



# AvalonBay Communities

## Stormwater Management Report Revised

### Avalon Hingham Shipyard II

Prepared by  
**Howard Stein Hudson**

**February 25, 2016**  
**Revised March 30, 2016**





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# Introduction

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This Stormwater Management Report describes the existing drainage conditions and proposed stormwater best management practices (BMPs) designed to treat and control runoff at Avalon Hingham Shipyard II (the “Project”).

The existing site encompasses approximately 3.8± acres of land. It contains a vacant 163,760± square foot (sf) building and paved parking and loading areas. The majority of the existing site is impervious. Currently, a majority of the site’s stormwater runoff flows overland to USS Amesbury Drive with some runoff flowing to Lincoln Street. The runoff flowing to USS Amesbury Drive flows into two different drainage pipe systems and the runoff flowing to Lincoln Street enters into another drainage system. All three drainage systems flow into Weymouth Back River and ultimately to Hingham Bay. There are six catch basins in the front of the building that, along with the rooftop runoff, appear to discharge into the USS Amesbury Drive drainage system. The parking area to the south of the existing building contains a catch basin that drains into the drainage system on Lincoln Street. The existing runoff generally receives no water quality treatment.

The Project is a new 190-unit, 5-story multi-residential apartment building with a small surface parking lot and a parking garage. The proposed improvements to the site will result in a decrease in impervious area of approximately 0.52 acres. Stormwater BMPs will be constructed to improve the water quality of runoff from the Project and mitigate peak flows. Stormwater BMPs will include deep sump catch basins, proprietary stormwater treatment (water quality) units, and a subsurface recharge system. The system will capture and help reduce pollutant concentrations in the stormwater runoff prior to discharging to the three separate drainage systems.

The Soil Map available from the Natural Resources Conservation Service indicates that the soils on-site are Udorthents (0% to 8% slopes). Hydrologic Soil Group B classification was used as a basis for the calculations. Refer to Appendix A for the Soils Map.

Pre and post-construction hydrology was analyzed with HydroCAD v 10.0, model using TR-20 methodology. The rainfall data was obtained from Technical Paper No. 40 (TP 40) Rainfall Frequency Atlas of the United States for 24 hour storms. The result of this analysis shows there will be a decrease in the peak discharge rates & volumes from the site in the post-development conditions for all the storm events analyzed (Refer to Table 1 for pre- and post-development peak discharge rate comparisons). The Project is a redevelopment project and is designed to the maximum extent practicable to be in compliance with the Massachusetts Department of Environmental Protection’s Stormwater Management Policy for Redevelopment.



Closed drainage system calculations can be found in Appendix E. The Rational Method and the Manning's Equation were used to size the pipes for the stormwater management system.

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## Hydrology

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### PRE-CONSTRUCTION HYDROLOGY

The hydrology calculations analyze three design points: (DP#1) flow drainage system one, (DP#2) flow to drainage system 2, (DP#3) drainage system 3, and (DP#4) drainage system 4. The existing project site was divided into 4 Subcatchment areas. These Subcatchment areas are shown on the plans entitled "Pre-Development Drainage Areas" provided in Appendix B.

Subcatchment E1 collects stormwater from a southwesterly portion of the parking lot and a portion of the building roof which flows directly to Lincoln Street and into a catch basin connected to drainage system 1 (DP#1). Some of the drainage flows into a catch basin located on the existing property which is connected to drainage system 1.

Subcatchment E2 collects stormwater from a southeasterly portion of the parking lot and a small portion of the building roof which flows directly to USS Amesbury Drive and into a catch basin connected to drainage system 2 (DP#2).

A majority of the surface runoff from Subcatchment E3 flows overland in a northeasterly direction into a catch basin on the northern property connected to drainage system 3 (DP#3). The half of the rooftop runoff appears to discharge through two 12-inch outlet pipes located north of the building and into a pipe system that connects to drainage system 3.

Subcatchment E4 collects stormwater from a southwesterly portion of the roof from roof drains that discharge onto the parking lot surface which flows directly to Lincoln Street and into a catch basin connected to drainage system 4 (DP#4).

### POST-CONSTRUCTION HYDROLOGY

The proposed development will improve the stormwater management system by introducing elements to improve the water quality of the runoff. Structural Best Management practices (BMPs) proposed include: deep sump catch basins, a subsurface recharge system, and stormwater treatment units. The proposed project site was divided into 6 subcatchment areas. These subcatchment areas are shown on the plans entitled "Post-Development Drainage Areas" provided in Appendix C.

## **DRAINAGE SYSTEM 1 (DP#1)**

In the proposed condition, stormwater generated to southeast will flow into a water quality inlet structure and into drainage system 1 (DP#1). A small portion of the stormwater from pervious area will flow overland into Lincoln Street and into a catch basin connected to drainage system 1. Drainage system 1 discharges into Weymouth Back River and ultimately to Hingham Bay.

## **DRAINAGE SYSTEM 2 (DP#2)**

In the proposed condition, stormwater generated to the east side of the property next to the building will flow overland into USS Amesbury Drive and into a catch basin connected to drainage system 2. Drainage system 2 discharges into Weymouth Back River and ultimately to Hingham Bay.

## **DRAINAGE SYSTEM 3 (DP#3)**

In the proposed condition, stormwater runoff generated from northern driveway and sidewalk will be collected by deep sump catch basins and treated by water quality structures prior to discharging into the existing drainage system in USS Amesbury Drive. The roof runoff will be piped separately. A portion of the roof runoff will be directed to a subsurface infiltration system within the footprint of the building. The remaining portion of the roof runoff will directly discharge to the existing system. These areas will discharge into drainage system 3 located in USS Amesbury Drive and discharge into Weymouth Back River and ultimately to Hingham Bay.

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# **Stormwater Management Standards**

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## **STANDARD 1: NO NEW UNTREATED DISCHARGES**

The Massachusetts Stormwater Handbook requires that the project demonstrates that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands.

The project will improve the water quality of the runoff leaving the site through the use of deep sump catch basins, a subsurface infiltration system, and water quality treatment units.

## **STANDARD 2: POST-DEVELOPMENT PEAK DISCHARGE RATES NOT TO EXCEED PRE-DEVELOPMENT PEAK DISCHARGE RATES**

The Post-development peak discharge rate is less than the existing peak discharge rate due to the decrease in impervious area and the peak mitigation provided by the installation of a subsurface infiltration system. A summary of the peak discharge rates are in Table 1.



*Table 1. Pre- Vs Post-Development Peak Discharge Rates*

Design Point	Pre-Development Rate (cfs)	Post-Development Rate (cfs)
<b>2-Year Storm Event</b>		
DP #1: Drainage System 1	3.11	1.01
DP #2: Drainage System 2	0.69	0.09
DP #3: Drainage System 3	7.45	7.40
DP #4: Drainage System 4	1.06	0.01
<b>Sub-total</b>	<b>12.31</b>	<b>8.59</b>
<b>10-Year Storm Event</b>		
DP #1: Drainage System 1	4.33	1.91
DP #2: Drainage System 2	0.96	0.20
DP#3: Drainage System 3	10.41	9.66
DP #4: Drainage System 4	1.47	0.02
<b>Sub-total</b>	<b>17.17</b>	<b>11.79</b>
<b>100-Year Storm Event</b>		
DP #1: Drainage System 1	6.47	3.41
DP #2: Drainage System 2	1.44	0.46
DP #3: Drainage System 3	15.62	13.62
DP #4: Drainage System 4	2.20	0.06
<b>Sub-total</b>	<b>25.73</b>	<b>17.53</b>

**STANDARD 3: MINIMIZE OR ELIMINATE LOSS OF ANNUAL RECHARGE TO GROUNDWATER**

The project proposes to decrease the amount of impervious area on site which will allow greater recharge to groundwater than in the existing condition.

**STANDARD 4: STORMWATER MANAGEMENT SYSTEM TO REMOVE 80% OF AVERAGE ANNUAL LOAD OF TOTAL SUSPENDED SOLIDS (TSS)**

The stormwater management system is designed to remove 80% of the average annual total suspended solids (TSS) from a majority of the project site. This is accomplished by the installation of deep sump catch basins and water quality treatment units. The water quality treatment units were designed to treat the 1 inch water quality volume.

## **STANDARD 5: LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS**

The development is not considered a land use that generally produces higher potential pollutant loads.

## **STANDARD 6: STORMWATER DISCHARGES TO CRITICAL AREAS**

The proposed stormwater system does not discharge to a critical area.

## **STANDARD 7: REDEVELOPMENT PROJECTS**

The project is a redevelopment project and improves existing conditions by decreasing the amount of impervious area on site and by treating surface parking and driveways to improve TSS removal. This project meets the requirements of Standards 1, 2, and 4 and meets the requirement to the greatest extent practicable of Standards 3.

## **STANDARD 8: CONTROL CONSTRUCTION-RELATED IMPACTS**

The project will install erosion and sediment controls prior to any major earthwork activity. A Storm Water Pollution Prevention Plan will be prepared in conjunction with the General Permit for Construction Activity that will have to be filed with the Environmental Protection Agency.

## **STANDARD 9: LONG-TERM OPERATION AND MAINTENANCE PLAN**

A long-term operation and maintenance plan is provided for the stormwater management system in Appendix F.

## **STANDARD 10: NO ILLICIT DISCHARGES**

There are no known or proposed illicit connections associated with this project. An illicit discharge compliance statement will be provided by the property owner.



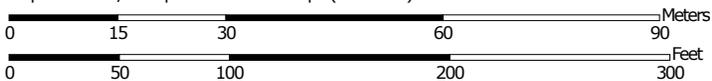
# Appendix A.

## Soil Information

Hydrologic Soil Group—Plymouth County, Massachusetts  
(319 Lincoln Street)



Map Scale: 1:1,040 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84



## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Plymouth County, Massachusetts  
 Survey Area Data: Version 8, Sep 28, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Plymouth County, Massachusetts (MA023)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	B	5.3	100.0%
<b>Totals for Area of Interest</b>			<b>5.3</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

### Rating Options

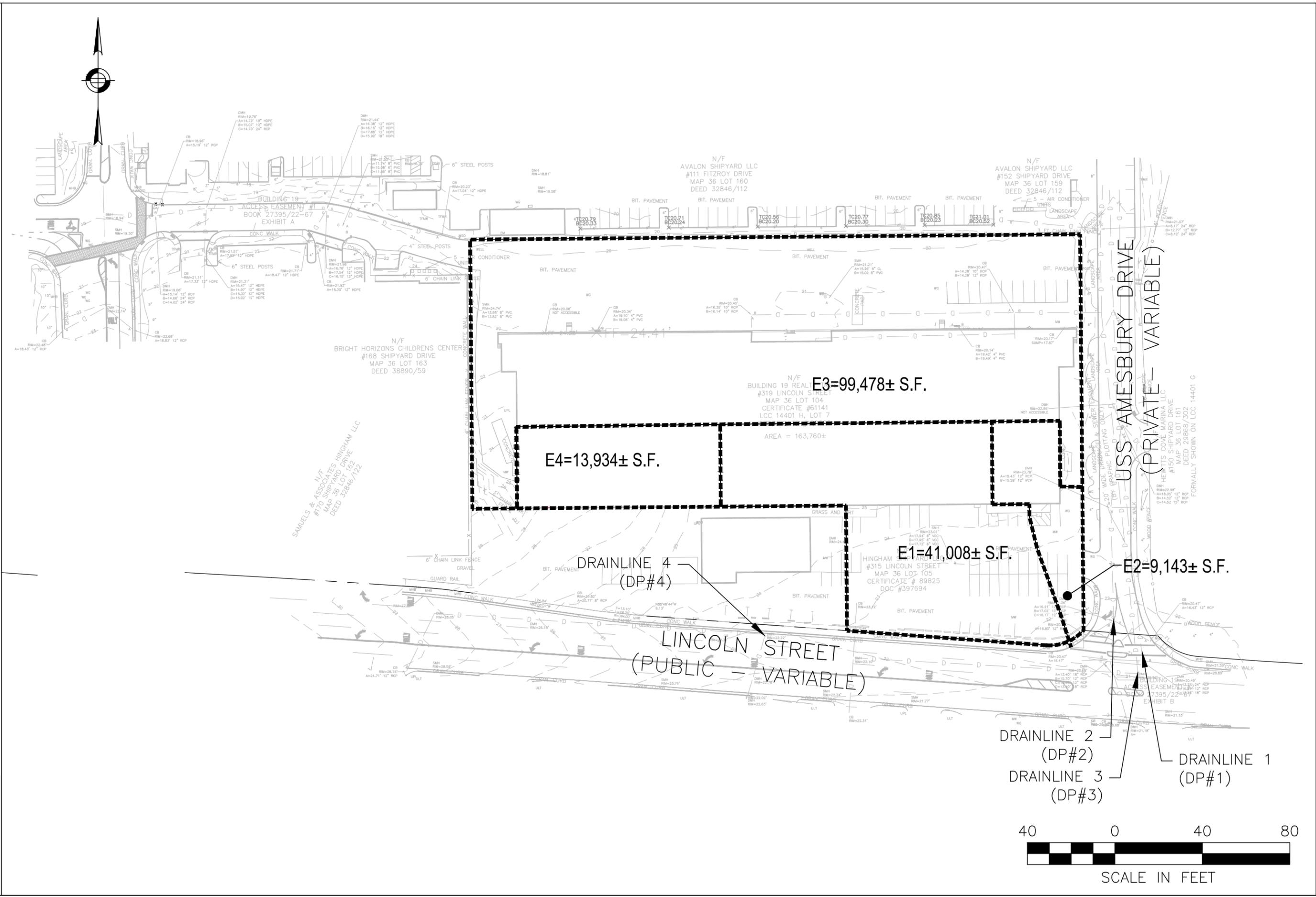
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified



## **Appendix B.**

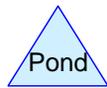
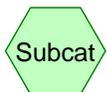
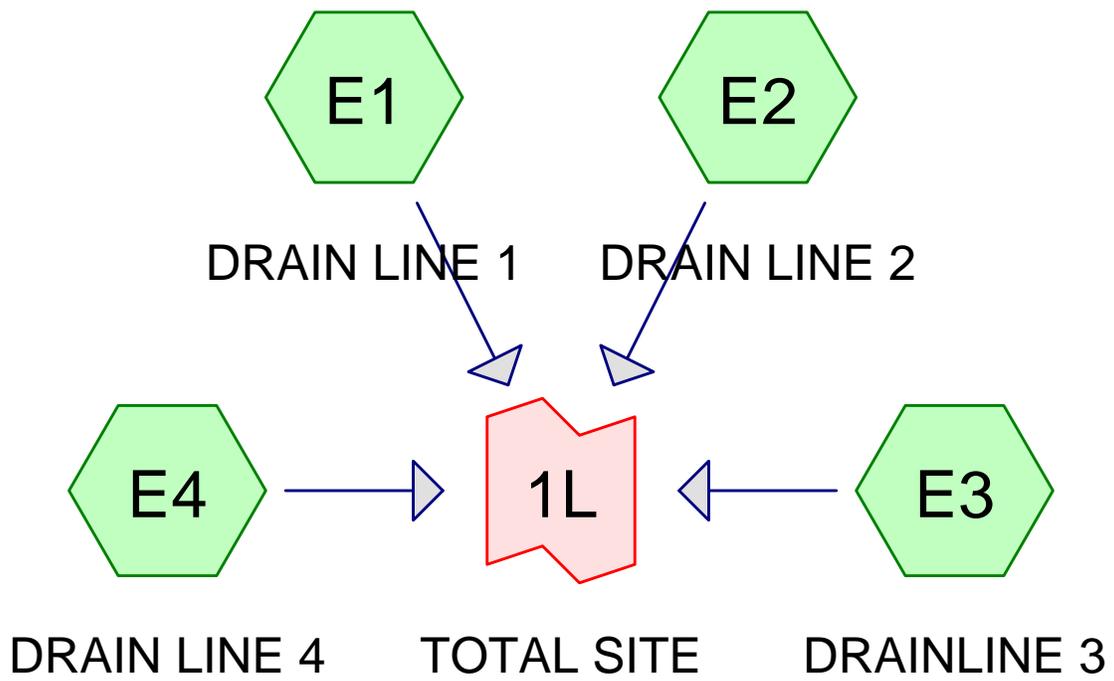
### Pre-Construction Hydrology



**PRE-DEVELOPMENT DRAINAGE AREAS**  
**AVALON BAY HINGHAM SHIPYARD II**

**HOWARD STEIN HUDSON**  
11 Beacon Street, Suite 1010  
Boston, MA 02108  
www.hshassoc.com

**FIGURE**  
**D.1**





PRE

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Avalon Hingham SY II

Type III 24-hr 2-YR Rainfall=3.40"

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### Summary for Subcatchment E1: DRAIN LINE 1

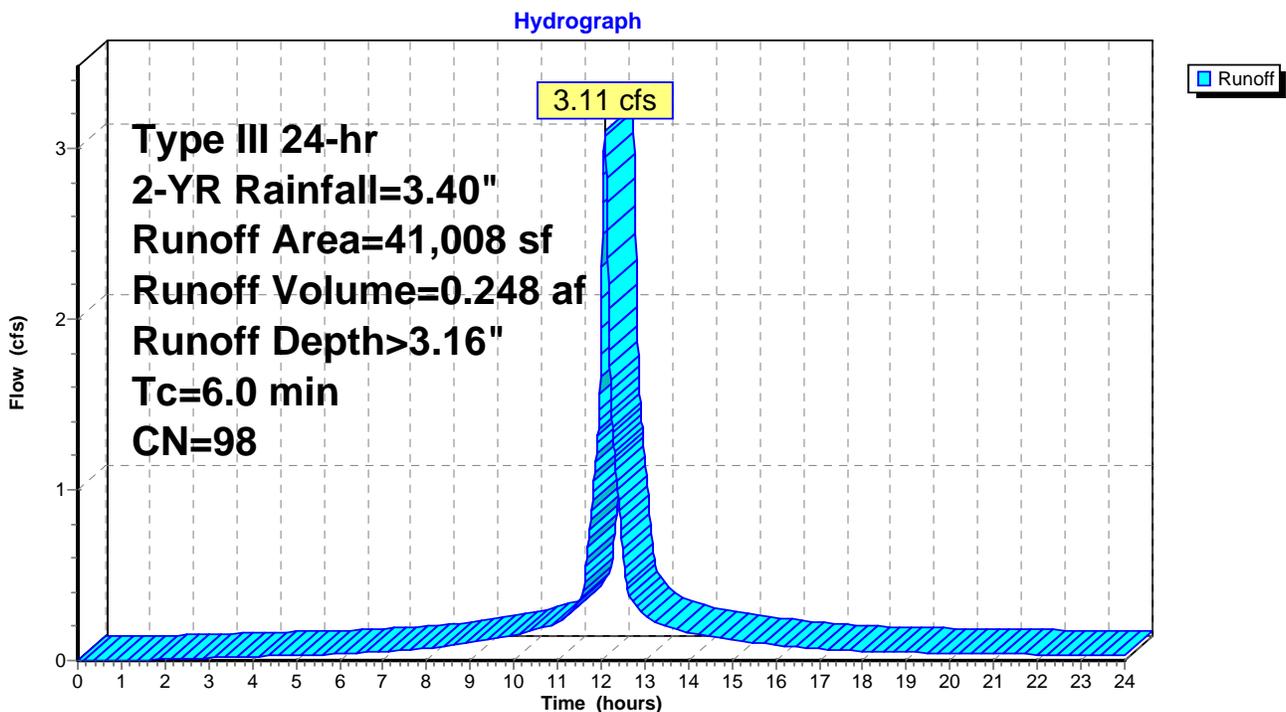
Runoff = 3.11 cfs @ 12.08 hrs, Volume= 0.248 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
22,292	98	Paved parking, HSG B
18,716	98	Roofs, HSG B
41,008	98	Weighted Average
41,008		100.00% Impervious Area

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

### Subcatchment E1: DRAIN LINE 1



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Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment E2: DRAIN LINE 2**

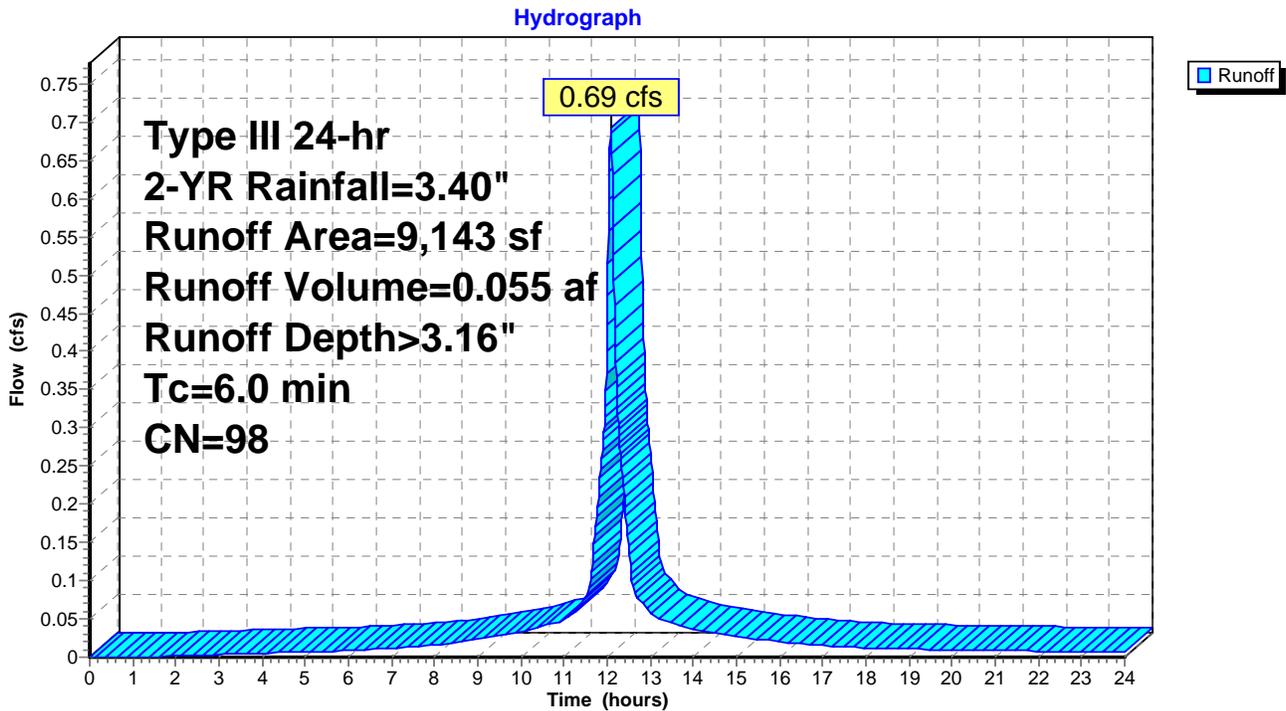
Runoff = 0.69 cfs @ 12.08 hrs, Volume= 0.055 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
4,351	98	Paved parking, HSG B
87	61	>75% Grass cover, Good, HSG B
4,705	98	Roofs, HSG B
9,143	98	Weighted Average
87		0.95% Pervious Area
9,056		99.05% Impervious Area

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

**Subcatchment E2: DRAIN LINE 2**



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Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment E3: DRAINLINE 3**

Runoff = 7.45 cfs @ 12.08 hrs, Volume= 0.581 af, Depth> 3.05"

