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**Date:** 12/22/2022  
**From:** Chuck Gregory, PE - Principal  
**Project Name:** PGE Tonquin Substation  
**AKS Job No.:** 8464  
**Project Site:** 12150 SW Tualatin Sherwood Rd. Tualatin OR, 97140  
**Subject:** **PGE Tonquin Substation - Stormwater Memorandum**

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## **1.0 Purpose of Memorandum**

This memorandum analyzes the effects of the proposed site improvements with respect to the existing and proposed stormwater conveyance system. Evaluation of the stormwater system includes documentation of regulatory criteria, methodology, and informational sources used to design/evaluate the stormwater system. The results of the preliminary hydraulic analysis are presented.

## **2.0 Regulatory Design Criteria**

### **2.1 Stormwater Quantity**

Per *Clean Water Services (CWS) Design and Construction Standards Manual for Sanitary Sewer and Surface Water Management (R&O 19-05), Section 4.02, Quantity Control Requirements for Conveyance Capacity*; on-site detention for conveyance capacity (25-year storm event) is required when any of the following conditions exist:

1. *There is an identified downstream deficiency and the District or City determines that detention rather than conveyance system enlargement is the more effective solution.*
2. *There is an identified regional detention site within the boundary of the development.*
3. *Water quantity facilities are required by District-adopted watershed management plans or adopted subbasin master plans.*

Per CWS standards, the stormwater facilities must be designed to detain the subject site's post-developed 25-year storm event peak flow to the site pre-developed 25-year storm event peak flow.

### **2.2 Stormwater Hydromodification**

Per *CWS R&O 19-05, Section 4.03, Hydromodification Approach Requirements*; stormwater hydromodification is required unless the project meets any of the following criteria:

1. *The project results in the addition and/or modification of less than 12,000 square feet of impervious surface.*
2. *The project is located in an area with a District approved subbasin strategy with an identified regional stormwater management approach for hydromodification.*

Per listed criteria in the Hydromodification Approach Project Category Table 4-2, the subject project is identified as Category 3. Therefore, the subject project will meet CWS hydromodification requirements by providing peak-flow matching detention, using the design criteria established within CWS Section 4.08.6.

### **2.3 Stormwater Quality**

The proposed project must meet CWS stormwater quality standards, providing stormwater treatment to all impervious surface's runoff. Stormwater quality management for this project will be provided by an

extended dry basin as well as stormwater filter cartridges. The stormwater facilities have been designed per CWS standards as established in section 4.04.

### 3.0 Design Methodology

The Santa Barbara Urban Hydrograph (SBUH) Method was used to analyze stormwater runoff from the site. This method utilizes the SCS Type 1A 24-hour design storm.

### 4.0 Design Parameters

#### 4.1 Design Storms

Per CWS requirements, the following rainfall intensities and durations were used in analyzing the existing and proposed hydrologic site conditions:

Recurrence Interval (Years)	Storm Period (hours)	Total Precipitation Depth (Inches)
WQ	4	0.36
2	24	2.50
5	24	3.10
10	24	3.45
25	24	3.90

#### 4.2 Pre-Developed Site Conditions

##### 4.2.1 Site Topography

Existing on-site grades vary from  $\pm 1\%$  to  $\pm 50\%$ , with a high point of  $\pm 250$  feet near the southwest corner of the site and a low point of  $\pm 233$  feet near the northwest corner of the site. The site slopes from south to north.

##### 4.3 Soil Type

The soils beneath the project site and the associated drainage basins consist of medium dense to very dense gravel with varying amounts of clay, silt, and sand. Soil also consists of cobbles and boulders, dense silt sand with gravel. Weak to medium strength weathered basalt was also encountered. Soils underlying the site classify as Hydrologic Soil Group D.

#### 4.4 Post-Developed Site Conditions

##### 4.4.1 Site Topography

The onsite slopes will be modified with cuts and fills to accommodate the construction of the drive aisles and substation's gravel pad.

### 5.0 Stormwater Analyses

#### 5.1 Proposed Stormwater Quality Management

Stormwater quality for the proposed project will be provided via one extended dry basin and two stormwater filter cartridge catch basins, designed per CWS Design and Construction Standards.

The water quality volume will be routed through the proposed extended dry basin and stormwater filter cartridges which will provide water quality treatment per CWS standards.

**5.2 Stormwater Hydromodification Management**

The proposed project will generate approximately 3.4 acres of impervious area, thus classifying as a Large Project. Per CWS Hydromod Planning Tool, the subject site is located within an expansion area and eventually drains into a low-risk level existing stream. Based on these parameters and CWS Table 4-2, the subject project is within Category 3 Hydromodification Approach.

Per CWS Category 3, the subject site will provide peak-flow matching detention, using design criteria in CWS Section 4.08.6. Specifically, the subject site’s post-developed 2-year storm event runoff flows will not exceed 50% of the site’s pre-developed 2-year storm event runoff flows and will be less than or equal to the 5-year, 10-year, and 25-year flows.

The site will utilize an extended dry basin as well as underground chamber trenches for stormwater detention.

**Table 6-1: Total Pre and Post Developed Flows**

Recurrence Interval (Years)	Peak Pre-Development Flows (cfs)	Peak Post-Development Flows (cfs)	Peak Flow Increase or (Decrease) – (cfs)
2	*0.39	0.39	0.00
5	1.17	0.74	(0.43)
10	1.41	1.03	(0.38)
25	1.72	1.67	(0.05)

\*Peak pre-developed flow for 2-year storm event is calculated by subtracting 50% of the subject site peak flow from the total pre-developed peak flow.

**5.3 Downstream Analysis**

Stormwater runoff from the project site will be conveyed and directed into the existing public storm system located within SW Blake St. From there, runoff is directed west into the storm system located within SW 124<sup>th</sup> Ave.

A quarter mile downstream visual investigation of the storm system was performed, and no evidence of stormwater system conveyance capacity issues were found.

If you have any questions, please call or email.

Sincerely,  
**AKS ENGINEERING & FORESTRY, LLC**

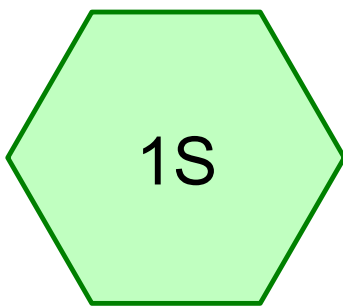
Chuck Gregory, PE, Principal  
 12965 SW Herman Road, Suite 100  
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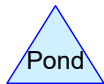
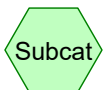
RENEWS: JUNE 30, 2023

A Final Stormwater Report that includes supporting documentation will be provided during final engineering.

Attachments: HydroCAD Reports



PRE-DEVELOPED  
AREA SURFACE RUNOFF



**8464 PRE-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 2

**Summary for Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**

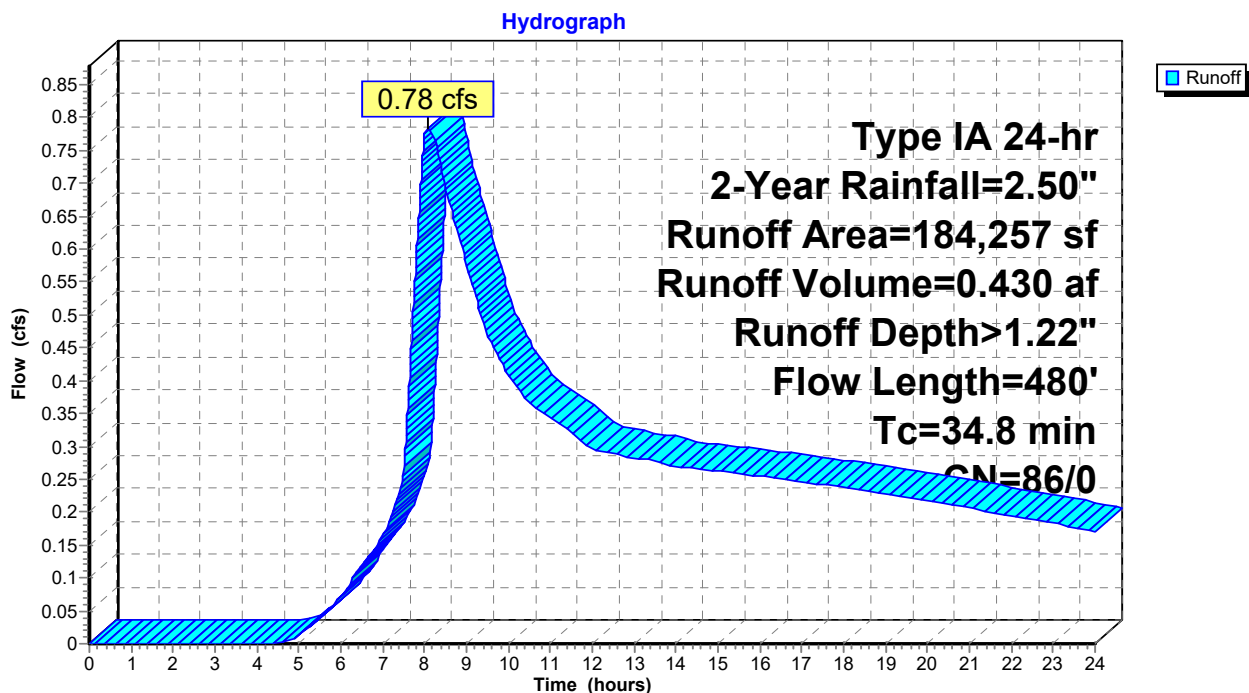
Runoff = 0.78 cfs @ 8.09 hrs, Volume= 0.430 af, Depth> 1.22"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
184,257	86	Woods/grass comb., Poor, HSG D
184,257	86	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	150	0.0305	0.09		<b>Sheet Flow, Sheet</b> Woods: Light underbrush n= 0.400 P2= 2.50"
6.4	330	0.0296	0.86		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
34.8	480	Total			

**Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**



**8464 PRE-DEVELOPED MODEL**

Type IA 24-hr 5-Year Rainfall=3.10"

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**Summary for Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**

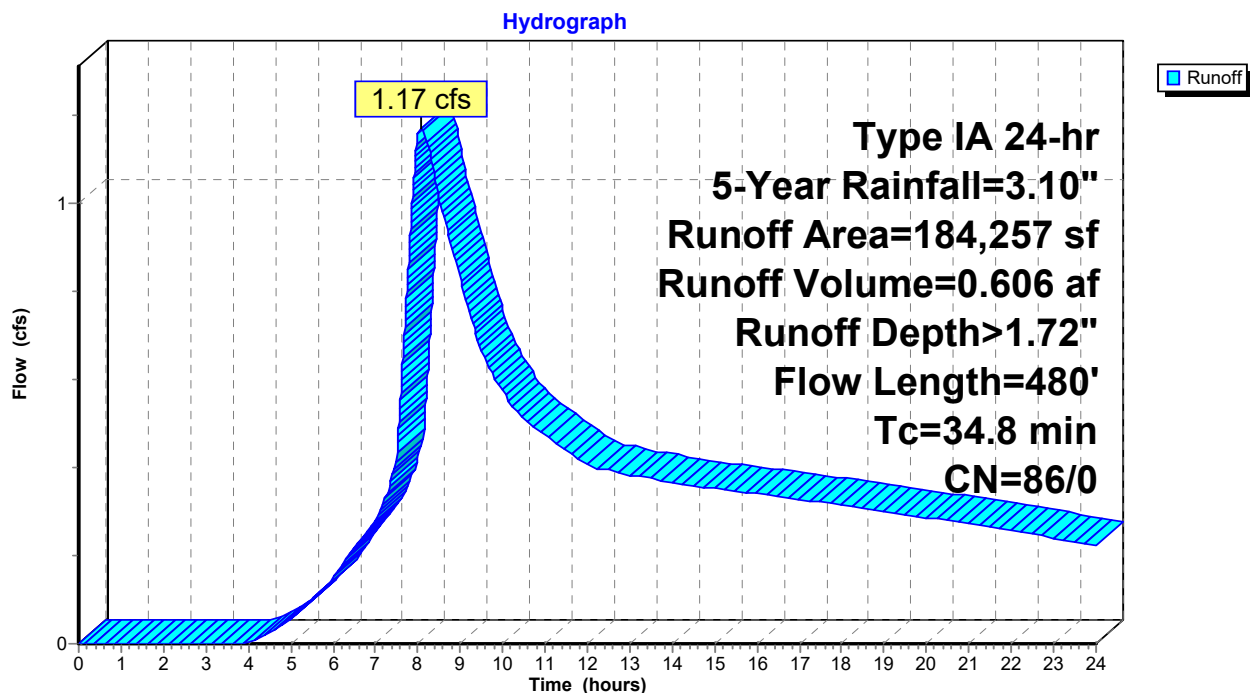
Runoff = 1.17 cfs @ 8.06 hrs, Volume= 0.606 af, Depth> 1.72"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
184,257	86	Woods/grass comb., Poor, HSG D
184,257	86	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	150	0.0305	0.09		<b>Sheet Flow, Sheet</b> Woods: Light underbrush n= 0.400 P2= 2.50"
6.4	330	0.0296	0.86		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
34.8	480	Total			

**Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**



**8464 PRE-DEVELOPED MODEL**

Type IA 24-hr 10-Year Rainfall=3.45"

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**Summary for Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**

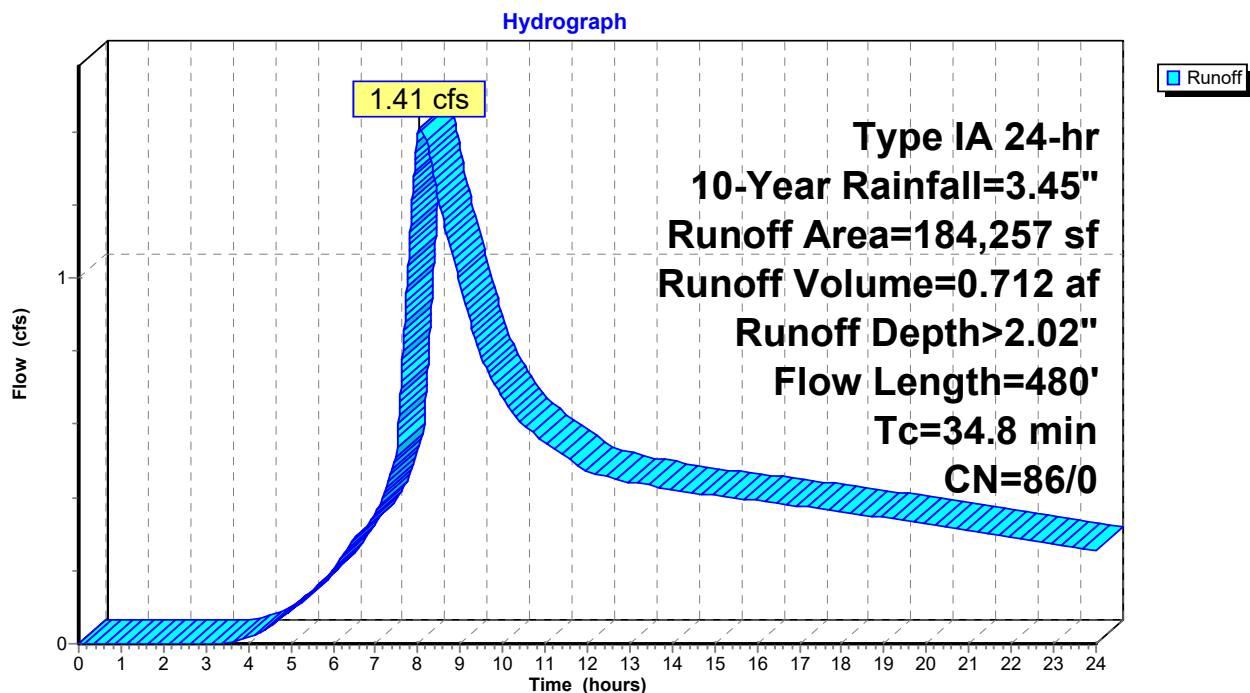
Runoff = 1.41 cfs @ 8.05 hrs, Volume= 0.712 af, Depth> 2.02"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
184,257	86	Woods/grass comb., Poor, HSG D
184,257	86	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	150	0.0305	0.09		<b>Sheet Flow, Sheet</b> Woods: Light underbrush n= 0.400 P2= 2.50"
6.4	330	0.0296	0.86		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
34.8	480	Total			

**Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**



**8464 PRE-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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**Summary for Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**

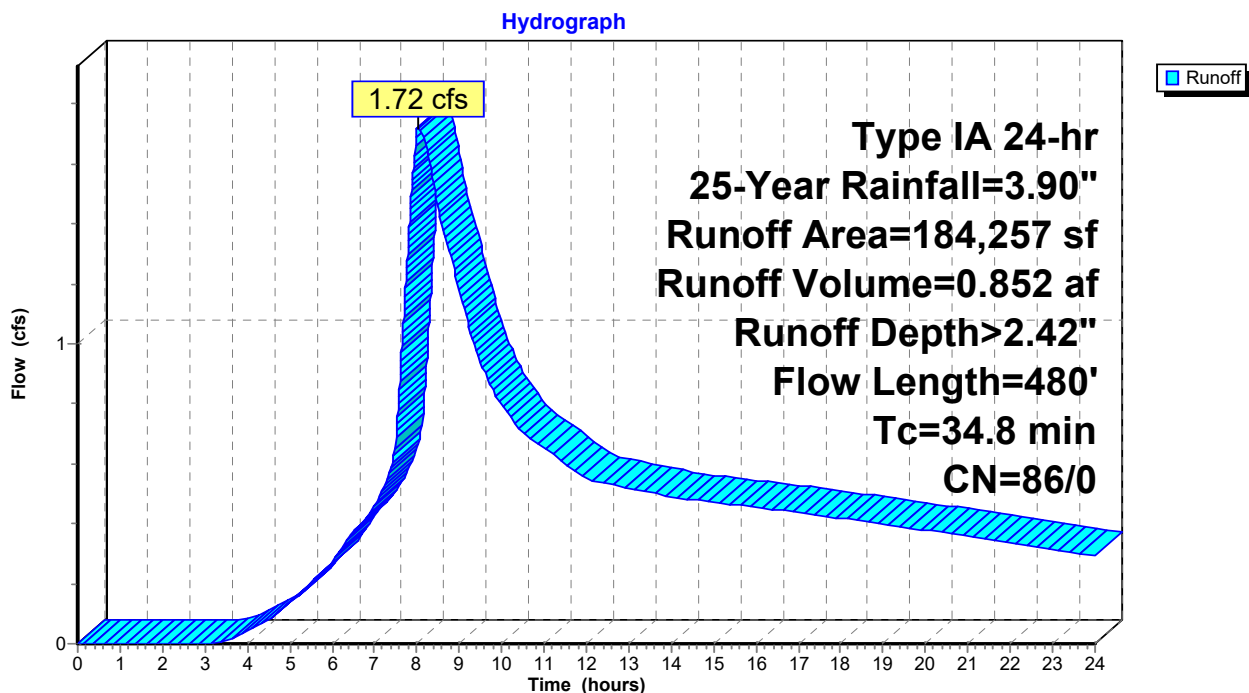
Runoff = 1.72 cfs @ 8.04 hrs, Volume= 0.852 af, Depth> 2.42"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 25-Year Rainfall=3.90"

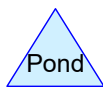
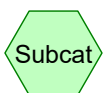
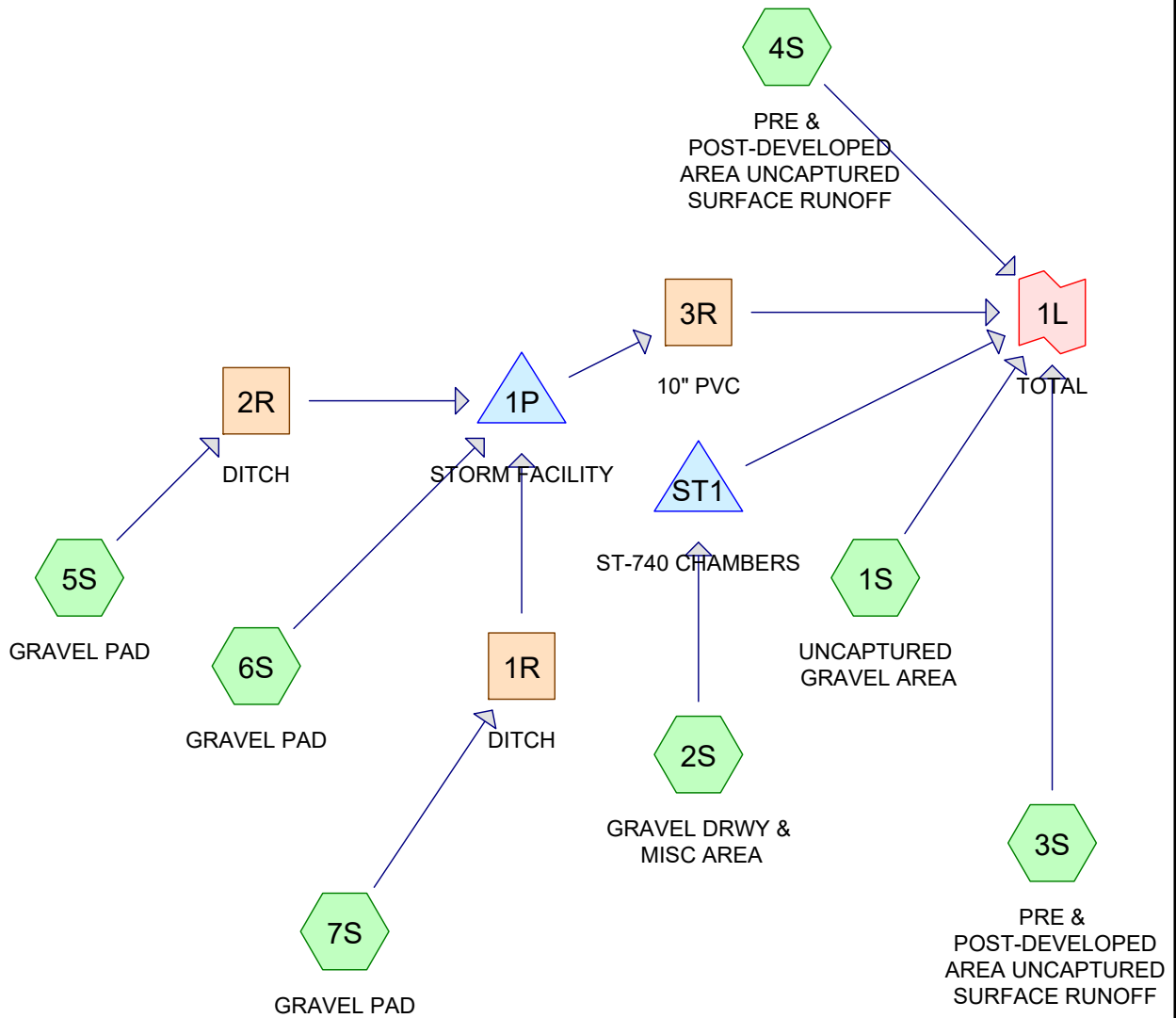
Area (sf)	CN	Description
184,257	86	Woods/grass comb., Poor, HSG D
184,257	86	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	150	0.0305	0.09		<b>Sheet Flow, Sheet</b> Woods: Light underbrush n= 0.400 P2= 2.50"
6.4	330	0.0296	0.86		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
34.8	480	Total			

**Subcatchment 1S: PRE-DEVELOPED AREA SURFACE RUNOFF**







## 8464 POST-DEVELOPED MODEL

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### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
41,846	80	>75% Grass cover, Good, HSG D (2S, 3S, 4S)
108,292	98	Gravel surface, HSG D (1S, 2S, 5S, 7S)
34,119	98	Gravel surface, HSG D & POND (6S)
<b>184,257</b>	<b>94</b>	<b>TOTAL AREA</b>

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**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
184,257	HSG D	1S, 2S, 3S, 4S, 5S, 6S, 7S
0	Other	
<b>184,257</b>		<b>TOTAL AREA</b>

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**Ground Covers (all nodes)**

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	41,846	0	41,846	>75% Grass cover, Good
0	0	0	142,411	0	142,411	Gravel surface
<b>0</b>	<b>0</b>	<b>0</b>	<b>184,257</b>	<b>0</b>	<b>184,257</b>	<b>TOTAL AREA</b>

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**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3R	3.00	1.30	85.0	0.0200	0.013	10.0	0.0	0.0
2	1P	4.50	4.30	10.0	0.0200	0.013	12.0	0.0	0.0
3	ST1	0.90	0.80	10.0	0.0100	0.013	6.0	0.0	0.0

**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 6

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: UNCAPTURED** Runoff Area=2,199 sf 100.00% Impervious Runoff Depth>2.27"  
Tc=5.0 min CN=0/98 Runoff=0.03 cfs 415 cf

**Subcatchment 2S: GRAVEL DRWY &** Runoff Area=24,834 sf 82.69% Impervious Runoff Depth>2.02"  
Flow Length=347' Tc=11.3 min CN=80/98 Runoff=0.27 cfs 4,187 cf

**Subcatchment 3S: PRE &** Runoff Area=14,359 sf 0.00% Impervious Runoff Depth>0.89"  
Tc=5.0 min CN=80/0 Runoff=0.06 cfs 1,060 cf

**Subcatchment 4S: PRE &** Runoff Area=23,187 sf 0.00% Impervious Runoff Depth>0.89"  
Tc=5.0 min CN=80/0 Runoff=0.09 cfs 1,712 cf

**Subcatchment 5S: GRAVEL PAD** Runoff Area=15,626 sf 100.00% Impervious Runoff Depth>2.27"  
Tc=5.0 min CN=0/98 Runoff=0.21 cfs 2,952 cf

**Subcatchment 6S: GRAVEL PAD** Runoff Area=34,119 sf 100.00% Impervious Runoff Depth>2.27"  
Tc=5.0 min CN=0/98 Runoff=0.45 cfs 6,445 cf

**Subcatchment 7S: GRAVEL PAD** Runoff Area=69,933 sf 100.00% Impervious Runoff Depth>2.27"  
Tc=5.0 min CN=0/98 Runoff=0.93 cfs 13,210 cf

**Reach 1R: DITCH** Avg. Flow Depth=0.69' Max Vel=0.97 fps Inflow=0.93 cfs 13,210 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=0.92 cfs 13,176 cf

**Reach 2R: DITCH** Avg. Flow Depth=0.39' Max Vel=0.66 fps Inflow=0.21 cfs 2,952 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=0.20 cfs 2,941 cf

**Reach 3R: 10" PVC** Avg. Flow Depth=0.16' Max Vel=3.44 fps Inflow=0.26 cfs 12,988 cf  
10.0" Round Pipe n=0.013 L=85.0' S=0.0200 '/' Capacity=3.10 cfs Outflow=0.26 cfs 12,983 cf

**Pond 1P: STORM FACILITY** Peak Elev=8.29' Storage=10,797 cf Inflow=1.57 cfs 22,562 cf  
Outflow=0.26 cfs 12,988 cf

**Pond ST1: ST-740 CHAMBERS** Peak Elev=3.45' Storage=264 cf Inflow=0.27 cfs 4,187 cf  
Outflow=0.17 cfs 4,186 cf

**Link 1L: TOTAL** Inflow=0.39 cfs 20,358 cf  
Primary=0.39 cfs 20,358 cf

**Total Runoff Area = 184,257 sf Runoff Volume = 29,982 cf Average Runoff Depth = 1.95"**  
**22.71% Pervious = 41,846 sf 77.29% Impervious = 142,411 sf**

**Summary for Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Runoff = 0.03 cfs @ 7.88 hrs, Volume= 415 cf, Depth> 2.27"

