

Drainage Report and Stormwater Management Plan

Emerson Homes Comprehensive Permit

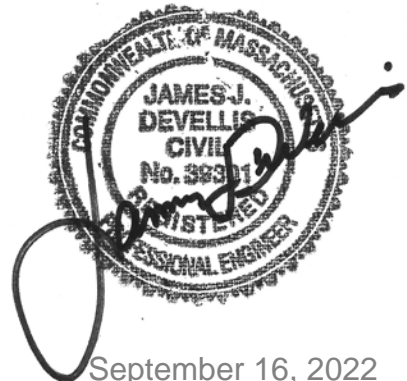
10 High Street
Topsfield, Massachusetts

Applicant

The Caleb Group/Emerson Homes

Civil Engineer, Landscape Architect & Site Planner

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September 16, 2022
Rev. March 15, 2023

Drainage Report

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1. Executive Summary

The Applicant is proposing a new residential building through the Comprehensive Permit Application process to be located at 10 High Street (the Site) in Topsfield, Massachusetts.

This project consists of one elderly housing residential apartment building serviced by a new access driveway from High Street with 48 parking spaces. Proposed utilities (water, gas, electric/cable/fire and drainage, on-site septic) are proposed within the proposed development.

The Site currently consists of grass, ball fields, a tennis court and wooded areas.

A Notice of Intent will be submitted to address working within the wetland jurisdictional areas. As there are on-site wetland resources areas on the eastern and western perimeters of the Site. The Site is outside of any FEMA-FIRM 100-year flood zones and within Zone X (Minimal Flood Hazard).

This report addresses the drainage characteristics of the proposed residential project with respect to current and future stormwater runoff. It qualifies and quantifies the drainage mitigation with respect to stormwater runoff volumes, runoff rates, and stormwater quality as well as the addressing sediment and runoff controls during and after the construction process.

DeVellis Zrein Inc. (DZI) has analyzed the pre-development and post-development conditions of the project site and developed a stormwater management plan to mitigate the impacts resulting from this proposed project. The report addresses the stormwater maintenance protocol required to help ensure that the drainage system is maintained properly and achieve longevity and effectiveness. The proposed construction will increase the impervious surface area on-site and the stormwater management system has been designed to mitigate any increase in stormwater runoff to ensure that the post-development peak runoff rate from the site will be less than to the existing peak runoff rates. DEP Regulations require an applicant to match the rate in which stormwater leaves the Site. The future stormwater runoff from the development area will be reduced with drainage improvements such as a closed piping system with catch basin structures, a surface rain garden and a surface stormwater detention basin.

The future maintenance and upkeep of the site will be the responsibility of the Applicant and the project. The stormwater design addresses ease of maintenance concerns while meeting all of the state stormwater requirements and standards. Massachusetts Performance Standards and Regulations for Stormwater Management "Best Management Practices" have all been exceeded.

The following narrative provides a description of both the existing and proposed site conditions, and the methodology for design and implementation of stormwater management systems for the project.

Drainage Report

2. Existing Conditions

The project site is approximately 12.5+/- acres, located along the northern edge of High Street.

There are Massachusetts Department of Environmental Protection (DEP) regulated resources on site jurisdictional buffer limits. The site is serviced by Municipal water. The proposed building will require an on-site septic system as no municipal sewer service is available.

The site will be accessed from High Street which is a public way.

The site is currently undeveloped with the exception of playing fields and a tennis court and can be generally described as having a combination of woods and open grass.

The topography is sloping from higher areas (elevation 67 feet) along the northwestern area and towards the east (elevation 64) and west (elevation 66) site where the wetland resource areas exist. A small area abutting High Street drains back to High Street (elevation 68 down to elevation 66). In general, the site is considered relatively flat.

Description of Contributing Area

The following is a brief description of the drainage area:

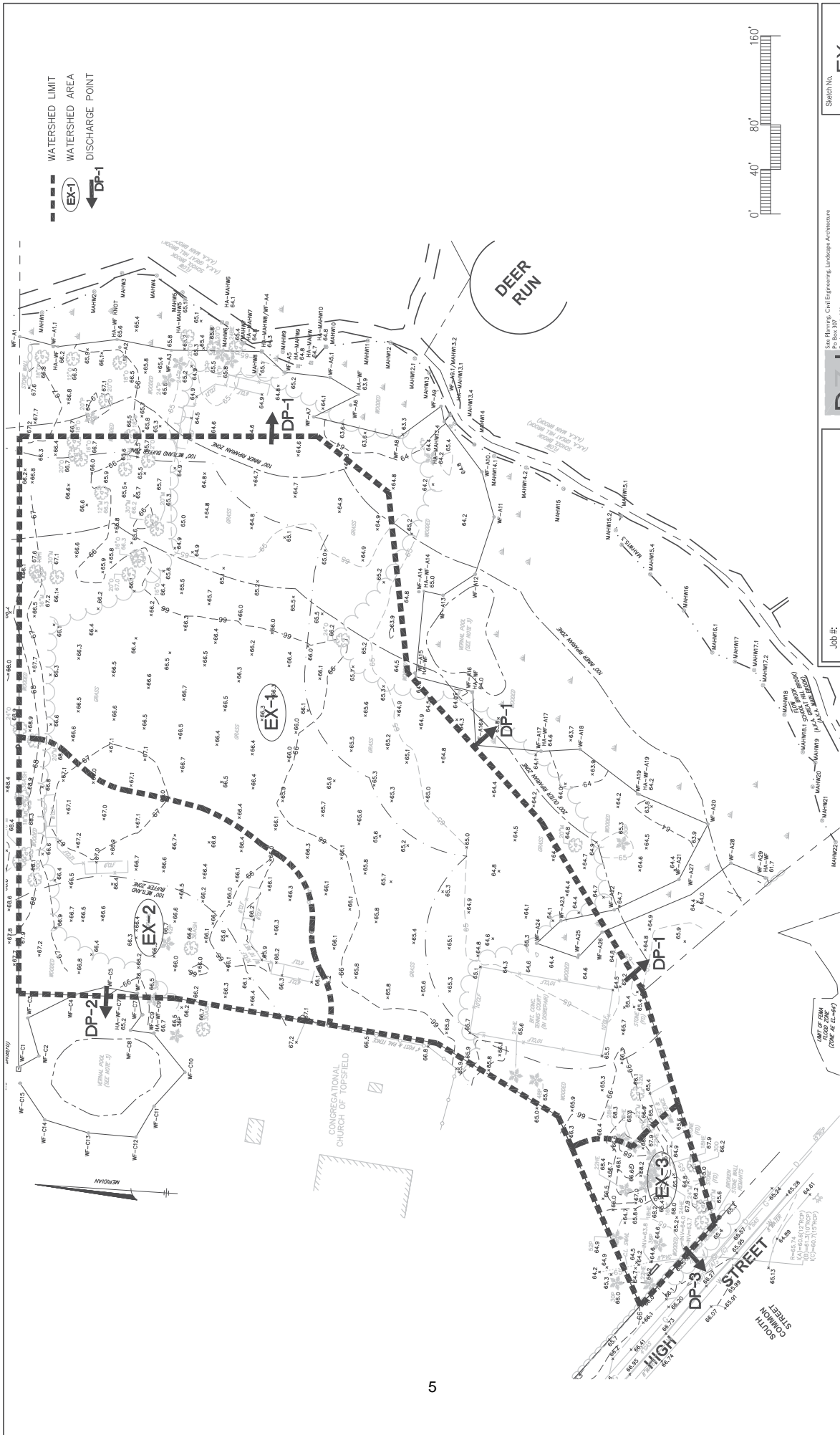
The analysis has been prepared to identify each existing drainage area and the design has been performed to reduce pre- and post- runoff conditions to each area.

The existing development area and the area of effective drainage study is approximately 5.6 acres (Figure EX) and is categorized with three distinct watersheds; EX-1, EX-2 and EX-3 which are tributary to both wetland areas and the small area at High Street.

DZI has performed test pits throughout the site to determine subsurface conditions and current and historic high groundwater levels on the Site.

For the purpose of this hydrologic analysis, the following assumptions were made:

- Whenever possible, the property line and/or an arbitrary line, outside the limit of proposed work are delineated as the watershed boundary.
- The total watershed area for the existing conditions is used as the comparison base for the watershed area in the proposed conditions.



Job #: _____ Drawn by: KZ Checked by: _____ Date: 08.03.22 Scale: 1" = 80'	<div style="text-align: center;">  DeVellis Zrein Inc. <small>Site Planning, Civil Engineering, Landscape Architecture 10 High Street Topsfield, MA 01968 978-673-4111 info@devellis.com</small> </div>	Sketch No. EX Project Name: 10 High Street Topsfield, MA
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Title: **EXISTING WATERSHED MAP**

Drainage Report

Soil Conditions

The soils are defined by the Soil Conservation Services (SCS) Soil Survey of Essex County, Massachusetts. The site development area is comprised of soil Type B. See copy of the SCS Soils Survey at the end of this memo. The following table lists the soil designation, soil name and the soil group.

Table 1 - SCS Soil Types

Map Designation	Soil Name	Soil Group
260A	Sudbury Fine Sandy Loam 0 to 3% slopes	B

Existing Drainage Area Summary

The following table summarizes the existing drainage area, including the pertinent information used for the hydrologic analysis:

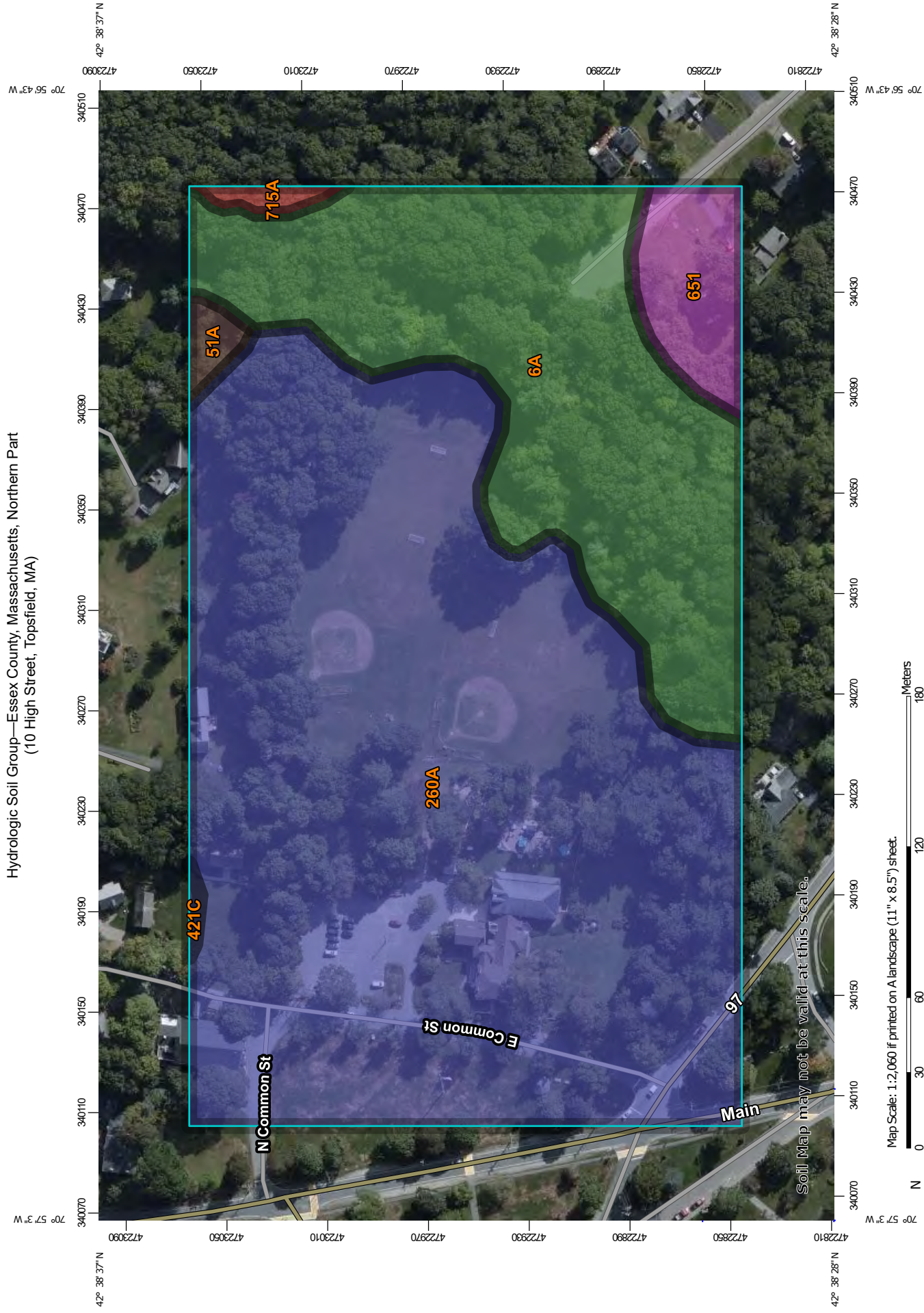
Existing Conditions Drainage Area - Characteristics

Drainage Area	Area (acres)	Curve Number	Tc (min.)
EX-1	4.2	68	16.5
EX-2	1.1	68	6.0
EX-3	0.3	60	6.0

Peak Discharge Runoff Rates

The existing peak flow rates, tributary to the drainage point, were calculated for the 2, 10, 25 and 100-year storm events in accordance with guidelines given in DEP's Stormwater Management Policy. Results are presented in the following section of this report. Refer to Existing Watershed Plan for a delineation of the watershed areas and their respective points of concentration.

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part (10 High Street, Topsfield, MA)



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

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

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

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

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

Date(s) aerial images were photographed: Sep 13, 2019—Oct 5, 2019

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
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	5.4	26.5%
51A	Swansea muck, 0 to 1 percent slopes	B/D	0.2	0.8%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	B	13.9	68.1%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	B	0.0	0.1%
651	Udorthents, smoothed	A	0.8	3.9%
715A	Ridgebury and Leicester fine sandy loams, 0 to 3 percent slopes, extremely stony	D	0.1	0.6%
Totals for Area of Interest			20.4	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

3. Proposed Conditions

This proposed project consists of one residential apartment building serviced by a new access driveway from High Street with 48 parking spaces. Proposed utilities (water, gas, electric/cable/fire and drainage, on-site septic) are proposed within the proposed development.

When impervious surfaces such as pavement and roof top are proposed, there will be an increase in stormwater runoff if mitigation is not provided. A stormwater management system is required to maintain the characteristics of the existing watersheds to the extent practicable.

Meeting current conditions are the requirement. Runoff rates at the discharge point are required to be maintained to existing conditions by temporarily holding runoff and slowly releasing it off site to meet existing peak flow rates.

The stormwater objectives of this project are summarized as follows:

1. Decrease the rate of runoff by providing stormwater retention
2. Exceed proper engineering standards of Topsfield's DPW and the DEP

Drainage Area PR-1A

Drainage Area PR-1A encompasses the proposed building, the majority of the access drive, the parking area and the above round stormwater detention basin with perimeter landscaping.

All areas within PR-1A will eventually enter into the stormwater detention area to reduce the rates of runoff by collection and detention.

Drainage Area PR-1B

Drainage Area PR-1B encompasses areas outside of the building and parking and generally described as lawn area, landscaping or woods. This area will sheet flows towards the direction of the wetland area (DP-1) un-detained.

Drainage Area PR-2

Drainage Area PR-2B encompasses areas outside of the building and parking and generally described as lawn area, landscaping or woods. This area will sheet flows towards the direction of the wetland area (DP-2) un-detained.

Drainage Area PR-3

Drainage Area PR-3 encompasses part of the access drive area closest to High Street, perimeter landscape areas and the rain garden along the site access drive near High Street. Runoff from the paved area is collected by a catch basin and is carried to the rain garden. Outflow from the rain garden is connected to an existing drain line that originates from the site and carries stormwater from the abutting land to the west (DP-3).

Drainage Report

Proposed Drainage Area Summary

The following summarizes the proposed drainage areas, including the pertinent information used for the hydrologic analysis:

Proposed Conditions Drainage Area Characteristics Summary:

Drainage Area	Area (Acres)	Curve Number	T_c (min.)
PR-1A	1.99	93	6.0
PR-1B	2.20	61	6.0
PR-2	1.02	65	6.0
PR-3	0.38	70	6.0

Peak Discharge Runoff Rates

The proposed peak flow rates, tributary to the drainage point, were calculated for the 2, 10, 25 and 100-year storm events in accordance with guidelines given in DEP's Stormwater Management Policy. Results are presented in the following table. Refer to Proposed Watershed Plan for a delineation of the watershed areas and their respective points of concentration.

Summary of Results

As previously stated, the resultant post-development peak discharge rates for the discharge points are less than the pre-development peak discharge rates. The following table provides a summary of the pre and post development data. The following table demonstrates peak flows at the design points for each of the design storms has been met.

Peak Rates of Runoff Leaving the Site:

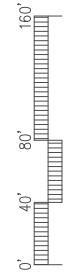
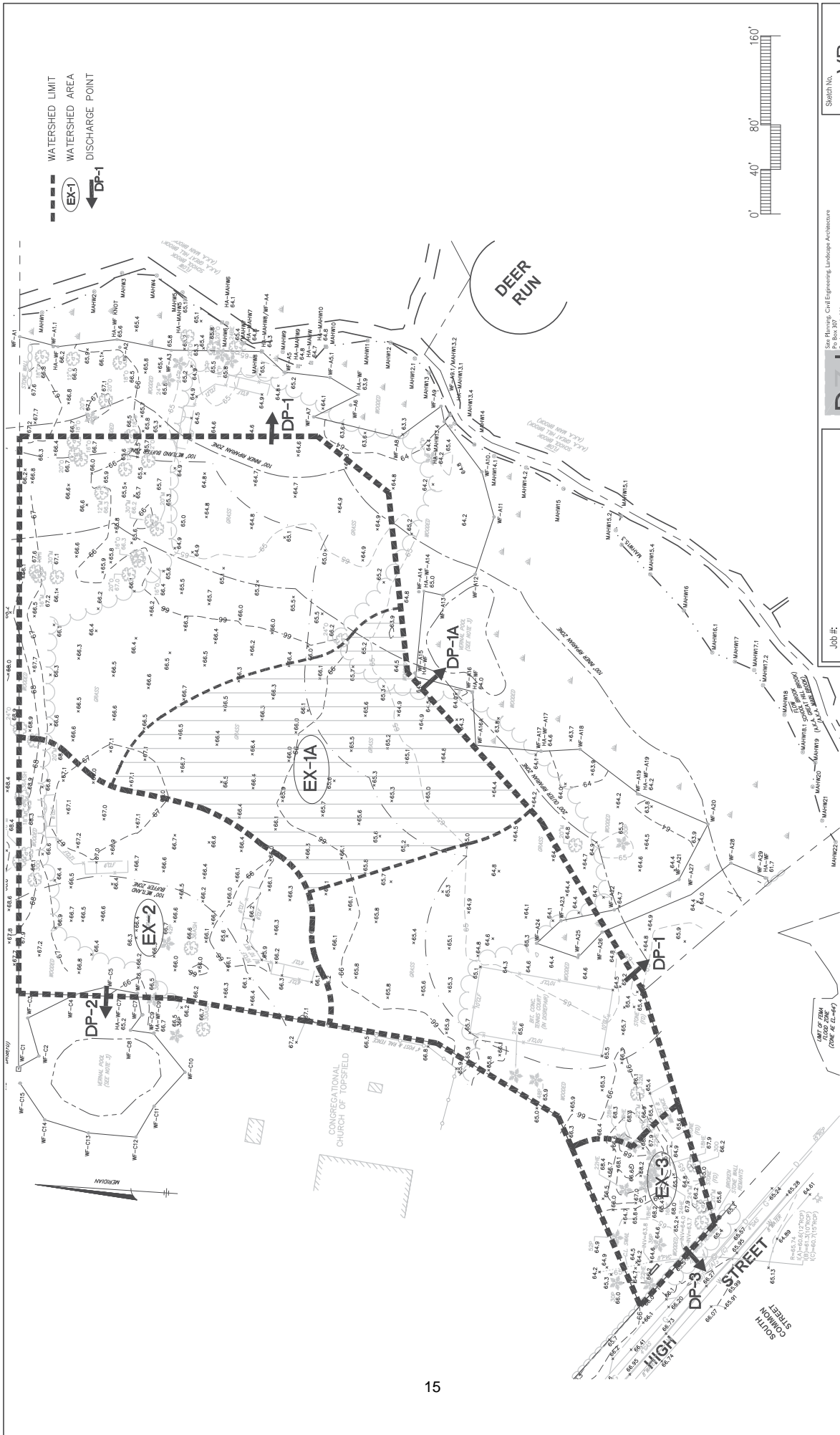
Location	2-Year Storm		10-Year Storm		25-Year Storm		100-Year Storm	
	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)
DP-1	1.96	1.07	5.53	4.00	8.83	6.62	16.31	12.69
DP-2	0.75	0.52	2.07	1.64	3.28	2.75	6.00	5.11
DP-3	0.07	0.00	0.33	0.00	0.59	0.12	1.22	0.50

Drainage Report

4. Potential Vernal Pool

A separate analysis was requested to be performed to evaluate the stormwater runoff to the existing potential vernal pool, located east of the proposed development. See figure VP and attached calculations. In order to maintain similar hydrologic characteristics to the vernal pool area, a small outlet pipe is added to the stormwater basin outlets and is located near the potential vernal pool area. Given that the majority of the storms are a 1" or less storms, the outlet pipe to the potential vernal pool is designed to mimic existing conditions for the 2- and 10-year storm events. The table below shows a comparison of the existing runoff vs the proposed runoff to the vernal pool area.

Location	2-Year Storm		10-Year Storm	
	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)
DP-1A	0.61	0.61	1.70	1.04



<p>Site Planning Civil Engineering Landscape Architecture 10 High Street Topsheld, MA 01968 508-673-4111 info@devellis.com</p>		<p>Sketch No. VP</p>
<p>Project Name: 10 High Street Topsheld, MA</p>		<p>Job #:</p>
<p>Client: DeVellis Zrein Inc.</p>		<p>Drawn by: NZ Checked by:</p>
<p>Date: 03.15.23</p>		<p>Scale: 1" = 80'</p>
<p>Title: EXISTING WATERSHED TO VP</p>		

Drainage Report

1. Methodology and Design Criteria Hydrologic Model

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-20 method and the drainage software HydroCAD 7.10, as developed by Applied Microcomputer Systems. Data used in the design is as follows:

Design Storms

Rainfall data for the 2, 10, 25 and 100- year frequency rainfall events (for a 24-hour precipitation) was taken from the Rainfall Frequency Atlas of Northeast Regional Climate Center "Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada". The following table outlines the rainfall used for the TR-20 method.

Rainfall Data

Storm Event	Rainfall
2-Year	3.15 inches
10-Year	4.83 inches
25-Year	6.16 inches
100-Year	8.94 inches

Time of Concentration

The 'time of concentration' (T_c) for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the TR-55 Method and HydroCAD. A minimum T_c of 6.0 minutes was used.

Curve Numbers

Based on the cover type and hydrologic soil group, a weighted curve number (CN) was determined for each of the watersheds utilizing the SCS TR-55 method.

2. Department of Environmental Protection Stormwater Management Standards

Standard 1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The project does not propose any new untreated outfalls or discharge of untreated water into wetlands or waters of the Commonwealth. All proposed impervious surfaces will be collected and treated with catch basins and detained on-site with a detention / recharge system.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The project will reduce the post-development stormwater peak discharge rate to pre-development conditions via infiltration pipes and a detention system.

Standard 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The intent of this standard is to ensure that the infiltration volume of precipitation into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions. Standard 3 requires the restoration of recharge, using infiltration measures and careful site design.

The project will provide groundwater recharge. The infiltration provided within the detention / recharge system recharges stormwater back into the ground per the required amounts.

The NRCS classifies soils into one hydrologic groups B, indicative of the minimum infiltration obtained for a soil after prolonged wetting. Group A soils have the lowest runoff potential and the highest infiltration rates, while Group D soils have the highest runoff potential and the lowest infiltration rates. The required recharge volume, the stormwater volume that must be infiltrated, was determined using existing site conditions and the infiltration rates set forth below.

Drainage Report

Hydrologic Group Volume to Recharge (Total Impervious Area)	
Hydrologic Group	Volume to Recharge Total Impervious Area
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

The soils are defined by the Soil Conservation Services (SCS) Soil Survey of Essex County, Massachusetts. The site area is comprised of one soil types.

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

This standard is met by this project:

- a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
- b) Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
- c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

The stormwater runoff from the proposed parking and access drive will exceed the 80% TSS removal as the project is equipped with catch basins and a detention basin.

A long-term Operation and Maintenance Plan associated with this project has been designed and is included within this report.

Standard 5: Regards land uses with higher potential pollutant loads:

This is Not Applicable.

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

Drainage Report

This is Not Applicable.

Standard 7: Regards redevelopment projects:

This is Not Applicable.

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

The Sediment and Erosion Control Plan contains provisions for the construction related items such as silt controls, sequencing and Operation and Maintenance provisions for construction and post construction activities. A NPDES/SWPPP will be required and when a contractor is awarded the project, this plan will be submitted with all of the appropriate information on it.

Standard 9: A Long -Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The Long-Term Operation and Maintenance Plan has been prepared within this report and referenced on the plans that include the routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks.

Standard 10: All illicit discharges to the stormwater management system are prohibited.

Standard 10 prohibits illicit discharges to stormwater management systems. By acceptance of this document, the Applicant acknowledges that the stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. This document shall serve as the Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and within the pollution prevention plan measures to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.



(Signature)

(agent for Applicant The Caleb Group/Emerson Homes)



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 8²
- Operation and Maintenance Plan required by Standard 9

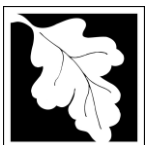
In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans 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.



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.

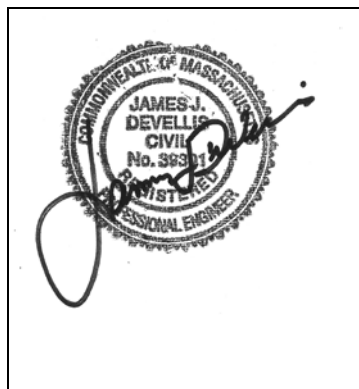
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



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): Rain Garden / Detention Basin

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 Field¹
- ☒ 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)

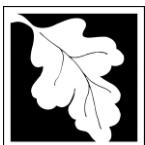
Standard 3: Recharge (continued)

- ☒ 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.

6. Stormwater Operation and Maintenance Plan

Introduction

DeVellis Zrein Inc. has prepared this report as a guide to establish maintenance protocol for the on-site drainage improvements serving the Proposed Falcon Farms Subdivision. The goal of the Storm Water Operation and Maintenance Plan is not only to protect off-site wetlands and water resources abutting the site, but also to protect those resources in the region that may be affected by the activities at the site.

The proposed site drainage improvements include:

- Catch Basin Inlets
- Drain pipe network
- Rain Garden System
- Detention Basin System
- Landscaping

The proposed water quality treatment measures will result in improved removal of the total suspended solids (TSS) load in runoff from the site for the proposed parking improvements as well as throughout the existing parking areas.

An effective drainage maintenance program will ensure that the removal of TSS from the stormwater runoff continues for the life of the facility. The Operation and Maintenance Plan will be implemented by the Applicant and will not be the responsibility of the Town of Topsfield

Source Control

The first tier of non-structural controls includes a comprehensive source control program of regular maintenance of the stormwater management components.

Pavement Sweeping Program

The removal of contaminants directly from paved surfaces before contact with storm water is a valuable method for reducing pollutant loading in stormwater.

It is proposed that the parking and drive areas will be cleaned on a bi-annual basis with two sweepings per year. Sweeping at the beginning of spring is recommended and at the end of fall. Because of the small size of the project, the sweeping can be accomplished with a traditional street sweeper or through routine landscape maintenance with hands sweeping and blowers.

Drainage Report

Catch Basins

The new catch basins along the drive will be equipped with deep sumps to collect sands and solids and a hood to hold floatable materials and oil/gas contaminants from leaving the catch basin. The catch basins are recommended to be cleaned during the same schedule as the sweeping.

Detention Basin System

The actual removal of sediments and associated pollutants and trash occurs only when inlets are cleaned out; therefore, regular maintenance is required. At a minimum, the water quality basin and should be cleaned two times per year and inspected annually. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. Access to the basin is provided and shall be kept unobstructed.

