MILLENNIUM ENGINEERING, INC.

Land Surveyors and Civil Engineers

STORMWATER MANAGEMENT REPORT

FOR THE

FLEXIBLE RESIDENTIAL DEVELOPMENT

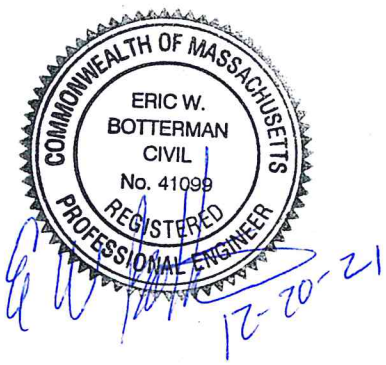
AT

46 BEACH ROAD AND 2 GRAVEL WAY
SALISBURY, MA

PREPARED FOR:

DOWNEAST BUILDING AND DEVELOPMENT
18 MAPLE LANE
NORTHBOROUGH, MA 01532

DATE: NOVEMBER 5, 2021
REVISED: DECEMBER 15, 2021



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Stormwater Management Report
46 Beach Road, Salisbury, MA

I. Introduction

Introduction

The subject parcel is described as Tax Map 4, Lots 121-122 and 136 on the Town of Salisbury, MA Assessor's Map. The project parcel is 1.83 acres in size. Elevations on the site range from 18.00' in the northwest corner of the parcel to 13.00' at the southeast corner of the site. These elevations are based upon 1988 NAV datum.

The Flexible Residential Development at 46 Beach Road proposes to rehabilitate the existing dwelling, finish construction on the dwelling at 2 Gravel Way and construction two additional single-family dwellings located on approximately 1.83 acres in Salisbury, Massachusetts. The project will consist of the construction of a new residential shared driveway, the rehabilitation of the existing house, finish the construction of a previously permitted single-family dwelling, and construct two additional single-family dwellings. The proposed stormwater management system for the project includes an exfiltrating bioretention area, vegetated filter strip, sediment forebay, and a water quality swale. The water quality swale will remove suspended solids prior to discharging. The exfiltrating bio-retention area will provide stormwater recharge to the groundwater and mitigate peak runoff rates so the post-development runoff rates will be less than or equal to the pre-development rates.

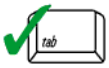
II. Stormwater Management Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

[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.

B. Stormwater Checklist and Certification

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

Checklist for Stormwater Report

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.

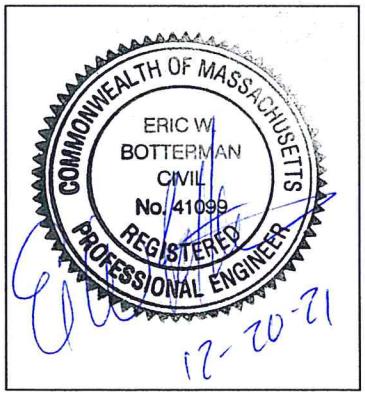
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



12-20-21

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

Checklist for Stormwater Report

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

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☒ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Checklist for Stormwater Report

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist (continued)

Checklist for Stormwater Report

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 (continued)

Checklist for Stormwater Report

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 (continued)

Checklist for Stormwater Report

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 (continued)

Checklist for Stormwater Report

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.

III. Hydrologic Analysis

Existing Site Characteristics

In general, the property is irregular in shape and fronts Beach Road (Route 1A). A wetland resource area is present along the southern portion of the site. An existing single-family dwelling with associated driveway, a gravel drive, a single-family under construction, and utilities are located on-site. See the accompanying plan for a more detailed description of the existing site conditions and topography.

The lot consists of two soil groups: Windsor Loamy Sand, 255A (Hydrologic Soil Group A); and Deerfield Loamy Fine Sand, 256A (Hydrologic Soil Group A). 4 test probes were performed onsite in September 2021. The test probes indicated sandy soils throughout the site, more indicative of A soils being present throughout the site. See Appendix E for the NRCS soil map.

Proposed Site Features

The Applicant proposes to construct a shared driveway to serve three of the four single-family dwellings. The fourth dwelling will be served by an individual driveway. Access to the property will be via Beach Road (Rt 1A). Sewer and water services are proposed to be connected to the Town of Salisbury's sewer main and water main located in the Beach Road Right of Way.

In order to address stormwater management regulations, water quality swales, an exfiltrating bio-retention area, and roof drywells are proposed to treat, store, and infiltrate runoff.

WATERSHED ANALYSIS AND METHODOLOGY

The stormwater runoff management system was analyzed using the storm events of the 2-year, 10-year and 100-year frequency. The analysis was performed using HydroCAD, version 10.00. Using USDA NRCS TR-20 and TR-55 methods of estimating runoff, the program uses the measured characteristics of the site and computes runoff produced by simulated rainfall events. The results are then used to design runoff control structures.

Existing drainage area boundaries were developed using an onsite topographic survey performed by Millennium Engineering, Inc. Proposed site development boundaries were developed from proposed grades and ground cover designed to minimize site storm water management structure requirements.

Hydrologic soil groups and curve numbers were estimated for existing and proposed developed conditions using available NRCS Soil Maps, current vegetation, and terrain.

DRAINAGE ANALYSIS

The purpose of the drainage analysis is two-fold. The first is to analyze and quantify the pre-development runoff flows through the site. The second purpose is to evaluate the impact of the proposed development on drainage patterns and flows, both within and outside the site, and to design a stormwater management system to adequately convey post-development runoff.

The design of the stormwater management system has the following goals:

1.) Minimize or eliminate erosion and sedimentation during construction as well as after development.

2.) To ensure that post-development flows do not have an adverse effect on downstream drainage structures and landowners.

3.) To design a stormwater and treatment system which will carry the surface runoff and satisfy goals one and two.

To determine the hydrological effect of the proposed development on the watershed, the existing conditions must first be analyzed.

WATERSHED DESCRIPTION: EXISTING CONDITIONS

Depending on the soil classification, type of ground cover present and the direction of the flow of runoff, the existing site is divided into watershed areas. Watershed area E1 consists of the front portion of the site that flows to Beach Road. Area E2 consists of the remainder of the site that drains to the bordering vegetated wetlands on site. Area E3 consists of a small portion of lawn that flows overland to 50 Beach Road. See the attached plans (Watersheds and HydroCad Data, sheet 1 of 2) for the watershed area boundaries and the pre-development time of concentration flow paths.

WATERSHED ANALYSIS: EXISTING CONDITIONS

The existing conditions were modeled using the tabular hydrograph method with a Type III synthetic storm distribution for the 2, 10 and 100-year storm recurrence intervals. Runoff hydrographs were produced to estimate existing peak discharge.

Flows for the three storm simulations are as follows:

Existing (Pre-development) Peak Runoff Rates (c.f.s.)

Subcatchment	Size	2 Yr	10 Yr	100 Yr
	(Acres)	Storm	Storm	Storm
E1	0.35	0.11	0.46	1.61
E2	1.11	0.00	0.07	1.50
E3	0.23	0.00	0.02	0.50

The pre-development drainage calculations can be found in Appendix A.

WATERSHED DESCRIPTION: POST-DEVELOPMENT CONDITIONS

To determine the post development runoff, new watersheds, runoff curve numbers and times of concentration were generated reflecting the changes in the topography and surface cover. The post-development watersheds are shown on the attached plans (Watersheds and HydroCad Data, sheet 2 of 2). Watershed area P1 consists of the existing dwelling, driveway, a portion of the shared driveway and lawn areas. The runoff flows over land towards Beach Road. Areas P2A consists of lawn areas and woods that flow overland to the BVW. Area P2B consists of the remainder of the shared driveway, individual driveways to the single-family dwellings and associated lawn areas. Area P3 consists of a small area of lawn that flows to 50 Beach Road. The runoff is directed either into a water quality swale or towards a vegetated filter strip, into a sediment forebay, into an exfiltrating bio-retention area and ultimately towards the BVW along the southern portion of the site.

WATERSHED ANALYSIS: POST-DEVELOPMENT CONDITIONS

The proposed developed conditions were modeled using the tabular hydrograph method with a Type III synthetic storm distribution for the 2, 10 and 100-year storm recurrence intervals. Runoff hydrographs were produced to estimate the post-development peak discharge.

Flows for the three storm simulations are as follows:

Post-Developed Peak Runoff Rates (c.f.s.)

Subcatchment	Size	2 Yr	10 Yr	100 Yr
	(Acres)	Storm	Storm	Storm
Total P1	0.31	0.01	0.20	1.05
Total P2	1.30	0.00	0.01	1.24
Total P3	0.07	0.00	0.00	0.10

The post-development drainage calculations can be found in Appendix B.

IV. Stormwater Recharge Calculations

Stormwater Recharge Calculations

Calculations were performed to ensure that the proposed project will comply with the groundwater recharge requirements of the Mass **DEP** Stormwater Management Standards. The required recharge volume was calculated as follows:

The Required Recharge Volume equals a depth of runoff corresponding to the soil type times the impervious areas located on site.

Rv = Fx Impervious area Where:

Rv = Required Recharge Volume, expressed in cubic feet

F = Target Depth Factor associated with each Hydrologic Soil

Group Impervious Area = pavement and rooftop area on site

For the proposed project:

Required Recharge volume, Rv (B soil) = F * impervious area
= 0.6 in * 14,026 s.f.
= 701 c.f.

Total Required Recharge Volume = 701 c.f.

Adjusted Required Recharge Volume

Since only a portion of the new impervious areas are to be directed into the infiltration BMP, it is necessary to calculate an Adjusted Required Recharge Volume:

1. The Required Recharge Volume = 701 cubic feet
2. The total proposed impervious area is 14,026 s.f.
3. The proposed impervious area draining to all infiltration areas is 10,353 s.f.
4. The ratio of total site impervious area to impervious are draining to the infiltration BMP is 14,026 / 10,353= 1.36

5. The Adjusted Required Recharge Volume = 1.36 x 701 cubic feet = 954 cubic feet.

Stormwater recharge will be accomplished on the site through the infiltration areas to be constructed.

The Dynamic Method has been used to evaluate and infiltrative capacities of the infiltration areas.

Rv = F x impervious area
Rv = A x (D+KT)

Bio-retention Area
RV=1340x(.6+(2)(8.27/12)
RV=2,651 c.f.

Total Recharge provided = 2,651 c.f.

Drawdown Calculation

Exfiltrating Bio-retention Area

$$\text{Drawdown Time} = \frac{Rv}{(K)\,(\text{Bottom Area})}$$

Rv=Storage Volume= 896 c.f.
K=Saturated Hydraulic Conductivity=8.27 in./hr
Bottom Area=1,340 s.f.

$$\text{Drawdown Time} = \frac{896 \text{ c.f.}}{(8.27 \text{ in/hr})(1\text{ft}/12\text{in})(1{,}340 \text{ s.f.})}$$

Drawdown Time = 0.97 hours

V. TSS Removal 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: Pre-treatment for Bio-retention Area

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Water Quality Swale - Dry	0.70	1.00	0.70	0.30
	0.00	0.30	0.00	0.30
	0.00	0.30	0.00	0.30
	0.00	0.30	0.00	0.30
	0.00	0.30	0.00	0.30

Total TSS Removal = 70%

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

Project: M213965
Prepared By: JTM
Date: 12/15/2021

*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: Water Quality Swale

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Water Quality Swale - Dry	**0.70**	**1.00**	**0.70**	**0.30**
	0.00	**0.30**	**0.00**	**0.30**
	0.00	**0.30**	**0.00**	**0.30**
	0.00	**0.30**	**0.00**	**0.30**
	0.00	**0.30**	**0.00**	**0.30**

Total TSS Removal = **70%**

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

Project: M213965
Prepared By: JTM
Date: 9/27/2021

*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: Exfiltrating Bio-retention Area

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

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

Project: M213965
Prepared By: JTM
Date: 9/27/2021

*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

VI. Water Quality Calculations

Water Quality Calculations

The Massachusetts DEP requires water quality calculations based on 1 inch of runoff for the total impervious area associated with the proposed development. The following calculation identifies the water quality volume required.

Infiltration Area 1

Total Impervious Area contributing to the exfiltrating bio-retention area = 10,542 s.f.
10,542 s.f. * 1" / 12 (to convert to ft) = 848 c.f. of runoff to be treated for water quality.

Volume of the exfiltrating bio-retention area below the lowest outlet = 897 c.f.

VII. Soils Analysis

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part

September 28, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:708 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 30 60 120 180

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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 16, Jun 9, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
255A	Windsor loamy sand, 0 to 3 percent slopes	0.6	34.6%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	1.1	65.4%
Totals for Area of Interest		**1.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Northern Part

255A—Windsor loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svkg
Elevation: 0 to 990 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Windsor, loamy sand, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor, Loamy Sand

Setting

Landform: Outwash terraces, outwash plains, dunes, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

O - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield, loamy sand

Percent of map unit: 10 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hinckley, loamy sand

Percent of map unit: 5 percent
Landform: Outwash plains, eskers, kames, deltas
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Outwash plains, outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave, convex
Across-slope shape: Concave, linear, convex
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash terraces, outwash plains, outwash deltas, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Outwash terraces, outwash deltas, kame terraces, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Outwash terraces, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Concave, convex
Hydric soil rating: No

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VIII. Long Term Pollution Prevention and Operations and Maintenance Plan

This long-term Stormwater Management System Operations and Maintenance (O&M) Plan, filed with the Town of Salisbury, shall be implemented for the proposed development at 46 Beach Road to ensure that the stormwater management system functions as designed. The Owner holds the primary responsibility for overseeing and implementing the O&M Plan and assigning a Property Manager who will be responsible for the proper operation and maintenance of the stormwater structures. In case of transfer of property ownership, future property owners shall be notified of the presence of the stormwater management system and the requirements for proper implementation of the O&M Plan. Included in the manual is a Stormwater Management O&M Plan identifying the key components of the stormwater system and a log for tracking inspections and maintenance.

The stormwater management system protects and enhances the stormwater runoff water quality through the removal of sediment and pollutants, and source control significantly reduces the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular vacuuming and litter removal, and prohibitions on the use of pesticides.

The purpose of the Stormwater Operations and Maintenance (O&M) plan is to ensure inspection of the system, removal of accumulated sediments, oils, and debris, and implementation of corrective action and record keeping activities.

The ongoing responsibility is the Owner, its successors and assigns. Adequate maintenance is defined in this document as good working condition.

Contact information is provided below:

Responsibility for Operations and Maintenance
Downeast Building and Development
16 Maple Lane
Northborough, MA

Illicit Discharge Compliance Statement

I, _____, verify that all illicit discharges to the stormwater management system are prohibited and no illicit discharges exist on the site.

EROSION AND SEDIMENT CONTROL BMPs

Minimize Disturbed Area and Protect Natural Features and Soil

Topsoil

Topsoil stripped from the immediate construction area can be temporarily stockpiled on site providing that the perimeter of the stockpiles is properly staked with silt fence at the toe of slope. The stockpiles shall be in areas that will not interfere with construction and at least 15 feet away from areas of concentrated flows or pavement. The area shall be inspected weekly for erosion and immediately after storm events. Areas on or around the stockpile that have eroded shall be stabilized immediately with erosion controls.

Stabilize Soils

Temporary Stabilization

- All vegetated areas which do not exhibit a minimum of 85% vegetative growth by Oct. 15th, or which are disturbed after Oct. 15th, shall be stabilized by seeding and installing erosion control blankets on slopes greater than 3:1, and seeding and placing 3 to 4 tons of mulch per acre, secured with anchored netting, elsewhere. The placement of erosion control blankets or mulch and netting shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events.
- All ditches or swales which do not exhibit a minimum of 85% vegetative growth by Oct. 15th, or which are disturbed after Oct. 15th, shall be stabilized with stone or erosion control blankets appropriate for the design flow conditions.
- After November 15th, incomplete road surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel.

Protect Slopes

Geotextile erosion control blankets shall be used to provide stabilization for slopes exceeding 3:1. Prepare soil before installing erosion control blanket, including any necessary application of lime, fertilizer, and seed. Begin at the top of the slope by anchoring the blanket in a 6" deep x 6" wide trench with approximately 12" extended beyond the upslope portion of the trench. Anchor the blanket with a row of staples/stakes approximately 12" apart in the bottom of the trench. Backfill and compact the trench after stapling. Apply seed to compacted soil and fold remaining 12" portion of back over seed and compacted soil. Secure over compacted soil with a row of staples/stakes spaced approximately 12" apart across the width of the blanket. Roll erosion control blanket either down or horizontally across the slope. Blanket will unroll with appropriate side against the soil surface. All blankets must be securely fastened to soil surface by placing staples/stakes in appropriate locations as shown in the staple pattern guide. When using the dot system, staples/stakes should be placed through each of the colored dots corresponding to the appropriate staple pattern. The edges of parallel blankets must be stapled with approximately

2"-5" overlap. Consecutive blankets spliced down the slope must be placed end over end (shingle style) with an approximate 3" overlap. Staple through overlapped area, approximately 12" apart across entire blanket's width. In loose soil conditions, the use of staple or stake lengths greater than 6" may be necessary to properly anchor the blanket.

Establish Perimeter Controls and Sediment Barriers

Silt fence shall be installed along the edge of wetlands. The silt fence shall be installed before construction begins. Wooden posts shall be doubled and coupled at filter cloth seams. Filter cloth shall be fastened securely to support netting with ties spaced every 24" at top, midsection, and bottom. When two sections of filter cloth adjoin each other, they shall be overlapped by 6 inches, folded and stapled. Silt fence shall be removed upon completion of the project and stabilization of all soil.

Maintenance:
1. Silt fence shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any repairs that are required shall be made immediately.
2. If the fabric on the silt fence shall decompose or become ineffective during the expected life of the fence, the fabric shall be replaced promptly.
3. Sediment deposits shall be inspected after every storm event. The deposits shall be removed when they reach approximately one-half the height of the barrier.
4. Sediment deposits that are removed or left in place after the fabric has been removed shall be graded to conform with the existing topography and vegetated.

Establish Stabilized Construction Entrance

A stabilized construction entrance shall be installed before construction begins on the site. The stone anti-tracking pad shall remain in place until the subgrade of pavement is installed.

1. Stone shall be 1-2" stone, reclaimed stone, or recycled concrete equivalent.
2. The length of the stabilized entrance shall not be less than 50'.
3. The thickness of the stone for the stabilized entrance shall not be less than 6".
4. Geotextile filter cloth shall be placed over the entire area prior to placing the stone.
5. All surface water that is flowing to or diverted toward the construction entrance shall be piped beneath the entrance. If piping is impractical, a berm with 5:1 slope that can be crossed by vehicles may be substituted for the pipe.
6. The entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top-dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, washed, or tracked onto public rights-of-way must be removed promptly.
7. Wheels shall be cleaned to remove mud prior to entrance onto public rights-of way. When washing is required, it shall be done on an area stabilized with stone which drains into an approved sediment trapping device.

Catch Basin Inlet Protection

Inlet protection devices intercept and/or filter sediment before it can be transported from a site into the storm drain system and discharged into a lake, river, stream, wetland, or other waterbody. These devices also keep sediment from filling or clogging storm drain pipes, ditches, and downgradient sediment traps or ponds. A siltsack or approved equal shall be used for catch basin inlet protection. It should be inspected weekly. When the restraint cord is no longer visible, siltsack is full and shall be emptied.

POST-CONSTRUCTION BMPs

Snow and Snow Melt Management

Proper management of snow and snow melt, snow removal and storage, use of deicing compounds, and other practices can minimize major runoff and pollutant loading impacts. Snow will be stored in areas adjacent to the edge of the roadway. Use of alternative deicing compounds, such as calcium chloride and calcium magnesium acetate, will be investigated for use. Professional services will be used for snow management.

Exfiltrating Bioretention Area

Exfiltrating Bioretention Areas are incorporated into the site design for rooftop infiltration. After rainstorms, inspect the garden and make sure that drainage paths are clear and that ponding water dissipates over 4-6 hours. Inspect and repair erosion monthly. Use small stones to stabilize erosion along drainage paths. Re-mulch any void areas by hand as needed and every year, in the spring, add a fresh mulch layer. Immediately after the completion of garden construction, water plant material for 14 consecutive days unless there is sufficient natural rainfall. Twice a year remove and replace all dead and diseased vegetation. The Homeowners' Association will be responsible for proper maintenance of the rain gardens.

Vegetated Filter Strip

Inspect the regularly for sediment build-up, erosion and bare spots. Regularly mow the grass.

Sediment Forebay

Sediment forebays are included in the stormwater management plan as pretreatment for the proposed infiltration basins. The forebays will be portioned from the basins by use of a stone filter berm. The forebays and riprap shall be inspected monthly during construction and cleaned upon completion of the project. The forebays shall be inspected monthly and cleaned twice per year by a landscaping contractor hired by the Owner. Sediments removed during cleaning shall be disposed of at an approved DEP landfill.

Water Quality Swale

Inspect the swale for erosion and adequate vegetation for the first few months after installation and twice per year after that. Mow the swale as needed. Remove sediment and debris once per year. Re-seed the swale as needed.

Rip Rap

Inspect the rip rap outlets regularly, especially after major storm events. Notation of any low spots or erosion should be made.

