Drainage Analysis

HAARTZ Corporation

Site Plan Redevelopment

Map F3 Parcel 1

87 Hayward Road

Acton, Massachusetts

01720

May 28, 2015

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1. INTRODUCTION

The existing site is located at 87 Hayward Road and is shown as Parcel 1 on Assessors Map F3. The objective of this project is to construct a 3,880 square foot addition on the existing building near the main office of the main building. Also to construct a parking lot over an existing and proposed septic system behind the main building with surface drainage system, utilities and associated grading. There is an existing wetland area to the East, South Westerly and South Easterly side of the site.

The flood zone is shown on the current FEMA map with no designated elevation. The site does lie within flood zone X according to FEMA Map 25017C03524F, dated July 7, 2014.

2. SITE DESCRIPTION

2.1 PRE-DEVELOPMENT CONDITIONS

This project site is located at 87 Hayward Road, Acton, Massachusetts on Assessor's Map F3 Parcel 1. As shown on Figure 1: Aerial Photographic Map and Figure 2: Existing Conditions & Soil Evaluation Plan of this report. The existing site is industrial/manufacturing facility approximately 47.9± acres with five stand-alone building structures in which a combined total of 18 buildings exist. The site grade is generally 0-25% with paved parking with wetlands to the south and east sides of the site. The main building with offices is located at the southerly portion of the site with parking and landscaping. The existing septic system is located approximately in the middle of the site to the west of building #6. The site in these areas described are divided into drainage areas – EXDA1 thru EXDA7. EXDA1 thru EXDA-7 flows from west to east of the site towards the existing wetlands.

The site, as shown in Figure 3: FEMA Flood Insurance Rate Map of this report, is located within a FEMA Flood Zone X, which is an area determined to be inside the area of 1% annual chance flood plain with average depths of less than 1 foot or with drainage areas less than 1 square mile. The site lies outside of any Area of Critical Environmental Concern (ACEC), Zone II, and wellhead protection area.

2.2 POST-DEVELOPMENT CONDITIONS

The proposed development includes a building addition for a 3,880± s.f. lunch room off of building #5 and a newly constructed parking lot expansion will be over the existing septic system west of building #6. The proposed building for the lunch room will tie-into the existing drainage system that leads to the wetlands to the east of the site. The proposed parking expansion shall have curbed and graded to collect surface runoff to a detention pond at the north side with associated parking and grading throughout the site.

2.3 SOILS

The proposed project is based on test pit data provided on a plan titled, “Sewage Disposal Plan, prepared by Stamski and McNary, Inc, dated October 30, 2014 as attached to the Appendix A of the Appendices contents of this report.

2.4 SITE TOPOGRAPHY

The proposed portion of the site topography ranges from elevation 223’ at the high point at building #16 to elevation 199' at the wetlands to the east. The site slopes generally 0-25% in an West to Easterly direction to the existing low point of the site.

3. DRAINAGE CALCULATIONS

To mitigate the water quality and quantity of stormwater runoff discharging the site into the sub-surface drainage system, a stormwater management system is proposed. The stormwater system will be comprised of a proposed detention basin in order to capture stormwater. The proposed stormwater management system has been designed to treat the prescribed stormwater water quality volume and to mange the peak rate of runoff. Presently limited Best Management Practices are employed on site to treat the stormwater run-off and there are no controls to manage the rate of stormwater quantity.

The proposed system includes a series of BMPs for pretreatment, treatment, and flood control. Various BMPs are installed in the parking area, such as underground pretreatment structures, and at grade structural BMPs. A detailed hydrologic and hydraulic analysis of the system was completed in order to evaluate their performance and document compliance.

MBL has prepared the following drainage system calculations for the proposed project site. These calculations are broken into two main sections; Hydrologic and Hydraulic Analysis. The analysis has been prepared in conformance with the Stormwater Management Standards, as well as general engineering practice.

3.1 HYDROLOGIC ANALYSIS

The Soil Conservation Service (SCS) Unit Hydrograph methodology was used to develop a hydrologic model of the site. MBL utilized a computer program entitled HydroCAD Version 10.0, developed by HydroCAD Software Solutions LLC in order to create and analyze the site hydrology. The analysis was conducted in order to establish the peak discharge rates and estimated run-off volume from the project site. This was accomplished to properly evaluate pre- and post-development conditions during various storm events. Contributing drainage areas were identified and soils, surface cover, watershed slope, and flow paths were evaluated to develop the necessary HydroCAD model input parameters. A minimum Time of Concentration (Tc) of (6) minutes was used in the calculations.

Drainage calculations were performed for the Pre and Post-Development conditions for the 24-hour, 2, 10, 25, and 100-year Type III storm events depicted in Appendix B. The total rainfall for each of the storm events was based upon data published by the National Weather Service Technical Paper 40. The total rainfall values used in the hydrologic modeling for each event are shown in the following table:

Table 3.1: Table Design Rainfall Data

2-year, 24-hour storm	10-year, 24-hour storm	25-year, 24-hour storm	100-year, 24-hour storm
3.2 inches	4.5 inches	5.3 inches	6.0 inches

3.1.1 Design Points

In order to compare the difference between pre and post-development peak flows, existing and proposed watersheds were delineated. A Design Point (DP) for each watershed was established with flow paths representing the longest time of concentration of run-off in each contributory watershed. The location of the design point does not differ in the pre and post-development analysis. For this analysis two design point were chosen which are as follows:

- 8R

3.1.2 Pre-Development Hydrology

The existing portion of the site is divided into 7 existing watershed for the pre-development analysis, each discharging to design point. The existing watershed area, EXDA-1 thru EXDA-7 are shown on the attached Figure 4 titled “Pre-Development Drainage Area Plan”. The existing watershed areas were modeled as follows:

The hydrographs for each watershed were generated to develop the peak discharge rates for the 24-hour, 2, 10, 25, and 100-year Type III storm events for pre-development conditions.

3.1.3 Post-Development Hydrology

The portion of the proposed site is divided into 10 proposed watersheds for the post-development analysis. The three proposed watershed areas, PDA-1 thru PDA-10 are shown on the attached Figure 5 entitled “Post-Development Drainage Area Plan”. The proposed watershed areas were modeled as follows:

The hydrographs for each watershed were generated and routed through the BMPs to develop the peak discharge rates for the 24-hour, 2, 10, 25, and 100-year Type III storm events for post-development conditions.

3.1.4 Peak Discharge Rates

The table below summarizes the Pre and Post-Development peak discharge rates for each Design Point. As depicted in the table, the post develop peak rate of discharge does not increase over pre-development peak discharge rate conditions. This is accomplished by provided onsite infiltration through the detention basin controlling the discharge rates and volume runoff rates.

Table 3.2.4 Pre- and Post-Development Peak Discharge Rates

Design Point	2-year storm (cfs)		10-year storm (cfs)		100-year storm (cfs)	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
8R	22.69	22.17	34.69	33.09	48.66	49.86
Total	22.69	22.17	34.69	33.09	48.66	49.86

Table 3.2.5 Pre- and Post-Development Volume Runoff Rates

Design Point	2-year storm (af)		10-year storm (af)		100-year storm (af)	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
8R	1.749	1.735	2.692	2.686	3.811	3.812
Total	22.69	22.17	34.69	33.09	48.66	49.86

3.2 HYDRAULIC ANALYSIS

There are no proposed stormwater (underground piping) drainage system discharging to BMP's.

4. BEST MANAGEMENT PRACTICES

The Massachusetts Stormwater Standards requires 80% removal rate over an average annual basis, for Total Suspended Solids (TSS) contained in stormwater runoff. The water quality volume or "first flush" is defined as the volume obtained by multiplying one-half inch (½") or one inch (1") times the impervious surface area of the contributing drainage area. Water quality volume calculations are provided in Appendix D, Water Quality Volume. When this volume is incorporated into properly designed BMPs an 80% reduction of average annual TSS loading will result. The following Best Management Practices will be employed for the project.

4.1 DETENTION POND

Sub-surface Infiltration system will achieve a TSS removal rate of 80%, while also removing phosphorus, nitrogen, metals, organics, and bacteria to varying degrees.

5. STORMWATER MANAGEMENT STANDARDS COMPLIANCE

The proposed re-development of the existing industrial/manufacturing site with the proposed lunch room and parking lot expansion will utilize the best management practices (BMPs) selection and their placement within the treatment train of the stormwater management system has been strategically planned and designed as prescribed by the Massachusetts Stormwater Management Handbook. The following addresses how the project complies with the standards set forth in the Massachusetts Stormwater Standards #1 thru #10:

Standard 1

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

There are no new untreated discharges to or that will cause erosion in wetlands or waters of the Commonwealth. All stormwater runoff from impervious surfaces are collected and conveyed through the proposed stormwater management system. The stormwater is treated by structural BMP's including street sweeping and a detention pond.

Standard 2

Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.

The Stormwater Management System has been designed in conformance with the MADEP Stormwater Handbook. The post-development peak discharge rates are less than the pre-development rate for the 2-year, 10-year, 25-year, and 100-year 24-hour storms. A narrative describing compliance with this standard is located in Section 3.0 Drainage Calculations of this report. Supporting documentation such as HydroCAD computer model output, required computations, and tables are located in Appendix B.

Standard 3

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance.

The proposed stormwater management system has been designed to collect stormwater runoff from the project area and to attempt to recharge the majority of the runoff back into the ground. The site is conducive to recharge. Supporting documentation is located in Appendix G such as *Required Recharge Volume Calculations*.

Standard 4

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

The required removal of 80% TSS has been achieved through the use of a series of structural BMP's including street sweeping and a detention basin. Computations and documentation are provided in Appendix H which includes the required MADEP TSS

removal worksheet, requires Water Quality Volume Calculations, and MASTEP Technology Review for the Downstream Defender Units.

Standard 5

For land uses with higher potential loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

Not applicable to the site.

Standard 6

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

Not applicable to the site.

Standard 7

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing Stormwater discharges shall comply with Standard 1 only to the maximum extent practicable.

Standard 8

A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

A construction period erosion, sedimentation, and pollution prevention plan has been provided and included in the Construction Period Pollution Prevention Plan (CPPPP) located in Appendix I.

Standard 9

A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

Long-Term Operation and Maintenance Plan (O&M Plan) for the site bio-retention facilities is included in this report and a Long-Term Pollution Prevention Plan (LPPP) located in Appendix J.

Standard 10

All illicit discharges to the stormwater management system are prohibited.

An Illicit discharge statement has been provided in Appendix I.

6. CONCLUSION

The proposed development will not increase the rate of storm water runoff for the 2yr and 10yr storm events for this site over pre-existing conditions. This is accomplished by implementing BMPs that will provide enhance the quality of stormwater run-off while also providing a means of flood control. The proposed stormwater system design is in conformance with the Massachusetts Stormwater Management Standards.

Figure 1: Ortho Map

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No.	DATE	DESCRIPTION	BY

REVISIONS

AERIAL PHOTOGRAPH MAP

87 HAYWARD ROAD

ASSESSORS MAP F3 PARCEL 1

ACTON MASSACHUSETTS

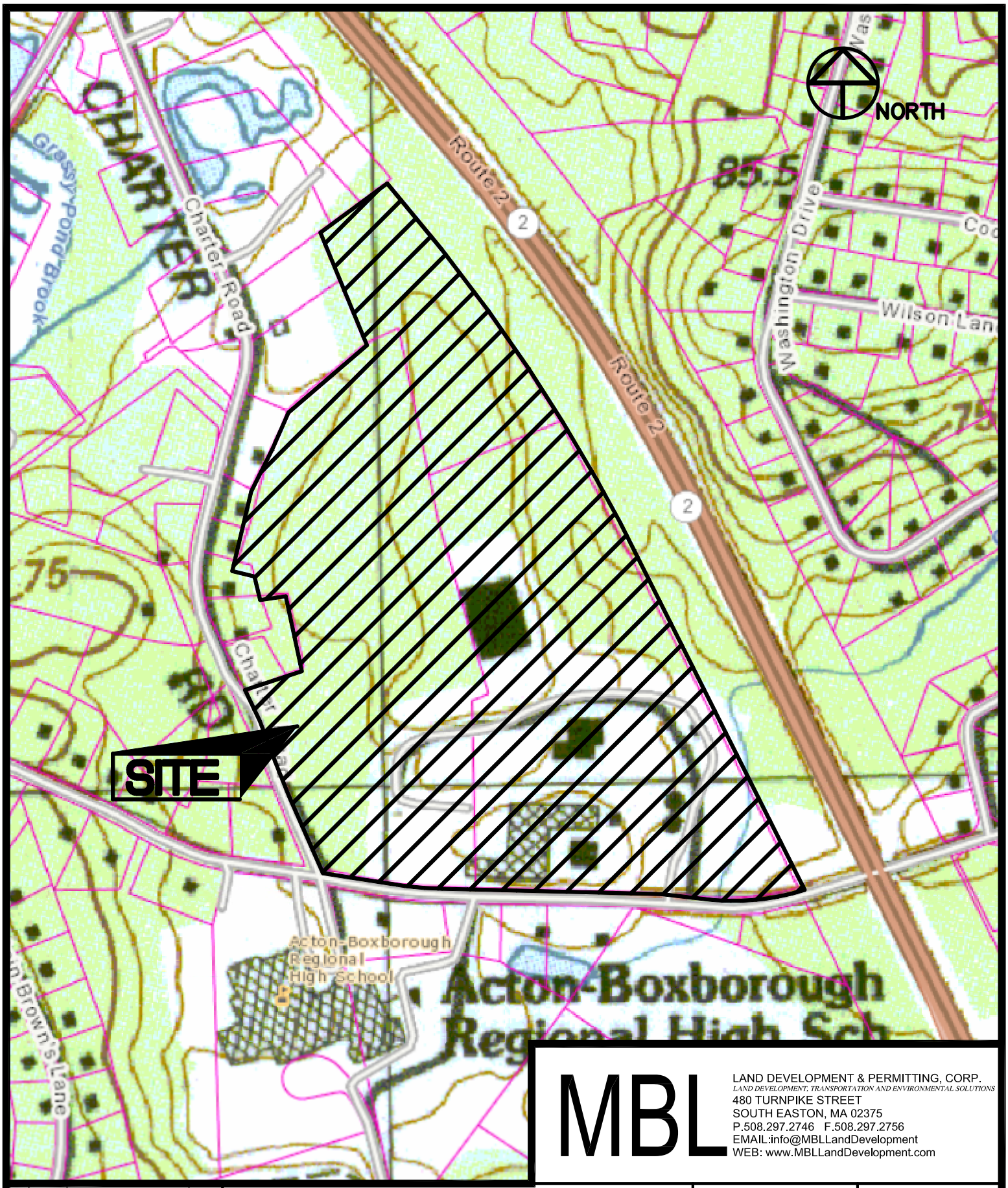
SCALE:
HORZ.: N.T.S.
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

PROJ. No.: 2014-028

DATE: MAY 28, 2015

FIG.1

Figure 2: USGS Site Location Map



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USGS QUAD MAP

87 HAYWARD ROAD

ASSESSORS MAP F3 PARCEL 1

ACTON MASSACHUSETTS

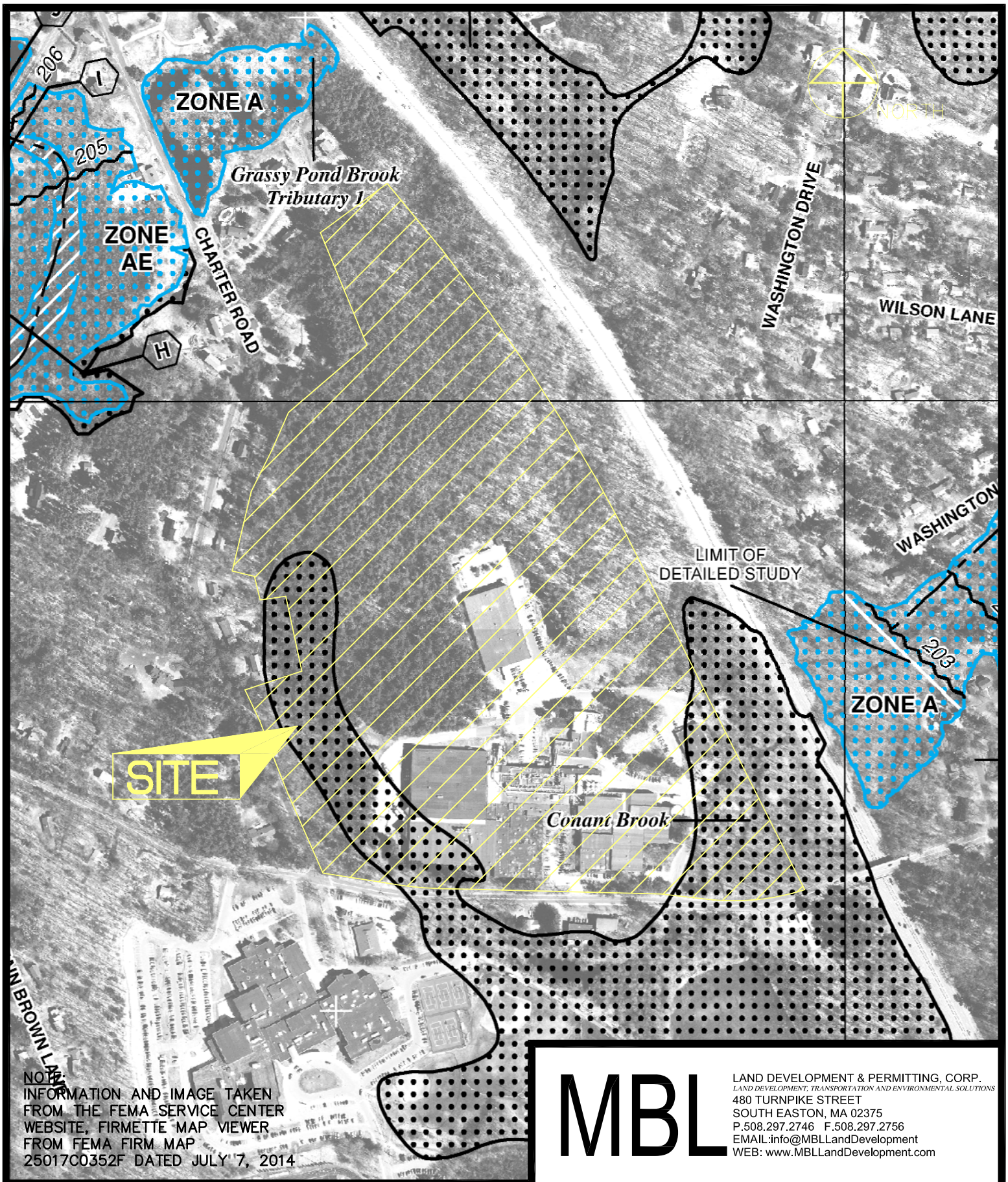
SCALE:
HORZ.: N.T.S.
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

PROJ. No.: 2014-028

DATE: MAY 28, 2015

FIG.2

Figure 3: Flood Insurance Rate Map



NOTE:
INFORMATION AND IMAGE TAKEN FROM THE FEMA SERVICE CENTER WEBSITE, FIRMETTE MAP VIEWER FROM FEMA FIRM MAP 25017C0352F DATED JULY 7, 2014

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FEMA FIRM MAP

87 HAYWARD ROAD

ASSESSORS MAP F3 PARCEL 1

ACTON MASSACHUSETTS

SCALE:
HORZ.: N.T.S.
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

PROJ. No.: 2014-028

DATE: APRIL 8, 2015

FIG.3

Figure 4: Pre-Development Drainage Area Plan

MBL NORTH

ROUTE 2 – STATE HIGHWAY LAYOUT
1950 STATE HIGHWAY LAYOUT – PLAN NO. 346

HAYWARD (PUBLIC VARIABLE WIDTH) ROAD

EXDA–1
74,919 S.F.
IMPERV. = 31,221 S.F.
GRASS = 34,691 S.F.
ROOF = 9,007 S.F.

EXDA–2
78,956 S.F.
IMPERV. = 40,047 S.F.
GRASS = 31,309 S.F.
ROOF = 7,600 S.F.

EXDA–3
157,633 S.F.
ROOF = 157,633 S.F.

EXDA–4
13,822 S.F.
PAVEMENT = 8,546 S.F.
LAWN = 4,960 S.F.
CONCRETE PADS = 316 S.F.
Tc=6 MINS.

EXDA–5
25,504 S.F.
PAVEMENT = 16,755 S.F.
LAWN = 7,765 S.F.
CONCRETE PADS = 984 S.F.

EXDA–6
2,022 S.F.
PAVEMENT = 1,622 S.F.
GRASS = 400 S.F.
Tc=6 MINS.

EXDA–7
55,563 S.F.
PAVEMENT = 19,119 S.F.
ROOF = 2,766 S.F.
GRASS = 28,751 S.F.
WOODS = 5,107 S.F.

BUILDING #18
BUILDING #16
BUILDING #13A
BUILDING #13
BUILDING #6
BUILDING #5A
BUILDING #5
BUILDING #10
BUILDING #2
BUILDING #1
BUILDING #1A

				PROJ. MANAGER:	
				CHIEF DESIGNER:	
				REVIEWED BY:	DATE
No.	DATE	DESCRIPTION	BY		
REVISIONS					

SEAL

SEAL

PREPARED FOR
HAARTZ CORPORATION
87 HAYWARD ROAD
ACTON MASSACHUSETTS

SCALE:
HORZ.: 1"=40'
VERT.:
DATUM:
HORZ.:
VERT.:
40 20 0 40
GRAPHIC SCALE

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SITE DEVELOPMENT PLANS
PRE-DEVELOPMENT PLAN
87 HAYWARD ROAD
ACTON MASSACHUSETTS

PROJ. No.: 2014-028
DATE: MAY 28, 2015

FIG. 4

UCS: | MS VIEW: | LMAN: | CTB:
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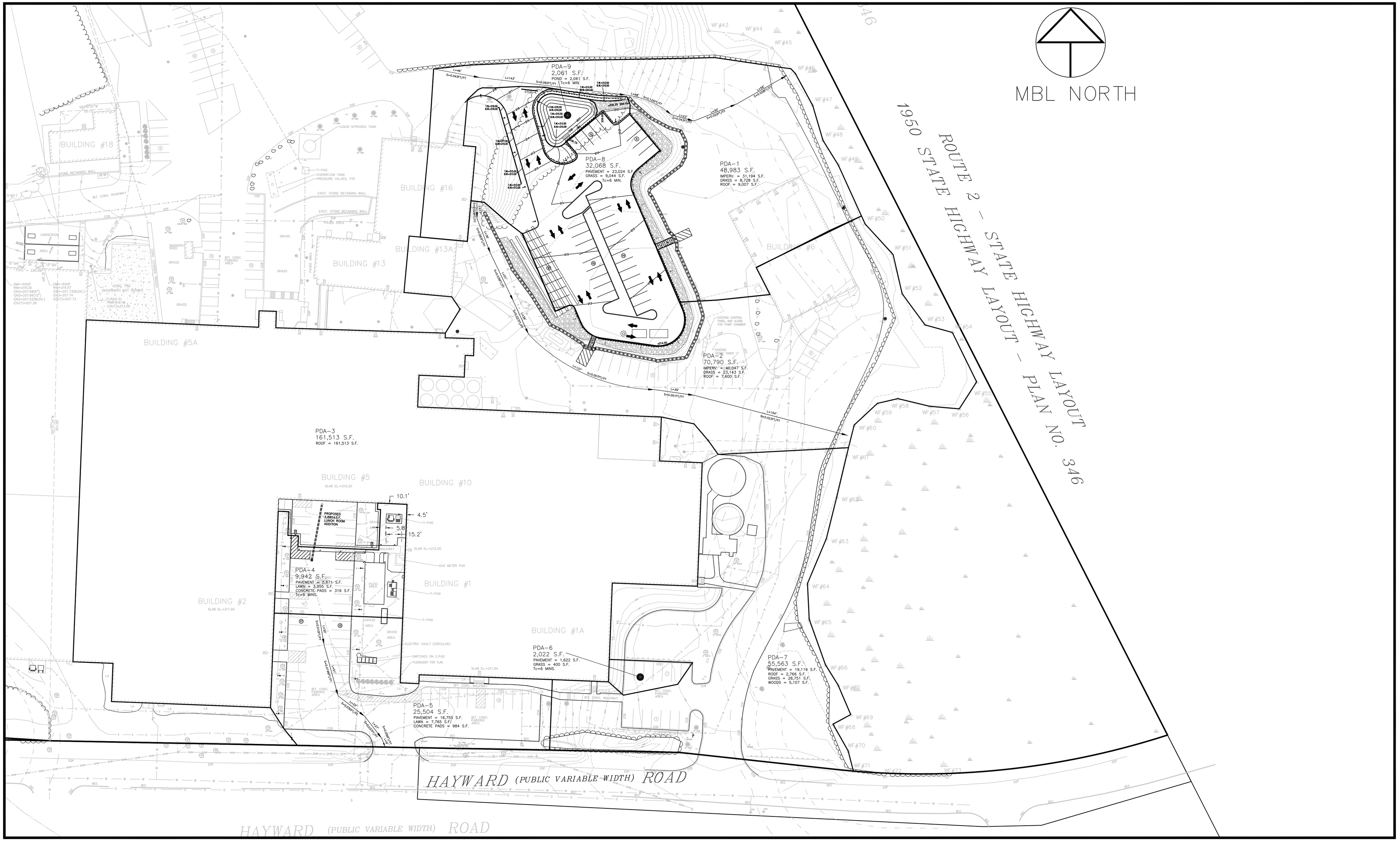
Figure 5: Post-Development Drainage Area Plan



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PROJ. MANAGER:
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REVIEWED BY: DATE

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SEAL

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87 HAYWARD ROAD
ACTON MASSACHUSETTS

SCALE:
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DATUM:
HORZ.:
VERT.:
20 10 0 20
GRAPHIC SCALE

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SITE DEVELOPMENT PLANS
POST-DEVELOPMENT PLAN
87 HAYWARD ROAD
ACTON MASSACHUSETTS

PROJ. No.: 2014-028
DATE: MAY 28, 2015

FIG. 5

UCS: | MS VIEW: | LMAN: | CTB:
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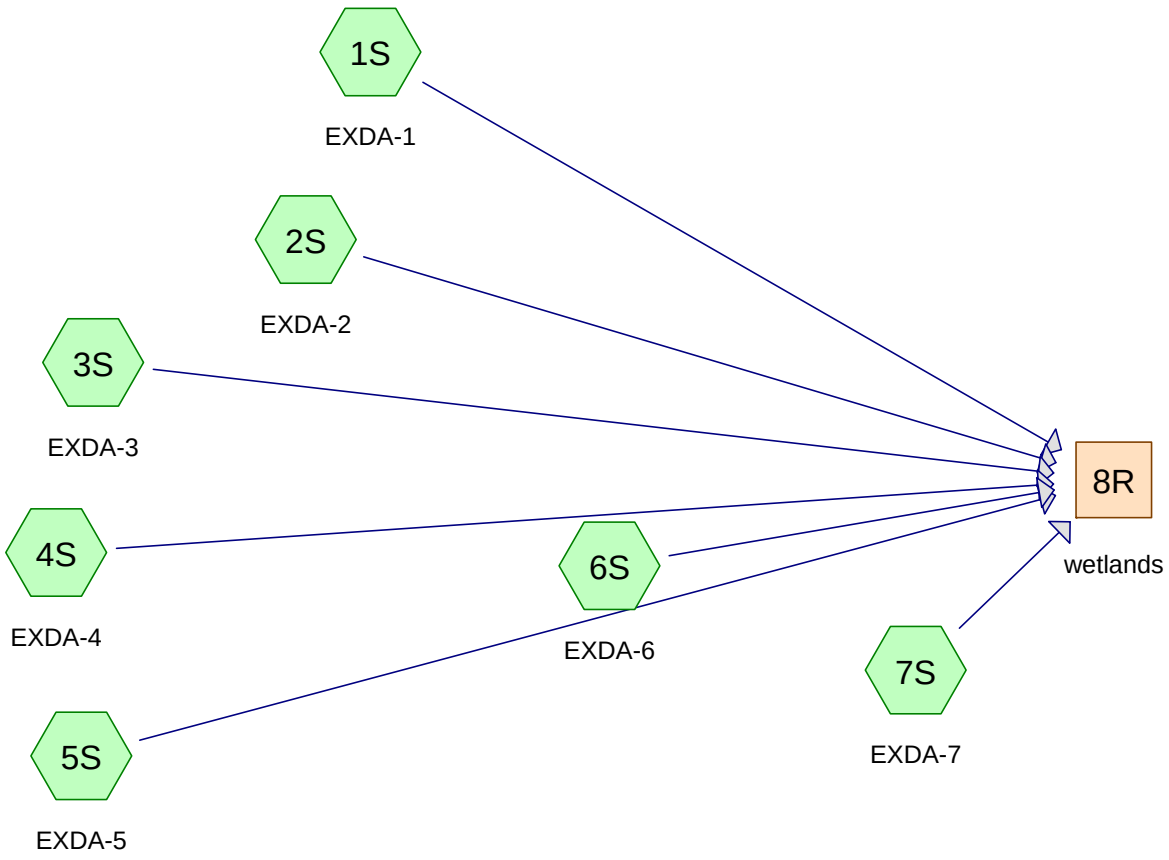
APPENDIX A: SOIL DATA

APPENDIX B: HYDROLOGIC ANALYSIS



Subcat Reach Pond Link

Drainage Diagram for 2014-028PRE

Prepared by MBL Land Development & Permitting, Corp. 5/29/2015

HydroCAD® 8.00 s/n 004337 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
0.117	60	Woods, Fair, HSG B (7S)
2.472	69	50-75% Grass cover, Fair, HSG B (1S,2S,4S,5S,6S,7S)
0.030	98	Concrete Pad (4S,5S)
2.693	98	Pavement (1S,2S,4S,5S,6S,7S)
4.063	98	Roof (1S,2S,3S,7S)
9.376		

Time span=0.10-48.00 hrs, dt=0.05 hrs, 959 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: EXDA-1 Runoff Area=74,919 sf Runoff Depth=1.76"
Tc=6.0 min CN=85 Runoff=3.48 cfs 0.252 af

Subcatchment 2S: EXDA-2 Runoff Area=78,956 sf Runoff Depth=1.91"
Tc=6.0 min CN=87 Runoff=3.98 cfs 0.289 af

Subcatchment 3S: EXDA-3 Runoff Area=157,633 sf Runoff Depth=2.97"
Tc=6.0 min CN=98 Runoff=10.98 cfs 0.895 af

Subcatchment 4S: EXDA-4 Runoff Area=13,822 sf Runoff Depth=2.00"
Tc=6.0 min CN=88 Runoff=0.72 cfs 0.053 af

Subcatchment 5S: EXDA-5 Runoff Area=25,504 sf Runoff Depth=2.08"
Tc=6.0 min CN=89 Runoff=1.39 cfs 0.102 af

Subcatchment 6S: EXDA-6 Runoff Area=2,022 sf Runoff Depth=2.35"
Tc=6.0 min CN=92 Runoff=0.12 cfs 0.009 af

Subcatchment 7S: EXDA-7 Runoff Area=55,563 sf Runoff Depth=1.40"
Tc=6.0 min CN=80 Runoff=2.04 cfs 0.149 af

Reach 8R: wetlands Inflow=22.69 cfs 1.749 af
Outflow=22.69 cfs 1.749 af

Total Runoff Area = 9.376 ac Runoff Volume = 1.749 af Average Runoff Depth = 2.24"
27.62% Pervious Area = 2.590 ac 72.38% Impervious Area = 6.786 ac

