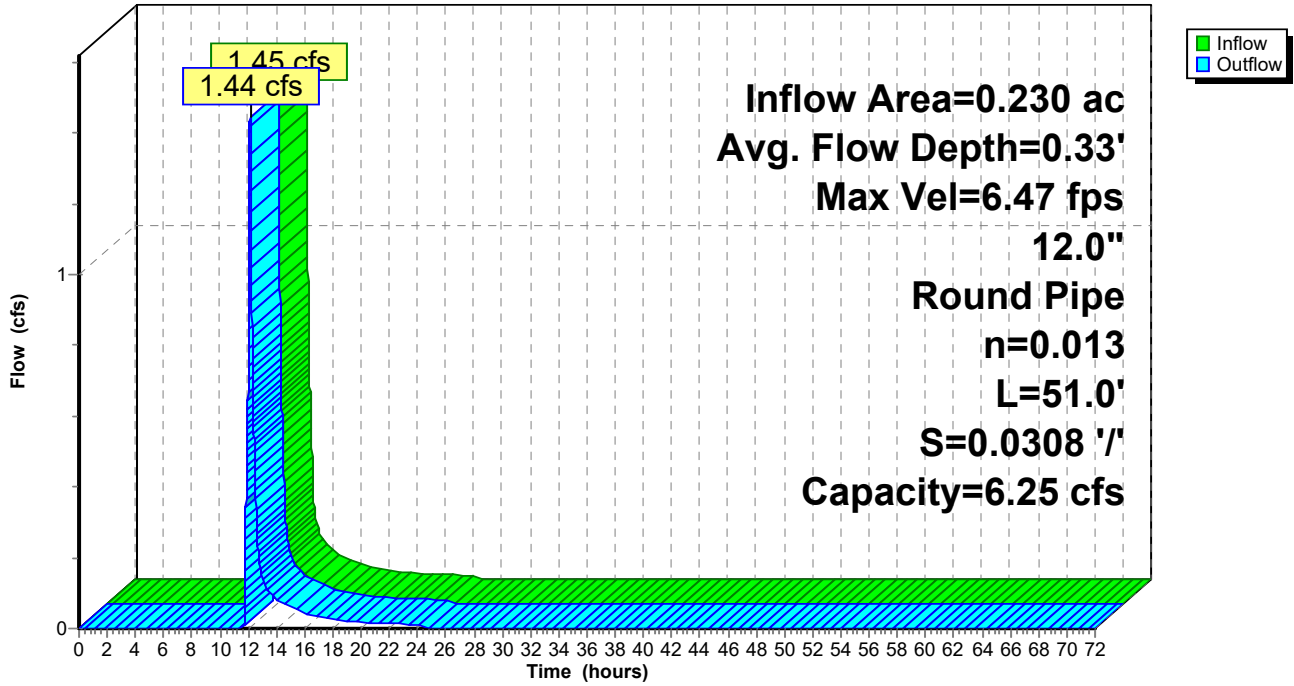
Peak Storage= 11 cf @ 12.12 hrs  
Average Depth at Peak Storage= 0.33'  
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 6.25 cfs

12.0" Round Pipe  
n= 0.013 Corrugated PE, smooth interior  
Length= 51.0' Slope= 0.0308 '/  
Inlet Invert= 7.46', Outlet Invert= 5.89'



### Reach P-2: 12" HDPE

Hydrograph



### Summary for Reach P-3: 18" HDPE

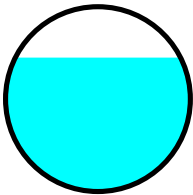
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 6.07" for 100yr event  
 Inflow = 6.49 cfs @ 12.10 hrs, Volume= 0.501 af  
 Outflow = 6.49 cfs @ 12.10 hrs, Volume= 0.501 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 4.74 fps, Min. Travel Time= 0.1 min  
 Avg. Velocity = 1.58 fps, Avg. Travel Time= 0.3 min

