STORMWATER REPORT

for

PARKING IMPROVEMENTS

DUDLEY HOUSING AUTHORITY, JOSHUA PLACE-667-1

22 Joshua Place
Dudley, MA 01571

Prepared for:

Dudley Housing Authority
22 Joshua Place
Dudley, MA 01571

Date:

October 11, 2023

Prepared By:

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NARRATIVE

Project Description

Site Location: Parking Improvements
Dudley Housing Authority
22 Joshua Place, Dudley, MA

Development Type: Elderly Housing, Multi-Family Residential

Project Summary:

The proposed project consists of full-depth reclamation and repaving of an existing parking lot, and the installation of additional parking spaces and related stormwater improvements on a developed site.

A drainage and stormwater management system will treat and attenuate runoff from the project in full compliance with MassDEP Stormwater Management Standards.

Existing Site Conditions

Location: The project site is located at 22 Joshua Place.

Ground Cover: The ground cover in the drainage study area is a mix of impervious, lawn, and woods.

Slopes: The portion of the site in the existing parking lot which is outside of the drainage study area generally slopes from south to north towards a catch basin at the end of the driveway. The drainage area of the site drains from south to north towards abutters 191 West Main Dudley, LLC and Gentex Optics, Inc.

Soil Types: Site soil types as mapped by the USDA-NRCS are Paxton fine sandy loam and Scituate fine sandy loam (map unit symbols 307B and 315B respectively). These soils are classified as hydrologic soil group (HSG) “C”. Refer to Appendix D for more detailed USDA-NRCS soil information and to the site plans for onsite soil testing logs.

HYDROLOGY CALCULATIONS

Methodology

Peak rate of runoff flows were calculated using SCS TR-20 and TR-55 methodology as implemented by the HydroCAD Stormwater Modeling System computer program. The 2, 10, 25, and 100-year storm events were analyzed with the HydroCAD program using site-specific NRCC rainfall frequency data as follows:

Rainfall Amounts (inches) by Frequency (NRCC)			
2 Year	**10 Year**	**25 Year**	**100 Year**
3.19	4.73	5.92	8.35

Pre-Development

The total pre-development drainage area studied in this report consists of approximately 6.755 sq.ft. The pre-development hydrology has been modeled as one subcatchment that drains to a single discharge point (design point).

Design Point #1: This design point represents runoff from the proposed parking spaces to the northern portion of the property.

Refer to Appendix B for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Pre-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 (North)	0.17	0.36	0.52	0.86

Post-Development

The total post-development drainage area is the same total area as the pre-development and is broken into two subcatchments that ultimately drain to the same design point.

Refer to Appendix C for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Post-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 (North)	0.12	0.36	0.52	0.83

The total net change in peak rate of runoff from pre-development to post-development at the design point for each storm is as follows:

Comparison of Pre- vs. Post-Development Peak Rate of Runoff (cfs) Net Change				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 (North)	-0.05	0.00	0.00	-0.03

STORMWATER MANAGEMENT

To demonstrate compliance with MassDEP Stormwater Management, we offer the following in response to each of the 10 Standards.

Drain Outfall Riprap Sizing Calculations (Stormwater Management Standard 1)

There are two drain outfalls that requires the design of a riprap apron. We have utilized the Connecticut Guidelines for Soil and Erosion Control outfall protection design criteria as our experience has found this to be a conservative design method that results in a stable outfall structures and good velocity dissipation. The calculations are as follows:

L= {1.7Q/D^1.5} + 8D where, L=length of the riprap apron (ft.)
Q =anticipated design flow (25-year storm flow in this case) (ft^3/s)
D=diameter of outlet pipe (ft.)

W= 3D + L where, W=width of riprap apron at end of apron

Proposed Infiltration Basin Outfall (6" Culvert)
Q_{25}=0.17 cfs (from HydroCAD)
D= 0.5' (6")

L = {(1.7)(0.17) / (0.5)^1.5} + (8)(0.5) = 4.82 feet

W= (3)(0.5) + 4.82 = 6.32 feet

Peak Rate Attenuation (Stormwater Management Standard 2)

Runoff is attenuated for the 2, 10, 25 and 100-year storm events.

Recharge to Groundwater (Stormwater Management Standard 3)

USDA-NRCS soil survey indicates site soils in area of proposed impervious are hydrologic group C soils. The recharge calculations are as follows:

Required recharge volume

Required Recharge Volume (R_v) = F x Impervious Area where, F = Target Depth Factor (in.)
F = 0.25" for 'C' Soils

Net increase in site impervious area (pre to post conditions) = 1,990 ft²

R_v = (0.25"/12") x 1,990 ft² = 41.46 ft³

The proposed bioretention area has a total volume of 172 ft³ below the lowest outlet, thus Standard 3 is satisfied. See attached HydroCAD Stage-Area-Storage worksheet demonstrating the volume of the system.

Based upon an exfiltration rate of 0.27 in./hr. (Rawls rate for silt loam 'C' soils), the drawdown time is calculated as follows:

$Time_{drawdown}$ = R_v / (K x Bottom Area) where, R_v= recharge BMP storage volume
K= Saturated Hydraulic Conductivity (Rawls) Rate

Bioretention Area
$Time_{drawdown}$ = 41.46 ft³ / (0.27 in./hr./12" x 201.43 ft²) = 9 hours < 72 hours.

Water Quality Calculations (Stormwater Management Standard 4)

The site does not discharge to any known or mapped Critical Areas thus the required Water Quality Volume shall be calculated using 0.5 inches of runoff times the impervious area. Refer to Appendix G for detailed TSS calculations that demonstrate better than 80% TSS removal rates for the site.

Water Quality Volume: V= 0.5"/12 x A_{IMP}

V= 0.5"/12 x 1,990 ft² = 82.92 ft³ required volume
Provided volume = 172 ft³ (below lowest orifice)

(see HydroCAD stage-storage-volume sheet following this Narrative)

Additionally, a Long-Term Pollution Prevention Plan has been developed for the site (refer to Appendix F).

Higher Potential Pollutant Loads (Stormwater Management Standard 5)

The site's existing and proposed use (residential) does not constitute a land use with a higher potential pollutant load (LUHPPL).

Protection of Critical Areas (Stormwater Management Standard 6)

The site does not discharge to a known or mapped Critical Area.

Redevelopment Projects (Stormwater Management Standard 7)

The site does not meet the criteria of a redevelopment project as the net impervious area will increase.

Erosion/Sediment Control (Stormwater Management Standard 8)

Site development plans provide details for erosion and sediment control during construction.

Operation/Maintenance Plan (Stormwater Management Standard 9)

Refer to Appendix E for the site Long-Term Drainage System Operation & Maintenance Plan.

Illicit Discharge Compliance Statement (Stormwater Management Standard 10)

There are no existing illicit discharges to GEI or the owner's knowledge and there are no proposed illicit discharges. There are no cross-connections between the stormwater system and the wastewater system and discharges to each will remain separate; these systems are shown on the project drawings.

Stage-Area-Storage for Pond 1P: Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
540.00	201	0
540.02	207	4
540.04	213	8
540.06	218	13
540.08	224	17
540.10	230	22
540.12	236	26
540.14	241	31
540.16	247	36
540.18	253	41
540.20	259	46
540.22	264	51
540.24	270	57
540.26	276	62
540.28	282	68
540.30	287	73
540.32	293	79
540.34	299	85
540.36	305	91
540.38	310	97
540.40	316	103
540.42	322	110
540.44	328	116
540.46	333	123
540.48	339	130
540.50	345	137
540.52	351	143
540.54	357	151
540.56	362	158
540.58	368	165
540.60	374	172
540.62	380	180
540.64	385	188
540.66	391	195
540.68	397	203
540.70	403	211
540.72	408	219
540.74	414	228
540.76	420	236
540.78	426	244
540.80	431	253
540.82	437	262
540.84	443	270
540.86	449	279
540.88	454	288
540.90	460	298
540.92	466	307
540.94	472	316
540.96	477	326
540.98	483	335
541.00	489	345
541.02	496	355
541.04	503	365
541.06	510	375
541.08	517	385
541.10	523	396
541.12	530	406
541.14	537	417
541.16	544	428
541.18	551	439
541.20	558	450
541.22	565	461
541.24	572	472
541.26	578	484
541.28	585	495
541.30	592	507
541.32	599	519
541.34	606	531
541.36	613	543
541.38	620	556
541.40	627	568
541.42	633	581
541.44	640	593
541.46	647	606
541.48	654	619
541.50	661	633
541.52	668	646
541.54	675	659
541.56	682	673
541.58	689	686
541.60	695	700
541.62	702	714
541.64	709	728
541.66	716	743
541.68	723	757
541.70	730	772
541.72	737	786
541.74	744	801
541.76	750	816
541.78	757	831
541.80	764	846
541.82	771	862
541.84	778	877
541.86	785	893
541.88	792	909
541.90	799	924
541.92	805	940
541.94	812	957
541.96	819	973
541.98	826	989
542.00	**833**	**1,006**

VOLUME BELOW LOWEST OUTLET = 172 cf

Extreme Precipitation Tables

Northeast Regional Climate Center

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

Metadata for Point

Smoothing	Yes
State	
Location	
Latitude	42.039 degrees North
Longitude	71.912 degrees West
Elevation	160 feet
Date/Time	Fri Oct 06 2023 15:58:44 GMT-0400 (Eastern Daylight Time)

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.47	0.59	0.77	0.96	1.20	**1yr**	0.83	1.12	1.38	1.72	2.13	2.65	2.94	**1yr**	2.34	2.83	3.26	3.95	4.54	**1yr**
2yr	0.36	0.55	0.69	0.91	1.14	1.43	**2yr**	0.98	1.32	1.65	2.06	2.57	3.19	3.54	**2yr**	2.82	3.41	3.91	4.65	5.27	**2yr**
5yr	0.43	0.66	0.83	1.11	1.42	1.80	**5yr**	1.23	1.62	2.09	2.60	3.23	3.99	4.48	**5yr**	3.53	4.31	4.95	5.81	6.53	**5yr**
10yr	0.48	0.76	0.95	1.30	1.69	2.15	**10yr**	1.46	1.91	2.50	3.12	3.85	4.73	5.35	**10yr**	4.19	5.14	5.91	6.89	7.68	**10yr**
25yr	0.57	0.91	1.16	1.60	2.11	2.71	**25yr**	1.82	2.35	3.16	3.94	4.85	5.92	6.77	**25yr**	5.24	6.51	7.49	8.62	9.52	**25yr**
50yr	0.64	1.03	1.32	1.86	2.50	3.25	**50yr**	2.16	2.76	3.79	4.72	5.79	7.03	8.10	**50yr**	6.22	7.79	8.96	10.22	11.21	**50yr**
100yr	0.73	1.19	1.53	2.17	2.97	3.88	**100yr**	2.56	3.25	4.53	5.64	6.90	8.35	9.69	**100yr**	7.39	9.32	10.73	12.12	13.20	**100yr**
200yr	0.85	1.38	1.79	2.56	3.52	4.62	**200yr**	3.04	3.82	5.40	6.73	8.22	9.92	11.60	**200yr**	8.78	11.16	12.85	14.37	15.55	**200yr**
500yr	1.02	1.68	2.18	3.16	4.42	5.83	**500yr**	3.82	4.74	6.83	8.51	10.37	12.46	14.75	**500yr**	11.03	14.18	16.32	18.02	19.31	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.25	0.38	0.46	0.62	0.76	1.04	1yr	0.66	1.02	1.15	1.44	1.81	2.23	2.53	1yr	1.97	2.43	2.97	3.29	3.95	1yr
2yr	0.35	0.54	0.66	0.89	1.10	1.29	2yr	0.95	1.26	1.48	1.93	2.45	3.10	3.44	2yr	2.74	3.31	3.79	4.49	5.11	2yr
5yr	0.39	0.60	0.74	1.02	1.30	1.55	5yr	1.12	1.52	1.72	2.23	2.85	3.71	4.16	5yr	3.29	4.00	4.62	5.34	6.03	5yr
10yr	0.42	0.65	0.80	1.12	1.45	1.71	10yr	1.25	1.67	1.93	2.50	3.17	4.27	4.83	10yr	3.78	4.64	5.32	6.10	6.84	10yr
25yr	0.46	0.70	0.88	1.25	1.65	1.98	25yr	1.42	1.94	2.25	2.89	3.63	5.14	5.86	25yr	4.55	5.63	6.46	7.29	8.10	25yr
50yr	0.49	0.74	0.92	1.33	1.79	2.23	50yr	1.54	2.18	2.54	3.24	4.05	5.92	6.80	50yr	5.24	6.53	7.51	8.37	9.21	50yr
100yr	0.52	0.78	0.98	1.42	1.94	2.51	100yr	1.68	2.45	2.87	3.63	4.52	6.86	7.92	100yr	6.07	7.62	8.72	9.61	10.50	100yr
200yr	0.55	0.83	1.05	1.52	2.12	2.82	200yr	1.83	2.76	3.23	4.08	5.04	7.94	9.25	200yr	7.03	8.90	10.18	11.07	11.98	200yr
500yr	0.65	0.97	1.25	1.81	2.57	3.32	500yr	2.22	3.25	3.80	4.77	5.83	9.68	11.46	500yr	8.56	11.02	12.55	13.36	14.31	500yr

Upper Confidence Limits

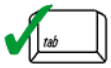
	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.34	0.53	0.65	0.87	1.07	1.24	1yr	0.93	1.21	1.40	1.86	2.42	2.93	3.24	1yr	2.59	3.11	3.55	4.31	4.93	1yr
2yr	0.38	0.59	0.73	0.99	1.22	1.39	2yr	1.05	1.36	1.57	2.04	2.63	3.30	3.69	2yr	2.92	3.55	4.08	4.84	5.49	2yr
5yr	0.46	0.71	0.88	1.21	1.53	1.76	5yr	1.32	1.72	2.03	2.63	3.26	4.28	4.79	5yr	3.79	4.61	5.31	6.34	7.07	5yr
10yr	0.54	0.83	1.02	1.43	1.85	2.14	10yr	1.59	2.09	2.47	3.20	3.89	5.21	5.83	10yr	4.61	5.61	6.51	7.77	8.59	10yr
25yr	0.68	1.03	1.28	1.83	2.40	2.76	25yr	2.07	2.70	3.22	4.15	4.91	6.76	7.59	25yr	5.98	7.30	8.54	10.16	11.11	25yr
50yr	0.80	1.22	1.52	2.18	2.93	3.35	50yr	2.53	3.28	3.93	5.03	5.86	8.22	9.25	50yr	7.28	8.90	10.46	12.44	13.48	50yr
100yr	0.96	1.45	1.81	2.62	3.59	4.06	100yr	3.10	3.97	4.79	6.11	7.00	10.02	11.27	100yr	8.87	10.84	12.79	15.20	16.36	100yr
200yr	1.14	1.72	2.18	3.16	4.41	4.92	200yr	3.80	4.81	5.84	7.41	8.37	12.19	13.73	200yr	10.79	13.20	15.63	18.57	19.84	200yr
500yr	1.53	2.28	2.94	4.27	6.07	6.35	500yr	5.23	6.21	7.59	9.59	10.58	15.76	17.82	500yr	13.95	17.14	20.39	24.17	25.61	500yr