Subcatchment 1S: EXDA-1

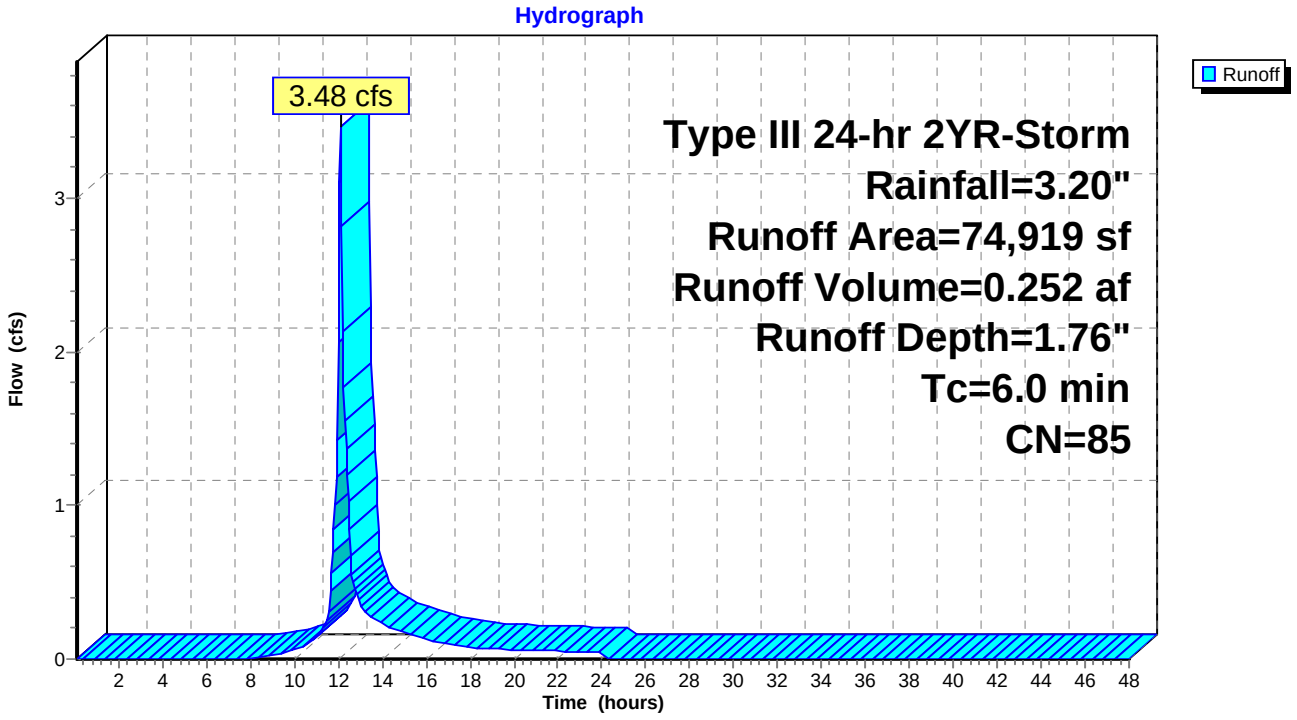
Runoff = 3.48 cfs @ 12.09 hrs, Volume= 0.252 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
31,221	98	Pavement
34,691	69	50-75% Grass cover, Fair, HSG B
9,007	98	Roof
74,919	85	Weighted Average
34,691		Pervious Area
40,228		Impervious Area

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

Subcatchment 1S: EXDA-1



Subcatchment 2S: EXDA-2

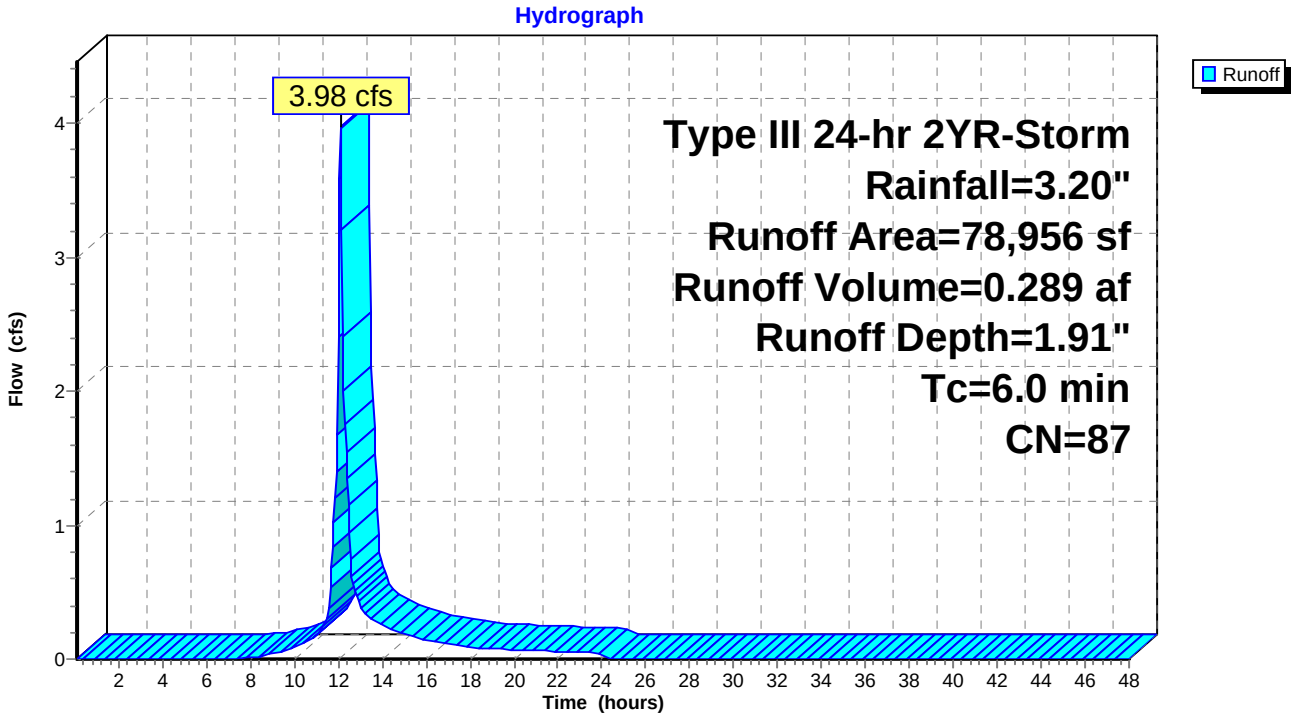
Runoff = 3.98 cfs @ 12.09 hrs, Volume= 0.289 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
40,047	98	Pavement
31,309	69	50-75% Grass cover, Fair, HSG B
7,600	98	Roof
78,956	87	Weighted Average
31,309		Pervious Area
47,647		Impervious Area

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

Subcatchment 2S: EXDA-2



Subcatchment 3S: EXDA-3

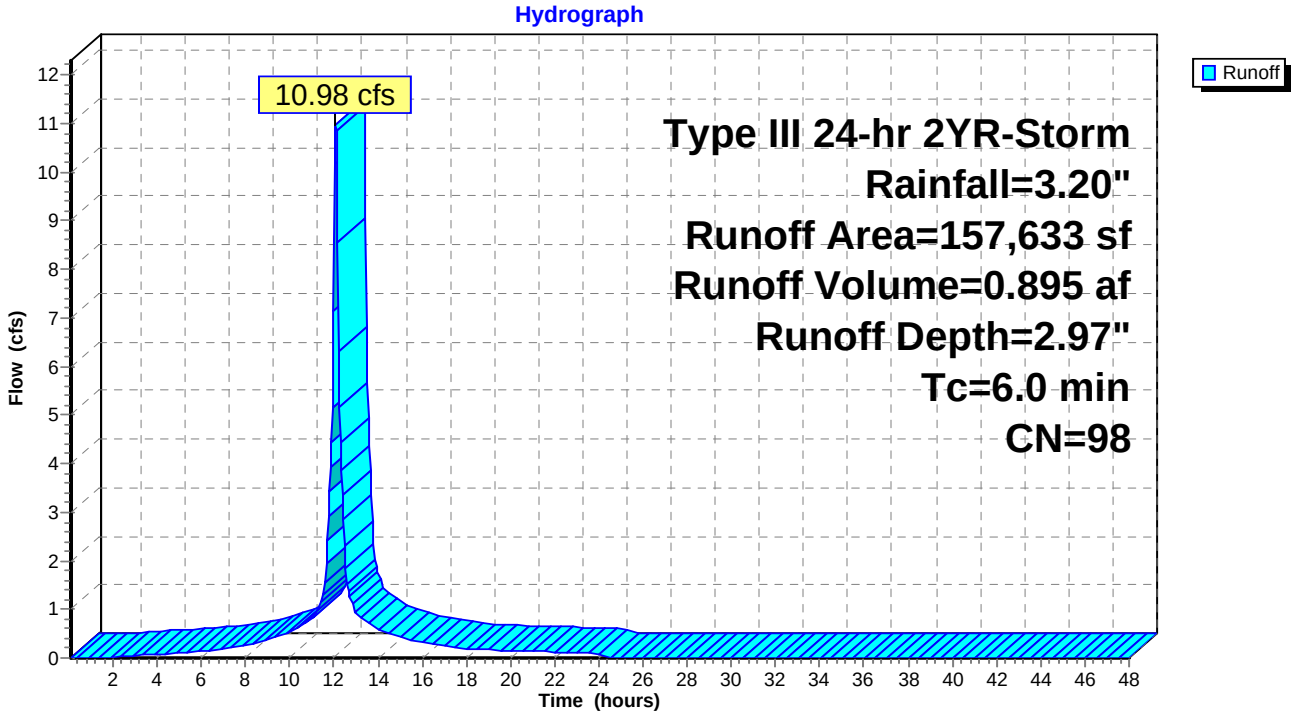
Runoff = 10.98 cfs @ 12.09 hrs, Volume= 0.895 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
157,633	98	Roof
157,633		Impervious Area

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

Subcatchment 3S: EXDA-3



Subcatchment 4S: EXDA-4

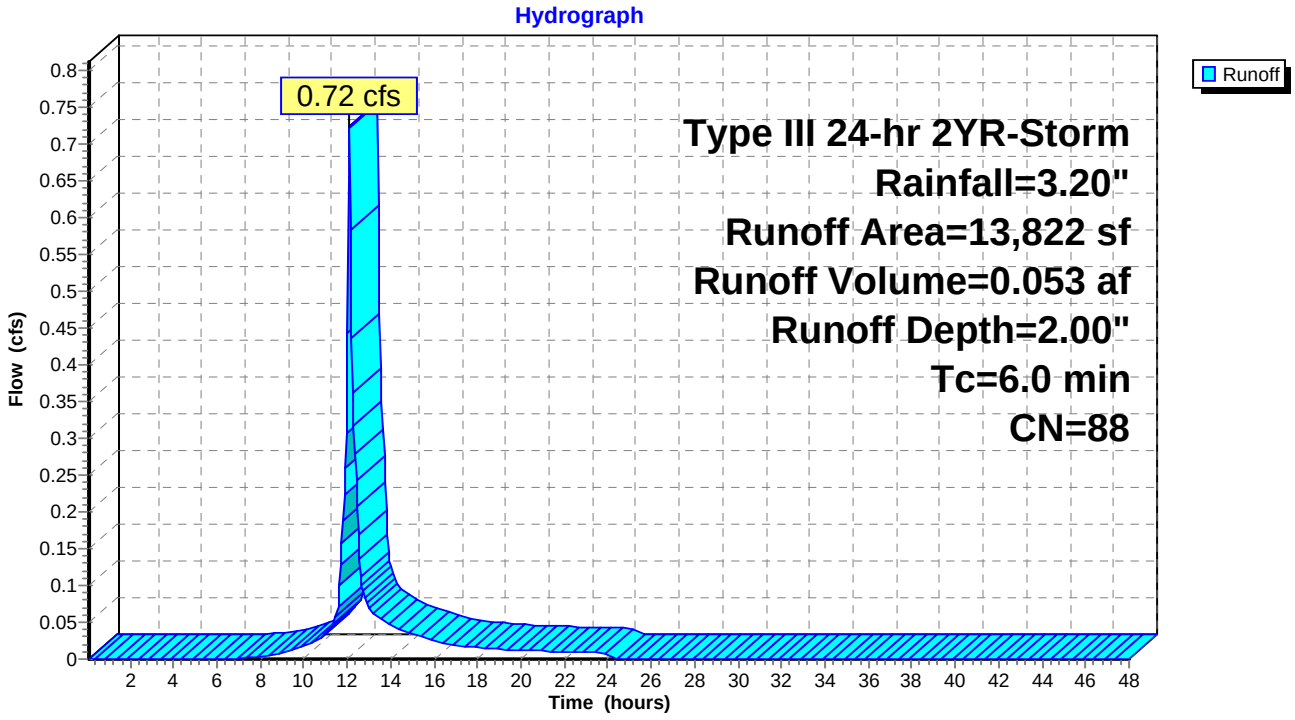
Runoff = 0.72 cfs @ 12.09 hrs, Volume= 0.053 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
8,546	98	Pavement
4,960	69	50-75% Grass cover, Fair, HSG B
316	98	Concrete Pad
13,822	88	Weighted Average
4,960		Pervious Area
8,862		Impervious Area

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

Subcatchment 4S: EXDA-4



Subcatchment 5S: EXDA-5

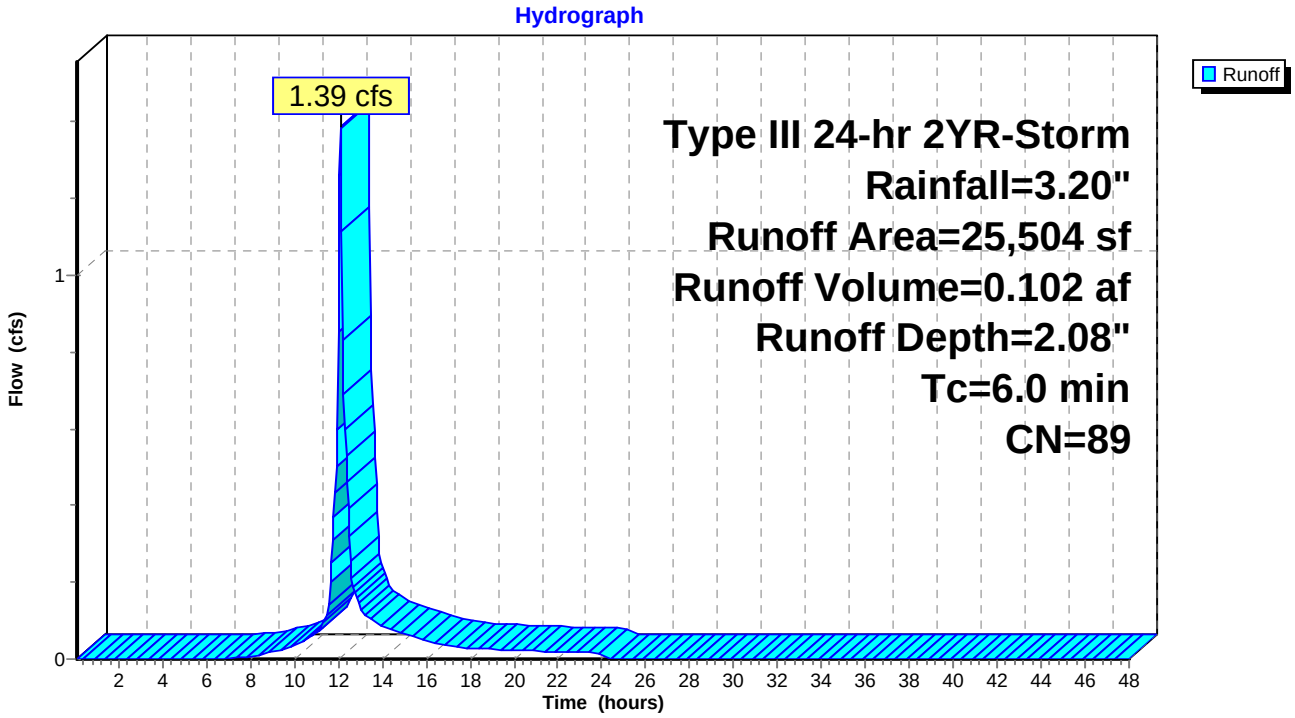
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.102 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
16,755	98	Pavement
7,765	69	50-75% Grass cover, Fair, HSG B
984	98	Concrete Pad
25,504	89	Weighted Average
7,765		Pervious Area
17,739		Impervious Area

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

Subcatchment 5S: EXDA-5



Subcatchment 6S: EXDA-6

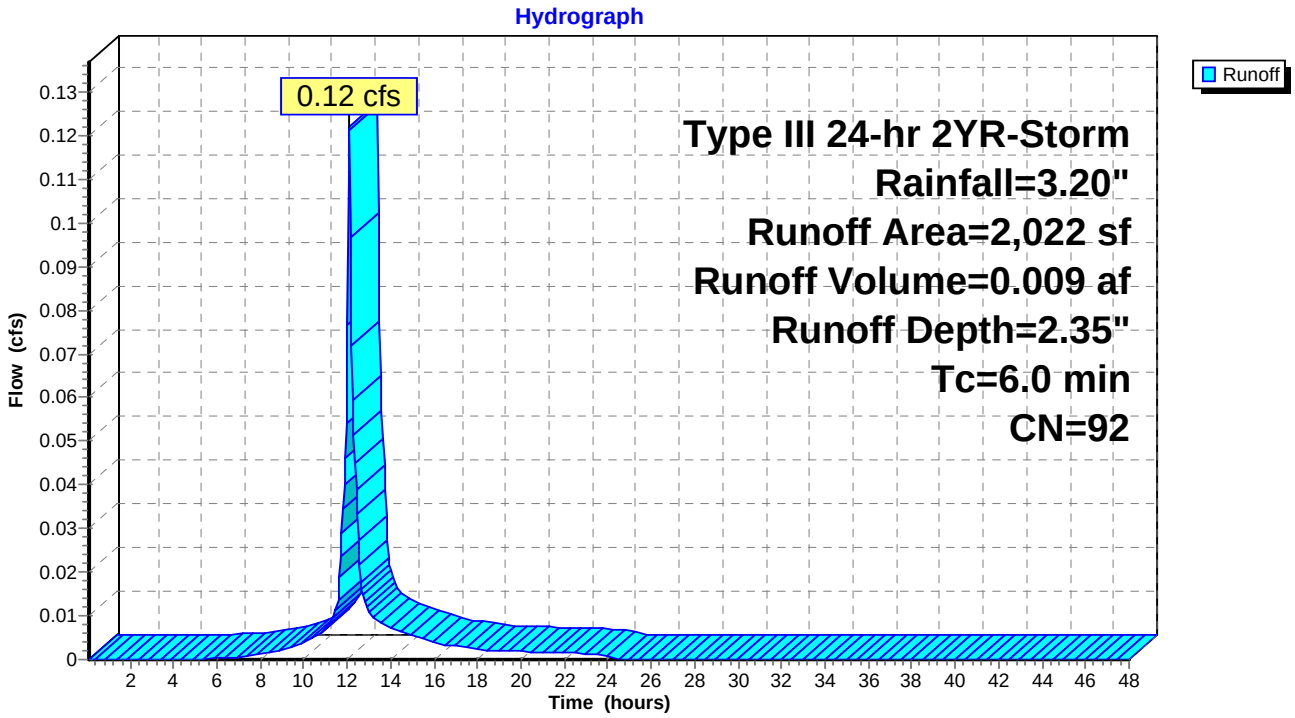
Runoff = 0.12 cfs @ 12.09 hrs, Volume= 0.009 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
1,622	98	Pavement
400	69	50-75% Grass cover, Fair, HSG B
2,022	92	Weighted Average
400		Pervious Area
1,622		Impervious Area

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

Subcatchment 6S: EXDA-6



Subcatchment 7S: EXDA-7

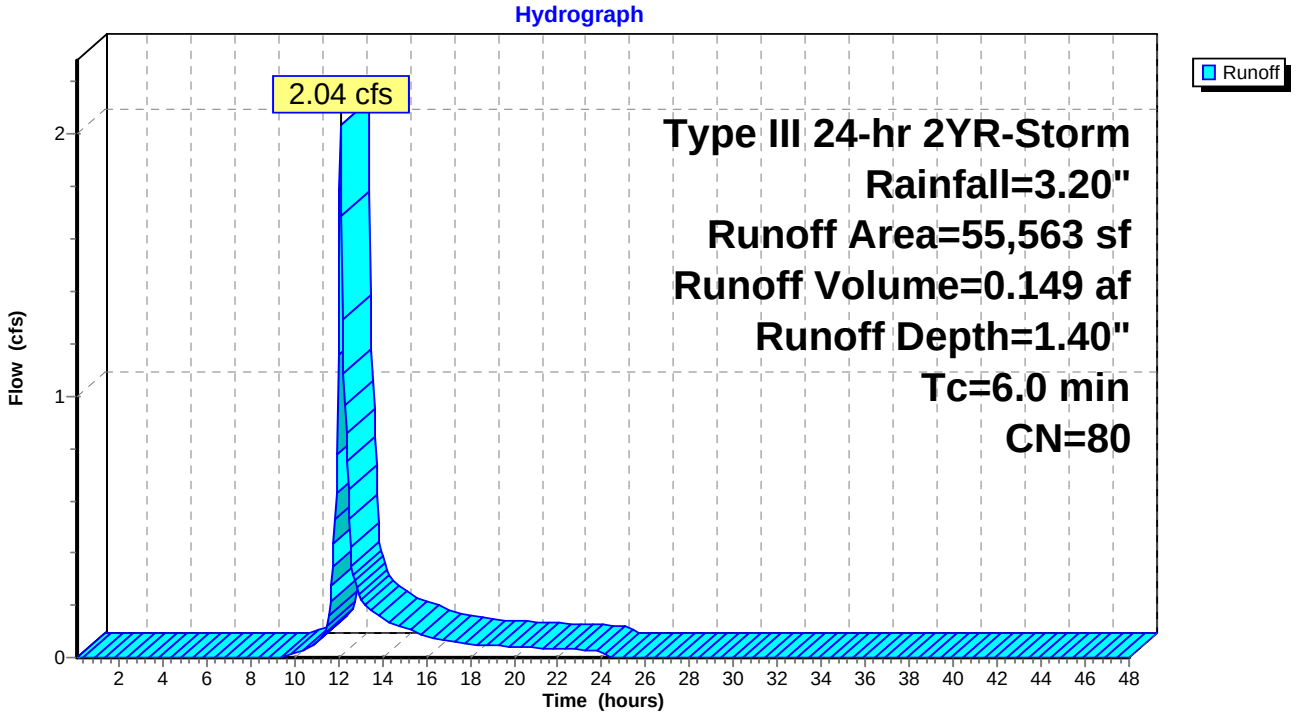
Runoff = 2.04 cfs @ 12.10 hrs, Volume= 0.149 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
19,119	98	Pavement
2,766	98	Roof
28,571	69	50-75% Grass cover, Fair, HSG B
5,107	60	Woods, Fair, HSG B
55,563	80	Weighted Average
33,678		Pervious Area
21,885		Impervious Area

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

Subcatchment 7S: EXDA-7

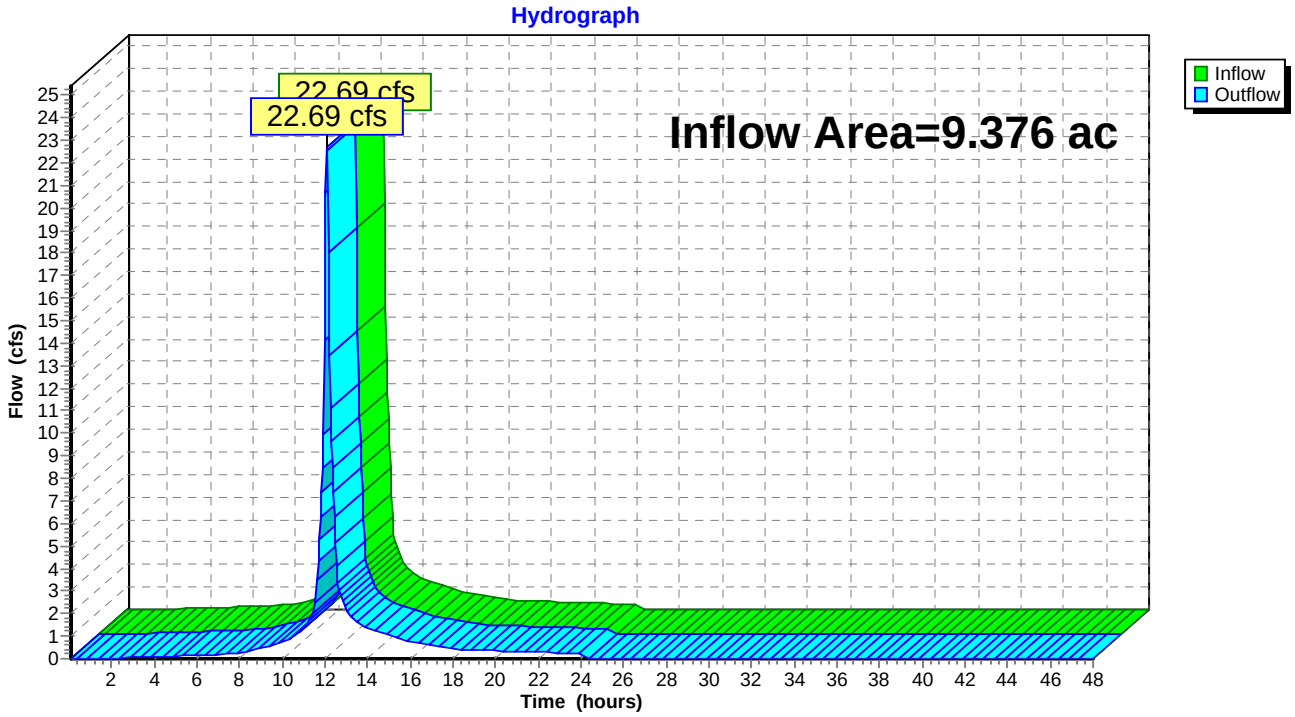


Reach 8R: wetlands

Inflow Area = 9.376 ac, Inflow Depth = 2.24" for 2YR-Storm event
Inflow = 22.69 cfs @ 12.09 hrs, Volume= 1.749 af
Outflow = 22.69 cfs @ 12.09 hrs, Volume= 1.749 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Reach 8R: wetlands



Time span=0.10-48.00 hrs, dt=0.05 hrs, 959 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: EXDA-1 Runoff Area=74,919 sf Runoff Depth=2.91"
Tc=6.0 min CN=85 Runoff=5.71 cfs 0.417 af

Subcatchment 2S: EXDA-2 Runoff Area=78,956 sf Runoff Depth=3.10"
Tc=6.0 min CN=87 Runoff=6.36 cfs 0.468 af

Subcatchment 3S: EXDA-3 Runoff Area=157,633 sf Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=15.54 cfs 1.286 af

Subcatchment 4S: EXDA-4 Runoff Area=13,822 sf Runoff Depth=3.20"
Tc=6.0 min CN=88 Runoff=1.14 cfs 0.085 af

Subcatchment 5S: EXDA-5 Runoff Area=25,504 sf Runoff Depth=3.30"
Tc=6.0 min CN=89 Runoff=2.16 cfs 0.161 af

Subcatchment 6S: EXDA-6 Runoff Area=2,022 sf Runoff Depth=3.60"
Tc=6.0 min CN=92 Runoff=0.18 cfs 0.014 af

Subcatchment 7S: EXDA-7 Runoff Area=55,563 sf Runoff Depth=2.46"
Tc=6.0 min CN=80 Runoff=3.61 cfs 0.262 af

Reach 8R: wetlands Inflow=34.69 cfs 2.692 af
Outflow=34.69 cfs 2.692 af

Total Runoff Area = 9.376 ac Runoff Volume = 2.692 af Average Runoff Depth = 3.45"
27.62% Pervious Area = 2.590 ac 72.38% Impervious Area = 6.786 ac

Subcatchment 1S: EXDA-1

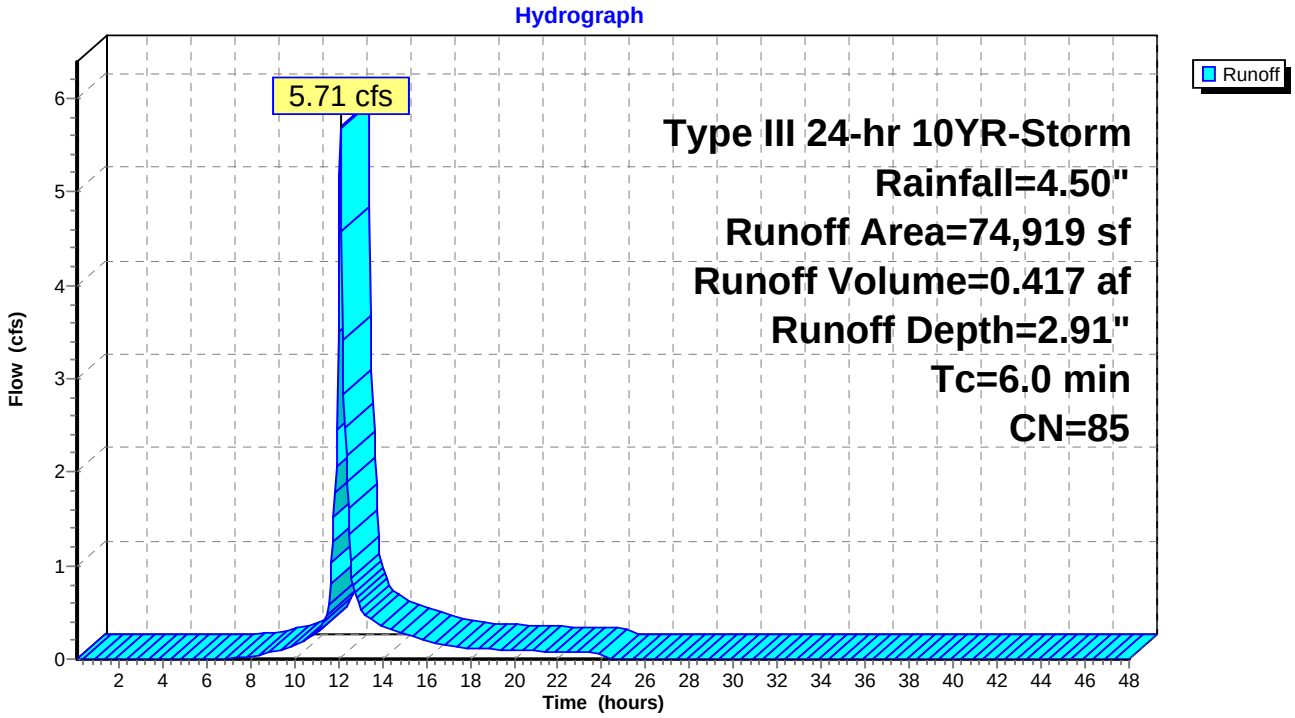
Runoff = 5.71 cfs @ 12.09 hrs, Volume= 0.417 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
31,221	98	Pavement
34,691	69	50-75% Grass cover, Fair, HSG B
9,007	98	Roof
74,919	85	Weighted Average
34,691		Pervious Area
40,228		Impervious Area

