STORMWATER MANAGEMENT REPORT

Prepared for:

FEDERAL REALTY INVESTMENT TRUST

Block 340.02, Lot 7
22 N.J.S.H. Route 70 West

Township of Cherry Hill
Camden County, New Jersey

Prepared by:

BOHLER

N.J. Certificate of Authorization 24GA28161700

10000 Midlantic Drive, Suite 410W
Mount Laurel, NJ 08054
856-930-4000

BENJ File No. JM180678

Ahmad Tamous, P.E.
New Jersey Professional Engineer License No. 46184

May 2020
Revised November 2020

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Appendices

1. Introduction

The purpose of this report is to analyze the stormwater drainage conditions that will occur as a result of the proposed redevelopment located at 22 N.J.S.H. Route 70, Cherry Hill Township, Camden County, New Jersey. The property is identified as Block 340.02, Lot 7 on the Township of Cherry Hill tax maps and is a total of 27.143 acres in size and will hereafter be referred to as "the site". The site is bordered to the north and west by residential properties; to the east by Kings Highway North and commercial properties beyond; and to the south by N.J.S.H. Route 70 and commercial properties beyond. A tax map and aerial map is included at the beginning of Appendix C for reference.

The site is currently a developed shopping center within the B-3 (Shopping Center Business) Zone. This Stormwater Management Report is based proposed improvements that include the conversion of the existing Sleepy's into a BurgerFi restaurant and the new construction of a 2,975 SF restaurant. The improvements also include all associated utilities, landscaping, lighting and parking areas. A proposed stormwater management system will convey the runoff from the proposed development and impervious areas.

The scope of this report includes a description of the pre & post development conditions. All site improvements will be within the proposed limit of disturbance of ±3 acres. The project is exempt from providing water quality/TSS removal since an decrease of 1,456 SF in impervious area is proposed. Therefore, there will be no groundwater recharge deficit and no increase in peak runoff rate after construction of the proposed development. The following items are addressed within this report:

- Narrative of pre- and post-development conditions
- Calculations to verify the capacity of the proposed stormwater conveyance system.

The primary design constraints for this project are based on the Cherry Hill Township Land Use Ordinances, the New Jersey Department of Environmental Protection (NJDEP) Rules and Regulations, and the Camden County Soil Conservation District. They are as follows:

Cherry Hill Township:

- Cherry Hill Township has fully adopted the NJDEP Storm Water Management Regulations of February 2004.

NJDEP:

- Recharge 100% of pre development annual average recharge amount
- Provide water quality if an additional one-quarter acre of impervious surface is proposed
- Post-development peak runoff rates for the site will not exceed the pre-development stormwater runoff rates.

Camden County Soil Conservation District:

- Post-development peak runoff rates for the site will not exceed the pre-development stormwater runoff rates.

2. Pre-Development Site Conditions

The site contains a total area of 27.143 acres. The topography of the site generally slopes from northeast to southwest with slopes ranging from 1% to 5% in impervious areas and up to 20% in pervious areas. Runoff generally flows through the site towards the southwest corner which is ultimately conveyed via underground pipes to the Route 70 right-of-way in both the existing and proposed conditions and will be accounted for in the proposed stormwater management design.

A portion of the development, along the eastern edge of the property, approximately 0.75 acres of land, flows overland and through underground conveyance system to inlets within the Kings Highway right-of-way in both the existing and proposed conditions and will be accounted for in the proposed stormwater management design. The topography of the area slopes from north to south with slopes ranging from 1% to 10%.

3. Post-Development Site Conditions

The post-development condition for the site includes the conversion of the existing Sleepy's into a BurgerFi restaurant and the new construction of a 2,975 SF restaurant. The development will also include all associated utilities, landscaping, lighting and parking area improvements. The proposed site is designed in a manner that generally maintains the existing drainage patterns. Under proposed conditions the impervious coverage of the site decreases by approximately 1,456 SF, with the remainder of the site maintaining current conditions. Runoff from the

proposed buildings will be collected via roof leaders and runoff from the proposed parking area will be collected via the existing inlets.

4. Methodology

4.1 Groundwater Recharge

The NJDEP Stormwater Management Rules dictates that the "groundwater recharge requirement does not apply to projects within the 'urban redevelopment area'" (N.J.A.C. 7:8-5.4 (a)2.ii.). The site is located in the State's Metropolitan Zone; therefore, the groundwater recharge requirements do not apply for this project.

4.2 Water Quality

The NJDEP Stormwater Management Rules dictate that the water quality standards (N.J.A.C. 7:8-5.5) apply only if there is a net increase of 10,890 sf (0.25 Ac.) or more of impervious surface coverage. There is a net decrease in impervious coverage of 1,456 SF as a result of this development, therefore, the water quality standards do not apply for this redevelopment project.

4.3 Water Quantity

The NJDEP Stormwater Management Rules dictate that the runoff quantity standards (N.J.A.C. 7:8-5.4(a)3) apply if there is a net increase of 10,890 sf (0.25 Ac.) or more of impervious surface. There is a net decrease in impervious coverage of 1,456 SF as a result of this development, therefore, the water quality standards do not apply for this redevelopment project.

EDA #1 vs. PDA #1 to Northeast of Site		
Storm Event	Exist. Peak Flow Rate (CFS)	Total Post Developed Flow (CFS)
WQ	18.55	**18.55**
2-year	34.69	**34.69**
10-year	59.95	**59.95**
25-year	77.50	**77.50**
100-year	109.46	**109.46**

EDA #2 vs. PDA #2 to Southwest of Site		
Storm Event	Exist. Peak Flow Rate (CFS)	Total Post Developed Flow (CFS)
WQ	0.59	**0.59**
2-year	1.19	**1.19**
10-year	2.08	**2.08**
25-year	2.71	**2.71**
100-year	3.85	**3.85**

4.4 Pipe Sizing

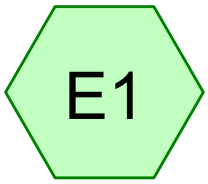
Pipe sizing calculations have been performed using the Rational Method and 25-year design storm for capacity verification. The calculations are conservatively based on a minimum of ten (10) minute time of concentration and a weighted ‘C’ of 0.95. Conveyance calculations are in Appendix A of this report.

5. Conclusions

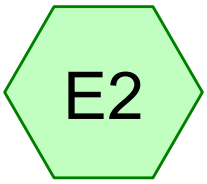
The proposed stormwater conveyance system for the proposed shopping center improvements has been designed to convey stormwater runoff in a manner which will not adversely affect the existing drainage patterns found in the surrounding areas. Since the proposed development does not increase the peak stormwater runoff rate, it is evident that the proposed development will not adversely impact the existing drainage system.

A. DESIGN CALCULATIONS

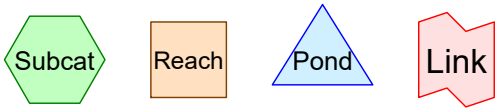
- **Existing & Proposed Drainage Calculations**
- **Pipe Sizing**



EXISTING DRAINAGE AREA #1



EXISTING DRAINAGE AREA #2



Routing Diagram for EX-PR
Prepared by {enter your company name here}, Printed 11/6/2020

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.980	39	>75% Grass cover, Good, HSG A (E1, E2)
1.030	61	>75% Grass cover, Good, HSG B (E1, E2)
0.730	74	>75% Grass cover, Good, HSG C (E1)
17.010	98	Paved parking, HSG A (E1, E2)
0.150	32	Woods/grass comb., Good, HSG A (E1)
0.670	72	Woods/grass comb., Good, HSG C (E1)
21.570	**89**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
19.140	HSG A	E1, E2
1.030	HSG B	E1, E2
1.400	HSG C	E1
0.000	HSG D	
0.000	Other	
21.570		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.980	1.030	0.730	0.000	0.000	3.740	>75% Grass cover, Good	E1, E2
17.010	0.000	0.000	0.000	0.000	17.010	Paved parking	E1, E2
0.150	0.000	0.670	0.000	0.000	0.820	Woods/grass comb., Good	E1
19.140	**1.030**	**1.400**	**0.000**	**0.000**	**21.570**	**TOTAL AREA**	

Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: EXISTING DRAINAGE Runoff Area=20.830 ac 78.97% Impervious Runoff Depth=2.18"
Tc=10.0 min CN=89 Runoff=34.69 cfs 3.788 af

Subcatchment E2: EXISTING DRAINAGE Runoff Area=0.740 ac 75.68% Impervious Runoff Depth=2.10"
Tc=10.0 min CN=88 Runoff=1.19 cfs 0.129 af

Total Runoff Area = 21.570 ac Runoff Volume = 3.917 af Average Runoff Depth = 2.18"
21.14% Pervious = 4.560 ac 78.86% Impervious = 17.010 ac

