Drainage Analysis

for the

Newton Commonwealth Golf Course
Maintenance Facilities Improvements & Renovations
212 Kenrick Street
Newton, MA 02458
Parcels 72039 0017 & 72039 0018

Owner:

City of Newton
1000 Commonwealth Avenue
Newton, MA 02459

Architect:

Raymond Design Associates
60 Ledgewood Place
Rockland, MA 02370
(781) 561-5270

Representative/Engineer:

GARCIA•GALUSKA•DESOUSA
Consulting Engineers Inc.
375 Faunce Corner Road – Suite D, Dartmouth, MA 02747
(508) 998-5700 Fax: (508) 998-0883 Email: info@g-g-d.com

Date:
August 5, 2021

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Consulting Engineers Inc.

Drainage Analysis
for the Newton Commonwealth Golf Course

Description of Project

The project site, consisting of approximately 76.5 acres of City-owned land, is current developed as a municipal golf course with associated buildings, paved parking lots, cart paths, walkways, storage areas and grass surfaces spread among 8 parcels of land. The site is located on the south side of Kenrick Street between the intersections of Magnolia Avenue and Lake Shore Road. The site is located at 212 Kenrick Street in Newton, MA. The work is proposed to occur on Newton Parcels 72039 0017 and 72039 0018 on the east side of the course.

The project scope includes the construction of a building addition with an approximate footprint of 3,000 square feet to the existing maintenance building on the building's north side. In addition, a replacement driveway will be installed from the existing golf course parking lot to the new addition and new utilities extended to the building. The construction of the new building and driveway will result in approximately 2,100 square feet of additional impervious cover on the site.

The project proposes to connect the downspouts of the addition as well as the northern half of the existing maintenance building to underground piping to a subsurface infiltration bed located south of the existing course parking lot. A deep-sump catch basin will be installed at an equipment washdown pad and will connect into the roof drainage system as well. The subsurface infiltration bed has been sized to reduce or maintain the peak flows for the 1, 2 and 10-year storm event. The 25 and 100-year storm peak flows exceed the existing, however, the volume of runoff has been reduced. The peak flows are provided under the Standard 2 portion of this report.

Study Area

The area surrounding the existing maintenance building, proposed addition and driveway slopes easterly towards the property line where it is intercepted by the abutter's driveway and catch basins.

The area encompassed by this analysis and design includes all onsite catchment areas that will be disturbed by the proposed construction as well as offsite areas that contribute to the subject site. Areas outside of the catchment limits will not be disturbed under this project and are not included in this analysis.

Runoff rates and storm volumes for both the existing and developed conditions were calculated utilizing the SCS TR-20 method and analyzed for the 1, 2, 10, 25 and 100 year storm frequencies utilizing HydroCAD 10.00. Rainfall distribution is based on 24-Hour Storm event with the rainfall intensity utilizing a Type-III distribution. The rainfall intensity is based on values published by Cornell University for the region. The HydroCAD stormwater modeling associated with the subject site is based on the Dynamic Storage Indicator method, which is capable of simultaneously analyzing upstream and downstream effect of the modeled system.

The catchment area soil is classified as Udorthents, wet substratum, on the United States Department of Agriculture Natural Resources Conservation Service soil maps. These soils have typically been previously disturbed and therefore, no hydrologic soil group has been assigned by the USDA. A test pit at the proposed subsurface infiltration bed show the soils consists of loamy sand and silt loam. Based

on the upper horizon, the soil is presumed to by Hydrologic Soil Group 'A' for the development of runoff rates. The catchment area also includes Canton-Charlton-Urban land complex, which is classified as Hydrologic Soil Group 'A'. Due to the presence of Silt Loam in the lower horizon of the test pit at the subsurface infiltration bed, an infiltration rate of 0.27 inches per hour was used, consistent with a Hydrologic Soil Group 'C' soil.

Stormwater Standards:

Standard 1: No New Untreated Discharges

The proposed stormwater infrastructure for the addition and existing maintenance building and washdown area will continue to convey runoff to the north abutter.

Standard 2: Peak Rate Attenuation

The proposed stormwater infrastructure for the paved surfaces and building has been designed to attenuate the peak flows for the 1, 2 and 10-year storm to reduce or match the existing condition. Below are the existing and proposed peak flow rates and volume of stormwater associated with the area of disturbance:

Existing:

Catchment		1-Year	2-Year	10-Year	25-Year	100-Year
DP1 (E1)	Peak Flow (cfs)	0.59	0.71	1.09	1.71	2.59
	Volume (a-f)	0.052	0.063	0.106	0.175	0.250

Proposed:

Catchment		1-Year	2-Year	10-Year	25-Year	100-Year
DP1 (N1 & N1A)	Peak Flow (cfs)	0.43	0.52	0.79	2.00	2.92
	Volume (a-f)	0.038	0.046	0.085	0.170	0.250

Standard 3: Recharge

Recharge is proposed to mitigate the additional 2,100 square feet of impervious cover. MassDEP requires approximately 105 cubic feet of stormwater recharge based on Hydrologic Soil Group 'A' soils. During the annual rain event, approximately 697 cubic feet of runoff will be recharged. At peak storage, the subsurface infiltration bed is expected to drain in approximately 72 hours based on a recharge rate of 0.27 inches per hour:

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Subsurfce Infiltration Bed #1				
A	B	C	D	
Storage Volume (ft^3)	Bottom Area (ft^2) (LxW)	Infiltration Rate (Inches/Hour)	Drawdown Time (Hrs) (A / (B x (C / 12)))	
1238	765	0.27	71.92	< 72 hrs. **OK**

Standard 4: Water Quality

The stormwater from the addition and existing building is considered clean runoff. No further treatment is provided. The concrete washdown pad is equipped with a deep-sump catch basin to collect solids and floatable particulates.

The provided drawings outline the type and frequency of maintenance to be provided for each of the drain structure types.

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

The current land use is not considered a land use with higher potential pollutant loads as defined in 310 CMR 10.04 and 314 CMR 9.02.

Standard 6: Critical Areas

The stormwater does not discharge near or to a critical area.

Standard 7: Redevelopment and Other Projects Subjects to the Standards Only to the Maximum Extent Practicable

The project consists of redeveloping existing driveway for an addition, however, the project is in compliance with all standards of the Stormwater Regulations.

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

The project will disturb less than 1 acre of land. An Erosion & Sediment Control Narrative as well as Site Operational Procedures Narrative are provided on Drawing C0.01 outlining the minimum requirements the Contractor needs to follow.

Standard 9: Operation and Maintenance Plan

The provided drawings outline the type and frequency of maintenance to be provided for each of the

drain structure types.

Standard 10: Prohibition of Illicit Discharges

The proposed storage building will have no running water or sanitary sewer. No drainage connections beyond those shown on the included drawings for downspouts and catch basins is proposed.

139-22

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	71.169 degrees West
Latitude	42.343 degrees North
Elevation	0 feet
Date/Time	Wed, 25 Mar 2020 06:33:37 -0400

Extreme Precipitation Estimates

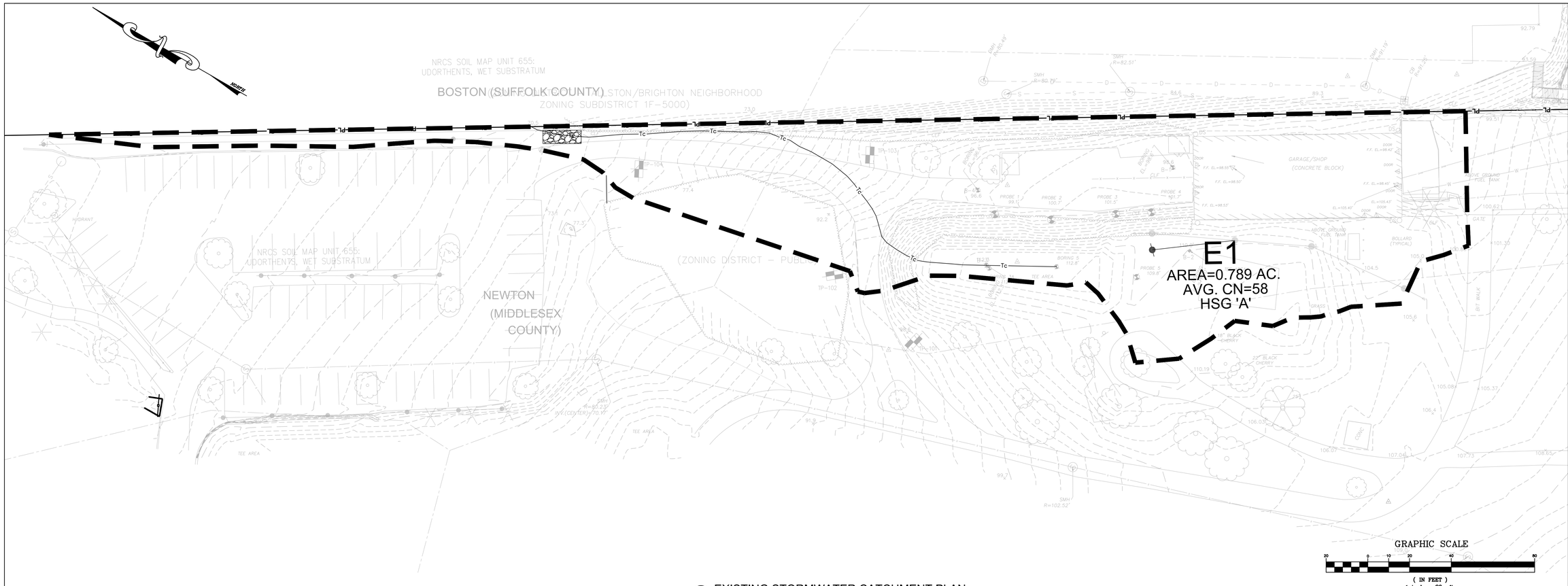
	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.54	0.70	0.88	1.11	**1yr**	0.76	1.05	1.29	1.64	2.09	2.68	2.92	**1yr**	2.38	2.81	3.29	3.96	4.65	**1yr**
2yr	0.35	0.54	0.68	0.89	1.12	1.41	**2yr**	0.97	1.29	1.63	2.05	2.57	3.22	3.58	**2yr**	2.85	3.44	3.94	4.68	5.33	**2yr**
5yr	0.42	0.66	0.82	1.10	1.41	1.79	**5yr**	1.22	1.62	2.08	2.61	3.27	4.08	4.55	**5yr**	3.61	4.38	5.00	5.95	6.67	**5yr**
10yr	0.48	0.75	0.95	1.29	1.68	2.15	**10yr**	1.45	1.93	2.51	3.15	3.93	4.88	5.47	**10yr**	4.32	5.26	6.00	7.14	7.89	**10yr**
25yr	0.57	0.91	1.16	1.59	2.11	2.73	**25yr**	1.82	2.42	3.19	4.01	5.00	6.18	6.96	**25yr**	5.47	6.69	7.62	9.09	9.88	**25yr**
50yr	0.65	1.04	1.34	1.87	2.52	3.29	**50yr**	2.18	2.88	3.85	4.85	6.02	7.40	8.37	**50yr**	6.55	8.04	9.14	10.91	11.71	**50yr**
100yr	0.74	1.21	1.56	2.21	3.01	3.96	**100yr**	2.60	3.43	4.64	5.84	7.23	8.86	10.06	**100yr**	7.84	9.67	10.97	13.10	13.89	**100yr**
200yr	0.86	1.40	1.81	2.60	3.60	4.75	**200yr**	3.11	4.08	5.59	7.03	8.70	10.62	12.10	**200yr**	9.40	11.63	13.17	15.74	16.48	**200yr**
500yr	1.04	1.72	2.24	3.26	4.56	6.06	**500yr**	3.94	5.14	7.14	8.98	11.09	13.49	15.45	**500yr**	11.94	14.86	16.77	20.07	20.66	**500yr**

Lower Confidence Limits

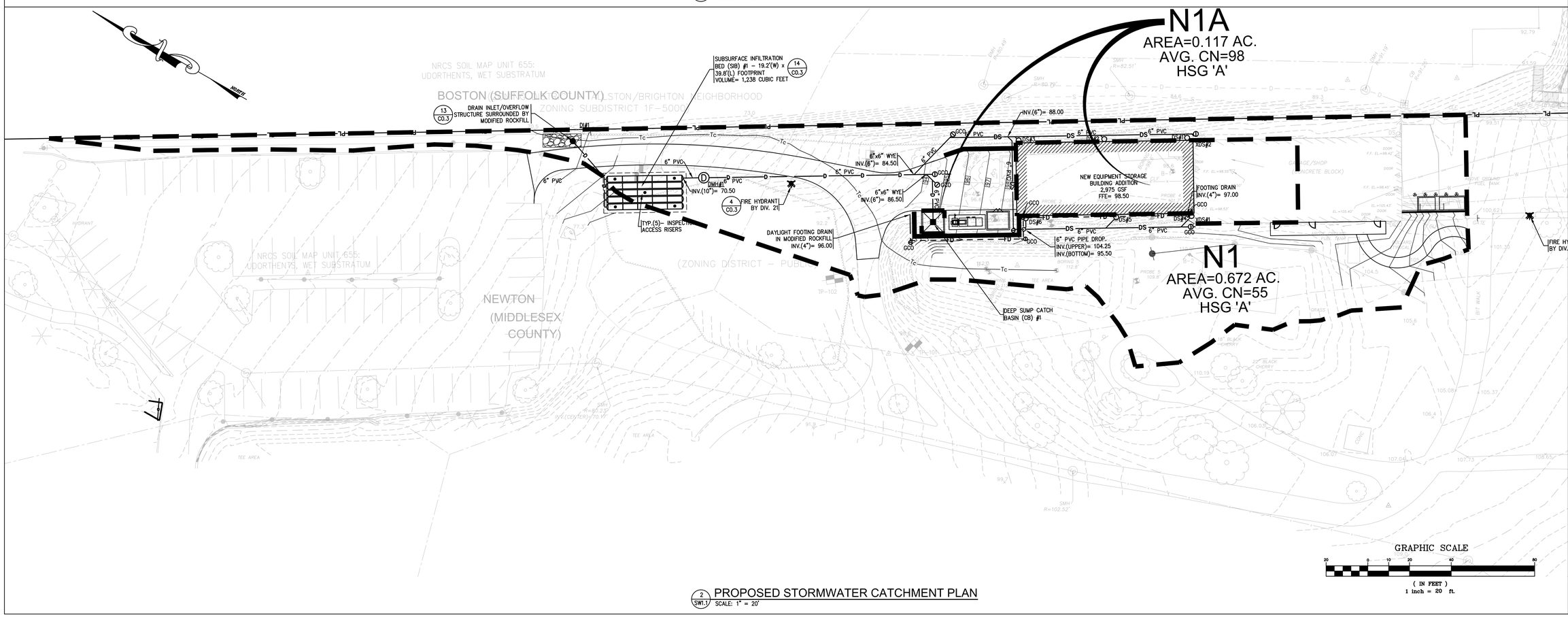
	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.46	0.61	0.75	0.85	**1yr**	0.65	0.84	1.12	1.45	1.80	2.49	2.58	**1yr**	2.20	2.48	2.92	3.53	4.26	**1yr**
2yr	0.34	0.52	0.64	0.86	1.06	1.27	**2yr**	0.92	1.24	1.45	1.93	2.50	3.12	3.47	**2yr**	2.76	3.33	3.82	4.53	5.18	**2yr**
5yr	0.39	0.60	0.75	1.03	1.31	1.52	**5yr**	1.13	1.48	1.74	2.27	2.92	3.78	4.22	**5yr**	3.35	4.06	4.61	5.49	6.17	**5yr**
10yr	0.44	0.67	0.84	1.17	1.51	1.74	**10yr**	1.30	1.70	1.96	2.55	3.28	4.38	4.87	**10yr**	3.88	4.68	5.29	6.35	7.00	**10yr**
25yr	0.51	0.77	0.96	1.37	1.81	2.06	**25yr**	1.56	2.01	2.31	2.99	3.84	5.30	5.86	**25yr**	4.69	5.63	6.36	7.65	8.26	**25yr**
50yr	0.56	0.86	1.07	1.54	2.07	2.35	**50yr**	1.78	2.30	2.62	3.38	4.32	6.10	6.73	**50yr**	5.40	6.47	7.26	8.81	9.35	**50yr**
100yr	0.63	0.95	1.19	1.72	2.36	2.68	**100yr**	2.04	2.62	2.97	3.64	4.86	7.06	7.71	**100yr**	6.25	7.41	8.32	10.11	10.58	**100yr**
200yr	0.71	1.06	1.35	1.95	2.72	3.05	**200yr**	2.34	2.99	3.37	4.06	5.49	8.15	8.81	**200yr**	7.22	8.47	9.49	11.59	11.94	**200yr**
500yr	0.82	1.22	1.58	2.29	3.25	3.63	**500yr**	2.81	3.55	3.97	4.70	6.45	9.87	10.46	**500yr**	8.73	10.06	11.30	13.85	13.97	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.48	0.59	0.80	0.98	1.15	**1yr**	0.84	1.13	1.35	1.80	2.29	2.84	3.11	**1yr**	2.52	2.99	3.49	4.20	4.96	**1yr**
2yr	0.37	0.57	0.70	0.95	1.17	1.37	**2yr**	1.01	1.34	1.58	2.10	2.71	3.32	3.71	**2yr**	2.93	3.56	4.10	4.85	5.53	**2yr**
5yr	0.46	0.71	0.88	1.21	1.54	1.81	**5yr**	1.33	1.77	2.07	2.69	3.43	4.38	4.93	**5yr**	3.88	4.75	5.37	6.44	7.16	**5yr**
10yr	0.56	0.86	1.07	1.49	1.93	2.24	**10yr**	1.66	2.19	2.59	3.26	4.12	5.42	6.17	**10yr**	4.80	5.94	6.63	8.01	8.73	**10yr**
25yr	0.73	1.11	1.38	1.97	2.60	2.96	**25yr**	2.24	2.90	3.46	4.21	5.26	7.17	8.34	**25yr**	6.35	8.02	8.78	10.70	11.41	**25yr**
50yr	0.89	1.35	1.68	2.42	3.26	3.67	**50yr**	2.81	3.59	4.29	5.12	6.33	8.87	10.46	**50yr**	7.85	10.06	10.83	13.35	13.97	**50yr**
100yr	1.09	1.65	2.06	2.98	4.09	4.55	**100yr**	3.53	4.44	5.34	6.52	7.61	10.98	13.15	**100yr**	9.72	12.64	13.39	16.69	17.15	**100yr**
200yr	1.33	2.01	2.54	3.68	5.13	5.63	**200yr**	4.43	5.51	6.65	7.98	9.14	13.62	16.56	**200yr**	12.06	15.92	16.59	20.88	21.07	**200yr**
500yr	1.75	2.61	3.35	4.87	6.93	7.45	**500yr**	5.98	7.29	8.89	10.45	11.66	18.10	22.49	**500yr**	16.02	21.63	22.02	28.12	27.72	**500yr**



1 SW1.1 EXISTING STORMWATER CATCHMENT PLAN
SCALE: 1" = 20'



2 SW1.1 PROPOSED STORMWATER CATCHMENT PLAN
SCALE: 1" = 20'

RDA

Raymond Design Associates, Inc.
Architects & Planners
60 Ledgewood Place
Rockland MA, 02370

NEWTON COMMONWEALTH GOLF COURSE
Maintenance Facilities Improvements & Renovations
212 Kenrick Street, Newton, MA 02458