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

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Electronically stamped by Michael Andrade, PE: 10/02/23

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

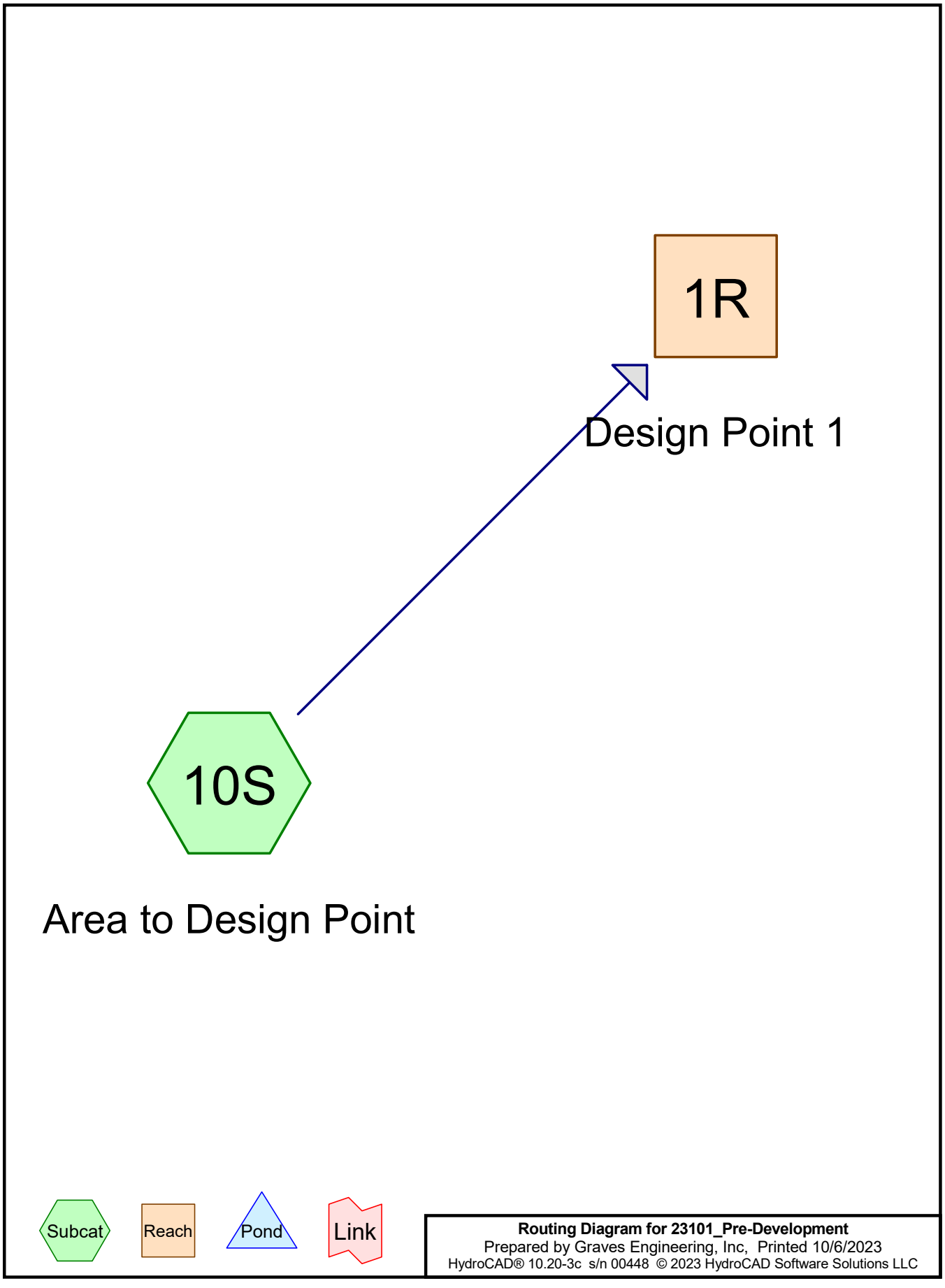
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B

HYDROCAD REPORTS
PRE-DEVELOPMENT



Routing Diagram for 23101_Pre-Development
Prepared by Graves Engineering, Inc, Printed 10/6/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
6,755	74	>75% Grass cover, Good, HSG C (10S)
6,755	**74**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
6,755	HSG C	10S
0	HSG D	
0	Other	
6,755		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	0	6,755	0	0	6,755	>75% Grass cover, Good	
0	**0**	**6,755**	**0**	**0**	**6,755**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Area to Design Point Runoff Area=6,755 sf 0.00% Impervious Runoff Depth>1.03"
Tc=6.0 min CN=74 Runoff=0.17 cfs 579 cf

Reach 1R: Design Point 1 Inflow=0.17 cfs 579 cf
Outflow=0.17 cfs 579 cf

Total Runoff Area = 6,755 sf Runoff Volume = 579 cf Average Runoff Depth = 1.03"
100.00% Pervious = 6,755 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 10S: Area to Design Point

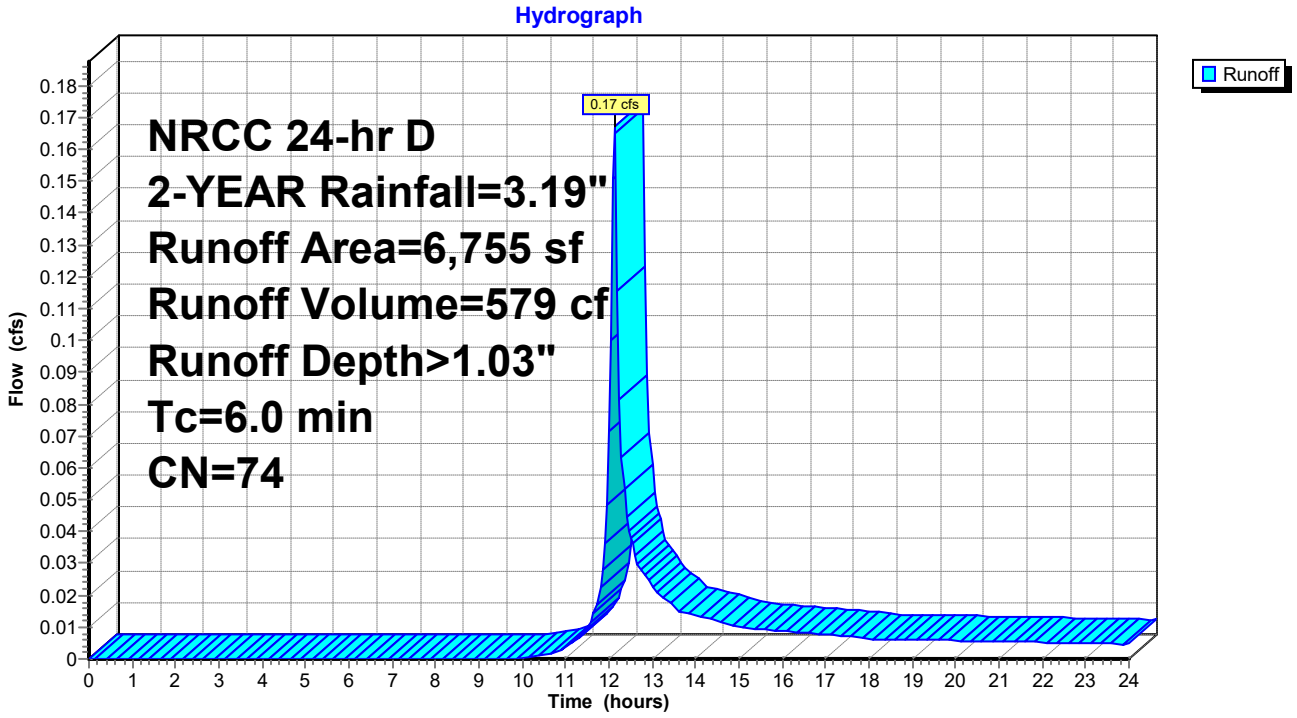
Runoff = 0.17 cfs @ 12.14 hrs, Volume= 579 cf, Depth> 1.03"
Routed to Reach 1R : Design Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-YEAR Rainfall=3.19"

Area (sf)	CN	Description
6,755	74	>75% Grass cover, Good, HSG C
6,755		100.00% Pervious Area

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

Subcatchment 10S: Area to Design Point

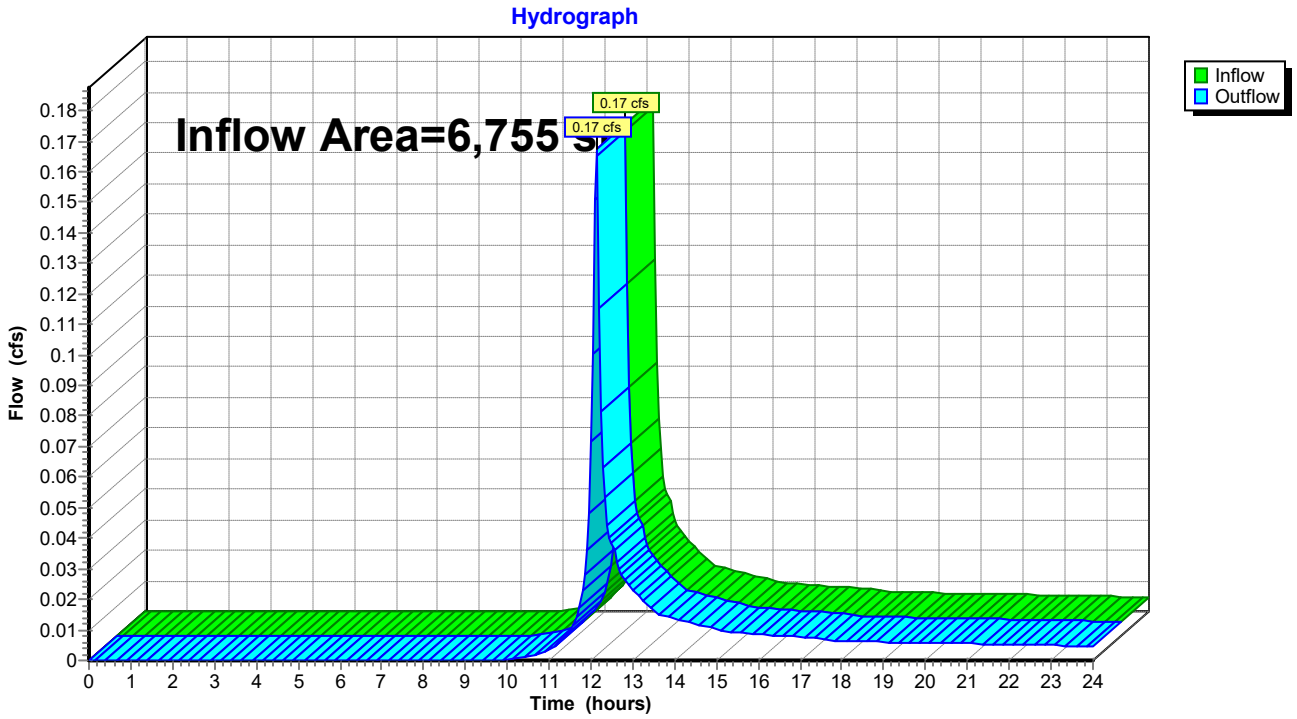


Summary for Reach 1R: Design Point 1

Inflow Area = 6,755 sf, 0.00% Impervious, Inflow Depth > 1.03" for 2-YEAR event
Inflow = 0.17 cfs @ 12.14 hrs, Volume= 579 cf
Outflow = 0.17 cfs @ 12.14 hrs, Volume= 579 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1R: Design Point 1



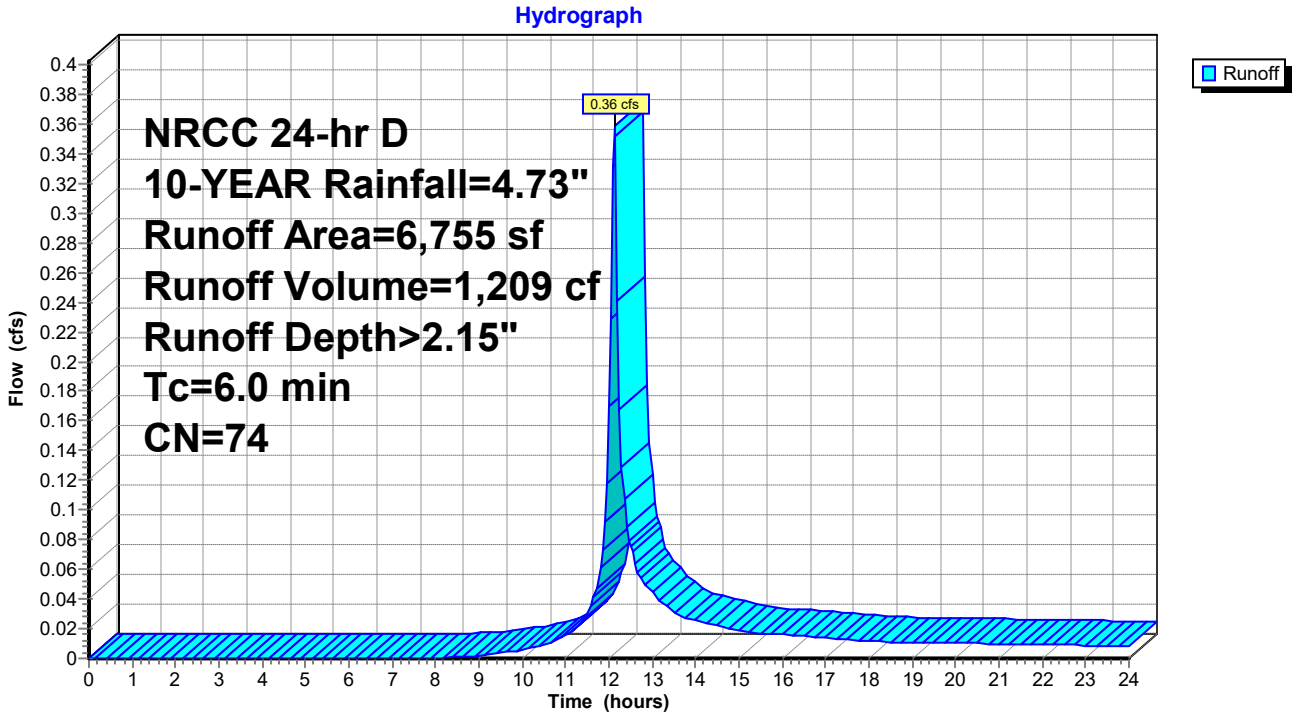
Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Area to Design Point Runoff Area=6,755 sf 0.00% Impervious Runoff Depth>2.15"
Tc=6.0 min CN=74 Runoff=0.36 cfs 1,209 cf