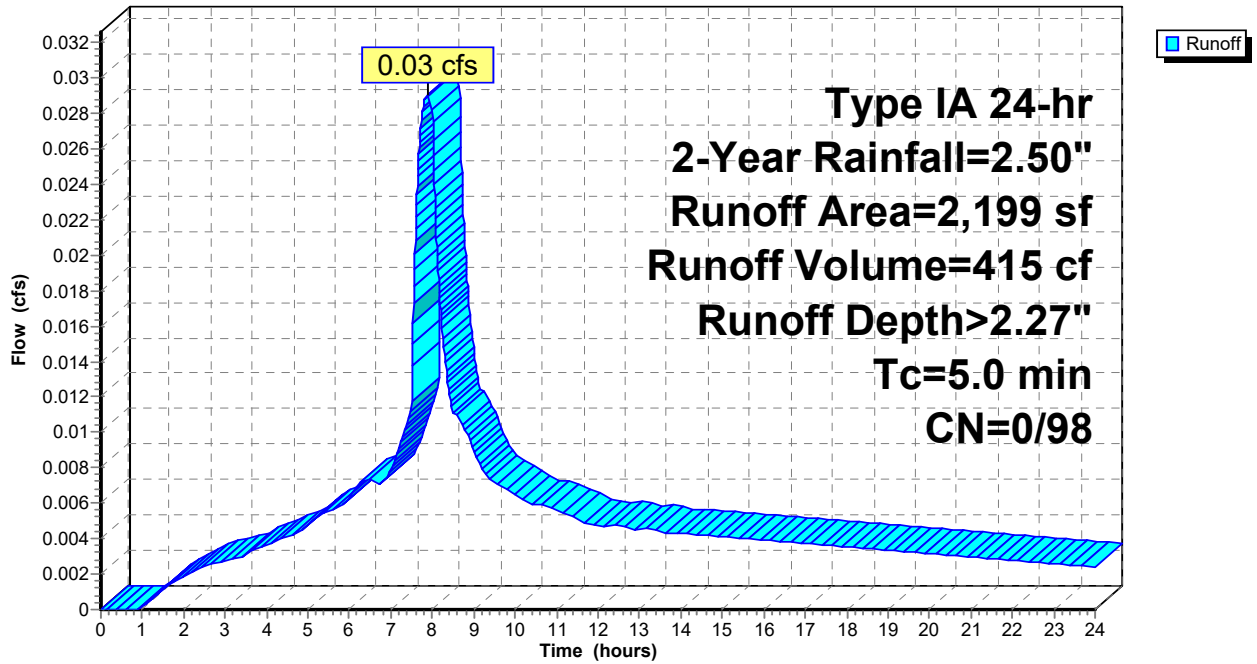
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
* 2,199	98	Gravel surface, HSG D
2,199	98	100.00% Impervious Area

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

**Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Runoff = 0.27 cfs @ 7.99 hrs, Volume= 4,187 cf, Depth> 2.02"

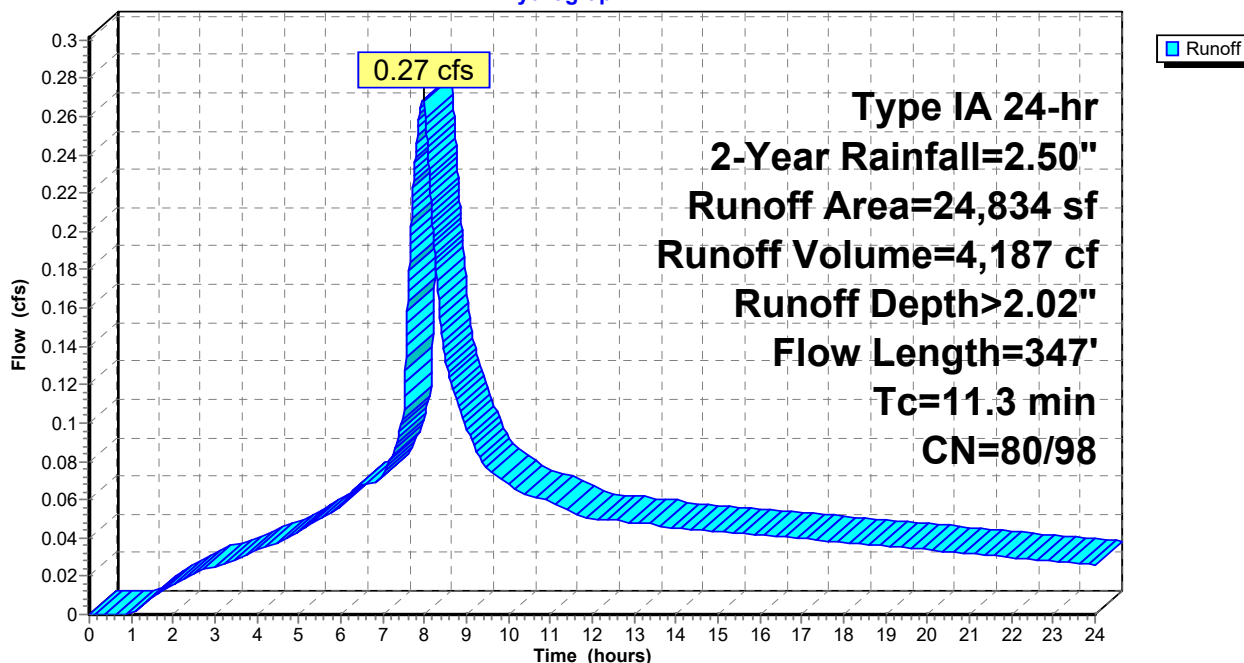
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
4,300	80	>75% Grass cover, Good, HSG D
* 20,534	98	Gravel surface, HSG D
24,834	95	Weighted Average
4,300	80	17.31% Pervious Area
20,534	98	82.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	55	0.0727	0.10		<b>Sheet Flow, SHEET</b> Woods: Light underbrush n= 0.400 P2= 2.50"
2.3	292	0.0450	2.08		<b>Sheet Flow, SHEET</b> Smooth surfaces n= 0.011 P2= 2.50"
11.3	347	Total			

**Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Hydrograph





**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

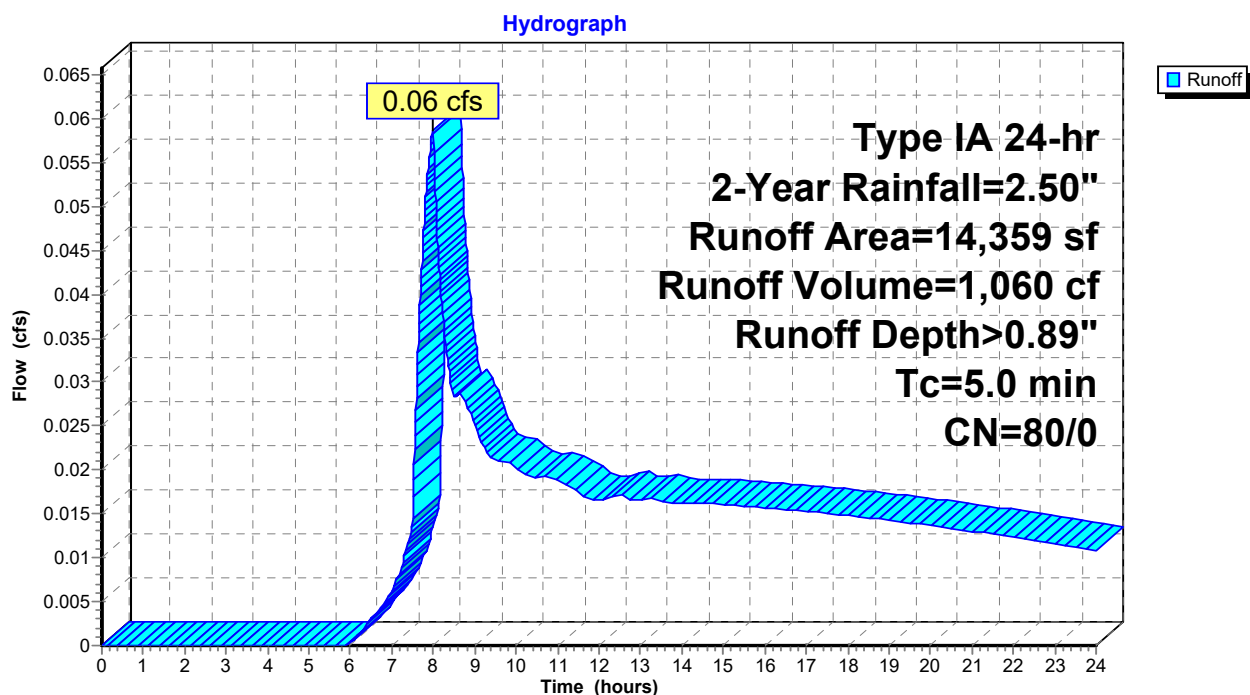
Runoff = 0.06 cfs @ 8.00 hrs, Volume= 1,060 cf, Depth> 0.89"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
14,359	80	>75% Grass cover, Good, HSG D
14,359	80	100.00% Pervious Area

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

**Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 10

**Summary for Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

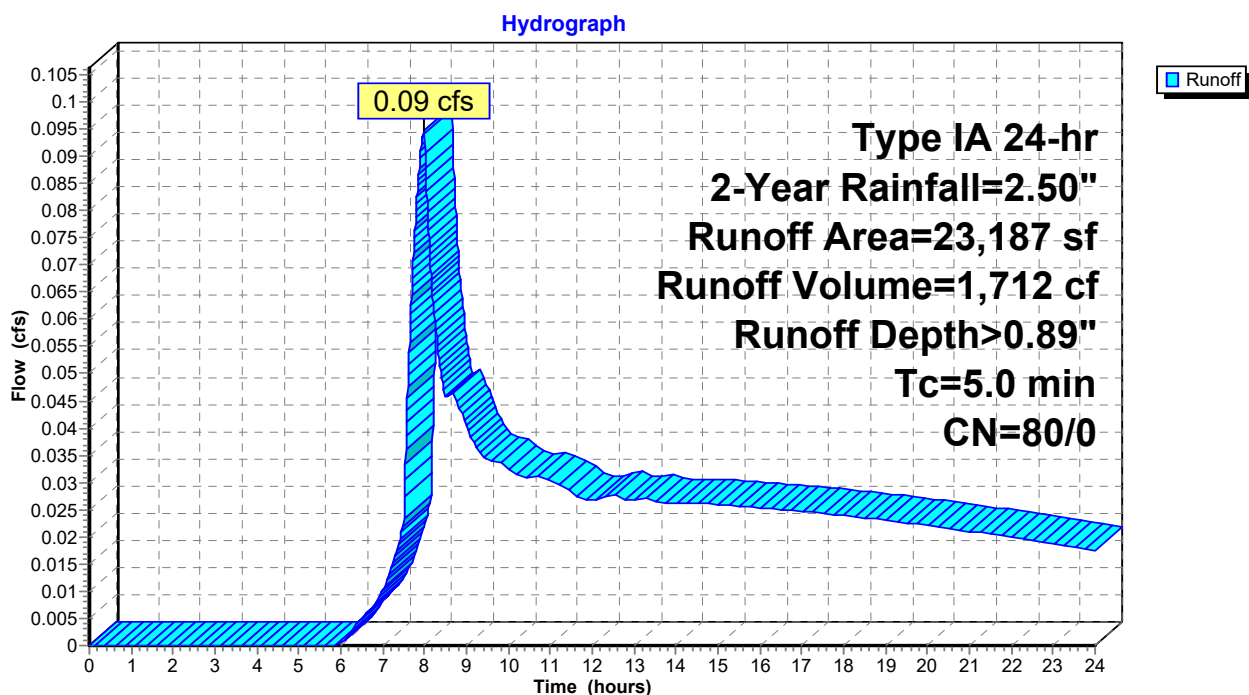
Runoff = 0.09 cfs @ 8.00 hrs, Volume= 1,712 cf, Depth> 0.89"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
23,187	80	>75% Grass cover, Good, HSG D
23,187	80	100.00% Pervious Area

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

**Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 11

**Summary for Subcatchment 5S: GRAVEL PAD**

Runoff = 0.21 cfs @ 7.88 hrs, Volume= 2,952 cf, Depth> 2.27"

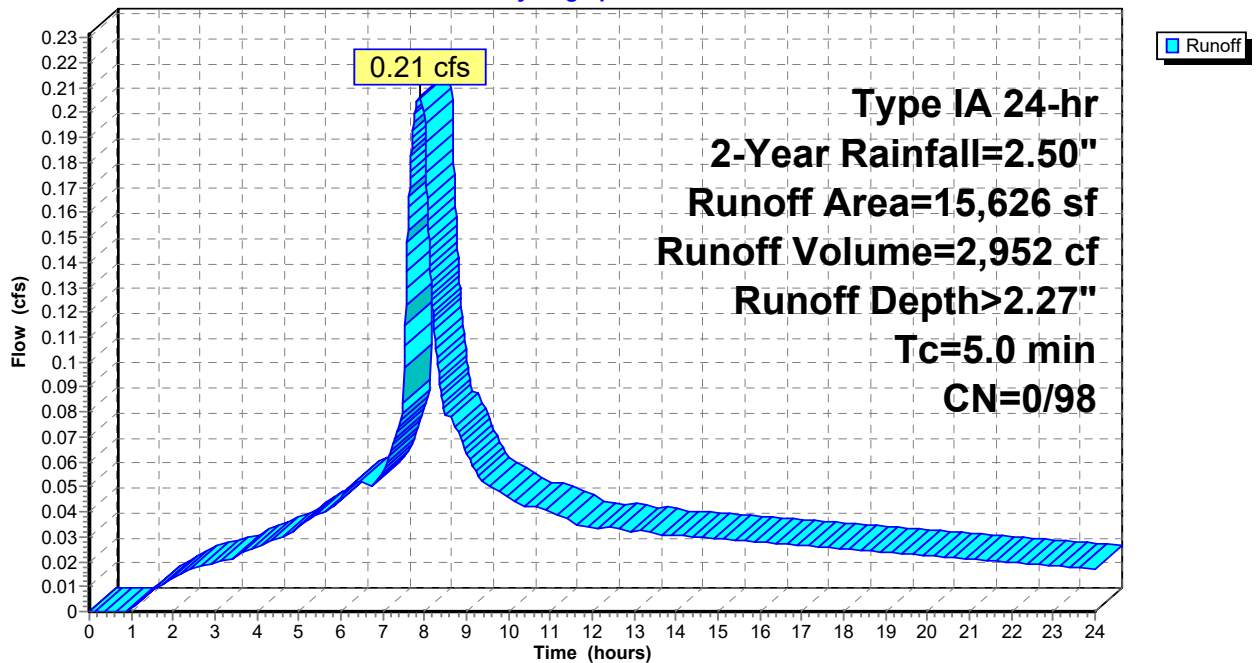
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
* 15,626	98	Gravel surface, HSG D
15,626	98	100.00% Impervious Area

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

**Subcatchment 5S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 6S: GRAVEL PAD**

Runoff = 0.45 cfs @ 7.88 hrs, Volume= 6,445 cf, Depth> 2.27"

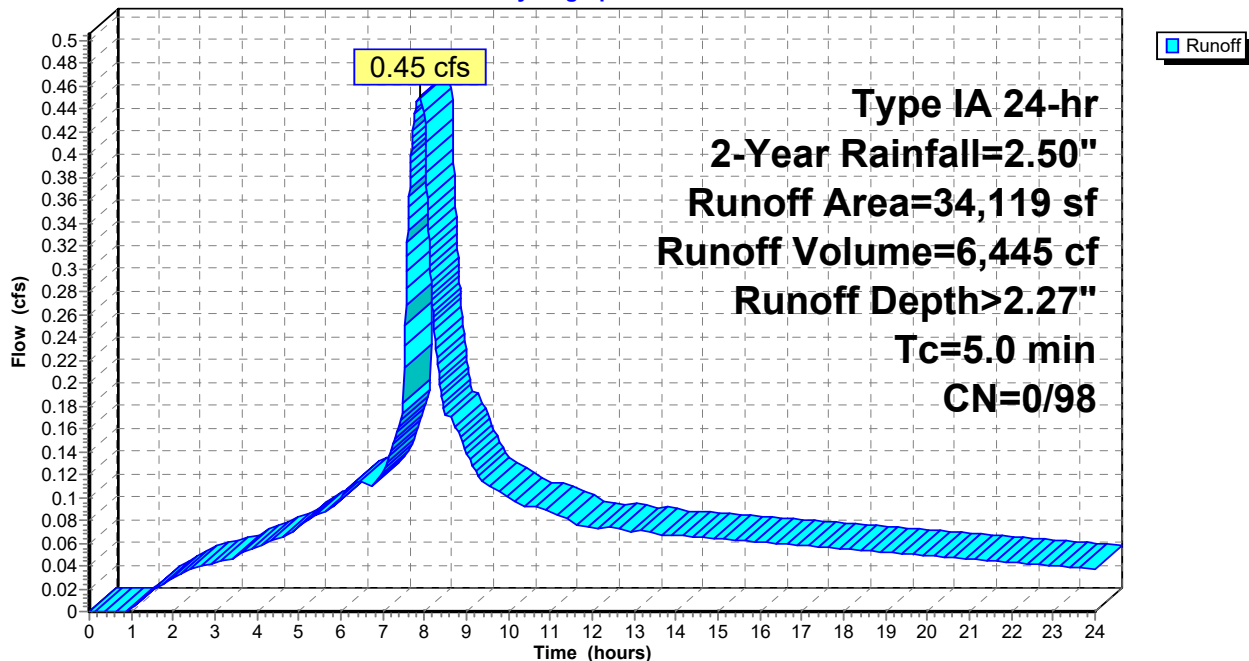
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
* 34,119	98	Gravel surface, HSG D & POND
34,119	98	100.00% Impervious Area

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

**Subcatchment 6S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 7S: GRAVEL PAD**

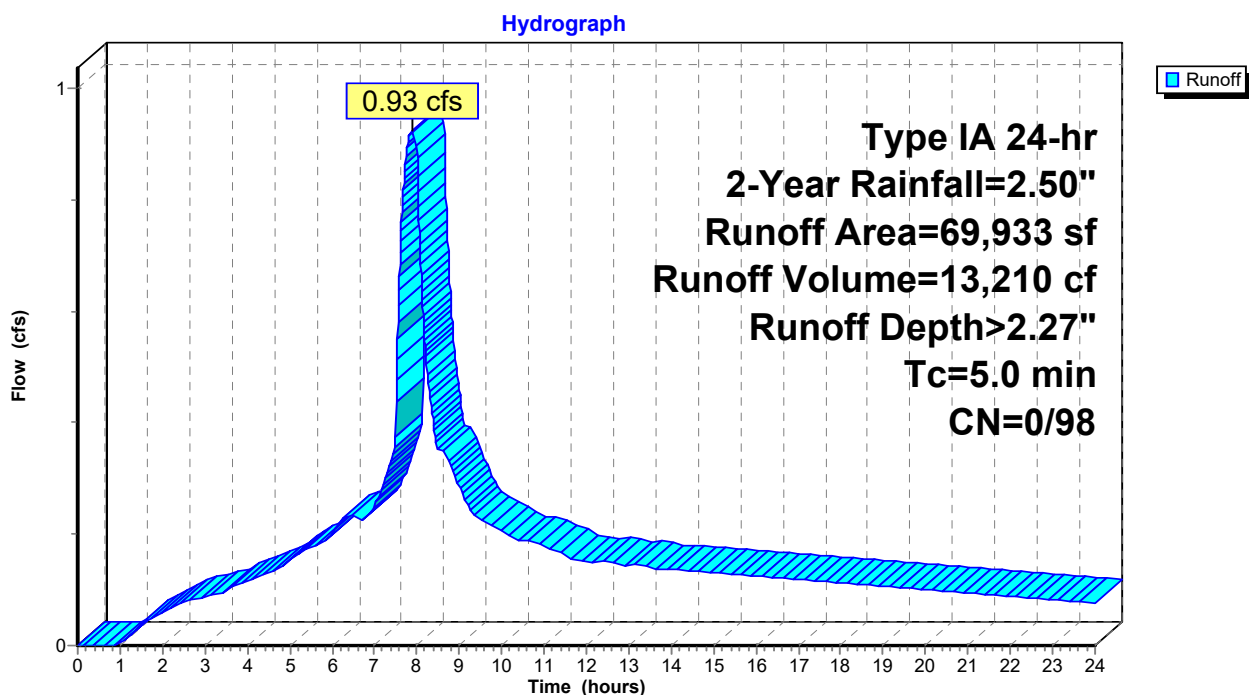
Runoff = 0.93 cfs @ 7.88 hrs, Volume= 13,210 cf, Depth> 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
69,933	98	Gravel surface, HSG D
69,933	98	100.00% Impervious Area

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

**Subcatchment 7S: GRAVEL PAD**



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 14

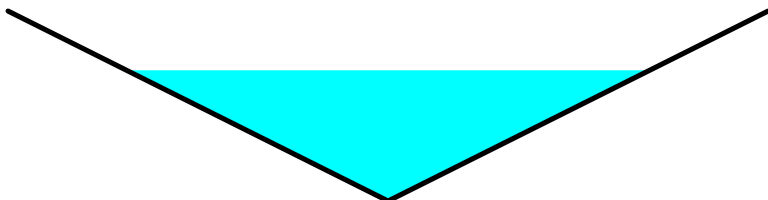
**Summary for Reach 1R: DITCH**

Inflow Area = 69,933 sf, 100.00% Impervious, Inflow Depth > 2.27" for 2-Year event  
Inflow = 0.93 cfs @ 7.88 hrs, Volume= 13,210 cf  
Outflow = 0.92 cfs @ 7.93 hrs, Volume= 13,176 cf, Atten= 1%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Max. Velocity= 0.97 fps, Min. Travel Time= 4.0 min  
Avg. Velocity = 0.60 fps, Avg. Travel Time= 6.5 min

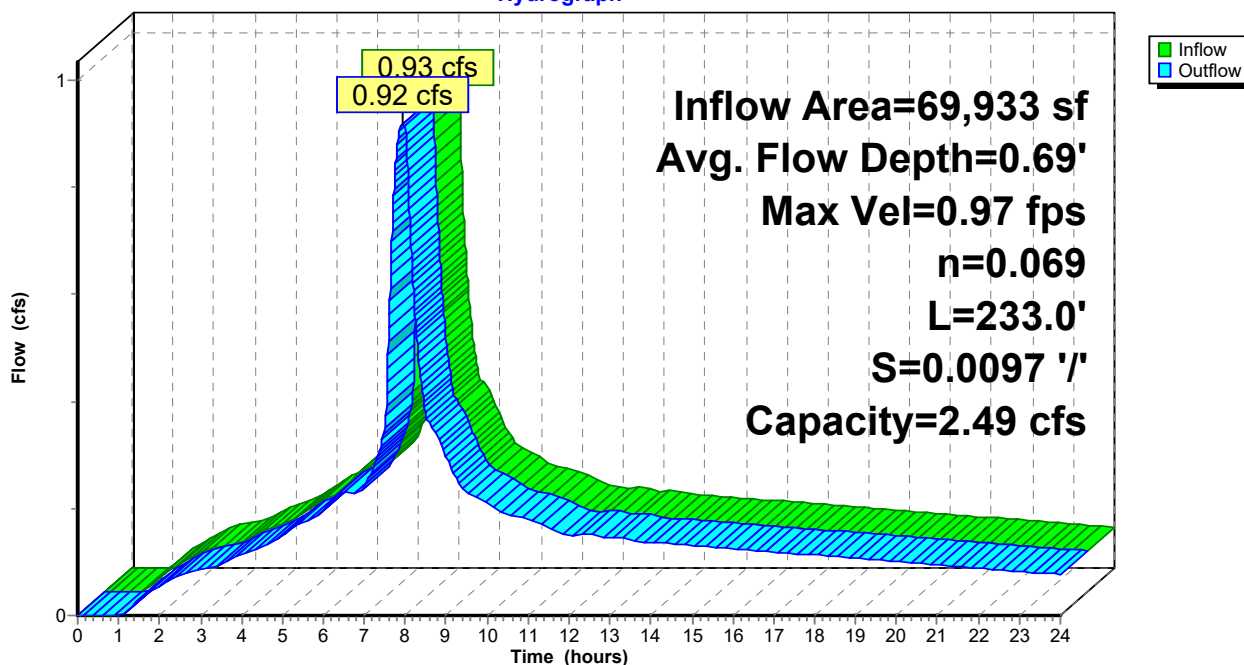
Peak Storage= 221 cf @ 7.93 hrs  
Average Depth at Peak Storage= 0.69'  
Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
Side Slope Z-value= 2.0 ' / ' Top Width= 4.00'  
Length= 233.0' Slope= 0.0097 ' / '  
Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 1R: DITCH**

Hydrograph



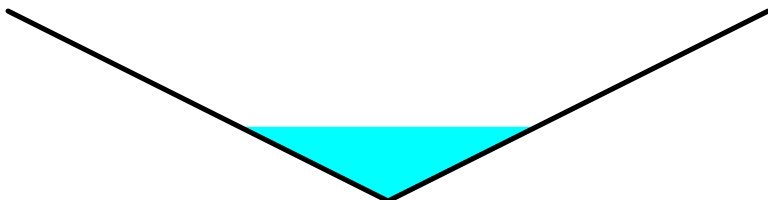
**Summary for Reach 2R: DITCH**

Inflow Area = 15,626 sf, 100.00% Impervious, Inflow Depth > 2.27" for 2-Year event  
 Inflow = 0.21 cfs @ 7.88 hrs, Volume= 2,952 cf  
 Outflow = 0.20 cfs @ 7.96 hrs, Volume= 2,941 cf, Atten= 2%, Lag= 4.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 0.66 fps, Min. Travel Time= 5.8 min  
 Avg. Velocity = 0.41 fps, Avg. Travel Time= 9.4 min

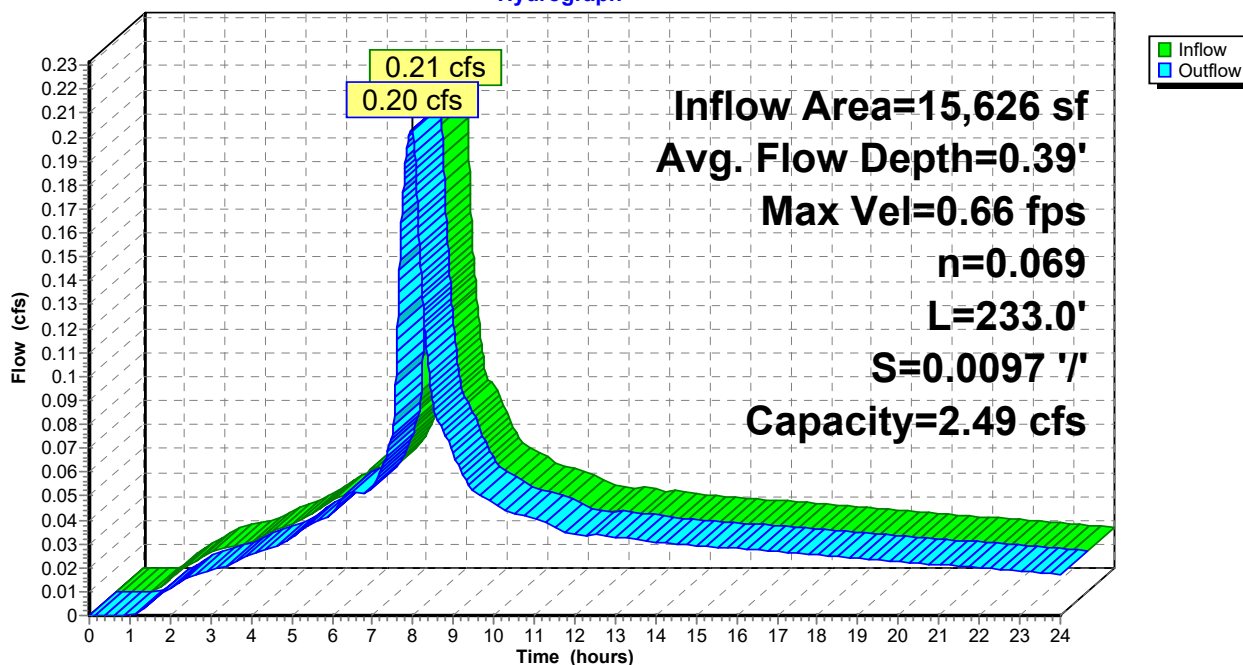
Peak Storage= 71 cf @ 7.96 hrs  
 Average Depth at Peak Storage= 0.39'  
 Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
 Side Slope Z-value= 2.0 ' / ' Top Width= 4.00'  
 Length= 233.0' Slope= 0.0097 ' / '  
 Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 2R: DITCH**

