STORMWATER REPORT
264 PEARL STREET
NEWTON, MASSACHUSETTS

June 24, 2019

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INTRODUCTION

VTP Associates has performed a stormwater management analysis to evaluate the post-development impacts created by the proposed residential at #264 Pearl Street in Newton, Massachusetts. The project will include a new residence building with approximately 3 units, a new surface driveway with parking, landscaped areas, and an associated stormwater management system.

VTP Associates analyzed the hydrology for the drainage areas impacted by the proposed work utilizing the Soil Conservation Service's (SCS) Runoff Curve Number (CN) methodology. VTP Associates used the HydroCAD computer modeling system in conjunction with the SCS's methods to determine the peak rate of runoff for the 2, 10, and 100-year storm events.

VTP Associates proposes the use of best management practices (BMPs) as defined by the Massachusetts Department of Environmental Protection (MA DEP) for stormwater management onsite to protect downstream receiving waters from adverse water quality impacts due to stormwater runoff. Mitigating the rate and quality of stormwater runoff from the project site will also help to lessen the environmental impact of the proposed development.

METHODOLOGY

Hydrology and Hydraulics

VTP Associates analyzed the survey base plan and conducted a site visit to determine the existing drainage flow patterns onsite. The existing conditions survey, in conjunction with aerial photography, and site visits were used to determine existing surface coverage areas for the site. VTP Associates determined that a majority of the pre-developed surface cover for the study area is impervious cover. Initial soil research was determined using the Natural Resources Conservation Service (NRCS) soil survey maps for Middlesex County, Massachusetts via Web Soil Survey 1.1. According to the soil survey, the soil on the site consists of the following:

626B: Merrimac – Urban land complex, 0 to 8 percent slopes

Test pits were conducted and determined that the site consists of a very low drain peat. Based upon these findings, VTP Associates used a Hydrologic soil group 'D' for its drainage calculations. The test pit information has been included within this report. As per the Mass DEP Stormwater Hydrology Handbook for Conservation Commissions, VTP used a design infiltration rate of 0.05in/hr for 'D' soils.

For each subcatchment area, VTP Associates determined drainage flow path lengths, surface cover type and slopes for sheet and shallow concentrated flow. The information was used to calculate the time of concentration (Tc) for each subcatchment areas. Where applicable, a minimum Tc of 5 minutes was used; the minimum value for highly developed, small catchment areas. SCS Runoff Curve Numbers were selected by using the cover type and hydrologic soil group of each area. The peak runoff rates for the 2, 10 and 100-year storm events were then determined by inputting the weighted CN, Tc, drainage areas, and drainage system information into the HydroCAD storm water modeling system computer program. The storm events were based on the 24-hour duration storm with a SCS Type III storm distribution curve.

Storm Event

VTP Associates used Massachusetts rainfall data maps from Technical Paper 40, Rainfall Frequency Atlas of the United States and the City of Newton's Requirements for On-Site Drainage to estimate the rainfall depth for the 2, 10 and 100-year storms. The rainfall depths for the 24-hour storm events used are as follows:

Storm Event	24-Hour Rainfall Depth (inches)
2-year	3.1
10-year	4.5
100-year	8.78

HYDROLOGICAL ANALYSIS

Pre-Development Conditions

The existing site consists of a two-story wood house, a surface driveway, and landscape areas. Approximately 2,128 square feet (14.6%) of the site is impervious cover. The site is bound by residential building to the south, north and west, and Pearl Street to the east.

VTP Associates compiled the existing drainage areas from an existing conditions survey prepared by VTP Associates. Additionally, VTP Associates conducted site visits to evaluate the existing onsite drainage patterns and watershed divides from the existing conditions survey. At present, stormwater runoffs from the existing study area drain to the north abutters (POD1). The pre-development drainage areas are shown on "Figure 1: Pre-Development Drainage Areas."

Post Development Conditions

The proposed project includes the construction of a new multi-family residence, consisting 3 units, on ground driveway/parking, walkways, landscaped areas, and associated drainage improvements. As a result, approximately 5,733 square feet (39.2%) of the site is impervious. The same overall area was analyzed for the proposed conditions as the pre-development conditions and is shown on "Figure 2: Post-Development Drainage Areas." Similar to pre-development conditions, the stormwater runoff flows in the same direction. The same design points were used as in the pre-development conditions.

The new residence will have approximately 3,122 square feet of impervious, or roof, and the driveway will be approximately 3,507 square feet. The roof runoff areas are separated into two drainage areas. The roof runoff area (PR1) will be collected by the roof leaders and discharge through the proposed retaining wall into the backyard. The roof runoff area (PR2) will be collected by roof leaders and discharge into the onsite 2,500 gal. Tank #2 (TNK) which have an overflow to the onsite 2,500 gal. Tank #1. The driveway runoff (PD) will be collected by two catch basins and trench drain and discharge into the onsite 2,500 gal. Tank #1 (TNK). The Tank #1 includes two pumps connected to the City Drain. The intent of the proposed stormwater management system is to control runoff of the proposed building and driveway/parking. The infiltration system was designed to control the 100-year storm with the addition of two tanks and pump system connected to the City Drain. These improvements will help mitigate proposed peak rates of runoff to less than existing conditions. The drainage areas can be seen on "Figure 2: Post-Development Drainage Areas."

VTP Associates analyzed the pre- and post-development site conditions to determine the peak rates of runoff at the design points. By incorporating the stormwater management features discussed above, the peak rates of runoff in the post-development condition is to be better than pre-development levels. Pre-development peak runoff rates vs. post-development peak runoff rates for the 2, 10, and 100-year storm events are presented in Table 1 below.

Table 1, Pre-development vs. Post-Development Peak Rate of Runoff

Design Point #1 – North Abutters (POD1)

STORM EVENT (DESIGN POINT)	PRE-DEVELOPMENT PEAK RATE (CFS)	POST-DEVELOPMENT PEAK RATE (CFS)	PRE-DEVELOPMENT VOLUME (AF)	POST-DEVELOPMENT VOLUME (AF)
2-YEAR	0.59	0.42	0.041	0.030
10-YEAR	1.07	0.71	0.074	0.051
100-YEAR	2.62	1.64	0.185	0.120

CONCLUSION

The post-development peak rate of runoff is expected to be less than or equal to pre-development levels for the 2, 10, and 100-year storm events. Although there is increased impervious coverage on the site as a result of the proposed redevelopment, with the addition of two tanks and pump system connected to the City Drain will control the post-development runoff to pre-development levels or better.

ENCLOSURES

Test Pit
NRCS Soil Map
Pre-Development Drainage Areas (Figure 1)
Post-Development Drainage Areas (Figure 2)
Pre & Post Development HydroCAD Calculations
Tanks Buoyancy Calculation

TESTPIT LOG

TEST PIT #1

0–29"	TOPSOIL
29–41"	COARSE SAND W/GRAVEL (FILL)
41–49"	ASH (FILL)
49–100"	PEAT

WATER @ 63"
NO REFUSAL

TEST PIT #2

0–15"	TOPSOIL
15–21"	ASH (FILL)
21–52"	PEAT

WATER @ 35"
NO REFUSAL

TEST PIT #3

0–20"	TOPSOIL
20–30"	ASH & FILL
30–57"	PEAT

WATER @ 41"
NO REFUSAL

Hydrologic Soil Group—Middlesex County, Massachusetts
(264 Pearl Street Newton, MA)

Map Scale: 1:424 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Middlesex County, Massachusetts
Survey Area Data: Version 18, Sep 7, 2018

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	0.4	100.0%
Totals for Area of Interest			**0.4**	**100.0%**

Description

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

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

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

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

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

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

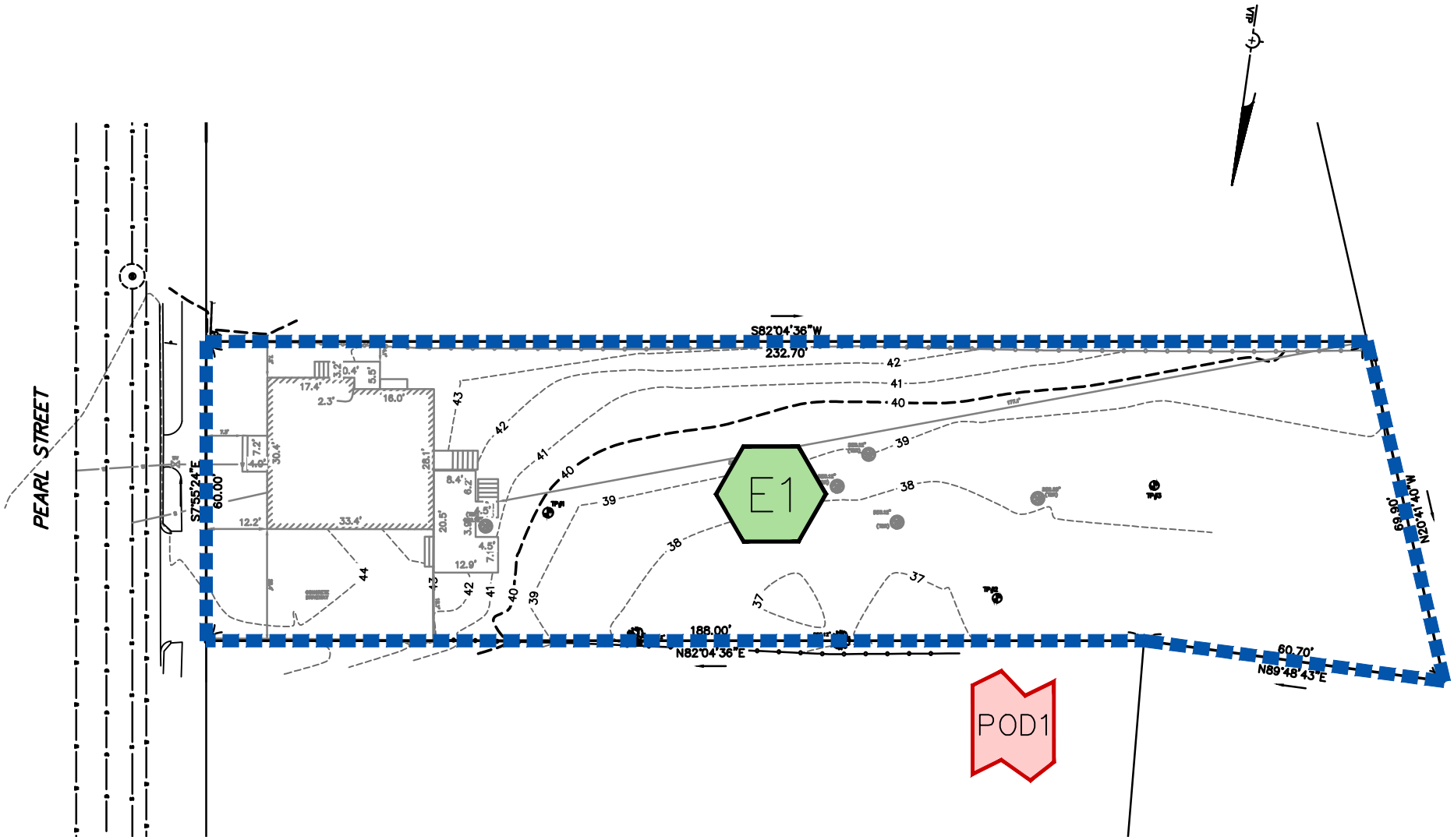
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

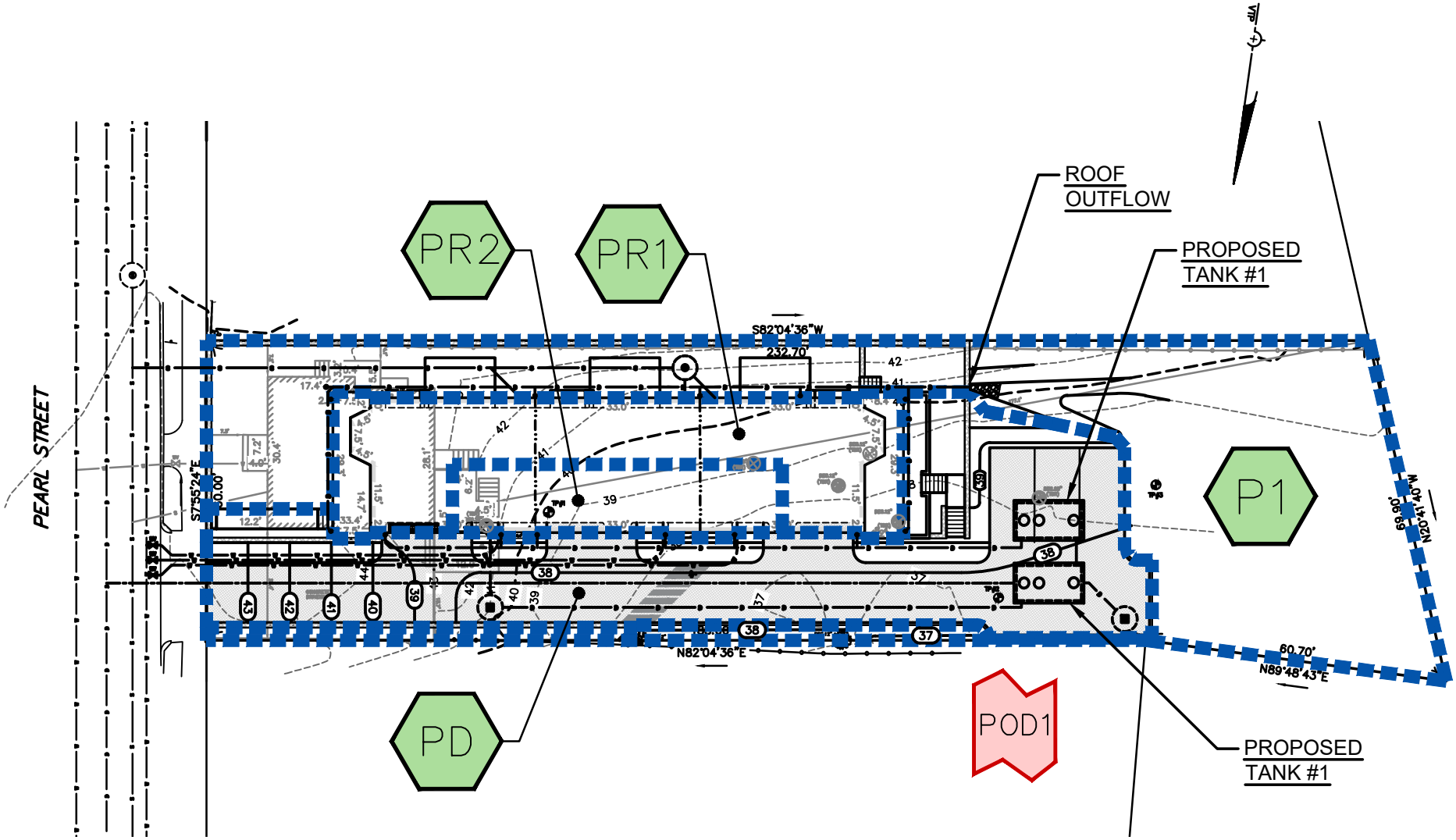
Component Percent Cutoff: None Specified