Rain Garden

The raingarden at the site entrance will collect stormwater from the southern portion of the drive. The selected plantings will clean the water and provide habitat and food for the wildlife. In the summer months, the raingardens also allow the stormwater water to cool and infiltrate into the root systems. This area provides surface stormwater mitigation which can easily be maintained and cared for and is located in a highly visible area that will be cared for. Access to the basin is provided and shall be kept unobstructed.

Landscaping

The proposed project provides extensive landscaping along the perimeter and throughout.

A landscape plan has been provided to include hardy indigenous plants that are appropriate to survive in a parking environment in New England winters.

In the spring, the owner shall verify that the plants planted and included on the Planting Plan remain in good health in perpetuity. If there is damage, the plants are to be replaced in the same manner.

NPDES/SWPPP

The project shall submit a Stormwater Prevention Pollution Protection Plan and a National Pollution Discharge Elimination System application and receive this permit prior to any construction commencing. This permit shall be submitted to the Town Conservation and Engineering departments for review and comment prior to construction.

Drainage Report

During Construction

- Prior to construction, install tree protection and erosion and sediment control measures as shown on the plan and details.
- The site contractor shall inspect all sediment and erosion control structures after each rainfall event and at the end of the working day.
- All measures shall be maintained in good working order. If repair is necessary, it shall be initiated within 24 hours of inspection.
- Silt shall be removed from the silt fence if 3-inches or greater and as needed.
- Sediment shall be contained within the construction site and away from drainage structures.
- Damaged or deteriorated erosion control measures will be repaired immediately after identification
- The silt fence shall be kept in close contact with the ground and reset as necessary.
- The contractor's site superintendent will be responsible for inspection, maintenance and repair activities.
- All disturbed areas will be treated with 4" of topsoil and seed.
- Remove siltation controls upon completion of permanent vegetation over disturbed areas.

Post Construction

The following site performance requirements are to be established at the property:

- Parking and drive areas will be cleaned with sweeper on a bi-annual basis with two (2) sweepings per year. Sweeping at the beginning of each season is recommended.
- Inspect the perimeter landscaping annually, in the spring, for erosion of side slopes, embankments, and accumulated sediment. Necessary sediment removal, earth repair and/or reseeding shall be performed immediately upon identification.
- Routinely pick up and remove litter from the parking areas, islands and perimeter landscape area, in addition to pavement sweeping.
- Inspect and clean drainage inlets and sediment forebays yearly. Clean and/or repair as needed.
- Maintain the basin and rain garden annually and replace all plants that have died. Prune vegetation within to maintain health structure and avoid woody growth that would impact the functionality of the basin.
- Inspect and clean outlet flared end sections and associated rip-rap yearly. Clean and/or repair as needed.

Drainage Report

Stormwater Management System Owner

This site is owned by the Applicant (or successor/owner) who will be responsible for the Operation and Maintenance.

SITE OPERATION AND MAINTENANCE PLAN

Project: EMERSON HOMES

DATE: March 10, 2023

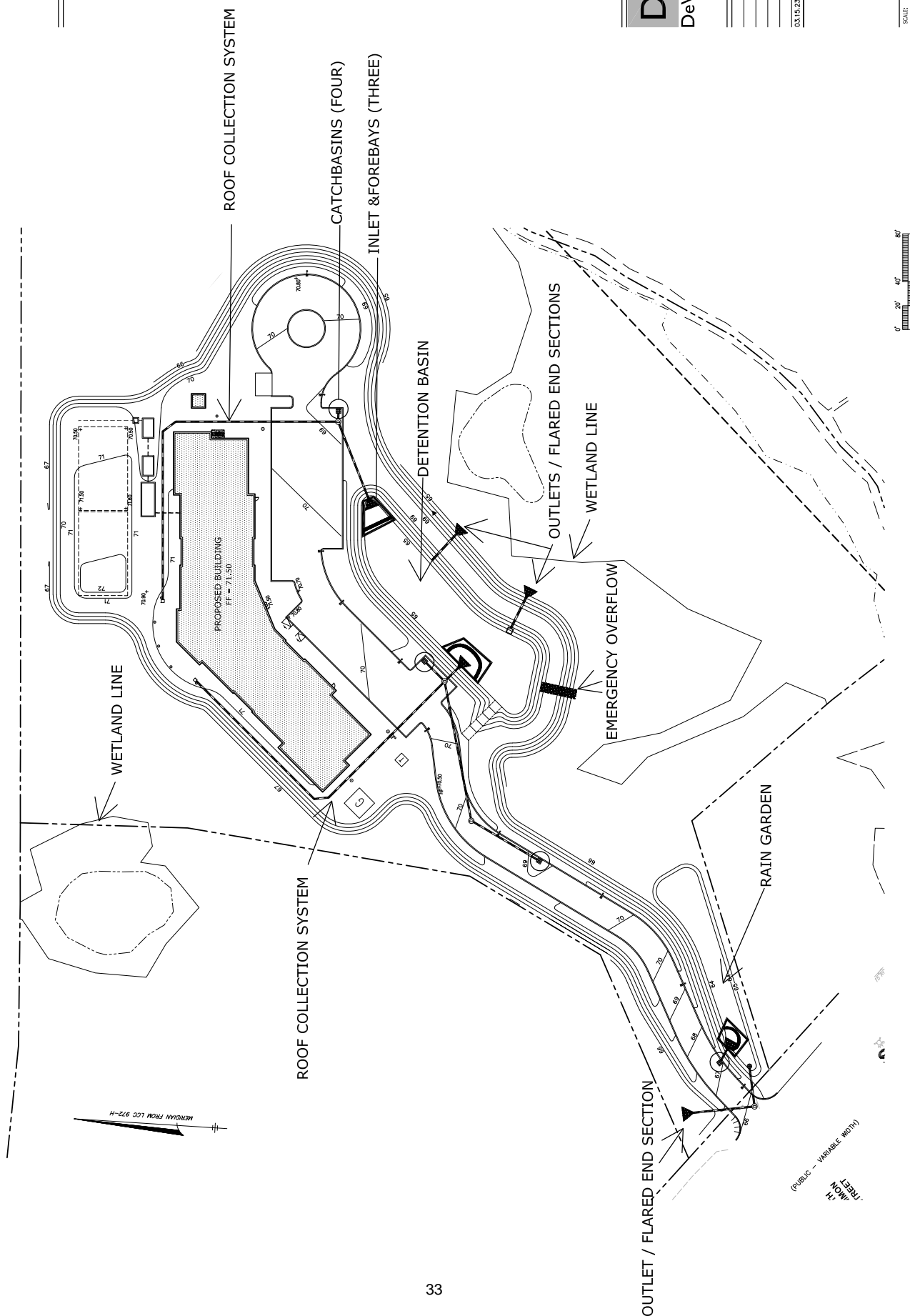
EXTENT OF SERVICE	DAILY (M-F)	WEEKLY	MONTHLY	QUARTERLY	TWICE / YR	YEARLY	AS NEEDED
1 SNOW REMOVAL PER O&M Plan							X
2 EMPTY DUMPSTER)							X
3 GENERAL LANDSCAPING UPKEEP			X				
4 SPRING LANDSCAPE CLEANUP						X	
5 FALL CLEANUP						X	
6 PARKING LOT SWEEPING					X		
7 CATCHBASIN CLEANING					X		
8 RAINGARDEN LANDSCAPING				X			
9 ROOF GUTTER CLEANING						X	
10 BASIN AND RAINGARDEN INSPECTION						X	
11 CLEANING BLOWN TRASH FROM PERIMETER				X			

Prepared by DeVellis Zrein, Inc. for use by the Emerson Homes maintenance team

This document is a minimum guideline recommended to develop a process for the maintenance and upkeep of the site and building.

Once a process is decided, it is recommended that the facility prepare a signoff sheet with a final schedule and responsible parties for accountability

Owner and Responsible Entity for Operation and Maintenance: EMERSON HOMES



Drainage Report

Estimated Operations Budget

It is not anticipated that the stormwater maintenance required would be considered extraordinary. A yearly estimated operations budget for consideration to carry out the Operations and Maintenance Plan requirements is as follows:

- **\$1000:** Inspect the perimeter landscaping annually, in the spring, for erosion of side slopes, embankments, and accumulated sediment. Necessary sediment removal, earth repair and/or reseeding shall be performed immediately upon identification.
- **\$2000:** Clean all catch basin structures bi-annually (twice per year) to remove accumulated sand, sediment, and floatable products. Dispose and transport accumulated sediment off-site in accordance with applicable local, state and federal guidelines and regulations.
- **\$500:** Remove accumulated leaves and debris from catch basins and inlet/outlet openings.
- **\$500:** Routinely pick up and remove litter from the Site.
- **\$500:** Replant/replenish the detention basin and rain garden systems with specific plantings. Trim and prune as needed.

Appendix A – Hydrologic Calculations and Drain Pipe Calculations

- Hydrologic Model - Existing Conditions
Stormwater Runoff Area Calculations
Existing Conditions Calculations
2-Year Storm
10-Year Storm
25-Year Storm
100-Year Storm
- Hydrologic Model - Existing Conditions
Stormwater Runoff Area Calculations to the Potential Vernal Pool
Existing Conditions Calculations
2-Year Storm
10-Year Storm
- Hydrologic Model - Proposed Conditions
Stormwater Runoff Area Calculations
Proposed Conditions Calculations
2-Year Storm
10-Year Storm
25-Year Storm
100-Year Storm
- Hydrologic Model - Proposed Conditions
Stormwater Runoff Area Calculations to the Potential Vernal Pool
Proposed Conditions Calculations
2-Year Storm
10-Year Storm

Drainage Report

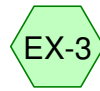
Hydrologic Model - Existing Conditions



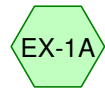
EX-1



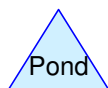
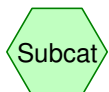
EX-2



EX-3



EX TO VP



Routing Diagram for Existing Conditions

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Existing Conditions

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.15	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.83	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	6.16	2
4	100-Year	NRCC 24-hr	D	Default	24.00	1	8.94	2

Existing Conditions

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.962	69	50-75% Grass cover, Fair, HSG B (EX-1, EX-1A, EX-2)
0.020	98	Impervious, HSG B (EX-2)
0.165	98	Paved Tennis Court, HSG B (EX-1)
1.569	60	Woods, Fair, HSG B (EX-1, EX-1A, EX-2, EX-3)
6.717	68	TOTAL AREA

Existing Conditions

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
6.717	HSG B	EX-1, EX-1A, EX-2, EX-3
0.000	HSG C	
0.000	HSG D	
0.000	Other	
6.717		TOTAL AREA

Existing Conditions

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	4.962	0.000	0.000	0.000	4.962	50-75% Grass cover, Fair	EX-1, EX-1A, EX-2
0.000	0.020	0.000	0.000	0.000	0.020	Impervious	EX-2
0.000	0.165	0.000	0.000	0.000	0.165	Paved Tennis Court	EX-1
0.000	1.569	0.000	0.000	0.000	1.569	Woods, Fair	EX-1, EX-1A, EX-2, EX-3
0.000	6.717	0.000	0.000	0.000	6.717	TOTAL AREA	

Existing Conditions

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10 High Street, Topsfield
NRCC 24-hr D 2-Year Rainfall=3.15"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 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 EX-1: EX-1

Runoff Area=183,039 sf 3.93% Impervious Runoff Depth=0.71"
Flow Length=330' Tc=16.5 min CN=68 Runoff=1.96 cfs 0.247 af

Subcatchment EX-1A: EX TO VP

Runoff Area=49,109 sf 0.00% Impervious Runoff Depth=0.71"
Flow Length=290' Tc=11.9 min CN=68 Runoff=0.61 cfs 0.066 af

Subcatchment EX-2: EX-2

Runoff Area=48,302 sf 1.78% Impervious Runoff Depth=0.71"
Tc=6.0 min CN=68 Runoff=0.75 cfs 0.065 af

Subcatchment EX-3: EX-3

Runoff Area=12,123 sf 0.00% Impervious Runoff Depth=0.39"
Tc=6.0 min CN=60 Runoff=0.07 cfs 0.009 af

Total Runoff Area = 6.717 ac Runoff Volume = 0.388 af Average Runoff Depth = 0.69"
97.25% Pervious = 6.532 ac 2.75% Impervious = 0.185 ac

Existing Conditions

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10 High Street, Topsfield
NRCC 24-hr D 2-Year Rainfall=3.15"

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Summary for Subcatchment EX-1: EX-1

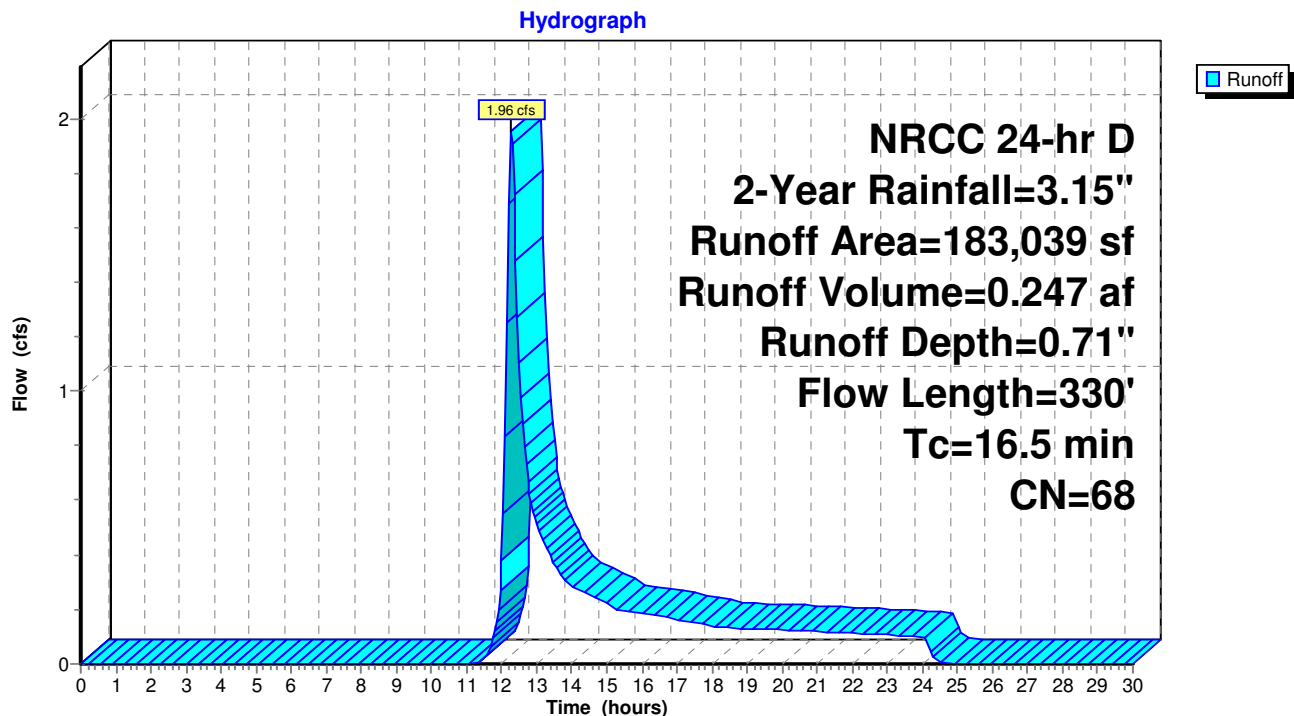
Runoff = 1.96 cfs @ 12.27 hrs, Volume= 0.247 af, Depth= 0.71"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
*	7,192	98	Paved Tennis Court, HSG B
	44,957	60	Woods, Fair, HSG B
	130,890	69	50-75% Grass cover, Fair, HSG B
	183,039	68	Weighted Average
	175,847		96.07% Pervious Area
	7,192		3.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.7	280	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
16.5	330	Total			

Subcatchment EX-1: EX-1



Existing Conditions

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10 High Street, Topsfield
NRCC 24-hr D 2-Year Rainfall=3.15"

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Summary for Subcatchment EX-1A: EX TO VP

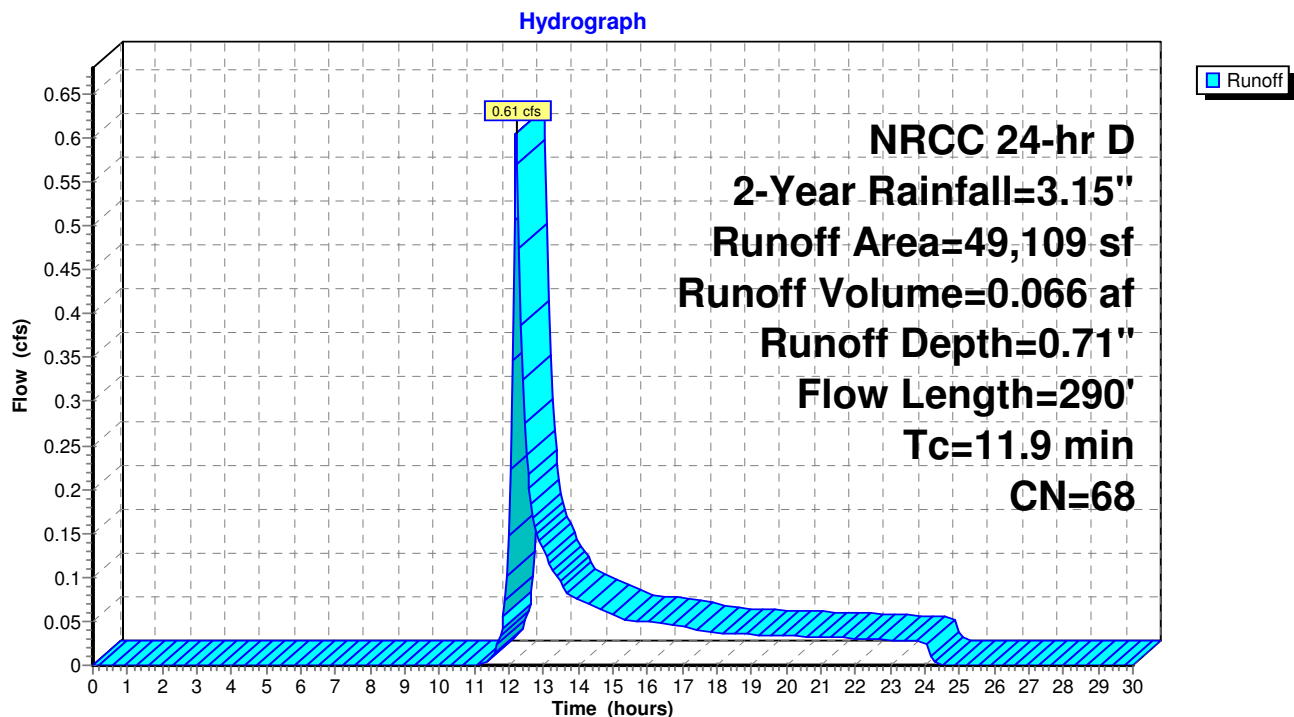
Runoff = 0.61 cfs @ 12.21 hrs, Volume= 0.066 af, Depth= 0.71"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
3,106	60	Woods, Fair, HSG B
46,003	69	50-75% Grass cover, Fair, HSG B
49,109	68	Weighted Average
49,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	25	0.0050	0.07		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.3	265	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
11.9	290	Total			

Subcatchment EX-1A: EX TO VP



Existing Conditions

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10 High Street, Topsfield
NRCC 24-hr D 2-Year Rainfall=3.15"

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Summary for Subcatchment EX-2: EX-2

Runoff = 0.75 cfs @ 12.14 hrs, Volume= 0.065 af, Depth= 0.71"

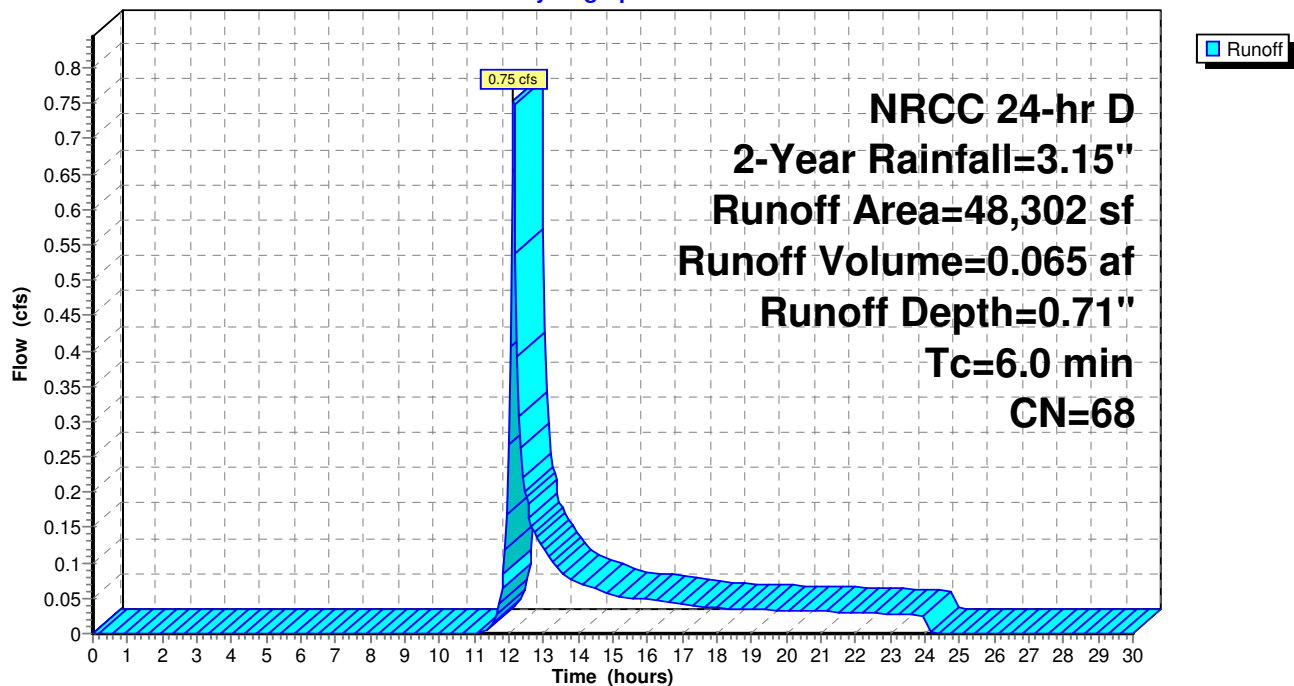
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
8,171	60	Woods, Fair, HSG B
39,271	69	50-75% Grass cover, Fair, HSG B
* 860	98	Impervious, HSG B
48,302	68	Weighted Average
47,442		98.22% Pervious Area
860		1.78% Impervious Area

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

Subcatchment EX-2: EX-2

Hydrograph



Existing Conditions

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NRCC 24-hr D 2-Year Rainfall=3.15"

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Summary for Subcatchment EX-3: EX-3

Runoff = 0.07 cfs @ 12.16 hrs, Volume= 0.009 af, Depth= 0.39"

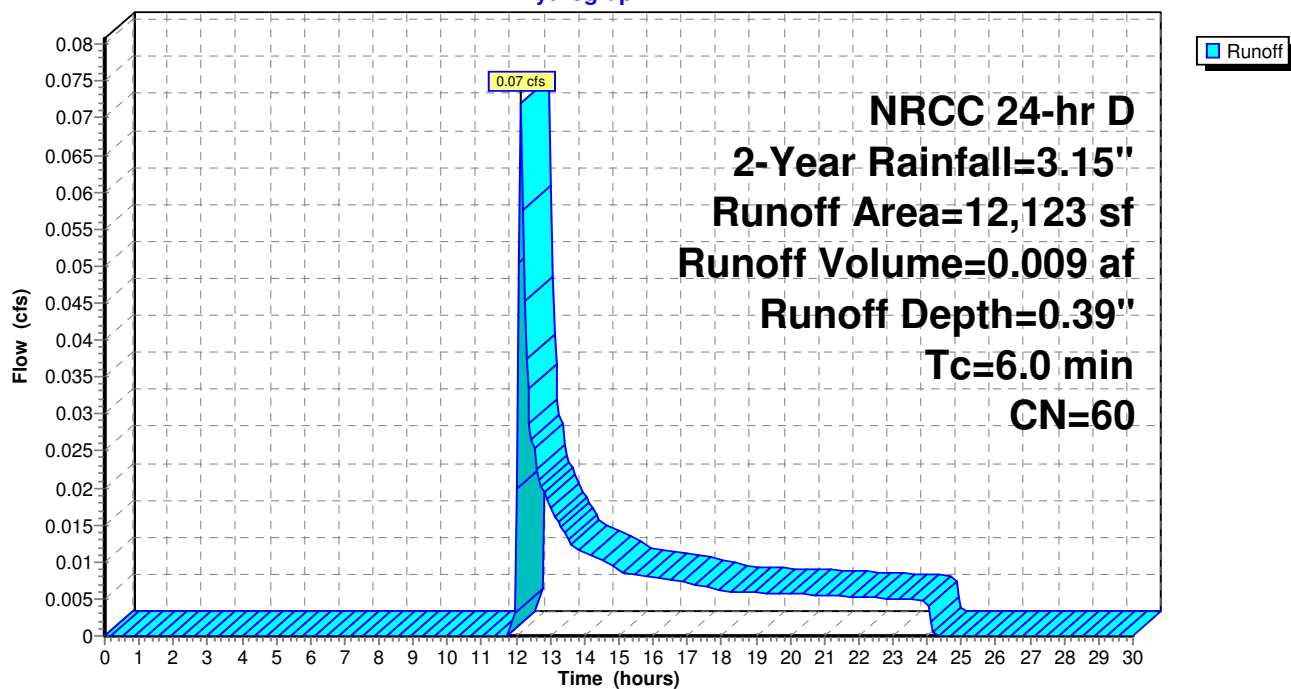
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
12,123	60	Woods, Fair, HSG B
12,123		100.00% Pervious Area

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

Subcatchment EX-3: EX-3

Hydrograph



Existing Conditions

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NRCC 24-hr D 10-Year Rainfall=4.83"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 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 EX-1: EX-1

Runoff Area=183,039 sf 3.93% Impervious Runoff Depth=1.76"
Flow Length=330' Tc=16.5 min CN=68 Runoff=5.53 cfs 0.616 af

Subcatchment EX-1A: EX TO VP

Runoff Area=49,109 sf 0.00% Impervious Runoff Depth=1.76"
Flow Length=290' Tc=11.9 min CN=68 Runoff=1.70 cfs 0.165 af

Subcatchment EX-2: EX-2

Runoff Area=48,302 sf 1.78% Impervious Runoff Depth=1.76"
Tc=6.0 min CN=68 Runoff=2.07 cfs 0.163 af

Subcatchment EX-3: EX-3

Runoff Area=12,123 sf 0.00% Impervious Runoff Depth=1.20"
Tc=6.0 min CN=60 Runoff=0.33 cfs 0.028 af

Total Runoff Area = 6.717 ac Runoff Volume = 0.972 af Average Runoff Depth = 1.74"
97.25% Pervious = 6.532 ac 2.75% Impervious = 0.185 ac

Existing Conditions

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NRCC 24-hr D 10-Year Rainfall=4.83"

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Summary for Subcatchment EX-1: EX-1