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

Subcatchment 1S: EXDA-1



Subcatchment 2S: EXDA-2

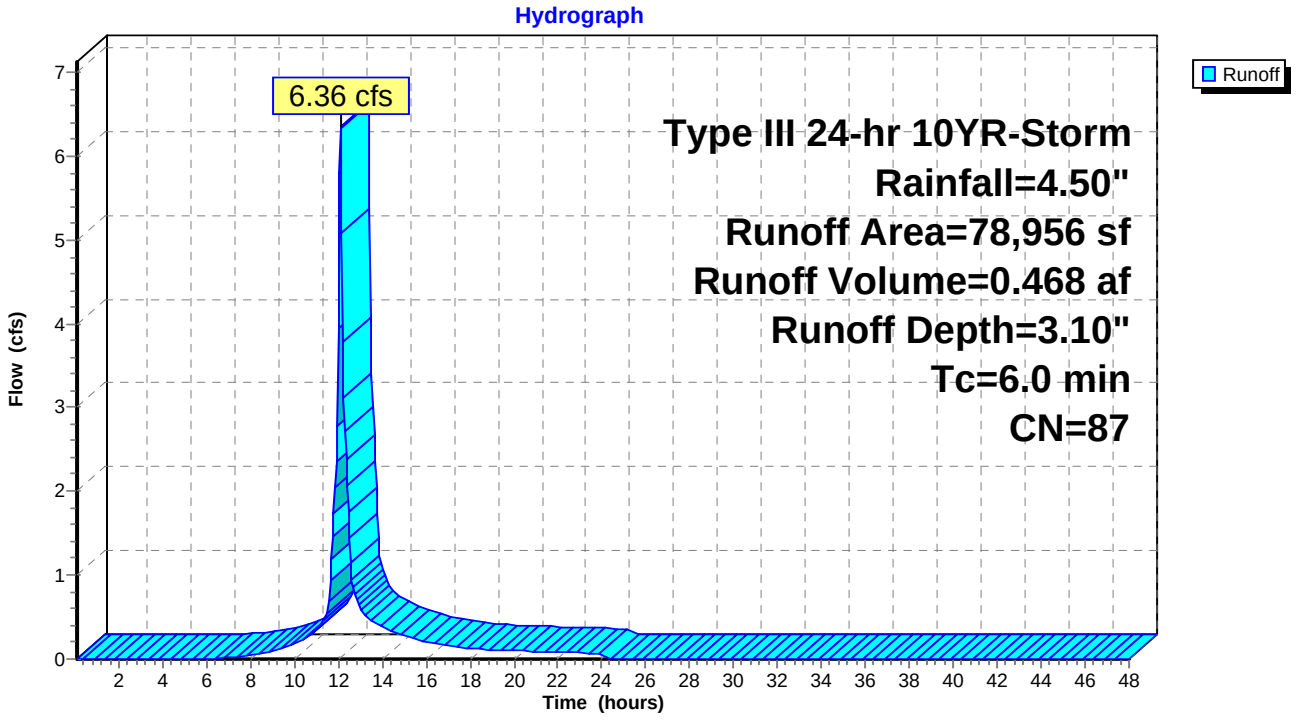
Runoff = 6.36 cfs @ 12.09 hrs, Volume= 0.468 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
40,047	98	Pavement
31,309	69	50-75% Grass cover, Fair, HSG B
7,600	98	Roof
78,956	87	Weighted Average
31,309		Pervious Area
47,647		Impervious Area

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

Subcatchment 2S: EXDA-2



Subcatchment 3S: EXDA-3

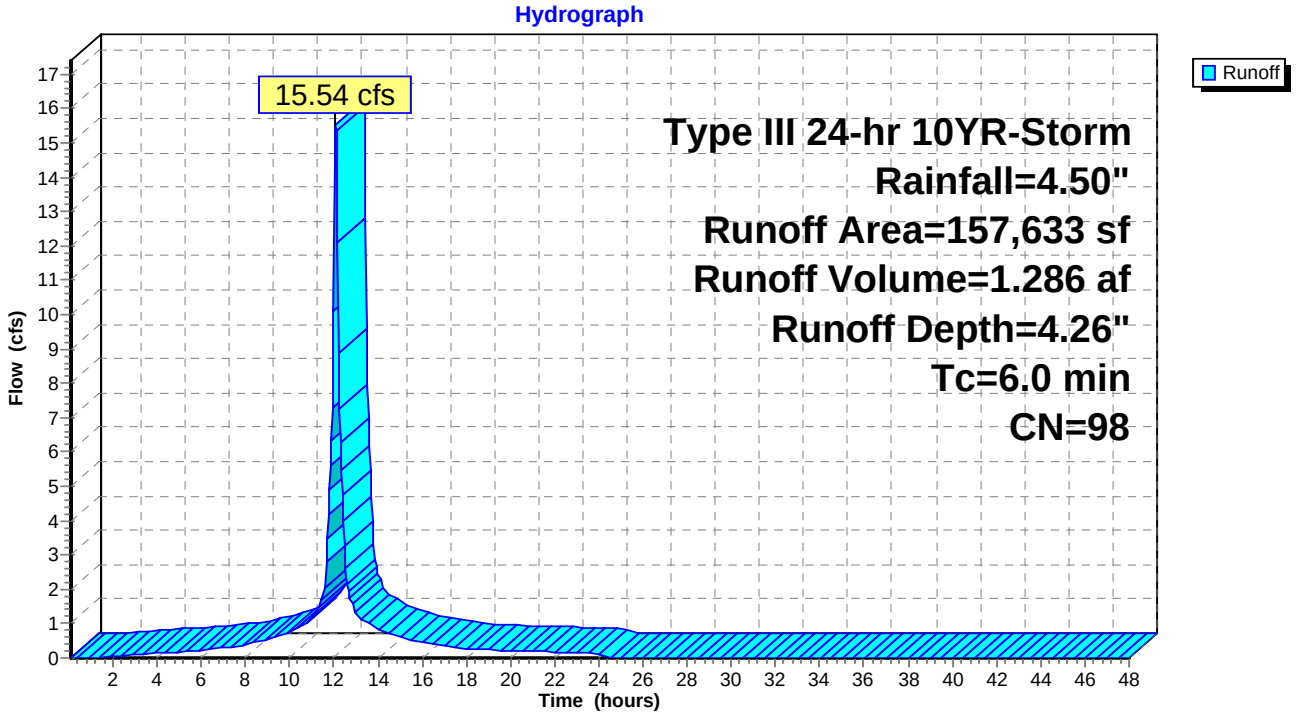
Runoff = 15.54 cfs @ 12.09 hrs, Volume= 1.286 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
157,633	98	Roof
157,633		Impervious Area

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

Subcatchment 3S: EXDA-3



Subcatchment 4S: EXDA-4

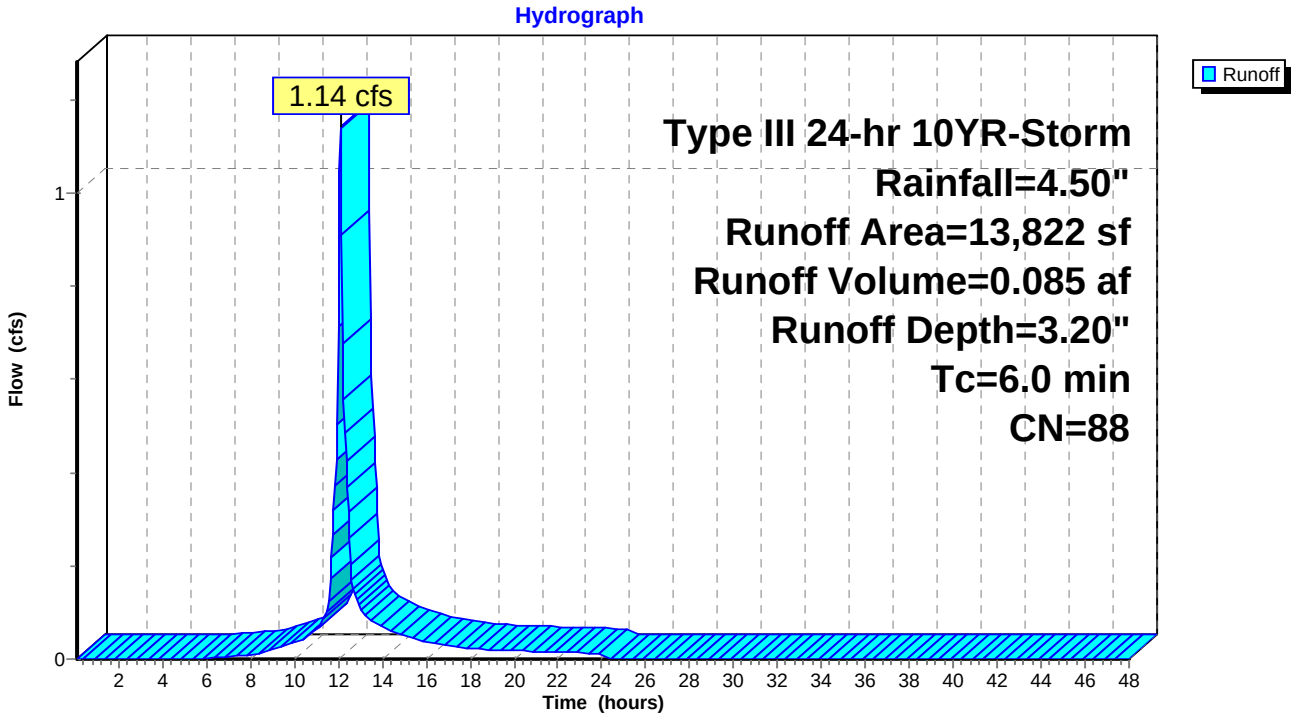
Runoff = 1.14 cfs @ 12.09 hrs, Volume= 0.085 af, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
8,546	98	Pavement
4,960	69	50-75% Grass cover, Fair, HSG B
316	98	Concrete Pad
13,822	88	Weighted Average
4,960		Pervious Area
8,862		Impervious Area

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

Subcatchment 4S: EXDA-4



Subcatchment 5S: EXDA-5

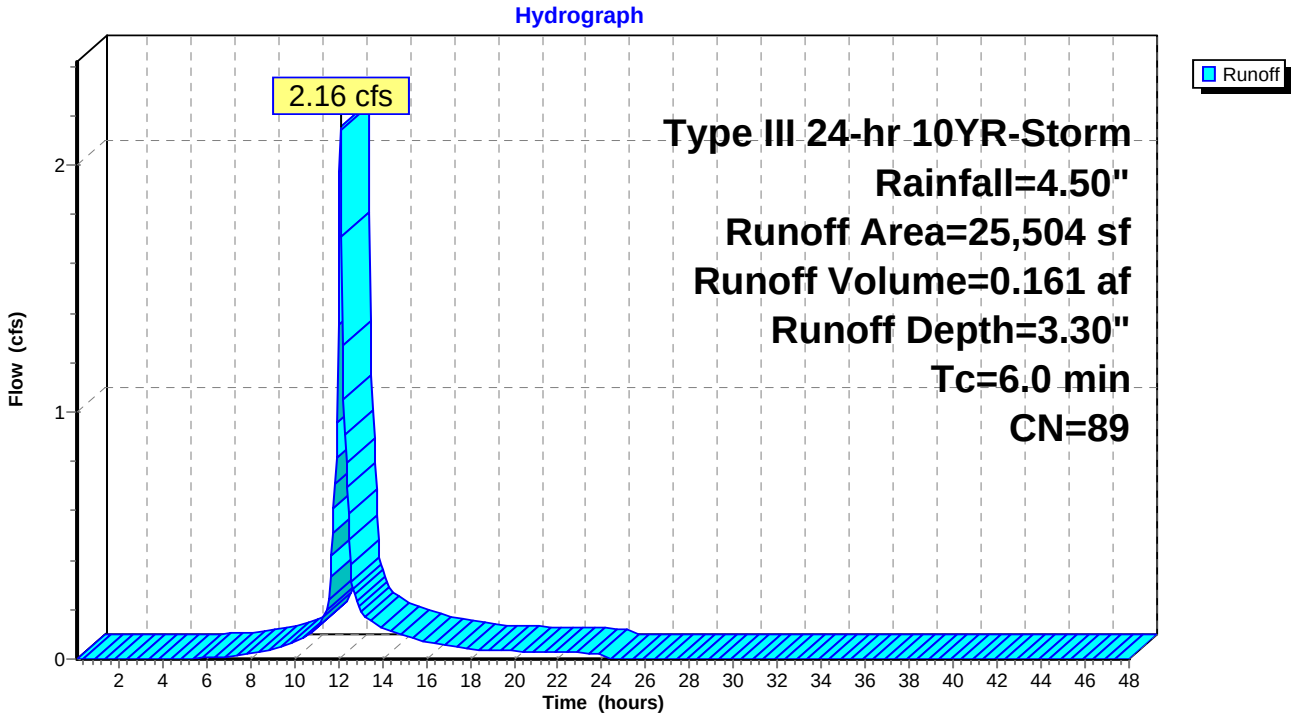
Runoff = 2.16 cfs @ 12.09 hrs, Volume= 0.161 af, Depth= 3.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
16,755	98	Pavement
7,765	69	50-75% Grass cover, Fair, HSG B
984	98	Concrete Pad
25,504	89	Weighted Average
7,765		Pervious Area
17,739		Impervious Area

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

Subcatchment 5S: EXDA-5



Subcatchment 6S: EXDA-6

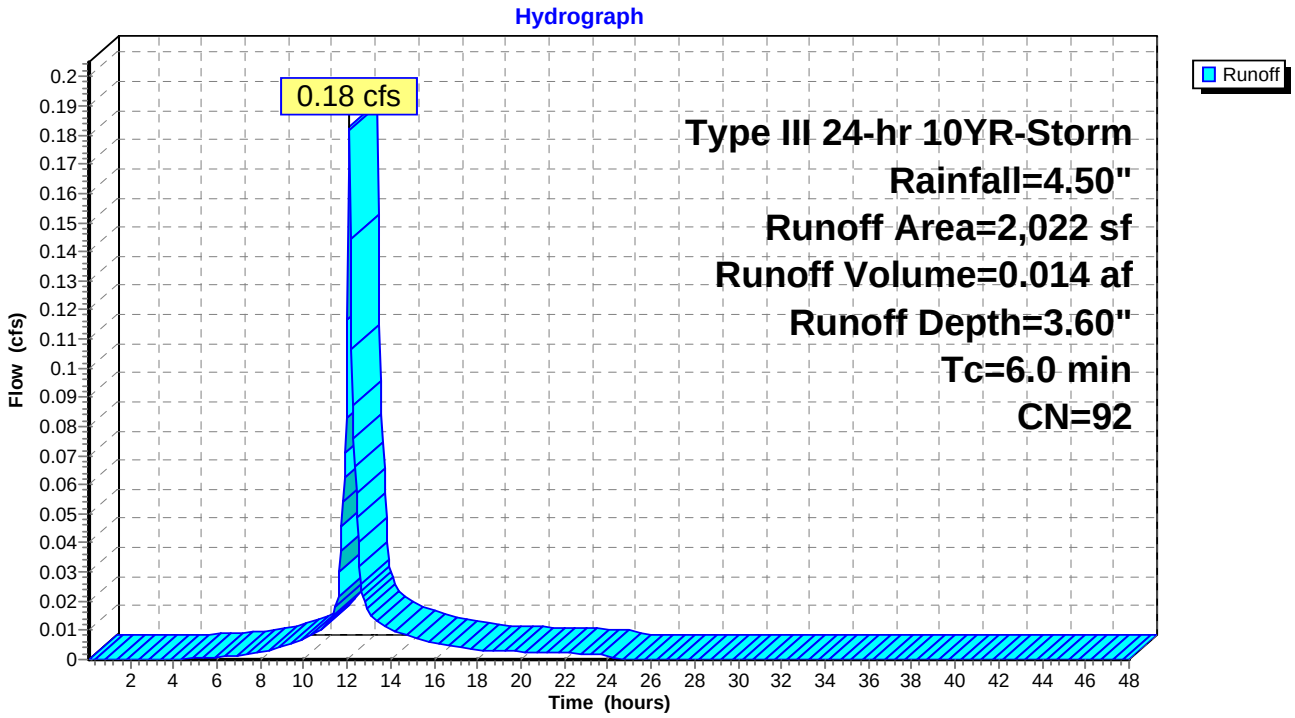
Runoff = 0.18 cfs @ 12.09 hrs, Volume= 0.014 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
1,622	98	Pavement
400	69	50-75% Grass cover, Fair, HSG B
2,022	92	Weighted Average
400		Pervious Area
1,622		Impervious Area

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

Subcatchment 6S: EXDA-6



Subcatchment 7S: EXDA-7

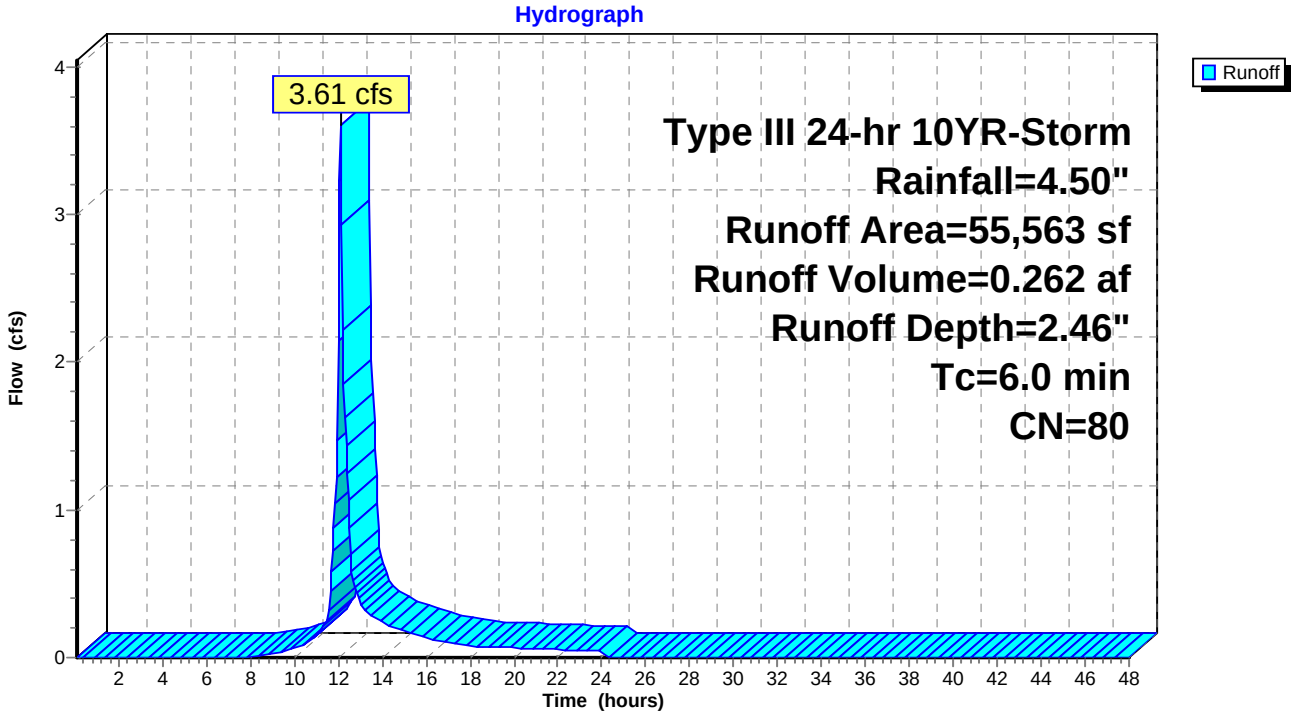
Runoff = 3.61 cfs @ 12.09 hrs, Volume= 0.262 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
19,119	98	Pavement
2,766	98	Roof
28,571	69	50-75% Grass cover, Fair, HSG B
5,107	60	Woods, Fair, HSG B
55,563	80	Weighted Average
33,678		Pervious Area
21,885		Impervious Area

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

Subcatchment 7S: EXDA-7

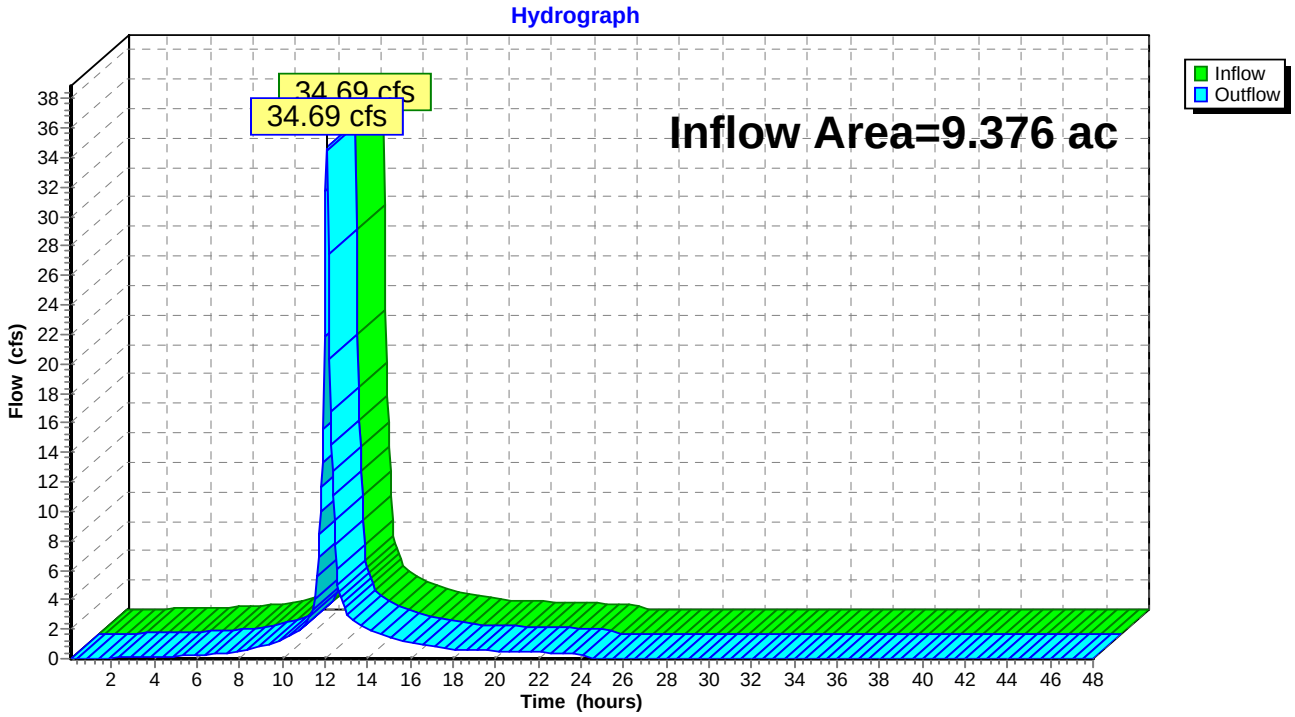


Reach 8R: wetlands

Inflow Area = 9.376 ac, Inflow Depth = 3.45" for 10YR-Storm event
Inflow = 34.69 cfs @ 12.09 hrs, Volume= 2.692 af
Outflow = 34.69 cfs @ 12.09 hrs, Volume= 2.692 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Reach 8R: wetlands



Time span=0.10-48.00 hrs, dt=0.05 hrs, 959 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: EXDA-1 Runoff Area=74,919 sf Runoff Depth=4.30"
Tc=6.0 min CN=85 Runoff=8.32 cfs 0.617 af

Subcatchment 2S: EXDA-2 Runoff Area=78,956 sf Runoff Depth=4.52"
Tc=6.0 min CN=87 Runoff=9.12 cfs 0.682 af

Subcatchment 3S: EXDA-3 Runoff Area=157,633 sf Runoff Depth=5.76"
Tc=6.0 min CN=98 Runoff=20.78 cfs 1.738 af

Subcatchment 4S: EXDA-4 Runoff Area=13,822 sf Runoff Depth=4.63"
Tc=6.0 min CN=88 Runoff=1.63 cfs 0.122 af

Subcatchment 5S: EXDA-5 Runoff Area=25,504 sf Runoff Depth=4.74"
Tc=6.0 min CN=89 Runoff=3.05 cfs 0.231 af

Subcatchment 6S: EXDA-6 Runoff Area=2,022 sf Runoff Depth=5.07"
Tc=6.0 min CN=92 Runoff=0.25 cfs 0.020 af

Subcatchment 7S: EXDA-7 Runoff Area=55,563 sf Runoff Depth=3.78"
Tc=6.0 min CN=80 Runoff=5.51 cfs 0.402 af

Reach 8R: wetlands Inflow=48.66 cfs 3.811 af
Outflow=48.66 cfs 3.811 af

Total Runoff Area = 9.376 ac Runoff Volume = 3.811 af Average Runoff Depth = 4.88"
27.62% Pervious Area = 2.590 ac 72.38% Impervious Area = 6.786 ac

Subcatchment 1S: EXDA-1

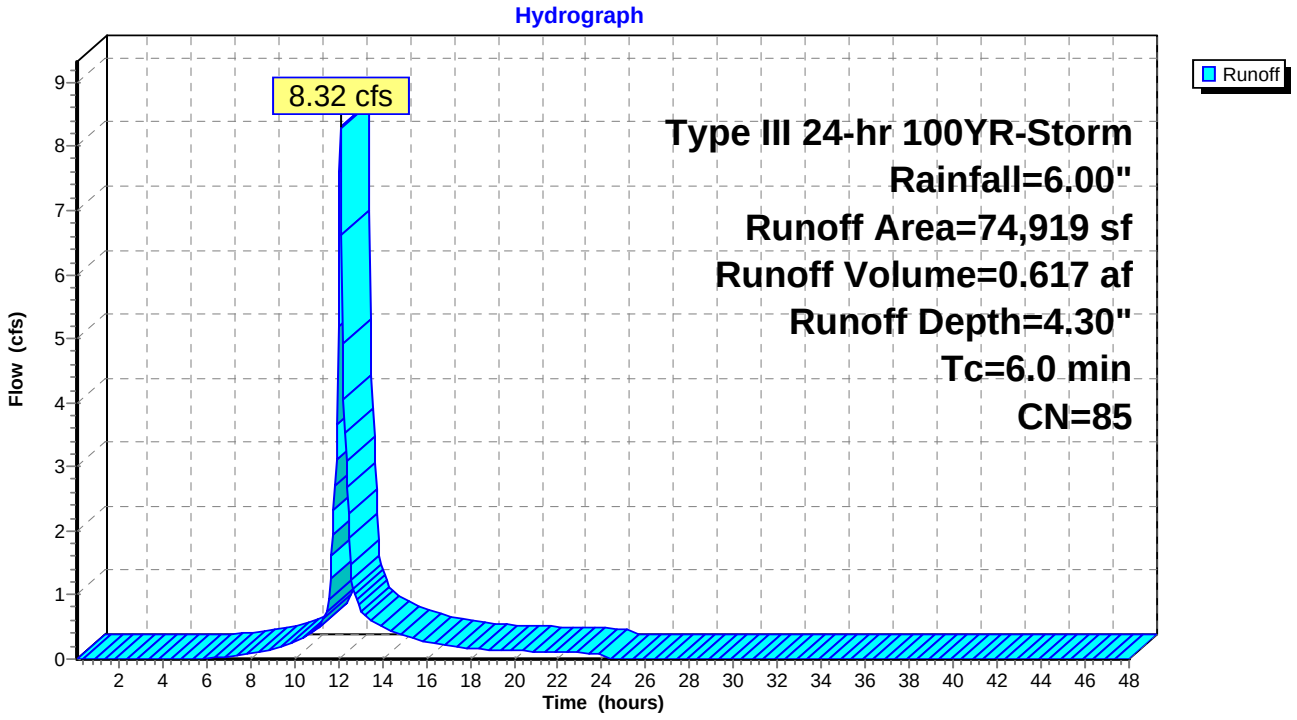
Runoff = 8.32 cfs @ 12.09 hrs, Volume= 0.617 af, Depth= 4.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
31,221	98	Pavement
34,691	69	50-75% Grass cover, Fair, HSG B
9,007	98	Roof
74,919	85	Weighted Average
34,691		Pervious Area
40,228		Impervious Area

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

Subcatchment 1S: EXDA-1



Subcatchment 2S: EXDA-2

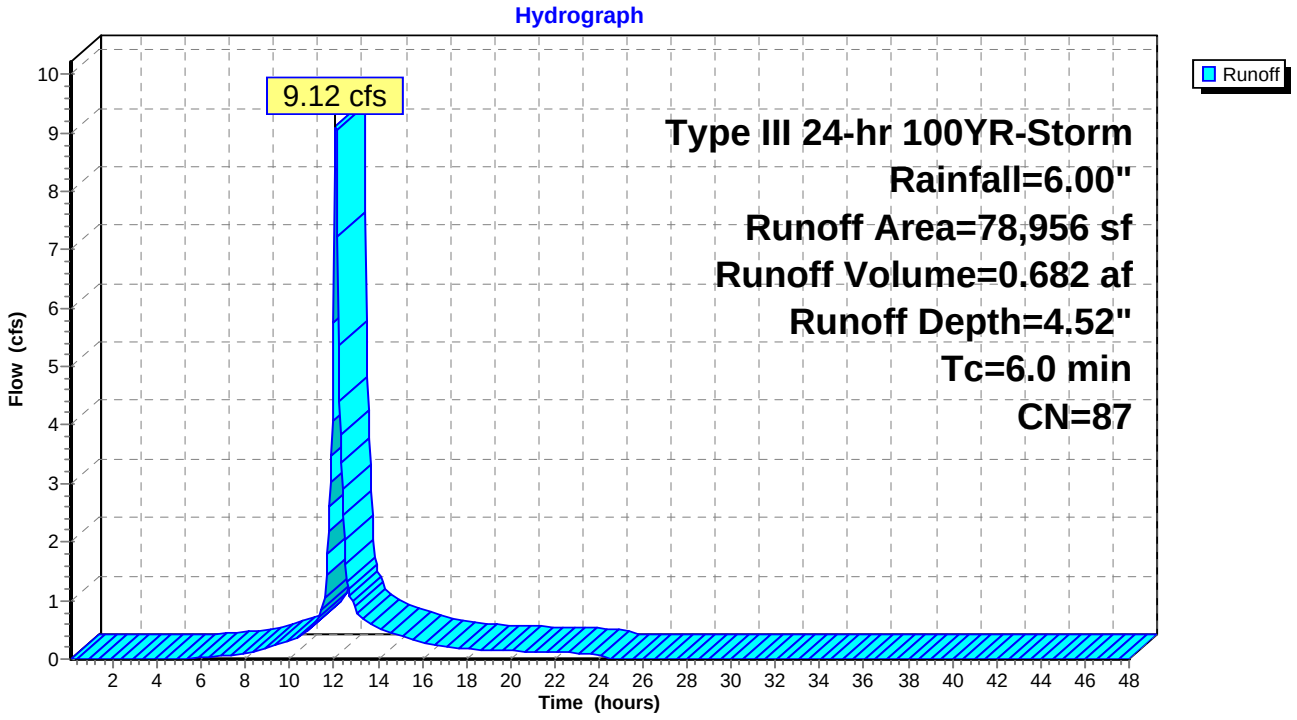
Runoff = 9.12 cfs @ 12.09 hrs, Volume= 0.682 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
40,047	98	Pavement
31,309	69	50-75% Grass cover, Fair, HSG B
7,600	98	Roof
78,956	87	Weighted Average
31,309		Pervious Area
47,647		Impervious Area