Tie-break Rule: Higher



SCALE: 1in.=30ft.
DATE: JUNE 24, 2019

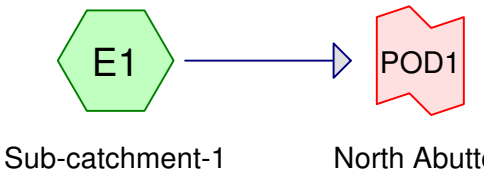
FIGURE 1:
PRE-DEVELOPMENT DRAINAGE AREAS
#264 PEARL STREET
NEWTON, MA



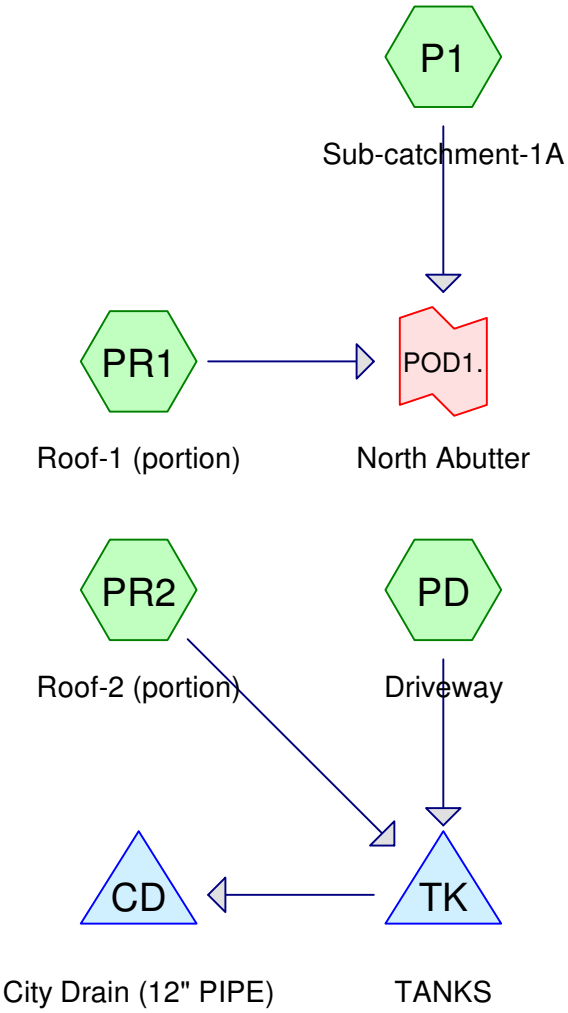
SCALE: 1in.=30ft.
DATE: JUNE 24, 2019

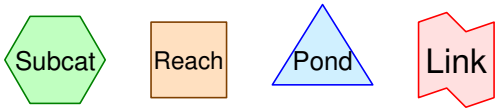
FIGURE 2:
POST-DEVELOPMENT DRAINAGE AREAS
#264 PEARL STREET
NEWTON, MA

PRE-DEVELOPMENT CONDITIONS



POST-DEVELOPMENT CONDITIONS





Routing Diagram for 218199_264 Pearl St Newton, MA
Prepared by {enter your company name here}, Printed 6/24/2019

Summary for Subcatchment E1: Sub-catchment-1

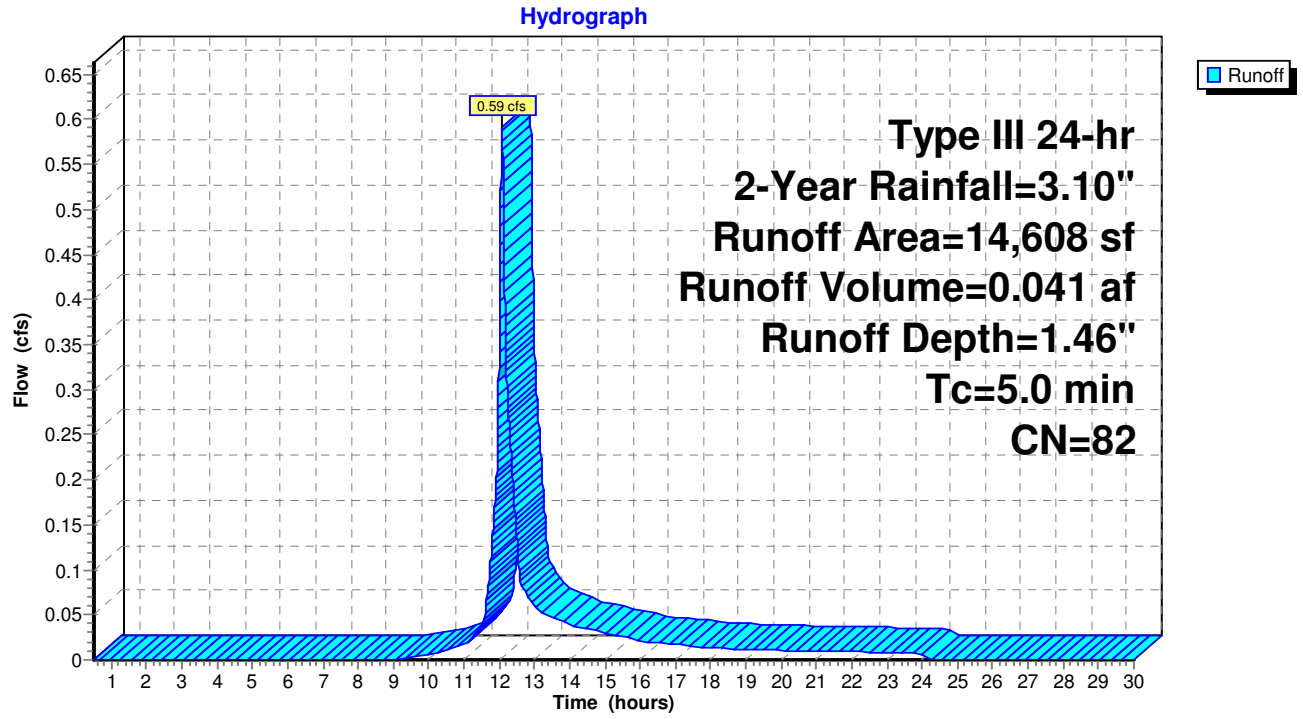
Runoff = 0.59 cfs @ 12.08 hrs, Volume= 0.041 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	988	98	House Roof
*	1,019	98	Driveway
*	121	98	Landing/Steps/Walks
	3,337	80	>75% Grass cover, Good, HSG D
	9,143	79	Woods/grass comb., Good, HSG D
	14,608	82	Weighted Average
	12,480		85.43% Pervious Area
	2,128		14.57% Impervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1A

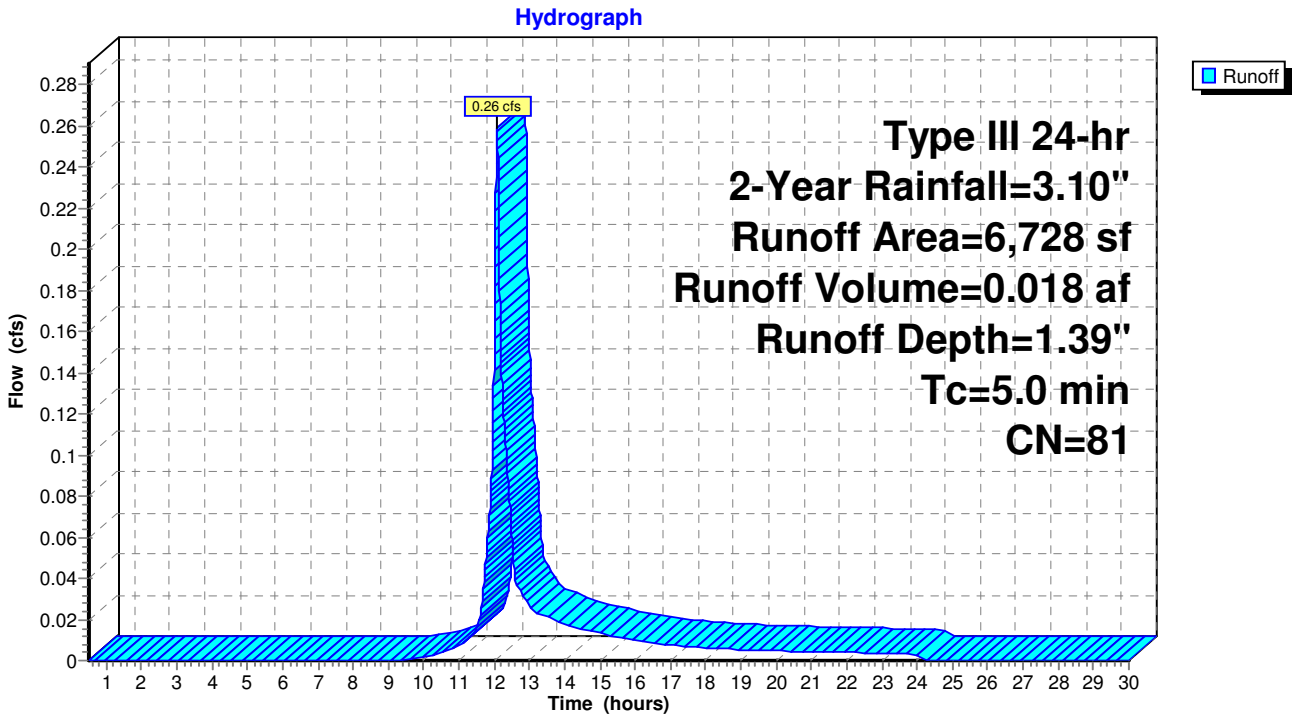
Runoff = 0.26 cfs @ 12.08 hrs, Volume= 0.018 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	167	98	Ret. Wall
*	13	98	Steps
*	33	98	Patio
	6,515	80	>75% Grass cover, Good, HSG D
	6,728	81	Weighted Average
	6,515		96.83% Pervious Area
	213		3.17% Impervious Area

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

Subcatchment P1: Sub-catchment-1A



Summary for Subcatchment PD: Driveway

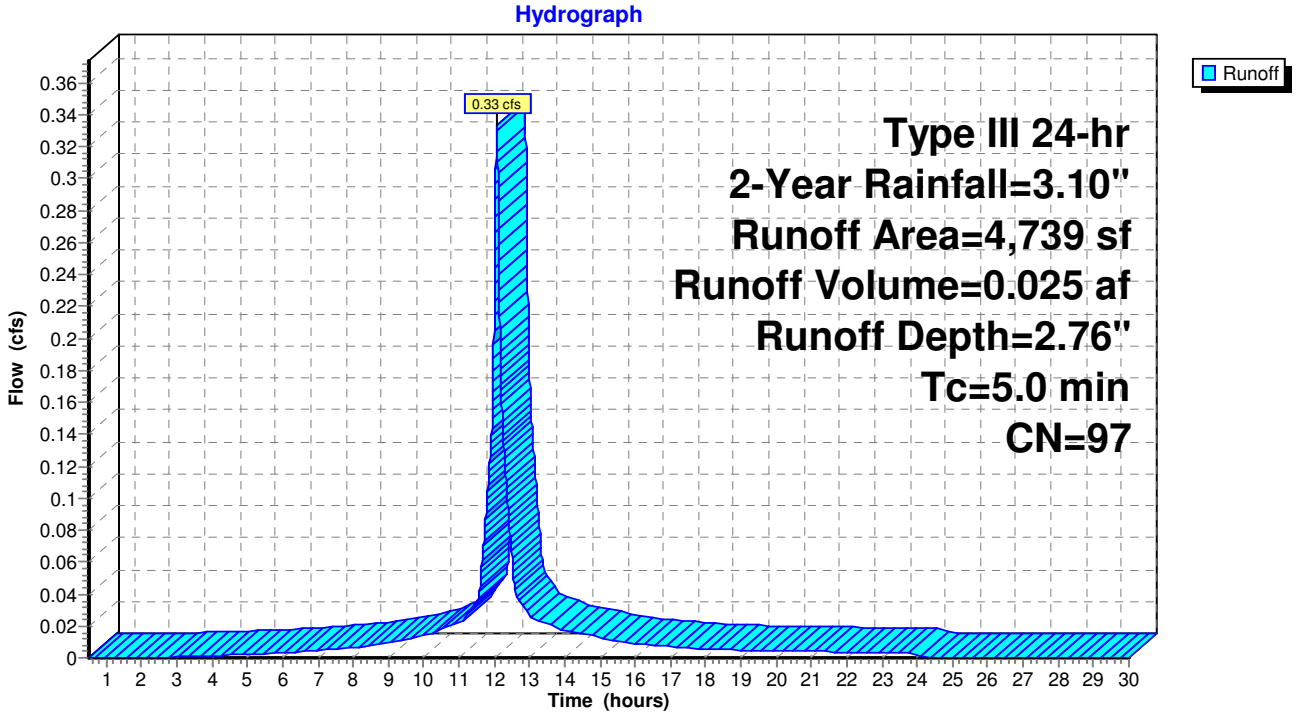
Runoff = 0.33 cfs @ 12.07 hrs, Volume= 0.025 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	3,507	98	Driveway
*	165	98	Ret. Wall
*	578	98	Landing/Steps/Landings
*	148	98	Terrace
	341	80	>75% Grass cover, Good, HSG D
	4,739	97	Weighted Average
	341		7.20% Pervious Area
	4,398		92.80% Impervious Area