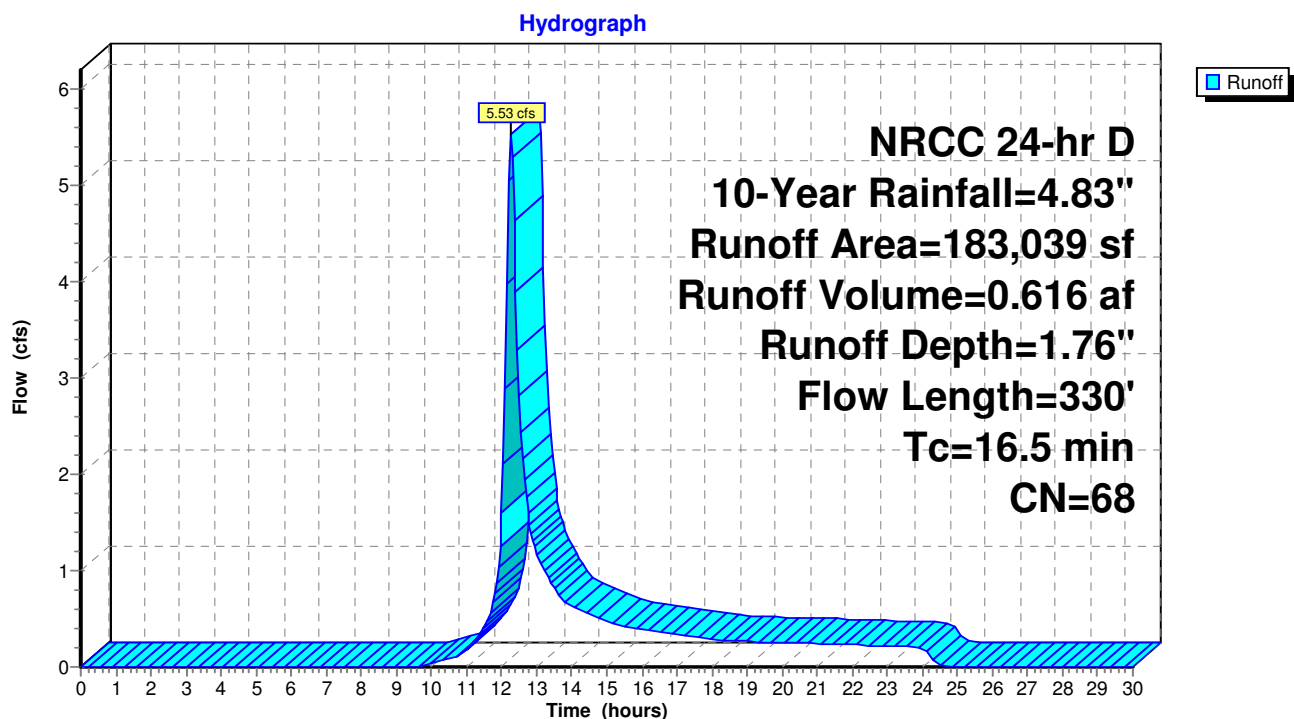
Runoff = 5.53 cfs @ 12.26 hrs, Volume= 0.616 af, Depth= 1.76"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

	Area (sf)	CN	Description
*	7,192	98	Paved Tennis Court, HSG B
	44,957	60	Woods, Fair, HSG B
	130,890	69	50-75% Grass cover, Fair, HSG B
	183,039	68	Weighted Average
	175,847		96.07% Pervious Area
	7,192		3.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.7	280	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
16.5	330	Total			

Subcatchment EX-1: EX-1



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NRCC 24-hr D 10-Year Rainfall=4.83"

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Summary for Subcatchment EX-1A: EX TO VP

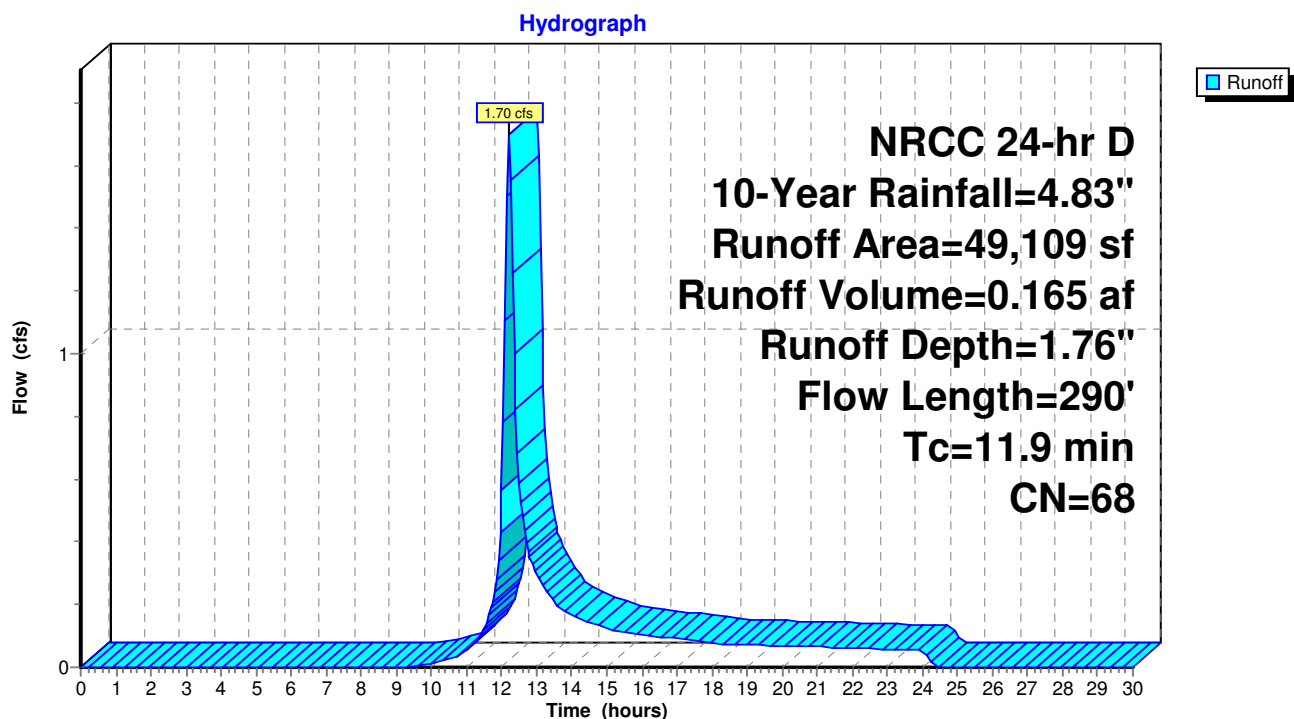
Runoff = 1.70 cfs @ 12.20 hrs, Volume= 0.165 af, Depth= 1.76"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
3,106	60	Woods, Fair, HSG B
46,003	69	50-75% Grass cover, Fair, HSG B
49,109	68	Weighted Average
49,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	25	0.0050	0.07		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.3	265	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
11.9	290	Total			

Subcatchment EX-1A: EX TO VP



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NRCC 24-hr D 10-Year Rainfall=4.83"

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Summary for Subcatchment EX-2: EX-2

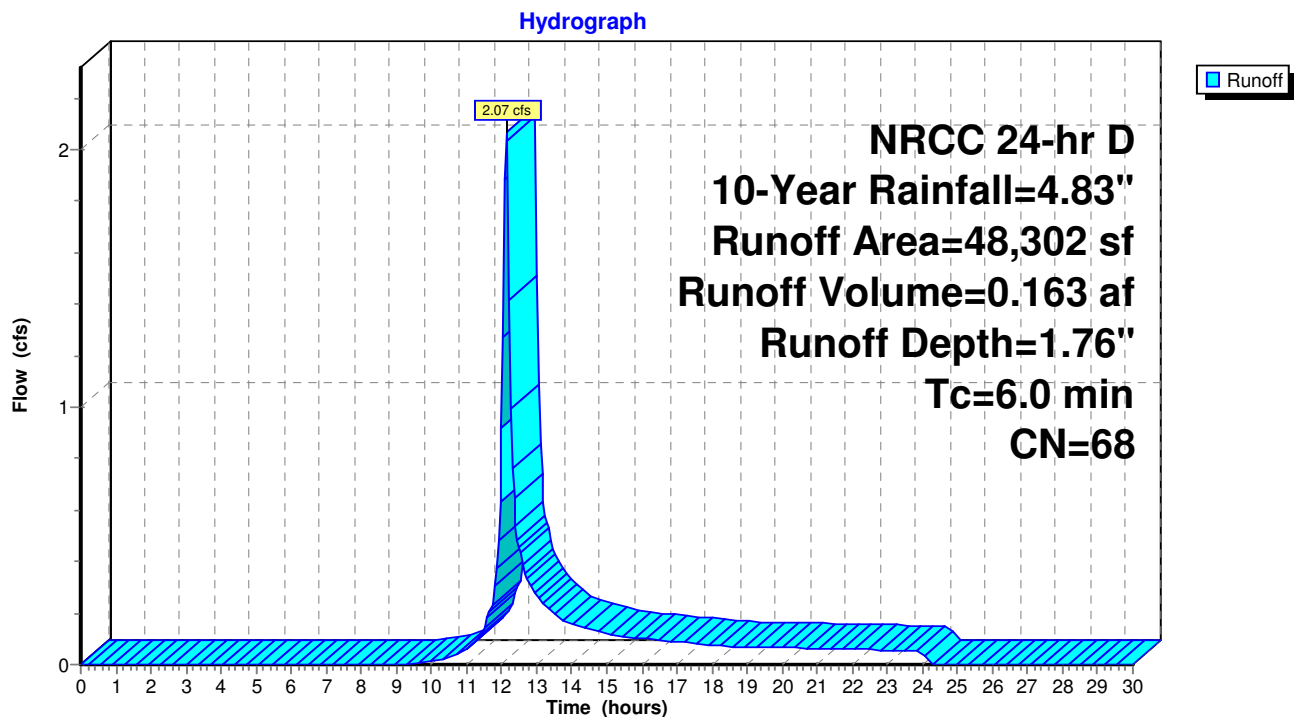
Runoff = 2.07 cfs @ 12.13 hrs, Volume= 0.163 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
8,171	60	Woods, Fair, HSG B
39,271	69	50-75% Grass cover, Fair, HSG B
* 860	98	Impervious, HSG B
48,302	68	Weighted Average
47,442		98.22% Pervious Area
860		1.78% Impervious Area

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

Subcatchment EX-2: EX-2



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NRCC 24-hr D 10-Year Rainfall=4.83"

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Summary for Subcatchment EX-3: EX-3

Runoff = 0.33 cfs @ 12.14 hrs, Volume= 0.028 af, Depth= 1.20"

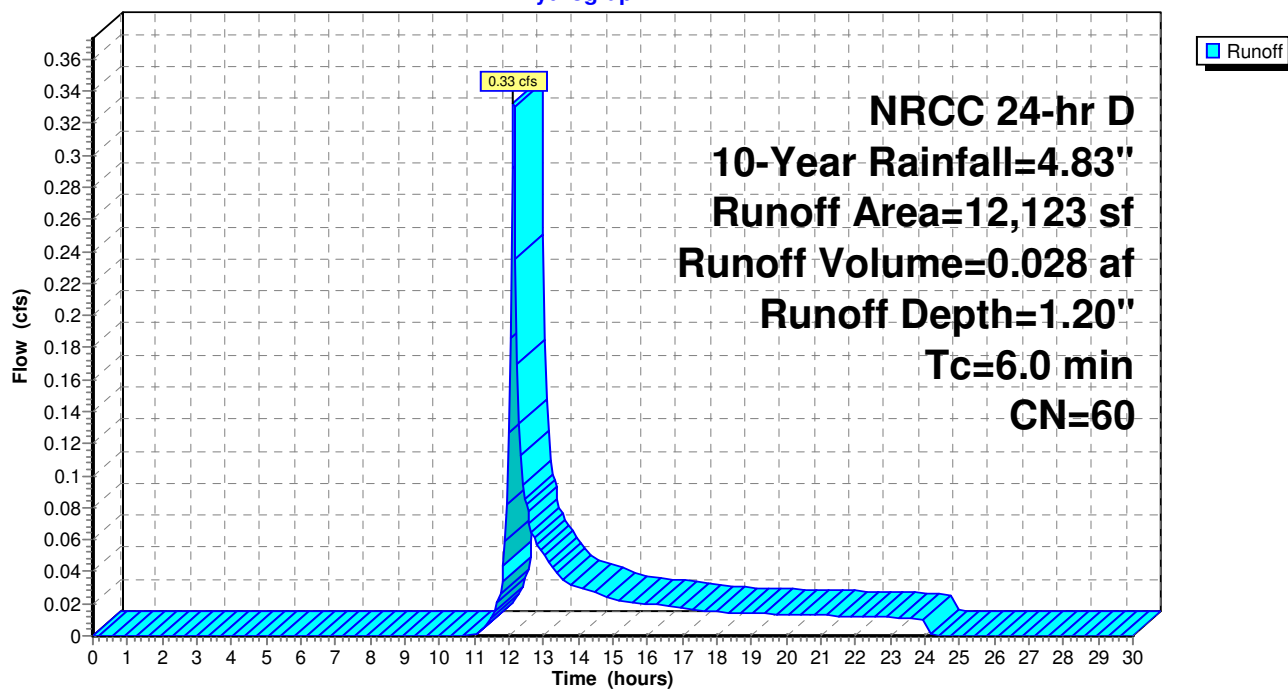
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
12,123	60	Woods, Fair, HSG B
12,123		100.00% Pervious Area

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

Subcatchment EX-3: EX-3

Hydrograph



Existing Conditions

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10 High Street, Topsfield
NRCC 24-hr D 25-Year Rainfall=6.16"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 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 EX-1: EX-1

Runoff Area=183,039 sf 3.93% Impervious Runoff Depth=2.74"
Flow Length=330' Tc=16.5 min CN=68 Runoff=8.83 cfs 0.961 af

Subcatchment EX-1A: EX TO VP

Runoff Area=49,109 sf 0.00% Impervious Runoff Depth=2.74"
Flow Length=290' Tc=11.9 min CN=68 Runoff=2.71 cfs 0.258 af

Subcatchment EX-2: EX-2

Runoff Area=48,302 sf 1.78% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=68 Runoff=3.28 cfs 0.254 af

Subcatchment EX-3: EX-3

Runoff Area=12,123 sf 0.00% Impervious Runoff Depth=2.03"
Tc=6.0 min CN=60 Runoff=0.59 cfs 0.047 af

Total Runoff Area = 6.717 ac Runoff Volume = 1.519 af Average Runoff Depth = 2.71"
97.25% Pervious = 6.532 ac 2.75% Impervious = 0.185 ac

Existing Conditions

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NRCC 24-hr D 25-Year Rainfall=6.16"

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Summary for Subcatchment EX-1: EX-1

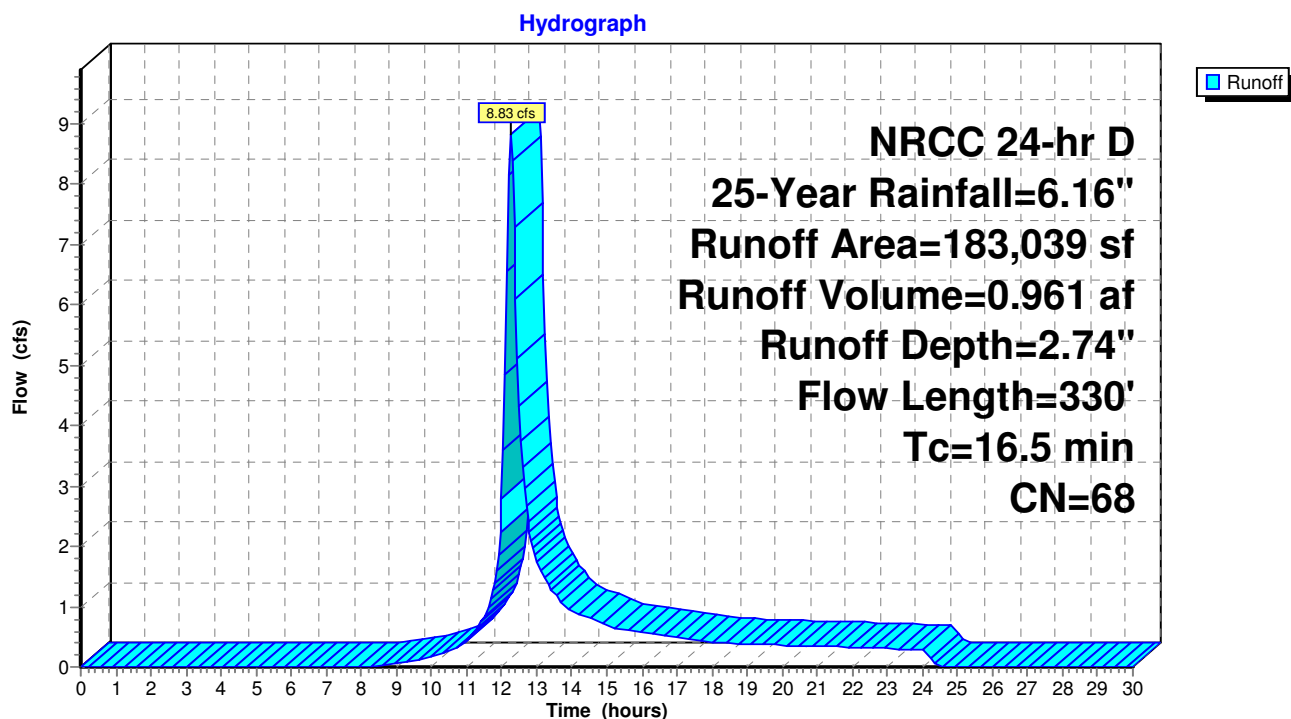
Runoff = 8.83 cfs @ 12.25 hrs, Volume= 0.961 af, Depth= 2.74"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

	Area (sf)	CN	Description
*	7,192	98	Paved Tennis Court, HSG B
	44,957	60	Woods, Fair, HSG B
	130,890	69	50-75% Grass cover, Fair, HSG B
	183,039	68	Weighted Average
	175,847		96.07% Pervious Area
	7,192		3.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.7	280	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
16.5	330	Total			

Subcatchment EX-1: EX-1



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NRCC 24-hr D 25-Year Rainfall=6.16"

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Summary for Subcatchment EX-1A: EX TO VP

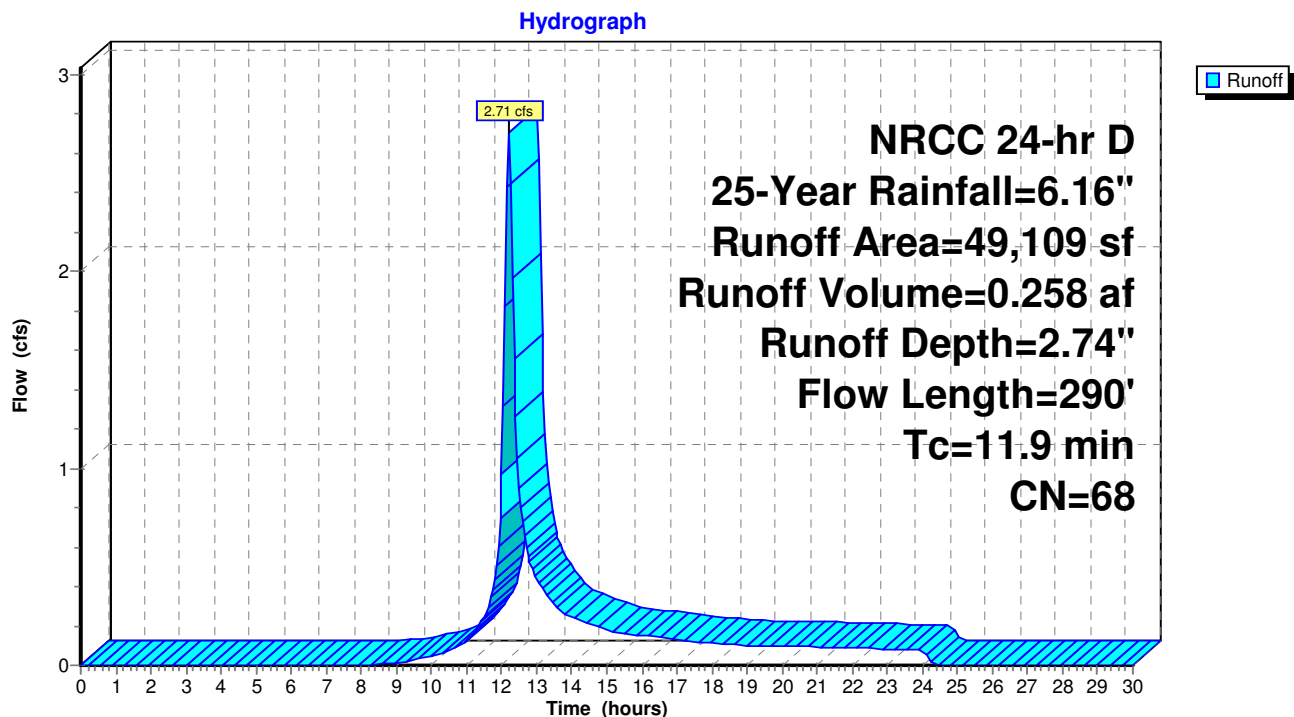
Runoff = 2.71 cfs @ 12.20 hrs, Volume= 0.258 af, Depth= 2.74"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

Area (sf)	CN	Description
3,106	60	Woods, Fair, HSG B
46,003	69	50-75% Grass cover, Fair, HSG B
49,109	68	Weighted Average
49,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	25	0.0050	0.07		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.3	265	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
11.9	290	Total			

Subcatchment EX-1A: EX TO VP



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NRCC 24-hr D 25-Year Rainfall=6.16"

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Summary for Subcatchment EX-2: EX-2

Runoff = 3.28 cfs @ 12.13 hrs, Volume= 0.254 af, Depth= 2.74"

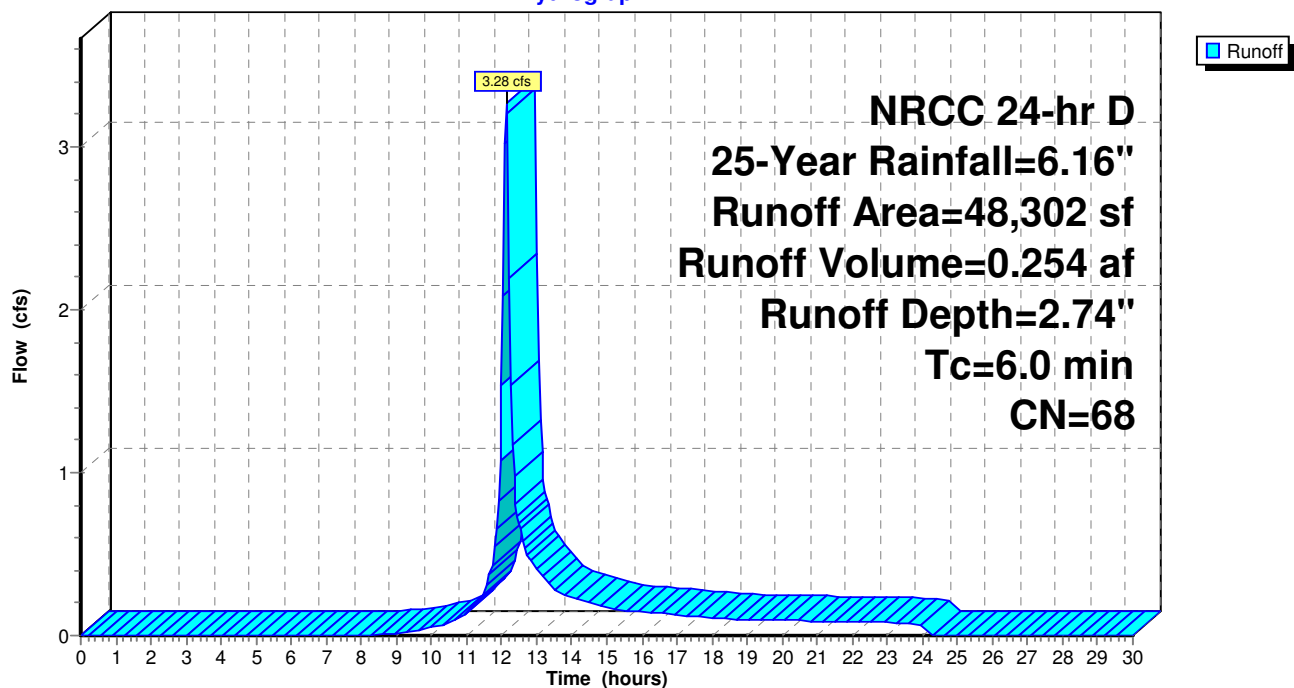
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

Area (sf)	CN	Description
8,171	60	Woods, Fair, HSG B
39,271	69	50-75% Grass cover, Fair, HSG B
* 860	98	Impervious, HSG B
48,302	68	Weighted Average
47,442		98.22% Pervious Area
860		1.78% Impervious Area

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

Subcatchment EX-2: EX-2

Hydrograph



Existing Conditions

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NRCC 24-hr D 25-Year Rainfall=6.16"

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Summary for Subcatchment EX-3: EX-3

Runoff = 0.59 cfs @ 12.14 hrs, Volume= 0.047 af, Depth= 2.03"

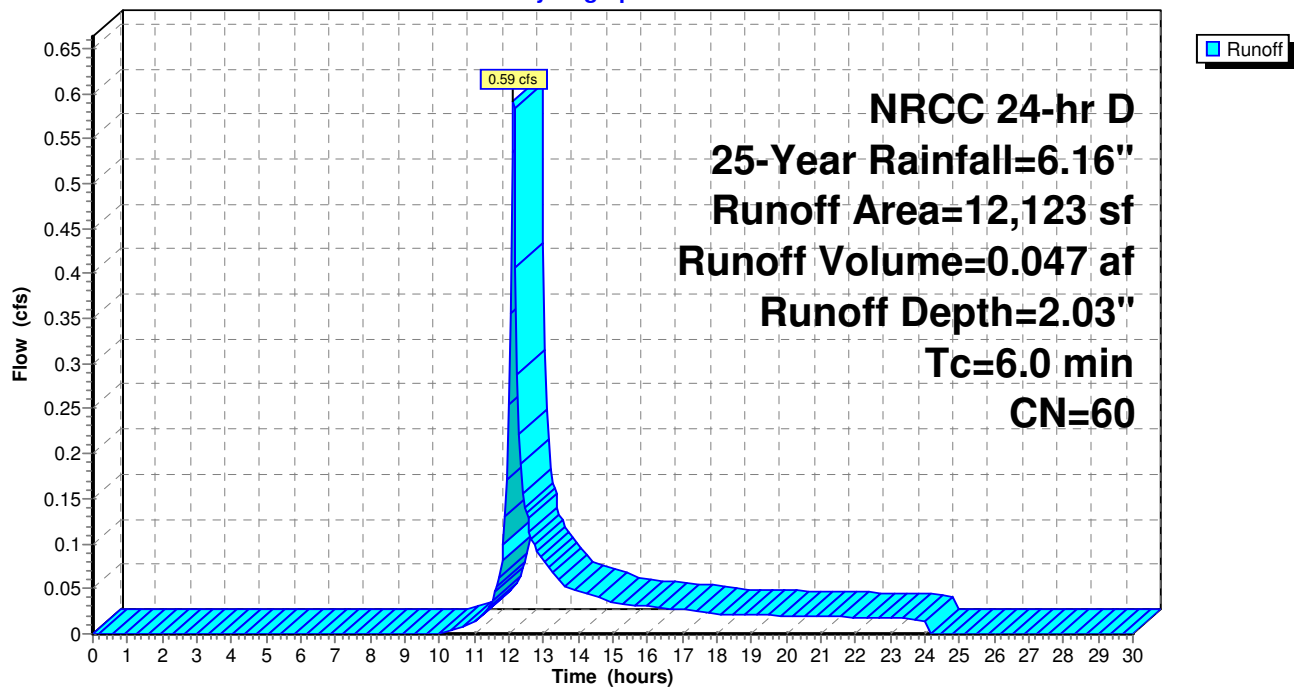
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

Area (sf)	CN	Description
12,123	60	Woods, Fair, HSG B
12,123		100.00% Pervious Area

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

Subcatchment EX-3: EX-3

Hydrograph



Existing Conditions

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NRCC 24-hr D 100-Year Rainfall=8.94"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 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 EX-1: EX-1

Runoff Area=183,039 sf 3.93% Impervious Runoff Depth=5.04"
Flow Length=330' Tc=16.5 min CN=68 Runoff=16.31 cfs 1.763 af

Subcatchment EX-1A: EX TO VP

Runoff Area=49,109 sf 0.00% Impervious Runoff Depth=5.04"
Flow Length=290' Tc=11.9 min CN=68 Runoff=4.99 cfs 0.473 af

Subcatchment EX-2: EX-2

Runoff Area=48,302 sf 1.78% Impervious Runoff Depth=5.04"
Tc=6.0 min CN=68 Runoff=6.00 cfs 0.465 af

Subcatchment EX-3: EX-3

Runoff Area=12,123 sf 0.00% Impervious Runoff Depth=4.05"
Tc=6.0 min CN=60 Runoff=1.22 cfs 0.094 af

Total Runoff Area = 6.717 ac Runoff Volume = 2.796 af Average Runoff Depth = 5.00"
97.25% Pervious = 6.532 ac 2.75% Impervious = 0.185 ac

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NRCC 24-hr D 100-Year Rainfall=8.94"

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Summary for Subcatchment EX-1: EX-1