Summary for Subcatchment E1: EXISTING DRAINAGE AREA #1

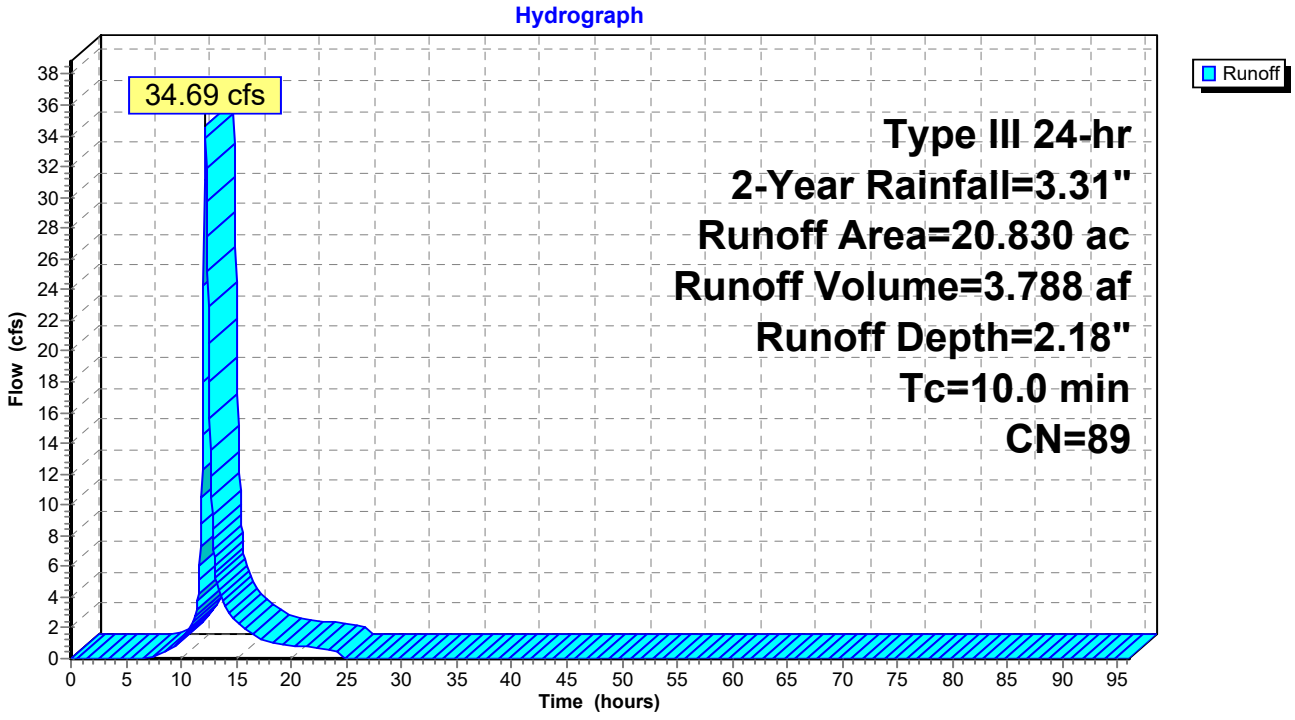
Runoff = 34.69 cfs @ 12.17 hrs, Volume= 3.788 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
16.450	98	Paved parking, HSG A
1.930	39	>75% Grass cover, Good, HSG A
0.900	61	>75% Grass cover, Good, HSG B
0.730	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.380		21.03% Pervious Area
16.450		78.97% Impervious Area

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

Subcatchment E1: EXISTING DRAINAGE AREA #1



Summary for Subcatchment E2: EXISTING DRAINAGE AREA #2

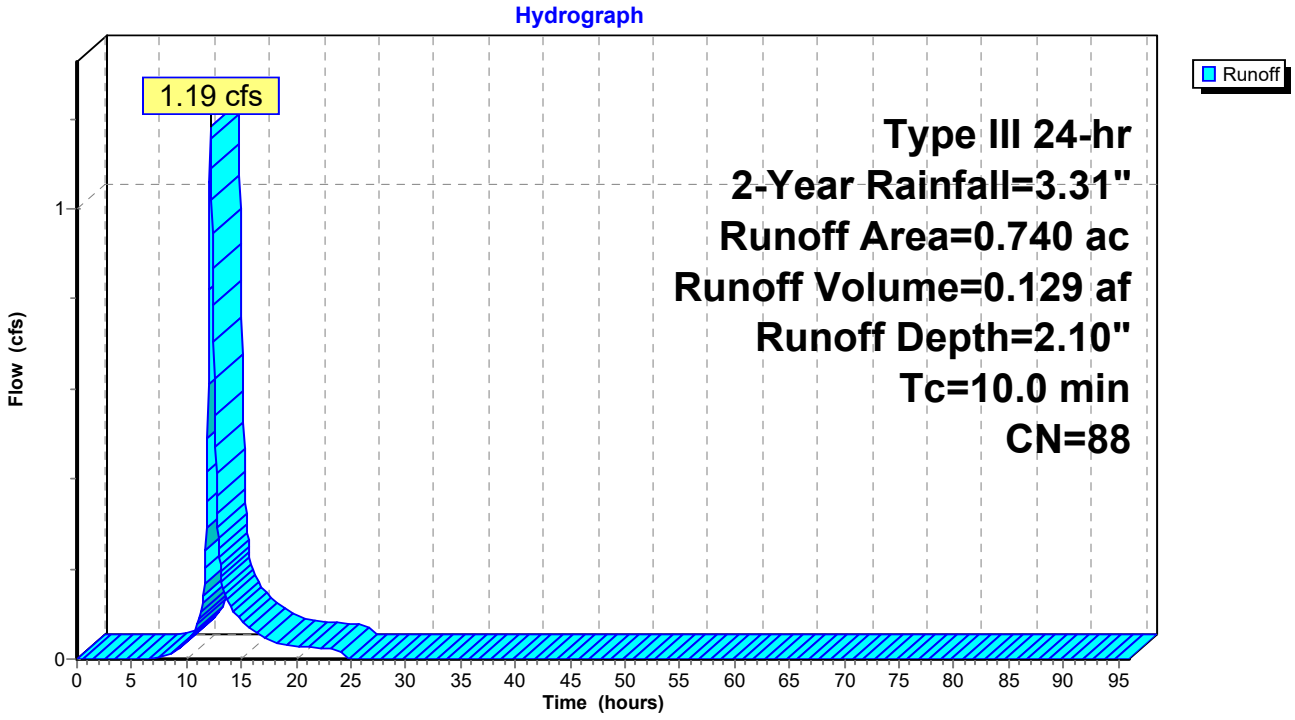
Runoff = 1.19 cfs @ 12.17 hrs, Volume= 0.129 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.560	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.130	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.180		24.32% Pervious Area
0.560		75.68% Impervious Area

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

Subcatchment E2: EXISTING DRAINAGE AREA #2



Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: EXISTING DRAINAGE Runoff Area=20.830 ac 78.97% Impervious Runoff Depth=3.83"
Tc=10.0 min CN=89 Runoff=59.95 cfs 6.647 af

Subcatchment E2: EXISTING DRAINAGE Runoff Area=0.740 ac 75.68% Impervious Runoff Depth=3.73"
Tc=10.0 min CN=88 Runoff=2.08 cfs 0.230 af

Total Runoff Area = 21.570 ac Runoff Volume = 6.877 af Average Runoff Depth = 3.83"
21.14% Pervious = 4.560 ac 78.86% Impervious = 17.010 ac

Summary for Subcatchment E1: EXISTING DRAINAGE AREA #1

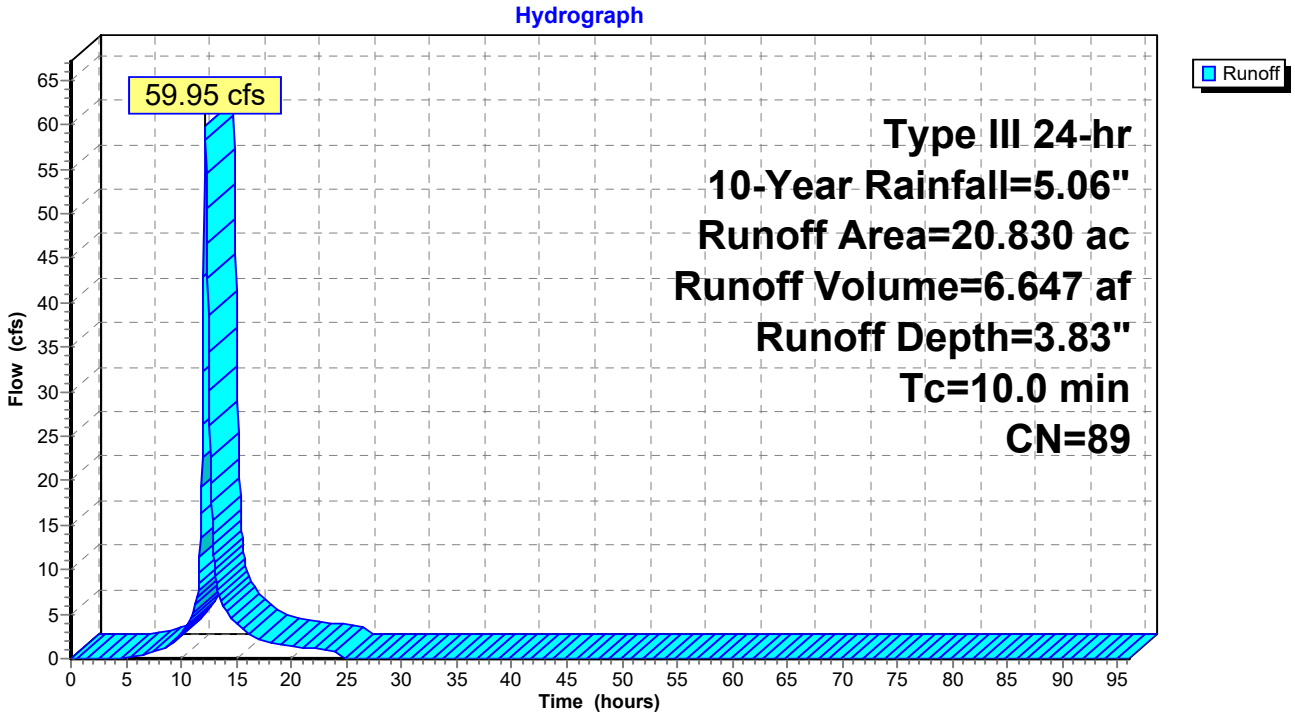
Runoff = 59.95 cfs @ 12.16 hrs, Volume= 6.647 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.06"