EXISTING & PROPOSED STORMWATER CATCHMENT PLAN

Revisions:

No.	Date	Description

Drawn By: NCK
Checked By: CMG
Approved By: CMG

Drawing Scale: 1" = 20'

Date: AUGUST 5, 2021

SW1.1

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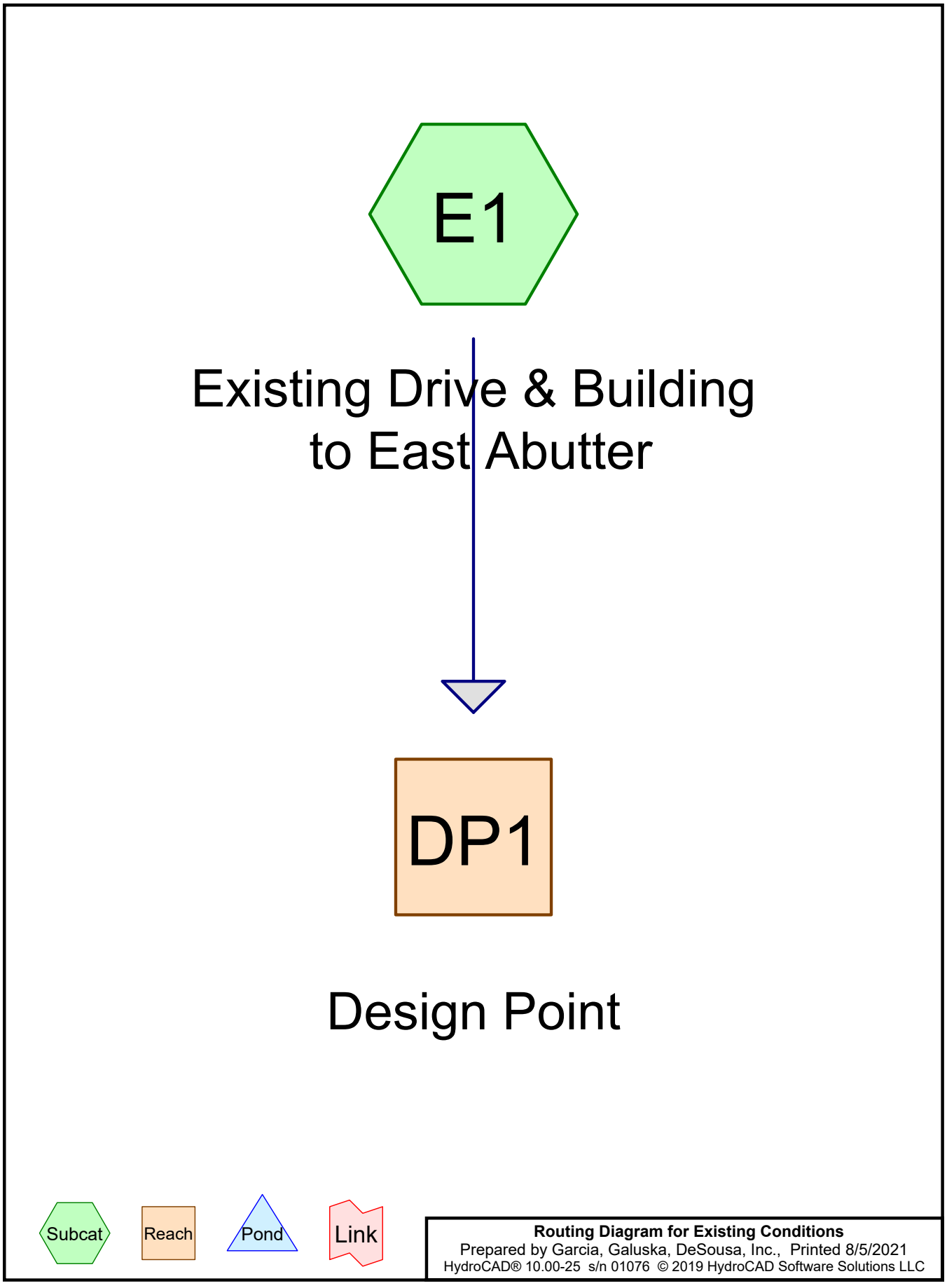
Consulting Engineers Inc.

Project: Newton Commonwealth Golf Course
Location: Newton, MA

Drainage Calculations
Existing Conditions


E1
Existing Drive & Building
to East Abutter
DP1
Design Point
Subcat
Reach
Pond
Link
Routing Diagram for Existing Conditions
Prepared by Garcia, Galuska, DeSousa, Inc., Printed 8/5/2021
HydroCAD® 10.00-25 s/n 01076 © 2019 HydroCAD Software Solutions LLC

Summary for Subcatchment E1: Existing Drive & Building to East Abutter

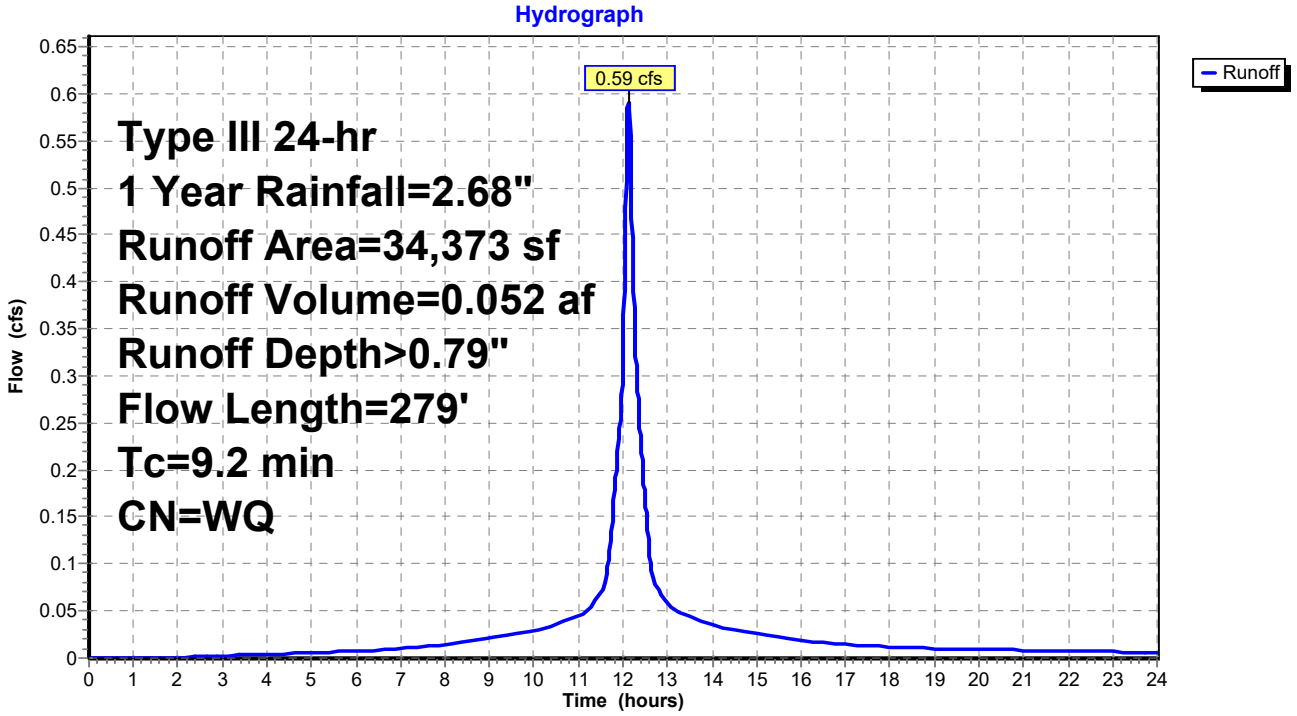
Runoff = 0.59 cfs @ 12.12 hrs, Volume= 0.052 af, Depth> 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1 Year Rainfall=2.68"

Area (sf)	CN	Description
6,957	98	Paved parking, HSG A
4,093	98	Roofs, HSG A
23,323	39	>75% Grass cover, Good, HSG A
34,373		Weighted Average
23,323		67.85% Pervious Area
11,050		32.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment E1: Existing Drive & Building to East Abutter



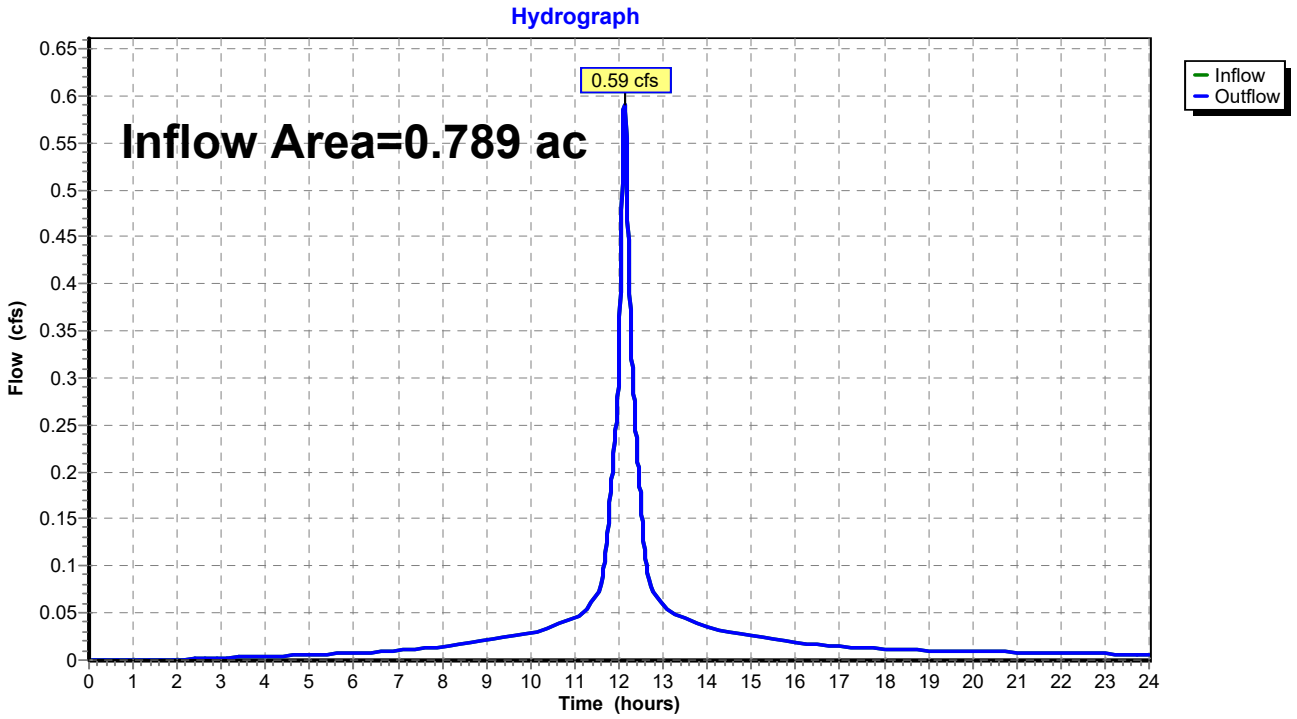
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 32.15% Impervious, Inflow Depth > 0.79" for 1 Year event
Inflow = 0.59 cfs @ 12.12 hrs, Volume= 0.052 af
Outflow = 0.59 cfs @ 12.12 hrs, Volume= 0.052 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment E1: Existing Drive & Building to East Abutter

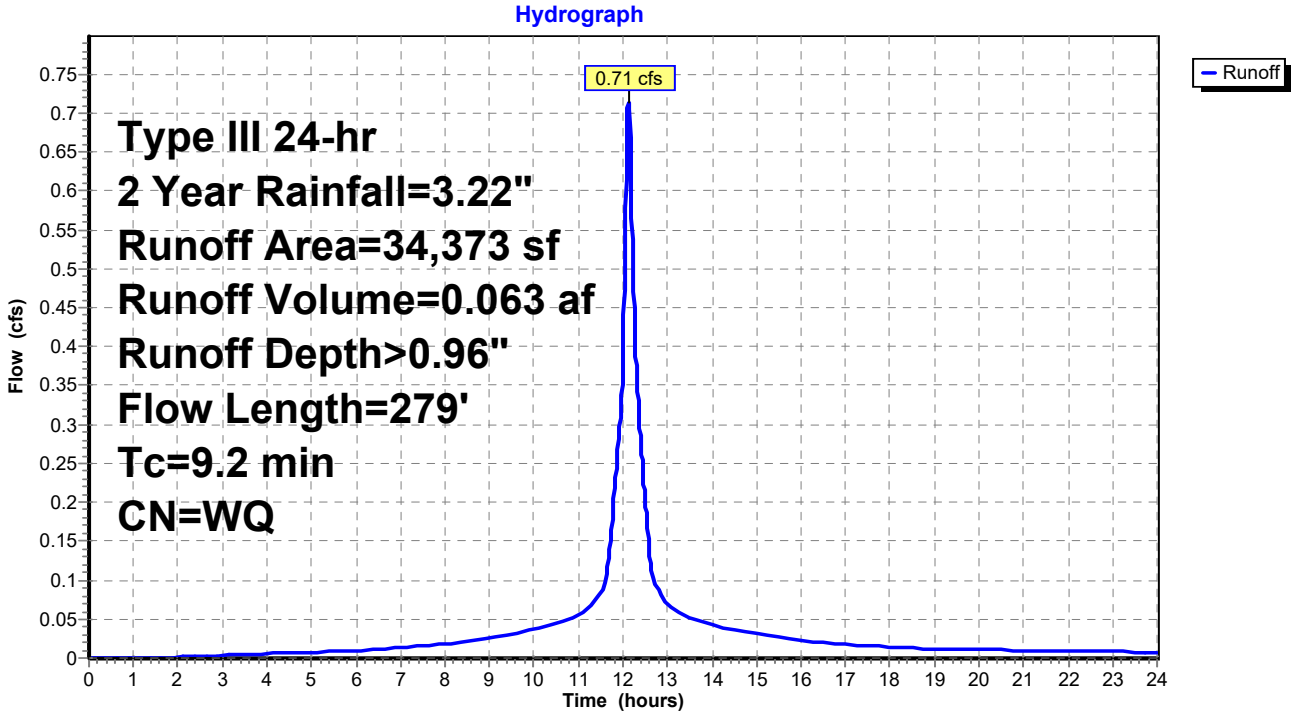
Runoff = 0.71 cfs @ 12.12 hrs, Volume= 0.063 af, Depth> 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.22"

Area (sf)	CN	Description
6,957	98	Paved parking, HSG A
4,093	98	Roofs, HSG A
23,323	39	>75% Grass cover, Good, HSG A
34,373		Weighted Average
23,323		67.85% Pervious Area
11,050		32.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment E1: Existing Drive & Building to East Abutter



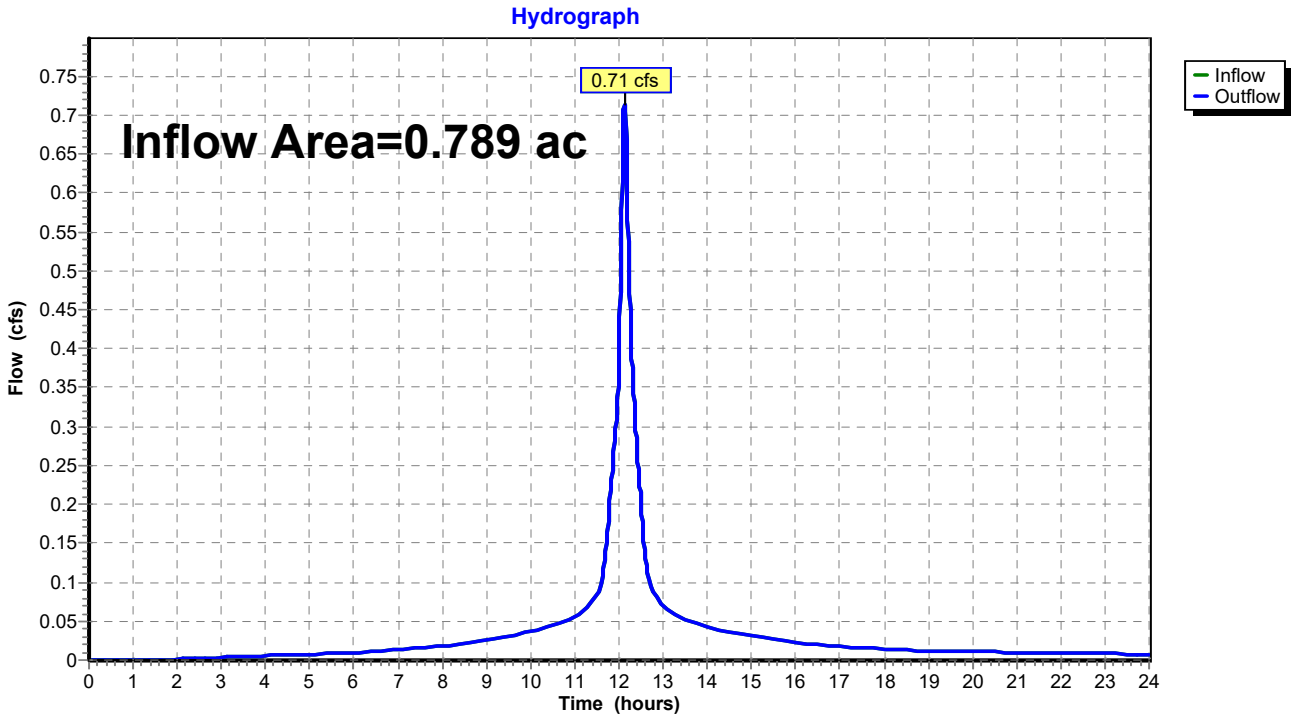
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 32.15% Impervious, Inflow Depth > 0.96" for 2 Year event
Inflow = 0.71 cfs @ 12.12 hrs, Volume= 0.063 af
Outflow = 0.71 cfs @ 12.12 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment E1: Existing Drive & Building to East Abutter

