STORM DRAINAGE MANAGEMENT REPORT

REBARS AND MESH

111 AVCO ROAD

HAVERHILL, MASSACHUSETTS

AUGUST 28, 2016

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1.0 INTRODUCTION:

This report represents the hydraulic analysis for the proposed Industrial Building at 111 Avco Road in Haverhill, Massachusetts. The project will consist of the construction of a new 15,560 square foot Industrial Building, utilities and associated parking and loading facilities. The purpose of this analysis is to demonstrate that the proposed project will not cause any adverse impact on the downstream site in accordance with the Department of Environmental Protection Regulations under the two, ten, twenty five and one-hundred year storm events.

The project site does not contain land uses with higher potential pollutant loads. Currently all surface runoff generated sheet flows towards the eastern property line and the Merrimack River. All roof runoff will be collected and directed thru a downspout collection system and an infiltration basin to maximize groundwater recharge.

2.0 WATERSHED ANALYSIS AND METHODOLGY:

The storm run-off management systems were analyzed using a 2-year, 10-year, 25-year, 50-year and 100-year frequency storm event. The rainfall distribution used in this study is based on synthetic 24-hour storm events. The synthetic distribution was developed by the United States Department of Agriculture [USDA] Soil Conservation Service [SCS] for different geographical regions in the United States using National Weather Service [NWS] duration-frequency data or compiled local storm data. A NRCC distribution was used to simulate New England Rainfall.

Based upon the US Department of Commerce a 2-year frequency, 24-hour duration storm results in a precipitation of 3.13 inches, a 10-year frequency storm results in a precipitation of 4.68 inches, a 25-year frequency storm results in a precipitation of 5.88 inches, and a 100-year frequency storm results into a precipitation of 8.34 inches for the property location. The storm runoff produced was estimated using the Modified Soil Cover Complex Model.

The Analysis was performed using the HydroCAD Version 10.18 software. Using the USDA SCS method of estimated runoff, the program uses the measured hydraulic characteristics of drainage structures to predict hydrologic conditions in the various drainage areas of the site. The model computes runoff for the given rainfall events, produces runoffs hydrographs and routes the flow through the designated detention facilities to calculate one outflow hydrograph per drainage basin. The results generated by this analysis are used to evaluate the suitability of the proposed storm run-off management system.

The drainage areas boundaries are based upon a site survey and the proposed site plans for the project. Hydrologic soil groups and curve numbers [CN] were estimated using available soil information obtained from the NCRS Soil Maps. The soils are classified as sandy loam [NCRS Hydrologic Soil Group “B”]. The conservatively estimated infiltration rates were taken from Volume 3, Documenting Compliance with the Massachusetts Stormwater Management Standards, Table 2.3.3 Rawls Rates.

The attached analysis compares the area of the proposed building in the existing and post development condition. Currently the proposed building location is a very dense gravel which is used for the outdoor storage of steel reinforcing materials. We have assumed a CN number of 96 [HSG “B”] for the existing condition. When compared with the runoff generated by the new building roof [CN=98] the additional runoff generated is small as demonstrated in this analysis. We have designed a roof collection system consisting of 18” perforated HDPE pipe encased in washed stone and filter fabric to infiltrate the roof runoff. Any additional runoff is then routed thru an infiltration basin before a spillway directs the water towards the wetland consistent with its current flow path. These systems reduce the runoff rate and volume below the existing condition. Additionally, the basin provides ability to capture sediment from the gravel yard area prior to runoff heading towards the wetland.

3.0 WATERSHED ANALYSIS: PRE-DEVELOPMENT

We have analyzed one design point for the property. This area has been identified as Design Point 1. Runoff hydrographs were developed for the design point using HydroCAD Version 10.0 for the 2-year, 10-year, 25-year, and 100-year, 24 hour duration frequencies using a Type III rainfall distribution. Analysis of the runoff hydrographs produced the following existing peak site discharges off-site:

Table 1: Pre-Development

STORM EVENT	PEAK RUNOFF RATE [CFS]	RUN-OFF VOLUMES [ACRE-FEET]
2 YEAR EVENT	1.00 cfs	0.076 acre-feet
10 YEAR EVENT	1.53 cfs	0.119 acre feet
25 YEAR EVENT	1.93 cfs	0.153 acre feet
100 YEAR EVENT	2.76 cfs	0.221 acre feet

4.0 WATERSHED ANALYSIS: POST-DEVELOPMENT

The proposed development will consist of new roof and paved areas. Based upon the available soil data, the onsite soils are loamy sands [NRCS Hydrologic Soil Group A] therefore a conservative infiltration rate of 2.41 in/hour was utilized in this analysis. The Infiltration Basins have been designed to store and recharge the run-off generated by the building roofs. The basins will store and recharge the stormwater runoff up to and including the 2 year storm event. An emergency overflow spillway will be constructed to direct runoff consistent with the existing drainage pattern.

Run-off hydrographs were developed for the proposed development using the HydroCAD software for the 2-year, 10-year, 25-year, and 100-year, 24-hour duration frequencies using a Type III rainfall distribution. Analysis of the proposed development produced the following peak flow rates:

Table 2: Post-Development

STORM EVENT	PEAK RUNOFF RATE [CFS]	RUN-OFF VOLUMES [ACRE-FEET]
2 YEAR EVENT	0.07 cfs	0.004 acre-feet
10 YEAR EVENT	1.22 cfs	.036 acre feet
25 YEAR EVENT	1.87 cfs	0.063 acre feet
100 YEAR EVENT	2.68 cfs	0.121 acre feet

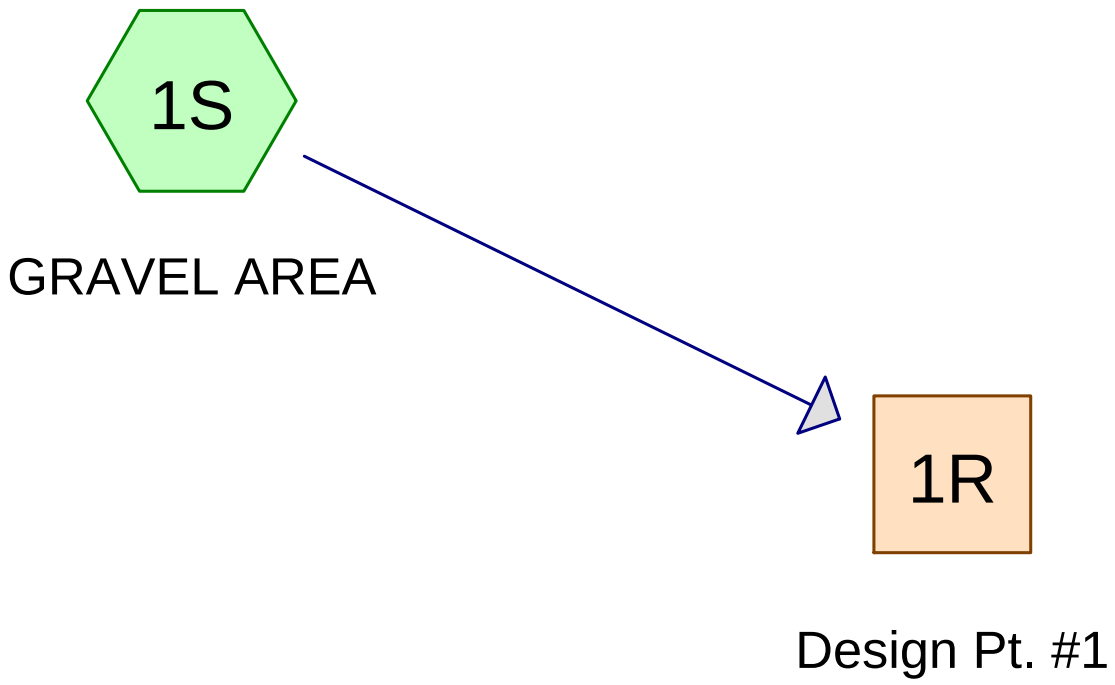
5.0 SUMMARY:

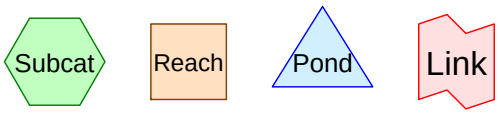
The peak flow rates in this study have been conservatively estimated for both the pre-development and post-development conditions. The peak run-off rates of post-development rates were compared with the corresponding rates of run-off for the pre-development rates.

The analysis summarized by the above tables demonstrate that during the rainfall events analyzed, there will be no increase in the peak run-off rate and run-off volume as a result of the proposed development. There will be reduction in peak run-off and volume as result of this project. The proposed drainage system will use groundwater recharge principles through the infiltration basins.

The proposed drainage system improvements meet or exceed the regulations and standards of the latest Massachusetts Department of Environmental Protection Stormwater Management Policy.

PRE-DEVELOPMENT ANALYSIS





Routing Diagram for Rebars Bldg PRE
Prepared by Microsoft, Printed 8/28/2016
HydroCAD® 10.00-18 s/n 05084 © 2016 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.357	96	Gravel surface, HSG A (1S)
0.357	**96**	**TOTAL AREA**

Summary for Subcatchment 1S: GRAVEL AREA

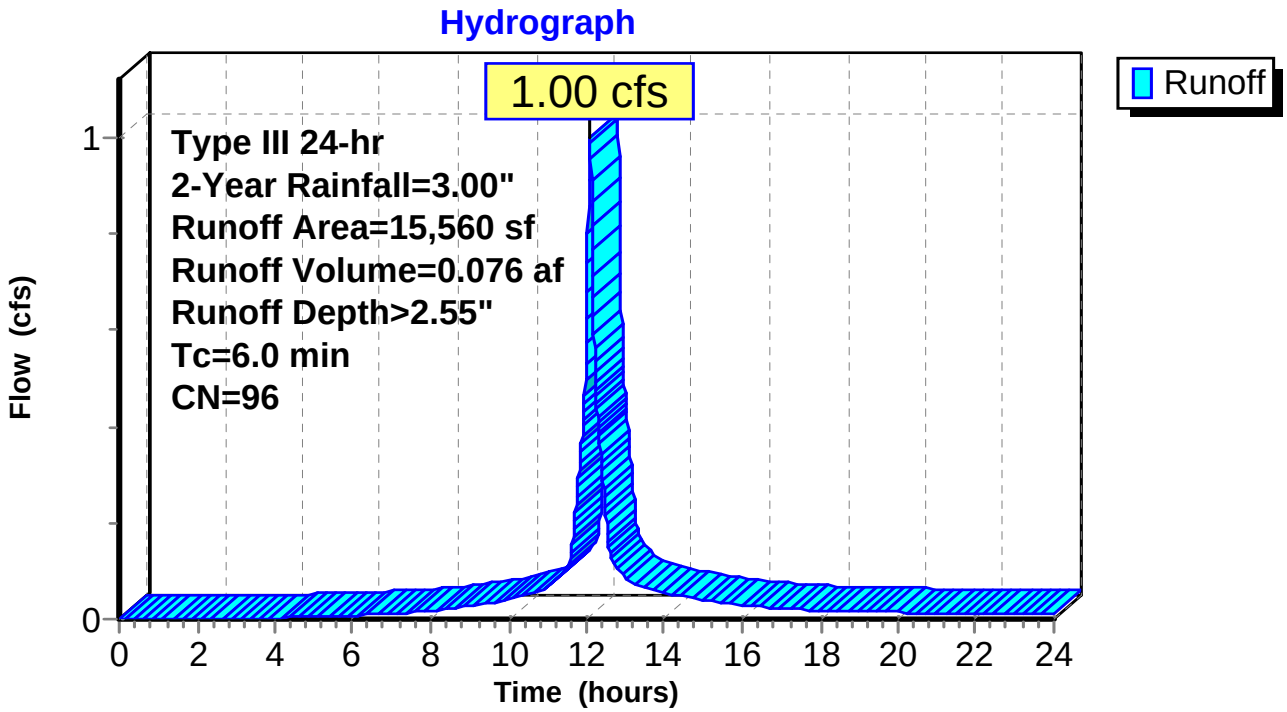
Runoff = 1.00 cfs @ 12.08 hrs, Volume= 0.076 af, Depth> 2.55"

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-Year Rainfall=3.00"

Area (sf)	CN	Description
15,560	96	Gravel surface, HSG A
15,560		100.00% Pervious Area

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

Subcatchment 1S: GRAVEL AREA

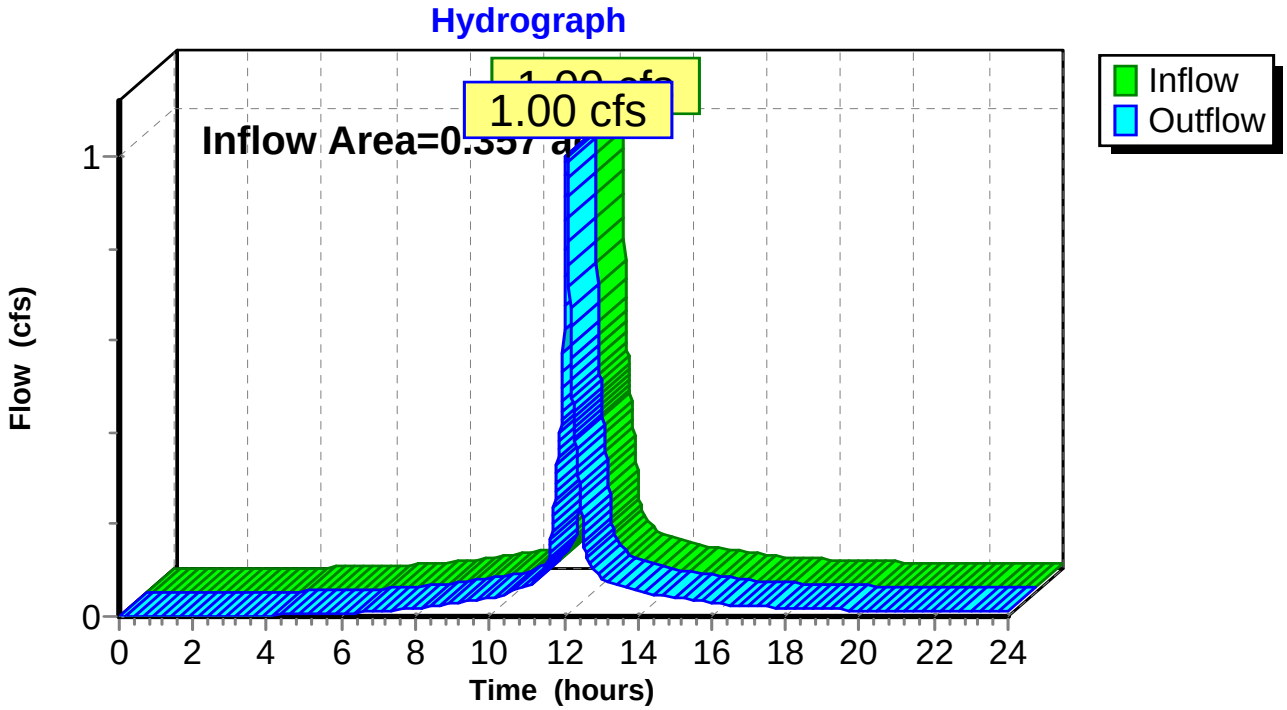


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac, 0.00% Impervious, Inflow Depth > 2.55" for 2-Year event
Inflow = 1.00 cfs @ 12.08 hrs, Volume= 0.076 af
Outflow = 1.00 cfs @ 12.08 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Subcatchment 1S: GRAVEL AREA