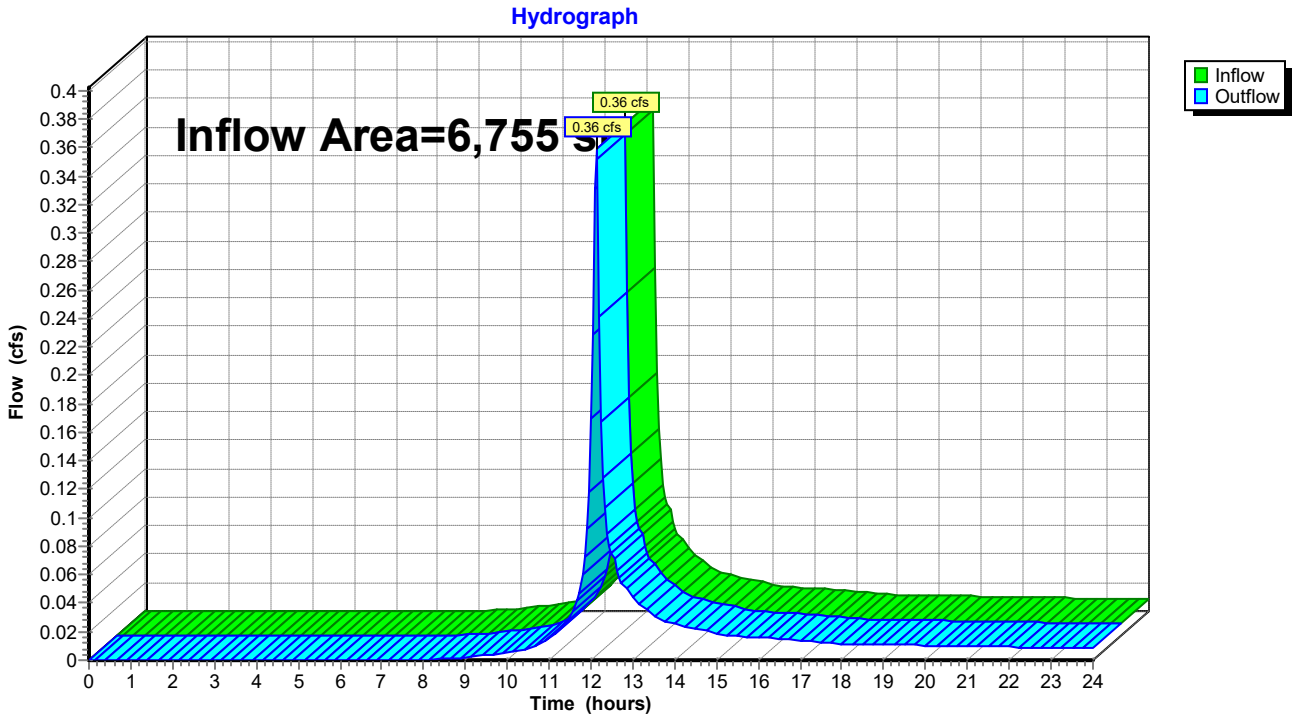
Reach 1R: Design Point 1 Inflow=0.36 cfs 1,209 cf
Outflow=0.36 cfs 1,209 cf

Total Runoff Area = 6,755 sf Runoff Volume = 1,209 cf Average Runoff Depth = 2.15"
100.00% Pervious = 6,755 sf 0.00% Impervious = 0 sf

Subcatchment 10S: Area to Design Point



Reach 1R: Design Point 1



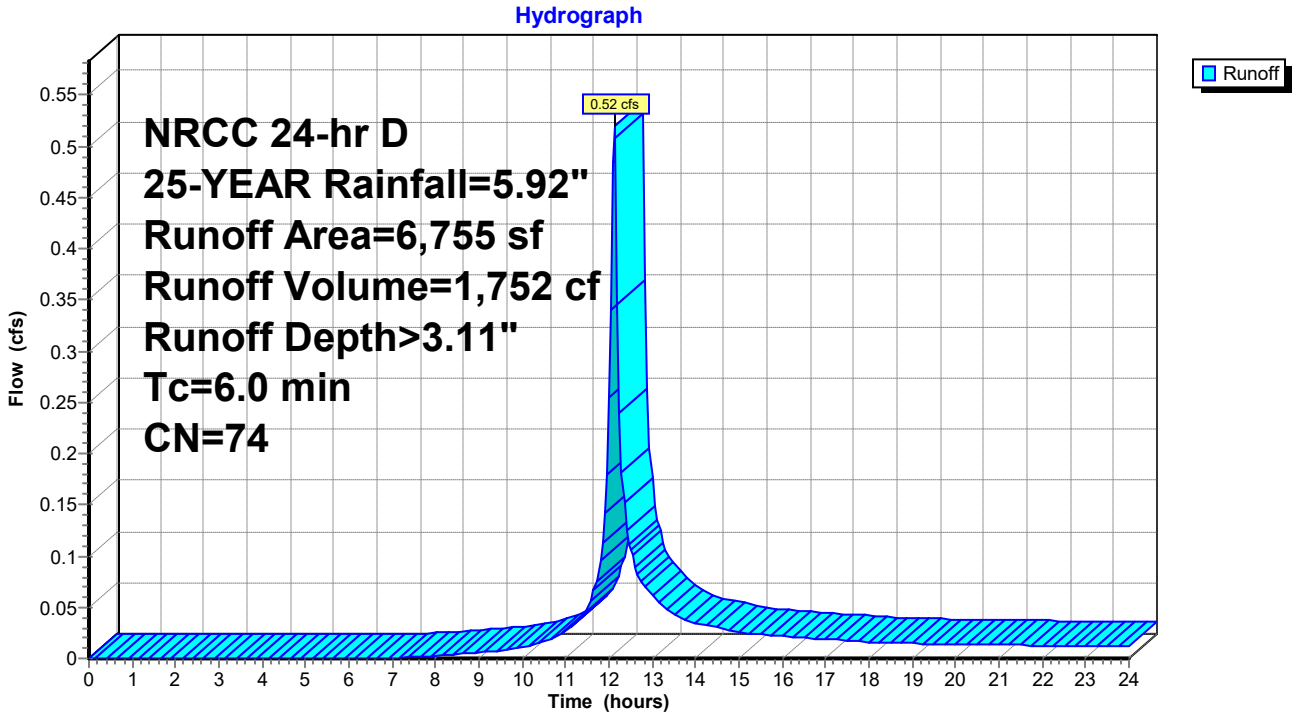
Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Area to Design Point Runoff Area=6,755 sf 0.00% Impervious Runoff Depth>3.11"
Tc=6.0 min CN=74 Runoff=0.52 cfs 1,752 cf

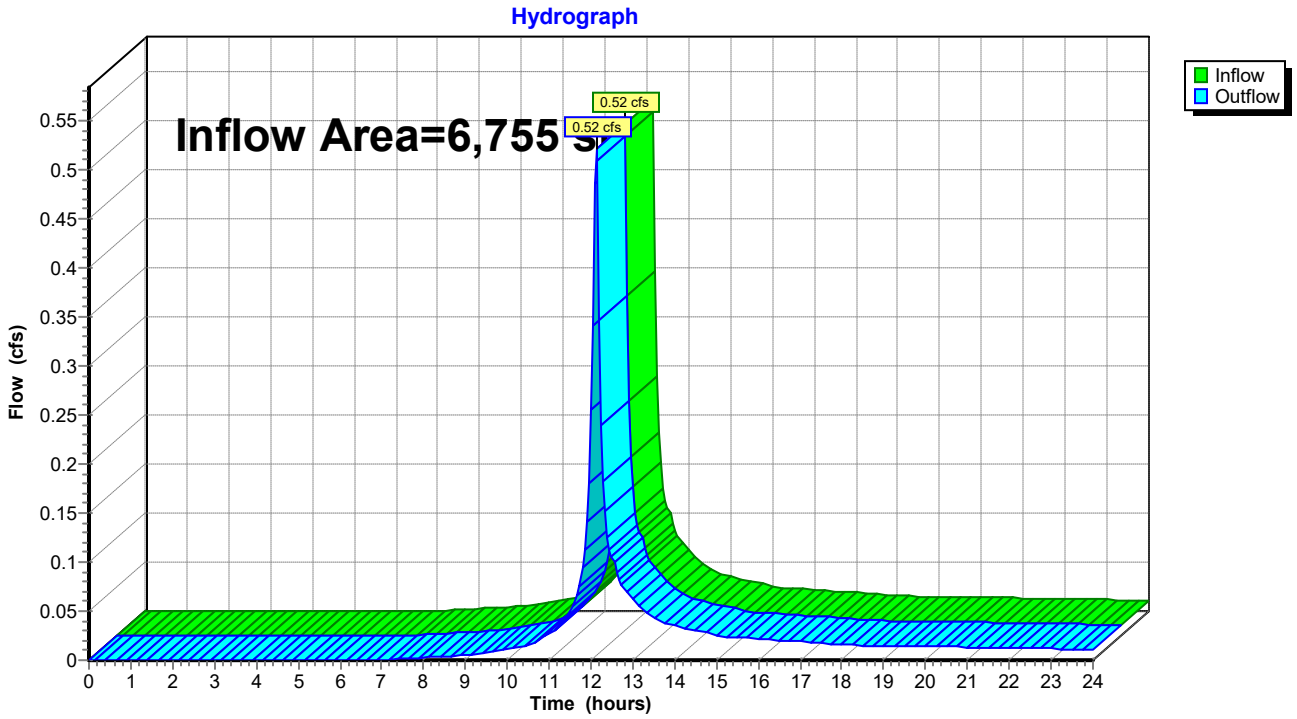
Reach 1R: Design Point 1 Inflow=0.52 cfs 1,752 cf
Outflow=0.52 cfs 1,752 cf

Total Runoff Area = 6,755 sf Runoff Volume = 1,752 cf Average Runoff Depth = 3.11"
100.00% Pervious = 6,755 sf 0.00% Impervious = 0 sf

Subcatchment 10S: Area to Design Point



Reach 1R: Design Point 1



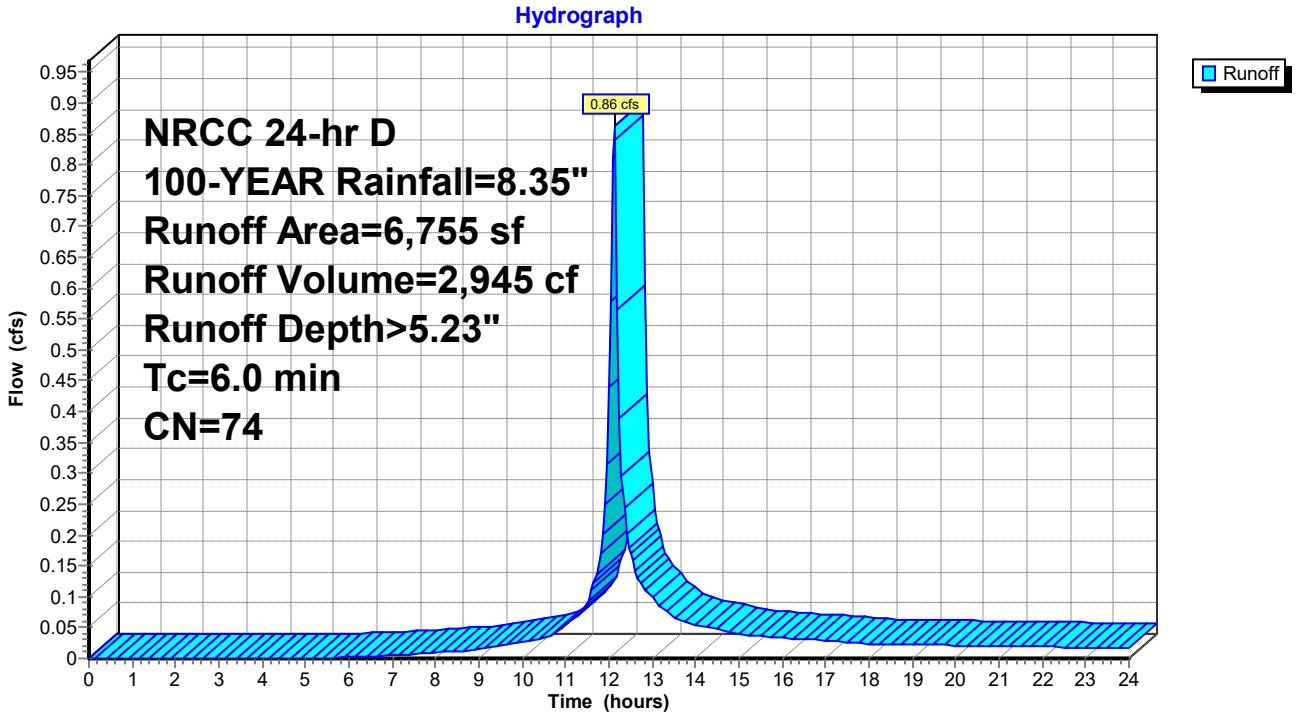
Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Area to Design Point Runoff Area=6,755 sf 0.00% Impervious Runoff Depth>5.23"
Tc=6.0 min CN=74 Runoff=0.86 cfs 2,945 cf