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

Subcatchment PD: Driveway



Summary for Subcatchment PR1: Roof-1 (portion)

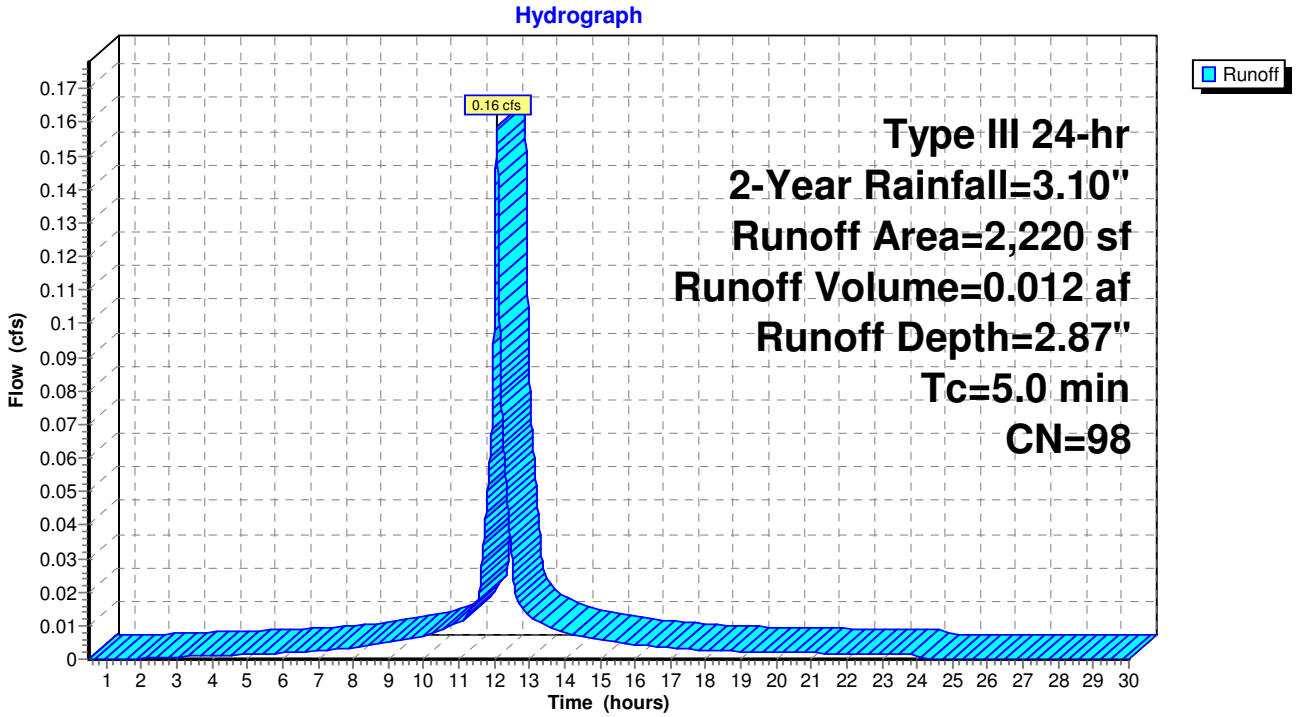
Runoff = 0.16 cfs @ 12.07 hrs, Volume= 0.012 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	2,220	98	Prop. Roof-1
	2,220		100.00% Impervious Area

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

Subcatchment PR1: Roof-1 (portion)



Summary for Subcatchment PR2: Roof-2 (portion)

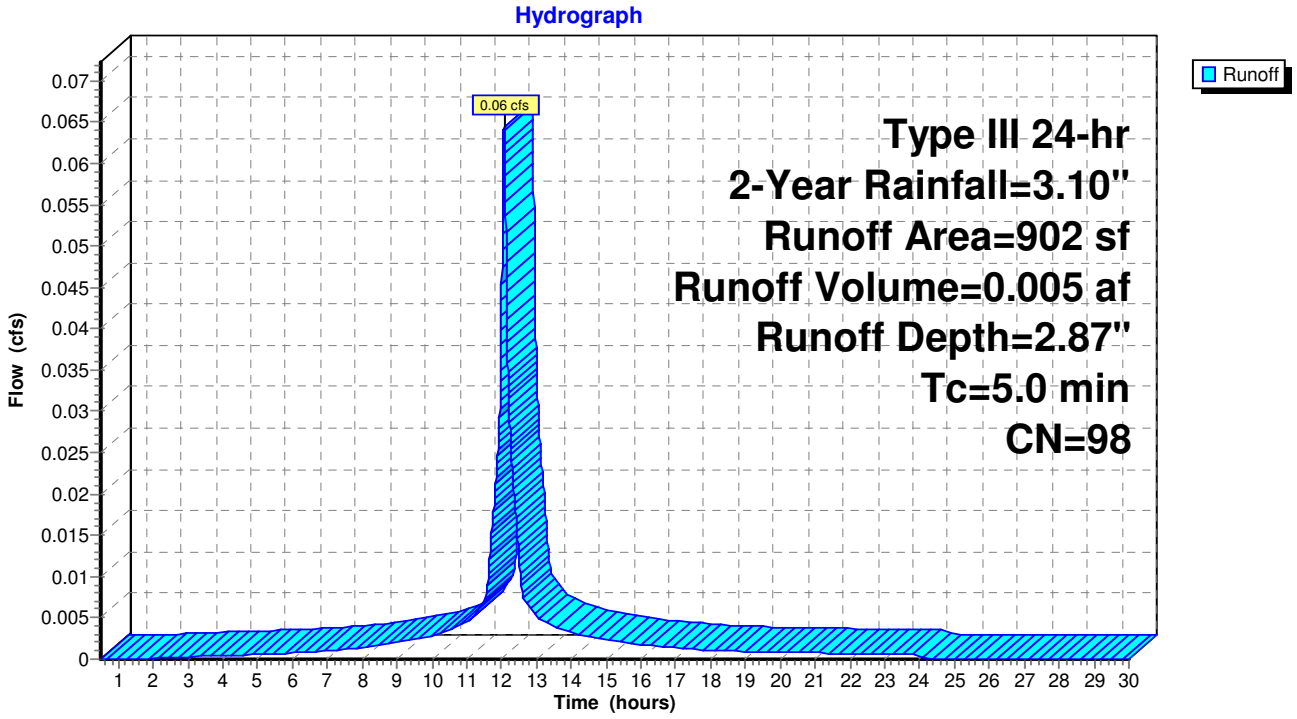
Runoff = 0.06 cfs @ 12.07 hrs, Volume= 0.005 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	902	98	Prop. Roof-2
	902		100.00% Impervious Area

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

Subcatchment PR2: Roof-2 (portion)

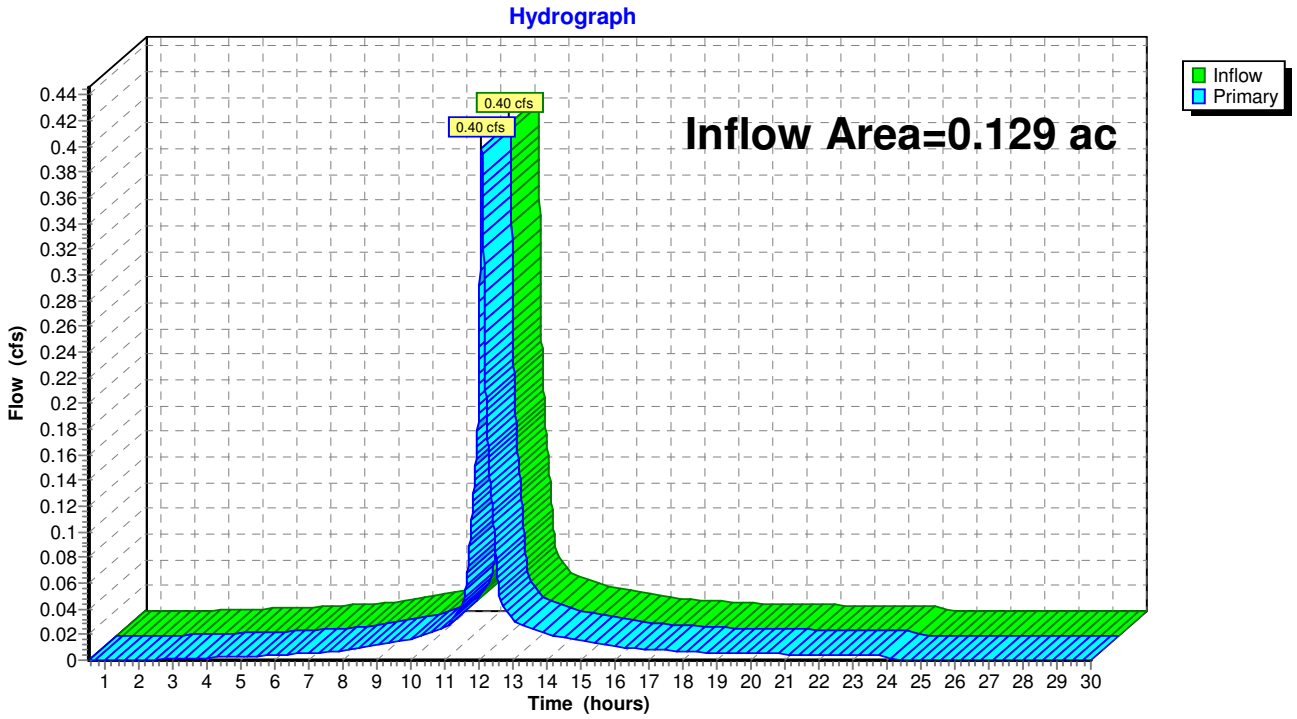


Summary for Pond CD: City Drain (12" PIPE)

Inflow Area = 0.129 ac, 93.95% Impervious, Inflow Depth = 2.78" for 2-Year event
Inflow = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af
Primary = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Pond CD: City Drain (12" PIPE)

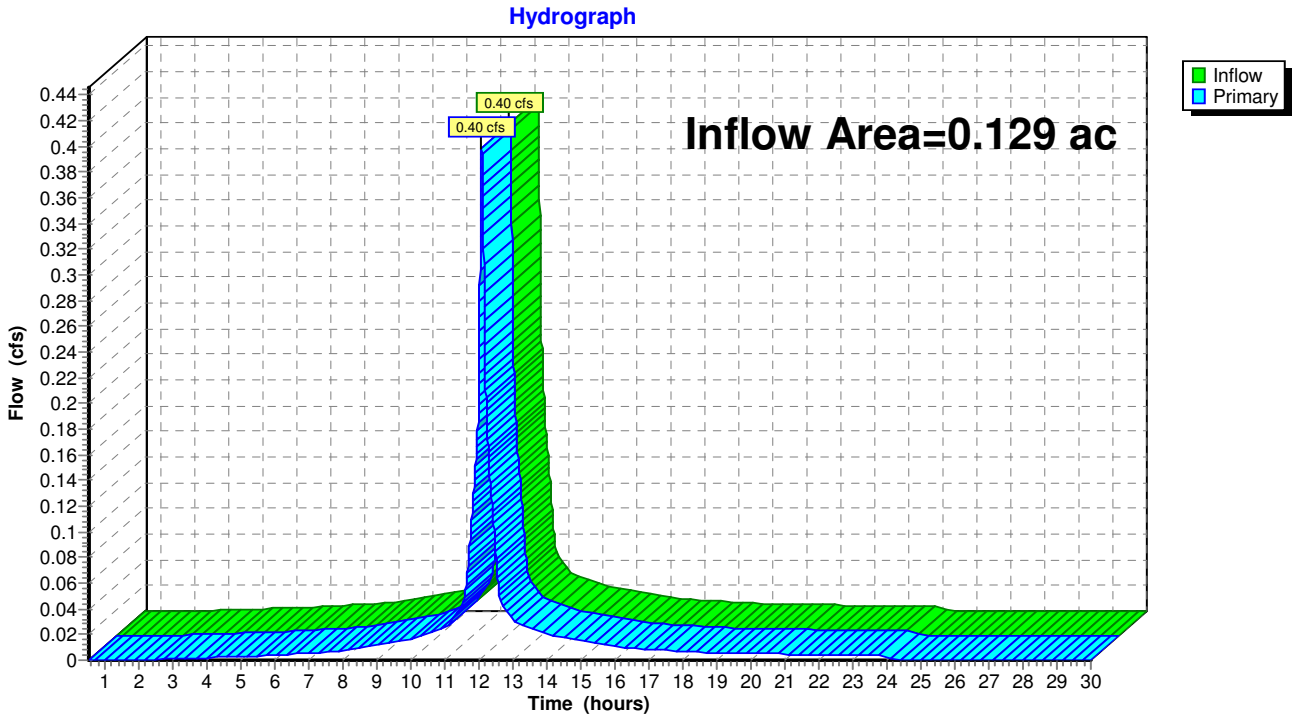


Summary for Pond TK: TANKS

Inflow Area = 0.129 ac, 93.95% Impervious, Inflow Depth = 2.78" for 2-Year event
Inflow = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af
Primary = 0.40 cfs @ 12.07 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Pond TK: TANKS