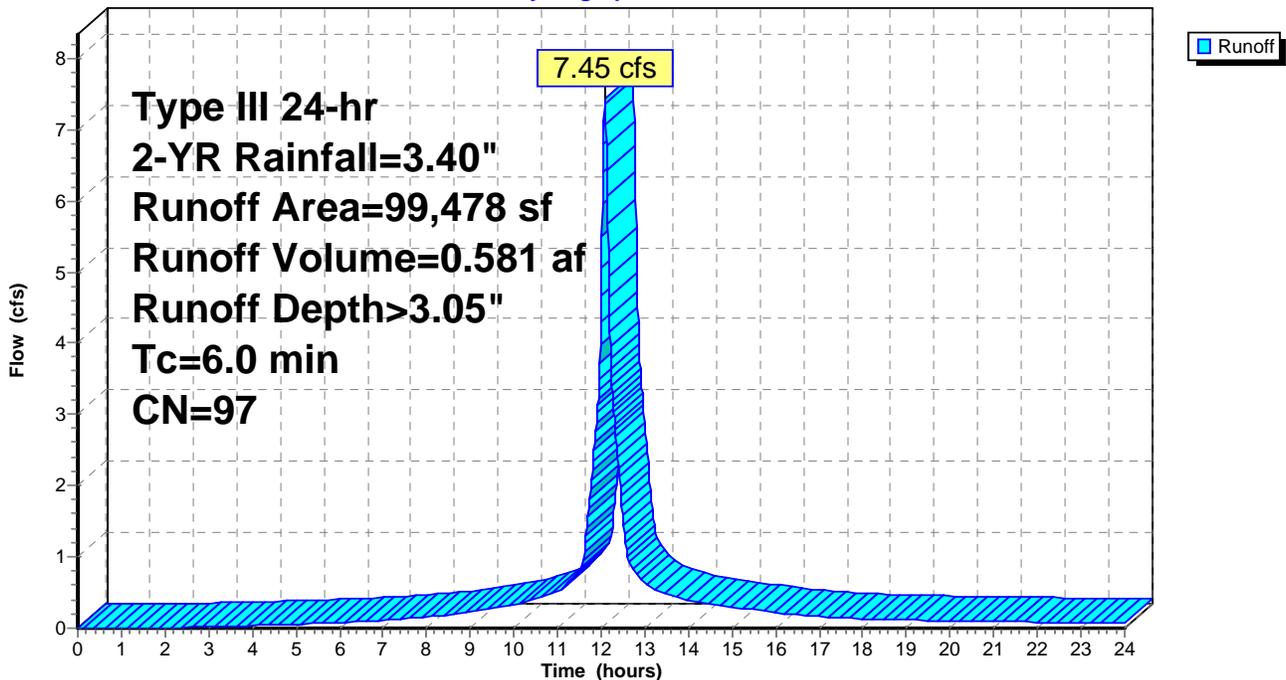
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
54,025	98	Paved parking, HSG B
2,669	61	>75% Grass cover, Good, HSG B
42,784	98	Roofs, HSG B
99,478	97	Weighted Average
2,669		2.68% Pervious Area
96,809		97.32% Impervious Area

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

**Subcatchment E3: DRAINLINE 3**

Hydrograph



PRE

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Type III 24-hr 2-YR Rainfall=3.40"

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### Summary for Subcatchment E4: DRAIN LINE 4

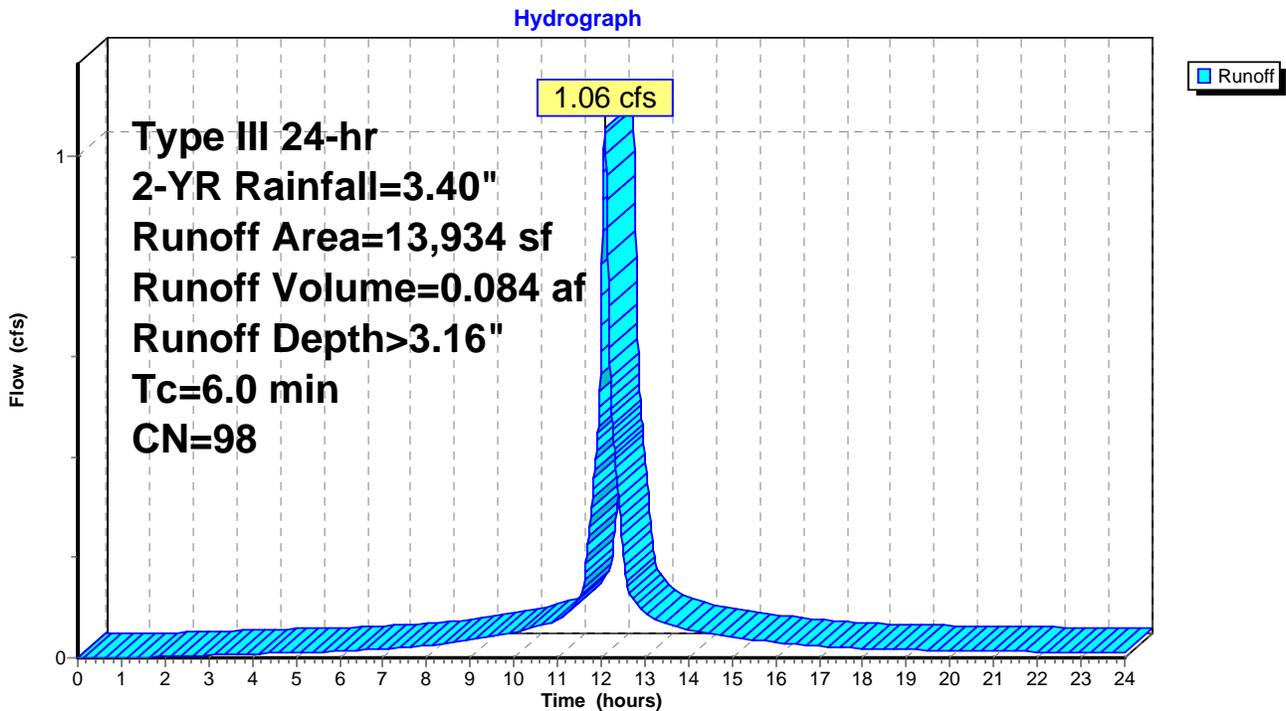
Runoff = 1.06 cfs @ 12.08 hrs, Volume= 0.084 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
13,934	98	Roofs, HSG B
13,934		100.00% Impervious Area

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

### Subcatchment E4: DRAIN LINE 4



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Type III 24-hr 2-YR Rainfall=3.40"

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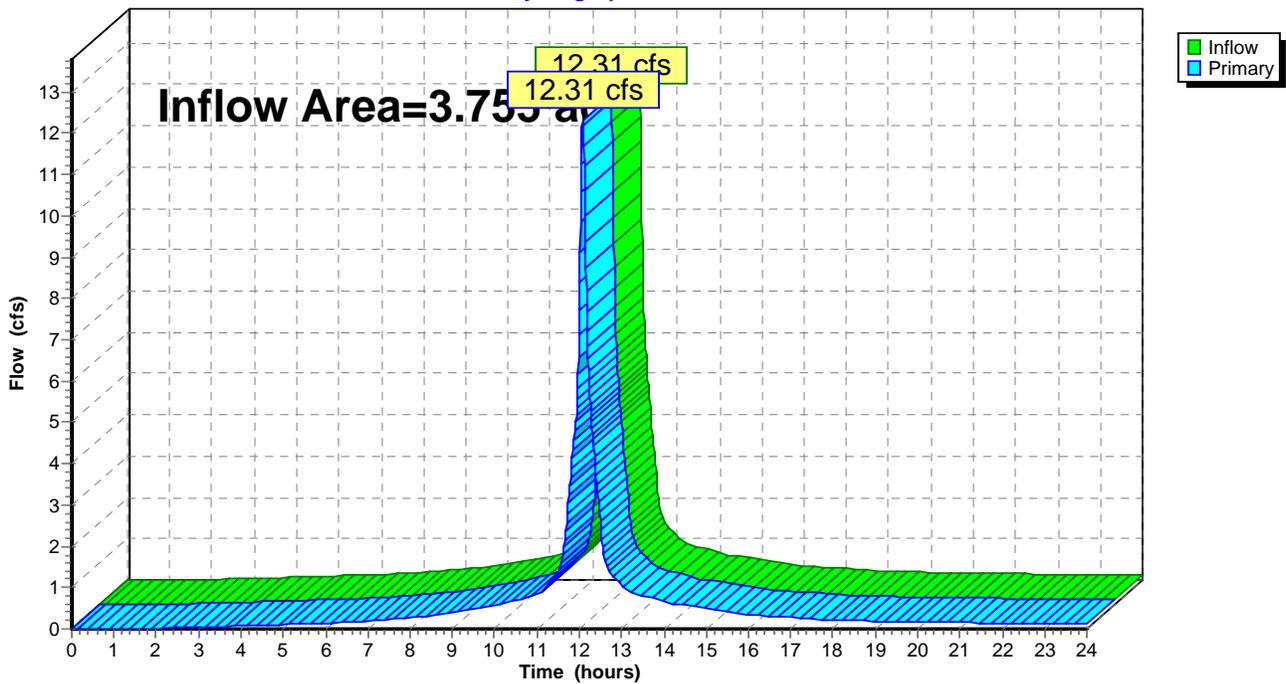
### Summary for Link 1L: TOTAL SITE

Inflow Area = 3.755 ac, 98.32% Impervious, Inflow Depth > 3.10" for 2-YR event  
Inflow = 12.31 cfs @ 12.08 hrs, Volume= 0.969 af  
Primary = 12.31 cfs @ 12.08 hrs, Volume= 0.969 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 1L: TOTAL SITE

Hydrograph



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Avalon Hingham SY II  
Type III 24-hr 10-YR Rainfall=4.70"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 E1: DRAIN LINE 1** Runoff Area=41,008 sf 100.00% Impervious Runoff Depth>4.46"  
Tc=6.0 min CN=98 Runoff=4.33 cfs 0.350 af

**Subcatchment E2: DRAIN LINE 2** Runoff Area=9,143 sf 99.05% Impervious Runoff Depth>4.46"  
Tc=6.0 min CN=98 Runoff=0.96 cfs 0.078 af

**Subcatchment E3: DRAIN LINE 3** Runoff Area=99,478 sf 97.32% Impervious Runoff Depth>4.34"  
Tc=6.0 min CN=97 Runoff=10.41 cfs 0.827 af

**Subcatchment E4: DRAIN LINE 4** Runoff Area=13,934 sf 100.00% Impervious Runoff Depth>4.46"  
Tc=6.0 min CN=98 Runoff=1.47 cfs 0.119 af

**Link 1L: TOTAL SITE** Inflow=17.17 cfs 1.374 af  
Primary=17.17 cfs 1.374 af

**Total Runoff Area = 3.755 ac Runoff Volume = 1.374 af Average Runoff Depth = 4.39"**  
**1.68% Pervious = 0.063 ac 98.32% Impervious = 3.692 ac**

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Type III 24-hr 10-YR Rainfall=4.70"

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### Summary for Subcatchment E1: DRAIN LINE 1

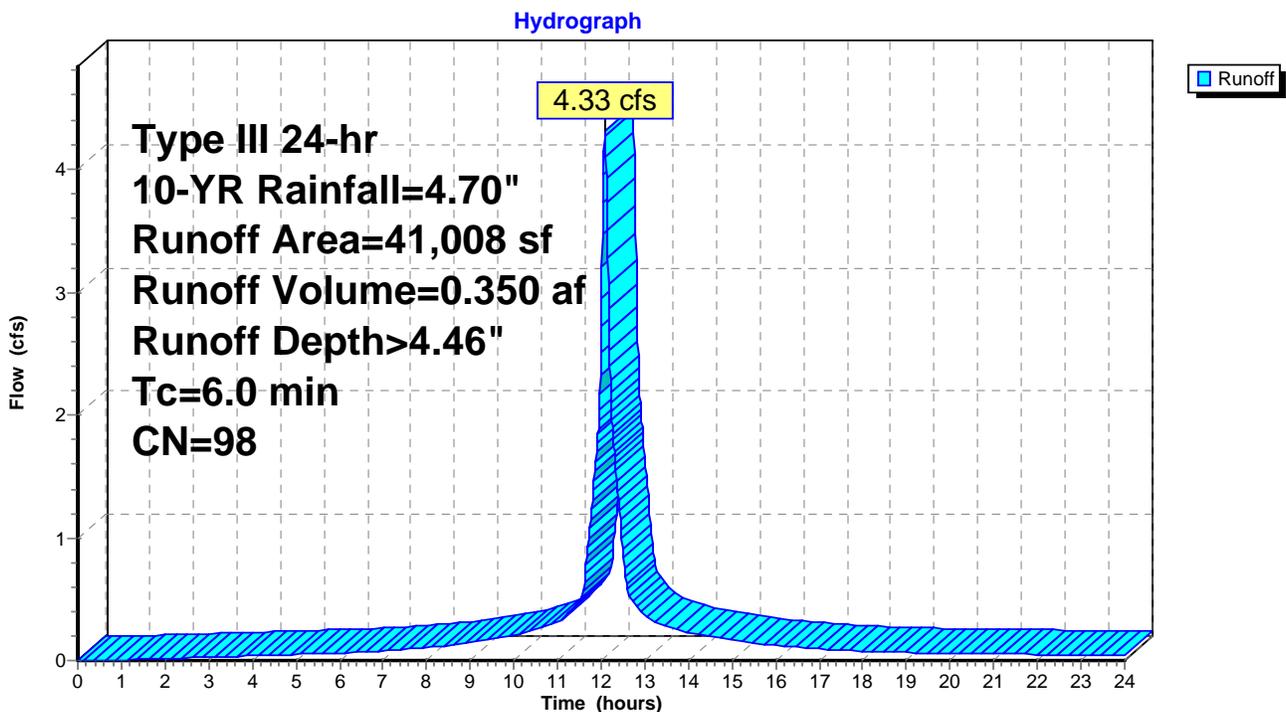
Runoff = 4.33 cfs @ 12.08 hrs, Volume= 0.350 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
22,292	98	Paved parking, HSG B
18,716	98	Roofs, HSG B
41,008	98	Weighted Average
41,008		100.00% Impervious Area

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

### Subcatchment E1: DRAIN LINE 1



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Avalon Hingham SY II

Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment E2: DRAIN LINE 2**

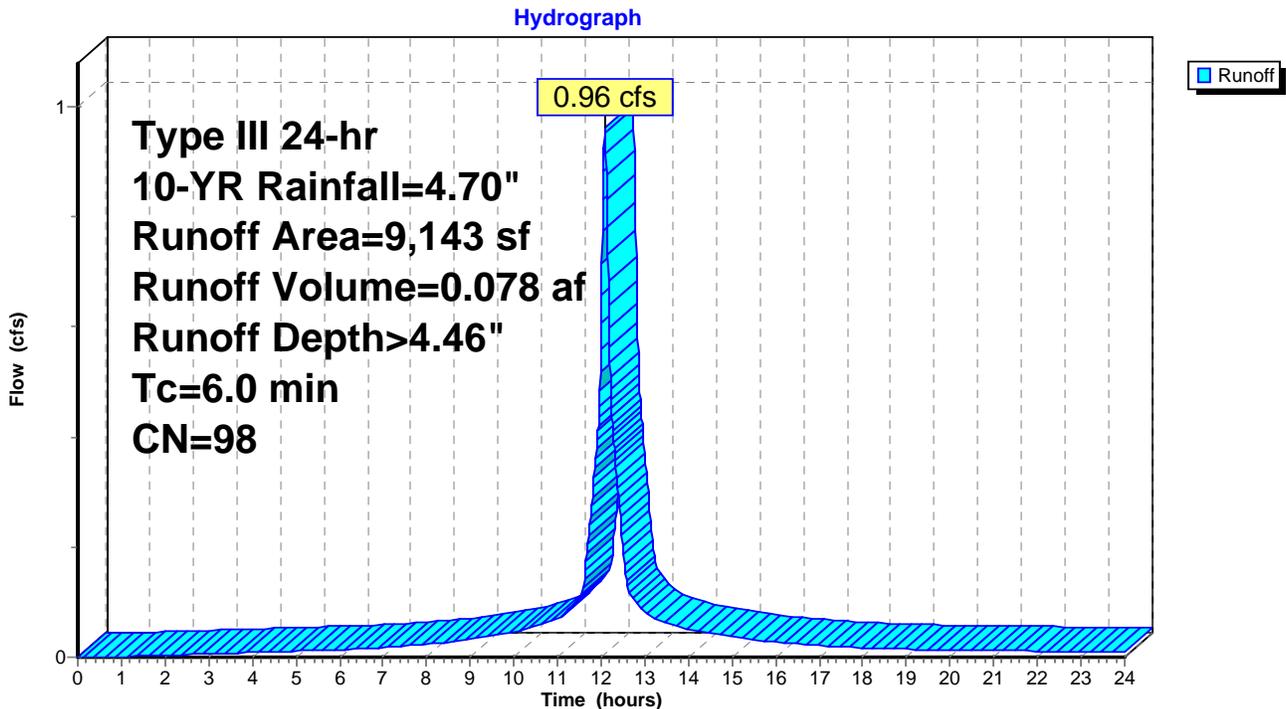
Runoff = 0.96 cfs @ 12.08 hrs, Volume= 0.078 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
4,351	98	Paved parking, HSG B
87	61	>75% Grass cover, Good, HSG B
4,705	98	Roofs, HSG B
9,143	98	Weighted Average
87		0.95% Pervious Area
9,056		99.05% Impervious Area

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

**Subcatchment E2: DRAIN LINE 2**



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Avalon Hingham SY II  
Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment E3: DRAINLINE 3**

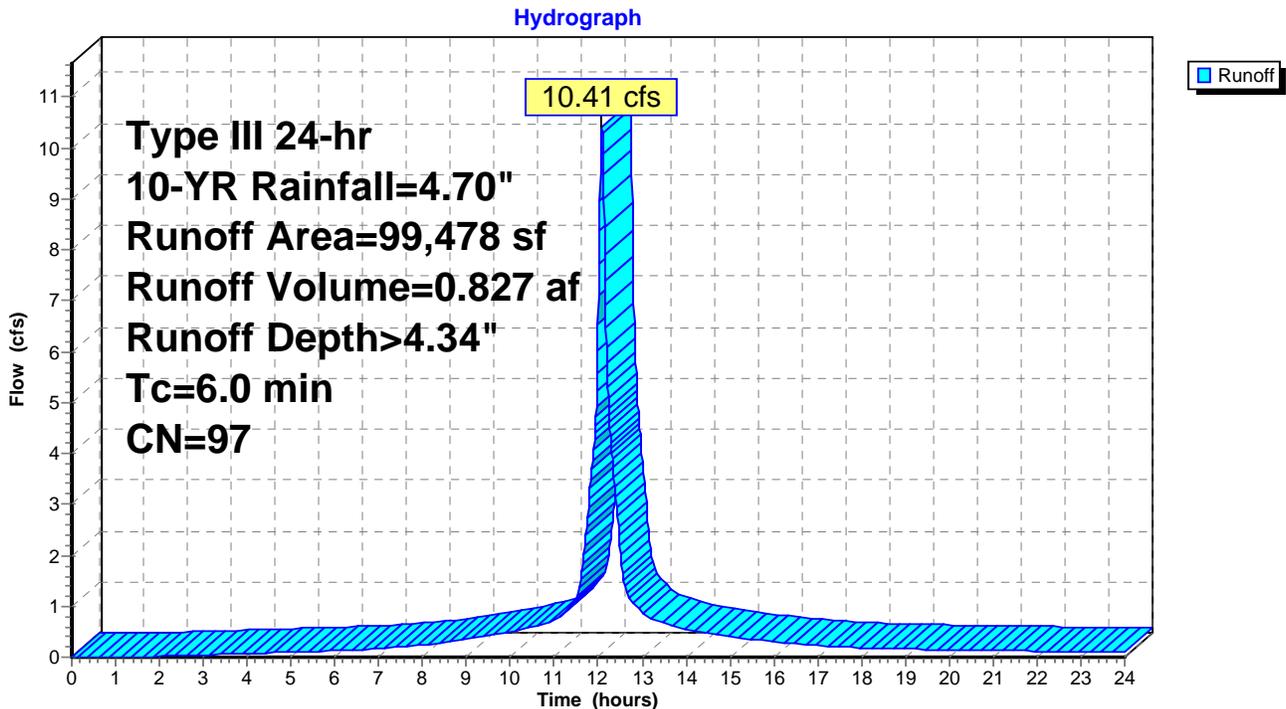
Runoff = 10.41 cfs @ 12.08 hrs, Volume= 0.827 af, Depth> 4.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
54,025	98	Paved parking, HSG B
2,669	61	>75% Grass cover, Good, HSG B
42,784	98	Roofs, HSG B
99,478	97	Weighted Average
2,669		2.68% Pervious Area
96,809		97.32% Impervious Area

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

**Subcatchment E3: DRAINLINE 3**



PRE

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Avalon Hingham SY II

Type III 24-hr 10-YR Rainfall=4.70"

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### Summary for Subcatchment E4: DRAIN LINE 4

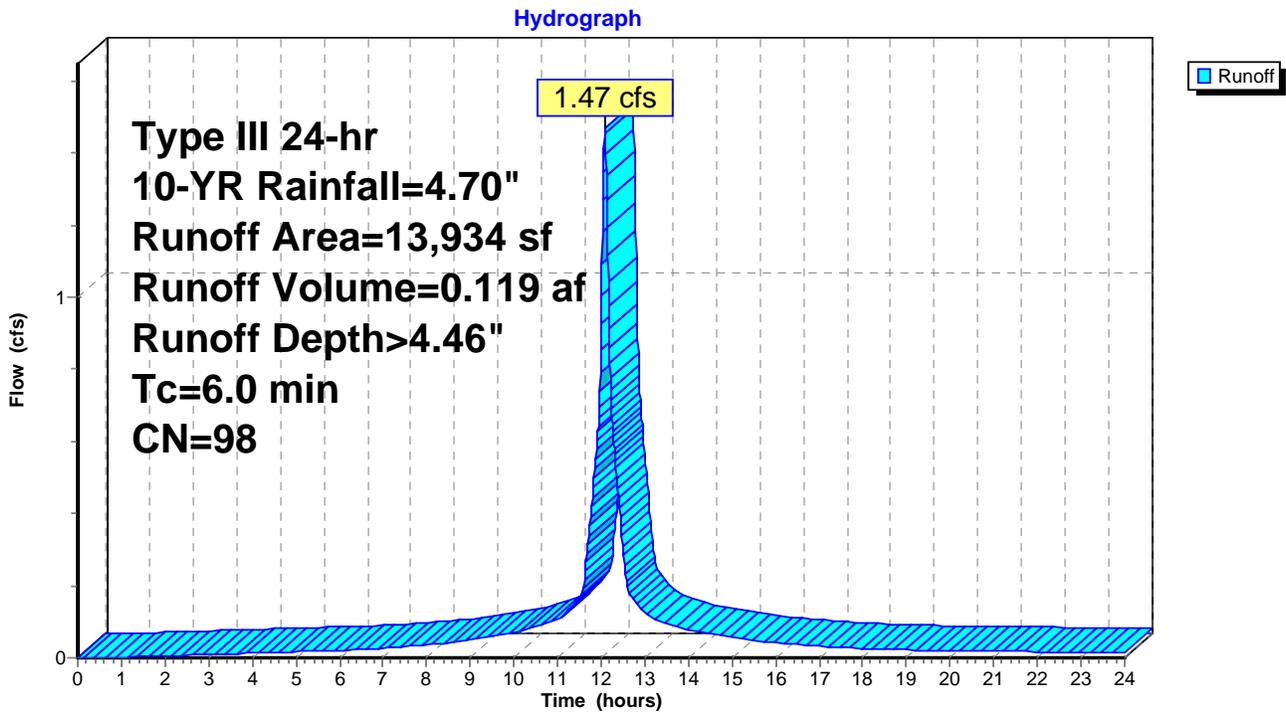
Runoff = 1.47 cfs @ 12.08 hrs, Volume= 0.119 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
13,934	98	Roofs, HSG B
13,934		100.00% Impervious Area