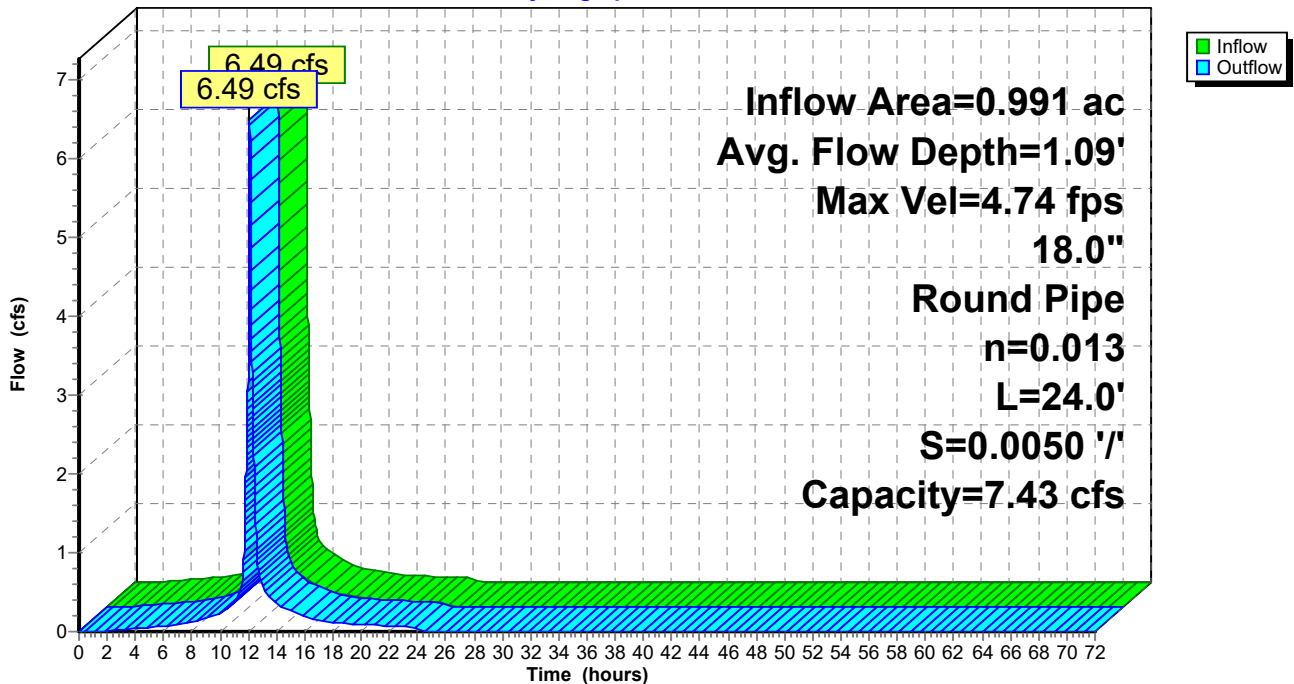
Peak Storage= 33 cf @ 12.10 hrs  
 Average Depth at Peak Storage= 1.09'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe  
 n= 0.013  
 Length= 24.0' Slope= 0.0050 '/'  
 Inlet Invert= 5.89', Outlet Invert= 5.77'



### Reach P-3: 18" HDPE

Hydrograph



### Summary for Reach WQI-1: Water Quality Inlet

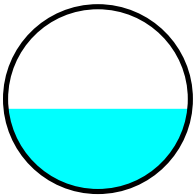
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.367 ac, 95.99% Impervious, Inflow Depth = 6.64" for 100yr event  
 Inflow = 2.51 cfs @ 12.08 hrs, Volume= 0.203 af  
 Outflow = 2.51 cfs @ 12.08 hrs, Volume= 0.203 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 7.40 fps, Min. Travel Time= 0.0 min  
 Avg. Velocity = 2.48 fps, Avg. Travel Time= 0.1 min

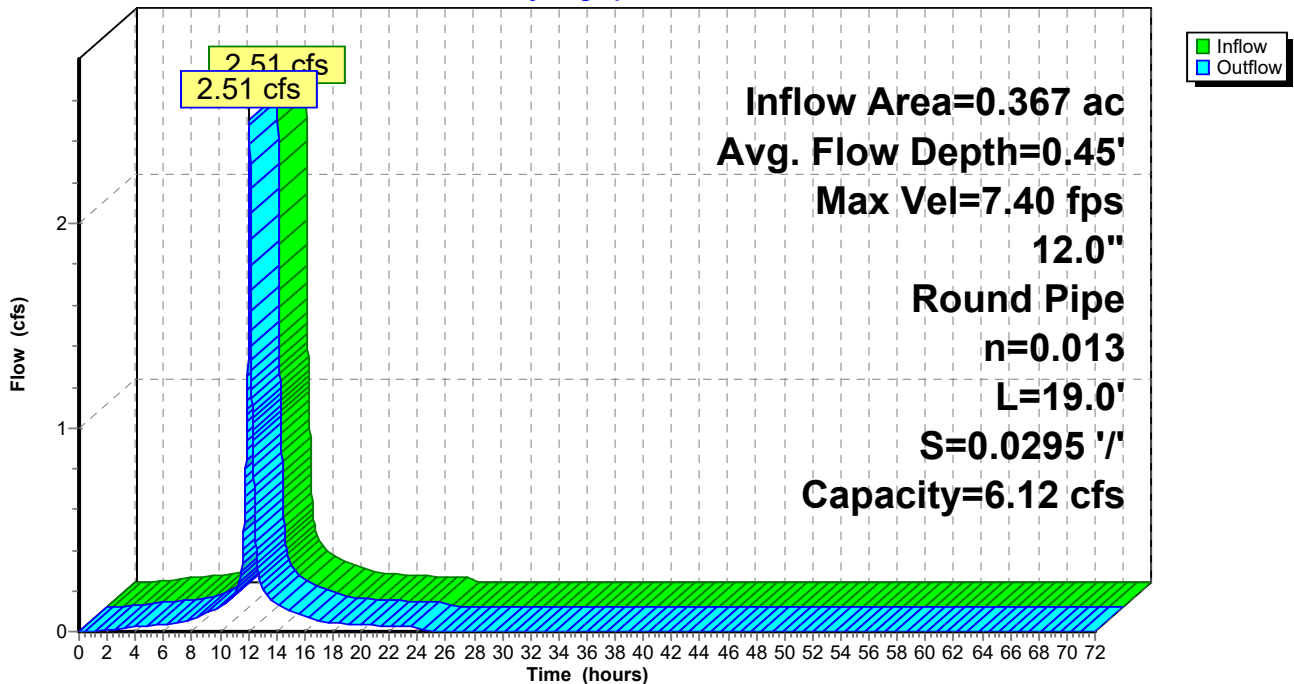
Peak Storage= 6 cf @ 12.08 hrs  
 Average Depth at Peak Storage= 0.45'  
 Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 6.12 cfs