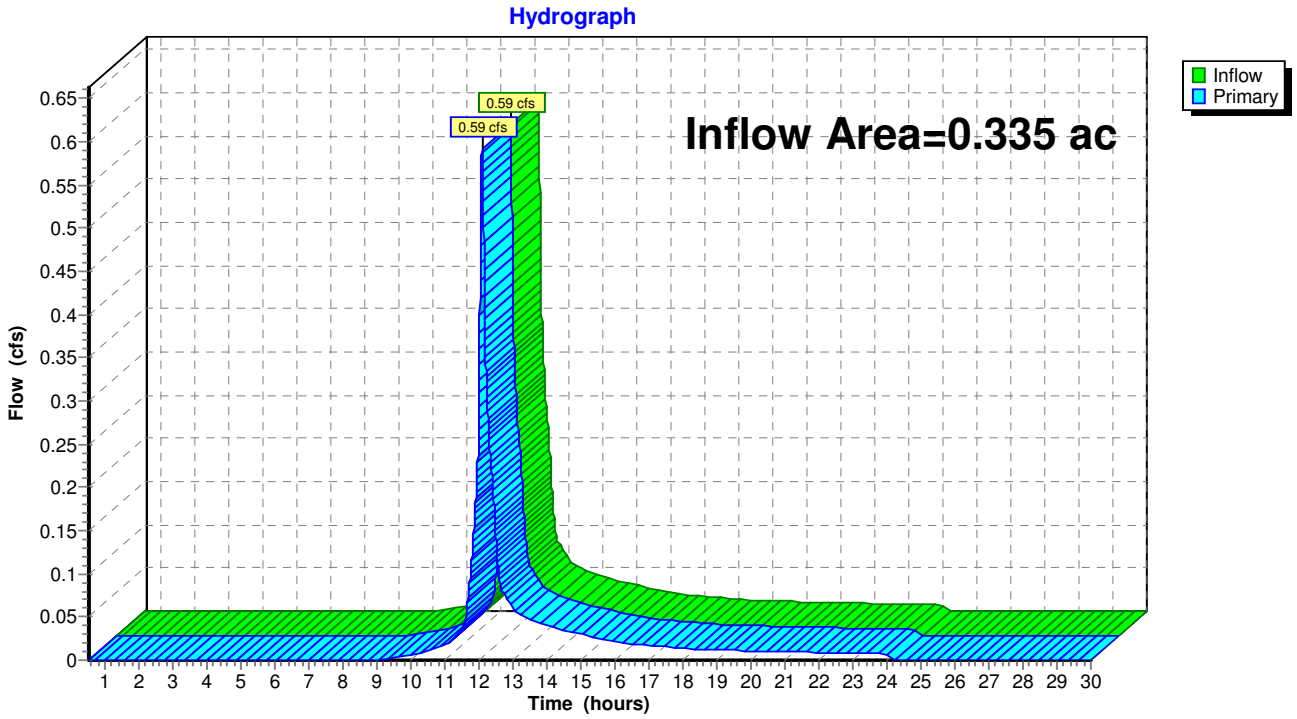


Summary for Link POD1: North Abutter

Inflow Area = 0.335 ac, 14.57% Impervious, Inflow Depth = 1.46" for 2-Year event
Inflow = 0.59 cfs @ 12.08 hrs, Volume= 0.041 af
Primary = 0.59 cfs @ 12.08 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Link POD1: North Abutter

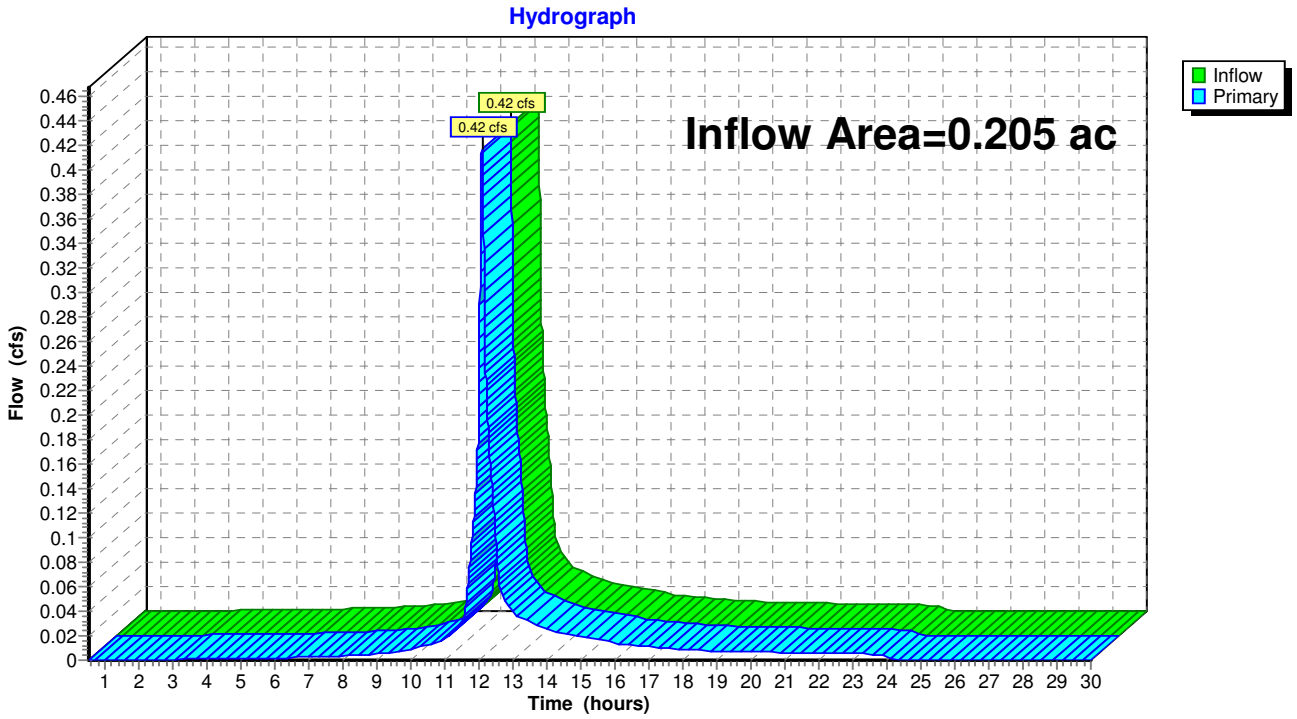


Summary for Link POD1.: North Abutter

Inflow Area = 0.205 ac, 27.19% Impervious, Inflow Depth = 1.76" for 2-Year event
Inflow = 0.42 cfs @ 12.07 hrs, Volume= 0.030 af
Primary = 0.42 cfs @ 12.07 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Link POD1.: North Abutter



Summary for Subcatchment E1: Sub-catchment-1

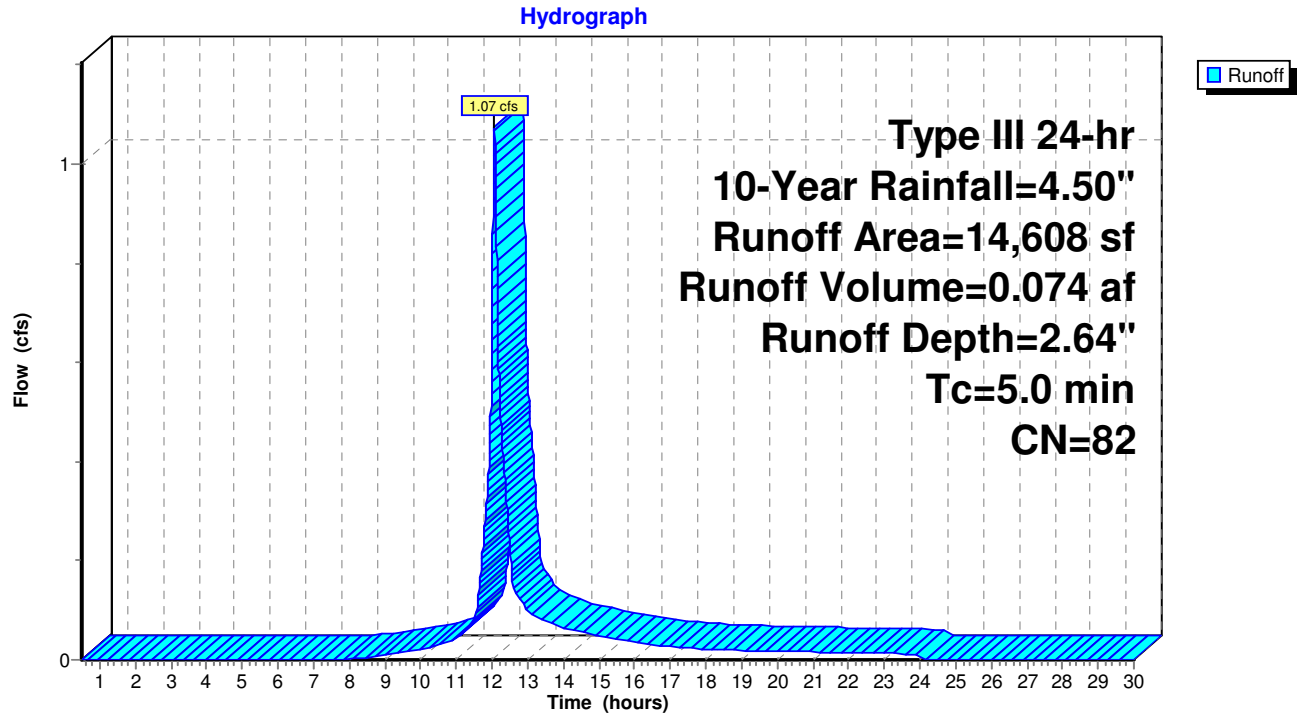
Runoff = 1.07 cfs @ 12.07 hrs, Volume= 0.074 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	988	98	House Roof
*	1,019	98	Driveway
*	121	98	Landing/Steps/Walks
	3,337	80	>75% Grass cover, Good, HSG D
	9,143	79	Woods/grass comb., Good, HSG D
	14,608	82	Weighted Average
	12,480		85.43% Pervious Area
	2,128		14.57% Impervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1A

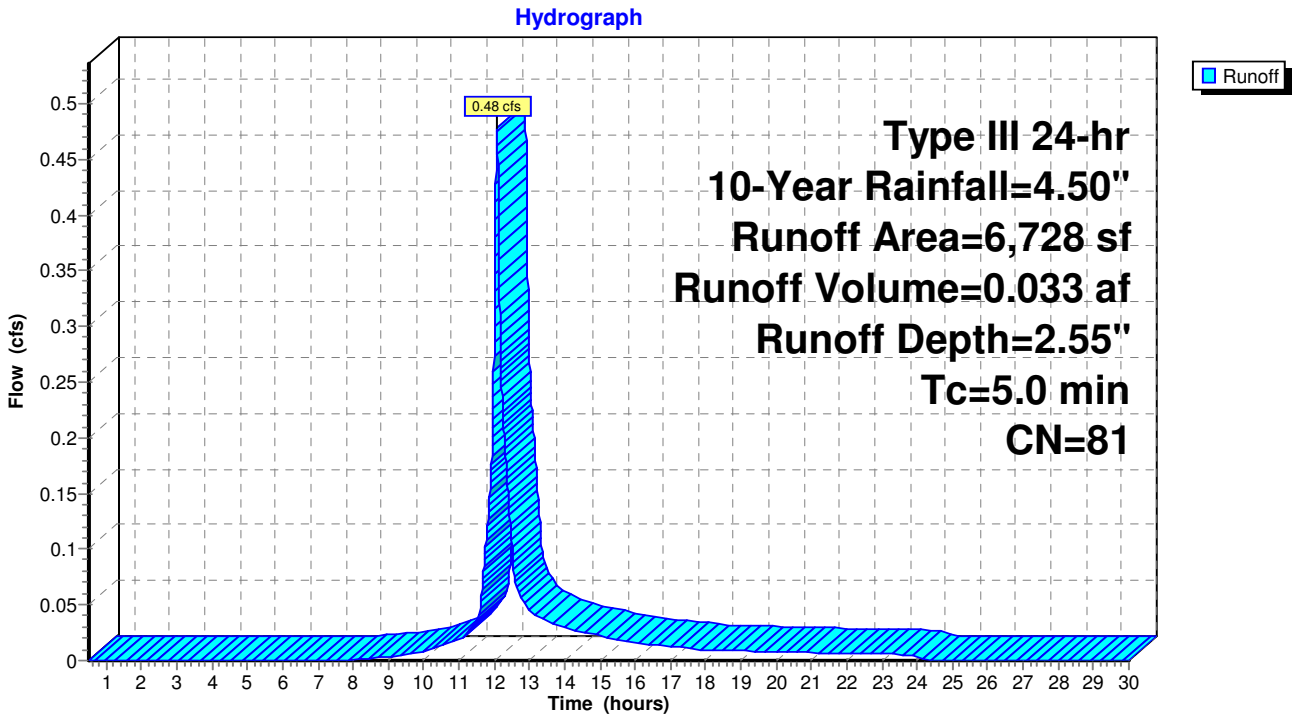
Runoff = 0.48 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	167	98	Ret. Wall
*	13	98	Steps
*	33	98	Patio
	6,515	80	>75% Grass cover, Good, HSG D
	6,728	81	Weighted Average
	6,515		96.83% Pervious Area
	213		3.17% Impervious Area