Area (ac)	CN	Description
16.450	98	Paved parking, HSG A
1.930	39	>75% Grass cover, Good, HSG A
0.900	61	>75% Grass cover, Good, HSG B
0.730	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.380		21.03% Pervious Area
16.450		78.97% Impervious Area

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

Subcatchment E1: EXISTING DRAINAGE AREA #1



Summary for Subcatchment E2: EXISTING DRAINAGE AREA #2

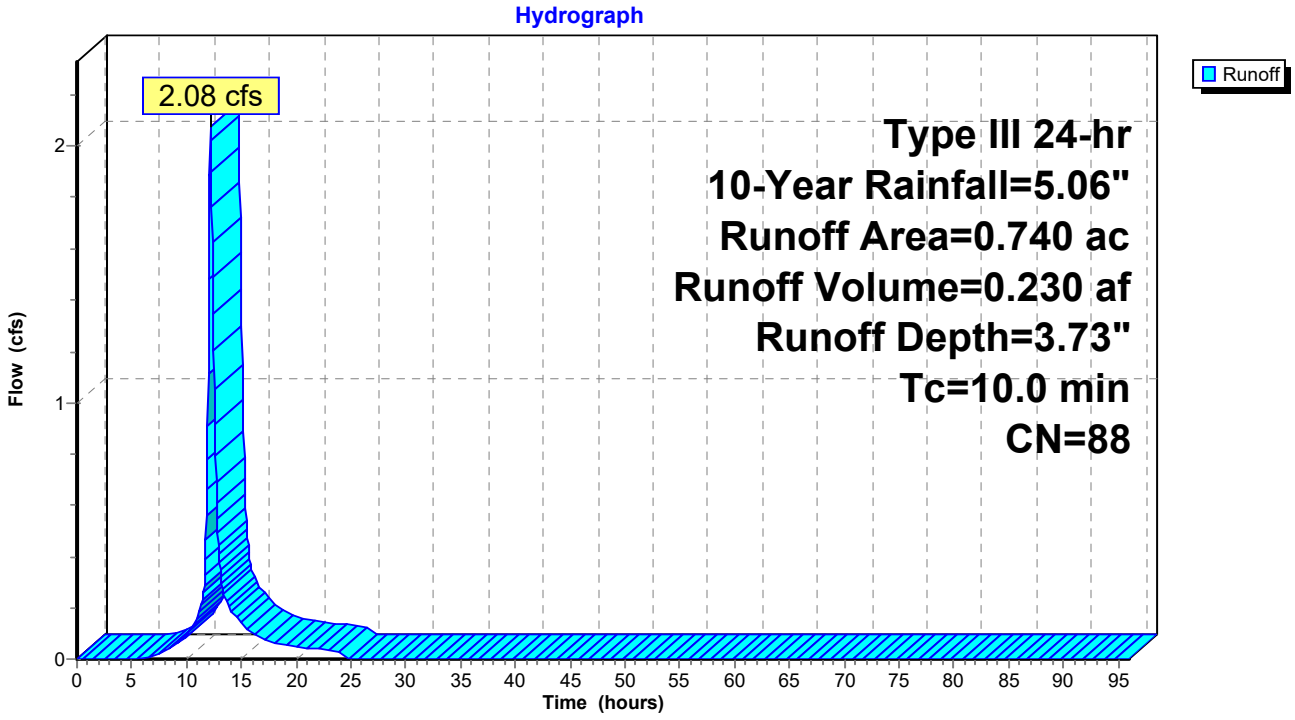
Runoff = 2.08 cfs @ 12.17 hrs, Volume= 0.230 af, Depth= 3.73"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.06"

Area (ac)	CN	Description
0.560	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.130	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.180		24.32% Pervious Area
0.560		75.68% Impervious Area

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

Subcatchment E2: EXISTING DRAINAGE AREA #2



Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: EXISTING DRAINAGE Runoff Area=20.830 ac 78.97% Impervious Runoff Depth=7.20"
Tc=10.0 min CN=89 Runoff=109.46 cfs 12.494 af

Subcatchment E2: EXISTING DRAINAGE Runoff Area=0.740 ac 75.68% Impervious Runoff Depth=7.08"
Tc=10.0 min CN=88 Runoff=3.85 cfs 0.436 af

Total Runoff Area = 21.570 ac Runoff Volume = 12.930 af Average Runoff Depth = 7.19"
21.14% Pervious = 4.560 ac 78.86% Impervious = 17.010 ac

Summary for Subcatchment E1: EXISTING DRAINAGE AREA #1

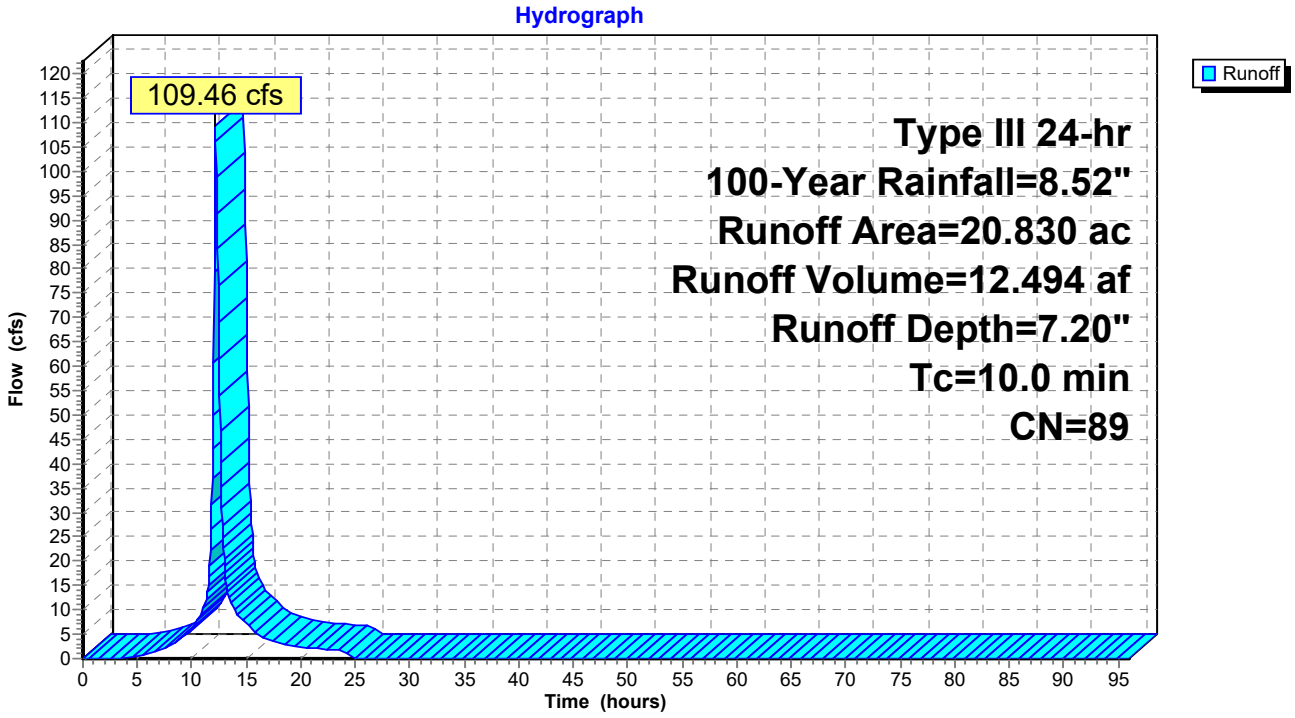
Runoff = 109.46 cfs @ 12.16 hrs, Volume= 12.494 af, Depth= 7.20"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.52"

Area (ac)	CN	Description
16.450	98	Paved parking, HSG A
1.930	39	>75% Grass cover, Good, HSG A
0.900	61	>75% Grass cover, Good, HSG B
0.730	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.380		21.03% Pervious Area
16.450		78.97% Impervious Area