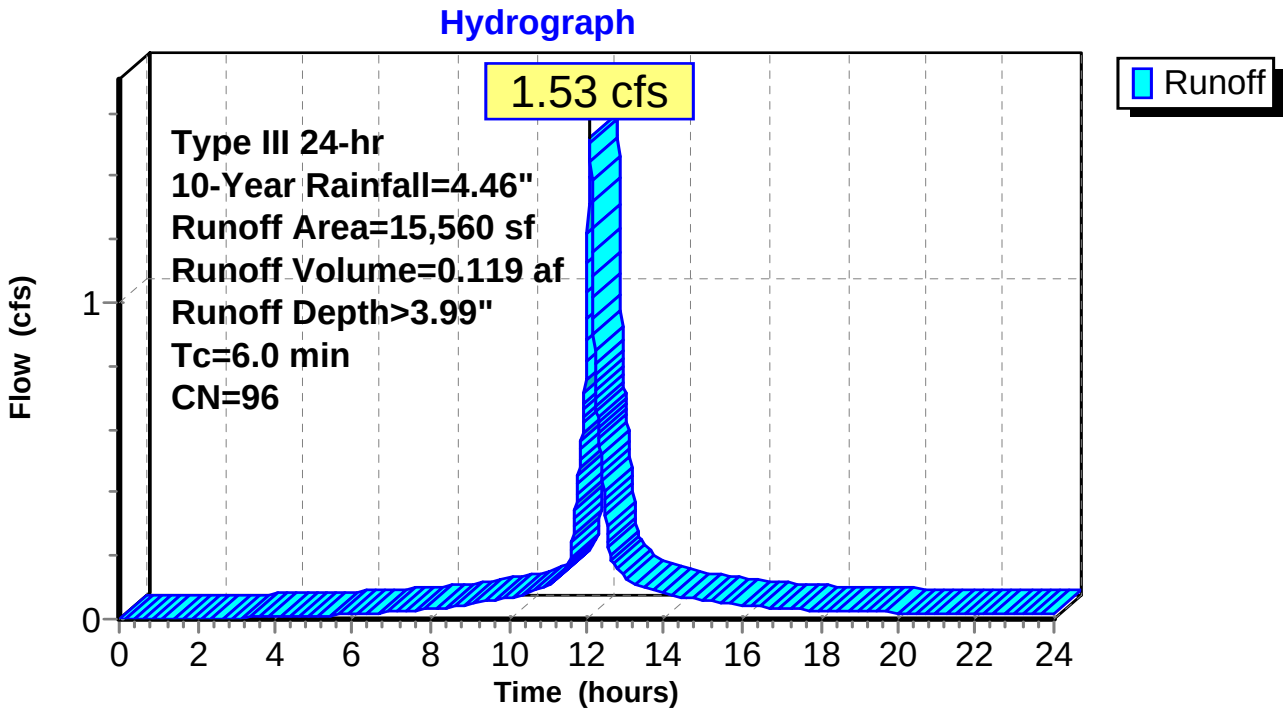
Runoff = 1.53 cfs @ 12.08 hrs, Volume= 0.119 af, Depth> 3.99"

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-Year Rainfall=4.46"

Area (sf)	CN	Description
15,560	96	Gravel surface, HSG A
15,560		100.00% Pervious Area

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

Subcatchment 1S: GRAVEL AREA

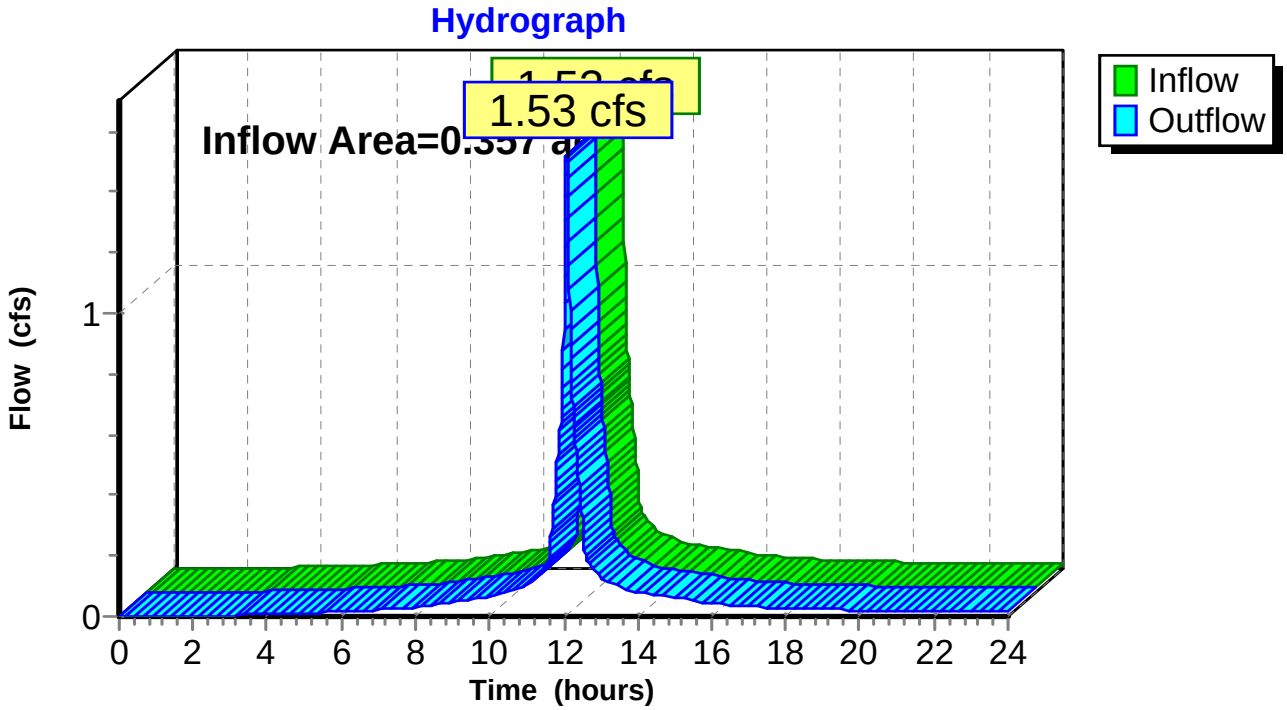


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac, 0.00% Impervious, Inflow Depth > 3.99" for 10-Year event
Inflow = 1.53 cfs @ 12.08 hrs, Volume= 0.119 af
Outflow = 1.53 cfs @ 12.08 hrs, Volume= 0.119 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Subcatchment 1S: GRAVEL AREA

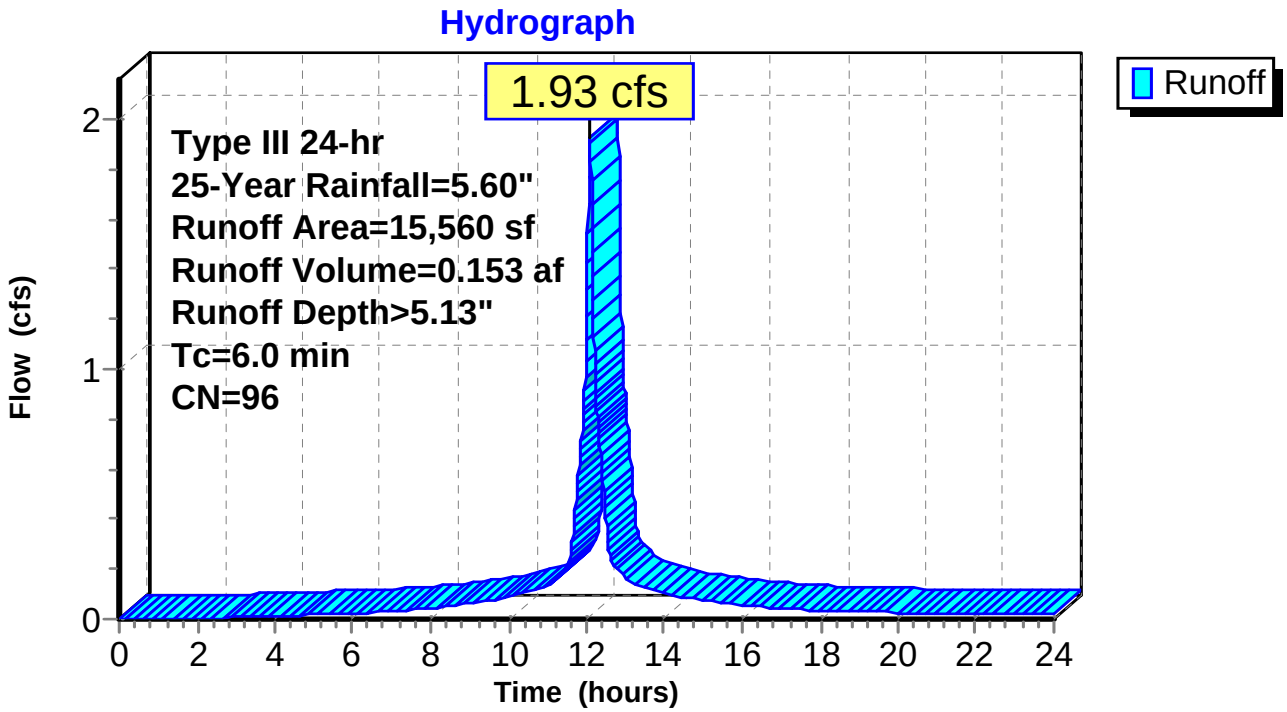
Runoff = 1.93 cfs @ 12.08 hrs, Volume= 0.153 af, Depth> 5.13"

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 25-Year Rainfall=5.60"

Area (sf)	CN	Description
15,560	96	Gravel surface, HSG A
15,560		100.00% Pervious Area

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

Subcatchment 1S: GRAVEL AREA

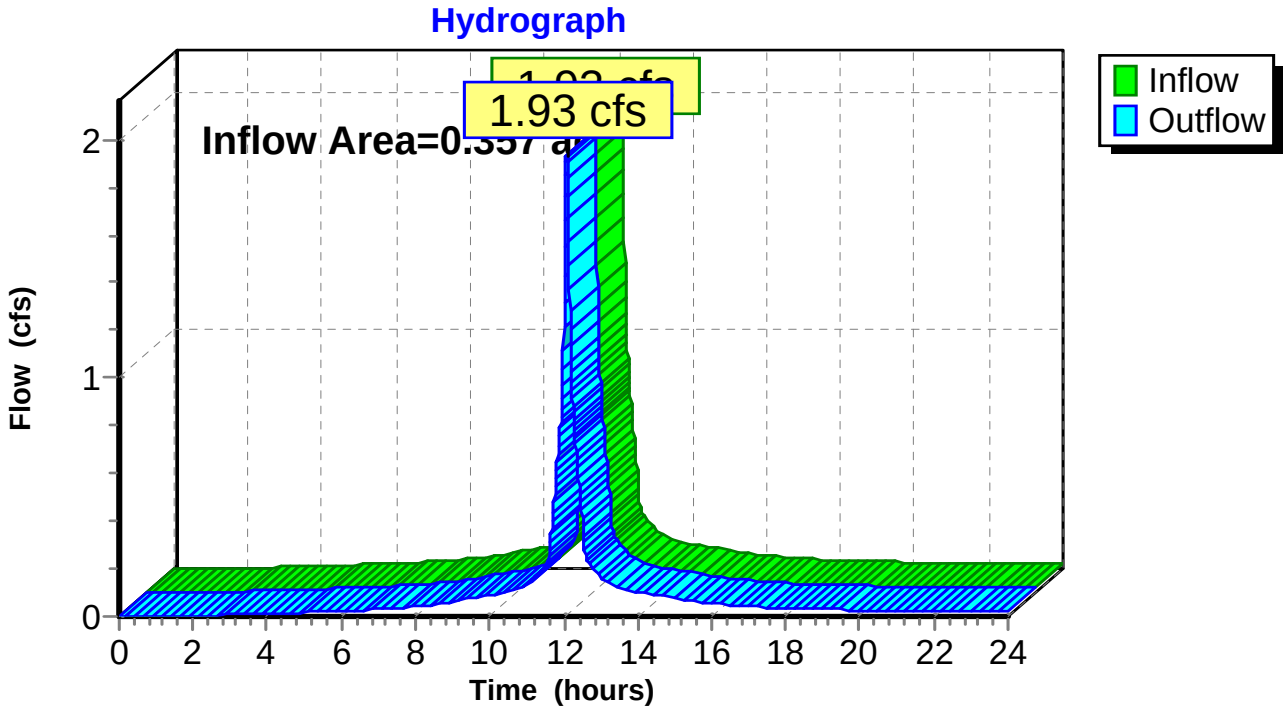


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac, 0.00% Impervious, Inflow Depth > 5.13" for 25-Year event
Inflow = 1.93 cfs @ 12.08 hrs, Volume= 0.153 af
Outflow = 1.93 cfs @ 12.08 hrs, Volume= 0.153 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Subcatchment 1S: GRAVEL AREA

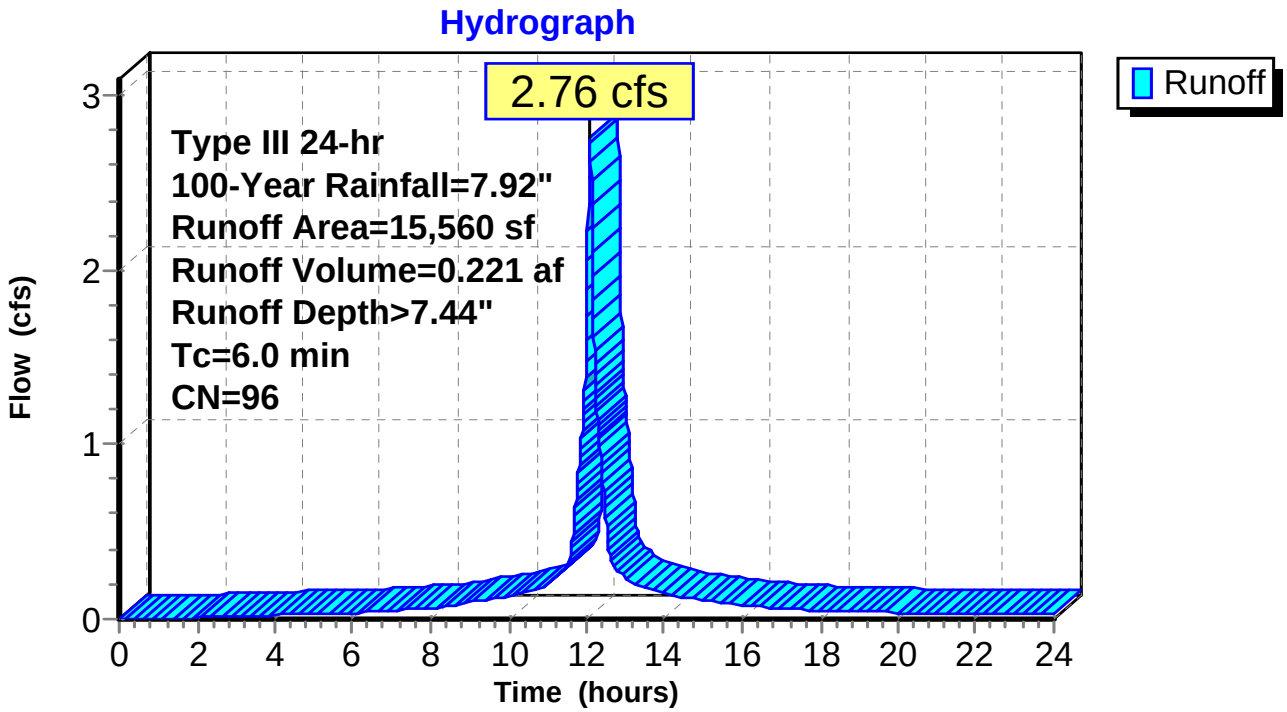
Runoff = 2.76 cfs @ 12.08 hrs, Volume= 0.221 af, Depth> 7.44"