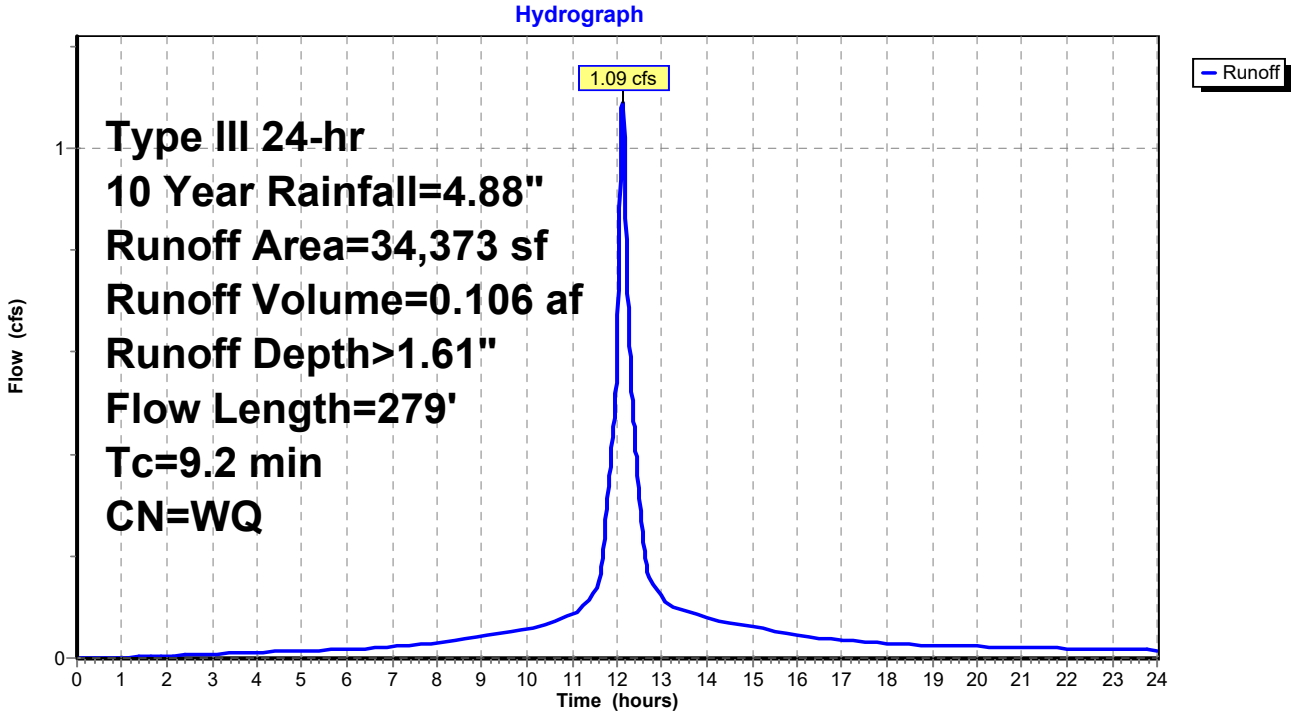
Runoff = 1.09 cfs @ 12.12 hrs, Volume= 0.106 af, Depth> 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.88"

Area (sf)	CN	Description
6,957	98	Paved parking, HSG A
4,093	98	Roofs, HSG A
23,323	39	>75% Grass cover, Good, HSG A
34,373		Weighted Average
23,323		67.85% Pervious Area
11,050		32.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment E1: Existing Drive & Building to East Abutter



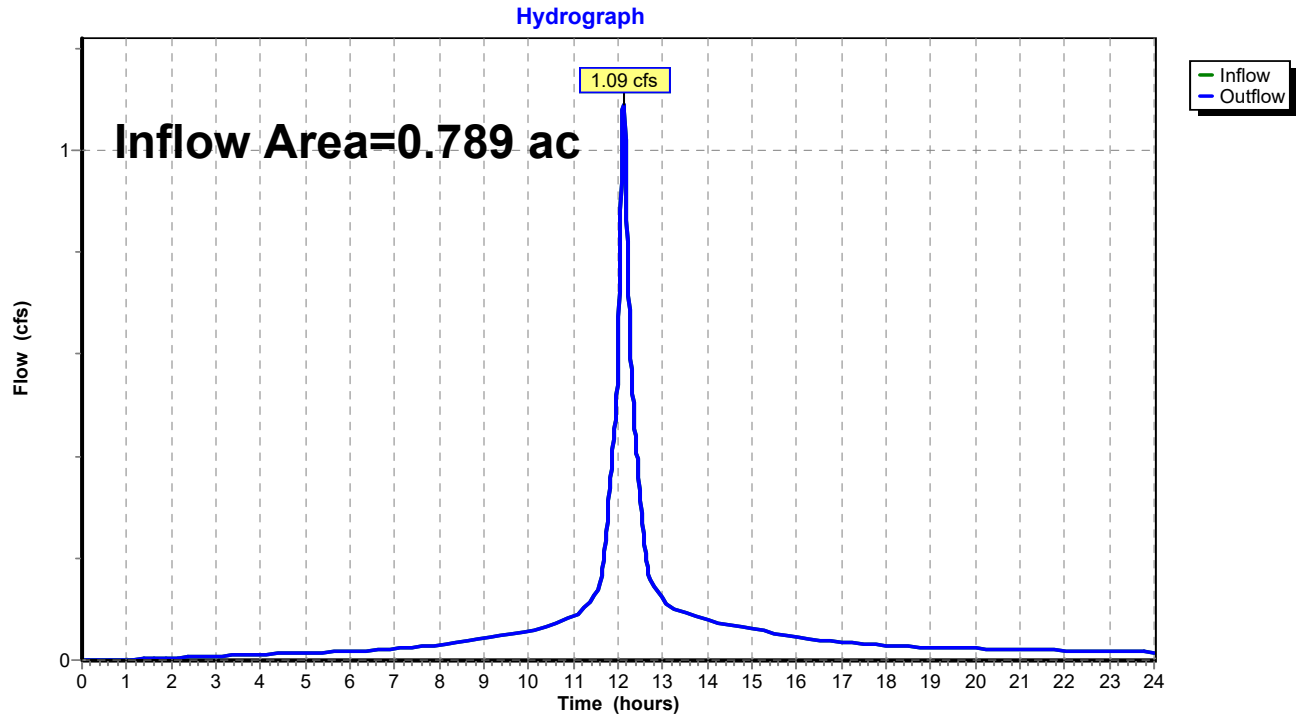
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 32.15% Impervious, Inflow Depth > 1.61" for 10 Year event
Inflow = 1.09 cfs @ 12.12 hrs, Volume= 0.106 af
Outflow = 1.09 cfs @ 12.12 hrs, Volume= 0.106 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment E1: Existing Drive & Building to East Abutter

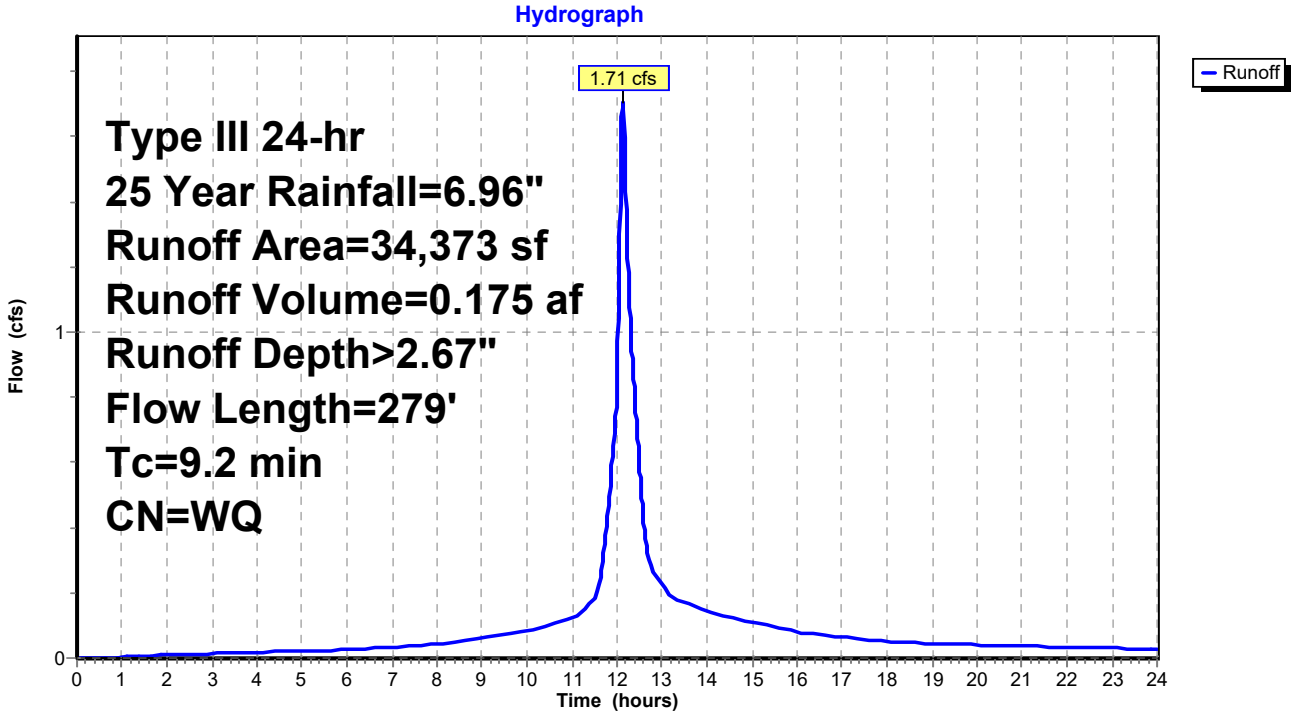
Runoff = 1.71 cfs @ 12.13 hrs, Volume= 0.175 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.96"

Area (sf)	CN	Description
6,957	98	Paved parking, HSG A
4,093	98	Roofs, HSG A
23,323	39	>75% Grass cover, Good, HSG A
34,373		Weighted Average
23,323		67.85% Pervious Area
11,050		32.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment E1: Existing Drive & Building to East Abutter



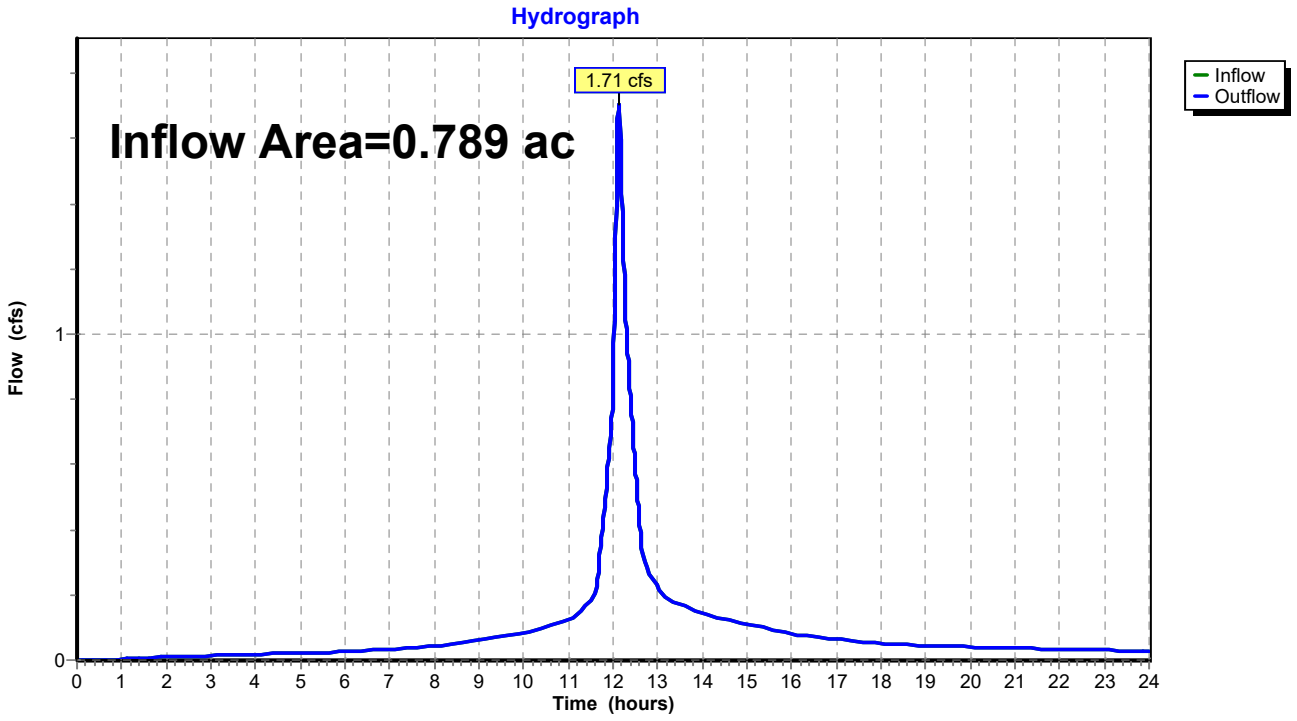
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 32.15% Impervious, Inflow Depth > 2.67" for 25 Year event
Inflow = 1.71 cfs @ 12.13 hrs, Volume= 0.175 af
Outflow = 1.71 cfs @ 12.13 hrs, Volume= 0.175 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment E1: Existing Drive & Building to East Abutter

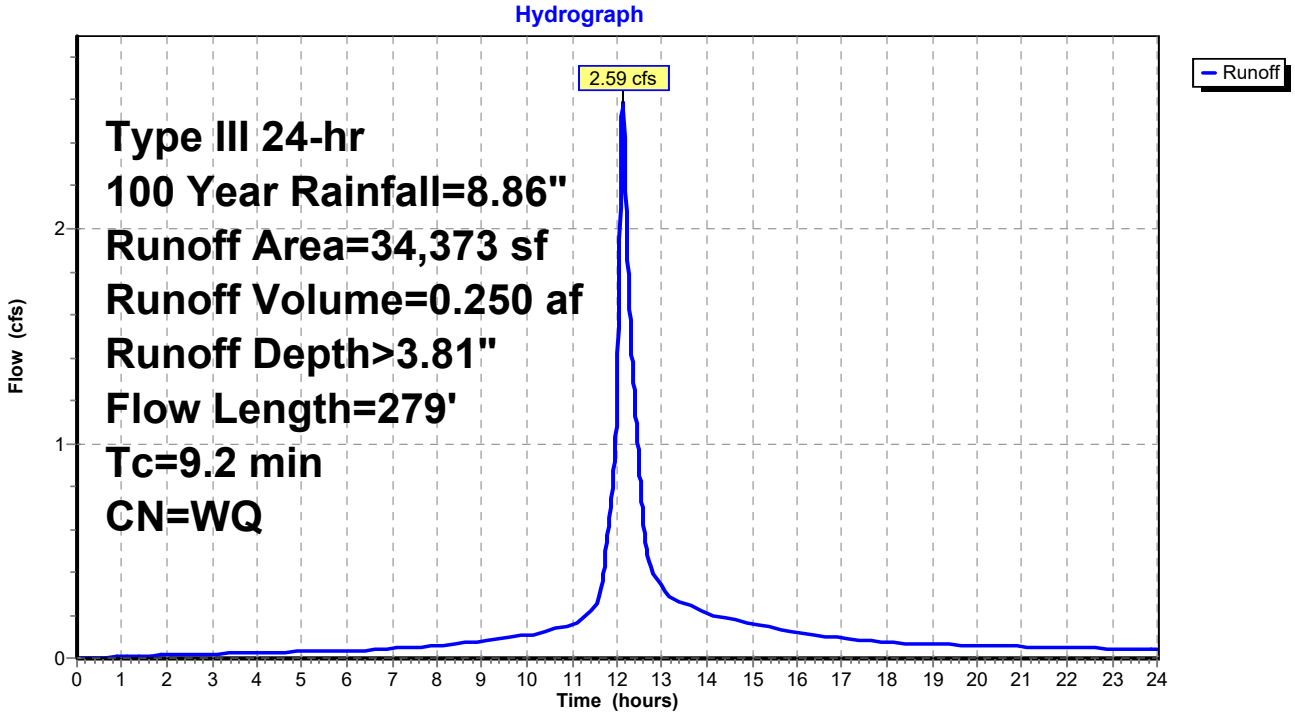
Runoff = 2.59 cfs @ 12.13 hrs, Volume= 0.250 af, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.86"

Area (sf)	CN	Description
6,957	98	Paved parking, HSG A
4,093	98	Roofs, HSG A
23,323	39	>75% Grass cover, Good, HSG A
34,373		Weighted Average
23,323		67.85% Pervious Area
11,050		32.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment E1: Existing Drive & Building to East Abutter



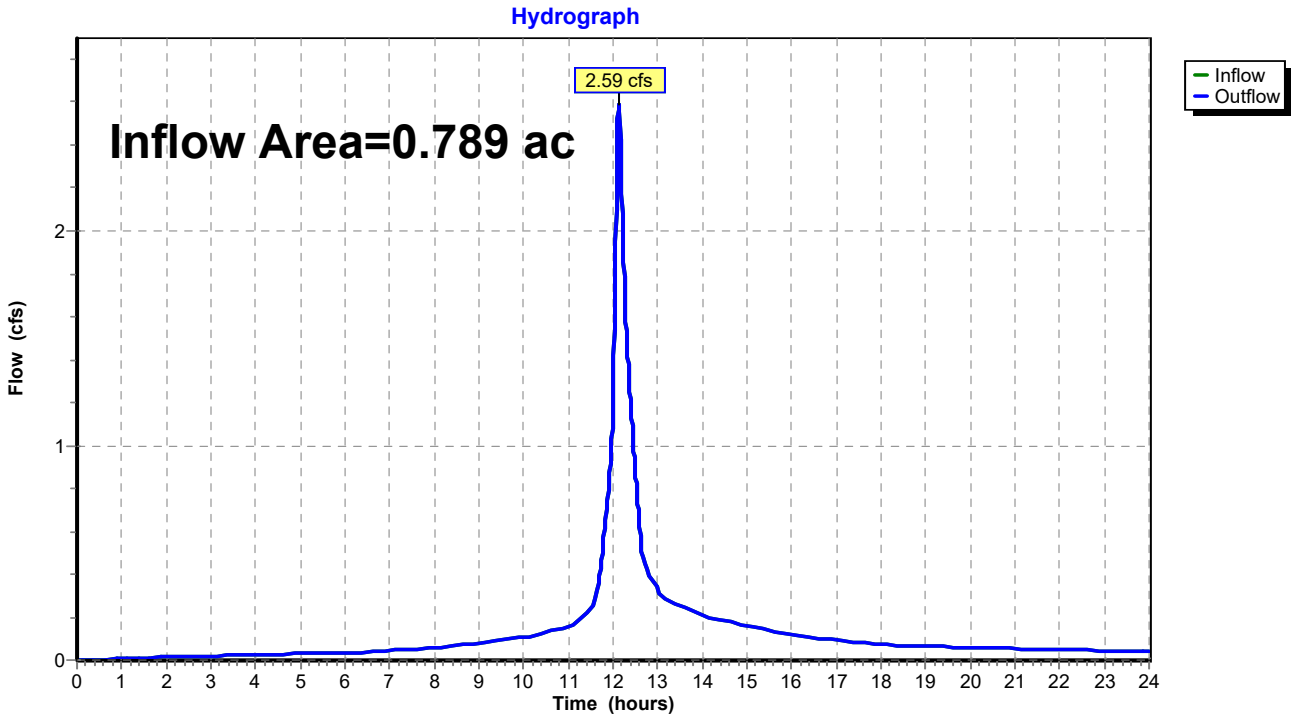
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 32.15% Impervious, Inflow Depth > 3.81" for 100 Year event
Inflow = 2.59 cfs @ 12.13 hrs, Volume= 0.250 af
Outflow = 2.59 cfs @ 12.13 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min