FINAL STABILIZATION

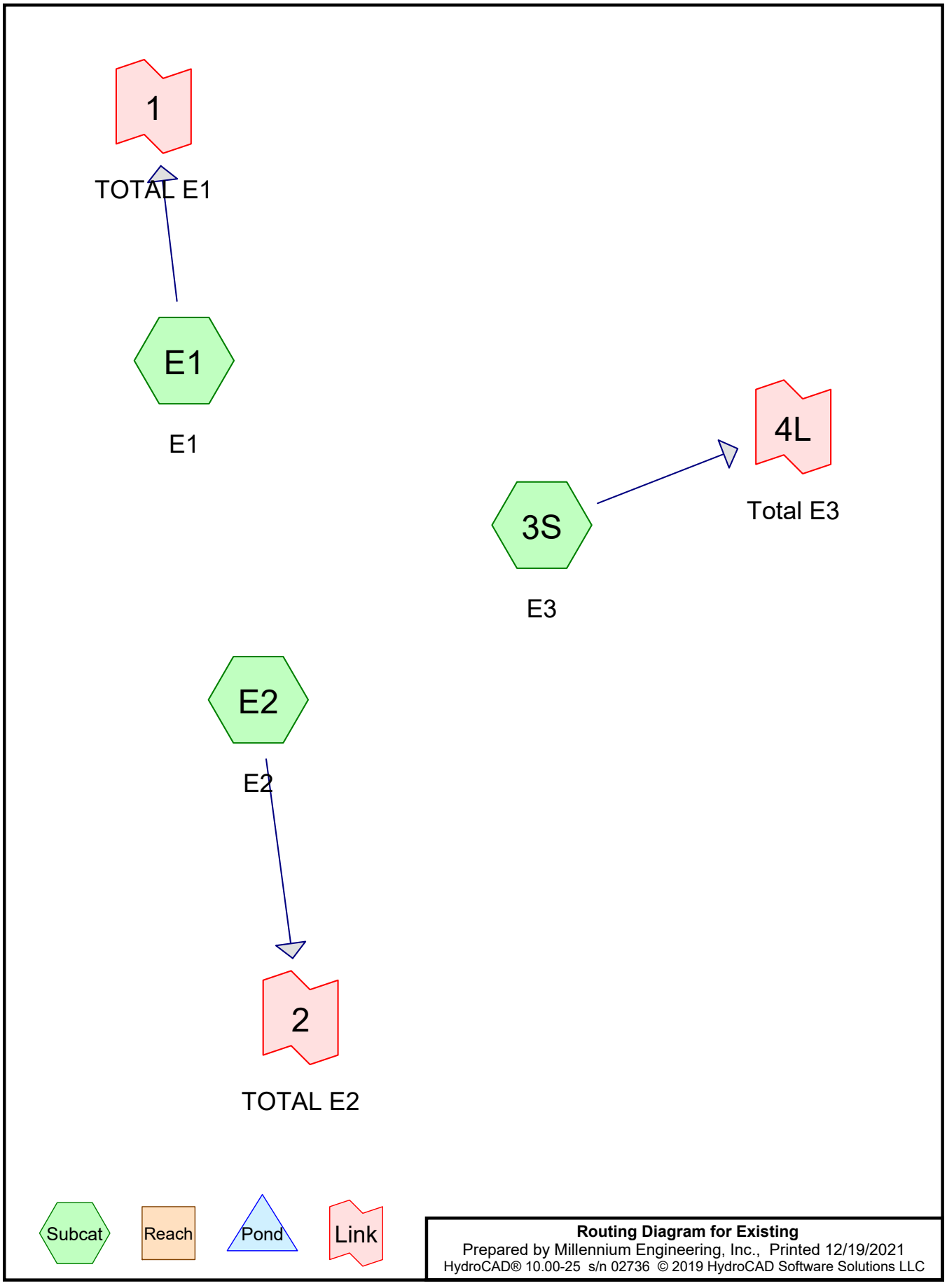
Permanent Seeding

Loam and hydroseed any disturbed surfaces after the final design grades have been achieved. A minimum of 6" of loam shall be installed. Seed mix shall be a maximum of 10% rye grass and a minimum of 90% permanent bluegrass and/or fescue. Lime shall be applied at a rate of 2 tons/acre.

Construction debris, trash and temporary BMPs (including silt fences, material storage areas, and inlet protection) will also be removed and any areas disturbed during removal will be seeded immediately.

IIX. **Appendix**

a. Existing Conditions HydroCAD Report



Routing Diagram for Existing
Prepared by Millennium Engineering, Inc., Printed 12/19/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.837	49	50-75% Grass cover, Fair, HSG A (E1, E2)
0.215	39	>75% Grass cover, Good, HSG A (3S)
0.083	96	Gravel surface, HSG A (3S, E1, E2)
0.049	98	Paved parking, HSG A (E1)
0.031	98	Unconnected pavement, HSG A (E2)
0.055	98	Unconnected roofs, HSG A (E1, E2)
0.437	30	Woods, Good, HSG A (E2)
1.706	**49**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.706	HSG A	3S, E1, E2
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.706		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.837	0.000	0.000	0.000	0.000	0.837	50-75% Grass cover, Fair	E1, E2
0.215	0.000	0.000	0.000	0.000	0.215	>75% Grass cover, Good	3S
0.083	0.000	0.000	0.000	0.000	0.083	Gravel surface	3S, E1, E2
0.049	0.000	0.000	0.000	0.000	0.049	Paved parking	E1
0.031	0.000	0.000	0.000	0.000	0.031	Unconnected pavement	E2
0.055	0.000	0.000	0.000	0.000	0.055	Unconnected roofs	E1, E2
0.437	0.000	0.000	0.000	0.000	0.437	Woods, Good	E2
1.706	**0.000**	**0.000**	**0.000**	**0.000**	**1.706**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 3S: E3 Runoff Area=10,342 sf 0.00% Impervious Runoff Depth>0.01"
Tc=6.0 min CN=44 Runoff=0.00 cfs 0.000 af

Subcatchment E1: E1 Runoff Area=15,457 sf 19.25% Impervious Runoff Depth>0.34"
Flow Length=74' Tc=5.8 min UI Adjusted CN=61 Runoff=0.11 cfs 0.010 af

Subcatchment E2: E2 Runoff Area=48,505 sf 5.89% Impervious Runoff Depth>0.01"
Flow Length=197' Slope=0.0100 '/' Tc=19.0 min UI Adjusted CN=44 Runoff=0.00 cfs 0.001 af

Link 1: TOTAL E1 Inflow=0.11 cfs 0.010 af
Primary=0.11 cfs 0.010 af

Link 2: TOTAL E2 Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Link 4L: Total E3 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 1.706 ac Runoff Volume = 0.011 af Average Runoff Depth = 0.08"
92.15% Pervious = 1.572 ac 7.85% Impervious = 0.134 ac

Summary for Subcatchment 3S: E3

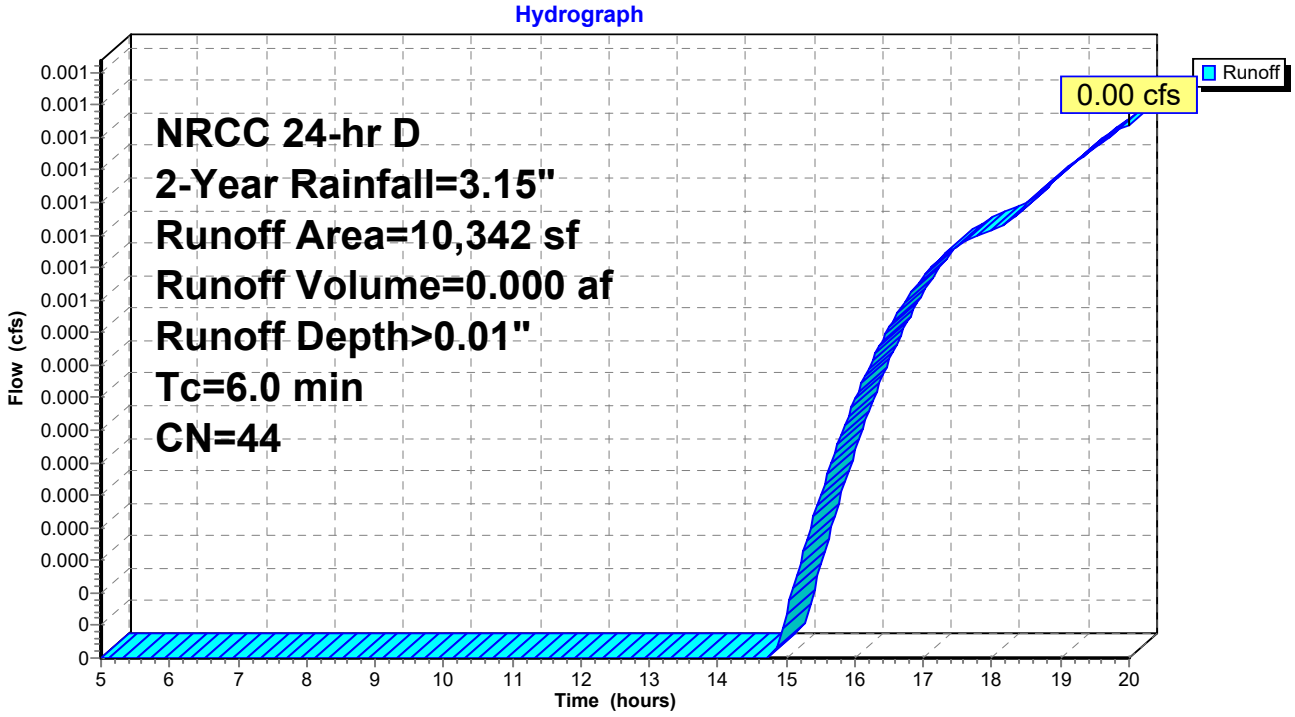
Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
958	96	Gravel surface, HSG A
9,384	39	>75% Grass cover, Good, HSG A
10,342	44	Weighted Average
10,342		100.00% Pervious Area

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

Subcatchment 3S: E3



Summary for Subcatchment E1: E1

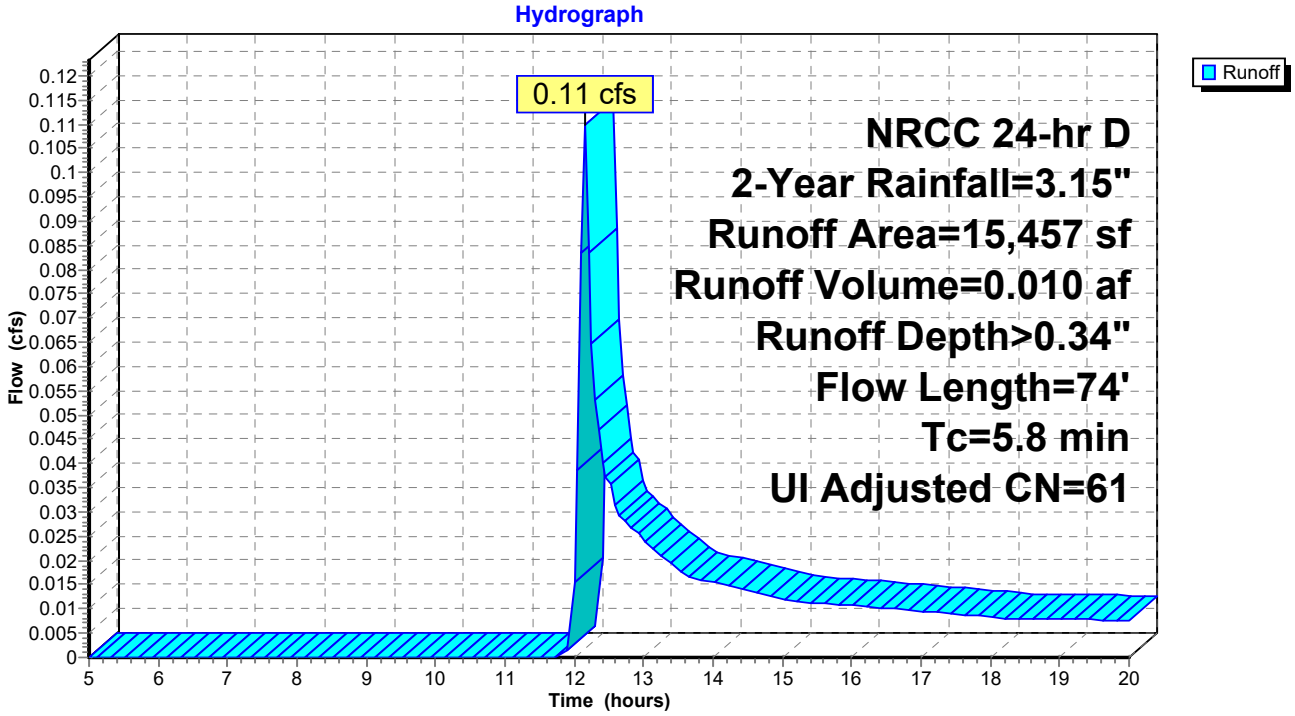
Runoff = 0.11 cfs @ 12.15 hrs, Volume= 0.010 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
856	98		Unconnected roofs, HSG A
2,119	98		Paved parking, HSG A
1,203	96		Gravel surface, HSG A
11,279	49		50-75% Grass cover, Fair, HSG A
15,457	62	61	Weighted Average, UI Adjusted
12,482			80.75% Pervious Area
2,975			19.25% Impervious Area
856			28.77% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.1	24	0.0600	3.94		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.8	74	Total			

Subcatchment E1: E1



Summary for Subcatchment E2: E2

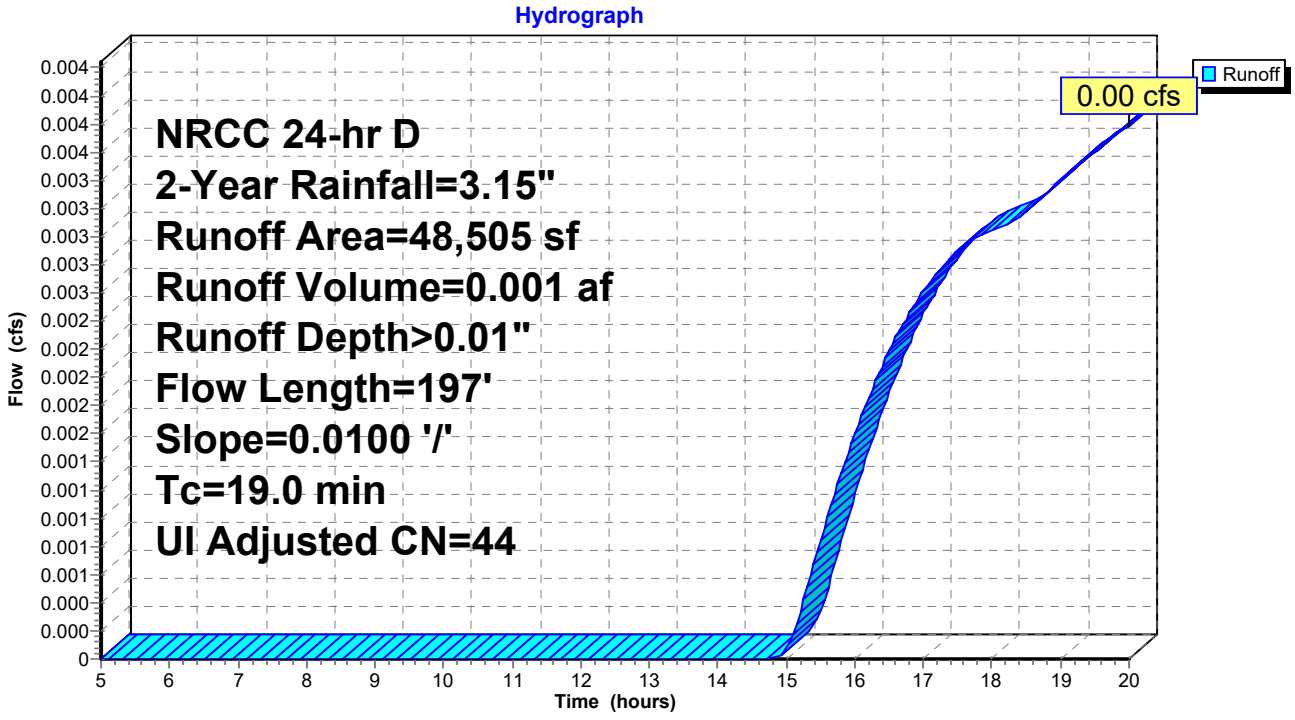
Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.001 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
1,521	98		Unconnected roofs, HSG A
1,444	96		Gravel surface, HSG A
19,026	30		Woods, Good, HSG A
1,337	98		Unconnected pavement, HSG A
25,177	49		50-75% Grass cover, Fair, HSG A
48,505	46	44	Weighted Average, UI Adjusted
45,647			94.11% Pervious Area
2,858			5.89% Impervious Area
2,858			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.4	147	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
19.0	197	Total			

Subcatchment E2: E2

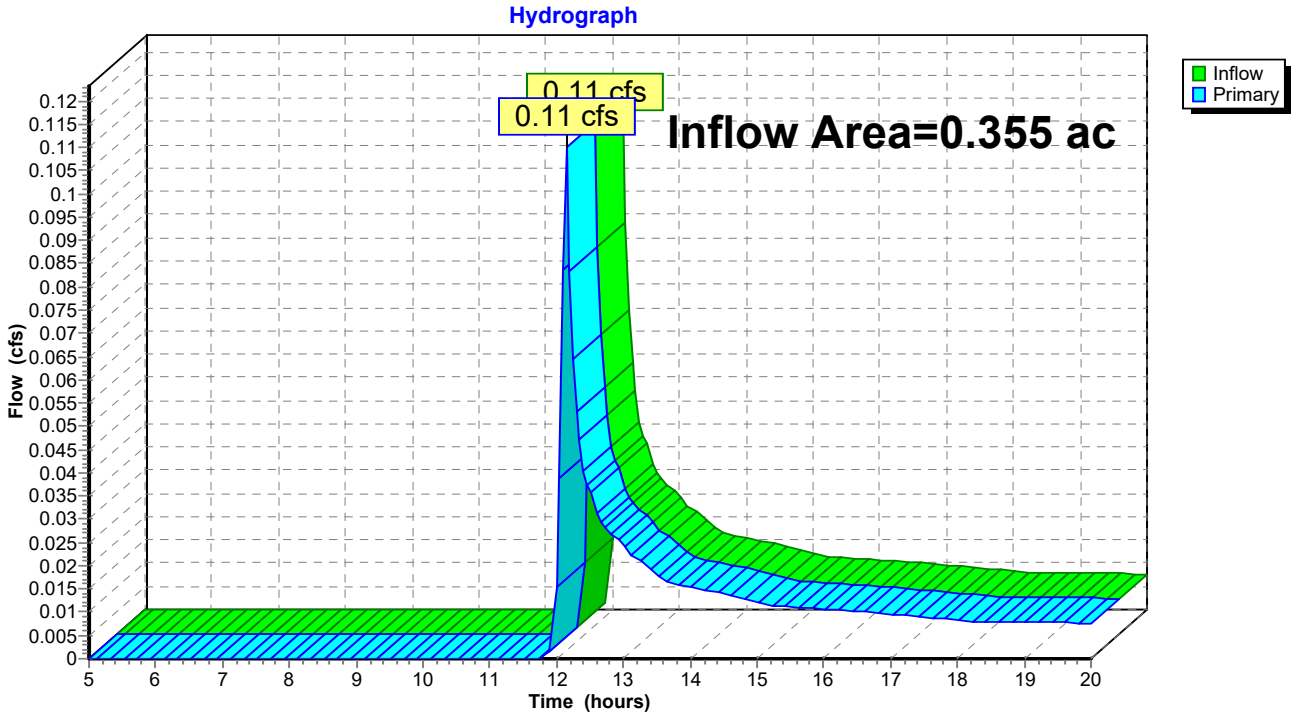


Summary for Link 1: TOTAL E1

Inflow Area = 0.355 ac, 19.25% Impervious, Inflow Depth > 0.34" for 2-Year event
Inflow = 0.11 cfs @ 12.15 hrs, Volume= 0.010 af
Primary = 0.11 cfs @ 12.15 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1: TOTAL E1

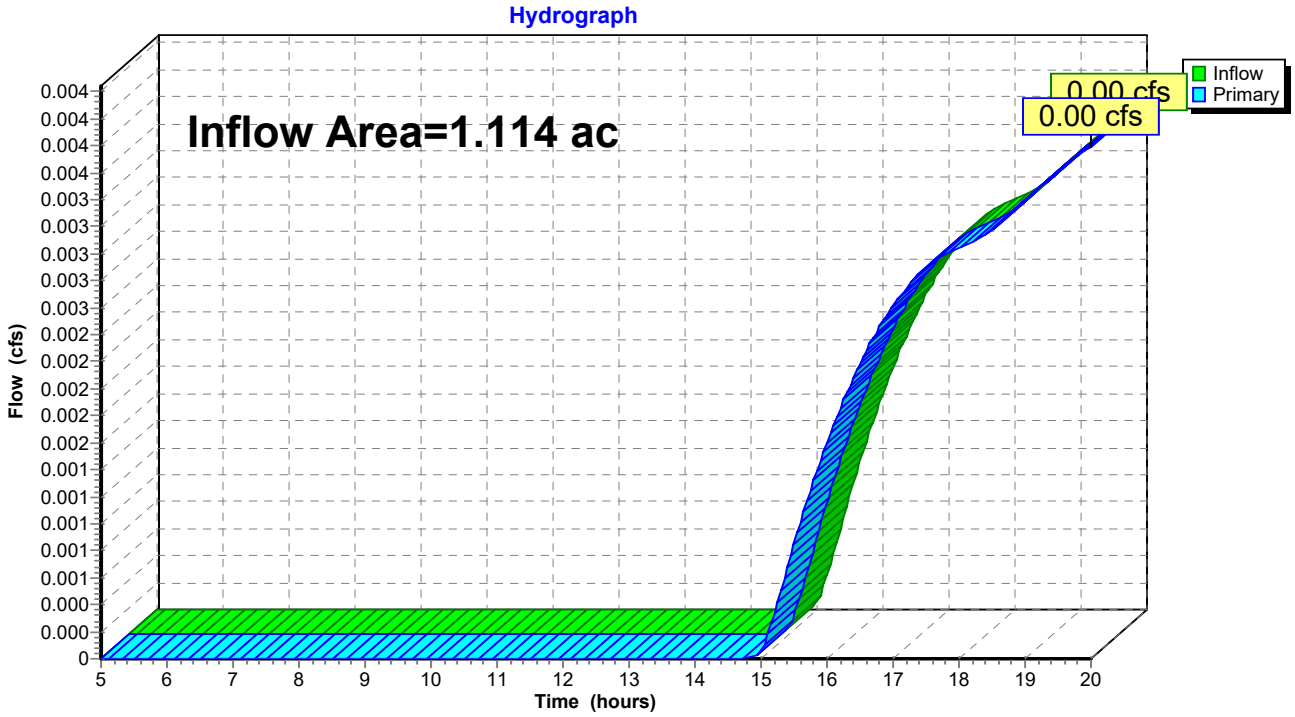


Summary for Link 2: TOTAL E2

Inflow Area = 1.114 ac, 5.89% Impervious, Inflow Depth > 0.01" for 2-Year event
Inflow = 0.00 cfs @ 20.00 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 20.00 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2: TOTAL E2