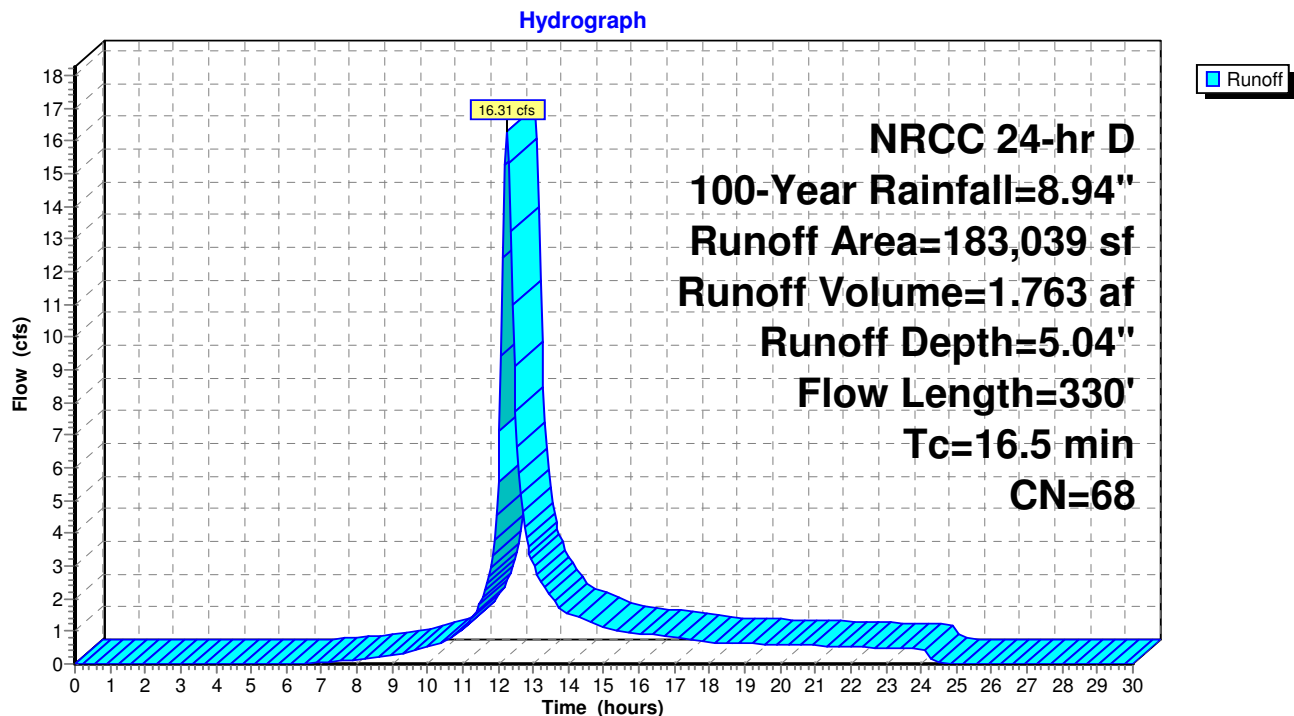
Runoff = 16.31 cfs @ 12.25 hrs, Volume= 1.763 af, Depth= 5.04"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
*	7,192	98	Paved Tennis Court, HSG B
	44,957	60	Woods, Fair, HSG B
	130,890	69	50-75% Grass cover, Fair, HSG B
	183,039	68	Weighted Average
	175,847		96.07% Pervious Area
	7,192		3.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0050	0.09		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.7	280	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
16.5	330	Total			

Subcatchment EX-1: EX-1



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Summary for Subcatchment EX-1A: EX TO VP

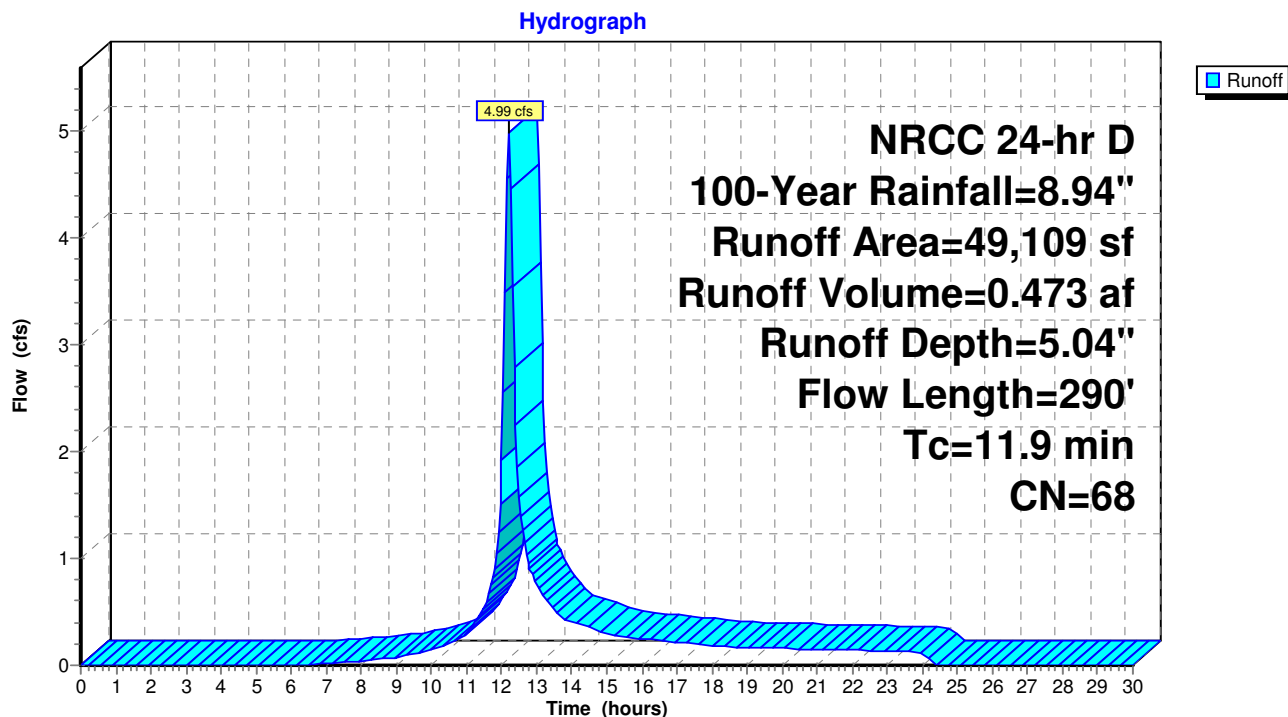
Runoff = 4.99 cfs @ 12.20 hrs, Volume= 0.473 af, Depth= 5.04"
Routed to nonexistent node DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
3,106	60	Woods, Fair, HSG B
46,003	69	50-75% Grass cover, Fair, HSG B
49,109	68	Weighted Average
49,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	25	0.0050	0.07		Sheet Flow, T1
					Grass: Short n= 0.150 P2= 3.20"
6.3	265	0.0100	0.70		Shallow Concentrated Flow, T2
					Short Grass Pasture Kv= 7.0 fps
11.9	290	Total			

Subcatchment EX-1A: EX TO VP



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Summary for Subcatchment EX-2: EX-2

Runoff = 6.00 cfs @ 12.13 hrs, Volume= 0.465 af, Depth= 5.04"

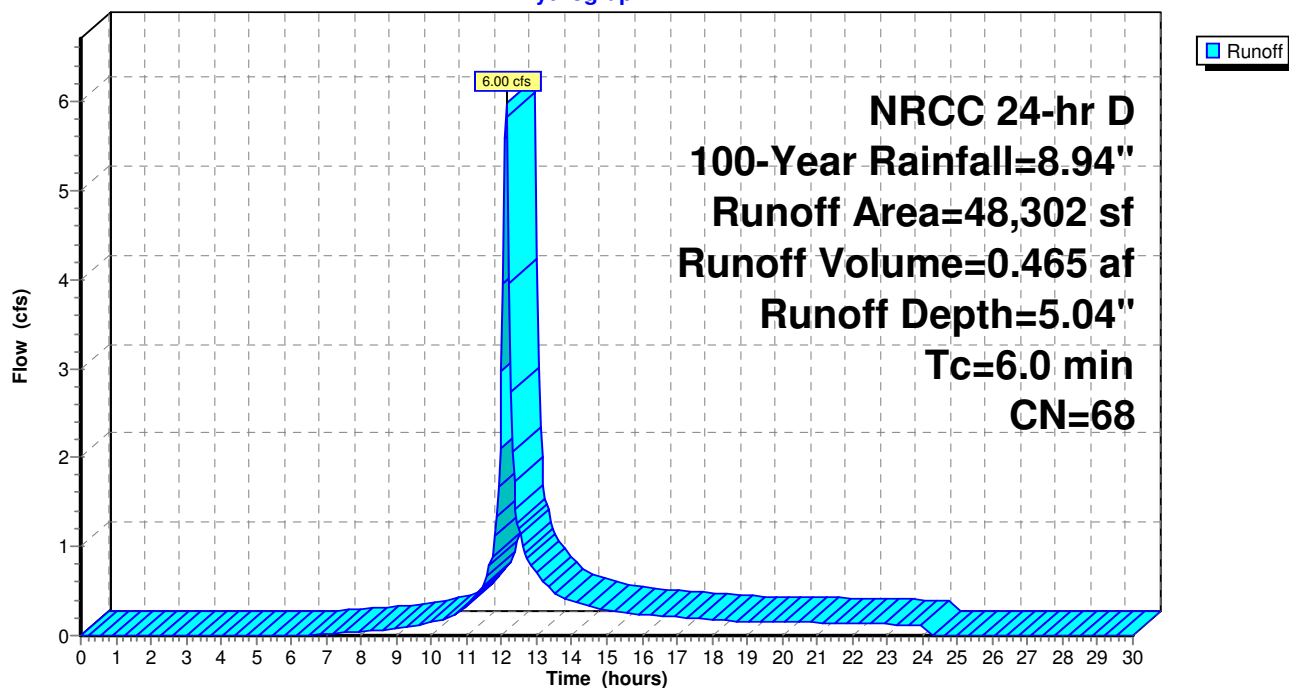
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
8,171	60	Woods, Fair, HSG B
39,271	69	50-75% Grass cover, Fair, HSG B
* 860	98	Impervious, HSG B
48,302	68	Weighted Average
47,442		98.22% Pervious Area
860		1.78% Impervious Area

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

Subcatchment EX-2: EX-2

Hydrograph



Existing Conditions

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NRCC 24-hr D 100-Year Rainfall=8.94"

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Summary for Subcatchment EX-3: EX-3

Runoff = 1.22 cfs @ 12.13 hrs, Volume= 0.094 af, Depth= 4.05"

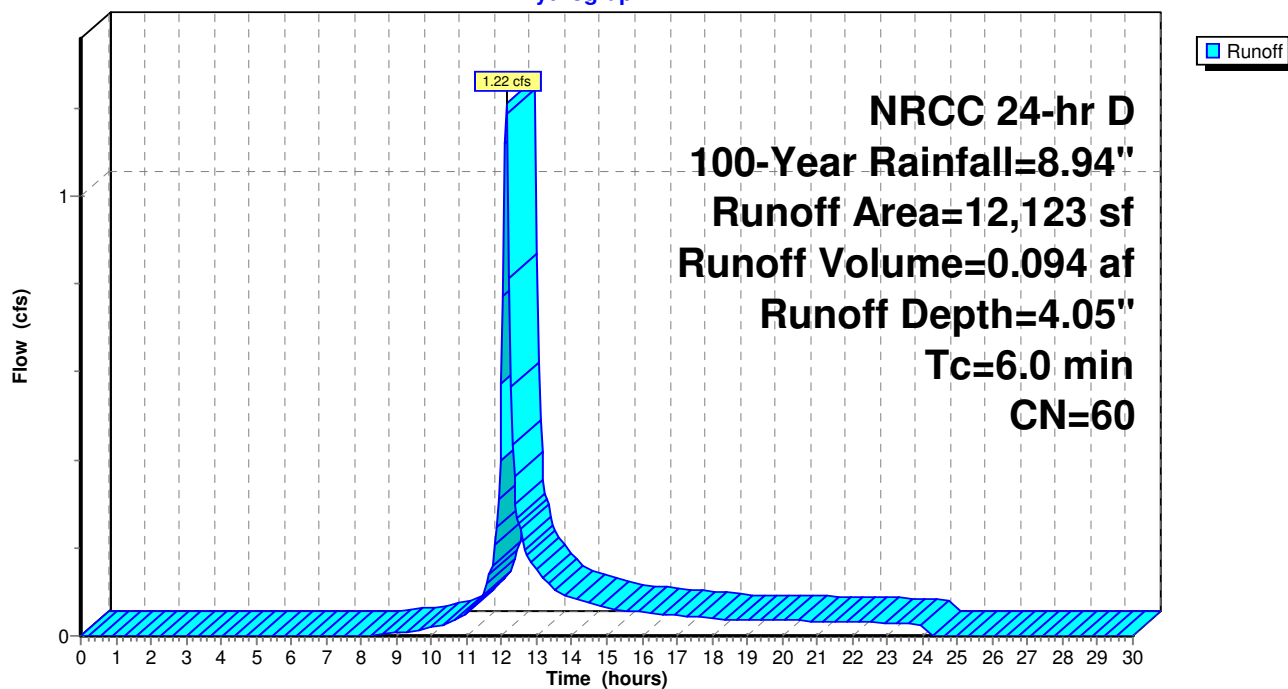
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
12,123	60	Woods, Fair, HSG B
12,123		100.00% Pervious Area

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

Subcatchment EX-3: EX-3

Hydrograph



Existing Conditions

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10 High Street, Topsfield

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Hydrologic Model - Proposed Conditions



Detained



Detention Basin



Un-Detained



PR-2



PR-3



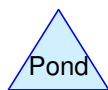
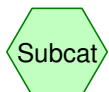
Rain Garden



DP-1



DP-3



Routing Diagram for Proposed Conditions

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.15	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.83	2
3	25-Year	NRCC 24-hr	D	Default	24.00	1	6.16	2
4	100-Year	NRCC 24-hr	D	Default	24.00	1	8.94	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.518	69	50-75% Grass cover, Fair, HSG B (PR-2)
2.429	61	>75% Grass cover, Good, HSG B (PR-2, PR-3, PR1A, PR1B)
0.369	98	Detention Basin (PR1A)
1.343	98	Paved parking and roof, HSG B (PR1A)
0.098	98	Paved parking, HSG B (PR-3)
0.832	60	Woods, Fair, HSG B (PR-2, PR-3, PR1B)
5.589	74	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
5.220	HSG B	PR-2, PR-3, PR1A, PR1B
0.000	HSG C	
0.000	HSG D	
0.369	Other	PR1A
5.589		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.518	0.000	0.000	0.000	0.518	50-75% Grass cover, Fair	PR-2
0.000	2.429	0.000	0.000	0.000	2.429	>75% Grass cover, Good	PR-2, PR-3, PR1A, PR1B
0.000	0.000	0.000	0.000	0.369	0.369	Detention Basin	PR1A
0.000	0.098	0.000	0.000	0.000	0.098	Paved parking	PR-3
0.000	1.343	0.000	0.000	0.000	1.343	Paved parking and roof	PR1A
0.000	0.832	0.000	0.000	0.000	0.832	Woods, Fair	PR-2, PR-3, PR1B
0.000	5.220	0.000	0.000	0.369	5.589	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	65.10	64.92	36.0	0.0050	0.010	0.0	8.0	0.0

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 PR-2: PR-2 Runoff Area=44,310 sf 0.00% Impervious Runoff Depth=0.58"
Tc=6.0 min CN=65 Runoff=0.52 cfs 0.049 af

Subcatchment PR-3: PR-3 Runoff Area=16,655 sf 25.64% Impervious Runoff Depth=0.80"
Tc=6.0 min CN=70 Runoff=0.31 cfs 0.025 af

Subcatchment PR1A: Detained Runoff Area=86,719 sf 85.97% Impervious Runoff Depth=2.40"
Tc=6.0 min CN=93 Runoff=4.89 cfs 0.398 af

Subcatchment PR1B: Un-Detained Runoff Area=95,780 sf 0.00% Impervious Runoff Depth=0.42"
Tc=6.0 min CN=61 Runoff=0.68 cfs 0.078 af

Reach DP-1: DP-1 Inflow=1.07 cfs 0.205 af
Outflow=1.07 cfs 0.205 af

Reach DP-3: DP-3 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 1P: Detention Basin Peak Elev=65.65' Storage=5,661 cf Inflow=4.89 cfs 0.398 af
Discarded=0.26 cfs 0.270 af Primary=0.66 cfs 0.128 af Outflow=0.92 cfs 0.398 af

Pond 2P: Rain Garden Peak Elev=64.04' Storage=157 cf Inflow=0.31 cfs 0.025 af
Discarded=0.09 cfs 0.025 af Primary=0.00 cfs 0.000 af Outflow=0.09 cfs 0.025 af

Total Runoff Area = 5.589 ac Runoff Volume = 0.550 af Average Runoff Depth = 1.18"
67.63% Pervious = 3.780 ac 32.37% Impervious = 1.809 ac

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Summary for Subcatchment PR-2: PR-2

Runoff = 0.52 cfs @ 12.14 hrs, Volume= 0.049 af, Depth= 0.58"

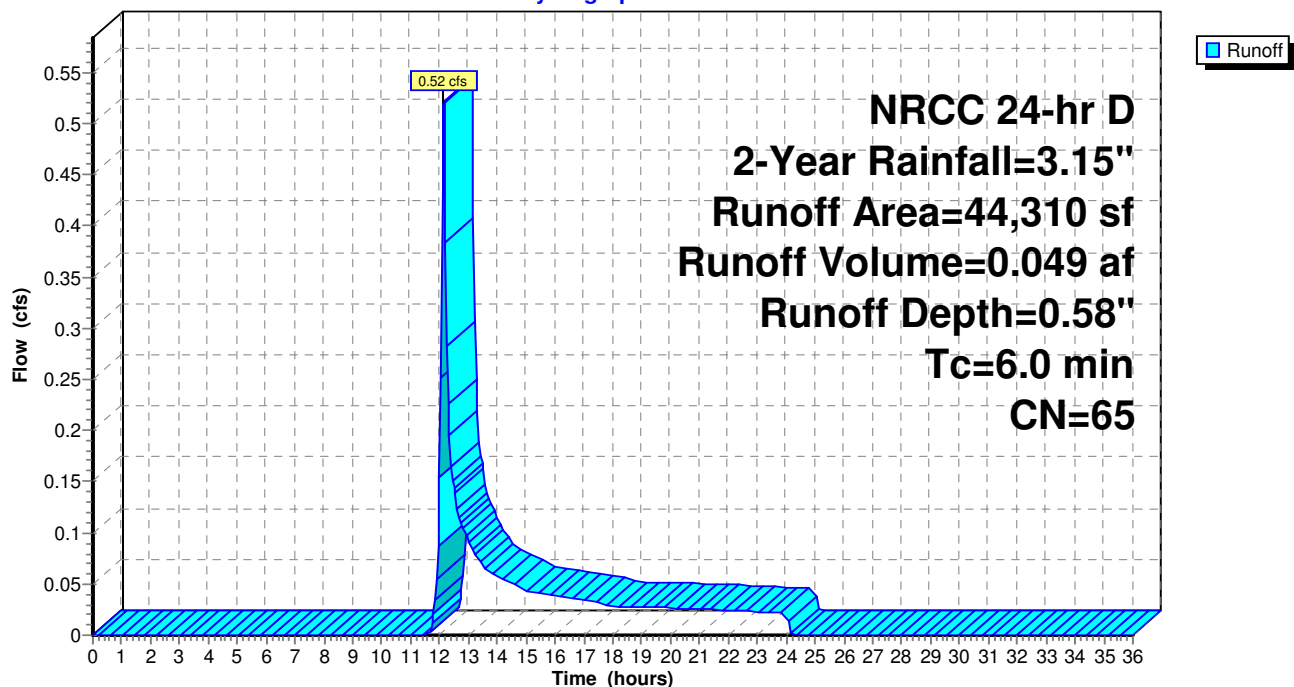
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
11,793	61	>75% Grass cover, Good, HSG B
9,948	60	Woods, Fair, HSG B
22,569	69	50-75% Grass cover, Fair, HSG B
44,310	65	Weighted Average
44,310		100.00% Pervious Area

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

Subcatchment PR-2: PR-2

Hydrograph



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Summary for Subcatchment PR-3: PR-3

Runoff = 0.31 cfs @ 12.14 hrs, Volume= 0.025 af, Depth= 0.80"
Routed to Pond 2P : Rain Garden

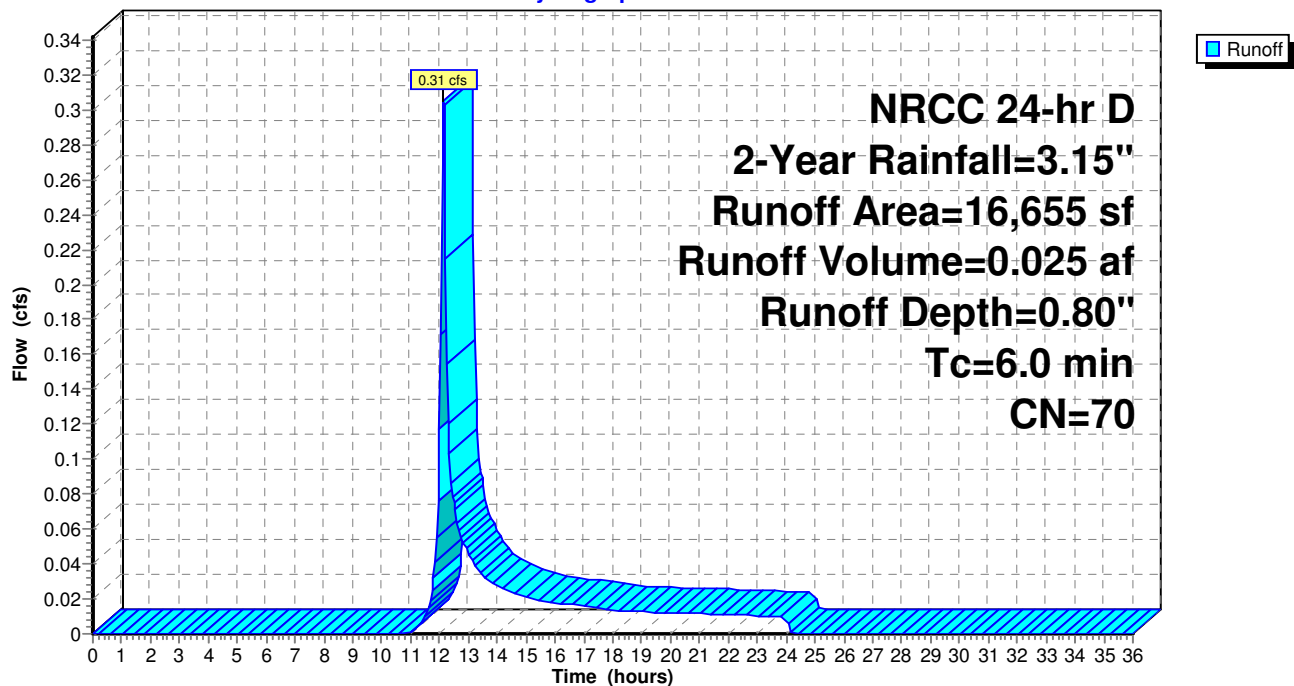
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
4,270	98	Paved parking, HSG B
9,642	61	>75% Grass cover, Good, HSG B
2,743	60	Woods, Fair, HSG B
16,655	70	Weighted Average
12,385		74.36% Pervious Area
4,270		25.64% Impervious Area

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

Subcatchment PR-3: PR-3

Hydrograph



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Summary for Subcatchment PR1A: Detained

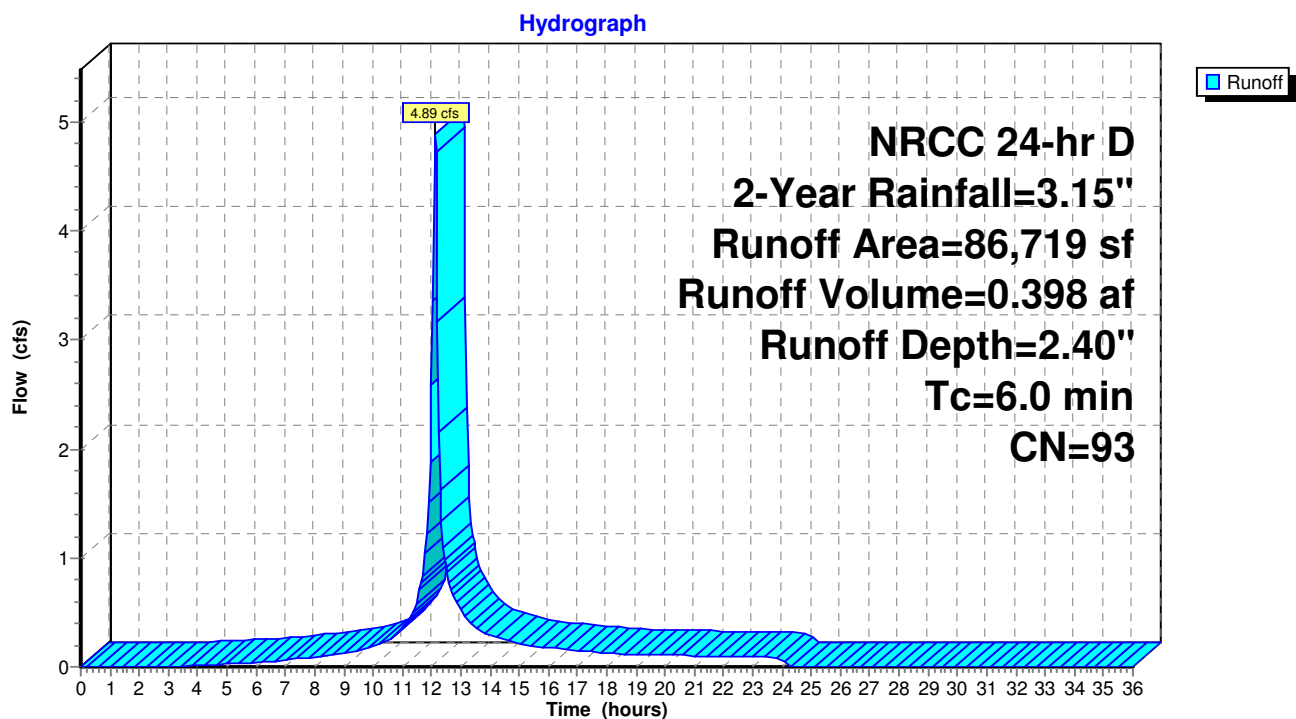
Runoff = 4.89 cfs @ 12.13 hrs, Volume= 0.398 af, Depth= 2.40"
Routed to Pond 1P : Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
*	58,487	98	Paved parking and roof, HSG B
	12,170	61	>75% Grass cover, Good, HSG B
*	16,062	98	Detention Basin
	86,719	93	Weighted Average
	12,170		14.03% Pervious Area
	74,549		85.97% Impervious Area

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

Subcatchment PR1A: Detained



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Summary for Subcatchment PR1B: Un-Detained

Runoff = 0.68 cfs @ 12.15 hrs, Volume= 0.078 af, Depth= 0.42"
Routed to Reach DP-1 : DP-1