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-Year Rainfall=7.92"

Area (sf)	CN	Description
15,560	96	Gravel surface, HSG A
15,560		100.00% Pervious Area

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

Subcatchment 1S: GRAVEL AREA

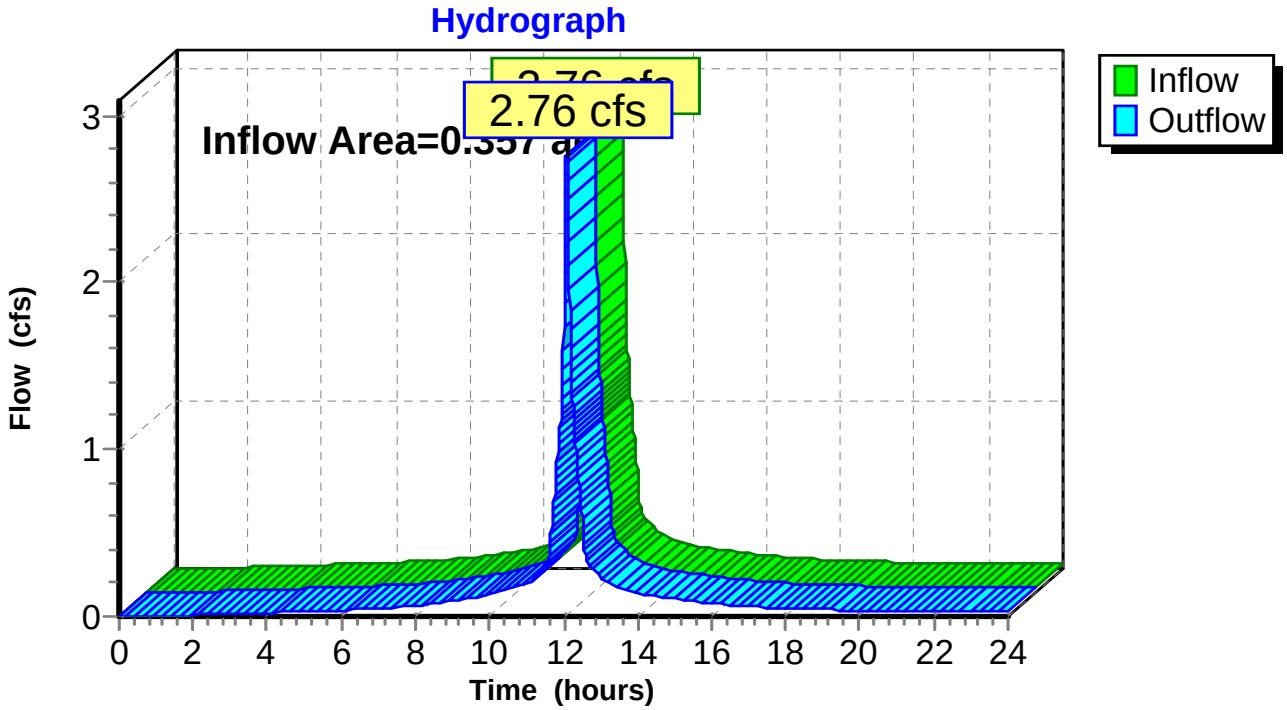


Summary for Reach 1R: Design Pt. #1

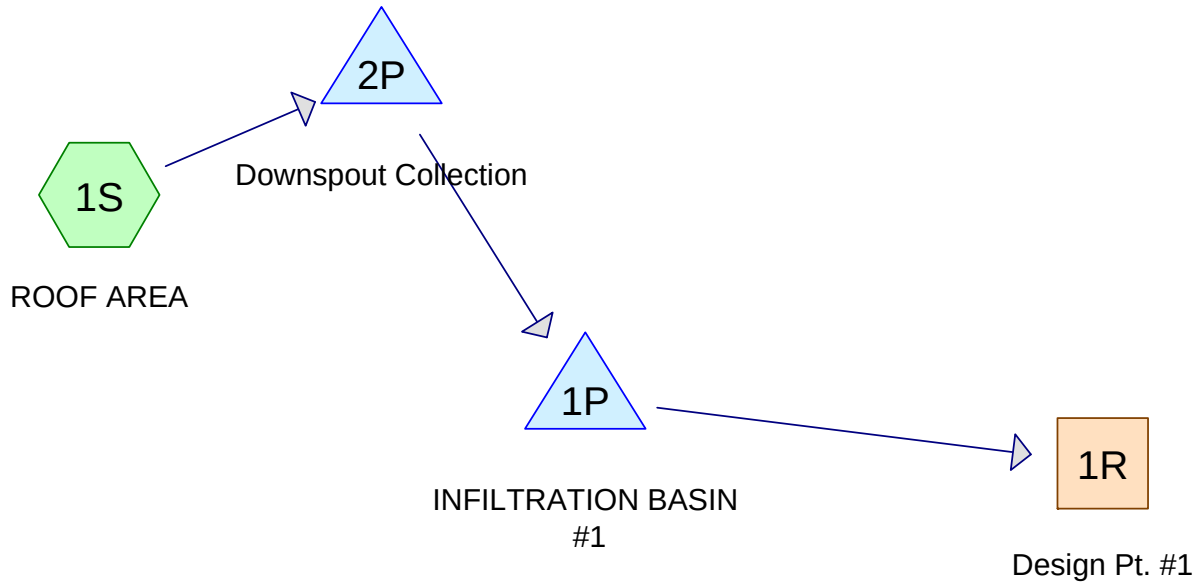
Inflow Area = 0.357 ac, 0.00% Impervious, Inflow Depth > 7.44" for 100-Year event
Inflow = 2.76 cfs @ 12.08 hrs, Volume= 0.221 af
Outflow = 2.76 cfs @ 12.08 hrs, Volume= 0.221 af, Atten= 0%, Lag= 0.0 min

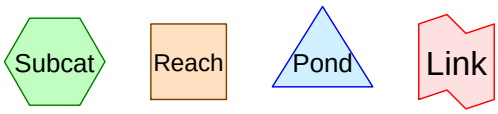
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



POST-DEVELOPMENT ANALYSIS





Routing Diagram for Rebars Bldg Post
Prepared by Microsoft, Printed 8/28/2016
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.357	98	Roofs, HSG B (1S)
0.357	**98**	**TOTAL AREA**

Summary for Subcatchment 1S: ROOF AREA

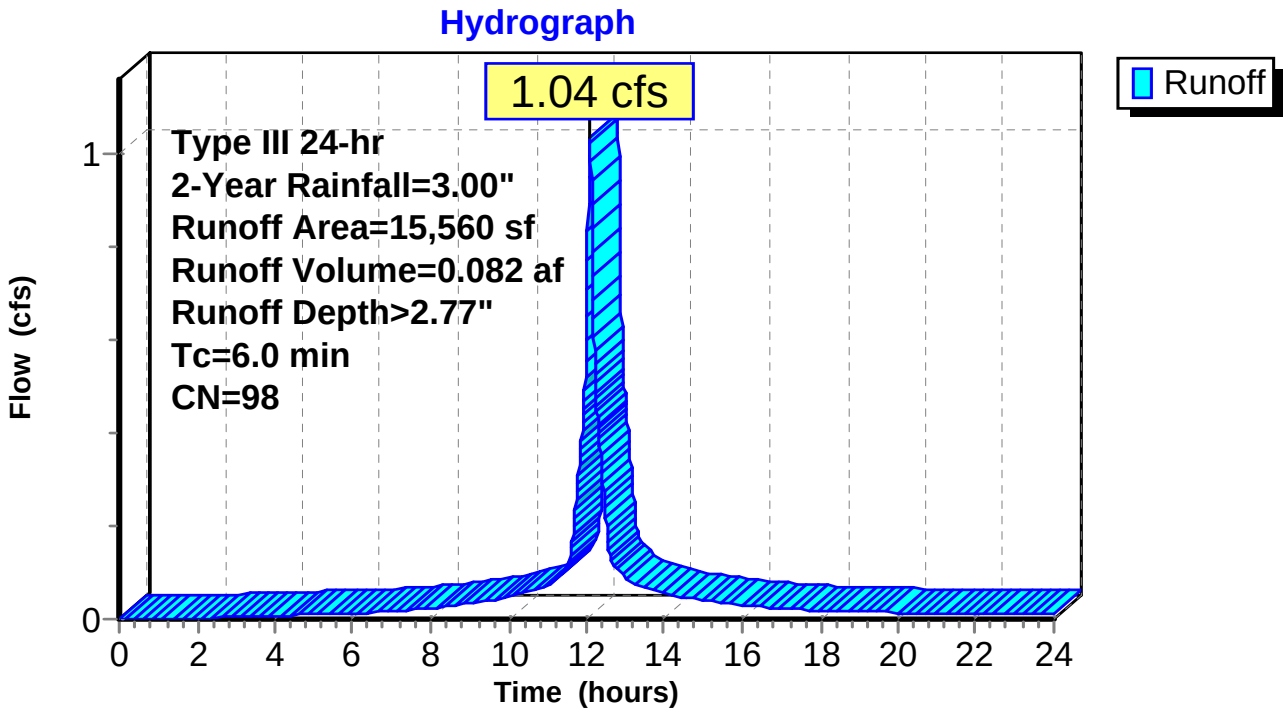
Runoff = 1.04 cfs @ 12.08 hrs, Volume= 0.082 af, Depth> 2.77"

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-Year Rainfall=3.00"

Area (sf)	CN	Description
15,560	98	Roofs, HSG B
15,560		100.00% Impervious Area

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

Subcatchment 1S: ROOF AREA

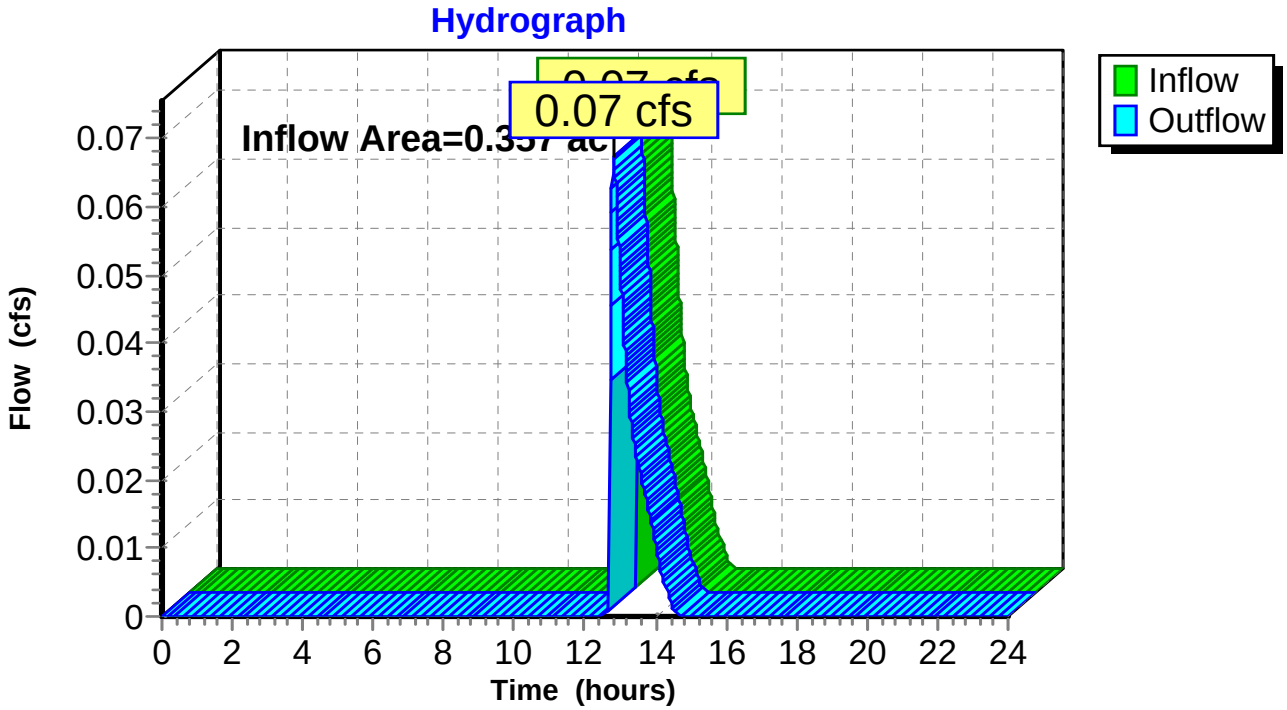


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac,100.00% Impervious, Inflow Depth = 0.12" for 2-Year event
Inflow = 0.07 cfs @ 12.81 hrs, Volume= 0.004 af
Outflow = 0.07 cfs @ 12.81 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Pond 1P: INFILTRATION BASIN #1

Inflow Area =	0.357 ac,100.00% Impervious, Inflow Depth = 1.42" for 2-Year event				
Inflow =	0.98 cfs @	12.10 hrs,	Volume=	0.042 af	
Outflow =	0.09 cfs @	12.81 hrs,	Volume=	0.025 af,	Atten= 91%, Lag= 42.3 min
Discarded =	0.02 cfs @	12.81 hrs,	Volume=	0.021 af	
Primary =	0.07 cfs @	12.81 hrs,	Volume=	0.004 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 93.51' @ 12.81 hrs Surf.Area= 972 sf Storage= 1,376 cf

Plug-Flow detention time= 297.1 min calculated for 0.025 af (59% of inflow)
Center-of-Mass det. time= 268.2 min (1,021.3 - 753.1)

Volume	Invert	Avail.Storage	Storage Description
#1	91.00'	1,898 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