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

### Subcatchment E4: DRAIN LINE 4



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Type III 24-hr 10-YR Rainfall=4.70"

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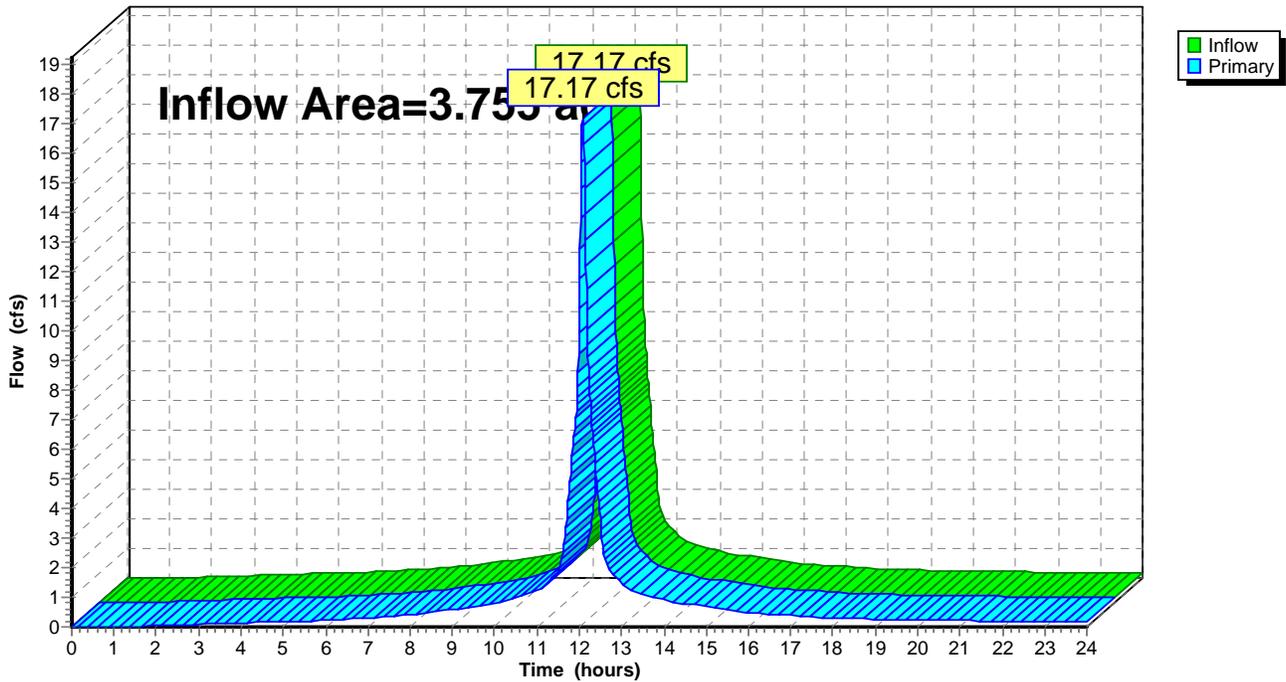
### Summary for Link 1L: TOTAL SITE

Inflow Area = 3.755 ac, 98.32% Impervious, Inflow Depth > 4.39" for 10-YR event  
Inflow = 17.17 cfs @ 12.08 hrs, Volume= 1.374 af  
Primary = 17.17 cfs @ 12.08 hrs, Volume= 1.374 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 1L: TOTAL SITE

Hydrograph



**PRE**

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Type III 24-hr 100-YR Rainfall=7.00"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 E1: DRAIN LINE 1** Runoff Area=41,008 sf 100.00% Impervious Runoff Depth>6.76"  
Tc=6.0 min CN=98 Runoff=6.47 cfs 0.530 af

**Subcatchment E2: DRAIN LINE 2** Runoff Area=9,143 sf 99.05% Impervious Runoff Depth>6.76"  
Tc=6.0 min CN=98 Runoff=1.44 cfs 0.118 af

**Subcatchment E3: DRAIN LINE 3** Runoff Area=99,478 sf 97.32% Impervious Runoff Depth>6.64"  
Tc=6.0 min CN=97 Runoff=15.62 cfs 1.263 af

**Subcatchment E4: DRAIN LINE 4** Runoff Area=13,934 sf 100.00% Impervious Runoff Depth>6.76"  
Tc=6.0 min CN=98 Runoff=2.20 cfs 0.180 af

**Link 1L: TOTAL SITE** Inflow=25.73 cfs 2.091 af  
Primary=25.73 cfs 2.091 af

**Total Runoff Area = 3.755 ac Runoff Volume = 2.091 af Average Runoff Depth = 6.68"**  
**1.68% Pervious = 0.063 ac 98.32% Impervious = 3.692 ac**

PRE

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Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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### Summary for Subcatchment E1: DRAIN LINE 1

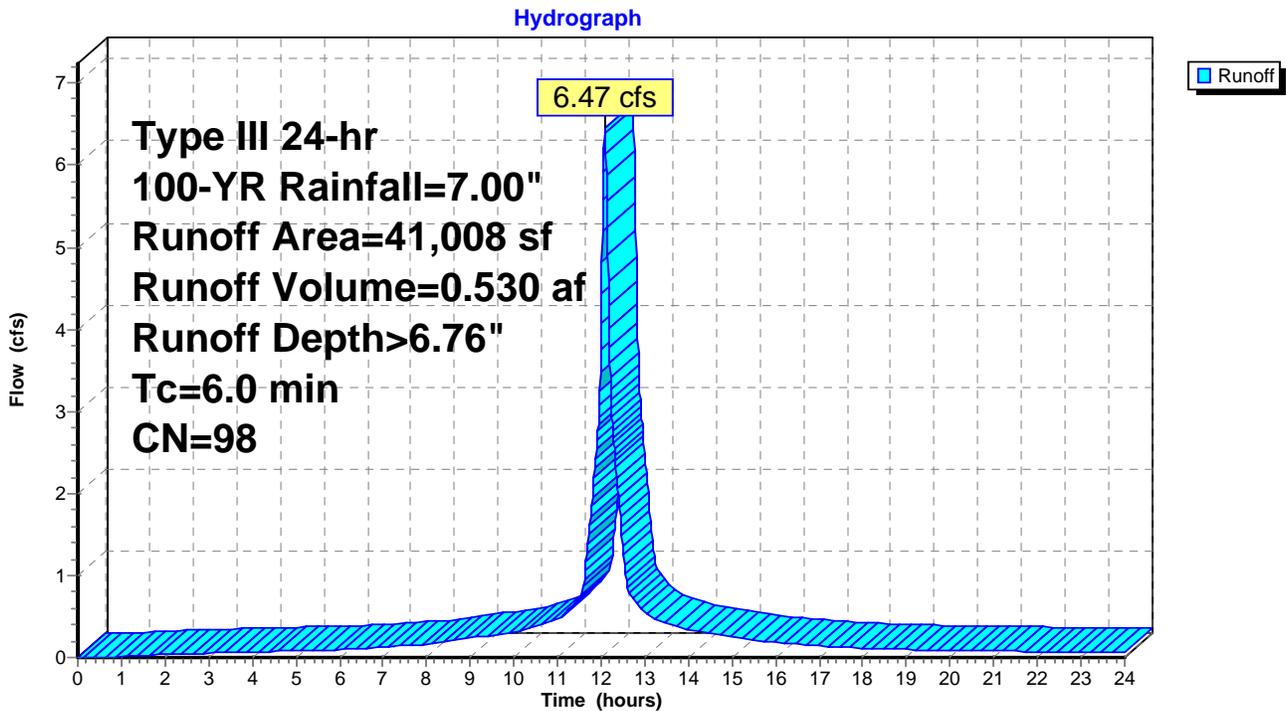
Runoff = 6.47 cfs @ 12.08 hrs, Volume= 0.530 af, Depth> 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
22,292	98	Paved parking, HSG B
18,716	98	Roofs, HSG B
41,008	98	Weighted Average
41,008		100.00% Impervious Area

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

### Subcatchment E1: DRAIN LINE 1



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Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment E2: DRAIN LINE 2**

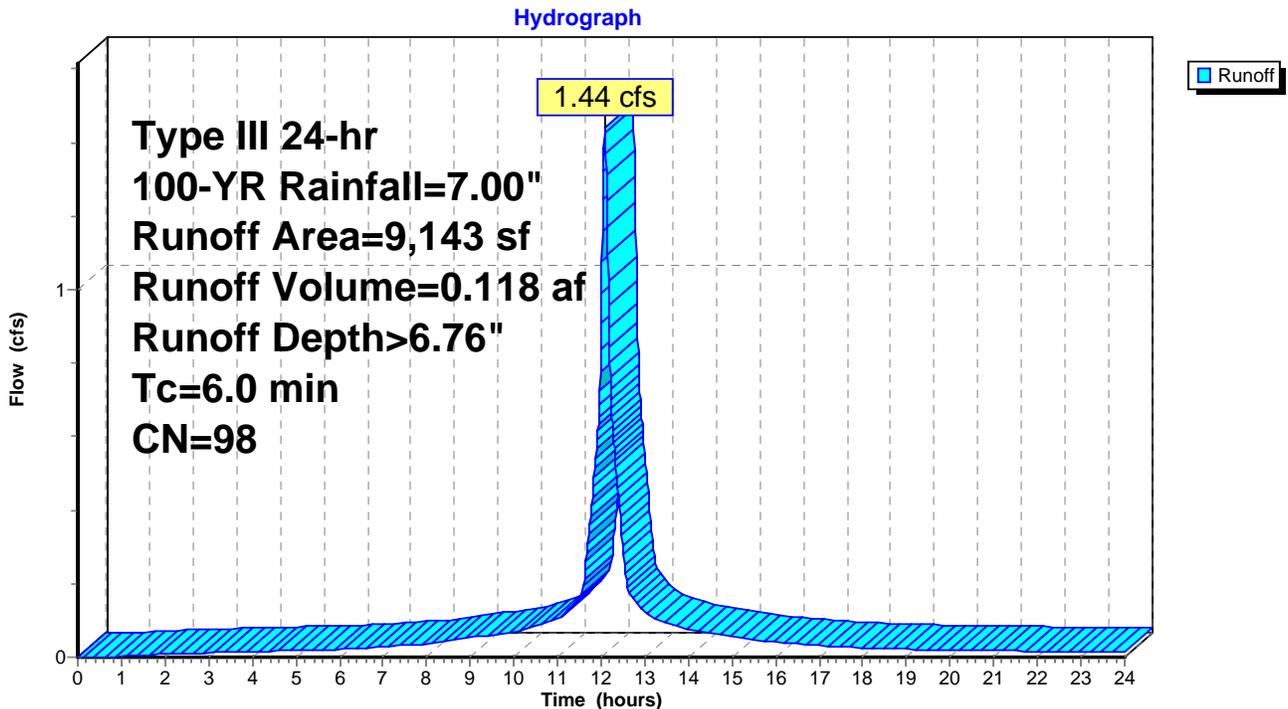
Runoff = 1.44 cfs @ 12.08 hrs, Volume= 0.118 af, Depth> 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
4,351	98	Paved parking, HSG B
87	61	>75% Grass cover, Good, HSG B
4,705	98	Roofs, HSG B
9,143	98	Weighted Average
87		0.95% Pervious Area
9,056		99.05% Impervious Area

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

**Subcatchment E2: DRAIN LINE 2**



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Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment E3: DRAINLINE 3**

Runoff = 15.62 cfs @ 12.08 hrs, Volume= 1.263 af, Depth> 6.64"

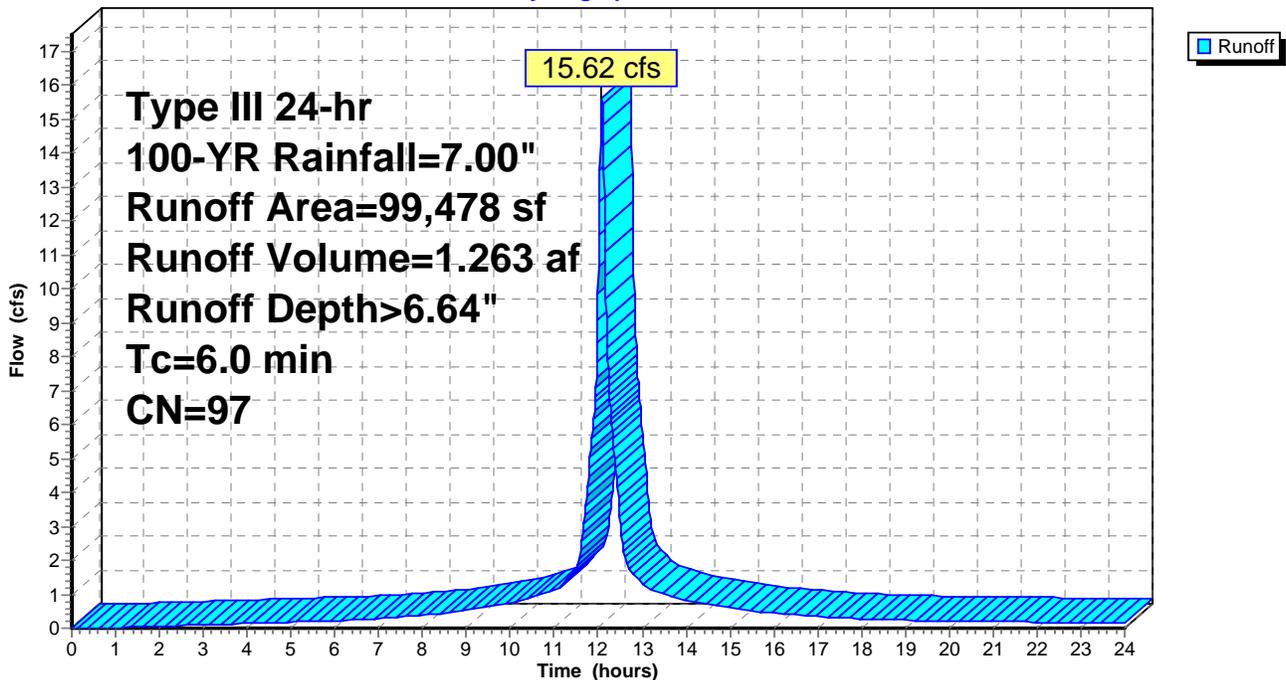
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
54,025	98	Paved parking, HSG B
2,669	61	>75% Grass cover, Good, HSG B
42,784	98	Roofs, HSG B
99,478	97	Weighted Average
2,669		2.68% Pervious Area
96,809		97.32% Impervious Area

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

**Subcatchment E3: DRAINLINE 3**

Hydrograph



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Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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### Summary for Subcatchment E4: DRAIN LINE 4

Runoff = 2.20 cfs @ 12.08 hrs, Volume= 0.180 af, Depth> 6.76"

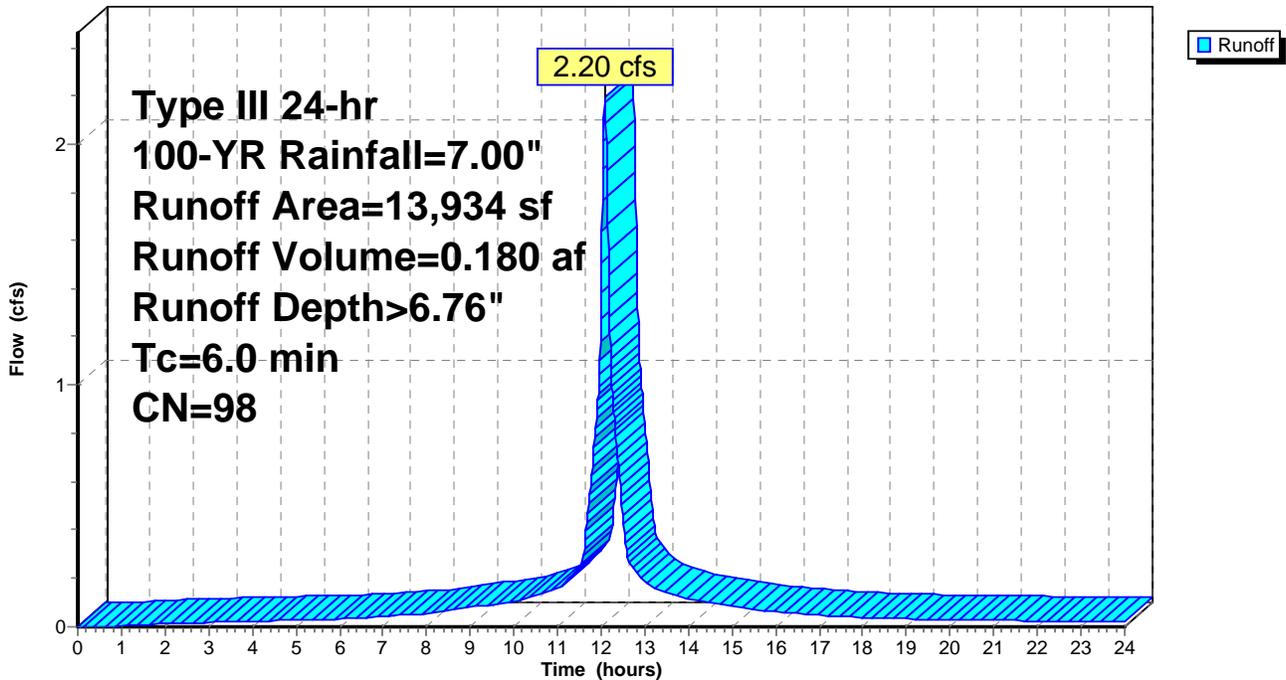
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
13,934	98	Roofs, HSG B
13,934		100.00% Impervious Area

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

### Subcatchment E4: DRAIN LINE 4

Hydrograph



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Avalon Hingham SY II

Type III 24-hr 100-YR Rainfall=7.00"

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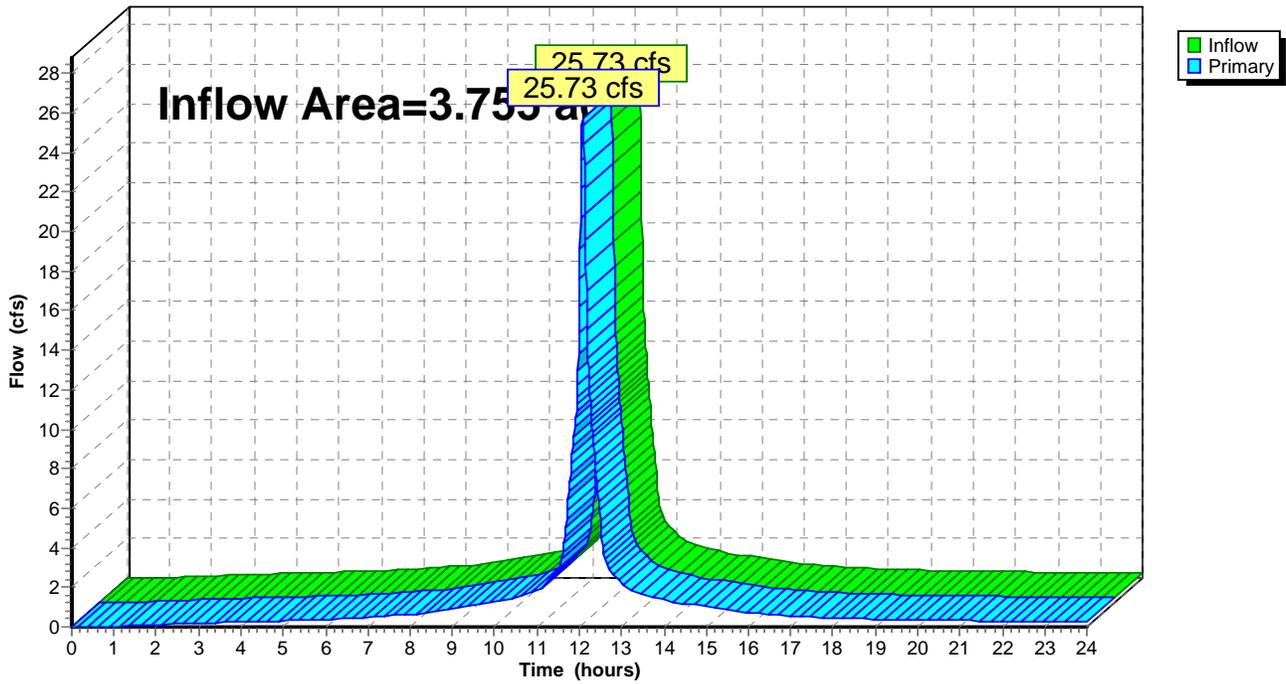
### Summary for Link 1L: TOTAL SITE

Inflow Area = 3.755 ac, 98.32% Impervious, Inflow Depth > 6.68" for 100-YR event  
Inflow = 25.73 cfs @ 12.08 hrs, Volume= 2.091 af  
Primary = 25.73 cfs @ 12.08 hrs, Volume= 2.091 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 1L: TOTAL SITE

Hydrograph

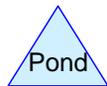
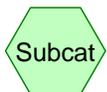
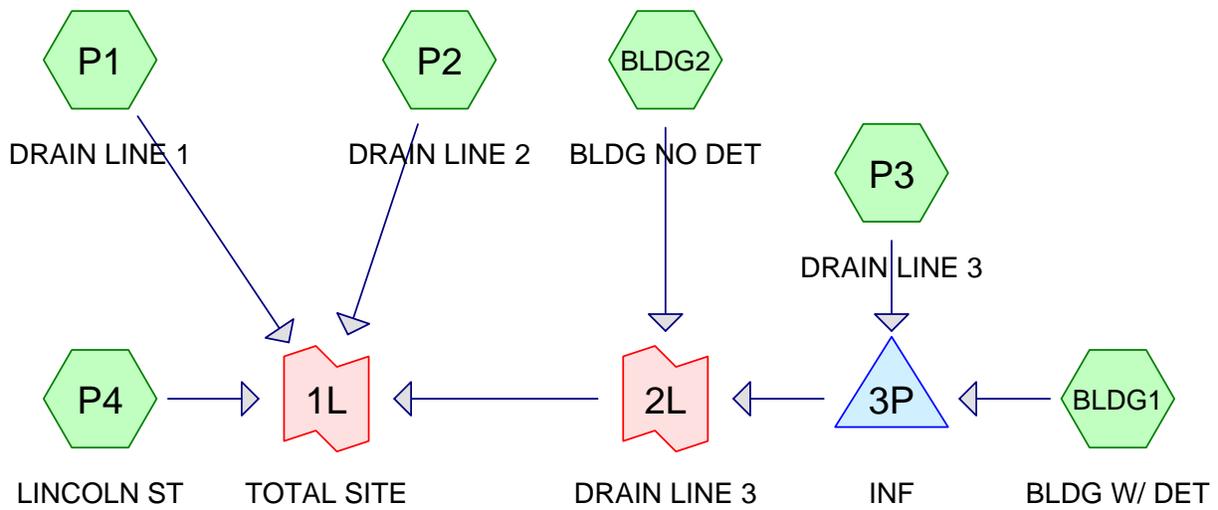