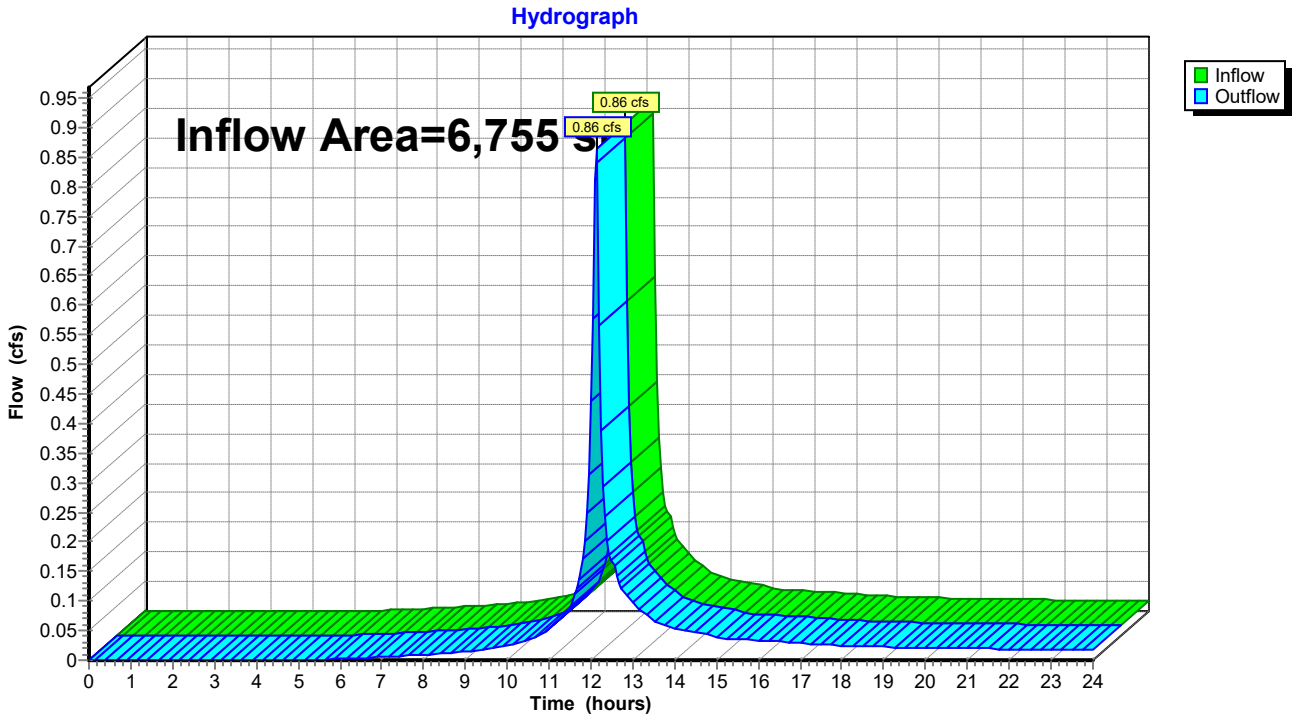
Reach 1R: Design Point 1 Inflow=0.86 cfs 2,945 cf
Outflow=0.86 cfs 2,945 cf

Total Runoff Area = 6,755 sf Runoff Volume = 2,945 cf Average Runoff Depth = 5.23"
100.00% Pervious = 6,755 sf 0.00% Impervious = 0 sf

Subcatchment 10S: Area to Design Point

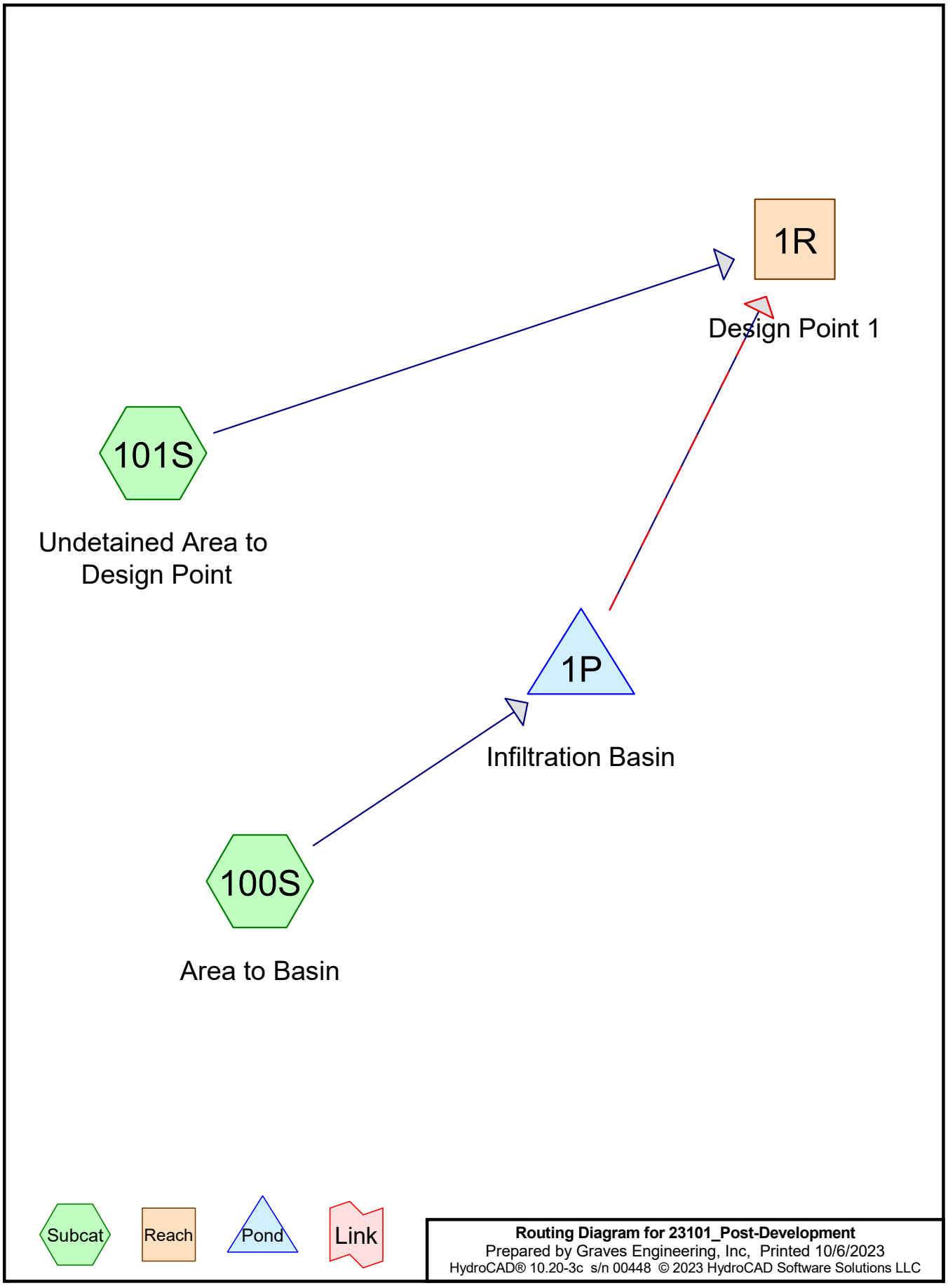


Reach 1R: Design Point 1



APPENDIX C

HYDROCAD REPORTS
POST-DEVELOPMENT



Routing Diagram for 23101_Post-Development
Prepared by Graves Engineering, Inc, Printed 10/6/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
4,765	74	>75% Grass cover, Good, HSG C (101S)
1,990	98	Paved parking, HSG C (100S)
6,755	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
6,755	HSG C	100S, 101S
0	HSG D	
0	Other	
6,755		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
0	0	4,765	0	0	4,765	>75% Grass cover, Good	
0	0	1,990	0	0	1,990	Paved parking	
0	**0**	**6,755**	**0**	**0**	**6,755**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100S: Area to Basin Runoff Area=1,990 sf 100.00% Impervious Runoff Depth>2.95"
Tc=6.0 min CN=98 Runoff=0.13 cfs 490 cf

Subcatchment 101S: Undetained Area to Runoff Area=4,765 sf 0.00% Impervious Runoff Depth>1.03"
Tc=6.0 min CN=74 Runoff=0.12 cfs 409 cf

Reach 1R: Design Point 1 Inflow=0.12 cfs 572 cf
Outflow=0.12 cfs 572 cf

Pond 1P: Infiltration Basin Peak Elev=540.72' Storage=219 cf Inflow=0.13 cfs 490 cf
Discarded=0.00 cfs 154 cf Primary=0.03 cfs 163 cf Secondary=0.00 cfs 0 cf Outflow=0.04 cfs 317 cf

Total Runoff Area = 6,755 sf Runoff Volume = 898 cf Average Runoff Depth = 1.60"
70.54% Pervious = 4,765 sf 29.46% Impervious = 1,990 sf

Summary for Subcatchment 100S: Area to Basin

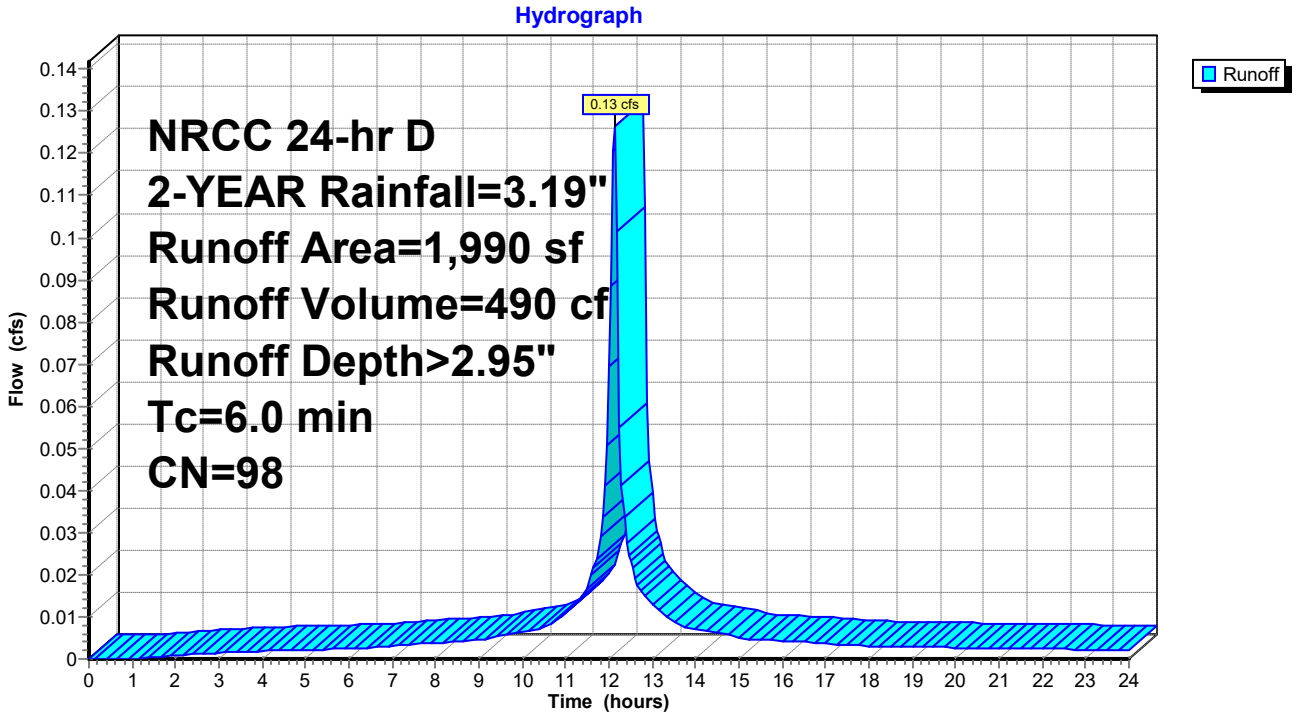
Runoff = 0.13 cfs @ 12.13 hrs, Volume= 490 cf, Depth> 2.95"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-YEAR Rainfall=3.19"

Area (sf)	CN	Description
1,990	98	Paved parking, HSG C
1,990		100.00% Impervious Area

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

Subcatchment 100S: Area to Basin



Summary for Subcatchment 101S: Undetained Area to Design Point

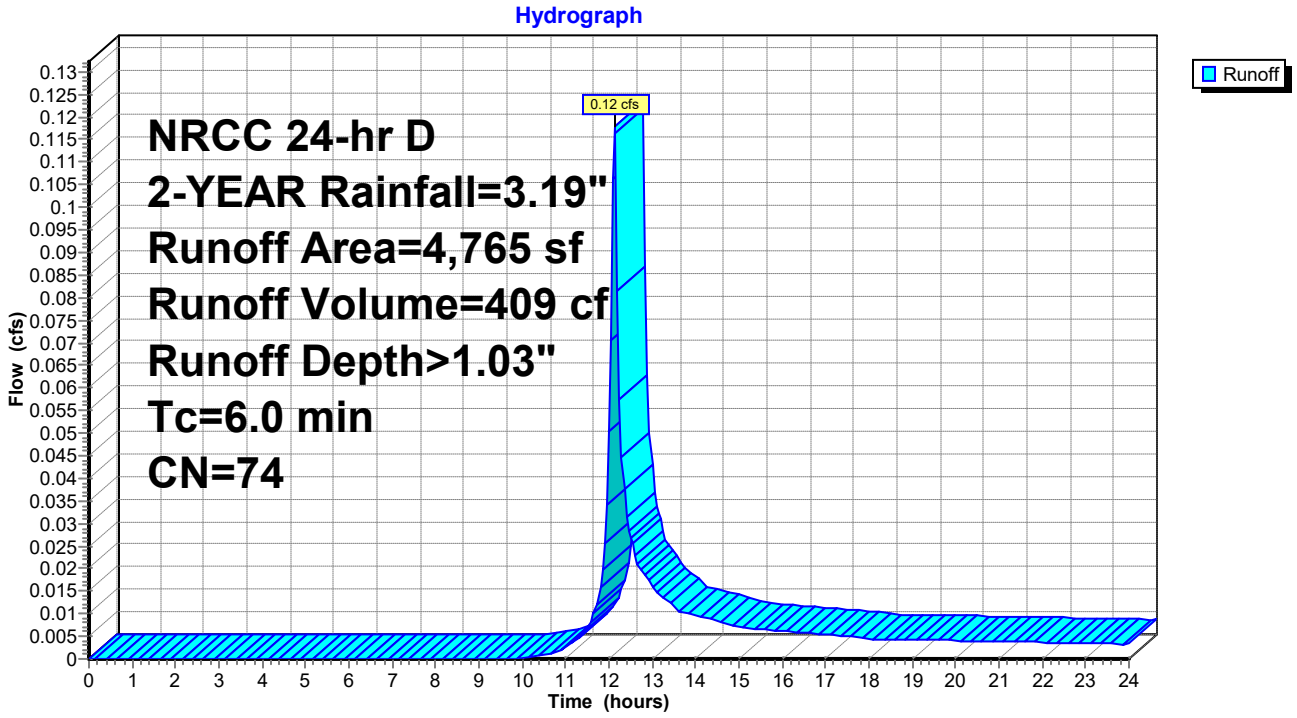
Runoff = 0.12 cfs @ 12.14 hrs, Volume= 409 cf, Depth> 1.03"
Routed to Reach 1R : Design Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-YEAR Rainfall=3.19"