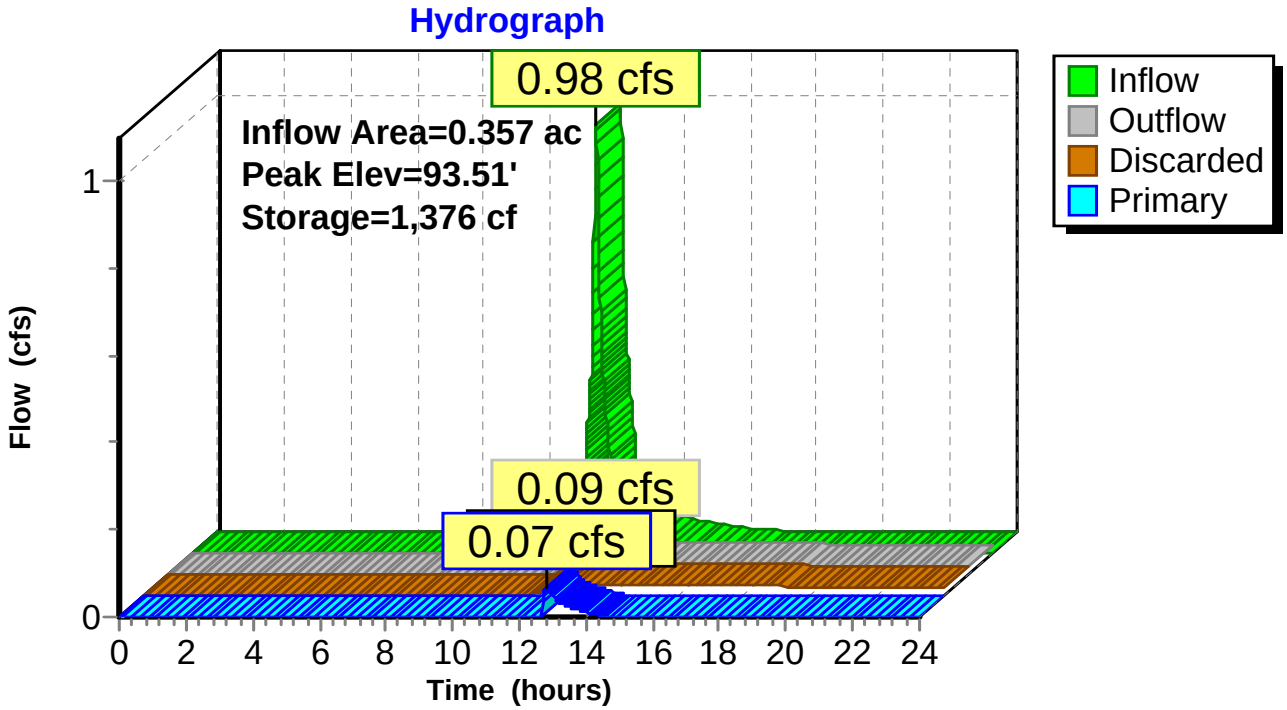
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.00	220	0	0
92.00	425	323	323
94.00	1,150	1,575	1,898

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.00'	**1.070 in/hr Exfiltration over Surface area**
#2	Primary	93.50'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 12.81 hrs HW=93.51' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.04 cfs @ 12.81 hrs HW=93.51' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.04 cfs @ 0.25 fps)

Pond 1P: INFILTRATION BASIN #1



Summary for Pond 2P: Downspout Collection

Inflow Area =	0.357 ac,100.00% Impervious, Inflow Depth > 2.77" for 2-Year event				
Inflow =	1.04 cfs @	12.08 hrs,	Volume=	0.082 af	
Outflow =	1.01 cfs @	12.10 hrs,	Volume=	0.076 af,	Atten= 3%, Lag= 1.3 min
Discarded =	0.03 cfs @	12.10 hrs,	Volume=	0.034 af	
Primary =	0.98 cfs @	12.10 hrs,	Volume=	0.042 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 93.95' @ 12.10 hrs Surf.Area= 480 sf Storage= 647 cf

Plug-Flow detention time= 98.0 min calculated for 0.076 af (92% of inflow)
Center-of-Mass det. time= 57.2 min (814.5 - 757.2)

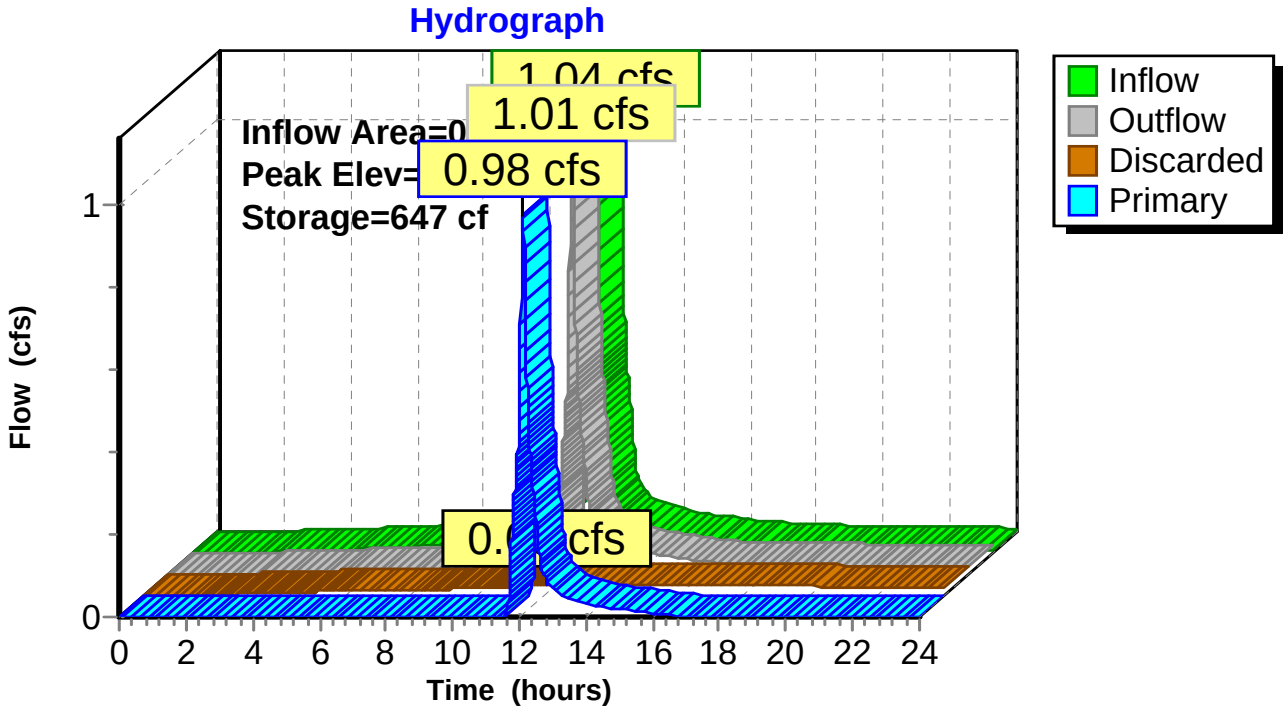
Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	392 cf	**3.00'W x 160.00'L x 3.00'H Prismatoid** 1,440 cf Overall - 459 cf Embedded = 981 cf x 40.0% Voids
#2	92.50'	459 cf	**18.0" Round Pipe Storage** Inside #1 L= 260.0'
		852 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.070 in/hr Exfiltration over Wetted area**
#2	Primary	93.50'	**12.0" Round Culvert** L= 15.0' Ke= 0.200 Inlet / Outlet Invert= 93.50' / 93.00' S= 0.0333 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=93.95' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.98 cfs @ 12.10 hrs HW=93.95' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.98 cfs @ 2.85 fps)

Pond 2P: Downspout Collection



Summary for Subcatchment 1S: ROOF AREA

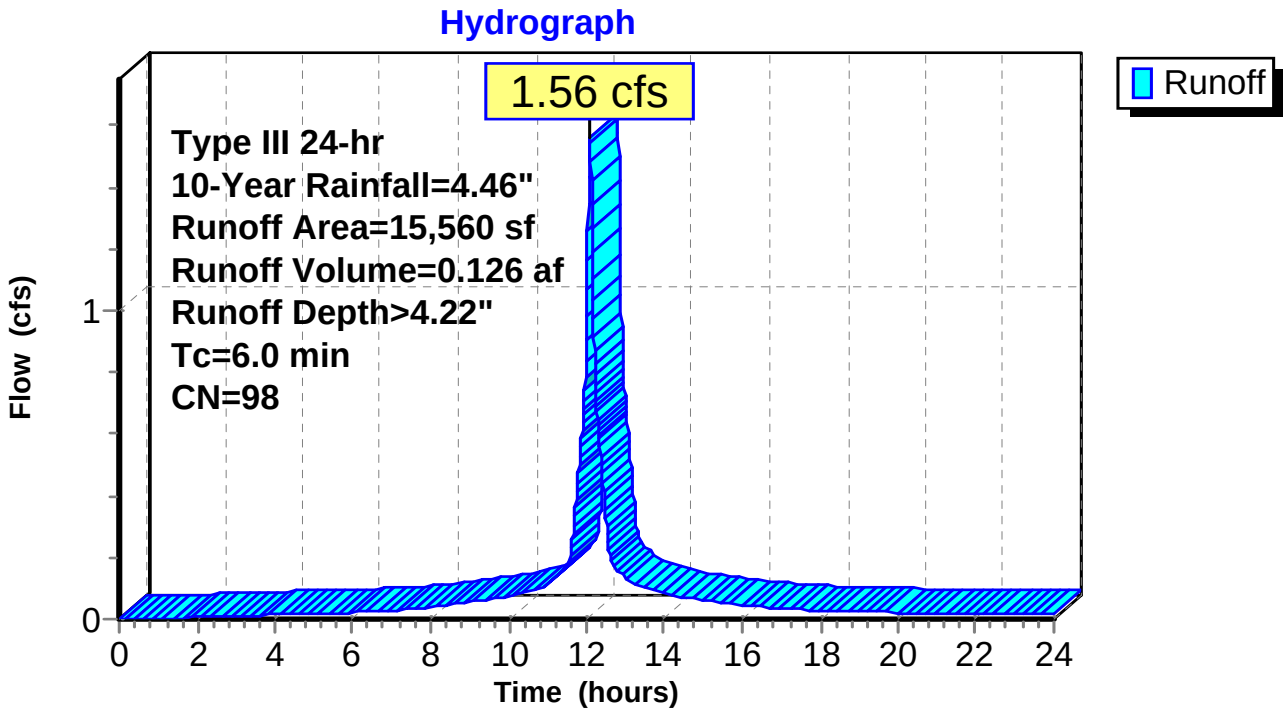
Runoff = 1.56 cfs @ 12.08 hrs, Volume= 0.126 af, Depth> 4.22"

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-Year Rainfall=4.46"

Area (sf)	CN	Description
15,560	98	Roofs, HSG B
15,560		100.00% Impervious Area

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

Subcatchment 1S: ROOF AREA

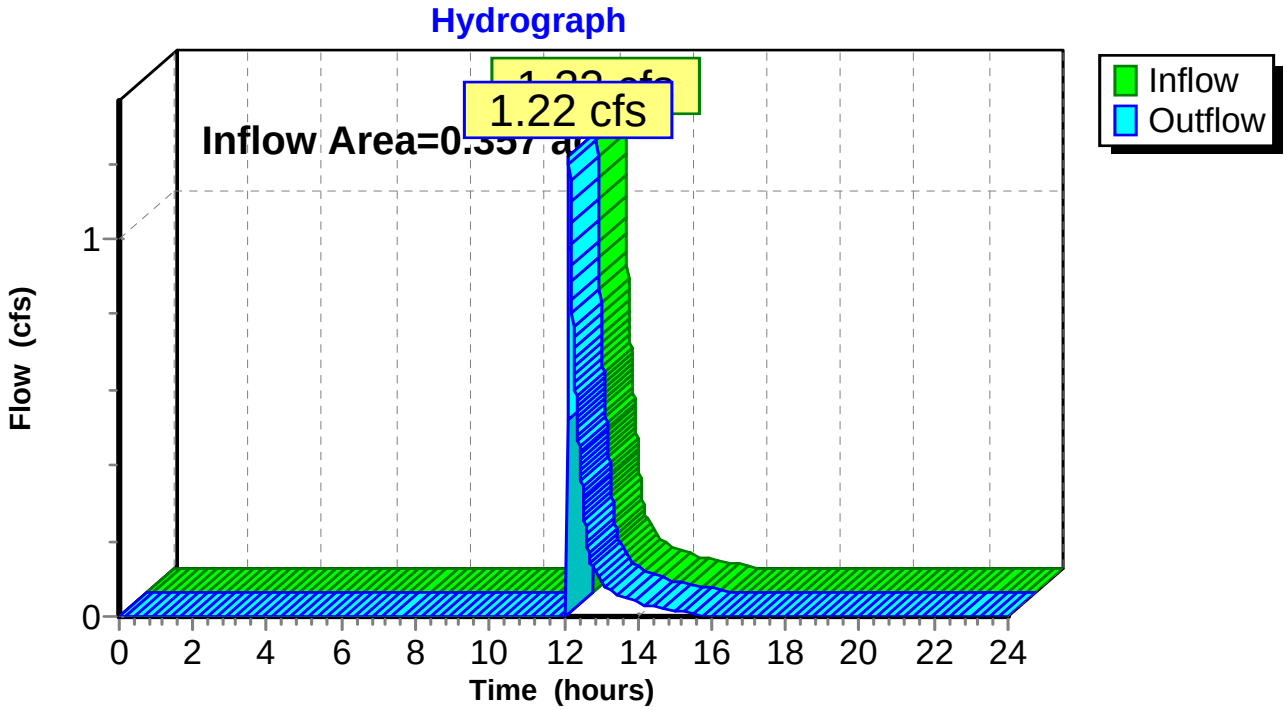


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac,100.00% Impervious, Inflow Depth = 1.22" for 10-Year event
Inflow = 1.22 cfs @ 12.15 hrs, Volume= 0.036 af
Outflow = 1.22 cfs @ 12.15 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Pond 1P: INFILTRATION BASIN #1

Inflow Area =	0.357 ac,100.00% Impervious, Inflow Depth = 2.65" for 10-Year event				
Inflow =	1.51 cfs @	12.10 hrs,	Volume=	0.079 af	
Outflow =	1.25 cfs @	12.15 hrs,	Volume=	0.060 af,	Atten= 18%, Lag= 3.4 min
Discarded =	0.02 cfs @	12.15 hrs,	Volume=	0.023 af	
Primary =	1.22 cfs @	12.15 hrs,	Volume=	0.036 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 93.58' @ 12.15 hrs Surf.Area= 998 sf Storage= 1,447 cf

Plug-Flow detention time= 152.4 min calculated for 0.060 af (76% of inflow)
Center-of-Mass det. time= 120.0 min (872.6 - 752.6)

Volume	Invert	Avail.Storage	Storage Description
#1	91.00'	1,898 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