## **Appendix C.**

### Post-Construction Hydrology





**Routing Diagram for Post Final**  
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**Post Final**

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Avalon Hingham SY II  
Type III 24-hr 2-YR Rainfall=3.40"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 BLDG1: BLDG W/ DET** Runoff Area=51,980 sf 100.00% Impervious Runoff Depth>3.16"  
Tc=6.0 min CN=98 Runoff=3.94 cfs 0.315 af

**Subcatchment BLDG2: BLDG NO DET** Runoff Area=53,885 sf 100.00% Impervious Runoff Depth>3.16"  
Tc=6.0 min CN=98 Runoff=4.09 cfs 0.326 af

**Subcatchment P1: DRAIN LINE 1** Runoff Area=27,825 sf 48.41% Impervious Runoff Depth>1.49"  
Tc=6.0 min CN=79 Runoff=1.10 cfs 0.079 af

**Subcatchment P2: DRAIN LINE 2** Runoff Area=5,545 sf 10.01% Impervious Runoff Depth>0.70"  
Tc=6.0 min CN=65 Runoff=0.09 cfs 0.007 af

**Subcatchment P3: DRAIN LINE 3** Runoff Area=23,511 sf 77.60% Impervious Runoff Depth>2.35"  
Tc=6.0 min CN=90 Runoff=1.47 cfs 0.106 af

**Subcatchment P4: LINCOLN ST** Runoff Area=828 sf 0.00% Impervious Runoff Depth>0.53"  
Tc=6.0 min CN=61 Runoff=0.01 cfs 0.001 af

**Pond 3P: INF** Peak Elev=18.71' Storage=2,730 cf Inflow=5.41 cfs 0.420 af  
Discarded=0.09 cfs 0.112 af Primary=3.60 cfs 0.296 af Outflow=3.69 cfs 0.408 af

**Link 1L: TOTAL SITE** Inflow=8.59 cfs 0.709 af  
Primary=8.59 cfs 0.709 af

**Link 2L: DRAIN LINE 3** Inflow=7.40 cfs 0.622 af  
Primary=7.40 cfs 0.622 af

**Total Runoff Area = 3.755 ac Runoff Volume = 0.834 af Average Runoff Depth = 2.67"**  
**15.55% Pervious = 0.584 ac 84.45% Impervious = 3.171 ac**

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Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment BLDG1: BLDG W/ DET**

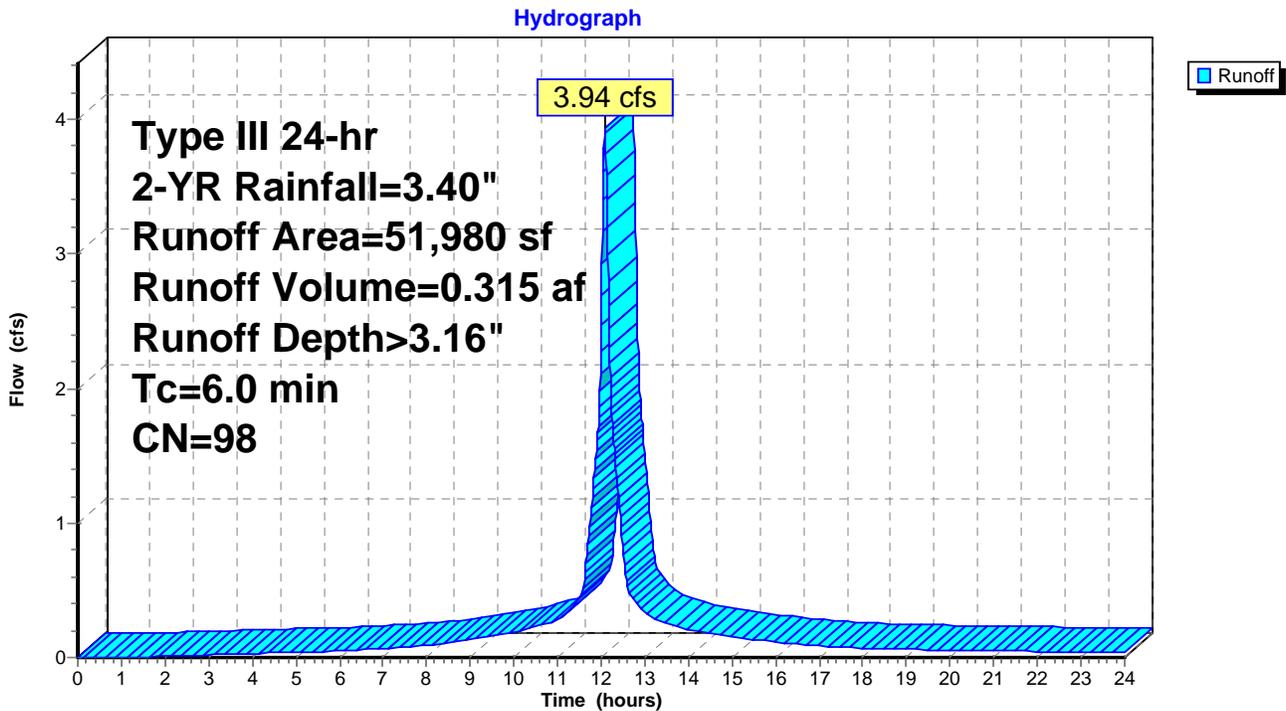
Runoff = 3.94 cfs @ 12.08 hrs, Volume= 0.315 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
46,980	98	Roofs, HSG B
5,000	98	Roofs, HSG B
51,980	98	Weighted Average
51,980		100.00% Impervious Area

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

**Subcatchment BLDG1: BLDG W/ DET**



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Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment BLDG2: BLDG NO DET**

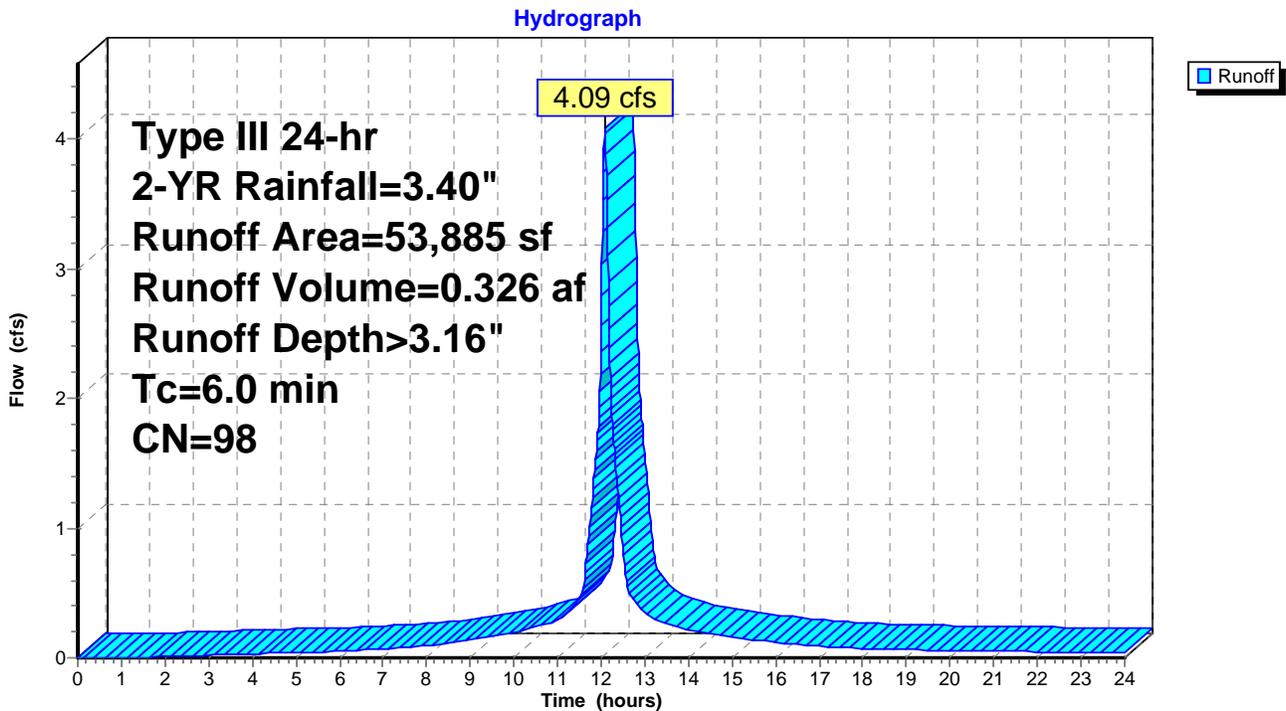
Runoff = 4.09 cfs @ 12.08 hrs, Volume= 0.326 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
53,885	98	Roofs, HSG B
53,885		100.00% Impervious Area

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

**Subcatchment BLDG2: BLDG NO DET**



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Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment P1: DRAIN LINE 1**

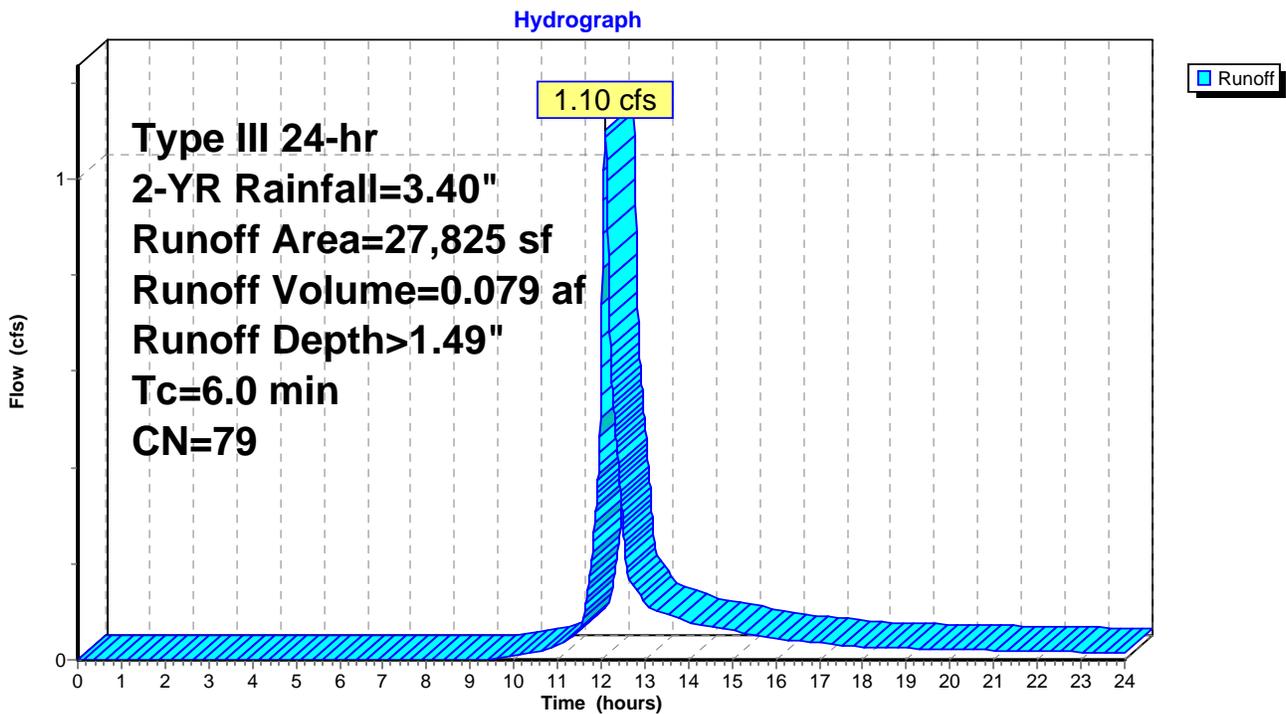
Runoff = 1.10 cfs @ 12.09 hrs, Volume= 0.079 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
14,356	61	>75% Grass cover, Good, HSG B
13,469	98	Paved parking, HSG B
27,825	79	Weighted Average
14,356		51.59% Pervious Area
13,469		48.41% Impervious Area

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

**Subcatchment P1: DRAIN LINE 1**



**Post Final**

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Avalon Hingham SY II  
Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment P2: DRAIN LINE 2**

Runoff = 0.09 cfs @ 12.11 hrs, Volume= 0.007 af, Depth> 0.70"

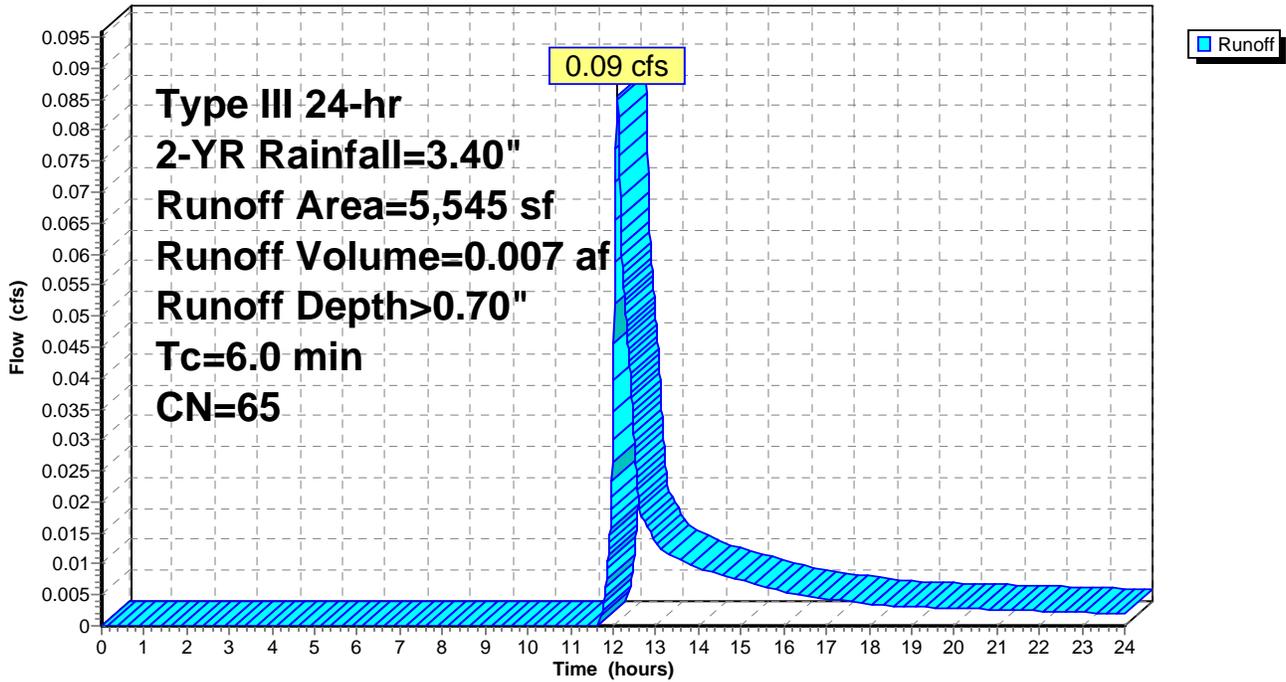
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
555	98	Paved parking, HSG B
4,990	61	>75% Grass cover, Good, HSG B
5,545	65	Weighted Average
4,990		89.99% Pervious Area
555		10.01% Impervious Area

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

**Subcatchment P2: DRAIN LINE 2**

Hydrograph



**Post Final**

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Avalon Hingham SY II

Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment P3: DRAIN LINE 3**

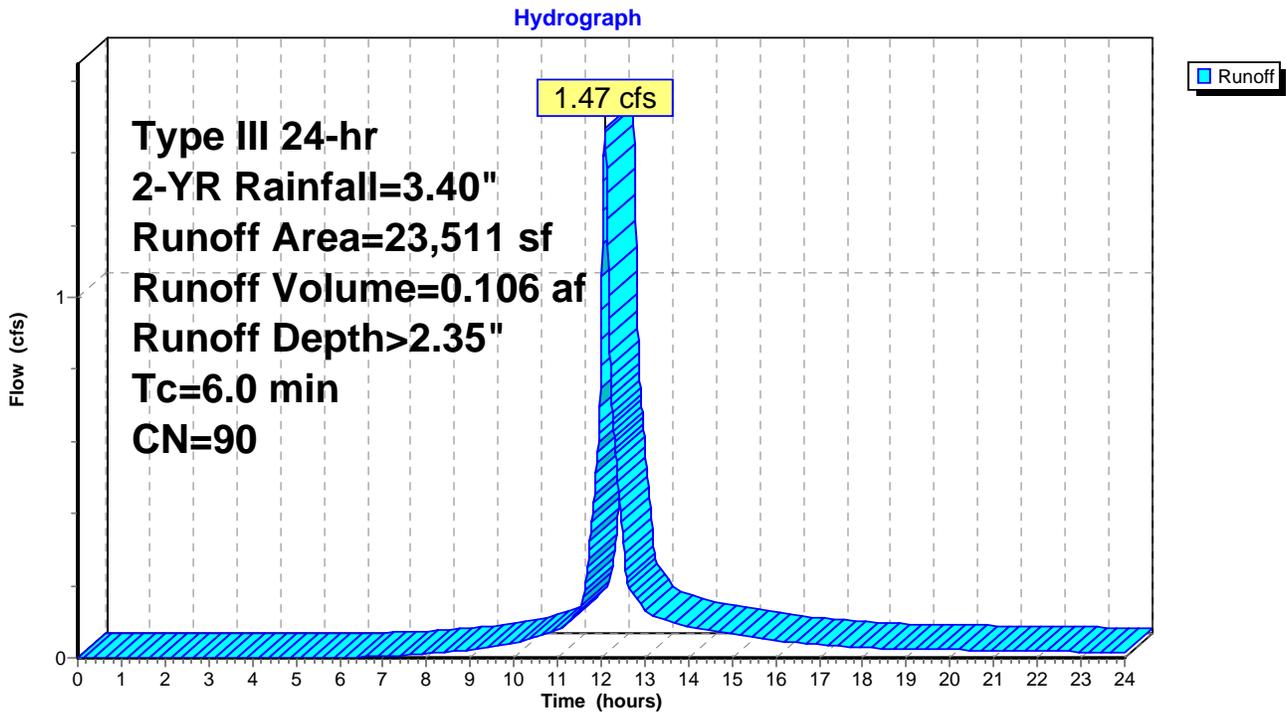
Runoff = 1.47 cfs @ 12.09 hrs, Volume= 0.106 af, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
18,245	98	Paved parking, HSG B
5,266	61	>75% Grass cover, Good, HSG B
23,511	90	Weighted Average
5,266		22.40% Pervious Area
18,245		77.60% Impervious Area

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

**Subcatchment P3: DRAIN LINE 3**



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Avalon Hingham SY II

Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Subcatchment P4: LINCOLN ST**

Runoff = 0.01 cfs @ 12.12 hrs, Volume= 0.001 af, Depth> 0.53"

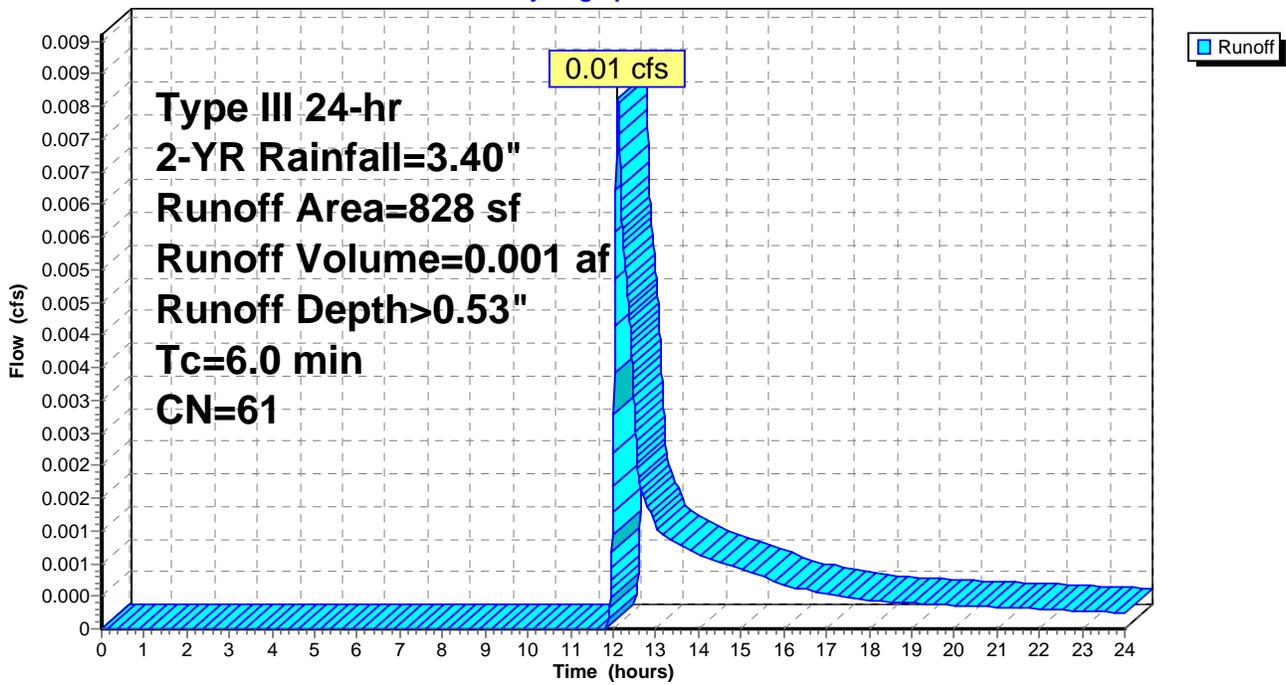
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-YR Rainfall=3.40"

Area (sf)	CN	Description
828	61	>75% Grass cover, Good, HSG B
828		100.00% Pervious Area

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

**Subcatchment P4: LINCOLN ST**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.40"

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**Summary for Pond 3P: INF**

Inflow Area = 1.733 ac, 93.02% Impervious, Inflow Depth > 2.91" for 2-YR event  
 Inflow = 5.41 cfs @ 12.08 hrs, Volume= 0.420 af  
 Outflow = 3.69 cfs @ 12.17 hrs, Volume= 0.408 af, Atten= 32%, Lag= 5.0 min  
 Discarded = 0.09 cfs @ 12.17 hrs, Volume= 0.112 af  
 Primary = 3.60 cfs @ 12.17 hrs, Volume= 0.296 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 18.71' @ 12.17 hrs Surf.Area= 4,720 sf Storage= 2,730 cf

Plug-Flow detention time= 39.4 min calculated for 0.408 af (97% of inflow)  
 Center-of-Mass det. time= 21.5 min ( 788.5 - 767.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	2,891 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 14,160 cf Overall - 4,524 cf Embedded = 9,636 cf x 30.0% Voids
#2	18.00'	4,524 cf	<b>24.0" Round Pipe Storage</b> x 1.44 Inside #1 L= 1,000.0'
		7,415 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	4,720	0	0
20.50	4,720	14,160	14,160