12.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 19.0' Slope= 0.0295 '/'  
 Inlet Invert= 6.45', Outlet Invert= 5.89'



### Reach WQI-1: Water Quality Inlet

Hydrograph



### Summary for Reach WQI-2: Water Quality Inlet

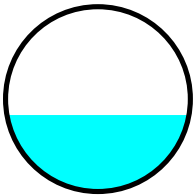
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.395 ac, 89.01% Impervious, Inflow Depth = 6.41" for 100yr event  
 Inflow = 2.67 cfs @ 12.08 hrs, Volume= 0.211 af  
 Outflow = 2.64 cfs @ 12.11 hrs, Volume= 0.211 af, Atten= 1%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 3.85 fps, Min. Travel Time= 0.9 min  
 Avg. Velocity = 1.26 fps, Avg. Travel Time= 2.7 min

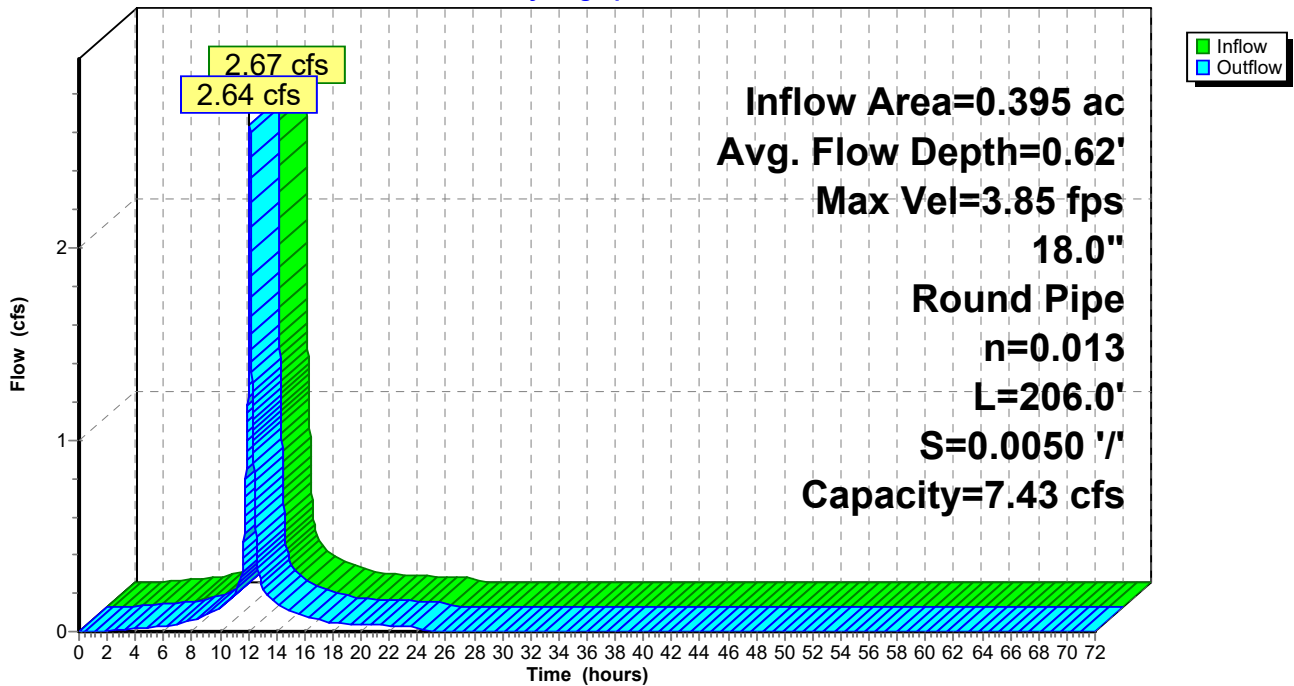
Peak Storage= 142 cf @ 12.09 hrs  
 Average Depth at Peak Storage= 0.62'  
 Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe  
 n= 0.013 Corrugated PE, smooth interior  
 Length= 206.0' Slope= 0.0050 '/'  
 Inlet Invert= 6.92', Outlet Invert= 5.89'