Area (sf)	CN	Description
4,765	74	>75% Grass cover, Good, HSG C
4,765		100.00% Pervious Area

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

Subcatchment 101S: Undetained Area to Design Point

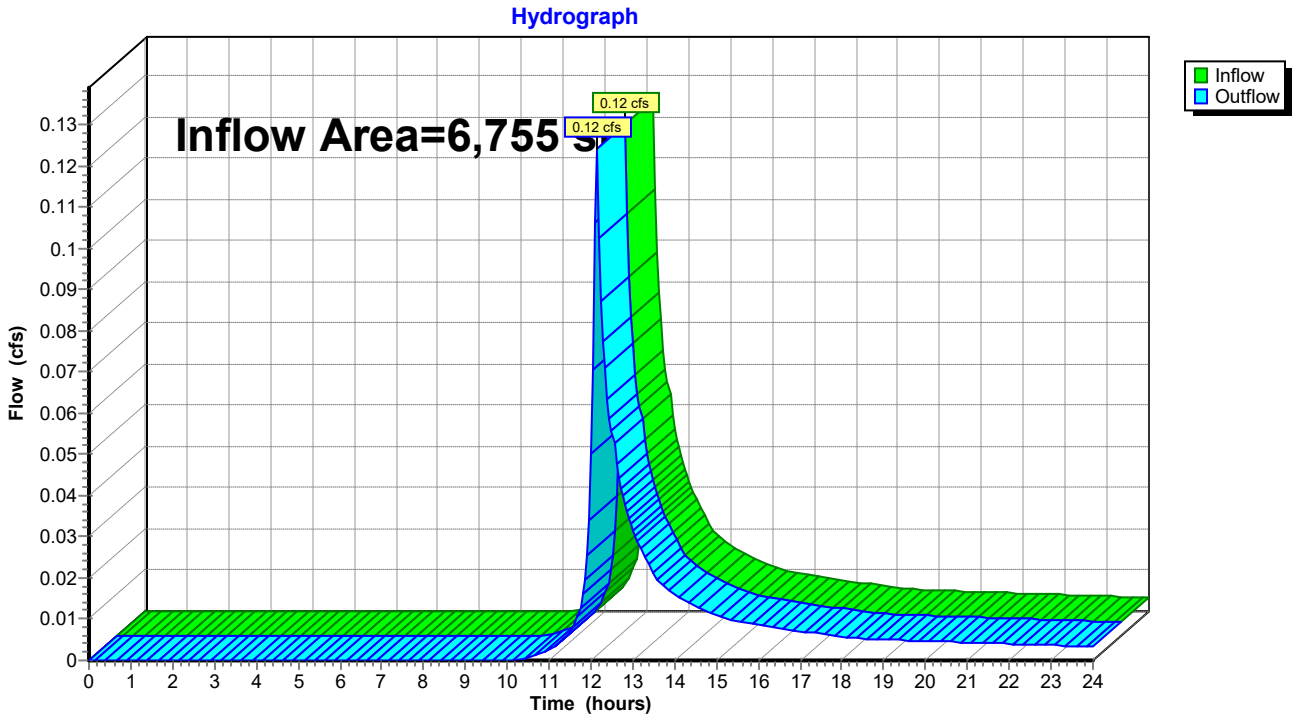


Summary for Reach 1R: Design Point 1

Inflow Area = 6,755 sf, 29.46% Impervious, Inflow Depth > 1.02" for 2-YEAR event
Inflow = 0.12 cfs @ 12.15 hrs, Volume= 572 cf
Outflow = 0.12 cfs @ 12.15 hrs, Volume= 572 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1R: Design Point 1



Summary for Pond 1P: Infiltration Basin

Inflow Area = 1,990 sf,100.00% Impervious, Inflow Depth > 2.95" for 2-YEAR event
Inflow = 0.13 cfs @ 12.13 hrs, Volume= 490 cf
Outflow = 0.04 cfs @ 12.34 hrs, Volume= 317 cf, Atten= 72%, Lag= 12.7 min
Discarded = 0.00 cfs @ 12.34 hrs, Volume= 154 cf
Primary = 0.03 cfs @ 12.34 hrs, Volume= 163 cf
Routed to Reach 1R : Design Point 1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach 1R : Design Point 1

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 540.72' @ 12.34 hrs Surf.Area= 408 sf Storage= 219 cf
Flood Elev= 542.00' Surf.Area= 833 sf Storage= 1,006 cf

Plug-Flow detention time= 223.1 min calculated for 317 cf (65% of inflow)
Center-of-Mass det. time= 96.1 min (855.9 - 759.8)

Volume	Invert	Avail.Storage	Storage Description
#1	540.00'	1,006 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
540.00	201	0	0
541.00	489	345	345
542.00	833	661	1,006

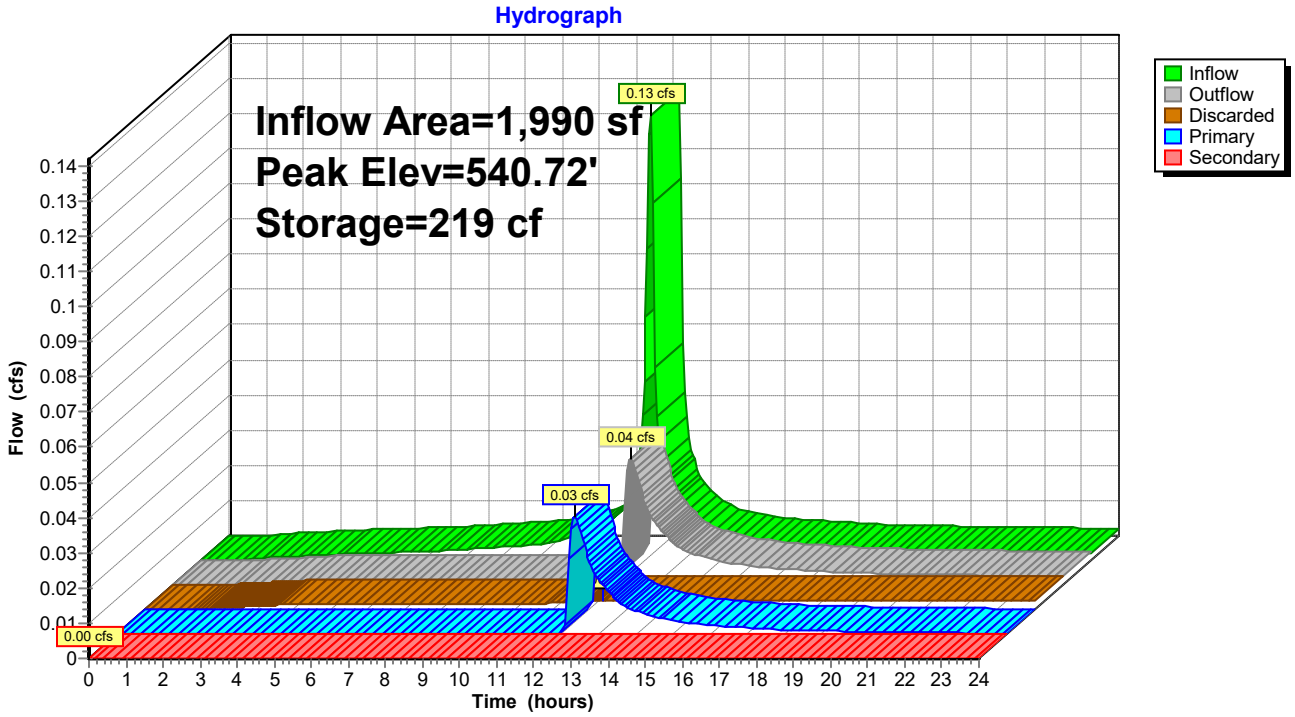
Device	Routing	Invert	Outlet Devices
#1	Discarded	540.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	540.60'	**6.0" Round Outlet Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 540.60' / 540.00' S= 0.0300 '/' Cc= 0.900 n= 0.010, Flow Area= 0.20 sf
#3	Secondary	541.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.00 cfs @ 12.34 hrs HW=540.72' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.03 cfs @ 12.34 hrs HW=540.72' (Free Discharge)
2=Outlet Culvert (Inlet Controls 0.03 cfs @ 0.93 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=540.00' (Free Discharge)
3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Infiltration Basin



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100S: Area to Basin Runoff Area=1,990 sf 100.00% Impervious Runoff Depth>4.49"
Tc=6.0 min CN=98 Runoff=0.19 cfs 744 cf

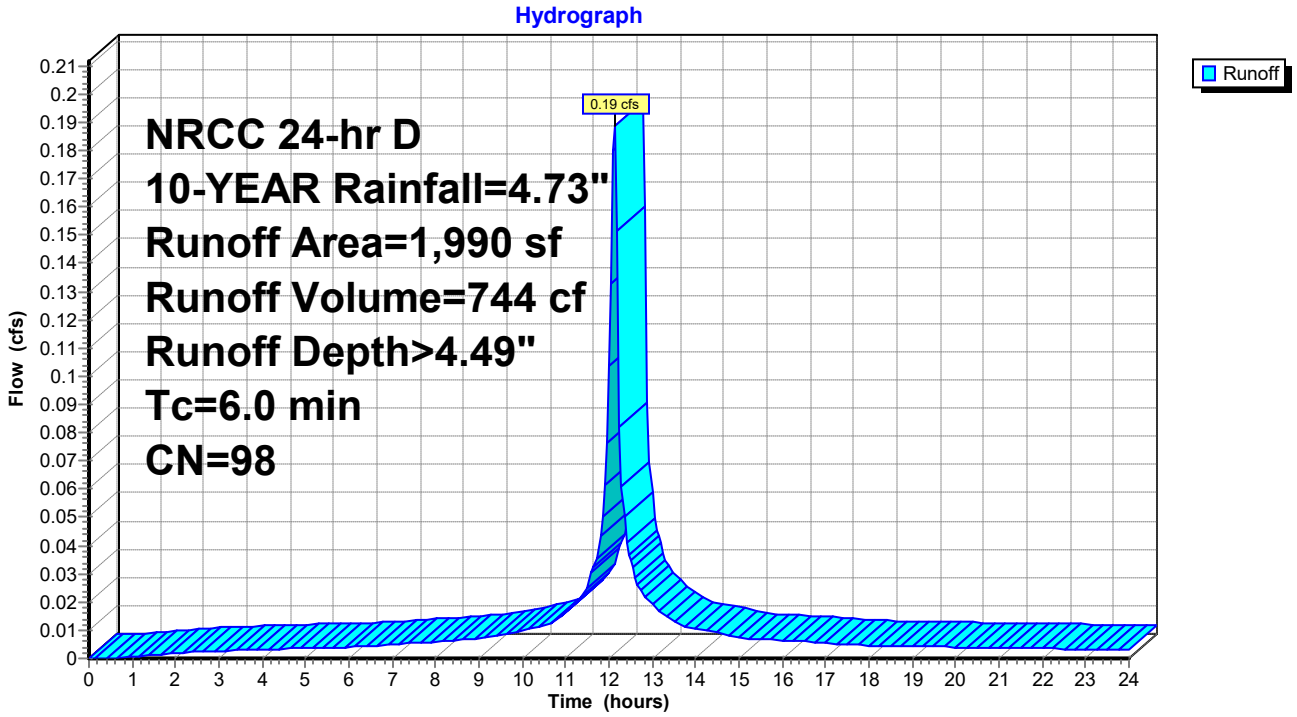
Subcatchment 101S: Undetained Area to Runoff Area=4,765 sf 0.00% Impervious Runoff Depth>2.15"
Tc=6.0 min CN=74 Runoff=0.25 cfs 853 cf

Reach 1R: Design Point 1 Inflow=0.36 cfs 1,252 cf
Outflow=0.36 cfs 1,252 cf

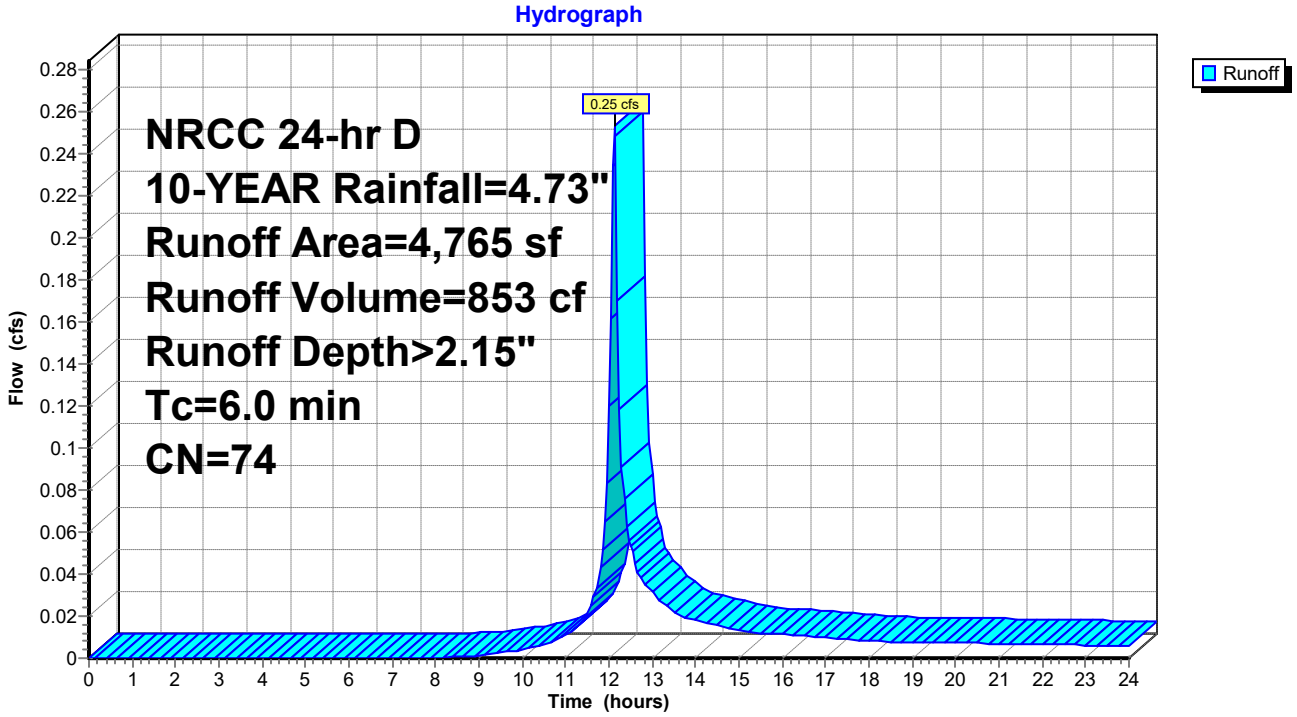
Pond 1P: Infiltration Basin Peak Elev=540.84' Storage=271 cf Inflow=0.19 cfs 744 cf
Discarded=0.00 cfs 166 cf Primary=0.12 cfs 399 cf Secondary=0.00 cfs 0 cf Outflow=0.13 cfs 565 cf