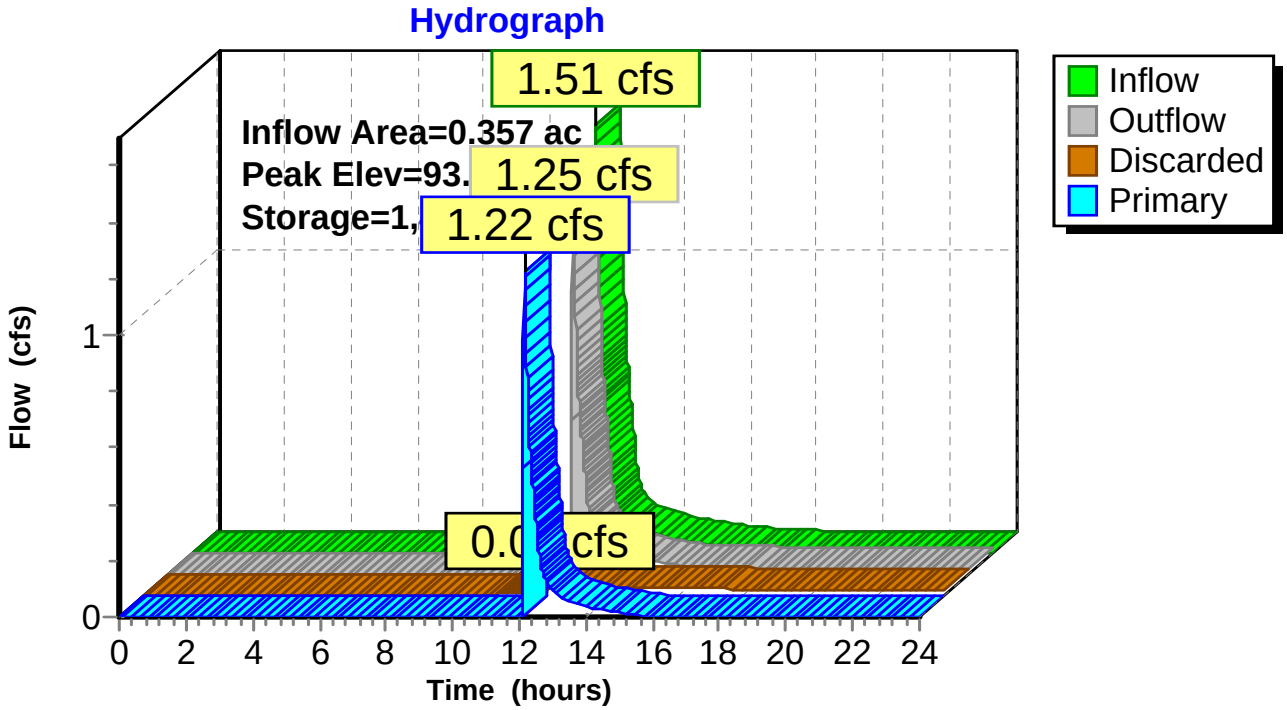
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.00	220	0	0
92.00	425	323	323
94.00	1,150	1,575	1,898

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.00'	**1.070 in/hr Exfiltration over Surface area**
#2	Primary	93.50'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 12.15 hrs HW=93.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.21 cfs @ 12.15 hrs HW=93.58' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.21 cfs @ 0.76 fps)

Pond 1P: INFILTRATION BASIN #1



Summary for Pond 2P: Downspout Collection

Inflow Area =	0.357 ac,100.00% Impervious, Inflow Depth > 4.22" for 10-Year event				
Inflow =	1.56 cfs @	12.08 hrs,	Volume=	0.126 af	
Outflow =	1.54 cfs @	12.10 hrs,	Volume=	0.117 af,	Atten= 1%, Lag= 0.7 min
Discarded =	0.03 cfs @	12.10 hrs,	Volume=	0.038 af	
Primary =	1.51 cfs @	12.10 hrs,	Volume=	0.079 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 94.08' @ 12.10 hrs Surf.Area= 480 sf Storage= 674 cf

Plug-Flow detention time= 75.8 min calculated for 0.117 af (93% of inflow)
Center-of-Mass det. time= 36.7 min (786.1 - 749.4)

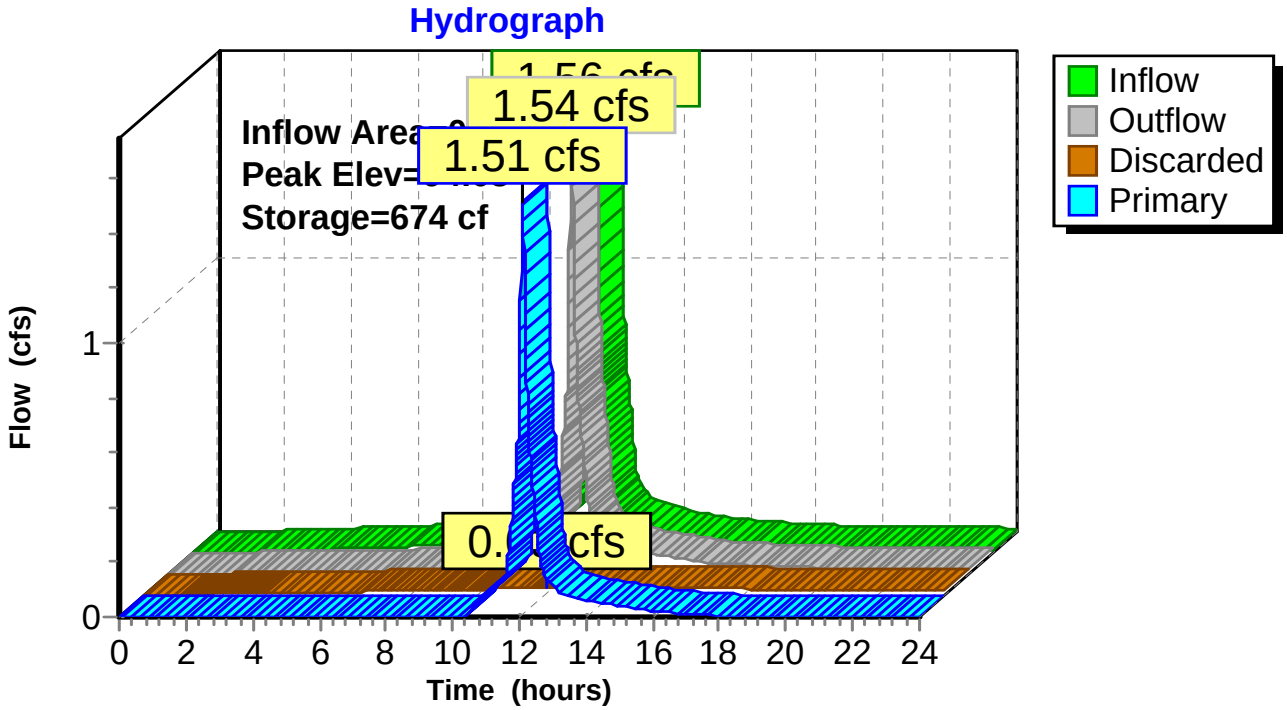
Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	392 cf	**3.00'W x 160.00'L x 3.00'H Prismatoid** 1,440 cf Overall - 459 cf Embedded = 981 cf x 40.0% Voids
#2	92.50'	459 cf	**18.0" Round Pipe Storage** Inside #1 L= 260.0'
		852 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.070 in/hr Exfiltration over Wetted area**
#2	Primary	93.50'	**12.0" Round Culvert** L= 15.0' Ke= 0.200 Inlet / Outlet Invert= 93.50' / 93.00' S= 0.0333 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=94.07' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.51 cfs @ 12.10 hrs HW=94.07' (Free Discharge)
└─**2=Culvert** (Inlet Controls 1.51 cfs @ 3.23 fps)

Pond 2P: Downspout Collection



Summary for Subcatchment 1S: ROOF AREA

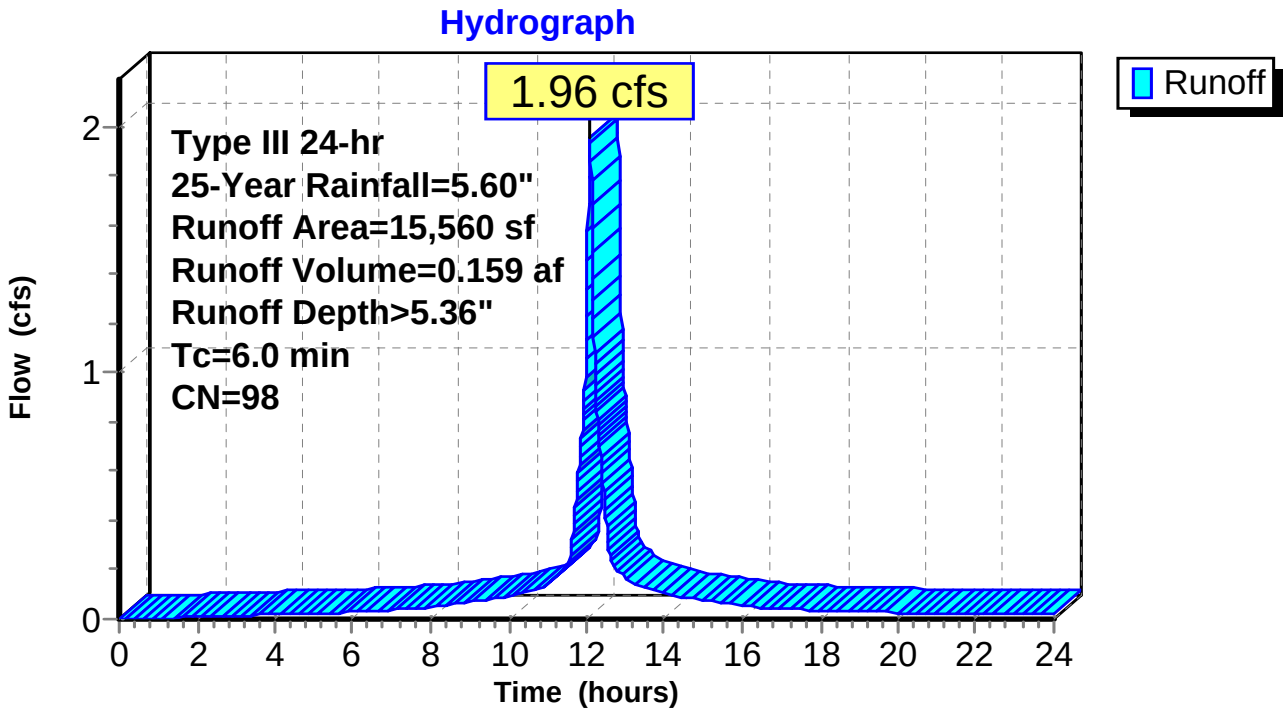
Runoff = 1.96 cfs @ 12.08 hrs, Volume= 0.159 af, Depth> 5.36"

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 25-Year Rainfall=5.60"

Area (sf)	CN	Description
15,560	98	Roofs, HSG B
15,560		100.00% Impervious Area

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

Subcatchment 1S: ROOF AREA

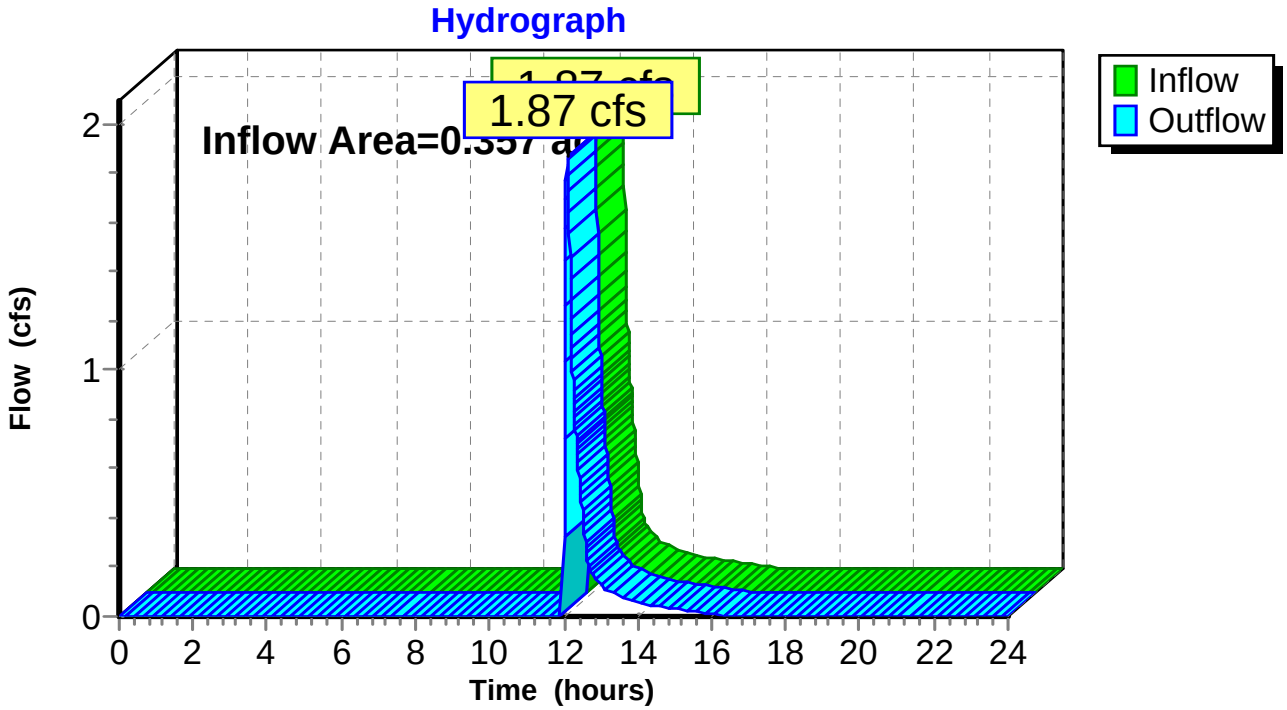


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac,100.00% Impervious, Inflow Depth = 2.13" for 25-Year event
Inflow = 1.87 cfs @ 12.11 hrs, Volume= 0.063 af
Outflow = 1.87 cfs @ 12.11 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Pond 1P: INFILTRATION BASIN #1

Inflow Area =	0.357 ac,100.00% Impervious, Inflow Depth = 3.68" for 25-Year event				
Inflow =	1.91 cfs @	12.09 hrs,	Volume=	0.109 af	
Outflow =	1.89 cfs @	12.11 hrs,	Volume=	0.088 af,	Atten= 1%, Lag= 0.7 min
Discarded =	0.02 cfs @	12.11 hrs,	Volume=	0.025 af	
Primary =	1.87 cfs @	12.11 hrs,	Volume=	0.063 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 93.61' @ 12.11 hrs Surf.Area= 1,007 sf Storage= 1,473 cf

Plug-Flow detention time= 118.6 min calculated for 0.088 af (81% of inflow)
Center-of-Mass det. time= 83.3 min (835.9 - 752.6)