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	<b>15.0" Round Culvert</b> L= 7.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.50' / 17.15' S= 0.0500 '/ Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	20.00'	<b>4.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	17.95'	<b>2.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Discarded	17.50'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 15.50'

**Discarded OutFlow** Max=0.09 cfs @ 12.17 hrs HW=18.71' (Free Discharge)  
 ↳ **4=Exfiltration** ( Controls 0.09 cfs)

**Primary OutFlow** Max=3.60 cfs @ 12.17 hrs HW=18.71' (Free Discharge)  
 ↳ **1=Culvert** (Inlet Controls 3.60 cfs @ 2.96 fps)  
 ↳ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)  
 ↳ **3=Broad-Crested Rectangular Weir** (Passes 3.60 cfs of 4.34 cfs potential flow)

**Post Final**

Prepared by Howard Stein Hudson

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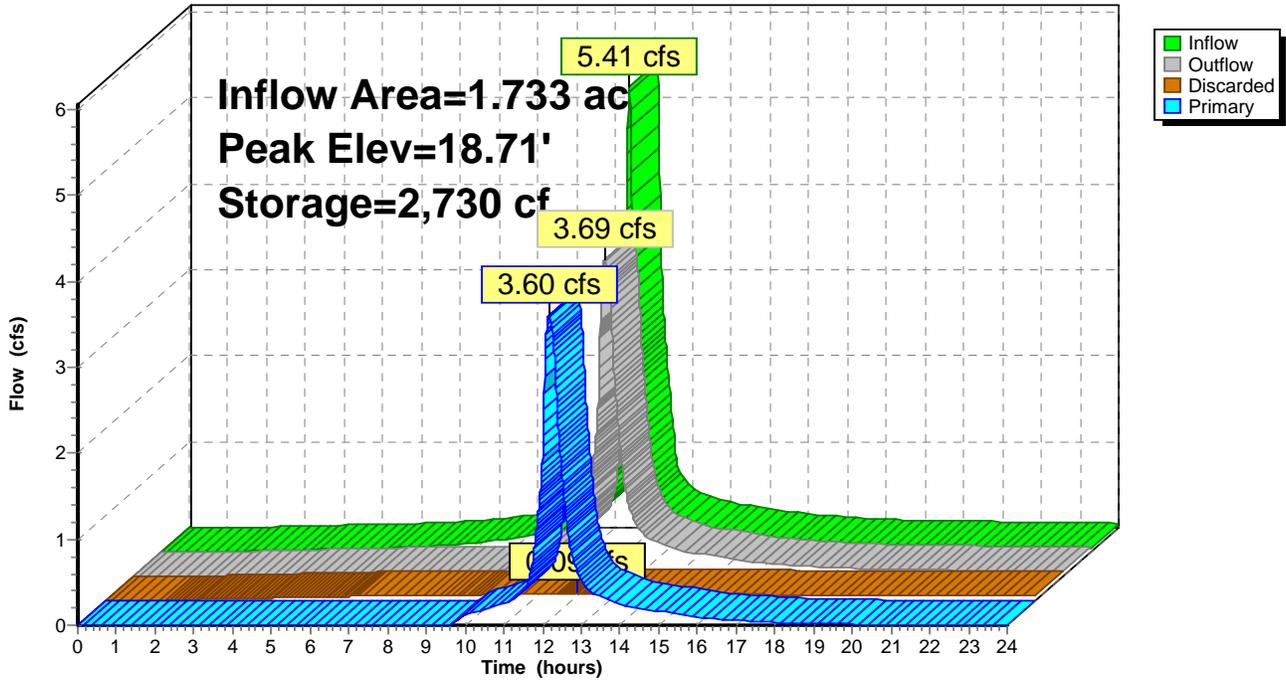
Avalon Hingham SY II  
Type III 24-hr 2-YR Rainfall=3.40"

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**Pond 3P: INF**

Hydrograph



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Avalon Hingham SY II

Type III 24-hr 2-YR Rainfall=3.40"

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**Stage-Area-Storage for Pond 3P: INF**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
17.50	<b>4,720</b>	0	20.10	4,720	6,848
17.55	4,720	71	20.15	4,720	6,919
17.60	4,720	142	20.20	4,720	6,990
17.65	4,720	212	20.25	4,720	7,061
17.70	4,720	283	20.30	4,720	7,132
17.75	4,720	354	20.35	4,720	7,202
17.80	4,720	425	20.40	4,720	7,273
17.85	4,720	496	20.45	4,720	7,344
17.90	4,720	566	20.50	4,720	<b>7,415</b>
17.95	4,720	637			
18.00	4,720	708			
18.05	4,720	800			
18.10	4,720	909			
18.15	4,720	1,028			
18.20	4,720	1,156			
18.25	4,720	1,290			
18.30	4,720	1,431			
18.35	4,720	1,576			
18.40	4,720	1,725			
18.45	4,720	1,879			
18.50	4,720	2,035			
18.55	4,720	2,195			
18.60	4,720	2,357			
18.65	4,720	2,521			
18.70	4,720	2,687			
18.75	4,720	2,855			
18.80	4,720	3,024			
18.85	4,720	3,194			
18.90	4,720	3,364			
18.95	4,720	3,536			
19.00	4,720	3,707			
19.05	4,720	3,879			
19.10	4,720	4,050			
19.15	4,720	4,221			
19.20	4,720	4,391			
19.25	4,720	4,560			
19.30	4,720	4,728			
19.35	4,720	4,894			
19.40	4,720	5,058			
19.45	4,720	5,220			
19.50	4,720	5,380			
19.55	4,720	5,536			
19.60	4,720	5,689			
19.65	4,720	5,839			
19.70	4,720	5,984			
19.75	4,720	6,124			
19.80	4,720	6,259			
19.85	4,720	6,386			
19.90	4,720	6,506			
19.95	4,720	6,615			
20.00	4,720	6,707			
20.05	4,720	6,778			

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Type III 24-hr 2-YR Rainfall=3.40"

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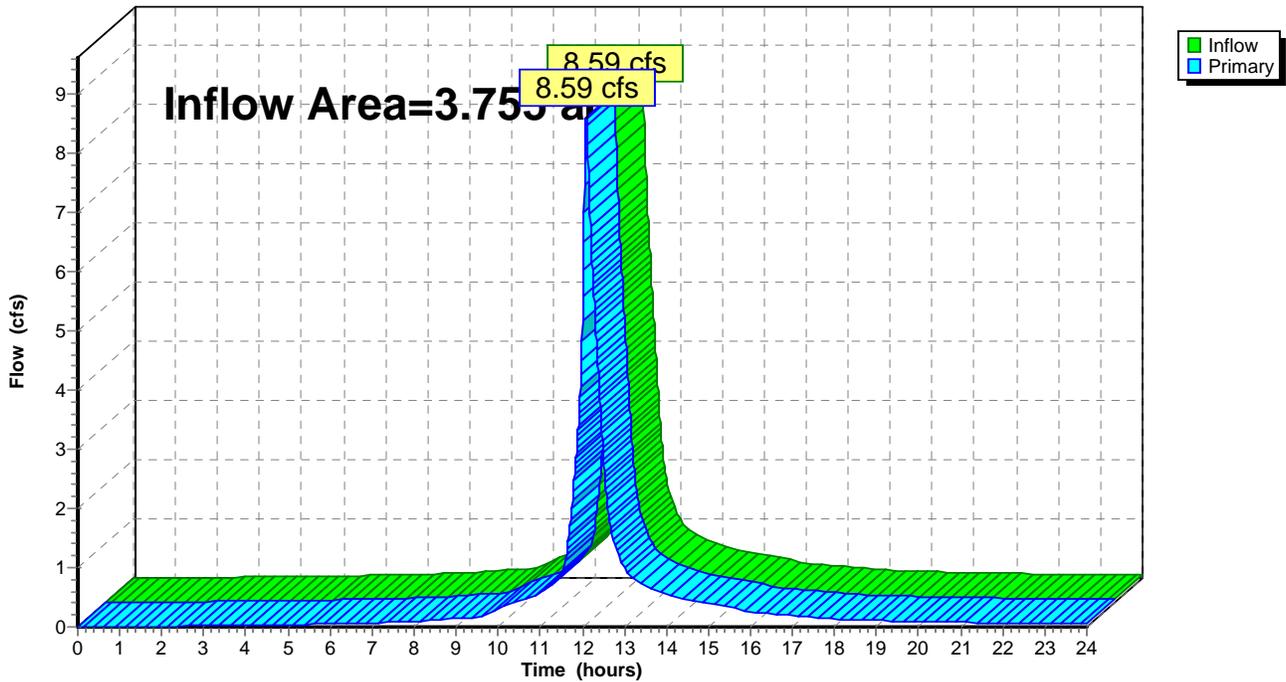
**Summary for Link 1L: TOTAL SITE**

Inflow Area = 3.755 ac, 84.45% Impervious, Inflow Depth > 2.27" for 2-YR event  
Inflow = 8.59 cfs @ 12.10 hrs, Volume= 0.709 af  
Primary = 8.59 cfs @ 12.10 hrs, Volume= 0.709 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: TOTAL SITE**

Hydrograph



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Type III 24-hr 2-YR Rainfall=3.40"

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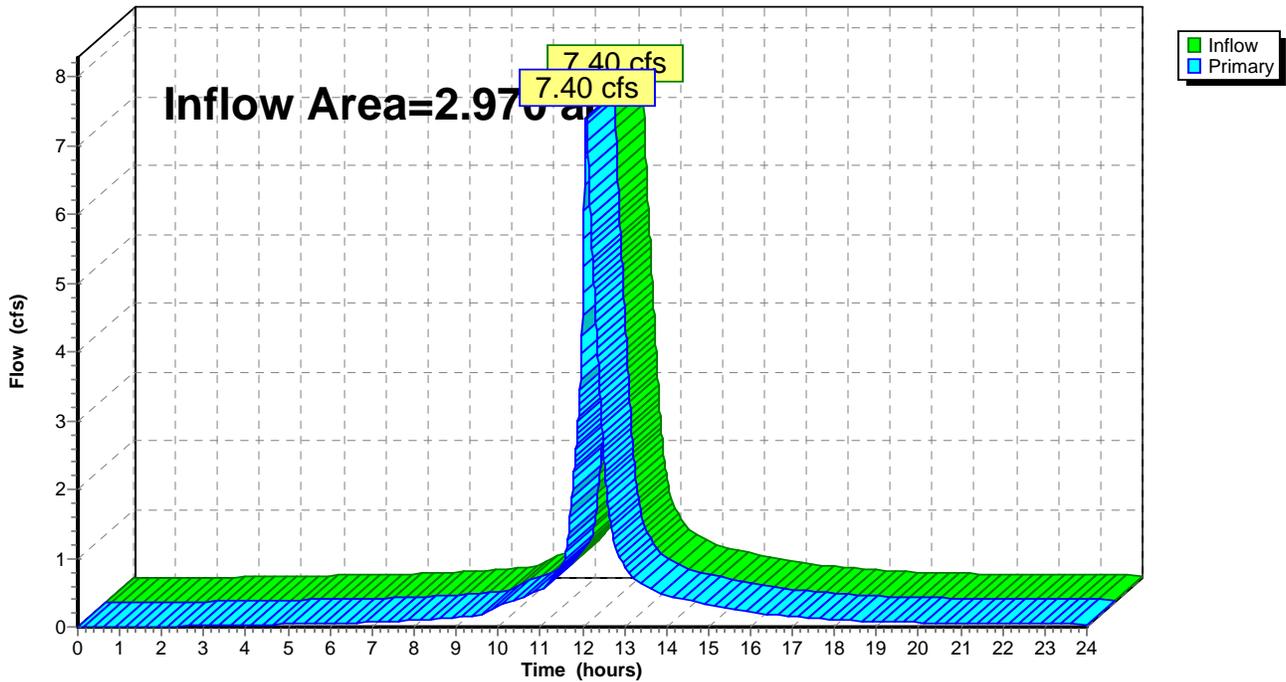
**Summary for Link 2L: DRAIN LINE 3**

Inflow Area = 2.970 ac, 95.93% Impervious, Inflow Depth > 2.51" for 2-YR event  
Inflow = 7.40 cfs @ 12.10 hrs, Volume= 0.622 af  
Primary = 7.40 cfs @ 12.10 hrs, Volume= 0.622 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 2L: DRAIN LINE 3**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.70"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 BLDG1: BLDG W/ DET** Runoff Area=51,980 sf 100.00% Impervious Runoff Depth>4.46"  
Tc=6.0 min CN=98 Runoff=5.48 cfs 0.444 af

**Subcatchment BLDG2: BLDG NO DET** Runoff Area=53,885 sf 100.00% Impervious Runoff Depth>4.46"  
Tc=6.0 min CN=98 Runoff=5.68 cfs 0.460 af

**Subcatchment P1: DRAIN LINE 1** Runoff Area=27,825 sf 48.41% Impervious Runoff Depth>2.54"  
Tc=6.0 min CN=79 Runoff=1.91 cfs 0.135 af

**Subcatchment P2: DRAIN LINE 2** Runoff Area=5,545 sf 10.01% Impervious Runoff Depth>1.46"  
Tc=6.0 min CN=65 Runoff=0.20 cfs 0.015 af

**Subcatchment P3: DRAIN LINE 3** Runoff Area=23,511 sf 77.60% Impervious Runoff Depth>3.58"  
Tc=6.0 min CN=90 Runoff=2.20 cfs 0.161 af

**Subcatchment P4: LINCOLN ST** Runoff Area=828 sf 0.00% Impervious Runoff Depth>1.19"  
Tc=6.0 min CN=61 Runoff=0.02 cfs 0.002 af

**Pond 3P: INF** Peak Elev=19.04' Storage=3,856 cf Inflow=7.68 cfs 0.605 af  
Discarded=0.10 cfs 0.122 af Primary=4.47 cfs 0.468 af Outflow=4.57 cfs 0.590 af

**Link 1L: TOTAL SITE** Inflow=11.79 cfs 1.080 af  
Primary=11.79 cfs 1.080 af

**Link 2L: DRAIN LINE 3** Inflow=9.66 cfs 0.928 af  
Primary=9.66 cfs 0.928 af

**Total Runoff Area = 3.755 ac Runoff Volume = 1.217 af Average Runoff Depth = 3.89"**  
**15.55% Pervious = 0.584 ac 84.45% Impervious = 3.171 ac**

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Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment BLDG1: BLDG W/ DET**

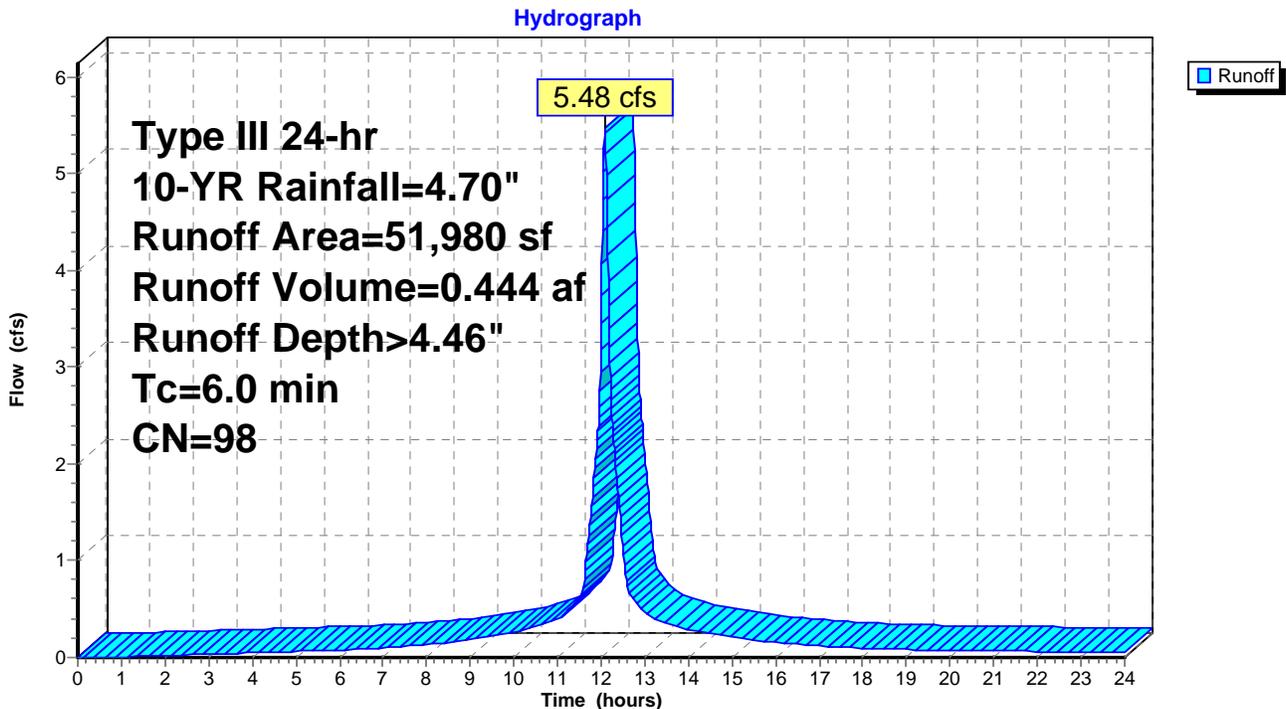
Runoff = 5.48 cfs @ 12.08 hrs, Volume= 0.444 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
46,980	98	Roofs, HSG B
5,000	98	Roofs, HSG B
51,980	98	Weighted Average
51,980		100.00% Impervious Area

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

**Subcatchment BLDG1: BLDG W/ DET**



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Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment BLDG2: BLDG NO DET**

Runoff = 5.68 cfs @ 12.08 hrs, Volume= 0.460 af, Depth> 4.46"

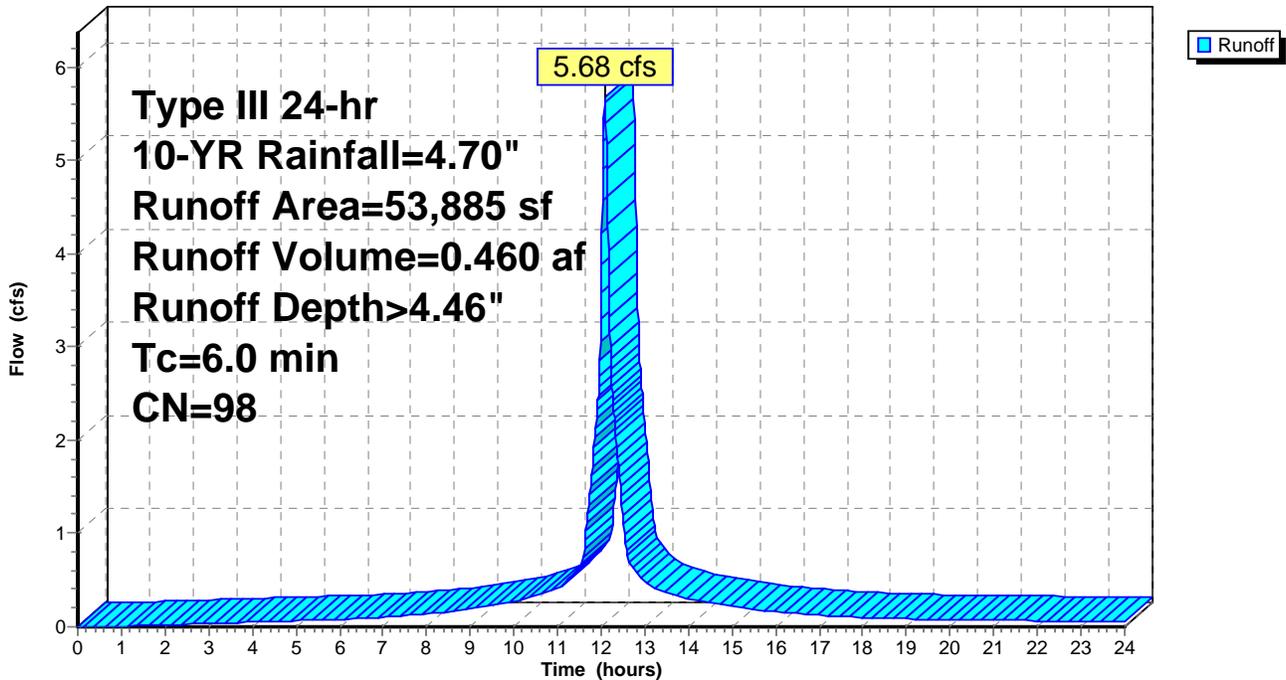
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
53,885	98	Roofs, HSG B
53,885		100.00% Impervious Area

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

**Subcatchment BLDG2: BLDG NO DET**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment P1: DRAIN LINE 1**

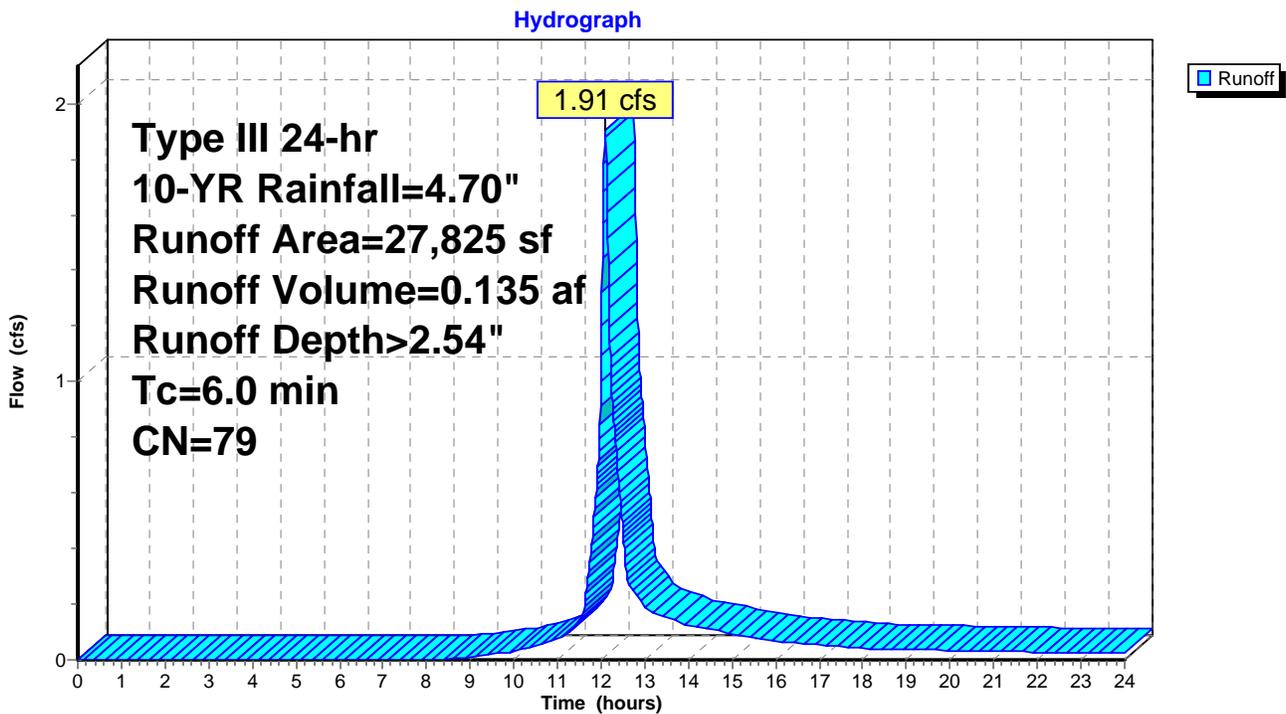
Runoff = 1.91 cfs @ 12.09 hrs, Volume= 0.135 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
14,356	61	>75% Grass cover, Good, HSG B
13,469	98	Paved parking, HSG B
27,825	79	Weighted Average
14,356		51.59% Pervious Area
13,469		48.41% Impervious Area