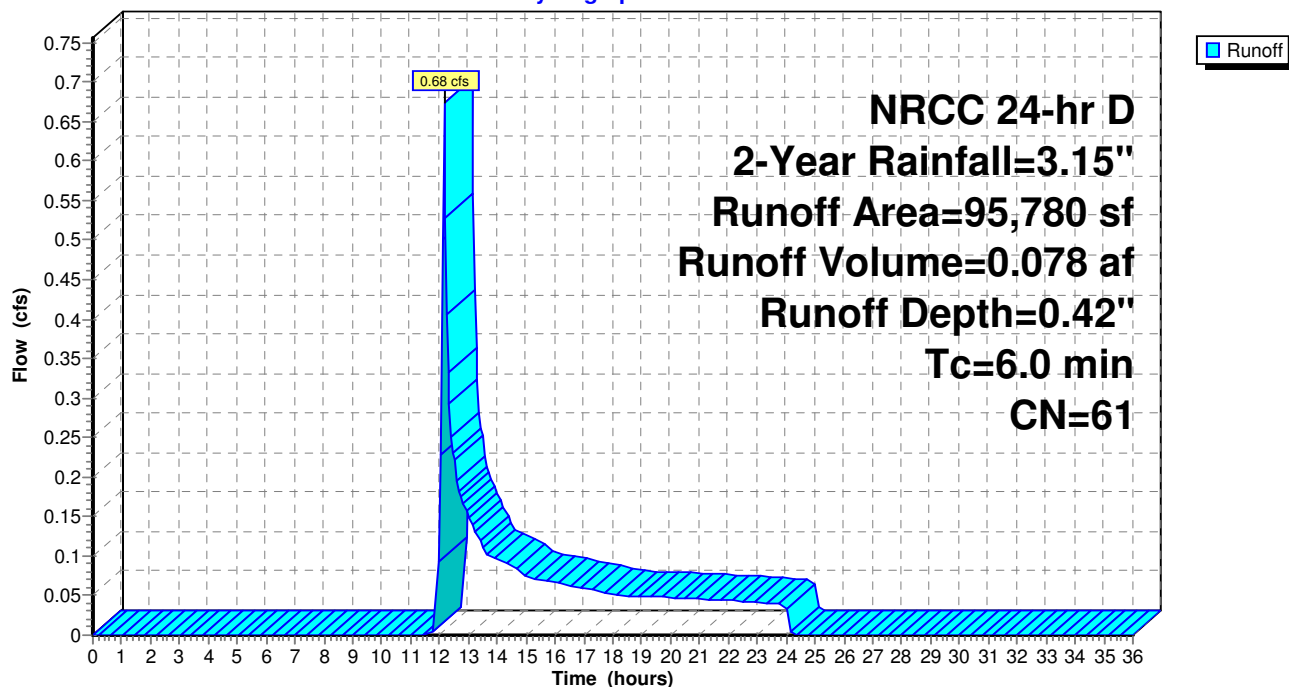
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
23,560	60	Woods, Fair, HSG B
72,220	61	>75% Grass cover, Good, HSG B
95,780	61	Weighted Average
95,780		100.00% Pervious Area

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

Subcatchment PR1B: Un-Detained

Hydrograph



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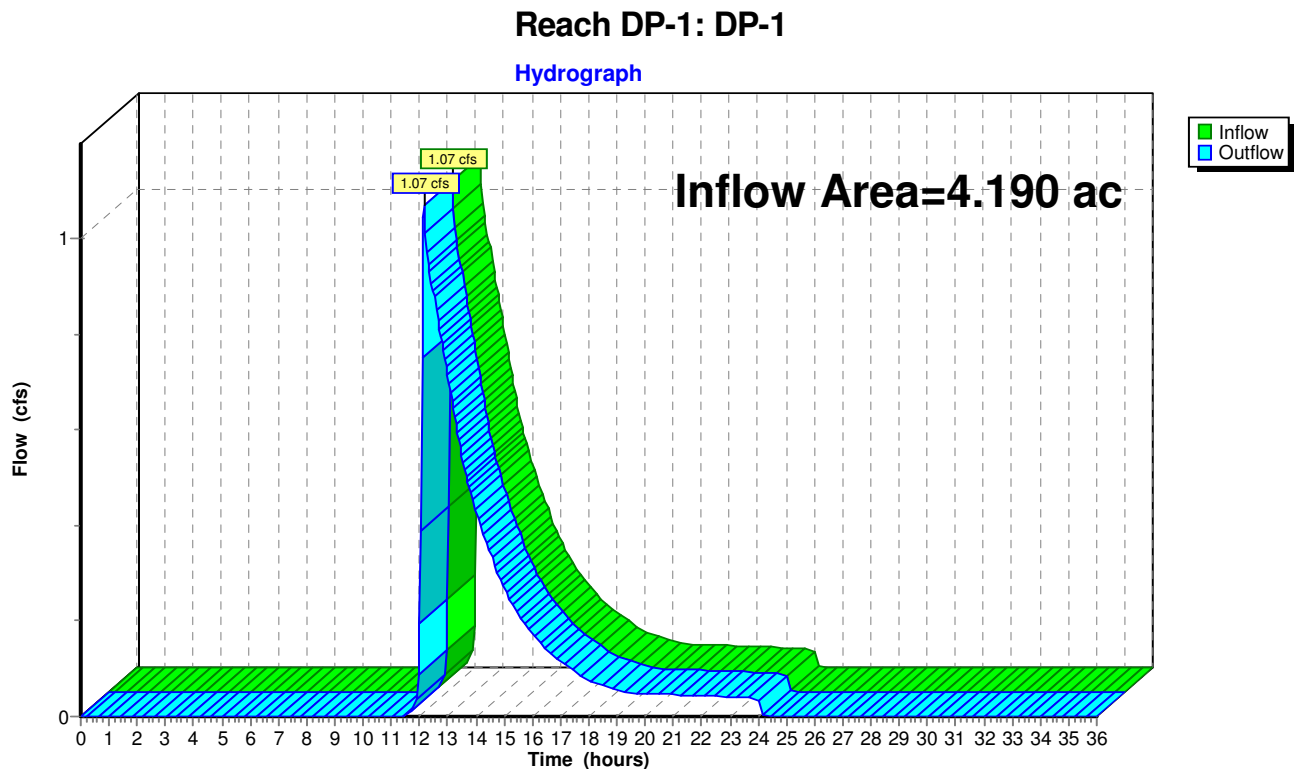
Page 12

Summary for Reach DP-1: DP-1

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

Inflow Area = 4.190 ac, 40.85% Impervious, Inflow Depth = 0.59" for 2-Year event
Inflow = 1.07 cfs @ 12.17 hrs, Volume= 0.205 af
Outflow = 1.07 cfs @ 12.17 hrs, Volume= 0.205 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



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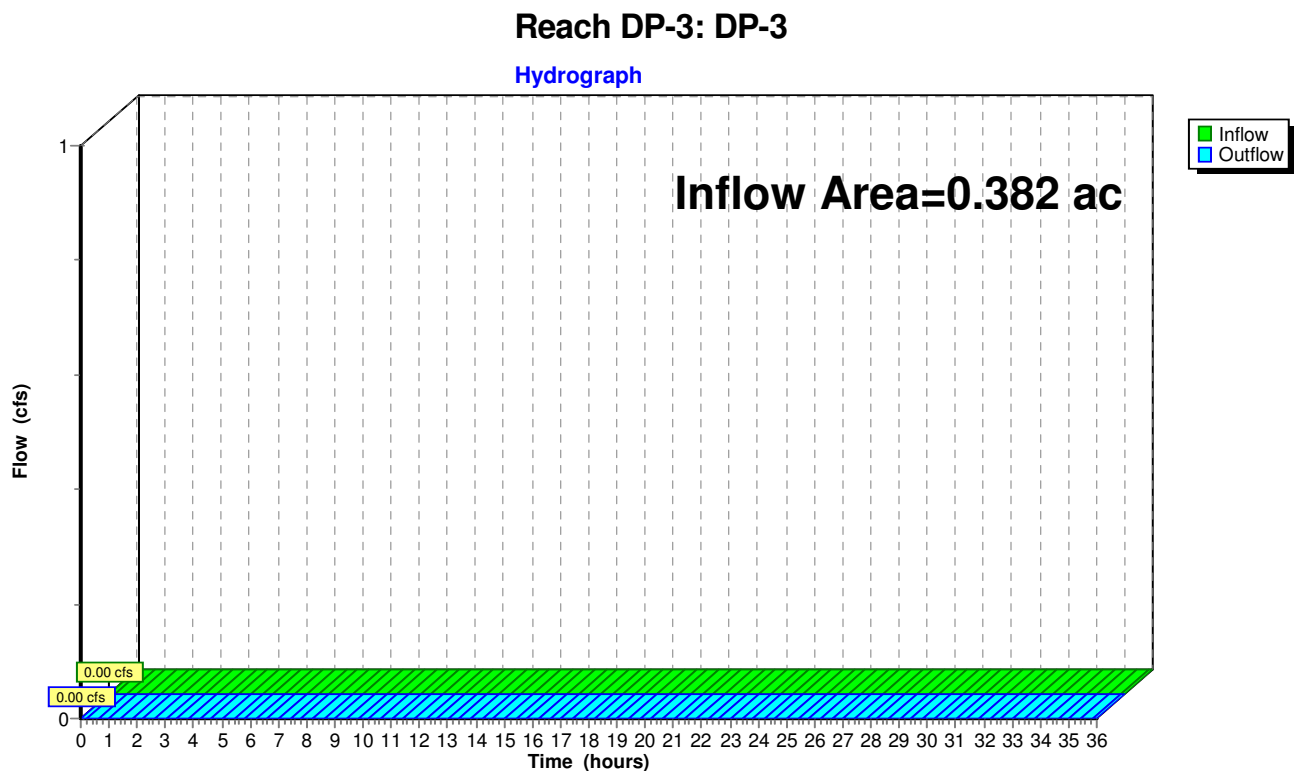
Page 13

Summary for Reach DP-3: DP-3

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

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



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Summary for Pond 1P: Detention Basin

Inflow Area = 1.991 ac, 85.97% Impervious, Inflow Depth = 2.40" for 2-Year event
Inflow = 4.89 cfs @ 12.13 hrs, Volume= 0.398 af
Outflow = 0.92 cfs @ 12.50 hrs, Volume= 0.398 af, Atten= 81%, Lag= 22.3 min
Discarded = 0.26 cfs @ 12.50 hrs, Volume= 0.270 af
Primary = 0.66 cfs @ 12.50 hrs, Volume= 0.128 af
Routed to Reach DP-1 : DP-1

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 65.65' @ 12.50 hrs Surf.Area= 9,245 sf Storage= 5,661 cf

Plug-Flow detention time= 92.7 min calculated for 0.398 af (100% of inflow)
Center-of-Mass det. time= 92.3 min (898.8 - 806.5)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	45,433 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
65.00	8,280	0	0
66.00	9,774	9,027	9,027
67.00	11,319	10,547	19,574
68.00	12,917	12,118	31,692
69.00	14,566	13,742	45,433

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	65.50'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Primary	66.00'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Primary	65.10'	8.0" Round Culvert L= 36.0' Ke= 0.900 Inlet / Outlet Invert= 65.10' / 64.92' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.26 cfs @ 12.50 hrs HW=65.65' (Free Discharge)

↑ **1=Exfiltration** (Controls 0.26 cfs)

Primary OutFlow Max=0.66 cfs @ 12.50 hrs HW=65.65' (Free Discharge)

↑ **2=Orifice/Grate** (Orifice Controls 0.06 cfs @ 1.30 fps)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

↑ **4=Culvert** (Barrel Controls 0.60 cfs @ 2.66 fps)

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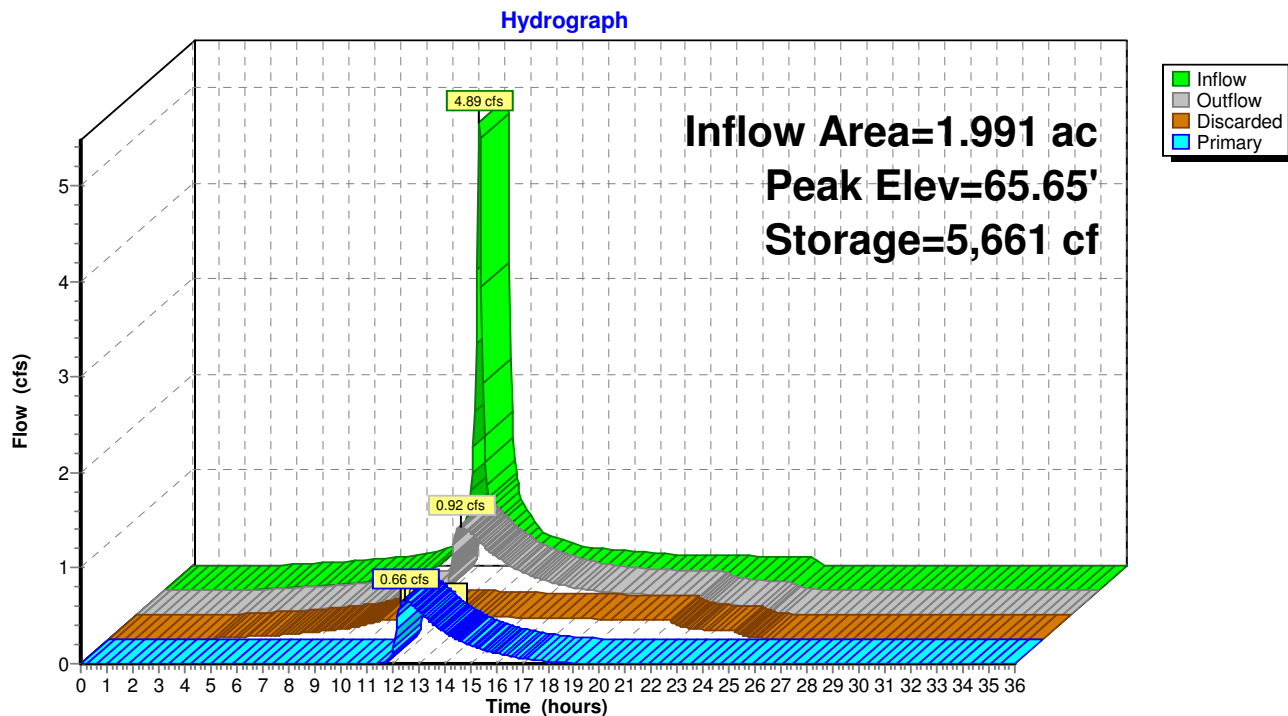
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Pond 1P: Detention Basin



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Summary for Pond 2P: Rain Garden

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 0.80" for 2-Year event
Inflow = 0.31 cfs @ 12.14 hrs, Volume= 0.025 af
Outflow = 0.09 cfs @ 12.39 hrs, Volume= 0.025 af, Atten= 70%, Lag= 14.8 min
Discarded = 0.09 cfs @ 12.39 hrs, Volume= 0.025 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-3 : DP-3

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 64.04' @ 12.39 hrs Surf.Area= 3,806 sf Storage= 157 cf

Plug-Flow detention time= 12.1 min calculated for 0.025 af (100% of inflow)
Center-of-Mass det. time= 12.0 min (925.3 - 913.3)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	4,361 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	3,756	0	0
65.00	4,965	4,361	4,361

Device	Routing	Invert	Outlet Devices
#1	Discarded	64.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	64.20'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.09 cfs @ 12.39 hrs HW=64.04' (Free Discharge)
↑**1=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.00' (Free Discharge)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

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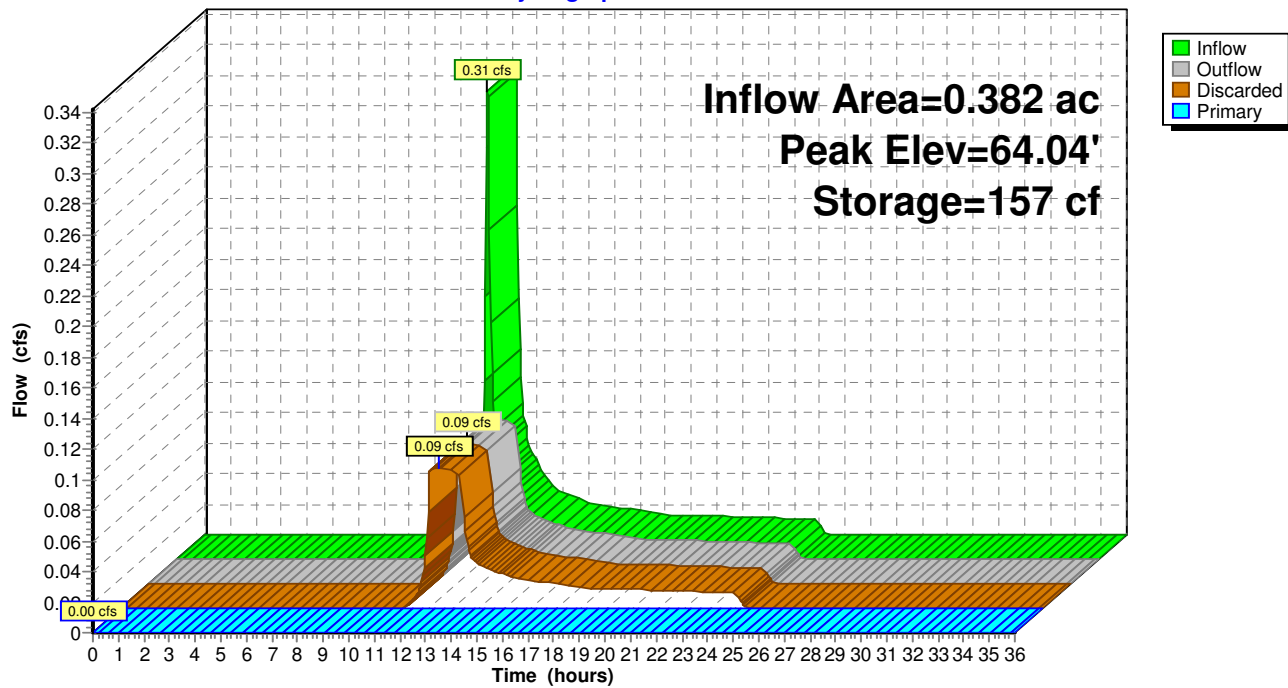
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Pond 2P: Rain Garden

Hydrograph



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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 PR-2: PR-2	Runoff Area=44,310 sf 0.00% Impervious Runoff Depth=1.54" Tc=6.0 min CN=65 Runoff=1.64 cfs 0.131 af
Subcatchment PR-3: PR-3	Runoff Area=16,655 sf 25.64% Impervious Runoff Depth=1.91" Tc=6.0 min CN=70 Runoff=0.78 cfs 0.061 af
Subcatchment PR1A: Detained	Runoff Area=86,719 sf 85.97% Impervious Runoff Depth=4.03" Tc=6.0 min CN=93 Runoff=7.96 cfs 0.669 af
Subcatchment PR1B: Un-Detained	Runoff Area=95,780 sf 0.00% Impervious Runoff Depth=1.27" Tc=6.0 min CN=61 Runoff=2.81 cfs 0.232 af
Reach DP-1: DP-1	Inflow=4.00 cfs 0.546 af Outflow=4.00 cfs 0.546 af
Reach DP-3: DP-3	Inflow=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af
Pond 1P: Detention Basin	Peak Elev=66.05' Storage=9,496 cf Inflow=7.96 cfs 0.669 af Discarded=0.31 cfs 0.355 af Primary=1.56 cfs 0.314 af Outflow=1.87 cfs 0.669 af
Pond 2P: Rain Garden	Peak Elev=64.18' Storage=715 cf Inflow=0.78 cfs 0.061 af Discarded=0.10 cfs 0.061 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.061 af
Total Runoff Area = 5.589 ac Runoff Volume = 1.093 af Average Runoff Depth = 2.35" 67.63% Pervious = 3.780 ac 32.37% Impervious = 1.809 ac	

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Summary for Subcatchment PR-2: PR-2

Runoff = 1.64 cfs @ 12.14 hrs, Volume= 0.131 af, Depth= 1.54"

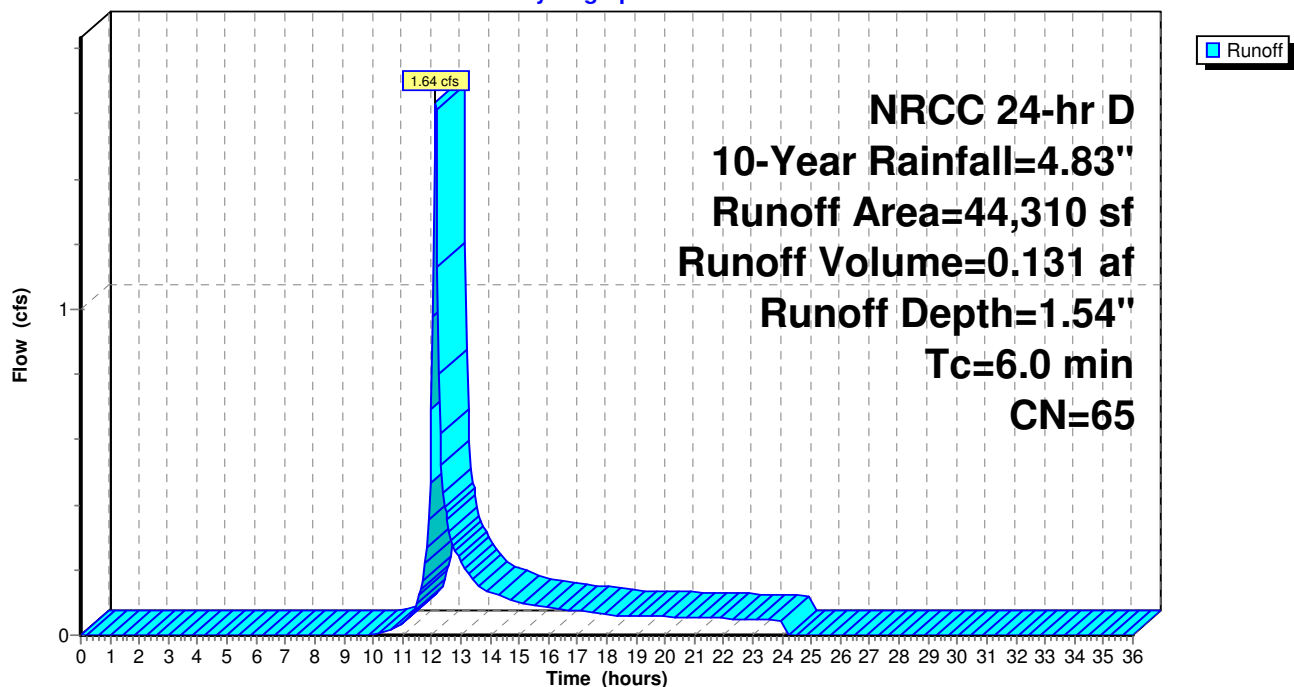
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
11,793	61	>75% Grass cover, Good, HSG B
9,948	60	Woods, Fair, HSG B
22,569	69	50-75% Grass cover, Fair, HSG B
44,310	65	Weighted Average
44,310		100.00% Pervious Area

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

Subcatchment PR-2: PR-2

Hydrograph



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Summary for Subcatchment PR-3: PR-3

Runoff = 0.78 cfs @ 12.13 hrs, Volume= 0.061 af, Depth= 1.91"
Routed to Pond 2P : Rain Garden

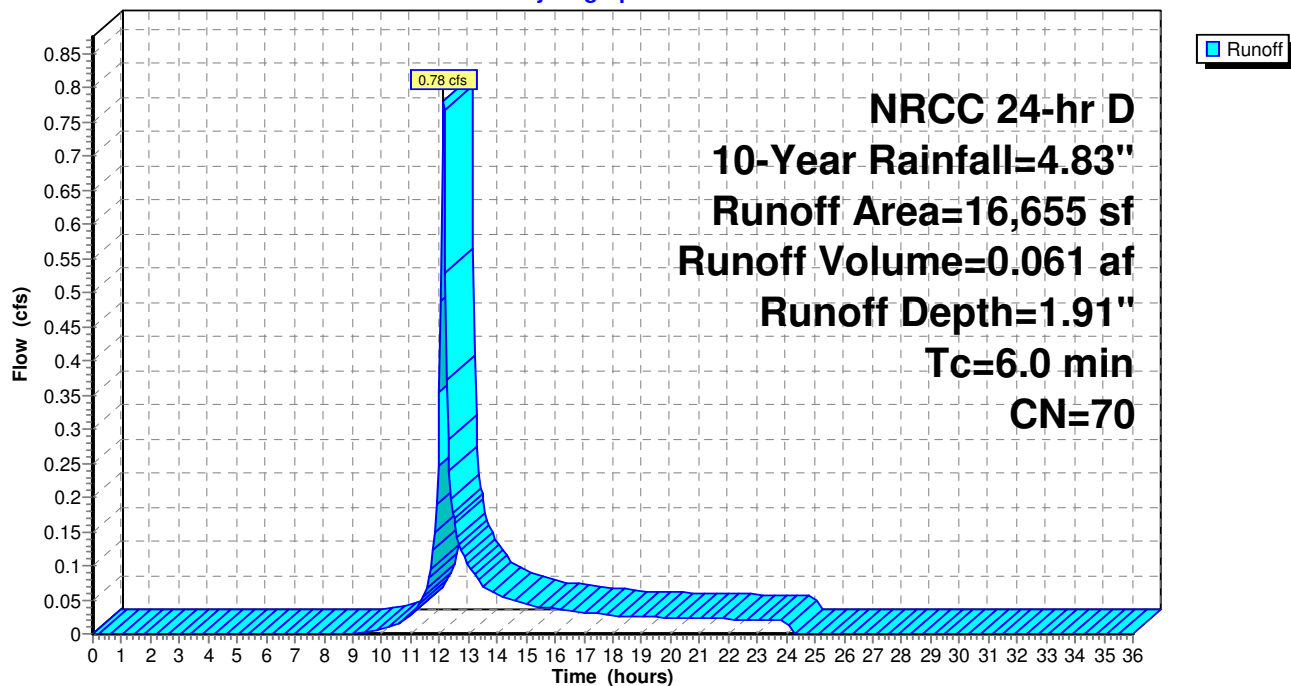
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
4,270	98	Paved parking, HSG B
9,642	61	>75% Grass cover, Good, HSG B
2,743	60	Woods, Fair, HSG B
16,655	70	Weighted Average
12,385		74.36% Pervious Area
4,270		25.64% Impervious Area

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

Subcatchment PR-3: PR-3

Hydrograph



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Summary for Subcatchment PR1A: Detained

Runoff = 7.96 cfs @ 12.13 hrs, Volume= 0.669 af, Depth= 4.03"
Routed to Pond 1P : Detention Basin

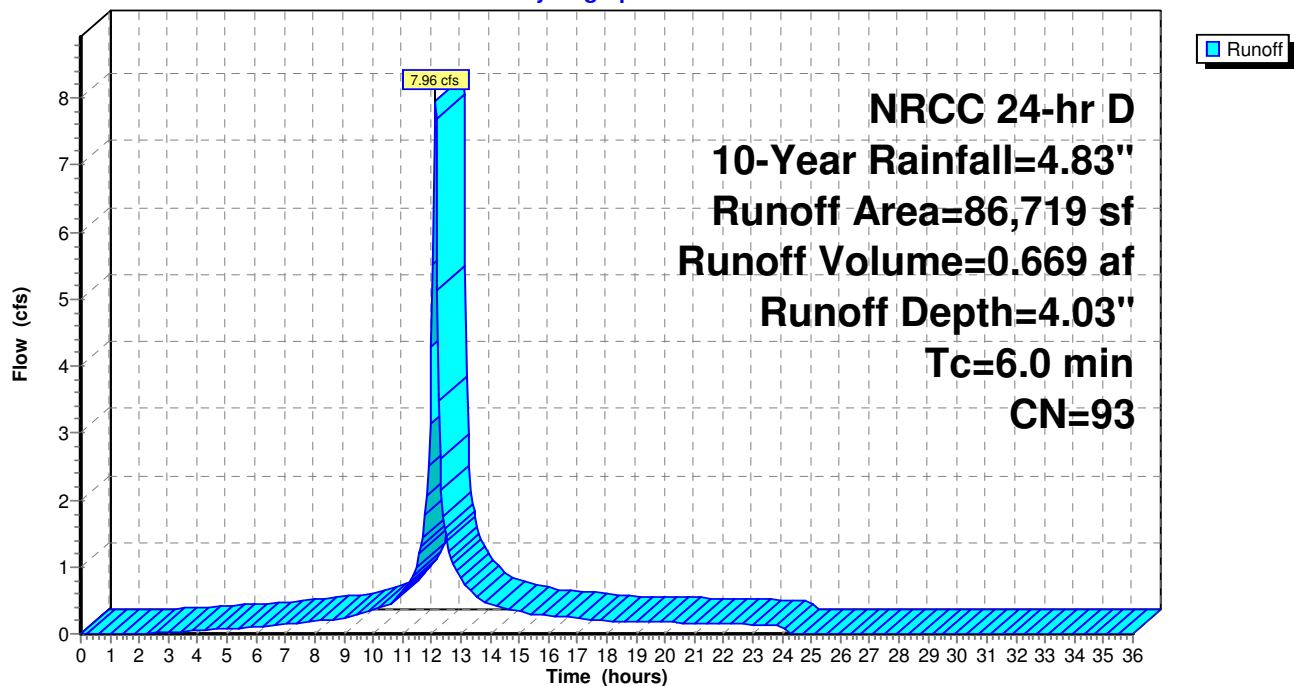
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