Volume	Invert	Avail.Storage	Storage Description
#1	91.00'	1,898 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

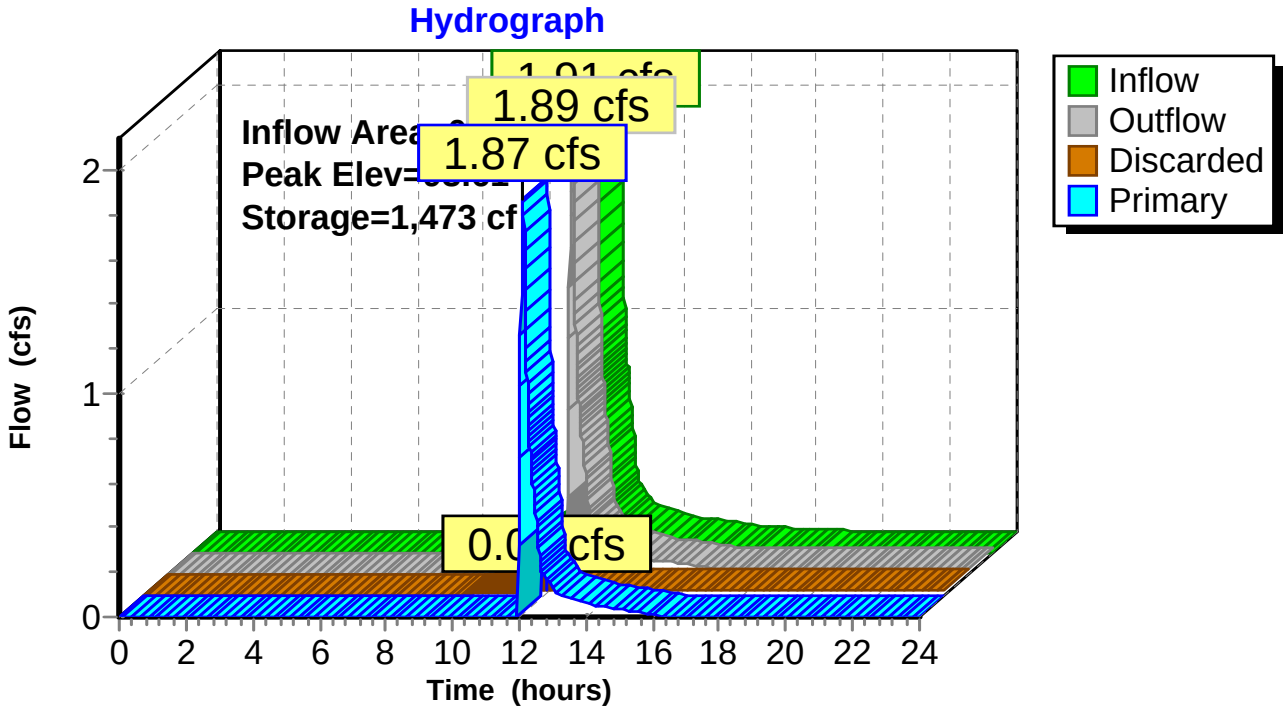
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.00	220	0	0
92.00	425	323	323
94.00	1,150	1,575	1,898

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.00'	**1.070 in/hr Exfiltration over Surface area**
#2	Primary	93.50'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 12.11 hrs HW=93.61' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.86 cfs @ 12.11 hrs HW=93.61' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.86 cfs @ 0.88 fps)

Pond 1P: INFILTRATION BASIN #1



Summary for Pond 2P: Downspout Collection

Inflow Area = 0.357 ac,100.00% Impervious, Inflow Depth > 5.36" for 25-Year event
Inflow = 1.96 cfs @ 12.08 hrs, Volume= 0.159 af
Outflow = 1.94 cfs @ 12.09 hrs, Volume= 0.149 af, Atten= 1%, Lag= 0.7 min
Discarded = 0.03 cfs @ 12.09 hrs, Volume= 0.040 af
Primary = 1.91 cfs @ 12.09 hrs, Volume= 0.109 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 94.16' @ 12.09 hrs Surf.Area= 480 sf Storage= 691 cf

Plug-Flow detention time= 65.4 min calculated for 0.149 af (93% of inflow)
Center-of-Mass det. time= 29.4 min (775.0 - 745.6)

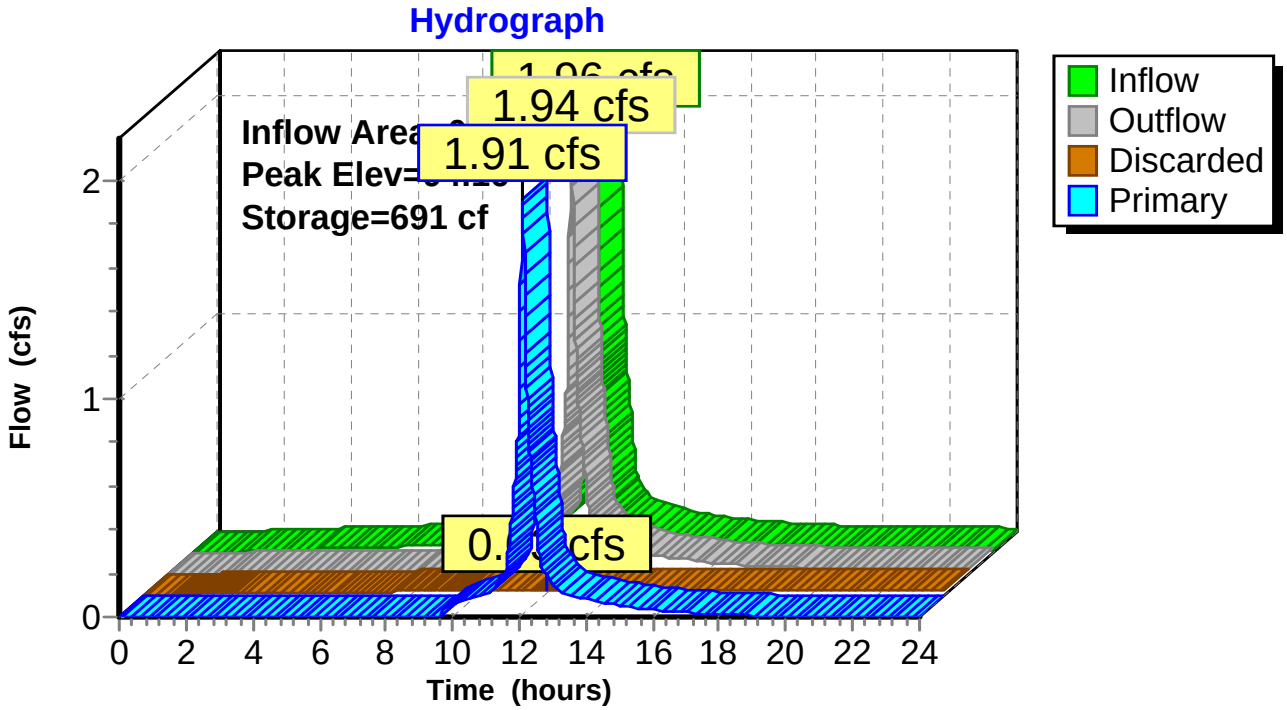
Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	392 cf	**3.00'W x 160.00'L x 3.00'H Prismatoid** 1,440 cf Overall - 459 cf Embedded = 981 cf x 40.0% Voids
#2	92.50'	459 cf	**18.0" Round Pipe Storage** Inside #1 L= 260.0'
		852 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.070 in/hr Exfiltration over Wetted area**
#2	Primary	93.50'	**12.0" Round Culvert** L= 15.0' Ke= 0.200 Inlet / Outlet Invert= 93.50' / 93.00' S= 0.0333 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 12.09 hrs HW=94.16' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.91 cfs @ 12.09 hrs HW=94.16' (Free Discharge)
└─**2=Culvert** (Inlet Controls 1.91 cfs @ 3.46 fps)

Pond 2P: Downspout Collection



Summary for Subcatchment 1S: ROOF AREA

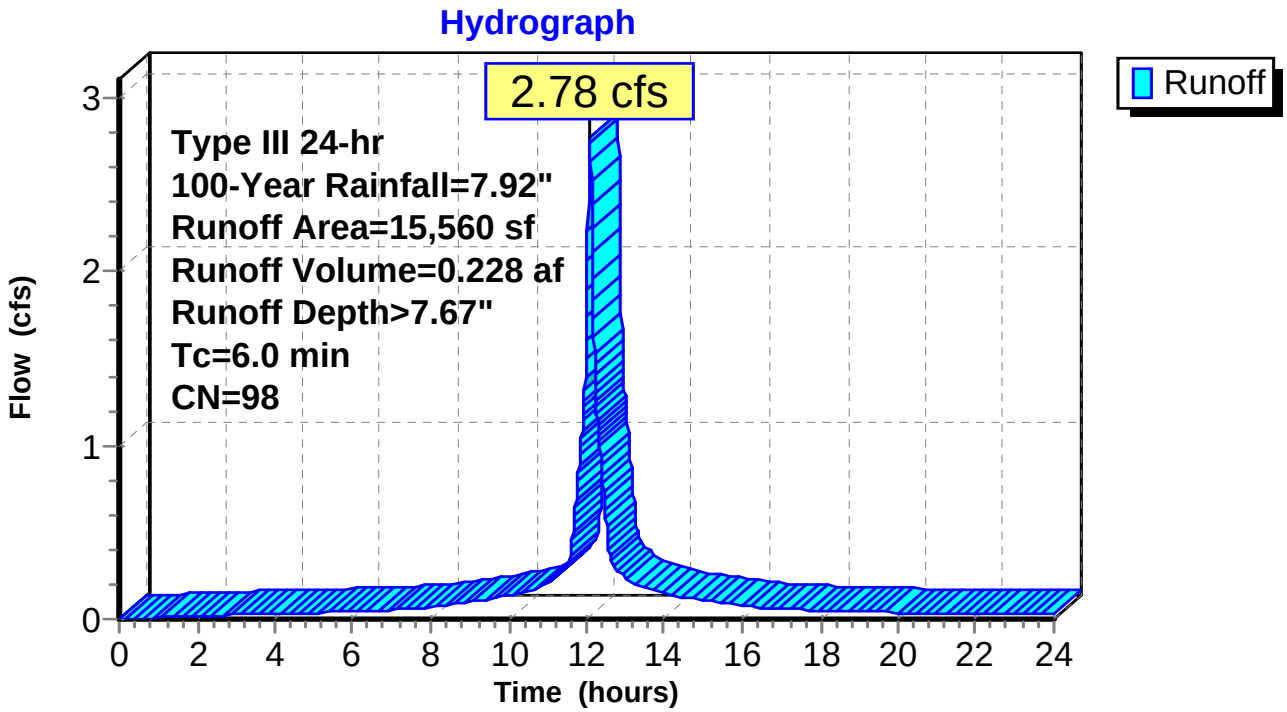
Runoff = 2.78 cfs @ 12.08 hrs, Volume= 0.228 af, Depth> 7.67"

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-Year Rainfall=7.92"

Area (sf)	CN	Description
15,560	98	Roofs, HSG B
15,560		100.00% Impervious Area

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

Subcatchment 1S: ROOF AREA

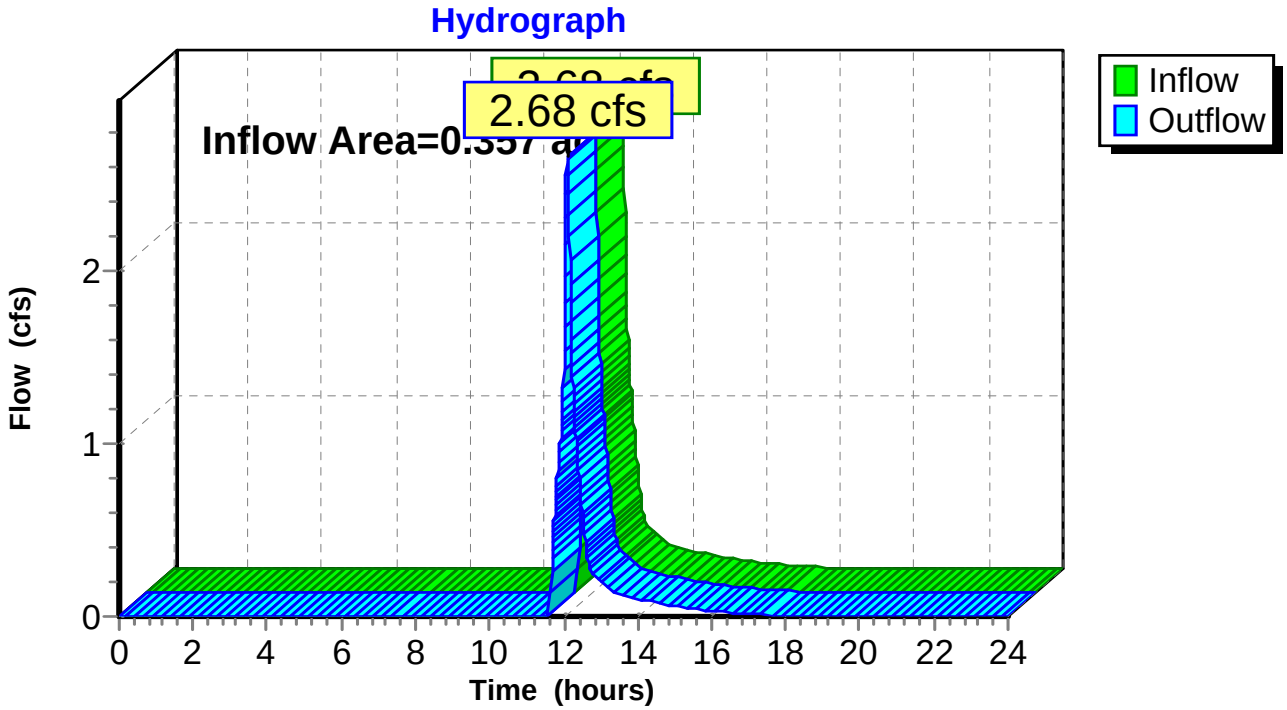


Summary for Reach 1R: Design Pt. #1

Inflow Area = 0.357 ac,100.00% Impervious, Inflow Depth = 4.08" for 100-Year event
Inflow = 2.68 cfs @ 12.10 hrs, Volume= 0.121 af
Outflow = 2.68 cfs @ 12.10 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 1R: Design Pt. #1



Summary for Pond 1P: INFILTRATION BASIN #1

Inflow Area =	0.357 ac,100.00% Impervious, Inflow Depth > 5.87" for 100-Year event				
Inflow =	2.72 cfs @	12.09 hrs,	Volume=	0.175 af	
Outflow =	2.70 cfs @	12.10 hrs,	Volume=	0.149 af,	Atten= 1%, Lag= 0.6 min
Discarded =	0.03 cfs @	12.10 hrs,	Volume=	0.028 af	
Primary =	2.68 cfs @	12.10 hrs,	Volume=	0.121 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 93.63' @ 12.10 hrs Surf.Area= 1,018 sf Storage= 1,502 cf