Hydrograph



# 8464 POST-DEVELOPED MODEL

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 16

## Summary for Reach 3R: 10" PVC

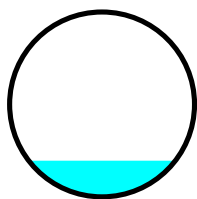
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 1.30" for 2-Year event  
Inflow = 0.26 cfs @ 12.60 hrs, Volume= 12,988 cf  
Outflow = 0.26 cfs @ 12.61 hrs, Volume= 12,983 cf, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Max. Velocity= 3.44 fps, Min. Travel Time= 0.4 min  
Avg. Velocity = 2.75 fps, Avg. Travel Time= 0.5 min

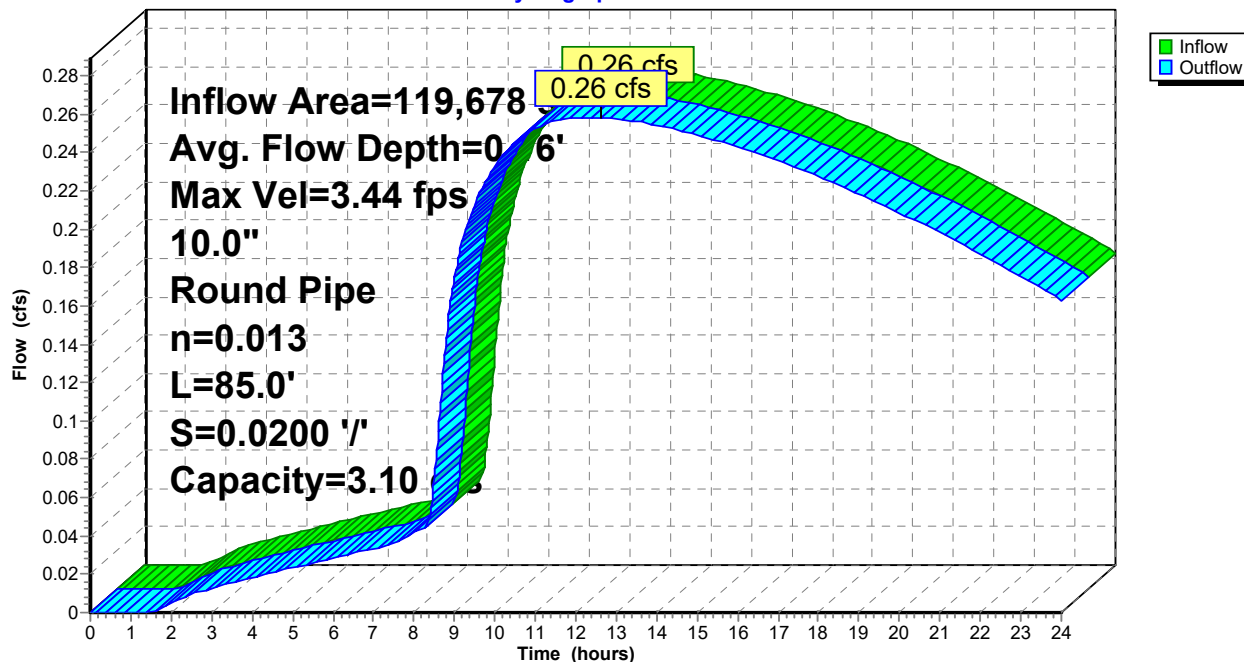
Peak Storage= 6 cf @ 12.61 hrs  
Average Depth at Peak Storage= 0.16'  
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.10 cfs

10.0" Round Pipe  
n= 0.013  
Length= 85.0' Slope= 0.0200 '/'  
Inlet Invert= 3.00', Outlet Invert= 1.30'



## Reach 3R: 10" PVC

Hydrograph





**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 17

**Summary for Pond 1P: STORM FACILITY**

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 2.26" for 2-Year event  
 Inflow = 1.57 cfs @ 7.92 hrs, Volume= 22,562 cf  
 Outflow = 0.26 cfs @ 12.60 hrs, Volume= 12,988 cf, Atten= 84%, Lag= 280.8 min  
 Primary = 0.26 cfs @ 12.60 hrs, Volume= 12,988 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 8.29' @ 12.60 hrs Surf.Area= 4,551 sf Storage= 10,797 cf  
 Flood Elev= 10.00' Surf.Area= 6,063 sf Storage= 19,838 cf

Plug-Flow detention time= 492.5 min calculated for 12,988 cf (58% of inflow)  
 Center-of-Mass det. time= 255.3 min ( 929.6 - 674.3 )

Volume	Invert	Avail.Storage	Storage Description			
#1	5.00'	19,838 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
5.00	2,123	207.2	0	0	2,123	
6.00	2,787	235.3	2,447	2,447	3,137	
7.00	3,521	254.1	3,147	5,594	3,909	
8.00	4,312	273.0	3,910	9,504	4,744	
9.00	5,159	291.8	4,729	14,233	5,635	
10.00	6,063	310.7	5,605	19,838	6,590	

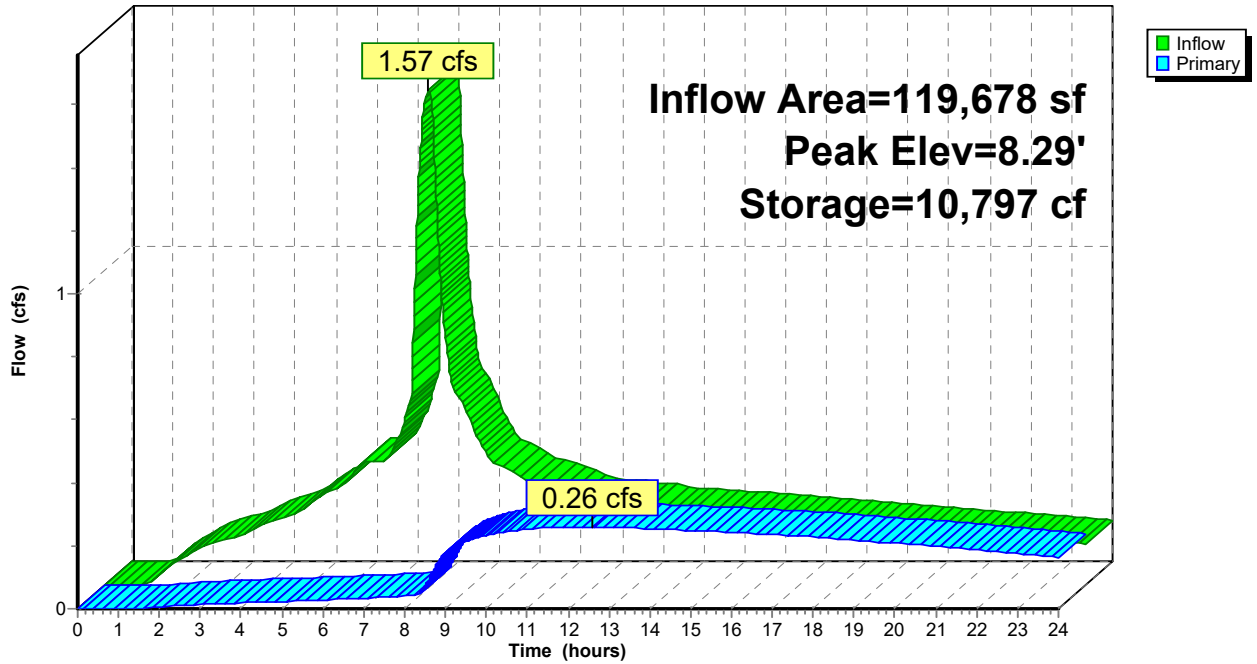
Device	Routing	Invert	Outlet Devices
#1	Primary	4.50'	<b>12.0" Round Culvert</b> L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 4.50' / 4.30' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	5.00'	<b>1.0" Vert. WQ Orifice</b> C= 0.620
#3	Device 1	7.75'	<b>3.5" Vert. Orifice/Grate</b> C= 0.620
#4	Device 1	8.55'	<b>2.2' long (Profile 17) Broad-Crested Rectangular Weir</b> Head (feet) 0.49 0.98 1.48 1.97 2.46 2.95 Coef. (English) 2.84 3.13 3.26 3.30 3.31 3.31

**Primary OutFlow** Max=0.26 cfs @ 12.60 hrs HW=8.29' TW=3.16' (Dynamic Tailwater)

- 1=Culvert (Passes 0.26 cfs of 6.86 cfs potential flow)
- 2=WQ Orifice (Orifice Controls 0.05 cfs @ 8.97 fps)
- 3=Orifice/Grate (Orifice Controls 0.21 cfs @ 3.13 fps)
- 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

Pond 1P: STORM FACILITY

Hydrograph



**Summary for Pond ST1: ST-740 CHAMBERS**

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 24,834 sf, 82.69% Impervious, Inflow Depth > 2.02" for 2-Year event  
 Inflow = 0.27 cfs @ 7.99 hrs, Volume= 4,187 cf  
 Outflow = 0.17 cfs @ 8.30 hrs, Volume= 4,186 cf, Atten= 36%, Lag= 18.4 min  
 Primary = 0.17 cfs @ 8.30 hrs, Volume= 4,186 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 3.45' @ 8.30 hrs Surf.Area= 196 sf Storage= 264 cf

Plug-Flow detention time= 6.8 min calculated for 4,185 cf (100% of inflow)  
 Center-of-Mass det. time= 6.8 min ( 696.0 - 689.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	1.00'	151 cf	<b>11.00'W x 17.86'L x 3.50'H Field A</b> 687 cf Overall - 184 cf Embedded = 504 cf x 30.0% Voids
#2A	1.50'	184 cf	<b>ADS_StormTech SC-740 +Cap x 4 Inside #1</b> Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 2 Rows of 2 Chambers
		335 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.90'	<b>6.0" Round Culvert</b> L= 10.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.90' / 0.80' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Device 1	0.90'	<b>2.0" Horiz. Orifice</b> C= 0.620 Limited to weir flow at low heads
#3	Device 1	4.00'	<b>6.0" Vert. Overflow Outlet</b> C= 0.620

**Primary OutFlow** Max=0.17 cfs @ 8.30 hrs HW=3.45' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 0.17 cfs of 1.43 cfs potential flow)
- ↑ **2=Orifice** (Orifice Controls 0.17 cfs @ 7.95 fps)
- ↑ **3=Overflow Outlet** ( Controls 0.00 cfs)

**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 2-Year Rainfall=2.50"

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Page 20

**Pond ST1: ST-740 CHAMBERS - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +12.0" End Stone x 2 = 17.86' Base Length

2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

687.5 cf Field - 183.8 cf Chambers = 503.7 cf Stone x 30.0% Voids = 151.1 cf Stone Storage

Chamber Storage + Stone Storage = 334.9 cf = 0.008 af

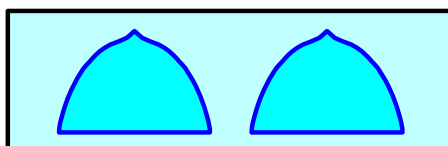
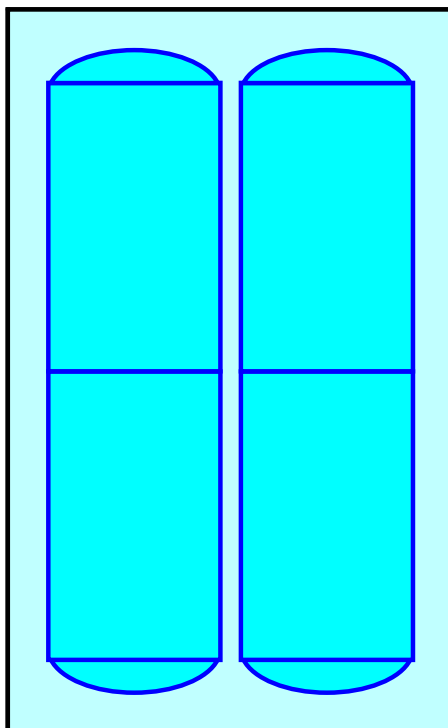
Overall Storage Efficiency = 48.7%

Overall System Size = 17.86' x 11.00' x 3.50'

4 Chambers

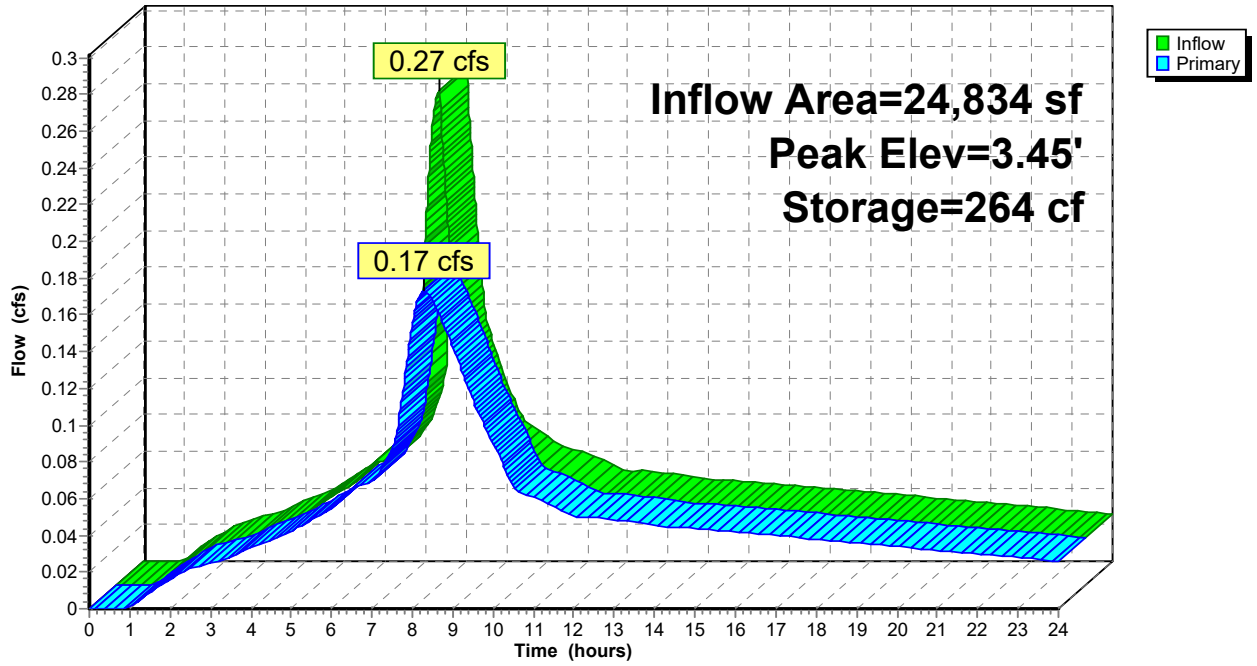
25.5 cy Field

18.7 cy Stone



### Pond ST1: ST-740 CHAMBERS

Hydrograph



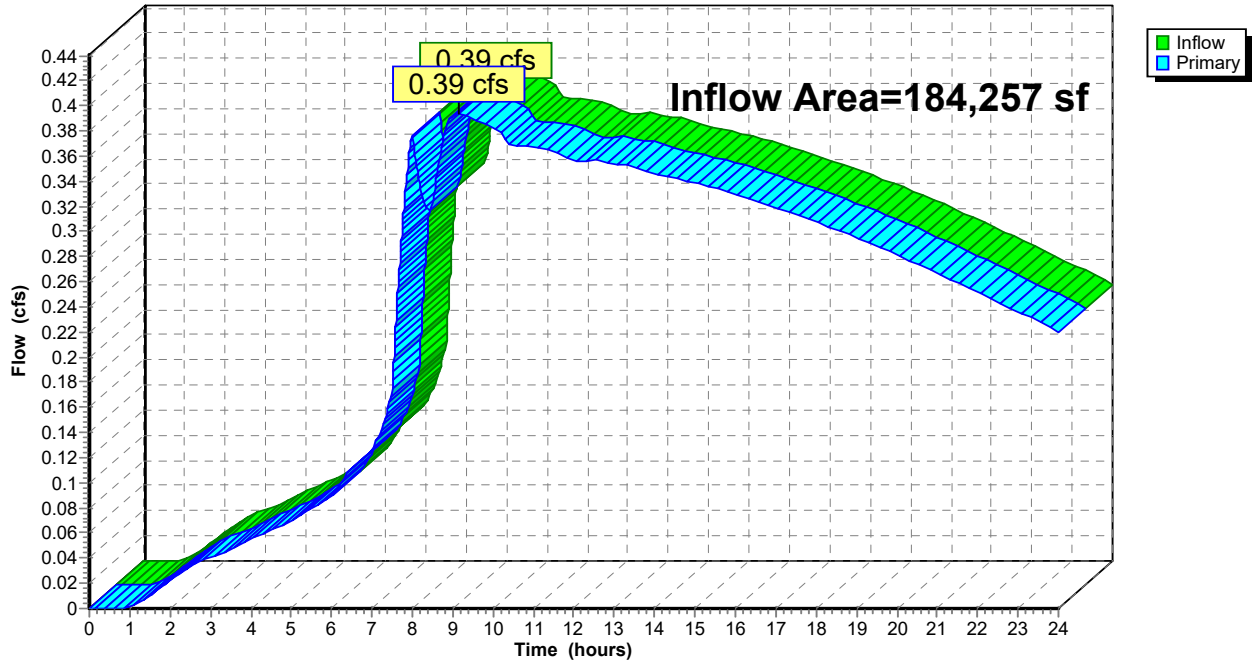
### Summary for Link 1L: TOTAL

Inflow Area = 184,257 sf, 77.29% Impervious, Inflow Depth > 1.33" for 2-Year event  
Inflow = 0.39 cfs @ 9.14 hrs, Volume= 20,358 cf  
Primary = 0.39 cfs @ 9.14 hrs, Volume= 20,358 cf, Atten= 0%, Lag= 0.0 min

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

### Link 1L: TOTAL

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 5-Year Rainfall=3.10"

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Page 23

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: UNCAPTURED** Runoff Area=2,199 sf 100.00% Impervious Runoff Depth>2.86"  
Tc=5.0 min CN=0/98 Runoff=0.04 cfs 525 cf

**Subcatchment 2S: GRAVEL DRWY &** Runoff Area=24,834 sf 82.69% Impervious Runoff Depth>2.59"  
Flow Length=347' Tc=11.3 min CN=80/98 Runoff=0.34 cfs 5,360 cf

**Subcatchment 3S: PRE &** Runoff Area=14,359 sf 0.00% Impervious Runoff Depth>1.32"  
Tc=5.0 min CN=80/0 Runoff=0.10 cfs 1,582 cf

**Subcatchment 4S: PRE &** Runoff Area=23,187 sf 0.00% Impervious Runoff Depth>1.32"  
Tc=5.0 min CN=80/0 Runoff=0.15 cfs 2,554 cf

**Subcatchment 5S: GRAVEL PAD** Runoff Area=15,626 sf 100.00% Impervious Runoff Depth>2.86"  
Tc=5.0 min CN=0/98 Runoff=0.26 cfs 3,728 cf

**Subcatchment 6S: GRAVEL PAD** Runoff Area=34,119 sf 100.00% Impervious Runoff Depth>2.86"  
Tc=5.0 min CN=0/98 Runoff=0.57 cfs 8,140 cf

**Subcatchment 7S: GRAVEL PAD** Runoff Area=69,933 sf 100.00% Impervious Runoff Depth>2.86"  
Tc=5.0 min CN=0/98 Runoff=1.16 cfs 16,685 cf

**Reach 1R: DITCH** Avg. Flow Depth=0.75' Max Vel=1.03 fps Inflow=1.16 cfs 16,685 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=1.15 cfs 16,644 cf

**Reach 2R: DITCH** Avg. Flow Depth=0.43' Max Vel=0.70 fps Inflow=0.26 cfs 3,728 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=0.26 cfs 3,715 cf

**Reach 3R: 10" PVC** Avg. Flow Depth=0.21' Max Vel=4.04 fps Inflow=0.45 cfs 18,307 cf  
10.0" Round Pipe n=0.013 L=85.0' S=0.0200 '/' Capacity=3.10 cfs Outflow=0.45 cfs 18,301 cf

**Pond 1P: STORM FACILITY** Peak Elev=8.62' Storage=12,330 cf Inflow=1.97 cfs 28,500 cf  
Outflow=0.45 cfs 18,307 cf

**Pond ST1: ST-740 CHAMBERS** Peak Elev=4.21' Storage=318 cf Inflow=0.34 cfs 5,360 cf  
Outflow=0.32 cfs 5,359 cf

**Link 1L: TOTAL** Inflow=0.74 cfs 28,321 cf  
Primary=0.74 cfs 28,321 cf

**Total Runoff Area = 184,257 sf Runoff Volume = 38,574 cf Average Runoff Depth = 2.51"**  
**22.71% Pervious = 41,846 sf 77.29% Impervious = 142,411 sf**

**Summary for Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Runoff = 0.04 cfs @ 7.88 hrs, Volume= 525 cf, Depth> 2.86"

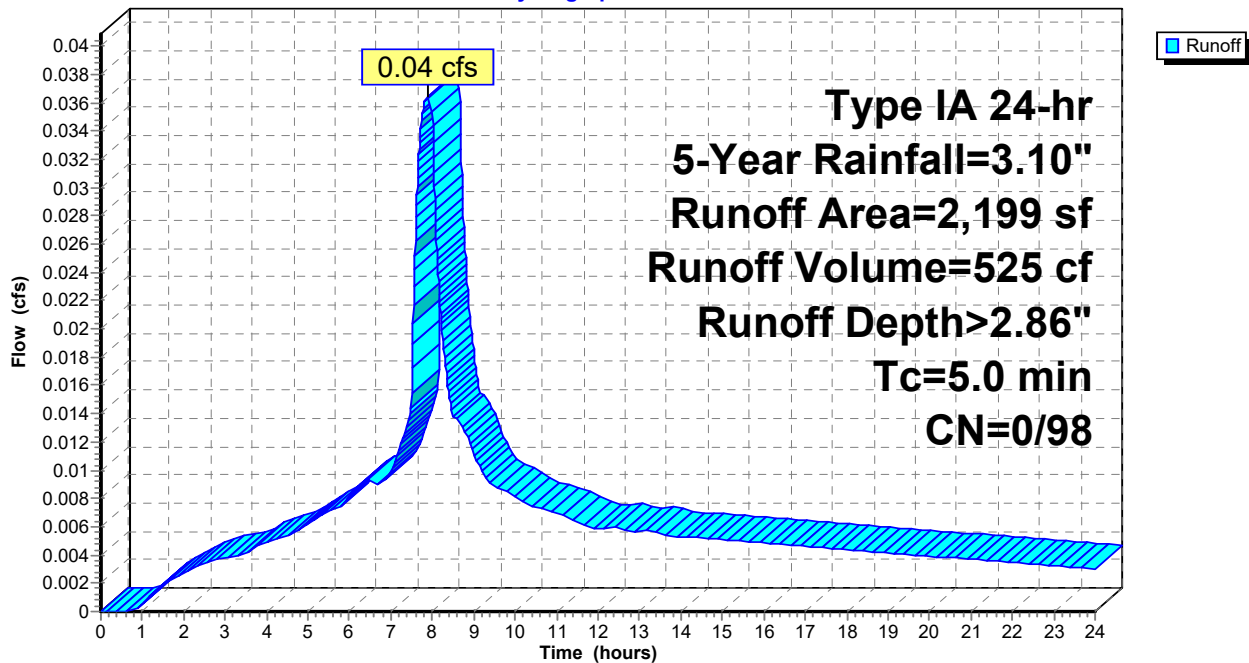
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
* 2,199	98	Gravel surface, HSG D
2,199	98	100.00% Impervious Area

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

**Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Hydrograph





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Type IA 24-hr 5-Year Rainfall=3.10"

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Page 25

**Summary for Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Runoff = 0.34 cfs @ 7.99 hrs, Volume= 5,360 cf, Depth> 2.59"

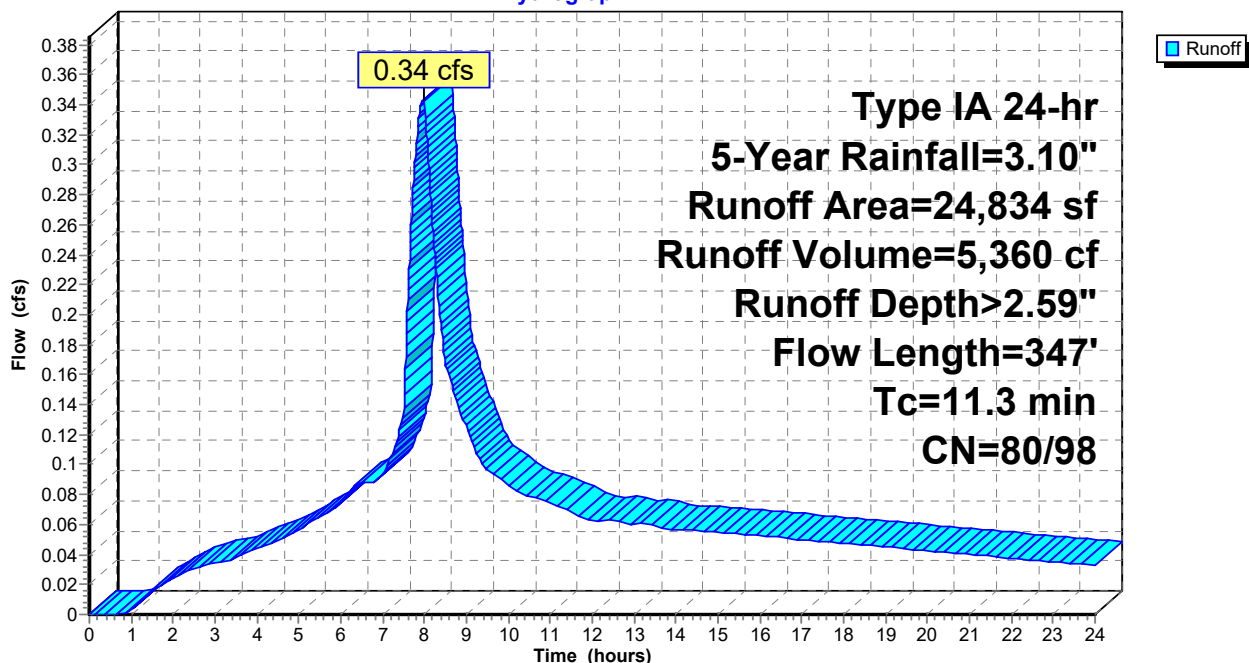
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
4,300	80	>75% Grass cover, Good, HSG D
* 20,534	98	Gravel surface, HSG D
24,834	95	Weighted Average
4,300	80	17.31% Pervious Area
20,534	98	82.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	55	0.0727	0.10		<b>Sheet Flow, SHEET</b> Woods: Light underbrush n= 0.400 P2= 2.50"
2.3	292	0.0450	2.08		<b>Sheet Flow, SHEET</b> Smooth surfaces n= 0.011 P2= 2.50"
11.3	347	Total			

**Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Hydrograph



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Page 26

**Summary for Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

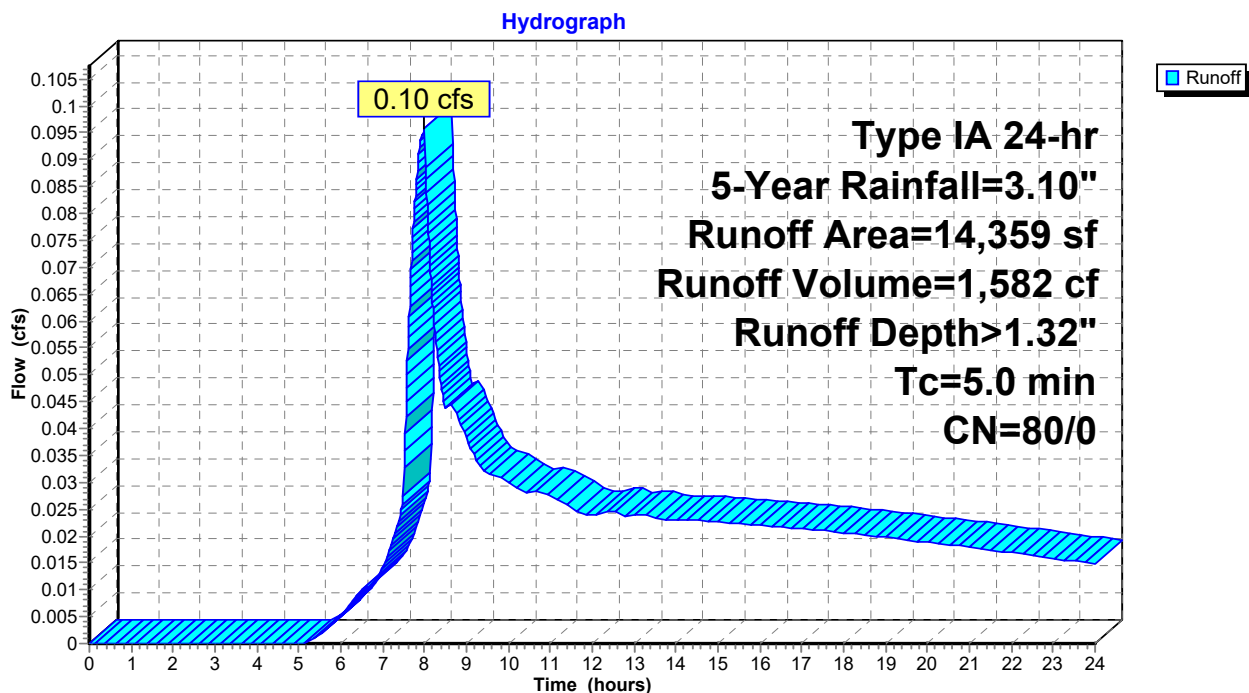
Runoff = 0.10 cfs @ 8.00 hrs, Volume= 1,582 cf, Depth> 1.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
14,359	80	>75% Grass cover, Good, HSG D
14,359	80	100.00% Pervious Area

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

**Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 5-Year Rainfall=3.10"

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Page 27

**Summary for Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

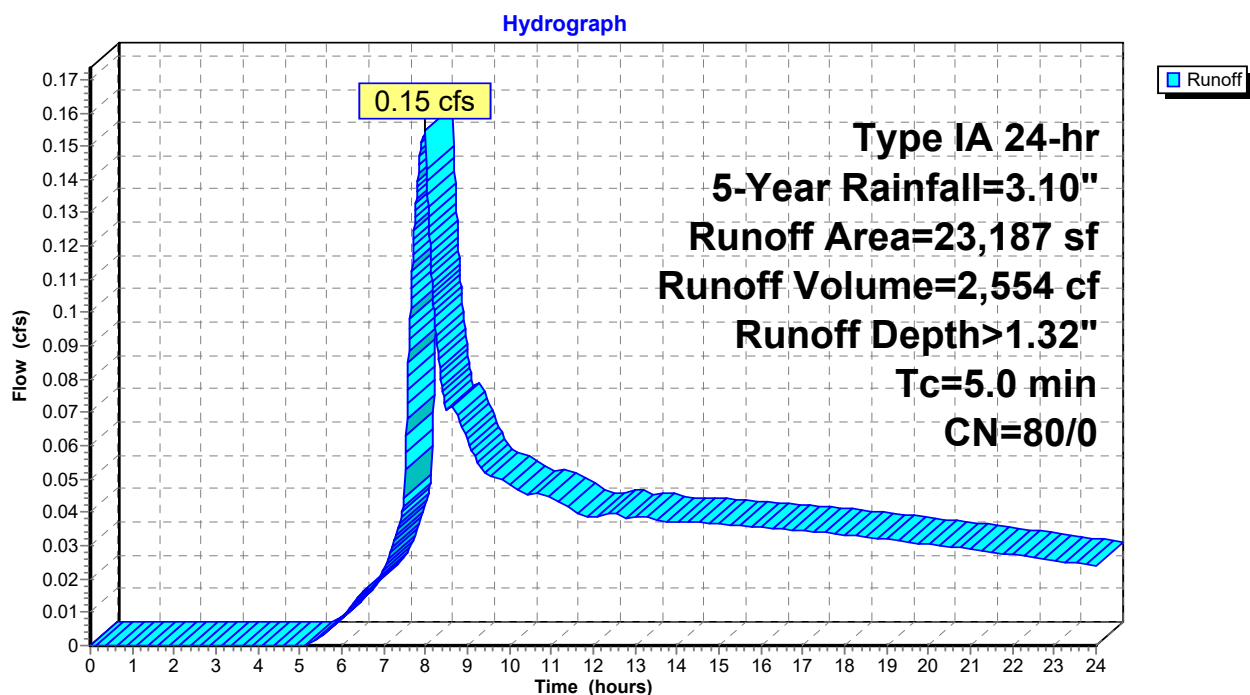
Runoff = 0.15 cfs @ 8.00 hrs, Volume= 2,554 cf, Depth> 1.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
23,187	80	>75% Grass cover, Good, HSG D
23,187	80	100.00% Pervious Area

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

**Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**Summary for Subcatchment 5S: GRAVEL PAD**

Runoff = 0.26 cfs @ 7.88 hrs, Volume= 3,728 cf, Depth> 2.86"

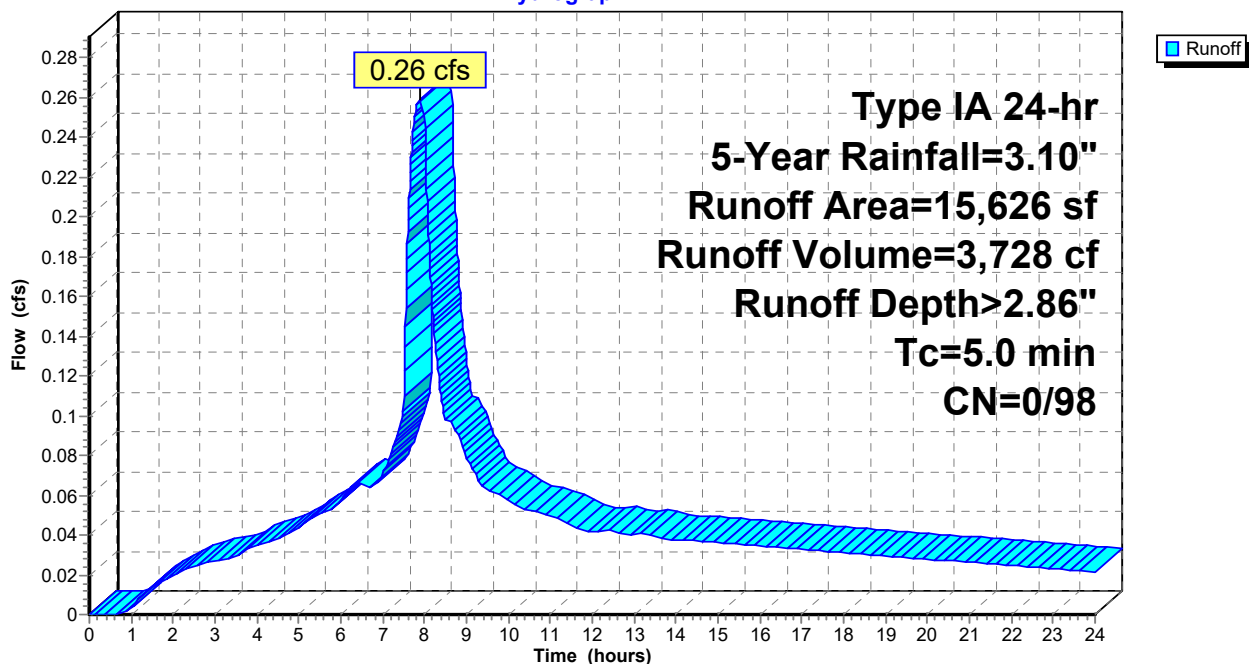
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
* 15,626	98	Gravel surface, HSG D
15,626	98	100.00% Impervious Area

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

**Subcatchment 5S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 6S: GRAVEL PAD**

Runoff = 0.57 cfs @ 7.88 hrs, Volume= 8,140 cf, Depth> 2.86"

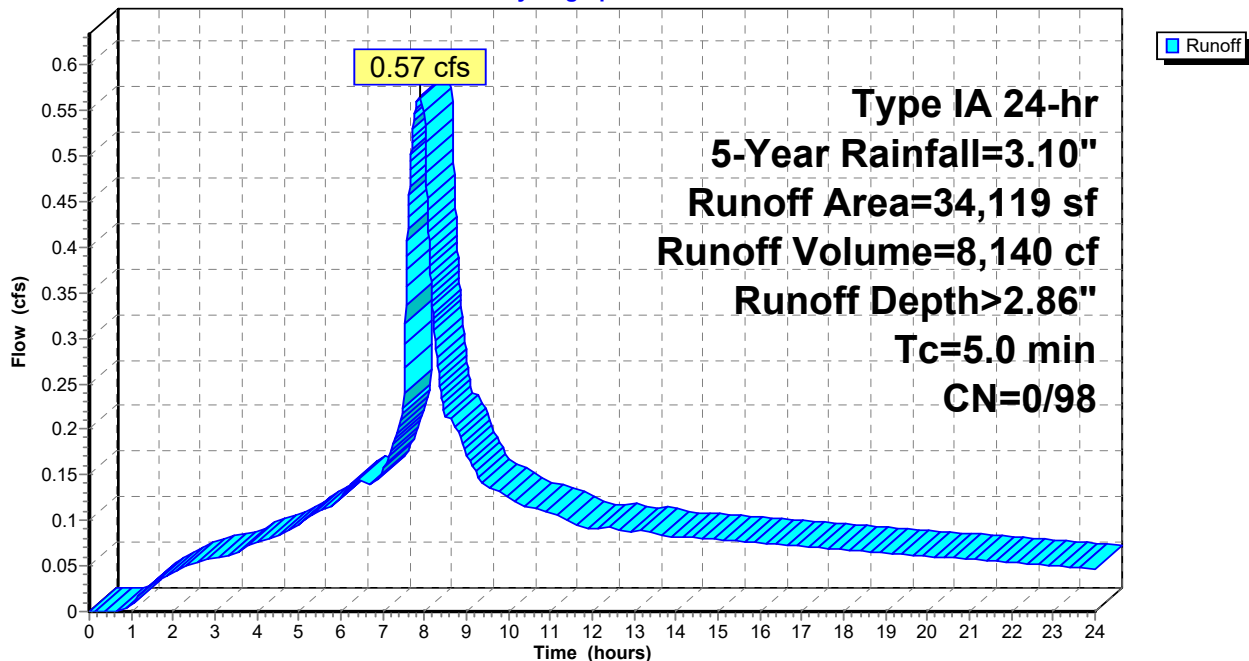
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
* 34,119	98	Gravel surface, HSG D & POND
34,119	98	100.00% Impervious Area

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

**Subcatchment 6S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 7S: GRAVEL PAD**

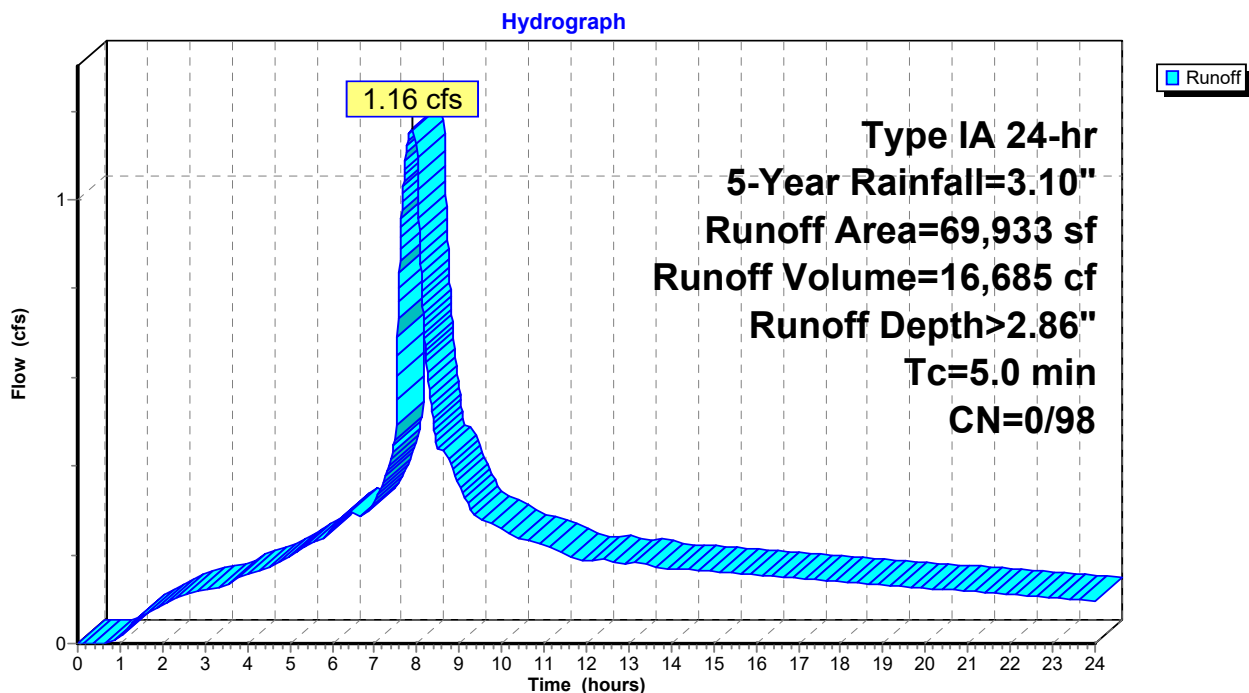
Runoff = 1.16 cfs @ 7.88 hrs, Volume= 16,685 cf, Depth> 2.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
69,933	98	Gravel surface, HSG D
69,933	98	100.00% Impervious Area

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

**Subcatchment 7S: GRAVEL PAD**



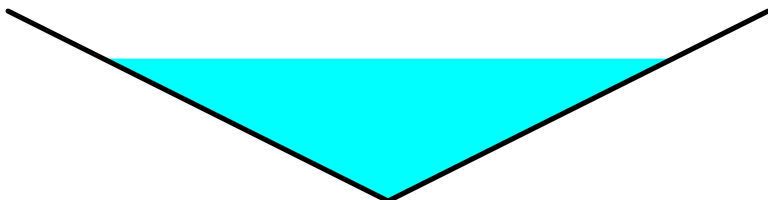
**Summary for Reach 1R: DITCH**

Inflow Area = 69,933 sf, 100.00% Impervious, Inflow Depth > 2.86" for 5-Year event  
 Inflow = 1.16 cfs @ 7.88 hrs, Volume= 16,685 cf  
 Outflow = 1.15 cfs @ 7.93 hrs, Volume= 16,644 cf, Atten= 1%, Lag= 3.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 1.03 fps, Min. Travel Time= 3.8 min  
 Avg. Velocity = 0.63 fps, Avg. Travel Time= 6.1 min

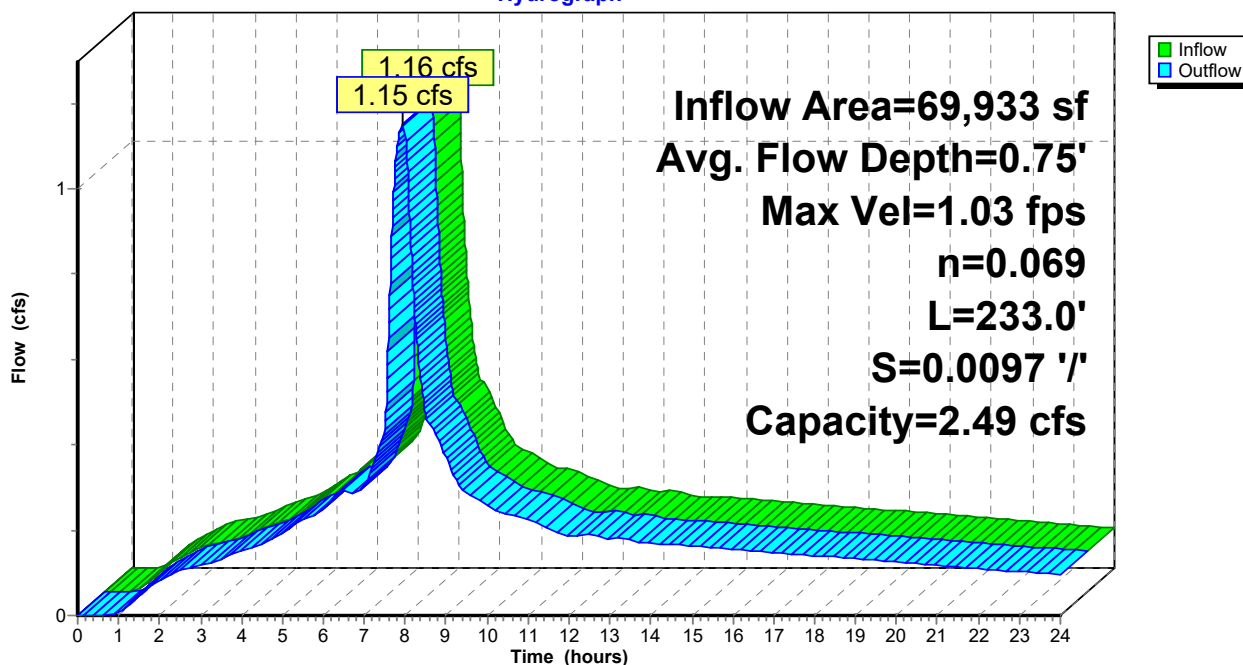
Peak Storage= 262 cf @ 7.93 hrs  
 Average Depth at Peak Storage= 0.75'  
 Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
 Side Slope Z-value= 2.0 ' / ' Top Width= 4.00'  
 Length= 233.0' Slope= 0.0097 ' / '  
 Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 1R: DITCH**

Hydrograph



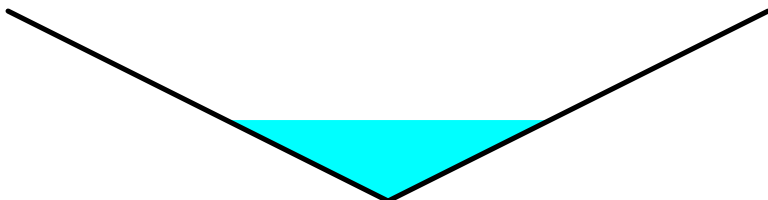
**Summary for Reach 2R: DITCH**

Inflow Area = 15,626 sf, 100.00% Impervious, Inflow Depth > 2.86" for 5-Year event  
 Inflow = 0.26 cfs @ 7.88 hrs, Volume= 3,728 cf  
 Outflow = 0.26 cfs @ 7.95 hrs, Volume= 3,715 cf, Atten= 1%, Lag= 4.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 0.70 fps, Min. Travel Time= 5.5 min  
 Avg. Velocity = 0.44 fps, Avg. Travel Time= 8.9 min

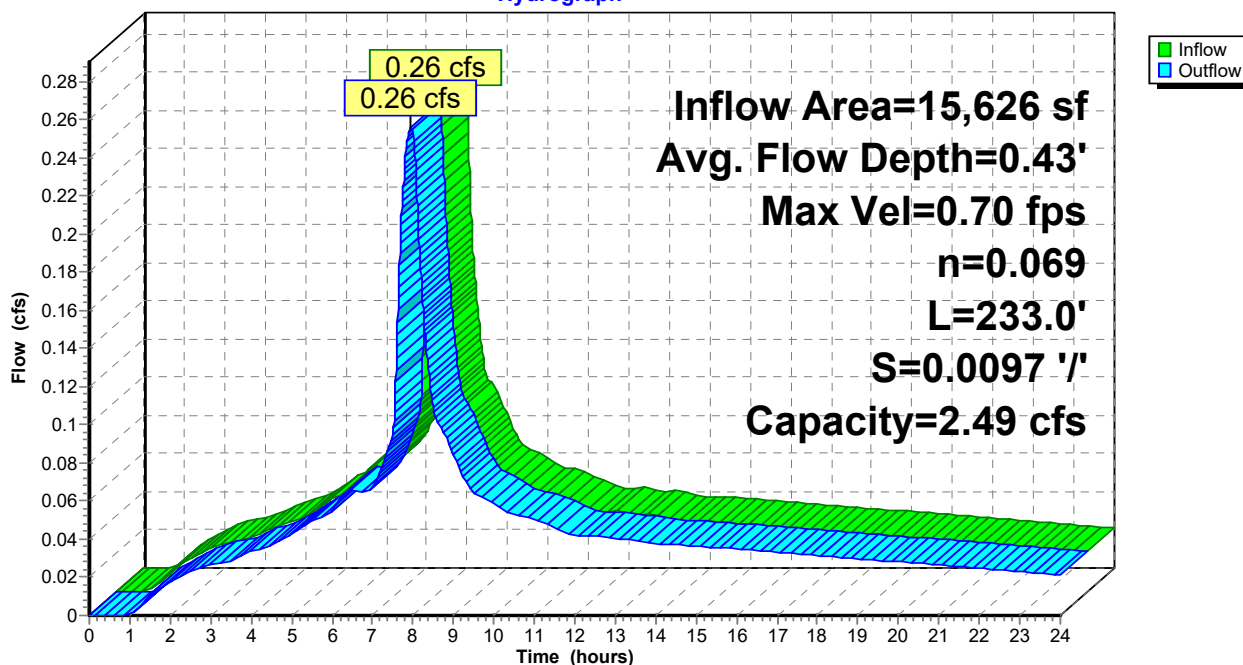
Peak Storage= 85 cf @ 7.95 hrs  
 Average Depth at Peak Storage= 0.43'  
 Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
 Side Slope Z-value= 2.0 '/' Top Width= 4.00'  
 Length= 233.0' Slope= 0.0097 '/'  
 Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 2R: DITCH**

Hydrograph





# 8464 POST-DEVELOPED MODEL

Type IA 24-hr 5-Year Rainfall=3.10"

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Page 33

## Summary for Reach 3R: 10" PVC

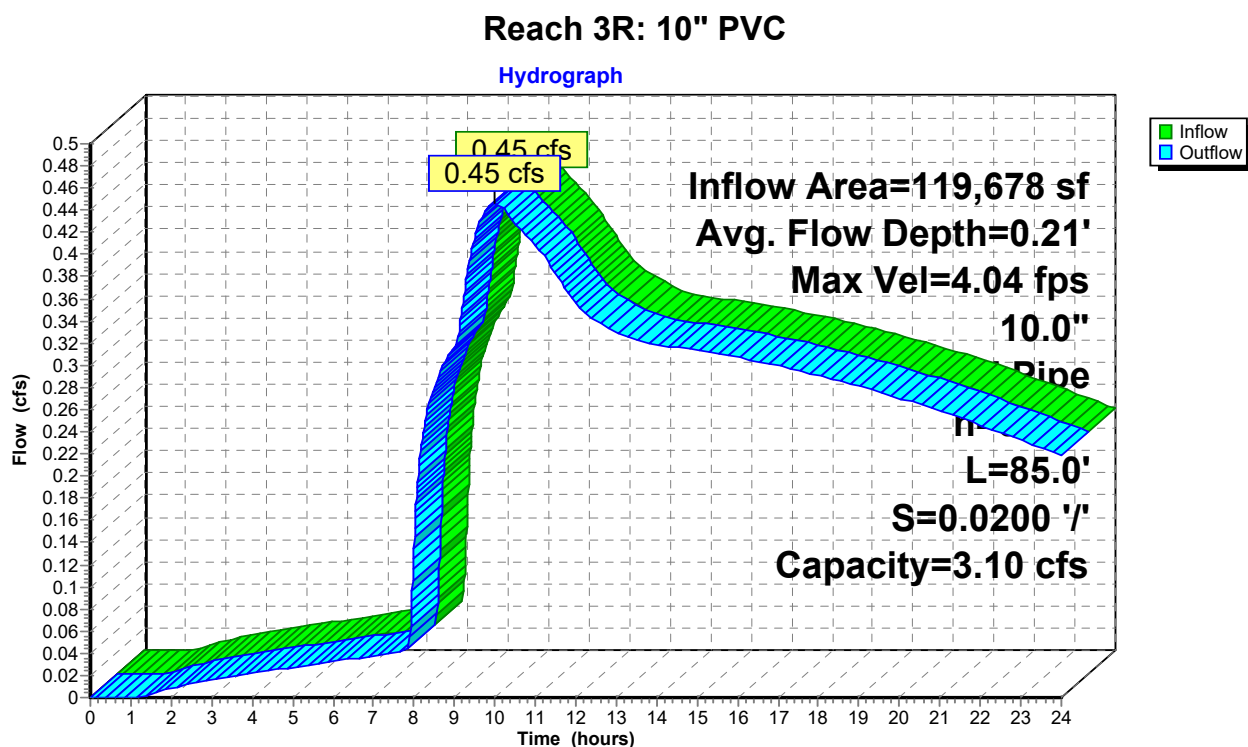
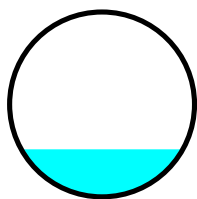
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 1.84" for 5-Year event  
Inflow = 0.45 cfs @ 10.01 hrs, Volume= 18,307 cf  
Outflow = 0.45 cfs @ 10.01 hrs, Volume= 18,301 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Max. Velocity= 4.04 fps, Min. Travel Time= 0.4 min  
Avg. Velocity = 3.02 fps, Avg. Travel Time= 0.5 min

Peak Storage= 9 cf @ 10.01 hrs  
Average Depth at Peak Storage= 0.21'  
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.10 cfs

10.0" Round Pipe  
n= 0.013  
Length= 85.0' Slope= 0.0200 '/'  
Inlet Invert= 3.00', Outlet Invert= 1.30'



**8464 POST-DEVELOPED MODEL**

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Page 34

**Summary for Pond 1P: STORM FACILITY**

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 2.86" for 5-Year event  
 Inflow = 1.97 cfs @ 7.92 hrs, Volume= 28,500 cf  
 Outflow = 0.45 cfs @ 10.01 hrs, Volume= 18,307 cf, Atten= 77%, Lag= 125.4 min  
 Primary = 0.45 cfs @ 10.01 hrs, Volume= 18,307 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 8.62' @ 10.01 hrs Surf.Area= 4,827 sf Storage= 12,330 cf  
 Flood Elev= 10.00' Surf.Area= 6,063 sf Storage= 19,838 cf

Plug-Flow detention time= 444.9 min calculated for 18,307 cf (64% of inflow)  
 Center-of-Mass det. time= 233.4 min ( 901.1 - 667.7 )