Total Runoff Area = 6,755 sf Runoff Volume = 1,597 cf Average Runoff Depth = 2.84"
70.54% Pervious = 4,765 sf 29.46% Impervious = 1,990 sf

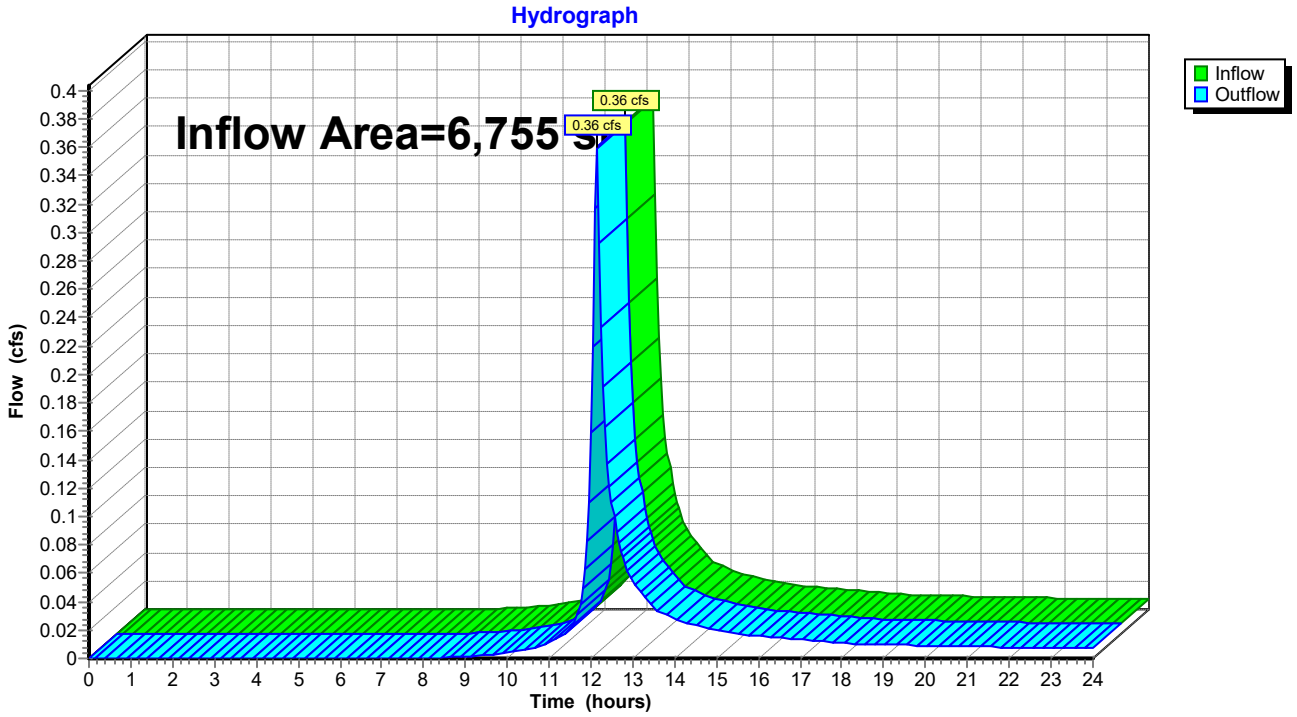
Subcatchment 100S: Area to Basin



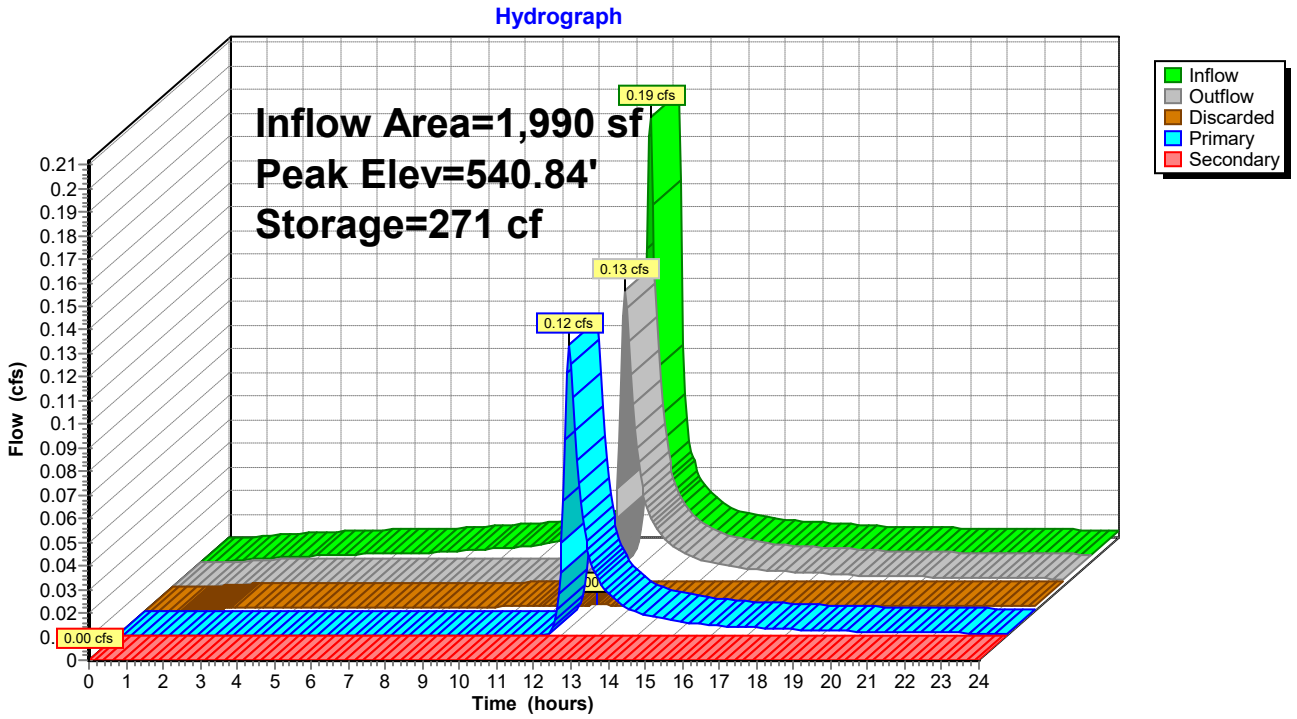
Subcatchment 101S: Undetained Area to Design Point



Reach 1R: Design Point 1



Pond 1P: Infiltration Basin



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100S: Area to Basin Runoff Area=1,990 sf 100.00% Impervious Runoff Depth>5.68"
Tc=6.0 min CN=98 Runoff=0.24 cfs 941 cf

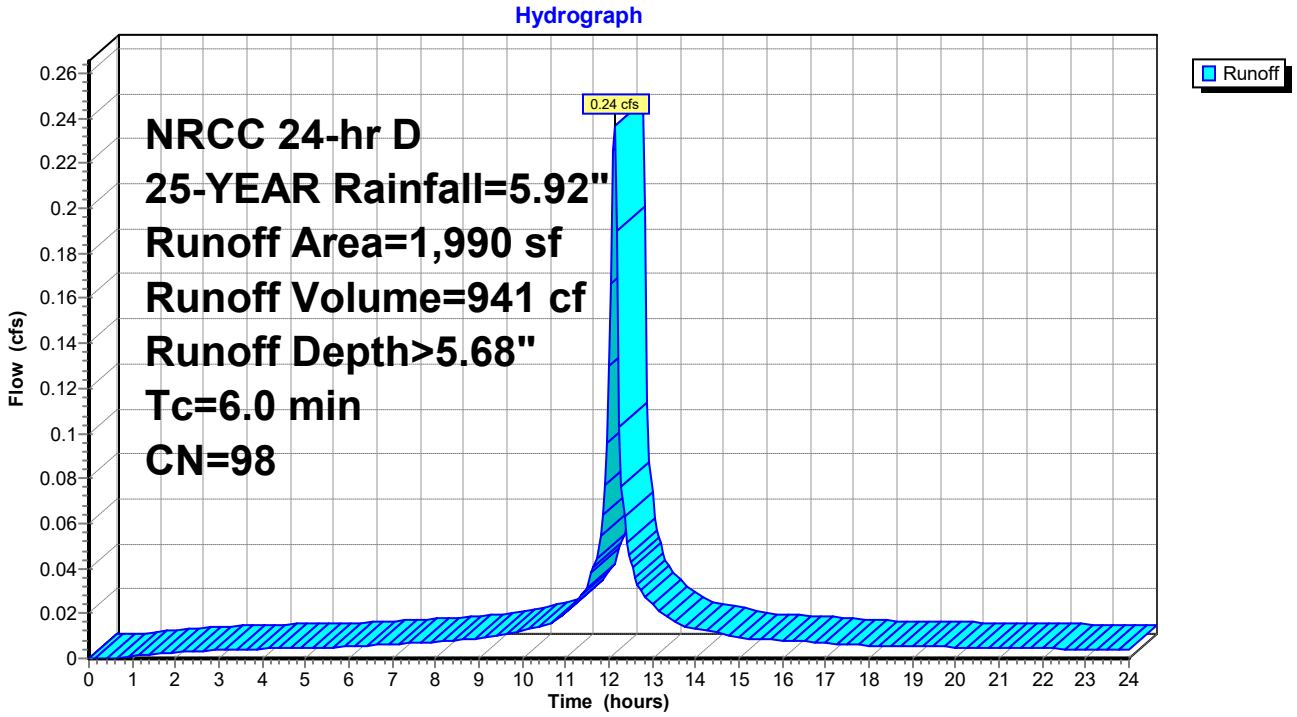
Subcatchment 101S: Undetained Area to Runoff Area=4,765 sf 0.00% Impervious Runoff Depth>3.11"
Tc=6.0 min CN=74 Runoff=0.37 cfs 1,236 cf

Reach 1R: Design Point 1 Inflow=0.52 cfs 1,823 cf
Outflow=0.52 cfs 1,823 cf

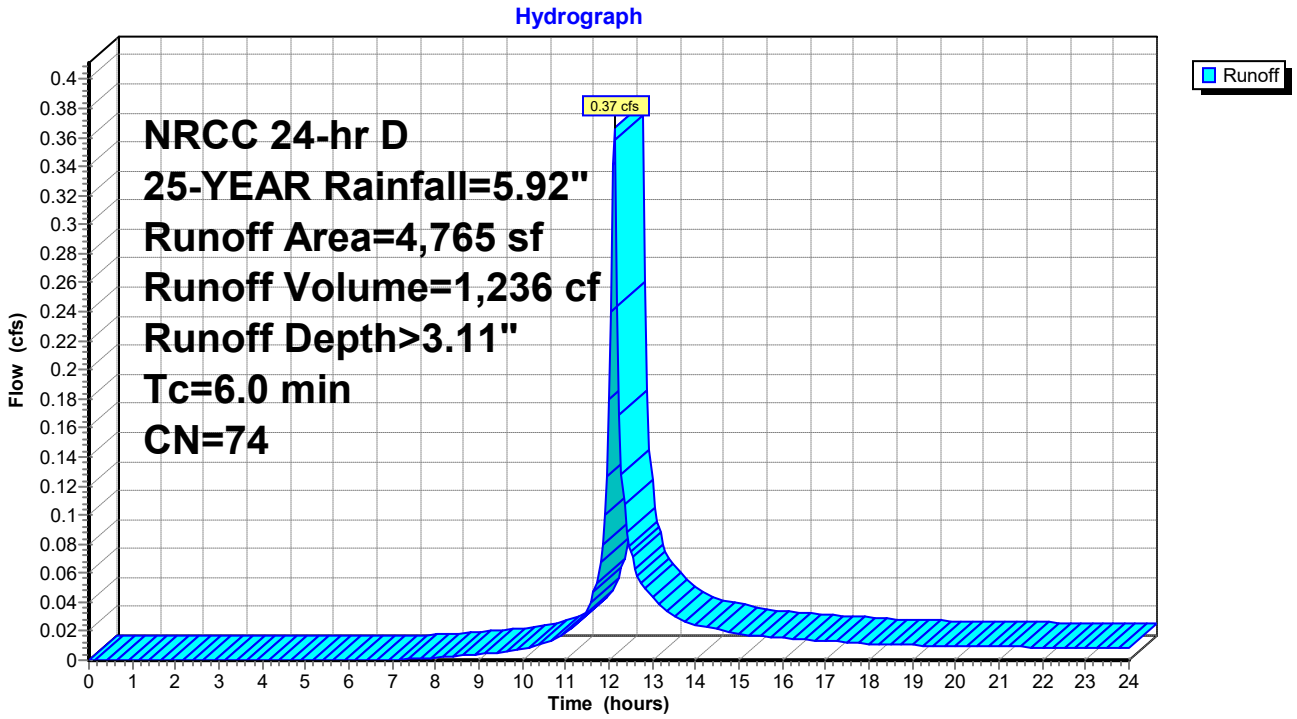
Pond 1P: Infiltration Basin Peak Elev=540.88' Storage=290 cf Inflow=0.24 cfs 941 cf
Discarded=0.00 cfs 173 cf Primary=0.17 cfs 587 cf Secondary=0.00 cfs 0 cf Outflow=0.17 cfs 760 cf

Total Runoff Area = 6,755 sf Runoff Volume = 2,177 cf Average Runoff Depth = 3.87"
70.54% Pervious = 4,765 sf 29.46% Impervious = 1,990 sf