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

**Subcatchment P1: DRAIN LINE 1**



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Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment P2: DRAIN LINE 2**

Runoff = 0.20 cfs @ 12.10 hrs, Volume= 0.015 af, Depth> 1.46"

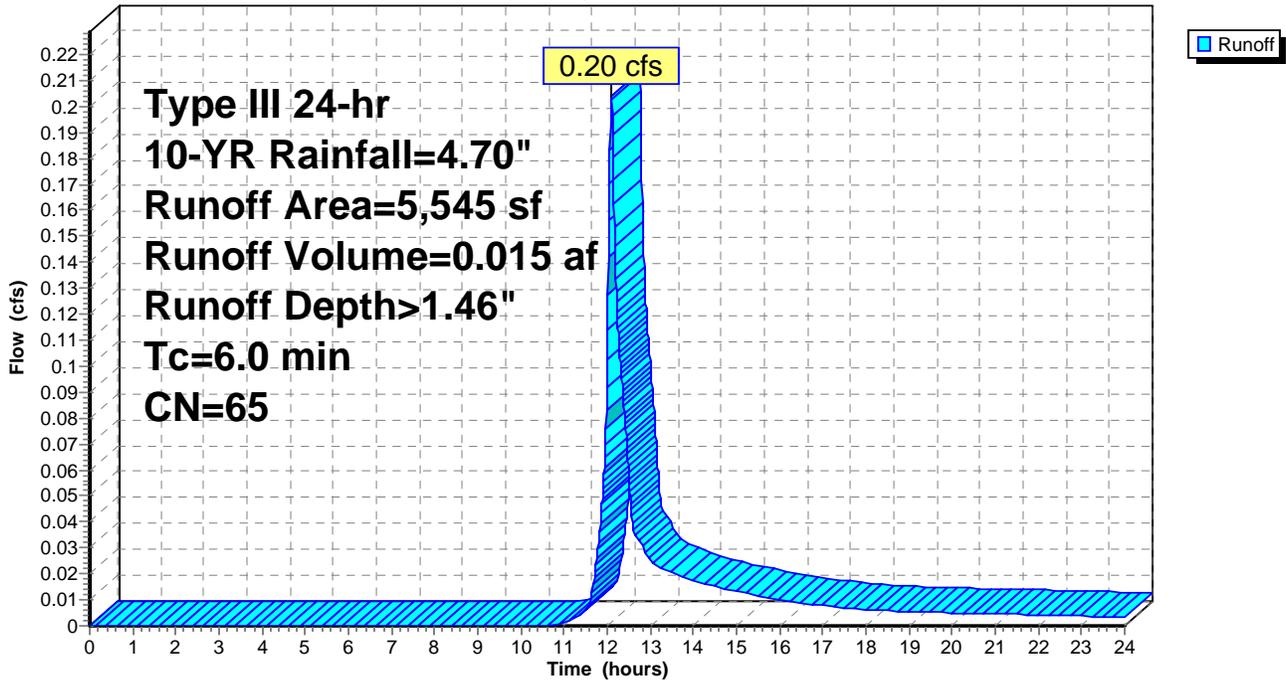
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
555	98	Paved parking, HSG B
4,990	61	>75% Grass cover, Good, HSG B
5,545	65	Weighted Average
4,990		89.99% Pervious Area
555		10.01% Impervious Area

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

**Subcatchment P2: DRAIN LINE 2**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment P3: DRAIN LINE 3**

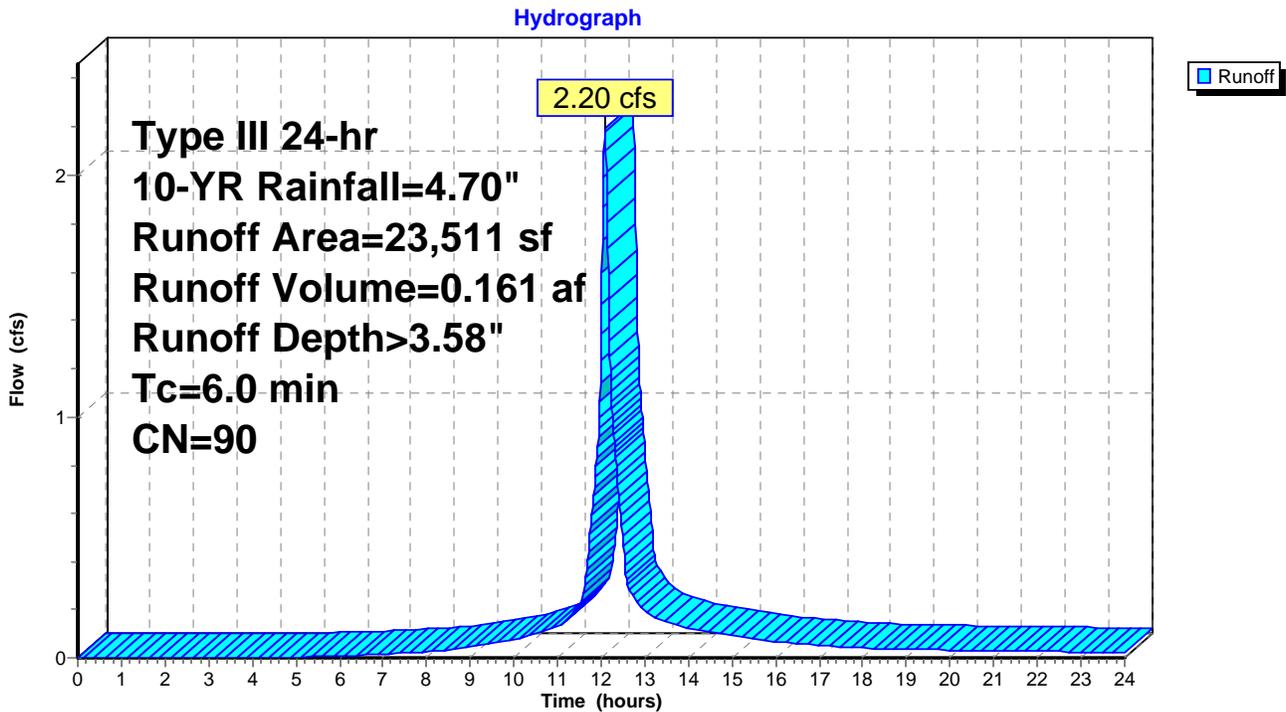
Runoff = 2.20 cfs @ 12.09 hrs, Volume= 0.161 af, Depth> 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
18,245	98	Paved parking, HSG B
5,266	61	>75% Grass cover, Good, HSG B
23,511	90	Weighted Average
5,266		22.40% Pervious Area
18,245		77.60% Impervious Area

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

**Subcatchment P3: DRAIN LINE 3**



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Type III 24-hr 10-YR Rainfall=4.70"

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**Summary for Subcatchment P4: LINCOLN ST**

Runoff = 0.02 cfs @ 12.10 hrs, Volume= 0.002 af, Depth> 1.19"

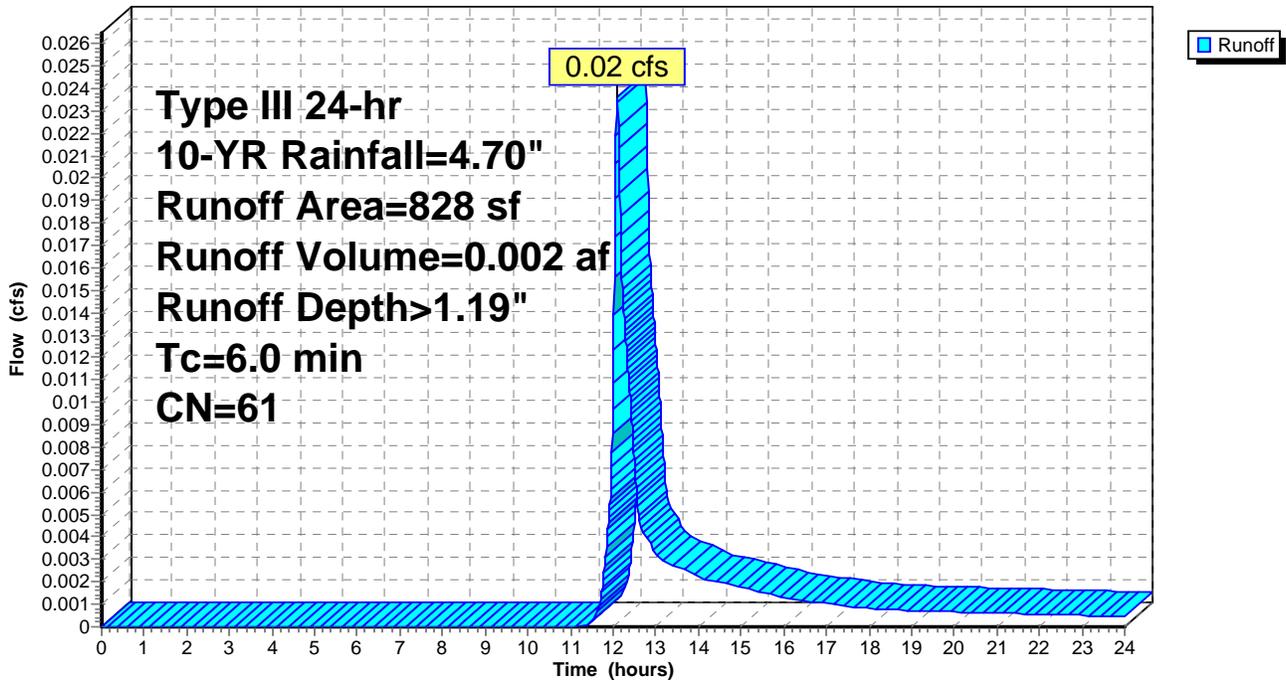
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-YR Rainfall=4.70"

Area (sf)	CN	Description
828	61	>75% Grass cover, Good, HSG B
828		100.00% Pervious Area

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

**Subcatchment P4: LINCOLN ST**

Hydrograph



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**Summary for Pond 3P: INF**

Inflow Area = 1.733 ac, 93.02% Impervious, Inflow Depth > 4.19" for 10-YR event  
 Inflow = 7.68 cfs @ 12.08 hrs, Volume= 0.605 af  
 Outflow = 4.57 cfs @ 12.19 hrs, Volume= 0.590 af, Atten= 40%, Lag= 6.3 min  
 Discarded = 0.10 cfs @ 12.19 hrs, Volume= 0.122 af  
 Primary = 4.47 cfs @ 12.19 hrs, Volume= 0.468 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 19.04' @ 12.19 hrs Surf.Area= 4,720 sf Storage= 3,856 cf

Plug-Flow detention time= 33.3 min calculated for 0.590 af (98% of inflow)  
 Center-of-Mass det. time= 18.1 min ( 778.2 - 760.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	2,891 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 14,160 cf Overall - 4,524 cf Embedded = 9,636 cf x 30.0% Voids
#2	18.00'	4,524 cf	<b>24.0" Round Pipe Storage</b> x 1.44 Inside #1 L= 1,000.0'
		7,415 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	4,720	0	0
20.50	4,720	14,160	14,160

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	<b>15.0" Round Culvert</b> L= 7.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.50' / 17.15' S= 0.0500 '/ Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	20.00'	<b>4.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	17.95'	<b>2.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Discarded	17.50'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 15.50'

**Discarded OutFlow** Max=0.10 cfs @ 12.19 hrs HW=19.04' (Free Discharge)  
 ↳ **4=Exfiltration** ( Controls 0.10 cfs)

**Primary OutFlow** Max=4.47 cfs @ 12.19 hrs HW=19.04' (Free Discharge)  
 ↳ **1=Culvert** (Inlet Controls 4.47 cfs @ 3.64 fps)  
 ↳ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)  
 ↳ **3=Broad-Crested Rectangular Weir** (Passes 4.47 cfs of 7.59 cfs potential flow)

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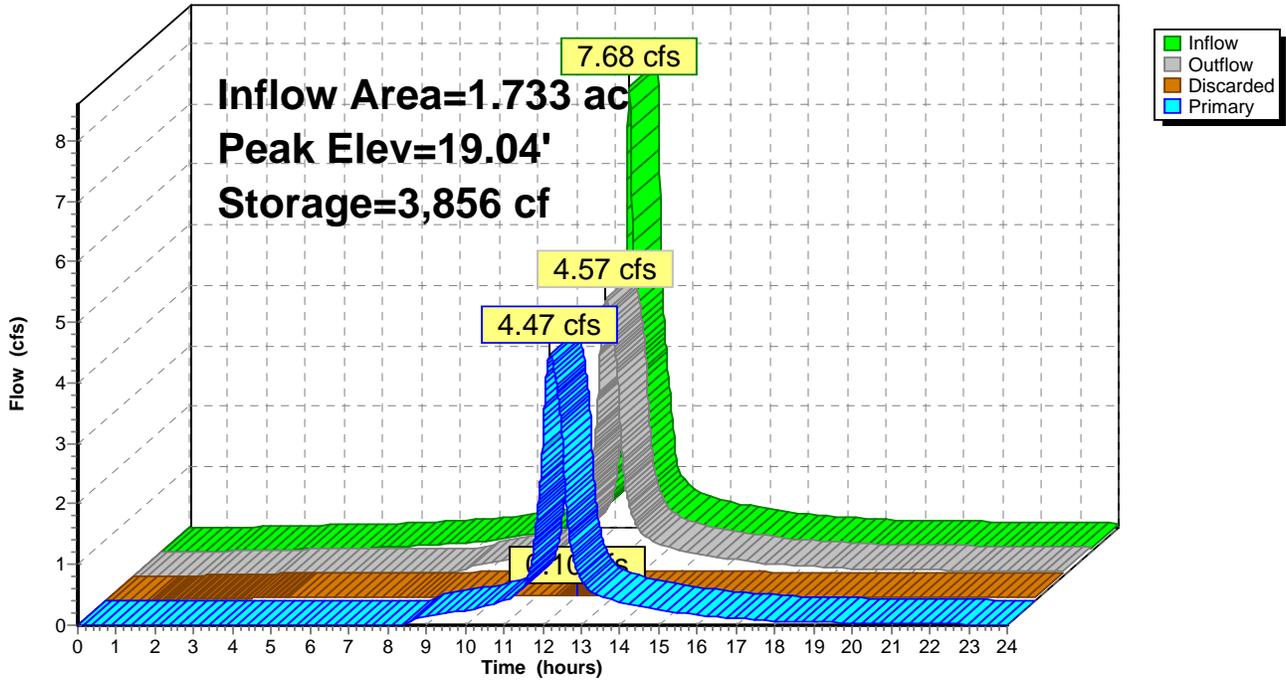
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Type III 24-hr 10-YR Rainfall=4.70"

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**Pond 3P: INF**

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**Stage-Area-Storage for Pond 3P: INF**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
17.50	<b>4,720</b>	0	20.10	4,720	6,848
17.55	4,720	71	20.15	4,720	6,919
17.60	4,720	142	20.20	4,720	6,990
17.65	4,720	212	20.25	4,720	7,061
17.70	4,720	283	20.30	4,720	7,132
17.75	4,720	354	20.35	4,720	7,202
17.80	4,720	425	20.40	4,720	7,273
17.85	4,720	496	20.45	4,720	7,344
17.90	4,720	566	20.50	4,720	<b>7,415</b>
17.95	4,720	637			
18.00	4,720	708			
18.05	4,720	800			
18.10	4,720	909			
18.15	4,720	1,028			
18.20	4,720	1,156			
18.25	4,720	1,290			
18.30	4,720	1,431			
18.35	4,720	1,576			
18.40	4,720	1,725			
18.45	4,720	1,879			
18.50	4,720	2,035			
18.55	4,720	2,195			
18.60	4,720	2,357			
18.65	4,720	2,521			
18.70	4,720	2,687			
18.75	4,720	2,855			
18.80	4,720	3,024			
18.85	4,720	3,194			
18.90	4,720	3,364			
18.95	4,720	3,536			
19.00	4,720	3,707			
19.05	4,720	3,879			
19.10	4,720	4,050			
19.15	4,720	4,221			
19.20	4,720	4,391			
19.25	4,720	4,560			
19.30	4,720	4,728			
19.35	4,720	4,894			
19.40	4,720	5,058			
19.45	4,720	5,220			
19.50	4,720	5,380			
19.55	4,720	5,536			
19.60	4,720	5,689			
19.65	4,720	5,839			
19.70	4,720	5,984			
19.75	4,720	6,124			
19.80	4,720	6,259			
19.85	4,720	6,386			
19.90	4,720	6,506			
19.95	4,720	6,615			
20.00	4,720	6,707			
20.05	4,720	6,778			

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Type III 24-hr 10-YR Rainfall=4.70"

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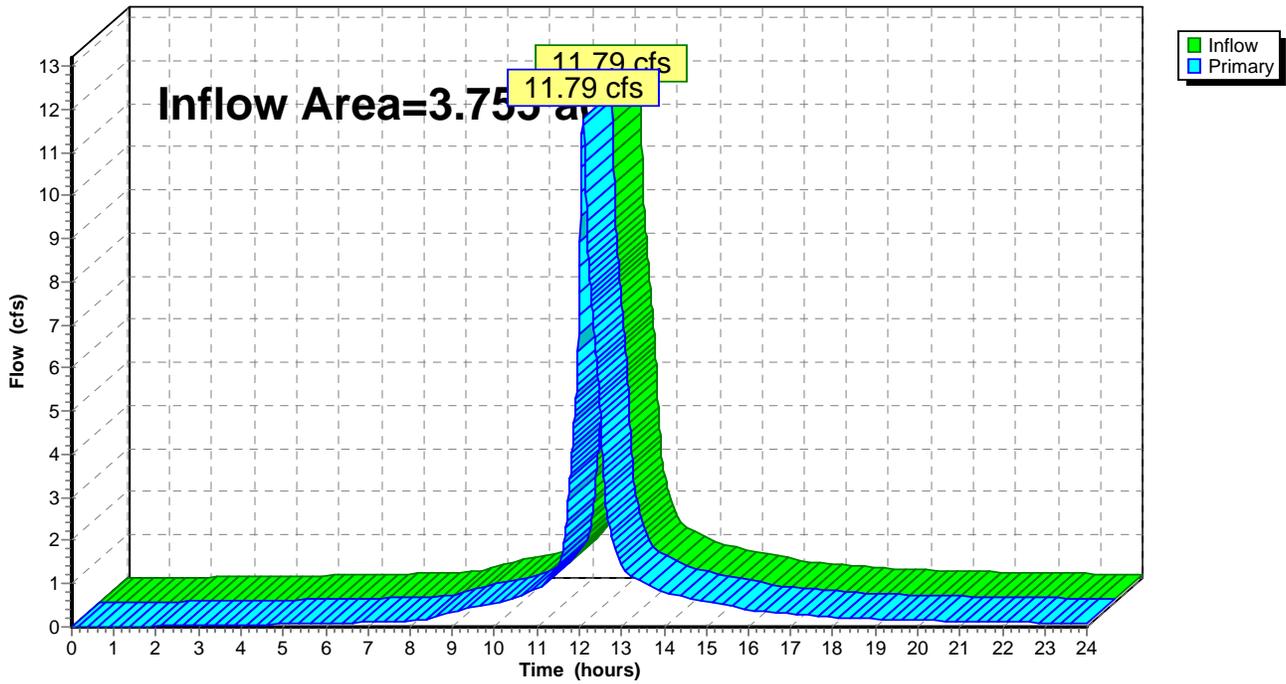
**Summary for Link 1L: TOTAL SITE**

Inflow Area = 3.755 ac, 84.45% Impervious, Inflow Depth > 3.45" for 10-YR event  
Inflow = 11.79 cfs @ 12.09 hrs, Volume= 1.080 af  
Primary = 11.79 cfs @ 12.09 hrs, Volume= 1.080 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: TOTAL SITE**

Hydrograph



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Type III 24-hr 10-YR Rainfall=4.70"

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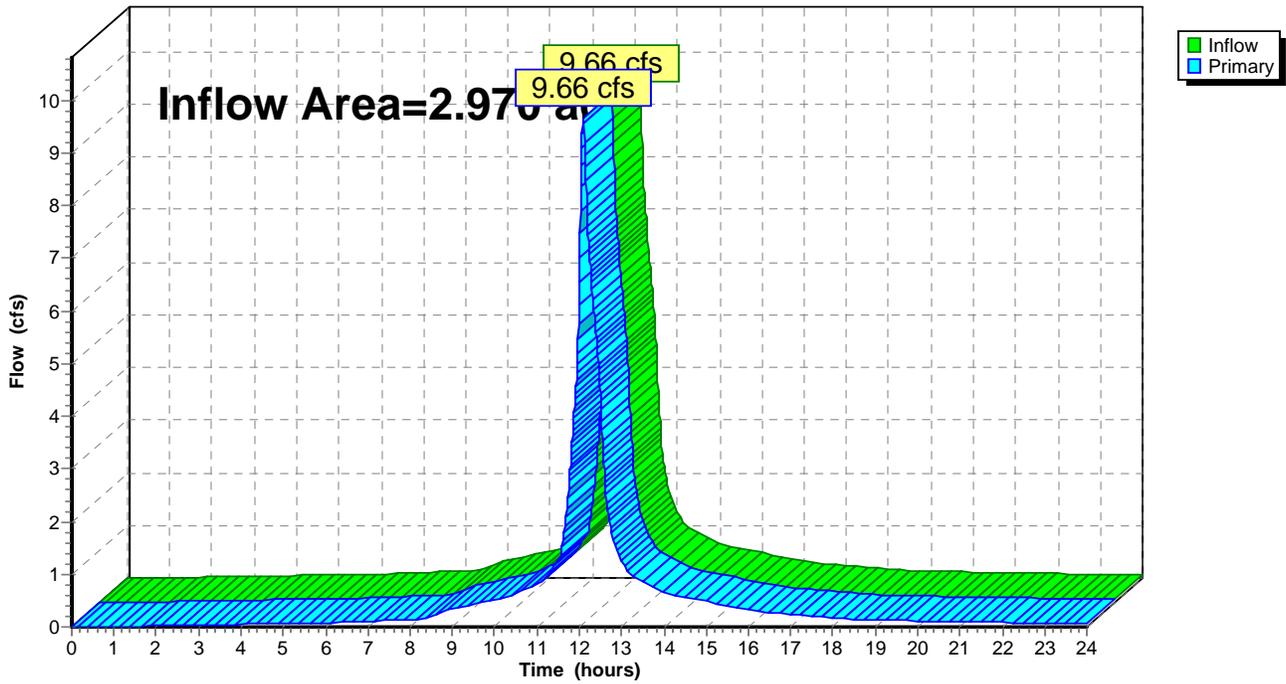
**Summary for Link 2L: DRAIN LINE 3**