Volume	Invert	Avail.Storage	Storage Description			
#1	5.00'	19,838 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
5.00	2,123	207.2	0	0	2,123	
6.00	2,787	235.3	2,447	2,447	3,137	
7.00	3,521	254.1	3,147	5,594	3,909	
8.00	4,312	273.0	3,910	9,504	4,744	
9.00	5,159	291.8	4,729	14,233	5,635	
10.00	6,063	310.7	5,605	19,838	6,590	

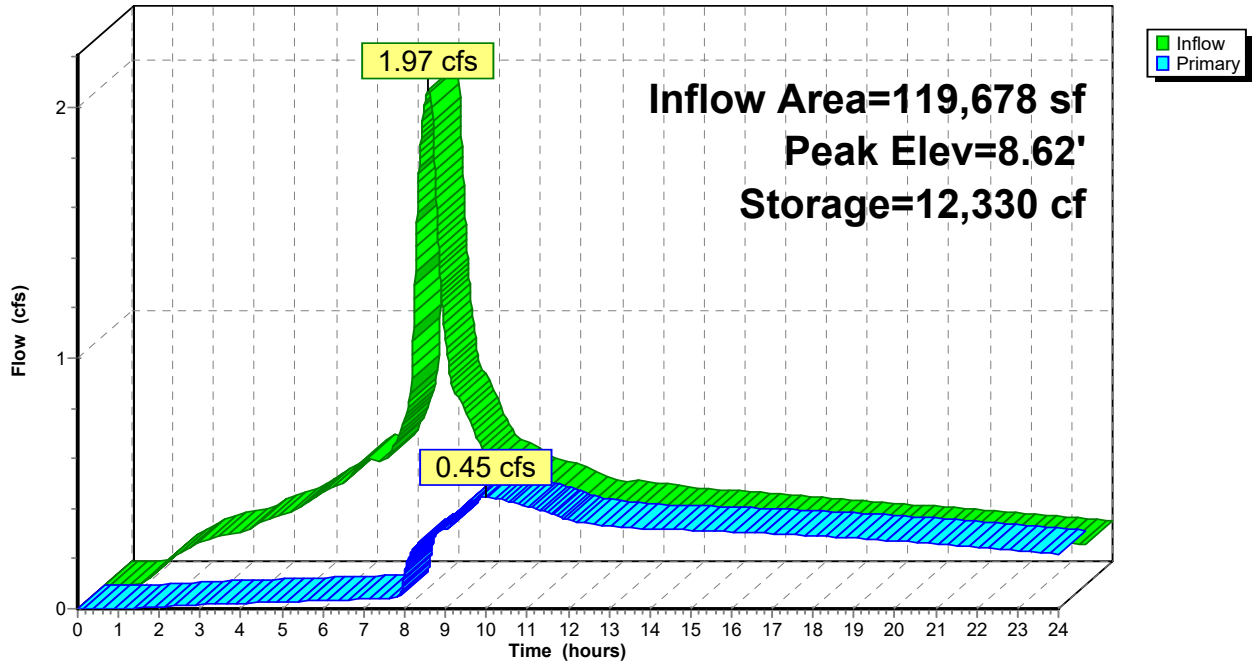
Device	Routing	Invert	Outlet Devices
#1	Primary	4.50'	<b>12.0" Round Culvert</b> L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 4.50' / 4.30' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	5.00'	<b>1.0" Vert. WQ Orifice</b> C= 0.620
#3	Device 1	7.75'	<b>3.5" Vert. Orifice/Grate</b> C= 0.620
#4	Device 1	8.55'	<b>2.2' long (Profile 17) Broad-Crested Rectangular Weir</b> Head (feet) 0.49 0.98 1.48 1.97 2.46 2.95 Coef. (English) 2.84 3.13 3.26 3.30 3.31 3.31

**Primary OutFlow** Max=0.45 cfs @ 10.01 hrs HW=8.62' TW=3.21' (Dynamic Tailwater)

- 1=Culvert (Passes 0.45 cfs of 7.19 cfs potential flow)
- 2=WQ Orifice (Orifice Controls 0.05 cfs @ 9.41 fps)
- 3=Orifice/Grate (Orifice Controls 0.28 cfs @ 4.23 fps)
- 4=Broad-Crested Rectangular Weir (Weir Controls 0.11 cfs @ 0.74 fps)

### Pond 1P: STORM FACILITY

Hydrograph



**Summary for Pond ST1: ST-740 CHAMBERS**

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 24,834 sf, 82.69% Impervious, Inflow Depth > 2.59" for 5-Year event  
 Inflow = 0.34 cfs @ 7.99 hrs, Volume= 5,360 cf  
 Outflow = 0.32 cfs @ 8.05 hrs, Volume= 5,359 cf, Atten= 7%, Lag= 3.8 min  
 Primary = 0.32 cfs @ 8.05 hrs, Volume= 5,359 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 4.21' @ 8.05 hrs Surf.Area= 196 sf Storage= 318 cf

Plug-Flow detention time= 8.6 min calculated for 5,357 cf (100% of inflow)  
 Center-of-Mass det. time= 8.5 min ( 691.7 - 683.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	1.00'	151 cf	<b>11.00'W x 17.86'L x 3.50'H Field A</b> 687 cf Overall - 184 cf Embedded = 504 cf x 30.0% Voids
#2A	1.50'	184 cf	<b>ADS_StormTech SC-740 +Cap x 4 Inside #1</b> Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 2 Rows of 2 Chambers
		335 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.90'	<b>6.0" Round Culvert</b> L= 10.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.90' / 0.80' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Device 1	0.90'	<b>2.0" Horiz. Orifice</b> C= 0.620 Limited to weir flow at low heads
#3	Device 1	4.00'	<b>6.0" Vert. Overflow Outlet</b> C= 0.620

**Primary OutFlow** Max=0.32 cfs @ 8.05 hrs HW=4.21' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 0.32 cfs of 1.65 cfs potential flow)
- 2=Orifice (Orifice Controls 0.20 cfs @ 9.05 fps)
- 3=Overflow Outlet (Orifice Controls 0.12 cfs @ 1.60 fps)

**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 5-Year Rainfall=3.10"

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Page 37

**Pond ST1: ST-740 CHAMBERS - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +12.0" End Stone x 2 = 17.86' Base Length

2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

687.5 cf Field - 183.8 cf Chambers = 503.7 cf Stone x 30.0% Voids = 151.1 cf Stone Storage

Chamber Storage + Stone Storage = 334.9 cf = 0.008 af

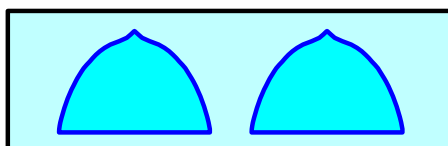
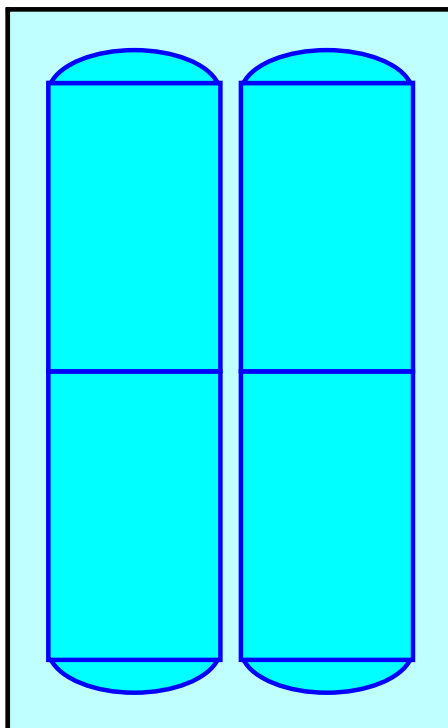
Overall Storage Efficiency = 48.7%

Overall System Size = 17.86' x 11.00' x 3.50'

4 Chambers

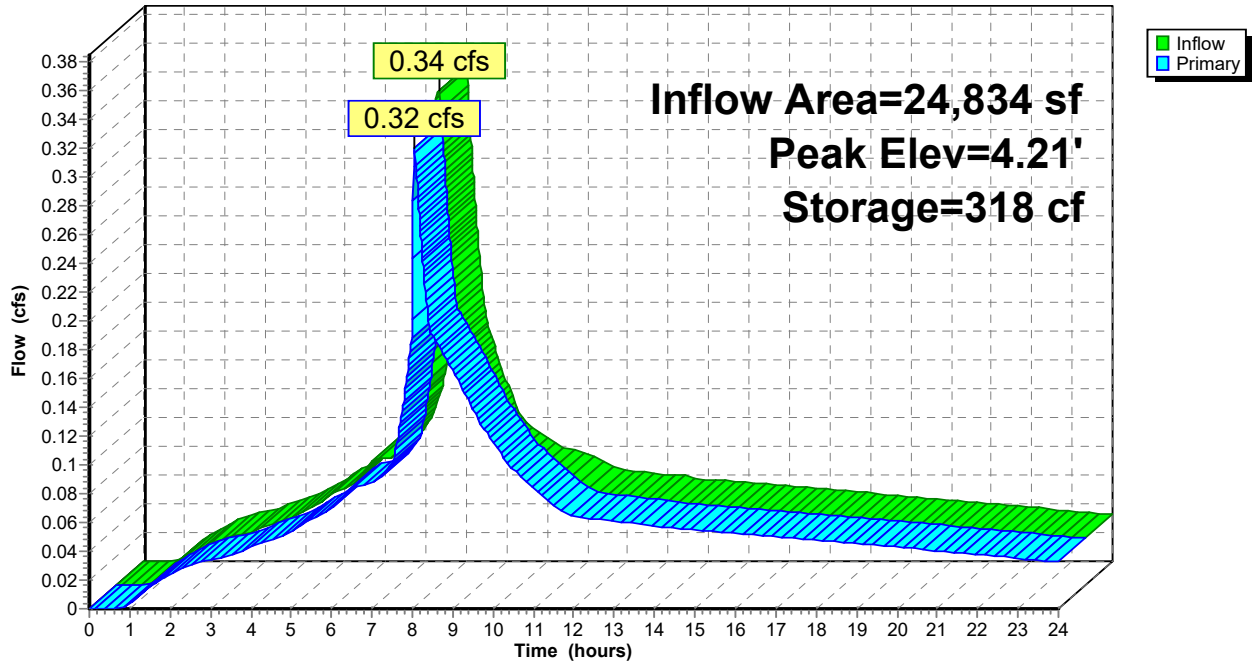
25.5 cy Field

18.7 cy Stone



### Pond ST1: ST-740 CHAMBERS

Hydrograph



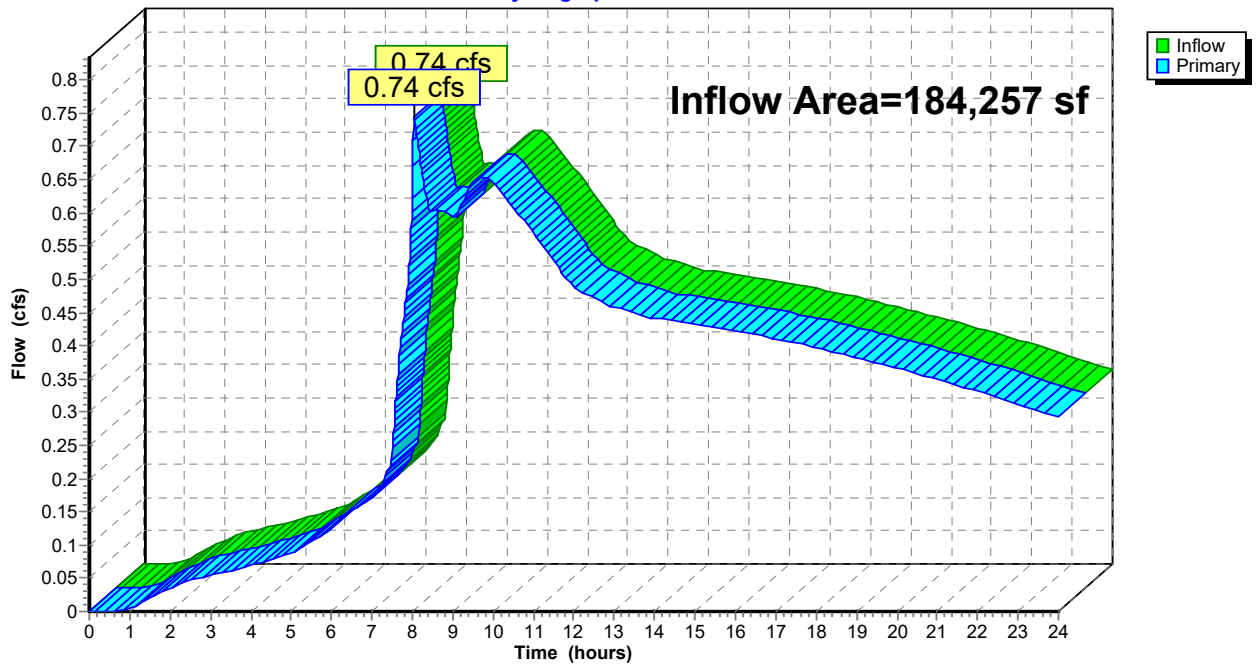
### Summary for Link 1L: TOTAL

Inflow Area = 184,257 sf, 77.29% Impervious, Inflow Depth > 1.84" for 5-Year event  
Inflow = 0.74 cfs @ 8.05 hrs, Volume= 28,321 cf  
Primary = 0.74 cfs @ 8.05 hrs, Volume= 28,321 cf, Atten= 0%, Lag= 0.0 min

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

### Link 1L: TOTAL

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 10-Year Rainfall=3.45"

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Page 40

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: UNCAPTURED** Runoff Area=2,199 sf 100.00% Impervious Runoff Depth>3.21"  
Tc=5.0 min CN=0/98 Runoff=0.04 cfs 588 cf

**Subcatchment 2S: GRAVEL DRWY &** Runoff Area=24,834 sf 82.69% Impervious Runoff Depth>2.92"  
Flow Length=347' Tc=11.3 min CN=80/98 Runoff=0.39 cfs 6,052 cf

**Subcatchment 3S: PRE &** Runoff Area=14,359 sf 0.00% Impervious Runoff Depth>1.59"  
Tc=5.0 min CN=80/0 Runoff=0.12 cfs 1,906 cf

**Subcatchment 4S: PRE &** Runoff Area=23,187 sf 0.00% Impervious Runoff Depth>1.59"  
Tc=5.0 min CN=80/0 Runoff=0.19 cfs 3,077 cf

**Subcatchment 5S: GRAVEL PAD** Runoff Area=15,626 sf 100.00% Impervious Runoff Depth>3.21"  
Tc=5.0 min CN=0/98 Runoff=0.29 cfs 4,182 cf

**Subcatchment 6S: GRAVEL PAD** Runoff Area=34,119 sf 100.00% Impervious Runoff Depth>3.21"  
Tc=5.0 min CN=0/98 Runoff=0.63 cfs 9,130 cf

**Subcatchment 7S: GRAVEL PAD** Runoff Area=69,933 sf 100.00% Impervious Runoff Depth>3.21"  
Tc=5.0 min CN=0/98 Runoff=1.30 cfs 18,714 cf

**Reach 1R: DITCH** Avg. Flow Depth=0.78' Max Vel=1.05 fps Inflow=1.30 cfs 18,714 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=1.29 cfs 18,670 cf

**Reach 2R: DITCH** Avg. Flow Depth=0.44' Max Vel=0.72 fps Inflow=0.29 cfs 4,182 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=0.29 cfs 4,167 cf

**Reach 3R: 10" PVC** Avg. Flow Depth=0.27' Max Vel=4.61 fps Inflow=0.71 cfs 21,408 cf  
10.0" Round Pipe n=0.013 L=85.0' S=0.0200 '/' Capacity=3.10 cfs Outflow=0.71 cfs 21,402 cf

**Pond 1P: STORM FACILITY** Peak Elev=8.70' Storage=12,724 cf Inflow=2.20 cfs 31,968 cf  
Outflow=0.71 cfs 21,408 cf

**Pond ST1: ST-740 CHAMBERS** Peak Elev=4.26' Storage=321 cf Inflow=0.39 cfs 6,052 cf  
Outflow=0.39 cfs 6,050 cf

**Link 1L: TOTAL** Inflow=1.03 cfs 33,024 cf  
Primary=1.03 cfs 33,024 cf

**Total Runoff Area = 184,257 sf Runoff Volume = 43,649 cf Average Runoff Depth = 2.84"**  
**22.71% Pervious = 41,846 sf 77.29% Impervious = 142,411 sf**



**Summary for Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Runoff = 0.04 cfs @ 7.88 hrs, Volume= 588 cf, Depth> 3.21"

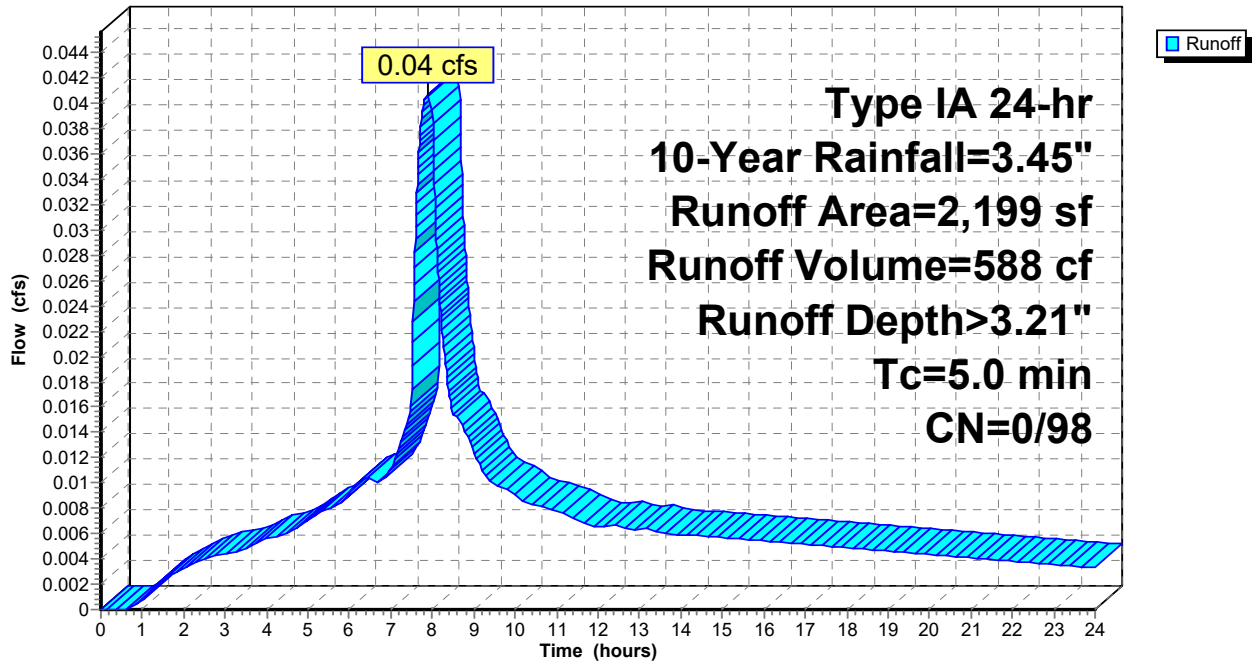
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
* 2,199	98	Gravel surface, HSG D
2,199	98	100.00% Impervious Area

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

**Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 10-Year Rainfall=3.45"

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Page 42

**Summary for Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Runoff = 0.39 cfs @ 7.99 hrs, Volume= 6,052 cf, Depth> 2.92"

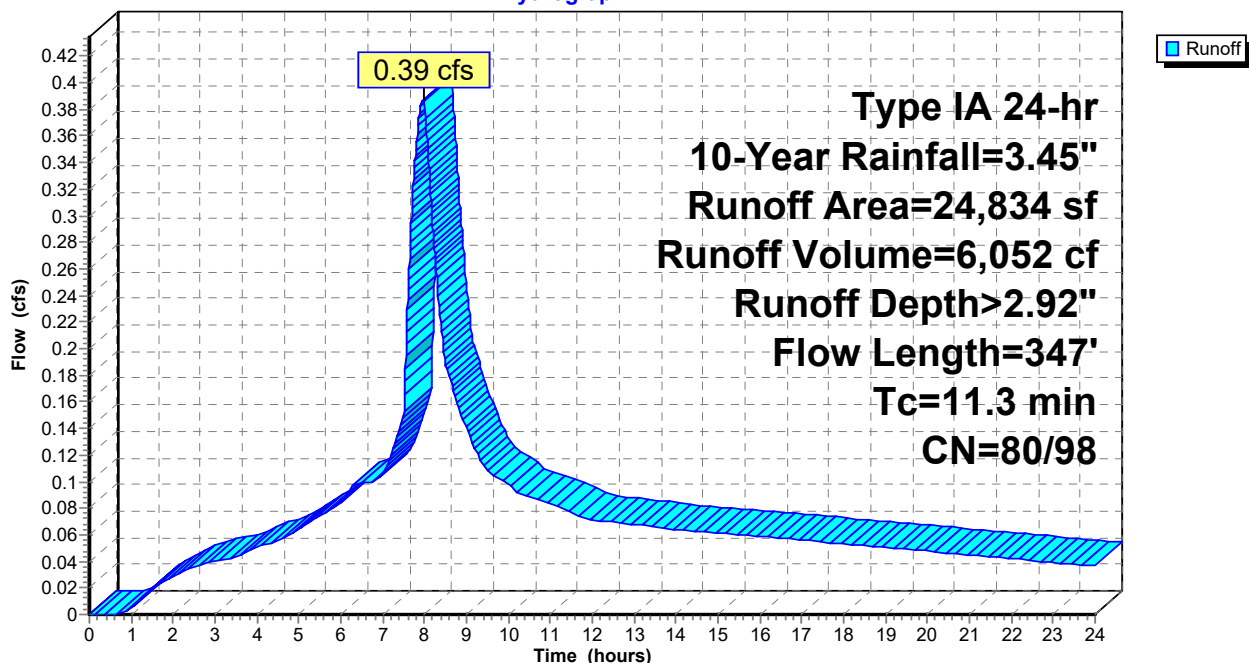
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
4,300	80	>75% Grass cover, Good, HSG D
* 20,534	98	Gravel surface, HSG D
24,834	95	Weighted Average
4,300	80	17.31% Pervious Area
20,534	98	82.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	55	0.0727	0.10		<b>Sheet Flow, SHEET</b> Woods: Light underbrush n= 0.400 P2= 2.50"
2.3	292	0.0450	2.08		<b>Sheet Flow, SHEET</b> Smooth surfaces n= 0.011 P2= 2.50"
11.3	347	Total			

**Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Hydrograph



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Page 43

**Summary for Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

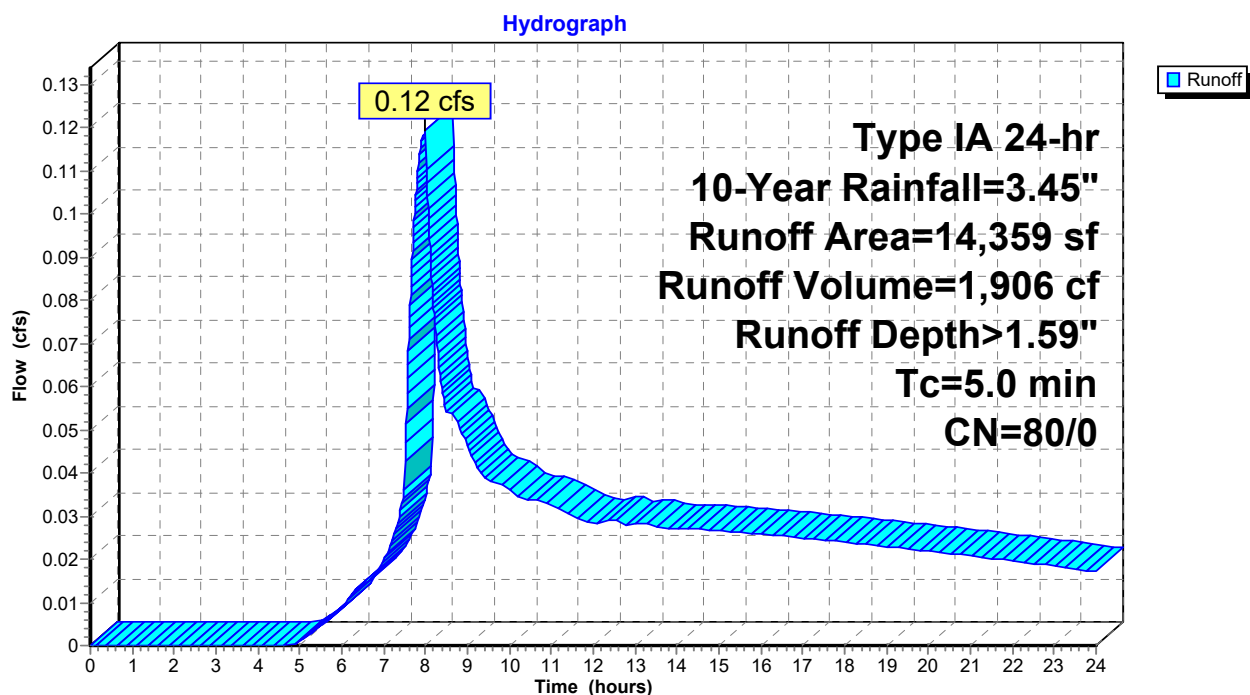
Runoff = 0.12 cfs @ 7.98 hrs, Volume= 1,906 cf, Depth> 1.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
14,359	80	>75% Grass cover, Good, HSG D
14,359	80	100.00% Pervious Area

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

**Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 10-Year Rainfall=3.45"

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Page 44

**Summary for Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

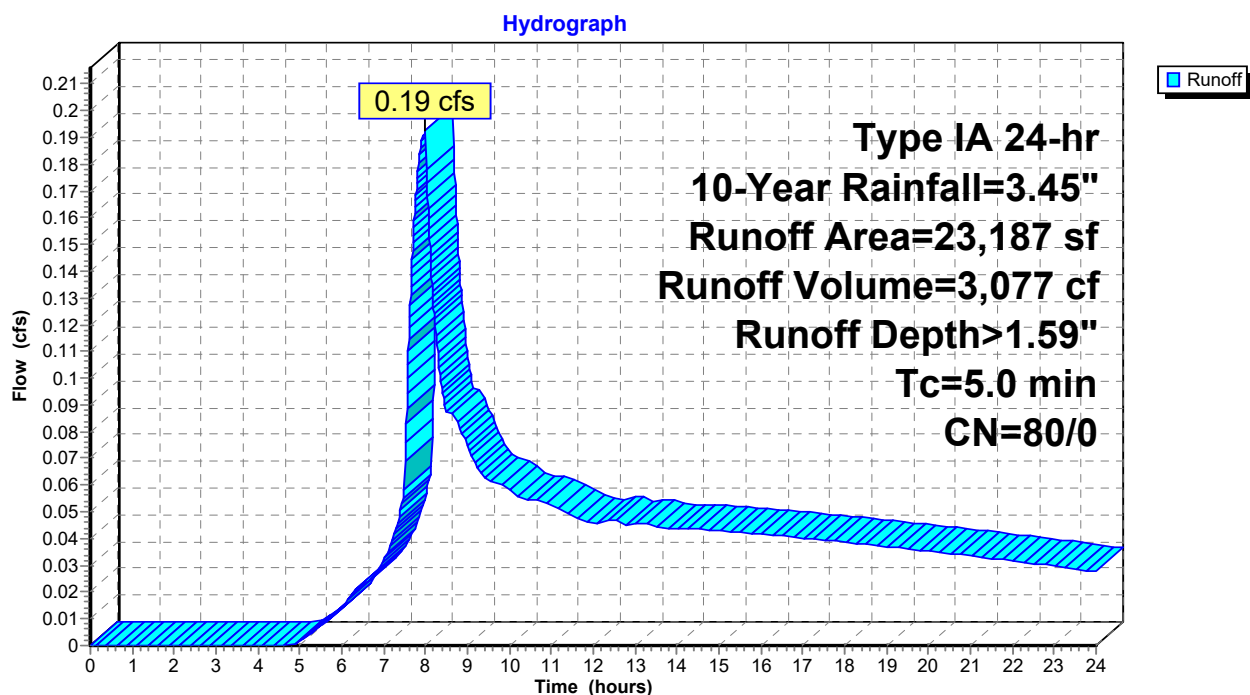
Runoff = 0.19 cfs @ 7.98 hrs, Volume= 3,077 cf, Depth> 1.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
23,187	80	>75% Grass cover, Good, HSG D
23,187	80	100.00% Pervious Area