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

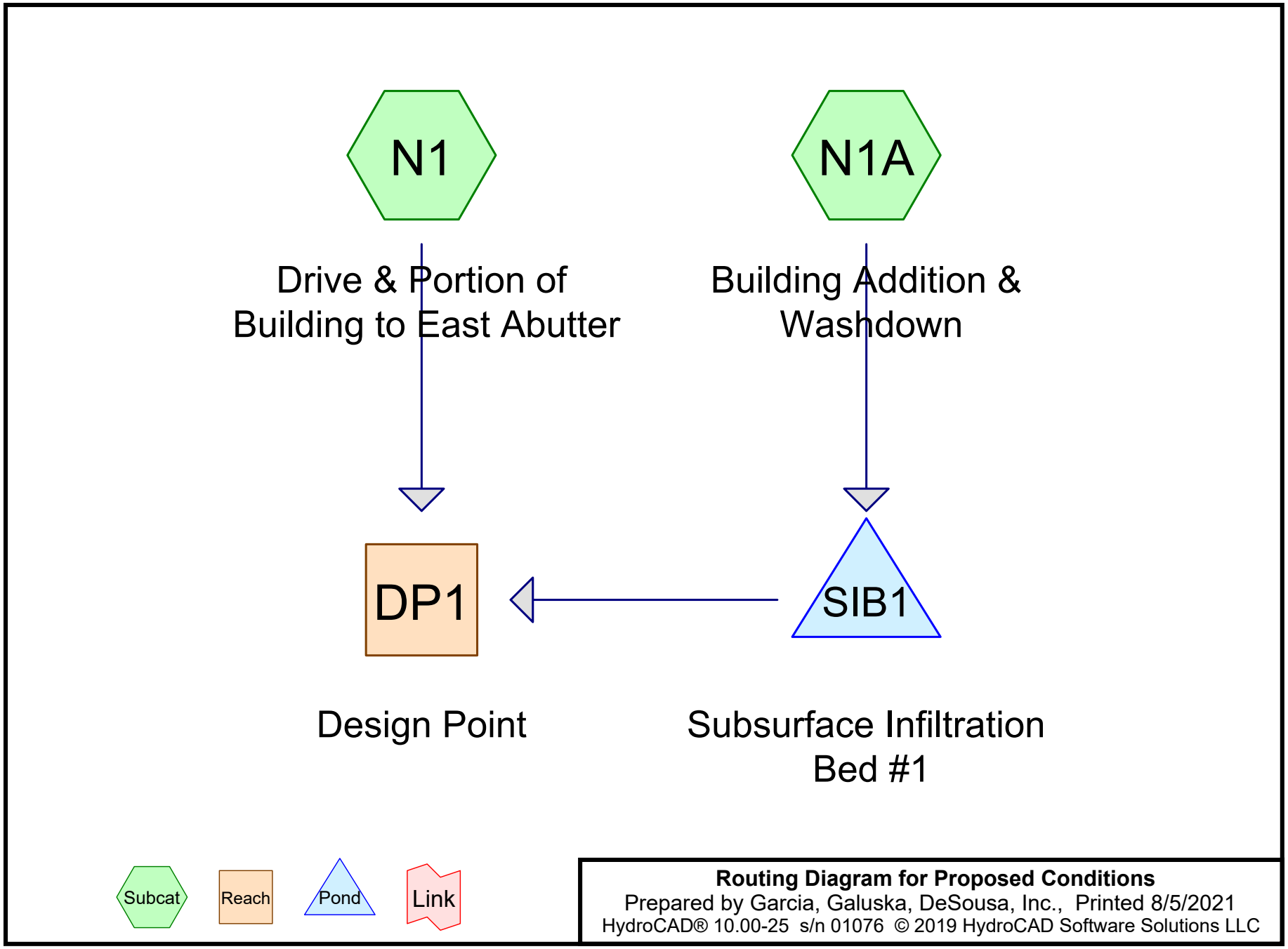
Reach DP1: Design Point



GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Project: Newton Commonwealth Golf Course
Location: Newton, MA

Drainage Calculations
Developed Conditions



Routing Diagram for Proposed Conditions
Prepared by Garcia, Galuska, DeSousa, Inc., Printed 8/5/2021

Summary for Subcatchment N1: Drive & Portion of Building to East Abutter

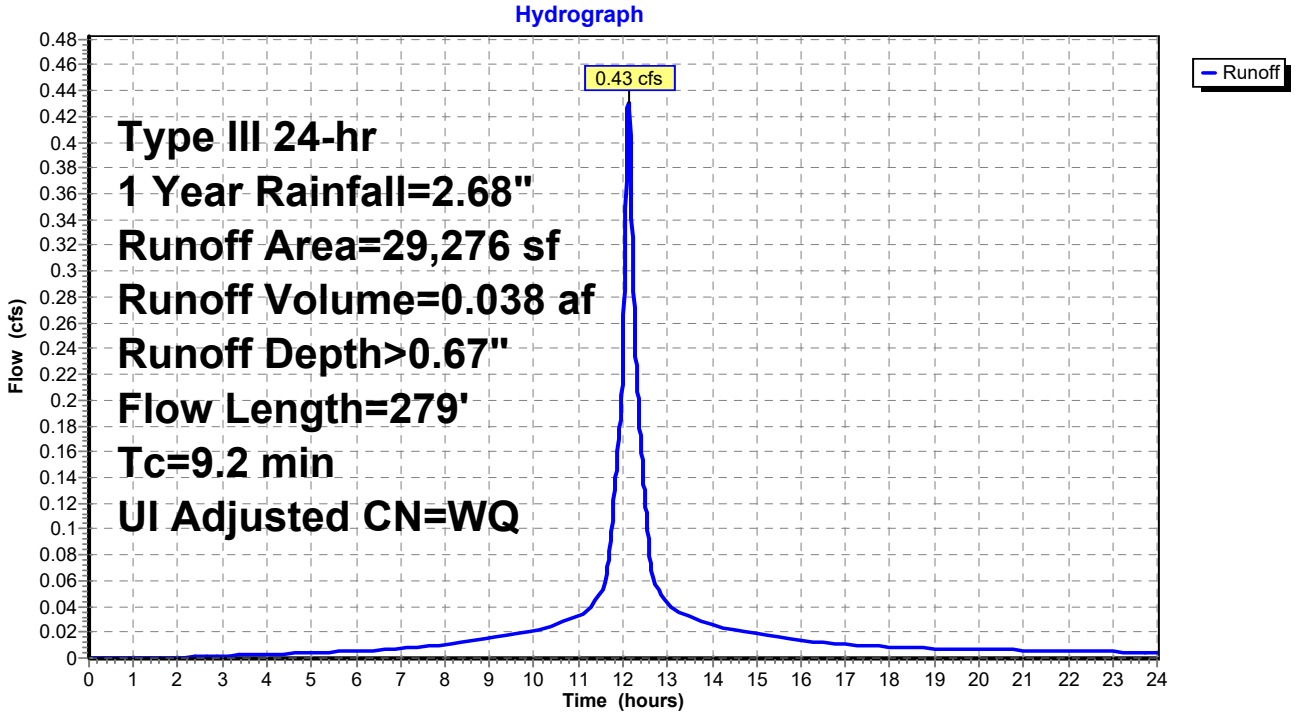
Runoff = 0.43 cfs @ 12.12 hrs, Volume= 0.038 af, Depth> 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1 Year Rainfall=2.68"

Area (sf)	CN	Adj	Description
6,047	98	98	Unconnected pavement, HSG A
2,012	98	98	Roofs, HSG A
21,217	39	39	>75% Grass cover, Good, HSG A
29,276			Weighted Average
21,217			72.47% Pervious Area
8,059			27.53% Impervious Area
6,047			75.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment N1: Drive & Portion of Building to East Abutter



Summary for Subcatchment N1A: Building Addition & Washdown

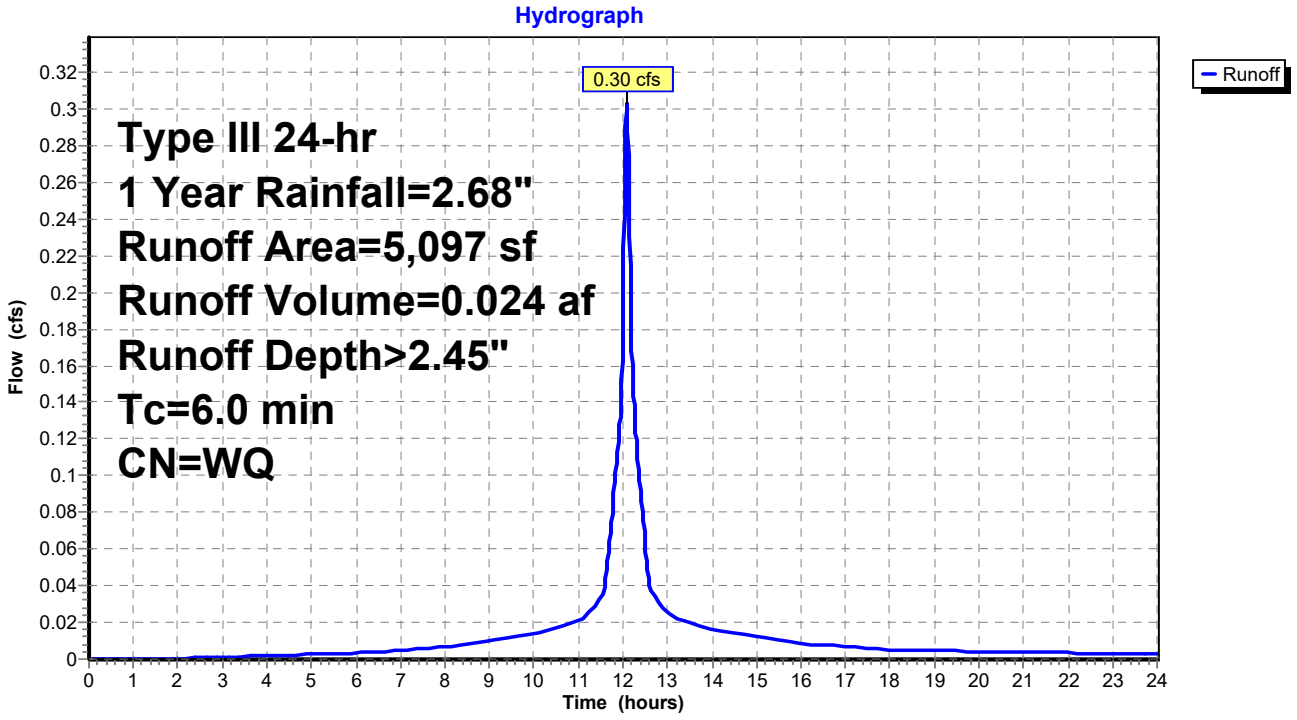
Runoff = 0.30 cfs @ 12.08 hrs, Volume= 0.024 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 1 Year Rainfall=2.68"

Area (sf)	CN	Description
4,976	98	Unconnected roofs, HSG A
121	98	Unconnected pavement, HSG A
5,097		Weighted Average
5,097		100.00% Impervious Area
5,097		100.00% Unconnected

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

Subcatchment N1A: Building Addition & Washdown



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.117 ac,100.00% Impervious, Inflow Depth > 2.45" for 1 Year event
Inflow = 0.30 cfs @ 12.08 hrs, Volume= 0.024 af
Outflow = 0.01 cfs @ 8.68 hrs, Volume= 0.008 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.01 cfs @ 8.68 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 70.99' @ 18.02 hrs Surf.Area= 0.019 ac Storage= 0.016 af
Flood Elev= 72.63' Surf.Area= 0.019 ac Storage= 0.030 af

Plug-Flow detention time= 267.9 min calculated for 0.008 af (34% of inflow)
Center-of-Mass det. time= 104.8 min (864.5 - 759.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	69.30'	0.022 af	**20.17'W x 40.80'L x 3.33'H Field A** 0.063 af Overall - 0.008 af Embedded = 0.055 af x 40.0% Voids
#2A	70.30'	0.008 af	**ADS_StormTech SC-310 +Cap** x 25 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 25 Chambers in 5 Rows
		0.030 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	69.30'	**0.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	72.50'	**1.2" x 15.5" Horiz. Orifice/Grate X 10.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 8.68 hrs HW=69.33' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.30' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond SIB1: Subsurface Infiltration Bed #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-310 +Cap (ADS StormTech® SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

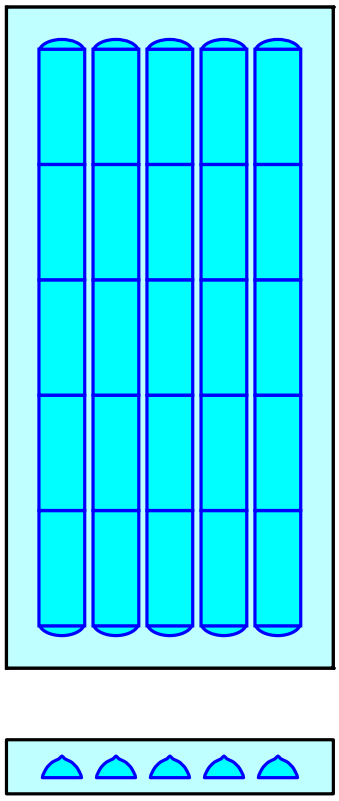
5 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 36.80' Row Length +24.0" End Stone x 2 = 40.80' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 24.0" Side Stone x 2 = 20.17' Base Width
12.0" Base + 16.0" Chamber Height + 12.0" Cover = 3.33' Field Height

25 Chambers x 14.7 cf = 368.5 cf Chamber Storage

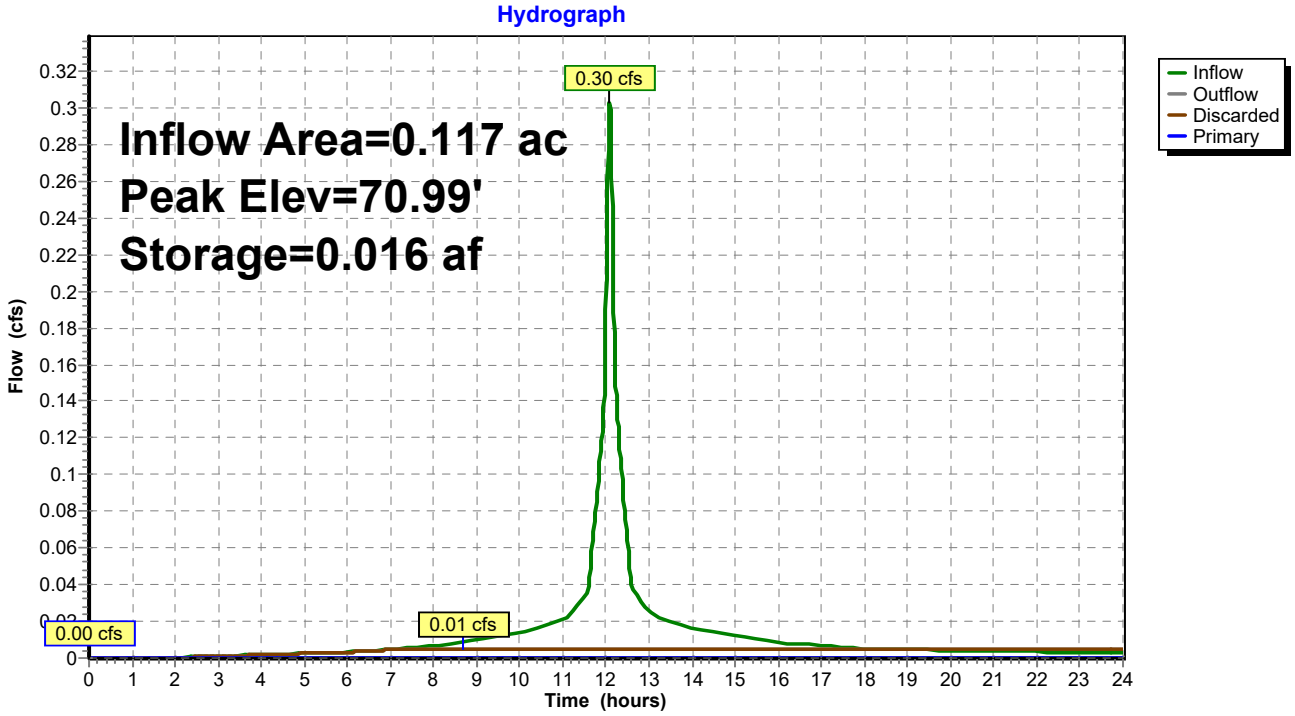
2,742.7 cf Field - 368.5 cf Chambers = 2,374.1 cf Stone x 40.0% Voids = 949.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,318.2 cf = 0.030 af
Overall Storage Efficiency = 48.1%
Overall System Size = 40.80' x 20.17' x 3.33'

25 Chambers
101.6 cy Field
87.9 cy Stone



Pond SIB1: Subsurface Infiltration Bed #1



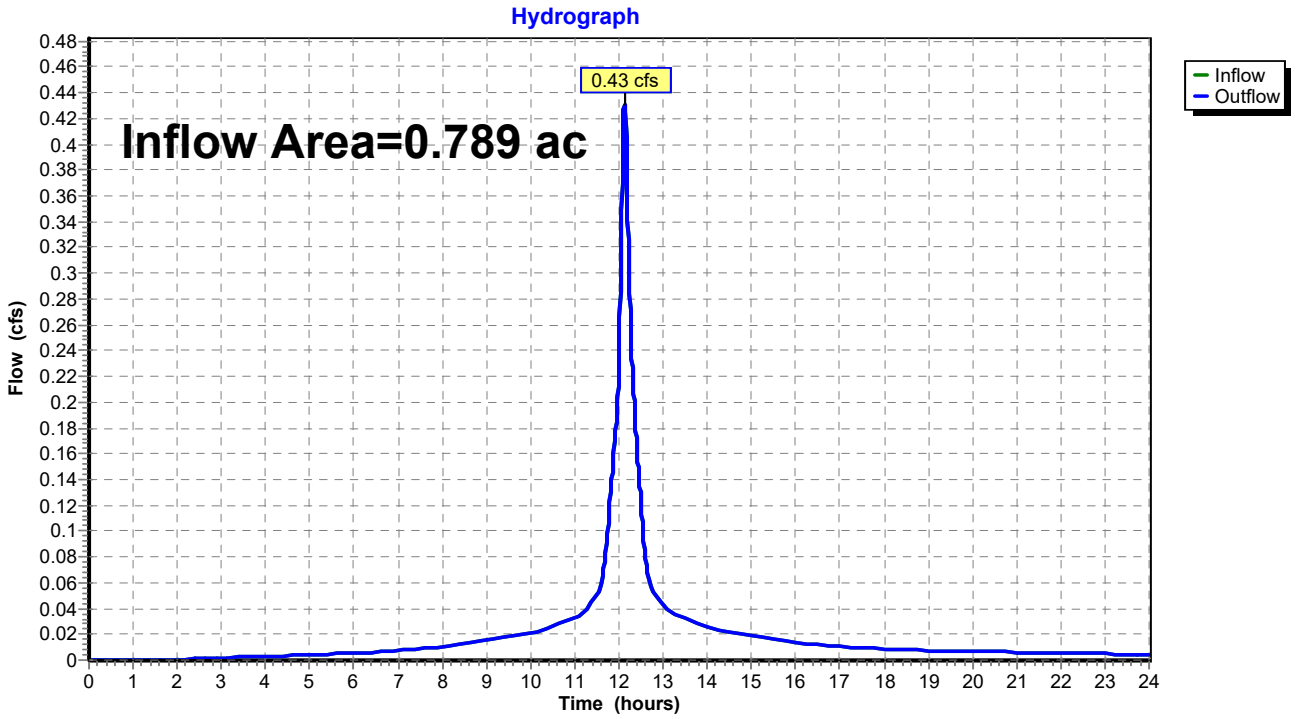
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 38.27% Impervious, Inflow Depth > 0.57" for 1 Year event
Inflow = 0.43 cfs @ 12.12 hrs, Volume= 0.038 af
Outflow = 0.43 cfs @ 12.12 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment N1: Drive & Portion of Building to East Abutter