	Area (sf)	CN	Description
*	58,487	98	Paved parking and roof, HSG B
	12,170	61	>75% Grass cover, Good, HSG B
*	16,062	98	Detention Basin
	86,719	93	Weighted Average
	12,170		14.03% Pervious Area
	74,549		85.97% Impervious Area

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

Subcatchment PR1A: Detained

Hydrograph



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Summary for Subcatchment PR1B: Un-Detained

Runoff = 2.81 cfs @ 12.14 hrs, Volume= 0.232 af, Depth= 1.27"
Routed to Reach DP-1 : DP-1

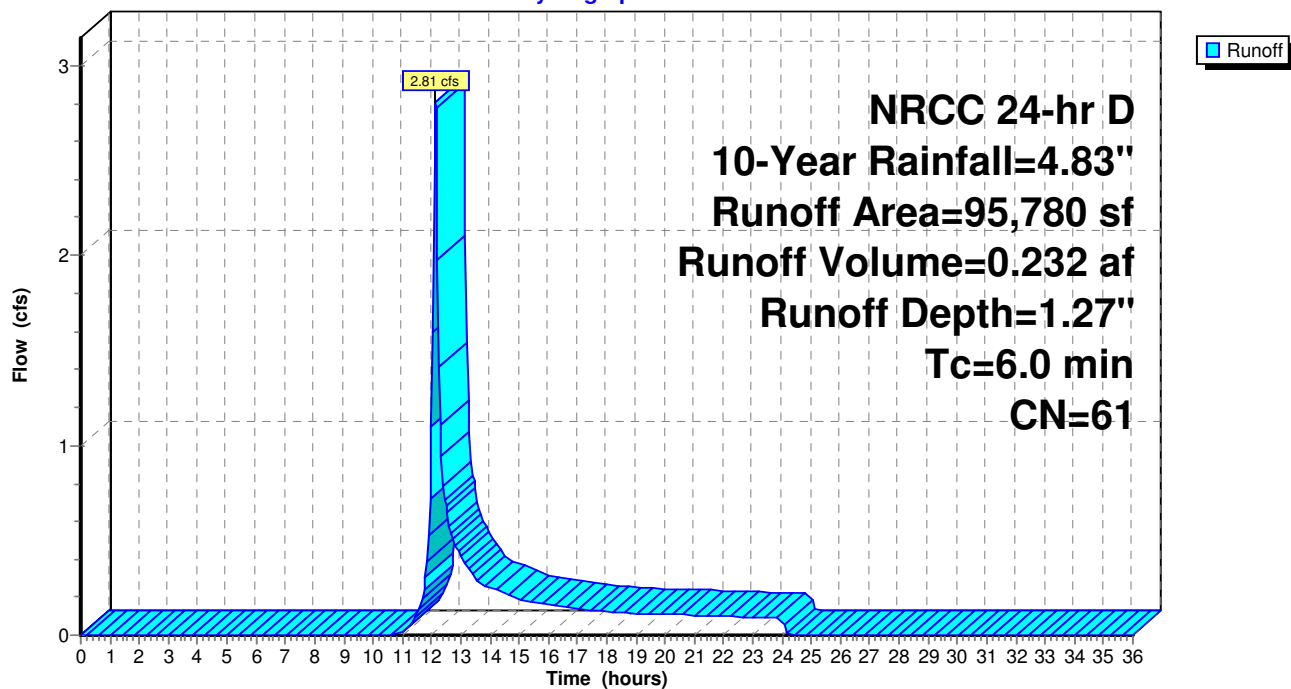
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
23,560	60	Woods, Fair, HSG B
72,220	61	>75% Grass cover, Good, HSG B
95,780	61	Weighted Average
95,780		100.00% Pervious Area

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

Subcatchment PR1B: Un-Detained

Hydrograph



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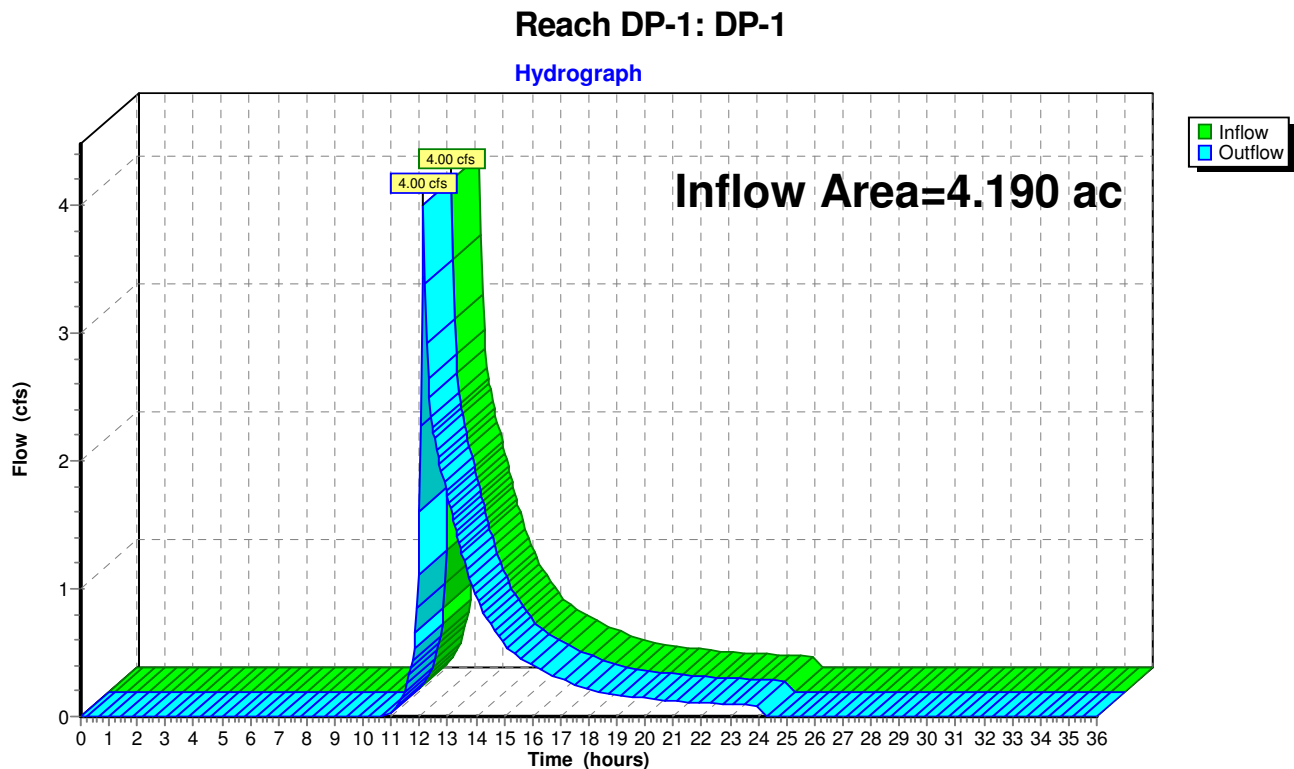
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Summary for Reach DP-1: DP-1

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

Inflow Area = 4.190 ac, 40.85% Impervious, Inflow Depth = 1.56" for 10-Year event
Inflow = 4.00 cfs @ 12.15 hrs, Volume= 0.546 af
Outflow = 4.00 cfs @ 12.15 hrs, Volume= 0.546 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



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Summary for Reach DP-3: DP-3

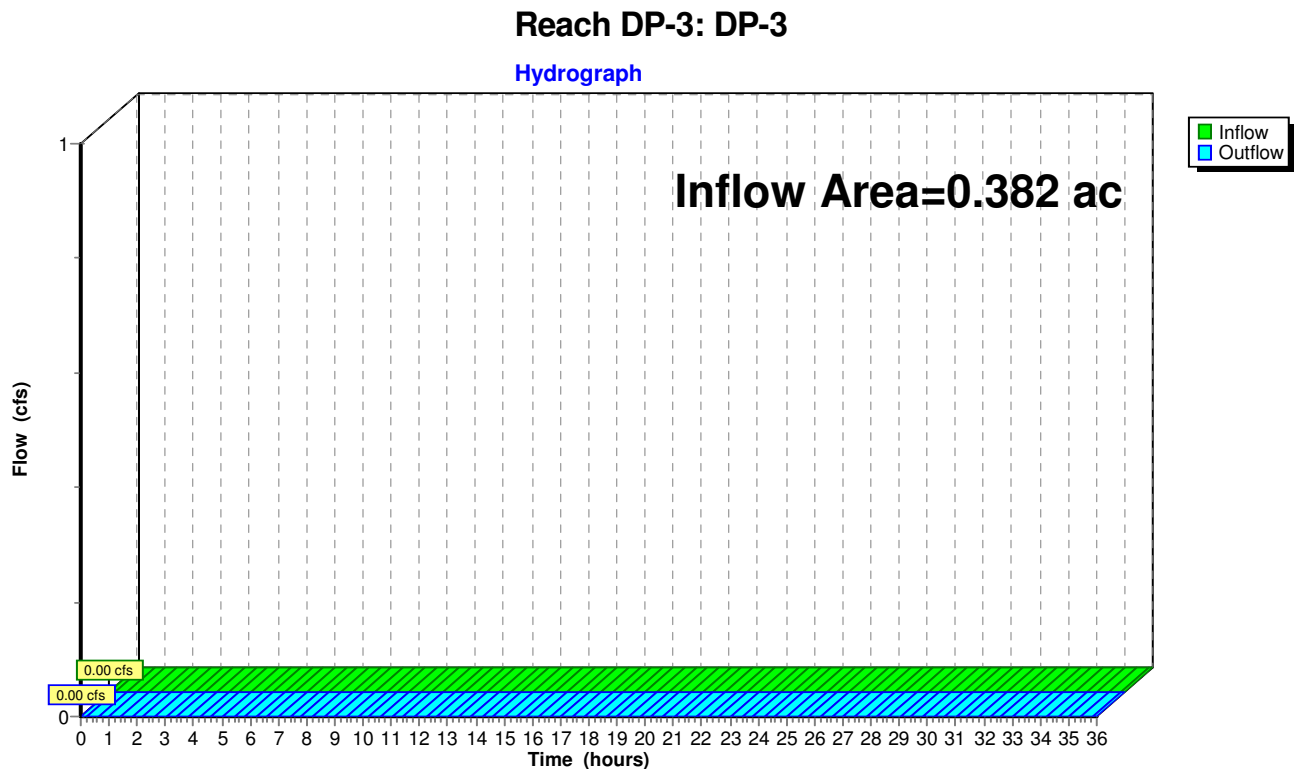
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 0.00" for 10-Year event

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



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Summary for Pond 1P: Detention Basin

Inflow Area = 1.991 ac, 85.97% Impervious, Inflow Depth = 4.03" for 10-Year event
Inflow = 7.96 cfs @ 12.13 hrs, Volume= 0.669 af
Outflow = 1.87 cfs @ 12.39 hrs, Volume= 0.669 af, Atten= 77%, Lag= 15.8 min
Discarded = 0.31 cfs @ 12.39 hrs, Volume= 0.355 af
Primary = 1.56 cfs @ 12.39 hrs, Volume= 0.314 af
Routed to Reach DP-1 : DP-1

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 66.05' @ 12.39 hrs Surf.Area= 9,848 sf Storage= 9,496 cf

Plug-Flow detention time= 93.7 min calculated for 0.668 af (100% of inflow)
Center-of-Mass det. time= 93.7 min (882.5 - 788.8)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	45,433 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
65.00	8,280	0	0
66.00	9,774	9,027	9,027
67.00	11,319	10,547	19,574
68.00	12,917	12,118	31,692
69.00	14,566	13,742	45,433

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	65.50'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Primary	66.00'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Primary	65.10'	8.0" Round Culvert L= 36.0' Ke= 0.900 Inlet / Outlet Invert= 65.10' / 64.92' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.31 cfs @ 12.39 hrs HW=66.05' (Free Discharge)

↑ **1=Exfiltration** (Controls 0.31 cfs)

Primary OutFlow Max=1.56 cfs @ 12.39 hrs HW=66.05' (Free Discharge)

↑ **2=Orifice/Grate** (Orifice Controls 0.52 cfs @ 2.63 fps)

↑ **3=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.74 fps)

↑ **4=Culvert** (Inlet Controls 1.04 cfs @ 2.98 fps)

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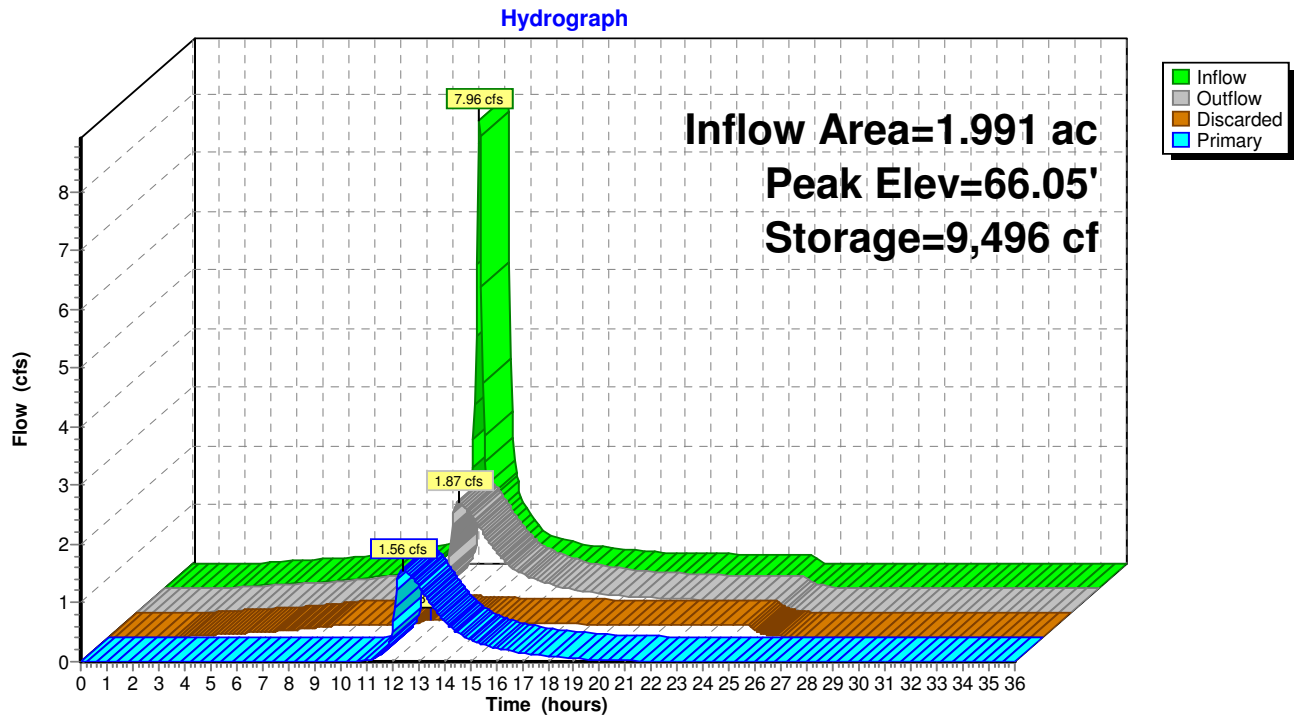
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Pond 1P: Detention Basin



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Summary for Pond 2P: Rain Garden

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 1.91" for 10-Year event
Inflow = 0.78 cfs @ 12.13 hrs, Volume= 0.061 af
Outflow = 0.10 cfs @ 12.99 hrs, Volume= 0.061 af, Atten= 87%, Lag= 51.2 min
Discarded = 0.10 cfs @ 12.99 hrs, Volume= 0.061 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-3 : DP-3

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 64.18' @ 12.99 hrs Surf.Area= 3,979 sf Storage= 715 cf

Plug-Flow detention time= 54.1 min calculated for 0.061 af (100% of inflow)
Center-of-Mass det. time= 54.0 min (933.2 - 879.1)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	4,361 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	3,756	0	0
65.00	4,965	4,361	4,361

Device	Routing	Invert	Outlet Devices
#1	Discarded	64.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	64.20'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.10 cfs @ 12.99 hrs HW=64.18' (Free Discharge)
↑**1=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=64.00' (Free Discharge)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

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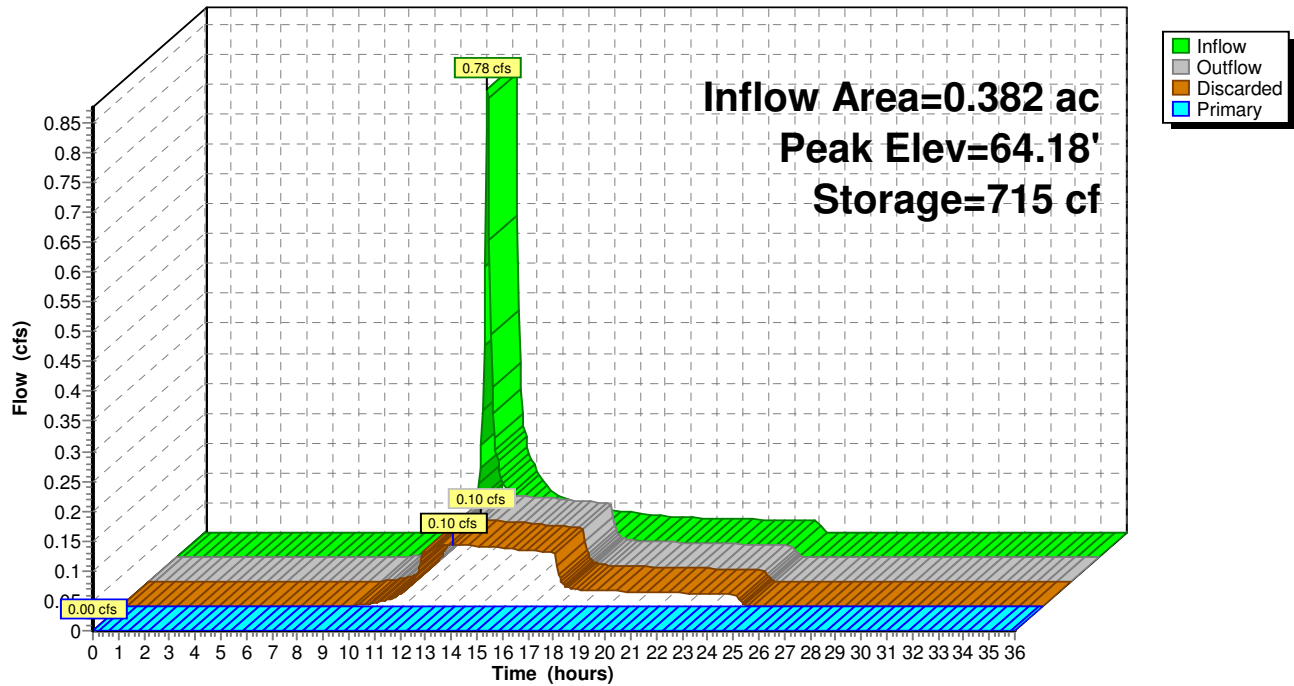
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Pond 2P: Rain Garden

Hydrograph



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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 PR-2: PR-2	Runoff Area=44,310 sf 0.00% Impervious Runoff Depth=2.47" Tc=6.0 min CN=65 Runoff=2.69 cfs 0.209 af
Subcatchment PR-3: PR-3	Runoff Area=16,655 sf 25.64% Impervious Runoff Depth=2.93" Tc=6.0 min CN=70 Runoff=1.21 cfs 0.093 af
Subcatchment PR1A: Detained	Runoff Area=86,719 sf 85.97% Impervious Runoff Depth=5.34" Tc=6.0 min CN=93 Runoff=10.37 cfs 0.886 af
Subcatchment PR1B: Un-Detained	Runoff Area=95,780 sf 0.00% Impervious Runoff Depth=2.11" Tc=6.0 min CN=61 Runoff=4.90 cfs 0.387 af
Reach DP-1: DP-1	Inflow=6.62 cfs 0.870 af Outflow=6.62 cfs 0.870 af
Reach DP-3: DP-3	Inflow=0.12 cfs 0.011 af Outflow=0.12 cfs 0.011 af
Pond 1P: Detention Basin	Peak Elev=66.34' Storage=12,460 cf Inflow=10.37 cfs 0.886 af Discarded=0.34 cfs 0.403 af Primary=2.28 cfs 0.483 af Outflow=2.62 cfs 0.886 af
Pond 2P: Rain Garden	Peak Elev=64.28' Storage=1,108 cf Inflow=1.21 cfs 0.093 af Discarded=0.11 cfs 0.082 af Primary=0.12 cfs 0.011 af Outflow=0.23 cfs 0.093 af
Total Runoff Area = 5.589 ac Runoff Volume = 1.576 af Average Runoff Depth = 3.38" 67.63% Pervious = 3.780 ac 32.37% Impervious = 1.809 ac	

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Summary for Subcatchment PR-2: PR-2

Runoff = 2.69 cfs @ 12.13 hrs, Volume= 0.209 af, Depth= 2.47"

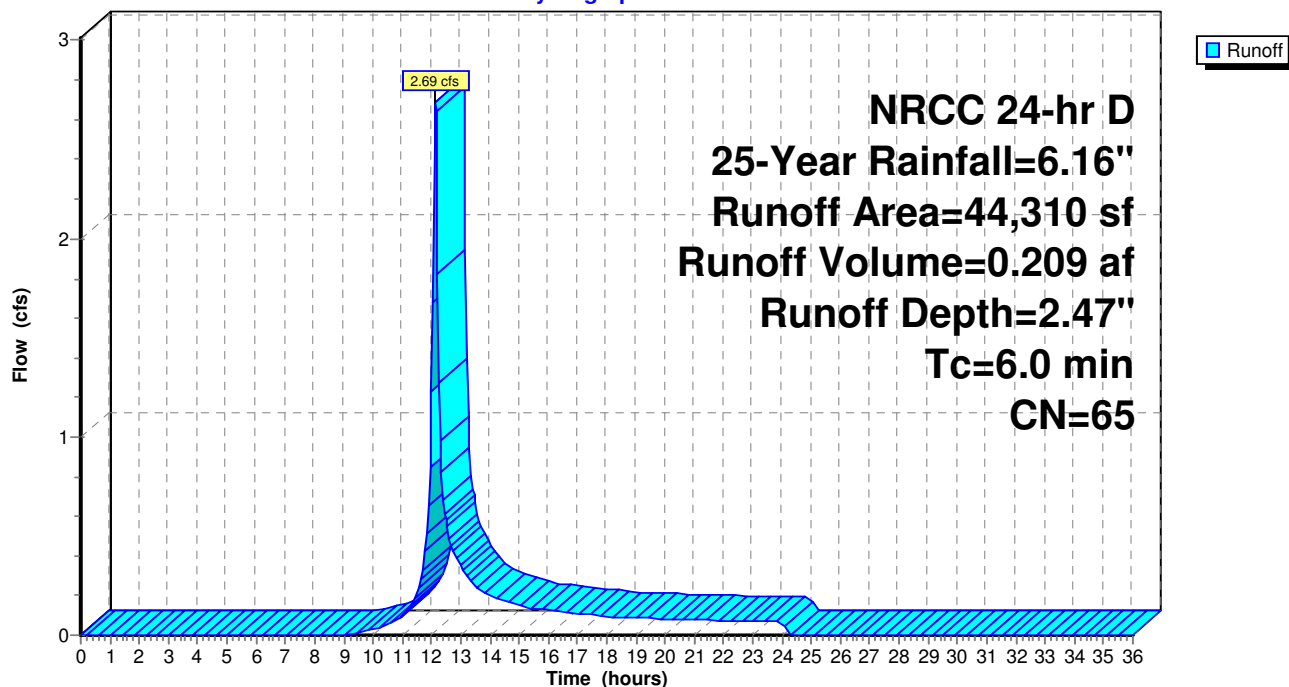
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

Area (sf)	CN	Description
11,793	61	>75% Grass cover, Good, HSG B
9,948	60	Woods, Fair, HSG B
22,569	69	50-75% Grass cover, Fair, HSG B
44,310	65	Weighted Average
44,310		100.00% Pervious Area

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

Subcatchment PR-2: PR-2

Hydrograph



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Summary for Subcatchment PR-3: PR-3

Runoff = 1.21 cfs @ 12.13 hrs, Volume= 0.093 af, Depth= 2.93"
Routed to Pond 2P : Rain Garden

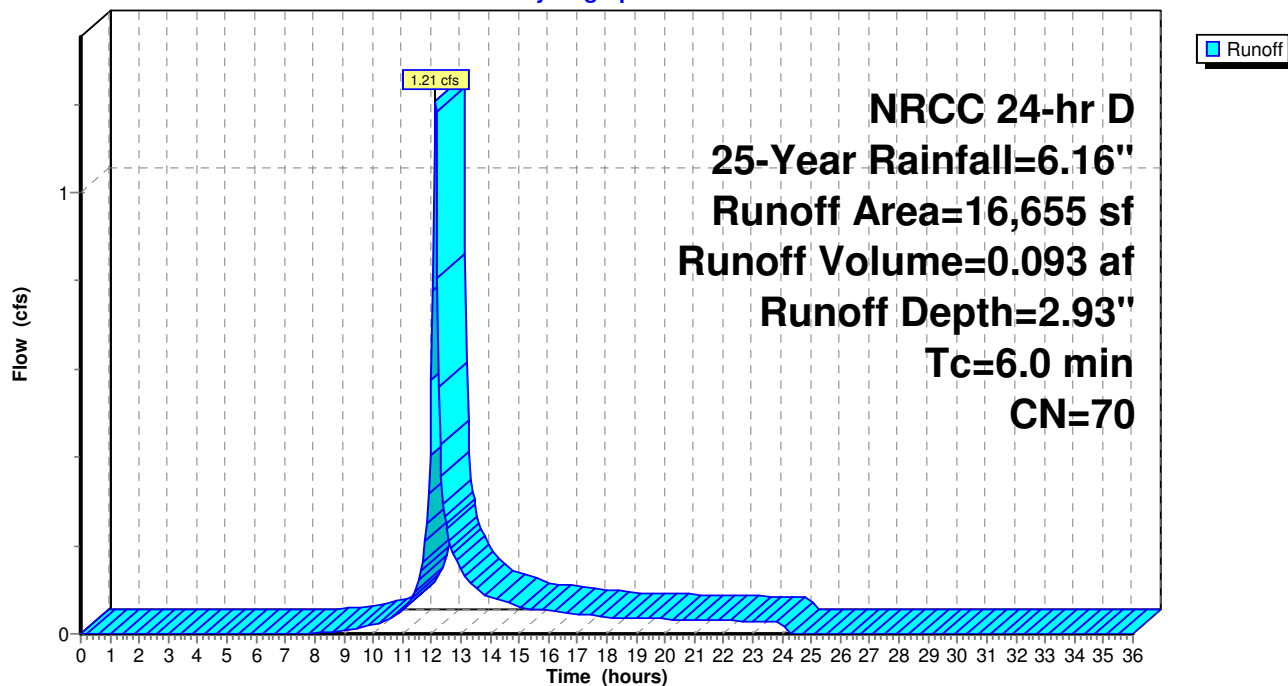
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

Area (sf)	CN	Description
4,270	98	Paved parking, HSG B
9,642	61	>75% Grass cover, Good, HSG B
2,743	60	Woods, Fair, HSG B
16,655	70	Weighted Average
12,385		74.36% Pervious Area
4,270		25.64% Impervious Area

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

Subcatchment PR-3: PR-3

Hydrograph



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Summary for Subcatchment PR1A: Detained

Runoff = 10.37 cfs @ 12.13 hrs, Volume= 0.886 af, Depth= 5.34"
Routed to Pond 1P : Detention Basin