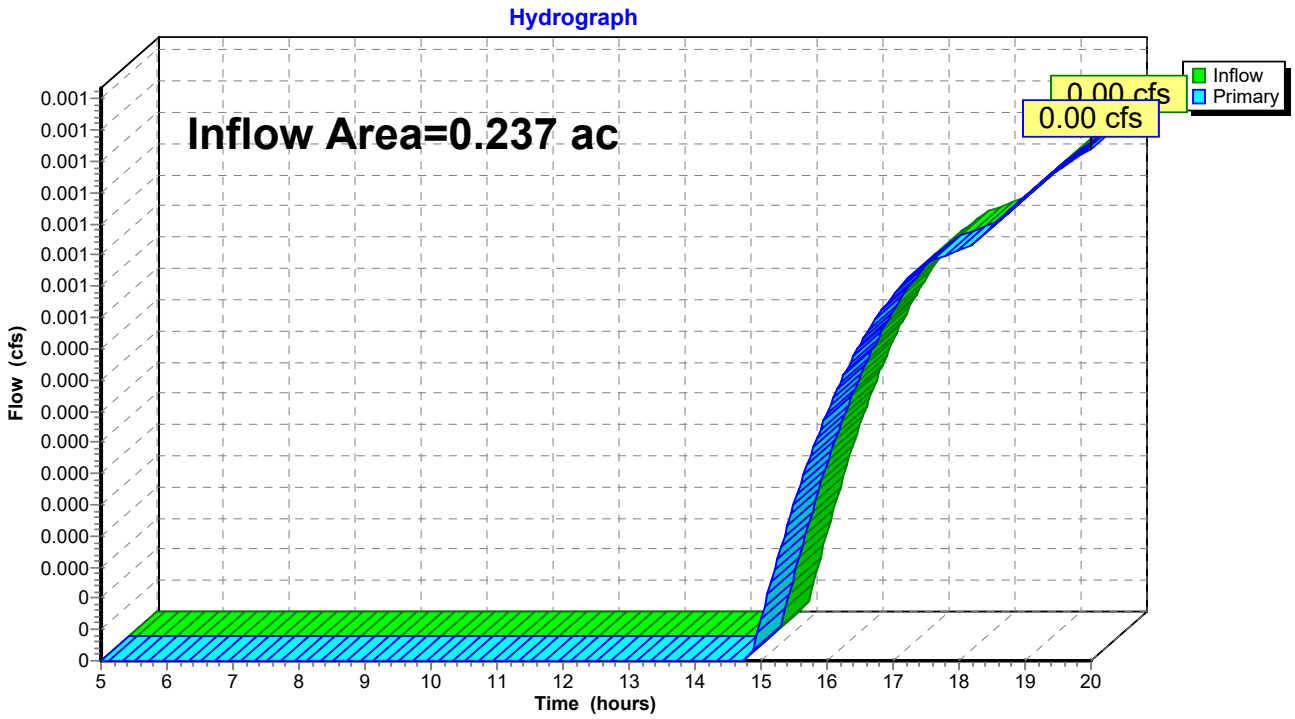


Summary for Link 4L: Total E3

Inflow Area = 0.237 ac, 0.00% Impervious, Inflow Depth > 0.01" for 2-Year event
Inflow = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 4L: Total E3



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 3S: E3 Runoff Area=10,342 sf 0.00% Impervious Runoff Depth>0.26"
Tc=6.0 min CN=44 Runoff=0.02 cfs 0.005 af

Subcatchment E1: E1 Runoff Area=15,457 sf 19.25% Impervious Runoff Depth>1.09"
Flow Length=74' Tc=5.8 min UI Adjusted CN=61 Runoff=0.46 cfs 0.032 af

Subcatchment E2: E2 Runoff Area=48,505 sf 5.89% Impervious Runoff Depth>0.26"
Flow Length=197' Slope=0.0100 '/' Tc=19.0 min UI Adjusted CN=44 Runoff=0.07 cfs 0.024 af

Link 1: TOTAL E1 Inflow=0.46 cfs 0.032 af
Primary=0.46 cfs 0.032 af

Link 2: TOTAL E2 Inflow=0.07 cfs 0.024 af
Primary=0.07 cfs 0.024 af

Link 4L: Total E3 Inflow=0.02 cfs 0.005 af
Primary=0.02 cfs 0.005 af

Total Runoff Area = 1.706 ac Runoff Volume = 0.061 af Average Runoff Depth = 0.43"
92.15% Pervious = 1.572 ac 7.85% Impervious = 0.134 ac

Summary for Subcatchment 3S: E3

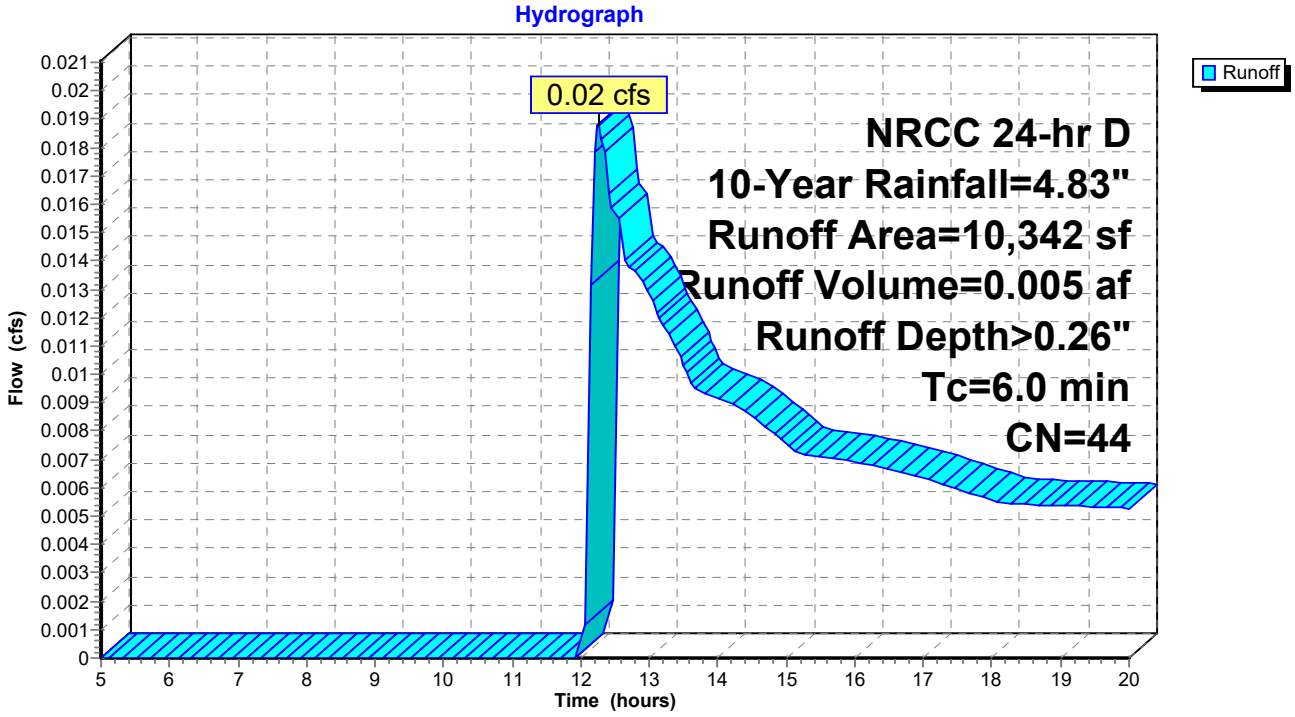
Runoff = 0.02 cfs @ 12.26 hrs, Volume= 0.005 af, Depth> 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
958	96	Gravel surface, HSG A
9,384	39	>75% Grass cover, Good, HSG A
10,342	44	Weighted Average
10,342		100.00% Pervious Area

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

Subcatchment 3S: E3



Summary for Subcatchment E1: E1

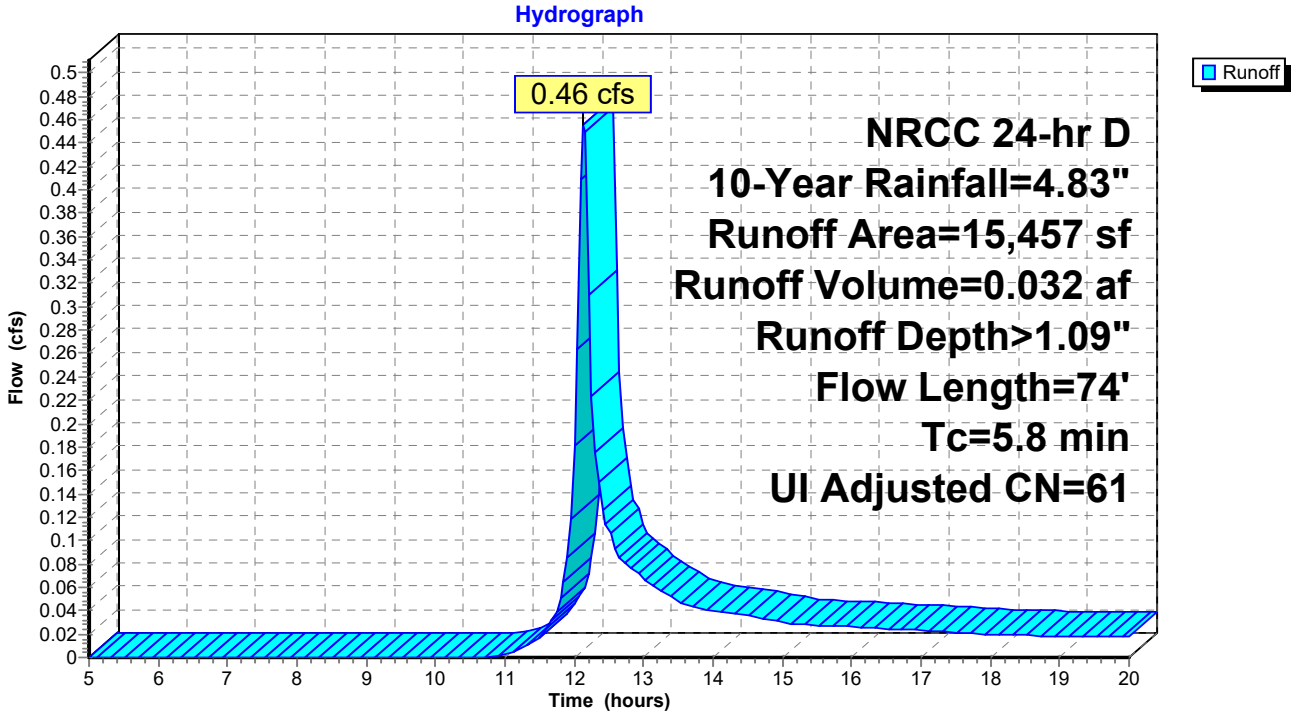
Runoff = 0.46 cfs @ 12.14 hrs, Volume= 0.032 af, Depth> 1.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
856	98		Unconnected roofs, HSG A
2,119	98		Paved parking, HSG A
1,203	96		Gravel surface, HSG A
11,279	49		50-75% Grass cover, Fair, HSG A
15,457	62	61	Weighted Average, UI Adjusted
12,482			80.75% Pervious Area
2,975			19.25% Impervious Area
856			28.77% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.1	24	0.0600	3.94		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.8	74	Total			

Subcatchment E1: E1



Summary for Subcatchment E2: E2

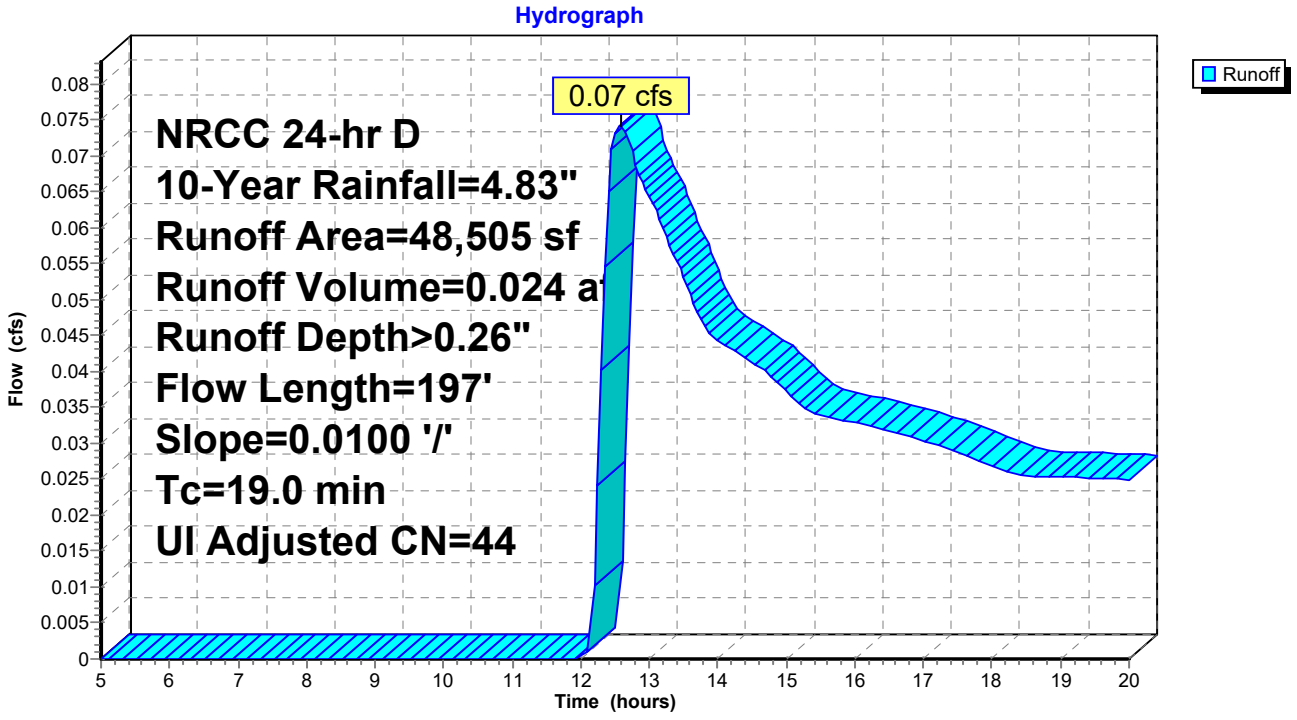
Runoff = 0.07 cfs @ 12.59 hrs, Volume= 0.024 af, Depth> 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
1,521	98		Unconnected roofs, HSG A
1,444	96		Gravel surface, HSG A
19,026	30		Woods, Good, HSG A
1,337	98		Unconnected pavement, HSG A
25,177	49		50-75% Grass cover, Fair, HSG A
48,505	46	44	Weighted Average, UI Adjusted
45,647			94.11% Pervious Area
2,858			5.89% Impervious Area
2,858			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.4	147	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
19.0	197	Total			

Subcatchment E2: E2

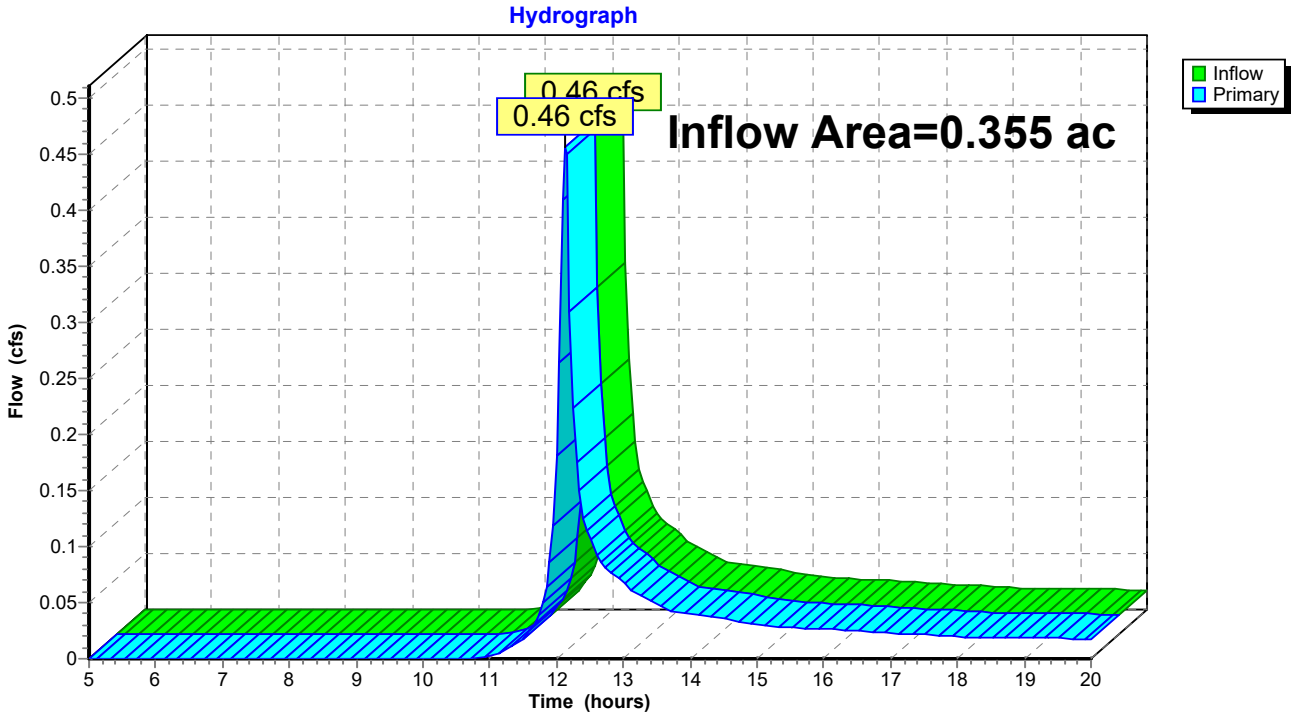


Summary for Link 1: TOTAL E1

Inflow Area = 0.355 ac, 19.25% Impervious, Inflow Depth > 1.09" for 10-Year event
Inflow = 0.46 cfs @ 12.14 hrs, Volume= 0.032 af
Primary = 0.46 cfs @ 12.14 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1: TOTAL E1

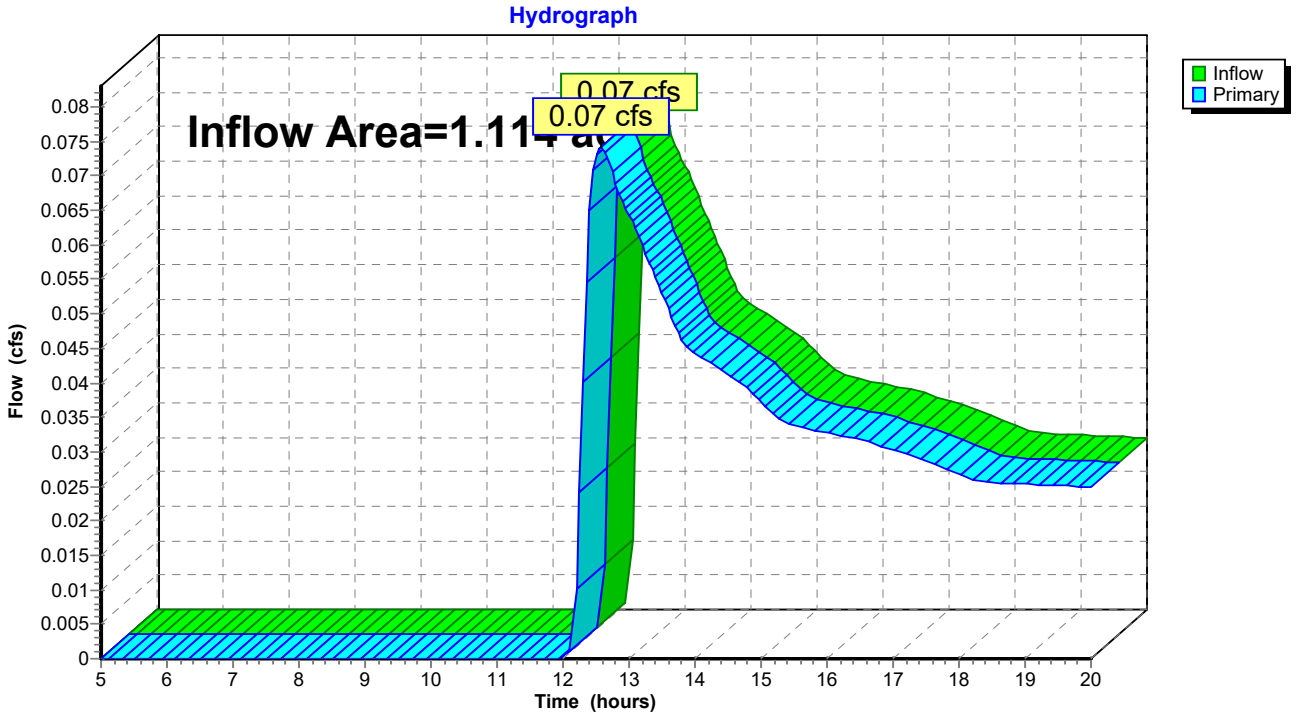


Summary for Link 2: TOTAL E2

Inflow Area = 1.114 ac, 5.89% Impervious, Inflow Depth > 0.26" for 10-Year event
Inflow = 0.07 cfs @ 12.59 hrs, Volume= 0.024 af
Primary = 0.07 cfs @ 12.59 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2: TOTAL E2

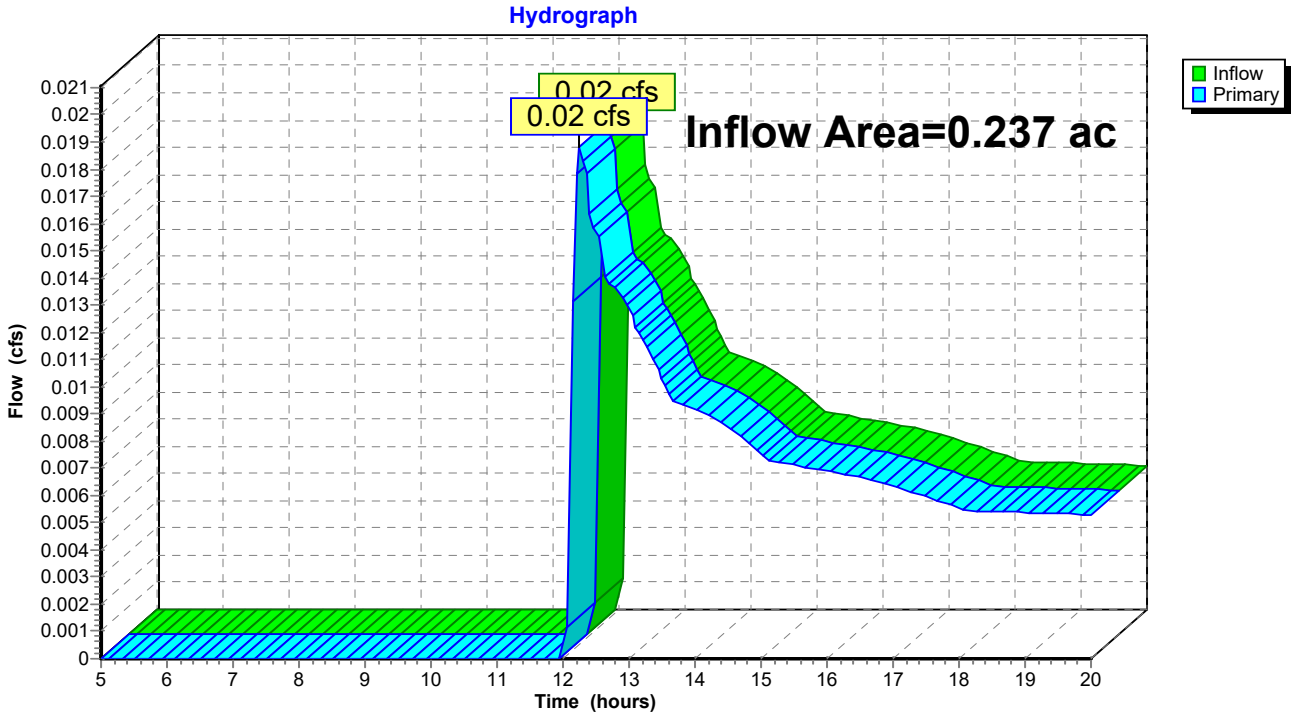


Summary for Link 4L: Total E3

Inflow Area = 0.237 ac, 0.00% Impervious, Inflow Depth > 0.26" for 10-Year event
Inflow = 0.02 cfs @ 12.26 hrs, Volume= 0.005 af
Primary = 0.02 cfs @ 12.26 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 4L: Total E3