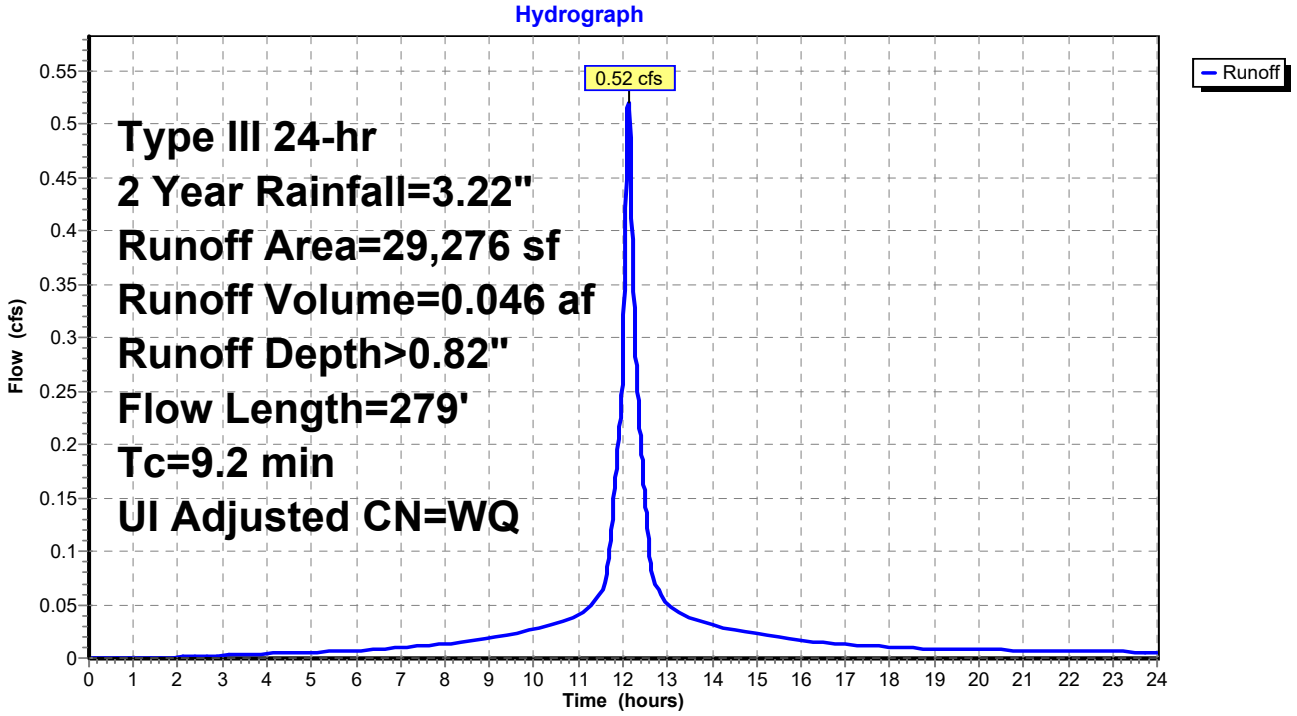
Runoff = 0.52 cfs @ 12.12 hrs, Volume= 0.046 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.22"

Area (sf)	CN	Adj	Description
6,047	98	98	Unconnected pavement, HSG A
2,012	98	98	Roofs, HSG A
21,217	39	39	>75% Grass cover, Good, HSG A
29,276			Weighted Average
21,217			72.47% Pervious Area
8,059			27.53% Impervious Area
6,047			75.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment N1: Drive & Portion of Building to East Abutter



Summary for Subcatchment N1A: Building Addition & Washdown

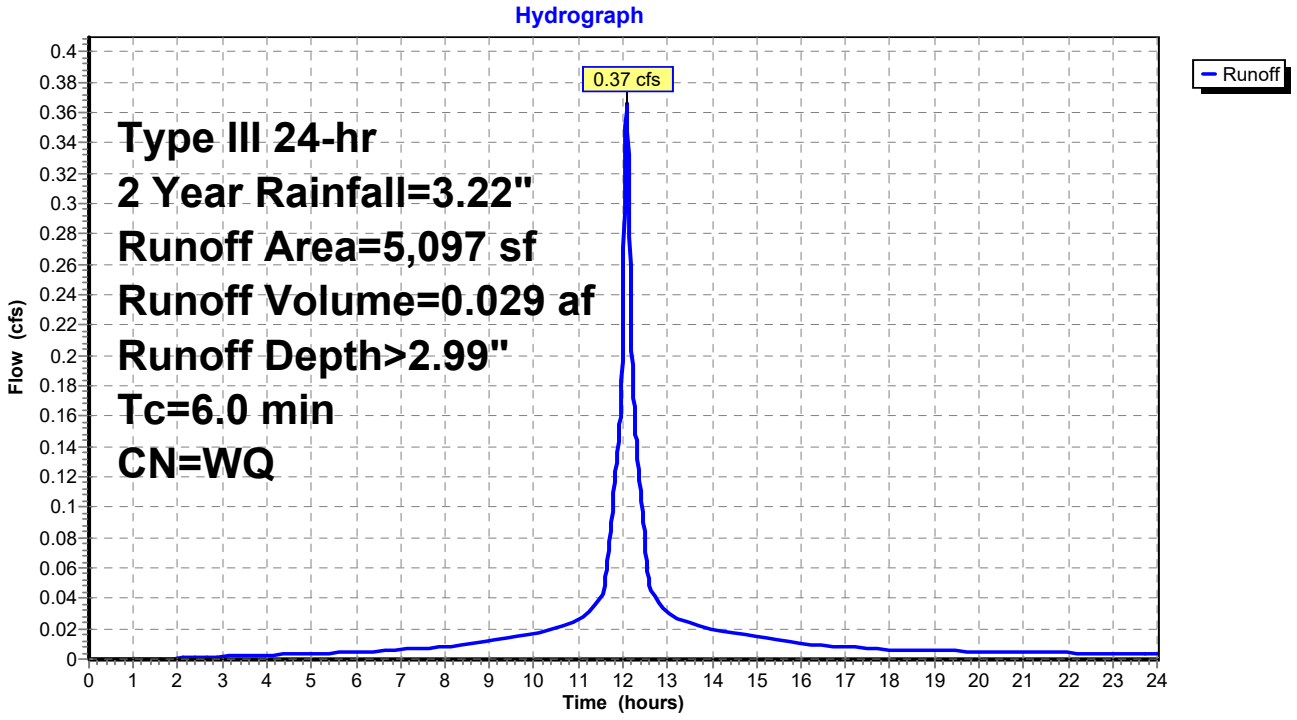
Runoff = 0.37 cfs @ 12.08 hrs, Volume= 0.029 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.22"

Area (sf)	CN	Description
4,976	98	Unconnected roofs, HSG A
121	98	Unconnected pavement, HSG A
5,097		Weighted Average
5,097		100.00% Impervious Area
5,097		100.00% Unconnected

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

Subcatchment N1A: Building Addition & Washdown



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.117 ac,100.00% Impervious, Inflow Depth > 2.99" for 2 Year event
Inflow = 0.37 cfs @ 12.08 hrs, Volume= 0.029 af
Outflow = 0.01 cfs @ 7.95 hrs, Volume= 0.008 af, Atten= 99%, Lag= 0.0 min
Discarded = 0.01 cfs @ 7.95 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 71.43' @ 19.70 hrs Surf.Area= 0.019 ac Storage= 0.021 af
Flood Elev= 72.63' Surf.Area= 0.019 ac Storage= 0.030 af

Plug-Flow detention time= 274.4 min calculated for 0.008 af (29% of inflow)
Center-of-Mass det. time= 85.9 min (841.6 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	69.30'	0.022 af	**20.17'W x 40.80'L x 3.33'H Field A** 0.063 af Overall - 0.008 af Embedded = 0.055 af x 40.0% Voids
#2A	70.30'	0.008 af	**ADS_StormTech SC-310 +Cap** x 25 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 25 Chambers in 5 Rows
		0.030 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	69.30'	**0.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	72.50'	**1.2" x 15.5" Horiz. Orifice/Grate X 10.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 7.95 hrs HW=69.33' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.30' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond SIB1: Subsurface Infiltration Bed #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-310 +Cap (ADS StormTech® SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

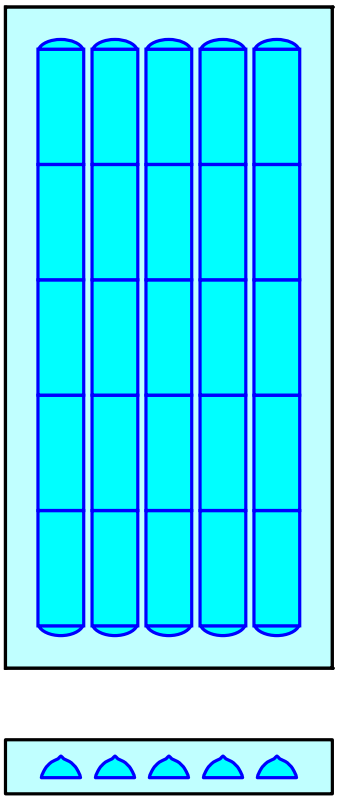
5 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 36.80' Row Length +24.0" End Stone x 2 = 40.80' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 24.0" Side Stone x 2 = 20.17' Base Width
12.0" Base + 16.0" Chamber Height + 12.0" Cover = 3.33' Field Height

25 Chambers x 14.7 cf = 368.5 cf Chamber Storage

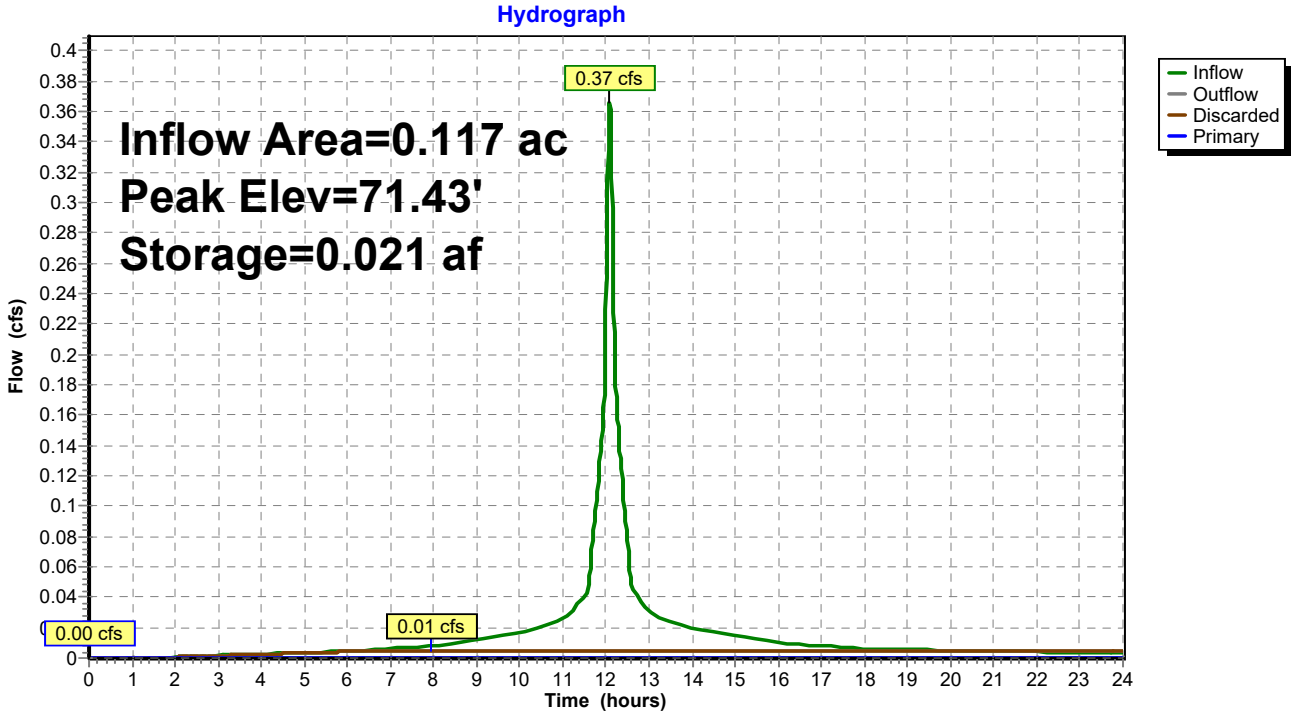
2,742.7 cf Field - 368.5 cf Chambers = 2,374.1 cf Stone x 40.0% Voids = 949.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,318.2 cf = 0.030 af
Overall Storage Efficiency = 48.1%
Overall System Size = 40.80' x 20.17' x 3.33'

25 Chambers
101.6 cy Field
87.9 cy Stone



Pond SIB1: Subsurface Infiltration Bed #1



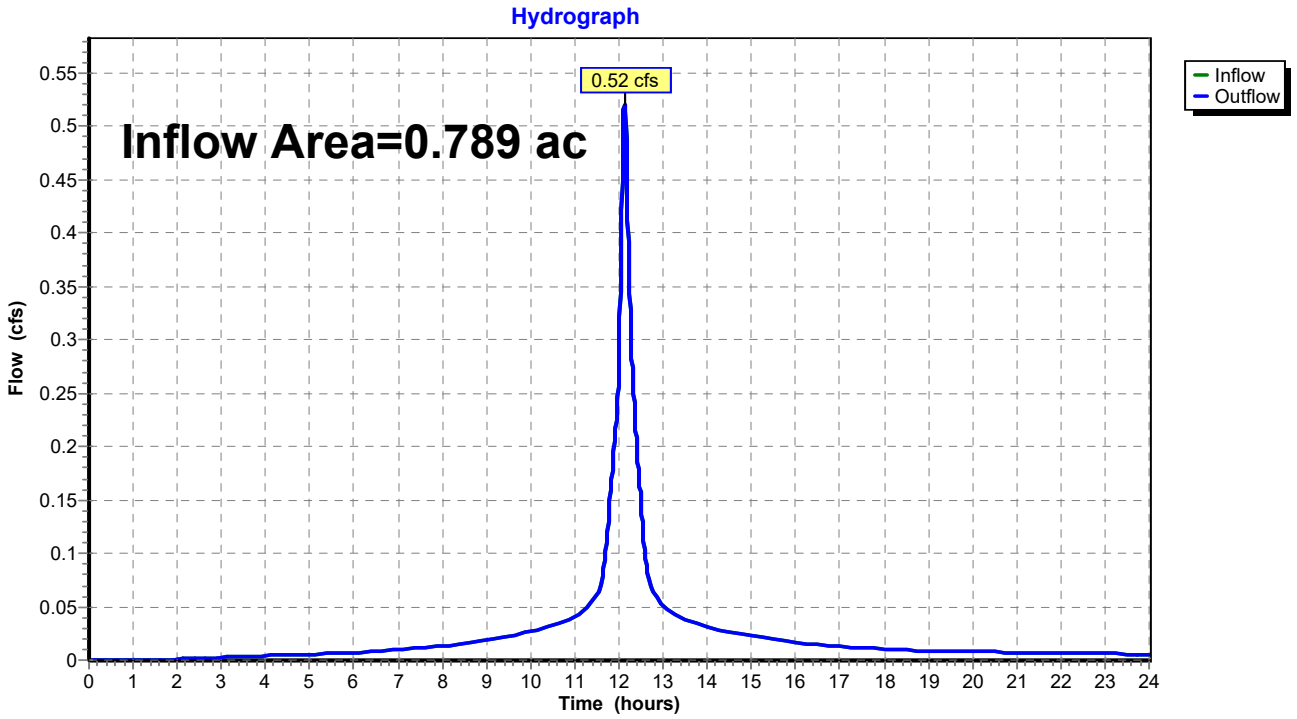
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 38.27% Impervious, Inflow Depth > 0.70" for 2 Year event
Inflow = 0.52 cfs @ 12.12 hrs, Volume= 0.046 af
Outflow = 0.52 cfs @ 12.12 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment N1: Drive & Portion of Building to East Abutter

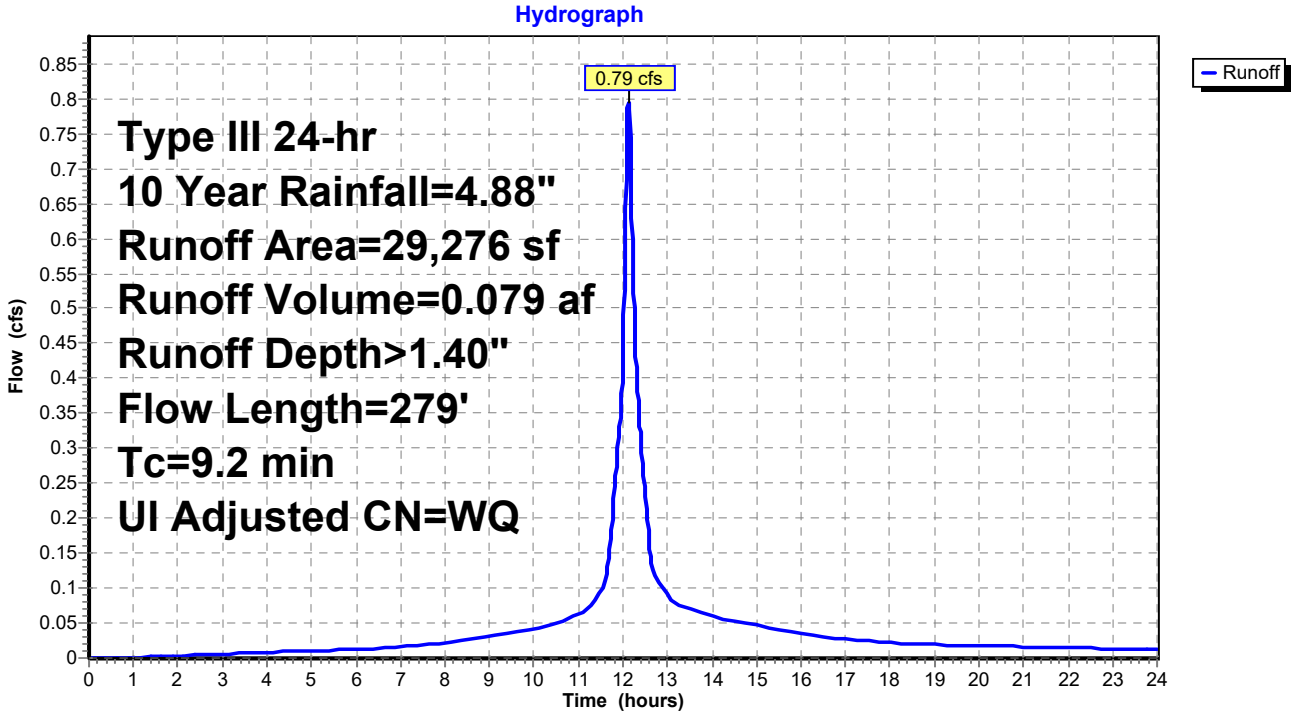
Runoff = 0.79 cfs @ 12.12 hrs, Volume= 0.079 af, Depth> 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.88"

Area (sf)	CN	Adj	Description
6,047	98	98	Unconnected pavement, HSG A
2,012	98	98	Roofs, HSG A
21,217	39	39	>75% Grass cover, Good, HSG A
29,276			Weighted Average
21,217			72.47% Pervious Area
8,059			27.53% Impervious Area
6,047			75.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment N1: Drive & Portion of Building to East Abutter