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

Subcatchment E1: EXISTING DRAINAGE AREA #1



Summary for Subcatchment E2: EXISTING DRAINAGE AREA #2

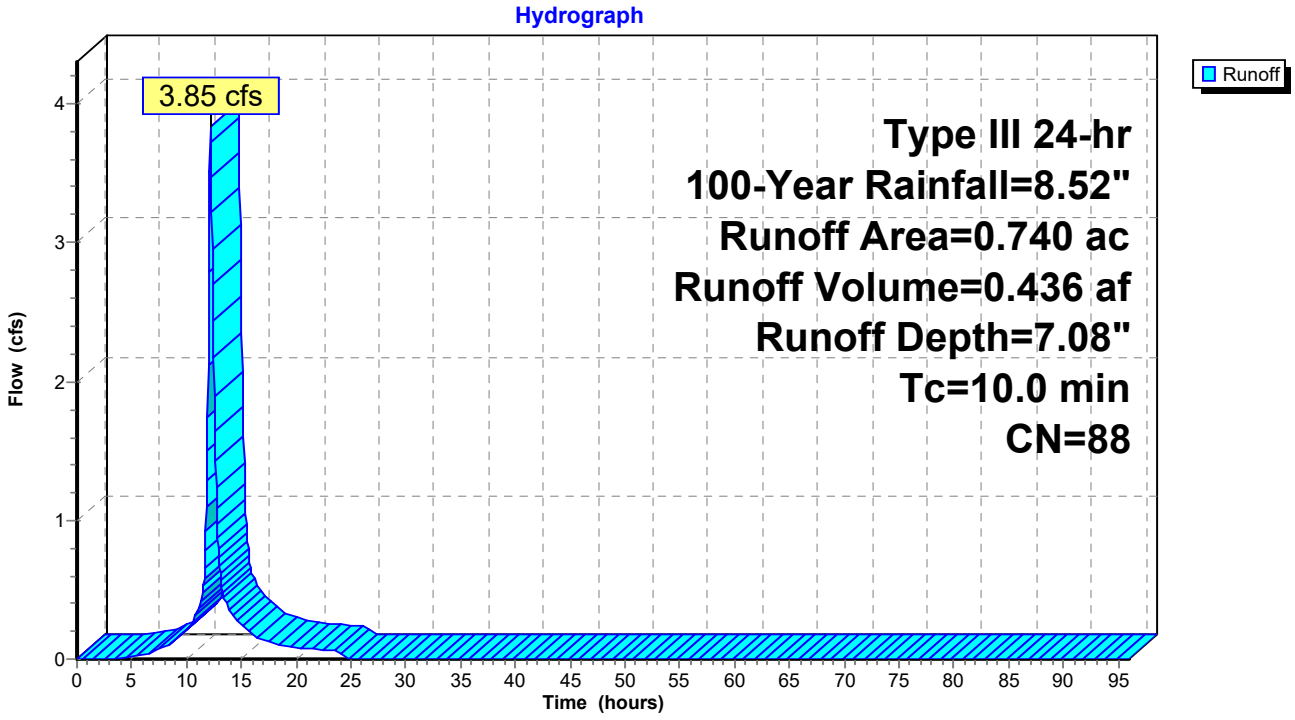
Runoff = 3.85 cfs @ 12.16 hrs, Volume= 0.436 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.52"

Area (ac)	CN	Description
0.560	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.130	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.180		24.32% Pervious Area
0.560		75.68% Impervious Area

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

Subcatchment E2: EXISTING DRAINAGE AREA #2



Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: EXISTING DRAINAGE Runoff Area=20.830 ac 78.97% Impervious Runoff Depth=0.45"
Tc=10.0 min CN=89 Runoff=18.55 cfs 0.780 af

Subcatchment E2: EXISTING DRAINAGE Runoff Area=0.740 ac 75.68% Impervious Runoff Depth=0.41"
Tc=10.0 min CN=88 Runoff=0.59 cfs 0.025 af

Total Runoff Area = 21.570 ac Runoff Volume = 0.805 af Average Runoff Depth = 0.45"
21.14% Pervious = 4.560 ac 78.86% Impervious = 17.010 ac

Summary for Subcatchment E1: EXISTING DRAINAGE AREA #1

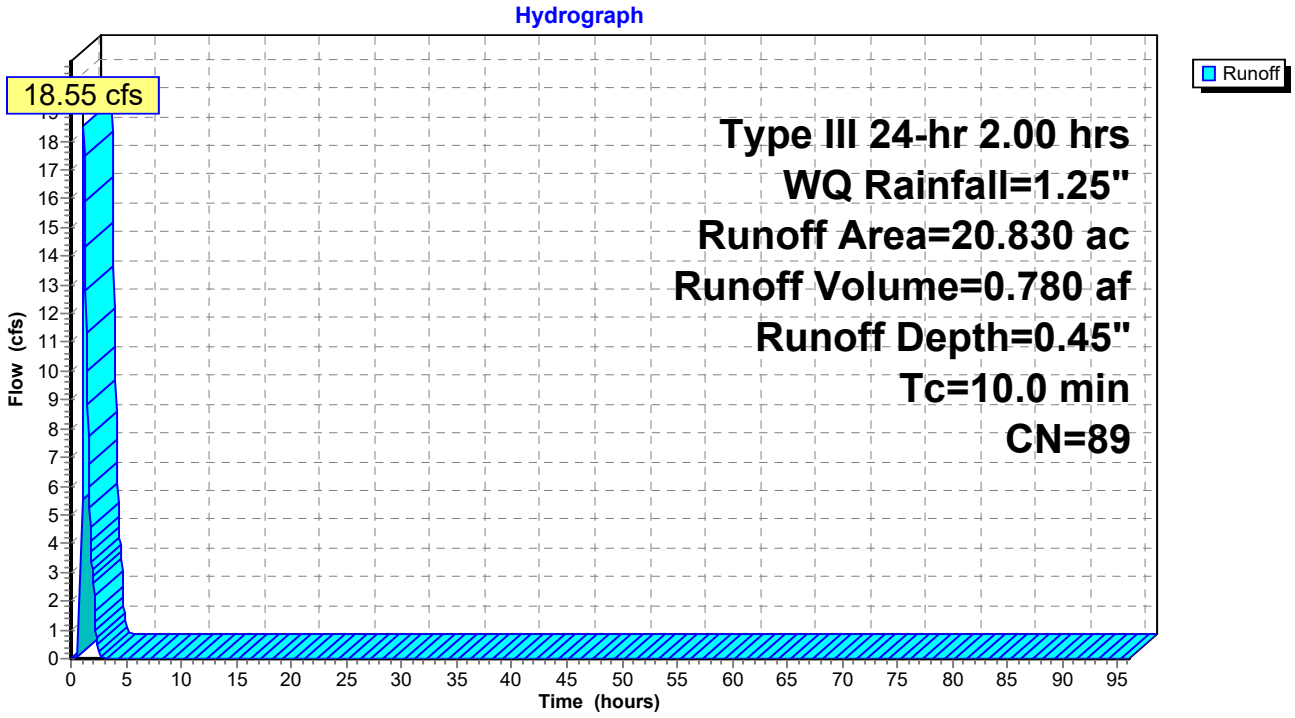
Runoff = 18.55 cfs @ 1.17 hrs, Volume= 0.780 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2.00 hrs WQ Rainfall=1.25"

Area (ac)	CN	Description
16.450	98	Paved parking, HSG A
1.930	39	>75% Grass cover, Good, HSG A
0.900	61	>75% Grass cover, Good, HSG B
0.730	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.380		21.03% Pervious Area
16.450		78.97% Impervious Area

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

Subcatchment E1: EXISTING DRAINAGE AREA #1



Summary for Subcatchment E2: EXISTING DRAINAGE AREA #2

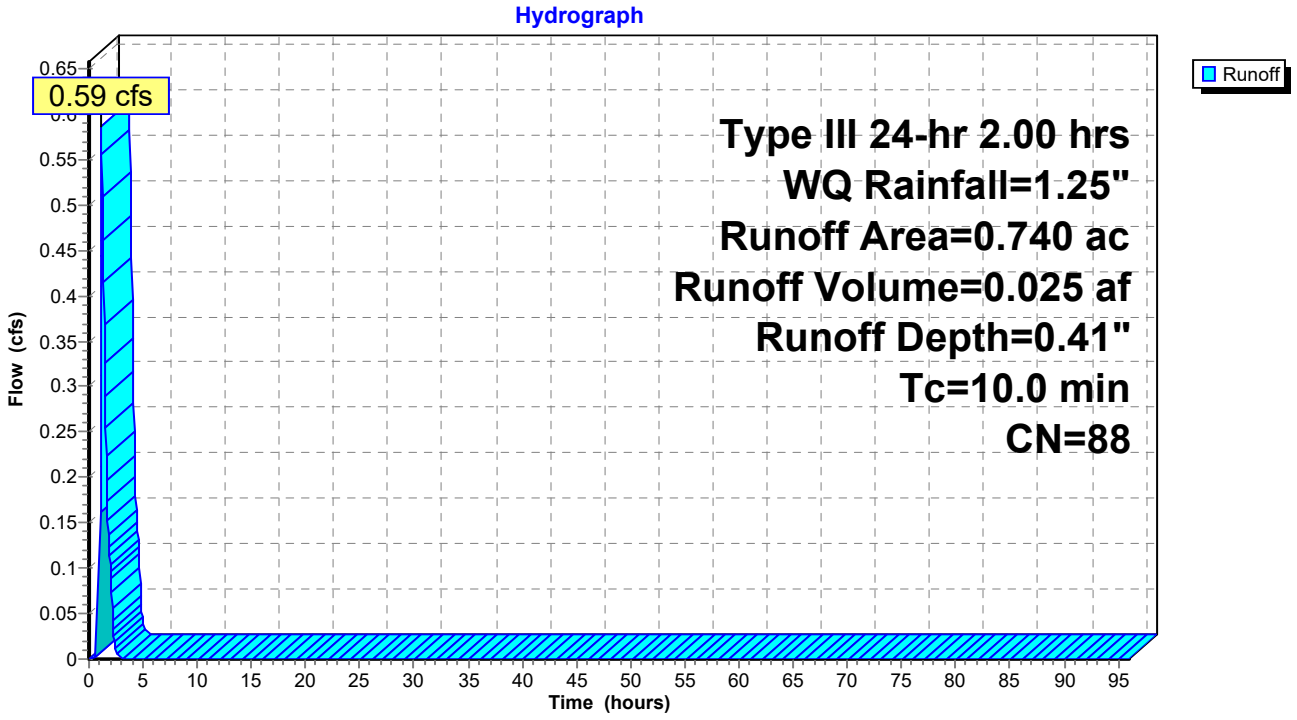
Runoff = 0.59 cfs @ 1.17 hrs, Volume= 0.025 af, Depth= 0.41"