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

Subcatchment 2S: EXDA-2



Subcatchment 3S: EXDA-3

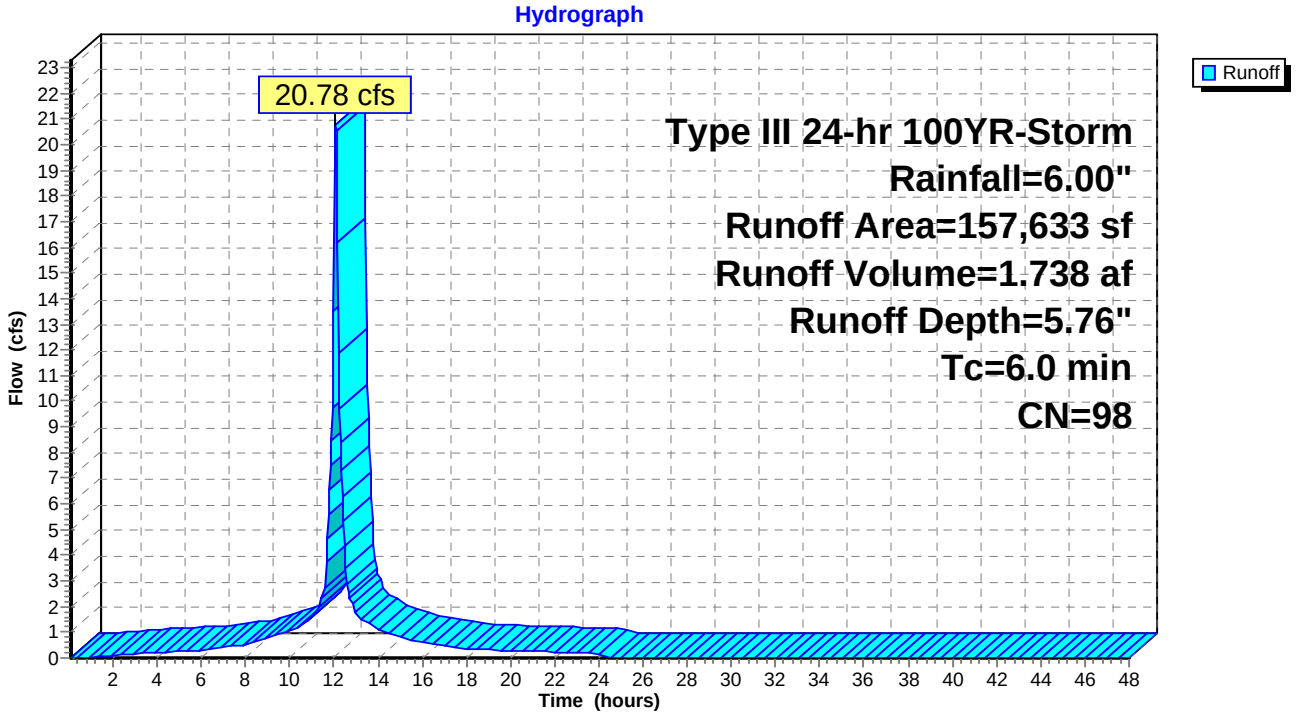
Runoff = 20.78 cfs @ 12.09 hrs, Volume= 1.738 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
157,633	98	Roof
157,633		Impervious Area

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

Subcatchment 3S: EXDA-3



Subcatchment 4S: EXDA-4

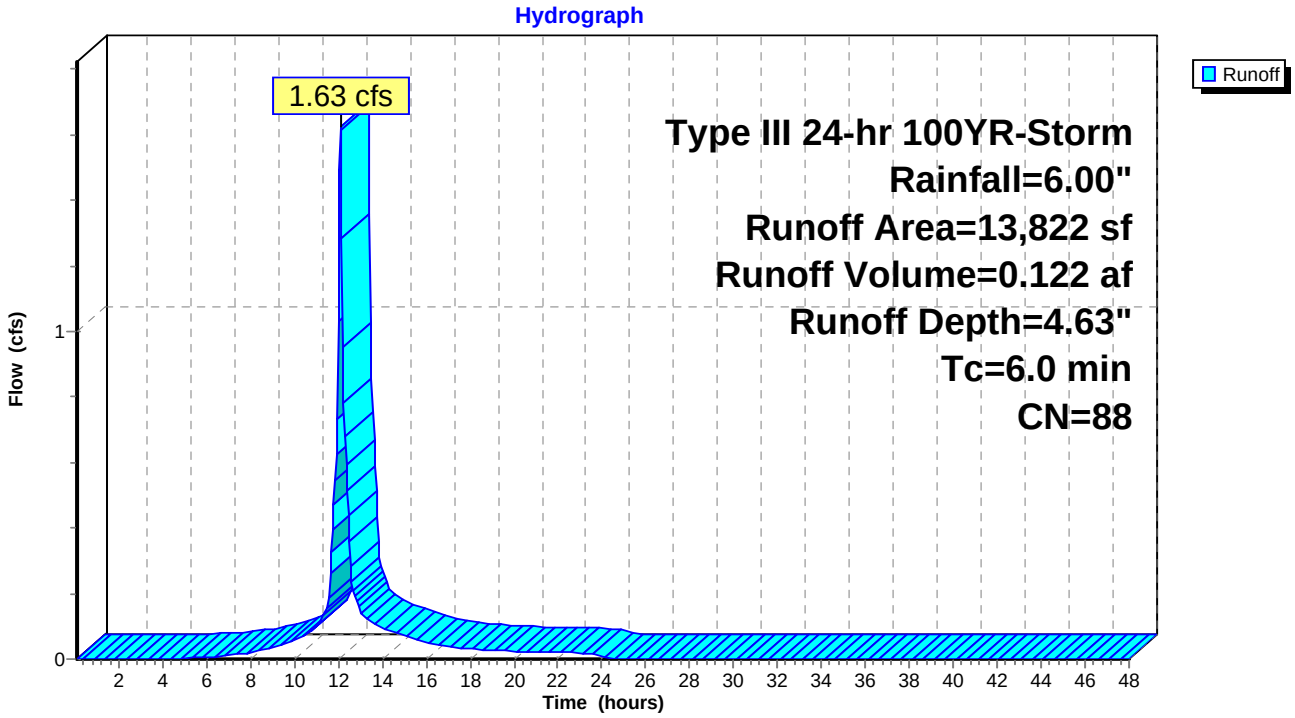
Runoff = 1.63 cfs @ 12.09 hrs, Volume= 0.122 af, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
8,546	98	Pavement
4,960	69	50-75% Grass cover, Fair, HSG B
316	98	Concrete Pad
13,822	88	Weighted Average
4,960		Pervious Area
8,862		Impervious Area

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

Subcatchment 4S: EXDA-4



Subcatchment 5S: EXDA-5

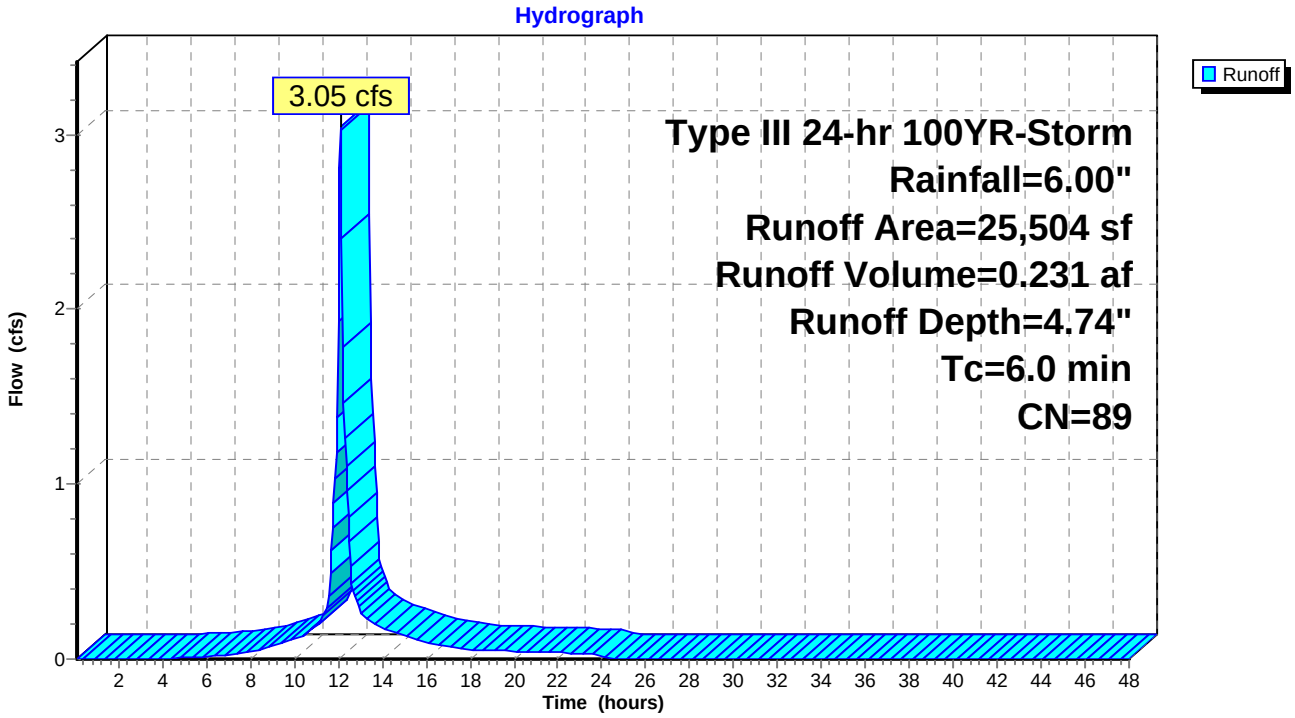
Runoff = 3.05 cfs @ 12.09 hrs, Volume= 0.231 af, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
16,755	98	Pavement
7,765	69	50-75% Grass cover, Fair, HSG B
984	98	Concrete Pad
25,504	89	Weighted Average
7,765		Pervious Area
17,739		Impervious Area

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

Subcatchment 5S: EXDA-5



Subcatchment 6S: EXDA-6

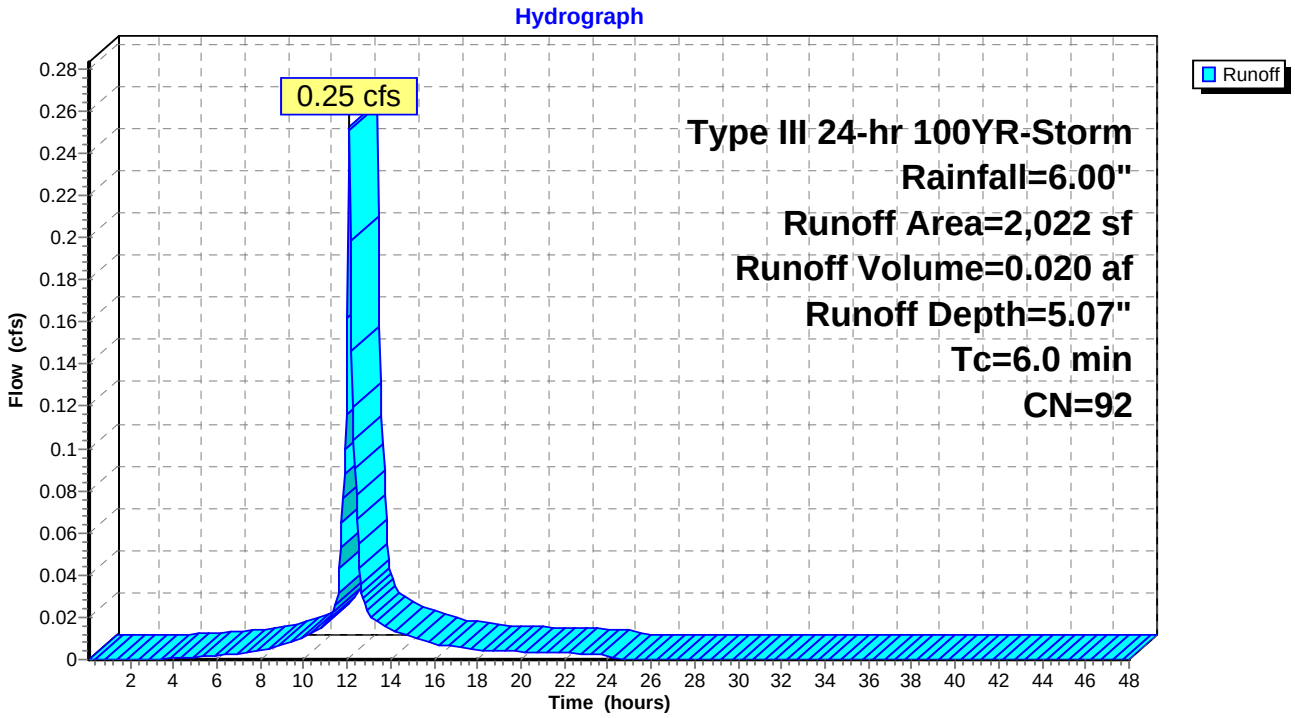
Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.020 af, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
1,622	98	Pavement
400	69	50-75% Grass cover, Fair, HSG B
2,022	92	Weighted Average
400		Pervious Area
1,622		Impervious Area

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

Subcatchment 6S: EXDA-6



Subcatchment 7S: EXDA-7

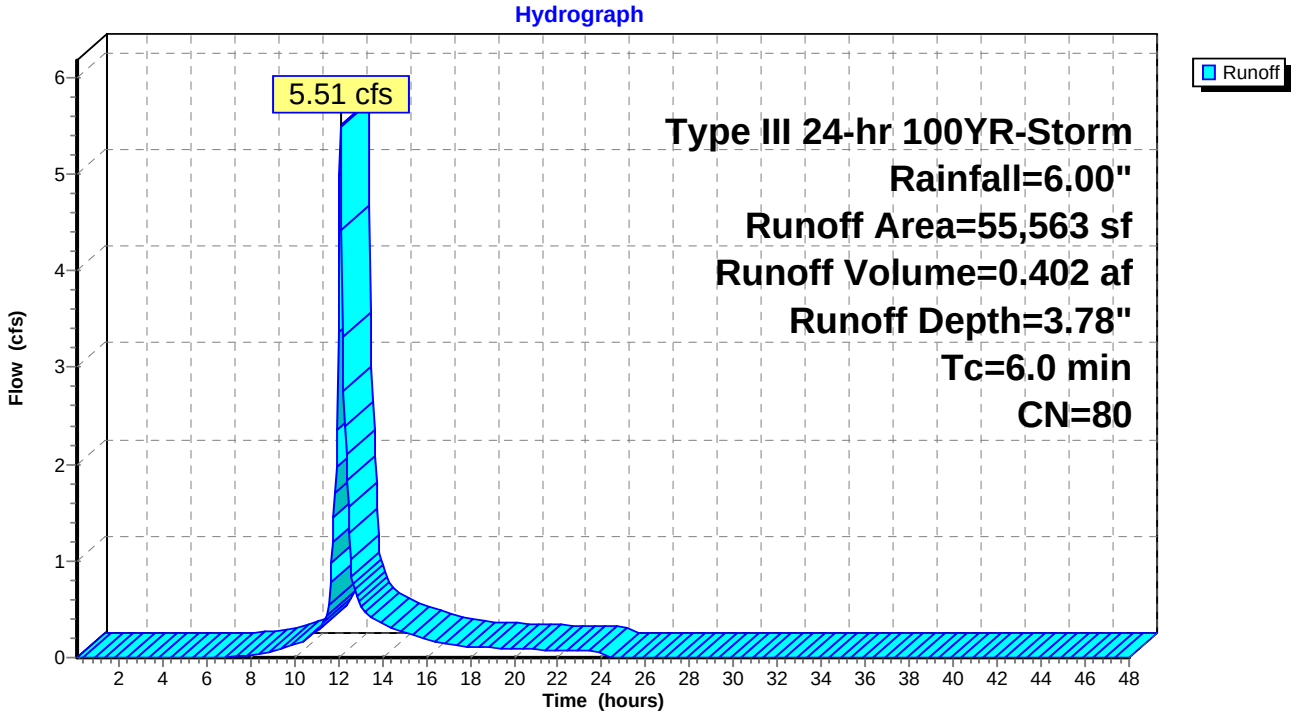
Runoff = 5.51 cfs @ 12.09 hrs, Volume= 0.402 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
19,119	98	Pavement
2,766	98	Roof
28,571	69	50-75% Grass cover, Fair, HSG B
5,107	60	Woods, Fair, HSG B
55,563	80	Weighted Average
33,678		Pervious Area
21,885		Impervious Area

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

Subcatchment 7S: EXDA-7

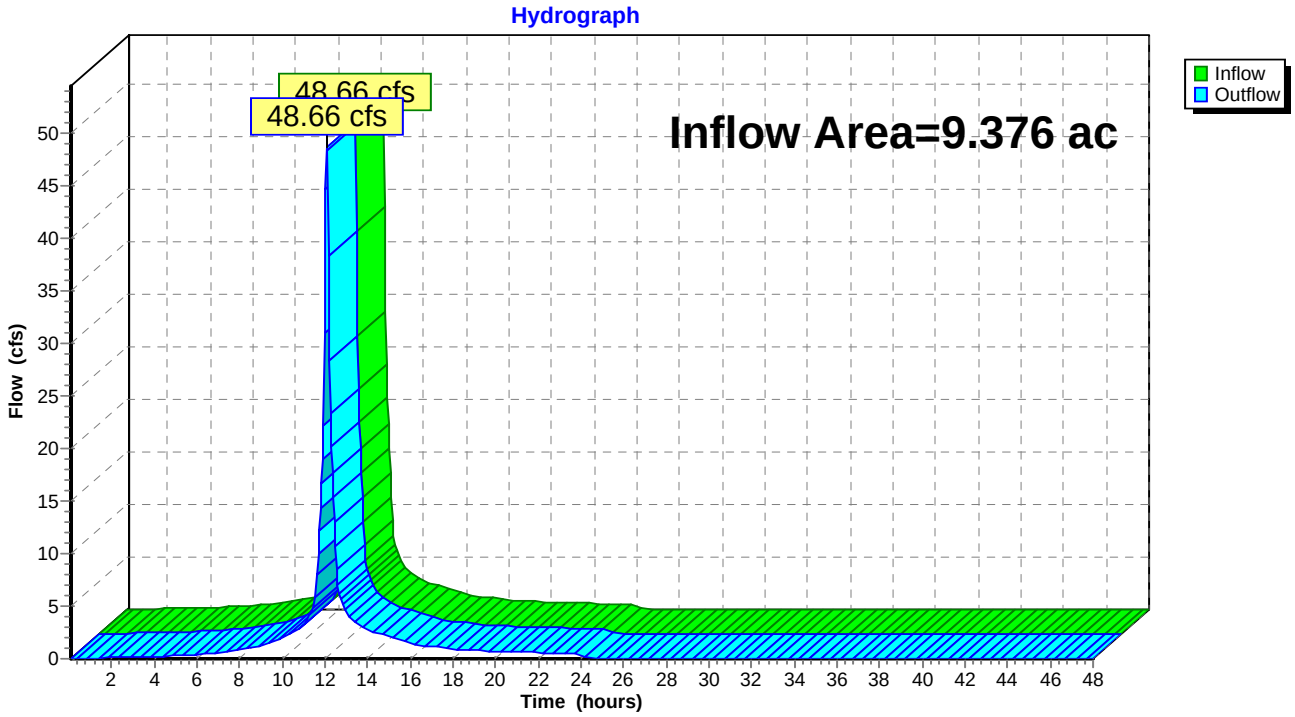


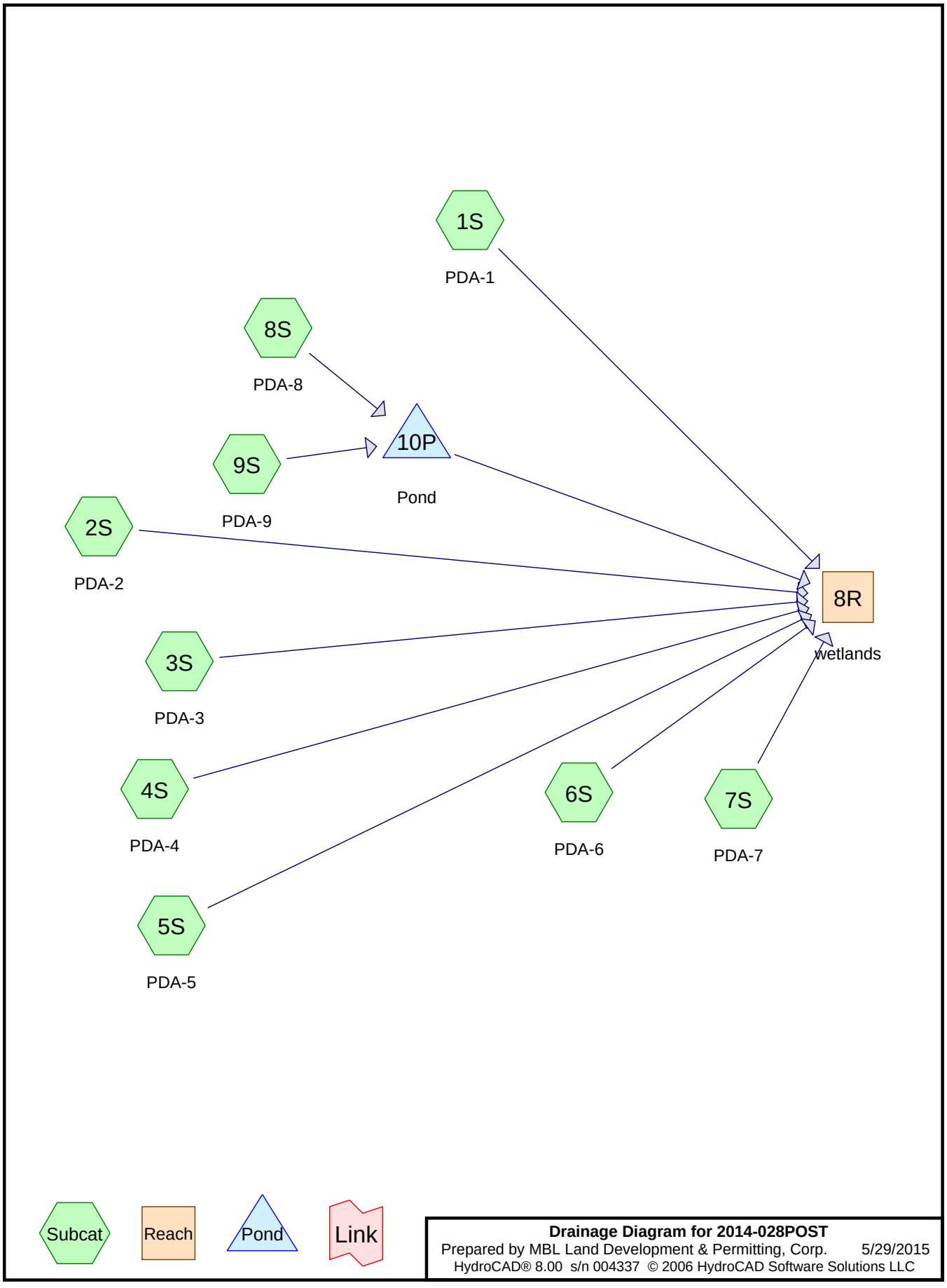
Reach 8R: wetlands

Inflow Area = 9.376 ac, Inflow Depth = 4.88" for 100YR-Storm event
Inflow = 48.66 cfs @ 12.09 hrs, Volume= 3.811 af
Outflow = 48.66 cfs @ 12.09 hrs, Volume= 3.811 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Reach 8R: wetlands





Drainage Diagram for 2014-028POST

Prepared by MBL Land Development & Permitting, Corp. 5/29/2015

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Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
0.117	60	Woods, Fair, HSG B (7S)
1.873	69	50-75% Grass cover, Fair, HSG B (1S,2S,4S,5S,6S,7S,8S)
0.047	87	Water (9S)
0.030	98	Concrete Pad (4S,5S)
3.155	98	Pavement (1S,2S,4S,5S,6S,7S,8S)
4.153	98	Roof (1S,2S,3S,7S)
9.375		

Time span=0.10-48.00 hrs, dt=0.05 hrs, 959 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: PDA-1 Runoff Area=48,929 sf Runoff Depth=2.45"
Tc=6.0 min CN=93 Runoff=3.05 cfs 0.229 af

Subcatchment 2S: PDA-2 Runoff Area=70,790 sf Runoff Depth=2.08"
Tc=6.0 min CN=89 Runoff=3.86 cfs 0.282 af

Subcatchment 3S: PDA-3 Runoff Area=161,513 sf Runoff Depth=2.97"
Tc=6.0 min CN=98 Runoff=11.25 cfs 0.917 af

Subcatchment 4S: PDA-4 Runoff Area=9,942 sf Runoff Depth=1.84"
Tc=6.0 min CN=86 Runoff=0.48 cfs 0.035 af

Subcatchment 5S: PDA-5 Runoff Area=25,504 sf Runoff Depth=2.08"
Tc=6.0 min CN=89 Runoff=1.39 cfs 0.102 af

Subcatchment 6S: PDA-6 Runoff Area=2,022 sf Runoff Depth=2.35"
Tc=6.0 min CN=92 Runoff=0.12 cfs 0.009 af

Subcatchment 7S: PDA-7 Runoff Area=55,563 sf Runoff Depth=1.40"
Tc=6.0 min CN=80 Runoff=2.04 cfs 0.149 af

Reach 8R: wetlands Inflow=22.17 cfs 1.735 af
Outflow=22.17 cfs 1.735 af

Subcatchment 8S: PDA-8 Runoff Area=32,068 sf Runoff Depth=2.17"
Tc=6.0 min CN=90 Runoff=1.81 cfs 0.133 af

Subcatchment 9S: PDA-9 Runoff Area=2,061 sf Runoff Depth=1.91"
Tc=6.0 min CN=87 Runoff=0.10 cfs 0.008 af

Pond 10P: Pond Peak Elev=209.61' Storage=3,613 cf Inflow=1.92 cfs 0.141 af
Discarded=0.05 cfs 0.121 af Primary=0.10 cfs 0.013 af Outflow=0.15 cfs 0.134 af

Total Runoff Area = 9.375 ac Runoff Volume = 1.863 af Average Runoff Depth = 2.38"
21.74% Pervious Area = 2.038 ac 78.26% Impervious Area = 7.337 ac

Subcatchment 1S: PDA-1

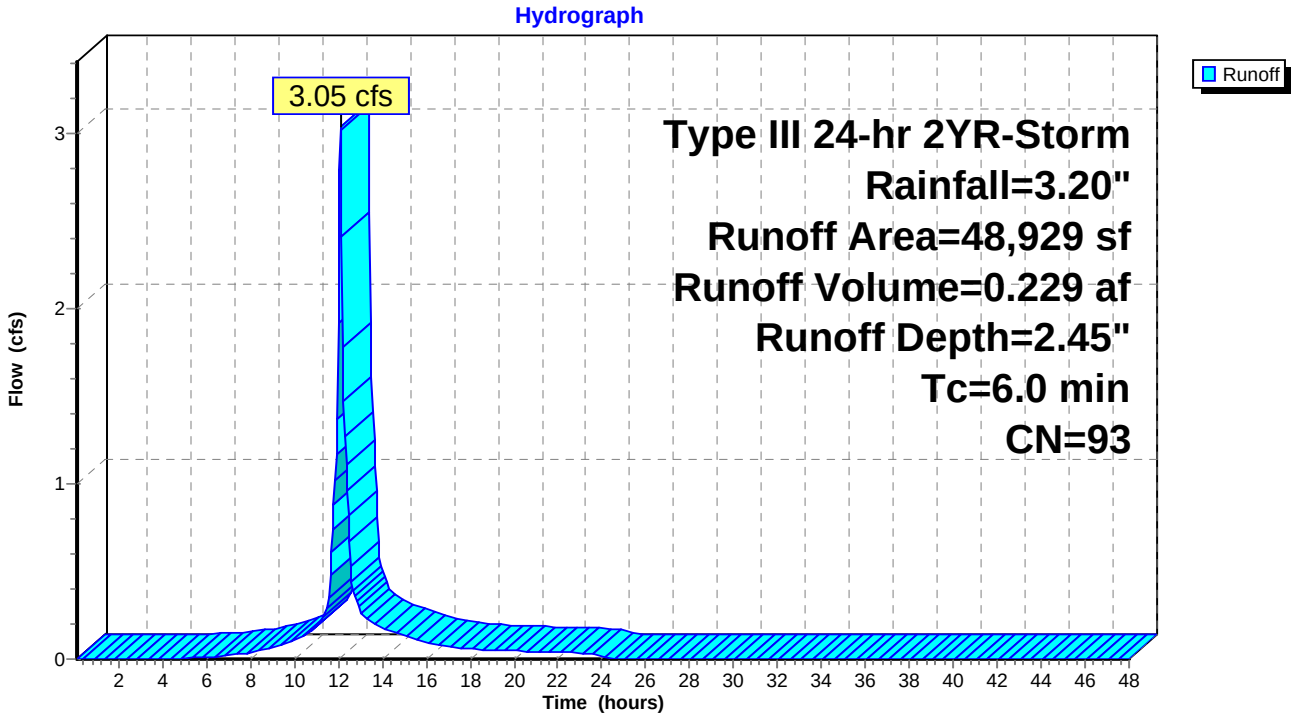
Runoff = 3.05 cfs @ 12.09 hrs, Volume= 0.229 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
31,194	98	Pavement
8,728	69	50-75% Grass cover, Fair, HSG B
9,007	98	Roof
48,929	93	Weighted Average
8,728		Pervious Area
40,201		Impervious Area

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

Subcatchment 1S: PDA-1



Subcatchment 2S: PDA-2

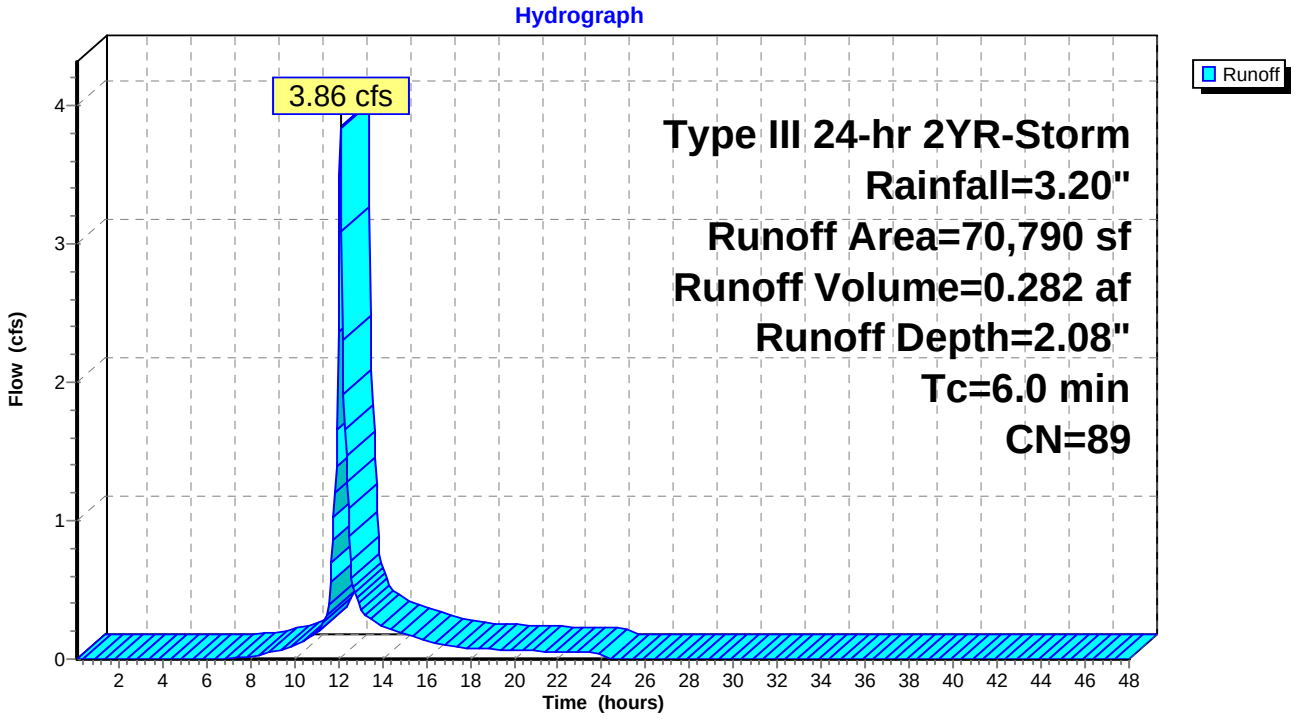
Runoff = 3.86 cfs @ 12.09 hrs, Volume= 0.282 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
40,047	98	Pavement
23,143	69	50-75% Grass cover, Fair, HSG B
7,600	98	Roof
70,790	89	Weighted Average
23,143		Pervious Area
47,647		Impervious Area