Summary for Subcatchment N1A: Building Addition & Washdown

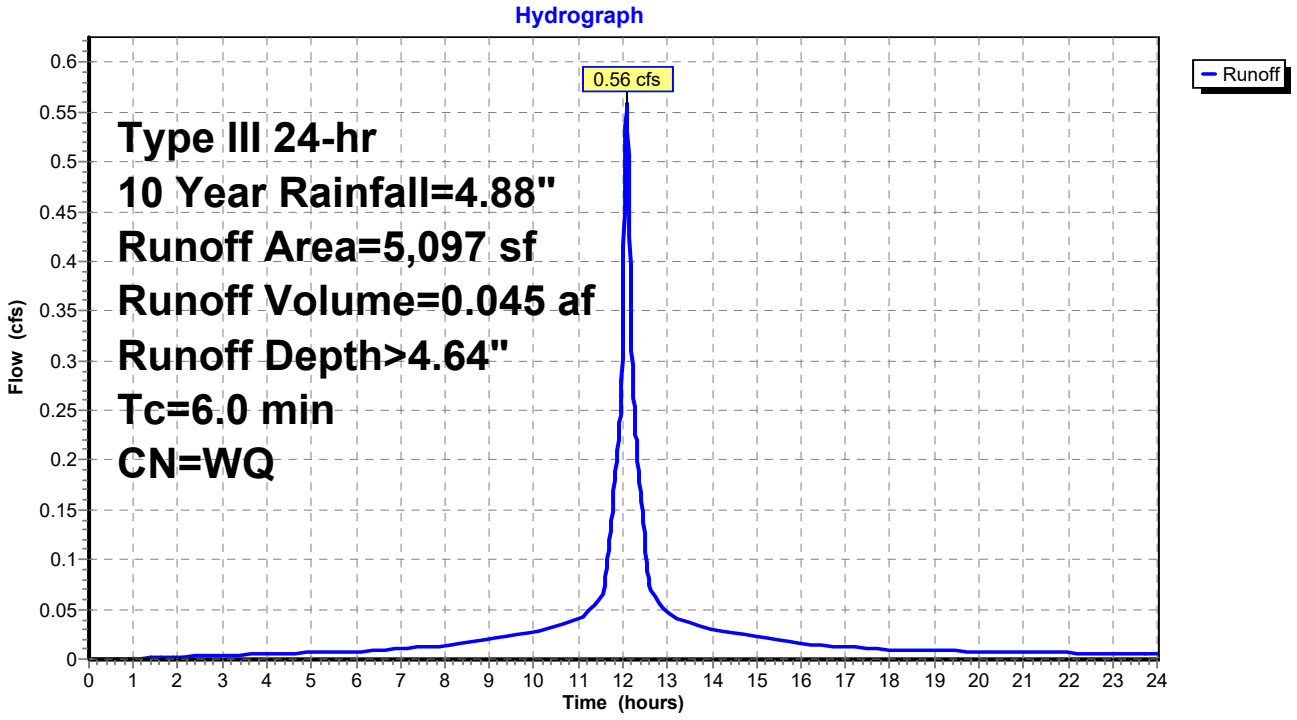
Runoff = 0.56 cfs @ 12.08 hrs, Volume= 0.045 af, Depth> 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.88"

Area (sf)	CN	Description
4,976	98	Unconnected roofs, HSG A
121	98	Unconnected pavement, HSG A
5,097		Weighted Average
5,097		100.00% Impervious Area
5,097		100.00% Unconnected

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

Subcatchment N1A: Building Addition & Washdown



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.117 ac,100.00% Impervious, Inflow Depth > 4.64" for 10 Year event
Inflow = 0.56 cfs @ 12.08 hrs, Volume= 0.045 af
Outflow = 0.04 cfs @ 13.27 hrs, Volume= 0.016 af, Atten= 93%, Lag= 70.9 min
Discarded = 0.01 cfs @ 5.84 hrs, Volume= 0.009 af
Primary = 0.03 cfs @ 13.27 hrs, Volume= 0.007 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 72.51' @ 13.27 hrs Surf.Area= 0.019 ac Storage= 0.029 af
Flood Elev= 72.63' Surf.Area= 0.019 ac Storage= 0.030 af

Plug-Flow detention time= 276.7 min calculated for 0.016 af (35% of inflow)
Center-of-Mass det. time= 105.3 min (853.2 - 747.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	69.30'	0.022 af	**20.17'W x 40.80'L x 3.33'H Field A** 0.063 af Overall - 0.008 af Embedded = 0.055 af x 40.0% Voids
#2A	70.30'	0.008 af	**ADS_StormTech SC-310 +Cap** x 25 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 25 Chambers in 5 Rows
		0.030 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	69.30'	**0.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	72.50'	**1.2" x 15.5" Horiz. Orifice/Grate X 10.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 5.84 hrs HW=69.33' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.03 cfs @ 13.27 hrs HW=72.51' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 0.03 cfs @ 0.24 fps)

Pond SIB1: Subsurface Infiltration Bed #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-310 +Cap (ADS StormTech® SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

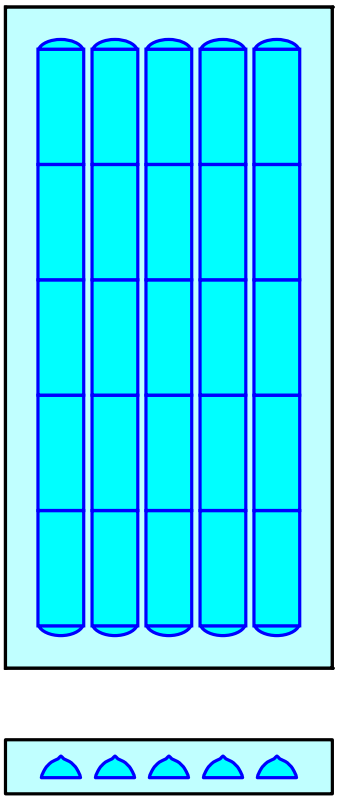
5 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 36.80' Row Length +24.0" End Stone x 2 = 40.80' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 24.0" Side Stone x 2 = 20.17' Base Width
12.0" Base + 16.0" Chamber Height + 12.0" Cover = 3.33' Field Height

25 Chambers x 14.7 cf = 368.5 cf Chamber Storage

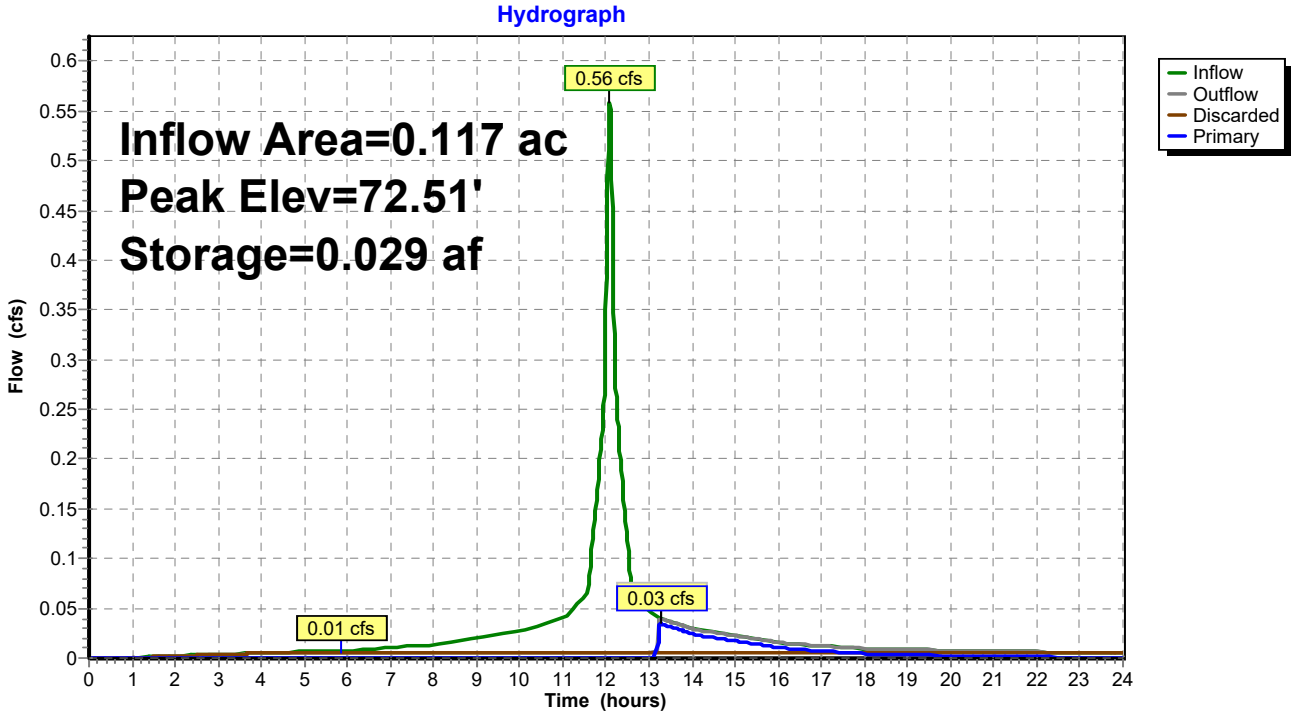
2,742.7 cf Field - 368.5 cf Chambers = 2,374.1 cf Stone x 40.0% Voids = 949.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,318.2 cf = 0.030 af
Overall Storage Efficiency = 48.1%
Overall System Size = 40.80' x 20.17' x 3.33'

25 Chambers
101.6 cy Field
87.9 cy Stone



Pond SIB1: Subsurface Infiltration Bed #1



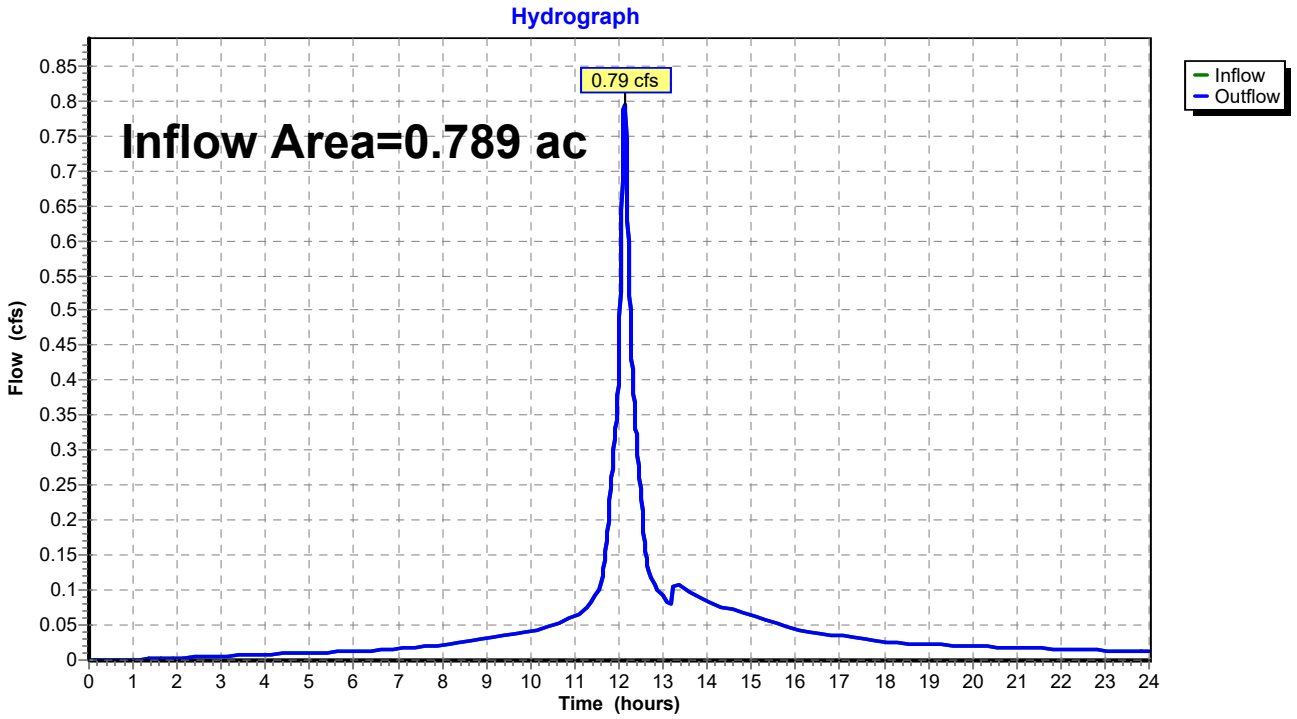
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 38.27% Impervious, Inflow Depth > 1.30" for 10 Year event
Inflow = 0.79 cfs @ 12.12 hrs, Volume= 0.085 af
Outflow = 0.79 cfs @ 12.12 hrs, Volume= 0.085 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment N1: Drive & Portion of Building to East Abutter

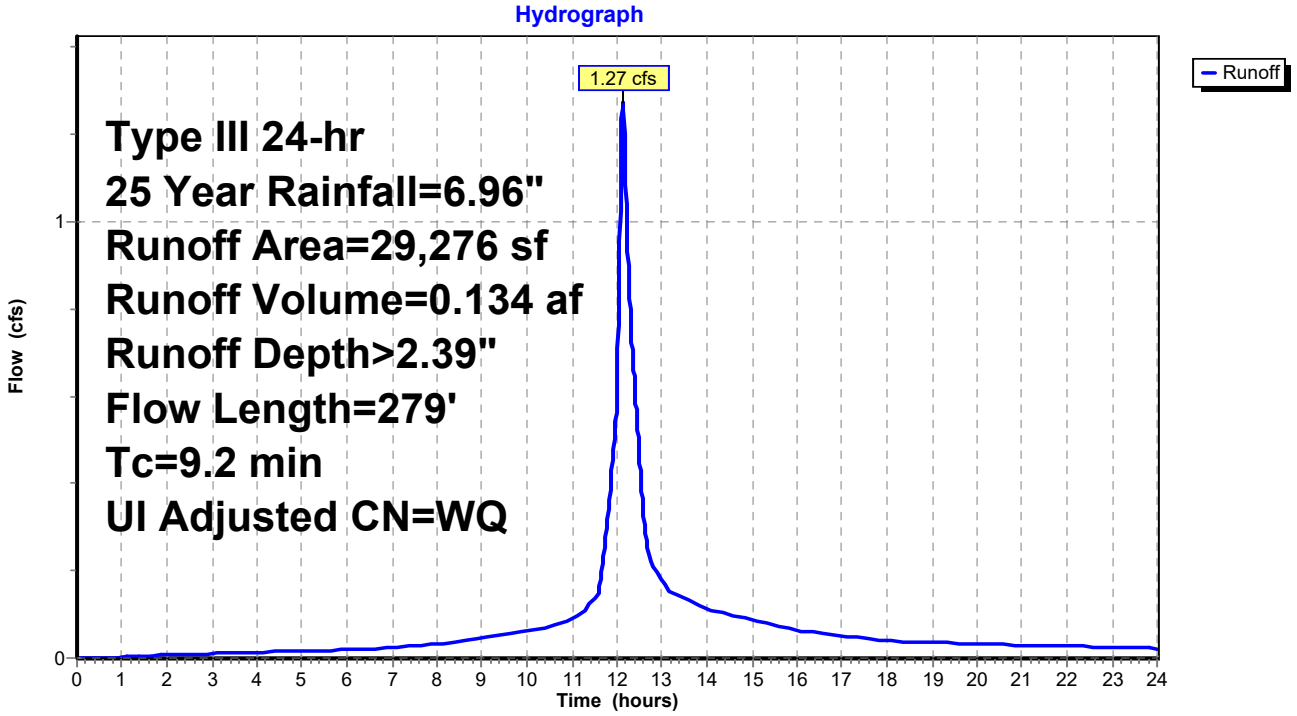
Runoff = 1.27 cfs @ 12.13 hrs, Volume= 0.134 af, Depth> 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.96"

Area (sf)	CN	Adj	Description
6,047	98	98	Unconnected pavement, HSG A
2,012	98	98	Roofs, HSG A
21,217	39	39	>75% Grass cover, Good, HSG A
29,276			Weighted Average
21,217			72.47% Pervious Area
8,059			27.53% Impervious Area
6,047			75.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment N1: Drive & Portion of Building to East Abutter



Summary for Subcatchment N1A: Building Addition & Washdown

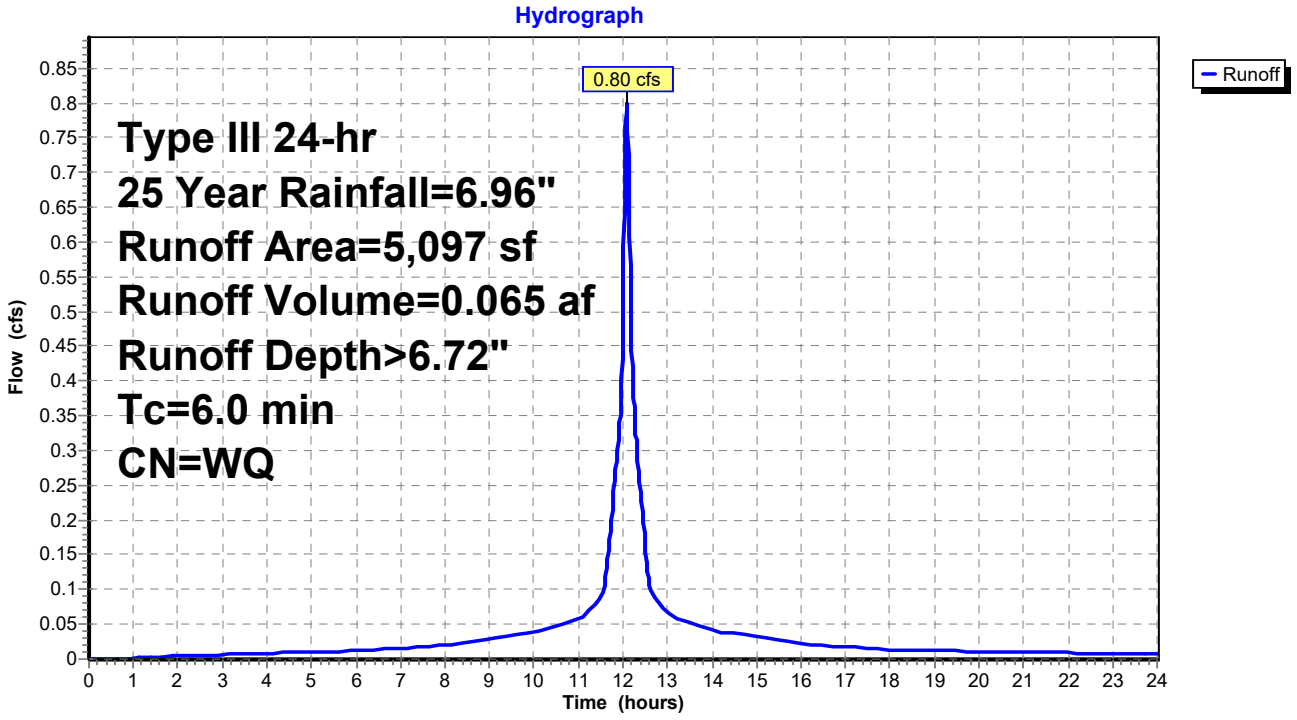
Runoff = 0.80 cfs @ 12.08 hrs, Volume= 0.065 af, Depth> 6.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.96"

Area (sf)	CN	Description
4,976	98	Unconnected roofs, HSG A
121	98	Unconnected pavement, HSG A
5,097		Weighted Average
5,097		100.00% Impervious Area
5,097		100.00% Unconnected