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

**Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**Summary for Subcatchment 5S: GRAVEL PAD**

Runoff = 0.29 cfs @ 7.88 hrs, Volume= 4,182 cf, Depth> 3.21"

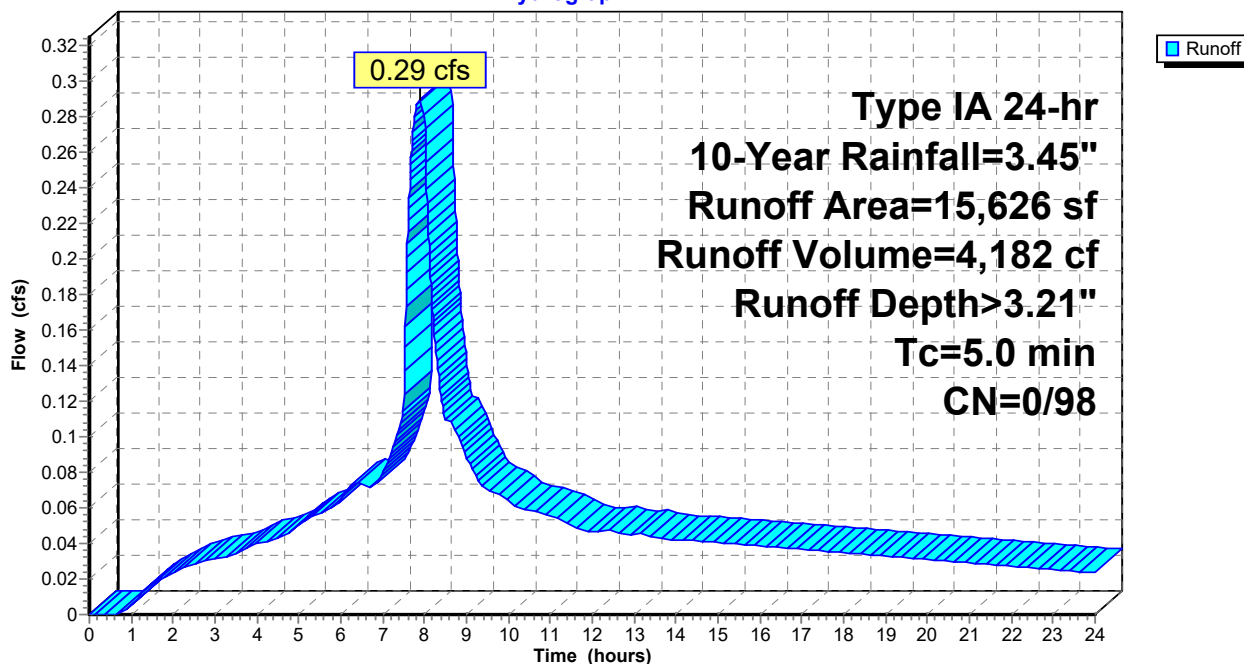
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
* 15,626	98	Gravel surface, HSG D
15,626	98	100.00% Impervious Area

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

**Subcatchment 5S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 6S: GRAVEL PAD**

Runoff = 0.63 cfs @ 7.88 hrs, Volume= 9,130 cf, Depth> 3.21"

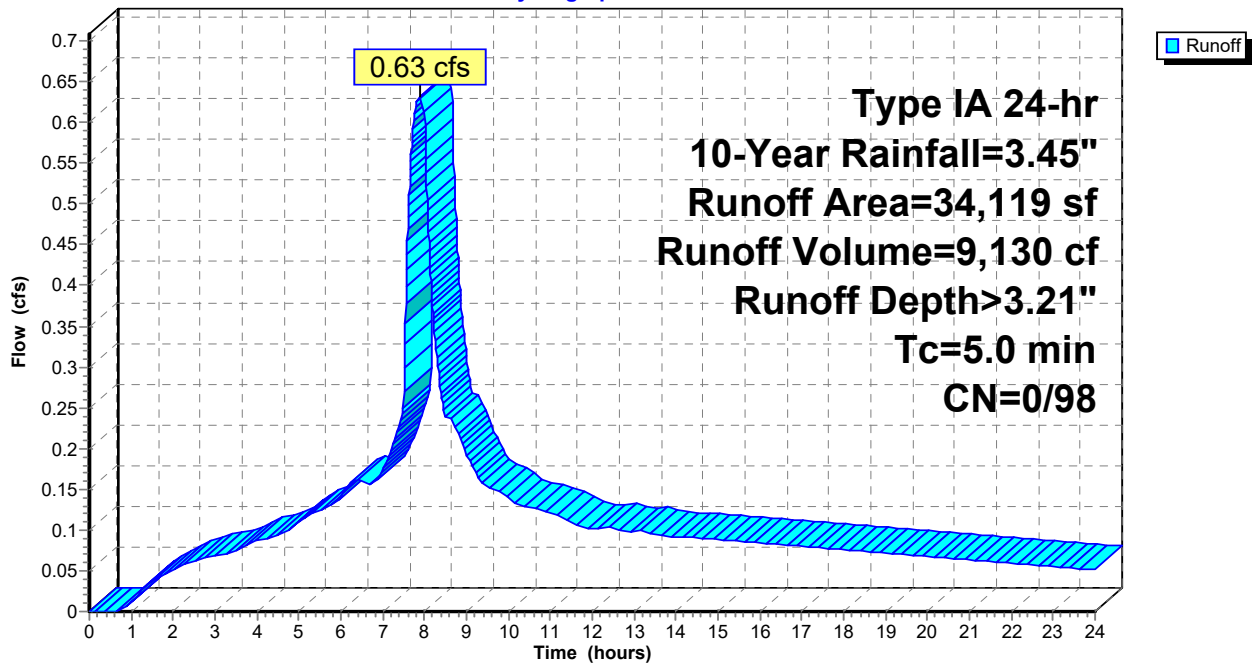
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
* 34,119	98	Gravel surface, HSG D & POND
34,119	98	100.00% Impervious Area

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

**Subcatchment 6S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 7S: GRAVEL PAD**

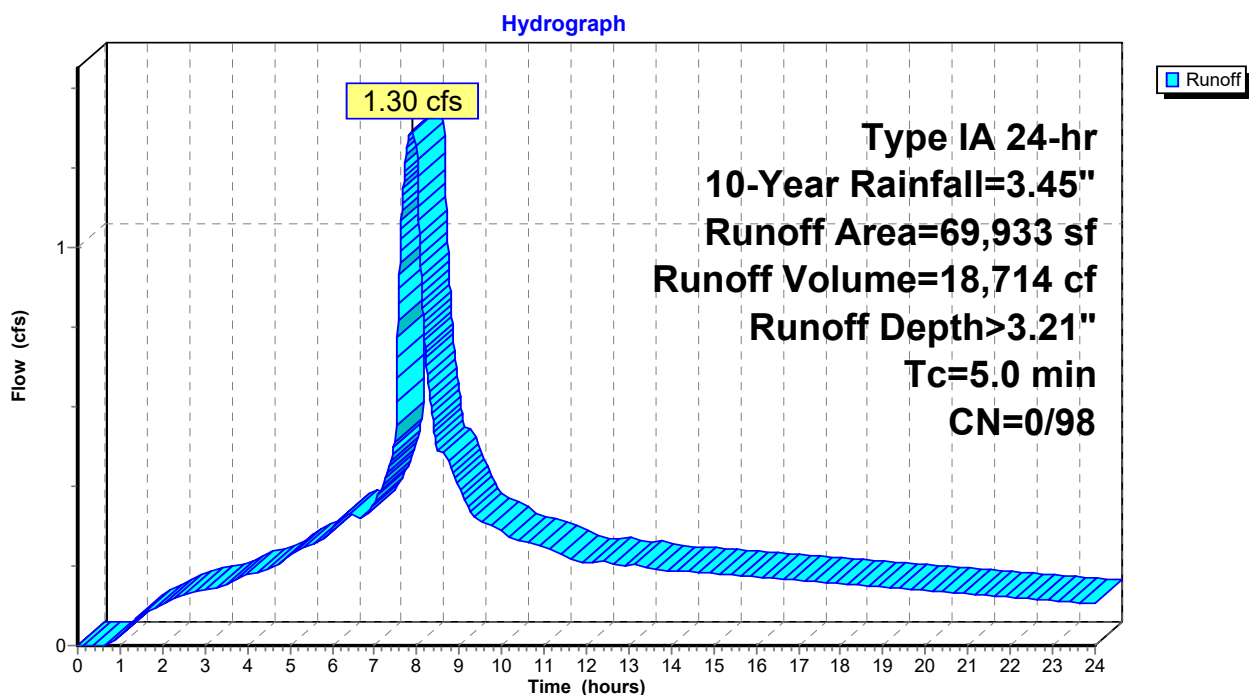
Runoff = 1.30 cfs @ 7.88 hrs, Volume= 18,714 cf, Depth> 3.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 10-Year Rainfall=3.45"

Area (sf)	CN	Description
69,933	98	Gravel surface, HSG D
69,933	98	100.00% Impervious Area

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

**Subcatchment 7S: GRAVEL PAD**



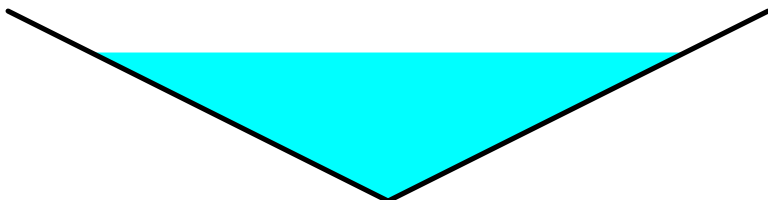
**Summary for Reach 1R: DITCH**

Inflow Area = 69,933 sf, 100.00% Impervious, Inflow Depth > 3.21" for 10-Year event  
 Inflow = 1.30 cfs @ 7.88 hrs, Volume= 18,714 cf  
 Outflow = 1.29 cfs @ 7.93 hrs, Volume= 18,670 cf, Atten= 1%, Lag= 2.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 1.05 fps, Min. Travel Time= 3.7 min  
 Avg. Velocity = 0.65 fps, Avg. Travel Time= 6.0 min

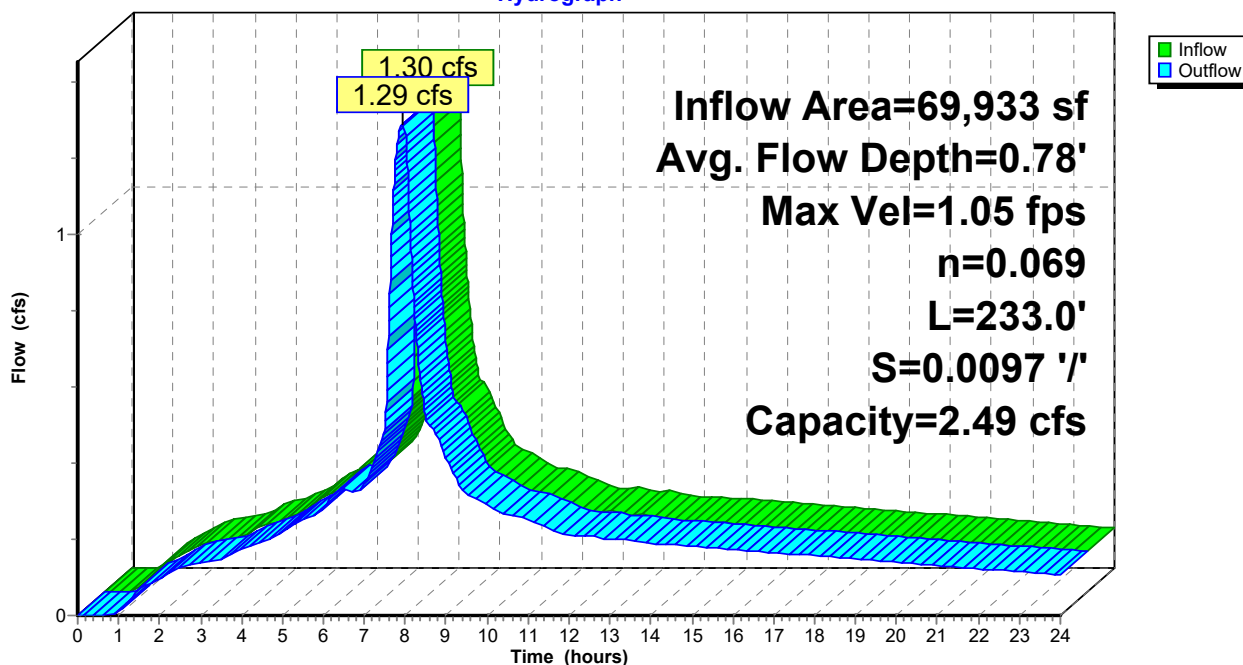
Peak Storage= 285 cf @ 7.93 hrs  
 Average Depth at Peak Storage= 0.78'  
 Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
 Side Slope Z-value= 2.0 '/' Top Width= 4.00'  
 Length= 233.0' Slope= 0.0097 '/'  
 Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 1R: DITCH**

Hydrograph





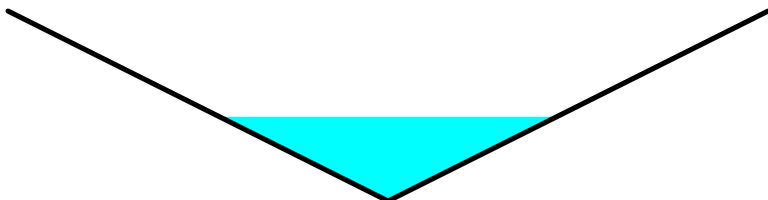
**Summary for Reach 2R: DITCH**

Inflow Area = 15,626 sf, 100.00% Impervious, Inflow Depth > 3.21" for 10-Year event  
 Inflow = 0.29 cfs @ 7.88 hrs, Volume= 4,182 cf  
 Outflow = 0.29 cfs @ 7.95 hrs, Volume= 4,167 cf, Atten= 1%, Lag= 4.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 0.72 fps, Min. Travel Time= 5.4 min  
 Avg. Velocity = 0.45 fps, Avg. Travel Time= 8.7 min

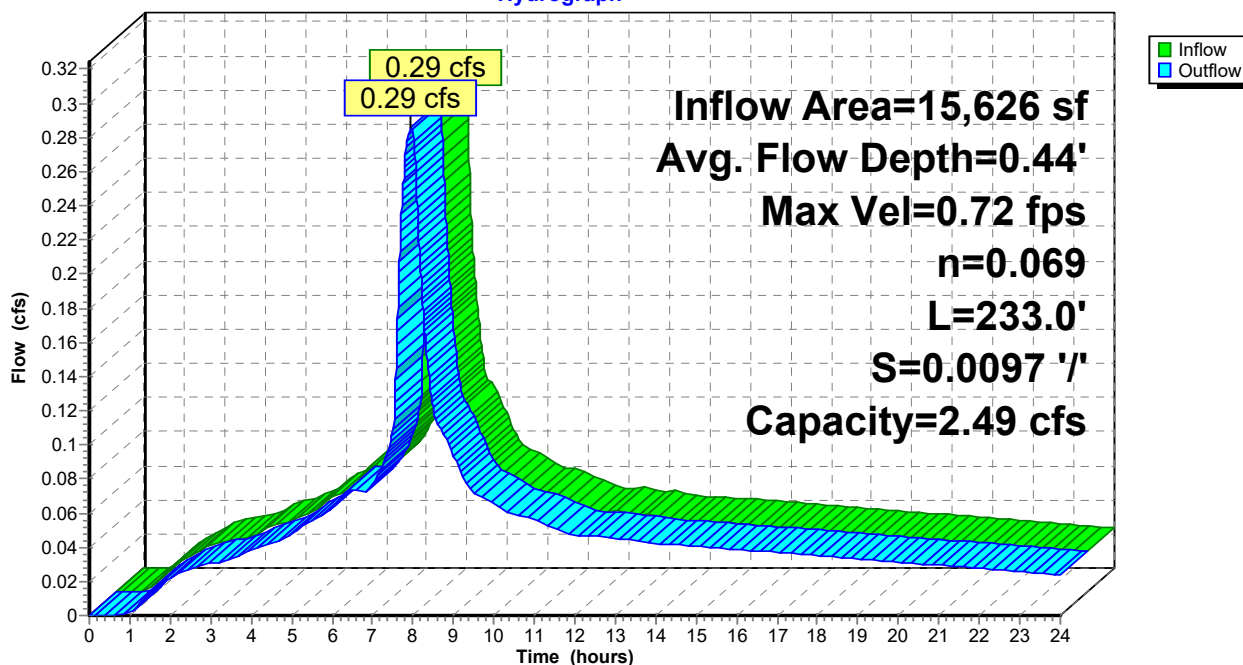
Peak Storage= 92 cf @ 7.95 hrs  
 Average Depth at Peak Storage= 0.44'  
 Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
 Side Slope Z-value= 2.0 ' / ' Top Width= 4.00'  
 Length= 233.0' Slope= 0.0097 ' / '  
 Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 2R: DITCH**

Hydrograph



**Summary for Reach 3R: 10" PVC**

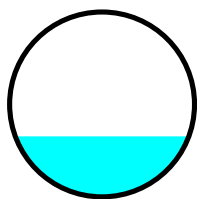
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 2.15" for 10-Year event  
 Inflow = 0.71 cfs @ 8.98 hrs, Volume= 21,408 cf  
 Outflow = 0.71 cfs @ 8.98 hrs, Volume= 21,402 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 4.61 fps, Min. Travel Time= 0.3 min  
 Avg. Velocity = 3.13 fps, Avg. Travel Time= 0.5 min

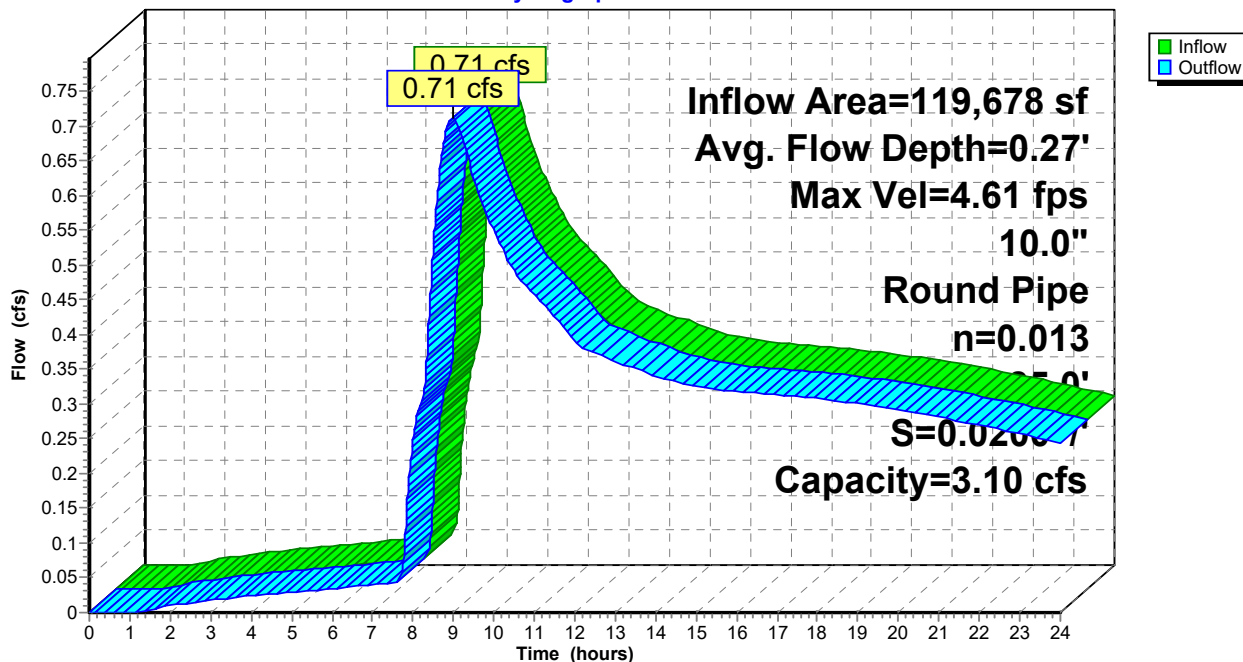
Peak Storage= 13 cf @ 8.98 hrs  
 Average Depth at Peak Storage= 0.27'  
 Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.10 cfs

10.0" Round Pipe  
 n= 0.013  
 Length= 85.0' Slope= 0.0200 '/  
 Inlet Invert= 3.00', Outlet Invert= 1.30'



**Reach 3R: 10" PVC**

Hydrograph



**Summary for Pond 1P: STORM FACILITY**

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 3.21" for 10-Year event  
 Inflow = 2.20 cfs @ 7.92 hrs, Volume= 31,968 cf  
 Outflow = 0.71 cfs @ 8.98 hrs, Volume= 21,408 cf, Atten= 68%, Lag= 63.5 min  
 Primary = 0.71 cfs @ 8.98 hrs, Volume= 21,408 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 8.70' @ 8.98 hrs Surf.Area= 4,897 sf Storage= 12,724 cf  
 Flood Elev= 10.00' Surf.Area= 6,063 sf Storage= 19,838 cf

Plug-Flow detention time= 408.0 min calculated for 21,400 cf (67% of inflow)  
 Center-of-Mass det. time= 208.2 min ( 872.9 - 664.7 )

Volume	Invert	Avail.Storage	Storage Description			
#1	5.00'	19,838 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
5.00	2,123	207.2	0	0	2,123	
6.00	2,787	235.3	2,447	2,447	3,137	
7.00	3,521	254.1	3,147	5,594	3,909	
8.00	4,312	273.0	3,910	9,504	4,744	
9.00	5,159	291.8	4,729	14,233	5,635	
10.00	6,063	310.7	5,605	19,838	6,590	

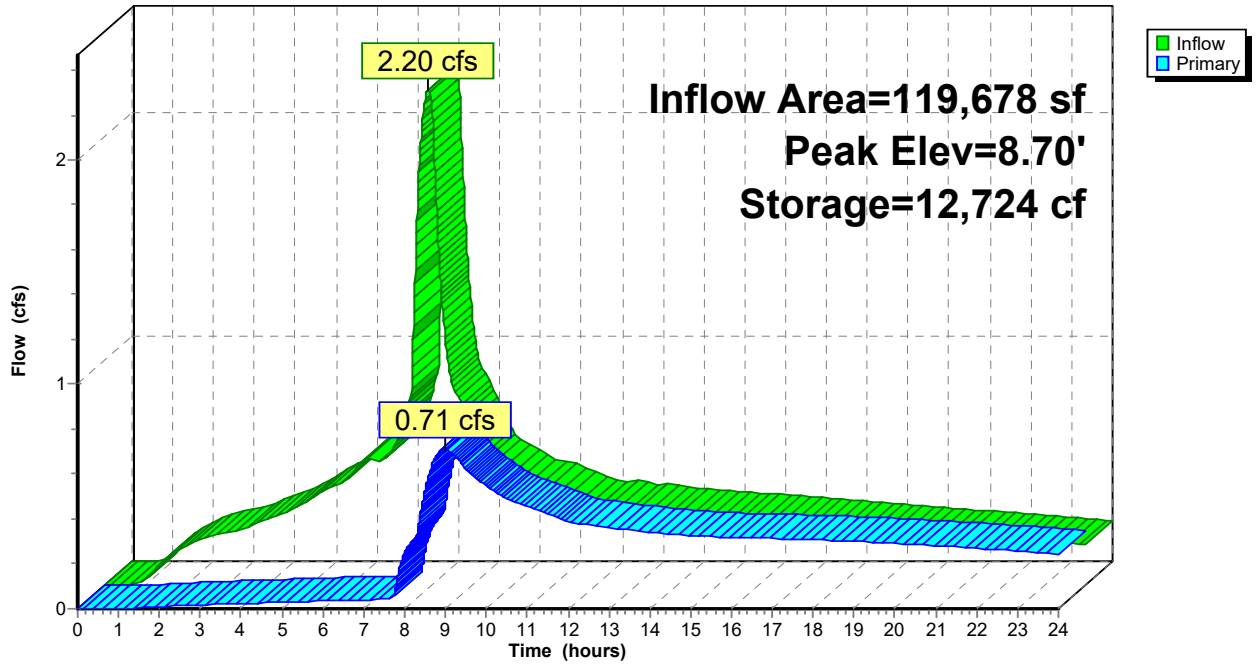
Device	Routing	Invert	Outlet Devices
#1	Primary	4.50'	<b>12.0" Round Culvert</b> L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 4.50' / 4.30' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	5.00'	<b>1.0" Vert. WQ Orifice</b> C= 0.620
#3	Device 1	7.75'	<b>3.5" Vert. Orifice/Grate</b> C= 0.620
#4	Device 1	8.55'	<b>2.2' long (Profile 17) Broad-Crested Rectangular Weir</b> Head (feet) 0.49 0.98 1.48 1.97 2.46 2.95 Coef. (English) 2.84 3.13 3.26 3.30 3.31 3.31

**Primary OutFlow** Max=0.71 cfs @ 8.98 hrs HW=8.70' TW=3.27' (Dynamic Tailwater)

- 1=Culvert (Passes 0.71 cfs of 7.27 cfs potential flow)
- 2=WQ Orifice (Orifice Controls 0.05 cfs @ 9.52 fps)
- 3=Orifice/Grate (Orifice Controls 0.30 cfs @ 4.46 fps)
- 4=Broad-Crested Rectangular Weir (Weir Controls 0.36 cfs @ 1.10 fps)

Pond 1P: STORM FACILITY

Hydrograph



**Summary for Pond ST1: ST-740 CHAMBERS**

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 24,834 sf, 82.69% Impervious, Inflow Depth > 2.92" for 10-Year event  
 Inflow = 0.39 cfs @ 7.99 hrs, Volume= 6,052 cf  
 Outflow = 0.39 cfs @ 8.00 hrs, Volume= 6,050 cf, Atten= 0%, Lag= 0.6 min  
 Primary = 0.39 cfs @ 8.00 hrs, Volume= 6,050 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 4.26' @ 8.00 hrs Surf.Area= 196 sf Storage= 321 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 9.2 min ( 689.6 - 680.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	1.00'	151 cf	<b>11.00'W x 17.86'L x 3.50'H Field A</b> 687 cf Overall - 184 cf Embedded = 504 cf x 30.0% Voids
#2A	1.50'	184 cf	<b>ADS_StormTech SC-740 +Cap x 4</b> Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 2 Rows of 2 Chambers
		335 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.90'	<b>6.0" Round Culvert</b> L= 10.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.90' / 0.80' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Device 1	0.90'	<b>2.0" Horiz. Orifice</b> C= 0.620 Limited to weir flow at low heads
#3	Device 1	4.00'	<b>6.0" Vert. Overflow Outlet</b> C= 0.620

**Primary OutFlow** Max=0.39 cfs @ 8.00 hrs HW=4.26' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 0.39 cfs of 1.67 cfs potential flow)
- ↑ **2=Orifice** (Orifice Controls 0.20 cfs @ 9.12 fps)
- ↑ **3=Overflow Outlet** (Orifice Controls 0.19 cfs @ 1.80 fps)