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

Subcatchment P1: Sub-catchment-1A



Summary for Subcatchment PD: Driveway

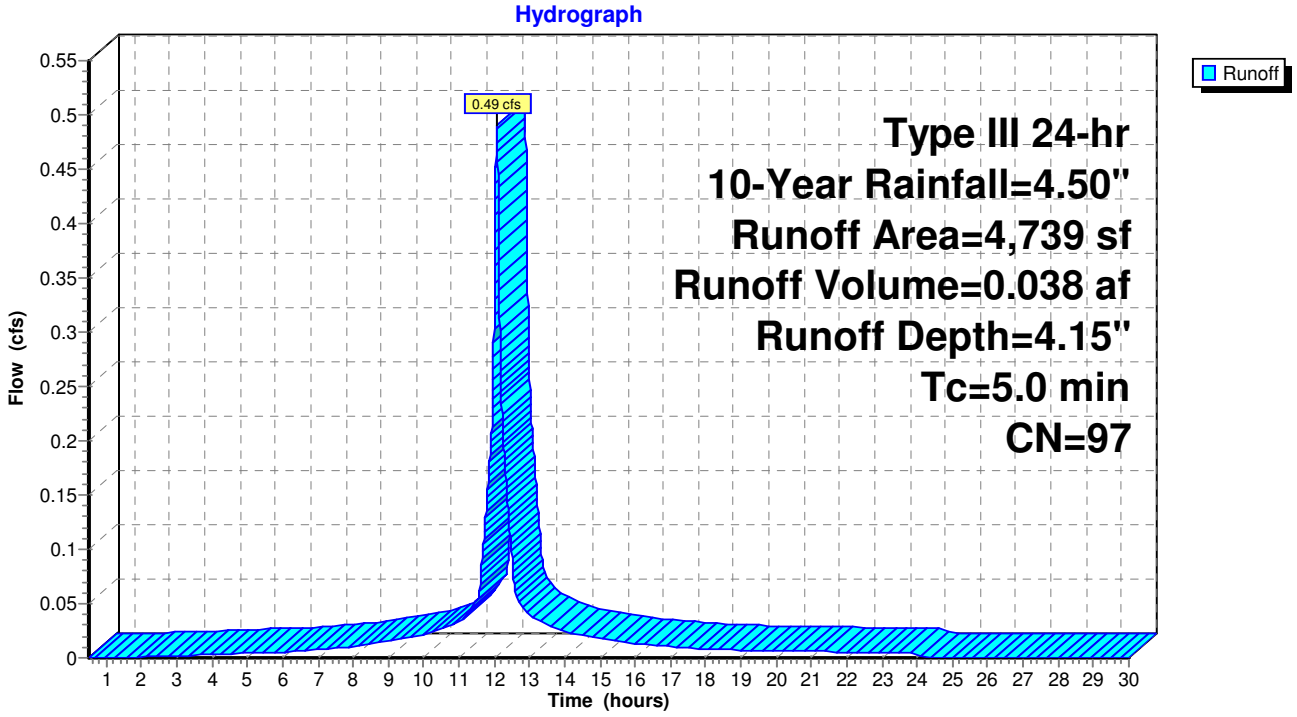
Runoff = 0.49 cfs @ 12.07 hrs, Volume= 0.038 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	3,507	98	Driveway
*	165	98	Ret. Wall
*	578	98	Landing/Steps/Landings
*	148	98	Terrace
	341	80	>75% Grass cover, Good, HSG D
	4,739	97	Weighted Average
	341		7.20% Pervious Area
	4,398		92.80% Impervious Area

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

Subcatchment PD: Driveway



Summary for Subcatchment PR1: Roof-1 (portion)

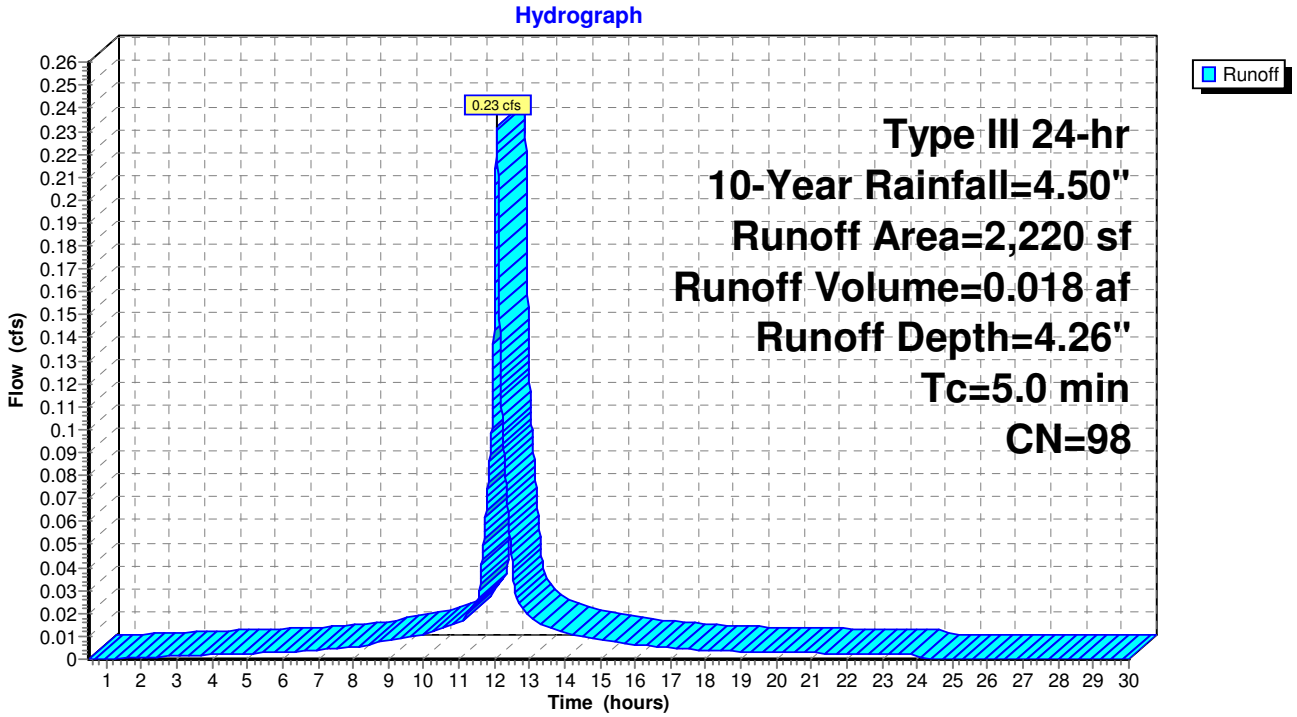
Runoff = 0.23 cfs @ 12.07 hrs, Volume= 0.018 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	2,220	98	Prop. Roof-1
	2,220		100.00% Impervious Area

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

Subcatchment PR1: Roof-1 (portion)



Summary for Subcatchment PR2: Roof-2 (portion)

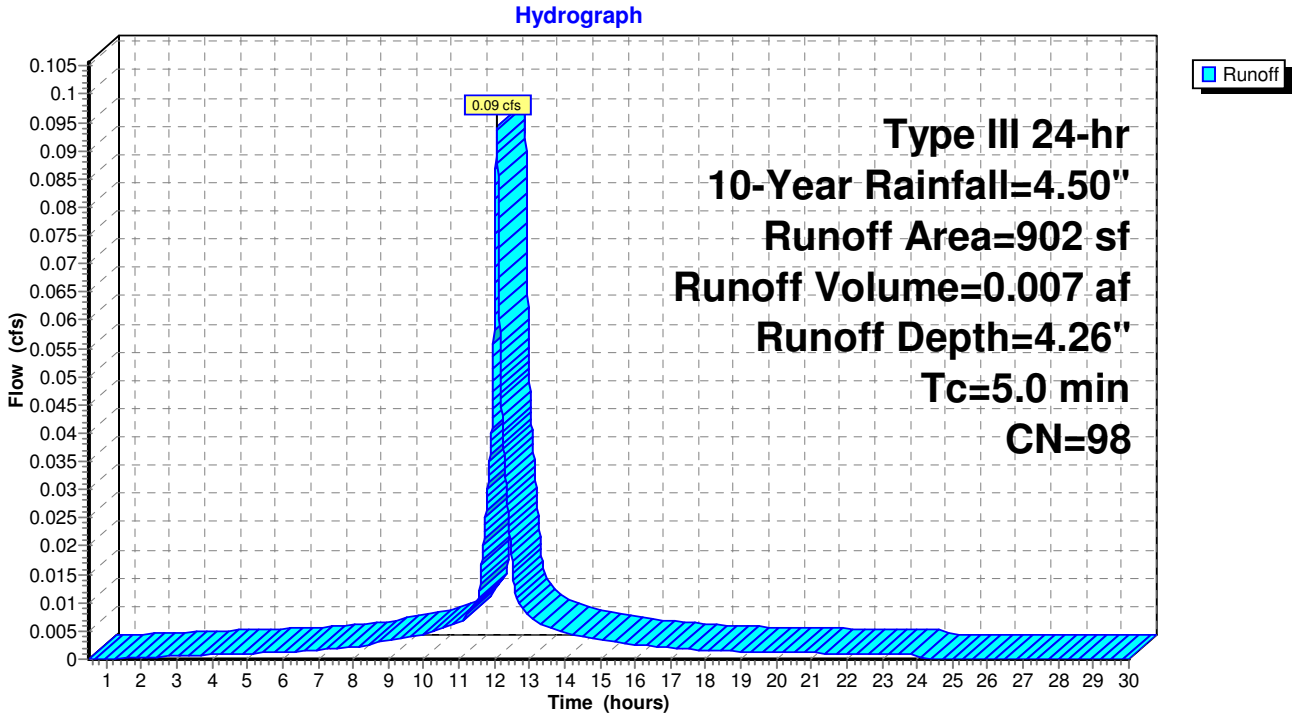
Runoff = 0.09 cfs @ 12.07 hrs, Volume= 0.007 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	902	98	Prop. Roof-2
	902		100.00% Impervious Area

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

Subcatchment PR2: Roof-2 (portion)

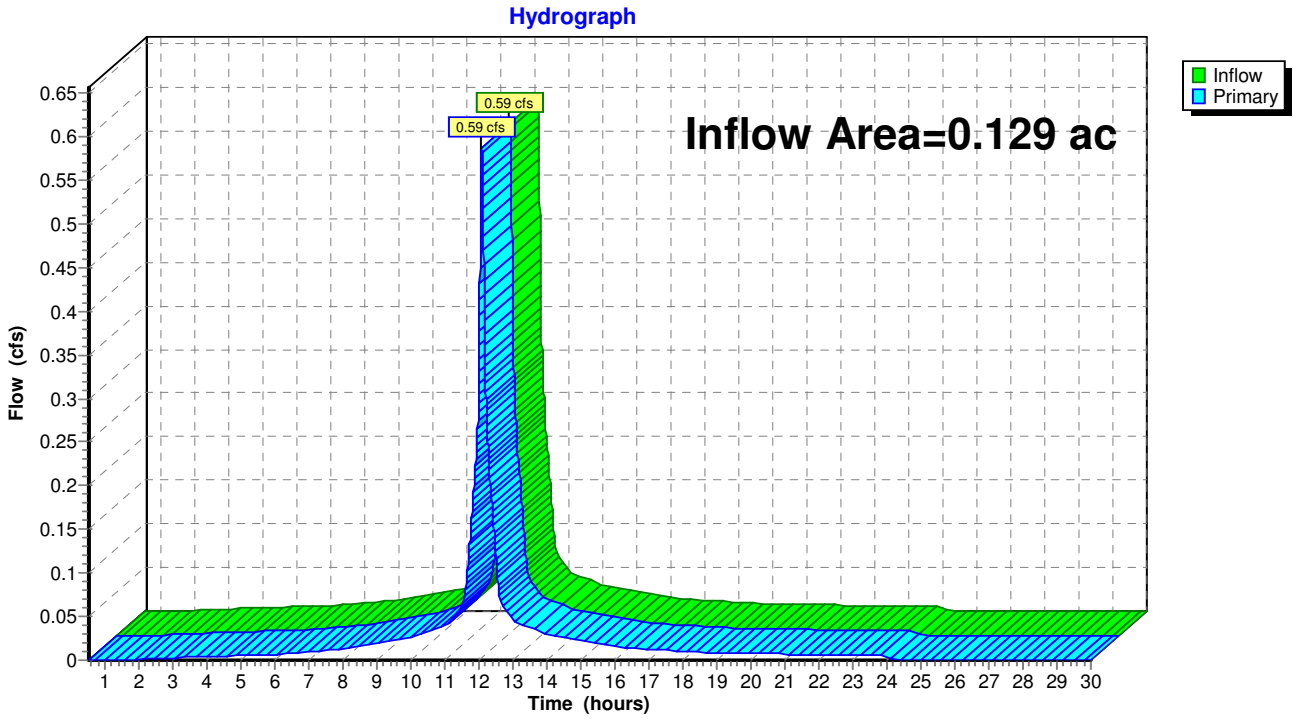


Summary for Pond CD: City Drain (12" PIPE)

Inflow Area = 0.129 ac, 93.95% Impervious, Inflow Depth = 4.17" for 10-Year event
Inflow = 0.59 cfs @ 12.07 hrs, Volume= 0.045 af
Primary = 0.59 cfs @ 12.07 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Pond CD: City Drain (12" PIPE)