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

Subcatchment 2S: PDA-2



Subcatchment 3S: PDA-3

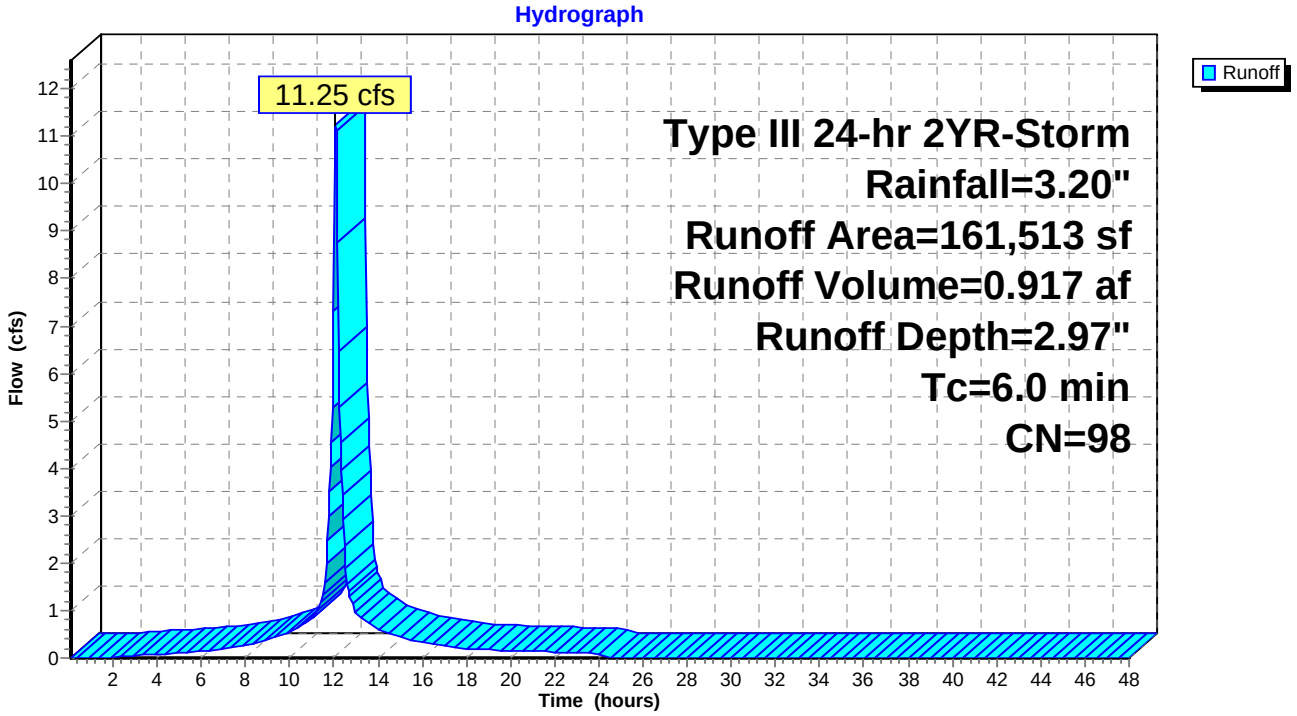
Runoff = 11.25 cfs @ 12.09 hrs, Volume= 0.917 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
161,513	98	Roof
161,513		Impervious Area

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

Subcatchment 3S: PDA-3



Subcatchment 4S: PDA-4

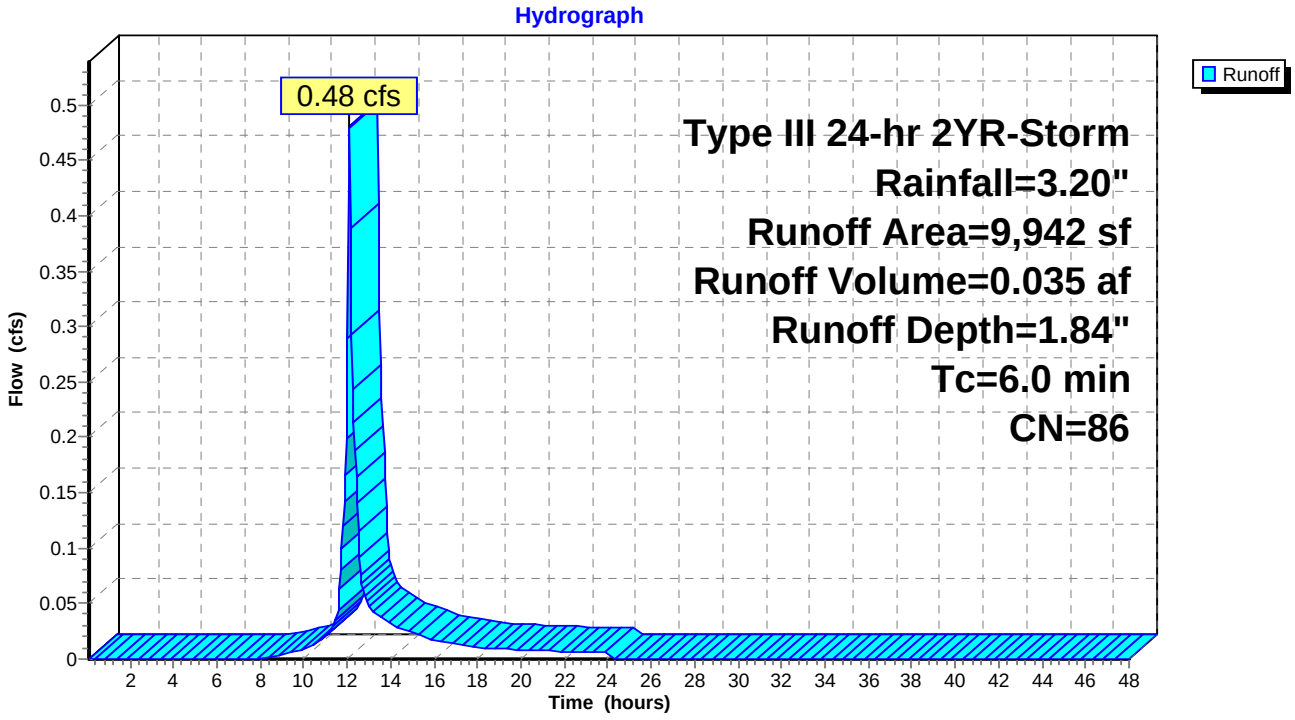
Runoff = 0.48 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
5,671	98	Pavement
3,955	69	50-75% Grass cover, Fair, HSG B
316	98	Concrete Pad
9,942	86	Weighted Average
3,955		Pervious Area
5,987		Impervious Area

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

Subcatchment 4S: PDA-4



Subcatchment 5S: PDA-5

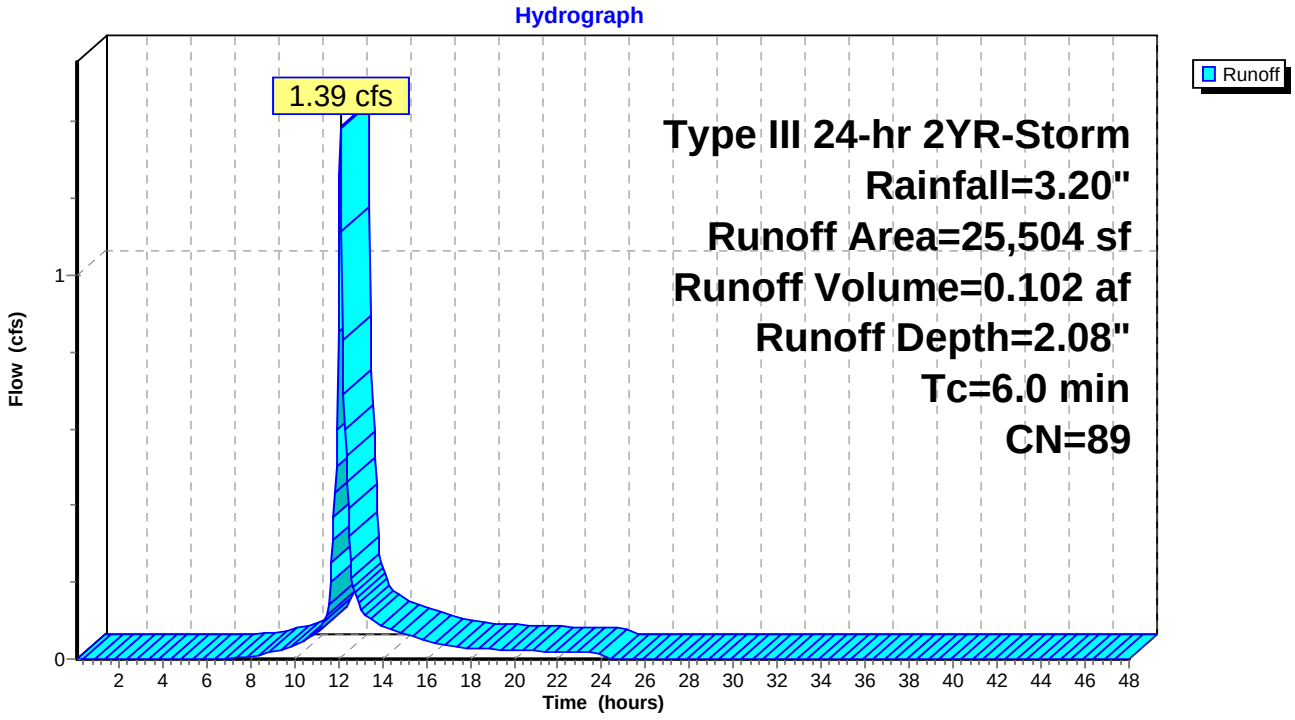
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.102 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
16,755	98	Pavement
7,765	69	50-75% Grass cover, Fair, HSG B
984	98	Concrete Pad
25,504	89	Weighted Average
7,765		Pervious Area
17,739		Impervious Area

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

Subcatchment 5S: PDA-5



Subcatchment 6S: PDA-6

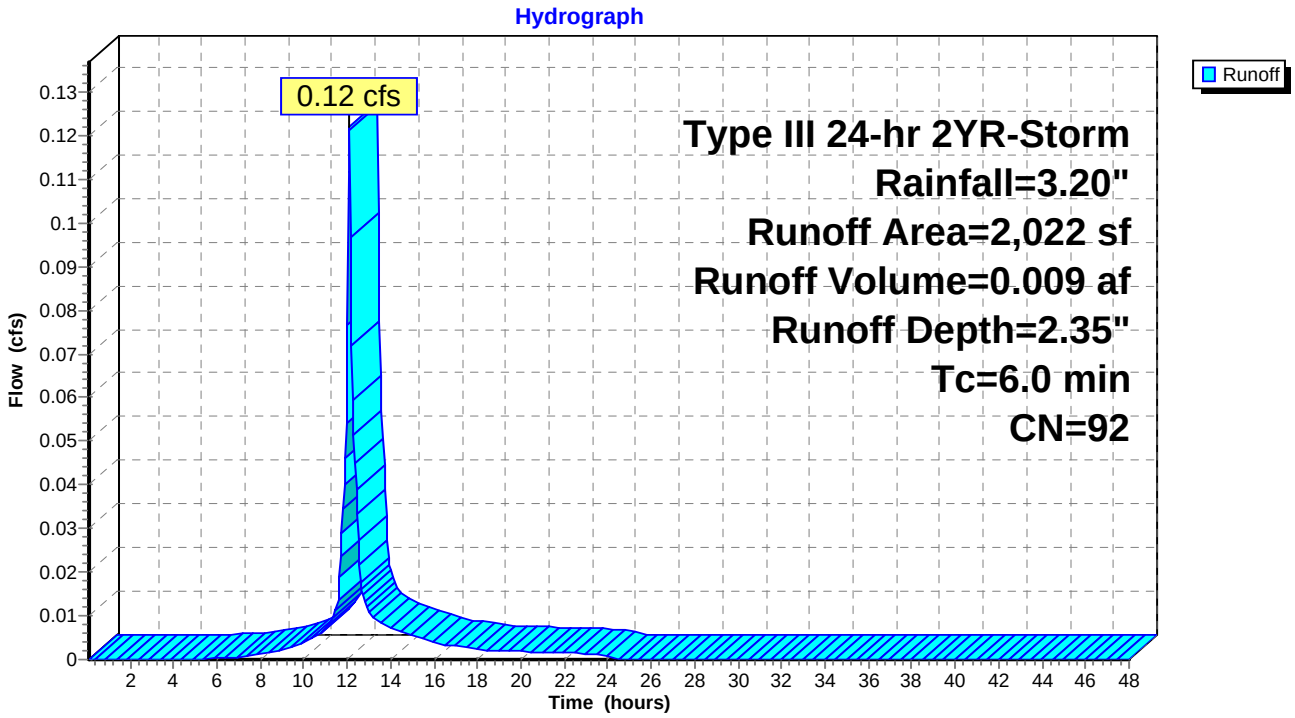
Runoff = 0.12 cfs @ 12.09 hrs, Volume= 0.009 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
1,622	98	Pavement
400	69	50-75% Grass cover, Fair, HSG B
2,022	92	Weighted Average
400		Pervious Area
1,622		Impervious Area

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

Subcatchment 6S: PDA-6



Subcatchment 7S: PDA-7

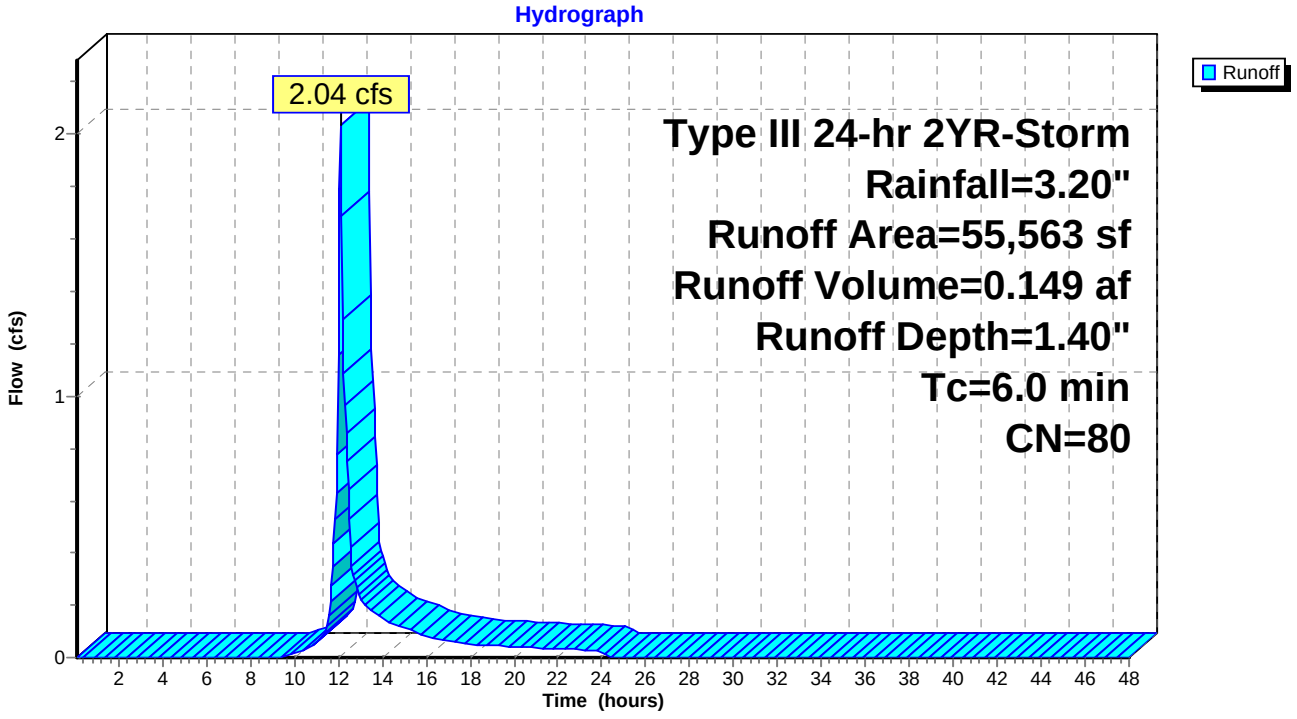
Runoff = 2.04 cfs @ 12.10 hrs, Volume= 0.149 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
19,119	98	Pavement
2,766	98	Roof
28,571	69	50-75% Grass cover, Fair, HSG B
5,107	60	Woods, Fair, HSG B
55,563	80	Weighted Average
33,678		Pervious Area
21,885		Impervious Area

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

Subcatchment 7S: PDA-7

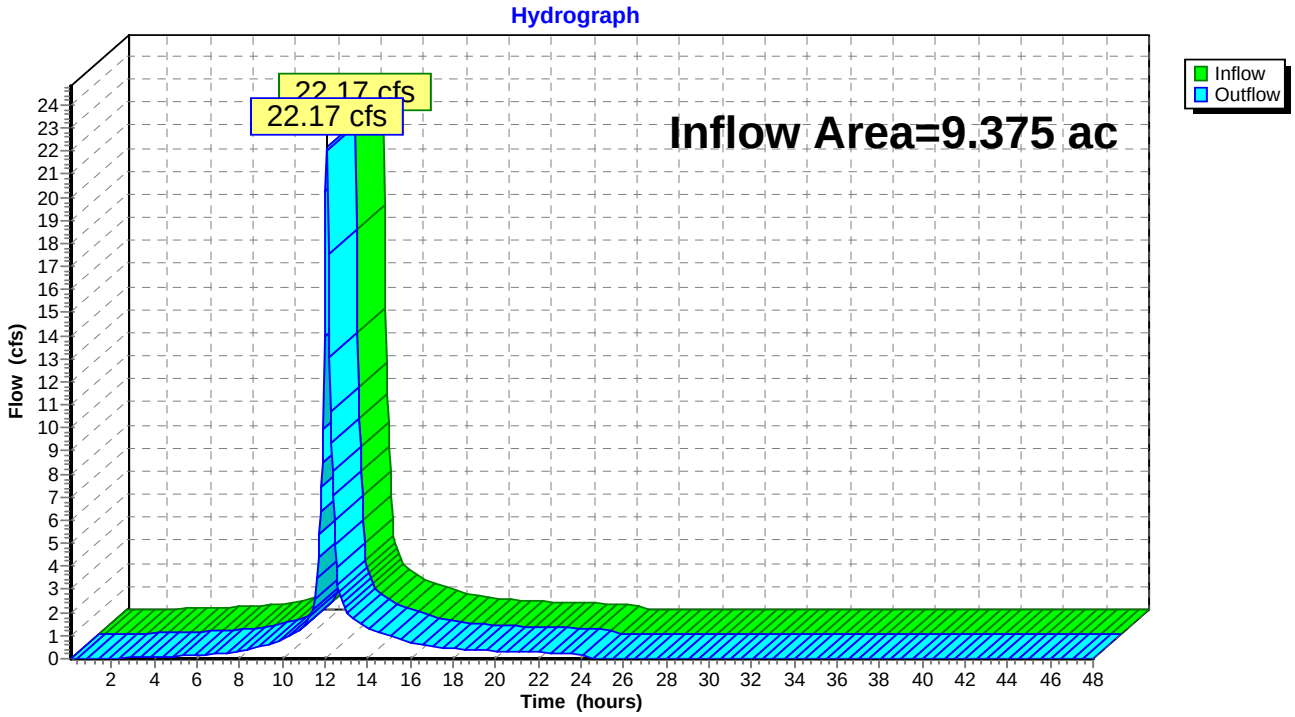


Reach 8R: wetlands

Inflow Area = 9.375 ac, Inflow Depth = 2.22" for 2YR-Storm event
Inflow = 22.17 cfs @ 12.09 hrs, Volume= 1.735 af
Outflow = 22.17 cfs @ 12.09 hrs, Volume= 1.735 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs / 3

Reach 8R: wetlands



Subcatchment 8S: PDA-8

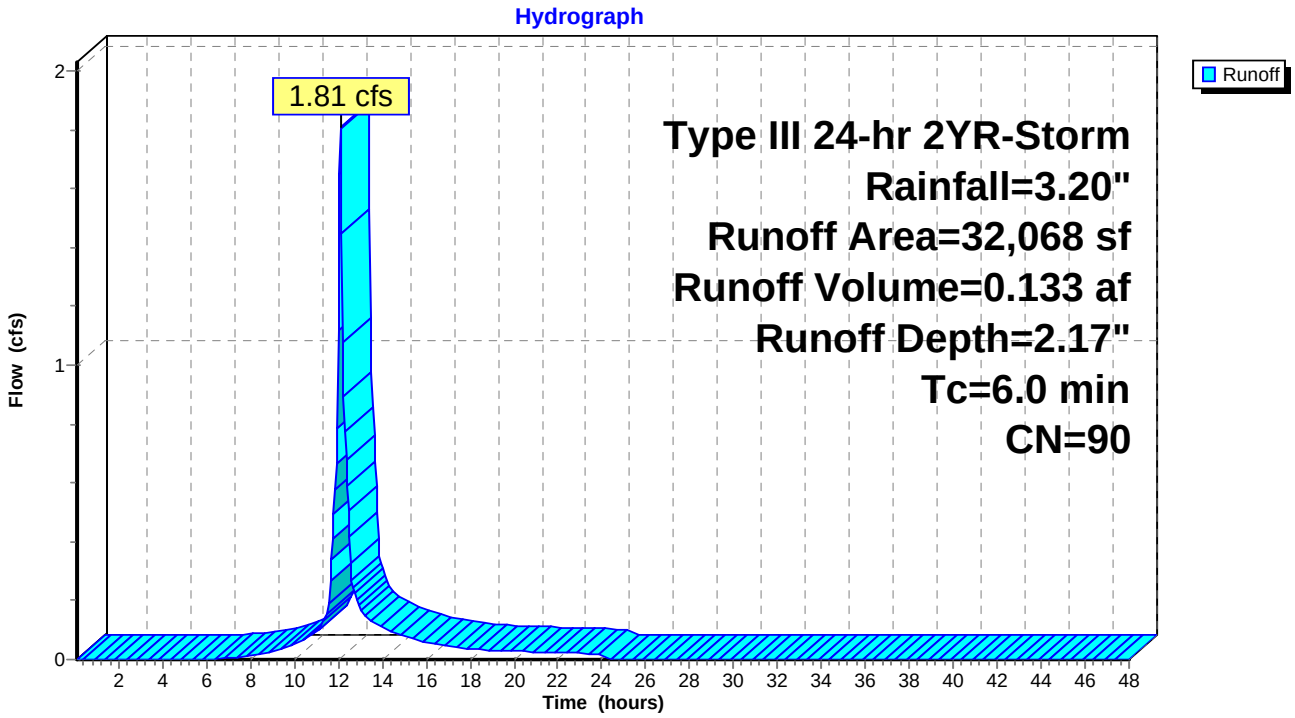
Runoff = 1.81 cfs @ 12.09 hrs, Volume= 0.133 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
23,024	98	Pavement
9,044	69	50-75% Grass cover, Fair, HSG B
32,068	90	Weighted Average
9,044		Pervious Area
23,024		Impervious Area

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

Subcatchment 8S: PDA-8



Subcatchment 9S: PDA-9

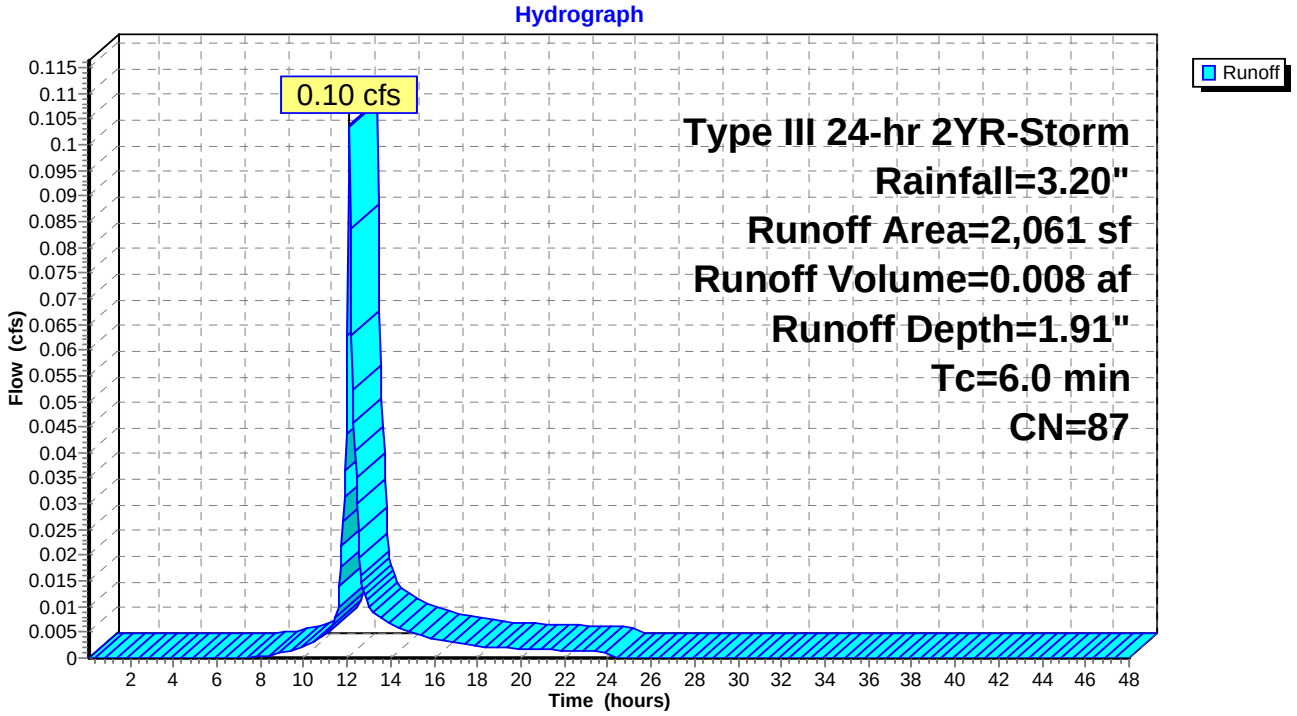
Runoff = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR-Storm Rainfall=3.20"

Area (sf)	CN	Description
2,061	87	Water
2,061		Pervious Area

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

Subcatchment 9S: PDA-9



Pond 10P: Pond

Inflow Area = 0.783 ac, Inflow Depth = 2.15" for 2YR-Storm event
Inflow = 1.92 cfs @ 12.09 hrs, Volume= 0.141 af
Outflow = 0.15 cfs @ 13.37 hrs, Volume= 0.134 af, Atten= 92%, Lag= 77.0 min
Discarded = 0.05 cfs @ 13.37 hrs, Volume= 0.121 af
Primary = 0.10 cfs @ 13.37 hrs, Volume= 0.013 af

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 209.61' @ 13.37 hrs Surf.Area= 2,131 sf Storage= 3,613 cf

Plug-Flow detention time= 734.3 min calculated for 0.134 af (95% of inflow)
Center-of-Mass det. time= 708.8 min (1,516.3 - 807.5)

Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	3,917 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

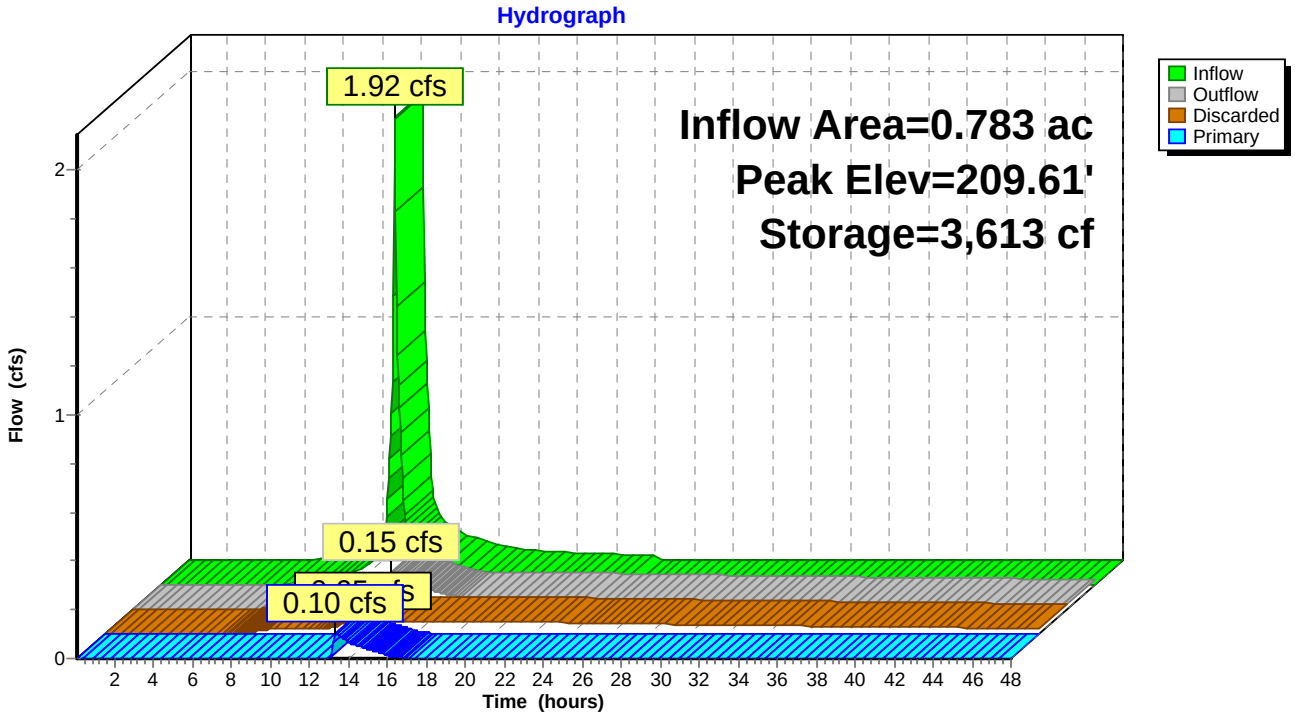
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
207.00	799	117.2	0	0	799
209.00	1,702	154.9	2,445	2,445	1,659
209.75	2,236	173.1	1,472	3,917	2,150