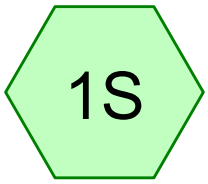
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2.00 hrs WQ Rainfall=1.25"

Area (ac)	CN	Description
0.560	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.130	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.180		24.32% Pervious Area
0.560		75.68% Impervious Area

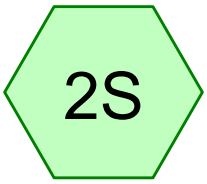
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum**

Subcatchment E2: EXISTING DRAINAGE AREA #2

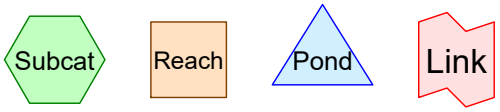




PROPOSED
DRAINAGE AREA #1



PROPOSED
DRAINAGE AREA #2



Routing Diagram for EX-PR
Prepared by {enter your company name here}, Printed 11/6/2020

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.000	39	>75% Grass cover, Good, HSG A (1S, 2S)
0.960	61	>75% Grass cover, Good, HSG B (1S, 2S)
0.820	74	>75% Grass cover, Good, HSG C (1S)
16.970	98	Paved parking, HSG A (1S, 2S)
0.150	32	Woods/grass comb., Good, HSG A (1S)
0.670	72	Woods/grass comb., Good, HSG C (1S)
21.570	**89**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
19.120	HSG A	1S, 2S
0.960	HSG B	1S, 2S
1.490	HSG C	1S
0.000	HSG D	
0.000	Other	
21.570		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
2.000	0.960	0.820	0.000	0.000	3.780	>75% Grass cover, Good	1S, 2S
16.970	0.000	0.000	0.000	0.000	16.970	Paved parking	1S, 2S
0.150	0.000	0.670	0.000	0.000	0.820	Woods/grass comb., Good	1S
19.120	**0.960**	**1.490**	**0.000**	**0.000**	**21.570**	**TOTAL AREA**	

Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PROPOSED Runoff Area=20.830 ac 78.68% Impervious Runoff Depth=2.18"
Tc=10.0 min CN=89 Runoff=34.69 cfs 3.788 af

Subcatchment 2S: PROPOSED DRAINAGE Runoff Area=0.740 ac 78.38% Impervious Runoff Depth=2.10"
Tc=10.0 min CN=88 Runoff=1.19 cfs 0.129 af

Total Runoff Area = 21.570 ac Runoff Volume = 3.917 af Average Runoff Depth = 2.18"
21.33% Pervious = 4.600 ac 78.67% Impervious = 16.970 ac

Summary for Subcatchment 1S: PROPOSED DRAINAGE AREA #1

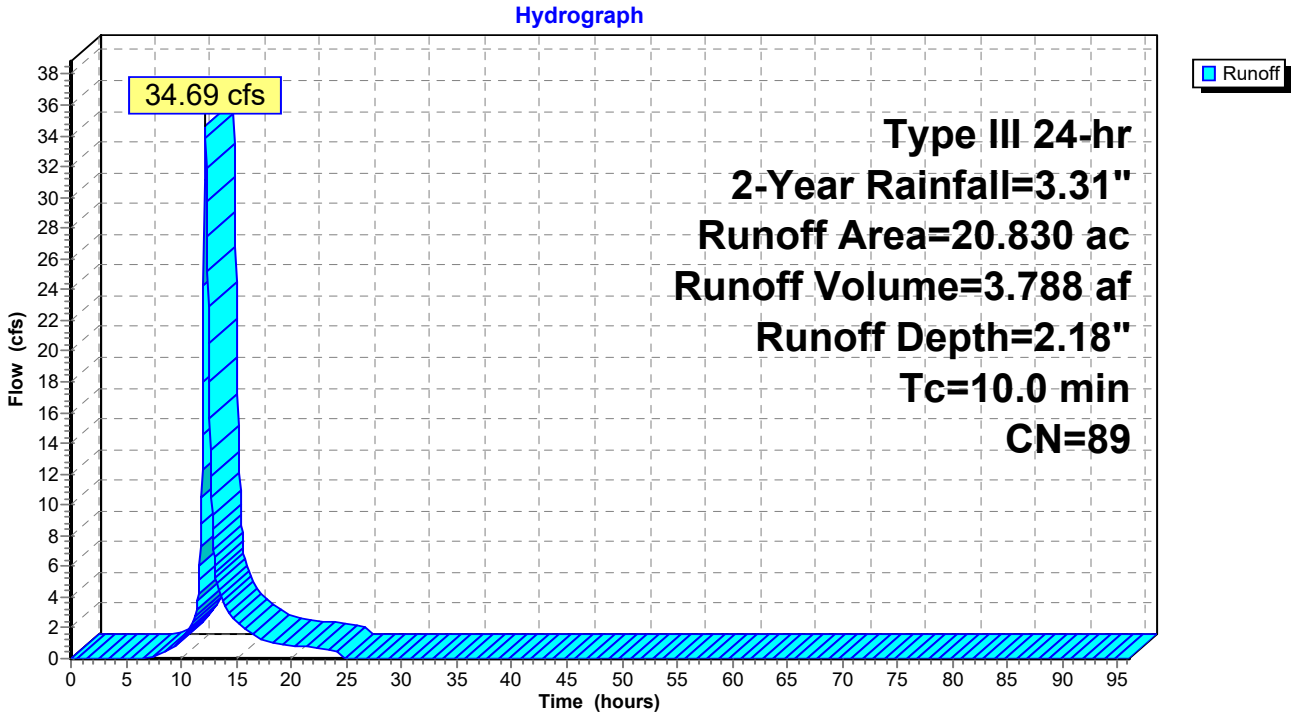
Runoff = 34.69 cfs @ 12.17 hrs, Volume= 3.788 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
16.390	98	Paved parking, HSG A
1.940	39	>75% Grass cover, Good, HSG A
0.860	61	>75% Grass cover, Good, HSG B
0.820	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.440		21.32% Pervious Area
16.390		78.68% Impervious Area

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

Subcatchment 1S: PROPOSED DRAINAGE AREA #1



Summary for Subcatchment 2S: PROPOSED DRAINAGE AREA #2

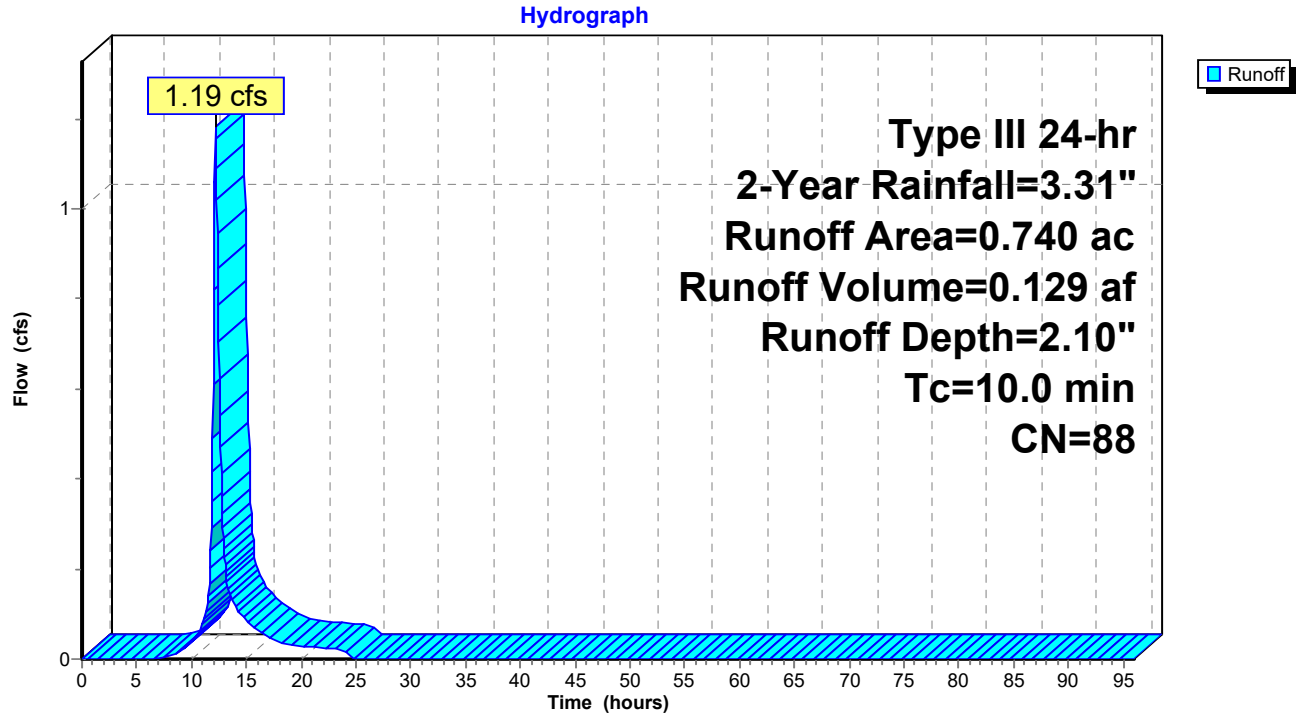
Runoff = 1.19 cfs @ 12.17 hrs, Volume= 0.129 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.580	98	Paved parking, HSG A
0.060	39	>75% Grass cover, Good, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.160		21.62% Pervious Area
0.580		78.38% Impervious Area