Inflow Area = 2.970 ac, 95.93% Impervious, Inflow Depth > 3.75" for 10-YR event  
Inflow = 9.66 cfs @ 12.09 hrs, Volume= 0.928 af  
Primary = 9.66 cfs @ 12.09 hrs, Volume= 0.928 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 2L: DRAIN LINE 3**

Hydrograph



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Type III 24-hr 100-YR Rainfall=7.00"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 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 BLDG1: BLDG W/ DET** Runoff Area=51,980 sf 100.00% Impervious Runoff Depth>6.76"  
Tc=6.0 min CN=98 Runoff=8.20 cfs 0.672 af

**Subcatchment BLDG2: BLDG NO DET** Runoff Area=53,885 sf 100.00% Impervious Runoff Depth>6.76"  
Tc=6.0 min CN=98 Runoff=8.50 cfs 0.696 af

**Subcatchment P1: DRAIN LINE 1** Runoff Area=27,825 sf 48.41% Impervious Runoff Depth>4.58"  
Tc=6.0 min CN=79 Runoff=3.41 cfs 0.244 af

**Subcatchment P2: DRAIN LINE 2** Runoff Area=5,545 sf 10.01% Impervious Runoff Depth>3.10"  
Tc=6.0 min CN=65 Runoff=0.46 cfs 0.033 af

**Subcatchment P3: DRAIN LINE 3** Runoff Area=23,511 sf 77.60% Impervious Runoff Depth>5.82"  
Tc=6.0 min CN=90 Runoff=3.48 cfs 0.262 af

**Subcatchment P4: LINCOLN ST** Runoff Area=828 sf 0.00% Impervious Runoff Depth>2.70"  
Tc=6.0 min CN=61 Runoff=0.06 cfs 0.004 af

**Pond 3P: INF** Peak Elev=19.77' Storage=6,189 cf Inflow=11.67 cfs 0.933 af  
Discarded=0.12 cfs 0.133 af Primary=5.99 cfs 0.785 af Outflow=6.11 cfs 0.918 af

**Link 1L: TOTAL SITE** Inflow=17.53 cfs 1.762 af  
Primary=17.53 cfs 1.762 af

**Link 2L: DRAIN LINE 3** Inflow=13.62 cfs 1.481 af  
Primary=13.62 cfs 1.481 af

**Total Runoff Area = 3.755 ac Runoff Volume = 1.911 af Average Runoff Depth = 6.11"**  
**15.55% Pervious = 0.584 ac 84.45% Impervious = 3.171 ac**

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Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment BLDG1: BLDG W/ DET**

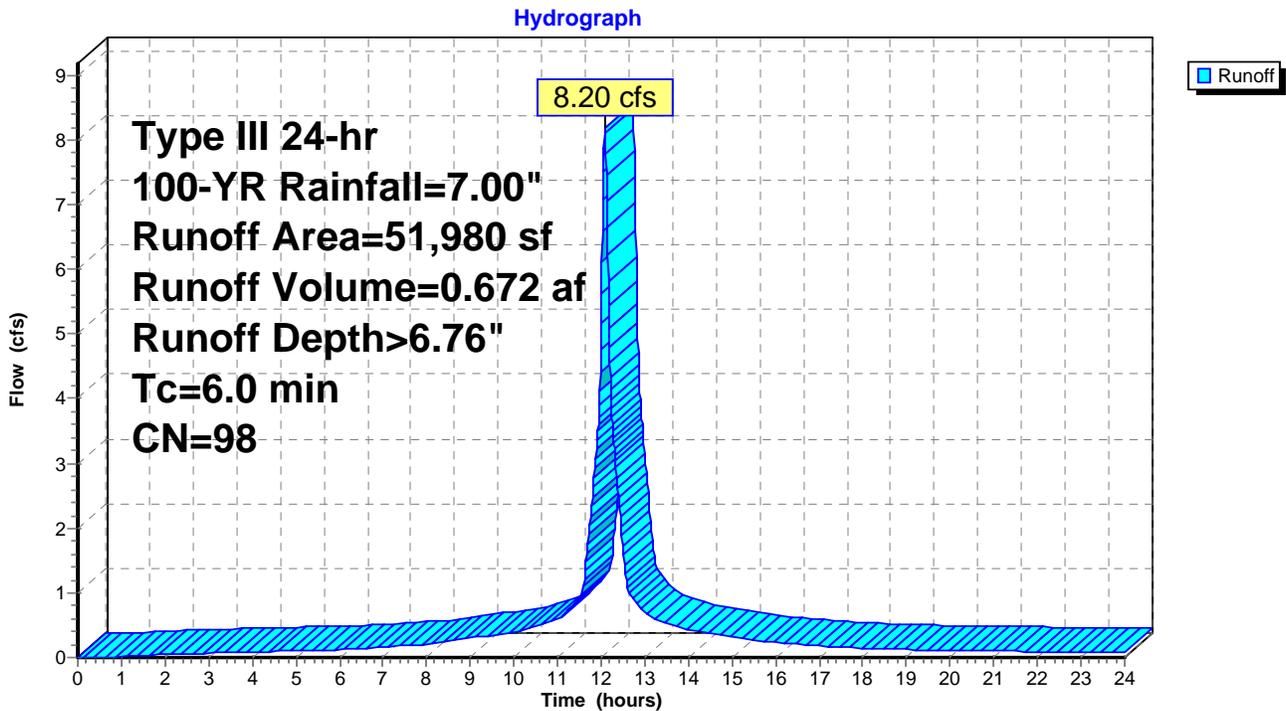
Runoff = 8.20 cfs @ 12.08 hrs, Volume= 0.672 af, Depth> 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
46,980	98	Roofs, HSG B
5,000	98	Roofs, HSG B
51,980	98	Weighted Average
51,980		100.00% Impervious Area

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

**Subcatchment BLDG1: BLDG W/ DET**



**Post Final**

Prepared by Howard Stein Hudson

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Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment BLDG2: BLDG NO DET**

Runoff = 8.50 cfs @ 12.08 hrs, Volume= 0.696 af, Depth> 6.76"

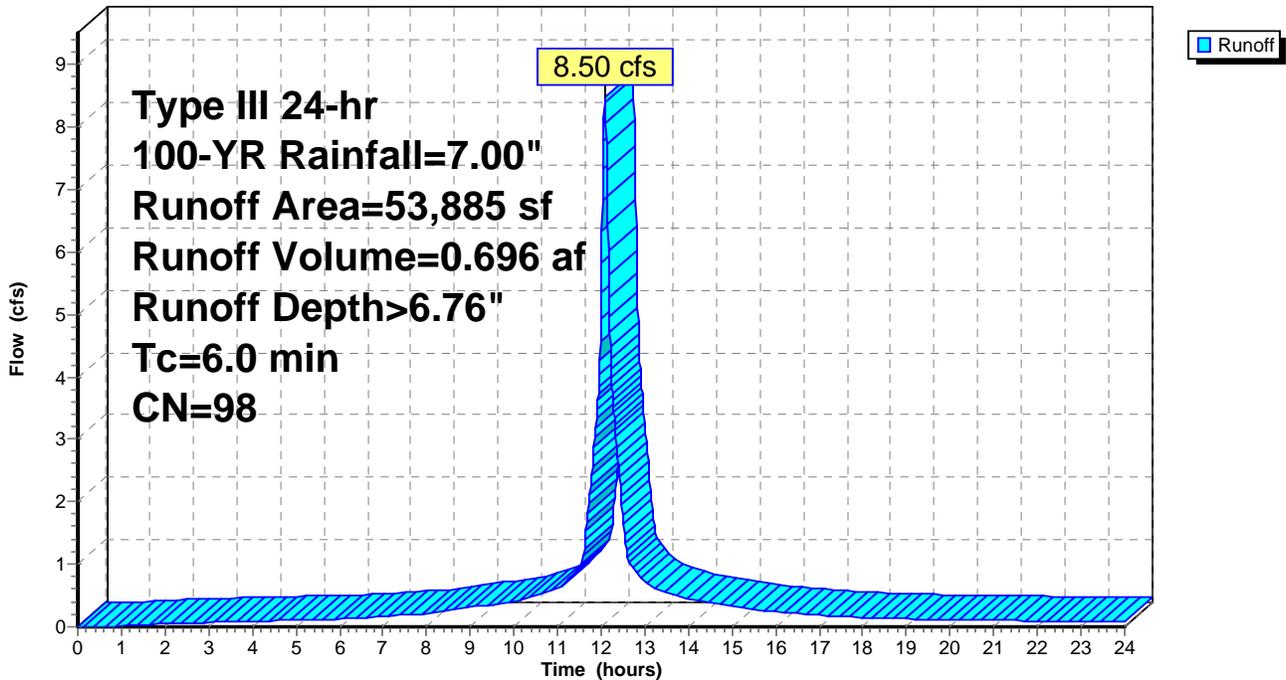
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
53,885	98	Roofs, HSG B
53,885		100.00% Impervious Area

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

**Subcatchment BLDG2: BLDG NO DET**

Hydrograph



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Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment P1: DRAIN LINE 1**

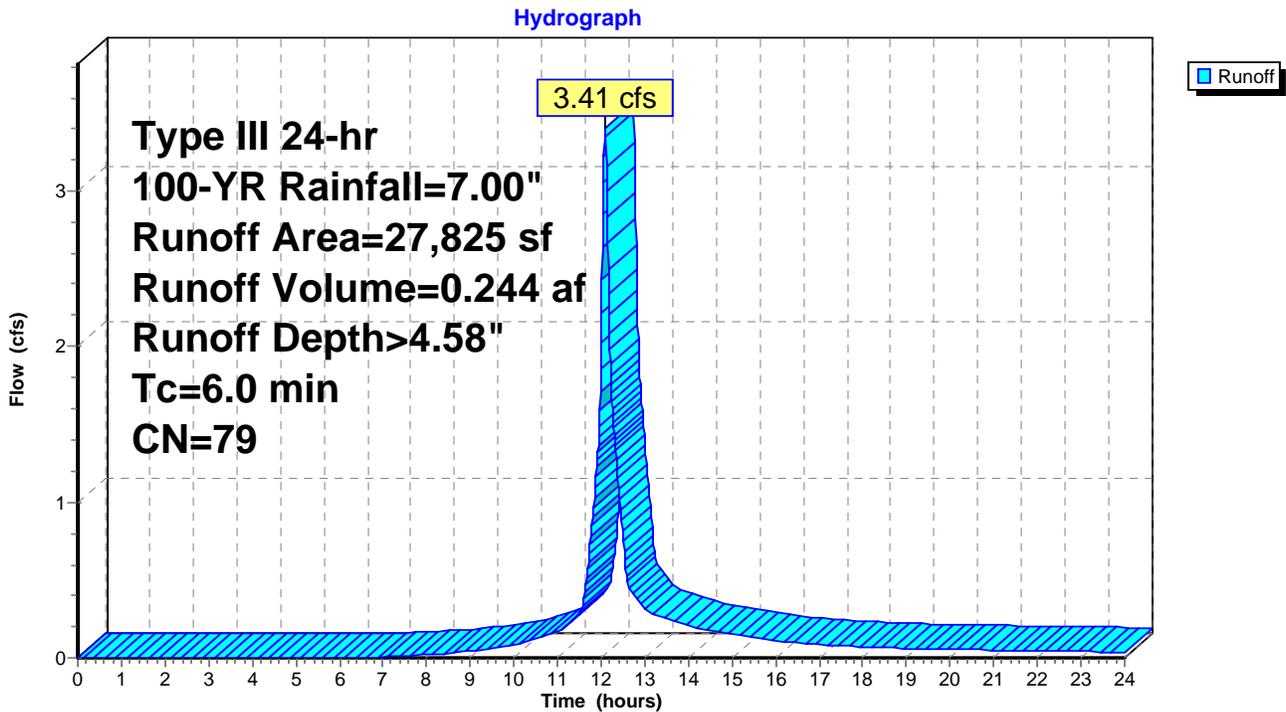
Runoff = 3.41 cfs @ 12.09 hrs, Volume= 0.244 af, Depth> 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
14,356	61	>75% Grass cover, Good, HSG B
13,469	98	Paved parking, HSG B
27,825	79	Weighted Average
14,356		51.59% Pervious Area
13,469		48.41% Impervious Area

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

**Subcatchment P1: DRAIN LINE 1**



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 Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment P2: DRAIN LINE 2**

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af, Depth> 3.10"

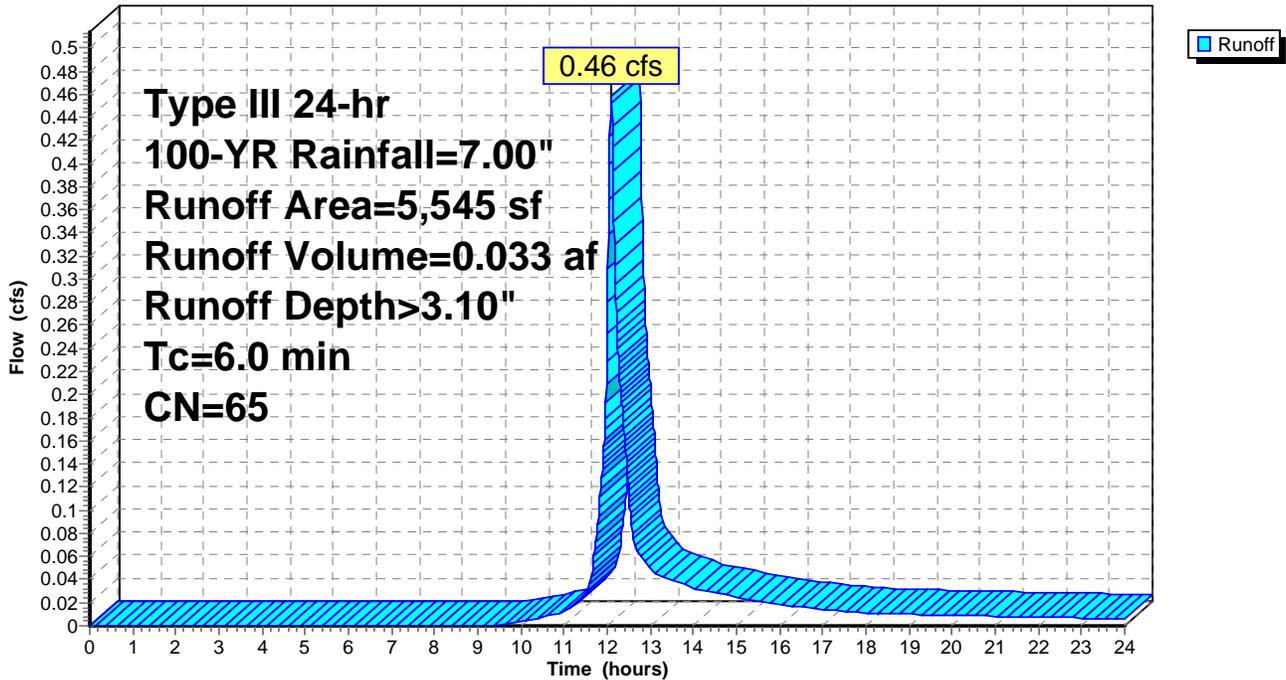
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
555	98	Paved parking, HSG B
4,990	61	>75% Grass cover, Good, HSG B
5,545	65	Weighted Average
4,990		89.99% Pervious Area
555		10.01% Impervious Area

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

**Subcatchment P2: DRAIN LINE 2**

Hydrograph



**Post Final**

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Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment P3: DRAIN LINE 3**

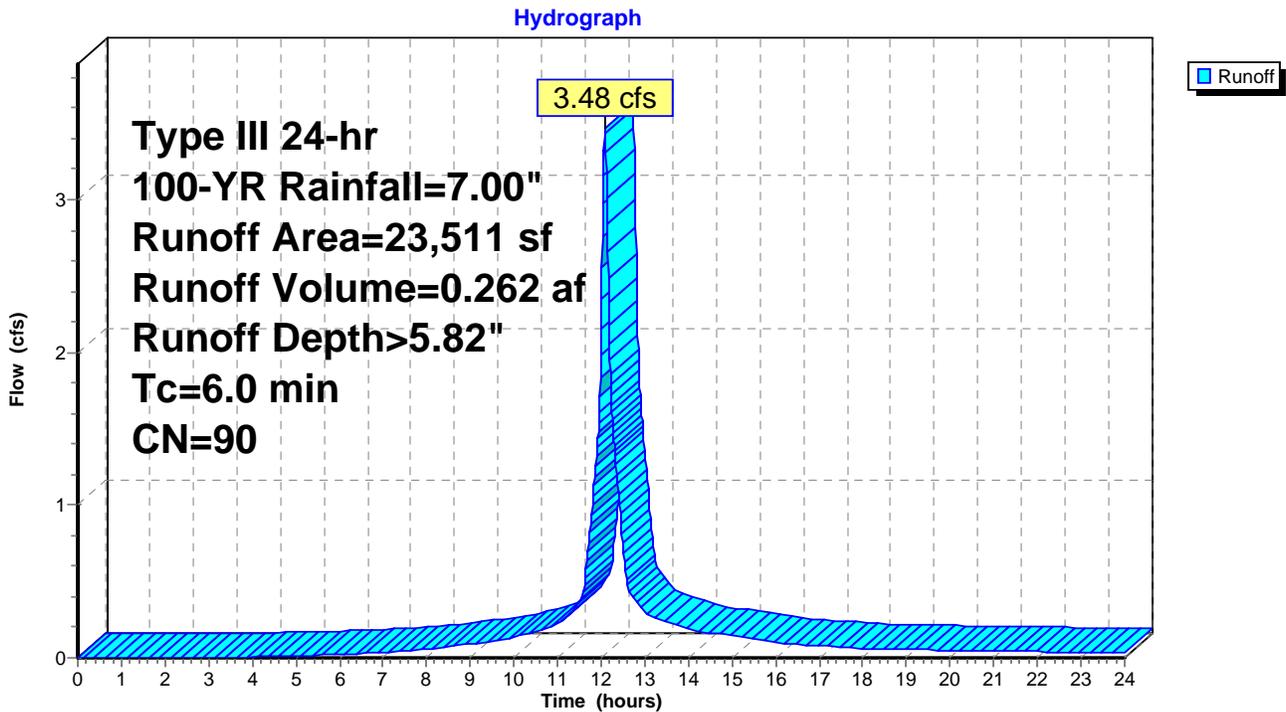
Runoff = 3.48 cfs @ 12.08 hrs, Volume= 0.262 af, Depth> 5.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
18,245	98	Paved parking, HSG B
5,266	61	>75% Grass cover, Good, HSG B
23,511	90	Weighted Average
5,266		22.40% Pervious Area
18,245		77.60% Impervious Area

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

**Subcatchment P3: DRAIN LINE 3**



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Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Subcatchment P4: LINCOLN ST**

Runoff = 0.06 cfs @ 12.09 hrs, Volume= 0.004 af, Depth> 2.70"

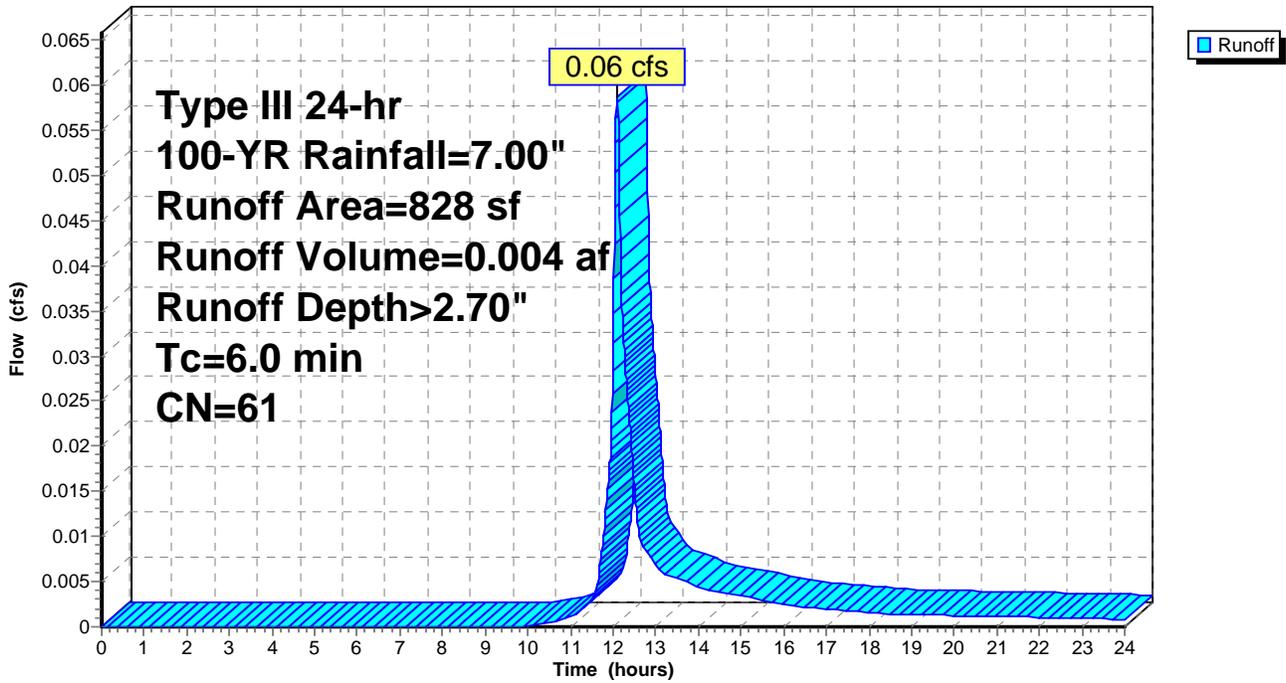
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-YR Rainfall=7.00"

Area (sf)	CN	Description
828	61	>75% Grass cover, Good, HSG B
828		100.00% Pervious Area

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

**Subcatchment P4: LINCOLN ST**

Hydrograph



**Post Final**

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 Type III 24-hr 100-YR Rainfall=7.00"

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**Summary for Pond 3P: INF**

Inflow Area = 1.733 ac, 93.02% Impervious, Inflow Depth > 6.46" for 100-YR event  
 Inflow = 11.67 cfs @ 12.08 hrs, Volume= 0.933 af  
 Outflow = 6.11 cfs @ 12.21 hrs, Volume= 0.918 af, Atten= 48%, Lag= 7.8 min  
 Discarded = 0.12 cfs @ 12.21 hrs, Volume= 0.133 af  
 Primary = 5.99 cfs @ 12.21 hrs, Volume= 0.785 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 19.77' @ 12.21 hrs Surf.Area= 4,720 sf Storage= 6,189 cf

Plug-Flow detention time= 28.5 min calculated for 0.917 af (98% of inflow)  
 Center-of-Mass det. time= 17.6 min ( 770.3 - 752.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	2,891 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 14,160 cf Overall - 4,524 cf Embedded = 9,636 cf x 30.0% Voids
#2	18.00'	4,524 cf	<b>24.0" Round Pipe Storage</b> x 1.44 Inside #1 L= 1,000.0'
		7,415 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	4,720	0	0
20.50	4,720	14,160	14,160

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	<b>15.0" Round Culvert</b> L= 7.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.50' / 17.15' S= 0.0500 '/ Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	20.00'	<b>4.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	17.95'	<b>2.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Discarded	17.50'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 15.50'