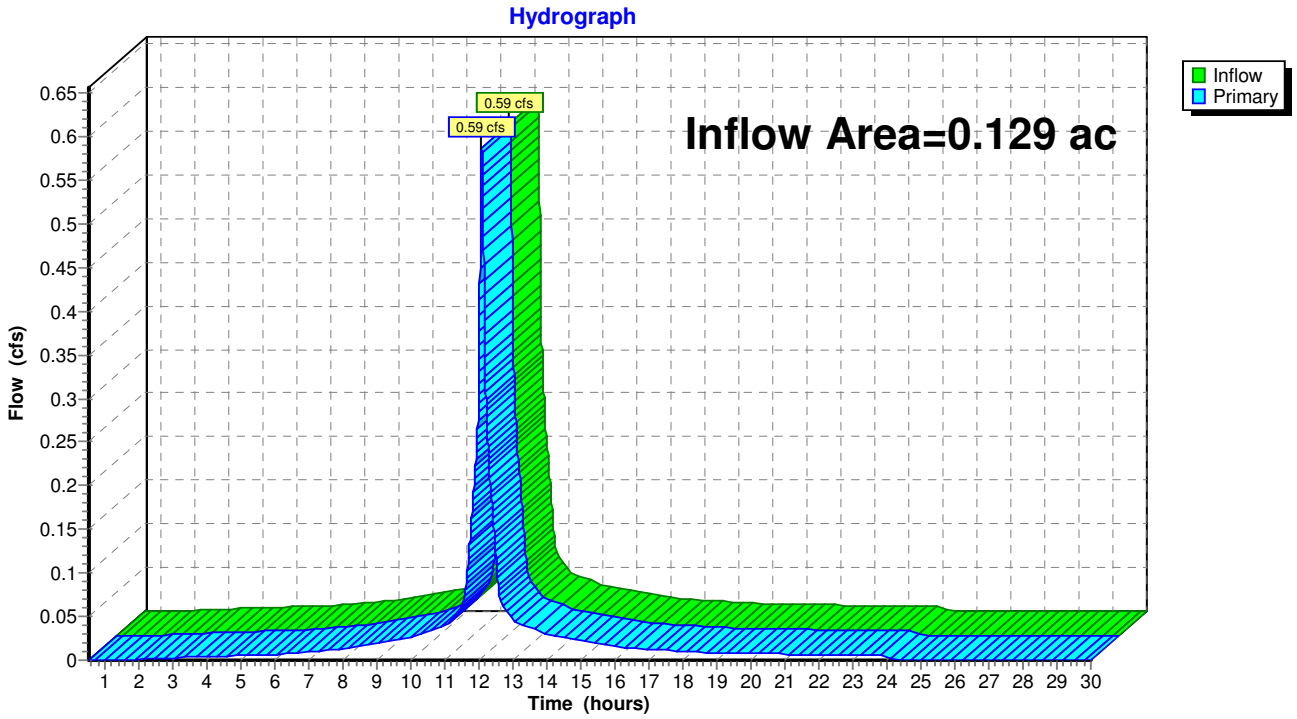


Summary for Pond TK: TANKS

Inflow Area = 0.129 ac, 93.95% Impervious, Inflow Depth = 4.17" for 10-Year event
Inflow = 0.59 cfs @ 12.07 hrs, Volume= 0.045 af
Primary = 0.59 cfs @ 12.07 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Pond TK: TANKS

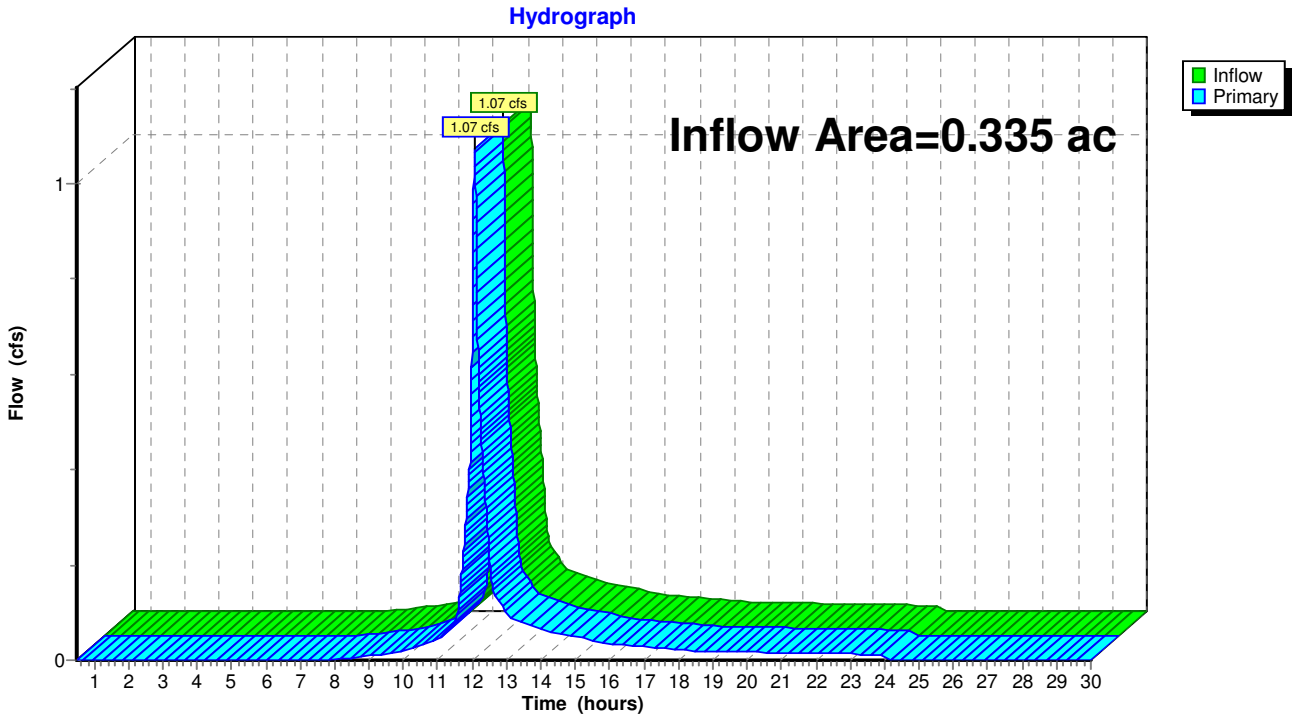


Summary for Link POD1: North Abutter

Inflow Area = 0.335 ac, 14.57% Impervious, Inflow Depth = 2.64" for 10-Year event
Inflow = 1.07 cfs @ 12.07 hrs, Volume= 0.074 af
Primary = 1.07 cfs @ 12.07 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Link POD1: North Abutter

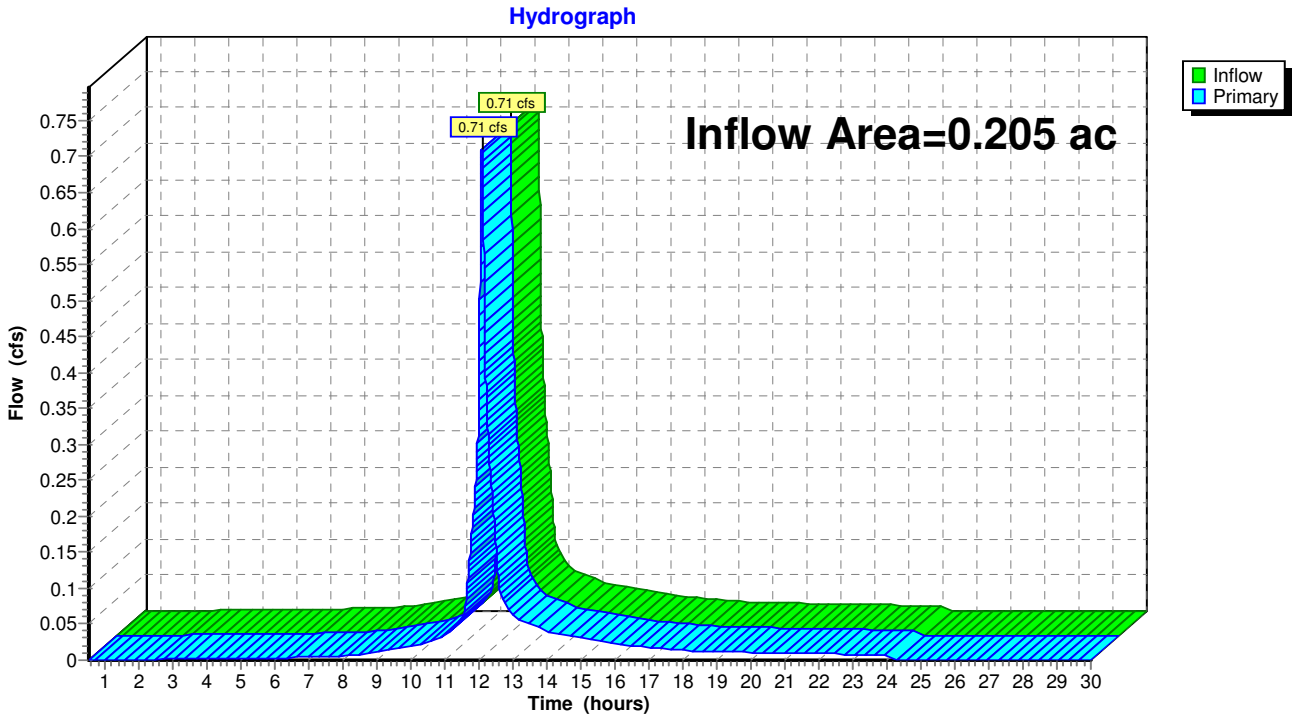


Summary for Link POD1.: North Abutter

Inflow Area = 0.205 ac, 27.19% Impervious, Inflow Depth = 2.97" for 10-Year event
Inflow = 0.71 cfs @ 12.07 hrs, Volume= 0.051 af
Primary = 0.71 cfs @ 12.07 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Link POD1.: North Abutter



Summary for Subcatchment E1: Sub-catchment-1

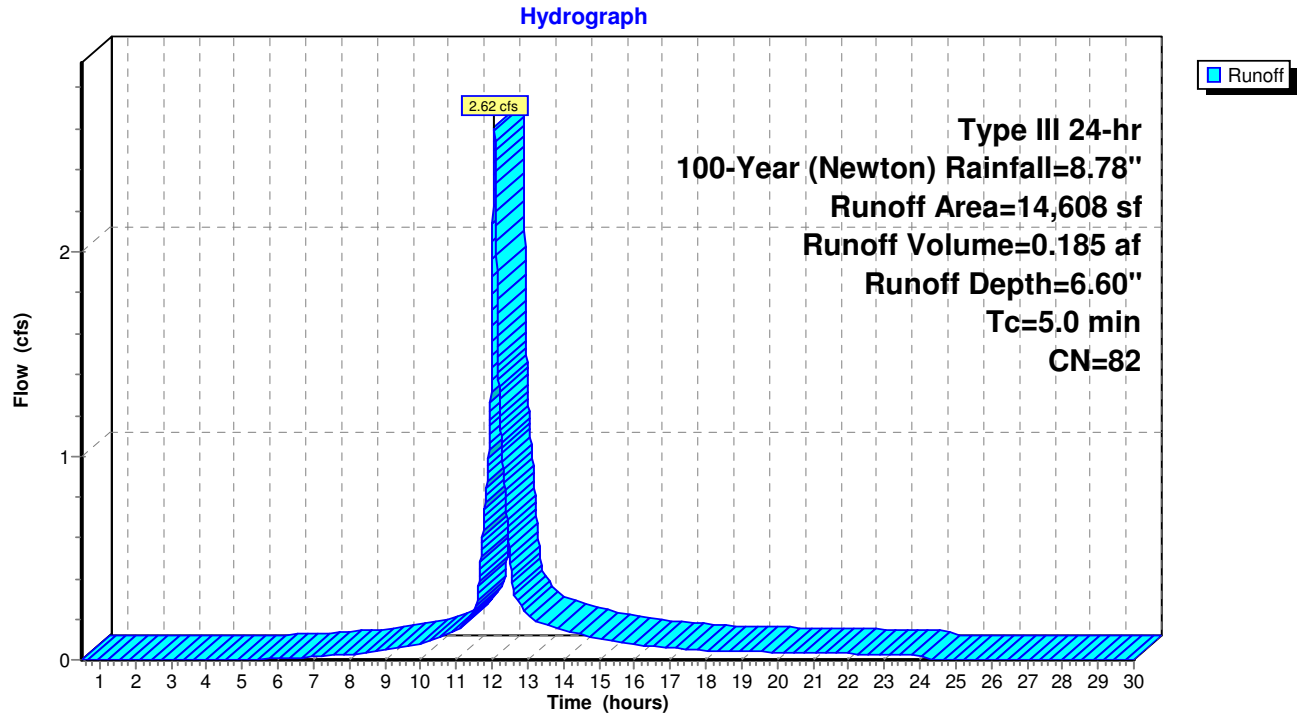
Runoff = 2.62 cfs @ 12.07 hrs, Volume= 0.185 af, Depth= 6.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 100-Year (Newton) Rainfall=8.78"

	Area (sf)	CN	Description
*	988	98	House Roof
*	1,019	98	Driveway
*	121	98	Landing/Steps/Walks
	3,337	80	>75% Grass cover, Good, HSG D
	9,143	79	Woods/grass comb., Good, HSG D
	14,608	82	Weighted Average
	12,480		85.43% Pervious Area
	2,128		14.57% Impervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1A