### Reach WQI-2: Water Quality Inlet

Hydrograph



### Summary for Pond DMH-1: Drain Manhole

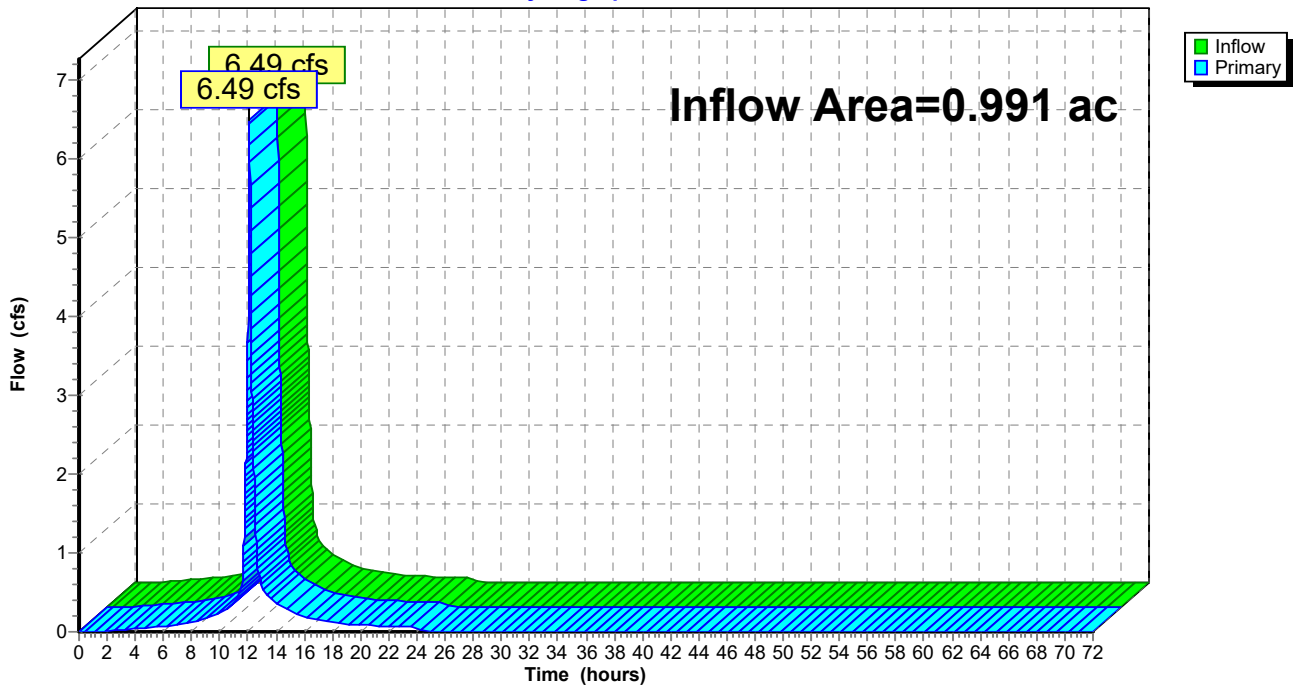
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 6.07" for 100yr event  
Inflow = 6.49 cfs @ 12.10 hrs, Volume= 0.501 af  
Primary = 6.49 cfs @ 12.10 hrs, Volume= 0.501 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