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

Subcatchment 2S: PROPOSED DRAINAGE AREA #2



Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PROPOSED Runoff Area=20.830 ac 78.68% Impervious Runoff Depth=3.83"
Tc=10.0 min CN=89 Runoff=59.95 cfs 6.647 af

Subcatchment 2S: PROPOSED DRAINAGE Runoff Area=0.740 ac 78.38% Impervious Runoff Depth=3.73"
Tc=10.0 min CN=88 Runoff=2.08 cfs 0.230 af

Total Runoff Area = 21.570 ac Runoff Volume = 6.877 af Average Runoff Depth = 3.83"
21.33% Pervious = 4.600 ac 78.67% Impervious = 16.970 ac

Summary for Subcatchment 1S: PROPOSED DRAINAGE AREA #1

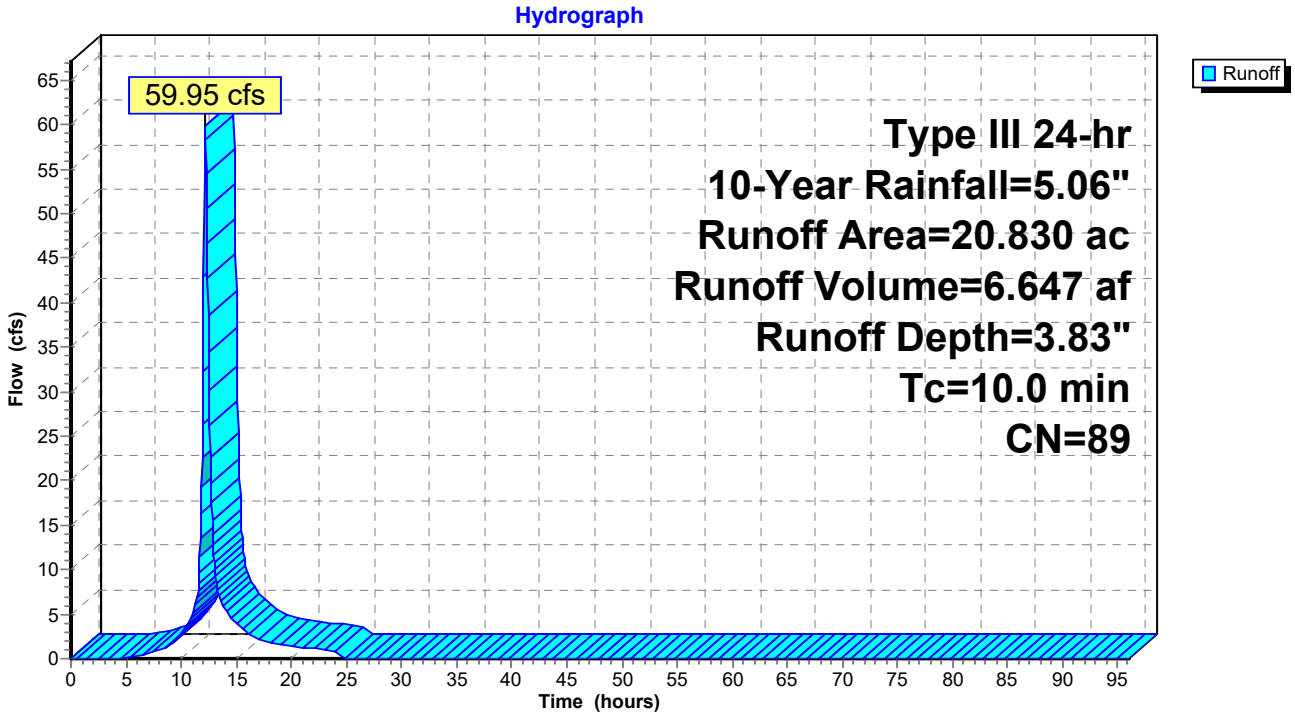
Runoff = 59.95 cfs @ 12.16 hrs, Volume= 6.647 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.06"

Area (ac)	CN	Description
16.390	98	Paved parking, HSG A
1.940	39	>75% Grass cover, Good, HSG A
0.860	61	>75% Grass cover, Good, HSG B
0.820	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.440		21.32% Pervious Area
16.390		78.68% Impervious Area

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

Subcatchment 1S: PROPOSED DRAINAGE AREA #1



Summary for Subcatchment 2S: PROPOSED DRAINAGE AREA #2

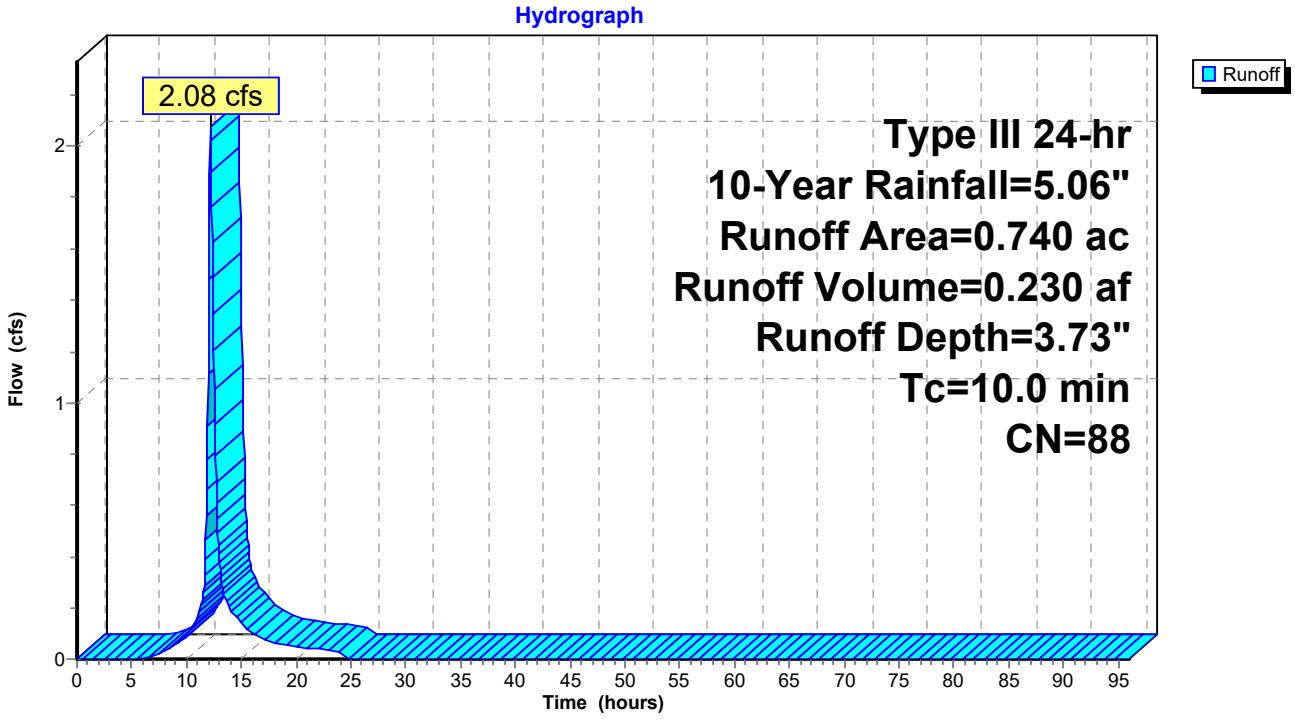
Runoff = 2.08 cfs @ 12.17 hrs, Volume= 0.230 af, Depth= 3.73"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.06"

Area (ac)	CN	Description
0.580	98	Paved parking, HSG A
0.060	39	>75% Grass cover, Good, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.160		21.62% Pervious Area
0.580		78.38% Impervious Area

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

Subcatchment 2S: PROPOSED DRAINAGE AREA #2



Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PROPOSED Runoff Area=20.830 ac 78.68% Impervious Runoff Depth=7.20"
Tc=10.0 min CN=89 Runoff=109.46 cfs 12.494 af

Subcatchment 2S: PROPOSED DRAINAGE Runoff Area=0.740 ac 78.38% Impervious Runoff Depth=7.08"
Tc=10.0 min CN=88 Runoff=3.85 cfs 0.436 af

Total Runoff Area = 21.570 ac Runoff Volume = 12.930 af Average Runoff Depth = 7.19"
21.33% Pervious = 4.600 ac 78.67% Impervious = 16.970 ac