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 3S: E3 Runoff Area=10,342 sf 0.00% Impervious Runoff Depth>1.82"
Tc=6.0 min CN=44 Runoff=0.50 cfs 0.036 af

Subcatchment E1: E1 Runoff Area=15,457 sf 19.25% Impervious Runoff Depth>3.72"
Flow Length=74' Tc=5.8 min UI Adjusted CN=61 Runoff=1.61 cfs 0.110 af

Subcatchment E2: E2 Runoff Area=48,505 sf 5.89% Impervious Runoff Depth>1.80"
Flow Length=197' Slope=0.0100 '/' Tc=19.0 min UI Adjusted CN=44 Runoff=1.50 cfs 0.167 af

Link 1: TOTAL E1 Inflow=1.61 cfs 0.110 af
Primary=1.61 cfs 0.110 af

Link 2: TOTAL E2 Inflow=1.50 cfs 0.167 af
Primary=1.50 cfs 0.167 af

Link 4L: Total E3 Inflow=0.50 cfs 0.036 af
Primary=0.50 cfs 0.036 af

Total Runoff Area = 1.706 ac Runoff Volume = 0.313 af Average Runoff Depth = 2.20"
92.15% Pervious = 1.572 ac 7.85% Impervious = 0.134 ac

Summary for Subcatchment 3S: E3

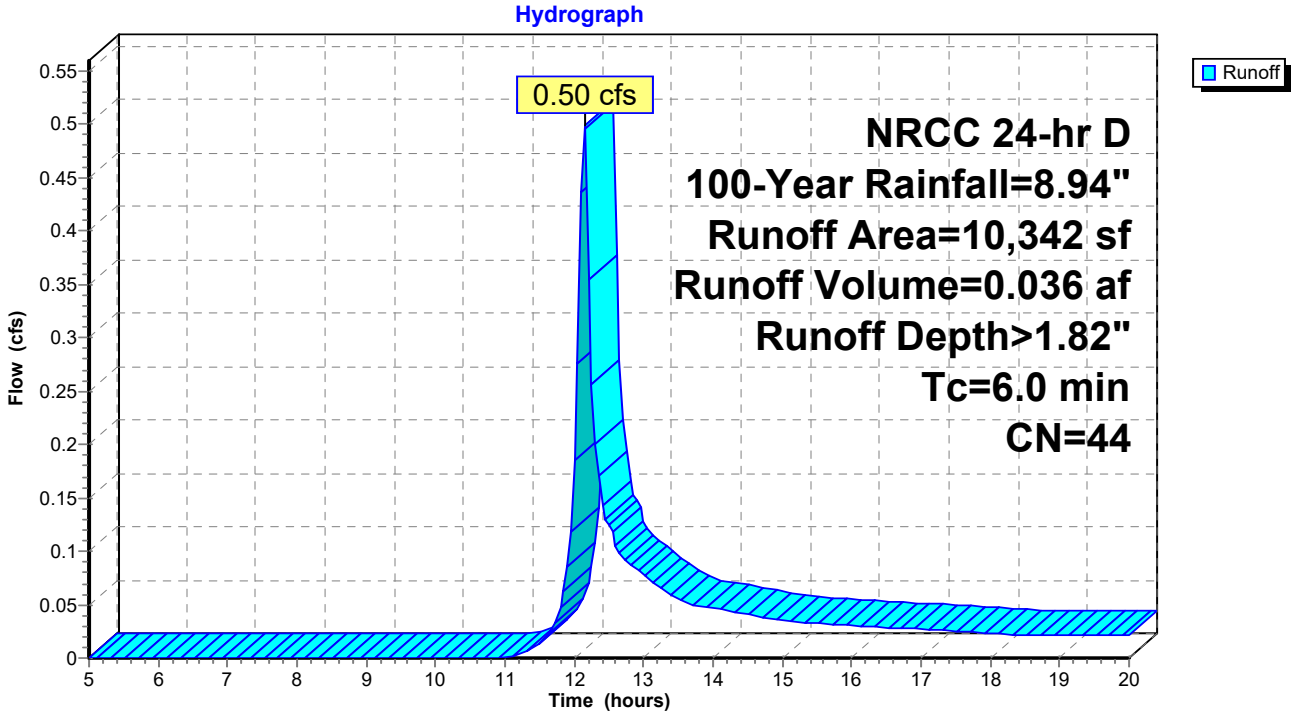
Runoff = 0.50 cfs @ 12.14 hrs, Volume= 0.036 af, Depth> 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
958	96	Gravel surface, HSG A
9,384	39	>75% Grass cover, Good, HSG A
10,342	44	Weighted Average
10,342		100.00% Pervious Area

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

Subcatchment 3S: E3



Summary for Subcatchment E1: E1

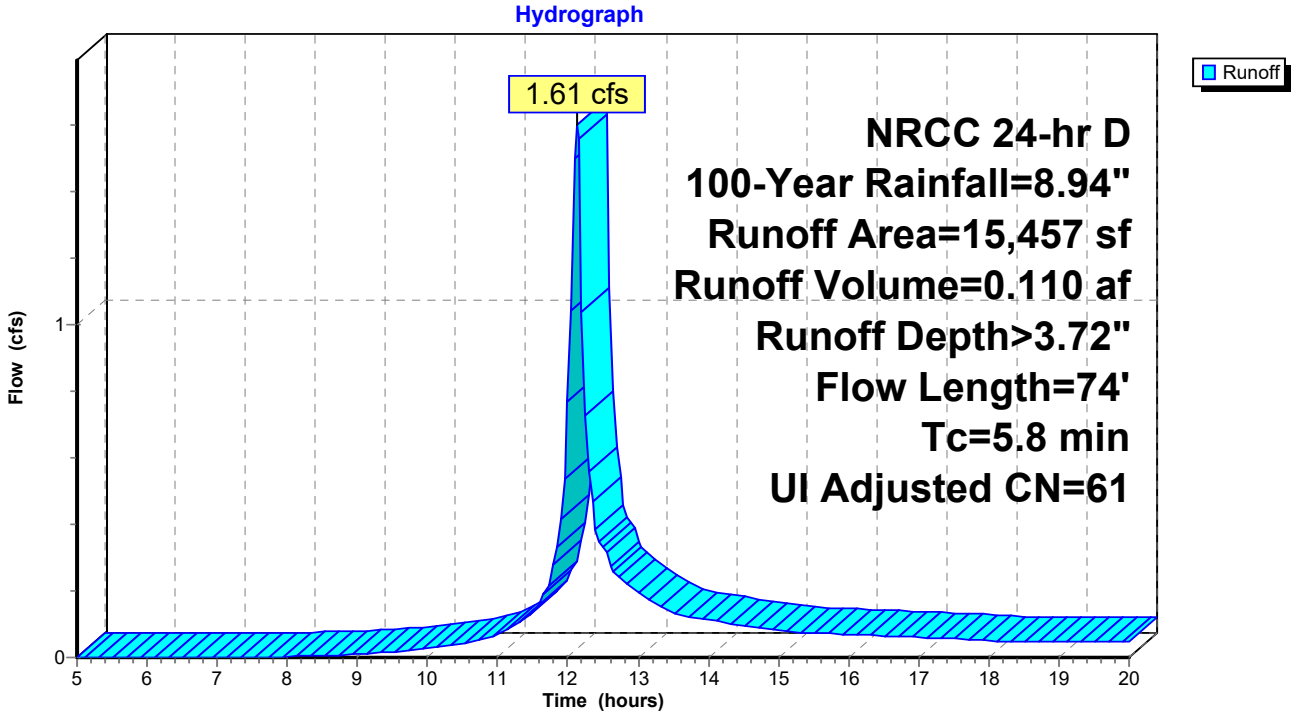
Runoff = 1.61 cfs @ 12.13 hrs, Volume= 0.110 af, Depth> 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
856	98		Unconnected roofs, HSG A
2,119	98		Paved parking, HSG A
1,203	96		Gravel surface, HSG A
11,279	49		50-75% Grass cover, Fair, HSG A
15,457	62	61	Weighted Average, UI Adjusted
12,482			80.75% Pervious Area
2,975			19.25% Impervious Area
856			28.77% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.1	24	0.0600	3.94		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.8	74	Total			

Subcatchment E1: E1



Summary for Subcatchment E2: E2

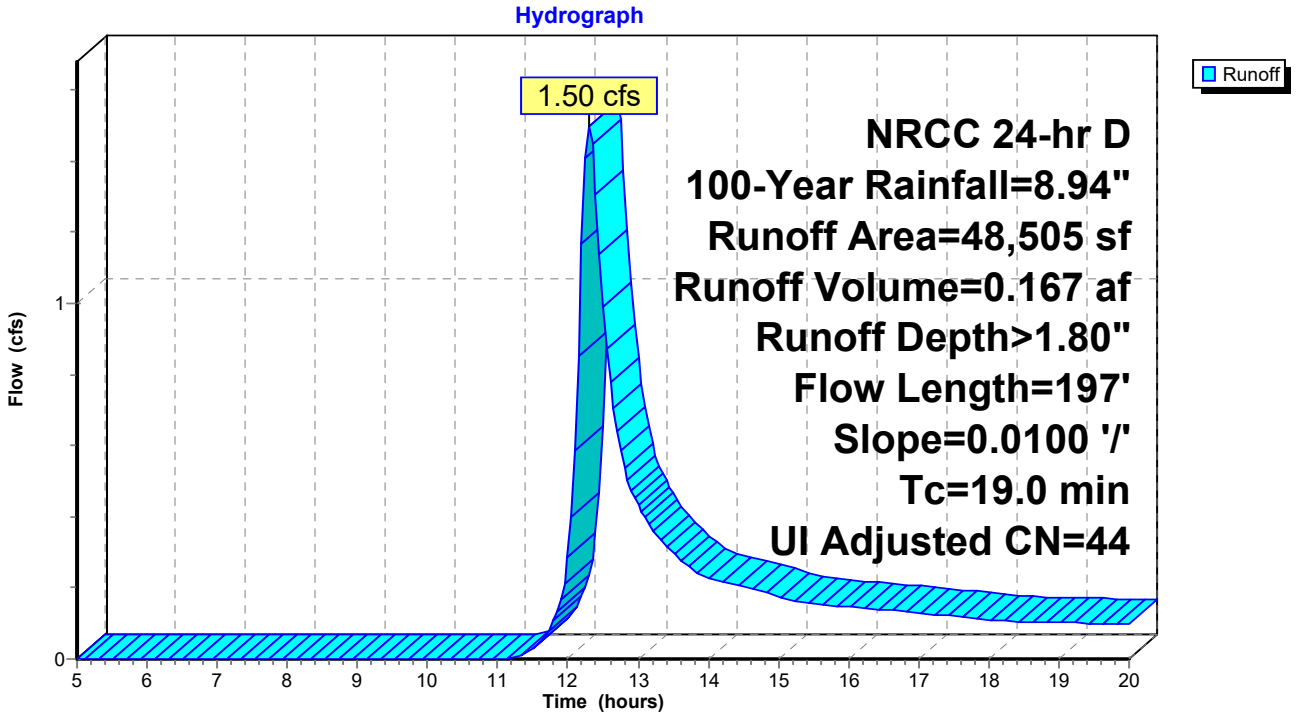
Runoff = 1.50 cfs @ 12.31 hrs, Volume= 0.167 af, Depth> 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
1,521	98		Unconnected roofs, HSG A
1,444	96		Gravel surface, HSG A
19,026	30		Woods, Good, HSG A
1,337	98		Unconnected pavement, HSG A
25,177	49		50-75% Grass cover, Fair, HSG A
48,505	46	44	Weighted Average, UI Adjusted
45,647			94.11% Pervious Area
2,858			5.89% Impervious Area
2,858			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.4	147	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
19.0	197	Total			

Subcatchment E2: E2

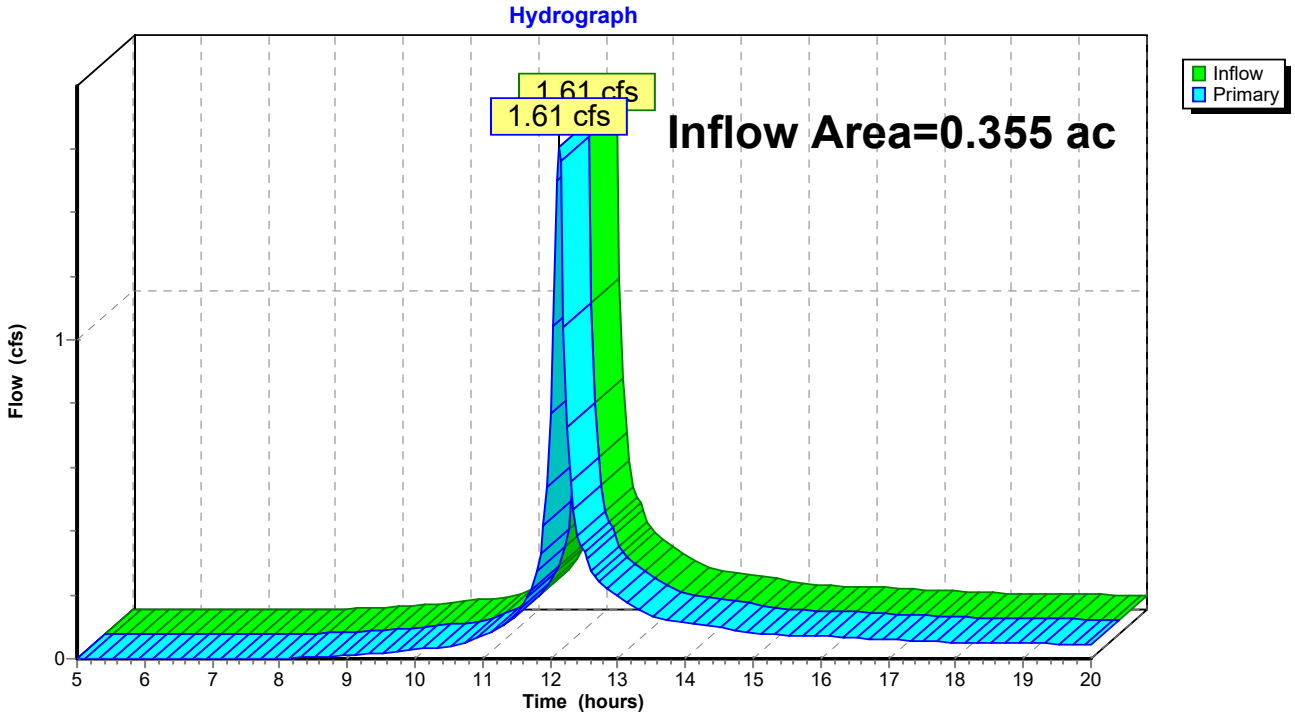


Summary for Link 1: TOTAL E1

Inflow Area = 0.355 ac, 19.25% Impervious, Inflow Depth > 3.72" for 100-Year event
Inflow = 1.61 cfs @ 12.13 hrs, Volume= 0.110 af
Primary = 1.61 cfs @ 12.13 hrs, Volume= 0.110 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 1: TOTAL E1

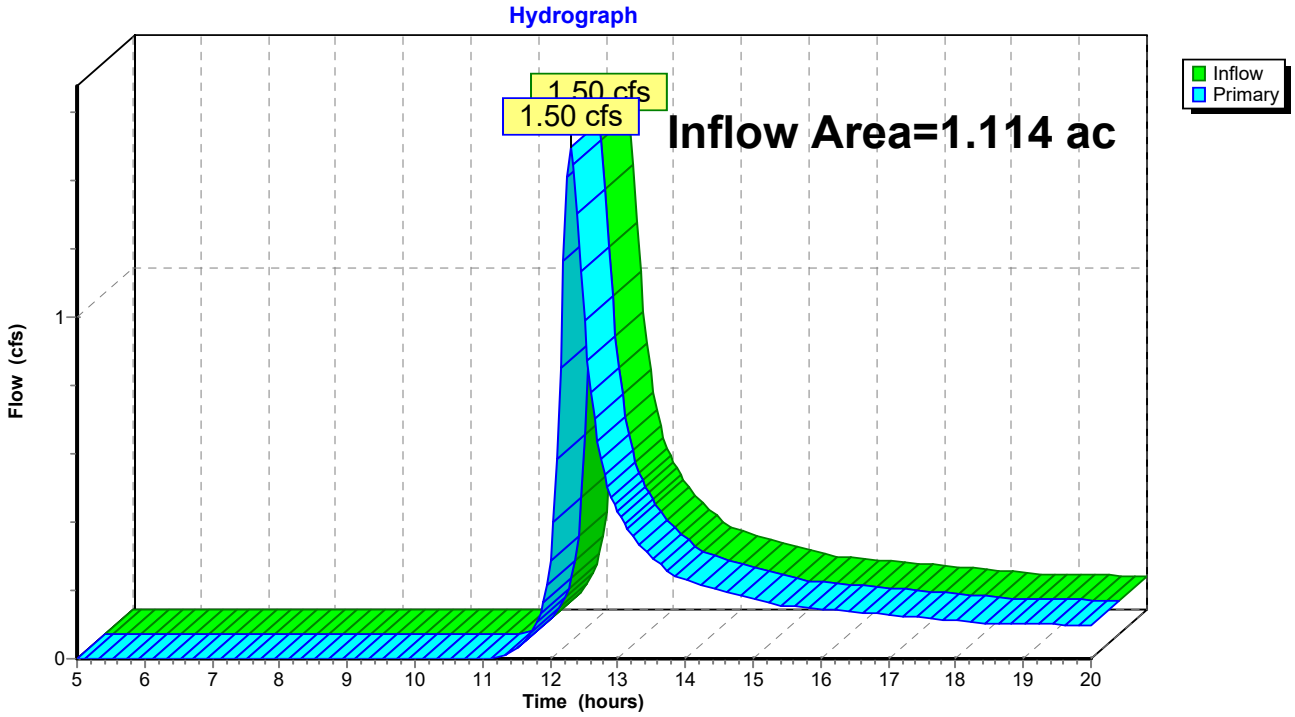


Summary for Link 2: TOTAL E2

Inflow Area = 1.114 ac, 5.89% Impervious, Inflow Depth > 1.80" for 100-Year event
Inflow = 1.50 cfs @ 12.31 hrs, Volume= 0.167 af
Primary = 1.50 cfs @ 12.31 hrs, Volume= 0.167 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 2: TOTAL E2

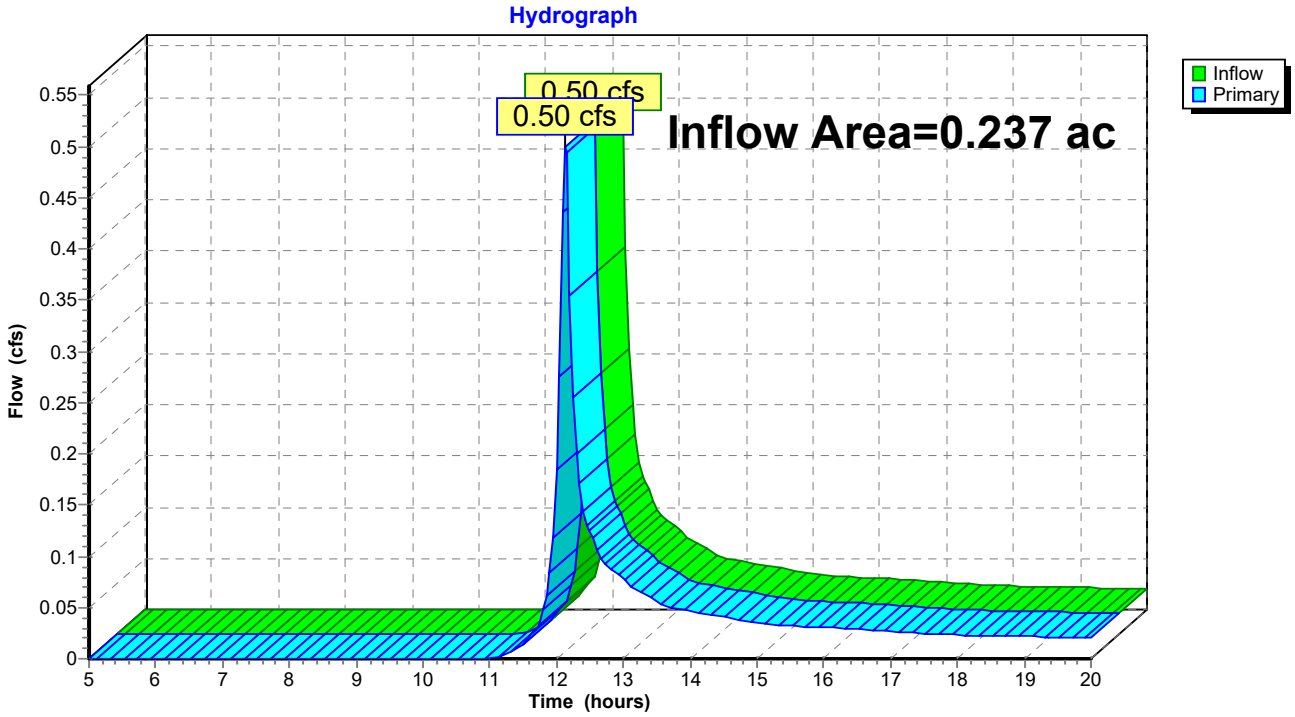


Summary for Link 4L: Total E3

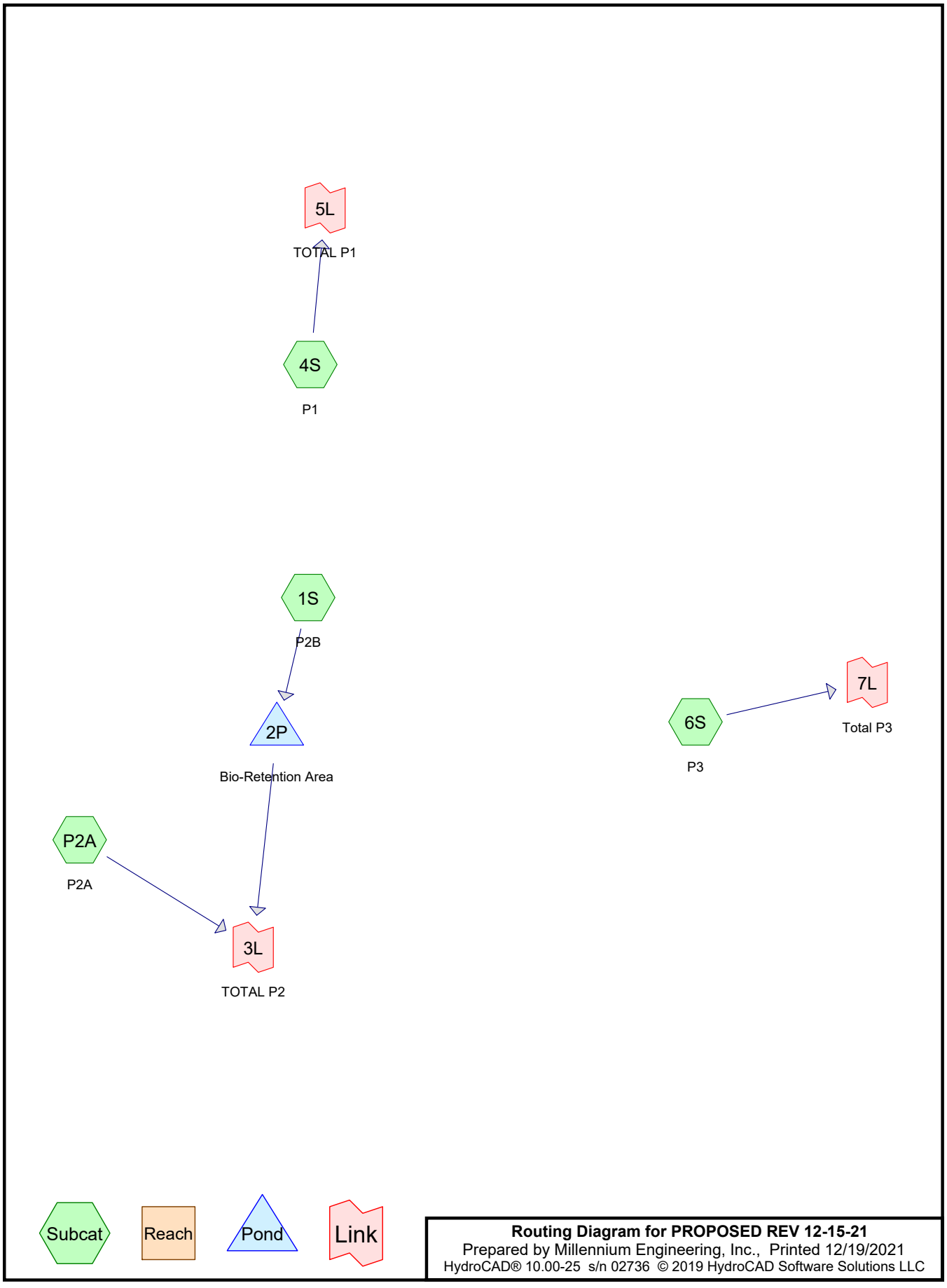
Inflow Area = 0.237 ac, 0.00% Impervious, Inflow Depth > 1.82" for 100-Year event
Inflow = 0.50 cfs @ 12.14 hrs, Volume= 0.036 af
Primary = 0.50 cfs @ 12.14 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 4L: Total E3