### Pond DMH-1: Drain Manhole

Hydrograph



### Summary for Pond DMH-2: Existing Drain Manhole

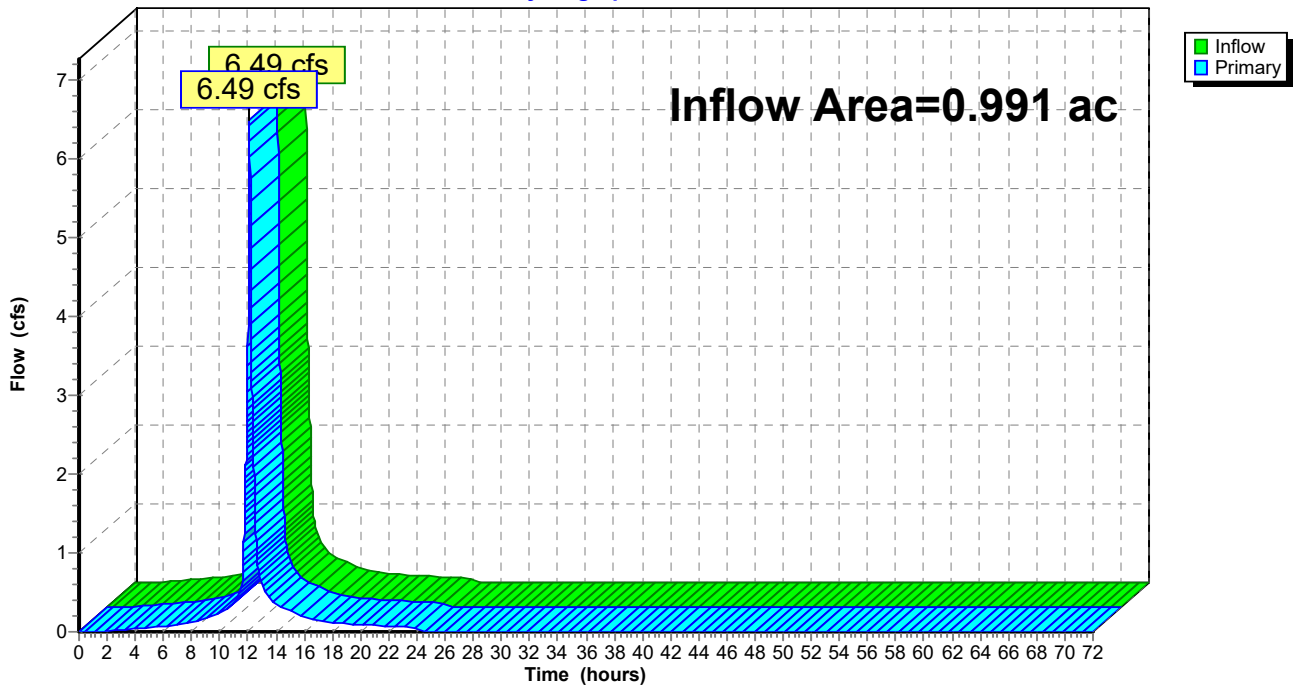
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.991 ac, 94.14% Impervious, Inflow Depth = 6.07" for 100yr event  
Inflow = 6.49 cfs @ 12.10 hrs, Volume= 0.501 af  
Primary = 6.49 cfs @ 12.10 hrs, Volume= 0.501 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

### Pond DMH-2: Existing Drain Manhole

Hydrograph



**Summary for Pond SRS-1: Subsurface Recharge System**

[63] Warning: Exceeded Reach P-1 INLET depth by 0.96' @ 12.13 hrs

Inflow Area = 0.230 ac, 100.00% Impervious, Inflow Depth = 6.76" for 100yr event  
 Inflow = 1.58 cfs @ 12.08 hrs, Volume= 0.129 af  
 Outflow = 1.45 cfs @ 12.12 hrs, Volume= 0.112 af, Atten= 8%, Lag= 2.1 min  
 Discarded = 0.00 cfs @ 2.00 hrs, Volume= 0.025 af  
 Primary = 1.45 cfs @ 12.12 hrs, Volume= 0.087 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
 Peak Elev= 8.20' @ 12.12 hrs Surf.Area= 684 sf Storage= 1,801 cf

Plug-Flow detention time= 448.0 min calculated for 0.112 af (87% of inflow)  
 Center-of-Mass det. time= 387.9 min ( 1,131.0 - 743.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	4.25'	1,046 cf	<b>16.68'W x 41.00'L x 5.75'H Prismaoid</b> 3,932 cf Overall - 1,317 cf Embedded = 2,616 cf x 40.0% Voids
#2	5.00'	1,317 cf	<b>Cultec R-902HD x 20 Inside #1</b> Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 20 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		2,363 cf	Total Available Storage

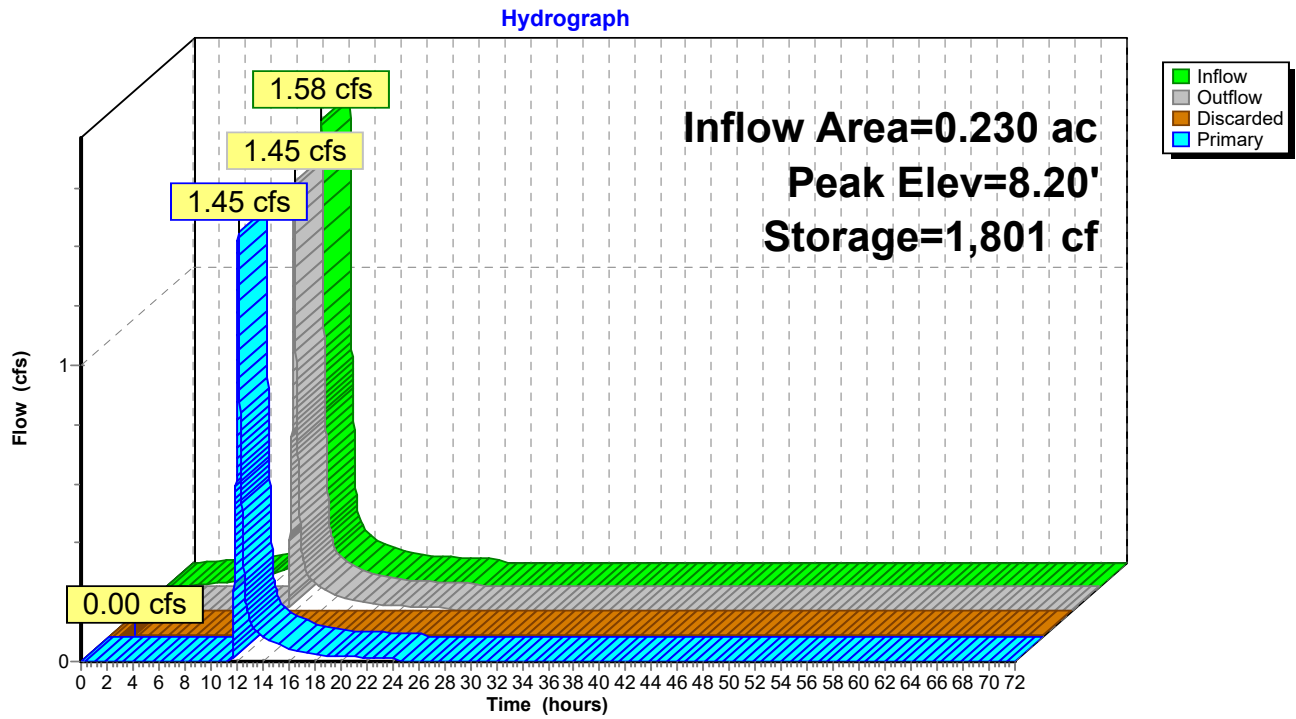
Device	Routing	Invert	Outlet Devices
#1	Discarded	4.25'	<b>0.270 in/hr Exfiltration over Surface area</b>
#2	Primary	7.46'	<b>12.0" Round Culvert</b> L= 51.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 7.46' / 5.89' S= 0.0308 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Discarded OutFlow** Max=0.00 cfs @ 2.00 hrs HW=4.31' (Free Discharge)  
 ↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=1.44 cfs @ 12.12 hrs HW=8.20' (Free Discharge)  
 ↑**2=Culvert** (Inlet Controls 1.44 cfs @ 2.31 fps)