**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 10-Year Rainfall=3.45"

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Page 54

**Pond ST1: ST-740 CHAMBERS - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +12.0" End Stone x 2 = 17.86' Base Length

2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

687.5 cf Field - 183.8 cf Chambers = 503.7 cf Stone x 30.0% Voids = 151.1 cf Stone Storage

Chamber Storage + Stone Storage = 334.9 cf = 0.008 af

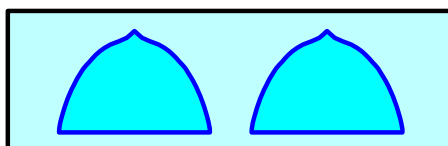
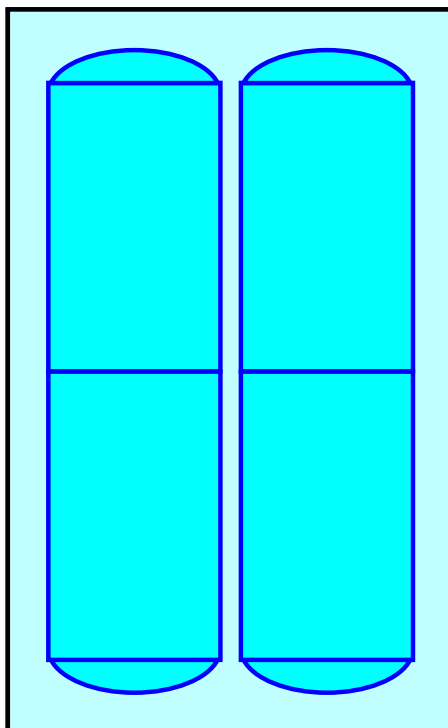
Overall Storage Efficiency = 48.7%

Overall System Size = 17.86' x 11.00' x 3.50'

4 Chambers

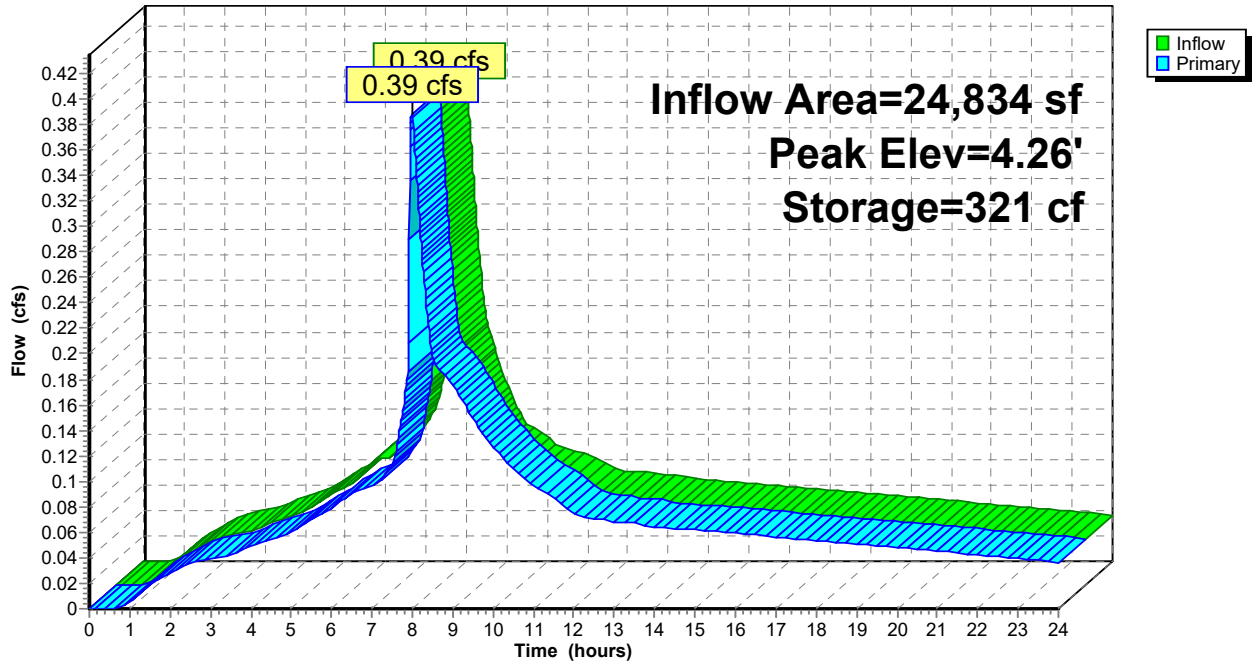
25.5 cy Field

18.7 cy Stone



### Pond ST1: ST-740 CHAMBERS

Hydrograph



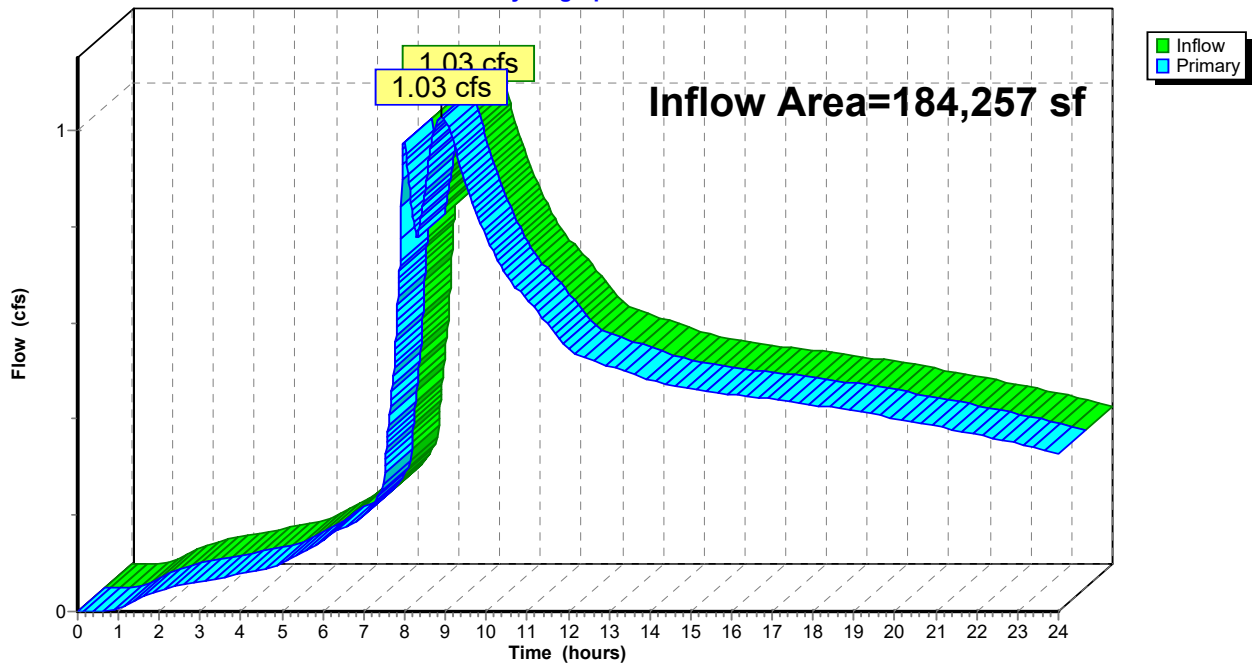
### Summary for Link 1L: TOTAL

Inflow Area = 184,257 sf, 77.29% Impervious, Inflow Depth > 2.15" for 10-Year event  
Inflow = 1.03 cfs @ 8.89 hrs, Volume= 33,024 cf  
Primary = 1.03 cfs @ 8.89 hrs, Volume= 33,024 cf, Atten= 0%, Lag= 0.0 min

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

### Link 1L: TOTAL

Hydrograph





**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 57

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: UNCAPTURED** Runoff Area=2,199 sf 100.00% Impervious Runoff Depth>3.66"  
Tc=5.0 min CN=0/98 Runoff=0.05 cfs 671 cf

**Subcatchment 2S: GRAVEL DRWY &** Runoff Area=24,834 sf 82.69% Impervious Runoff Depth>3.36"  
Flow Length=347' Tc=11.3 min CN=80/98 Runoff=0.44 cfs 6,946 cf

**Subcatchment 3S: PRE &** Runoff Area=14,359 sf 0.00% Impervious Runoff Depth>1.95"  
Tc=5.0 min CN=80/0 Runoff=0.15 cfs 2,338 cf

**Subcatchment 4S: PRE &** Runoff Area=23,187 sf 0.00% Impervious Runoff Depth>1.95"  
Tc=5.0 min CN=80/0 Runoff=0.24 cfs 3,776 cf

**Subcatchment 5S: GRAVEL PAD** Runoff Area=15,626 sf 100.00% Impervious Runoff Depth>3.66"  
Tc=5.0 min CN=0/98 Runoff=0.33 cfs 4,765 cf

**Subcatchment 6S: GRAVEL PAD** Runoff Area=34,119 sf 100.00% Impervious Runoff Depth>3.66"  
Tc=5.0 min CN=0/98 Runoff=0.72 cfs 10,404 cf

**Subcatchment 7S: GRAVEL PAD** Runoff Area=69,933 sf 100.00% Impervious Runoff Depth>3.66"  
Tc=5.0 min CN=0/98 Runoff=1.47 cfs 21,325 cf

**Reach 1R: DITCH** Avg. Flow Depth=0.82' Max Vel=1.09 fps Inflow=1.47 cfs 21,325 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=1.46 cfs 21,277 cf

**Reach 2R: DITCH** Avg. Flow Depth=0.47' Max Vel=0.75 fps Inflow=0.33 cfs 4,765 cf  
n=0.069 L=233.0' S=0.0097 '/' Capacity=2.49 cfs Outflow=0.32 cfs 4,749 cf

**Reach 3R: 10" PVC** Avg. Flow Depth=0.35' Max Vel=5.27 fps Inflow=1.16 cfs 25,422 cf  
10.0" Round Pipe n=0.013 L=85.0' S=0.0200 '/' Capacity=3.10 cfs Outflow=1.16 cfs 25,415 cf

**Pond 1P: STORM FACILITY** Peak Elev=8.80' Storage=13,231 cf Inflow=2.50 cfs 36,430 cf  
Outflow=1.16 cfs 25,422 cf

**Pond ST1: ST-740 CHAMBERS** Peak Elev=4.31' Storage=323 cf Inflow=0.44 cfs 6,946 cf  
Outflow=0.44 cfs 6,943 cf

**Link 1L: TOTAL** Inflow=1.67 cfs 39,143 cf  
Primary=1.67 cfs 39,143 cf

**Total Runoff Area = 184,257 sf Runoff Volume = 50,225 cf Average Runoff Depth = 3.27"**  
**22.71% Pervious = 41,846 sf 77.29% Impervious = 142,411 sf**

**Summary for Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Runoff = 0.05 cfs @ 7.88 hrs, Volume= 671 cf, Depth> 3.66"

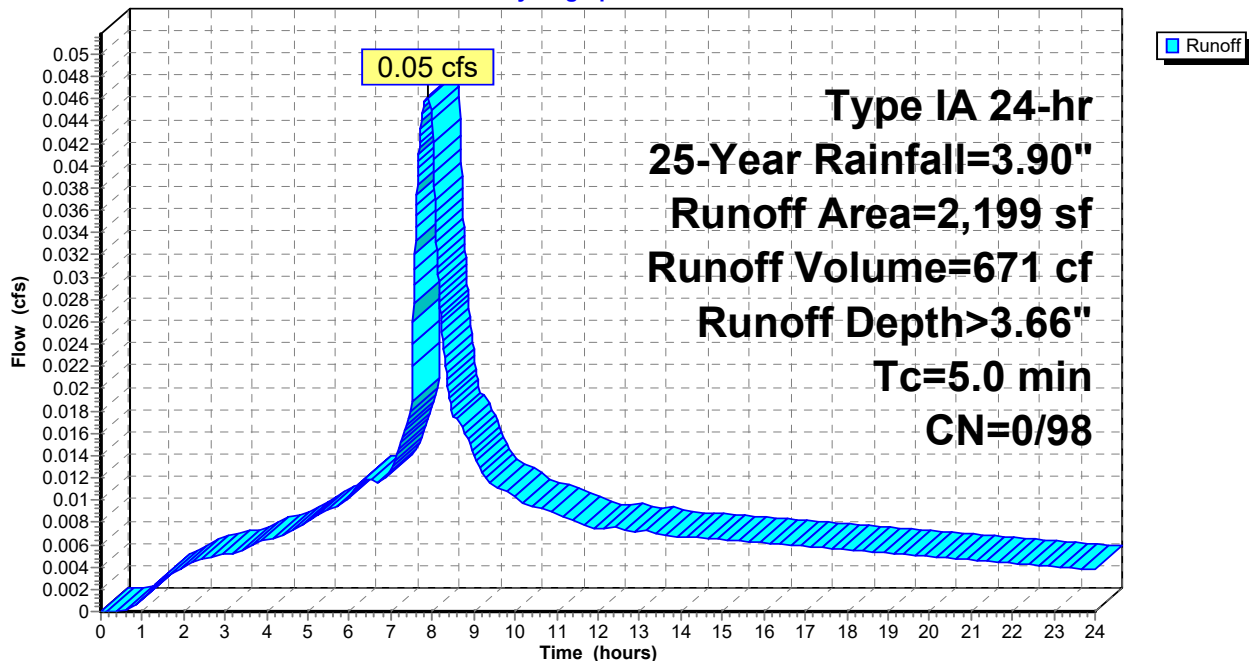
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
* 2,199	98	Gravel surface, HSG D
2,199	98	100.00% Impervious Area

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

**Subcatchment 1S: UNCAPTURED GRAVEL AREA**

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 59

**Summary for Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Runoff = 0.44 cfs @ 7.99 hrs, Volume= 6,946 cf, Depth> 3.36"

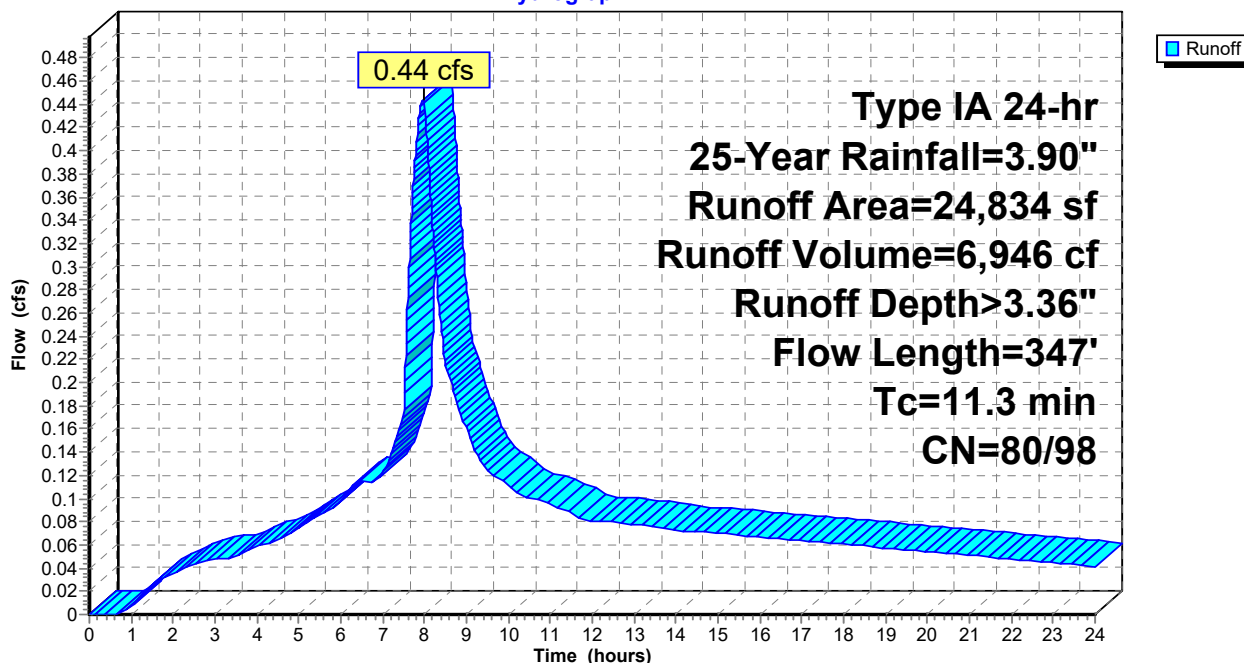
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
4,300	80	>75% Grass cover, Good, HSG D
* 20,534	98	Gravel surface, HSG D
24,834	95	Weighted Average
4,300	80	17.31% Pervious Area
20,534	98	82.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	55	0.0727	0.10		<b>Sheet Flow, SHEET</b> Woods: Light underbrush n= 0.400 P2= 2.50"
2.3	292	0.0450	2.08		<b>Sheet Flow, SHEET</b> Smooth surfaces n= 0.011 P2= 2.50"
11.3	347	Total			

**Subcatchment 2S: GRAVEL DRWY & MISC AREA**

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 60

**Summary for Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

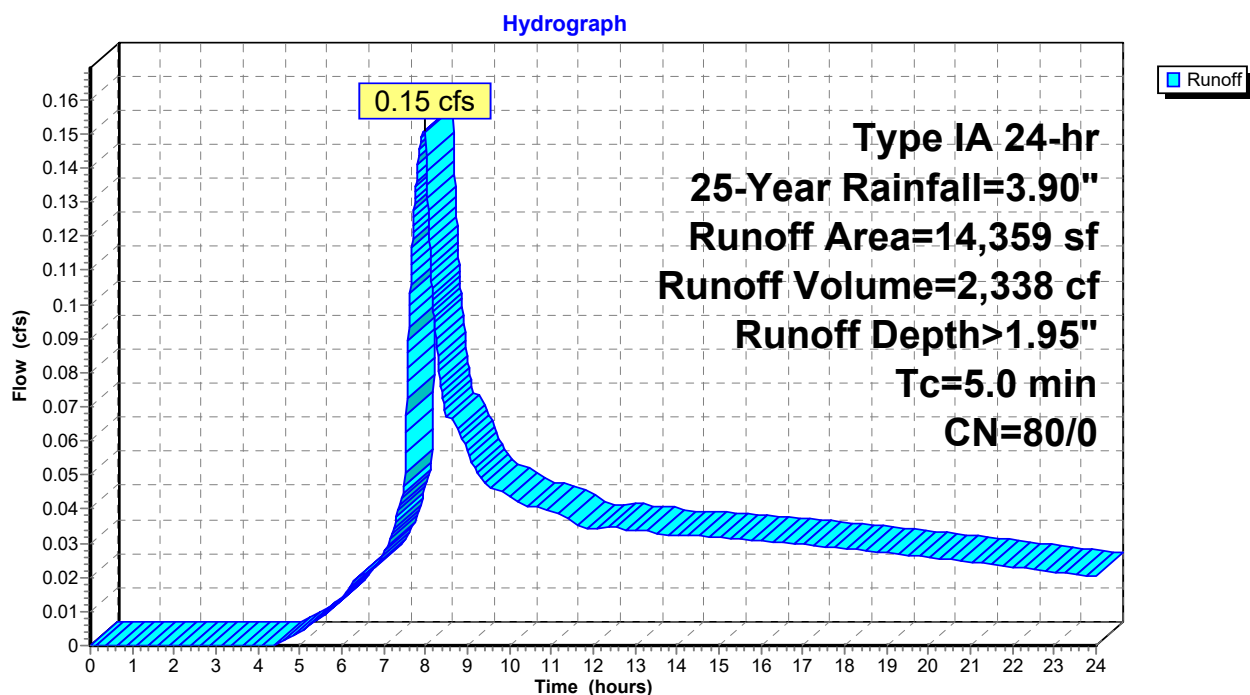
Runoff = 0.15 cfs @ 7.97 hrs, Volume= 2,338 cf, Depth> 1.95"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
14,359	80	>75% Grass cover, Good, HSG D
14,359	80	100.00% Pervious Area

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

**Subcatchment 3S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 61

**Summary for Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**

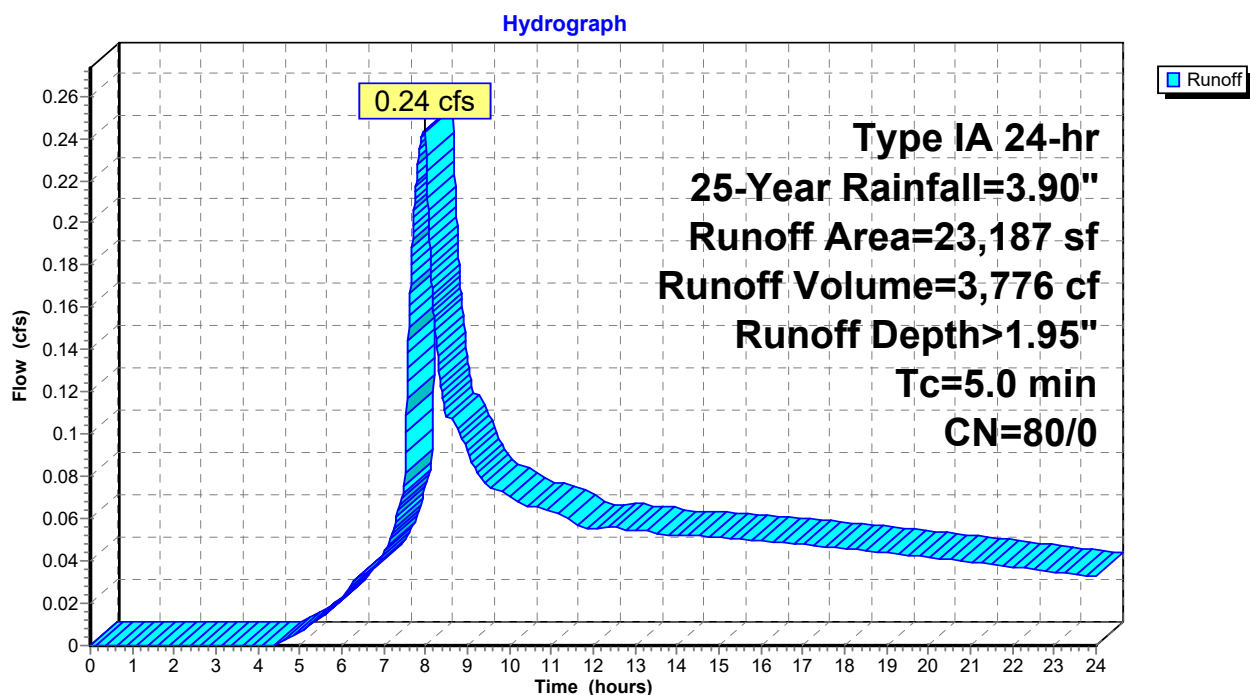
Runoff = 0.24 cfs @ 7.97 hrs, Volume= 3,776 cf, Depth> 1.95"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
23,187	80	>75% Grass cover, Good, HSG D
23,187	80	100.00% Pervious Area

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

**Subcatchment 4S: PRE & POST-DEVELOPED AREA UNCAPTURED SURFACE RUNOFF**



**Summary for Subcatchment 5S: GRAVEL PAD**

Runoff = 0.33 cfs @ 7.88 hrs, Volume= 4,765 cf, Depth> 3.66"

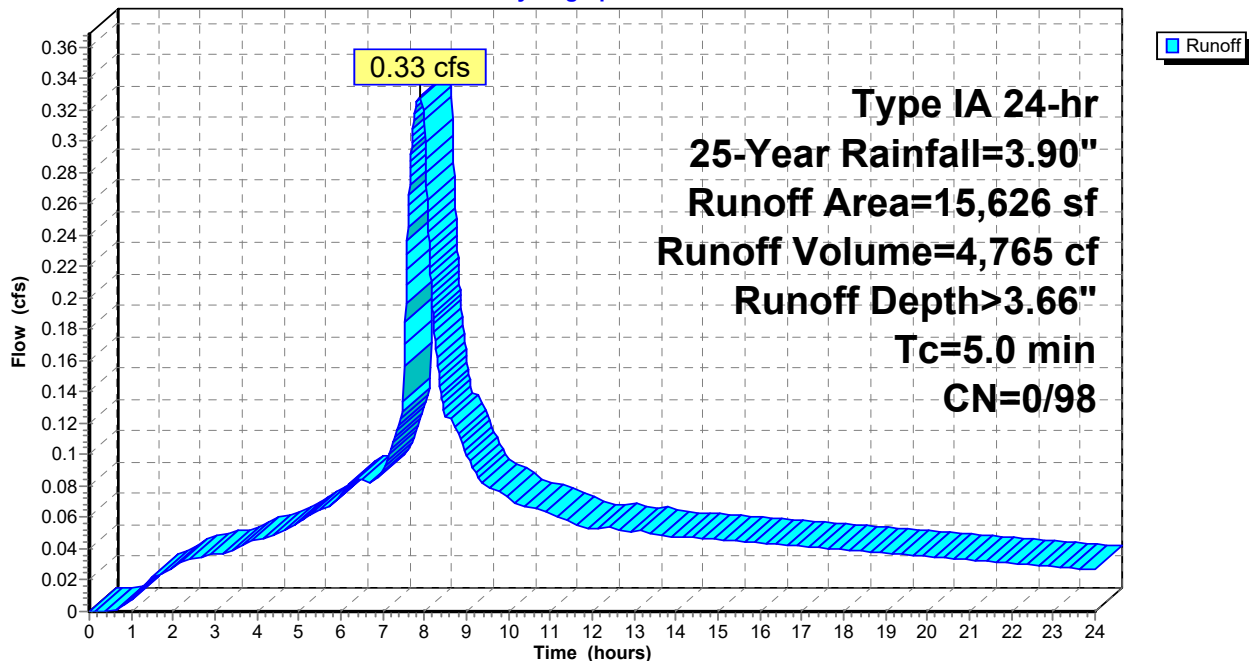
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
* 15,626	98	Gravel surface, HSG D
15,626	98	100.00% Impervious Area

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

**Subcatchment 5S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 6S: GRAVEL PAD**

Runoff = 0.72 cfs @ 7.88 hrs, Volume= 10,404 cf, Depth> 3.66"

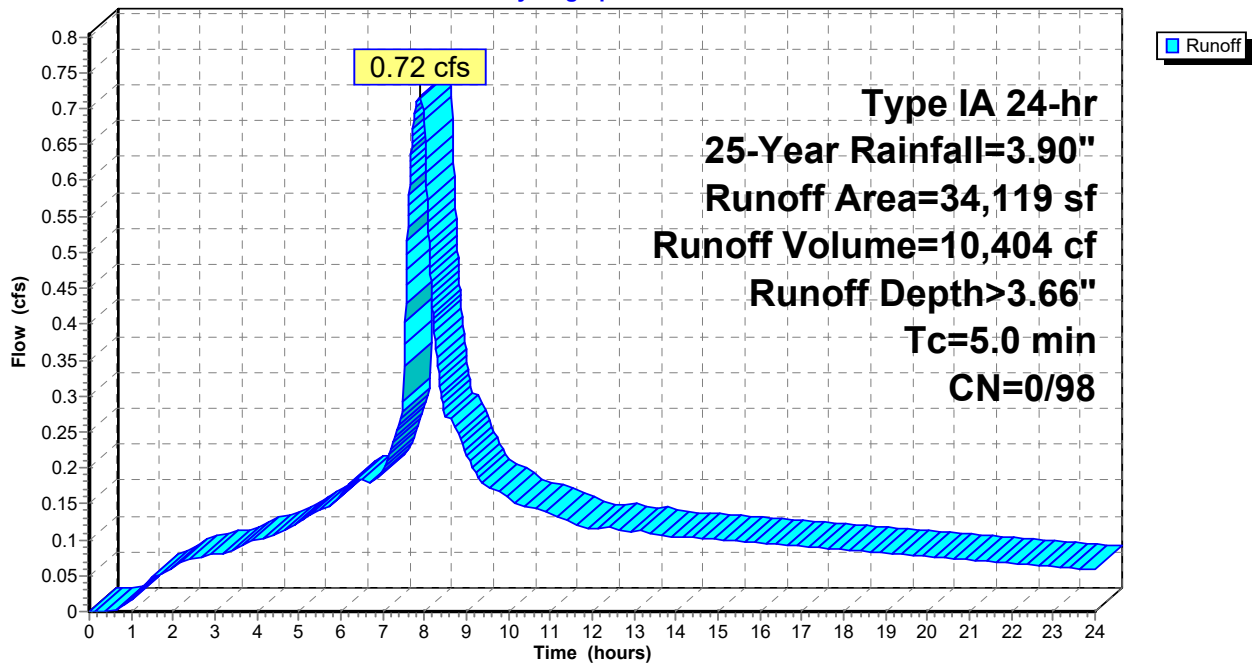
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
* 34,119	98	Gravel surface, HSG D & POND
34,119	98	100.00% Impervious Area