Device	Routing	Invert	Outlet Devices
#1	Primary	209.60'	**36.0' long x 7.4' 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 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.41 2.53 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.72 2.76
#2	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.05 cfs @ 13.37 hrs HW=209.61' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.10 cfs @ 13.37 hrs HW=209.61' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.10 cfs @ 0.25 fps)

Pond 10P: Pond



Time span=0.10-48.00 hrs, dt=0.05 hrs, 959 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: PDA-1 Runoff Area=48,929 sf Runoff Depth=3.71"
Tc=6.0 min CN=93 Runoff=4.52 cfs 0.347 af

Subcatchment 2S: PDA-2 Runoff Area=70,790 sf Runoff Depth=3.30"
Tc=6.0 min CN=89 Runoff=6.00 cfs 0.446 af

Subcatchment 3S: PDA-3 Runoff Area=161,513 sf Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=15.92 cfs 1.318 af

Subcatchment 4S: PDA-4 Runoff Area=9,942 sf Runoff Depth=3.00"
Tc=6.0 min CN=86 Runoff=0.78 cfs 0.057 af

Subcatchment 5S: PDA-5 Runoff Area=25,504 sf Runoff Depth=3.30"
Tc=6.0 min CN=89 Runoff=2.16 cfs 0.161 af

Subcatchment 6S: PDA-6 Runoff Area=2,022 sf Runoff Depth=3.60"
Tc=6.0 min CN=92 Runoff=0.18 cfs 0.014 af

Subcatchment 7S: PDA-7 Runoff Area=55,563 sf Runoff Depth=2.46"
Tc=6.0 min CN=80 Runoff=3.61 cfs 0.262 af

Reach 8R: wetlands Inflow=33.09 cfs 2.686 af
Outflow=33.09 cfs 2.686 af

Subcatchment 8S: PDA-8 Runoff Area=32,068 sf Runoff Depth=3.40"
Tc=6.0 min CN=90 Runoff=2.78 cfs 0.208 af

Subcatchment 9S: PDA-9 Runoff Area=2,061 sf Runoff Depth=3.10"
Tc=6.0 min CN=87 Runoff=0.17 cfs 0.012 af

Pond 10P: Pond Peak Elev=209.69' Storage=3,775 cf Inflow=2.95 cfs 0.221 af
Discarded=0.05 cfs 0.129 af Primary=2.18 cfs 0.082 af Outflow=2.23 cfs 0.211 af

Total Runoff Area = 9.375 ac Runoff Volume = 2.825 af Average Runoff Depth = 3.62"
21.74% Pervious Area = 2.038 ac 78.26% Impervious Area = 7.337 ac

Subcatchment 1S: PDA-1

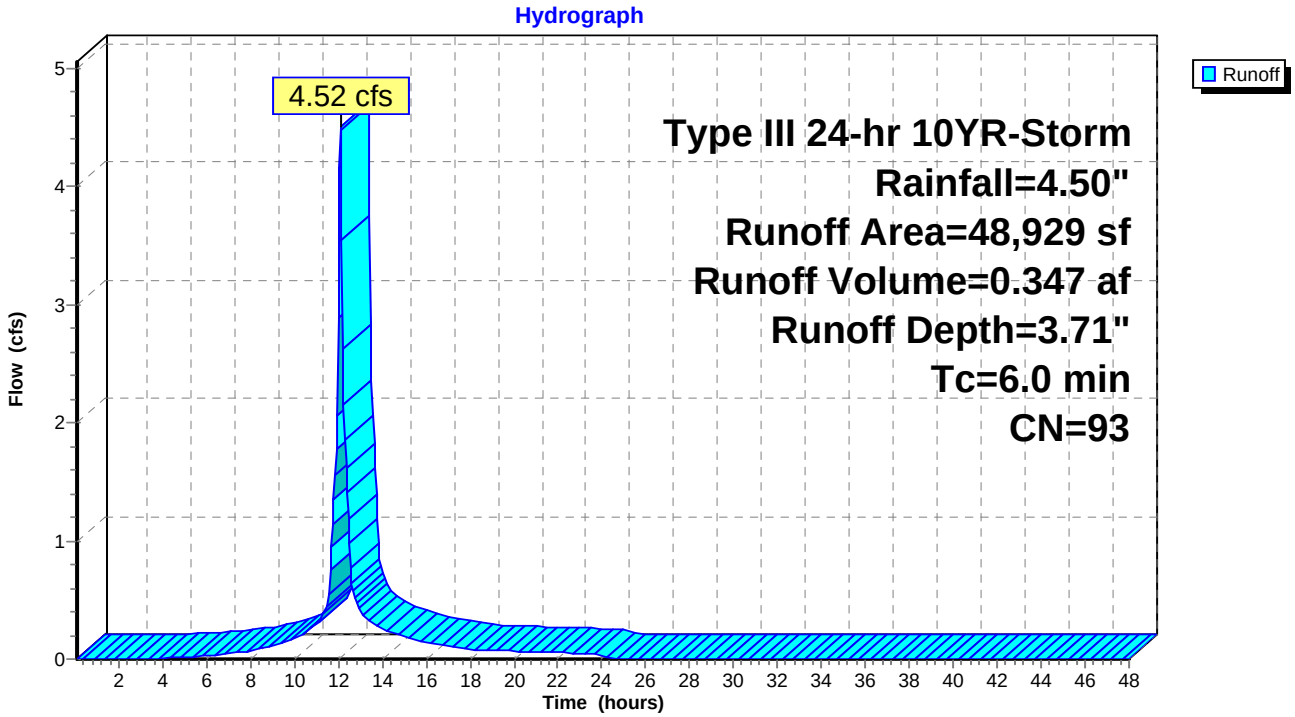
Runoff = 4.52 cfs @ 12.09 hrs, Volume= 0.347 af, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
31,194	98	Pavement
8,728	69	50-75% Grass cover, Fair, HSG B
9,007	98	Roof
48,929	93	Weighted Average
8,728		Pervious Area
40,201		Impervious Area

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

Subcatchment 1S: PDA-1



Subcatchment 2S: PDA-2

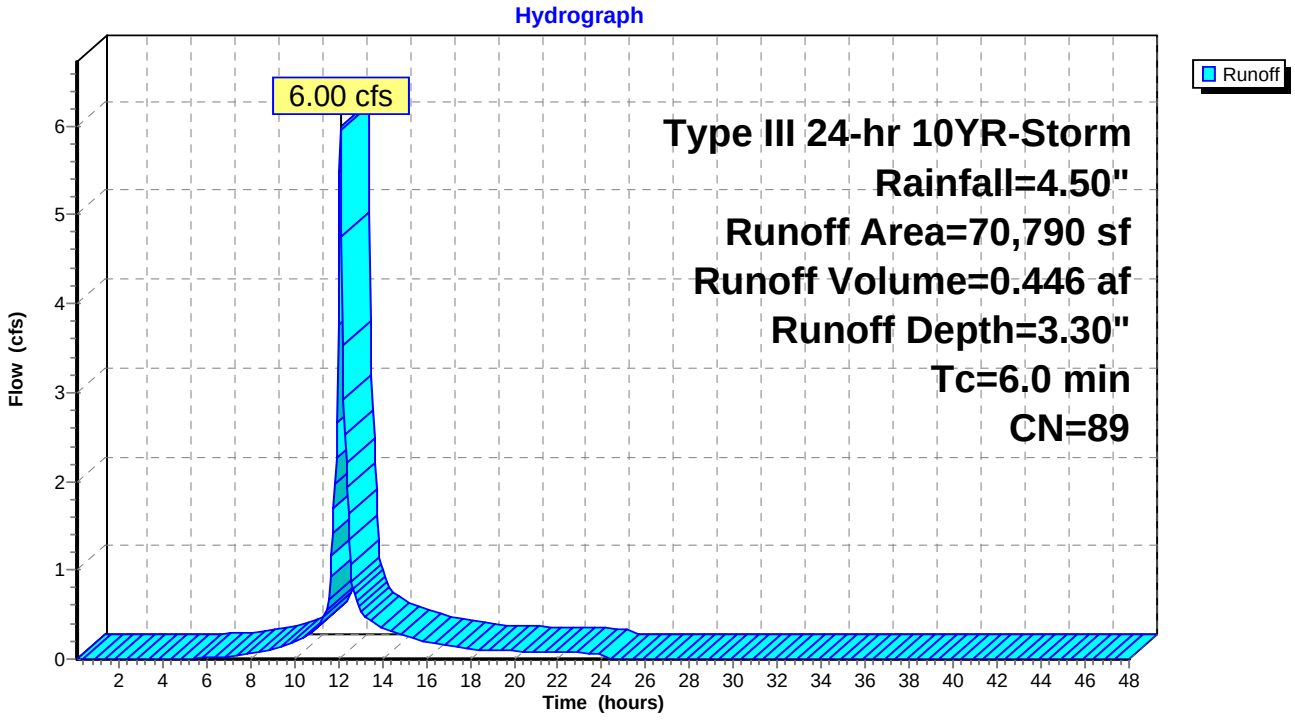
Runoff = 6.00 cfs @ 12.09 hrs, Volume= 0.446 af, Depth= 3.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
40,047	98	Pavement
23,143	69	50-75% Grass cover, Fair, HSG B
7,600	98	Roof
70,790	89	Weighted Average
23,143		Pervious Area
47,647		Impervious Area

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

Subcatchment 2S: PDA-2



Subcatchment 3S: PDA-3

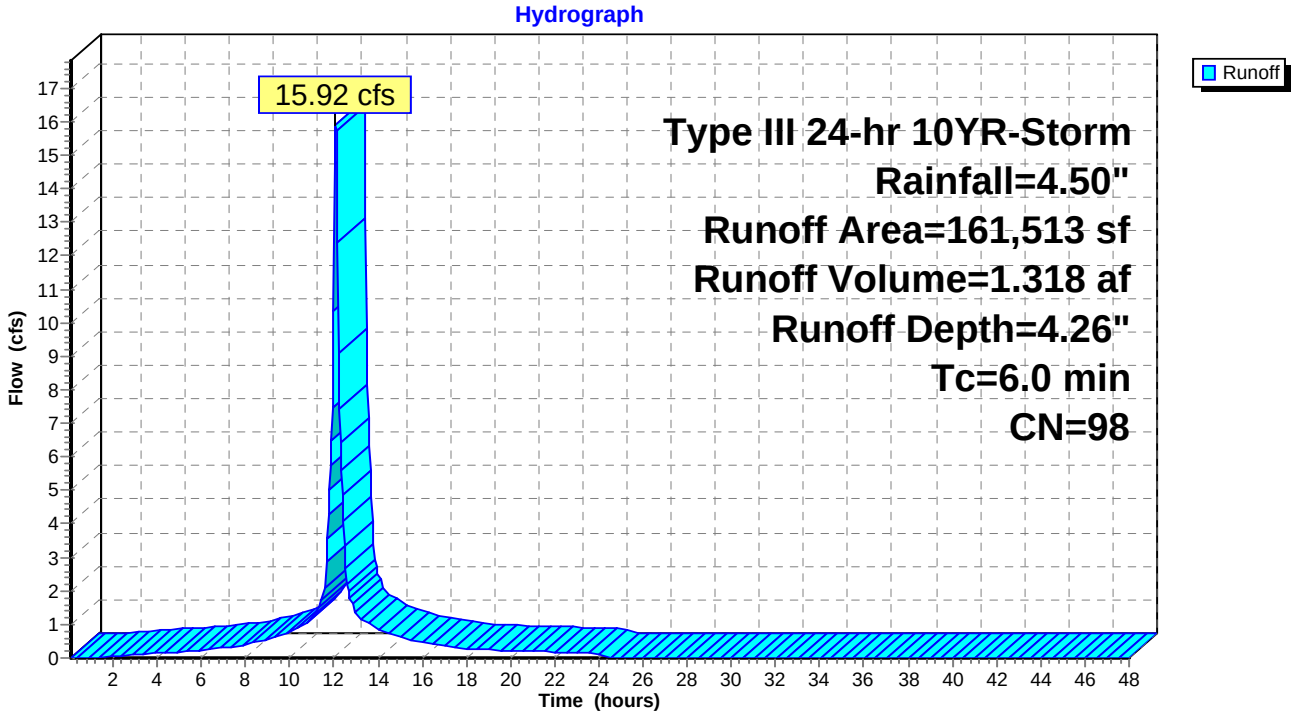
Runoff = 15.92 cfs @ 12.09 hrs, Volume= 1.318 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
161,513	98	Roof
161,513		Impervious Area

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

Subcatchment 3S: PDA-3



Subcatchment 4S: PDA-4

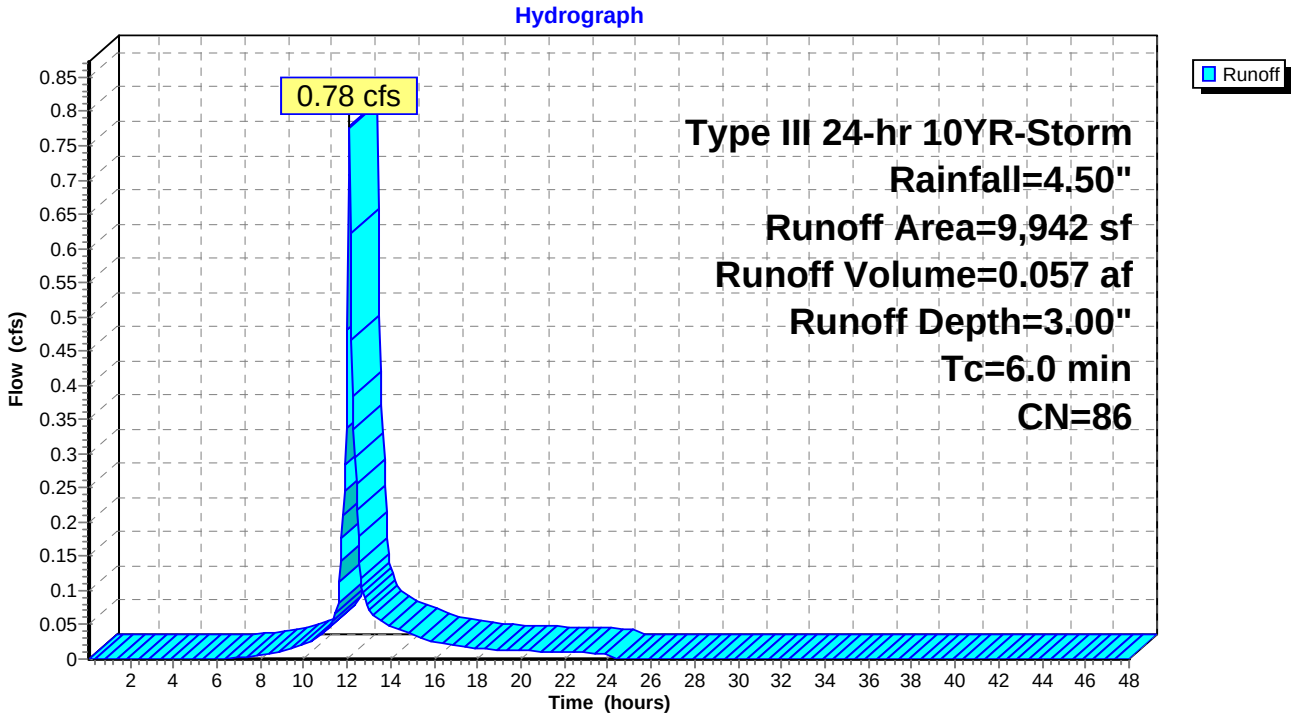
Runoff = 0.78 cfs @ 12.09 hrs, Volume= 0.057 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
5,671	98	Pavement
3,955	69	50-75% Grass cover, Fair, HSG B
316	98	Concrete Pad
9,942	86	Weighted Average
3,955		Pervious Area
5,987		Impervious Area

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

Subcatchment 4S: PDA-4



Subcatchment 5S: PDA-5

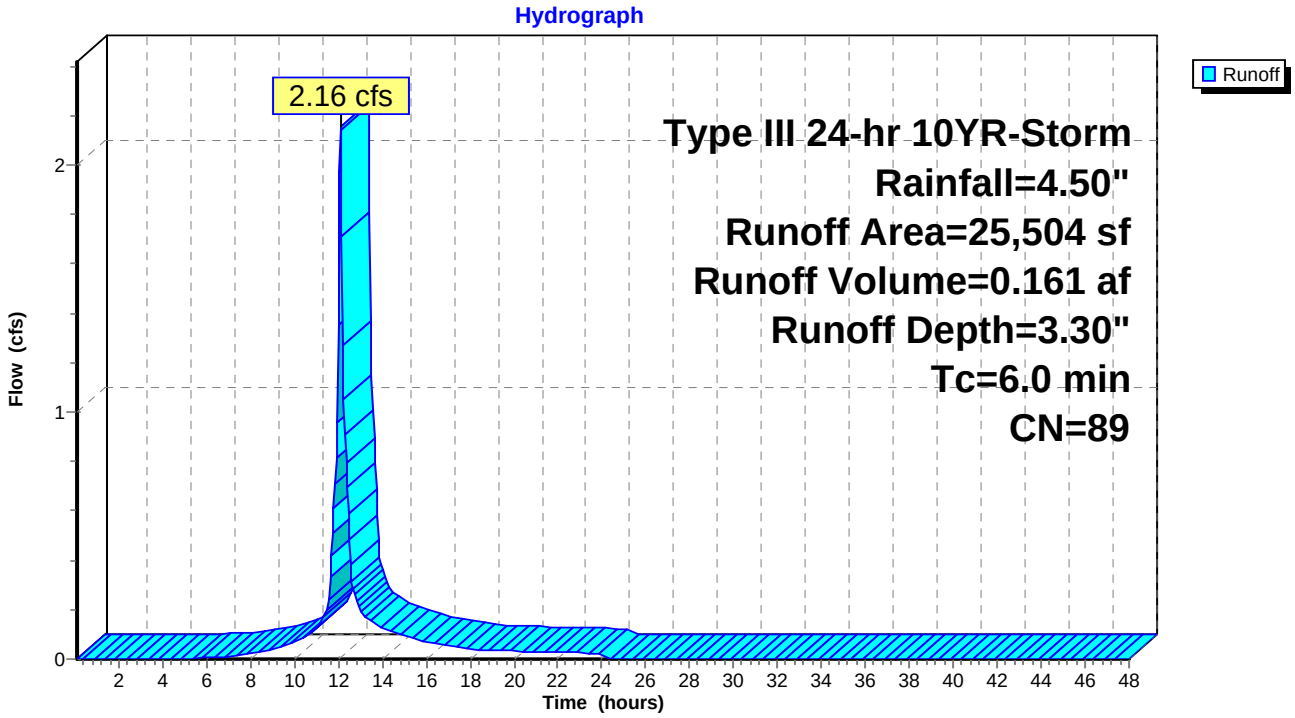
Runoff = 2.16 cfs @ 12.09 hrs, Volume= 0.161 af, Depth= 3.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
16,755	98	Pavement
7,765	69	50-75% Grass cover, Fair, HSG B
984	98	Concrete Pad
25,504	89	Weighted Average
7,765		Pervious Area
17,739		Impervious Area

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

Subcatchment 5S: PDA-5



Subcatchment 6S: PDA-6

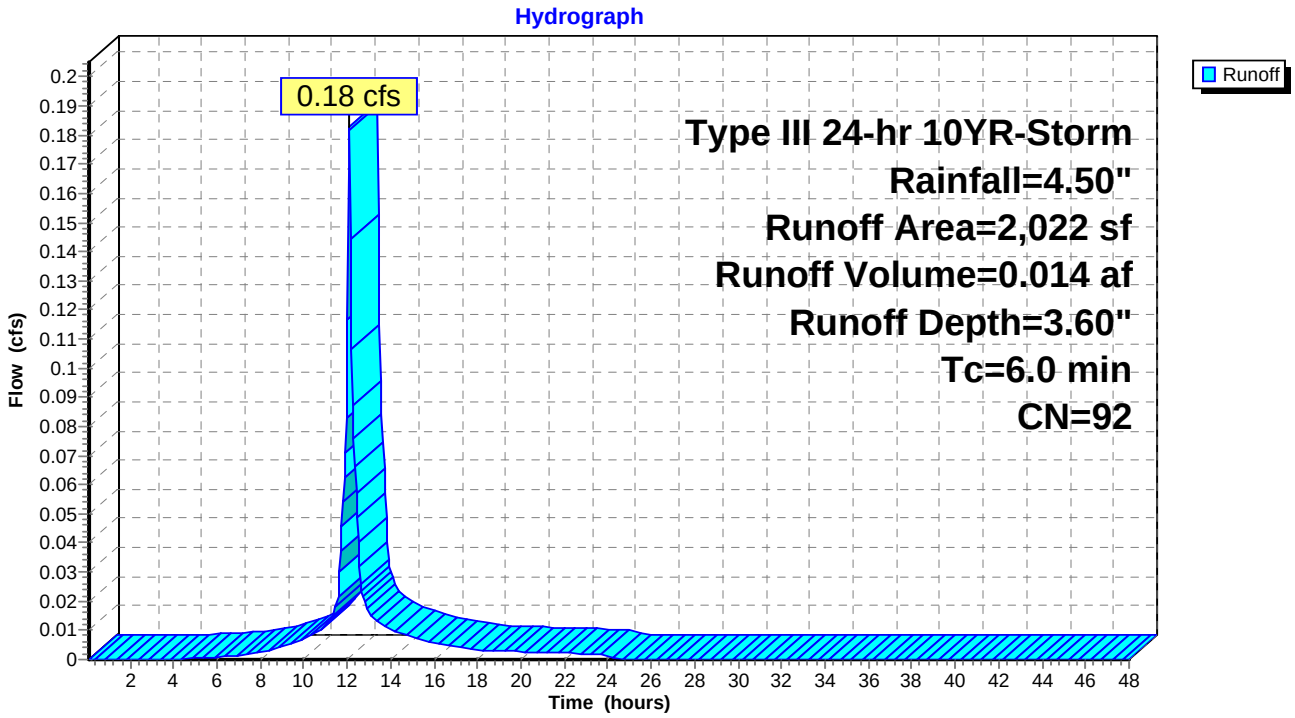
Runoff = 0.18 cfs @ 12.09 hrs, Volume= 0.014 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
1,622	98	Pavement
400	69	50-75% Grass cover, Fair, HSG B
2,022	92	Weighted Average
400		Pervious Area
1,622		Impervious Area

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

Subcatchment 6S: PDA-6



Subcatchment 7S: PDA-7

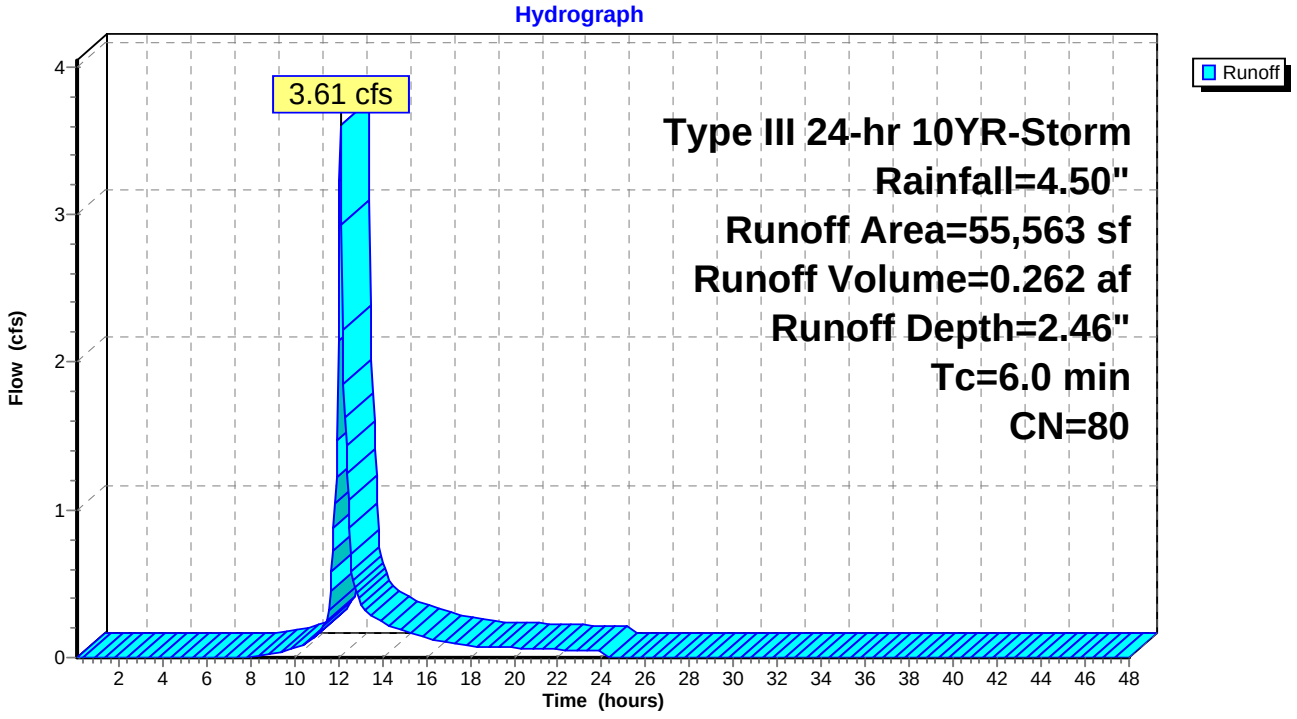
Runoff = 3.61 cfs @ 12.09 hrs, Volume= 0.262 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
19,119	98	Pavement
2,766	98	Roof
28,571	69	50-75% Grass cover, Fair, HSG B
5,107	60	Woods, Fair, HSG B
55,563	80	Weighted Average
33,678		Pervious Area
21,885		Impervious Area

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

Subcatchment 7S: PDA-7

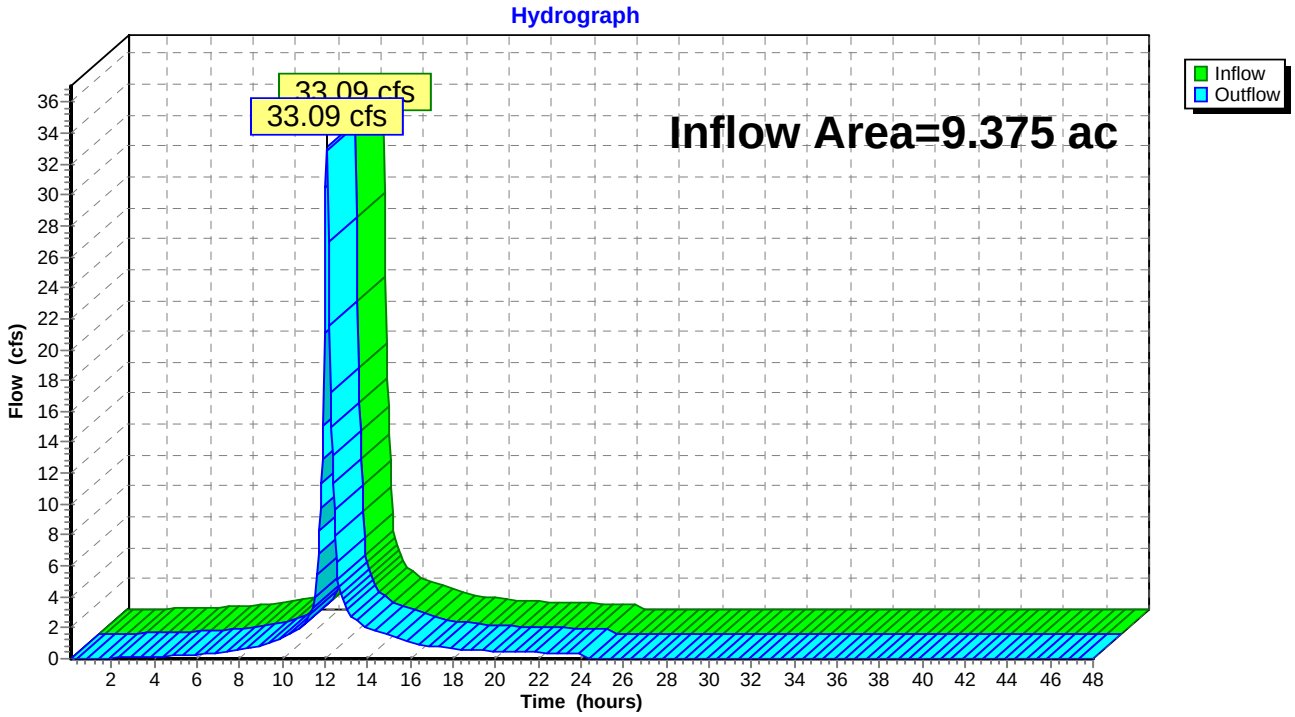


Reach 8R: wetlands

Inflow Area = 9.375 ac, Inflow Depth = 3.44" for 10YR-Storm event
Inflow = 33.09 cfs @ 12.09 hrs, Volume= 2.686 af
Outflow = 33.09 cfs @ 12.09 hrs, Volume= 2.686 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs / 3

Reach 8R: wetlands



Subcatchment 8S: PDA-8

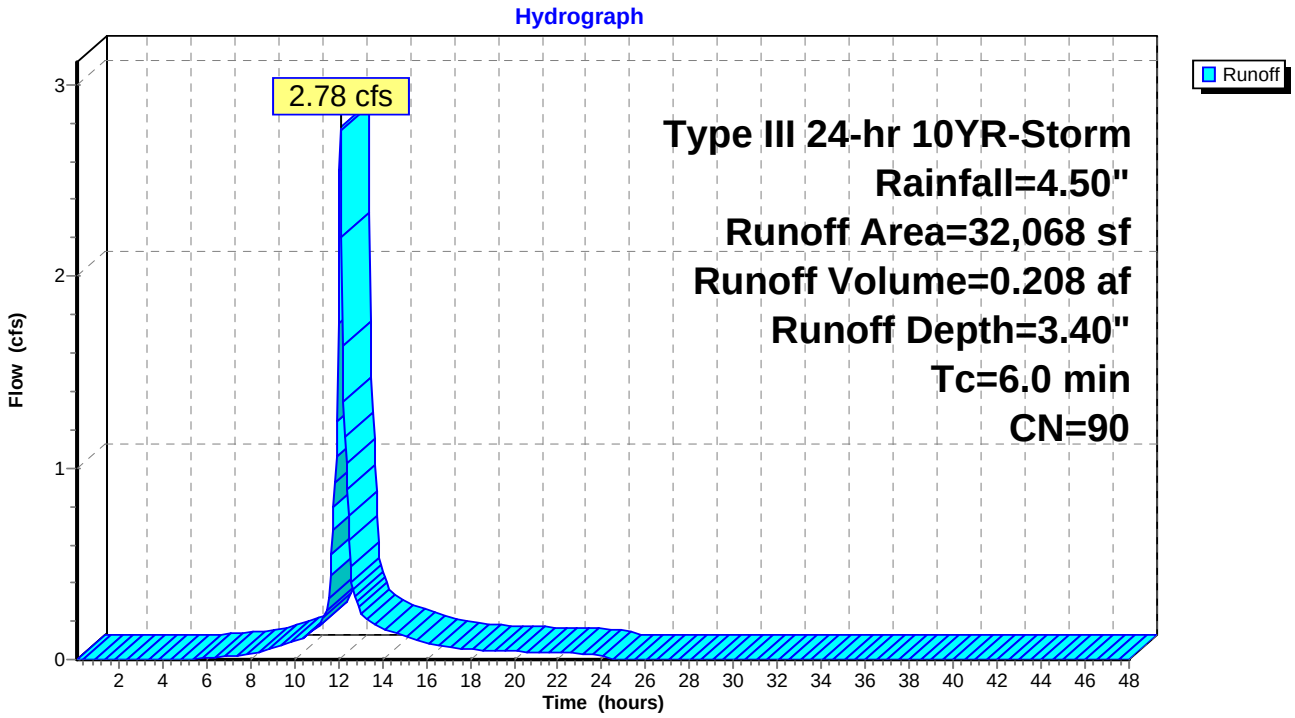
Runoff = 2.78 cfs @ 12.09 hrs, Volume= 0.208 af, Depth= 3.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
23,024	98	Pavement
9,044	69	50-75% Grass cover, Fair, HSG B
32,068	90	Weighted Average
9,044		Pervious Area
23,024		Impervious Area