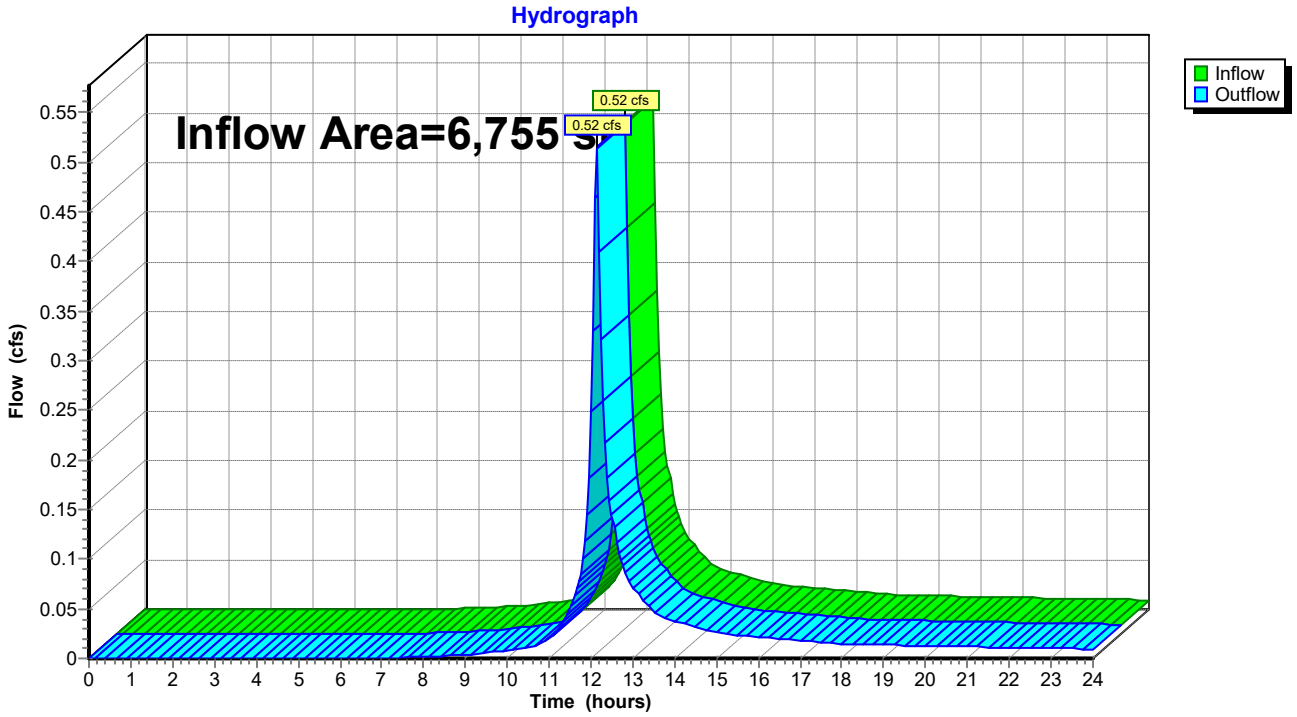
Subcatchment 100S: Area to Basin



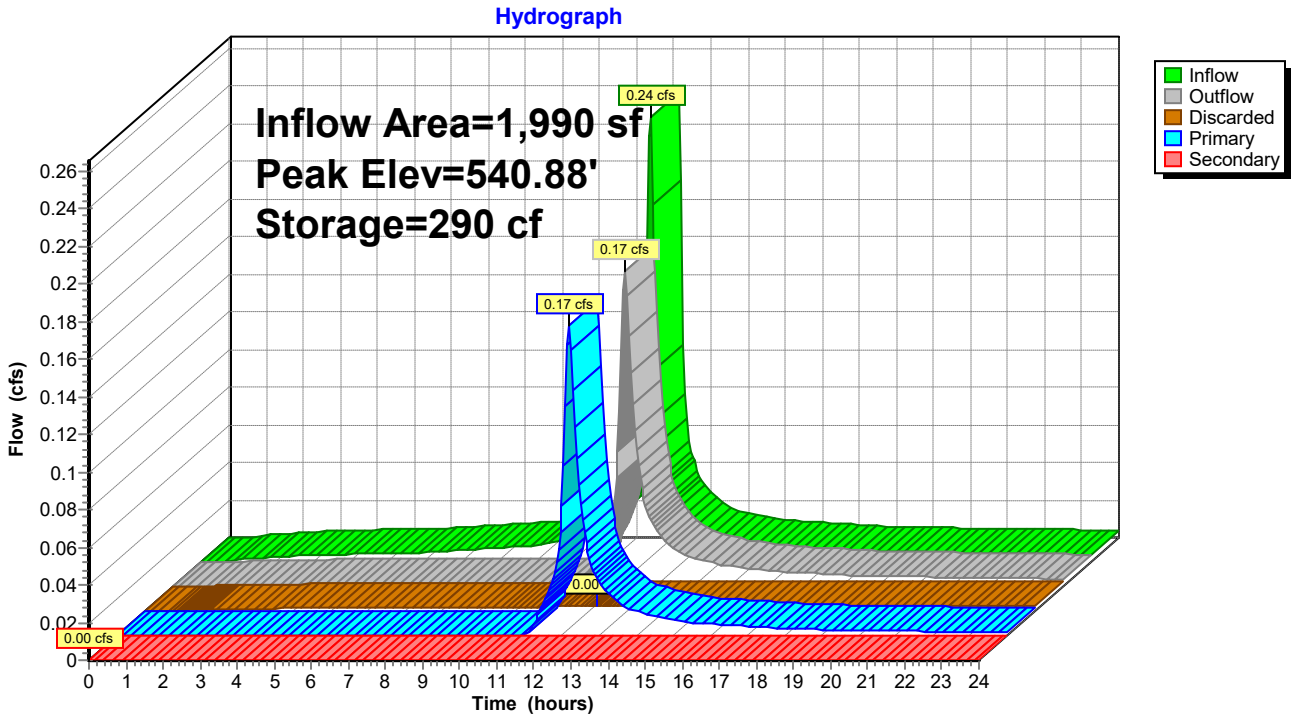
Subcatchment 101S: Undetained Area to Design Point



Reach 1R: Design Point 1



Pond 1P: Infiltration Basin



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100S: Area to Basin Runoff Area=1,990 sf 100.00% Impervious Runoff Depth>8.10"
Tc=6.0 min CN=98 Runoff=0.33 cfs 1,344 cf

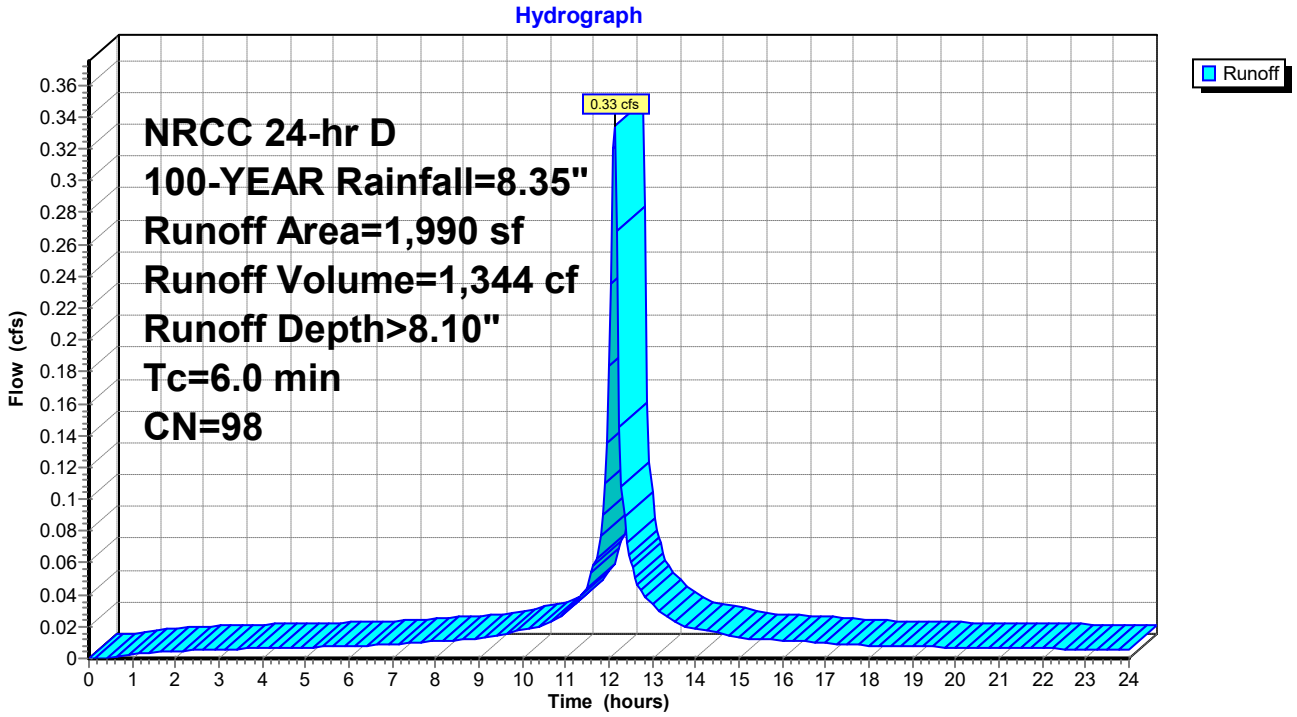
Subcatchment 101S: Undetained Area to Runoff Area=4,765 sf 0.00% Impervious Runoff Depth>5.23"
Tc=6.0 min CN=74 Runoff=0.61 cfs 2,078 cf

Reach 1R: Design Point 1 Inflow=0.83 cfs 3,052 cf
Outflow=0.83 cfs 3,052 cf

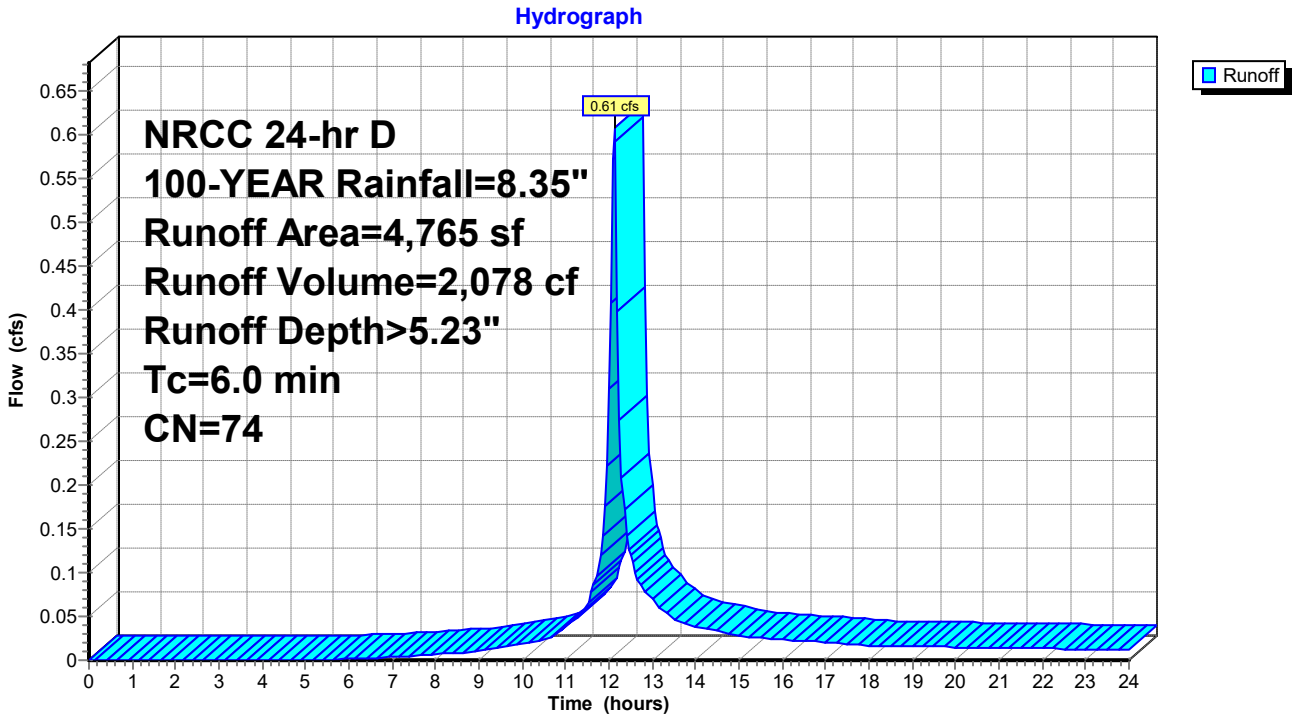
Pond 1P: Infiltration Basin Peak Elev=540.96' Storage=324 cf Inflow=0.33 cfs 1,344 cf
Discarded=0.00 cfs 183 cf Primary=0.24 cfs 974 cf Secondary=0.00 cfs 0 cf Outflow=0.24 cfs 1,158 cf

Total Runoff Area = 6,755 sf Runoff Volume = 3,421 cf Average Runoff Depth = 6.08"
70.54% Pervious = 4,765 sf 29.46% Impervious = 1,990 sf