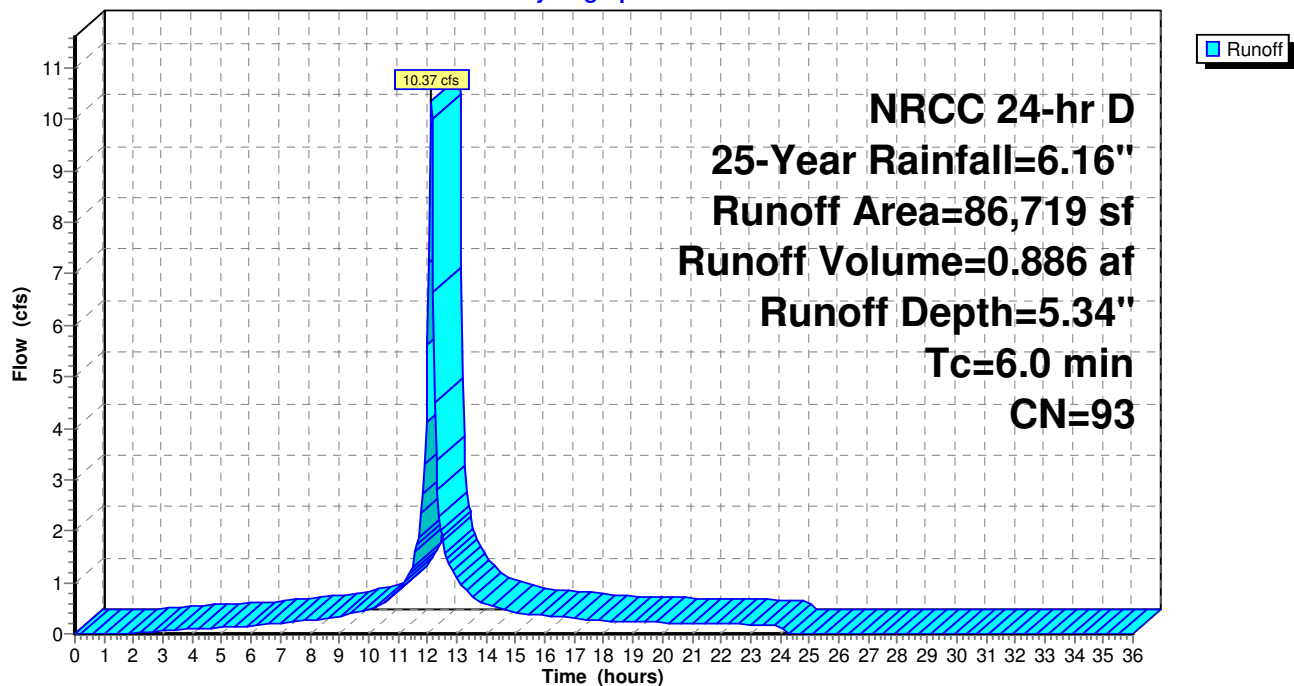
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

	Area (sf)	CN	Description
*	58,487	98	Paved parking and roof, HSG B
	12,170	61	>75% Grass cover, Good, HSG B
*	16,062	98	Detention Basin
	86,719	93	Weighted Average
	12,170		14.03% Pervious Area
	74,549		85.97% Impervious Area

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

Subcatchment PR1A: Detained

Hydrograph



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Summary for Subcatchment PR1B: Un-Detained

Runoff = 4.90 cfs @ 12.14 hrs, Volume= 0.387 af, Depth= 2.11"
Routed to Reach DP-1 : DP-1

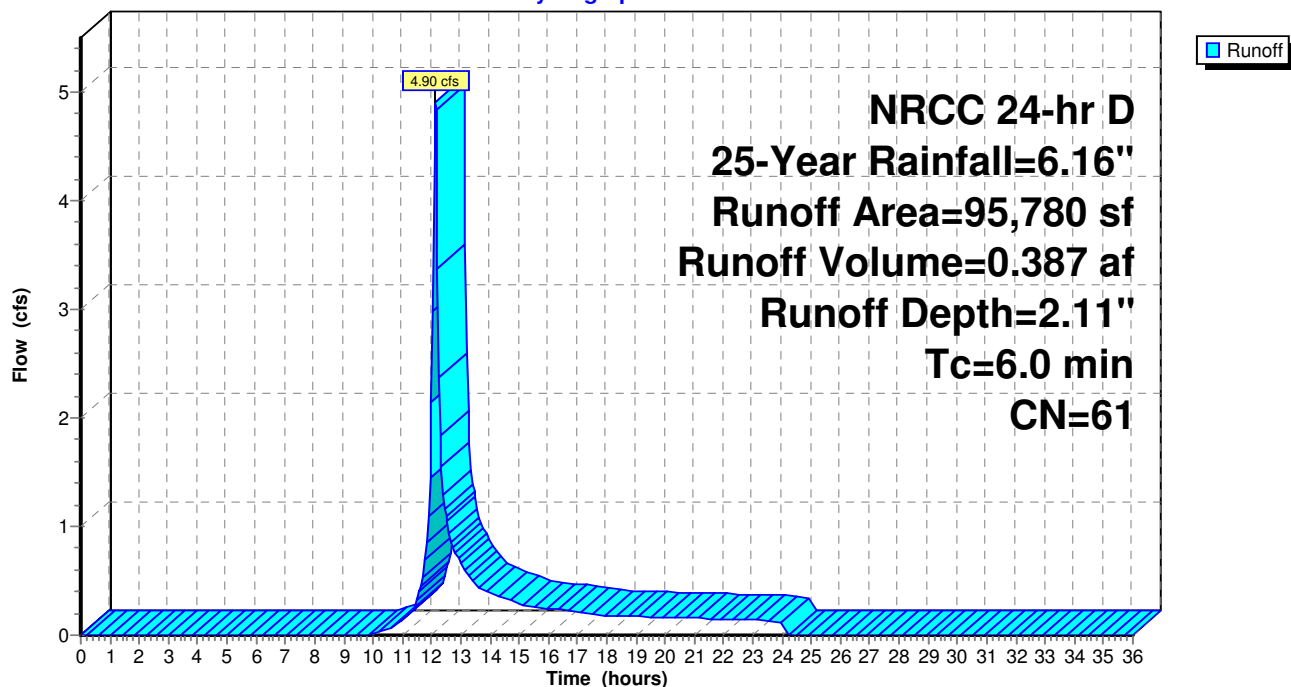
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-Year Rainfall=6.16"

Area (sf)	CN	Description
23,560	60	Woods, Fair, HSG B
72,220	61	>75% Grass cover, Good, HSG B
95,780	61	Weighted Average
95,780		100.00% Pervious Area

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

Subcatchment PR1B: Un-Detained

Hydrograph



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Summary for Reach DP-1: DP-1

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

Inflow Area = 4.190 ac, 40.85% Impervious, Inflow Depth = 2.49" for 25-Year event

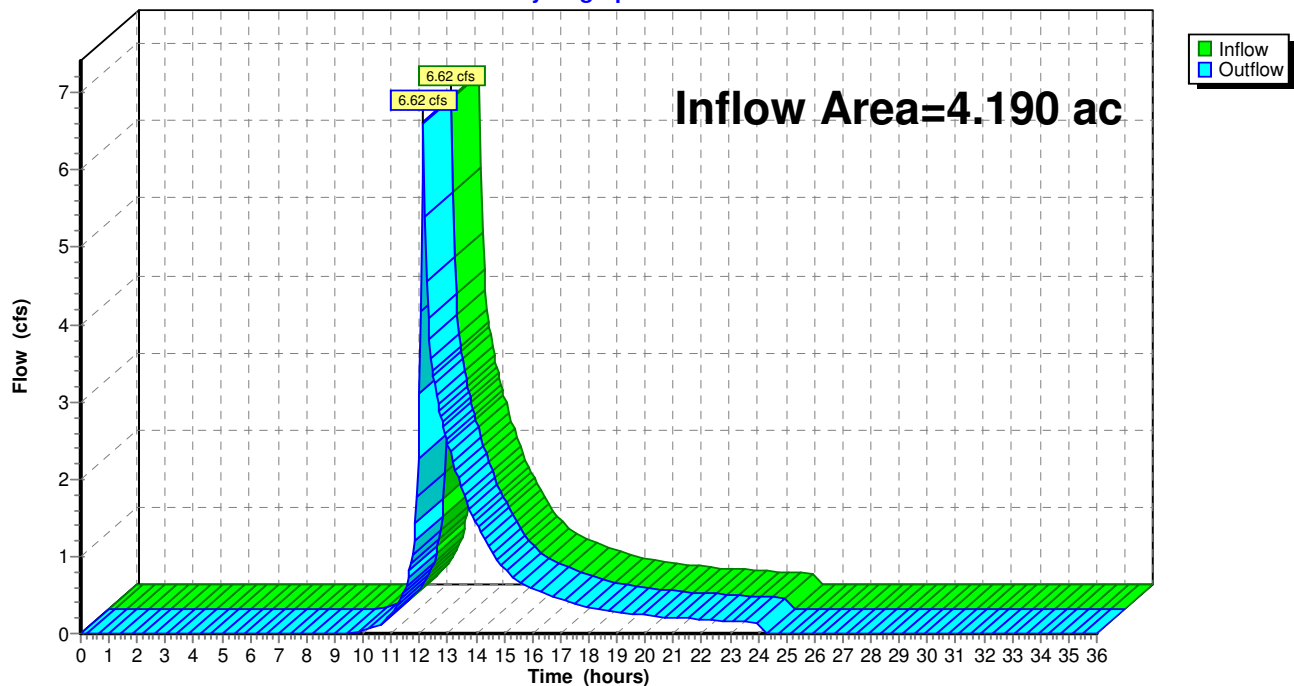
Inflow = 6.62 cfs @ 12.14 hrs, Volume= 0.870 af

Outflow = 6.62 cfs @ 12.14 hrs, Volume= 0.870 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach DP-1: DP-1

Hydrograph



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Summary for Reach DP-3: DP-3

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

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 0.36" for 25-Year event

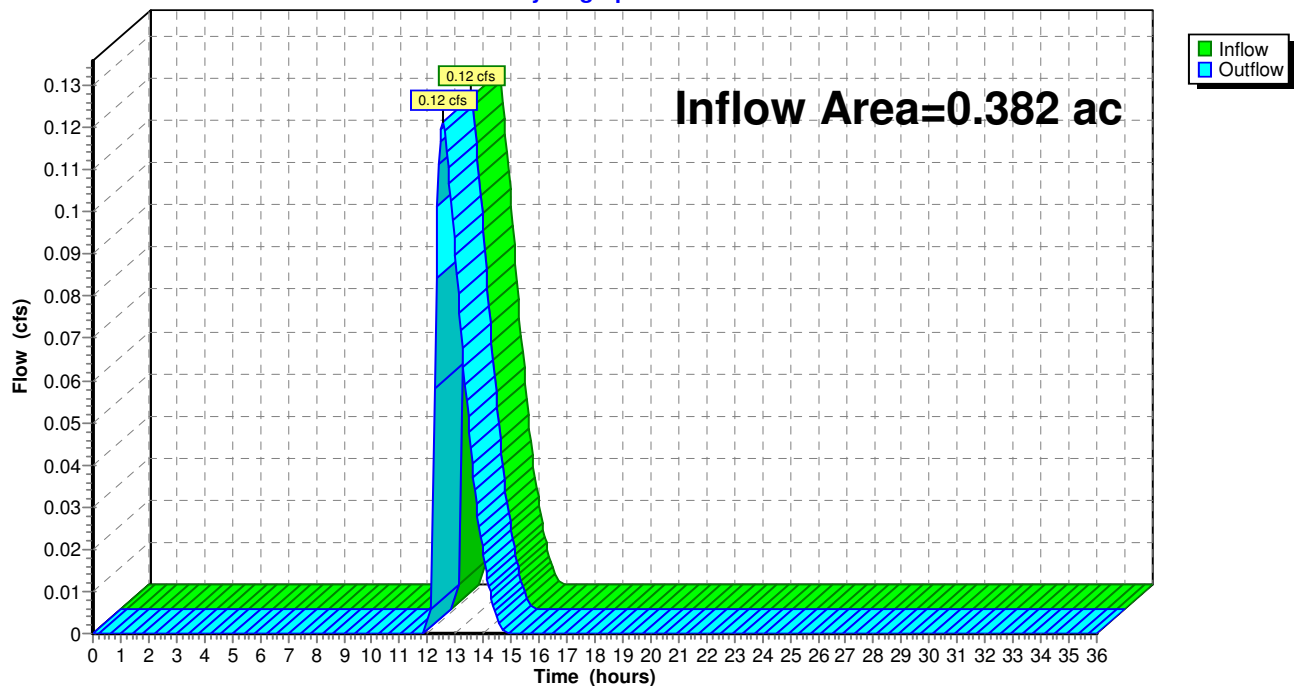
Inflow = 0.12 cfs @ 12.56 hrs, Volume= 0.011 af

Outflow = 0.12 cfs @ 12.56 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach DP-3: DP-3

Hydrograph



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Summary for Pond 1P: Detention Basin

Inflow Area = 1.991 ac, 85.97% Impervious, Inflow Depth = 5.34" for 25-Year event
Inflow = 10.37 cfs @ 12.13 hrs, Volume= 0.886 af
Outflow = 2.62 cfs @ 12.37 hrs, Volume= 0.886 af, Atten= 75%, Lag= 14.4 min
Discarded = 0.34 cfs @ 12.37 hrs, Volume= 0.403 af
Primary = 2.28 cfs @ 12.37 hrs, Volume= 0.483 af
Routed to Reach DP-1 : DP-1

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 66.34' @ 12.37 hrs Surf.Area= 10,302 sf Storage= 12,460 cf

Plug-Flow detention time= 94.0 min calculated for 0.885 af (100% of inflow)
Center-of-Mass det. time= 94.1 min (874.0 - 779.9)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	45,433 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
65.00	8,280	0	0
66.00	9,774	9,027	9,027
67.00	11,319	10,547	19,574
68.00	12,917	12,118	31,692
69.00	14,566	13,742	45,433

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	65.50'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Primary	66.00'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Primary	65.10'	8.0" Round Culvert L= 36.0' Ke= 0.900 Inlet / Outlet Invert= 65.10' / 64.92' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.34 cfs @ 12.37 hrs HW=66.34' (Free Discharge)

↑ **1=Exfiltration** (Controls 0.34 cfs)

Primary OutFlow Max=2.27 cfs @ 12.37 hrs HW=66.34' (Free Discharge)

↑ **2=Orifice/Grate** (Orifice Controls 0.73 cfs @ 3.70 fps)

↑ **3=Orifice/Grate** (Orifice Controls 0.28 cfs @ 1.99 fps)

↑ **4=Culvert** (Inlet Controls 1.26 cfs @ 3.62 fps)

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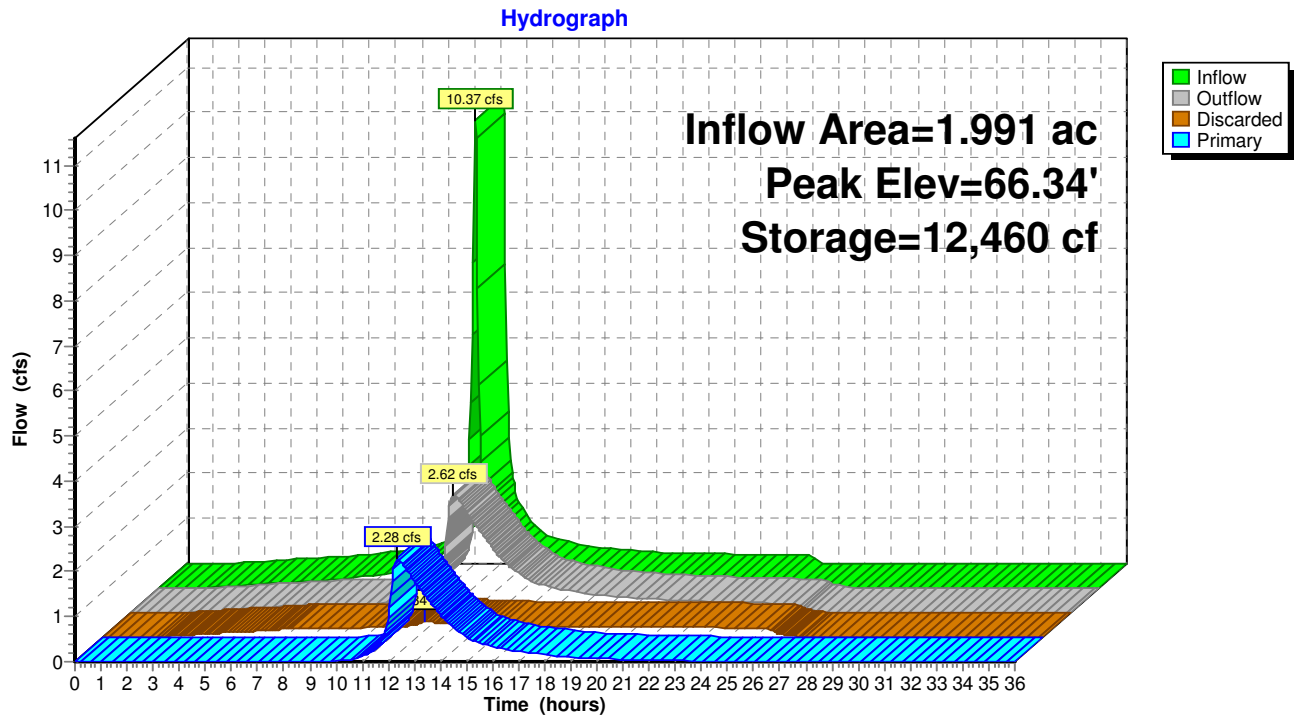
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Pond 1P: Detention Basin



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Summary for Pond 2P: Rain Garden

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 2.93" for 25-Year event
Inflow = 1.21 cfs @ 12.13 hrs, Volume= 0.093 af
Outflow = 0.23 cfs @ 12.56 hrs, Volume= 0.093 af, Atten= 81%, Lag= 25.6 min
Discarded = 0.11 cfs @ 12.56 hrs, Volume= 0.082 af
Primary = 0.12 cfs @ 12.56 hrs, Volume= 0.011 af
Routed to Reach DP-3 : DP-3

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 64.28' @ 12.56 hrs Surf.Area= 4,097 sf Storage= 1,108 cf

Plug-Flow detention time= 65.6 min calculated for 0.093 af (100% of inflow)
Center-of-Mass det. time= 65.5 min (928.6 - 863.1)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	4,361 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	3,756	0	0
65.00	4,965	4,361	4,361

Device	Routing	Invert	Outlet Devices
#1	Discarded	64.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	64.20'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.11 cfs @ 12.56 hrs HW=64.28' (Free Discharge)
↑**1=Exfiltration** (Controls 0.11 cfs)

Primary OutFlow Max=0.12 cfs @ 12.56 hrs HW=64.28' (Free Discharge)
↑**2=Orifice/Grate** (Weir Controls 0.12 cfs @ 0.94 fps)

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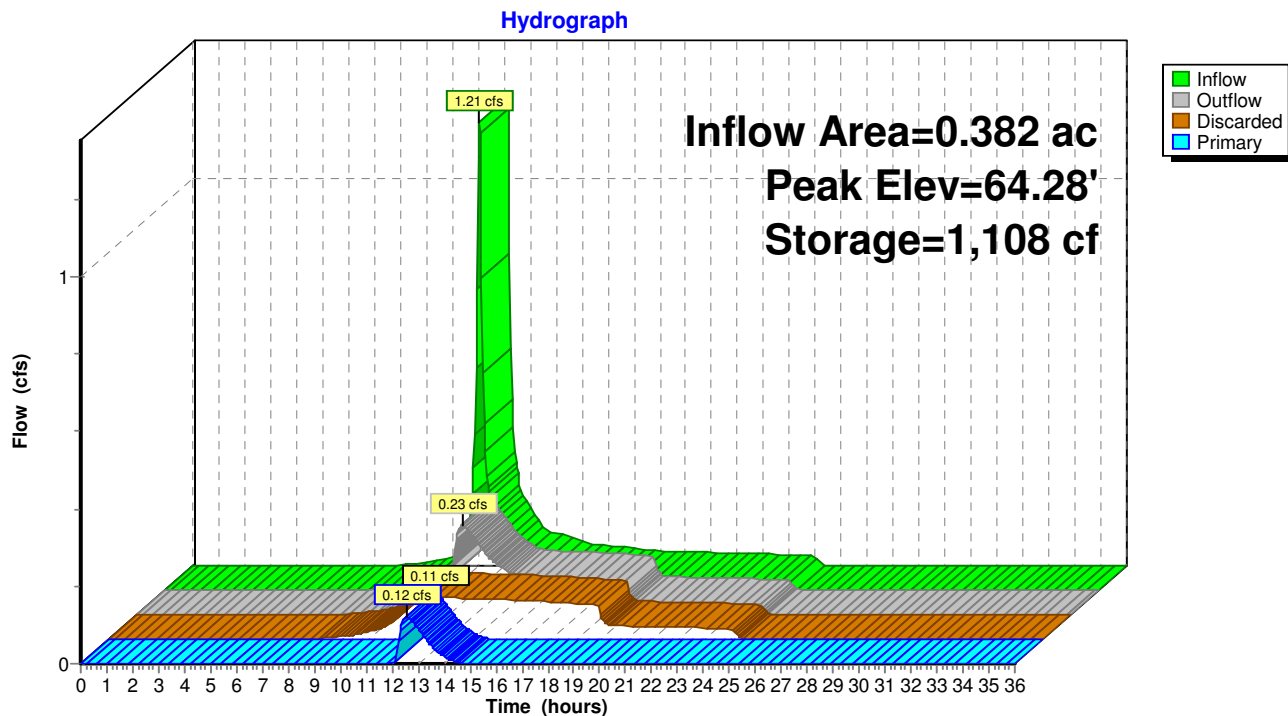
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Pond 2P: Rain Garden



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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 PR-2: PR-2 Runoff Area=44,310 sf 0.00% Impervious Runoff Depth=4.67"
Tc=6.0 min CN=65 Runoff=5.11 cfs 0.396 af

Subcatchment PR-3: PR-3 Runoff Area=16,655 sf 25.64% Impervious Runoff Depth=5.28"
Tc=6.0 min CN=70 Runoff=2.16 cfs 0.168 af

Subcatchment PR1A: Detained Runoff Area=86,719 sf 85.97% Impervious Runoff Depth=8.10"
Tc=6.0 min CN=93 Runoff=15.34 cfs 1.343 af

Subcatchment PR1B: Un-Detained Runoff Area=95,780 sf 0.00% Impervious Runoff Depth=4.18"
Tc=6.0 min CN=61 Runoff=9.90 cfs 0.765 af

Reach DP-1: DP-1 Inflow=12.69 cfs 1.633 af
Outflow=12.69 cfs 1.633 af

Reach DP-3: DP-3 Inflow=0.50 cfs 0.054 af
Outflow=0.50 cfs 0.054 af

Pond 1P: Detention Basin Peak Elev=66.89' Storage=18,354 cf Inflow=15.34 cfs 1.343 af
Discarded=0.40 cfs 0.475 af Primary=3.37 cfs 0.868 af Outflow=3.77 cfs 1.343 af

Pond 2P: Rain Garden Peak Elev=64.48' Storage=1,945 cf Inflow=2.16 cfs 0.168 af
Discarded=0.13 cfs 0.114 af Primary=0.50 cfs 0.054 af Outflow=0.63 cfs 0.168 af

Total Runoff Area = 5.589 ac Runoff Volume = 2.672 af Average Runoff Depth = 5.74"
67.63% Pervious = 3.780 ac 32.37% Impervious = 1.809 ac

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Summary for Subcatchment PR-2: PR-2

Runoff = 5.11 cfs @ 12.13 hrs, Volume= 0.396 af, Depth= 4.67"

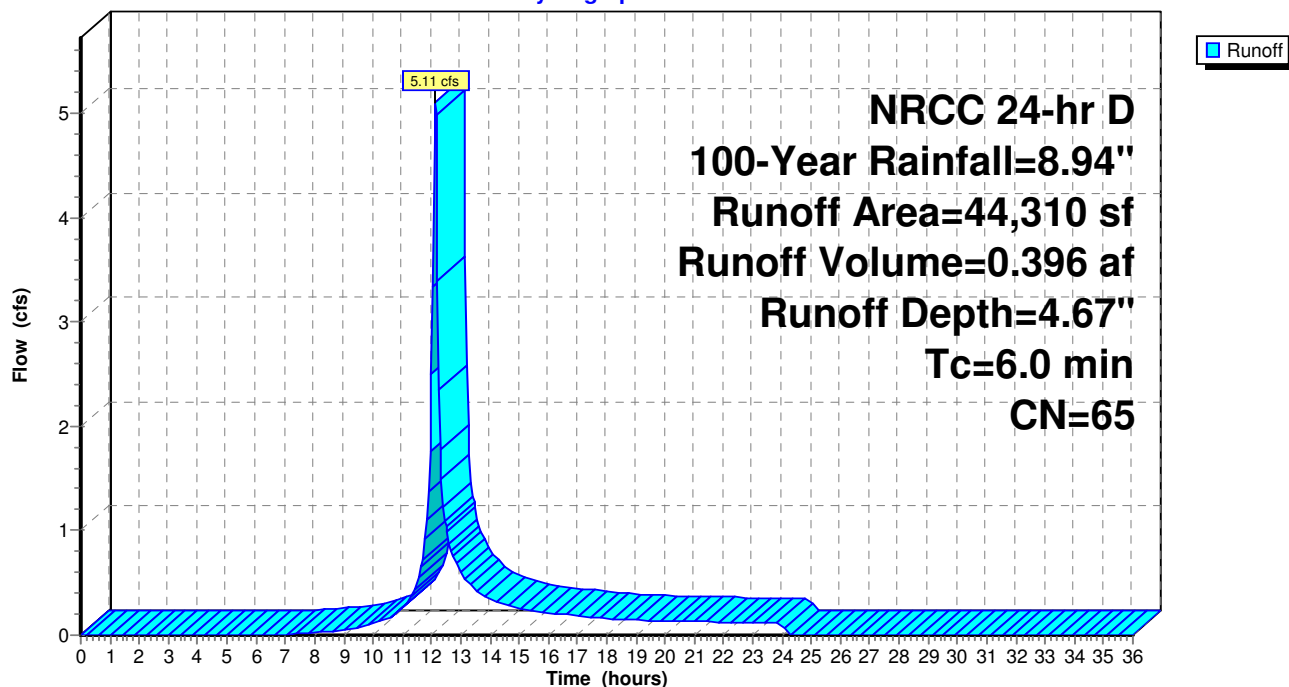
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
11,793	61	>75% Grass cover, Good, HSG B
9,948	60	Woods, Fair, HSG B
22,569	69	50-75% Grass cover, Fair, HSG B
44,310	65	Weighted Average
44,310		100.00% Pervious Area

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

Subcatchment PR-2: PR-2

Hydrograph



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Summary for Subcatchment PR-3: PR-3

Runoff = 2.16 cfs @ 12.13 hrs, Volume= 0.168 af, Depth= 5.28"
Routed to Pond 2P : Rain Garden

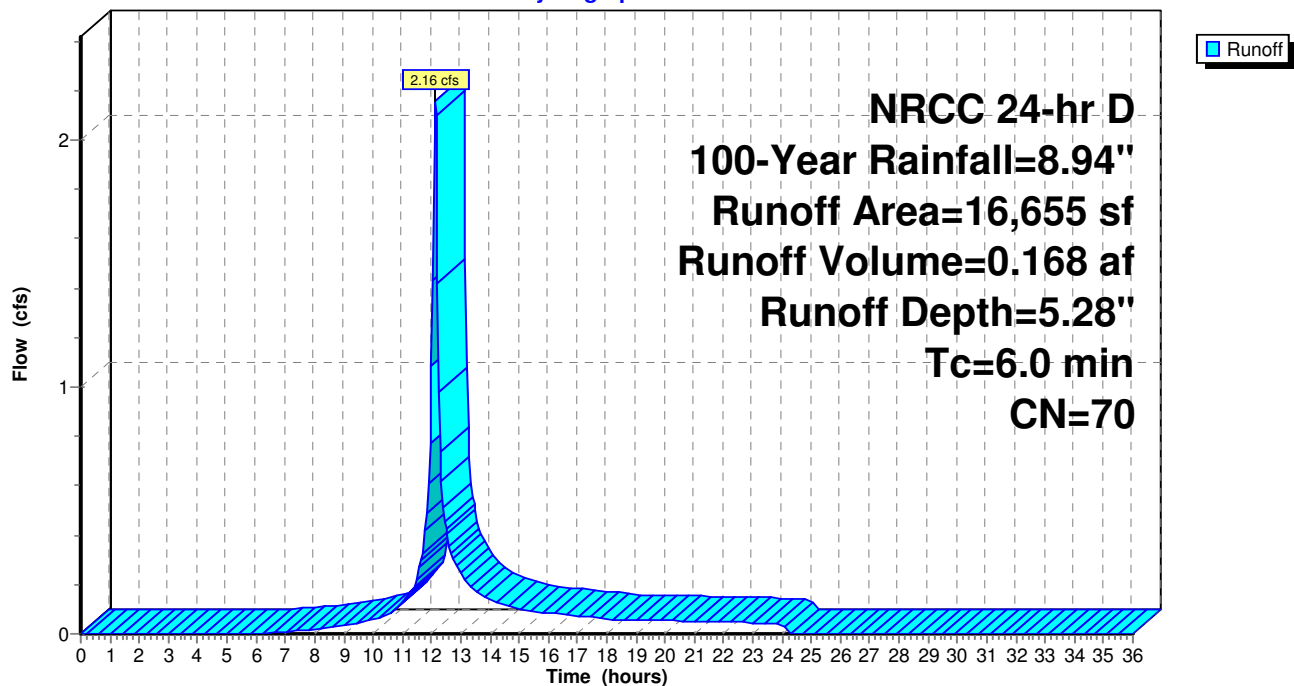
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
4,270	98	Paved parking, HSG B
9,642	61	>75% Grass cover, Good, HSG B
2,743	60	Woods, Fair, HSG B
16,655	70	Weighted Average
12,385		74.36% Pervious Area
4,270		25.64% Impervious Area