Plug-Flow detention time= 90.3 min calculated for 0.149 af (85% of inflow)
Center-of-Mass det. time= 49.7 min (804.1 - 754.5)

Volume	Invert	Avail.Storage	Storage Description
#1	91.00'	1,898 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

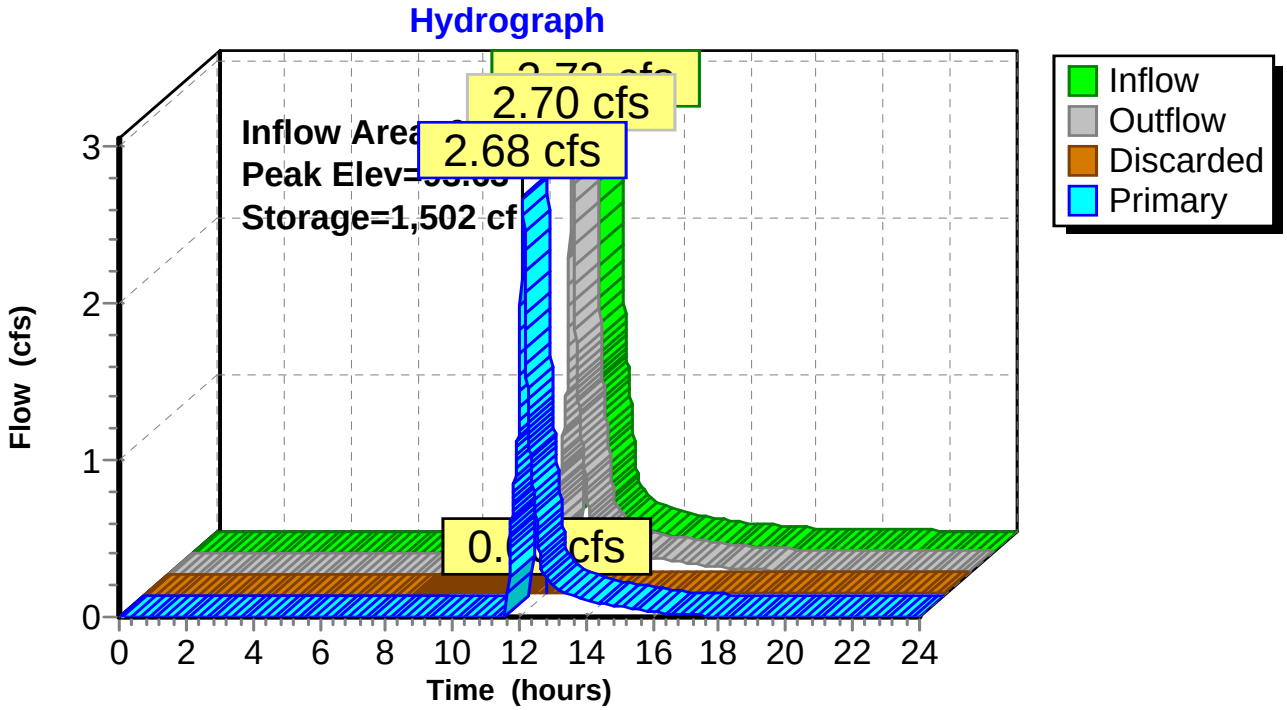
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.00	220	0	0
92.00	425	323	323
94.00	1,150	1,575	1,898

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.00'	**1.070 in/hr Exfiltration over Surface area**
#2	Primary	93.50'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=93.63' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=2.66 cfs @ 12.10 hrs HW=93.63' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.66 cfs @ 0.99 fps)

Pond 1P: INFILTRATION BASIN #1



Summary for Pond 2P: Downspout Collection

Inflow Area = 0.357 ac,100.00% Impervious, Inflow Depth > 7.67" for 100-Year event
Inflow = 2.78 cfs @ 12.08 hrs, Volume= 0.228 af
Outflow = 2.75 cfs @ 12.09 hrs, Volume= 0.217 af, Atten= 1%, Lag= 0.7 min
Discarded = 0.03 cfs @ 12.09 hrs, Volume= 0.042 af
Primary = 2.72 cfs @ 12.09 hrs, Volume= 0.175 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 94.33' @ 12.09 hrs Surf.Area= 480 sf Storage= 724 cf

Plug-Flow detention time= 53.1 min calculated for 0.217 af (95% of inflow)
Center-of-Mass det. time= 24.1 min (764.9 - 740.8)

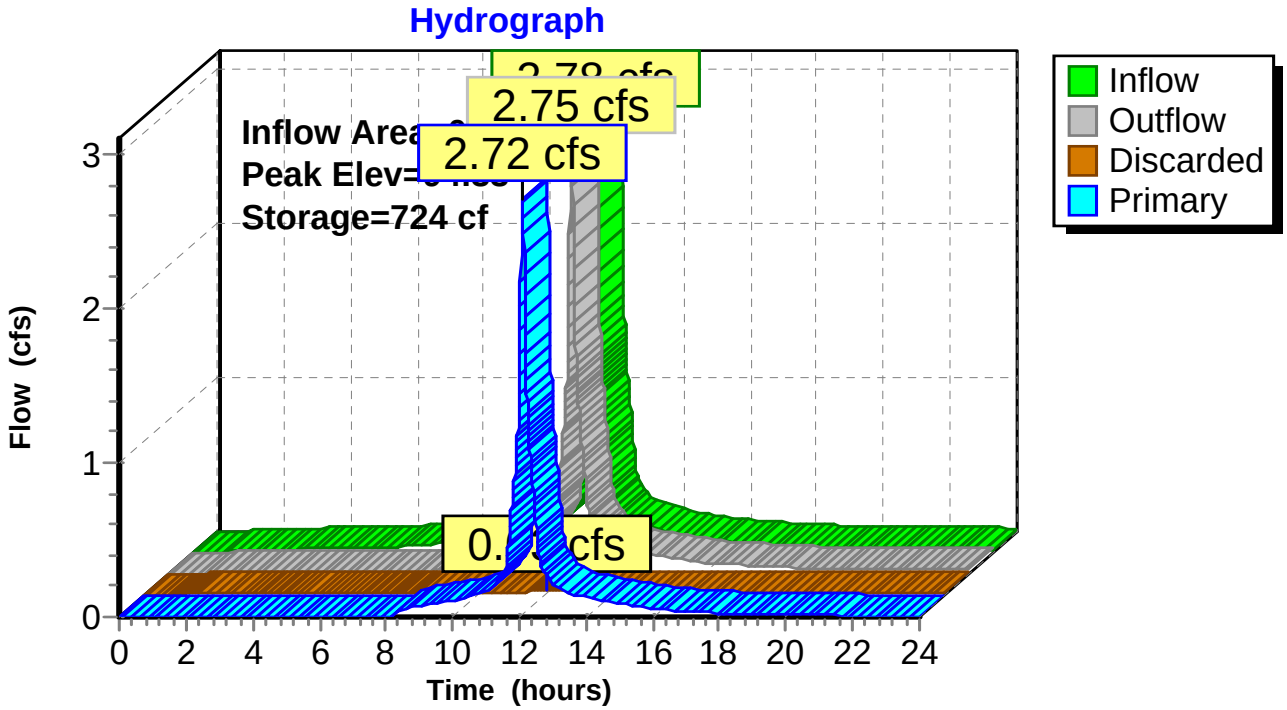
Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	392 cf	**3.00'W x 160.00'L x 3.00'H Prismatoid** 1,440 cf Overall - 459 cf Embedded = 981 cf x 40.0% Voids
#2	92.50'	459 cf	**18.0" Round Pipe Storage** Inside #1 L= 260.0'
		852 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.070 in/hr Exfiltration over Wetted area**
#2	Primary	93.50'	**12.0" Round Culvert** L= 15.0' Ke= 0.200 Inlet / Outlet Invert= 93.50' / 93.00' S= 0.0333 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 12.09 hrs HW=94.33' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

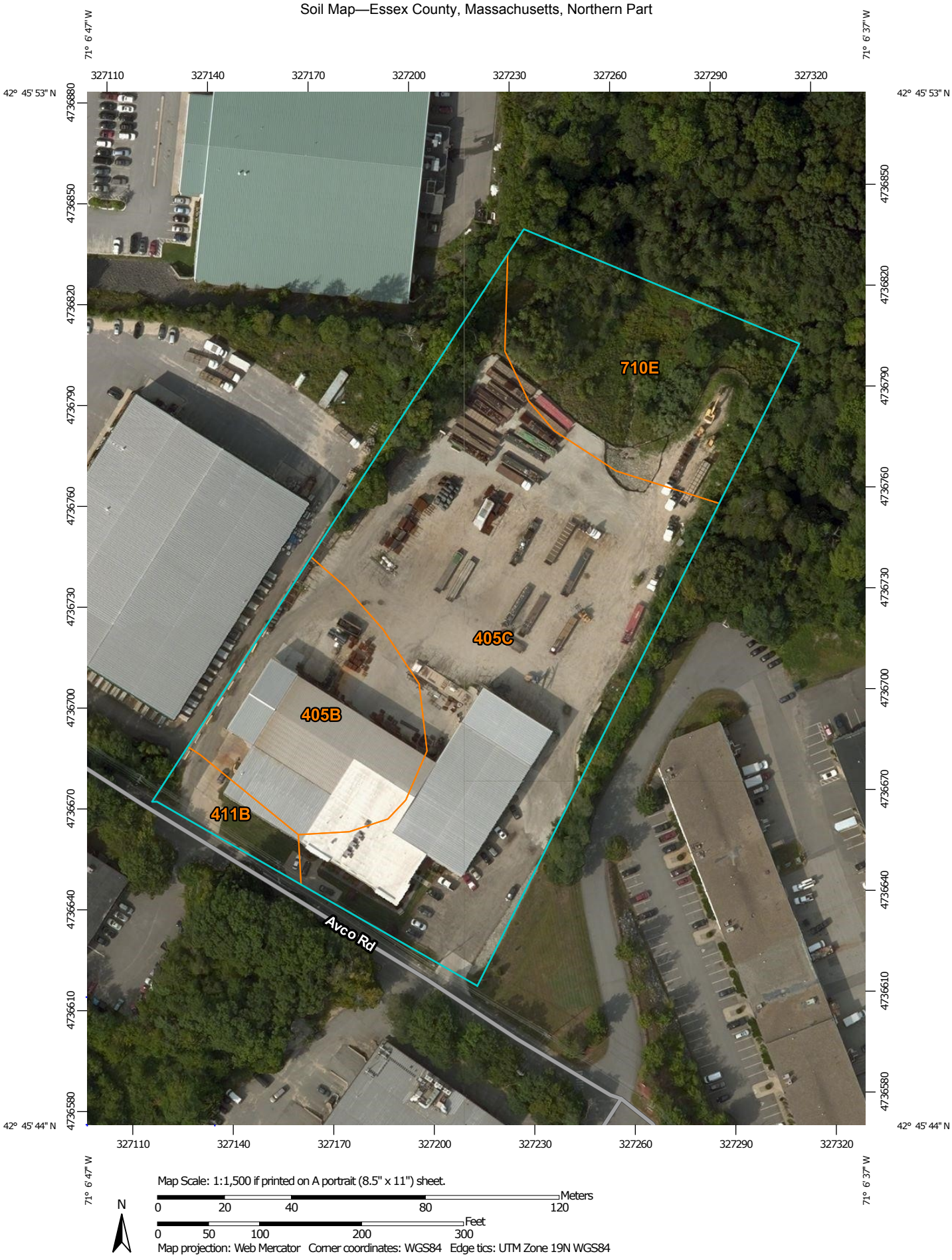
Primary OutFlow Max=2.71 cfs @ 12.09 hrs HW=94.33' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.71 cfs @ 3.88 fps)

Pond 2P: Downspout Collection



SOILS DATA

Soil Map—Essex County, Massachusetts, Northern Part



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 11, 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 29, 2014—Sep 19, 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.

Map Unit Legend

Essex County, Massachusetts, Northern Part (MA605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
405B	Charlton fine sandy loam, 3 to 8 percent slopes	0.9	17.3%
405C	Charlton fine sandy loam, 8 to 15 percent slopes	3.0	58.8%
411B	Sutton fine sandy loam, 3 to 8 percent slopes, very stony	0.2	3.5%
710E	Canton and Charlton fine sandy loams, steep, extremely stony	1.1	20.5%
Totals for Area of Interest		**5.1**	**100.0%**

TSS REMOVAL / RECHARGE / DRAWDOWN CALCULATIONS

PROJECT: *Rebars and Mesh*
111 Avco Road
Haverhill, Massachusetts

RECHARGE CALCULATIONS:

Recharge Requirement: 0. Inche35s of run-off [Group B Hydrologic Soils] of Total Impervious Area

Industrial Building Roof: = 15,560 s.f.

Total Impervious Area: 15,560 s.f.

Volume of Recharge Required: 15,560 s.f. x 0.35/12 inches of run-off = 454 cubic feet

Recharge Provided:

INFILTRATION BASIN #1: 1,338 CF @ ELEV. 93.50 [100 Year Storm Event]

The Stormwater drainage system significantly exceeds the recharge requirements to satisfy the MA DEP Stormwater Management Standards under all storm events.

DRAWDOWN CALCULATIONS:

INFILTRATION BASIN #1:

Basin Volume: 1,338 cubic feet @ Elev. 93.50

Total Bottom Area: 220 sf

Drawdown Time: 1,338 / [(1.07/12) * 220] = 68.2 hours

MASS DEP STORMWATER CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

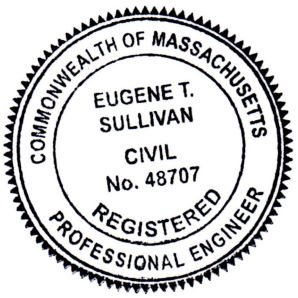
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☒ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☒ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

OPERATION & MAINTENANCE

MANUAL FOR THE STORM

DRAINAGE FACILITIES

LOCATED AT:

REBARS AND MESH

111 AVCO ROAD, HAVERHILL, MASSACHUSETTS

AUGUST 28, 2016

Prepared By:

Eugene T. Sullivan, Inc.
Consulting Engineers
230 Lowell Street – Suite 2A
Wilmington, Massachusetts
978.657.6469

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3.1 Infiltration Trenches
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4.0 SEDIMENT DISPOSAL

1.0 INTRODUCTION

The Site Stormwater management system for the roof runoff has been designed to attenuate stormwater runoff. Proper maintenance is essential to the continued effectiveness of the storm drainage facilities.

The drainage facility components include an Infiltration Trench and an Infiltration Basin. The drainage facility is designed to limit peak runoff to below the predevelopment conditions and recharge groundwater.

The following outline contains the procedures and frequency of tasks necessary to manage the system and avoid costly premature component failure. Refer to the labeled project site plan to assist in locating all drainage structures.

2.0 INITIAL NEW SYSTEM INSPECTION

The new system must be initially inspected within the first two months.