b. Proposed Conditions HydroCAD Report



Routing Diagram for PROPOSED REV 12-15-21
Prepared by Millennium Engineering, Inc., Printed 12/19/2021
HydroCAD® 10.00-25 s/n 02736 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.993	39	>75% Grass cover, Good, HSG A (1S, 4S, 6S, P2A)
0.225	98	Paved parking, HSG A (1S, 4S)
0.097	98	Unconnected roofs, HSG A (1S, 4S, P2A)
0.368	30	Woods, Good, HSG A (P2A)
1.683	**48**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.683	HSG A	1S, 4S, 6S, P2A
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.683		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.993	0.000	0.000	0.000	0.000	0.993	>75% Grass cover, Good	1S, 4S, 6S, P2A
0.225	0.000	0.000	0.000	0.000	0.225	Paved parking	1S, 4S
0.097	0.000	0.000	0.000	0.000	0.097	Unconnected roofs	1S, 4S, P2A
0.368	0.000	0.000	0.000	0.000	0.368	Woods, Good	P2A
1.683	**0.000**	**0.000**	**0.000**	**0.000**	**1.683**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: P2B Runoff Area=23,126 sf 33.74% Impervious Runoff Depth>0.28"
Flow Length=187' Tc=12.0 min CN=59 Runoff=0.08 cfs 0.012 af

Subcatchment 4S: P1 Runoff Area=13,474 sf 25.49% Impervious Runoff Depth>0.14"
Flow Length=136' Tc=6.0 min UI Adjusted CN=53 Runoff=0.01 cfs 0.004 af

Subcatchment 6S: P3 Runoff Area=3,069 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment P2A: P2A Runoff Area=33,646 sf 8.30% Impervious Runoff Depth=0.00"
Flow Length=176' Tc=10.4 min UI Adjusted CN=37 Runoff=0.00 cfs 0.000 af

Pond 2P: Bio-Retention Area Peak Elev=15.00' Storage=4 cf Inflow=0.08 cfs 0.012 af
Discarded=0.08 cfs 0.012 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.012 af

Link 3L: TOTAL P2 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link 5L: TOTAL P1 Inflow=0.01 cfs 0.004 af
Primary=0.01 cfs 0.004 af

Link 7L: Total P3 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 1.683 ac Runoff Volume = 0.016 af Average Runoff Depth = 0.11"
80.87% Pervious = 1.361 ac 19.13% Impervious = 0.322 ac

Summary for Subcatchment 1S: P2B

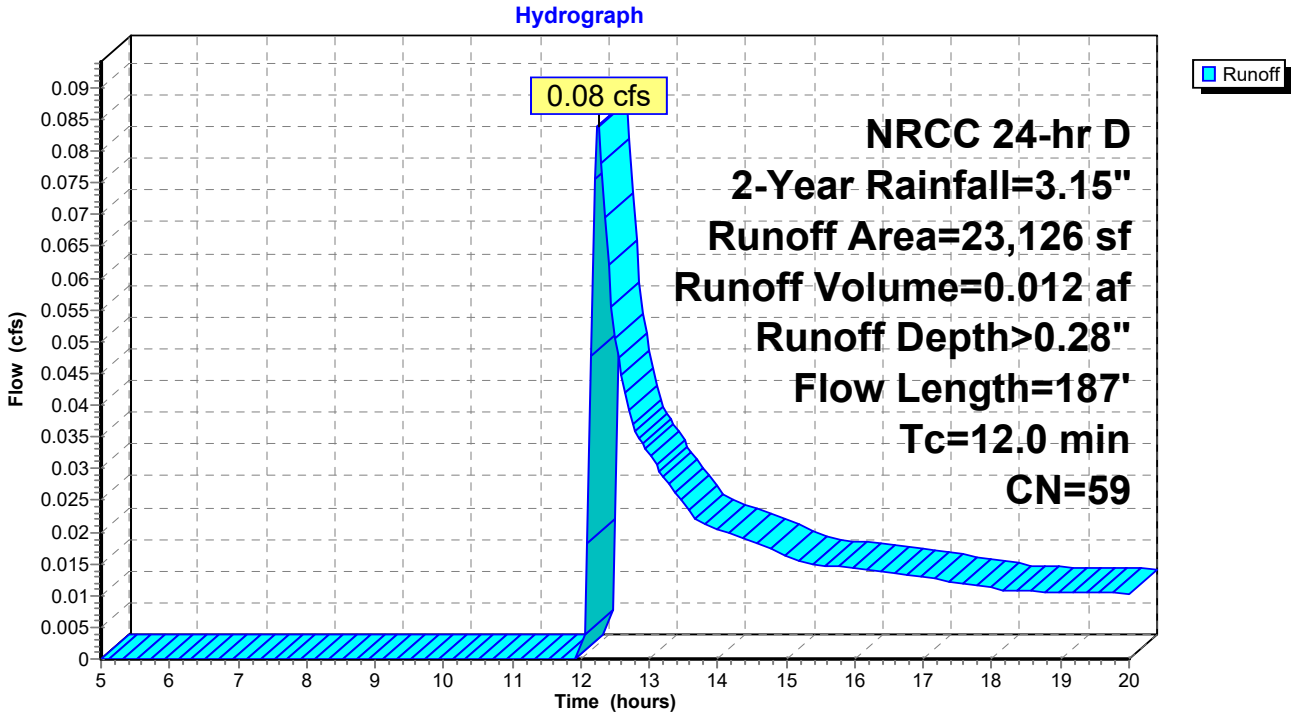
Runoff = 0.08 cfs @ 12.25 hrs, Volume= 0.012 af, Depth> 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
7,061	98	Paved parking, HSG A
15,324	39	>75% Grass cover, Good, HSG A
741	98	Unconnected roofs, HSG A
23,126	59	Weighted Average
15,324		66.26% Pervious Area
7,802		33.74% Impervious Area
741		9.50% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0060	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.4	101	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	36	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.0	187	Total			

Subcatchment 1S: P2B



Summary for Subcatchment 4S: P1

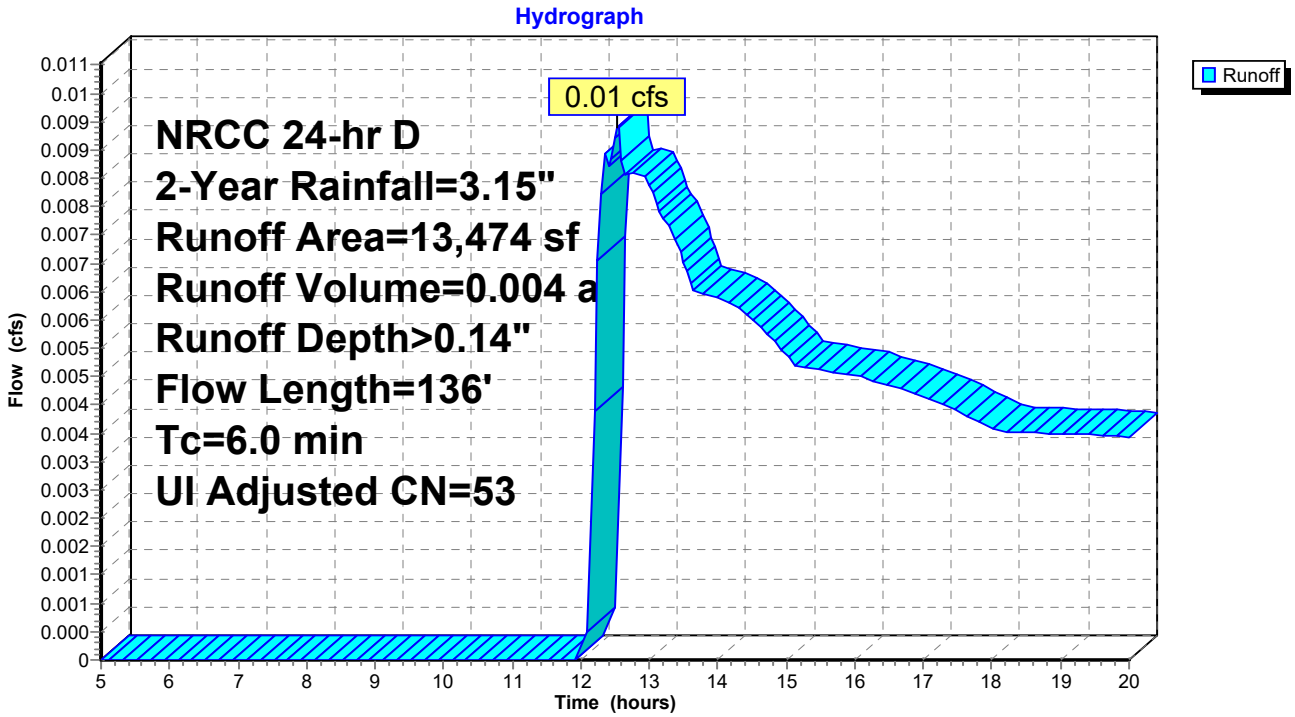
Runoff = 0.01 cfs @ 12.54 hrs, Volume= 0.004 af, Depth> 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
10,040	39		>75% Grass cover, Good, HSG A
677	98		Unconnected roofs, HSG A
2,757	98		Paved parking, HSG A
13,474	54	53	Weighted Average, UI Adjusted
10,040			74.51% Pervious Area
3,434			25.49% Impervious Area
677			19.71% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0240	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.7	86	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	136	Total			

Subcatchment 4S: P1



Summary for Subcatchment 6S: P3

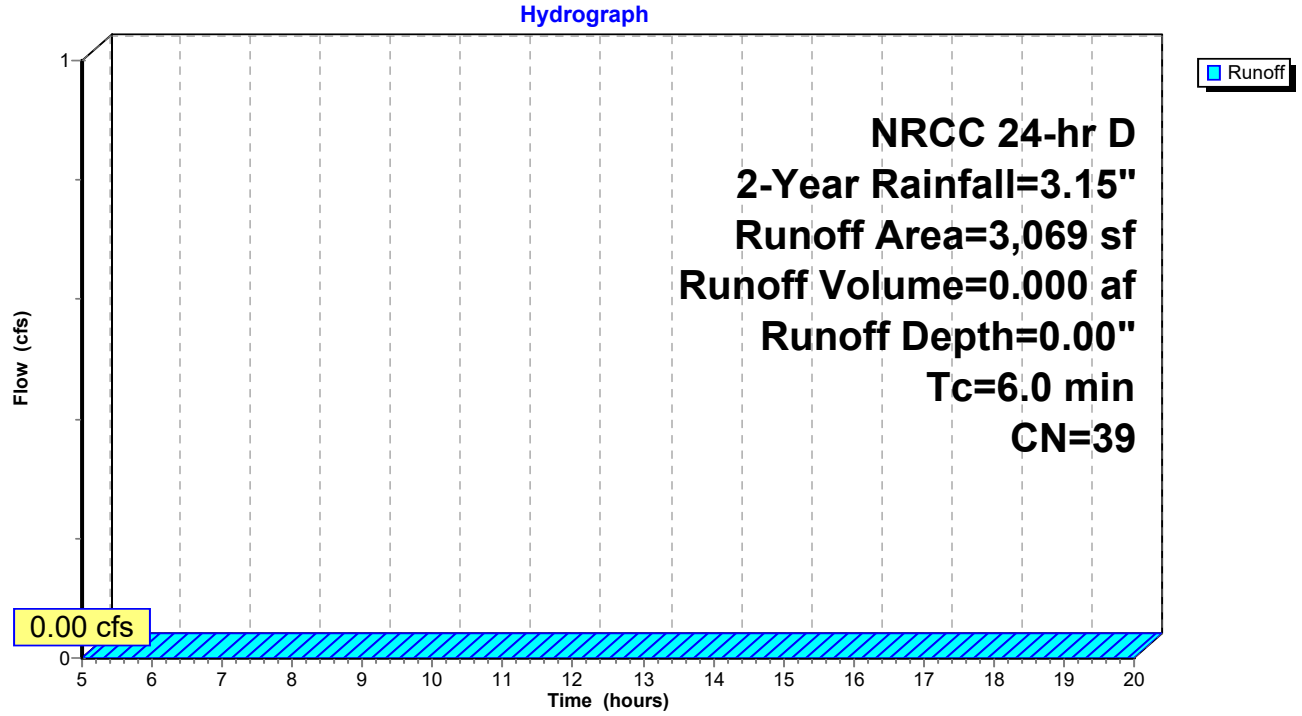
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
3,069	39	>75% Grass cover, Good, HSG A
3,069		100.00% Pervious Area

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

Subcatchment 6S: P3



Summary for Subcatchment P2A: P2A

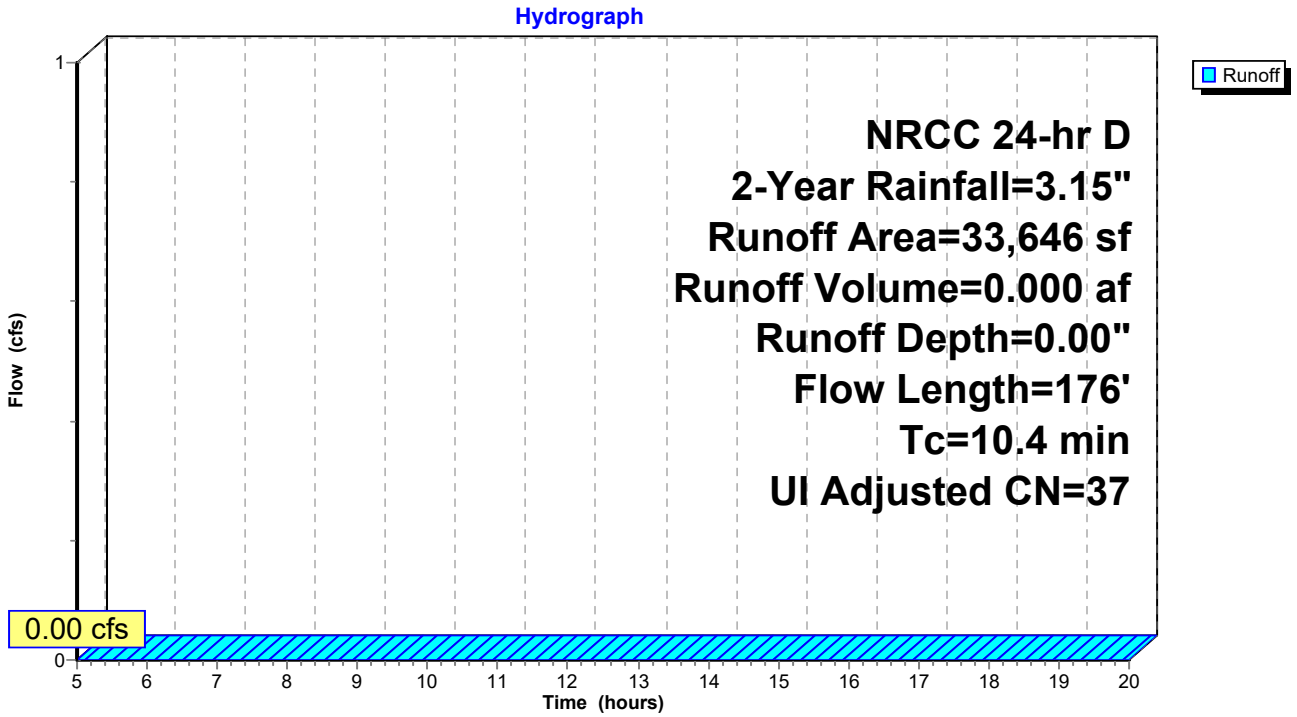
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
16,049	30		Woods, Good, HSG A
14,806	39		>75% Grass cover, Good, HSG A
2,791	98		Unconnected roofs, HSG A
33,646	40	37	Weighted Average, UI Adjusted
30,855			91.70% Pervious Area
2,791			8.30% Impervious Area
2,791			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.9	126	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	176	Total			

Subcatchment P2A: P2A



Summary for Pond 2P: Bio-Retention Area

Inflow Area = 0.531 ac, 33.74% Impervious, Inflow Depth > 0.28" for 2-Year event
Inflow = 0.08 cfs @ 12.25 hrs, Volume= 0.012 af
Outflow = 0.08 cfs @ 12.27 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.8 min
Discarded = 0.08 cfs @ 12.27 hrs, Volume= 0.012 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 15.00' @ 12.27 hrs Surf.Area= 1,342 sf Storage= 4 cf

Plug-Flow detention time= 0.9 min calculated for 0.012 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (892.8 - 892.2)

Volume	Invert	Avail.Storage	Storage Description
#1	15.00'	1,600 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

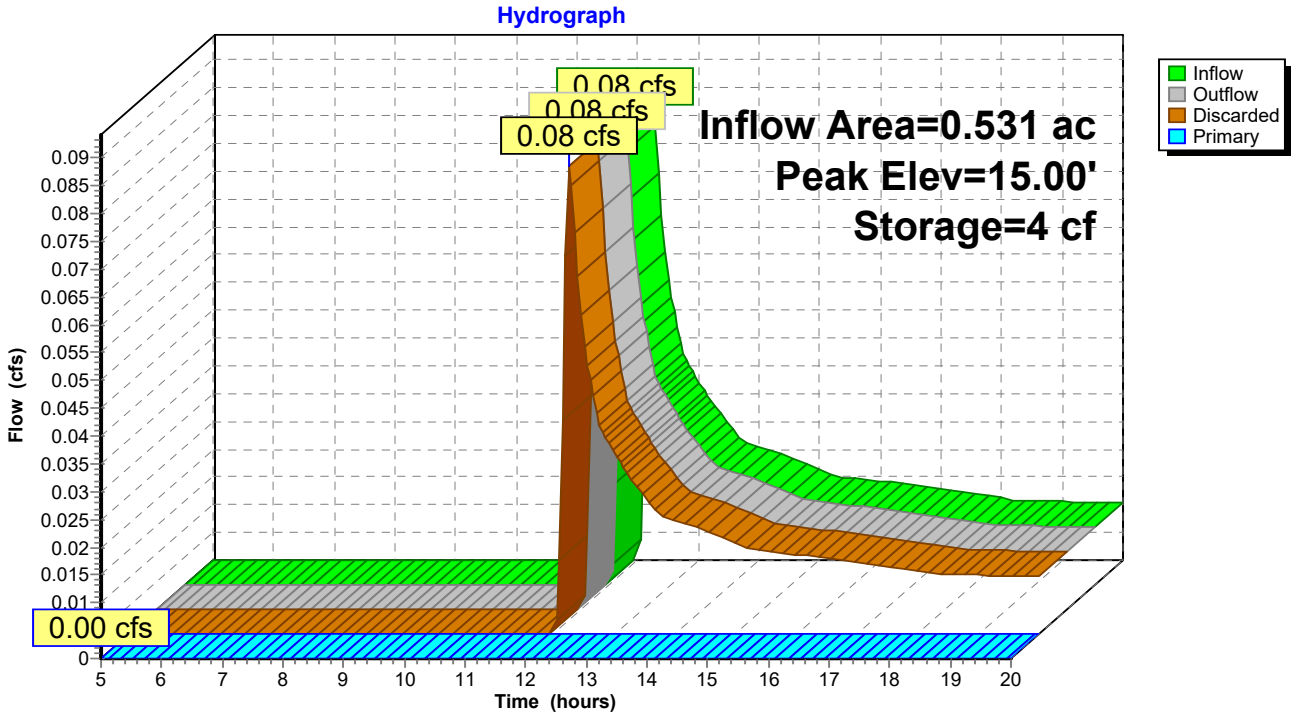
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.00	1,340	0	0
15.50	1,596	734	734
16.00	1,867	866	1,600

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.00'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 12.90'
#2	Primary	15.60'	**6.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.26 cfs @ 12.27 hrs HW=15.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.26 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=15.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bio-Retention Area