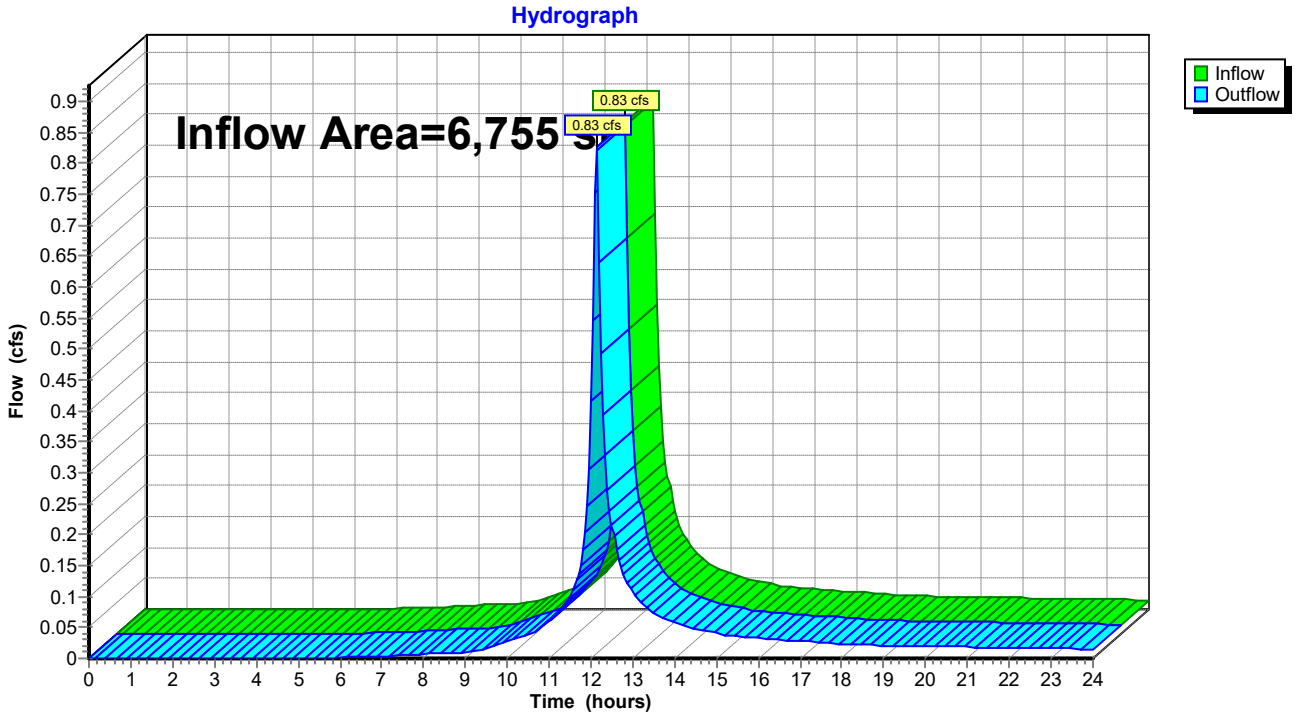
Subcatchment 100S: Area to Basin



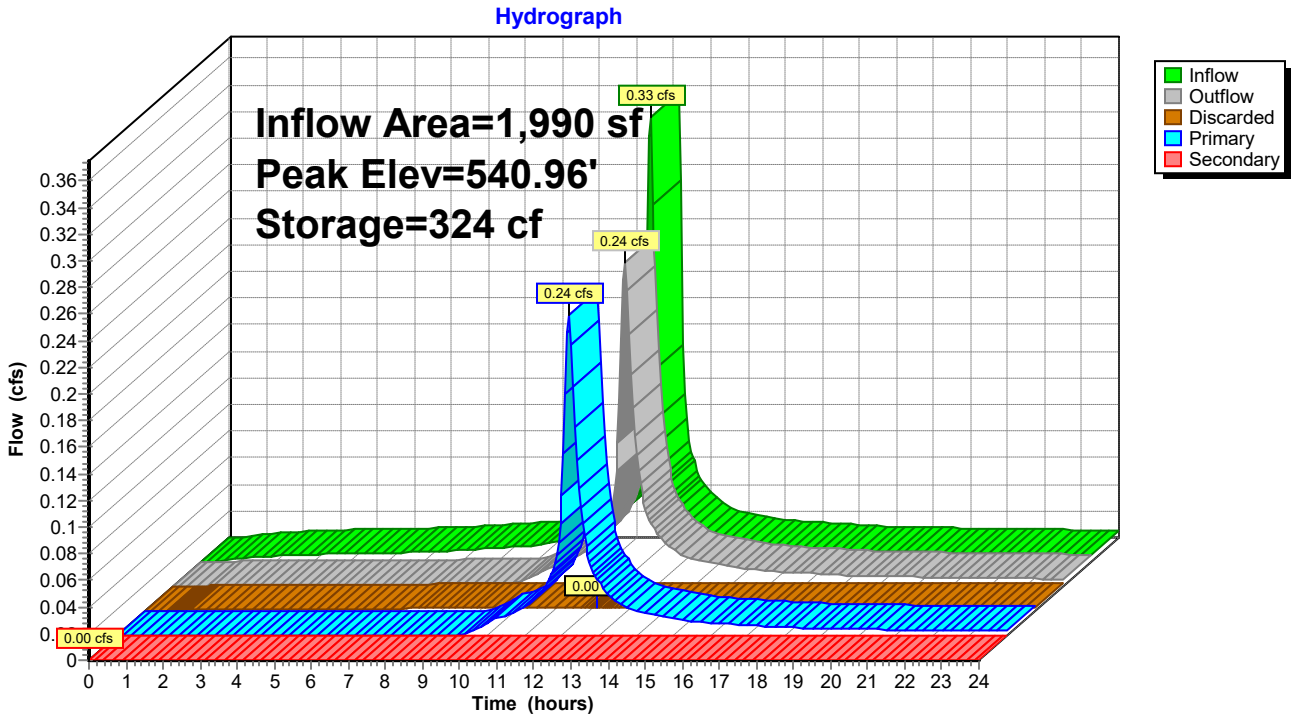
Subcatchment 101S: Undetained Area to Design Point



Reach 1R: Design Point 1

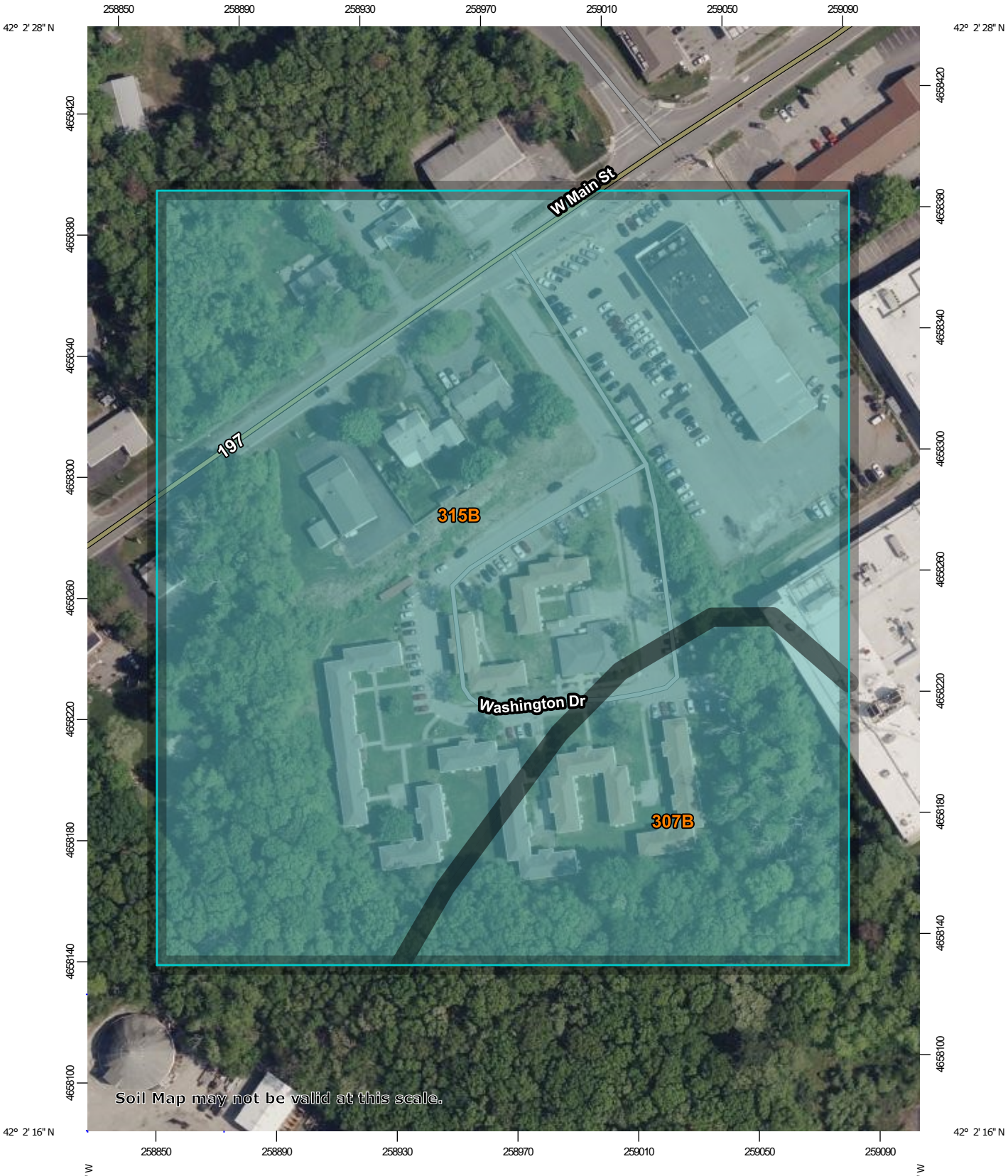


Pond 1P: Infiltration Basin



APPENDIX D

USDA-NRCS SITE SOILS MAP



Map Scale: 1:1,780 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 15, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	3.0	20.5%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	C	11.6	79.5%
Totals for Area of Interest			**14.6**	**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

APPENDIX E

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

System

The additional drainage system associated with the site at Joshua Place is an open drainage system consisting of an infiltration basin.

Responsible Parties

The drainage system located on site property will be operated and maintained by the owner, Dudley Housing Authority post-construction. Drainage system maintenance tasks shall include routine cleaning of the overall drainage network and specific duties as listed below.

The responsible party must designate a "qualified personnel" to perform the inspections associated with this plan. This means a person knowledgeable of the layout and overall function of the stormwater system. As necessary, this "qualified personnel" shall employ the services of a registered professional engineer when inspections reveal a failing stormwater system component or when similar attention is needed beyond the knowledge or experience of the inspector.

Operation and Maintenance Duties

The following duties shall be considered the minimum required and may be supplemented by additional measures as necessary to maintain the function of the drainage system. This operation and maintenance plan shall serve as a supplement to any and all existing drainage system duties.

Sweeping:
Sweeping of the impervious areas, parking lots and driveways should be done at least 2 times annually, namely in the spring and fall. It is imperative that sweeping take place immediately following final winter snowmelt to remove winter sand. All sediments containing hydrocarbons shall be handled properly and disposed of in accordance with local, state and federal guidelines and regulations.

Infiltration Basin:
Infiltration basin maintenance begins with education of the function and purpose of the structure; namely that of stormwater management and treatment. It is imperative that sand used in winter conditions not be allowed to enter the infiltration basin as it will clog the soil media. Reduced sanding should be employed in the area draining to the infiltration basin and any accumulated sand should be removed immediately. Snow must not be stored in the infiltration basin. Deicing chemicals should not be used in the area draining to the infiltration basin.

Inspections should be performed monthly and/or after every rain event of more than 2 inches of rainfall in 24 hours; there should be no ponding water within the infiltration basin after 72 hours following a rainstorm. Inspect the infiltration basin for signs of erosion and repair immediately if found. Re-hydroseed void areas as needed. Monthly inspections must also include the following:

- Remove litter and debris.
- Treat diseased plantings as needed; prune and replace dead vegetation with like material.
- Remove invasive vegetation and weeds.
- Fertilize and apply pesticides if needed.

- Maintain all culverts, outlet structure, and piping free of debris and blockages.

Annual Budget

An annual budget for the operation and maintenance tasks describe above is estimated at $1,000.

APPENDIX F

LONG-TERM POLLUTION PREVENTION PLAN

LONG-TERM POLLUTION PREVENTION PLAN

Pollution Prevention and Source Control Plan

The site lessee, Dudley Housing Authority, shall designate a pollution prevention team whose responsibilities are the following:

- Good housekeeping: General trash and litter cleanup of the site, inspect all vehicles on a regular basis for detention of leaking oil, gas and other fluids, provide routine visual inspections of potential pollution sources, maintain an inventory of potential pollution sources stored on site (i.e. paints, solvents, etc.). Initiate and maintain record keeping of activity with regard to the contents of this plan.
- Storing materials and waste products inside or under cover: All materials and waste products shall be stored within the building or within the covered dumpster.
- Vehicle washing: Vehicle washing is to be performed offsite.
- Routine inspections and maintenance of stormwater BMP's: Follow the requirements of the site *Long-Term Drainage System Operation & Maintenance Plan*. Be aware of site drainage components and Best Management Practices (BMP's) and their locations including the sediment forebay, bioretention area and riverfront restoration area.
- Spill prevention and response: In the event of a spill outside of the building, immediately initiate containment and cleanup procedures appropriate for the material including but not limited to sorbent media, towels and barriers, catch basin inlet seals, etc. as well as notifying the proper authorities. All attempts must be made to prevent spilled material from entering the drainage system or infiltrating into the ground.
- Maintenance of lawns and landscaped areas: Regularly mow lawn areas and weed landscaped areas.
- Storage and use of fertilizers, herbicides, and pesticides: All such materials shall be stored inside the proposed building(s). It is recommended not to store such materials in large quantities.

Dudley Housing Authority shall be responsible for training designated staff in the procedures described herein. Note that this Plan does not indemnify Dudley Housing Authority from the requirements of any local, state, or federal requirements of regulations regarding the storage or release of potentially hazardous materials.

Snow Management Plan

The goal of this plan is to employ proper management of snow and snow melt, in terms of snow removal and storage, use of de-icing compounds, and other practices that can prevent or minimize runoff pollutant loading impacts. The following measures shall be taken:

- *Use of de-icing compounds:*
  - Use alternative de-icing compounds such as calcium chloride ($CaCl_2$) and calcium magnesium acetate (CMA),
  - Reduce the use of de-icing compounds through better training and careful application.

- *Storage of de-icing compounds:*
  - Store compounds on sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.

- *Snow removal and storage:*
  - Place snow in designated area where it can slowly infiltrate however it should not be placed over any component of the site's stormwater management system nor the riverfront restoration area.

APPENDIX G

TSS REMOVAL CALCULATION WORKSHEET

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: To Design Point #1 (North) thru Infiltration Basin

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Infiltration Basin	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

Project: **Joshua Place**

Prepared By: **OGC**

Date: **10/2/2023**

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

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

1. From MassDEP Stormwater Handbook Vol. 1

GRAPHIC SCALE
(IN FEET)
1 inch = 10 ft.

N/F
191 WEST MAIN DUDLEY, LLC
BK. 61449 PG. 208
PL. BK. 342 PG. 4

DESIGN POINT #1

10S

20

PRE-DEVELOPMENT DRAINAGE AREAS
PARKING IMPROVEMENTS
DUDLEY HOUSING AUTHORITY, JOSHUA PLACE 667-1, EOHLC #080050

PREPARED FOR: DUDLEY HOUSING AUTHORITY
22 JOSHUA PLACE, DUDLEY, MA 01571

DATE: 10/3/23	SCALE: 1"=10'	DES. BY: OGC	DRW. BY: OGC	CHK. BY: MRA	PRJ. NO.: 23101

PRE-DA

NO.	DATE	BY	DESCRIPTION
1	10/11/23	MRA	ISSUED FOR PERMITTING

REVISIONS

GRAVES ENGINEERING, Inc.
100 GROVE STREET | WORCESTER MA 01605
T 508-856-0321 | F 508-856-0357
gravesengineering.com

GRAPHIC SCALE

(IN FEET)
1 inch = 10 ft.

10 0 5 10 20 40

N/F
191 WEST MAIN DUDLEY, LLC
BK. 61449 PG. 208
PL. BK. 342 PG. 4

DESIGN POINT #1

POST-DA

POST-DEVELOPMENT DRAINAGE AREAS

PARKING IMPROVEMENTS

DUDLEY HOUSING AUTHORITY, JOSHUA PLACE 667-1, EOHLC #080050

PREPARED FOR:
DUDLEY HOUSING AUTHORITY
22 JOSHUA PLACE, DUDLEY, MA 01571

DATE: 10/3/23	SCALE: 1"=10'	DES. BY: OGC	DRW. BY: OGC	CHK. BY: MRA	PRJ. NO.: 23101

NO.	DATE	BY	DESCRIPTION
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