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

Subcatchment PR-3: PR-3

Hydrograph



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Summary for Subcatchment PR1A: Detained

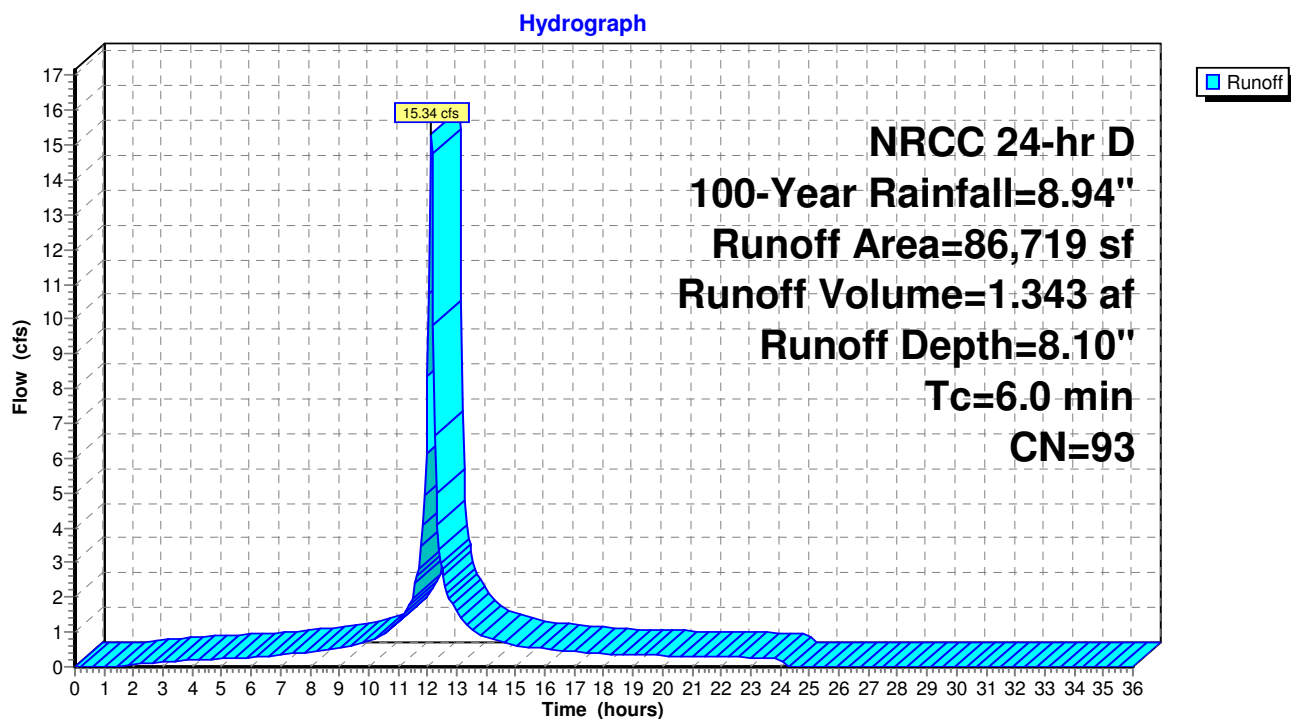
Runoff = 15.34 cfs @ 12.13 hrs, Volume= 1.343 af, Depth= 8.10"
Routed to Pond 1P : Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
*	58,487	98	Paved parking and roof, HSG B
	12,170	61	>75% Grass cover, Good, HSG B
*	16,062	98	Detention Basin
	86,719	93	Weighted Average
	12,170		14.03% Pervious Area
	74,549		85.97% Impervious Area

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

Subcatchment PR1A: Detained



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Summary for Subcatchment PR1B: Un-Detained

Runoff = 9.90 cfs @ 12.13 hrs, Volume= 0.765 af, Depth= 4.18"
Routed to Reach DP-1 : DP-1

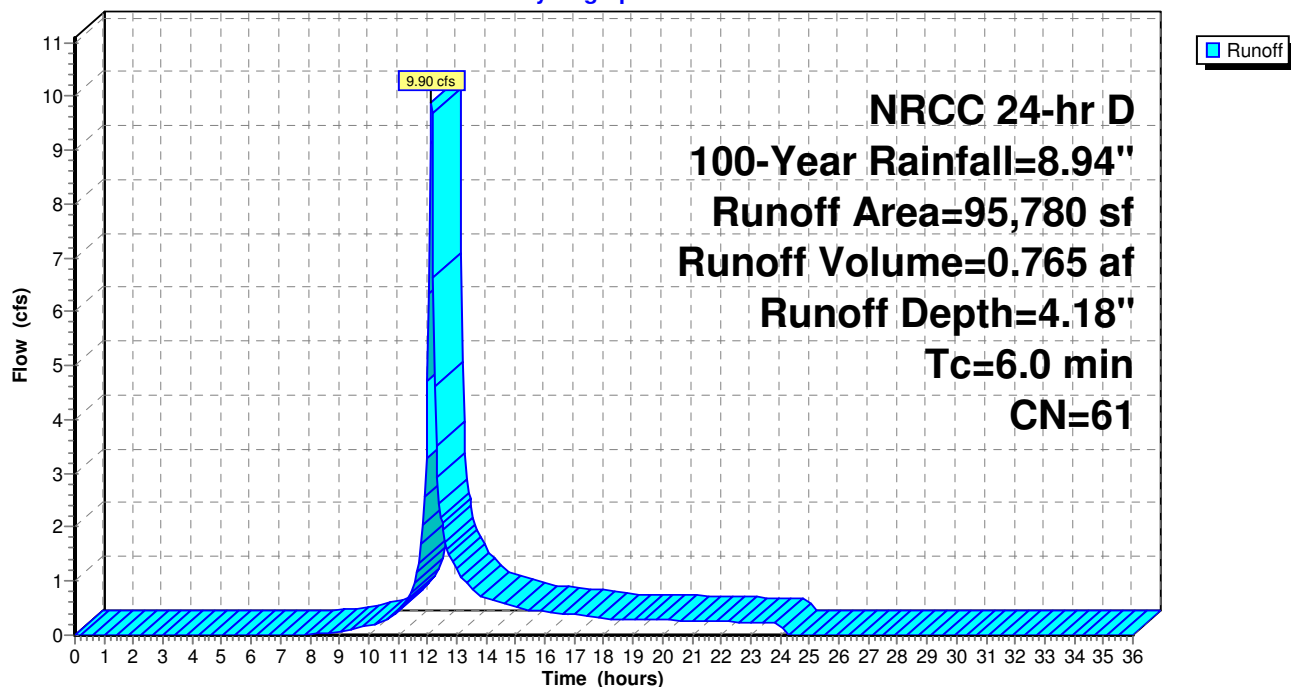
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
23,560	60	Woods, Fair, HSG B
72,220	61	>75% Grass cover, Good, HSG B
95,780	61	Weighted Average
95,780		100.00% Pervious Area

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

Subcatchment PR1B: Un-Detained

Hydrograph



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Summary for Reach DP-1: DP-1

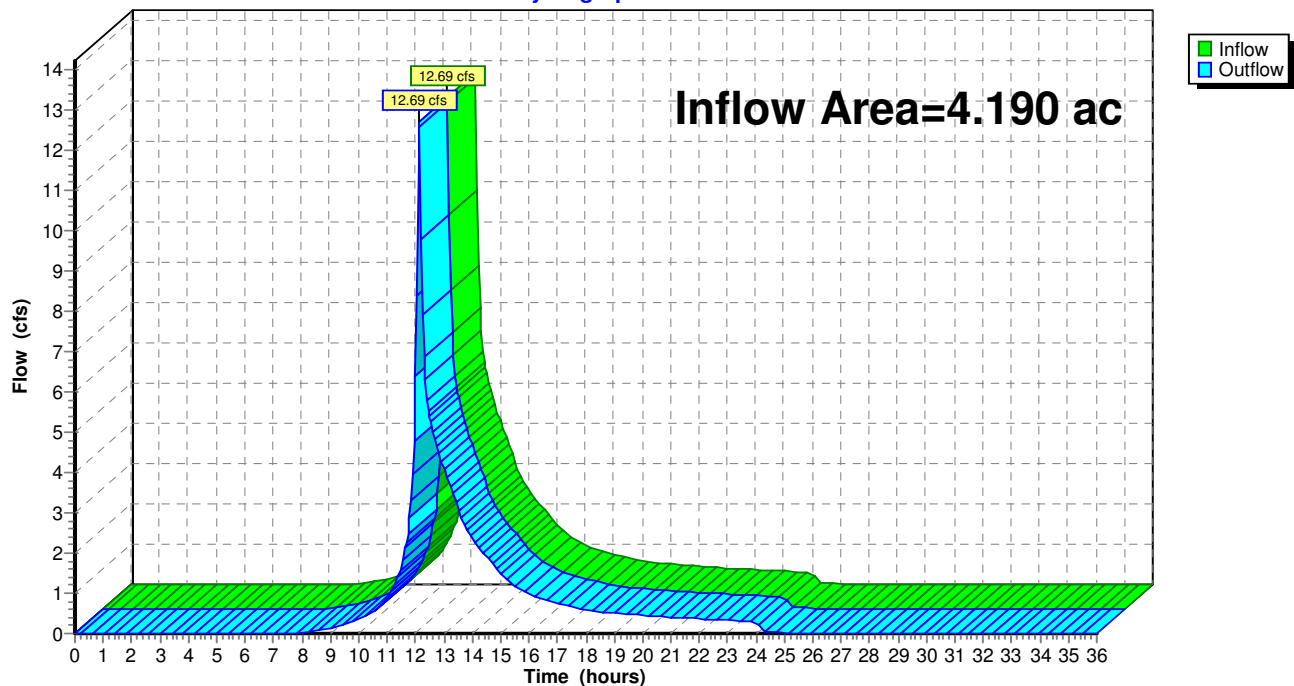
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.190 ac, 40.85% Impervious, Inflow Depth = 4.68" for 100-Year event
Inflow = 12.69 cfs @ 12.14 hrs, Volume= 1.633 af
Outflow = 12.69 cfs @ 12.14 hrs, Volume= 1.633 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach DP-1: DP-1

Hydrograph



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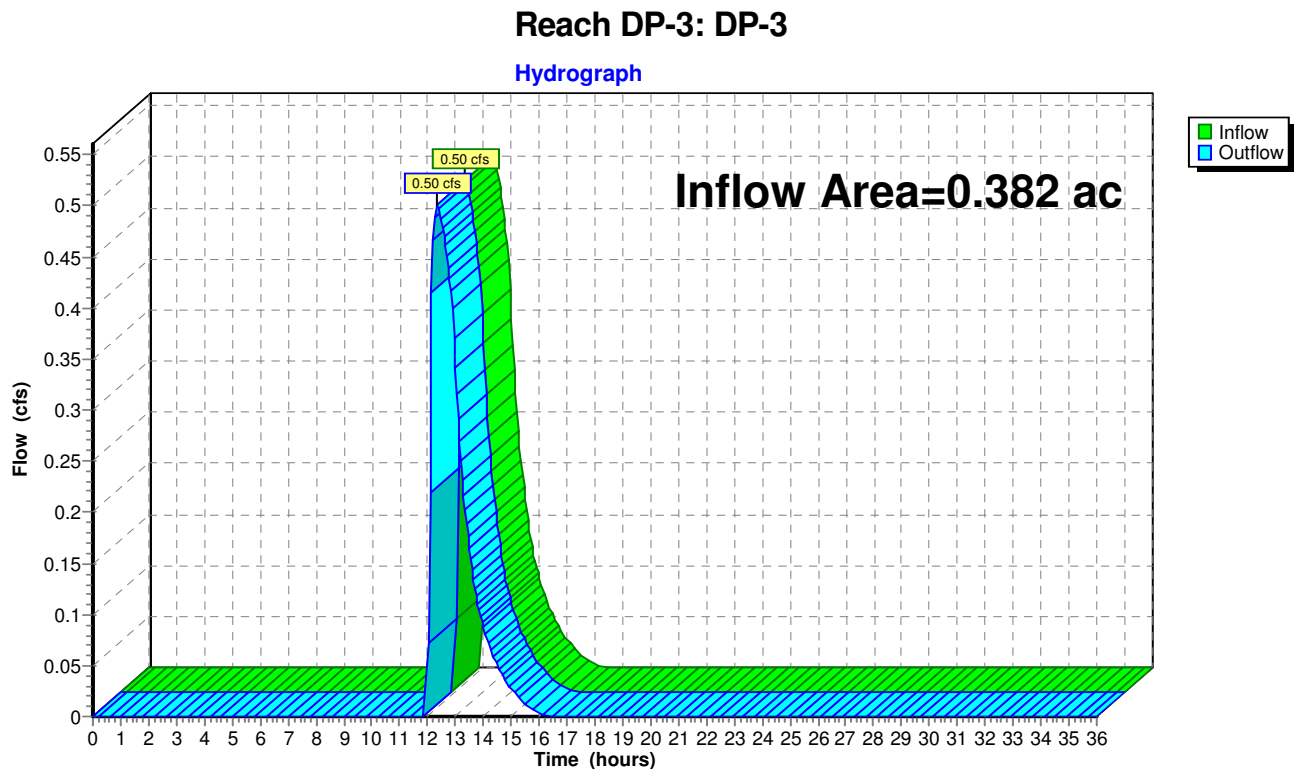
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Summary for Reach DP-3: DP-3

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

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 1.71" for 100-Year event
Inflow = 0.50 cfs @ 12.35 hrs, Volume= 0.054 af
Outflow = 0.50 cfs @ 12.35 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs



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Summary for Pond 1P: Detention Basin

Inflow Area = 1.991 ac, 85.97% Impervious, Inflow Depth = 8.10" for 100-Year event
Inflow = 15.34 cfs @ 12.13 hrs, Volume= 1.343 af
Outflow = 3.77 cfs @ 12.37 hrs, Volume= 1.343 af, Atten= 75%, Lag= 14.7 min
Discarded = 0.40 cfs @ 12.37 hrs, Volume= 0.475 af
Primary = 3.37 cfs @ 12.37 hrs, Volume= 0.868 af
Routed to Reach DP-1 : DP-1

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 66.89' @ 12.37 hrs Surf.Area= 11,151 sf Storage= 18,354 cf

Plug-Flow detention time= 93.7 min calculated for 1.343 af (100% of inflow)
Center-of-Mass det. time= 93.4 min (861.4 - 768.0)

Volume	Invert	Avail.Storage	Storage Description
#1	65.00'	45,433 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
65.00	8,280	0	0
66.00	9,774	9,027	9,027
67.00	11,319	10,547	19,574
68.00	12,917	12,118	31,692
69.00	14,566	13,742	45,433

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	65.50'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Primary	66.00'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Primary	65.10'	8.0" Round Culvert L= 36.0' Ke= 0.900 Inlet / Outlet Invert= 65.10' / 64.92' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.40 cfs @ 12.37 hrs HW=66.89' (Free Discharge)

↑ **1=Exfiltration** (Controls 0.40 cfs)

Primary OutFlow Max=3.37 cfs @ 12.37 hrs HW=66.89' (Free Discharge)

↑ **2=Orifice/Grate** (Orifice Controls 1.01 cfs @ 5.14 fps)

↑ **3=Orifice/Grate** (Orifice Controls 0.76 cfs @ 3.85 fps)

↑ **4=Culvert** (Inlet Controls 1.60 cfs @ 4.59 fps)

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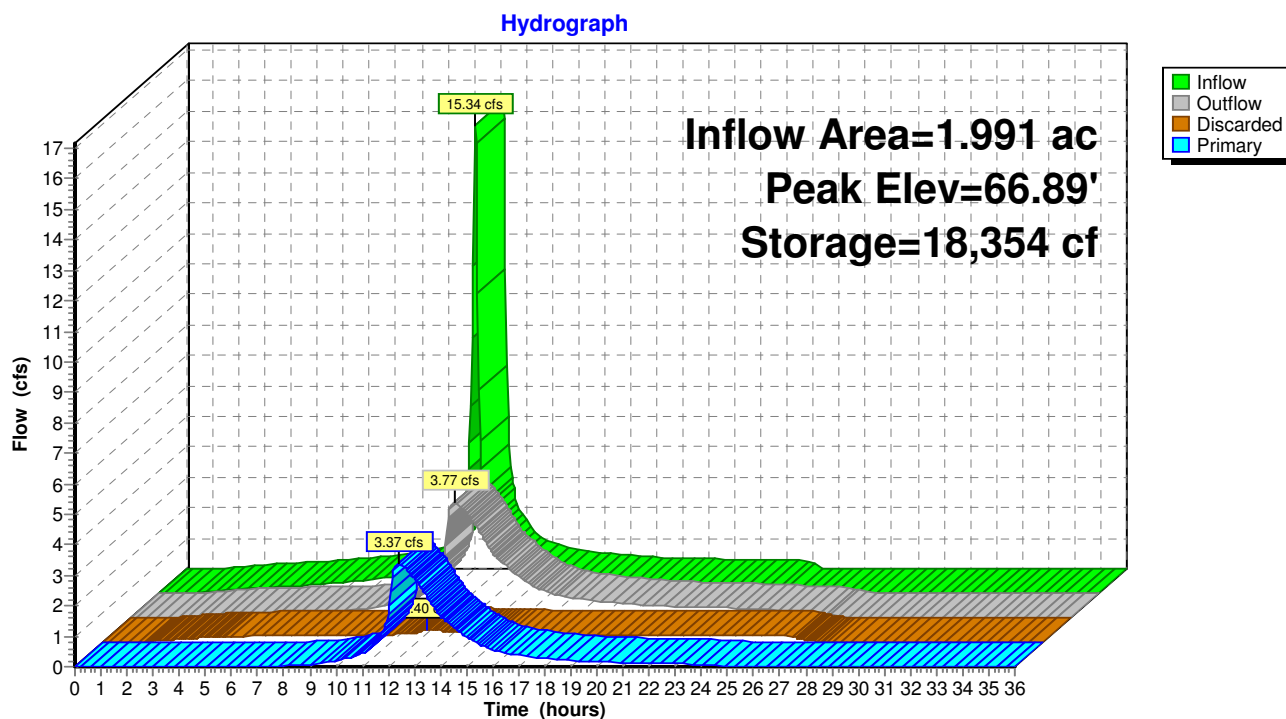
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Pond 1P: Detention Basin



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Summary for Pond 2P: Rain Garden

Inflow Area = 0.382 ac, 25.64% Impervious, Inflow Depth = 5.28" for 100-Year event
Inflow = 2.16 cfs @ 12.13 hrs, Volume= 0.168 af
Outflow = 0.63 cfs @ 12.35 hrs, Volume= 0.168 af, Atten= 71%, Lag= 13.1 min
Discarded = 0.13 cfs @ 12.35 hrs, Volume= 0.114 af
Primary = 0.50 cfs @ 12.35 hrs, Volume= 0.054 af
Routed to Reach DP-3 : DP-3

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 64.48' @ 12.35 hrs Surf.Area= 4,337 sf Storage= 1,945 cf

Plug-Flow detention time= 63.2 min calculated for 0.168 af (100% of inflow)
Center-of-Mass det. time= 63.1 min (904.3 - 841.2)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	4,361 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	3,756	0	0
65.00	4,965	4,361	4,361

Device	Routing	Invert	Outlet Devices
#1	Discarded	64.00'	1.020 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 62.00'
#2	Primary	64.20'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.13 cfs @ 12.35 hrs HW=64.48' (Free Discharge)
↑**1=Exfiltration** (Controls 0.13 cfs)

Primary OutFlow Max=0.50 cfs @ 12.35 hrs HW=64.48' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 0.50 cfs @ 2.55 fps)

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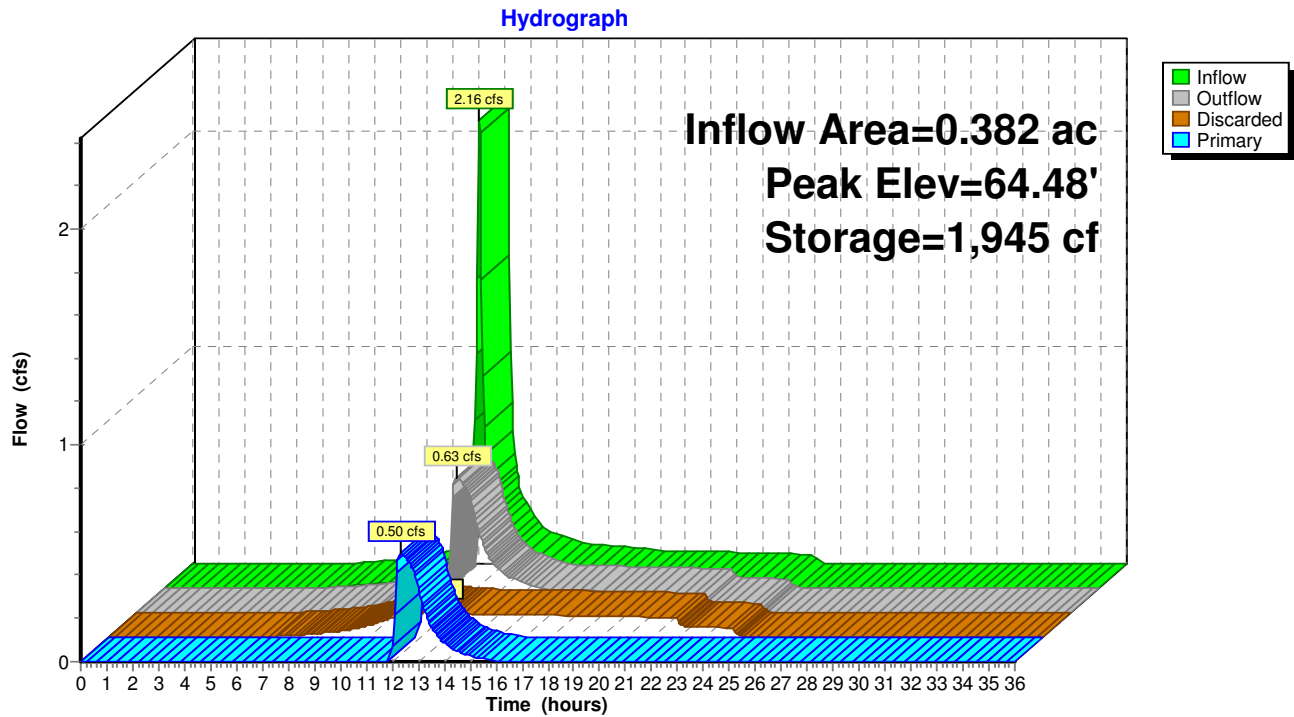
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Pond 2P: Rain Garden



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10 High Street, Topsfield

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Appendix B –

TSS Calculations

- TSS Removal Calculations for Basin
- TSS Removal Calculations for Raingarden

Infiltration Volume Recharge

- Infiltration Volume Recharge
- Drawdown Calculations

Water Volume Calculations

- Forebay Calculations
- Infiltration Volume Calculations

INSTRUCTIONS:

- 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.

Version 1, Automated: Mar. 4, 2008

Location: Emerson Homes Topsfield (Detention Basin)

B	C	D	E	F
BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Street Sweeping - 1%	0.01	1.00	0.01	0.99
Deep Sump and Hooded Catch Basin	0.25	0.99	0.25	0.74
Sediment Forebay	0.25	0.74	0.19	0.56
Infiltration Basin	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11

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

Total TSS Removal =

89%

Project:	Emerson Homes Topsfield
Prepared By:	DeVellis Zrein, Inc.
Date:	16-Sep-22

*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

INSTRUCTIONS:

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.

Version 1, Automated: Mar. 4, 2008

Location:

Emerson Homes Topsfield (Rain Garden)

B	C	D	E	F
BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Street Sweeping - 1%	0.01	1.00	0.01	0.99
Deep Sump and Hooded Catch Basin	0.25	0.99	0.25	0.74
Sediment Forebay	0.25	0.74	0.19	0.56
Infiltration Basin	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11

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

Total TSS Removal =

89%

Project:	Emerson Homes Topsfield
Prepared By:	DeVellis Zrein, Inc.
Date:	6-Mar-23

*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

DeVellis Zrein Inc.

Land Planning / Civil Engineering
PO Box 307
Foxboro MA 02035

Computations

Project	10 High Street	Project #	21-2G1S-463
Location	Topsfield	Sheet	1 of 1
Calculated by	IAZ	Date	3/7/2023
Checked by		Date	
Title	Draw Down Calculations		

Methodology DEP Stormwater Management Standards

Design

Criteria: Stormwater Infiltration system Draw down in less than 72 hours

Draw

Down Time = $R_v / (k)(\text{Bottom Area})$

Where:

R_v = Storage Volume

k = Hydraulic Conductivity

$$R_v = 0.168 \text{ ac-ft} = 7,318 \text{ CF}$$

$$k = 1.02 \text{ in/hr}$$

$$\text{Bottom Area} = 3,756 \text{ SF}$$

$$\text{Time} = 7318 / (1.02)(1/12)(3756)$$

$$\text{Time} = 22.9 \text{ hours}$$

DeVellis Zrein Inc.

Land Planning / Civil Engineering
PO Box 307
Foxboro MA 02035

Computations

Project	10 High Street	Project #	21-2G1S-463
Location	Topsfield	Sheet	1 of 1
Calculated by	IAZ	Date	9/9/2022
Checked by		Date	
Title	Draw Down Calculations		

Methodology DEP Stormwater Management Standards

Design

Criteria: Stormwater Infiltration system Draw down in less than 72 hours

Draw

Down Time = $R_v / (k)(\text{Bottom Area})$

Where:

R_v = Storage Volume

k = Hydraulic Conductivity

$R_v = 1,831 \text{ CF}$

$k = 1.02 \text{ in/hr}$

Bottom Area = 9,640 SF

Time = $1831 / (1.02)(1/12)(9640)$

Time = 2.2 hours

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PO Box 307
Foxboro MA 02035

Computations

Project	10 High Street	Project #	21-2G1S-463
Location	Topsfield	Sheet	1 1 of 1
Calculated by	JJD	Date	3/7/2023
Checked by		Date	
Title	Forebay Calculations		

Objective: To size the sediment forebay to provide 0.5-inches of collection volume fo

Stormwater Basin 1 Forebay to the East

Impervious area = 25,530 square feet

Required Volume = 25,530 sq ft x 0.1 inches/12 = 213 cubic feet

Volume Provided = 353 cubic feet

Stormwater Basin 1 Forebay to the West

Impervious area = 27,940 square feet

Required Volume = 27,940 sq ft x 0.1 inches/12 = 233 cubic feet

Volume Provided = 341 cubic feet

Rain Garden

Impervious area = 3,025 square feet

Required Volume = 3,025 sq ft x 0.1 inches/12 = 25 cubic feet

Volume Provided = 63 cubic feet

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PO Box 307
Foxboro MA 02035

Computations

Project	Emerson Homes Topsfield	Project #	21-2G1S-463
Location	Topsfield	Sheet	1 of 1
Calculated by	JJD	Date	9/16/2022
Checked by	TOG	Date	9/16/2022
Title	Recharge Volume		

Methodology DEP Stormwater Management Standards

Design

Criteria 1: Based on the NRCS Hydrologic Soil Group "B"

Recharge

Volume: Proposed Impervious Area within PR-1A = 62,770 SF

Required Recharge Volume = $62,770 \text{ sf} \times 0.35 \text{ inches}/12 \text{ (in/ft)}$

Required Recharge Volume = 1,831 C.F.

Provided Recharge Volume within the basin exfiltrated into the ground during the 2-year storm event = $0.350 \text{ ac feet} = 15,250 \text{ C.F.}$

$15,250 \text{ C.F.} > 1,831 \text{ C.F.}$ therefore exceeds requirement