2.1 Infiltration Trenches

The drainage system includes an Infiltration Trench. The units should be inspected after any major rainfall events for the first couple of months. There after the trenches should be inspected regularly as outlined in Section 3.2.

2.2 Infiltration Basin

The Drainage system contains Infiltration basins. The Basins should be inspected frequently during the first few months to ensure that the vegetation becomes adequately established. The basins should also be inspected after any major rainfall events during the first year. Initial Inspection is intended to observe proper stabilization of the soils, slopes and connected piping. Thereafter the infiltration basin should be inspected regularly as outlined in Section 3.3.

3.0 REGULAR INSPECTION AND MAINTENANCE OF STRUCTURES

3.1 Infiltration Trenches

Because Infiltration trenches are prone to failure due to clogging, it is imperative that they ne aggressively maintained on a regular schedule.

Inspection:

Inspections shall be performed initially and every six months thereafter.
Inspect for erosion above or around the infiltration trenches
Inspect for sediment accumulation around the inlets and outlets

Maintenance:

The Trench shall be cleaned as necessary or as required by inspection. At a minimum, the Trench shall be cleaned at least two times a year, (fall and spring).

3.2 Infiltration Basin

The actual removal of sediments and trash occurs when the basin is cleaned out, there maintenance is required. The more frequent the cleaning, the less likely the sediments will become re-suspended and subsequently discharged. Inspection and cleaning is critical to ensure proper functioning of the Infiltration Basin.

Inspection:

Inspections shall be performed initially and every six months thereafter.
Inspect for sediment accumulation.
Inspect for erosion within or around the basin area.
Inspect for sediment accumulation around the outlet.
Inspect for adequacy of the inlet/outlet erosion measures.
Inspect for erosion of the basin and the basin side slopes.

Maintenance:

The Basin shall be cleaned as necessary or as required by inspection. At a minimum, the Basin shall be cleaned at least two times a year, (fall and spring) and when there are discharges over the emergency spillway. The grass side slopes and bottom of the basin should be mowed and the grass clippings and the accumulated organic matter should be removed. When mowing the grasses, keep the grass height no greater than 6”. Check for signs of rilling and gullying and repair as needed. After removing sediments, replace any vegetation damaged by re-seeding *See sediment disposal section*.

The Inspection and Cleaning of the Infiltration Trench and Infiltration Basin shall be performed in April and October of each year. A report detailing the inspections and cleaning of the structures is to be submitted to the Public Works Department after each cleaning and shall be prepared by an appropriate Professional.

4.0 SEDIMENT DISPOSAL

All sediments, grease and hydrocarbons are considered hazardous waste and therefore should be handled properly and disposed of in accordance with applicable local, state and federal laws and regulations.

THE MAINTENANCE OF THE STORM DRAINAGE SYSTEMS IS THE RESPONSIBILITY OF THE OWNER OF THE PROPERTY.

EROSION CONTROLS PLAN

REBARS AND MESH

111 AVCO ROAD

HAVERHILL, MASSACHUSETTS

AUGUST 28, 2016

Prepared by:

EUGENE T. SULLIVAN, INC.

230 Lowell Street, Suite 2A

Wilmington, MA 01887

[978] 657.6469

EROSION AND SEDIMENT CONTROLS PLAN:

This report represents the Erosion and Sediment Controls Plan for the proposed development located at 111 Avco Road in Haverhill, Massachusetts.

The purpose of this report is to outline the methods and procedures to provide Erosion and Sediment controls to eliminate any adverse impact thru stormwater runoff or sediment accumulations to the adjacent properties, wetlands, and or roadways.

Erosion Control Notes and a Construction Sequence are identified on drawing C.1. As outlined on drawing C.1, the following Erosion Controls are to be Installed and Maintained throughout the Construction Project:

- Filtrexx Silt Soxx are to be installed around the perimeter of the Limit of Work.

Additional Erosion Controls Measures and Procedures are contained in the attached Stormwater Pollution Prevention Plan prepared for this project.

INSPECTIONS OF EROSION CONTROLS:

To ensure that ensure that erosion controls are installed and maintained throughout the construction project, the project Civil Engineer, Eugene T. Sullivan, Inc. will conduct onsite inspections of all erosion control measures at least once every fourteen [14] calendar days and within 24 hours of the end of a ½" or greater storm event from the start of construction until the site is permanently stabilized. For each inspection, a site inspection log must be completed. The Inspection logs must be maintained and available for review.

All erosion and sediment controls and other protective measures identified in the SWPPP must be maintained in effective condition. If the Inspections identify measures which need to be maintained or are not functioning effectively, repairs, maintenance or additional erosion control measures must be implemented immediately to correct any deficiencies.

Stormwater Pollution Prevention Plan

for:

111 AVCO ROAD
HAVERHILL, MASSACHUSETTS

Operators and Contacts:

MDK REALTY TRUST LLC
111 Avco Road
Haverhill, MA 01830

Prepared by:

EUGENE T. SULLIVAN, INC.
230 Lowell Street, Suite 2A
Wilmington, Massachusetts

SWPPP Preparation Date:

August 28, 2016

Estimated Project Dates:

Project Start Date: 10 / 01 / 2016
Project Completion Date: 4 / 31 / 2017

Contact Information/ Responsible Parties

Operator(s):
MDK Realty Trust
111 Avco Road
Haverhill, MA 01830
Attention: John Grady
Phone: 978.374.2244
Email: jgrady@rebarsandmesh.com

This SWPPP was Prepared by:
Eugene T. Sullivan Inc.
Gene Sullivan
230 Lowell Street, Suite 2A
Wilmington, MA 01887
978.657.6469
etspe@aol.com

SECTION 1: PROJECT DESCRIPTION

1.0 Nature Of Construction Activity

The proposed project consists of the construction of a new 15,560 sf Industrial Building including new utilities, and drainage systems.

What is the function of the construction activity?

Residential Commercial X Industrial ☐ Road Construction ☐ Linear Utility

Other (please specify):

Estimated Project Start Date: 10/ 01 / 2016

Estimated Project Completion Date: 04/ 31 / 2017

1.1 Soils, Slopes, Vegetation, and Current Drainage Patterns

Soil type(s): Loamy Sands

Slopes (describe current slopes and note any changes due to grading or fill activities):
The property slopes to the Northeast [between 3-15 % slopes].

Drainage Patterns: The existing site drains towards the Northeast side of the property towards the Merrimack River. This pattern will remain unchanged, although peak runoff rates and flows will be reduced as a result of this development.

Vegetation: Existing vegetation will remain to the maximum extent possible.

1.2 Construction Site Estimates

The following are estimates of the construction site:

Total project area	8.92 acres
Construction site area to be disturbed:	1.25 acres

1.3 Site Features and Sensitive Areas to be Protected

Due to the extensive slopes on the site erosion control is the most significant protective measure for this project.

Filtrexx Silt Soxx will be installed at the limit of work perimeter. The erosion controls will be maintained throughout construction activities.

1.4 Potential Sources of Pollution

Potential sources of sediment to Stormwater runoff:
Clearing and Grubbing Operations
Topsoil stripping and stockpiling operations.
Grading and Site Excavation Operations
Landscaping Operations

Potential pollutants and sources, other than sediment, to Stormwater runoff:
Ordinary Construction Activities
Concrete washout of trucks.

1.5 Maps

Site Plans and Maps are attached to this SWPPP.

SECTION 2: EROSION AND SEDIMENT CONTROL BMPS

2.1 Minimize Disturbed Area and Protect Natural Features and Soil

After the installation of erosion controls has been completed, Topsoil will be removed from the construction area. The erosion controls will be inspected weekly and after every significant [greater than ½"] storm event. Any erosion will addressed and stabilized immediately.

2.2 Stabilize Soils

Temporary Stabilization:

The site topography has significant slope, therefore there may be a need to stabilize exposed soils temporarily during construction activities. However, if stabilization is required, straw mulch will be applied to eliminate erosion. Disturbed areas will be inspected weekly or after storm events to check for movement or erosion. If erosion occurs, the surface will be repaired and more mulch will be applied.

Permanent Stabilization:

Permanent stabilization will be done after final design grades have been achieved. All areas disturbed during construction will be loamed and seeded. All seeded areas will be inspected weekly and after during storm events after installation, if failure is noticed, the area will be addressed and reseeded.

Dust Control:

Dust from the site will be controlled using a mobile pressure-type water truck to apply water to disturbed areas as necessary.

2.3 Protect Slopes

If slopes need to be protected, Geotextile Erosion Control Blankets will be used on the slopes.

2.5 Establish Perimeter Controls and Sediment Barriers

Prior to any disturbances on-site Filtrexx Silt Soxx will be installed along the project limit as indicated on the Erosion Controls drawing C.1. These erosion controls will prevent sediment from leaving the site.

2.6 Retain Sediment On-Site

Any sediment which may be created during the construction process will be collected by the siltation fencing and hay bales along the limit of work. The Erosion Controls will be inspected weekly and after every storm event. Any erosion will addressed and stabilized immediately. Sediments which may be collected will be removed, hauled and disposed of off-site as necessary.

2.7 Establish Stabilized Construction Exits

A deep stone mud trap will be constructed at the gravel driveway accessing the adjacent property to prevent the off-site transport of sediment by construction vehicles. The stabilized exits will be installed before construction begins on the site. The stone will remain in place until the sub-base of the pavement is installed. The exits will be inspected weekly, after significant storm events, and after periods of heavy use. The exit will be maintained so that they will prevent the tracking of sediment off-site.

2.8 Additional BMPs

Eugene T. Sullivan Inc. [the project Civil Engineer] will perform bi-weekly inspections of the site to ensure compliance with this SWPPP. ETS Inc. will maintain the SWPPP documentation and will conduct and document inspections in all areas of the site.

SECTION 3: GOOD HOUSEKEEPING BMPS

3.1 Material Handling and Waste Management

Construction Waste:

All waste materials will be collected and disposed of into metal trash dumpsters. The dumpsters will be located away from the limit of work and/or property lines, stormwater conveyances and drains and will meet all federal, state, and municipal regulations. Only trash and construction debris from the site will be deposited in the dumpster. No debris and/or construction materials will be buried on-site. The dumpsters will be inspected weekly and after storm events. The dumpsters will be emptied as necessary and disposed of in accordance with regulations.

Sanitary Waste:

At a minimum, two temporary portable toilets will be provided onsite throughout the construction phase. The portable toilets will be located away from the limit of work and/or property lines, stormwater conveyances and drains. Sanitary waste will be cleaned and collected from the portable toilets weekly.

3.2 Establish Proper Building Material Staging Areas

Construction Equipment and Materials will be staged in the area of the site as indicated on C.1. The storage area will be inspected weekly and after significant storm events to ensure that materials and/or sediment are not being created by the staging area. If necessary, erosion controls will be installed around the perimeter of the staging area.

3.3 Designate Washout Areas

A temporary above-grade concrete washout area will be constructed prior to any concrete deliveries to the site. A 10' x 10' washout will be constructed of staked hay bales and filter fabric. The washout area will be located adjacent to the materials staging area near proposed tennis courts.

Concrete pours will not be conducted during or before an anticipated storm event. Concrete trucks and chutes will be washed in the designated area or concrete wastes will be properly disposed off-site. When the temporary washout area is no longer needed, the hardened concrete and materials used to construct the area will be removed and disposed of properly.

3.4 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Vehicles and Equipment to be used on-site throughout the project include excavators, loaders, dump trucks and trailers, paving equipment etc. All major equipment/vehicle fueling will occur within the materials staging area. Absorbent, spill-cleanup materials will be available at the materials staging area. Vehicles and equipment will be inspected each day for leaks, leaks will be repaired immediately, or the problem equipment will be removed from the site immediately.

3.6 Spill Prevention and Control Plan

Contractor awareness is the key to an effective spill prevention and response program. Anticipated spills for this project would be a result of oil or gas leaks. These spills should be brought to the attention of the project manager immediately. The project manager should have an adequate supply of absorbent compounds, rags etc. readily available at all times. The project manager will be trained to handle small spill events using the following procedures:

1. Stop the spill at the source.
2. Contain the spilled materials.
3. Collect the spilled materials as necessary using absorbent compounds, rags etc.
4. Dispose of the materials properly.

If the spill occurs near a storm drain structure, absorbent pads and/or socks shall be placed around the drains to prevent the spill from entering the collection system.

Spills should not be washed down with water unless the water can be contained and disposed of properly.

If a significant spill event occurs and cannot be handled by the project manager, contact the Fire Department or Local Environmental Emergency Response Team as required.

SECTION 4: INSPECTIONS

4.1 Inspections

Eugene Sullivan PE, the Project Civil Engineer who prepared the Civil Engineering Drawings for the project, prepared this SWPPP is responsible for site compliance with this SWPPP and the EPA's Construction General Permit. Inspections will be conducted for all areas of the site disturbed during construction activities. Inspections will be performed weekly and after storm events as detailed in this SWPPP. These inspections will verify that all BMP's required in sections 2 and 3 of this plan are implemented, maintained and effectively minimizing erosion and preventing Stormwater contamination from construction activities.

4.2 Delegation of Authority

Duly Authorized Representative(s) or Position(s):

EUGENE T. SULLIVAN, INC.
Gene Sullivan
President
230 Lowell Street, Suite 2A
Wilmington, MA 01887
978.657.6469
etspe@aol.com

SECTION 5: FINAL STABILIZATION

After the entire site has been stabilized, any sediment collected during the construction process will be removed and hauled off-site. Construction debris, trash and temporary BMP's [material and equipment storage areas, portable toilets etc.] will be removed and areas disturbed will be prepared for final seeding. Permanent seeding will be applied after all final grades have been established.

SECTION 6: CERTIFICATION AND NOTIFICATION

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

Name: Eugene T. Sullivan PE Title: President

Signature:

Date: August 28, 2016

Appendix A:

Stormwater Construction Site Inspection Report

General Information			
Project Name	***REBARS AND MESH***		
NPDES Tracking No.		**Location**	111 AVCO ROAD
Date of Inspection		**Start/End Time**	
Inspector's Name(s)	GENE SULLIVAN, P.E.		
Inspector's Title(s)	PROJECT ENGINEER		
Inspector's Contact Information	978.657.6469 etspe@aol.com		
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Have any discharges occurred since the last inspection? ❑Yes ❑No **If yes, describe:**			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1	Downspout Collection	❑Yes ❑No	❑Yes ❑No	
2	Infiltration Basin	❑Yes ❑No	❑Yes ❑No	
3		❑Yes ❑No	❑Yes ❑No	
4		❑Yes ❑No	❑Yes ❑No	
5		❑Yes ❑No	❑Yes ❑No	
6		❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	
8		❑Yes ❑No	❑Yes ❑No	
9		❑Yes ❑No	❑Yes ❑No	
10		❑Yes ❑No	❑Yes ❑No	
11		❑Yes ❑No	❑Yes ❑No	
12		❑Yes ❑No	❑Yes ❑No	
13		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
4	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	Are storm drain inlets properly protected?	❑Yes ❑No	❑Yes ❑No	
6	Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
10	Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
12	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

Signature:_____ **Date:**_____