Summary for Subcatchment 1S: PROPOSED DRAINAGE AREA #1

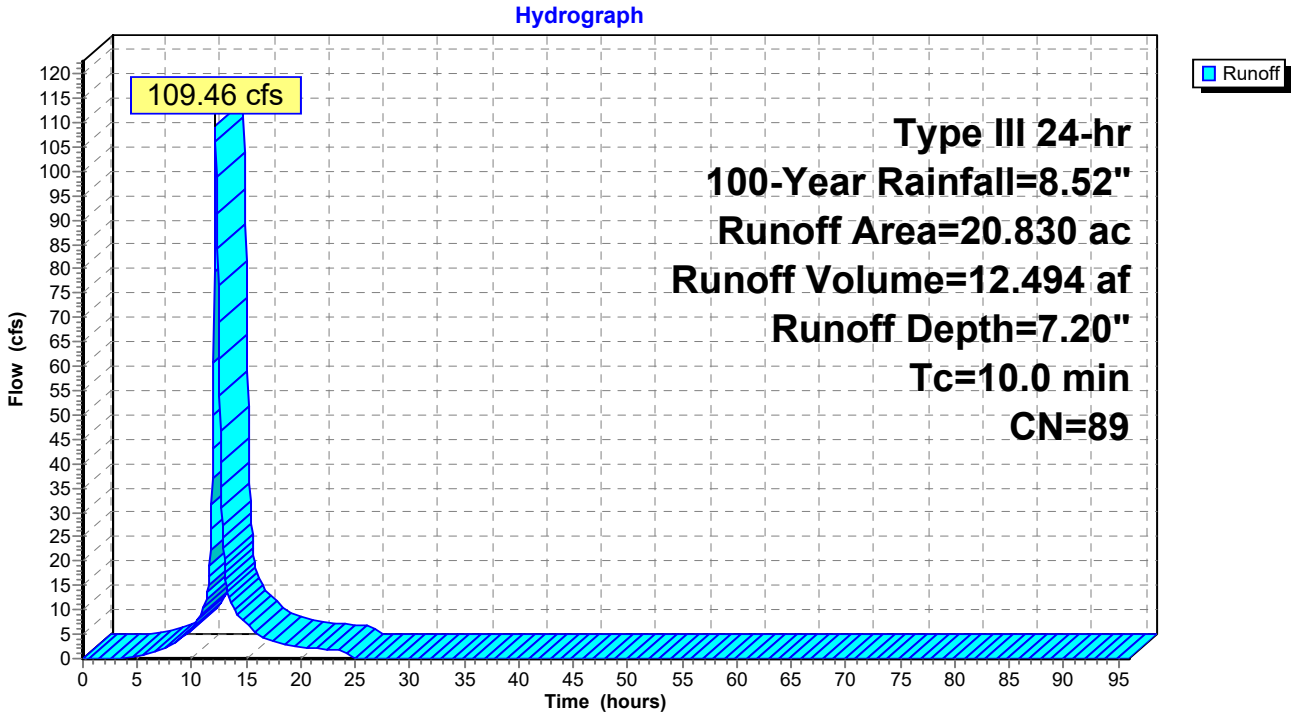
Runoff = 109.46 cfs @ 12.16 hrs, Volume= 12.494 af, Depth= 7.20"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.52"

Area (ac)	CN	Description
16.390	98	Paved parking, HSG A
1.940	39	>75% Grass cover, Good, HSG A
0.860	61	>75% Grass cover, Good, HSG B
0.820	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.440		21.32% Pervious Area
16.390		78.68% Impervious Area

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

Subcatchment 1S: PROPOSED DRAINAGE AREA #1



Summary for Subcatchment 2S: PROPOSED DRAINAGE AREA #2

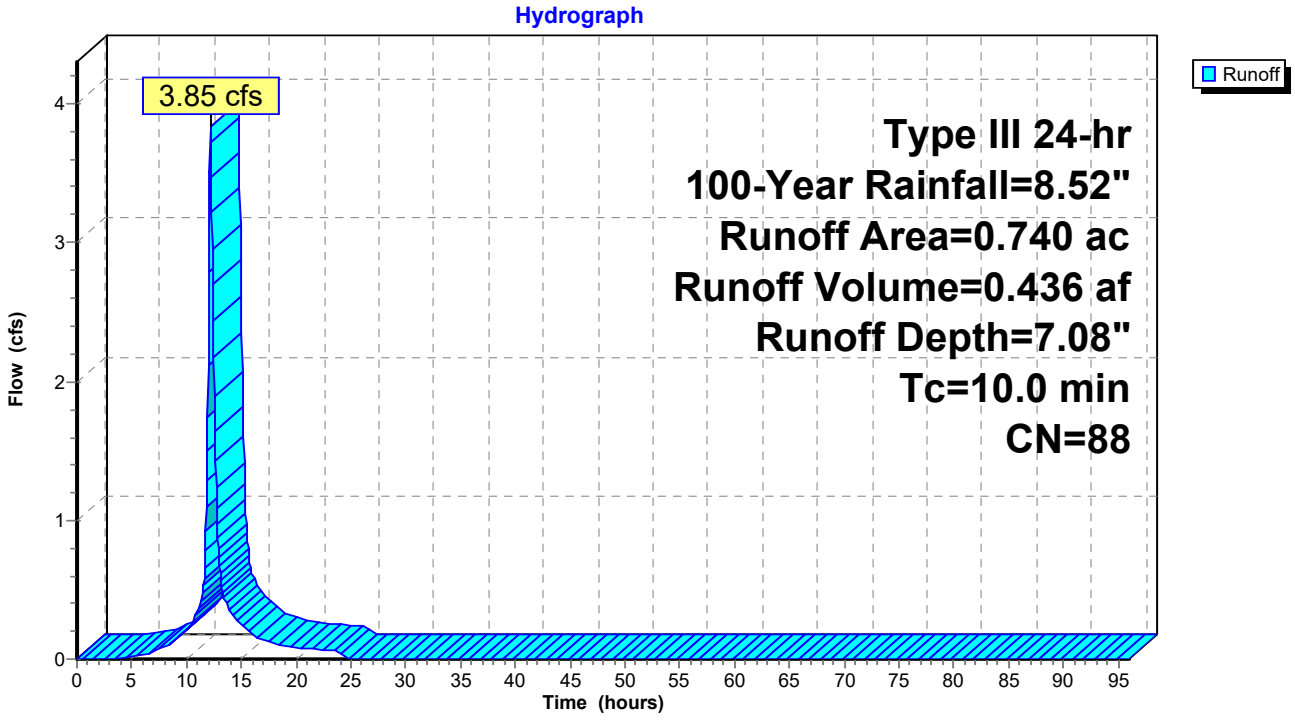
Runoff = 3.85 cfs @ 12.16 hrs, Volume= 0.436 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.52"

Area (ac)	CN	Description
0.580	98	Paved parking, HSG A
0.060	39	>75% Grass cover, Good, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.160		21.62% Pervious Area
0.580		78.38% Impervious Area

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

Subcatchment 2S: PROPOSED DRAINAGE AREA #2



Time span=0.00-96.00 hrs, dt=0.05 hrs, 1921 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PROPOSED Runoff Area=20.830 ac 78.68% Impervious Runoff Depth=0.45"
Tc=10.0 min CN=89 Runoff=18.55 cfs 0.780 af

Subcatchment 2S: PROPOSED DRAINAGE Runoff Area=0.740 ac 78.38% Impervious Runoff Depth=0.41"
Tc=10.0 min CN=88 Runoff=0.59 cfs 0.025 af

Total Runoff Area = 21.570 ac Runoff Volume = 0.805 af Average Runoff Depth = 0.45"
21.33% Pervious = 4.600 ac 78.67% Impervious = 16.970 ac

Summary for Subcatchment 1S: PROPOSED DRAINAGE AREA #1

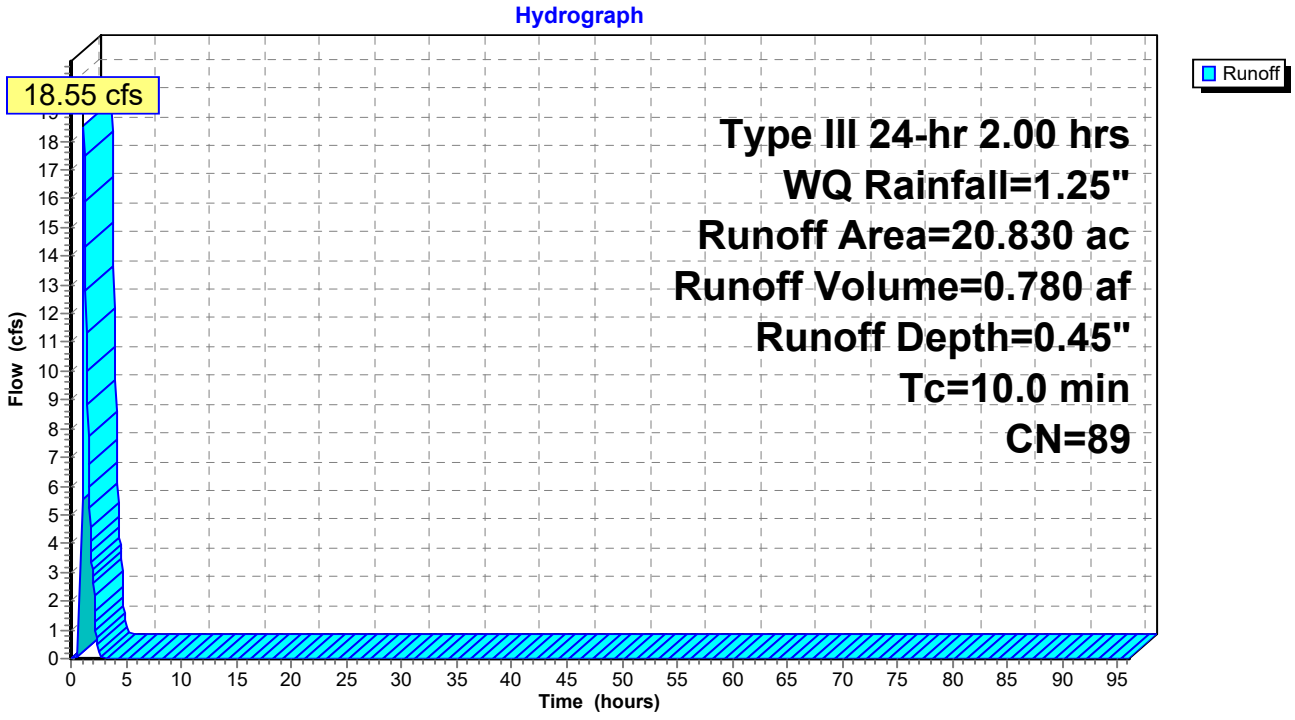
Runoff = 18.55 cfs @ 1.17 hrs, Volume= 0.780 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2.00 hrs WQ Rainfall=1.25"