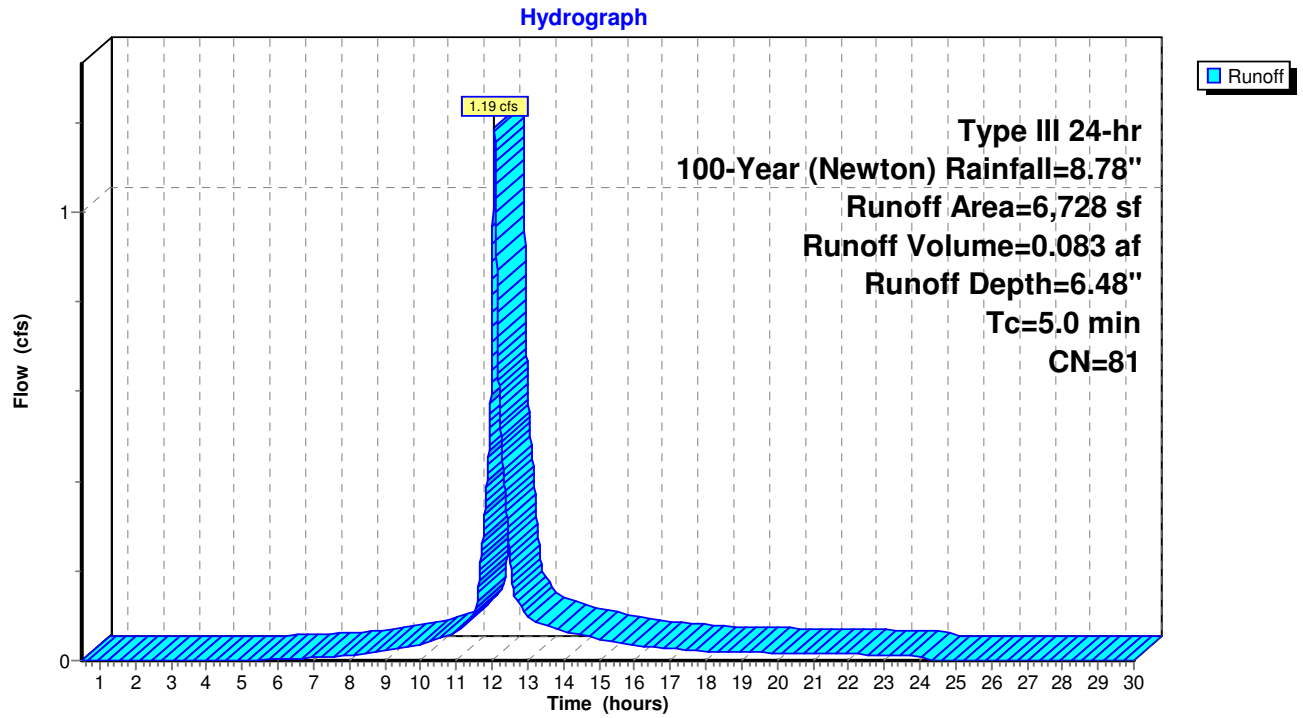
Runoff = 1.19 cfs @ 12.07 hrs, Volume= 0.083 af, Depth= 6.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 100-Year (Newton) Rainfall=8.78"

	Area (sf)	CN	Description
*	167	98	Ret. Wall
*	13	98	Steps
*	33	98	Patio
	6,515	80	>75% Grass cover, Good, HSG D
	6,728	81	Weighted Average
	6,515		96.83% Pervious Area
	213		3.17% Impervious Area

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

Subcatchment P1: Sub-catchment-1A



Summary for Subcatchment PD: Driveway

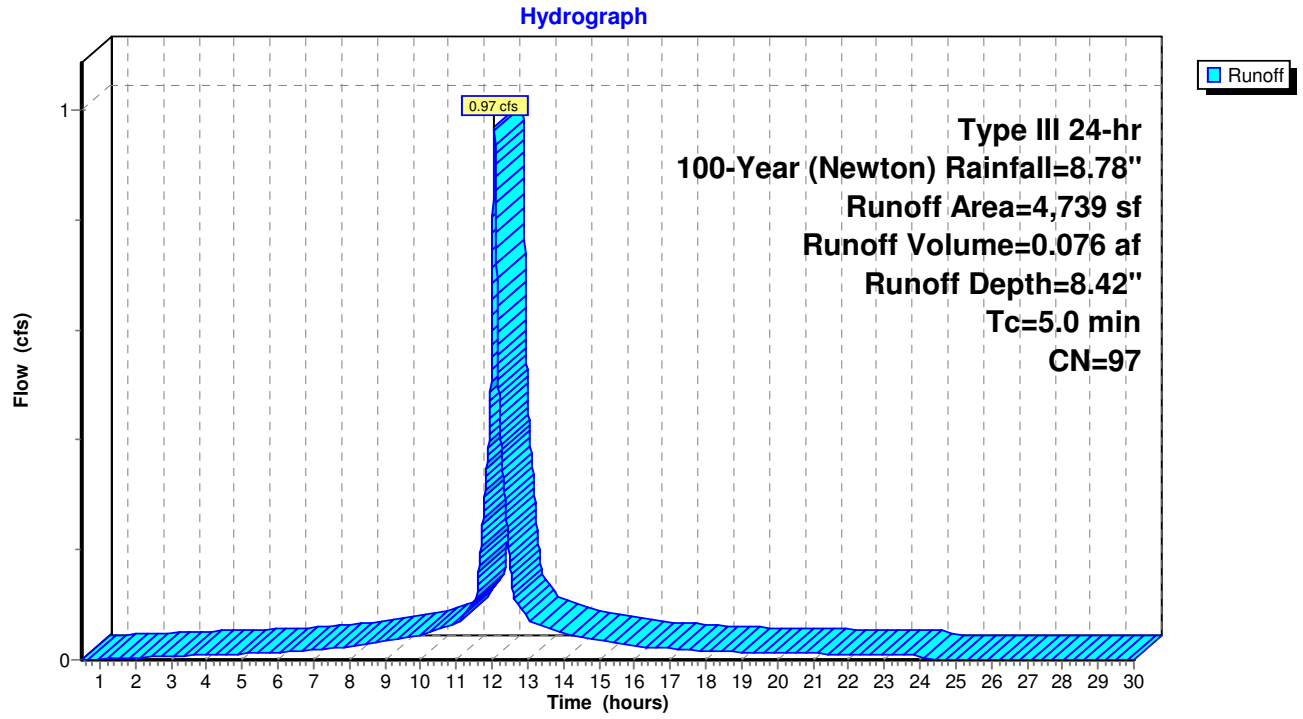
Runoff = 0.97 cfs @ 12.07 hrs, Volume= 0.076 af, Depth= 8.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 100-Year (Newton) Rainfall=8.78"

	Area (sf)	CN	Description
*	3,507	98	Driveway
*	165	98	Ret. Wall
*	578	98	Landing/Steps/Landings
*	148	98	Terrace
	341	80	>75% Grass cover, Good, HSG D
	4,739	97	Weighted Average
	341		7.20% Pervious Area
	4,398		92.80% Impervious Area

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

Subcatchment PD: Driveway



Summary for Subcatchment PR1: Roof-1 (portion)

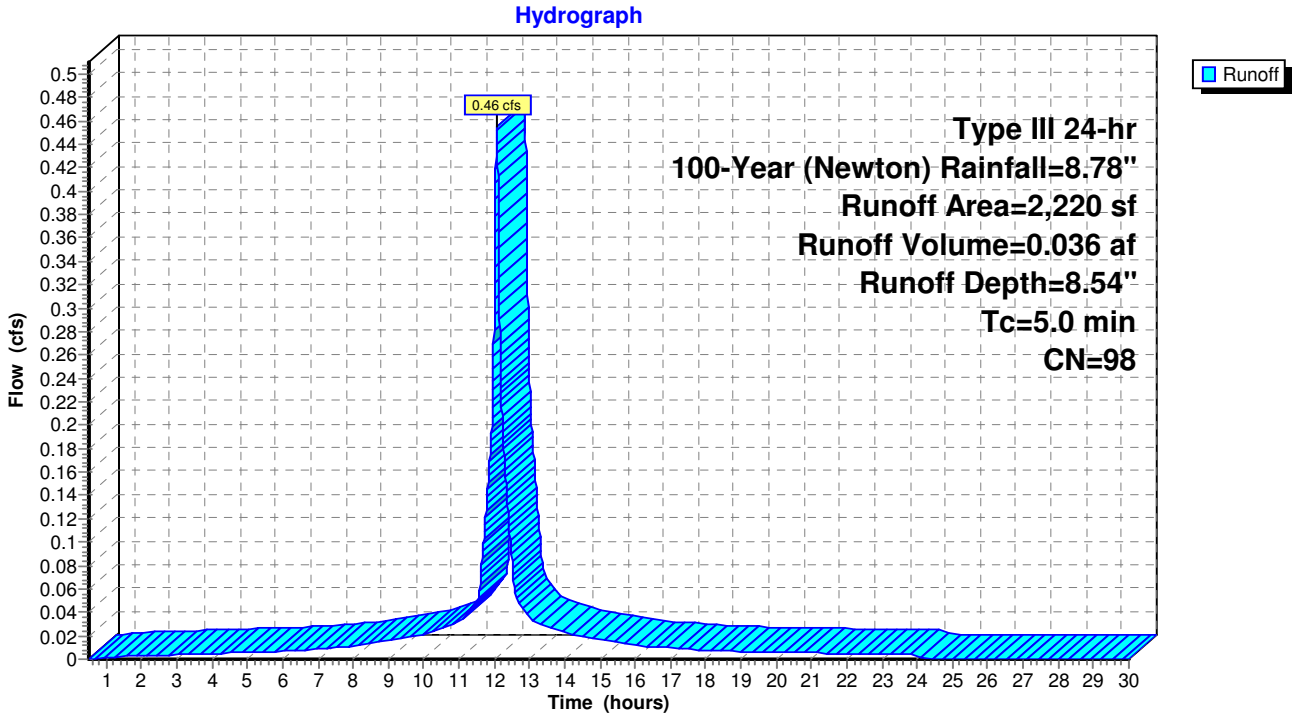
Runoff = 0.46 cfs @ 12.07 hrs, Volume= 0.036 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 100-Year (Newton) Rainfall=8.78"

	Area (sf)	CN	Description
*	2,220	98	Prop. Roof-1
	2,220		100.00% Impervious Area

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

Subcatchment PR1: Roof-1 (portion)



Summary for Subcatchment PR2: Roof-2 (portion)

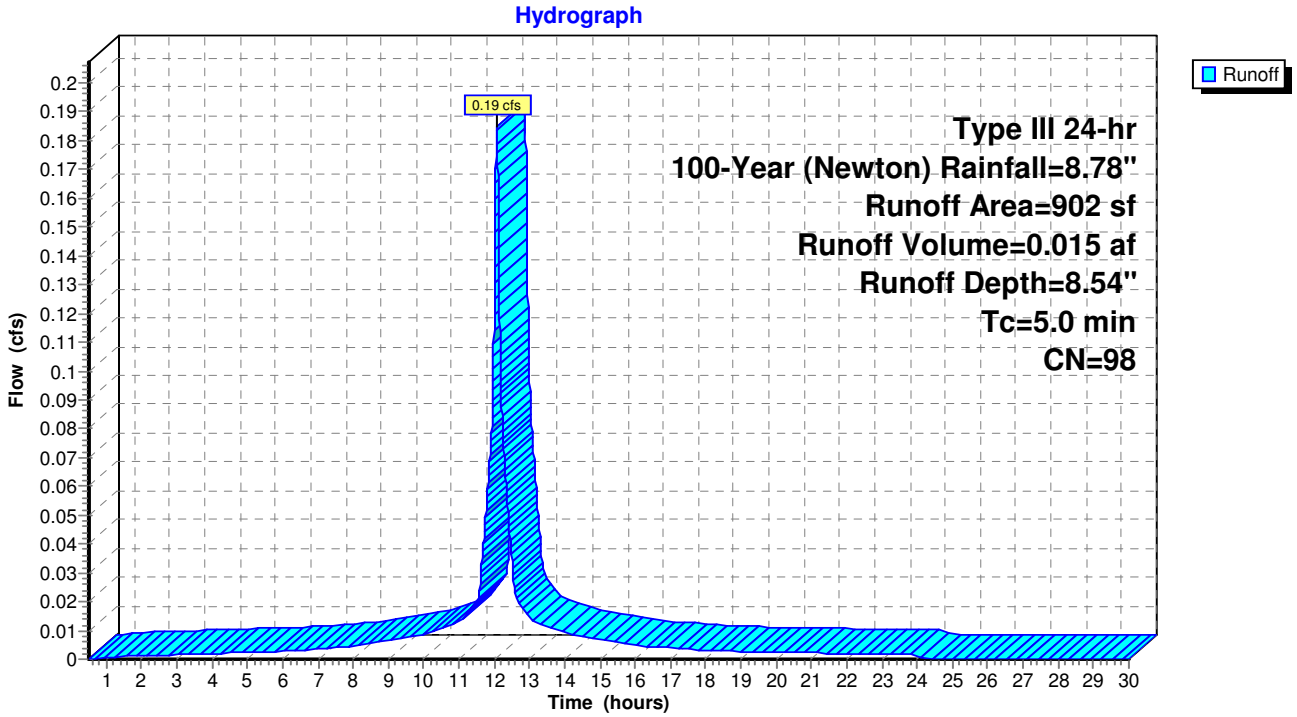
Runoff = 0.19 cfs @ 12.07 hrs, Volume= 0.015 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs
Type III 24-hr 100-Year (Newton) Rainfall=8.78"

	Area (sf)	CN	Description
*	902	98	Prop. Roof-2
	902		100.00% Impervious Area

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

Subcatchment PR2: Roof-2 (portion)