**Discarded OutFlow** Max=0.12 cfs @ 12.21 hrs HW=19.77' (Free Discharge)  
 ↳ **4=Exfiltration** ( Controls 0.12 cfs)

**Primary OutFlow** Max=5.99 cfs @ 12.21 hrs HW=19.77' (Free Discharge)  
 ↳ **1=Culvert** (Inlet Controls 5.99 cfs @ 4.88 fps)  
 ↳ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)  
 ↳ **3=Broad-Crested Rectangular Weir** (Passes 5.99 cfs of 16.35 cfs potential flow)

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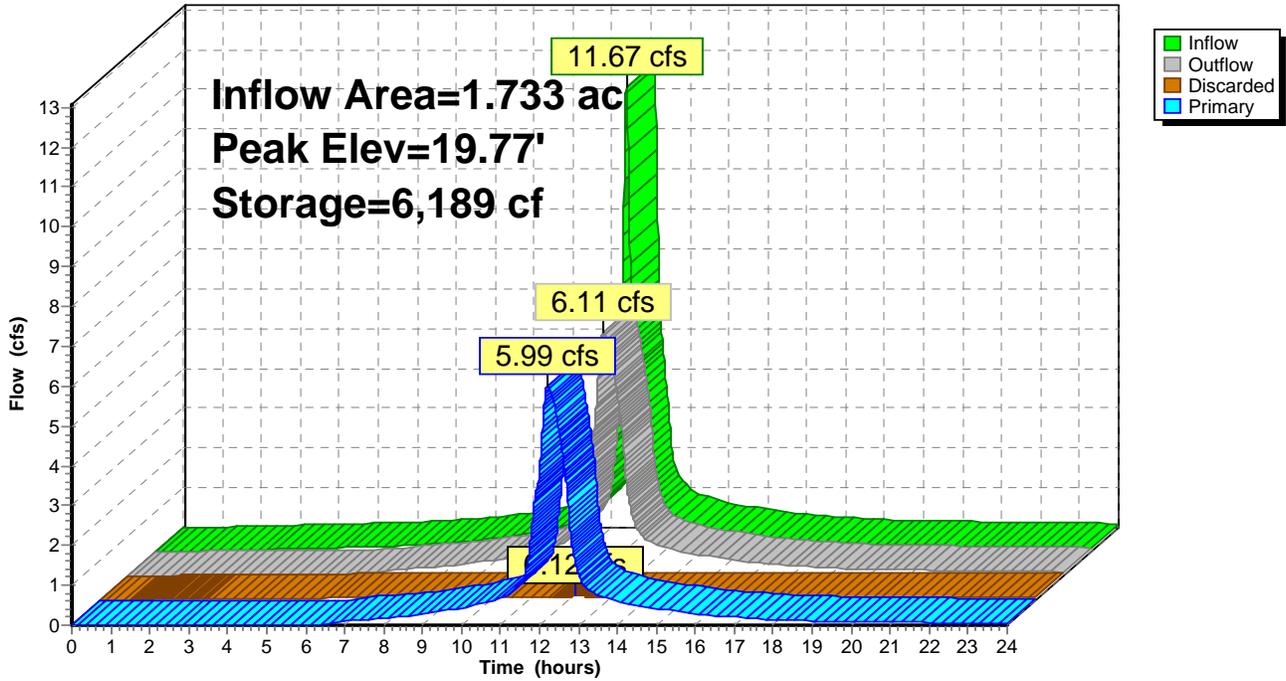
Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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**Pond 3P: INF**

Hydrograph



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**Stage-Area-Storage for Pond 3P: INF**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
17.50	<b>4,720</b>	0	20.10	4,720	6,848
17.55	4,720	71	20.15	4,720	6,919
17.60	4,720	142	20.20	4,720	6,990
17.65	4,720	212	20.25	4,720	7,061
17.70	4,720	283	20.30	4,720	7,132
17.75	4,720	354	20.35	4,720	7,202
17.80	4,720	425	20.40	4,720	7,273
17.85	4,720	496	20.45	4,720	7,344
17.90	4,720	566	20.50	4,720	<b>7,415</b>
17.95	4,720	637			
18.00	4,720	708			
18.05	4,720	800			
18.10	4,720	909			
18.15	4,720	1,028			
18.20	4,720	1,156			
18.25	4,720	1,290			
18.30	4,720	1,431			
18.35	4,720	1,576			
18.40	4,720	1,725			
18.45	4,720	1,879			
18.50	4,720	2,035			
18.55	4,720	2,195			
18.60	4,720	2,357			
18.65	4,720	2,521			
18.70	4,720	2,687			
18.75	4,720	2,855			
18.80	4,720	3,024			
18.85	4,720	3,194			
18.90	4,720	3,364			
18.95	4,720	3,536			
19.00	4,720	3,707			
19.05	4,720	3,879			
19.10	4,720	4,050			
19.15	4,720	4,221			
19.20	4,720	4,391			
19.25	4,720	4,560			
19.30	4,720	4,728			
19.35	4,720	4,894			
19.40	4,720	5,058			
19.45	4,720	5,220			
19.50	4,720	5,380			
19.55	4,720	5,536			
19.60	4,720	5,689			
19.65	4,720	5,839			
19.70	4,720	5,984			
19.75	4,720	6,124			
19.80	4,720	6,259			
19.85	4,720	6,386			
19.90	4,720	6,506			
19.95	4,720	6,615			
20.00	4,720	6,707			
20.05	4,720	6,778			

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Type III 24-hr 100-YR Rainfall=7.00"

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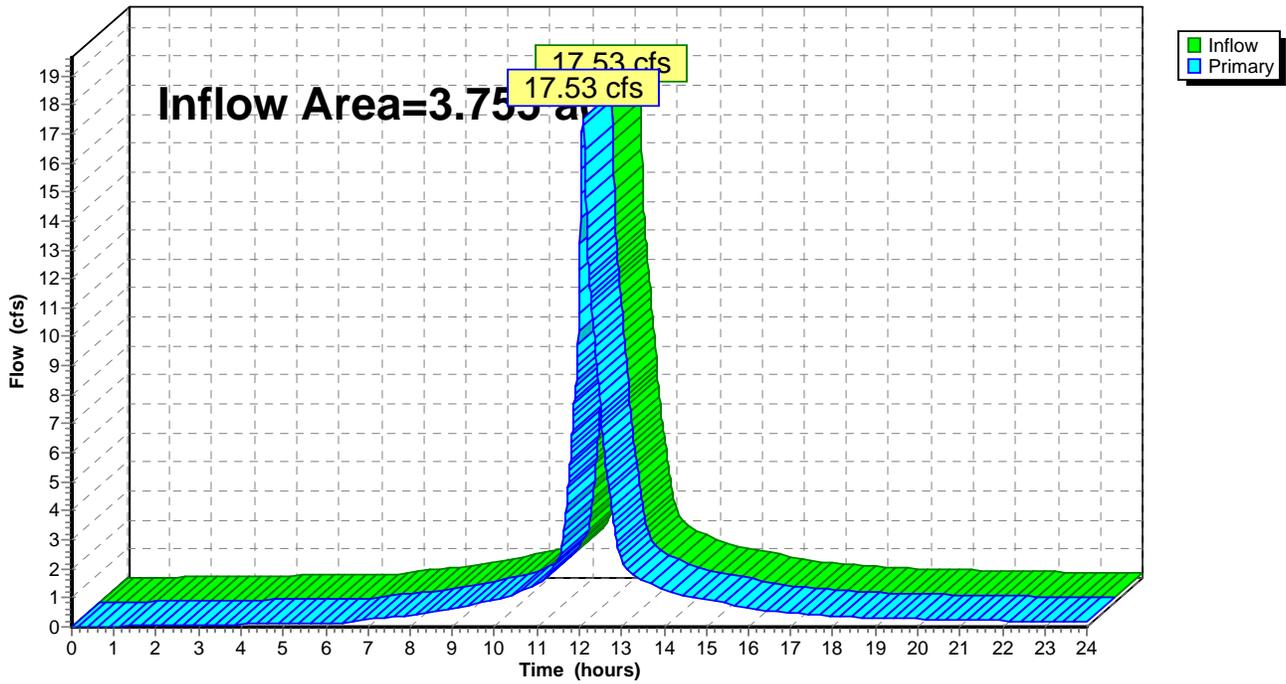
**Summary for Link 1L: TOTAL SITE**

Inflow Area = 3.755 ac, 84.45% Impervious, Inflow Depth > 5.63" for 100-YR event  
Inflow = 17.53 cfs @ 12.09 hrs, Volume= 1.762 af  
Primary = 17.53 cfs @ 12.09 hrs, Volume= 1.762 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: TOTAL SITE**

Hydrograph



**Post Final**

Prepared by Howard Stein Hudson

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Avalon Hingham SY II  
Type III 24-hr 100-YR Rainfall=7.00"

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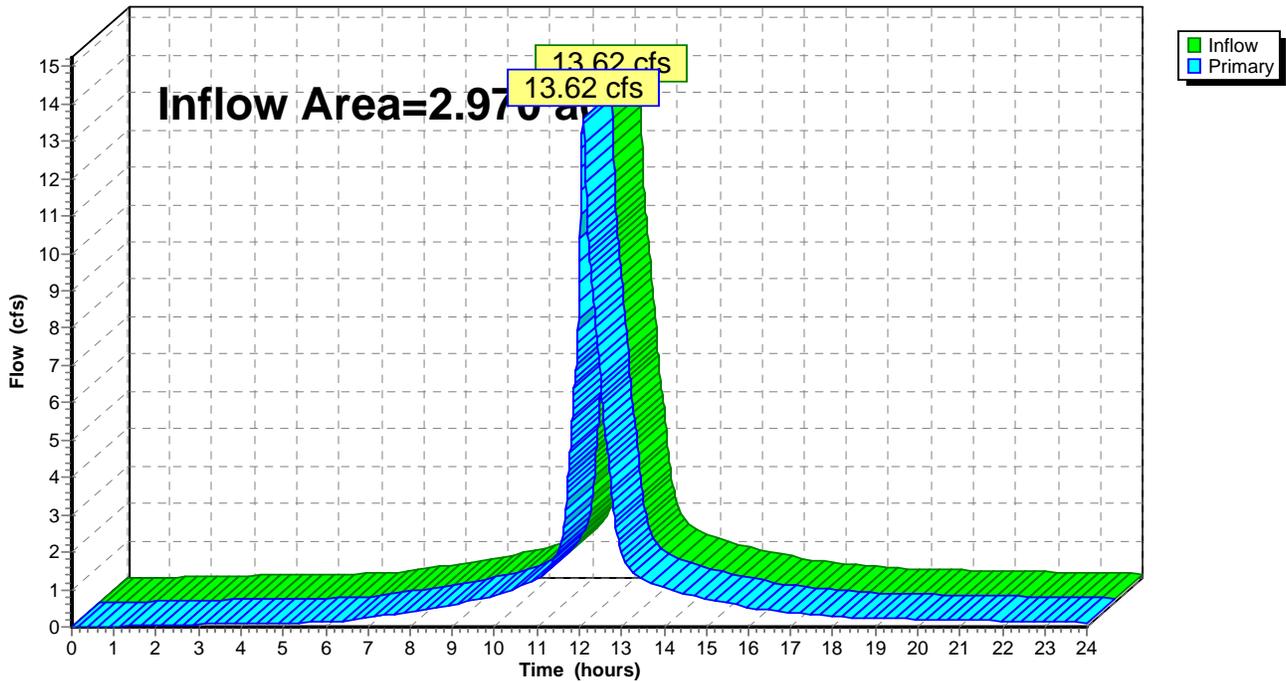
**Summary for Link 2L: DRAIN LINE 3**

Inflow Area = 2.970 ac, 95.93% Impervious, Inflow Depth > 5.98" for 100-YR event  
Inflow = 13.62 cfs @ 12.09 hrs, Volume= 1.481 af  
Primary = 13.62 cfs @ 12.09 hrs, Volume= 1.481 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 2L: DRAIN LINE 3**

Hydrograph





## **Appendix D.**

### Water Quality Calculations

**Avalon Hingham Shipyard II**

For first 1-inch Runoff WQV

$$Q=(qu)(A)(WQV)$$

Q= peak flow rate associaed with 1-inch of runoff (in cubic feet per second)

qu= the unit peak discharge, in csm/in.

A= impervious surface drainage area (in square miles)

WQV= water quality volume in watershed inches (1.0-inches in this case)

	qu (csm/in.)	A (sq.mi.)	WQV (in.)	Q (cfs)
CB-1	773	0.000483	1	0.37
DMH-4	773	0.00055	1	0.43



## **Appendix E.**

### Closed Drainage System Calculations

**CLOSED DRAINAGE SYSTEM CALCULATIONS  
10-YEAR FREQUENCY (PROPOSED CONDITION)**

Project: Avalon Hingham SY II  
 Proj. #: 2015151  
 Date: MARCH 30,2016  
 By: HV  
 Ckd by: HH

Notes: n= 0.011  
 c=0.95 (impervious areas)  
 c=0.15 (for lawn/planting areas)

Line	From	To	Length (ft)	Area (acres)	Runoff C	CA	SUM CA	Time of Concen.	Rainfall I (in./hr.)	Req. Cap. Qd (cfs)	Pipe (in)	Slope (ft/ft)	Flow Full		Design Vel. Vd (fps)	Rim Elev.(ft)	Inv. Elevations		Q/Qf	Pipe Cover	Time in Pipe	
													Qf (cfs)	Vf (fps)			Upper	Lower				
<b>DP 1</b>																						
CB 1	DMH 1		190	0.47	0.67	0.32	0.32	5.00	5.30	1.69	12.00	0.022	6.26	7.97	5.71	21.45	17.45	13.25	0.27	3.00	0.56	
<b>DP 2</b>																						
AD-1	EX MH		36	0.03	0.67	0.02	0.02	5.00	5.30	0.10	12.00	0.050	9.44	12.02	3.39	23.60	20.60	18.79	0.01	2.00	0.18	
<b>DP 3</b>																						
CB 2	DMH 2		8	0.21	0.92	0.20	0.20	5.00	5.30	1.04	12.00	0.10	13.31	16.95	8.47	19.65	15.65	14.85	0.08	3.00	0.02	
AD 2	DMH2		5	0.00	0.15	0.00	0.00	5.00	5.30	0.00	12.00	0.050	9.41	11.98	1.28	19.40	15.10	14.85	0.00	3.30	0.07	
DMH 2	DMH 3		266	0.00	0.92	0.00	0.20	5.07	5.30	1.04	12.00	0.010	4.21	5.36	3.74	19.78	14.85	12.19	0.25	3.93	1.18	
CB 3	DMH 3		3	0.17	0.88	0.15	0.15	5.00	5.30	0.78	12.00	0.094	12.93	16.46	7.64	21.46	12.49	12.19	0.06	7.97	0.01	
DMH 3	DMH 4		201	0.00	0.88	0.00	0.34	6.25	5.00	1.72	12.00	0.015	5.14	6.55	4.99	22.00	12.19	9.19	0.33	8.81	0.67	
CB 4	DMH 4		3	0.06	0.95	0.05	0.05	5.00	5.30	0.28	12.00	0.050	9.41	11.98	4.54	21.83	17.83	17.68	0.03	3.00	0.01	
DMH 4	DMH 5		22	0.00	0.95	0.00	0.40	6.92	4.80	1.91	12.00	0.010	4.21	5.36	4.46	22.00	9.19	8.97	0.45	11.81	0.08	
AD3	AD4		59	0.06	0.16	0.01	0.01	5.00	5.30	0.05	12.00	0.010	4.21	5.36	1.55	21.00	18.00	17.41	0.01	2.00	0.63	
AD4	DMH6		59	0.04	0.37	0.01	0.02	5.63	5.10	0.12	12.00	0.010	4.21	5.36	2.02	20.85	17.41	16.82	0.03	2.44	0.49	
DMH6	DMH7		173	0.00	0.37	0.00	0.02	5.63	5.10	0.12	12.00	0.010	4.21	5.36	2.02	20.70	16.82	15.09	0.03	2.88	1.43	
RD1	DMH7		18	1.24	0.95	1.18	1.18	5.00	5.30	6.23	12.00	0.043	8.71	11.08	10.53	22.70	15.86	15.09	0.72	5.84	0.03	
DMH7	DMH8		222	0.00	0.37	0.00	1.20	7.06	4.80	5.76	15.00	0.010	7.64	6.22	6.00	21.76	15.09	12.87	0.75	5.42	0.62	
DET	OCS		7	1.19	0.95	1.13	1.13	5.00	5.30	6.01	15.00	0.030	13.23	10.78	8.98	22.00	18.00	17.50	0.45	2.75	0.01	
OCS	DMH 8		12	0.00	0.95	0.00	1.13	5.01	5.30	6.01	12.00	0.030	7.29	9.28	9.19	22.48	17.50	16.90	0.82	3.98	0.02	
DMH 8	DMH 9		140	0.00	0.95	0.00	2.33	7.68	4.70	10.97	18.00	0.010	12.43	7.03	7.10	22.31	13.26	11.86	0.88	7.55	0.33	
DMH 9	DMH 5		18	0.00	0.95	0.00	2.33	8.01	4.60	10.73	15.00	0.010	7.64	6.22	7.19	22.10	11.47	11.29	1.41	9.38	0.04	

Cn=

.74 (Pervious C) .98 (Impervious)

.38 (Pervious A)

<b>ID</b>	<b>Total Area (ft<sup>2</sup>)</b>	<b>Acres</b>	<b>Pervious</b>	<b>Impervious</b>	<b>Weighted Cn</b>
EX1	41,008	0.94	-	41,008	0.98
EX2	9,143	0.21	87	9,056	0.98
EX3	99,478	2.28	2,669	96,809	0.97
EX4	13934.00	0.32	0.00	13934.00	0.98
<b>TOTALS</b>	<b>163,563</b>		<b>2,756</b>	<b>146,873</b>	
ACRES	3.75		0.06	3.37	

**WEIGHTED C CALCULATIONS**

Project: Hingham  
 Proj. #: 2015151  
 Date: MARCH 30, 2016  
 By: HV  
 Ckd by:

Notes:  
 n= 0.012 RCP  
 n= 0.01 PVC  
 c= 0.95 impervious areas  
 c= 0.15 lawn/planting areas

DRAINAGE AREA	A TOTAL (SF)	A TOTAL (ACRE)	A IMPERV (SF)	A IMPERV (ACRE)	IMPERV C FACTOR	IMPERV C X A	A GRASS (SF)	A GRASS (ACRE)	GRASS C FACTOR	GRASS C X A	WEIGHTED C FACTOR
<b>DP1</b>											
CB1	20,650.00	0.47	13,469.00	0.31	0.95	0.29	7,181.00	0.16	0.15	0.02	0.67
LAND	7,175.00	0.16	0.00	0.00	0.95	0.00	7,175.00	0.16	0.15	0.02	0.15
Total	27,825.00	0.64	13,469.00	0.31	0.95	0.29	14,356.00	0.33	0.15	0.05	0.54
<b>DP2</b>											
AD-1	1,256.00	0.03	0.00	0.00	0.95	0.00	1,256.00	0.03	0.15	0.00	0.15
LAND	4,289.00	0.10	555.00	0.01	0.95	0.01	3,734.00	0.09	0.15	0.01	0.25
Total	5,545.00	0.13	555.00	0.01	0.95	0.01	4,990.00	0.11	0.15	0.02	0.23
<b>DP3</b>											
CB2	9,256.00	0.21	8,921.00	0.20	0.95	0.19	335.00	0.01	0.15	0.00	0.92
AD2	195.00	0.00	0.00	0.00	0.95	0.00	195.00	0.00	0.15	0.00	0.15
CB3	7,293.00	0.17	6,674.00	0.15	0.95	0.15	619.00	0.01	0.15	0.00	0.88
CB4	2,445.00	0.06	2,445.00	0.06	0.95	0.05	0.00	0.00	0.15	0.00	0.95
DET	51,980.00	1.19	51,980.00	1.19	0.95	1.13	0.00	0.00	0.15	0.00	0.95
BLDG	53,885.00	1.24	53,885.00	1.24	0.95	1.18	0.00	0.00	0.15	0.00	0.95
AD 3	2,589.00	0.06	27.00	0.00	0.95	0.00	2,562.00	0.06	0.15	0.01	0.16
AD 4	1,733.00	0.04	482.00	0.01	0.95	0.01	1,251.00	0.03	0.15	0.00	0.37
Total	129,376.00	2.97	124,414.00	2.86	0.95	2.71	4,962.00	0.11	0.15	0.02	0.92
<b>DP4</b>											
LAND	828.00	0.02	0.00	0.00	0.95	0.00	828.00	0.02	0.15	0.00	0.15
Total	828.00	0.02	0.00	0.00	0.95	0.00	828.00	0.02	0.15	0.00	0.15

TOTAL	163,574.00	3.18
ACRES	3.76	3.18



## **Appendix F.**

### Operation and Maintenance Plan

---

**Avalon Hingham Shipyard II  
Stormwater Management System  
Operation and Maintenance Plan (O&M)  
and  
Long Term Pollution Prevention Plan (LTPPP)  
March 2016**

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This Stormwater Management System Operation and Maintenance Plan provides for the inspection and maintenance of structural Best Management Practices (BMPs) and for measures to prevent pollution associated with the Avalon Hingham Shipyard II Project at 319 Lincoln Street in Hingham, MA.

This document has been prepared in accordance with the requirements of the Stormwater Regulations included in the Massachusetts Wetlands Protection Act Regulations (310 CMR 10).

**Stormwater Management System Owner:**

**Hingham Shipyard Avalon II Inc.  
51 Sleeper Street, Suite 750  
Boston, MA 02210  
Tel.: (617) 737-3470**

The stormwater management system will be maintained properly to assure its continued performance, as follows.

1. Catch basins and area drains
  - a. Inspect quarterly (January, April, July, October).
  - b. Clean 4 times per year or when deposits reach  $\frac{1}{2}$  the depth of the sump.
  
2. Subsurface Infiltration System
  - a. Inspect every 6 months and after every major storm event, remove debris.
  - b. Remove any debris that may clog system.
  - c. Remove sediment if depth reaches 3 inches.

### 3. Water Quality Units

Follow manufacturer's recommendations including:

- a. Inspect twice a year (spring and fall) minimum
- b. System should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when appreciable level of hydrocarbons and trash has accumulated.

### 4. Semi-annually (generally May and November)

- a. Street sweeping

## PRACTICES FOR LONG TERM POLLUTION PREVENTION

### LITTER PICK-UP

The Owner will conduct litter pick-up from the stormwater management facilities in conjunction with routine maintenance activities.

### ROUTINE INSPECTION AND MAINTENANCE OF STORMWATER BMPS

The Owner will conduct inspection and maintenance of the stormwater management practices in accordance with the guidelines discussed above.

### MAINTENANCE OF LANDSCAPED AREAS

The Owner shall minimize use of fertilizers, herbicides, and pesticides for the maintenance of facilities covered by this plan.

### PROHIBITION OF ILLICIT DISCHARGES

The DEP Stormwater Management Standards prohibit illicit discharges to the storm water management system. Illicit discharges are discharges that do not entirely consist of stormwater, except for certain specified non-stormwater discharges.

Discharges from the following activities are not considered illicit discharges:

Firefighting	Foundation drains
Water line flushing	Footing drains
Landscape irrigation	Individual resident car washing
Uncontaminated groundwater	Flows from riparian habitats and wetlands
Potable water sources	Dechlorinated water from swimming pools
Water used to clean residential buildings without detergents	Water used for street washing
	Air conditioning condensation

There are no known or proposed illicit connections associated with this project.