### Pond SRS-1: Subsurface Recharge System



# RECHARGE CALCULATIONS



### **STANDARD 3: RECHARGE CALCULATIONS**

#### **REQUIRED:**

$$\begin{aligned} \text{Recharge Volume Required ("C" Soils)} &= [\text{Impervious Area} \times (\text{Recharge Depth} \\ &\text{inches}/12)] \\ &= [39,890 \text{ sf} \times (0.25"/12)] \\ &= \underline{831 \text{ cf}} \text{ (Required Volume)} \end{aligned}$$

$$\text{Total Required Recharge Volume} = \underline{831 \text{ cf}}$$

#### **STATIC METHOD:**

- Assume the entire Required Recharge Volume is discharged into the infiltration device before infiltration begins.

#### **PROVIDED:**

##### **Subsurface Infiltration System #1:**

- Cumulative Volume below the lowest outlet (Elev.=7.46) = 1,317 c.f.  
Total = 1,317 c.f.

Recharge Volume Provided >>> Recharge Volume Required  
1,317 c.f. >>> 831 c.f.

# TSS REMOVAL CALCULATIONS

**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

TSS Removal Calculation Worksheet	B	C	D	E	F
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
	Street Sweeping - 10%	0.10	1.00	0.10	0.90
	Subsurface Infiltration Structure	0.80	0.90	0.72	0.18
		0.00	0.18	0.00	0.18
		0.00	0.18	0.00	0.18
		0.00	0.18	0.00	0.18

**Total TSS Removal =**

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

Project:

Prepared By:

Date:

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed  
 1. From MassDEP Stormwater Handbook Vol. 1

**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

	B	C	D	E	F
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
<b>TSS Removal Calculation Worksheet</b>	Street Sweeping - 10%	0.10	1.00	0.10	0.90
	Oil Grit Separator	0.25	0.90	0.23	0.68
		0.00	0.68	0.00	0.68
		0.00	0.68	0.00	0.68
		0.00	0.68	0.00	0.68

**Total TSS Removal =**

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

Project:

Prepared By:

Date:

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed  
 1. From MassDEP Stormwater Handbook Vol. 1

# LONG TERM POLLUTION PREVENTION PLAN



# Long Term Pollution Prevention Plan

## **Site Plan** **Map 25 Lots 154 & 298** **WS Orchard Street** **New Bedford, MA 02744**

**June 5, 2019**

### **Record Owner(s):**

New Bedford Retail, LLC  
83 Orchard Hill Park Drive  
Leominster, MA 01453

### **Prepared For:**

Lisciotti Development Co.  
83 Orchard Hill Park Drive  
Leominster, MA 01453

### **Prepared By:**

Farland Corp.  
401 County Street  
New Bedford, MA 02740



## **Long Term Pollution Prevention Plan**

This Long Term Pollution Prevention Plan serves to outline good housekeeping practices in order to prevent pollution of the wetland resource areas and surrounding environment. The Long Term Operation & Maintenance Plan shall be taken as part of this document as it is a critical part of this plan and shall be adhered to. Proper operation and maintenance records shall be kept on file at all times.