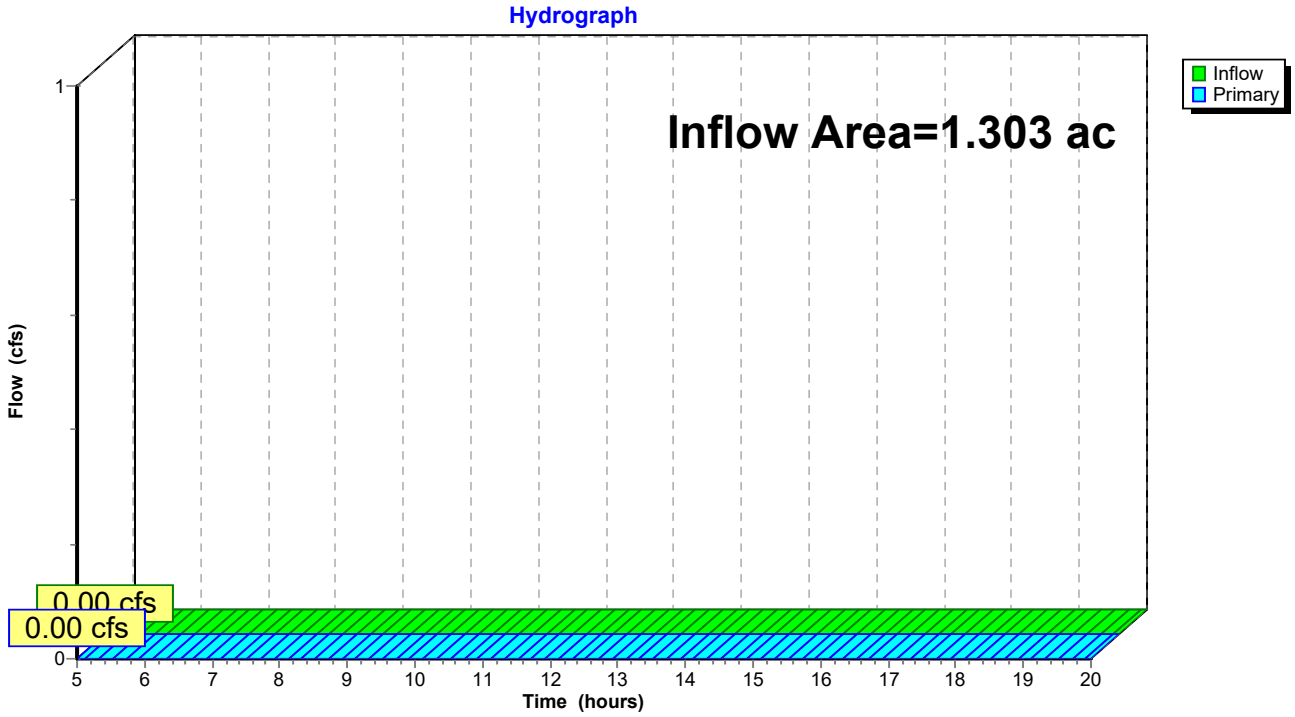


Summary for Link 3L: TOTAL P2

Inflow Area = 1.303 ac, 18.66% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: TOTAL P2

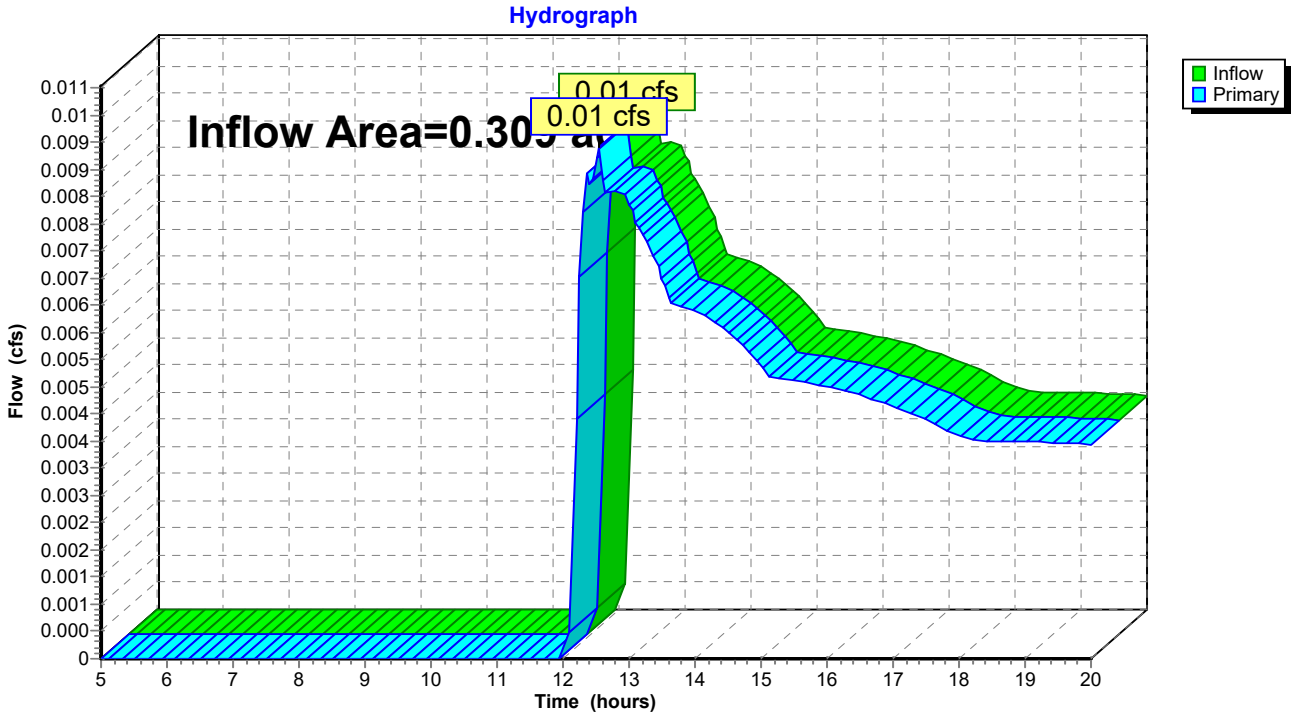


Summary for Link 5L: TOTAL P1

Inflow Area = 0.309 ac, 25.49% Impervious, Inflow Depth > 0.14" for 2-Year event
Inflow = 0.01 cfs @ 12.54 hrs, Volume= 0.004 af
Primary = 0.01 cfs @ 12.54 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: TOTAL P1

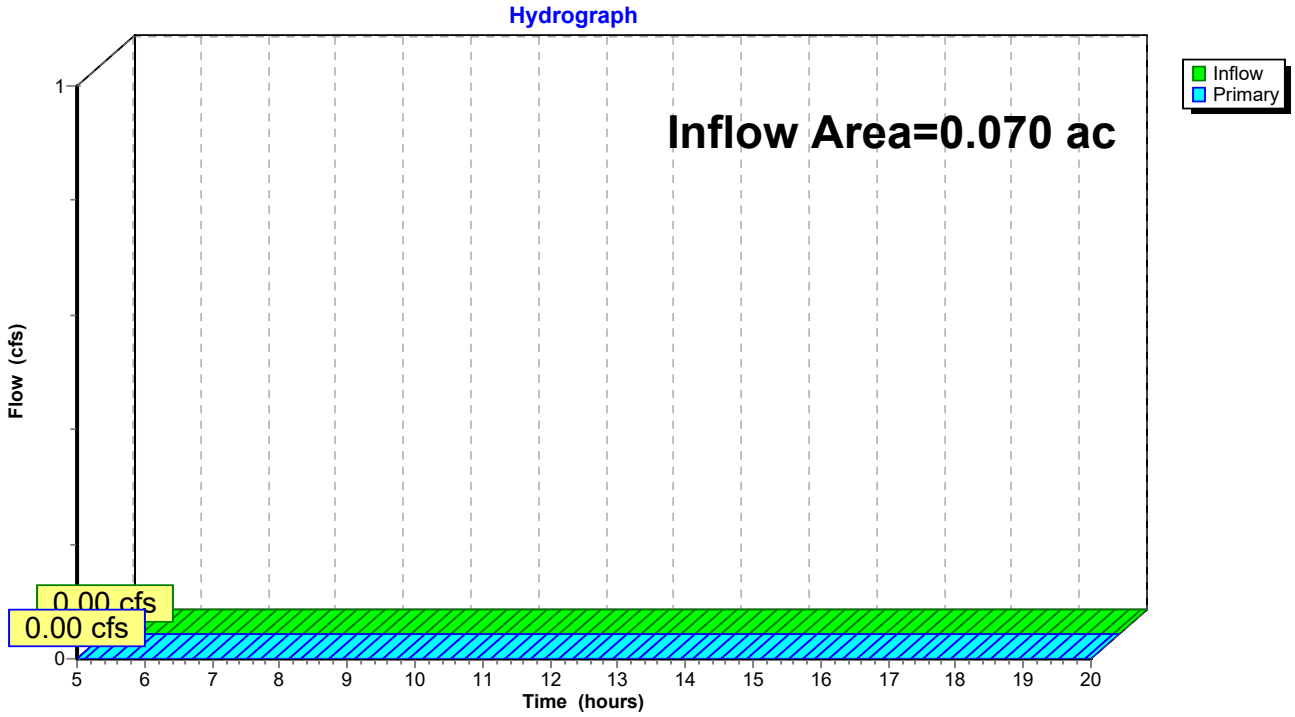


Summary for Link 7L: Total P3

Inflow Area = 0.070 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 7L: Total P3



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: P2B Runoff Area=23,126 sf 33.74% Impervious Runoff Depth>0.96"
Flow Length=187' Tc=12.0 min CN=59 Runoff=0.47 cfs 0.043 af

Subcatchment 4S: P1 Runoff Area=13,474 sf 25.49% Impervious Runoff Depth>0.65"
Flow Length=136' Tc=6.0 min UI Adjusted CN=53 Runoff=0.20 cfs 0.017 af

Subcatchment 6S: P3 Runoff Area=3,069 sf 0.00% Impervious Runoff Depth>0.11"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0.001 af

Subcatchment P2A: P2A Runoff Area=33,646 sf 8.30% Impervious Runoff Depth>0.07"
Flow Length=176' Tc=10.4 min UI Adjusted CN=37 Runoff=0.01 cfs 0.004 af

Pond 2P: Bio-Retention Area Peak Elev=15.09' Storage=125 cf Inflow=0.47 cfs 0.043 af
Discarded=0.28 cfs 0.043 af Primary=0.00 cfs 0.000 af Outflow=0.28 cfs 0.043 af

Link 3L: TOTAL P2 Inflow=0.01 cfs 0.004 af
Primary=0.01 cfs 0.004 af

Link 5L: TOTAL P1 Inflow=0.20 cfs 0.017 af
Primary=0.20 cfs 0.017 af

Link 7L: Total P3 Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Total Runoff Area = 1.683 ac Runoff Volume = 0.064 af Average Runoff Depth = 0.46"
80.87% Pervious = 1.361 ac 19.13% Impervious = 0.322 ac

Summary for Subcatchment 1S: P2B

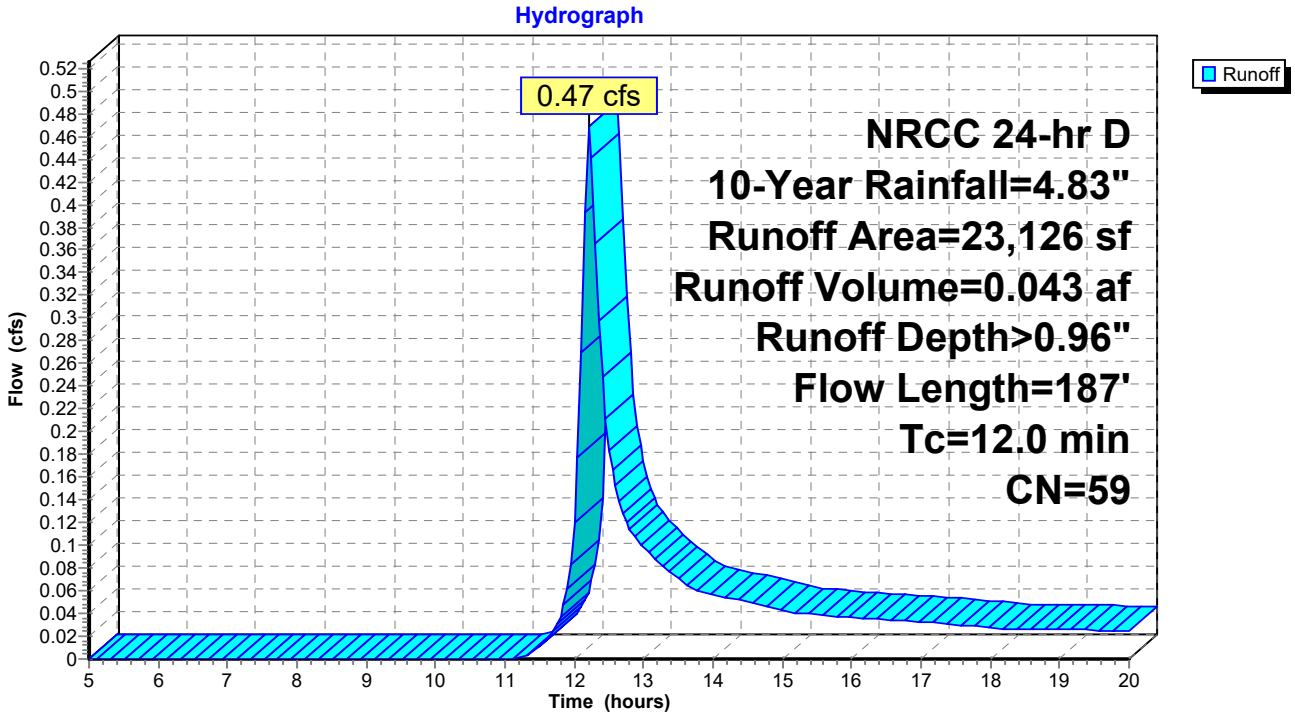
Runoff = 0.47 cfs @ 12.21 hrs, Volume= 0.043 af, Depth> 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
7,061	98	Paved parking, HSG A
15,324	39	>75% Grass cover, Good, HSG A
741	98	Unconnected roofs, HSG A
23,126	59	Weighted Average
15,324		66.26% Pervious Area
7,802		33.74% Impervious Area
741		9.50% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0060	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.4	101	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	36	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.0	187	Total			

Subcatchment 1S: P2B



Summary for Subcatchment 4S: P1

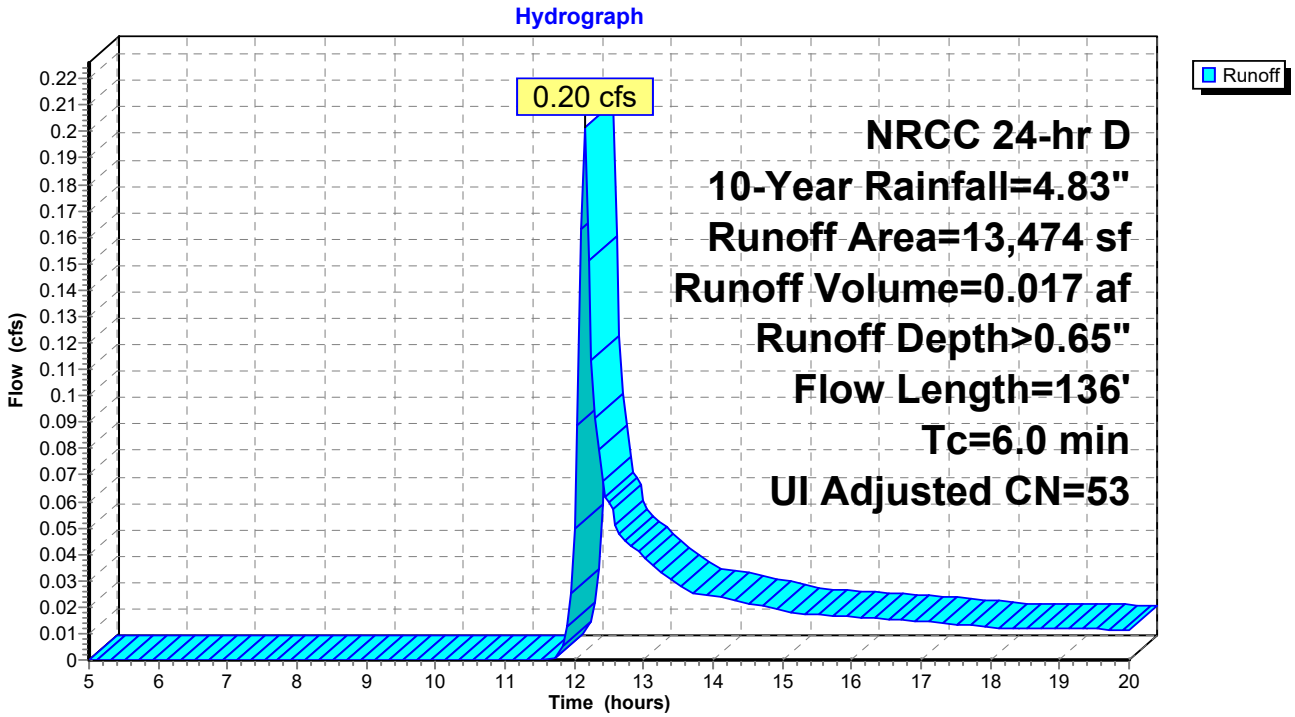
Runoff = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af, Depth> 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
10,040	39		>75% Grass cover, Good, HSG A
677	98		Unconnected roofs, HSG A
2,757	98		Paved parking, HSG A
13,474	54	53	Weighted Average, UI Adjusted
10,040			74.51% Pervious Area
3,434			25.49% Impervious Area
677			19.71% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0240	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.7	86	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	136	Total			

Subcatchment 4S: P1



Summary for Subcatchment 6S: P3

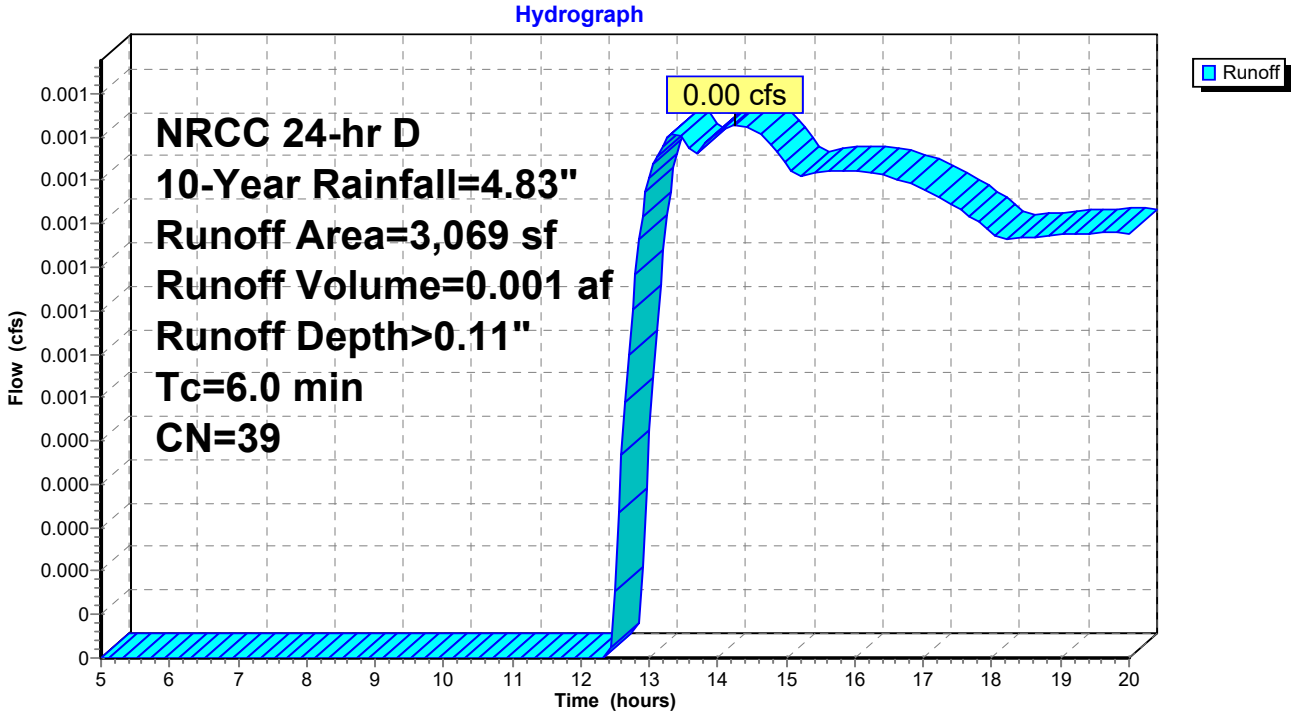
Runoff = 0.00 cfs @ 14.25 hrs, Volume= 0.001 af, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
3,069	39	>75% Grass cover, Good, HSG A
3,069		100.00% Pervious Area

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

Subcatchment 6S: P3



Summary for Subcatchment P2A: P2A

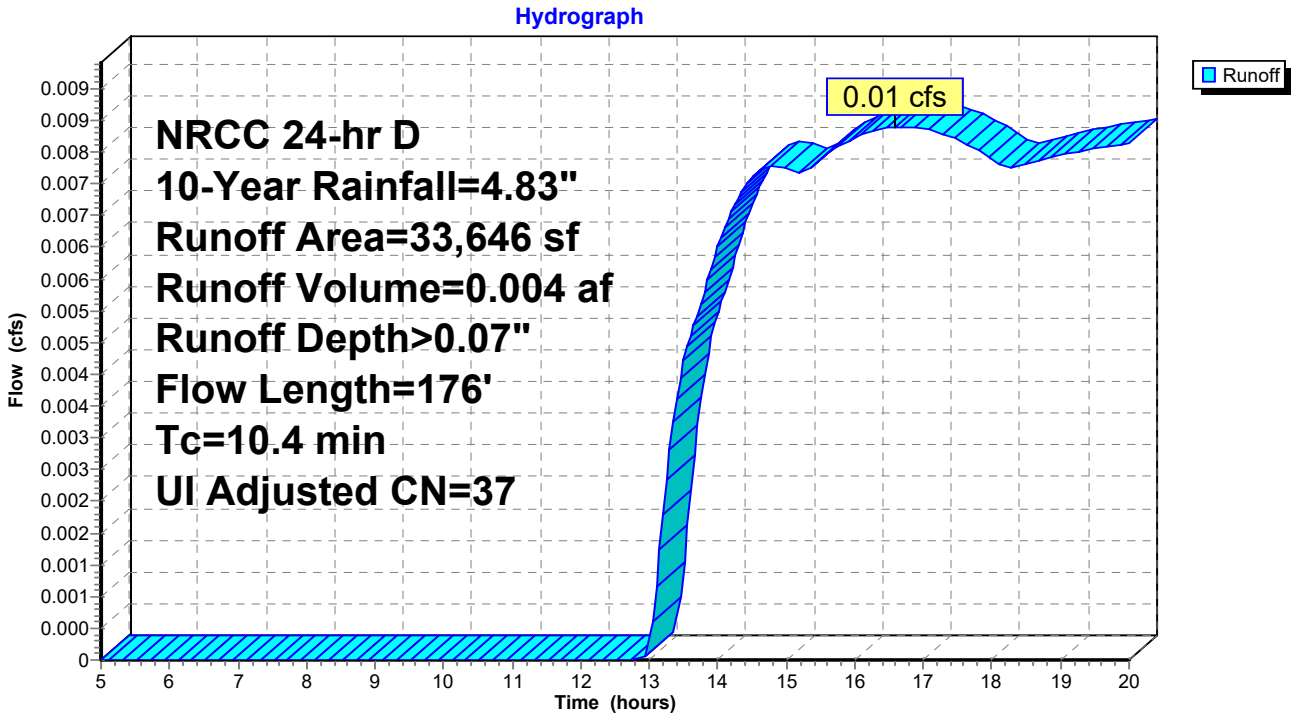
Runoff = 0.01 cfs @ 16.60 hrs, Volume= 0.004 af, Depth> 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
16,049	30		Woods, Good, HSG A
14,806	39		>75% Grass cover, Good, HSG A
2,791	98		Unconnected roofs, HSG A
33,646	40	37	Weighted Average, UI Adjusted
30,855			91.70% Pervious Area
2,791			8.30% Impervious Area
2,791			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.9	126	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	176	Total			