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

Subcatchment 8S: PDA-8



Subcatchment 9S: PDA-9

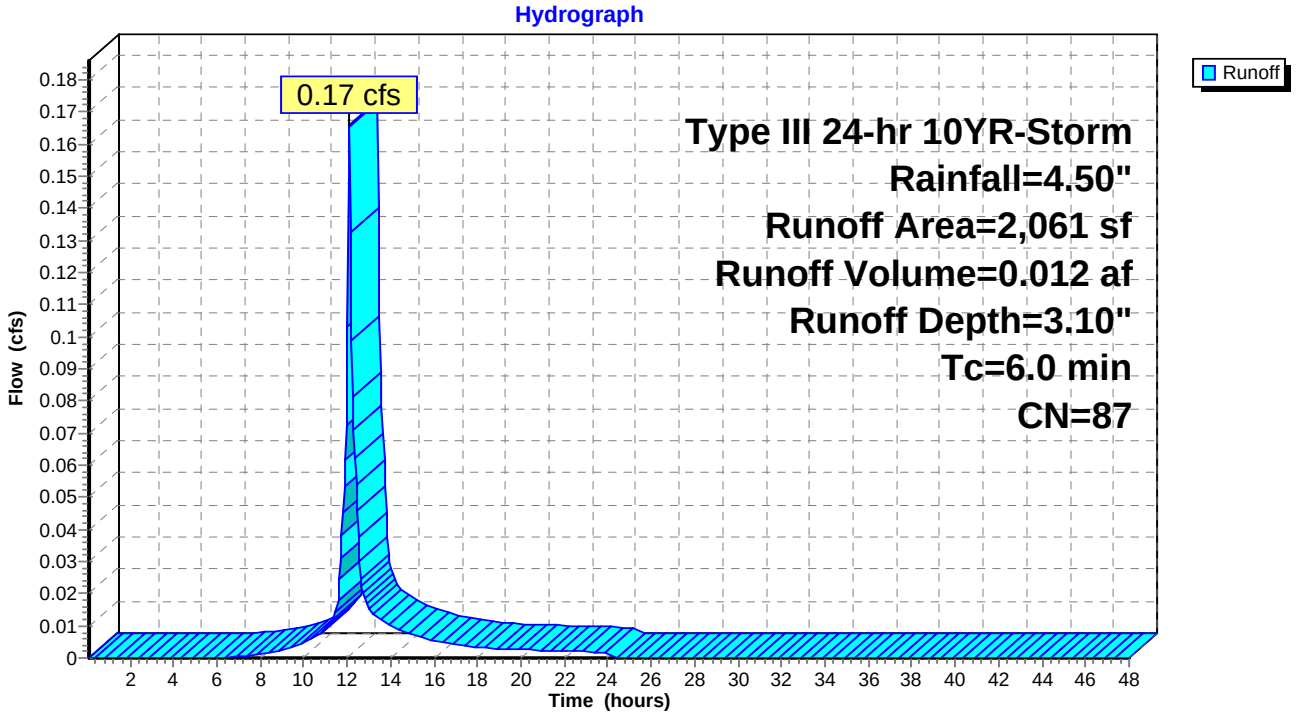
Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.012 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR-Storm Rainfall=4.50"

Area (sf)	CN	Description
2,061	87	Water
2,061		Pervious Area

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

Subcatchment 9S: PDA-9



Pond 10P: Pond

Inflow Area = 0.783 ac, Inflow Depth = 3.38" for 10YR-Storm event
Inflow = 2.95 cfs @ 12.09 hrs, Volume= 0.221 af
Outflow = 2.23 cfs @ 12.21 hrs, Volume= 0.211 af, Atten= 24%, Lag= 7.1 min
Discarded = 0.05 cfs @ 12.21 hrs, Volume= 0.129 af
Primary = 2.18 cfs @ 12.21 hrs, Volume= 0.082 af

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 209.69' @ 12.21 hrs Surf.Area= 2,188 sf Storage= 3,775 cf

Plug-Flow detention time= 493.1 min calculated for 0.211 af (96% of inflow)
Center-of-Mass det. time= 469.5 min (1,264.4 - 795.0)

Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	3,917 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

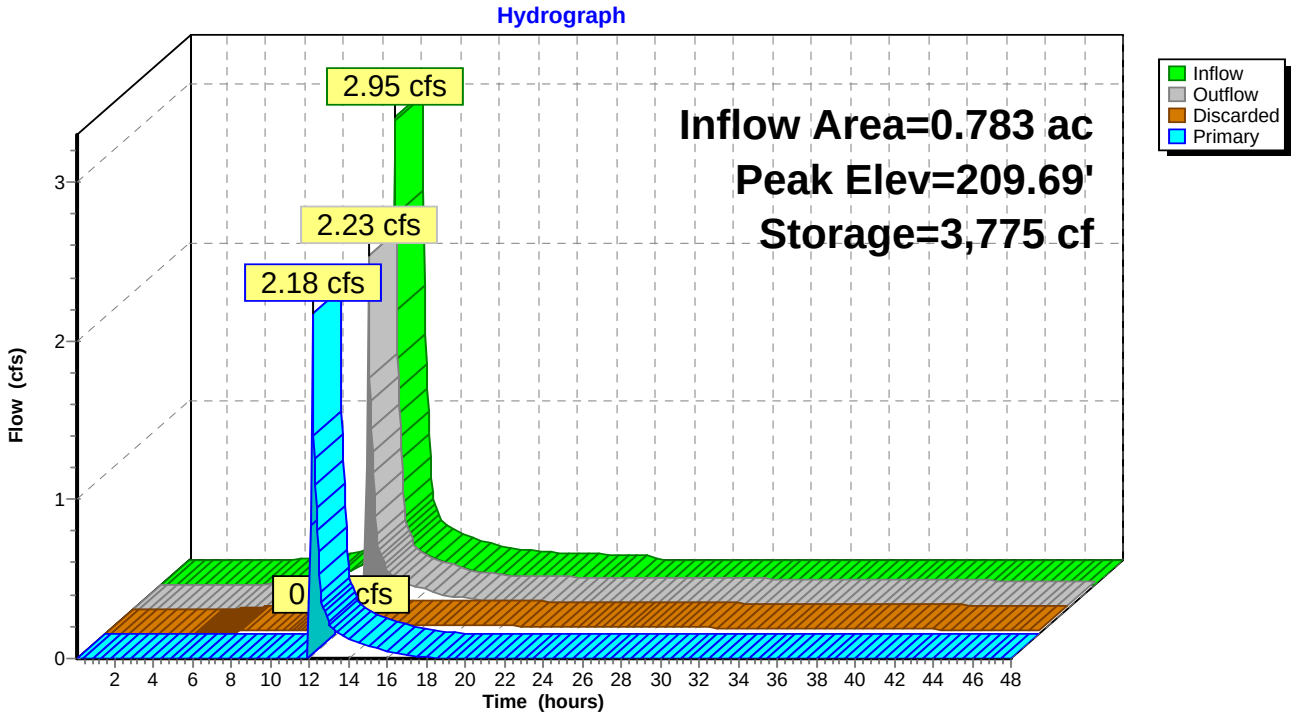
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
207.00	799	117.2	0	0	799
209.00	1,702	154.9	2,445	2,445	1,659
209.75	2,236	173.1	1,472	3,917	2,150

Device	Routing	Invert	Outlet Devices
#1	Primary	209.60'	**36.0' long x 7.4' 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 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.41 2.53 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.72 2.76
#2	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.05 cfs @ 12.21 hrs HW=209.68' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.05 cfs @ 12.21 hrs HW=209.68' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.05 cfs @ 0.69 fps)

Pond 10P: Pond



Time span=0.10-48.00 hrs, dt=0.05 hrs, 959 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: PDA-1 Runoff Area=48,929 sf Runoff Depth=5.18"
Tc=6.0 min CN=93 Runoff=6.19 cfs 0.485 af

Subcatchment 2S: PDA-2 Runoff Area=70,790 sf Runoff Depth=4.74"
Tc=6.0 min CN=89 Runoff=8.47 cfs 0.641 af

Subcatchment 3S: PDA-3 Runoff Area=161,513 sf Runoff Depth=5.76"
Tc=6.0 min CN=98 Runoff=21.29 cfs 1.780 af

Subcatchment 4S: PDA-4 Runoff Area=9,942 sf Runoff Depth=4.41"
Tc=6.0 min CN=86 Runoff=1.13 cfs 0.084 af

Subcatchment 5S: PDA-5 Runoff Area=25,504 sf Runoff Depth=4.74"
Tc=6.0 min CN=89 Runoff=3.05 cfs 0.231 af

Subcatchment 6S: PDA-6 Runoff Area=2,022 sf Runoff Depth=5.07"
Tc=6.0 min CN=92 Runoff=0.25 cfs 0.020 af

Subcatchment 7S: PDA-7 Runoff Area=55,563 sf Runoff Depth=3.78"
Tc=6.0 min CN=80 Runoff=5.51 cfs 0.402 af

Reach 8R: wetlands Inflow=49.86 cfs 3.812 af
Outflow=49.86 cfs 3.812 af

Subcatchment 8S: PDA-8 Runoff Area=32,068 sf Runoff Depth=4.85"
Tc=6.0 min CN=90 Runoff=3.90 cfs 0.297 af

Subcatchment 9S: PDA-9 Runoff Area=2,061 sf Runoff Depth=4.52"
Tc=6.0 min CN=87 Runoff=0.24 cfs 0.018 af

Pond 10P: Pond Peak Elev=209.73' Storage=3,869 cf Inflow=4.13 cfs 0.315 af
Discarded=0.05 cfs 0.135 af Primary=3.99 cfs 0.169 af Outflow=4.04 cfs 0.304 af

Total Runoff Area = 9.375 ac Runoff Volume = 3.958 af Average Runoff Depth = 5.07"
21.74% Pervious Area = 2.038 ac 78.26% Impervious Area = 7.337 ac

Subcatchment 1S: PDA-1

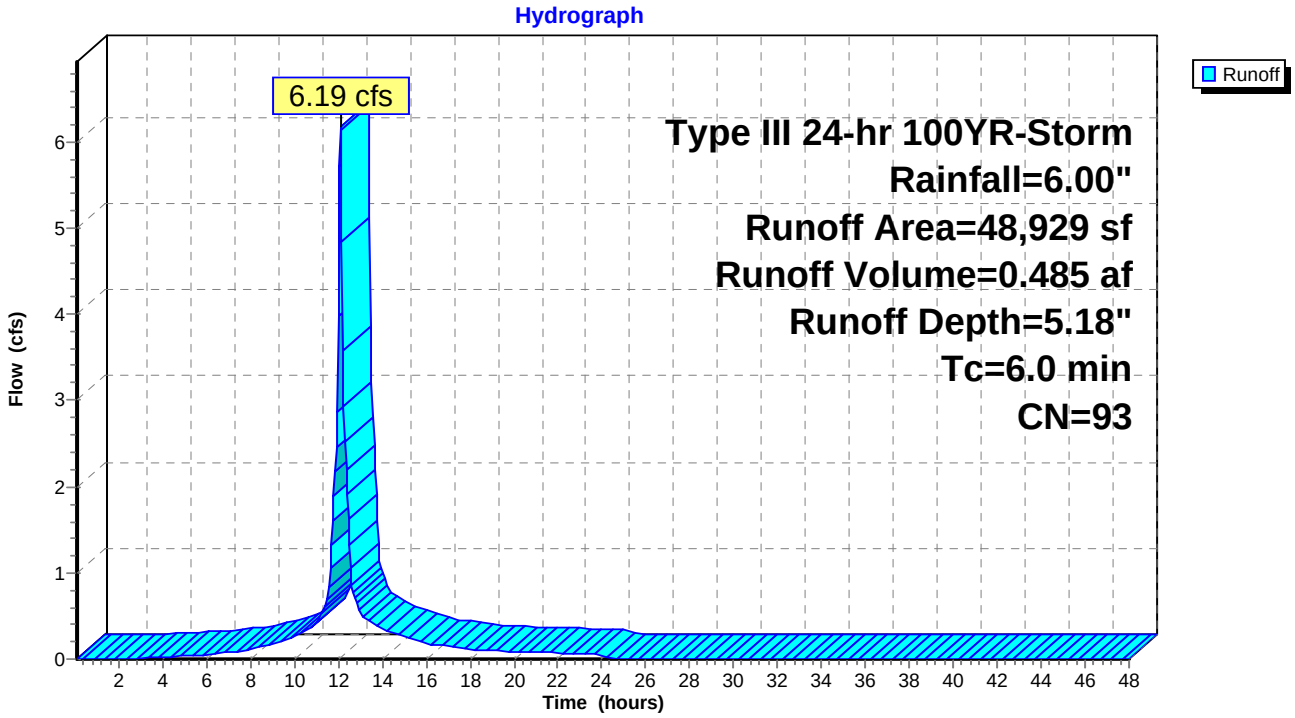
Runoff = 6.19 cfs @ 12.09 hrs, Volume= 0.485 af, Depth= 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
31,194	98	Pavement
8,728	69	50-75% Grass cover, Fair, HSG B
9,007	98	Roof
48,929	93	Weighted Average
8,728		Pervious Area
40,201		Impervious Area

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

Subcatchment 1S: PDA-1



Subcatchment 2S: PDA-2

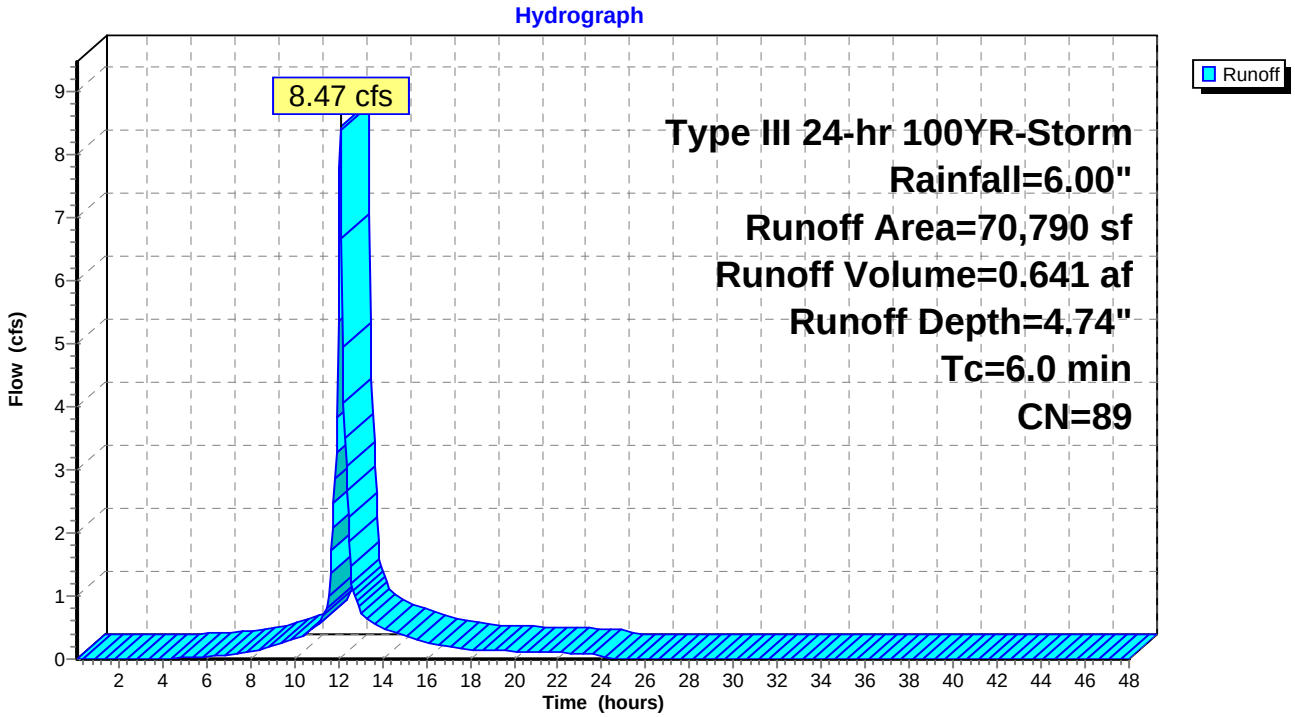
Runoff = 8.47 cfs @ 12.09 hrs, Volume= 0.641 af, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
40,047	98	Pavement
23,143	69	50-75% Grass cover, Fair, HSG B
7,600	98	Roof
70,790	89	Weighted Average
23,143		Pervious Area
47,647		Impervious Area

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

Subcatchment 2S: PDA-2



Subcatchment 3S: PDA-3

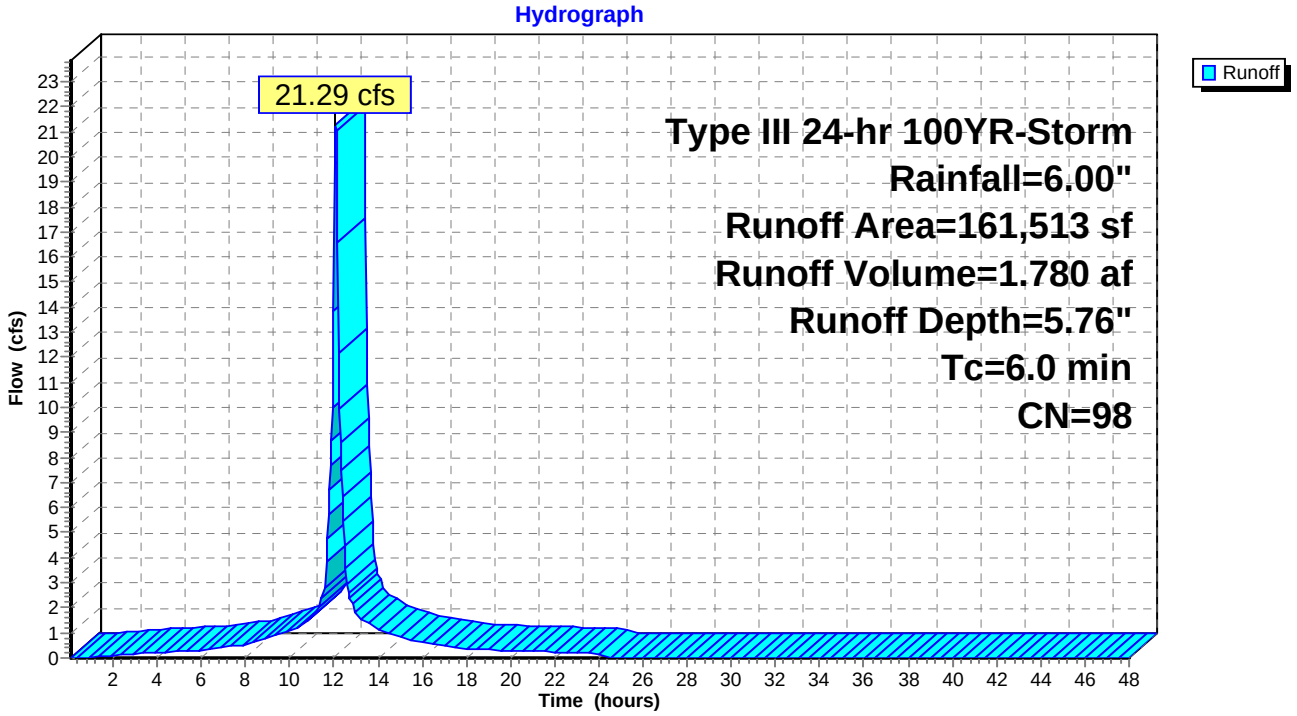
Runoff = 21.29 cfs @ 12.09 hrs, Volume= 1.780 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
161,513	98	Roof
161,513		Impervious Area

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

Subcatchment 3S: PDA-3



Subcatchment 4S: PDA-4

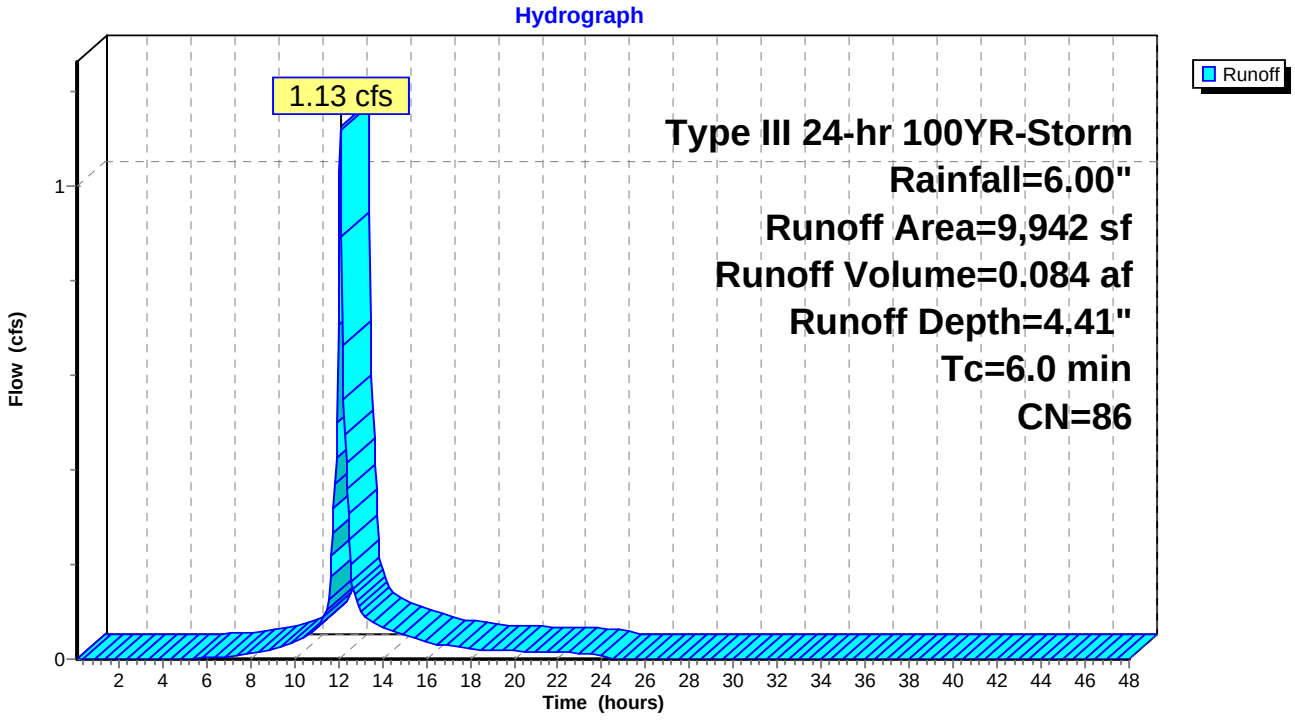
Runoff = 1.13 cfs @ 12.09 hrs, Volume= 0.084 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
5,671	98	Pavement
3,955	69	50-75% Grass cover, Fair, HSG B
316	98	Concrete Pad
9,942	86	Weighted Average
3,955		Pervious Area
5,987		Impervious Area

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

Subcatchment 4S: PDA-4



Subcatchment 5S: PDA-5

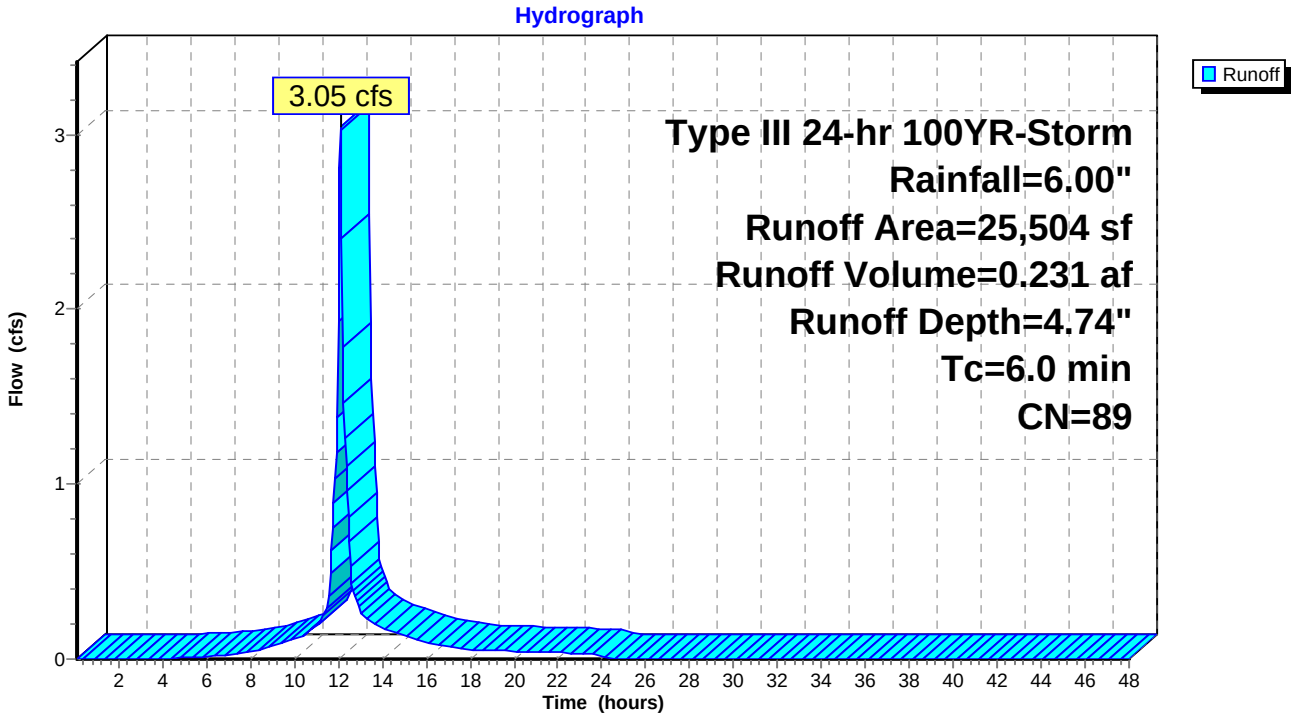
Runoff = 3.05 cfs @ 12.09 hrs, Volume= 0.231 af, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
16,755	98	Pavement
7,765	69	50-75% Grass cover, Fair, HSG B
984	98	Concrete Pad
25,504	89	Weighted Average
7,765		Pervious Area
17,739		Impervious Area

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

Subcatchment 5S: PDA-5



Subcatchment 6S: PDA-6

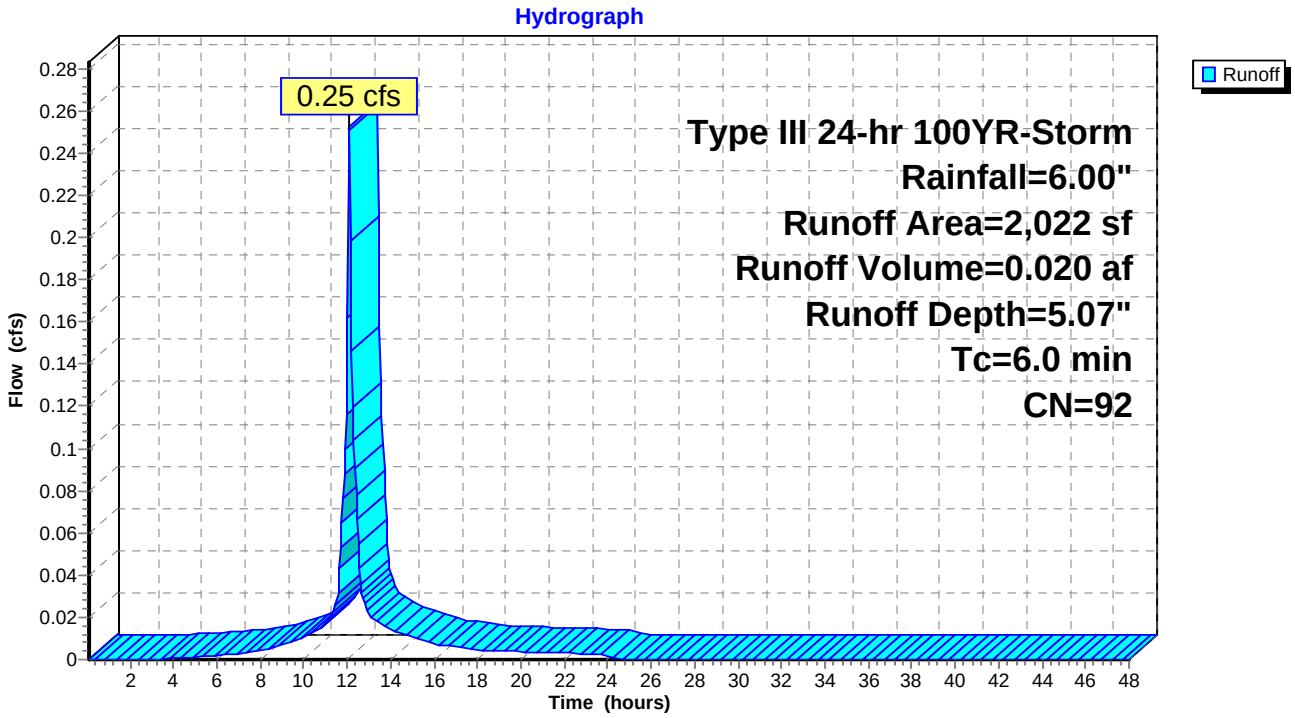
Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.020 af, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
1,622	98	Pavement
400	69	50-75% Grass cover, Fair, HSG B
2,022	92	Weighted Average
400		Pervious Area
1,622		Impervious Area