Area (ac)	CN	Description
16.390	98	Paved parking, HSG A
1.940	39	>75% Grass cover, Good, HSG A
0.860	61	>75% Grass cover, Good, HSG B
0.820	74	>75% Grass cover, Good, HSG C
0.150	32	Woods/grass comb., Good, HSG A
0.670	72	Woods/grass comb., Good, HSG C
20.830	89	Weighted Average
4.440		21.32% Pervious Area
16.390		78.68% Impervious Area

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

Subcatchment 1S: PROPOSED DRAINAGE AREA #1



Summary for Subcatchment 2S: PROPOSED DRAINAGE AREA #2

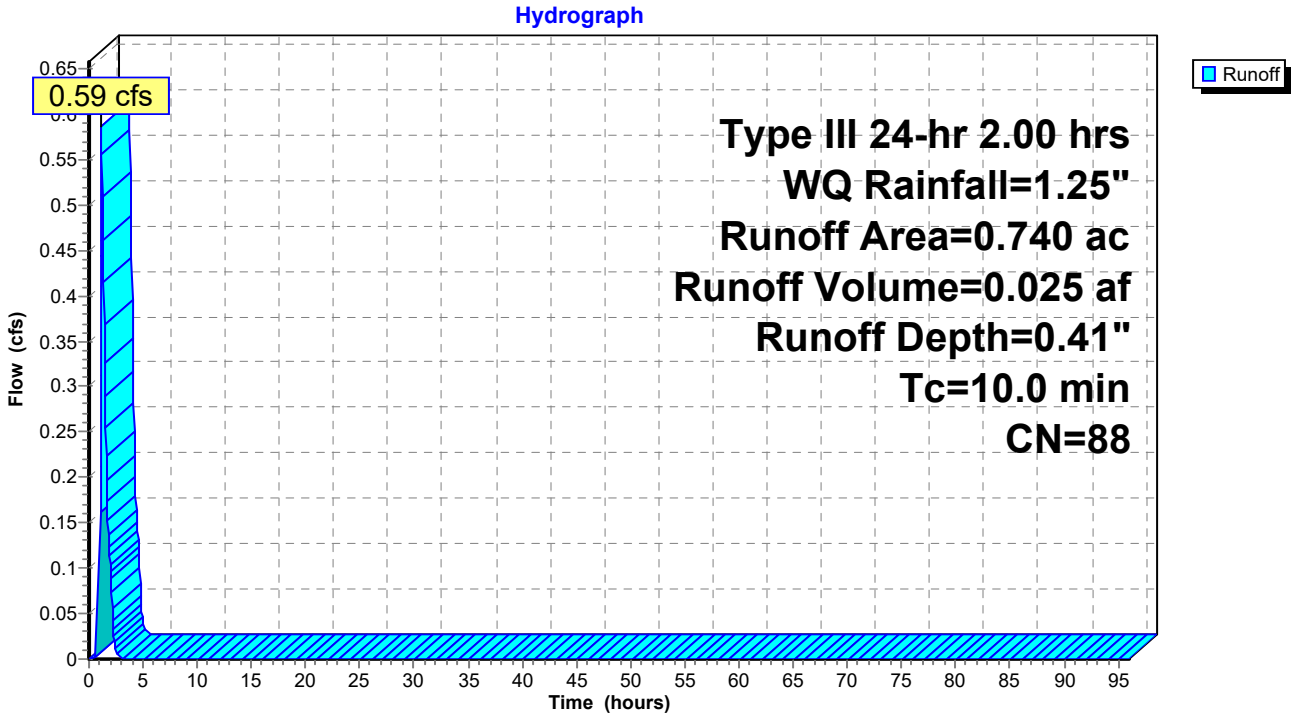
Runoff = 0.59 cfs @ 1.17 hrs, Volume= 0.025 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type III 24-hr 2.00 hrs WQ Rainfall=1.25"

Area (ac)	CN	Description
0.580	98	Paved parking, HSG A
0.060	39	>75% Grass cover, Good, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.740	88	Weighted Average
0.160		21.62% Pervious Area
0.580		78.38% Impervious Area

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

Subcatchment 2S: PROPOSED DRAINAGE AREA #2



BOHLER
10000 Midlantic Drive, Suite 410W, Mt. Laurel , NJ 08054
(856) 930-4000

Date: 5/12/2020
Project: Cherry Hill, NJ
Project No: 180678

Calculated By: AS
Checked By: AT

Manning's Equation

Design Parameters:

Pipe Diameter, D	6	in
Pipe Material	PVC	
Slope, s	2.00	%
Flow Depth, y	FULL	

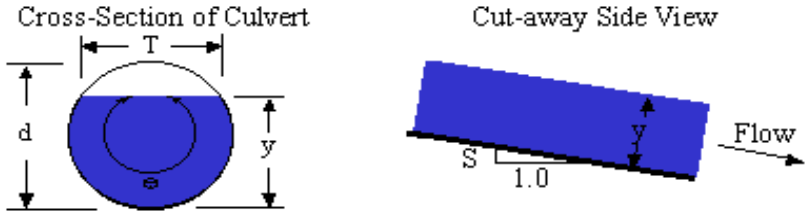
Calculations:

Cross-Sectional Area, $A = D^2/8\,[\theta - \sin(\theta)]$ =	0.20	ft^2
Manning's Coefficient, n	0.010	
Hydraulic Radius, R	0.13	ft
Angle, θ =	6.28	radians
Wetted Perimeter, $P = \theta D/2$	1.57	ft
Flow Depth, y	0.50	ft
Flow Top Width, $T = 2[y(D-y)]^{1/2}$	0.00	ft
Gravity Constant, g	32.174	ft/s^2
Froude Number, F	0.00	
	Subcritical Flow	

- **Flow & Velocity:**

Flow, $Q_o = \dfrac{1.486 \cdot R^{2/3} s^{1/2} A}{n}$ . . . . . **1.03 cfs**
0.67 MGD

Velocity, $V = Q/A$ . . . . . **5.25 fps**



$$Q=VA \qquad V=\frac{k}{n}R^{2/3}S^{1/2} \qquad R=\frac{A}{P} \qquad A=\frac{d^2}{8}\left(\theta-\sin(\theta)\right)$$

$$P=\frac{\theta d}{2} \qquad y=\frac{d}{2}\left[1-\cos\left(\frac{\theta}{2}\right)\right] \qquad T=2\sqrt{y(d-y)} \qquad F=V\sqrt{\frac{T}{gA\cos(Tan^{-1}S)}}$$

For a 2,975 sf roof area, the expected runoff is as follows:
2,975 sf / 43,560 sf / ac. = 0.07 ac.
Use Q=ciA (Rational Equation); 0.07 ac. x 0.99 x 6 in. / hr = 0.42 cfs
0.42 cfs < 1.03, OK

BOHLER
10000 Midlantic Drive, Suite 410W, Mt. Laurel , NJ 08054
(856) 930-4000

Date: 5/12/2020
Project: Cherry Hill, NJ
Project No: 180678

Calculated By: AS
Checked By: AT

Manning's Equation

Design Parameters:

Pipe Diameter, D	15	in
Pipe Material	RCP	
Slope, s	2.00	%
Flow Depth, y	FULL	

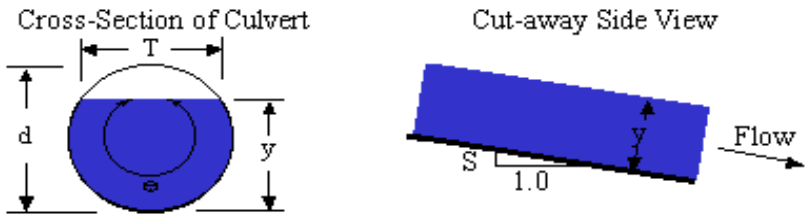
Calculations:

Cross-Sectional Area, $A = D^2/8\,[\theta - \sin(\theta)]$ =	1.23	ft^2
Manning's Coefficient, n	0.013	
Hydraulic Radius, R	0.31	ft
Angle, θ =	6.28	radians
Wetted Perimeter, $P = \theta D/2$	3.93	ft
Flow Depth, y	1.25	ft
Flow Top Width, $T = 2[y(D-y)]^{1/2}$	0.00	ft
Gravity Constant, g	32.174	ft/s^2
Froude Number, F	0.00	
	Subcritical Flow	

- **Flow & Velocity:**

Flow, $Q_o = \dfrac{1.486 \cdot R^{2/3} s^{1/2} A}{n}$ . . . . . **9.14 cfs** / **5.90 MGD**

Velocity, $V = Q/A$ . . . . . **7.44 fps**



$$Q=VA \qquad V=\frac{k}{n}R^{2/3}S^{1/2} \qquad R=\frac{A}{P} \qquad A=\frac{d^2}{8}\left(\theta-\sin(\theta)\right)$$

$$P=\frac{\theta d}{2} \qquad y=\frac{d}{2}\left[1-\cos\left(\frac{\theta}{2}\right)\right] \qquad T=2\sqrt{y(d-y)} \qquad F=V\sqrt{\frac{T}{gA\cos(Tan^{-1}S)}}$$

A. MAPS

- **Existing Drainage Area Map**
- **Proposed Drainage Area Map**