Subcatchment P2A: P2A



Summary for Pond 2P: Bio-Retention Area

Inflow Area = 0.531 ac, 33.74% Impervious, Inflow Depth > 0.96" for 10-Year event
Inflow = 0.47 cfs @ 12.21 hrs, Volume= 0.043 af
Outflow = 0.28 cfs @ 12.37 hrs, Volume= 0.043 af, Atten= 41%, Lag= 9.6 min
Discarded = 0.28 cfs @ 12.37 hrs, Volume= 0.043 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 15.09' @ 12.37 hrs Surf.Area= 1,387 sf Storage= 125 cf

Plug-Flow detention time= 2.1 min calculated for 0.043 af (100% of inflow)
Center-of-Mass det. time= 1.9 min (853.9 - 852.0)

Volume	Invert	Avail.Storage	Storage Description
#1	15.00'	1,600 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

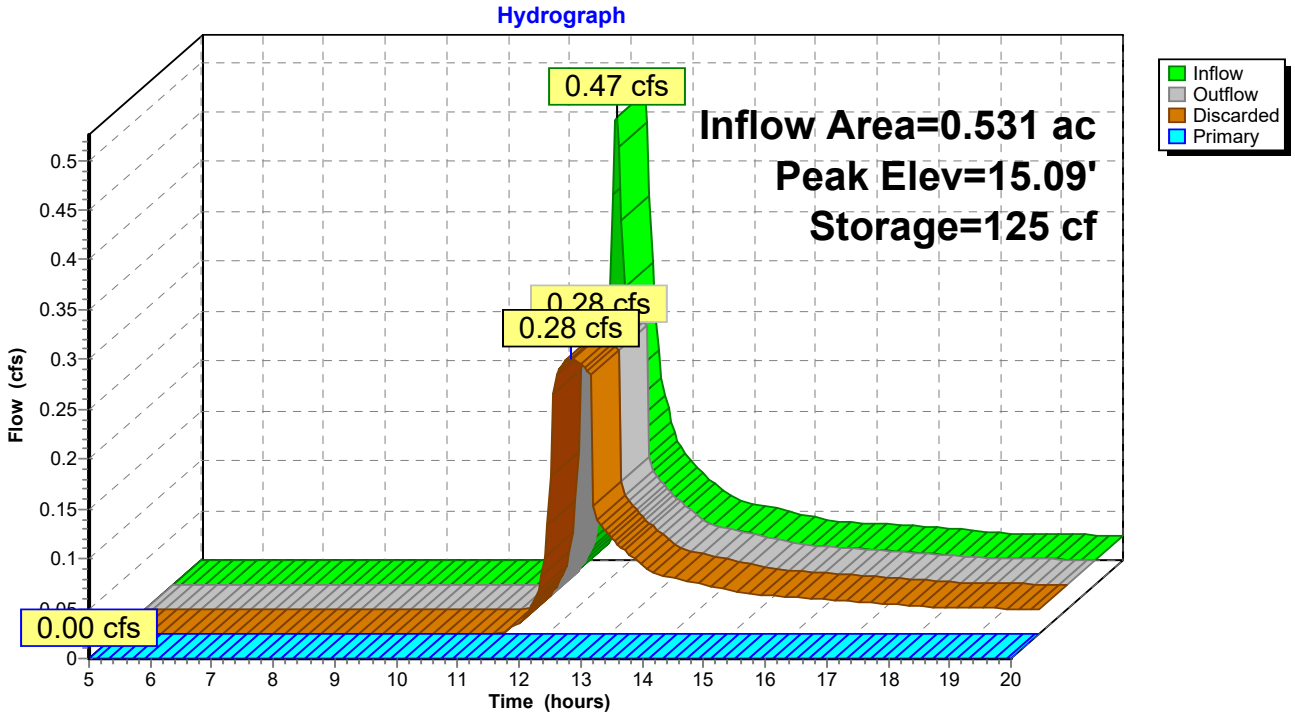
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.00	1,340	0	0
15.50	1,596	734	734
16.00	1,867	866	1,600

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.00'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 12.90'
#2	Primary	15.60'	**6.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.28 cfs @ 12.37 hrs HW=15.09' (Free Discharge)
1=Exfiltration (Controls 0.28 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=15.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Bio-Retention Area

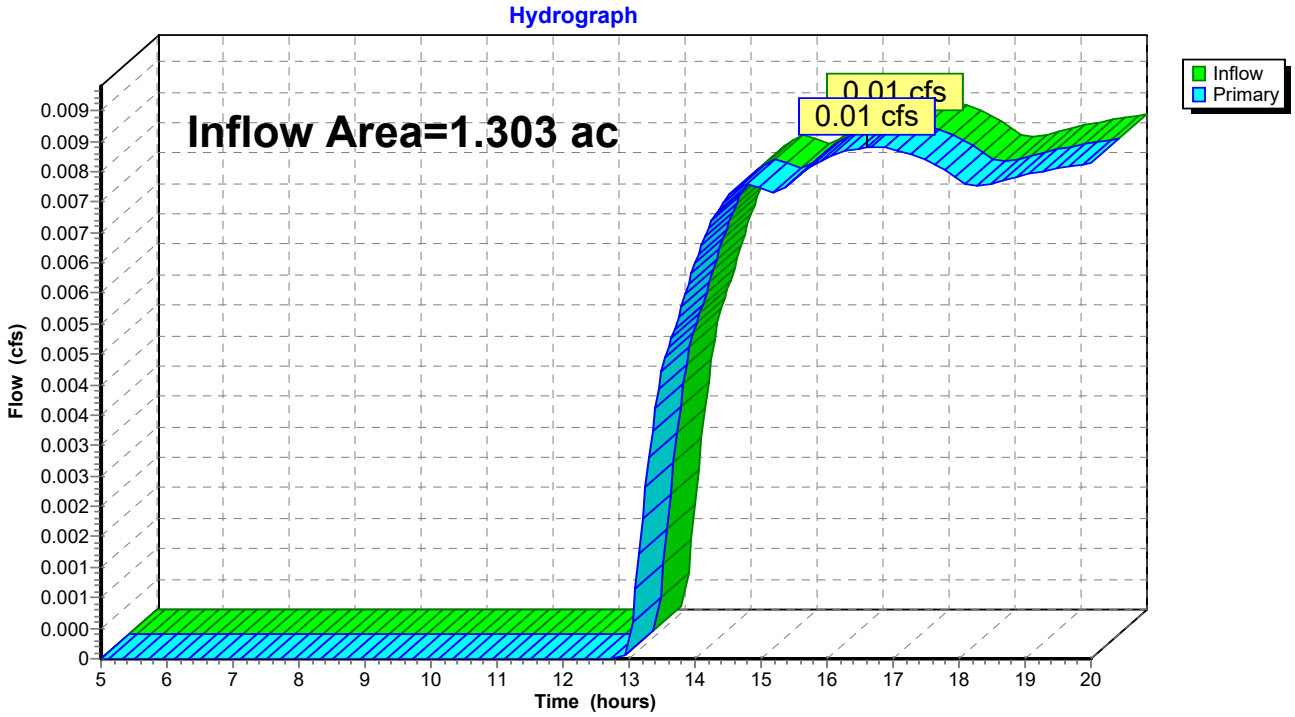


Summary for Link 3L: TOTAL P2

Inflow Area = 1.303 ac, 18.66% Impervious, Inflow Depth > 0.04" for 10-Year event
Inflow = 0.01 cfs @ 16.60 hrs, Volume= 0.004 af
Primary = 0.01 cfs @ 16.60 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: TOTAL P2

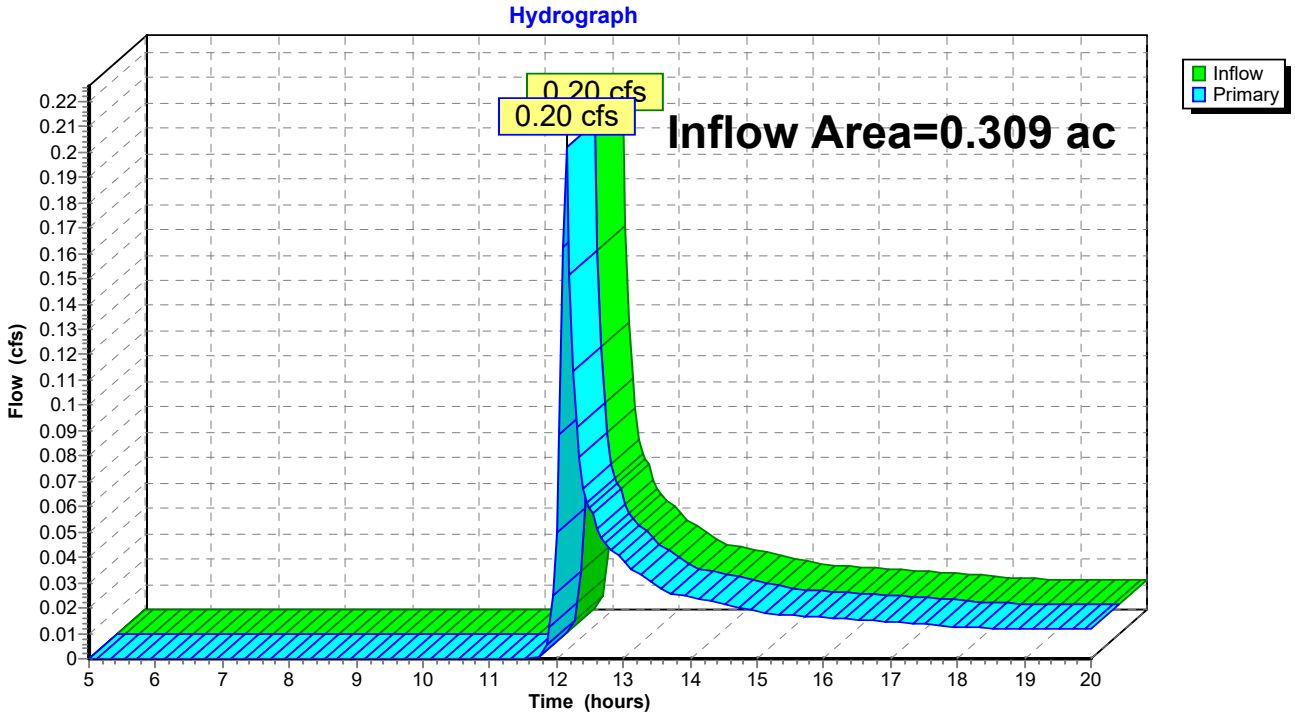


Summary for Link 5L: TOTAL P1

Inflow Area = 0.309 ac, 25.49% Impervious, Inflow Depth > 0.65" for 10-Year event
Inflow = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af
Primary = 0.20 cfs @ 12.15 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: TOTAL P1

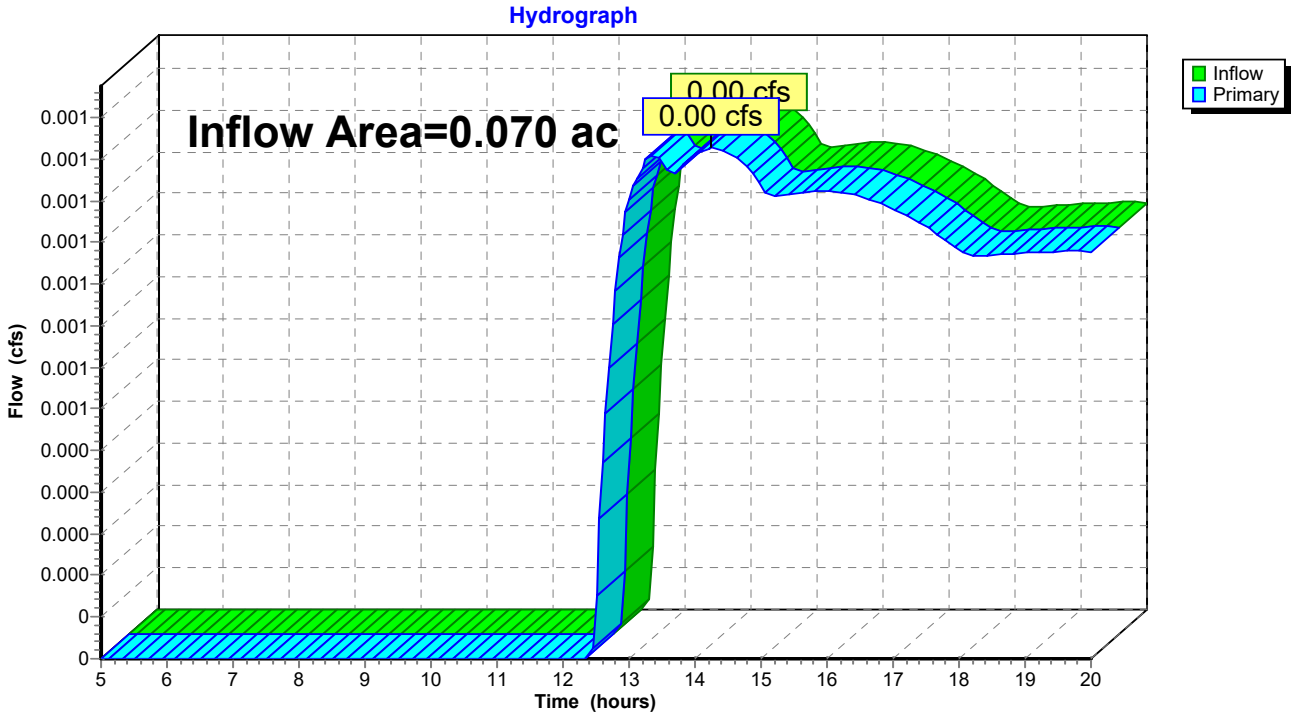


Summary for Link 7L: Total P3

Inflow Area = 0.070 ac, 0.00% Impervious, Inflow Depth > 0.11" for 10-Year event
Inflow = 0.00 cfs @ 14.25 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 14.25 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 7L: Total P3



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 1S: P2B Runoff Area=23,126 sf 33.74% Impervious Runoff Depth>3.47"
Flow Length=187' Tc=12.0 min CN=59 Runoff=1.82 cfs 0.154 af

Subcatchment 4S: P1 Runoff Area=13,474 sf 25.49% Impervious Runoff Depth>2.80"
Flow Length=136' Tc=6.0 min UI Adjusted CN=53 Runoff=1.05 cfs 0.072 af

Subcatchment 6S: P3 Runoff Area=3,069 sf 0.00% Impervious Runoff Depth>1.31"
Tc=6.0 min CN=39 Runoff=0.10 cfs 0.008 af

Subcatchment P2A: P2A Runoff Area=33,646 sf 8.30% Impervious Runoff Depth>1.11"
Flow Length=176' Tc=10.4 min UI Adjusted CN=37 Runoff=0.68 cfs 0.071 af

Pond 2P: Bio-Retention Area Peak Elev=15.74' Storage=1,125 cf Inflow=1.82 cfs 0.154 af
Discarded=0.43 cfs 0.137 af Primary=0.74 cfs 0.016 af Outflow=1.18 cfs 0.154 af

Link 3L: TOTAL P2 Inflow=1.24 cfs 0.088 af
Primary=1.24 cfs 0.088 af

Link 5L: TOTAL P1 Inflow=1.05 cfs 0.072 af
Primary=1.05 cfs 0.072 af

Link 7L: Total P3 Inflow=0.10 cfs 0.008 af
Primary=0.10 cfs 0.008 af

Total Runoff Area = 1.683 ac Runoff Volume = 0.305 af Average Runoff Depth = 2.17"
80.87% Pervious = 1.361 ac 19.13% Impervious = 0.322 ac

Summary for Subcatchment 1S: P2B

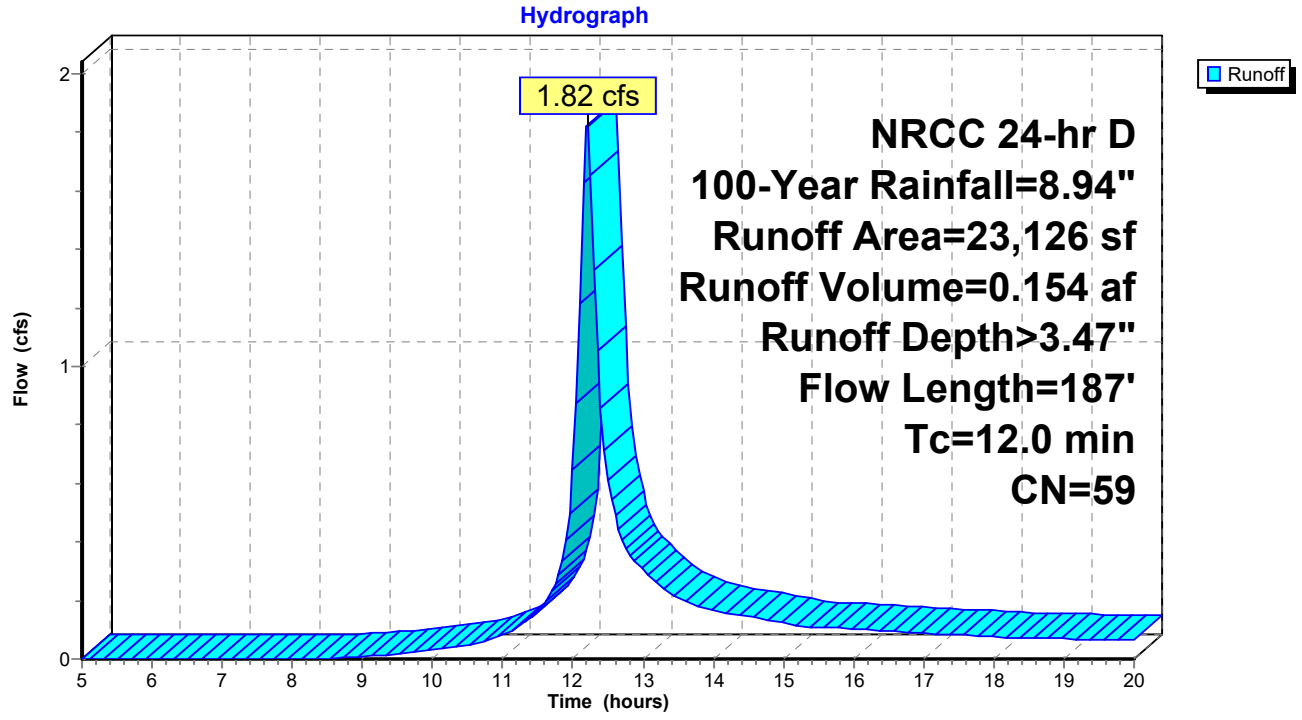
Runoff = 1.82 cfs @ 12.20 hrs, Volume= 0.154 af, Depth> 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
7,061	98	Paved parking, HSG A
15,324	39	>75% Grass cover, Good, HSG A
741	98	Unconnected roofs, HSG A
23,126	59	Weighted Average
15,324		66.26% Pervious Area
7,802		33.74% Impervious Area
741		9.50% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0060	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.4	101	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	36	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.0	187	Total			

Subcatchment 1S: P2B



Summary for Subcatchment 4S: P1

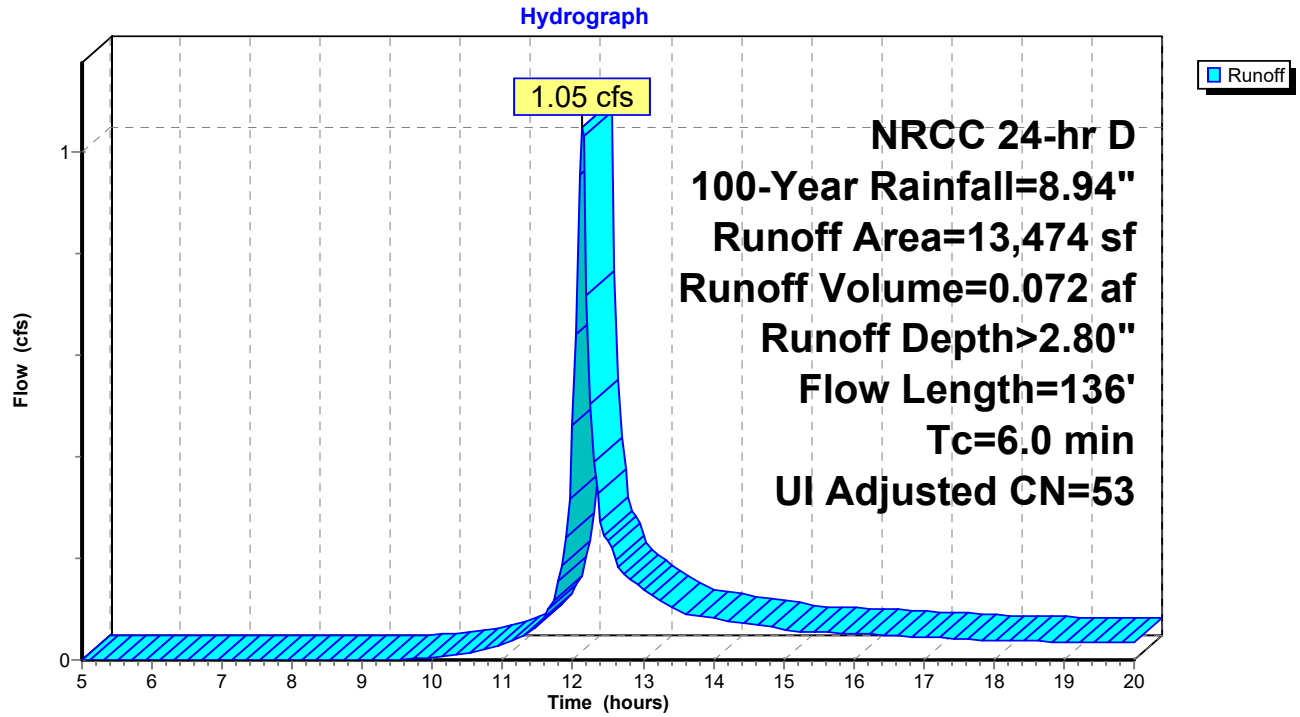
Runoff = 1.05 cfs @ 12.13 hrs, Volume= 0.072 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
10,040	39		>75% Grass cover, Good, HSG A
677	98		Unconnected roofs, HSG A
2,757	98		Paved parking, HSG A
13,474	54	53	Weighted Average, UI Adjusted
10,040			74.51% Pervious Area
3,434			25.49% Impervious Area
677			19.71% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0240	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.7	86	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	136	Total			