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

Subcatchment 6S: PDA-6



Subcatchment 7S: PDA-7

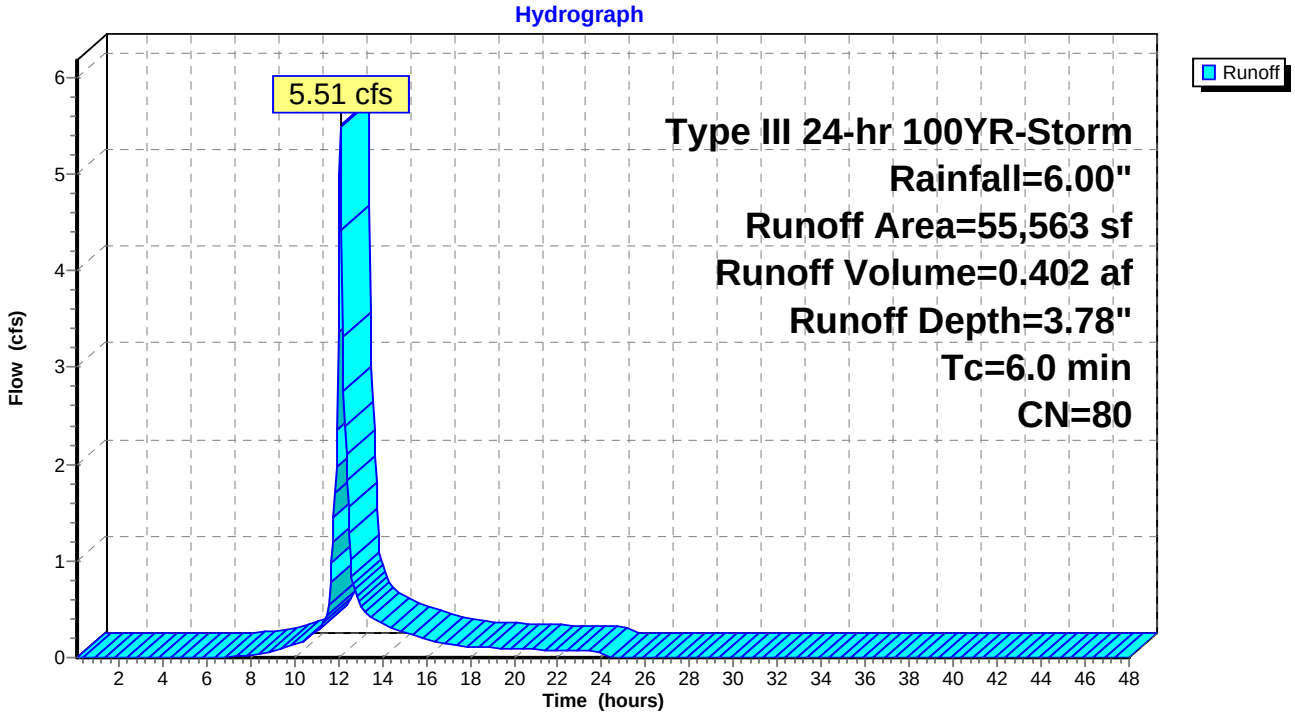
Runoff = 5.51 cfs @ 12.09 hrs, Volume= 0.402 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
19,119	98	Pavement
2,766	98	Roof
28,571	69	50-75% Grass cover, Fair, HSG B
5,107	60	Woods, Fair, HSG B
55,563	80	Weighted Average
33,678		Pervious Area
21,885		Impervious Area

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

Subcatchment 7S: PDA-7

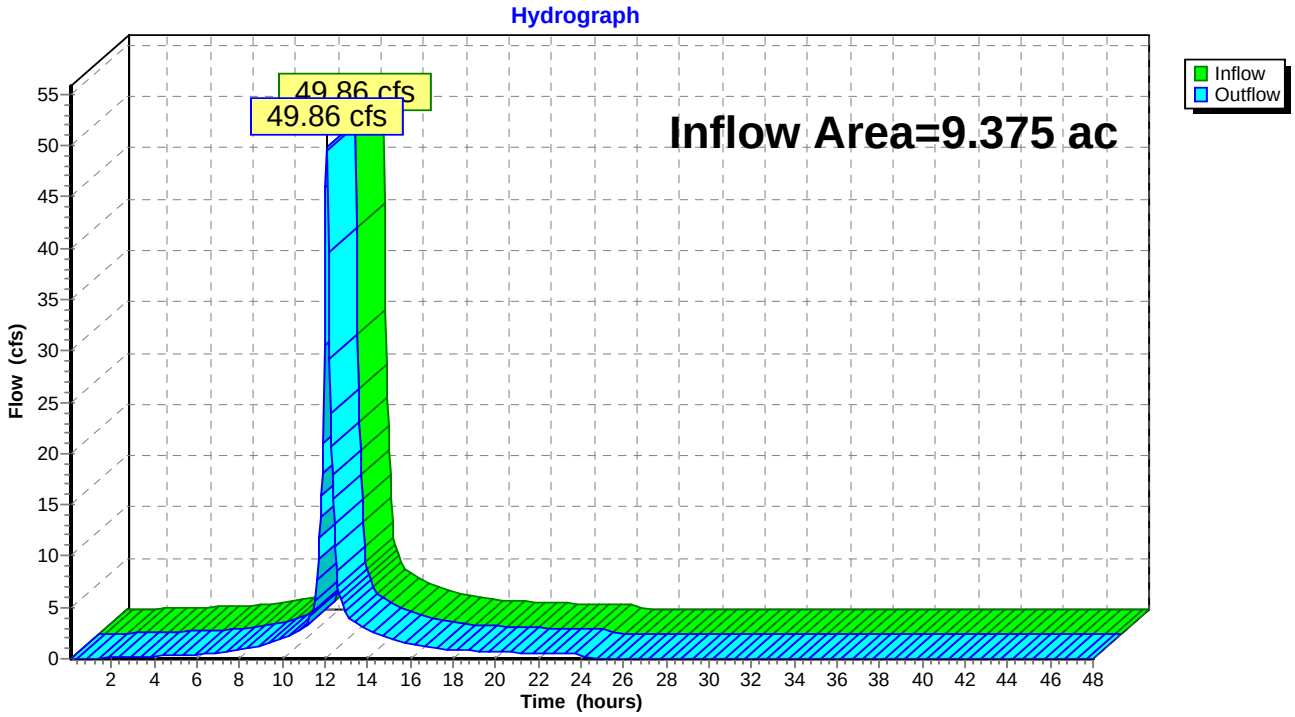


Reach 8R: wetlands

Inflow Area = 9.375 ac, Inflow Depth = 4.88" for 100YR-Storm event
Inflow = 49.86 cfs @ 12.09 hrs, Volume= 3.812 af
Outflow = 49.86 cfs @ 12.09 hrs, Volume= 3.812 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs / 3

Reach 8R: wetlands



Subcatchment 8S: PDA-8

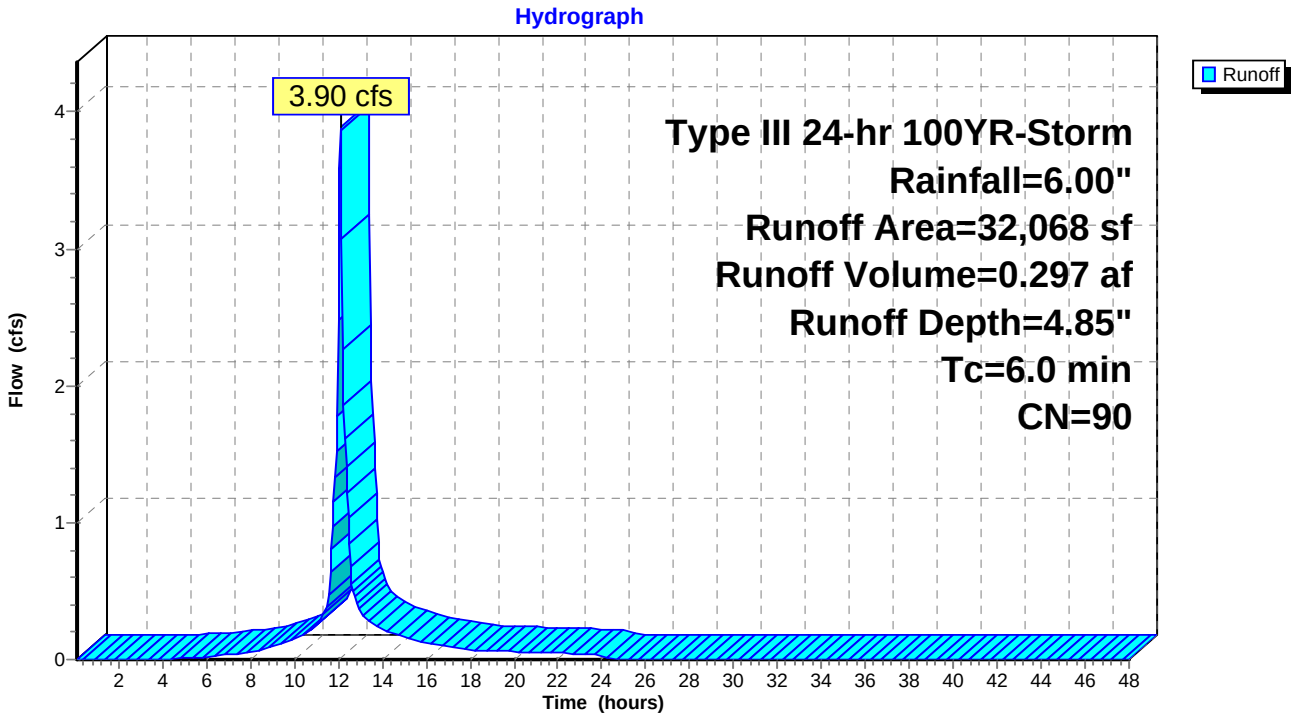
Runoff = 3.90 cfs @ 12.09 hrs, Volume= 0.297 af, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
23,024	98	Pavement
9,044	69	50-75% Grass cover, Fair, HSG B
32,068	90	Weighted Average
9,044		Pervious Area
23,024		Impervious Area

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

Subcatchment 8S: PDA-8



Subcatchment 9S: PDA-9

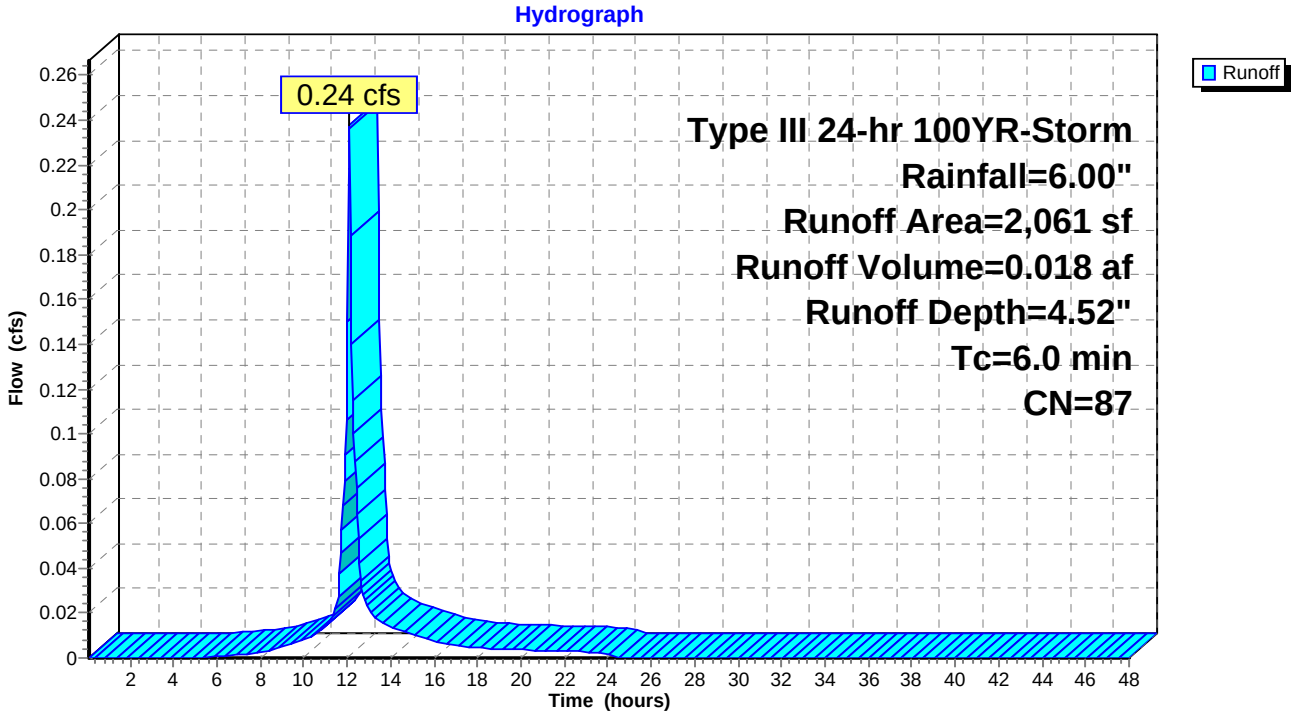
Runoff = 0.24 cfs @ 12.09 hrs, Volume= 0.018 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100YR-Storm Rainfall=6.00"

Area (sf)	CN	Description
2,061	87	Water
2,061		Pervious Area

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

Subcatchment 9S: PDA-9



Pond 10P: Pond

Inflow Area = 0.783 ac, Inflow Depth = 4.83" for 100YR-Storm event
Inflow = 4.13 cfs @ 12.09 hrs, Volume= 0.315 af
Outflow = 4.04 cfs @ 12.10 hrs, Volume= 0.304 af, Atten= 2%, Lag= 0.6 min
Discarded = 0.05 cfs @ 12.10 hrs, Volume= 0.135 af
Primary = 3.99 cfs @ 12.10 hrs, Volume= 0.169 af

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 209.73' @ 12.10 hrs Surf.Area= 2,220 sf Storage= 3,869 cf

Plug-Flow detention time= 357.0 min calculated for 0.303 af (96% of inflow)
Center-of-Mass det. time= 337.1 min (1,122.4 - 785.3)

Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	3,917 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

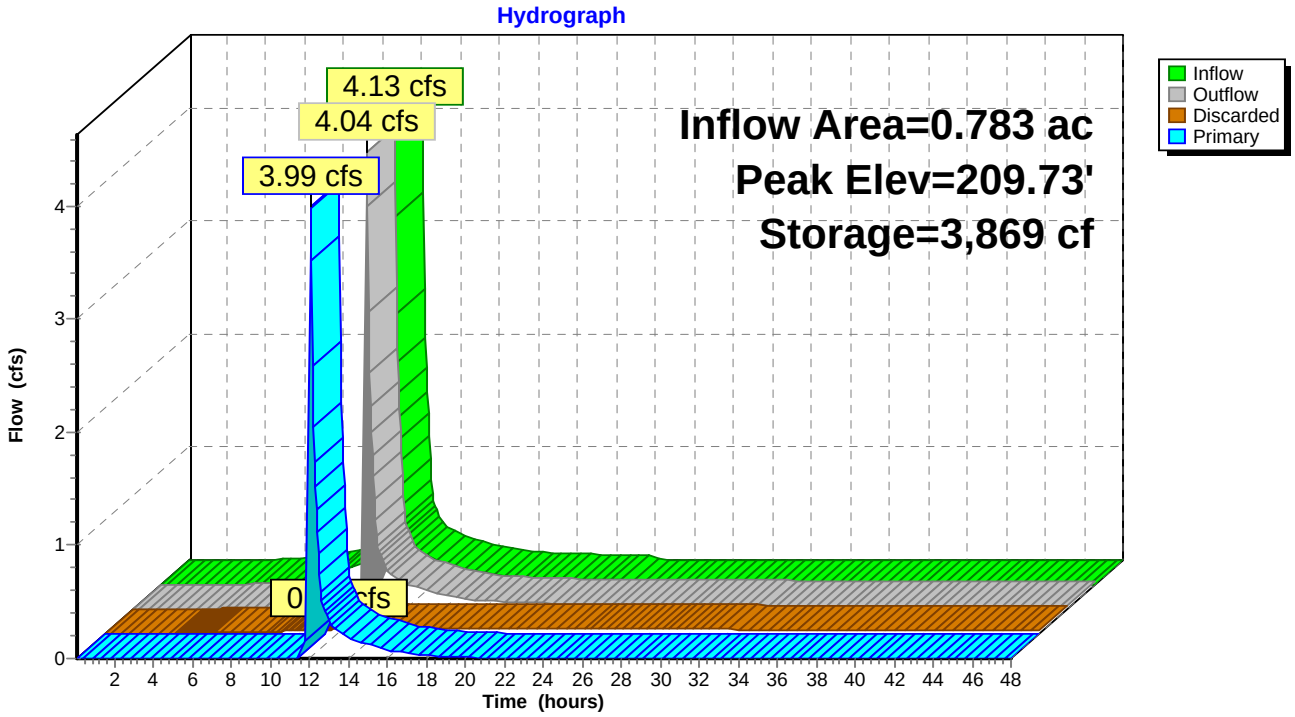
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
207.00	799	117.2	0	0	799
209.00	1,702	154.9	2,445	2,445	1,659
209.75	2,236	173.1	1,472	3,917	2,150

Device	Routing	Invert	Outlet Devices
#1	Primary	209.60'	**36.0' long x 7.4' 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 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.41 2.53 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.72 2.76
#2	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.05 cfs @ 12.10 hrs HW=209.73' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=3.97 cfs @ 12.10 hrs HW=209.73' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 3.97 cfs @ 0.86 fps)

Pond 10P: Pond



APPENDIX C: HYDRAULIC ANALYSIS

APPENDIX D: WATER QUALITY VOLUME CALCULATIONS

WATER QUALITY TREATMENT VOLUME CALCULATIONS

87 Hayward Road, Acton, MA

Date:	May 28, 2015
Job#:	2014-028
Client:	Haartz Corp.
Calculations By:	THL
Reviewed By:	MBL
Calculations Approved By:	MBL

Water Quality Treatment Volume

WQV = 1 IN X 0.5520 **(acres of impervious)
= 0.5520 AC-IN

0.5520 AC-IN / 12 IN / FT
= 0.0460 AC-FT

0.0460 AC-FT X 43,560 SF/AC
= 2,004 ± CU FT

2,004 ± CU FT X 7.485 GAL/CU FT
= 14,998 ± Gallons

The Detention Basin has a volume of 3,917 CU FT > 2,004 CU FT

APPENDIX E: REQUIRED RECHARGE

GROUNDWATER RECHARGE CALCULATIONS

TOTAL RECHARGE VOLUME REQUIRED(OVERALL SITE-NET INCREASE):

FOR NRCS Soil Class B, DEPTH = 0.35 inches
Total Site Impervious Area = 0.552 acres (Roof and Parking Lot)
Recharge Volume = 0.35 inches X 0.552 acres = 0.1932 acre-inches
0.1932 acre-inches / 12 inches/ft = 0.0161 acre-ft
0.0161 acre-ft X (43,560 s.f./acre) = 701.32 cu.ft. to recharge

TOTAL RECHARGE VOLUME PROVIDED THROUGH THE ROOF RECHARGE INFILTRATION CHAMBERS:

VOLUME OF AREA AT BOTTOM DETENTION BASIN

= 701.32 cu.ft.

1,598.00 cu.ft. > 701.32 cu.ft.
Recharge Volume Provided Conforms to the Stormwater Management Guidelines

APPENDIX F: TOTAL SUSPENDED SOLIDS

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: 87 Hayward Road, Acton, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	**0.05**	**1.00**	**0.05**	**0.95**
Extended Dry Detention Basin	**0.50**	**0.95**	**0.48**	**0.48**
	0.00	**0.48**	**0.00**	**0.48**
	0.00	**0.48**	**0.00**	**0.48**
	0.00	**0.48**	**0.00**	**0.48**

Total TSS Removal = **53%**

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

Project: 2014-028

Prepared By: MBL

Date: 5/28/2015

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

APPENDIX G: CONSTRUCTION PERIOD POLLUTION PLAN / EROSION AND SEDIMENTATION CONTROL PLAN

CONSTRUCTION PERIOD POLLUTION PREVENTION (CPPP) AND EROSION AND SEDIMENTATION CONTROL PLAN

This construction period pollution prevention plan has been prepared in accordance with the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), for the proposed site development of a Solar farm in Dighton, Massachusetts.

SECTION I: POTENTIAL SOURCES OF POLLUTION

The following potential sources of pollution should be monitored during construction.

WASTE MATERIALS

All waste materials will be collected and stored in a securely lidded metal dumpster located more than 100 feet from any resource area as is reasonable practical. The dumpster will meet all local and State solid waste management regulations. All trash and construction debris from the site will be deposited in the dumpster. No construction waste materials will be buried onsite. All personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the office trailer, and the individual who manages day-to-day site operations will be responsible for seeing that these practices are followed.

HAZARDOUS WASTE

All hazardous waste materials will be disposed of in the manner specified by local or State regulation or by the manufacturer. Site personnel will be instructed in these practices and the individual, whom manages day-to-day site operations, will be responsible for seeing that these practices are followed.

SANITARY WASTE

All sanitary waste will be collected from the portable units a minimum of three times per week by a licensed sanitary waste management contractor, as required by the local or State regulation.

NON-STORM WATER DISCHARGES

During construction activities at the site, some water from the site will be suitable for discharge. Uncontaminated groundwater from de-watering activities will be directed to recharge groundwater and to replenish wetland resource areas. The construction de-watering and all non-stormwater discharges will be directed through a silt sack and/or sedimentation pond prior to discharge to the wetlands. The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges and the Stormwater Pollution Prevention Plan prepared by MBL Land Development & Permitting, Corp.

SECTION II: CONSTRUCTION SEQUENCING

Described below are the major construction activities. They are presented in the order (or sequence) they are expected to begin, but each activity will not necessarily be completed before the next begins. Also, these activities could occur in a different order if necessary to maintain adequate erosion and sedimentation control. All activities and the timeframe (beginning and ending dates) shall be recorded by the General Contractor:

1. Contractor to verify trees to be saved have been marked with orange construction fence.

2. Install stabilized construction entrance.

3. Cut and clear trees within the limit of work, unless otherwise noted.

4. Construct temporary and permanent erosion control facilities prior to any earth moving operations.

5. Grub trees and shrubs

6. Grade and seed compensatory flood storage area prior to filling within the bordering land subject of flooding area.

7. Grade and plant (season permitting).

8. Grade temporary sedimentation ponds.

9. Rough grade. All slopes shall be stabilized immediately after grading. All disturbed areas shall be stabilized no later than 72-hours after construction activities cease. If earthwork temporarily ceases on a portion of or on the entire site, and will not resume within 21-days, the area shall be stabilized. (Stabilize proposed pavement areas with compacted gravels and other disturbed areas with temporary grass seed). An area shall be considered stabile if one of the following has occurred:

    A. Base course gravels have been installed in areas to be paved;
    B. A minimum of 85% vegetated growth has been established;
    C. A minimum of 3"of non-erosive material such as stone or rip-rap has been installed; or
    D. Erosion control blankets have been properly installed.

10. Construct retaining walls along western property.

11. Construct grassed swaled areas. Place rip rap and other BMPs according to the plan. The Contractor shall stabilize all ditches, swales and ponds/basins prior to directing flow to them.

12. Install all underground utilities.

13. Construct solar panels and finish grade sites according to the plan. All slopes shall be stabilized immediately after grading.

14. Inspect and maintain all erosion and sedimentation control measures periodically and immediately after storm events greater then 0.5" over a 24-hr period.

15. Complete permanent seeding and landscaping.

16. Remove temporary erosion control measures once all areas are stabilized with a suitable stand of grass, pavement or compacted gravels.

The general construction sequence presented above does not preclude the requirements for additional controls identified earlier in this report or utilization of any other appropriate techniques to limit erosion and sedimentation at the site. Any measures deemed necessary by the Zoning Board, Town Engineer, or Conservation Commission representative will be implemented within 48 hours.

SECTION III: BEST MANAGEMENT PRACTICES

An Erosion Control and Sedimentation Control program will be implemented to prevent indirect impact to the existing wetland, existing roadways, and surrounding sites during the construction. The program incorporates Best Management Practices (BMP's) as specified in the guidelines developed by DEP and the Environmental Protection Agency and complies with the requirements of the NPDES General Permit for Storm Water Discharges for Construction Activities. These measures include the installation of temporary erosion and sedimentation controls and construction sequencing. Areas of exposed soil will be kept to a minimum and/or phased during construction and a permanent vegetative cover or other forms of stabilization will be established as soon as practicable.

Proper implementation of the erosion and sedimentation control program will:

- Minimize exposed soils through temporary mulching or seeding or by sequencing so that the amount of exposed soil is kept to a minimum.
- Place erosion controls structures to manage erosion and site runoff.
- Managing the control structures through the life of the construction activities and repairing all damaged structures as well as removing trapped silt as soon as recommended.
- Establish a permanent vegetative cover or other forms of stabilization as soon as practicable.

The following erosion and sedimentation control BMP's are presented in the sequence to which they will be implemented at the site. The measures will be inspected on a weekly basis or immediately before and or after storm event greater than 0.5". The controls will be routinely maintained throughout the duration of the project. Any damaged controls will be repaired and or replaced immediately. The locations of the specified sedimentation and erosion control measures are depicted on the proposed design drawings.

EROSION CONTROL BARRIERS

Erosion control barriers will be installed and inspected by the appropriate authority at the down gradient limit of work prior to construction. The barriers will consist of siltation fence, coir logs and/or straw bales and will be entrenched into the substrate to prevent under flow. When necessary, additional straw bales and or silt fence barriers will be installed immediately down gradient of the erosion prone areas, such as the base of steep exposed slopes, around material stockpile areas, siltation ponds, throughout the construction phase of the project. A sufficient supply of material shall be kept on site to facilitate the repair or replacement of the proposed barriers.

STABILIZED CONSTRUCTION ENTRANCE

The stabilized construction entrance shall be installed after site clearing but before any earth moving activities. The exit should be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic topdressing with additional stone. Remove mud and sediment tracked or washed onto public road immediately. Reshape pad as needed for drainage and runoff control. Repair any broken road pavement immediately. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization is achieved or after the temporary practices are no longer needed. Trapped sediment shall be removed or stabilized on site. Inspect the exit pad and sediment disposal area weekly and after heavy rains or heavy use.

TEMPORARY SURFACE AND SLOPE STABILIZATION

Any area of exposed soil that will remain unstabilized for a period of more than twenty days will be covered with a layer of straw or mulch until the time of final loam and seeding.

TEMPORARY SEEDING

A temporary vegetative cover of fast growing indigenous grasses will be established on areas of exposed soils that remain unstabilized for a period of twenty-one days. Depending on the slope, the seeded surfaces will be covered with a layer of mulch.

PERMANENT SEEDING

Upon completion of the final grading, any area not covered by pavement, other forms of stabilization, or other landscaped methods will be loamed and seeded with New England Erosion Control/Restoration Mix (for dry sites) produced by New England Wetland Plants, Inc. (or approved equivalent). This mix includes grasses and broad leaf herbaceous plants that are indigenous to the northeastern Massachusetts. Depending on slope the seeded area will be covered with mulch or erosion control blanket. The seed mix will be applied at a rate of 25lbs/acre.

GRASSED SWALE PROTECTION

The following practices should be implemented by the contractor in order to protect the in-situ soils in the location of the grassed swale area

- Fence swale areas off prior to construction;
- Never allow heavy construction equipment to drive across areas;
- Limit smearing and compacting of soils in infiltration areas;
- Do not construct grassed swale during winter or during a rain event;
- Rotary till or disc harrow to a depth of 12” to restore infiltration rates after final grading.
- It is not recommended that the grassed swale shall be used as sedimentation ponds during construction. However, if the areas are to be used, the accumulated sediments and top 6” of the native soil of the floor and sidewall areas be removed and replaced with soil amendments, such as course sand.

APPENDIX H: LONG -TERM POLLUTION PREVENTION AND MAINTAINTNANCE PLAN

The operation and maintenance of all components of the proposed drainage system will be the responsibility of the following:

Contact Information:

Stormwater Management Practices Owner/Responsible Party for Operation and Maintenance

HAARTZ Corporation

87 Hayward Road

Acton, Massachusetts 01720

Engineer of Record

James E. Miller, P.E.

Miller Engineering

Plainville, MA

Overview

In accordance with the local, state, and federal regulations and the approved site plan for the project, the subject site contains stormwater management practices to collect and convey stormwater, control erosion and sediment, attenuate peak flow rates of runoff, and remove stormwater pollutants. Specific stormwater management practices for this project shall include street sweeping and a detention pond.

During and subsequent to construction, the following temporary and permanent erosion control measures will be utilized and maintained as follows in accordance with *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas*:

- Perimeter Sediment Controls: Combined hay bale / siltation barriers consisting of a filter fabric silt fence and hay bales will be erected in advance of construction along the perimeter of the project site in locations shown on the Erosion & Sedimentation Control Plan. Such barriers should be inspected immediately after each runoff-producing rainfall

and at least daily during prolonged rainfall. Sediment deposits must be removed when the level of deposition reaches approximately one-half the height of the barrier.

- Construction Entrance:

  The entrance should be inspected weekly and after heavy rains or heavy use. Mud and soil particles will eventually clog the voids in the gravel and the effectiveness of the gravel pad. When this occurs, the pad should be top dressed with new stone. Complete replacement of the pad may be necessary when the pad becomes completely clogged.

- Catch Basin Inlet Protection: Silt sacks have been proposed to be installed in all proposed and relevant existing catch basins in order to prevent sediment from entering the proposed storm drainage system prior to permanent stabilization of the disturbed site. All silt sacks should be inspected after every rain storm and repairs made as necessary. In addition to the silt sacks a perimeter of hay bales shall be installed as an additional filter around all catch basins and shall remain in place until paving operations occur. Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. Catch basin inlet protection should be removed and the area repaired as soon as the contributing drainage area to the inlet has been completely stabilized.

- Deep-Sump, Hooded Catch Basins: All catch basins shall be hooded deep sump catch basins. Catch basins shall be cleaned, at minimum, four times per year, and inspected monthly per *Volume Two of the Massachusetts Stormwater Technical Handbook*. Cleaning will take place at the completion of the construction, in early spring after sanding of roadways has ceased, and in the fall. The disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

- Conveyance System Flushing: Upon the stabilization of the site and prior to the completion of construction or acceptance by the owner, the contractor shall inspect all on-site catch basins, storm drain piping, water quality structures, and the sub-surface drainage facilities and clean and flush as necessary. The disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

- Proprietary Structures: Proprietary separators have wide range of TSS efficiencies. Proprietary separators are usually sized based on flow rate.

- Proprietary Maintenance:

  1. Inspect and clean these units in strict accordance with manufacturers' recommendations and requirements

  2. Clean the units using the method specified by the manufacturer

  3. Vactor trucks are typically used to clean these units: as needed

  4. Remove sediment manually: as needed

- Construction Inspections: Construction inspections shall be performed by personnel from the site contractor and/or the Engineer of Record. Inspection forms shall be executed for each corresponding inspection.

  The following inspection plan shall be performed:

  1. Stabilization Measures: inspect monthly or as needed.

  2. Structural Controls: inspect every 14 days or as needed.

  3. Discharge Points: inspect every 14 days or as needed.

  4. Construction Entrances: inspect every 14 days or as needed.

  5. Storage areas: inspect every 14 days or a needed.

  6. All areas of erosion and sedimentation control shall be inspected after major storm events.

- Post-Construction Inspections: Construction inspections shall be performed by the owner or operator or their representative in accordance with the regulations of the South Shore Tri-Town Development Corp. and MADEP Stormwater Regulations. Inspection forms shall be executed for each corresponding inspection.

  The following inspection plan shall be performed:

  - Stabilization Measures: inspect annually or as needed.
  - Structural Controls: inspect quarterly or as needed.
  - Discharge Points: inspect quarterly or as needed.
  - Storage areas: inspect every quarterly or a needed.

APPENDIX I: ILLICIT DISCHARGE STATEMENT

ILLICIT DISCHARGE COMPLIANCE STATEMENT

An illicit discharge is any discharge to a municipal separate storm sewer that is not comprised entirely of stormwater, discharges from fire-fighting activities, and certain non-designated non-stormwater discharges.

To the best of my knowledge, no detectable illicit discharge exists on site. The site plans included with this report detail the storm sewers that convey stormwater on the site and demonstrate that these systems do not include the entry of an illicit discharge. As the Site Owner's Representative, I will ultimately be responsible for implementing the Long Term Pollution Prevention Plan.

Signature: _____

Owner's Representative on behalf of HAARTZ Corporation, Acton, MA

APPENDIX J: STORMWATER POLLUTION PREVENTION PLAN