Snow disposal shall be carried out by the owner. The owner should follow DEP guideline #BWR G2015-01 for all snow removal requirements. For this site, it is anticipated that snow will be plowed from the impervious parking and driveway areas and piled along the shoulders of the driveway areas. Snow along the building is anticipated to be removed by shovel or snow blower.

Snow disposal in the following areas are prohibited:

- Dumping snow in the bordering vegetated wetlands is prohibited.
- Dumping of snow on top of storm drain catch basins or in stormwater drainage basin is prohibited. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Illicit discharges to the stormwater management system are prohibited. Illicit discharges are those that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities; firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual residence car washing, flows from riparian habitats and wetlands, de-chlorinated water from swimming pools, water used for street washing, and water used to clean residential buildings without detergents. Measures are provided below to prevent illicit discharges to the stormwater management system.

In order to prevent or minimize the potential for a spill of hazardous substances or oils to contaminate stormwater, a spill control and containment kit, including spill berm, absorbent materials, rags, gloves, and trash containers, shall be readily available. All product manufacturers recommended spill cleanup methods shall be known by maintenance personnel, who shall be trained regarding these procedures and the location of the cleanup procedure information and supplies. In the event of oil, gasoline or other hazardous waste spill on-site, the Norton Fire Department, DEP and the Conservation Agent shall be notified immediately. For spills of less than ¼ gallon, clean-up with absorbent materials or other appropriate means, unless circumstances dictate that the spill should be treated by a professional emergency response contractor. Spills which exceed the reportable quantities of substances mentioned in 40 CFR 110, 40 CFR 117, or 40 CFR 302 must be immediately reported to the EPA National Response Center (800) 242-8802. Any drainage inlet that may be affected by the spill shall be covered

immediately with a spill protector drain cover or similar product, or a spill berm placed around the perimeter of the opening to prevent any contamination into the drainage system. Proper cleanup and disposal of hazardous wastes must follow all applicable local and state regulations and must be carried out by a qualified contractor. Cumberland Farms spill response plan is attached to this document.

The maintenance of all lawns, gardens and landscaped areas shall be performed by the owner. Good housekeeping practices should include proper storage and minimal use of cleaning products and fertilizers. Facility owner should consult with a professional landscaper for proper maintenance of lawns and landscaped areas.

# OPERATION & MAINTENANCE PLAN



# **Long Term Operation and Maintenance Plan**

## **Site Plan Map 25 Lots 154 & 298 WS Orchard Street New Bedford, MA 02744**

**June 5, 2019**

### **Record Owner(s):**

New Bedford Retail, LLC  
83 Orchard Hill Park Drive  
Leominster, MA 01453

### **Prepared For:**

Lisciotti Development Co.  
83 Orchard Hill Park Drive  
Leominster, MA 01453

### **Prepared By:**

Farland Corp.  
401 County Street  
New Bedford, MA 02740

The Operator, Owner, and Party Responsible for Operation and Maintenance of the Stormwater BMP's will be the landowner of the property on which the BMP is located.

The responsible party shall:

- a) Maintain an operation and maintenance log for at least three years, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and disposal location)

## **Street Sweeping**

It shall be the responsibility of the owner to:

Inspections:

Inspect sediment deposit accumulations on the parking lots quarterly.

Maintenance:

Sweep parking lots at least twice annually, during March or April before spring rains wash residual sand from winter applications into stormwater systems, and in the fall after leaf drop.

Dispose of the accumulated sediment and hydrocarbons in accordance with local, state, and federal guidelines and regulations.

## **Drain Manholes**

The catch basins, trench grate, and manholes are to be inspected and maintained by the owner.

It shall be the responsibility of the owner to:

Inspections:

Inspect the catch basins and manholes quarterly.

Maintenance:

Remove accumulated sediment, trash, leaves and debris when the depth of deposits is greater than or equal to one half the depth from the bottom invert of the lowest pipe in the basin and/or manhole to the bottom elevation of the basin or manhole.

If upon inspection, evidence of hydrocarbons is observed, such material shall be immediately removed and disposed of in accordance with local, state, and federal guidelines and regulations.

To remove oil and other hydrocarbons that accumulate, it may be preferable to use adsorbent pads.

Dispose of the accumulated sediment and hydrocarbons in accordance with local, state, and federal guidelines and regulations.

## **CDS® Units**

The units are to be inspected and maintained by the owner.

CDS Units are proprietary products and must comply with manufacturer's inspection and maintenance requirements. Refer to the attached CDS Inspection and Maintenance Guide.

In the event of a spill, refer to Long Term Pollution Prevention Plan for necessary procedures to prevent discharge of petroleum product into the infiltration system.

It shall be the responsibility of the owner to:

### Inspections:

Inspect the units quarterly.

Prepare inspection reports as part of each inspection and include the following information:

1. Date of inspection
2. Maintenance personnel
3. Location of unit (GPS coordinates if possible)
4. Time since last rainfall
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural Deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/ volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/ or maintenance for the units
12. Estimation of time before maintenance is required if not required at time of inspection.