Subcatchment 4S: P1



Summary for Subcatchment 6S: P3

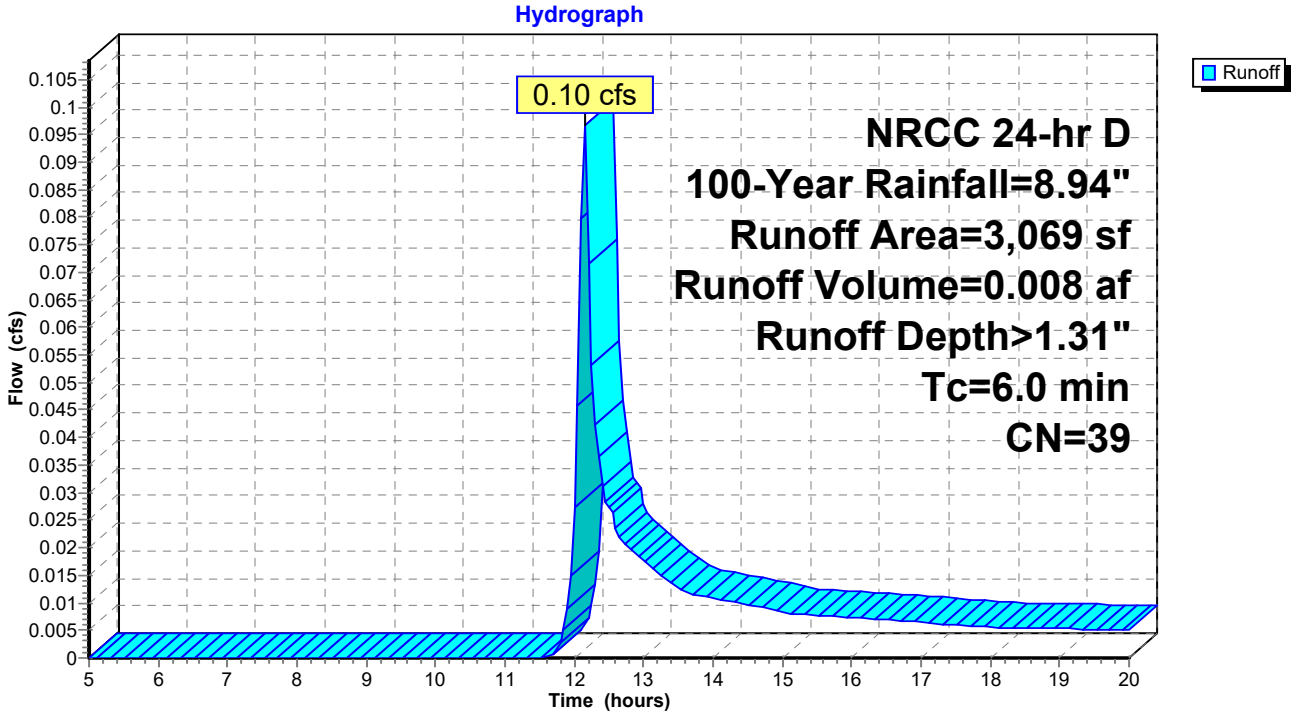
Runoff = 0.10 cfs @ 12.14 hrs, Volume= 0.008 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
3,069	39	>75% Grass cover, Good, HSG A
3,069		100.00% Pervious Area

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

Subcatchment 6S: P3



Summary for Subcatchment P2A: P2A

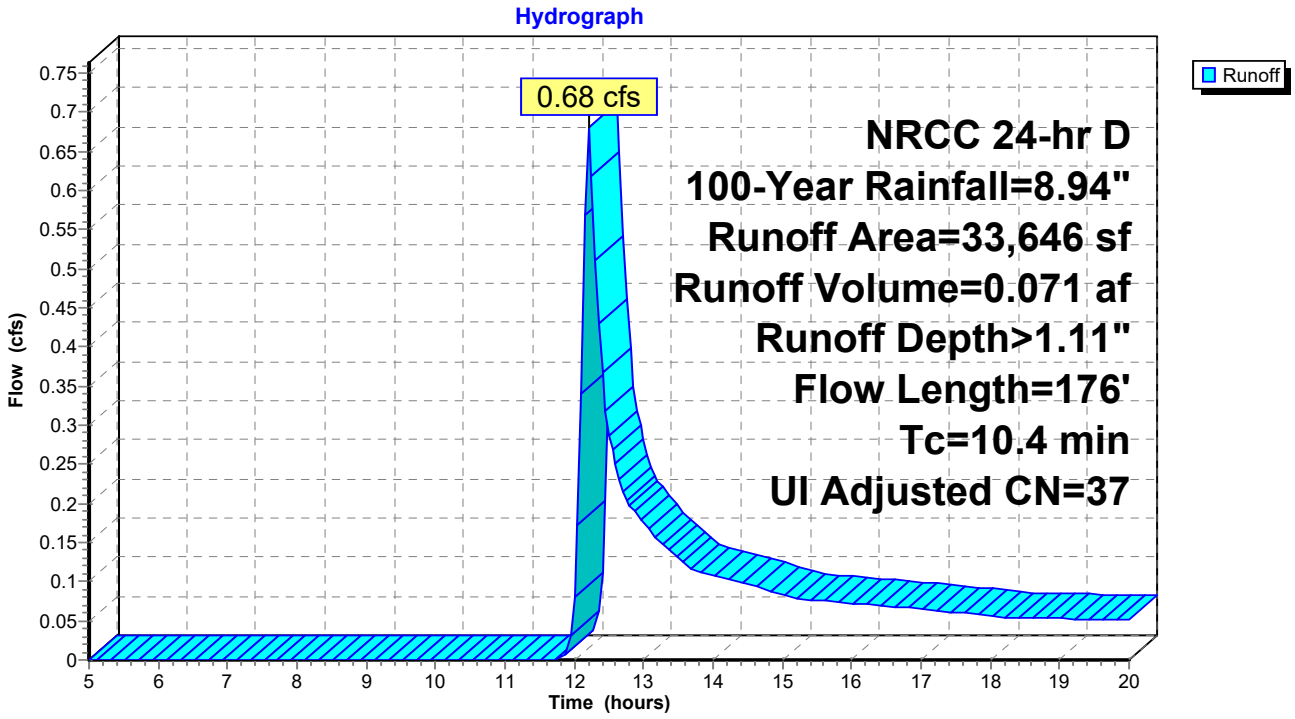
Runoff = 0.68 cfs @ 12.21 hrs, Volume= 0.071 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
16,049	30		Woods, Good, HSG A
14,806	39		>75% Grass cover, Good, HSG A
2,791	98		Unconnected roofs, HSG A
33,646	40	37	Weighted Average, UI Adjusted
30,855			91.70% Pervious Area
2,791			8.30% Impervious Area
2,791			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.9	126	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.4	176	Total			

Subcatchment P2A: P2A



Summary for Pond 2P: Bio-Retention Area

Inflow Area = 0.531 ac, 33.74% Impervious, Inflow Depth > 3.47" for 100-Year event
Inflow = 1.82 cfs @ 12.20 hrs, Volume= 0.154 af
Outflow = 1.18 cfs @ 12.34 hrs, Volume= 0.154 af, Atten= 36%, Lag= 8.1 min
Discarded = 0.43 cfs @ 12.34 hrs, Volume= 0.137 af
Primary = 0.74 cfs @ 12.34 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 15.74' @ 12.34 hrs Surf.Area= 1,724 sf Storage= 1,125 cf

Plug-Flow detention time= 15.0 min calculated for 0.154 af (100% of inflow)
Center-of-Mass det. time= 14.8 min (831.8 - 817.0)

Volume	Invert	Avail.Storage	Storage Description
#1	15.00'	1,600 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

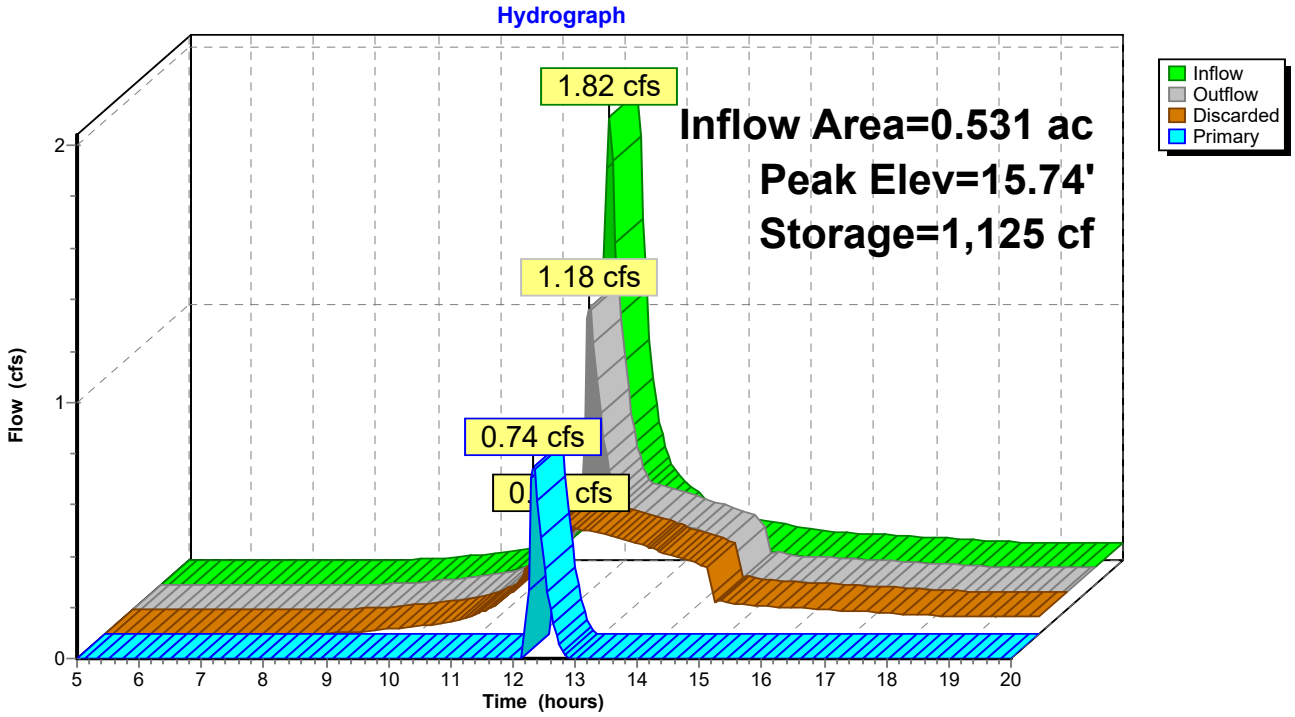
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.00	1,340	0	0
15.50	1,596	734	734
16.00	1,867	866	1,600

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.00'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 12.90'
#2	Primary	15.60'	**6.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.43 cfs @ 12.34 hrs HW=15.73' (Free Discharge)
1=Exfiltration (Controls 0.43 cfs)

Primary OutFlow Max=0.73 cfs @ 12.34 hrs HW=15.73' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 0.73 cfs @ 0.91 fps)

Pond 2P: Bio-Retention Area

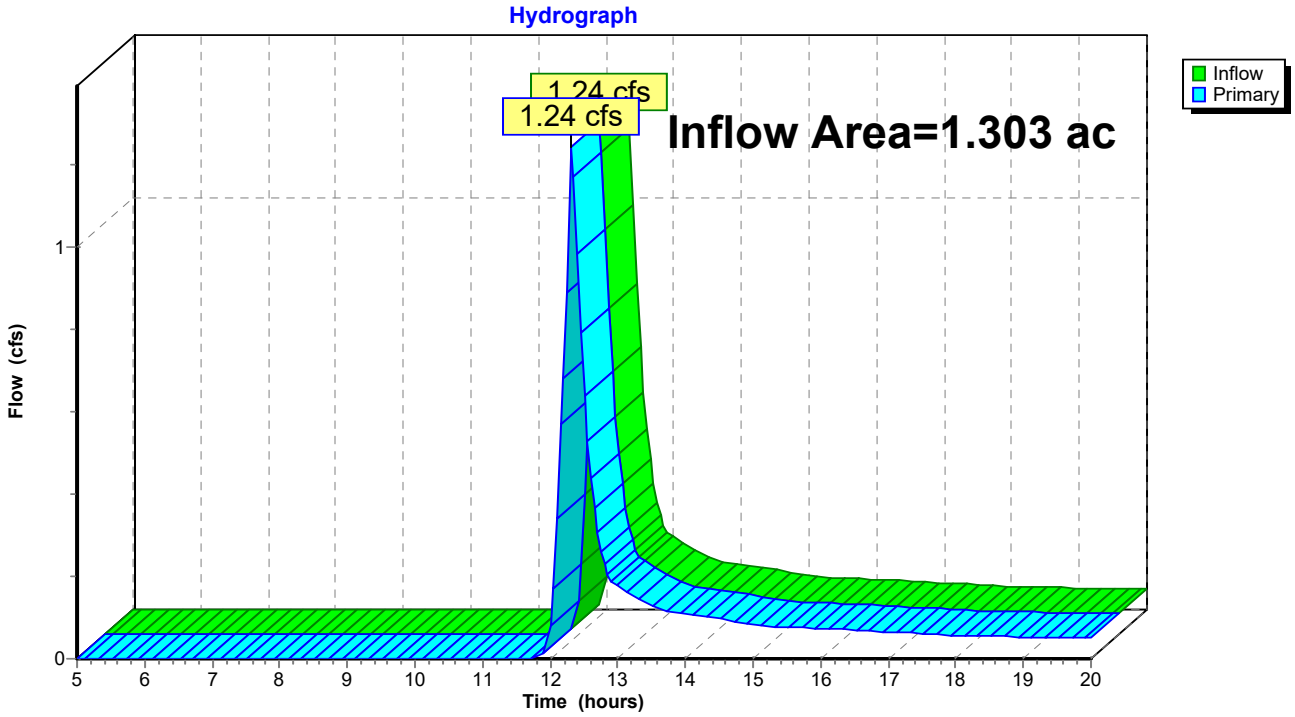


Summary for Link 3L: TOTAL P2

Inflow Area = 1.303 ac, 18.66% Impervious, Inflow Depth > 0.81" for 100-Year event
Inflow = 1.24 cfs @ 12.32 hrs, Volume= 0.088 af
Primary = 1.24 cfs @ 12.32 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 3L: TOTAL P2

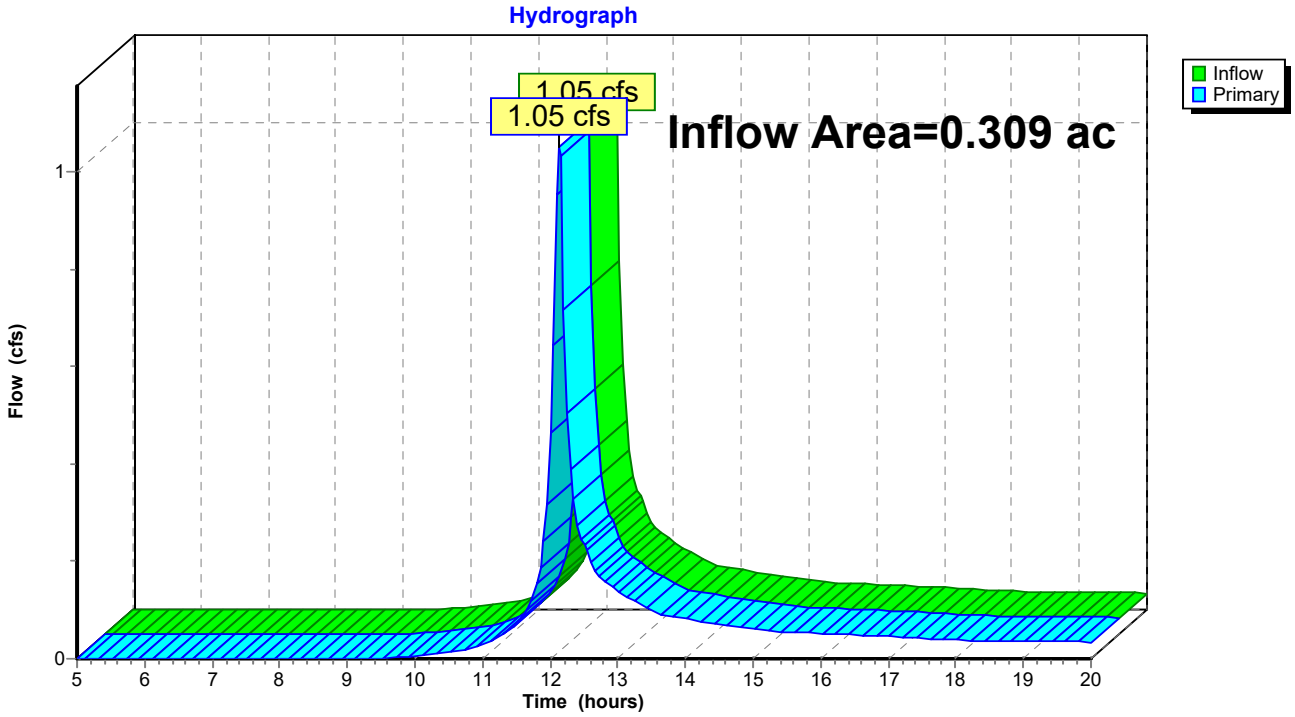


Summary for Link 5L: TOTAL P1

Inflow Area = 0.309 ac, 25.49% Impervious, Inflow Depth > 2.80" for 100-Year event
Inflow = 1.05 cfs @ 12.13 hrs, Volume= 0.072 af
Primary = 1.05 cfs @ 12.13 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 5L: TOTAL P1

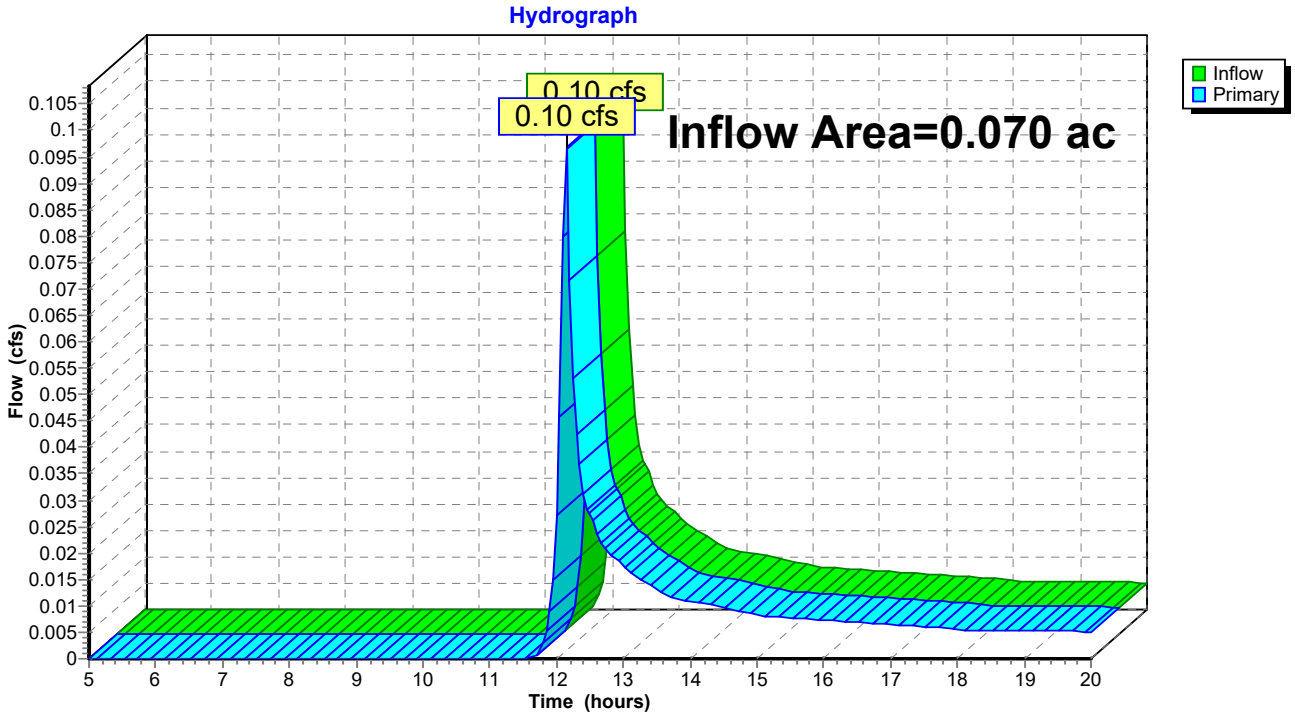


Summary for Link 7L: Total P3

Inflow Area = 0.070 ac, 0.00% Impervious, Inflow Depth > 1.31" for 100-Year event
Inflow = 0.10 cfs @ 12.14 hrs, Volume= 0.008 af
Primary = 0.10 cfs @ 12.14 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 7L: Total P3



c. Watershed Maps

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)

1 inch = 20'

PREPARED FOR

DOWNEAST BUILDING & DEVELOPMENT

18 MAPLE LANE

NORTHBOROUGH, MA 01532

NO.	DATE	DESCRIPTION	BY
1	12/15/21	RESPONSE TO PEER REVIEW	J.T.M.

MILLENNIUM ENGINEERING, INC.
ENGINEERING AND LAND SURVEYING
62 ELM ST. SALISBURY, MA 01952 (978) 463-8980
13 HAMPTON RD. EXETER, NH 03833 (603) 778-0528

SCALE: 1"=20' | CALC. BY: J.T.M. | PROJECT: M213965

DATE: SEPT. 27, 2021 | CHKD. BY: E.W.B.

FLEXIBLE RESIDENTIAL DEVELOPMENT

IN

SALISBURY, MA

AT

46 BEACH ROAD & 2 GRAVEL WAY

PRE-DEVELOPMENT WATERSHED PLAN

SHEET: 1 OF 2

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)

1 inch = 20'

PREPARED FOR

DOWNEAST BUILDING & DEVELOPMENT

18 MAPLE LANE

NORTHBOROUGH, MA 01532

NO.	DATE	DESCRIPTION	BY
1	12/15/21	RESPONSE TO PEER REVIEW	J.T.M.

MEI MILLENNIUM ENGINEERING, INC.

ENGINEERING AND LAND SURVEYING

62 ELM ST. SALISBURY, MA 01952 (978) 463-8980

13 HAMPTON RD. EXETER, NH 03833 (603) 778-0528

SCALE: 1"=20' | CALC. BY: J.T.M. | PROJECT: M213965

DATE: SEPT. 27, 2021 | CHKD. BY: E.W.B.

FLEXIBLE RESIDENTIAL DEVELOPMENT

IN

SALISBURY, MA

AT

46 BEACH ROAD & 2 GRAVEL WAY

POST-DEVELOPMENT WATERSHED PLAN

SHEET: 2 OF 2