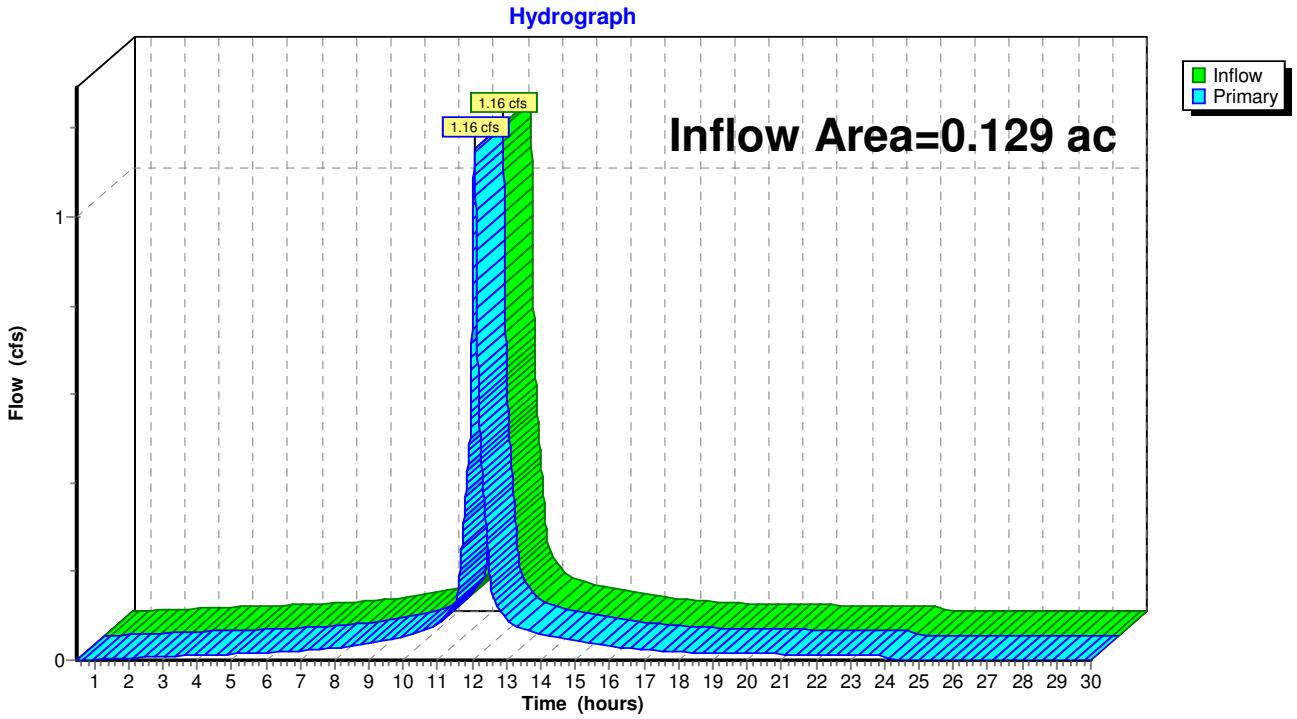


Summary for Pond CD: City Drain (12" PIPE)

Inflow Area = 0.129 ac, 93.95% Impervious, Inflow Depth = 8.44" for 100-Year (Newton) event
Inflow = 1.16 cfs @ 12.07 hrs, Volume= 0.091 af
Primary = 1.16 cfs @ 12.07 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Pond CD: City Drain (12" PIPE)

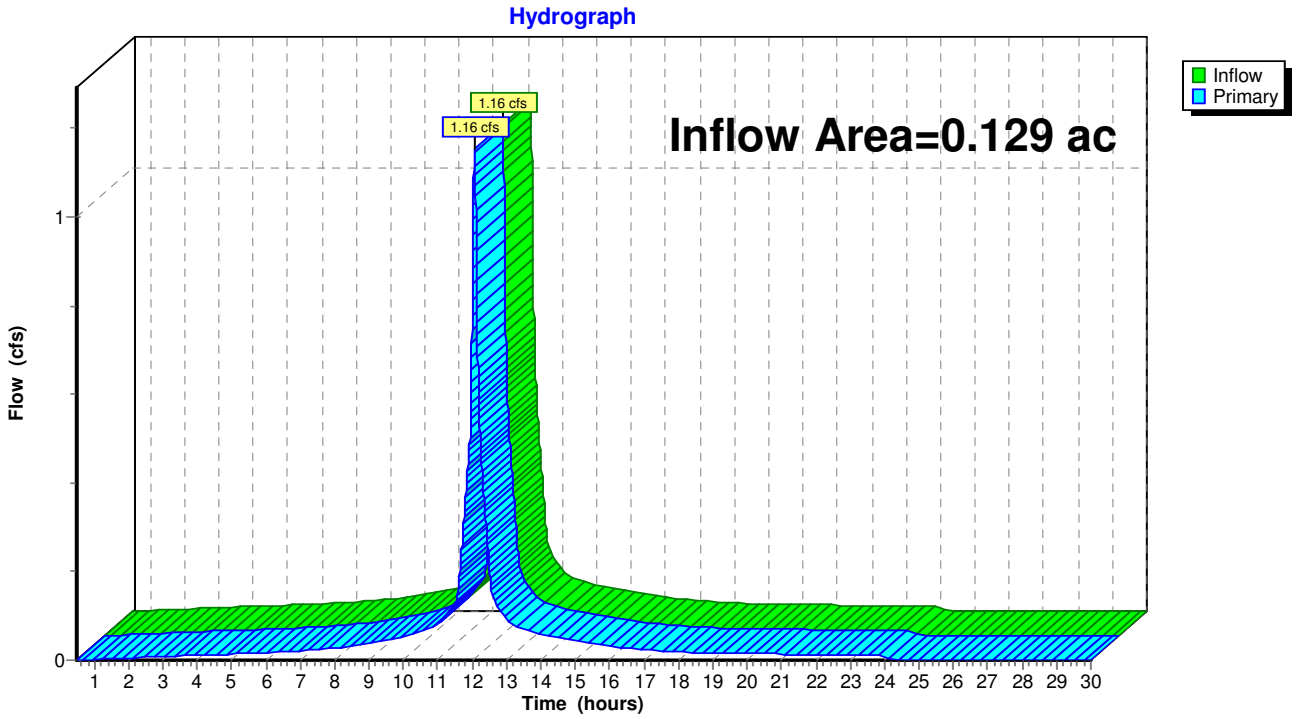


Summary for Pond TK: TANKS

Inflow Area = 0.129 ac, 93.95% Impervious, Inflow Depth = 8.44" for 100-Year (Newton) event
Inflow = 1.16 cfs @ 12.07 hrs, Volume= 0.091 af
Primary = 1.16 cfs @ 12.07 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Pond TK: TANKS

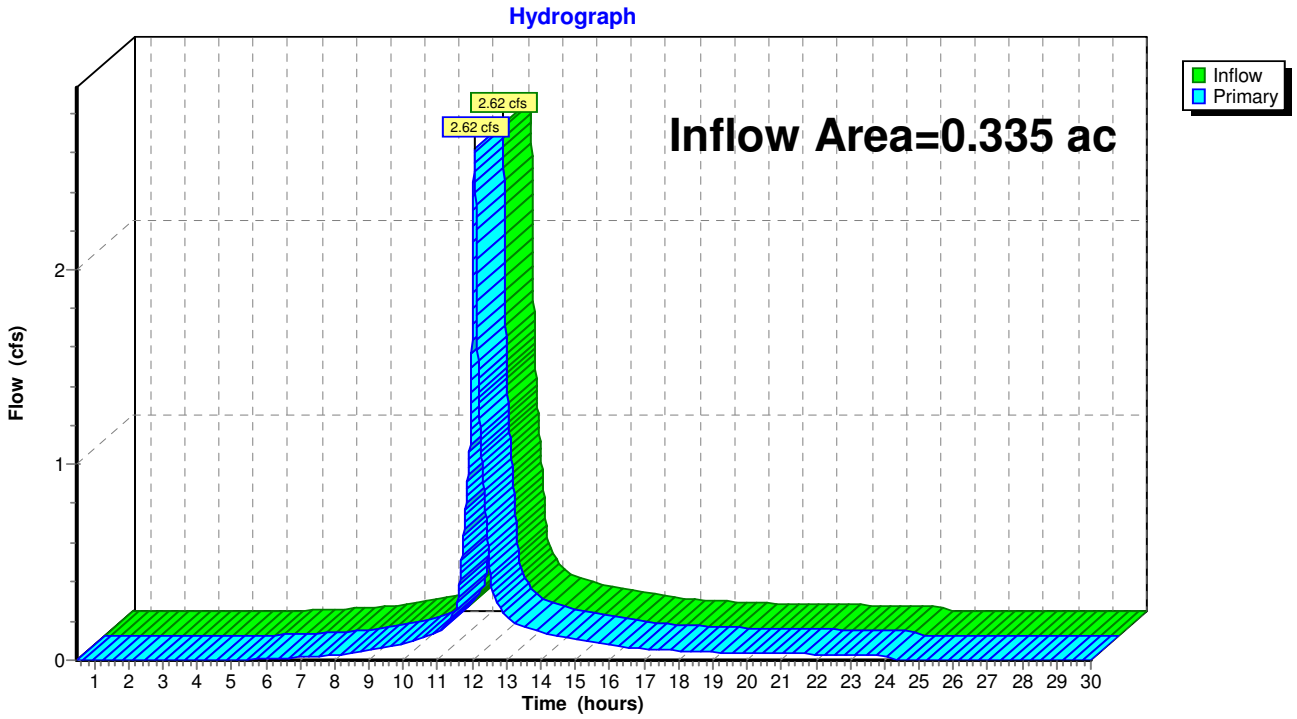


Summary for Link POD1: North Abutter

Inflow Area = 0.335 ac, 14.57% Impervious, Inflow Depth = 6.60" for 100-Year (Newton) event
Inflow = 2.62 cfs @ 12.07 hrs, Volume= 0.185 af
Primary = 2.62 cfs @ 12.07 hrs, Volume= 0.185 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Link POD1: North Abutter

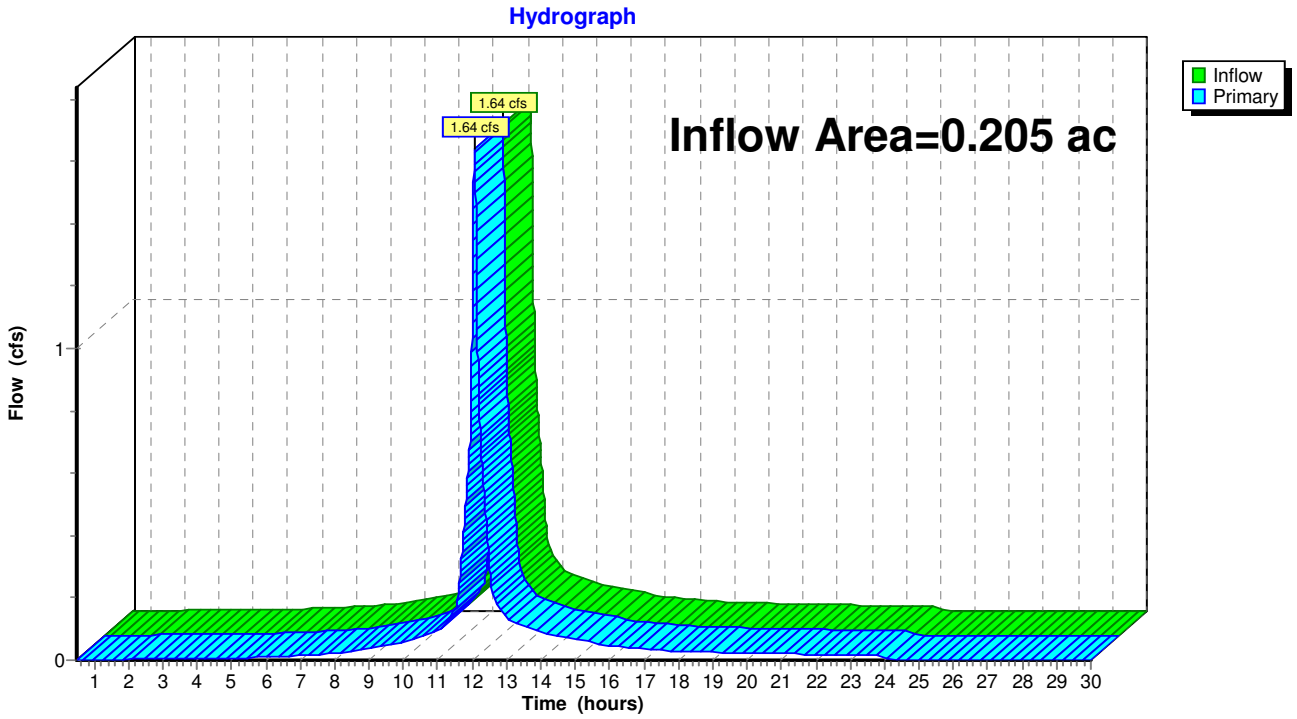


Summary for Link POD1.: North Abutter

Inflow Area = 0.205 ac, 27.19% Impervious, Inflow Depth = 6.99" for 100-Year (Newton) event
Inflow = 1.64 cfs @ 12.07 hrs, Volume= 0.120 af
Primary = 1.64 cfs @ 12.07 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.0050 hrs

Link POD1.: North Abutter



BUOYANT FORCE CALCULATION
264 Pearl Street
Newton, Massachusetts
Project No.: 218199

2500 Gal. Tanks by Shea Concrete

Unit Weight of Water	62.40	(lbs/cf)
Unit Weight of Soil	110.00	(lbs/cf)
Unit Weight of Submerged Soil	47.60	(lbs/cf)
Unit Weight of concrete	145.00	(lbs/cf)

A. Downward Forces:

Tank Weight = 32,820 lbs (Shea Concrete)

Weight of dray soil: 4'x8'x2.5') x 110 = 30,800 lbs

Total Downward Forces = 32,820 lbs + 30,800 lbs = 63,620 lbs

B. Upward Buoyant Forces:

Fb = L x W (H + Fill – WT) x Ww

Fb = 14' x 8' (6.08' + 2.5' – 2.5') x 62.41

Fb = 42,499 lbs

C. Difference of Forces:

Total Downward Forces – Fb = 21,121 lbs (Downward)

D. Safety Factor:

$$FS = \frac{63{,}620 \text{ lbs}}{42{,}499 \text{ lbs}}$$

FS = 1.49 > 1.1 Therefore structure will resist buoyancy forces with a FS of 1.49.