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

**Subcatchment 6S: GRAVEL PAD**

Hydrograph



**Summary for Subcatchment 7S: GRAVEL PAD**

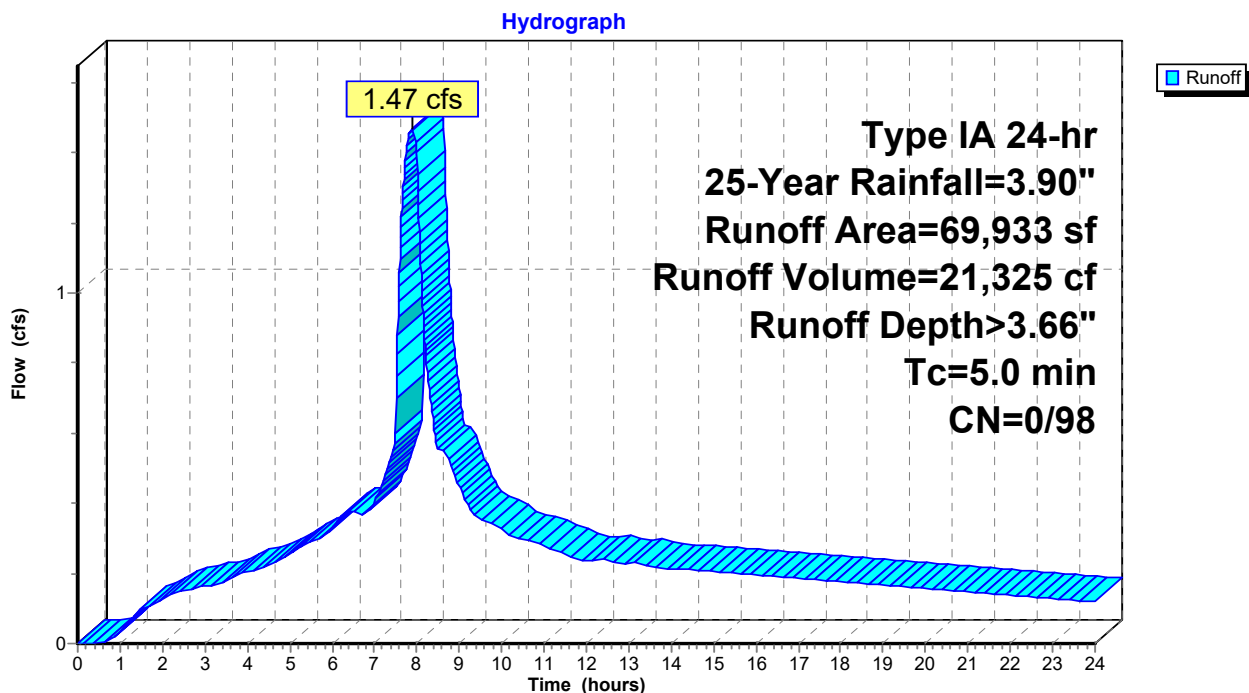
Runoff = 1.47 cfs @ 7.88 hrs, Volume= 21,325 cf, Depth> 3.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type IA 24-hr 25-Year Rainfall=3.90"

Area (sf)	CN	Description
69,933	98	Gravel surface, HSG D
69,933	98	100.00% Impervious Area

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

**Subcatchment 7S: GRAVEL PAD**





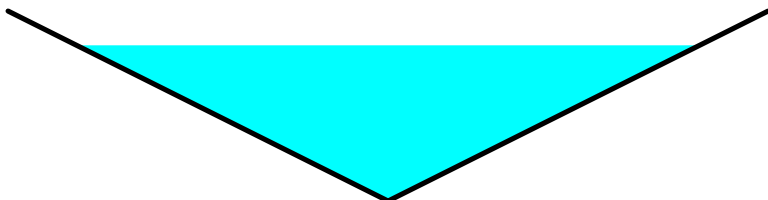
**Summary for Reach 1R: DITCH**

Inflow Area = 69,933 sf, 100.00% Impervious, Inflow Depth > 3.66" for 25-Year event  
 Inflow = 1.47 cfs @ 7.88 hrs, Volume= 21,325 cf  
 Outflow = 1.46 cfs @ 7.92 hrs, Volume= 21,277 cf, Atten= 1%, Lag= 2.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 1.09 fps, Min. Travel Time= 3.6 min  
 Avg. Velocity = 0.67 fps, Avg. Travel Time= 5.8 min

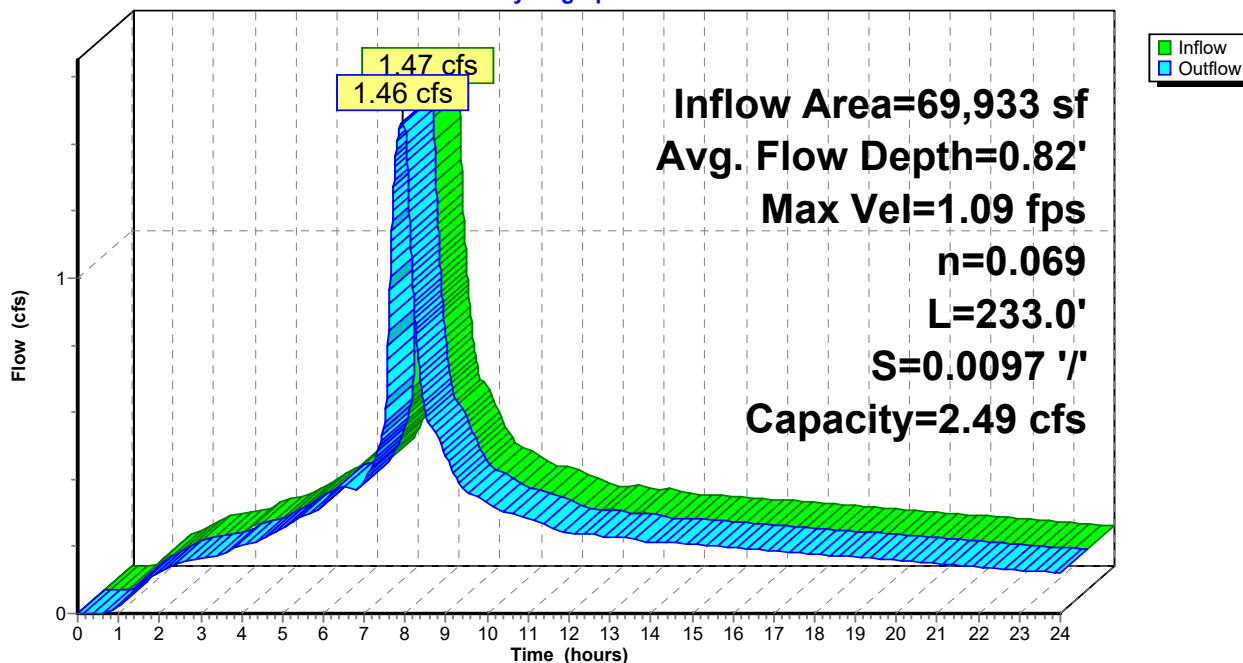
Peak Storage= 313 cf @ 7.92 hrs  
 Average Depth at Peak Storage= 0.82'  
 Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
 Side Slope Z-value= 2.0 ' / ' Top Width= 4.00'  
 Length= 233.0' Slope= 0.0097 ' / '  
 Inlet Invert= 245.54', Outlet Invert= 243.27'



**Reach 1R: DITCH**

Hydrograph



# 8464 POST-DEVELOPED MODEL

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 66

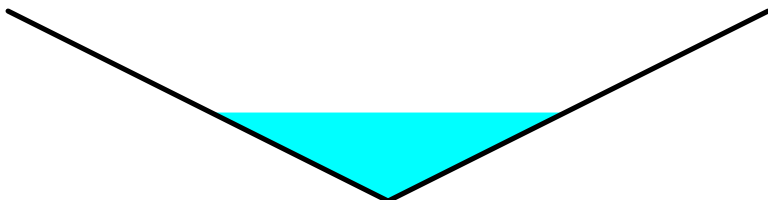
## Summary for Reach 2R: DITCH

Inflow Area = 15,626 sf, 100.00% Impervious, Inflow Depth > 3.66" for 25-Year event  
Inflow = 0.33 cfs @ 7.88 hrs, Volume= 4,765 cf  
Outflow = 0.32 cfs @ 7.95 hrs, Volume= 4,749 cf, Atten= 1%, Lag= 4.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Max. Velocity= 0.75 fps, Min. Travel Time= 5.2 min  
Avg. Velocity = 0.46 fps, Avg. Travel Time= 8.4 min

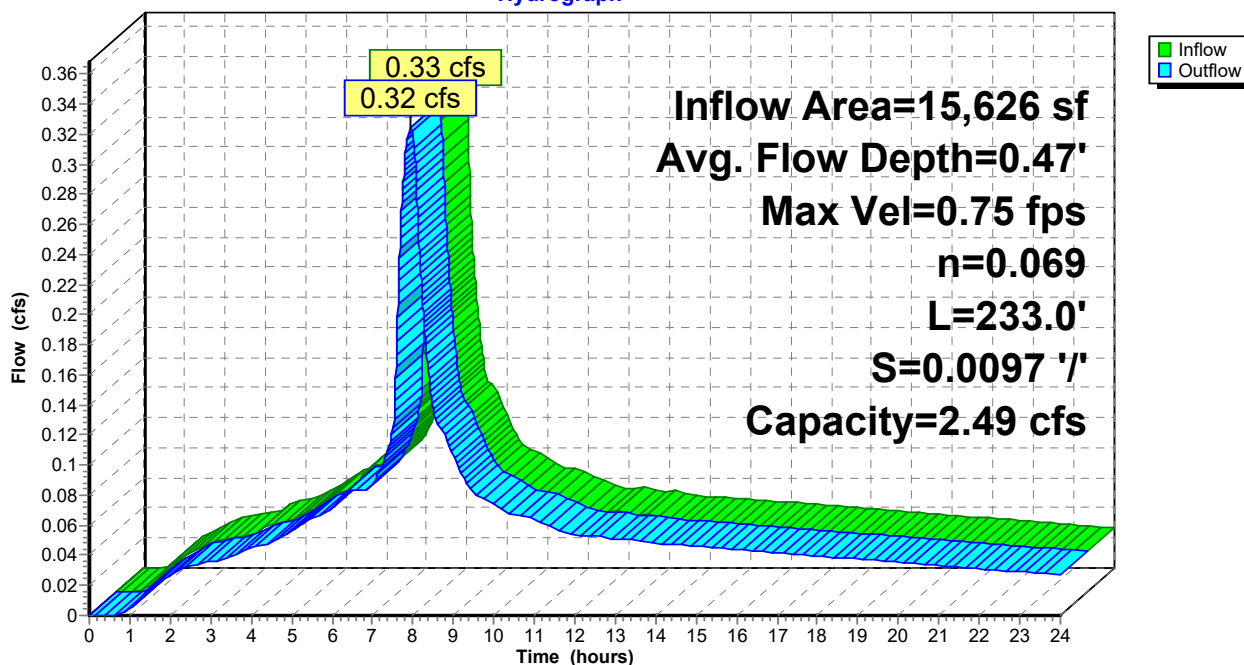
Peak Storage= 101 cf @ 7.95 hrs  
Average Depth at Peak Storage= 0.47'  
Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 2.49 cfs

0.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch  
Side Slope Z-value= 2.0 ' / ' Top Width= 4.00'  
Length= 233.0' Slope= 0.0097 ' / '  
Inlet Invert= 245.54', Outlet Invert= 243.27'



## Reach 2R: DITCH

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 67

**Summary for Reach 3R: 10" PVC**

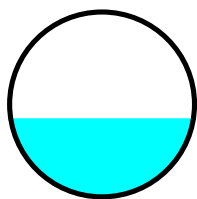
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =	119,678 sf, 100.00% Impervious,	Inflow Depth > 2.55"	for 25-Year event
Inflow =	1.16 cfs @ 8.38 hrs,	Volume=	25,422 cf
Outflow =	1.16 cfs @ 8.39 hrs,	Volume=	25,415 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Max. Velocity= 5.27 fps, Min. Travel Time= 0.3 min  
 Avg. Velocity = 3.26 fps, Avg. Travel Time= 0.4 min

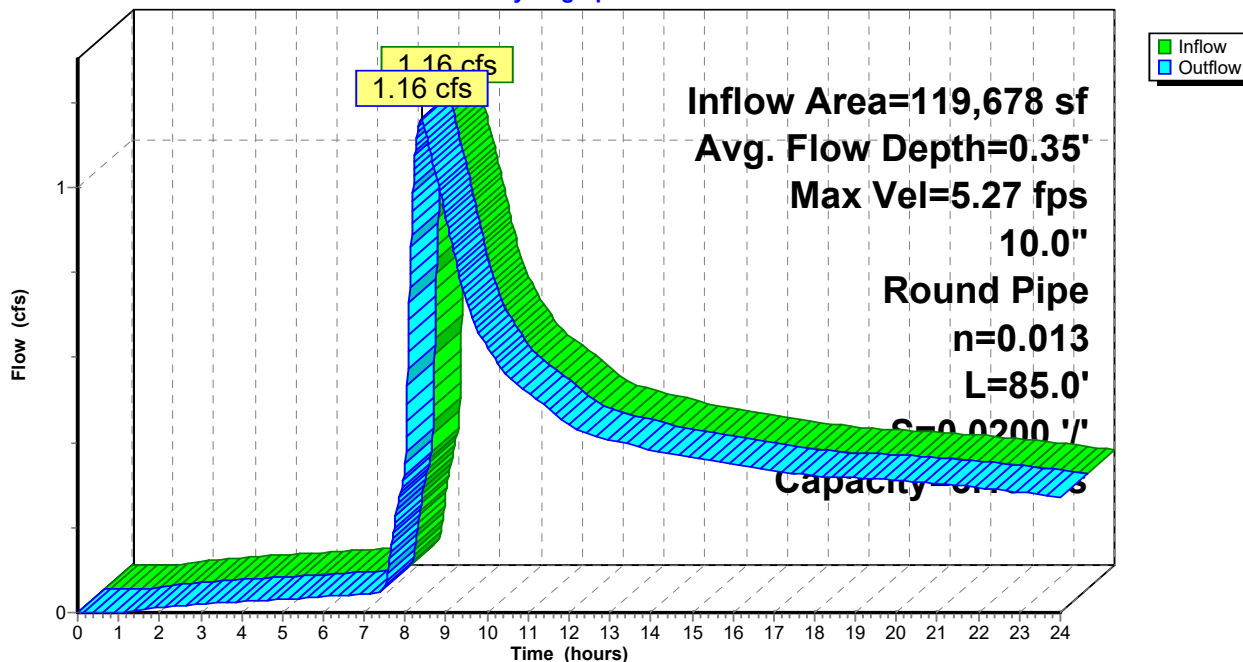
Peak Storage= 19 cf @ 8.39 hrs  
 Average Depth at Peak Storage= 0.35'  
 Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.10 cfs

10.0" Round Pipe  
 n= 0.013  
 Length= 85.0' Slope= 0.0200 '/'  
 Inlet Invert= 3.00', Outlet Invert= 1.30'



**Reach 3R: 10" PVC**

Hydrograph



**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 68

**Summary for Pond 1P: STORM FACILITY**

Inflow Area = 119,678 sf, 100.00% Impervious, Inflow Depth > 3.65" for 25-Year event  
 Inflow = 2.50 cfs @ 7.91 hrs, Volume= 36,430 cf  
 Outflow = 1.16 cfs @ 8.38 hrs, Volume= 25,422 cf, Atten= 54%, Lag= 28.1 min  
 Primary = 1.16 cfs @ 8.38 hrs, Volume= 25,422 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 8.80' @ 8.38 hrs Surf.Area= 4,986 sf Storage= 13,231 cf  
 Flood Elev= 10.00' Surf.Area= 6,063 sf Storage= 19,838 cf

Plug-Flow detention time= 367.3 min calculated for 25,422 cf (70% of inflow)  
 Center-of-Mass det. time= 180.1 min ( 841.7 - 661.6 )

Volume	Invert	Avail.Storage	Storage Description			
#1	5.00'	19,838 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
5.00	2,123	207.2	0	0	2,123	
6.00	2,787	235.3	2,447	2,447	3,137	
7.00	3,521	254.1	3,147	5,594	3,909	
8.00	4,312	273.0	3,910	9,504	4,744	
9.00	5,159	291.8	4,729	14,233	5,635	
10.00	6,063	310.7	5,605	19,838	6,590	

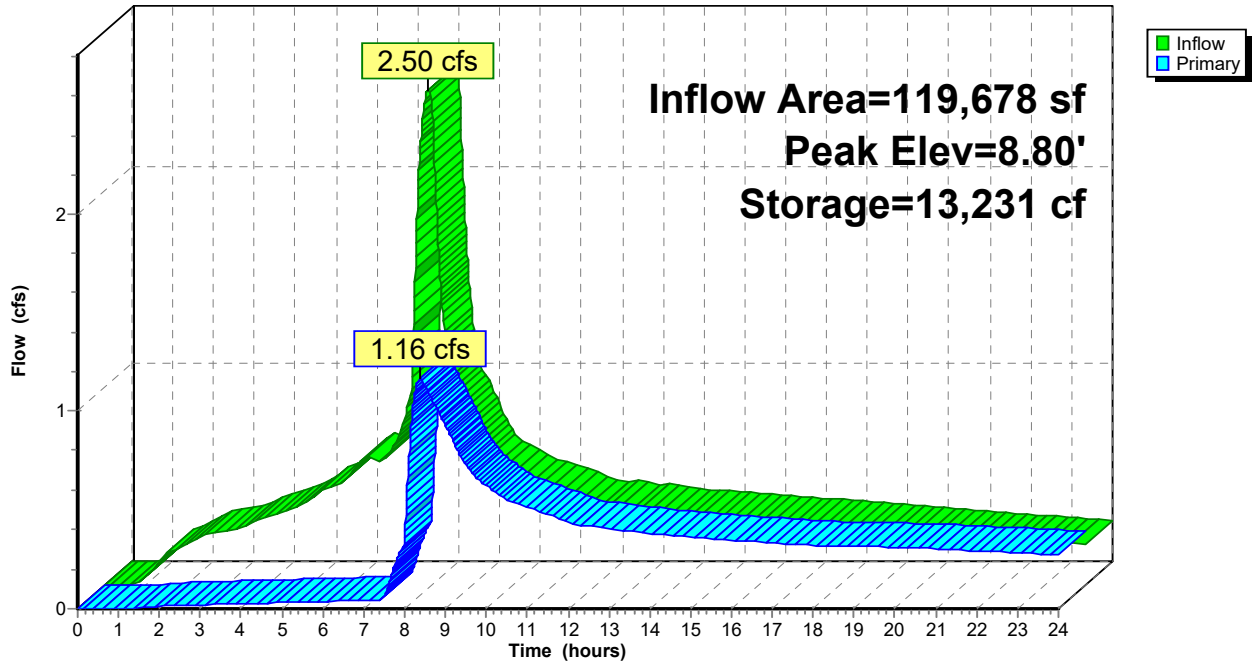
Device	Routing	Invert	Outlet Devices
#1	Primary	4.50'	<b>12.0" Round Culvert</b> L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 4.50' / 4.30' S= 0.0200 ' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	5.00'	<b>1.0" Vert. WQ Orifice</b> C= 0.620
#3	Device 1	7.75'	<b>3.5" Vert. Orifice/Grate</b> C= 0.620
#4	Device 1	8.55'	<b>2.2' long (Profile 17) Broad-Crested Rectangular Weir</b> Head (feet) 0.49 0.98 1.48 1.97 2.46 2.95 Coef. (English) 2.84 3.13 3.26 3.30 3.31 3.31

**Primary OutFlow** Max=1.16 cfs @ 8.38 hrs HW=8.80' TW=3.35' (Dynamic Tailwater)

- 1=Culvert (Passes 1.16 cfs of 7.37 cfs potential flow)
- 2=WQ Orifice (Orifice Controls 0.05 cfs @ 9.65 fps)
- 3=Orifice/Grate (Orifice Controls 0.32 cfs @ 4.74 fps)
- 4=Broad-Crested Rectangular Weir (Weir Controls 0.79 cfs @ 1.43 fps)

### Pond 1P: STORM FACILITY

Hydrograph



**Summary for Pond ST1: ST-740 CHAMBERS**

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 24,834 sf, 82.69% Impervious, Inflow Depth > 3.36" for 25-Year event  
 Inflow = 0.44 cfs @ 7.99 hrs, Volume= 6,946 cf  
 Outflow = 0.44 cfs @ 8.00 hrs, Volume= 6,943 cf, Atten= 0%, Lag= 0.5 min  
 Primary = 0.44 cfs @ 8.00 hrs, Volume= 6,943 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 4.31' @ 8.00 hrs Surf.Area= 196 sf Storage= 323 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 9.9 min ( 687.3 - 677.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	1.00'	151 cf	<b>11.00'W x 17.86'L x 3.50'H Field A</b> 687 cf Overall - 184 cf Embedded = 504 cf x 30.0% Voids
#2A	1.50'	184 cf	<b>ADS_StormTech SC-740 +Cap x 4 Inside #1</b> Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 2 Rows of 2 Chambers
		335 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.90'	<b>6.0" Round Culvert</b> L= 10.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.90' / 0.80' S= 0.0100 '/ Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Device 1	0.90'	<b>2.0" Horiz. Orifice</b> C= 0.620 Limited to weir flow at low heads
#3	Device 1	4.00'	<b>6.0" Vert. Overflow Outlet</b> C= 0.620

**Primary OutFlow** Max=0.44 cfs @ 8.00 hrs HW=4.31' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 0.44 cfs of 1.68 cfs potential flow)
- 2=Orifice (Orifice Controls 0.20 cfs @ 9.18 fps)
- 3=Overflow Outlet (Orifice Controls 0.24 cfs @ 1.94 fps)

**8464 POST-DEVELOPED MODEL**

Type IA 24-hr 25-Year Rainfall=3.90"

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Page 71

**Pond ST1: ST-740 CHAMBERS - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)**

Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +12.0" End Stone x 2 = 17.86' Base Length

2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width

6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

687.5 cf Field - 183.8 cf Chambers = 503.7 cf Stone x 30.0% Voids = 151.1 cf Stone Storage

Chamber Storage + Stone Storage = 334.9 cf = 0.008 af

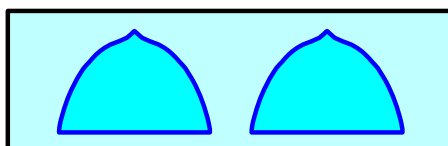
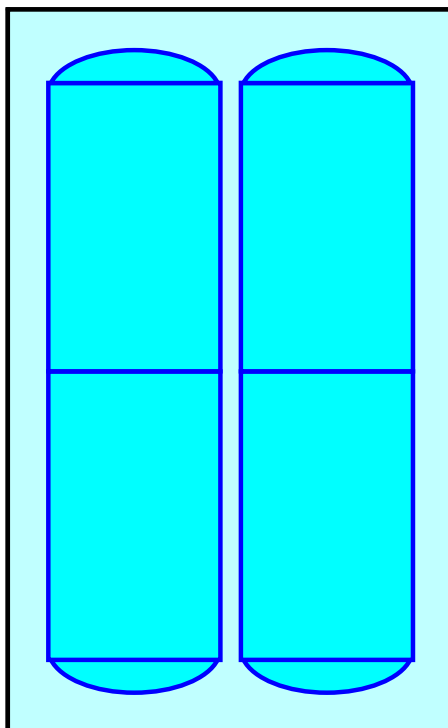
Overall Storage Efficiency = 48.7%

Overall System Size = 17.86' x 11.00' x 3.50'

4 Chambers

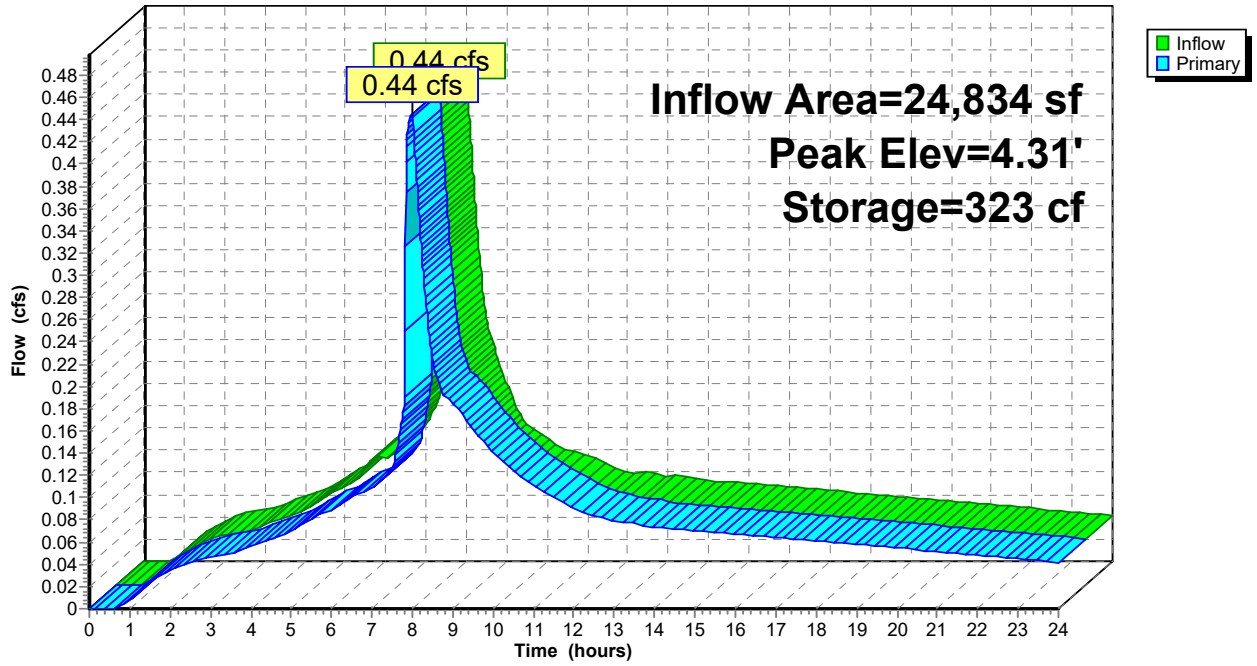
25.5 cy Field

18.7 cy Stone



Pond ST1: ST-740 CHAMBERS

Hydrograph





### Summary for Link 1L: TOTAL

Inflow Area = 184,257 sf, 77.29% Impervious, Inflow Depth > 2.55" for 25-Year event  
Inflow = 1.67 cfs @ 8.29 hrs, Volume= 39,143 cf  
Primary = 1.67 cfs @ 8.29 hrs, Volume= 39,143 cf, Atten= 0%, Lag= 0.0 min

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

### Link 1L: TOTAL

Hydrograph