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

Subcatchment N1A: Building Addition & Washdown



Summary for Pond SIB1: Subsurface Infiltration Bed #1

[90] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.117 ac,100.00% Impervious, Inflow Depth > 6.72" for 25 Year event
Inflow = 0.80 cfs @ 12.08 hrs, Volume= 0.065 af
Outflow = 0.83 cfs @ 12.07 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.83 cfs @ 12.07 hrs, Volume= 0.036 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 72.54' @ 12.07 hrs Surf.Area= 0.019 ac Storage= 0.030 af
Flood Elev= 72.63' Surf.Area= 0.019 ac Storage= 0.030 af

Plug-Flow detention time= 239.1 min calculated for 0.036 af (55% of inflow)
Center-of-Mass det. time= 118.3 min (860.8 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	69.30'	0.022 af	**20.17'W x 40.80'L x 3.33'H Field A** 0.063 af Overall - 0.008 af Embedded = 0.055 af x 40.0% Voids
#2A	70.30'	0.008 af	**ADS_StormTech SC-310 +Cap** x 25 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 25 Chambers in 5 Rows
		0.030 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	69.30'	**0.270 in/hr Exfiltration X 0.00 over Surface area** Phase-In= 0.01'
#2	Primary	72.50'	**1.2" x 15.5" Horiz. Orifice/Grate X 10.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.30' (Free Discharge)
↑**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.83 cfs @ 12.07 hrs HW=72.54' TW=0.00' (Dynamic Tailwater)
↑**2=Orifice/Grate** (Weir Controls 0.83 cfs @ 0.68 fps)

Pond SIB1: Subsurface Infiltration Bed #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-310 +Cap (ADS StormTech® SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

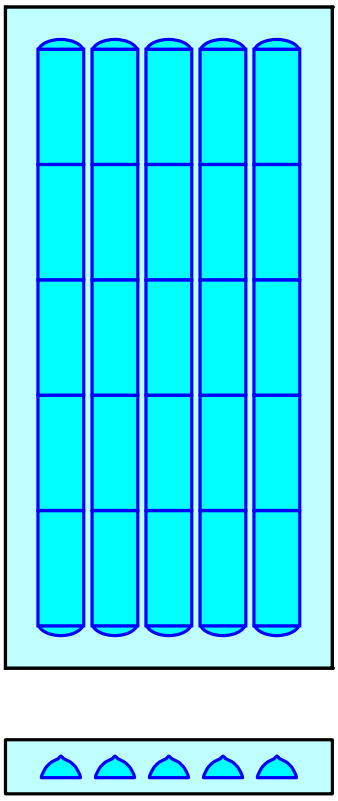
5 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 36.80' Row Length +24.0" End Stone x 2 = 40.80' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 24.0" Side Stone x 2 = 20.17' Base Width
12.0" Base + 16.0" Chamber Height + 12.0" Cover = 3.33' Field Height

25 Chambers x 14.7 cf = 368.5 cf Chamber Storage

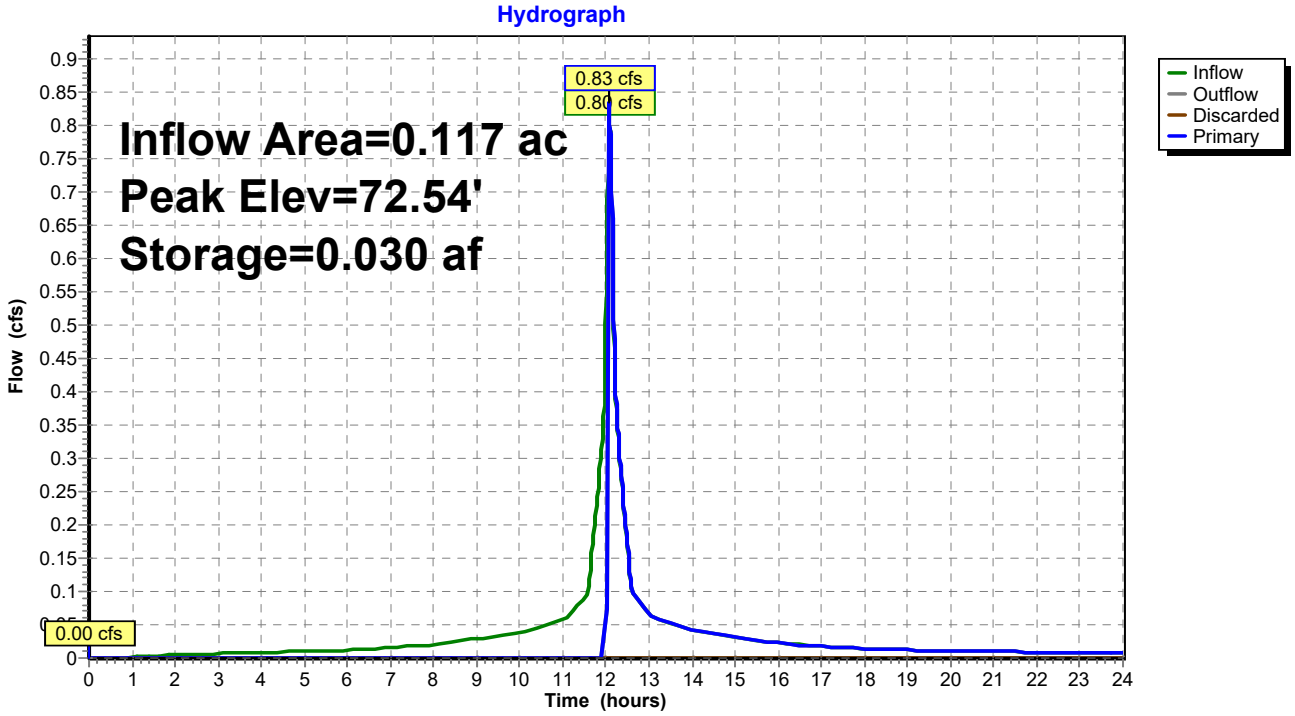
2,742.7 cf Field - 368.5 cf Chambers = 2,374.1 cf Stone x 40.0% Voids = 949.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,318.2 cf = 0.030 af
Overall Storage Efficiency = 48.1%
Overall System Size = 40.80' x 20.17' x 3.33'

25 Chambers
101.6 cy Field
87.9 cy Stone



Pond SIB1: Subsurface Infiltration Bed #1



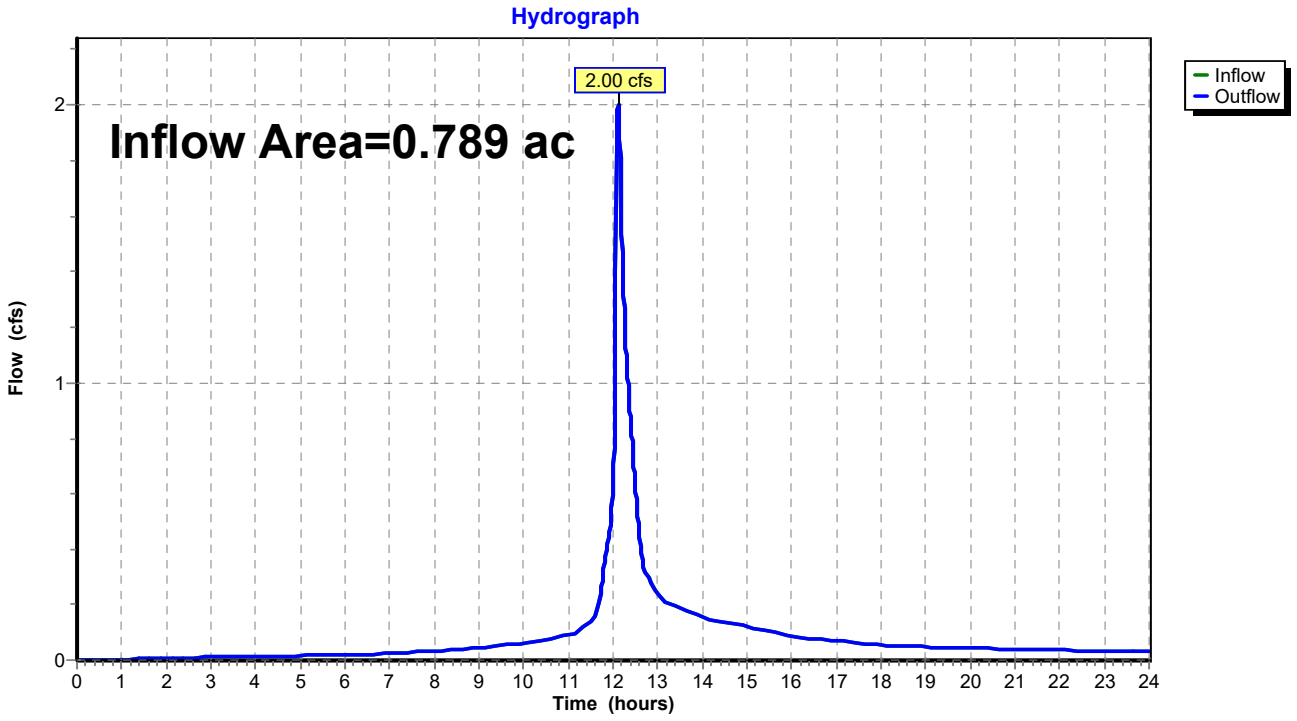
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 38.27% Impervious, Inflow Depth > 2.59" for 25 Year event
Inflow = 2.00 cfs @ 12.11 hrs, Volume= 0.170 af
Outflow = 2.00 cfs @ 12.11 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



Summary for Subcatchment N1: Drive & Portion of Building to East Abutter

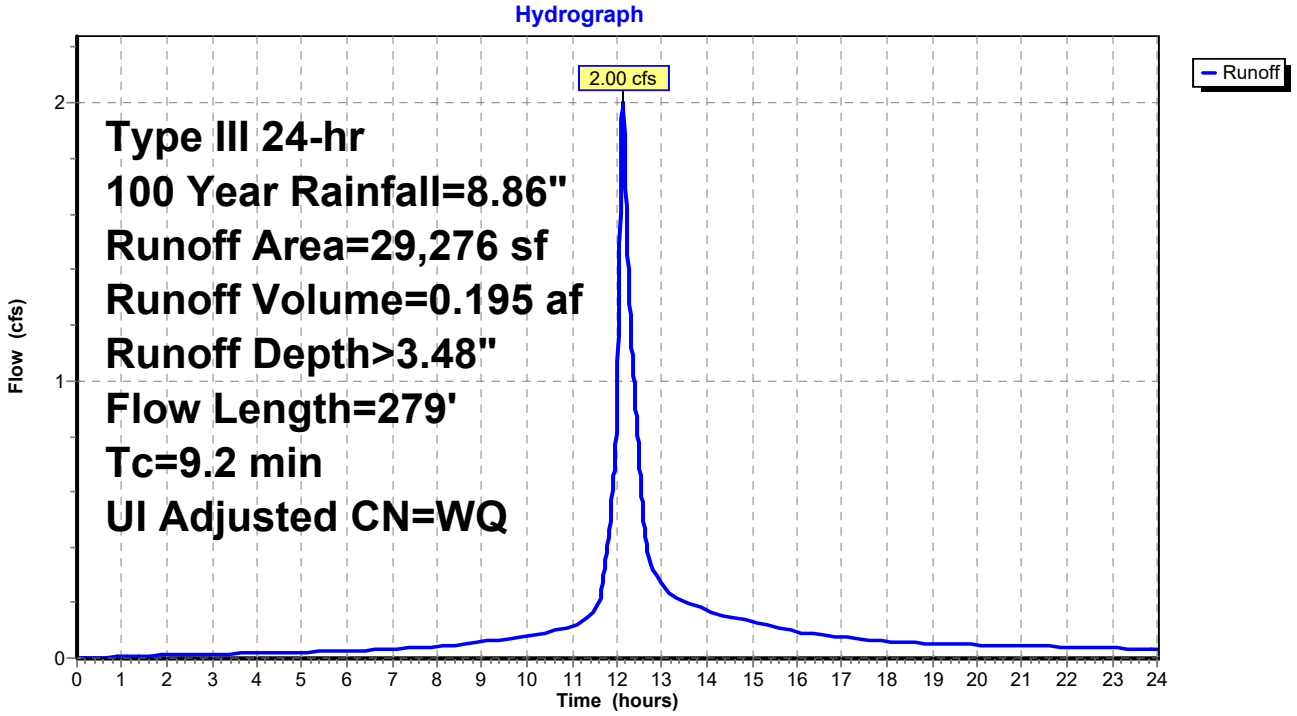
Runoff = 2.00 cfs @ 12.13 hrs, Volume= 0.195 af, Depth> 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.86"

Area (sf)	CN	Adj	Description
6,047	98	98	Unconnected pavement, HSG A
2,012	98	98	Roofs, HSG A
21,217	39	39	>75% Grass cover, Good, HSG A
29,276			Weighted Average
21,217			72.47% Pervious Area
8,059			27.53% Impervious Area
6,047			75.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0177	0.10		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.22"
0.1	37	0.4240	10.48		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.1	50	0.2000	9.08		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.4	142	0.1090	5.32		**Shallow Concentrated Flow, D to E** Unpaved Kv= 16.1 fps
9.2	279	Total			

Subcatchment N1: Drive & Portion of Building to East Abutter



Summary for Subcatchment N1A: Building Addition & Washdown

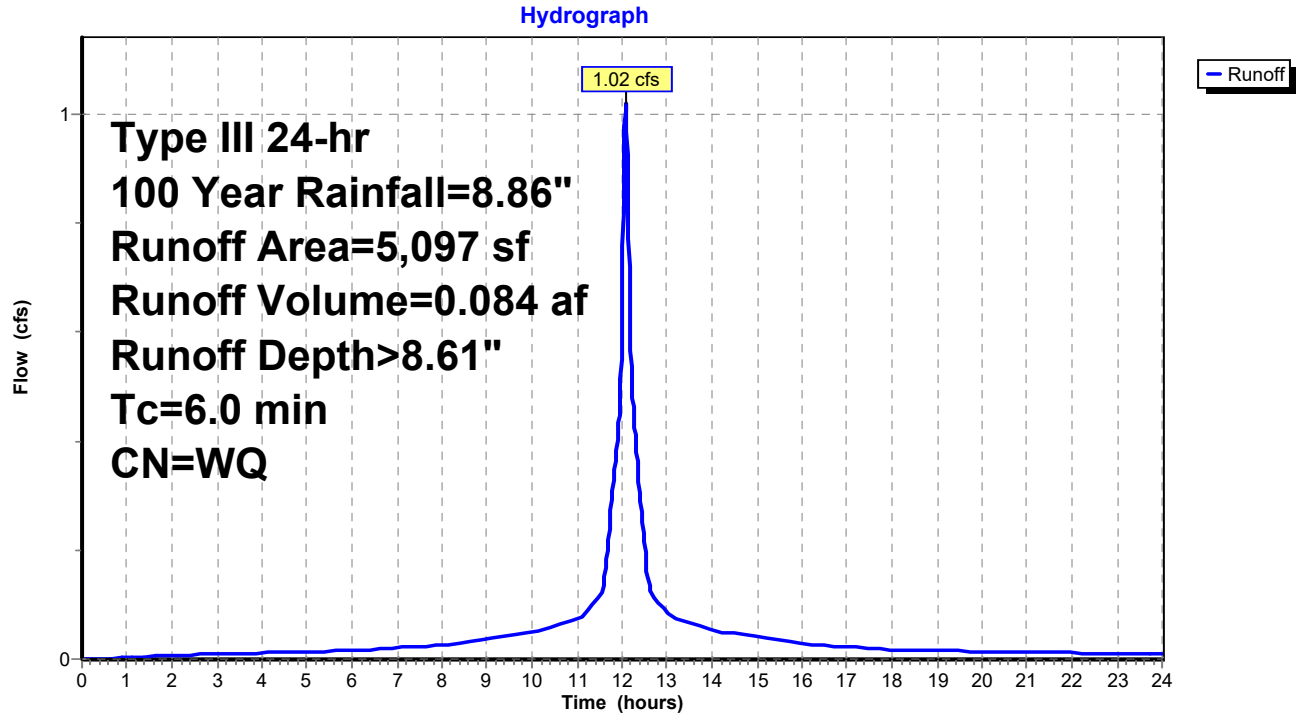
Runoff = 1.02 cfs @ 12.08 hrs, Volume= 0.084 af, Depth> 8.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.86"

Area (sf)	CN	Description
4,976	98	Unconnected roofs, HSG A
121	98	Unconnected pavement, HSG A
5,097		Weighted Average
5,097		100.00% Impervious Area
5,097		100.00% Unconnected

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

Subcatchment N1A: Building Addition & Washdown



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.117 ac,100.00% Impervious, Inflow Depth > 8.61" for 100 Year event
Inflow = 1.02 cfs @ 12.08 hrs, Volume= 0.084 af
Outflow = 1.02 cfs @ 12.09 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.2 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 1.02 cfs @ 12.09 hrs, Volume= 0.055 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 72.55' @ 12.09 hrs Surf.Area= 0.019 ac Storage= 0.030 af
Flood Elev= 72.63' Surf.Area= 0.019 ac Storage= 0.030 af

Plug-Flow detention time= 203.2 min calculated for 0.055 af (65% of inflow)
Center-of-Mass det. time= 99.0 min (838.5 - 739.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	69.30'	0.022 af	**20.17'W x 40.80'L x 3.33'H Field A** 0.063 af Overall - 0.008 af Embedded = 0.055 af x 40.0% Voids
#2A	70.30'	0.008 af	**ADS_StormTech SC-310 +Cap** x 25 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 25 Chambers in 5 Rows
		0.030 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	69.30'	**0.270 in/hr Exfiltration X 0.00 over Surface area** Phase-In= 0.01'
#2	Primary	72.50'	**1.2" x 15.5" Horiz. Orifice/Grate X 10.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=69.30' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=1.02 cfs @ 12.09 hrs HW=72.55' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 1.02 cfs @ 0.73 fps)

Pond SIB1: Subsurface Infiltration Bed #1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-310 +Cap (ADS StormTech® SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

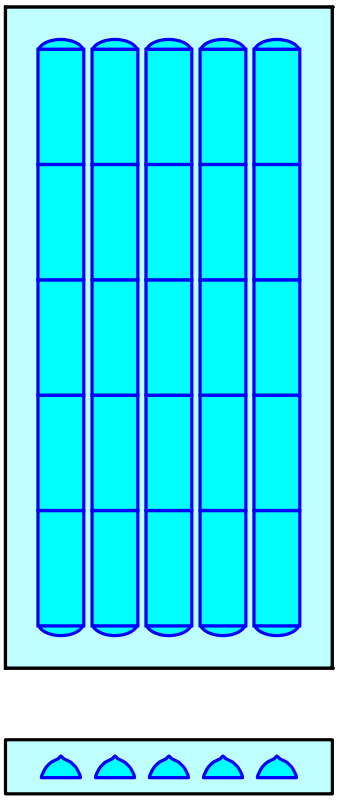
5 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 36.80' Row Length +24.0" End Stone x 2 = 40.80' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 24.0" Side Stone x 2 = 20.17' Base Width
12.0" Base + 16.0" Chamber Height + 12.0" Cover = 3.33' Field Height