### Maintenance:

Cleaning should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method for removing pollutants from the system. The screen should be power washed to ensure it is free of trash and debris.

The CDS® Unit shall be cleaned once the sediment depth reaches 75% of the storage capacity.

If upon inspection, evidence of hydrocarbons is observed, such material shall be immediately removed and disposed of in accordance with local, state, and federal guidelines and regulations.

To remove oil and other hydrocarbons that accumulate, it may be preferable to use adsorbent pads.

Dispose of the accumulated sediment and hydrocarbons in accordance with local, state, and federal guidelines and regulations.

### **Subsurface Infiltration Chambers**

The subsurface infiltration chambers are to be inspected and maintained by the owner. Subsurface infiltration chambers do not rely on standing pool of water, and have been designed to dewater within 72 hours after precipitation. Therefore, mosquito control is not required for the drainage system.

It shall be the responsibility of the owner to:

#### **Inspections:**

Inspect subsurface structures at least twice annually.

#### **Maintenance:**

If inspection of infiltration system shows that it does not dewater completely within 72 hours of a storm event, the owner shall take immediate steps to restore the function of the system, based on the recommendations of a qualified stormwater professional. Notice shall be provided to the Town of any such corrective action.

Any debris which may clog the system must be removed. Cleaning may be done by either clamshell bucket or vacuum truck. All sediment and hydrocarbons shall be properly disposed of in accordance with local, state, and federal guidelines and regulations.

### **Drain Lines**

After construction, the drain lines shall be inspected after every major storm for the first few months to ensure proper functions. Presence of accumulated sand and silt would indicate more frequent maintenance of the pre-treatment devices is required. Thereafter, the drain lines shall be inspected at least once per year. Accumulated silt shall be removed by a vacuum truck or other method preferred.

## **Access Ways & Parking Areas**

### Inspections:

- Inspect Daily
- Clear any debris daily
- Sweep bi-annually
- Repair cracks and potholes as needed
- Maintain painted lines as necessary for visibility

## **Fences/Walls**

### Inspections:

- Inspect Monthly
- Remove debris and litter daily
- Repair as necessary

## **Landscaping**

### Inspections:

- Inspect weekly
- Remove debris and litter as necessary
- Prune and fertilize bi-annually
- Mow lawn as necessary
- Fertilize quarterly



# ILLICIT DISCHARGE STATEMENT



June 5, 2019

New Bedford Planning Board  
City Hall, Rm 303  
133 William Street  
New Bedford, MA 02740

**RE: Site Plan – WS Orchard Street  
Illicit Discharge Compliance Statement (IDCS)**

To whom it concerns,

As required, we are submitting this Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site or are proposed. We have included in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.

The site plan identifies the location of any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system.

Please feel free to contact us if you should need any further information.

Very Truly Yours,

THOMPSON FARLAND, INC.

*Christian A. Farland*  
Christian A. Farland, P.E., LEED AP  
Principal Engineer and President

# PIPE CAPACITY CALCULATIONS



**PIPE CAPACITY CALCULATIONS**

10 YEAR STORM EVENT													
Pipe Description				Drainage Area (Acres)			Comp. C-Value	CA	Time of Concentration (min)			I (in./hr)	Qc=CA (cfs)
Length #	DA #	From	To	Total	Imperv. C=0.90	Pervious C=0.30			Inlet	Drain	Total		
<b>DRAINAGE PIPES</b>													
1		Roof	SRS	0.230	0.230	0.000	0.90	0.207	6	0.04	6.04	4.8	0.99
2		SRS	DHM-1	0.230	0.230	0.000	0.90	0.207	6	0.14	6.14	4.8	0.99
3		WQI-1	DMH-1	0.367	0.352	0.015	0.88	0.321	6	0.05	6.05	4.8	1.54
4		WQI-2	DMH-1	0.395	0.352	0.043	0.83	0.330	6	1.00	7.00	4.8	1.58
5		DMH-1	DMH-2	0.992	0.934	0.058	0.86	0.858	6	0.09	6.09	4.8	4.12

Length #	Pipe Diameter (in)	Pipe Material (n-value)	Slope (ft./ft.)	Length (ft)	Full Flow			Current Flow				Pipe capacity
					Vf (ft/sec)	Qf (cfs)	Vc (ft/sec)	Qc (cfs)	Qc/Qf	d/D (in.)	Flow Depth in pipe (in)	Flow capacity check
<b>DRAINAGE PIPES</b>												
1	12	0.013	0.0950	21	13.98	10.98	8.86	0.99	0.09	0.2	2.4	OK!
2	12	0.013	0.0310	51	7.99	6.27	6.03	0.99	0.16	0.3	3.3	OK!
3	12	0.013	0.0290	19	7.73	6.07	6.62	1.54	0.25	0.3	4.1	OK!
4	18	0.013	0.0050	206	4.20	7.43	3.44	1.58	0.21	0.3	5.6	OK!
5	18	0.013	0.0050	24	4.20	7.43	4.42	4.12	0.55	0.5	9.4	OK!

# WATERSHED PLANS