25 Chambers x 14.7 cf = 368.5 cf Chamber Storage

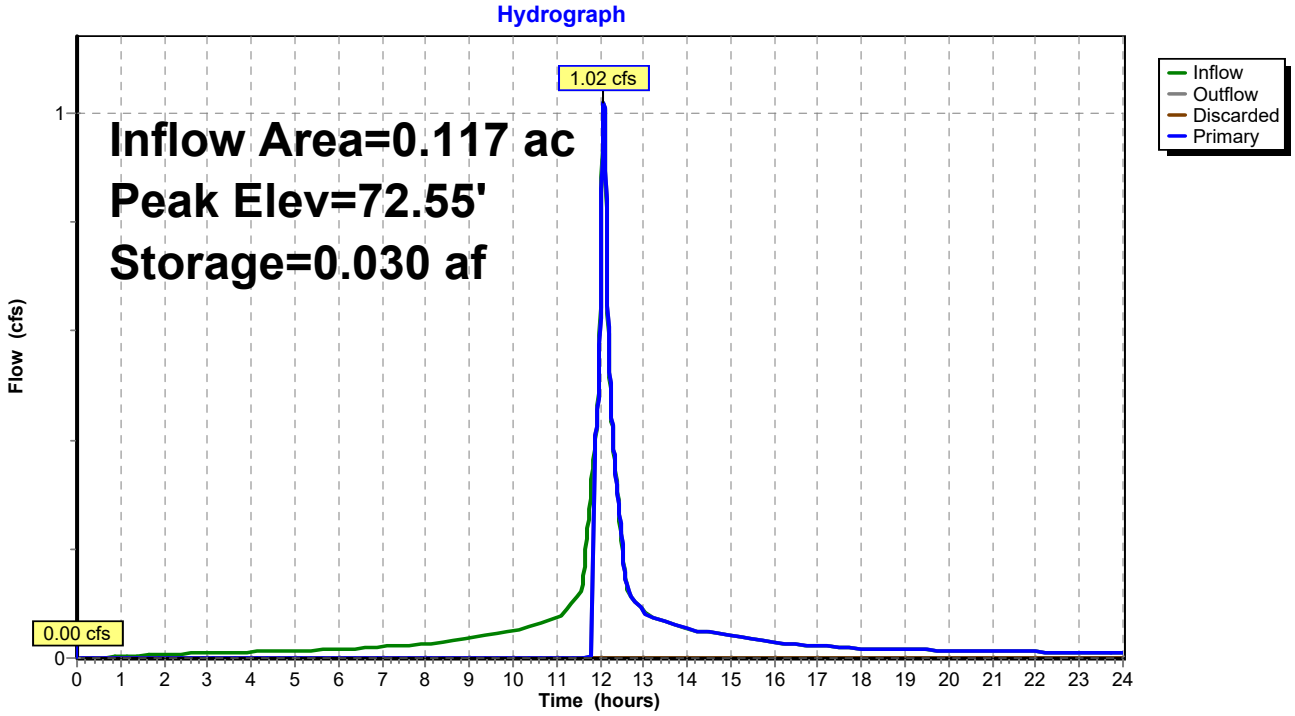
2,742.7 cf Field - 368.5 cf Chambers = 2,374.1 cf Stone x 40.0% Voids = 949.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,318.2 cf = 0.030 af
Overall Storage Efficiency = 48.1%
Overall System Size = 40.80' x 20.17' x 3.33'

25 Chambers
101.6 cy Field
87.9 cy Stone



Pond SIB1: Subsurface Infiltration Bed #1



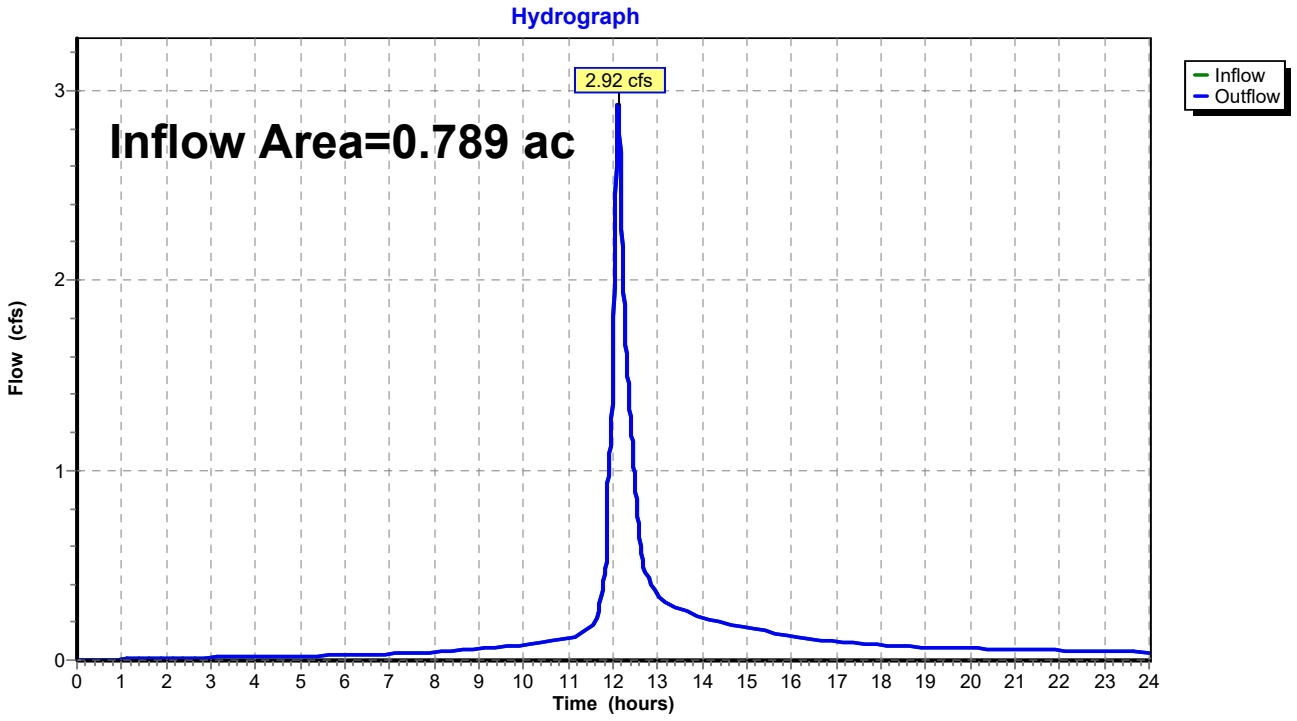
Summary for Reach DP1: Design Point

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.789 ac, 38.27% Impervious, Inflow Depth > 3.80" for 100 Year event
Inflow = 2.92 cfs @ 12.12 hrs, Volume= 0.250 af
Outflow = 2.92 cfs @ 12.12 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min

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

Reach DP1: Design Point



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Consulting Engineers Inc.

Project: Newton Commonwealth Golf Course
Location: Newton, MA

Attached Figures

- Figure 1: Quadrangle Map
- Figure 2: FEMA Flood Insurance Rate Map
- Figure 3: Water Supply Protection Areas Map
- Figure 4: Natural Resources Conservation Service Soil Map

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Figure 1

USGS Topographic Map

Newton Quad 1983
Newton, Massachusetts
Source: MassGIS Oliver

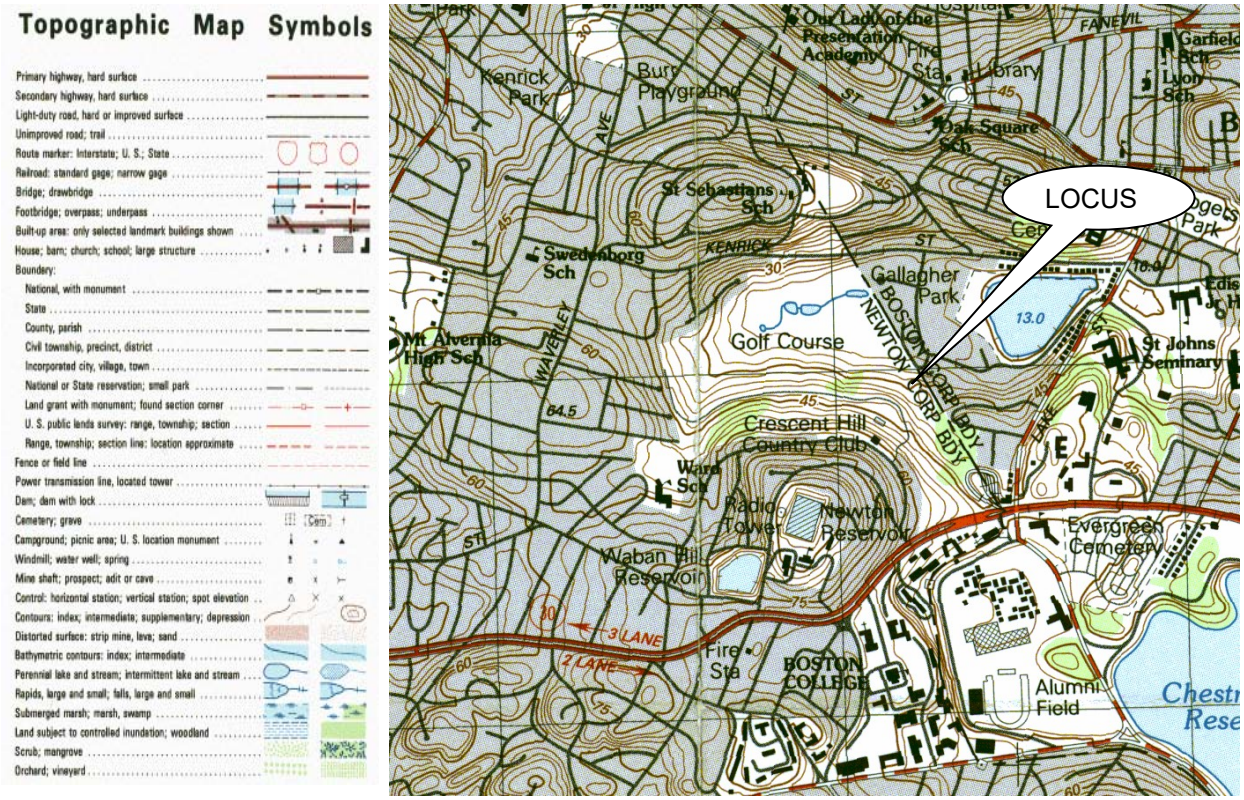

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Figure 2

Flood Insurance Rate Map
City of Newton, MA
Middlesex County
Community Panel Number: 250208 0558 E **Effective Date: June 4, 2010**

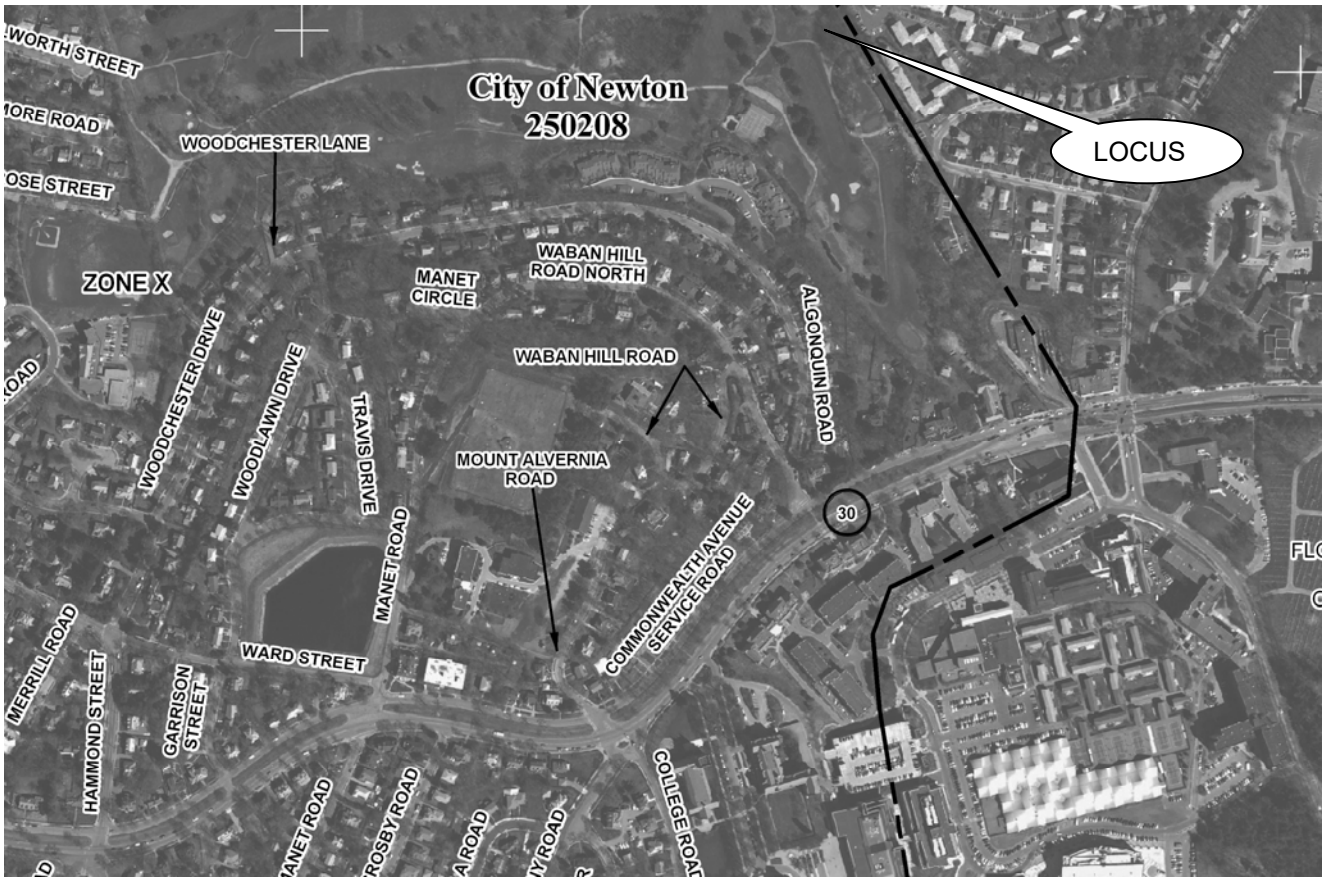

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Figure 3

Water Supply Protection Areas Map
Newton, MA
Source: Mass GIS

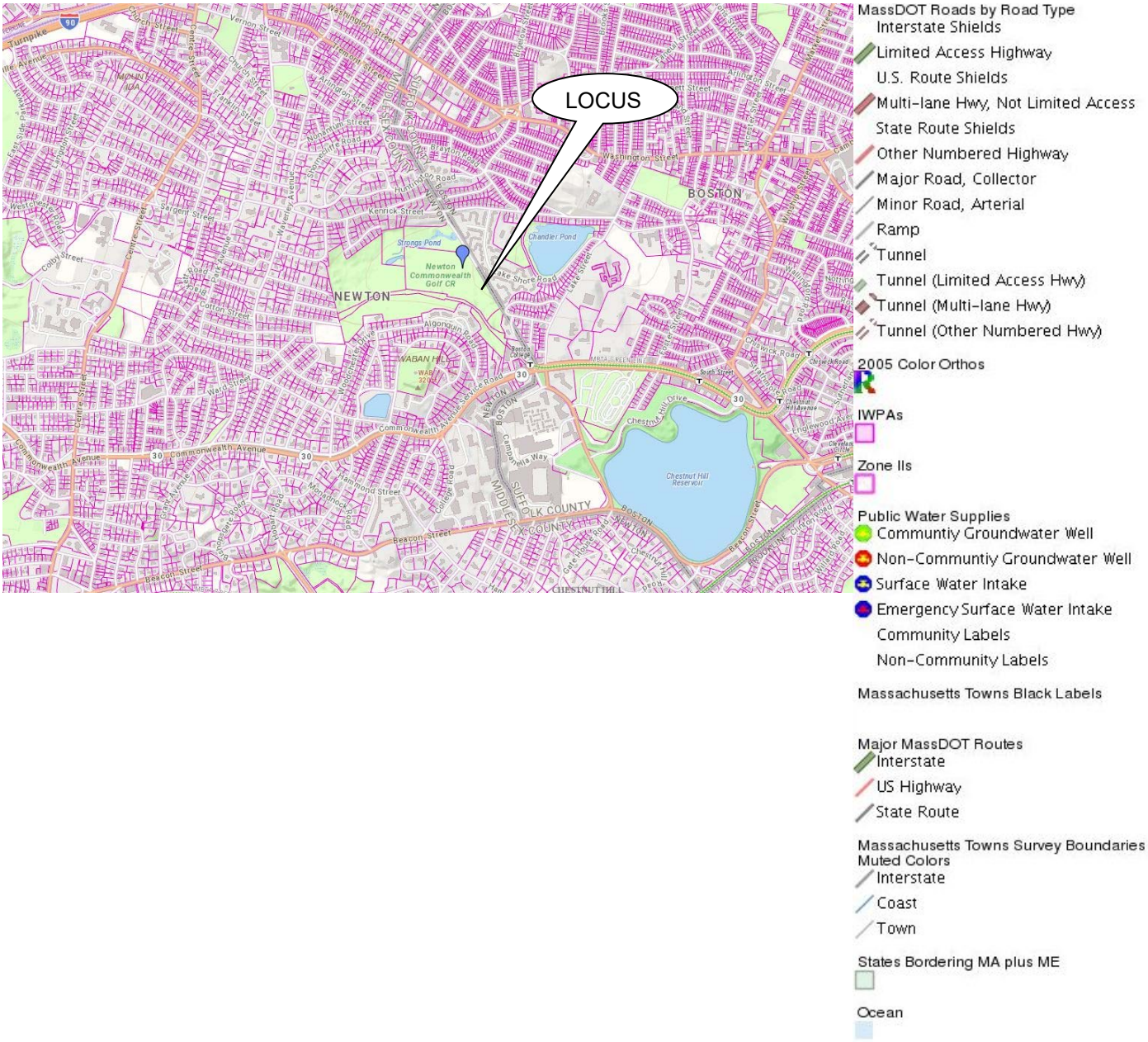

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Figure 4

Natural Resources Conservation Service Soil Ma **Effective Date: June 9, 2020 & June 11, 2020**

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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 20, Jun 9, 2020

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Sep 25, 2020—Oct 4, 2020

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FAX 508-998-0883
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Soil Map—Middlesex County, Massachusetts, and Norfolk and Suffolk Counties, Massachusetts

MAP LEGEND

MAP INFORMATION

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.

Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

TEL 508-998-5700 FAX 508-998-0883 email: info@g-g-d.com

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71B HSG 'D'	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	2.6	6.9%
325D HSG 'D'	Newport channery fine sandy loam, 8 to 25 percent slopes	13.3	35.3%
345B HSG 'D'	Pittstown silt loam, 3 to 8 percent slopes	5.0	13.1%
627C HSG 'D'	Newport-Urban land complex, 3 to 15 percent slopes	6.1	16.1%
629C HSG 'A'	Canton-Charlton-Urban land complex, 3 to 15 percent slopes	4.6	12.2%
655 HSG 'C' @ SIB1	Udorthents, wet substratum	2.4	6.4%
Subtotals for Soil Survey Area		**34.0**	**89.9%**
Totals for Area of Interest		**37.8**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
628C HSG 'A'	Canton-Urban land complex, 3 to 15 percent slopes	2.9	7.7%
655	Udorthents, wet substratum	0.9	2.4%
Subtotals for Soil Survey Area		**3.8**	**10.1%**
Totals for Area of Interest		**37.8**	**100.0%**